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UNITED STATES NATIONAL MUSEUM

BULLETIN 202

FISHES OF THE MARSHALL AND MARIANAS ISLANDS

BY

LEONARD P. SCHULTZ AND COLLABORATORS:
EARL S. HERALD, ERNEST A. LACHNER
ARTHUR D. WELANDER, AND LOREN P. WOODS

VOLUME 1

Families from Asymmetrontidae through Siganidae

SMITHSONIAN INSTITUTION

WASHINGTON, D. C.

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REMINGTON KELLOGG,
Director, United States National Museum.

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INTRODUCTION

By LEONARD P. SCHULTZ

This is a descriptive catalog of the fishes collected in the Marshall Islands in connection with, and after, the atom-bomb tests of Operation Crossroads, 1946. In addition, it includes material from the southern Marianas Islands and contains descriptions of new species and of new genera from various other areas of the tropical Indo-Pacific region, whenever these new forms were found and were needed in the clarification of the species of fishes encountered in the faunal area under investigation.

Bikini Atoll was discussed as a fish habitat in "The Biology of Bikini Atoll, With Special Reference to the Fishes," published by Schultz in the Annual Report of the Smithsonian Institution for 1947, pp. 301–316, pls. 1–17, 1948, and for that reason is not covered in detail here. In that article the reefs were classified into sandy areas, coral and algal areas, flat pavementlike areas, isolated tidal pools and solution channels, lithothamnion ridge, and the open-water habitat of the lagoon. Collecting methods were discussed, especially the use of rotenone and the use of a light at night.

The first expedition sailed from San Francisco in February 1946 on the U. S. S. *Bowditch*, under the direction of Commander Roger Revelle, U. S. N. R., and Lt. Comdr. Clifford A. Barnes, U. S. C. G. R., returning to the United States in September. The scientists assembled on this ship represented the fields of biology, oceanography, and geology, and it was their purpose to study Bikini Atoll in a thorough manner before and after the explosions so that if the atomic bombs caused any profound changes these might be detected. As control atolls, extensive biological studies were to be made at Rongelap, Rongerik, and Eniwetok in the northern Marshall Islands.

The second major expedition, the Bikini Scientific Resurvey, left San Diego July 1, 1947, on board the U. S. S. *Chilton* to determine the changes that had resulted from Operation Crossroads. This resurvey, made under the direction of Capt. C. L. Engleman, U. S. N., returned to San Diego on September 11 of that year.

Later expeditions were undertaken in 1948 and 1949 by the Applied Fisheries Laboratory, University of Washington, as part of a continuing study sponsored by the Atomic Energy Commission.

The biological field work in the northern Marshall Islands consisted of making extensive collections of the flora and fauna. The botanical studies were made in 1946 by Dr. William R. Taylor, Univer-

sity of Michigan. The physiology of aquatic plants was undertaken in 1947 by Drs. L. R. Blinks and P. M. Brooks, Stanford University, California. The marine invertebrates were studied in 1946 and 1947 by Dr. J. P. E. Morrison and in 1947 by F. M. Bayer, both of the Smithsonian Institution, Washington, D. C. During July and August 1947 special studies were made on echinoderms by Dr. D. M. Whitaker, Stanford University; on insects by Dr. A. C. Cole, University of Tennessee; and on the food of fishes by Dr. Robert W. Hiatt, University of Hawaii. Extensive collections of plankton were made by Dr. M. W. Johnson, Scripps Institution of Oceanography; the microbiology of Bikini was studied by Dr. D. B. Johnstone, New Jersey Agricultural Experiment Station, during 1946. The geology of Bikini and other Marshall Islands was studied by Dr. Harry S. Ladd, Dr. J. Harland Johnson, and Joshua I. Tracey, of the U. S. Geological Survey, aided by Dr. John W. Wells, then of Ohio State University, and Gordon G. Lill, Office of Naval Research. The bottom geology of Bikini was mapped in 1946 by Dr. K. O. Emery, University of Southern California. The study of the effect of radiation on marine animals, especially fishes, was made from 1946 to 1949 by Drs. Lauren R. Donaldson and Arthur D. Welander, Applied Fisheries Laboratory, University of Washington.

Since fishes represented the group of animals of greatest economic importance in and around the atoll, great emphasis was placed on them. Statistical studies were made both in 1946 and 1947 to measure the relative abundance of the reef and lagoon fishes, and of the pelagic fishes (sharks, barracuda, and tuna and their relatives). This latter work was accomplished by commercial fishermen, using trolling methods, under the immediate supervision of John C. Marr and Osgood R. Smith, U. S. Fish and Wildlife Service. The population studies of the lagoon fishes were made in 1946 and 1947 by Vernon E. Brock, director, Division of Fish and Game, Territory of Hawaii. Those of the reef fishes were made in 1946 by Dr. Earl S. Herald, then Captain, U. S. Army Medical Corps; and in 1946 and 1947 by Dr. Leonard P. Schultz, curator of fishes, U. S. National Museum, Smithsonian Institution.

AUTHORSHIP

Since the study of such large collections of fishes was a bigger task than could be accomplished by one person in a reasonable length of time, I enlisted the services of various ichthyologists: Dr. Earl S. Herald, director of the Steinhart Aquarium, spent about 4 months on the Syngnathidae during late 1946 and early 1947 and then continued his studies in the California Academy of Sciences; Loren P. Woods, curator of fishes, Chicago Natural History Museum, spent 18 months in the U. S. National Museum during 1946–48, and then continued on the Bikini fishes for a short time at the Chicago Natural History

Museum; on February 1, 1949, Dr. Ernest A. Lachner, associate curator of fishes, U. S. National Museum, began work on this report and was continuing at the time this volume went to press; Dr. Arthur D. Welander, University of Washington, spent July and August 1950 on the Bikini fish collections of the School of Fisheries, University of Washington; I have spent practically all my research time since the conception of this project, in September 1945, on the fishes of the Marshall and Marianas Islands and adjacent regions.

The portions of this work written by my collaborators are identified both in the table of contents and in the text. The appearance of my name as second author indicates that I furnished the ecological data and assisted in other ways but did not write major portions of the manuscript.

ACKNOWLEDGMENTS

The authors wish to express their appreciation of the fine work of the artists, Mrs. Aime M. Awl and Mrs. Dorothea B. Schultz, who have made most of the pen-and-ink drawings for this report; to John S. Lea, editor, and Gladys O. Visel, assistant editor, U. S. National Museum, for their full cooperation and aid in preparing this volume for printing.

During the atom-bomb tests of 1946 and the Bikini Scientific Resurvey of 1947 the United States Navy took about 400 kodachrome pictures of the fishes, for which the authors are very grateful. Although it is not feasible to reproduce these in color, many black-and-white prints have been made from them, which are herein reproduced. To the Smithsonian Photographic Laboratory we express our thanks for making many of the prints from the Kodachromes and all the photographs of color drawings in the *Albatross* Philippine collection. To the Atomic Energy Commission we express our appreciation for partial financial support of a study of the Bikini fishes at the Applied Fisheries Laboratory, University of Washington, during 1950.

Especially, we wish to acknowledge the partial financial support of this project by the Office of Naval Research and the Bureau of Ships of the Department of the Navy.

Among those who were principally engaged in this undertaking during Operations Crossroads in 1946 Brock, Herald, and Schultz, working together, collected most of the fishes and were often assisted by Kohler and Marr. During 1947 the active fish collectors were Brock, Hiatt, and Schultz, assisted by Marr, Myers, and Smith. The skill of Brock, Herald, and Hiatt in swimming, diving, and collecting unusual fishes was especially noteworthy.

The following list gives the names of those who collected fishes that were used in this report. In some cases, where specimens were forwarded to us by people engaged in other phases of Operation Crossroads, we were unable to obtain the complete name of the collector.

Baker, R. H.
Bayer, Frederick M.
Borror,
Brock, Vernon E.
Cali, Frank
Cloud, P. E.
Cole, A. C.
Craighead, Frank
Craighead, John
Davis, Alice
Donaldson, Lauren R.
Emory, Kenneth O.
Frey, David G.
Gressitt, J. L.
Herald, Earl S.
Hiatt, Robert W.
Holder,
Hornbostel, H. G.
Ingram, Robert
Johnson, David H.
Johnson, Martin W.
Kaley, G.
Kohler, Thomas F.
Ladd, H. S.
Lord,
Markley, M. H.
Marr, John C.
McBurney,
McChesney,
McElroy, L. P.
Morrison, J. P. E.
Myers, George S.
Necker, Walter L.
Norton, James H.
Otis, J. C.
Randall, John E.
Schaefer,
Schroyer, Fred B.
Schultz, Leonard P.
Seymour, Allan
Simon, J. R.
Smith, Osgood
Strassburg, Donald
Taylor, William R.
Tuiasosopa,
Warner,
Welander, Arthur D.
Welsh,
White, Thomas D.
Ziesenhenne, Fred C.

EXTENT OF INVESTIGATIONS

Altogether, over 50,000 specimens from the northern Marshall Islands and over 15,000 from the southern Marianas Islands were studied in preparing volumes 1 and 2 of this catalog. Most of these were obtained during Operation Crossroads, and during the Bikini Scientific Resurvey.

However, this study was not confined to that material alone. The U. S. Navy, Army, and Air Forces, during World War II, sent to the U. S. National Museum large and valuable fish collections from the Indo-Pacific region. For comparison we have used these and other extensive reef and shore collections in the U. S. National Museum from Japan, Okinawa, Philippine Islands, Hawaiian Islands, Johnston Island, Phoenix and Samoan Islands, Persian Gulf, Red Sea, and American eastern Pacific. We have also used similar lesser collections from the China coast, Fiji, Solomons, East Indies, Australia, and Mauritius. Likewise the vast collections made in the Pacific by the *Albatross* under the auspices of the U. S. Bureau of Fisheries during the early part of this century, also in the national collections, were used in various parts of this report.

In addition, about 10,000 specimens of fishes were studied by Drs. Welander and Schultz at the Applied Fisheries Laboratory, University of Washington, during July and August 1950. Dr. Wilbert M. Chapman's excellent Solomon Islands collections did not arrive in time to serve extensively in the preparation of this catalog.

Although we had ample library facilities for our work, type materials for many of the species of the Indo-Pacific were not available. In the numerous instances where we needed to verify characters on

type specimens, ichthyologists were requested to examine the types and to furnish pertinent information, but in spite of our care it has been necessary to assign a tentative name to some specimens, as the problem was not solvable. Usually, where doubt must be cast on our identifications, this has been pointed out in the text.

GENERAL FAUNAL RELATIONSHIPS

Our studies have revealed considerable information concerning the relationships of the wide-ranging species of the tropical Indo-Pacific. In general where we have had numerous specimens of a species from various island groups, small but distinct and constant differences can be found. These differences are of varying degree, and show up in counts, measurements, and coloration.

The importance of coloration as a factor in the recognition of species and subspecies cannot be overemphasized. This has been demonstrated by the constancy with which basic color patterns of browns, blackish shades, and light areas occur in preserved specimens of certain species and subspecies. These patterns were observed in live specimens and were recorded by means of color photographs. Their persistence after a few years of alcoholic preservation was later confirmed by comparison of these photographs with the preserved specimens.

We find that the old concept that has led to the combining of several species into one catch-all species, as has been done by some authors because they disregarded the basic color pattern, needs re-examination on the basis of comparing large series of specimens from the various island groups; and we find that probably the concept of subspecies should be applied to many of the species that exhibit small but distinct differences in coloration and are geographically isolated.

We have noted especially that the Hawaiian Island fishes have numerous distinct species and subspecies, and that similar distinct endemic elements exist in the area comprised of Polynesia and Micronesia, in that comprised of the Indo-Australian region and Melanesia, and in the area from Mauritius to the Red Sea. Furthermore, these relationships, on a lesser scale, also hold for some of the island groups within these general areas.

The study of those specimens on which this report is based, and their comparison with specimens from other faunal areas of the tropical Indo-Pacific region show conclusively: (1) That the vast Indo-Pacific fauna cannot be properly interpreted on a local basis, and that to approach a correct conclusion in identification, each species must be compared with all its close relatives from the east coast of

Africa to the west coast of the Americas; (2) to place the correct scientific name on our specimens has usually required us to make a tentative revision of the genus where no revision existed; (3) the investigator must study the original descriptions of each species, augmented by redescriptions of type specimens, and must not rely on unverified descriptions in the literature; (4) no reliance can be placed on lists of fishes that are based entirely on collections from a single group of islands, or that lack supporting descriptions and figures.

METHODS OF STUDY AND PRESENTATION

In the discussions following some of the family and generic names, we have included information pertinent to the relationships of the genera and species, respectively. In some instances, references to important literature have been included. In certain families and genera, in which the number of pelvic and branched caudal rays are constant for all species, these counts are noted in the discussion and omitted in the descriptions of the species.

KEYS

In many instances the keys include exotic genera and species that may or may not have been represented by specimens available to us. These extralimital species are included whenever it was considered important: (1) To compare them with related species in the faunal area treated, (2) to clarify the taxonomic position of those previously assigned to the wrong genus by authors, (3) to clarify the present interpretation of relationships within a genus, (4) to make the keys more useful and complete by recording more of the background information that applies to this study, and that supports the conclusions reached in this report.

The keys often give a range of counts greater than that shown in the description of a species. This difference is the result of using additional extralimital specimens, whereas the species descriptions were almost always based on specimens collected for us in the area treated in this report.

Wherever a new species or genus is described, the group to which it is related has been tentatively revised. Where investigation has uncovered extralimital species that are new, these are described in the text.

Additional references, synonyms, and comments often appear as footnotes to the key when the genus or the species is not described in the text.

The order of occurrence of the genera and species under each family is the same in the keys as in the text.

SYNONYMY

A complete list of synonyms for each genus and for each species did not seem to be warranted for this faunal study. Therefore, only the reference to the original description for each species in the text is given, together with those synonyms and references that have been verified to the satisfaction of each author.

SPECIMENS STUDIED

The term "specimens studied" refers for the most part to those specimens collected during Operation Crossroads, 1946, and the Bikini Scientific Resurvey, 1947, and to some others collected in the southern Marianas Islands during World War II. They are generally summarized according to the number of *stations* for each atoll of the northern Marshall Islands, as listed on pages XXIV–XXXII, or according to the number of *lots* for those collections not referable to a station number. However, collections are listed in detail for all new species and subspecies, and also in a few instances when it seemed desirable to call special notice to specimens that were unusual or that were the subject of special study. For these the United States National Museum (U.S.N.M.) catalog number is given. Symbols are used for the catalog numbers of specimens in other institutions as follows:

Academy of Natural Sciences of Philadelphia (A.N.S.P.).
American Museum of Natural History (A.M.N.H.).
California Academy of Natural Sciences (C.A.S.).
Chicago Natural History Museum (C.N.H.M.).
Museum of Comparative Zoology, Harvard University (M.C.Z.).
Stanford Natural History Museum (S.N.H.M.).
Applied Fisheries Laboratory, University of Washington: Univ. Washington.

References to a ship lost on the California coast also occur in this section. These refer to a small ship used by a group of commercial fishermen in their study of commercially important fishes of the northern Marshall Islands in 1946. On the way back from Bikini it ran aground in Halfmoon Bay near San Francisco, and all but about a hundred specimens of tuna and of sharks were lost. These drifted ashore in a bad condition and were saved.

TERMINOLOGY, MEASUREMENTS, COUNTS USED IN DESCRIPTIONS

Under each species occurs a description that has been based on the material listed under "specimens studied" unless otherwise indicated.

Terminology and methods of measuring and counting cannot be completely standardized where a large and diverse fauna is involved. Exceptions to terminology and methods as defined below are occasioned by differences in anatomical structures. Wherever these dif-

ferences occur in the text an explanation is made in parentheses at the point of use, but it applies only to that particular measurement. Often, however, notice or explanation of such change is given in the discussion preceding the particular family or genus involved.

Measurements.—Owing to the extent of this project, it was decided that, for those species revealing only slight variation, there was not sufficient time to make proportional measurements on more than two or three specimens, one small, one medium, and one of the largest. However, when relationships were close, or when a new species was described, measurements and counts were made on a series of sufficient number to determine the general limits of variability for that species.

Standard length is the distance from tip of snout to midbase of caudal fin.

Length of head is the distance from tip of snout to rear end of fleshy operculum.

Depth is the greatest depth of body.

Mouth or *length of maxillaries* is the distance from tip of snout to rear edge of maxillary.

Snout is the distance from tip of snout to front of eye.

Distance between nostrils or *nostrils to eye* is measured from the edge of the nasal opening unless otherwise indicated.

Interorbital space (*width*) is the least fleshy distance between eyes.

Bony interorbital space (*width*) is the least distance between bony orbits.

Postorbital length (*part*) of head is the distance from the rear edge of the eye to the posterior tip of the fleshy operculum.

Preorbital width is the least width of this bone.

Suborbital width is the least width of this bone.

Length of caudal peduncle is measured from the base of the last anal ray to the midbase of the caudal fin.

Depth of caudal peduncle is the least distance dorsoventrally.

Distances involving the *anus* are measured to the center of the anus.

Counts.—In the fin ray formulae that appear in this report small (lower case) Roman numerals represent the *simple, cross-striated, unbranched soft rays*; large (upper case) Roman numerals represent *non-cross-striated rays*, or *spines;* and Arabic numerals, the *branched soft rays.* As an example we read VII, ii, 8 as 7 spines, 2 unbranched soft rays, and 8 branched soft rays. A dash between elements in the fin ray formula (for example, VII–ii, 8) indicates that the two portions of the fin are divided and separate, whereas the comma indicates that the different fin rays are in the same portion of the fin. Counts made on paired fins are separated by a dash. We have represented

the branched rays of the caudal fin in a formula, thus 8+7 means that there are 8 rays in the upper lobe and 7 in the lower lobe.

In counting *fin rays*, each ray (including rudiments in the pectoral fin) with a separate base was counted as a single ray. In cases where the last ray was divided down to the base, this ray was counted as one ray when it had a single base; dissections were made and examined microscopically to determine the presence of one or two bases in doubtful cases.

The number of *gill rakers* (including rudiments on the first arch) are expressed in the formula 12+1+25=38, where the first number indicates those on the upper part of the arch, the second, that at the angle, the last, those in the lower part of the arch, and the equals sign indicates that the total number is 38.

In counting *scales* along the side of the body, the number of oblique rows were counted, along or just dorsal to the lateral line, from the upper edge of the gill opening to the midbase of the caudal fin. If the lateral line was absent, the scales were counted along the midside of the body.

On those fishes where the number of oblique or vertical scale rows above the lateral line differs from that below it, the rows were counted above the lateral line unless otherwise indicated. The number of scales above the lateral line was counted in an oblique or vertical row from the lateral line to some specified point along the base of the dorsal fin. The number of scales below the lateral line was counted in an oblique row extending posterodorsally from the anal origin to the lateral line.

Dentition.—In regard to dentition, the term *villiform* indicates numerous small or fine teeth all of approximately the same size, usually in a band or patch; *conical*, teeth with sharp points; *incisor*, chisel-shaped teeth; *canine*, any conical tooth that notably projects beyond the other teeth; and *molars*, flat-topped teeth.

COLORATION

Certain meanings were given the terms used in description of coloration: The term *bars* was used to indicate a vertical pattern on the body and transverse color marks on the fins; the terms *streaks* and *stripes* indicate lengthwise color marks; and the term *lines* was used when a color mark was very narrow, resembling a pen-and-ink line.

The heading *Color in alcohol* includes a description of the basic color pattern as observed in the alcoholically preserved specimens, whereas in the section *Color when alive*, the description is based on color notes made in the field by Dr. Schultz or on Kodachrome transparencies taken in the field of living or very recently dead specimens.

ECOLOGY

Under this heading we have summarized briefly our observations on the habitat of the species and in some instances information concerning habits.

REMARKS

This section includes miscellaneous information concerning relationships among closely related species and subspecies, pertinent characters used in recognizing the species, comments on literature, and possible synonyms.

ILLUSTRATIONS

Most of the photographs used for the plates were black and white prints made from kodachrome transparencies taken under field conditions. These pictures were made of fishes still alive or only recently dead, in order to record as nearly as possible their true coloration. In some instances, it has not been possible to delete the background entirely, since the net or reef on which the subject was photographed is visible through the fins.

FISH COLLECTING STATIONS

The following collecting stations were made during 1946 and 1947, using the U. S. S. *Bowditch* and the U. S. S. *Chilton* as headquarters, respectively (U. S. Navy map names are used for the islands of Bikini Atoll):

NORTH PACIFIC OCEAN

S–46–1, March 2, 1946, lat. 20°17′45″ N., long. 162°28′45″ W., trolling, Marr.
S–46–395, summer 1946, lat. 09°00′ N., long. 168°00′ E., plankton net at 4 feet below surface, Johnson.

BIKINI ATOLL, 1946 (see map, fig. 1)

S–46–2, March 11–31, lagoon, off Bikini Island to entrance at Enyu Island, hook and line, Brock, Marr, Schultz, and crew of *Bowditch*.
S–46–3, March 12, Enyu Island, lagoon, diving, spearing to depth of 30 feet, Brock.
S–46–7, March 11, north side of lagoon, diving, to depth of 15 feet, Brock.
S–46–8, March 16, Enyu Island, lagoon reef at channel entrance, poison, diving, and spear to depth of 20 feet, Schultz, Brock, and Marr.
S–46–9, March 19, Erik Island, at western end, ocean reef, Schultz and Brock.
S–46–10, March 20, Erik Island on lagoon side, large pool with sand and gravel bottom, Schultz and Brock.
S–46–15, March 22, Bikini Island, ocean reef, Schultz and Brock.
S–46–41, March 25, lagoon, eastern end, depth of 30 feet, diving, Brock.
S–46–42, March 26, lagoon, eastern end, coral heads at depths of 20 to 25 feet, diving, spearing, Brock and Schultz.
S–46–43, March 28, lagoon, *Bowditch* anchorage, 1 mile off Bikini Island, surface light, Schultz and Brock.
S–46–44, March 29, lagoon, eastern end, three dredge hauls at 180 to 200 feet over coral bottom, Schultz.

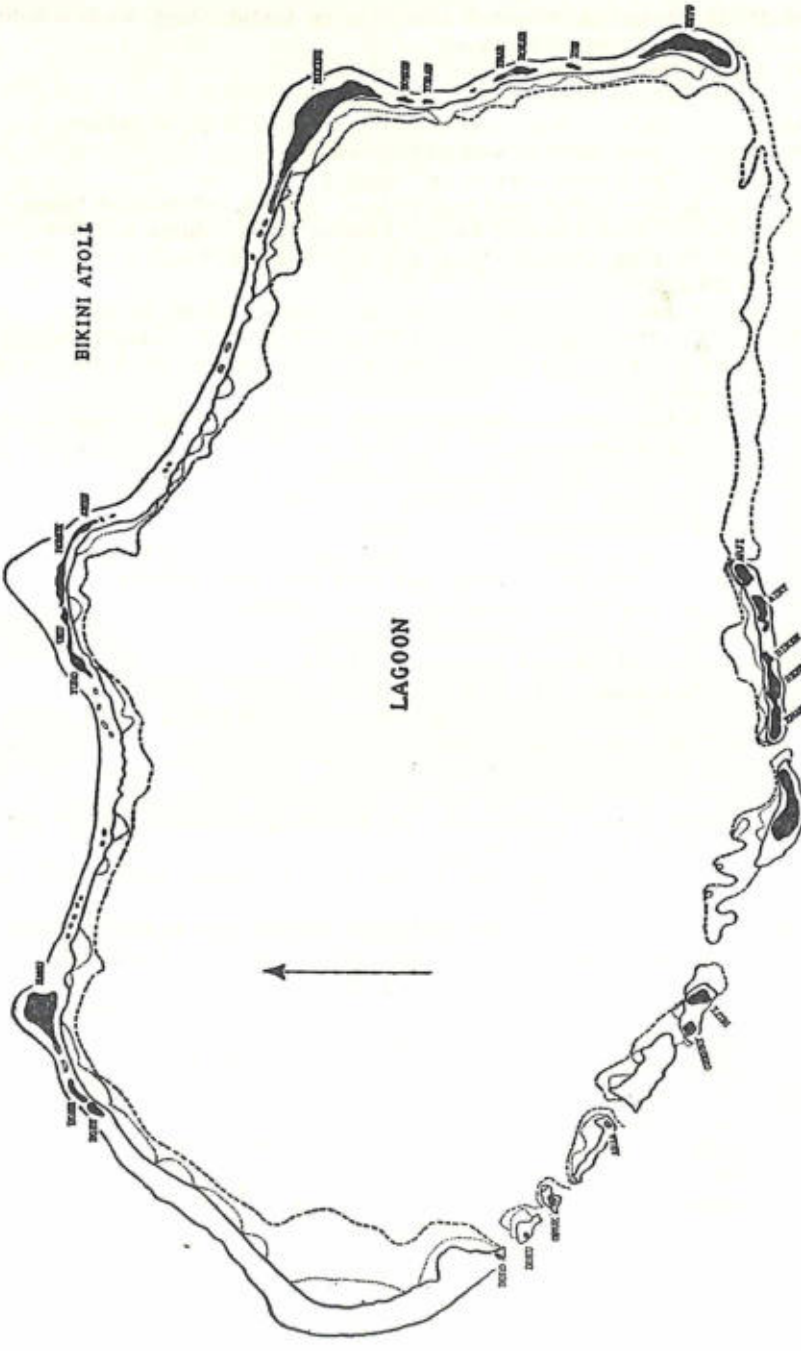

FIGURE 1.—Map of Bikini Atoll.

S–46–46, March 30, lagoon, *Bowditch* anchorage off Bikini Island, surface light at night, Schultz and Brock.
S–46–47, April 1, Romuk Island, ocean reef, Schultz.
S–46–48, April 2, Romuk Island, lagoon reef, Schultz.
S–46–49, April 3, Namu Island, lagoon side, shallow tidal pools, Schultz.
S–46–50, April 3, Namu Island, lagoon reef, Schultz.
S–46–51, April 4, Namu Island, ocean reef, Schultz.
S–46–52, April 6, Boro Island, reef next to Boro Channel, Schultz and Brock.
S–46–53, April 6–7, Boro Channel, surface light at night, Schultz and Brock.
S–46–54, April 6, Boro Channel, hook and line, Schultz, Brock and crew of *YMS 413*.
S–46–62, April 7, Boku Island, ocean reef next to Boro Channel, Brock.
S–46–72, April 1 to May 7, lagoon, general region of channels to leeward, trolling, hook and line, and spearing, Schultz, crew, officers, and scientists of *Bowditch*.
S–46–90, April 6, Ruji Channel, surface trolling, Brock and Schultz, spearing to depth of 8 feet, Brock.
S–46–92, April 12, lagoon, *Bowditch* anchorage, surface light, Schultz.
S–46–93, April 13, lagoon, western half, five dredge hauls at 150 to 180 feet over coral, algae, and algal sand, Schultz.
S–46–94, April 15, Bokon Island, ocean reef, at edge, Schultz and Brock.
S–46–95, April 15, Bokon Island, ocean reef, high tidal pools, Schultz.
S–46–96, April 16, Airy Island, ocean reef, in surf, Schultz.
S–46–97, April 17, Airy Island, lagoon reef, Schultz.
S–46–98, April 18, Cherry Island, ocean reef, Schultz.
S–46–99, April 18, Cherry Island, high tidal pools, Schultz.
S–46–108, April 23, lagoon, 1 mile south off west end of Bikini Island, dredge at 72 feet, Morrison.
S–46–109, April, lagoon, dredge, Emory.
S–46–110, April 17, Airy Island reef, picked out of algae, Taylor.
S–46–111, April 23, lagoon, northeastern end, *Bowditch* anchorage, surface light at night, Schultz and Morrison.
S–46–112, April 24, lagoon, east end at *Bowditch* anchorage, surface light at night, Schultz.
S–46–114, April 25, lagoon, *Bowditch* anchorage, surface light at night, Schultz.
S–46–115, April 24–25, lagoon, 4 miles south of western end of Bikini Island, dredge in 168 feet, Morrison and Ladd.
S–46–116, April 26, lagoon, east end, about 1 mile off northwestern end of Bikini Island, surface light at night, Schultz.
S–46–119, April 29, Bikini Island, off western end, lagoon side, Cali.
S–46–120, May 1, Bikini Island, 1¼ miles west, ocean reef in surf, Schultz.
S–46–121, May 4, Erik Island, at western end, ocean reef, Schultz.
S–46–122, May 5, Boro Channel, hook and line at 240 feet, Kohler.
S–46–124, May 8, Enyu Island, ocean reef, near high-tide line, under rock slabs, Schultz.
S–46–125, May 10, Bikini Island, south end, ocean reef, Schultz.
S–46–126, May 11, lagoon off Bikini Island, in sediment trap at 15 feet, Emory.
S–46–127, May 13–14, Romuk Island, reef at night with flashlight, turning over rocks, Schultz.
S–46–128, May 14, Romuk Island, east end, lagoon reef, Schultz.
S–46–153, May 1, lagoon near middle, plankton net, 60 feet to surface, Johnson.

S–46–212, May 3, lagoon, 5 miles northwest of Enyu Island, plankton net at 6 feet, Johnson.

S–46–245, July 8, Boku Pass, in channel, surface light at night, Herald.

S–46–246, July 10, Amen Island, ½ mile directly south on lagoon reef, spearing, by breaking up coral heads, Brock, Herald, and Kohler.

S–46–247, July 11, lagoon, submerged coral head, 4 miles southwest of Bikini Island, spearing, by breaking up coral heads, Brock, Herald, and Kohler.

S–46–249, July 11, lagoon, *Bowditch* anchorage, 3 miles northwest of Enyu Island, surface light at night, Herald

S–46–250, July 12, lagoon, YMS463 anchorage off Yuro Island, searchlight and dipnets, Herald.

S–46–251, July 13, Yuro Island, ocean reef, Herald.

S–46–252, July 13, lagoon, deep coral head at depth of 30–45 feet, lat. 11°35′13″ N., long. 165°28′39″ E., diving and spearing, Brook, Emory, and Kohler.

S–46–253, July 16, Bikini Island, ocean reef, Herald.

S–46–307, August 4, Amen Island, lagoon, diving at depth of 30 feet, Brock, Herald, and Kohler.

S–46–308, August 7, Arji Island, 100 yards off shore, lagoon coral area, depths from 0 to 40 feet, Brock and Herald.

S–46–325, August 6, Enyu Island, in channel 100 yards south of southern tip, fish trap at depth of 18 feet, Brock and Kohler.

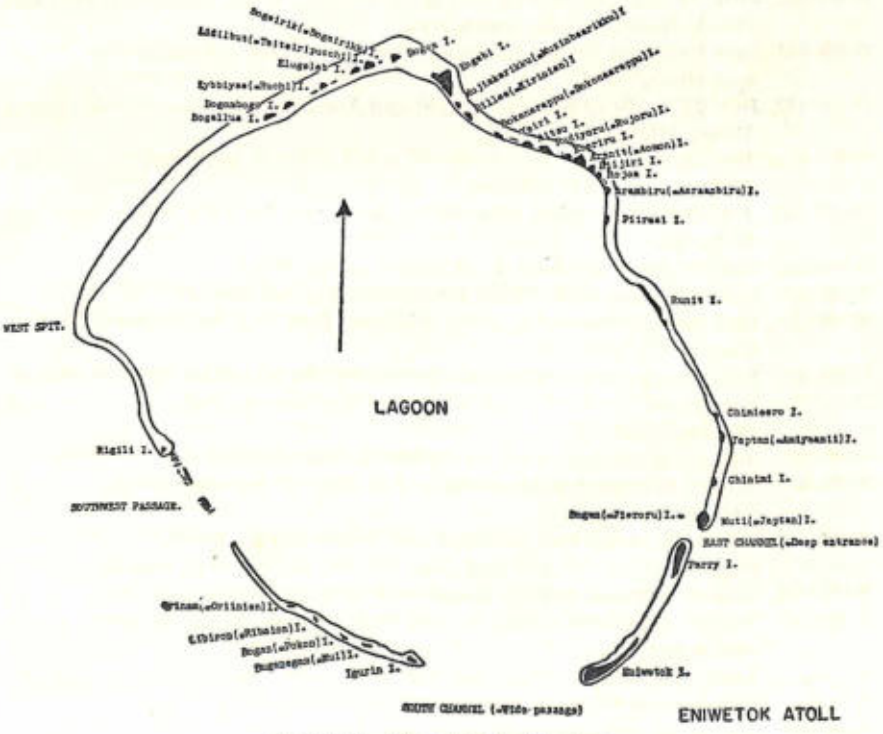

FIGURE 2.—Map of Eniwetok Atoll.

S–46–332, August 12, Reer Island, northwest side, lagoon reef, Herald and Brock.
S–46–333, August 13, Enyu Island, southeast end, ocean reef, Herald
S–46–349, August 14, Bikini Island, near northwest tip, ocean reef, Herald.
S–46–361, August 15, Cherry Island, ocean reef, Herald.
S–46–382, August 16, Oruk Island, ocean reef, Herald.
S–46–383, August 17, Boby Island, north end, ocean reef, Herald.
S–46–384, August 12, Boku Pass, 200 yards, off Oruk Island, hook and line at 54–60 feet, McChesney.
S–46–385, August 21, lagoon, *Bowditch* anchorage, ¾ mile due east of Rokar Island, hook and line, Norton.
S–46–390, August 9, Namu Island, 1 mile southeast, lagoon reef, poison and spear at depth of 30 to 45 feet, Brock and Herald.
S–46–396, August 27, lagoon, *Bowditch* anchorage, ¾ mile due east of Bokar Island, hook and line, Norton.

BIKINI ATOLL, 1947

S–46–402, July 15, lagoon, half mile off Bikini Island, light at night, Myers, Schultz, and O. Smith.
S–46–403, July 16, Eman Island, in lagoon, Brock.
S–46–404, July 16–18, Eman Island, Schultz, Morrison, and Bayer.
S–46–405, July 17, Eman Island, channel reef at western end, Schultz, Brock, Hiatt, and Myers.
S–46–421, July 17, Eman Island, lagoon, 20 feet depth, Brock and Hiatt.
S–46–422, July 18, between Eman and Reer Islands, large, shallow tidal pond, Brock, Hiatt, Schultz, and Myers.
S–46–441, July 19, Eman Island, ocean surf at eastern end, Schultz, Brock, Myers, and Hiatt.
S–46–442, July 21, halfway between Bikini and Amen Islands, lagoon side of reef, Brock, Hiatt, and Schultz.
S–46–458, July 20 to August 10, lagoon off Bikini Island, hook and line, Schultz and crew of U.S.S. *Chilton*.
S–46–473, July 22, off leeward side Bikini Atoll and in Aran Pass, Marr and O. Smith.
S–46–474, July 27, Enyu Channel, L. Marquis and Lt. Cox.
S–46–475, July 27, ocean reef, Bikini Island, Schultz and Bayer.
S–46–476, July 28, coral head 1½ miles off Eman-Erik Channel at depth 30 feet, Brock.
S–46–477, July 30, lagoon at *Chilton* anchorage off Bikini Island, crew of *Chilton*.
S–46–478, July 29–30, Boro Passage, hook and line, Brock, Marr, O. Smith, and Schultz.
S–46–482, July 31, ocean reef, western tip Bikini Island, Schultz.
S–46–483, August 1, Enyu Island, ocean reef at channel entrance, Schultz, Brock, and Hiatt.
S–46–505, August 1, ocean reef, western side Namu Island, Brock.
S–46–507, August 1–5, western side of Bikini Atoll, Marr and O. Smith.
S–46–508, August 6, Namu Island, lagoon reef, Schultz, Brock, and Hiatt.
S–42–533, August 18, Bikini Island, lagoon reef, western end of sandspit, Brock and Schultz.
S–42–564, August 18, Bikini Island, shallow rock pools, western end of sandspit, Schultz and Brock.
S–42–565, August 16, Bikini Island, ocean reef, Bayer.

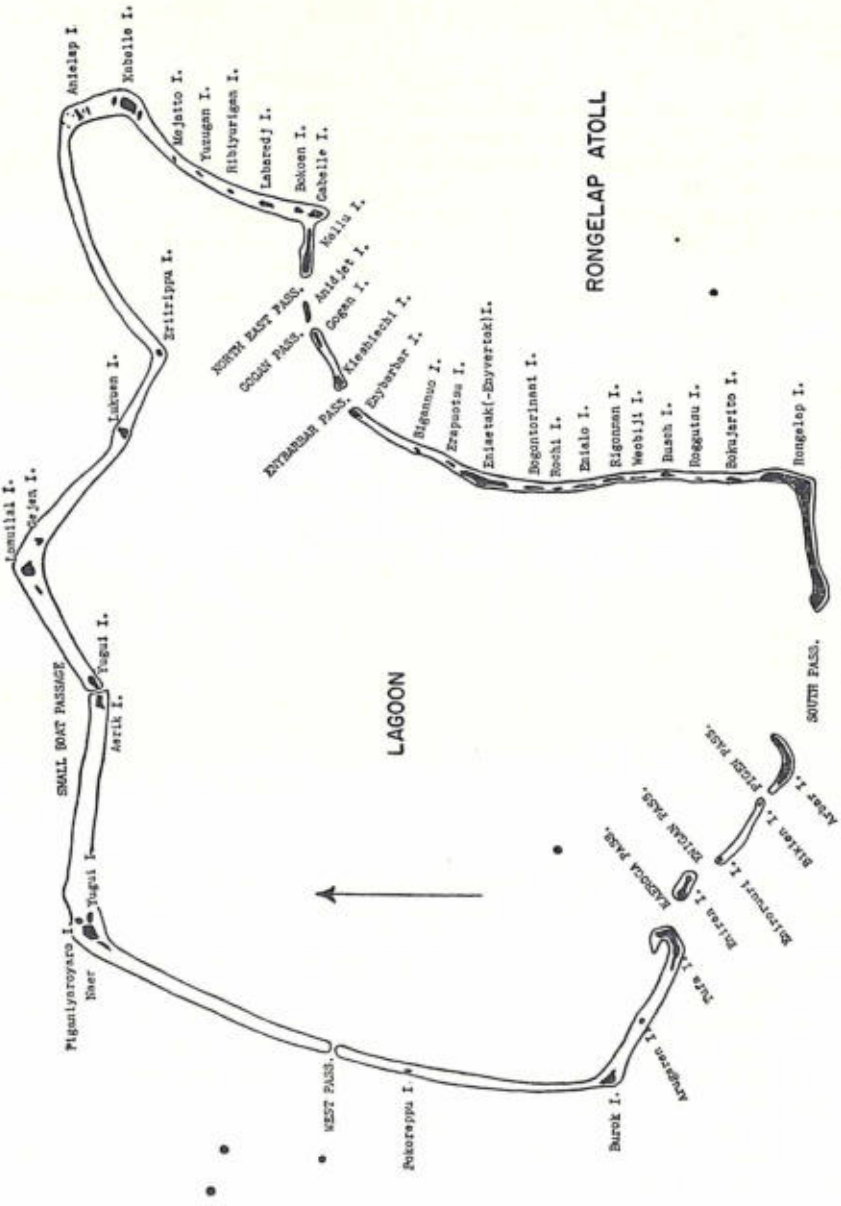

FIGURE 3.—Map of Rongelap Atoll.

S–42–566, August 19, Namu Island, western end, ocean reef, Brock and Schultz.
S–1019, August 7, Namu Island, ocean reef and in surf, Brock, Hiatt, and Schultz.
S–1040, August 7, Enyu Island, channel reef at 20 to 30 feet depth, Donaldson and Welander.

ENIWETOK ATOLL, 1946 (See map, fig. 2)

S–46–154, May 20 to June 6, Eniwetok lagoon, off southeast end of Eniwetok Island, *Bowditch* anchorage, hook and line, Welsh and Schaefer.
S–46–158, May 19, lagoon, 1½ miles off Eniwetok Island, surface light at night, Schultz.
S–46–159, May 20, Eniwetok Island, ocean reef in surf, Schultz.
S–46–174, May 21, Jieroru Island, southeast corner, lagoon reef, Schultz.
S–46–175, May 22, Igurin Island, reef, turning over rocks, Schultz.
S–46–180, May 26–30, Southwest Passage, about ⅘ mile south of Rigili Island, hook and line, at depth of 30 feet, Schultz and crew of *YMS 463*.
S–46–181, May 25, Chinieero Island, ocean reef, Taylor.
S–46–182, May 23, lagoon, *Bowditch* anchorage off Eniwetok Island, surface light at night, Schultz.
S–46–183, May 24, Southwest Passage, leeward side of reef 2 miles south of Rigili Island, surface light at night, Schultz.
S–46–184, May 25, Southwest Passage, leeward edge of reef, ⅘ mile south of Rigili Island, surface light at night, Schultz and Cali.
S–46–186, May 28, Mui Island, ocean reef in surf, Schultz.
S–46–187, May 29, Giriinien Island, ocean reef in surf, Schultz.
S–46–188, May 29, Giriinien Island, high tidal pool, Schultz.
S–46–189, May 30, Rigili Island, lagoon reef, Schultz.
S–46–195, June 2, Rujoru Island, lagoon reef, Schultz.
S–46–196, June 2, Rujoru Island, ocean reef, Morrison and Cali.
S–46–197, June 1, Teiteiripucchi Island, lagoon reef, Schultz.
S–46–198, June 3, Aaraanbiru Island, ocean reef, Schultz.
S–46–209, June 7, Runit Island, ocean reef, Schultz.
S–46–210, June 6, lagoon, *Bowditch* anchorage off Eniwetok Island, rod and reel, Norton.

RONGELAP ATOLL, 1946 (See map, fig. 3)

S–46–213, June 16, Arbor Island, western end, ocean reef, Schultz.
S–46–214, June 16, Arbor Island, ocean reef, high tidal pool, Schultz.
S–46–215, June 17, Eniaetok Island, north end, lagoon reef, Schultz.
S–46–216, June 18, Enybarbar Island, ocean reef next to Enybarbar Channel, Schultz.
S–46–217, June 18, Enybarbar Island, southern end, high-tidal pool, Schultz.
S–46–220, June 19, Mellu Island, lagoon reef, Schultz and Herald.
S–46–221, June 20, Rongelap Island, lagoon side, picked off coral head, Kaley.
S–46–222, June 16–28, lagoon, *Bowditch* anchorage, 1 mile off Rongelap Island, hook and line, Schultz and crew of *Bowditch*.
S–46–231, June 20, Kabelle Island, north end, lagoon reef, Schultz and Herald.
S–46–232, June 21, lagoon, 2 miles west of Bush Island, dredge at depth of 120 feet, Taylor.
S–46–259–A to I, July 17–27, lagoon, *Bowditch* anchorage, ½ mile off Rongelap Island, surface light at night, Herald.
S–46–260, July 18, Tufa Island, ocean and lagoon reef, Brock and Herald.
S–46–267, July 20, Eniaetok Island, north end, lagoon reef, Herald and Brock.

S–46–280, July 21, lagoon, *Bowditch* anchorage ½ mile off Rongelap Island, hook and line, Kohler.
S–46–282, July 23, Rongelap Island, southwest end, passageway, coral head at depths of 10 to 60 feet, spear, Brock, Herald, and Kohler.
S–46–285, July 24, Kieshiechi Island at north end, lagoon coral head at depth of 20 feet, Brock and Herald.
S–46–286, July 25, Rongelap Island near north end, lagoon coral head at depth of 18 feet, Brock, Herald, and Kohler.
S–46–295, July 26, Rongelap Island, ½ mile north of western end, at Able Buoy, top of coral head at depth of 15 feet, spear, Brock.
S–46–300, July 28, Tufa Island, lagoon coral heads at depth of 28 feet, poison and spear, Brock and Herald.
S–46–301, July 29, Naen Island, lagoon, surface light at night, Herald.
S–46–302, July 30, Naen Island, west side, lagoon reef, Herald.
S–46–303, July 30, Yugui Island, lagoon, surface light at night, Herald.
S–46–304, July 31, Yugui Island, west side, ocean reef next to small boat passage, Herald.
S–46–305, July 31, Lomuilal Island, lagoon side, surface light at night, Herald.
S–46–306, August 1, Lomuilal Island, lagoon reef, Herald.
S–46–331, July 25, lagoon off village on Rongelap Island, hook and line at 60 feet, Kohler.
S–46–389, July 21, Rongelap Island, lagoon side, spear at 10–20 feet, Brock.

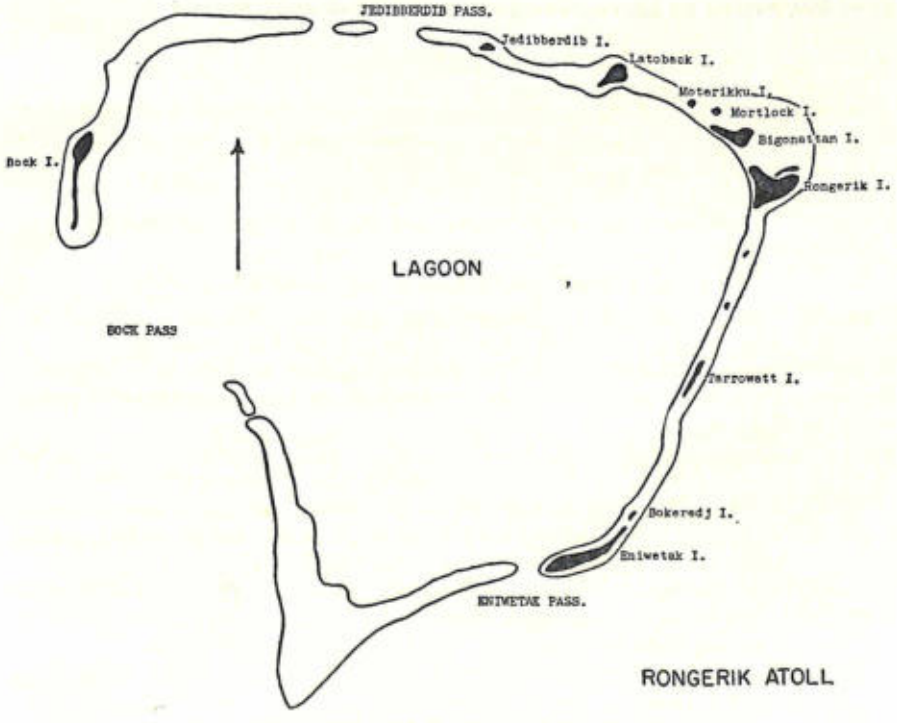

FIGURE 4.—Map of Rongerik Atoll.

RONGERIK ATOLL, 1946 (see map, fig. 4)

S–46–113, April 24, Bock Island, ocean reef, high tidal pool, Brock and Marr.
S–46–237, June 27, Bock Island, ocean reef, Schultz and Herald.
S–46–238, June 28, Latoback Island, lagoon reef, Schultz and Herald.
S–46–239, June 28, lagoon, off Latoback Island, hook and line at depth of 60 feet, crew of *YMS 463*.
S–46–241, June 29, Eniwetak Island, ocean reef in surf, Schultz and Herald.
S–46–242, June 28, lagoon, 200 yards off Eniwetak Island, surface light at night. Schultz and Herald.
S–46–276, July 20, Bock Pass, hook and line at 60 feet, Kohler.
S–46–391, April 26, lagoon off Rongerik Island, surface light at night, Marr.
S–46–392, April 23, lagoon, surface light at night, Marr.
S–46–393, April 25, off Rongerik Atoll, trolling, Marr.
S–46–394, April 27, Bock Pass, surface light at night, Marr.

RONGERIK ATOLL, 1947 (see map, fig. 4)

S–42–568, August 22, Rongerik Atoll, trolling, Marr.
S–1041, August 14, Latoback Island, lagoon, Schultz, Brock, and Donaldson.

KWAJALEIN ATOLL, 1946

S–46–397, September 1, Ennylabegan Island, near southern end, lagoon reef, Herald.

KWAJALEIN ATOLL, 1947

S–46–506, August 3, Enubu Island, lagoon reef, Brock, Schultz, and Donaldson.

JOHNSTON ISLAND, 1947

S–42–569, August 28–29, reef along northern side of atoll, Schultz.

FISHES OF THE MARSHALL AND MARIANAS ISLANDS

Phylum CHORDATA

Subphylum ACRANIA

Class CEPHALOCHORDATA

Order BRANCHIOSTOMIDA

Family ASYMMETRONTIDAE: Lancelets

By Leonard P. Schultz

We have a single specimen of a lancelet, probably in a postlarval stage, that we are not able to identify with any degree of certainty, but it resembles the following genus and species, as illustrated by Whitley:

Genus NOTASYMMETRON Whitley

Notasymmetron Whitley, Australian Zool., vol. 7, pt. 260, 1932. (Genotype, *Asymmetron caudatum* Willey.)

NOTASYMMETRON CAUDATUM (Willey)

Asymmetron caudatum Willey, Quart. Journ. Micr. Sci., vol. 39, p. 219, pl. 13, figs. 1–4 1896 (type locality, Deboyne Group, Louisiade Archipelago).—Whitley, Australian Zool., vol. 7, pt. 3, p. 26, pl. 13, fig. 6, 1932.

SPECIMEN STUDIED

U.S.N.M. No. 141724, Bikini Atoll, dredged in lagoon, April 1946, S–46–109, Emory, 1 specimen, 16 mm. total length.

Description.—This lancelet, only 16 mm. long, is referred to this genus and species with the greatest of doubt. It has about 60 to 65 myotomes and a long urostyloid projection; no gonads are developed, and no cirri can be found around what probably is the mouth.

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Subphylum CRANIATA

Superclass GNATHOSTOMATA

Class CHONDRICHTHYES: Cartilaginous Fishes

Subclass SELACHII

Superorder SELACHICA: Sharks

Order LAMNIDA

Suborder GALEINA

By LEONARD P. SCHULTZ

At least two species of sharks of which no specimens were secured were seen at Bikini. One was a hammerhead, genus *Sphyrna*, and one a species of *Carcharhinus* in which the second dorsal fin was larger than the anal as observable in a poor photograph.

KEY TO THE GENERA AND SPECIES OF SELACHII OBSERVED AT BIKINI

1*a*. Body not depressed, and not disk-shaped, instead streamlined or nearly so (superorder Selachica).

2*a*. Sides of caudal peduncle with a sharp-edged keel; teeth with serrated edges, triangular, without distinct notch on sides; last gill slit over insertion of pectoral fin; color gray or blackish above, dirty white below, with a prominent black spot on the axils of the pectorals; tips of pectorals more or less spotted with black on lower surface (family Isuridae).

Carcharodon carcharias (Linnaeus) (p. 4)

2*b*. Sides of caudal peduncle without a keel.

3*a*. Head not shaped like a double-bladed ax.

4*a*. An elongate nasal barbel reaching to or nearly to front of mouth and about twice length of eye; teeth small, with a central pointed cusp, projecting beyond 3 to 5 serrae on each side basally; last two gill openings very close together when compared with anterior ones, pelvic insertion under first dorsal origin; anal origin under second dorsal origin; color plain brownish (family Orectolobidae).

Ginglymostoma ferrugineum (Lesson) (p. 4)

4*b*. No nasal barbel, at most only a very short flat dermal flap; pelvic insertion notably behind base of first dorsal fin; anal origin under second dorsal origin, or nearly so.

5*a*. Teeth in both jaws with a distinct cusp on base at each side of large central cusp; a short nasal flap, somewhat folded, and extending a little past nasal opening; color grayish dorsally, whitish ventrally; tips of both dorsals, and of caudal lobes, white; anal and paired fins not white tipped and posterior margins of fins not white (family Triakidae)_____ Triaenodon obesus (Rüppell) (p. 5)

5*b*. Teeth without basal cusps on each side of central and main cusp (family Carcharhinidae).

6*a*. Spiracle present, though minute, a little less than an eye diameter behind eye, slightly larger than mucus pores.

7*a*. Teeth in both jaws characteristic, one side broadly convex with serrae, with point directed posteriorly, the other side with a deep notch, then a broad convex basal portion with large serrae secondarily serrated; side of caudal peduncle with a dermal ridge; color gray to brownish, paler below; small specimens up to 6 feet with dark brown spots or bars, these fading with further growth.

Galeocerdo cuvier (Lesueur) (p. 6)

7*b*. Teeth not as above; upper and lower teeth with central cusp but no denticulations or serrae basally, edges of teeth smooth; no dermal fold on caudal peduncle; notch present on dorsal and ventral sides of caudal peduncle at bases of caudal fin lobes.

Hemigaleops fosteri, new genus, new species (p. 9)

6*b*. Spiracle absent; teeth in upper jaw with acutely triangular central cusp, with a shallow notch on posterior side, and edges finely serrated; teeth in lower jaw more slender with or without finely serrated edges.

8*a*. Second dorsal fin larger than anal fin.

9*a*. Posterior margins and tips of all fins white; undersides of paired fins white; tip of snout to front of mouth 1.4 times in distance between corners of mouth; greatest width of pectoral about 2½ in its length; nasal opening without projecting dermal flap.

Carcharhinus albimarginatus (Rüppell) (p. 11)

9*b*. Posterior margins of fins not white, either grayish or blackish. Tip of snout to front of mouth about 1⅓ times distance between corners of mouth; claspers of male of the open-leaf type, not tightly rolled; greatest width of pectoral fin 2.2 to 2.4, and length of inner margin 4.1 to 4.7, in its length; color plain brownish; nasal openings without projecting dermal flap.

Carcharhinus brachyurus (Günther) (p. 12)

8*b*. Second dorsal and anal fins same size.

10*a*. Tips of both dorsals, anal, pectorals, and lower lobe of caudal fin black; posterior margin of caudal fin black edged; posterior distal tip and edge of pelvics black; nasal opening with a short projecting dermal flap; tip of snout to front of mouth 1⅓ times in distance between corners of mouth; greatest width of pectoral about 1⅓ in its length.

Carcharhinus melanopterus (Quoy and Gaimard) (p. 13)

10*b*. All fins grayish to blackish without distinct black tips; central part of underside of pectorals whitish, dorsally blackish; tip of snout to front of mouth equals distance between corners of mouth; nasal opening without projecting dermal flap; greatest width of pectoral about 1⅞ to 2⅛ in its length; claspers of male of the tightly rolled type.

Carcharhinus menisorrah (Müller and Henle) (p. 15)

3*b*. Head shaped like a double-bladed ax, eyes at sides of head (family Sphyrnidae).[1]

1*b*. Body depressed, disk-shaped, the head expanded sideways so that pectoral fins and head are not distinct, gill openings on ventral sides (superorder Rajica).

11*a*. Mouth on ventral side; no cephalic lobes; spiracles close behind eyes; tail with a serrated spine, the sting (family Dasyatidae).

11*b*. Mouth terminal, at each side an elongate fleshy appendage, the cephalic lobe, directed forward; teeth in lower jaw only; tail without a sting; gill rakers in the form of a sieve (family Mobulidae).

Family ISURIDAE: Mackerel Sharks

By Leonard P. Schultz

Genus CARCHARODON Agassiz

Carcharodon Agassiz, Poissons fossiles, vol. 3, p. 91, 1838. (Genotype, *Carcharodon versus* Agassiz=*Carcharias versus* Cloquet=*Squalus carcharias* Linnaeus.)

CARCHARODON CARCHARIAS (Linnaeus)

Squalus carcharias Linnaeus, Systema naturae, vol. 1, p. 235, 1758 (type locality, Europe).

SPECIMEN STUDIED

Bikini Atoll: 6 miles at sea southwest of Enyu Island, July 18, 1946, Univ. Washington, 1 head, about 10 inches wide and 14½ inches to first gill opening. Teeth only. A 6- or 7-foot-long shark swam past the U.S.S. *Chilton* in 1947. Its color as described by the observers suggested *Carcharodon*, the great white shark.

Family ORECTOLOBIDAE: Carpet Sharks

By Leonard P. Schultz

Genus GINGLYMOSTOMA Müller and Henle

Ginglymostoma Müller and Henle, Sitz.-Ber. Akad. Wiss. Berlin, 1837, p. 113. (Genotype, *Squalus cirratus* Bonnaterre.)

GINGLYMOSTOMA FERRUGINEUM (Lesson)

Scyllium ferrugineum Lesson, Voyage autour du monde, exécuté par order du roi, sur la corvette de sa majesté, La *Coquille*, pendant des années 1822, 1823, 1824 et 1825 . . . Zool., vol. 2, pt. 1, p. 95, 1830 (type locality, Port Praslin, New Ireland; Offack Bay, Waigiu).

SPECIMENS STUDIED

Bikini Atoll: Lagoon, *Chilton* anchorage, 1 mile off Bikini Island, S–46–477, July 30, 1947, Schultz and crew of U. S. S. *Chilton*, 1 specimen, only the head preserved; Bikini Island, western tip, on ocean side in shallow water, July 16, 1947, Univ. Washington, 1 specimen, 885 mm. total length.

Description.—The following measurements in millimeters are recorded first for the large specimen before part of it was discarded,

[1] Observed but not captured in northern Marshall Islands.

then for the small specimen preserved in alcohol: Total length 2,260 and 885; snout tip to notch at base of upper caudal fin lobe 1,600 and 590, to first dorsal origin 965 and 383, to second dorsal origin 1,470 and 497, to pelvic insertion 965 and 388, to pectoral insertion 406 and 178, to anal origin 1,400 and 526, and to front of anus 1,070 and 410; length of pectoral from its insertion to outer tip 381 and 124, and of pelvic 241 and 75; distance from notch at base of upper caudal fin lobe to its tip 648 and 288, of lower lobe 178 and 81; distance from middle of snout tip to eye 178 and 75, to first gill opening 432 and 140; interorbital space 228 and 96; distance from upper edge of first gill opening to last 127 and 51; width of first gill opening 63.5 and 21 mm., of last 65 and 22 mm.

Snout 2.0 and 1.9; eye 19.5 and 15.5; interorbital space 1.5 and 1.4; postorbital length of head to first gill opening 2.2 and 2.5; length from insertion to distal tip of pectoral fin 0.85 and 1.2; distance between outer corners of mouth 2.3 and 2.6, between inner edges of bases of nasal papillae 5.5 and 6.2; snout tip to front margin of mouth 6.2 and 6.8; distance between upper edges of first and last gill openings 2.7 and 3.0; all in head length to upper edge of first gill opening.

Teeth with a central pointed cusp, notably projecting, 3 to 5 small serrae on each side basally; nasal openings with an elongate nasal papilla that is nearly twice the length of the eye; head broadest through region of gill openings; first gill opening a little narrower than last one; last two gill openings very close together, the others much farther apart, last two gill clefts behind pectoral insertion; distance from tip of snout to front of mouth 2¾ times in distance between outer corners of mouth; a vertical line through pelvic insertion passes through first dorsal origin; anal origin under second dorsal origin; fins all pointed, with posterior margins a little concave; nictitating eyelid present.

Color when alive.—Plain brownish.

Ecology.—This species was caught on fish-baited hooks lying on the bottom at depths of 60 feet or more.

Family TRIAKIDAE: Smooth Dogfishes

By Leonard P. Schultz

Genus TRIAENODON Müller and Henle

Triaenodon Müller and Henle, Sitz.-Ber. Akad. Wiss. Berlin, 1837, p. 117. (Genotype, *Carcharias obesus* Rüppell.)

TRIAENODON OBESUS (Rüppell)

Carcharias obesus Rüppell, Neue Wirbelthiere . . . . Abyssinien gehörig. Fische des rothen Meeres, p. 64, pl. 18, fig. 2, 1835 (type locality, Red Sea.)

SPECIMEN STUDIED

Bikini Atoll: *Chilton* anchorage, 1 mile off Bikini Island, S–46–458, July 20 to August 10, 1947, Schultz, 1 specimen, length from snout tip to caudal notch 500 mm., to middle of caudal fin 550 mm., total length 675 mm.

Description.—Greatest depth 7.9; length of head to upper edge of first gill slit 4.3, to last gill slit 3.4; distance between dorsal origins 2.8; predorsal length 2.1; distance from notch at base of upper caudal lobe to its tip 2.9; all in length from tip to snout to notch at base of upper lobe of caudal fin.

Snout 2.7; eye 7.5; least width of interorbital space 1.8; postorbital length of head to first gill opening 1.9; greatest height or distance from fin origin to distal tip of first dorsal 1.3, of second dorsal 1.9, of anal 1.9; least depth of caudal peduncle 4.6; length from insertion to distal outer tip of pectoral 1.2, and of pelvic 2.4; distance between corners of mouth 2.3; distance between inner edges of nostrils 4.0; snout tip to front margin of mouth 4.4; distance between upper edges of first to last gill openings 3.9; all in length of head to upper edge of first gill slit.

Teeth in both jaws with a cusp at base of each side and sometimes with two on anterior side laterally; nasal flap folded over and extending past rear edge of nasal opening; head broadest just behind orbits, with a postorbital ridge; first gill opening a little narrower than last, the latter just behind front edge of pectoral insertion; distance from tip of snout to front of mouth twice the distance between corners of mouth; pelvic insertions opposite posterior basal tip of first dorsal fin; second dorsal and anal origins opposite; posterior margins of paired fins slightly concave, that of median fins strongly concave; nictitating eyelid present; pupil of eye oval, the long axis directed dorsoventrally.

Color in alcohol.—Grayish dorsally, pale to whitish ventrally; tips of both dorsal fins and tips of both lobes of caudal fin white, sharply contrasting with grayish fins; ventral edge of projecting basal tip of dorsal and of anal fins grayish like rest of fin; paired fins and anal not white tipped, except that pectorals appear a trifle whitish on ventral side at tips; ventral side of pectoral and pelvics, basally, white.

Family CARCHARHINIDAE: Gray Sharks

By Leonard P. Schultz

Genus GALEOCERDO Müller and Henle

Galeocerdo Müller and Henle, Sitz.-Ber. Akad. Wiss. Berlin, 1837, p. 115. (Genotype, *Squalus arcticus* Faber.)

GALEOCERDO CUVIER (Lesueur)

Squalus cuvier (Peron and Lesueur) Lesueur, Journ. Acad. Nat. Sci. Philadelphia, vol. 2, p. 351, 1822 (type locality, northwest coast of New Holland).

SPECIMEN STUDIED

Bikini Atoll: Boro Island on leeward side near channel at depth of 40 fathoms, taken by hook and line May 5, 1946, S–46–122, Kohler, 1 specimen (but only 2 teeth were preserved), female, no embryos but ovaries had numerous large eggs. Estimated weight about half a ton.

Description.—The following measurements were made the day after capture and all distances are projected lengths and do not follow the curvature of the body (data in inches):

Tip of snout to:	
middle of posterior edge of caudalfin	141
tip of upper lobe of caudal fin	166
dorsal notch of caudal peduncle	131
ventral notch of caudal peduncle	130.5
origin of first dorsal	50.5
origin of second dorsal	112
origin of anal fin	116
insertion of pectorals	37
insertion of pelvics	98
lower edge of first gill opening	29
lower edge of fifth gill opening	39
Length of fin from its origin to tip of anterior edge:	
first dorsal	16.5
second dorsal	7.0
anal	9.5
Length of paired fin from its insertion to its anterior outer tip:	
pectoral	22.5
pelvic	10.5
Length of paired fin from its insertion to tip of inner posterior edge:	
pectoral	15.8
pelvic	14.0
Length of caudal fin from peduncular notch to tip:	
upper lobe	36.5
lower lobe	18.7
Distance from rear base of fin to the posterior tip of that fin:	
first dorsal	8.5
second dorsal	6.5
anal	5.75
Distance from origin of fin to posterior basal tip of that fin:	
first dorsal	22.5
second dorsal	12.5
anal	11.5
Width of lobe of caudal fin at widest point:	
upper	9.25
lower	7
Length of first gill opening	6
Length of last gill opening	4.5
Distance between lower edges of first and last gill openings	11
Diameter of eye	1.5
Distance from rear of eye to front of spiracle	2.75
Distance from spiracle to upper edge of first gill opening	18.75
Tip of snout to rear corner of mouth	17.5

Color when alive.—Brownish dorsally, paler ventrally, with slight indications of dark spots along upper part of sides.

Remarks.—During dissection sting-ray spines were found embedded in the ventral part of the body wall. The stomach was empty.

HEMIGALEOPS, new genus

Genotype.—Hemigaleops fosteri, new species.

This new genus of sharks, of the family of Carcharhinidae, is most closely related to that group of sharks represented by *Hemigaleus* Bleeker and *Paragaleus* Budker. They have in common, among other characters: A tiny spiracle a little behind the eye, a small fold on each nostril, the median cusp of the teeth in both jaws not serrated but smooth edged. The three genera differ from each other in the character of the teeth as indicated in the following analysis:

1*a*. Teeth at sides of both jaws with their bases strongly denticulate on the outer sides ..... Paragaleus [2] Budker

1*b*. Teeth in lower jaw without denticulations, bases smooth.

2*a*. Teeth in upper jaw without denticulations, bases smooth edged. Hemigaleops, new genus

2*b*. Teeth in upper jaw with their bases strongly denticulate on the outer sides (see fig. 5, *g*, *h*) ..... Hemigaleus [3] Bleeker

Garman (Mem. Mus. Comp. Zool., vol. 36, pp. 149–152, 1913) included in the genus *Hemigaleus* four species: *pectoralis* Garman, *balfouri* Day, *microstoma* Bleeker, and *macrostoma* Bleeker. Fowler (U. S. Nat. Mus. Bull. 100, vol. 13, pp. 182–185, 1941) included the last three species mentioned in *Hemigaleus*, and *H. machlani* Herre. Bigelow and Schroeder (Fishes of the western North Atlantic, pt. 1, Sharks, pp. 275–280, fig. 45, 1948) recognized the genus *Paragaleus* Budker, 1935, and referred to it two species, *pectoralis* Garman and *gruveli* Budker. *Paragaleus* differs from *Hemigaleus* "by the fact that the lower teeth in the sides of the [lower] jaw are oblique, notched, with their bases strongly denticulate on the outer sides." This distinction leaves in the genus *Hemigaleus* the four species placed there by Fowler, 1941, namely, *machlani*, *macrostoma*, *balfouri*, and *microstoma*. These may be distinguished by the following analysis:

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[2] *Paragaleus* Budker, Bull. Mus. Hist. Nat. Paris, ser. 2, vol. 7, p. 107, 1935 (genotype, *Paragaleus gruveli* Budker, tropical West Africa, near Dakar); Cadenat, Bull. Inst. français Afrique noire, vol. 12, No. 2, pp. 412–417, 1950.

[3] *Hemigaleus* Bleeker, Verh. Batav. Genootsch., vol. 24, p. 45, 1852. (Genotype, *Hemigaleus microstoma* Bleeker, designated by Jordan, Genera of fishes, pt. 2, p. 250, 1919.)

Chaenogaleus Gill, Ann. Lyc. Nat. Hist. New York, vol. 7, p. 411, 1862. (Genotype, *Hemigaleus macrostoma* Bleeker.)

Negogaleus Whitley, Australian Zool., vol. 6, p. 334, 1931. (Genotype, *Hemigaleus microstoma* Bleeker, proposed by Whitley to replace *Hemigaleus* Bleeker, said by him to be preoccupied by *Hemigaleus* Jourdain, 1837, in mammals.)

KEY TO THE SPECIES OF HEMIGALEUS

1*a*. Cleft of mouth or distance from anterior tip of upper lip to rictus of mouth equal to preoral length of snout; cleft of mouth 1.1 in width of mouth; spiracle closer than an eye diameter behind eye.

2*a*. Vertical line through midpoint of base of first dorsal equidistant or a trifle closer to pelvic insertion than pectoral insertion; caudal fin length 4.8 in total length; preoral length of snout 0.9 to 1.0 in width of mouth; teeth 24/24 ..... Hemigaleus balfouri Day

2*b*. Vertical line through midpoint of base of first dosal a little nearer pectoral insertion than pelvic insertion; caudal fin 4.3 in total length; preoral length of snout 1.1 in width of snout (see fig. 5, *g*, *h*).

Hemigaleus macrostoma Bleeker

1*b*. Cleft of mouth shorter than preoral length of snout, probably about 1.7; cleft of mouth 1.5 to 1.6 in its width.

3*a*. Caudal fin length 3.6 in total length; midpoint of base of first dorsal not given; teeth 21/40 ..... Hemigaleus machlani Herre

3*b*. Caudal fin length 2 in total length; midpoint of base of first dorsal equidistant between pectoral and pelvic insertions; teeth 22/?; preoral length of snout 0.8 in width of mouth (see fig. 5, *i*, *j*).

Hemigaleus microstoma Bleeker

Adequate descriptions of the four species referable to *Hemigaleus* were not found. One point is clear, however: the teeth of the upper jaw of all four species are definitely described with strong denticulations on the outer sides of the basal part of the teeth. Our new genus lacks denticulations on the teeth of both jaws. Other characters of the new genus are those of the genotype, *Hemigaleops fosteri*.

HEMIGALEOPS FOSTERI Schultz and Welander, new species

FIGURE 5, *a–f*; PLATE 1

Holotype.—U.S.N.M. No. 152917, Bikini Atoll, Reer Island, July 8, 1946, Donaldson and Welander, total length 662 mm.

Description.—Certain measurements were made on the holotype, the only known specimen, and these are recorded in thousandths of the total length, as follows: Greatest depth 129.0; distance from middle of snout tip to eye 73, to first gill opening 192, to notch at base of upper caudal fin lobe 763, to spiracle 106, to first dorsal fin origin 347, to second dorsal fin origin 622, to pelvic insertion 483, to pectoral insertion 212, to anal fin origin 622, and to front of anus 514. Interorbital space 107; distance from upper edge of first gill opening to that of last 48; distance between corners of mouth 92; distance from upper lip to snout tip (preoral length of snout) 59; eye diameter 18; eye to spiracle 15; width of first gill opening 35, of last 32. Length of pectoral fin from its insertion to outer tip 157, of pelvic fin 87. Distance from notch at base of upper caudal fin lobe to its tip 234, of lower lobe 118. Distance from origin of dorsal fin to posterior basal tip 140, of second dorsal 119, of anal 95. Distance from insertion of pectoral fin to posterior basal edge 119, of pelvic 98. Distance

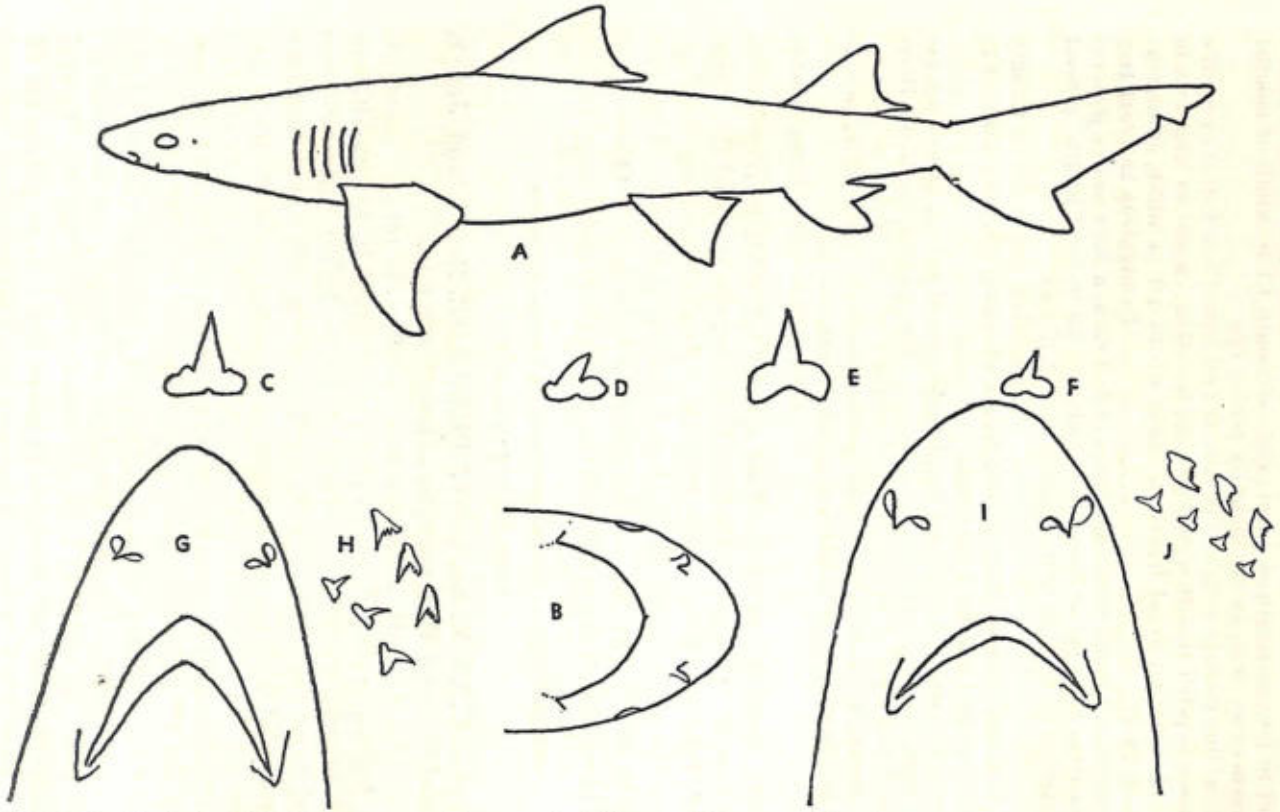

FIGURE 5.—*Hemigaleops fosteri*, new genus and new species, holotype, 662 mm. total length: *a*, Lateral view of holotype; *b*, ventral side of head; *c*, third upper tooth; *d*, tenth upper tooth; *e*, third lower tooth; *f*, tenth lower tooth. *Hemigaleus macrostoma* Bleeker (after Bleeker): *g*, Ventral side of head; *h*, teeth. *Hemigaleus microstoma* Bleeker (after Bleeker): *i*, Ventral side of head; *j*, teeth. (Sketches by author.)

from origin of first dorsal to its distal tip 130, of second dorsal 97, of anal 89. Distance from insertion of pectoral fin to its distal tip 165, of pelvic 88. Greatest width of pectoral fin 106.

Greatest depth 6; length of head to upper edge of first gill opening 4.3, to last gill slit 3.4; distance between dorsal origins 2.8; predorsal length 2.2; distance from notch at base of upper caudal lobe to its tip 3.4; all in the length from snout tip to notch at base of upper caudal lobe.

Snout 2.9; eye 10.5 to 11; least interorbital space 2.0; postorbital length of head to first gill opening 1.8; distance from fin origin to distal tip of first dorsal 1.5, of second dorsal 2.1, of anal 2.1; least depth of caudal peduncle 5.6; distance from insertion of fin to its distal outer tip of pectoral 1.2, of pelvic 2.2; distance between corners of mouth 2.3; distance between inner edges of nostrils 4.0; snout tip to front margin of mouth 3.6; distance between upper edges, first and last gill openings, 3.9; all in length of head to upper edge of first gill slit.

Teeth acutely triangular in both jaws, smooth edged, basal part without denticulations, numbering 28 in both jaws; nasal openings each with a short triangular dermal flap; head broadest behind orbits; first and last gill slits about same length, third and fourth a little longer than last; fourth gill cleft opposite pectoral insertion; distance from tip of snout to front of mouth is contained about 1.6 or 1.7 in width between corners of mouth; a vertical line through pelvic insertion is 3½ times closer to rear of base of soft dorsal than to origin of second dorsal; posterior margins of paired and median fins concave; nictitating eyelid present; a minute spiracle located not quite an eye diameter behind eye, and only a little larger than the nearby mucus pores.

Color in alcohol.—Brownish dorsally, light brownish ventrally.

Remarks.—Named *fosteri* in honor of Dr. Richard F. Foster, who participated in the Bikini Scientific Resurvey, 1947.

Genus CARCHARHINUS Blainville

Carcharhinus BLAINVILLE, Bull. Soc. Philom., 1816, p. 121; Journ. Phys. Chem. Hist. Nat., vol. 83, p. 264, 1816. (Genotype, *Squalus commersonii* Blainville.)

CARCHARHINUS ALBIMARGINATUS (Rüppell)

PLATE 2

Carcharias albimarginatus RÜPPELL, Neue Wirbelthiere .... Abyssininen gehörig. Fische des rothen Meeres, p. 64, pl. 18, fig. 1, 1835 (type locality, Red Sea).

SPECIMENS STUDIED

Bikini Atoll: Boro Channel, April 6, 1946, S-46-54, Schultz and Brock, 1 specimen, of which only the jaws were saved, after a photograph was taken.

The length from tip of snout to middle of concavity of caudal fin measured 1,790 mm. In its stomach was a 2-foot-long bone and joint, the remains of a roast thrown overboard from one of the ships in the lagoon, anchored 21 miles away.

Eniwetok Atoll: Southwest Passage, about ⅘ mile south of Rigili Island, May 26–30, 1946, S–46–180, Schultz and crew of *YMS 463*, 1 specimen, when alive measuring from tip of snout to notch at base of upper lobe of caudal fin 1,220 mm. (after 2 years' preservation, measuring 1,130 mm.), and total length 2,325 mm. (after 2 years' preservation, 1,560 mm.).

Description.—Greatest depth 5.6; length of head to upper edge of first gill slit 3.6, to last gill slit 3.1; distance between dorsal origins 2.1; predorsal length 2.1; distance from notch at base of upper caudal lobe to its tip 2.7; all in length from tip of snout to notch at base of upper lobe of caudal fin.

Snout 2.1; eye 2.4; least width of interorbital space 1.7; postorbital length of head to first gill opening 1.8; greatest height or distance from fin origin to distal tip of first dorsal 1.5, of second dorsal 5.3, of anal 3.7; least depth of caudal peduncle 6.0; length from insertion to distal outer tip of pectoral 0.9, of pelvic 3.7; distance between corners of mouth 1.9; distance between inner edges of nostrils 2.95; snout tip to front margin of mouth 2.8; distance between upper edges of first and last gill openings 4.4; all in length of head to upper edge of first gill slit.

Teeth, without basal cusps, broadly triangular in upper jaw, narrower in lower jaw, teeth of upper jaw with denticulated edges, those of lower jaw nearly smooth; nasal opening without a projecting dermal flap; head broadest behind orbits with a postorbital ridge; first gill opening a little longer than last; the last two gill openings behind insertion of pectoral fin; distance from tip of snout to front of mouth 1.4 times in distance between corners of mouth; vertical line through pelvic insertion closer to origin of second dorsal than to rear edge of base of first dorsal by a distance about equal to that between first and last gill clefts; posterior margins of paired fins slightly concave, those of median fins strongly concave; nictitating eyelid present; pupil of eye vertically oval shaped; greatest width of pectoral 2½ in its length.

Color when alive.—Grayish dorsally and ventrally whitish; posterior margins and tips of all fins white; undersides of paired fins white.

CARCHARHINUS BRACHYURUS (Günther)

Carcharias brachyurus GÜNTHER, Catalogue of the fishes in the British Museum, vol. 8, p. 369, 1870 (type locality, New Zealand).

SPECIMENS STUDIED

The following lots, collected from the northern Marshall Islands in 1946 by commercial fishermen (see p. XVI), were dried out and not in good condition, hav-

ing been recovered from the wreckage of the small ship in Halfmoon Bay, Calif. (see p. xxi) : Two specimens, length to peduncular notch, 1,020 and 1,540 mm., respectively; two specimens, about a meter long, dried and shrunken.

Description.—(These measurements are based on partly dried specimens). Greatest depth 5.7 to 6.7; length of head to upper edge of first gill slit 3.6 to 3.9, to last gill slit 2.9 to 3.1; distance between dorsal origins 2.3 to 2.4; predorsal length 2.0 to 2.1; distance from notch at base of upper caudal lobe to its tip 2.3 to 2.5; all in length from tip of snout to notch at base of upper lobe of caudal fin.

Snout 2.1 to 2.2; eye 11.5 to 15; least width of interorbital space 1.8 to 2.0; postorbital length of head to first gill opening 1.9 to 2.0; greatest height or distance from fin origin to distal tip of first dorsal 0.9 to 1.0, to second dorsal 3.4 to 5.7, to anal 2.7 to 3.3; least depth of caudal peduncle 4.8 to 5.3; length from insertions to distal outer tip of pectoral 0.7 to 0.9, of pelvic 2.2 to 3.3; distance between corners of mouth 2.0 to 2.4; distance between inner edges of nostrils 3.2 to 3.5; snout tip to front margin of mouth 2.9 to 3.2; distance between upper edges, first to last gill openings, 3.5 to 3.6; all in length of head to upper edge of first gill slit. Greatest width of pectoral in its length 2.2 to 2.4; length of inner edge of pectoral fin in its length 4.1 to 4.7.

Teeth broadly triangular in upper jaw, with serrated edges, and notched; teeth of lower jaw more slender, with smooth edges; nasal opening without a projecting dermal flap, head broadest behind orbits, with a very slight postorbital ridge; first gill slit longer than last; last two gill openings behind insertion of pectoral fin; distance from tip of snout to front of mouth about 1⅓ in distance between corners of mouth; vertical line through pelvic insertion closer to rear edge of base of first dorsal by length of pelvic fin; posterior edges of all fins concave; nictitating membrane present; anal fin notably larger than second dorsal fin, their origins opposite; claspers of male of the open-leaf type, not tightly rolled.

Color in alcohol.—Plain brownish.

Ecology.—This large species was taken only by the commercial fishermen using long set-lines off the leeward side of the reefs.

CARCHARHINUS MELANOPTERUS (Quoy and Gaimard)

PLATE 3, A

Carcharias melanopterus QUOY and GAIMARD, Voyage autour du monde . . . exécuté sur les corvettes de S. M. *L'Uranie* et La *Physicienne* . . . 1817–20, Zool., pts. 5, 6, p. 194, pl. 43, figs. 1, 2, 1824 (type locality, Waigu, Marianas).

Carcharias (*Prionodon*) *pleurotaenia* BLEEKER, Verh. Batav. Genootsch., vol. 24, pp. 28, 40, pl. 2, fig. 6, 1852 (type locality, Batavia) (based on specimens 535 to 590 mm. long, at which length the teeth of lower jaw would appear smooth-edged under low magnification).

SPECIMENS STUDIED

Bikini Atoll: Namu Island, ocean reef, April 4, 1946, S–46–51, Schultz, 1 specimen, 385 mm. to peduncular notch. This specimen before preservation measured 450 mm. to middle rear edge of caudal fin, and after 2 years in alcohol measured 410 mm. Lagoon, April 1–24, 1946, S–46–72, Schultz and crew of *Bowditch*, 1 specimen, 395 mm. to notch. Tidal pond between Eman and Reer Islands, ocean reef, July 18, 1947, S–46–422, Brock, Hiatt, Schultz, and Myers, 2 specimens, 345 mm. to notch. Eman Island, ocean surf and reef, July 19, 1947, S–46–441, Schultz, Brock, Myers, and Hiatt, 1 specimen, 355 mm. to notch.

Rongelap Atoll: *Bowditch* anchorage, 1 mile off Rongelap Island, June 16–28, 1946, S–46–222, Schultz and crew of *Bowditch*, 2 specimens, 540 and 595 mm. to peduncular notch.

Rongerik Atoll: Bock Pass, July 20, 1946, S–46–276, Kohler, 1 specimen, 328 mm. to notch. Fifty-four other specimens were captured that night and discarded.

Guam: Tartugan Point, July 1945, M. H. Markley, 1 specimen, 360 mm. to notch.

Description.—Greatest depth 5.9 to 6.2; length of head to upper edge of first gill slit 4.0 to 4.1, to last gill slit 3.2 to 3.3; distance between dorsal origins 2.4; predorsal length 2.3 to 2.4; distance from notch at base of upper caudal lobe to its tip 2.8 to 3.1; all in length from tip of snout to notch at base of upper lobe of caudal fin. Snout 2.2 to 2.3; eye 6.9 to 8.5; least width of interorbital space 1.6 to 1.7; postorbital length of head to first gill opening 2.0 to 2.1; greatest height or distance from fin origin to distal tip of first dorsal 1.4, of second dorsal 3.3, of anal 3.2 to 3.7; least depth of caudal peduncle 4.8 to 5.2; length from insertion to distal outer tip of pectoral 1.2, of pelvic 2.9 to 3.0; distance between corners of mouth 2.1 to 2.4; distance between inner edges of nostrils 3.1 to 3.2; snout tip to front margin of mouth 2.7 to 2.9; distance between upper edges of first to last gill openings 3.8 to 4.0; all in length of head to upper edge of first gill slit.

Specimens were measured, after about 2 years' preservation in alcohol, as follows:

Sex	Length, in mm., from snout tip to—		
	Dorsal caudal peduncle notch	Tip of upper caudal lobe	Posterior edge of middle caudal fin (anterior edge of concavity)
♀	595	805	600
♂	540	720	600
♂	328	450	370
♀	395	530	435
♂	378	490	410

Teeth on upper jaw triangular, with denticulate edges; teeth on lower jaw more slender, scarcely with denticulate edges but not smooth when examined under magnification; nasal opening with a short projecting dermal flap; head broadest just behind eyes, and with a slight postorbital ridge; last gill slit behind pectoral insertion, usually fourth gill slit over pectoral insertion; last gill slit notably not quite so long as first; distance between tip of snout and front of mouth about 1⅓ in distance between corners of mouth; vertical line through pelvic insertion passes through depressed tip of first dorsal fin; posterior margin of paired fins slightly concave, those of median fins strongly concave; nictitating eyelid present; pupil of eye vertically elongate; greatest width of pectoral 1⅔ to 1⅞ in its length.

Color in alcohol.—Distal tips of both dorsals, anal, pectorals, and lower lobe of caudal fins with a large black blotch, posterior margin of caudal black edged; posterior distal tip and edge of pelvics black; general color of back grayish or brownish, undersides pale or white, sides along mid-lengthwise axis abruptly paler, and usually a grayish streak below mid-lengthwise axis extends as far as pelvics and is separated by white color from grayish back.

Color when alive.—Same as in alcoholic preservation.

Ecology.—The black-tip shark is the commonest species seen, and unlike any other occurs in abundance in shallow water on the reefs, where it can be observed with its back exposed and the black tips of its fins showing. In the lagoon it was caught frequently in water as deep as 60 feet. When we were poisoning fishes, this shark seldom failed to become emboldened to the point of eating many of our specimens before we could pick them up. Although the general presence of sharks never actually troubled us, we were naturally somewhat cautious when 6-foot-long specimens began feeding ravenously a few feet away.

Remarks.—Bleeker described *Carcharias pleurotaenia* from Batavia. Fowler (U. S. Nat. Mus. Bull. 100, vol. 13, p. 166, fig. 8, 1941) recognized it as a species distinct from *melanopterus*. The difference between these two species is supposed to lie in the smooth-edged teeth on the lower jaw of *pleurotaenia*; we find that our specimens have nearly smooth-edged lower jaw teeth, but that if these are examined under good magnification, the finely serrated edges are fully evident. Since Bleeker had specimens only 535 to 590 mm. long, he could have overlooked (with only a hand lens for magnification) the finely denticulated edges.

CARCHARHINUS MENISORRAH (Müller and Henle)

Carcharias (*Prionodon*) *menisorrah* Müller and Henle, Systematische Beschreibung der Plagiostomen, p. 46, pl. 17, fig., 1841 (type locality, Java, Australia, Red Sea).

SPECIMENS STUDIED

Eniwetok Atoll: Southwest Passage, ⅘ mile south of Rigili Island, May 26–30, 1946, S–46–180, Schultz and crew of *YMS 463*, 2 specimens, 575 and 640 mm. to caudal notch.

Bikini Atoll: Boro Channel, April 6, 1946, S–46–54, Schultz and Brock, 5 embryos, 148 to 175 mm., and 2 small adults, 660 and 690 mm., all measured to peduncular notch; Boro Passage, July 29–30, 1947, S–46–478, Brock, Marr, and Smith, 3 embryos, 257 to 272 mm.; 1946, *YMS 413*, 1 embryo, 206 mm.

Rongelap Atoll: *Bowditch* anchorage in lagoon a mile off Rongelap Island, June 16–18, 1946, S–46–222, Schultz and crew of *Bowditch*, 2 specimens, 450 and 490 mm.

The following gray sharks from Boro Channel, Bikini, were measured and weighed, but not saved; however, the 5 embryos were preserved (S–46–54):

Sex	Length from snout tip to outer edge of concavity of caudal fin, in mm.	Weight, in pounds	Number of embryos present
♀	1, 210	45	–
♂	1, 100	27	–
♂	1, 180	31	–
♀	910	17	–
♀	1, 230	55	–
♀	1, 300	57	1
♀	900	15	–
♀	1, 090	31	–
♀	970	23	–
♀	1, 220	49	2
♀	1, 090	35	–
♀	980	23	–
♀	810	11	–
♀	770	10	–
♀	820	13	–
♀	1, 190	54	2

The following gray sharks from the Southwest Passage, Eniwetok Atoll, were measured but not preserved:

Sex	Length to notch at base of upper caudal fin lobe, in mm.	Total length, in mm.
♀	1, 180	1, 525
♀	1, 170	1, 525
♀	1, 120	1, 460
♀	1, 015	1, 345
♀	1, 040	1, 370
♀	1, 055	1, 525
♀	1, 725	2, 325

The following specimens were measured after 2 years of alcoholic preservation:

Sex	Length from snout tip to—		
	Dorsal caudal peduncular notch	Tip of upper caudal lobe	Anterior edge of concavity of caudal fin
♂	450	625	510
♀	575	785	635
♀	660	900	720
♀	690	910	770
♀	640	840	700
♂	490	679	540

Description.—Greatest depth 5.2 to 6.0; length of head to upper edge of first gill slit 3.3, to last gill slit 2.7; distance between dorsal origins 2.5 to 2.7; predorsal length 2.2 to 2.3; distance from notch at base of upper caudal lobe to its tip 2.8 to 3.5; all in length from tip of snout to notch at base of upper lobe of caudal fin.

Snout 2.4; eye 6.2 to 10; least interorbital space 1.8 to 1.9; postorbital length of head to first gill opening 1.9 to 2.1; greatest height or distance from fin origin to distal tip of first dorsal 1.6 to 1.7, of second dorsal 4.2 to 4.9, of anal 4.0 to 4.7; least depth of caudal peduncle 5.2 to 6.6; length from insertion to distal outer tip of pectoral 1.2 to 1.3, of pelvic 4.0 to 4.2; distance between corners of mouth 2.3 to 2.7; distance between inner edges of nostrils 3.4 to 3.5; snout tip to front margin of mouth 2.6 to 2.7; distance between upper edges of first to last gill openings 4.0 to 4.2; all in length of head from tip of snout to upper edge of first gill slit.

Teeth broadly triangular in upper jaw, narrower in lower jaw; upper teeth with denticulate edges, dentae on posterior side of base a little larger than distally; lower teeth without rough edges; nasal opening without a projecting dermal flap; head broadest behind orbits with a very slight postorbital ridge; first gill slit about same length or a little longer than last; third gill cleft about opposite pectoral insertion, last two gill slits behind it; distance from tip of snout to front of mouth equals distance between corners of mouth; vertical line through pelvic insertion a trifle closer to rear of first dorsal base than to origin of second dorsal; posterior margins of paired fins slightly concave, those of median fins strongly concave; nictitating eyelid present; pupil of eye vertically elongate.

Color when alive.—When this species is swimming, a narrow blackish band can be seen on posterior edge of upper lobe of caudal fin; back and upper sides grayish-black; fins generally grayish, becoming

blackish distally but not "black tipped;" pectorals notably blackish above and on under sides, except central and basal parts, which are paler.

Ecology.—This gray shark surpassed all other species in abundance as caught on fish-baited hook and line in the lagoon, channels, and shallow waters of the leeward side of the reefs. In Boro Passage on the night of July 29–30, 1947, a picket boat was anchored for the purpose of catching sharks. Tunafish were passed through a small sausage grinder, and the chopped-up meat and blood were cast slowly into the outward-flowing channel waters. Shortly sharks of this species were chummed to the boat by the presence of blood in the water. Then chunks of tuna meat the size of a man's fist were thrown into the water and others placed on big steel hooks. The gray sharks struck these baited hooks with greed and speed. They jumped from the water. Several would rush the bait and each other as they fed voraciously. At the end of 5 hours, 29 sharks measuring 3 to 7 feet long had been successfully landed on the boat. All were gray sharks. This species was not seen in the shallow waters over the reefs; it remained in deeper water.

Superorder RAJICA: Skates and Rays

Order RAJIDA

Suborder RAJINA

Family DASYATIDAE: Sting Rays

By LEONARD P. SCHULTZ

Genus TAENIURA Müller and Henle

Taeniura MÜLLER and HENLE, Sitz.-Ber. Akad. Wiss. Berlin, 1837, p. 117. (Genotype, *Trygon ornatum* Gray.)

TAENIURA BROCKI, new species

PLATE 4

Holotype.—U.S.N.M. No. 140978, Bikini Atoll, off Eman Island in lagoon, depth 20 feet, July 17, 1947, S–46–421, speared by Brock.

Description.—The measurements below were recorded in mm. on the preserved holotype about 10 months after capture (since some of the flesh had been dissected away near the base of the pectoral fins in order to get the approximately 100-pound sting ray into a tank, measurements involving the disk may be in error by a small percent-

age): Length of disk from tip of snout to most posterior tip of disk 820; greatest width of disk 950; tip of snout to center of anus 740; center of anus to origin of anal fin 360, to a vertical line through base of sting 360; tip of snout to base of sting 1,090; distance from attachment of pectoral fin at base of tail to base of sting 370, to tip of tail 740 (end of tail may have been bitten off); width of tail at rear base of pelvic fins 65; width of tail at base of sting 30, its depth at base of sting 26; length of outer edge of pelvic fins 150; length of clasper 210; greatest height of anal fin 22; tip of snout to front of eye 185; least width of interorbital space 100, between spiracles 157; eye 28; orbit and spiracle 83; tip of snout to front edge of oronasal groove 135, to front of mouth 165; width between front of oronasal grooves 110, corners of mouth 90; distance between inner edges of first and last gill openings 105, between their outer edges 115; width of first gill opening 28, of second 30, third 33, fourth 28, and fifth 21. Distance between inner edges of first gill openings 190, of last gill openings 130; length of spiracle 38; height of spiracle 50; distance from tip of snout to a line between most distal edge of pectoral fin or disk 285.

Disk rounded, a little wider than long, tail rather robust, only a little longer than length of disk, base of serrated spine or sting a little closer to tip than to base of tail, and opposite origin of anal fin, the latter extending along the ventral side of tail, posteriorly, no dorsal or caudal fin; no rostral cartilage; spiracles large, just at rear of eyes; interorbital space a little concave; anterior margin of disk rounded, with fleshy tip of snout projecting a little; nostrils large, separated by a narrow septum at front of mouth; upper lip or vellum fringed; lower lip and adjacent area behind with numerous papillae; middle of floor of lower jaw with 3 short papillae; nasal valves with a small free edge anteriorly and posteriorly projecting as a short dermal lobe or flap. Claspers tightly rolled, not of the open leaf-like form; teeth in both jaws in 30 oblique rows, each tooth with a short rounded tip directed forward; tail with some denticles, and with a median row along the mid-dorsal line of slightly enlarged denticles; shoulder with a few scattered denticles.

Color in alcohol.—Background light grayish with numerous small black blotches and spots of irregular shape on dorsal surface; ventral side plain pale to whitish.

Color when alive.—Background color whitish, the dark spots and blotches were brownish.

Ecology.—This sting ray was living on the sandy bottom of the lagoon floor in about 20 feet of water. Other sting rays, probably of this species, were seen occasionally in large tidal ponds 10 to 20 feet deep with sandy bottoms in the reef west of Namu Island.

Remarks.—*T. brocki* was named in honor of its collector, Vernon E. Brock. The following key, complied from the literature, should distinguish it from the other species referred to the genus:

KEY TO THE SPECIES OF TAENIURA

1*a*. Disk round; dorsal surface grayish with scattered, round, dark-edged, blue spots---------- Taeniura lymna (Forskål)
1*b*. Disk broader than long.
2*a*. Dorsal surface plain brown to blackish.
3*a*. Skin smooth---------- Taeniura meyeni Müller and Henle
3*b*. Skin rough---------- Taeniura atra Macleay
2*b*. Dorsal surface of disk with brown or black spots or numerous blotches; skin rough.
4*a*. Spine or sting inserted only a little behind first third of tail; numerous rounded black spots on dorsal surface of disk; snout length 6 times in greatest width of disk---------- Taeniura melanospila Bleeker
4*b*. Spine inserted at about half length of tail; very numerous irregularly shaped small brownish to blackish spots and blotches speckling dorsal surface of disk; snout length 5 times in width of disk. Taeniura brocki, new species

Family MOBULIDAE: Devil Rays; Manta

By Leonard P. Schultz

Genus MANTA Bancroft

Manta Bancroft, Zool. Journ., vol. 4, p. 144, 1828–29. (Genotype, *Cephalopterus manta* Bancroft.)

MANTA ALFREDI (Krefft)

Figure 6, Plate 5

Deratoptera alfredi Krefft, Illustrated Sydney News, vol. 5, pp. 3, 9, woodcut fig., July 11, 1868 (type locality, Port Jackson, New South Wales).
Daemomanta alfredi Whitley, Australian Zool., vol. 8, pt. 3, pp. 167–178, figs. 1–3, pl. 12, 1936 (Queensland; bibliography; description).

SPECIMEN STUDIED

Bikini Atoll: Enyu Channel, July 27, 1947, S–46–474, harpooned by Cox and Marquis, 1 specimen, female, without embryos, only right half preserved.

Description.—The lower jaw only with very small teeth; no spine exposed at base of tail; mouth terminal; eyes at sides near base of cephalic lobes.

The following measurements are recorded in mm.: Width across wings, or spread, 2,950; length from middle of snout to tip of tail 2,185; tip of pectoral fin to middle of snout 1,738; width of mouth 520; distance from rictus to tip of cephalic lobe, 420; distance from rictus to inner edge of first gill cleft 229, of second gill cleft 305, third gill cleft 394, fourth gill cleft 496, fifth gill cleft 597; width of

first gill cleft 330, of second 356, third 318, fourth 280, fifth 223; width between outer edges of first gill cleft 959, of last gill cleft 622; distance from outer edge of first gill cleft to outer edge of last gill cleft 430; distance from inner edge of first gill cleft to inner edge of last gill

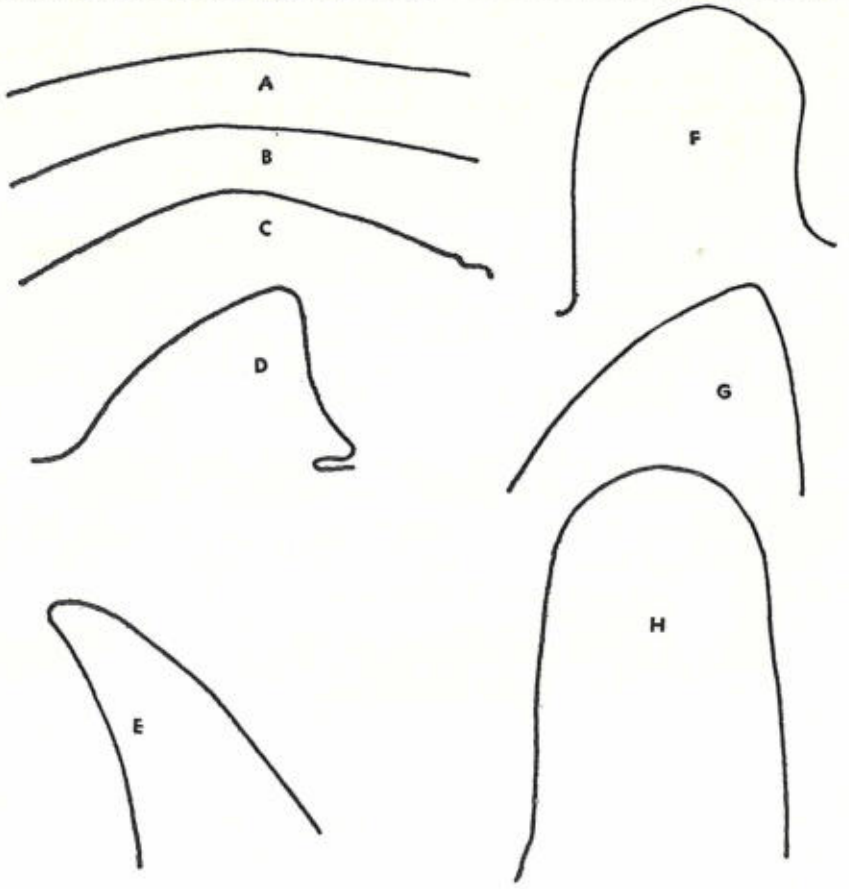

FIGURE 6.—Various parts of *Manta alfredi* (Krefft), from Bikini Atoll: *a*, Posterior edge of third gill cover; *b*, posterior edge of second gill cover; *c*, posterior edge of first gill cover; *d*, dorsal fin; *e*, outer tip of right pectoral fin; *f*, pelvic fin, inner edge at right; *g*, posterior tip of right pectoral fin; *h*, right cephalic lobe. (Sketches by author.)

cleft 325; distance from middle of snout to center of anus 1,245; distance from middle of snout to rear edge of disk 1,500. Line between tips of pectoral fins crosses the lengthwise axis of body 940 mm. behind middle of snout. Distance from origin of dorsal fin to its distal tip 185; greatest height of dorsal fin or from rear base to distal tip 140; length of base of dorsal fin 170; length of cephalic lobe from ventral edge to distal tip 380; width across base of cephalic lobe 200; greatest transverse width of cephalic lobe 175; lengthwise diameter of eye 73, vertical diameter 57; distance from outer edge of base of pelvic fin

to its distal tip 215; the pectoral fin slopes to a point distally, at an angle of approximately 30°.

Color in alcohol.—Generally the back is blackish; ventrally it is white with a few dark blotches. The large pectoral fin on its ventral side has dark colorations only along its outer edges, forming a narrow band, with irregular and fading inner edge. The cephalic lobe has a blackish inner edge, dorsally, with a width from 25 to 60 mm., widest forward; the ventral edge is white, but blackish submarginally anteriorly.

Color when alive.—Dorsal surface generally blackish with a V-shaped white shoulder patch on each side and a pale streak extending outward toward tip of each pectoral, this latter white marking fades over the central part of the body and is most intense part way out toward tips of pectorals. Ventral surface with three dark blotches between gill clefts, but area around gills white, two more dark blotches behind area of gills, and several more small dark blotches scattered posteriorly. Posterior part of pectorals with numerous small dark spots.

Ecology.—*Manta alfredi* was seen daily swimming around near the middle of Enyu channel at Bikini and occasionally at various places in the lagoons of Bikini, Eniwetok, Rongelap, and Rongerik Atolls.

The specimen preserved contained several quarts of crustacean larvae that it had strained from the water. Its swimming movements were typical of other *Manta*, the exposed tips of pectorals curved upward and outward as it slowly moved along the surface of the sea. These fish showed little fear of men or boats.

Remarks.—Our identification of the Bikini specimen of *Manta* was based on comparisons of photographs and drawings in our files and in the literature, as well as fragments and pieces of *Manta hamiltoni* from the Marquesas and Galápagos Islands in the National collections. Beebe and Tee-Van (Zoologica, vol. 26, pt. 3, pp. 274–278, fig. 39, 1941) give a most useful discussion of *M. hamiltoni* of the eastern Pacific and *M. birostris* of the Atlantic.

Our specimen from Bikini agrees with *alfredi* from Australia and differs from *hamiltoni* and *birostris* in coloration on the ventral side by having three dark blotches in the space between the right and left gill openings, no black color around or behind the gill openings, and by having numerous small black spots on the posterior one-third to one-half of the pectoral fin. *M. hamiltoni* and *M. birostris* have a broad black band on the ventral posterior side of the pectoral fin, black around the gill openings but no black blotches in the space between the gill openings.

All three species have the white shoulder patches.

Class OSTEICHTHYES: Bony Fishes

Subclass TELEOSTOMI

Superorder TELEOSTEICA

Order ISOPONDYLIDA

Suborder CLUPEINA

Family DUSSUMIERIDAE: Round Herrings

By Leonard P. Schultz and Arthur D. Welander

The round herrings are small, pelagic fishes that reach but a few inches in length and occur in tropical or subtropical and temperate waters. The family was recently revised by Leon Bertin (Bull. Inst. Oceanogr. No. 853, pp. 1–32, figs. 1–8, 1943). *Spratelloides atrofasciatus* Schultz was not included because the publication was not available to him during the war. In his analysis of the species of *Spratelloides*, he places major emphasis on the number of scales, and as a result *argyrotaeniata* (Bleeker) occurs as a synonym under *gracilis*. Our present study of specimens from various localities in the Pacific shows conclusively that *gracilis* as understood by Bertin and by Weber and de Beaufort (The fishes of the Indo-Australian Archipelago, vol. 2, p. 20, 1913) actually represents at least 2 species—*japonicus* (Houttuyn, 1782)=*gracilis* (Temminck and Schlegel), and *argyrotaeniata* (Bleeker)=*argyrotaenia* Bleeker. In addition *atrofasciatus* Schultz is a valid species (see table 1 for summary of counts).

KEY TO SPECIES OF DUSSUMIERIDAE OF NORTHERN MARSHALL ISLANDS

1*a*. Branchiostegal rays 14–19, coloration plain whitish or pale.
Dussumieria hasselti Bleeker

1*b*. Branchiostegal rays 6–7.

2*a*. Back and upper sides plain bluish black; no lateral band.
Spratelloides delicatulus (Bennett)

2*b*. Back and upper sides plain pale; distinct lateral band present.
Spratelloides atrofasciatus Schultz

Genus DUSSUMIERIA Cuvier and Valenciennes

Dussumieria Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 20, p. 467, 1847. (Genotype, *Dussumieria acuta* Cuvier and Valenciennes.)

TABLE 1.—*Counts made on certain species of* Spratelloides

Species	Dorsal rays			Anal rays (first ii or iii rays combined with branched ones)					Pectoral rays				Scales from upper edge of gill opening to caudal fin base									
	ii, 9	ii, 10	ii, 11	10	11	12	13	14	i, 10	i, 11	i, 12	i, 13	40	41	42	43	44	45	46	47	48	49
delicatulus (Marshall Islands)		8		10					1	6	4		1	3	2							
robustus (New South Wales, cotypes, U.S.N.M. No. 48824)		3		4						1	3											
japonicus (Japan)			5			1	2	2			4	5						1	1			
argyrotaeniata (East Indies; Philippines)	1	6				7			5	7	3						2		1	1	1	1
atrofasciatus (Phoenix, Marshall Islands)	2	4		1	5				7	1				1	1							

Species	Number of gill rakers on first gill arch																									
	Above angle						At angle	Below angle																		
	7	8	9	10	11	12	1	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	
delicatulus (Marshall Islands)			2	2	2		6											1	5							
robustus (New South Wales, cotypes, U.S.N.M. No. 48824)				2	1		3									1		1	1							
japonicus (Japan)				2	5	3	10															1	5	3	1	
argyrotaeniata (East Indies; Philippines)			4	4	1		9								2		3	3	1							
atrofasciatus (Phoenix, Marshall Islands)	7	2					9	1	1	4	2	2														

DUSSUMIERIA HASSELTI Bleeker

Dussumieria hasselti BLEEKER, Nat. Tijdschr. Nederl.-Indië, vol. 1, p. 422, 1850 (type locality, Batavia, Cheribon, Samarang, Surabaya).

SPECIMENS STUDIED

Bikini Atoll: Lagoon, light at night, July 27, 1949, Welander, 2 specimens, 37.9 and 62.0 mm., both damaged.

Description.—The following counts and measurements are recorded first for the 62.0-mm., then for the 37.9-mm. specimen (all fins were damaged, so that counts could not be separated by branched and simple rays, except on the caudal fins): Dorsal 18 and 16; anal 15 and 15; pectoral 12 and 11; pelvics 8 and 9; branched caudal rays 9+9 and 9+9; scale pockets (scales lost) from upper edge of gill opening to base of caudal about 61 in large specimen; about 12 scale pockets in transverse row dorsoventrally; gill rakers 10+1+21 in large specimen; branchiostegals 15 and 17.

Length of head 3.7 and 4.4; depth of body 6.7 and 8.2; tip of snout to dorsal origin 1.7 and 1.6, to pelvic insertion 1.6 and 1.6, to anal origin 1.3 and 1.3; pectoral insertion to pelvic insertion 3.0 and 2.5; all in standard length. Eye 4.2 and 4.5; snout 3.0 and 3.0; tip of snout to rear of maxillary 3.1 and 2.3; dorsal fin base 2.4 and 2.0; anal fin base 2.8 and 1.9; pelvic insertion to anal origin 1.4 and 1.3; interorbital space 4.8 and 5.7; postorbital length of head 2.2 and 2.9; least depth of caudal peduncle 3.7 and 3.8; all in length of head.

Body elongate, moderately compressed; scales lost except the following: Base of dorsal and anal fins sheathed in scales; all scales very thin, deciduous, with 4 or 5 circuli along their anterior margin, posterior field with very few irregular markings; gill rakers long and slender (about ⅓ eye diameter) in 62-mm. specimen; maxillary extends ¾ distance from snout to eye; nasal openings near tip of snout, separated by dermal flap, posterior opening larger than the anterior one; pelvics originate under insertion of dorsal fin; anus immediately in front of anal fin insertion; teeth curved, conical, in one series on premaxillary, maxillary, and dentary; teeth longer along maxillary and posterior part of dentary and imbedded in fleshy edge of lips.

Color in alcohol.—In these damaged specimens the color is undoubtedly atypical and the pale colors remaining indicate transparent specimens except for pigmented areas on occiput, along gill opening, dorsally between dorsal and caudal fin, on tip of dentary, and on premaxillary area in the 62.0-mm. specimen. In the 37.9-mm. specimen pigment is present along gill opening only.

Genus SPRATELLOIDES Bleeker

Spratelloides BLEEKER, Nat. Tijdschr. Nederl.-Indië, vol. 2, p. 214, 1851. (Genotype, *Clupea argyrotaenia* Bleeker.)

SPRATELLOIDES DELICATULUS (Bennett)

Clupea delicatula BENNETT, Proc. Zool. Soc. London, 1831, pt. 1, p. 168 (type locality, Mauritius).

SPECIMENS STUDIED

Bikini Atoll: 8 stations, 147 specimens, 16 to 61 mm. standard length.
Rongelap Atoll: 7 stations, 1,331 specimens, 15 to 61 mm.
Rongerik Atoll: 2 stations, 475 specimens, 17 to 31 mm.
Eniwetok Atoll: 4 stations, 37 specimens, 19 to 49 mm.
Kwajalein Atoll: 1 station, 11 specimens, 36 to 56 mm.
Likiep Atoll: 1 station, 5 specimens, 42 to 56 mm.

Description.—Dorsal rays usually ii, 10; anal ii, 8; pectoral i, 10 to 12; pelvics i, 7; branched caudal fin rays 8+7; scale rows from upper edge of gill opening to base of caudal fin usually 40 to 42, about 3 less from rear of head; gill rakers 9 to 11+1+27 to 30.

Length of head 3.6 to 4.2; depth of body 5.4 to 6.0; tip of snout to dorsal origin 2.2 to 2.3, to pelvic insertions 1.9, to anal origin 1.3; pectoral to pelvic insertions 3.4 to 3.8; all in standard length. Eye 2.8 to 3.5; snout 3.4 to 3.8; tip of snout to rear of maxillary 2.8 to 3.1; length of depressed dorsal 1.5 to 1.6; pelvic insertion to anal origin 0.8 to 1.0; interorbital space 4.7 to 5.0; postorbital length of head 2.2 to 2.3; length of longest pectoral ray 1.7 to 1.8; length of longest pelvic ray 2.3 to 2.5; all in length of head. Least depth of caudal peduncle 1.3 to 1.5 in its length.

Rear of isthmus at front of shoulder girdle with deep notch, behind which is a fleshy projection from shoulder girdle; gill rakers long, slender, about two-thirds diameter of eye; maxillary reaches to a vertical line through front of eye; each pair of nasal openings separated by a dermal flap, the posterior nasal opening larger than the anterior one; pelvics inserted under middle of length of depressed dorsal fin; anus in front of and close to anal fin origin, closer to caudal fin base than to pelvic insertions by a distance nearly equal to eye diameter; gill rakers lacking on posterior sides of first and second arches and on ventral part of third gill arch; upper and lower lobes of caudal fin each with a pair of glandular scales on both sides, the upper and lower black pigmented part of these glands about twice length of the inner pair, these glandular scales resembling somewhat a similar structure in certain Characidae, pigmented part of glandular scales contained about 3⅓ times in longest caudal fin ray.

Color in alcohol.—Back and upper sides plain dark brown or blackish, pale to silvery ventrally or light brownish; tip of snout, lower

jaw, and tongue dark brown; upper or inner edge of preorbital with a blackish spot; median and paired fins plain pale, or translucent, except that caudal fin has two black-pigmented streaks in each lobe forming part of glandular scales; peritoneum with numerous but scattered dark pigment cells.

Color when alive.—Back and upper sides bluish; lower sides silvery.

Ecology.—This round herring occurred in great schools around the ships anchored in the lagoons of the various atolls. Like other round herrings, it had a definite schooling pattern and would not approach closer than about a foot any large object in the water. When a can was thrown overboard into a school of *Spratelloides*, a cleared area down through the school could be seen around the can. The presence of a predaceous fish, rising from underneath to feed on the round herrings, would be signaled by the entire part of the school in his vicinity jumping clear of the water. In this way the passage of a jack through the length of a school could be traced. Generally, when undisturbed, the school would proceed together in one direction, but from time to time smaller groups would temporarily break away from the main body, their bright silvery sides flashing in the sunlight.

At night they would gather at the surface around a bright light, but usually they remained at a depth of about three feet. Their normal habitat was the waters of the open lagoon, but numerous individuals were taken over the reef in shallow water.

Remarks.—The larger females were distended with eggs in a ripe or nearly mature condition during the spring and summer months.

SPRATELLOIDES ATROFASCIATUS Schultz

FIGURE 7

Spratelloides atrofasciatus SCHULTZ, U. S. Nat. Mus. Bull. 180, p. 8, fig. 1, 1943 (type locality, Tutuila Island, Samoa).

SPECIMENS STUDIED

Bikini Atoll: 8 stations, 93 specimens, 14 to 33 mm. standard length.
Rongelap Atoll: 6 stations, 160 specimens, 15 to 37 mm.
Rongerik Atoll: 2 stations, 22 specimens, 12 to 35 mm.

Description.—Dorsal rays ii,9 or 10; anal ii or iii,8 or 9; pectoral i,10 or 11 (usually i,10); pelvics i,7; branched caudal fin rays 8+7; scale rows from upper edge of gill opening to base of caudal fin usually 41 or 42, and about 3 less when counted from rear of head; gill rakers 7 or 8+1+21 to 23.

Length of head 3.7 to 3.8; depth of body 6.4 to 6.9; tip of snout to dorsal origin 2.1 to 2.2, pelvic insertion 1.8 to 1.9, to anal origin 1.3; pectoral to pelvic insertions 3.4 to 3.5; all in standard length. Eye 2.5 to 2.8; snout 3.3 to 3.4; tip of snout to rear of maxillary 2.5;

length of depressed dorsal 1.5; pelvic insertion to anal origin 1.0; interorbital space 4.5 to 5.0; postorbital length of head 2.3; length of longest pectoral ray 1.7 to 1.8; length of longest pelvic ray 2.1 to 2.3; all in length of head. Least depth of caudal peduncle 1.0 to 1.2 in its length.

Rear of isthmus with usual notch and fleshy lobe on shoulder girdle; gill rakers long, slender, the longest equal to ⅔ eye diameter; maxillary extends past a vertical line through front of eye but not quite to one through front of pupil; nasal openings separated by a dermal flap; pelvics inserted a trifle in advance of a vertical line through middle of length of depressed dorsal fin; anus in front of and close to anal fin origin, a little closer to caudal fin base than to pelvic insertions; gill rakers lacking on posterior sides of first, second, and on ventral

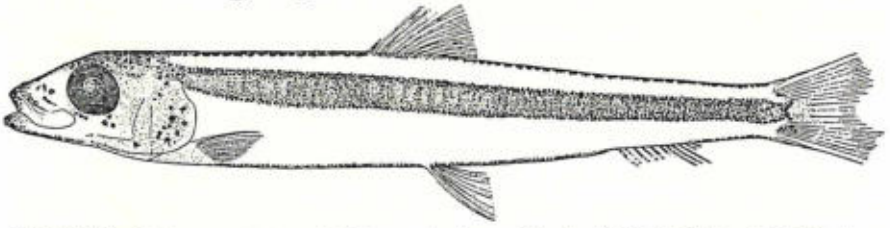

FIGURE 7.—Holotype of *Spratelloides atrofasciatus* Schultz (U.S.N.M. No. 115099), from Tutuila Island, Samoan Islands. (Drawing by Aime M. Awl.)

part of third gill arches; upper and lower lobes of caudal fin each with a pair of glandular scales, on both sides, that lack the black pigment as observed in *delicatulus*.

Color in alcohol.—The most characteristic color mark is the blackish or silvery lateral band, the greatest width of which is contained twice in postorbital length of head; tip of snout, tip of lower jaw, operculum, dorsal surface of brain with black pigment cells; middorsal line with a double row of black pigment cells and ventral edge of abdomen pigmented; peritoneum dusky. (See also under *Remarks*.)

Ecology.—This species was common in Bikini Lagoon and occurred in small compact schools but these did not join with the extensive schools of *S. delicatulus* that occurred around the anchored ships. *S. atrofasciatus* is a much smaller species than *delicatulus*. Males with enlarged testes were observed but females with mature eggs were not seen.

Remarks.—The sorting of young and postlarval *Spratelloides* from 16 or 17 mm. in standard length and shorter was not attempted, since the two species are very much alike in coloration, and time did not permit the counting of gill rakers. *S. delicatulus* at about 16 or 17 mm. has a dark lateral band and on each muscle segment below base

of dorsal fin are one or more pigment cells, otherwise the pale area above the dark band is unpigmented except along the midline of the back; at greater lengths the pigmentation fills in more and more of this pale area, so that at 21 mm. the dorsal part of sides and the back become blackish or brownish. In *S. atrofasciatus* the dorsal part of the sides and back above the dark lateral streak are unpigmented, except for black pigment cells along the middorsal line. At lengths of 14 or 15 mm. and shorter, the lateral streak does not occur in the material collected. For the above reasons we are not listing the lot from Eniwetok Atoll and two from Rongelap, which undoubtedly could have both species present.

Suborder INIOMINA

Family SYNODONTIDAE: Lizardfishes

By LEONARD P. SCHULTZ

There are two very useful revisions of the lizardfishes, one by J. R. Norman (Proc. Zool. Soc. London, 1935, pp. 99–135, figs. 1–18), and the revision of the Japanese species of *Synodus* by K. Matsubara (Journ. Imperial Fish. Inst., vol. 33, No. 1, pp. 1–36, 1938). Norman records but two species of *Synodus: variegatus* and *kaianus* from the Hawaiian Islands. During our study of the material in the United States National Museum, we were able to separate without doubt a third Hawaiian species, which we are describing as new, along with our Marshall Island specimens. This new species, *Synodus ulae*, is related to *variegatus* and probably represents the red phase of the two color phases, red and green, mentioned for the Hawaiian Islands both by Jordan and Evermann and by Norman.

In addition to the lizardfishes identified there remain 6 lots of post-larval Synodontids with 509 specimens, collected by Schultz and Herald with a light at night in the lagoons of Bikini, Rongelap, Rongerik, and Eniwetok Atolls, too small to be identified with certainty in the limited time available for this study.

The following key should facilitate the separation of Marshall Island species of the family, and serve to distinguish the new forms from all the species referred to the genus *Synodus* in the tropical Pacific region:

KEY TO SPECIES OF SYNODUS FROM TROPICAL PACIFIC AREA

1*a*. Palatine teeth in 2 bands, an outer elongate band and an inner short patch; teeth on jaws notably not covered with the lips, but exposed; posterior laminar process of pelvic girdle broad, short, greatest width 1½ times in its length; pelvic rays i, 8; anal rays ii, 7 to 9; pectoral i, 12 or 13; scale rows from upper edge of gill opening to midbase of caudal fin 52 to 54; scales from front part of dorsal fin base to lateral line 3½ to 4.

Saurida gracilis (Quoy and Gaimard) (p. 32)

1*b*. Palatine teeth in a single band, no inner patch; teeth on jaws notably covered with the lips except tips of the elongate caninelike teeth; pelvic rays i, 7; first four or more anal rays simple or unbranched; snout as long as or longer than eye (*Synodus*).

2*a*. Scales above lateral line to front part of dorsal fin base 3½ to 4 and below lateral line 5½ to 8½.

3*a*. Peritoneum black to grayish black; posterior laminar processes of pelvics long and slender; anal rays 9 to 11; dorsal rays 9 to 12.

4*a*. Scales 58 to 62; fins unmarked; side of body with a series of black spots. Synodus kaianus (Günther)

4*b*. Scales 49 to 55; 8 dark X-shaped blotches on middle of sides. Synodus macrops Tanaka

3*b*. Peritoneum white.

5*a*. Upper part of opercle with a black spot; posterior laminar process of pelvic moderately broad, greatest width about 2½ to 3 times in its length; scales 52 to 54; anal rays 9 or 10; dorsal 12 to 14, pectoral 11 or 12; sides barred and these extending below lateral line---------- Synodus hoshinonis [4] Tanaka

5*b*. No black spot on opercle.

6*a*. Anal rays 15; scales 52; pectoral 13; dorsal 12; fins unspotted. Synodus sageneus Waite

6*b*. Anal rays 8 to 12.

7*a*. Anterior dorsal rays extending to or past tips of succeeding dorsal rays when fin is depressed; dorsal rays ii, 8 to ii, 10.

8*a*. Anal rays vii to ix, 1; scales 49 to 55; no bars below lateral line---------- Synodus fuscus Tanaka

8*b*. Anal rays iii or iv, 6 to 8; scales 45 to 50; indistinct vertical bars on sides---- Synodus evermanni Jordan and Bollman

7*b*. Anterior dorsal rays notably not extending to tips of succeeding rays when fin is depressed, scales 54 to 57; total rays of dorsal 12 to 14, and of anal 8 to 10; color tending to form lengthwise streaks along upper sides and back.

9*a*. Dorsal origin equidistant between tip of snout and adipose fin base; middle rays of caudal fin without black tips. Synodus binotatus, new species (p. 35)

9*b*. Dorsal origin equidistant between rear margin of orbit and adipose origin; middle rays of caudal with blackish tips. Synodus indicus (Day)

2*b*. Scales above lateral line to front part of dorsal fin base 4½ to 7 and below lateral line 7½ to 11 to midventral line.

10*a*. Anal rays totaling 8 to 10; pelvic laminar process broad and short, its greatest width over 3 times in length.

11*a*. Scale rows from upper edge of gill opening to midbase of caudal fin 65 to 68; dorsal rays totaling 12 to 14; pectoral 12 to 14; snout plain brown or with 3 pairs of indistinct brownish spots, but none around anterior nasal openings. Synodus ulae, new species (p. 38)

11*b*. Scale rows 59 to 64.

12*a*. Dorsal fin origin closer to tip of snout than to adipose origin; snout without dark spots; 4½ scales above lateral line to front of dorsal fin base and 7½ below lateral line; scale rows 59 to 63; dorsal rays ii, 10 or 11; pectoral ii, 10 or 11; the

[4] *Synodus hoshinonis* Tanaka = *S. similis* McCulloch, 1921

four darker vertical brownish bars of a double nature, with pale interspace or centers, first near origin of dorsal, second opposite tips of dorsal rays, third at base of adipose fin, and fourth on caudal peduncle; between these less intensely colored bars or blotches; no dark streak along sides.

Synodus lacertinus [5] Gilbert

12*b*. Dorsal fin origin closer to adipose origin than tip of snout; dorsal surface of snout usually with 3 pairs of black spots and base of anterior nostril blackish; usually about 9 vertical bars on sides with darker blotches along the lateral line, sometimes with pale centers; usually 5½ to 6 scales above lateral line to dorsal base and 8½ to 10 scales below; no continuous dark streak or band along middle of sides.

Synodus variegatus (Lacepède) (p. 39)

12*c*. Dorsal origin equidistant between tip of snout and adipose origin; middle of sides with a brown streak and other wavy streaks along the scale rows on back; tip of snout plain brownish.

Synodus englemani, new species (p. 41)

10*b*. Anal rays totaling 12 to 14, with the last few rays branched; pelvic laminar process long and slender, its greatest width more than 5 times in length; first rays of dorsal fin reaching to tips of succeeding rays when fin is depressed.

Synodus altipinnis [6] (Günther)
S. scituliceps Jordan and Gilbert
S. lucioceps Ayers
S. sechurae Hildebrand

Genus SAURIDA Cuvier and Valenciennes

Saurida Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 22, p. 499, 1849. (Genotype, *Salmo tumbil* Bloch.)

SAURIDA GRACILIS (Quoy and Gaimard)

Plate 6, A

Saurus gracilis Quoy and Gaimard, Voyage autour du monde . . . exécuté sur les corvettes de S. M. L'*Uranie* et La *Physicienne* . . . 1817–20, Zool., p. 224, 1824 (type locality, Sandwich Islands; Isle de France).

SPECIMENS STUDIED

Bikini Atoll: 14 stations, 45 specimens, 43 to 198 mm. standard length.
Rongelap Atoll: 9 stations, 61 specimens, 34.5 to 169 mm.
Rongerik Atoll: 3 stations, 9 specimens, 59 to 184 mm.
Eniwetok Atoll: 2 stations, 11 specimens, 37 to 174 mm.
Likiep Atoll: 1 station, 2 specimens, 76 and 79 mm.
Rota Island: 1 lot, 1 specimen, 177 mm.

[5] Since I find 61 pores in the lateral line for *Synodus marchenae* Hildebrand and all counts, as well as general basic color pattern, the same for *lacertinus*, I believe *marchenae* to be the young of *lacertinus*. Their ranges overlap in the Galápagos Islands, from which localities I have compared specimens.

[6] These species are separated by Norman (loc. cit.) and by Hildebrand, U. S. Nat. Mus. Bull. 189, pp. 109–116, 1946.

Description.—Dorsal rays ii, 8 or 9; anal ii, 7 or 8; pectorals i, 12; pelvics i, 8; branched caudal fin rays 9 or 10+9; scales rows from upper edge of gill opening to midbase of caudal fin crossing lateral line 52; scales in a row from dorsal origin to midventral line 3½ to 4+1+5½ to 6. Additional counts are recorded in table 2.

Greatest depth 6 to 7.5; length of head 3.5 to 4.0; snout tip to dorsal origin 2.4; snout tip to pelvic origin 2.8; dorsal origin to adipose origin 2.6 to 2.7; length of caudal peduncle 5.7 to 6.6; all in the standard length. Snout 4.0 to 4.2, diameter of orbit 4.5 to 5.2, postorbital length of head 1.7 to 1.8, longest dorsal ray 1.3 to 1.4; longest pectoral fin ray 2.2; length of maxillaries 1.4 to 1.5; bony interorbital space 5.5 to 6.8; all in length of head from snout tip to rear edge of fleshy operculum. Length of inner ray of pelvic fin in fifth branched ray 1.4 to 1.5, in first, or simple, ray 0.8 to 0.9.

Body tubular in shape, with head and caudal region somewhat depressed; side of caudal peduncle with slightly developed keel; interorbital space concave; scales cycloid, covering body and head except dorsal and ventral surfaces, lips, and snout; adipose eyelids covering part of eye mostly in anterior and posterior parts; pectoral fin short, reaching a trifle past a vertical line through pelvic insertion; a vertical line through pelvic insertion passes through the fourth scale in front of dorsal origin; adipose fin base over rear of base of anal fin; teeth numerous, caninelike on jaws, and exposed when mouth is closed, not covered laterally by the lip; palatine teeth in a double series, the short inner patch separated by a deep groove from the outer elongate series; a few teeth on vomer, and many on the tongue; denticles on gill rakers very numerous; lower jaw a little shorter than upper; outer pelvic ray shortest, and inner pelvic rays shorter than fourth to sixth, the fifth pelvic ray longest and contained from 1.8 to 2.1 times in the distance from pelvic insertions to anal origin; posterior laminar process of pelvic girdle broad, short, greatest width 1½ in its length.

Color in alcohol.—Background whitish to straw colored, silvery white below, back and sides variegated with brown bars and blotches; usually 4 of the bars more prominent on the dorsal surface than the others, these located on posterior part of head, near base of dorsal fin (or just in front or just behind it), under adipose fin, and last at base of caudal fin; all of the fins usually barred; underside of head barred; 9 or 10 blotches on middle of sides; the adipose fin has a centrally located brownish spot with margins of this fin clear.

Color when alive.—Pale areas on back either grayish white or tinged with light orange-yellow; iris pale yellowish; pale areas on sides flecked with silver and pale yellowish orange; pectoral tinged with yellow-orange; blotches on sides purplish brown; clear area in adipose

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TABLE 2.—*Counts recorded for certain Pacific species of* Synodontidae

Genus and species	Dorsal rays					Anal rays						Pectoral rays					Pelvic rays	
	ii, 8	ii, 9	ii, 10	ii, 11	ii, 12	ii, 7	ii, 8	ii, 9	vii, 1	viii,1	ix, 1	i, 12	i, 13	ii, 9	ii, 10	ii, 11	i, 7	i, 8
Saurida gracilis:																		
Marshall Islands	1	3				1	2					7						7
Johnston Island		13					10	3				9	3					10
Synodus variegatus:																		
Marshall Islands and Guam		6	10						6	10					7	1	20	
Hawaiian Islands		1	4	6	1				3	8	1				6	15	9	
Japan and Okinawa		2	4						2	4					3	6		
Synodus binotatus:																		
Marshall Islands			3	11	2				4	11	1				14		15	
Johnston Island			2	3					1	3	1			1	9		10	
Synodus englemani			3	3					1	3	1				1	11	8	
Synodus ulae			2	8	4				4	6	2				3	24	8	

	Scales from upper edge of gill opening to midbase of caudal fin																Scales in posteriorly oblique row from anterior part of dorsal fin base to midventral line—									
																	Above lateral line				Below lateral line					
	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	3½ to 4	4½ to 5	5½ to 6	6½ to 7	5½ to 6	6½ to 7	7½ to 8	8½ to 9	9½ to 10	10½ to 11
Saurida gracilis:																											
Marshall Islands	5																	2				2					
Johnston Island		5	2															7				7					
Synodus variegatus																											
Marshall Islands and Guam								4	8	2										7					4	3	
Hawaiian Islands								1		6	2	5							1	11					9	3	
Japan and Okinawa									2	1	4	1	1							6				1	3	2	
Synodus binotatus:																											
Marshall Islands			3	5	4	1												8				1	4	2	1		
Johnston Island				4	1													5					2	3			
Synodus englemani											1	4	1							6							6
Synodus ulae														1	2	8	3		4	9					4	6	3

fin yellowish brown, as are spots in dorsal fin; lower jaw with 8 or 9 pale brownish bars on dentigerous area, upper jaw similarly colored.

Ecology.—This species occurred wherever there was a sandy bottom, and individuals lived both in the lagoon and on the ocean reef. It was never actually taken in the surf, but it occurred in the sandy bottom of deep surge channels.

Remarks.—This species agrees very well with Norman's (Proc. Zool. Soc. London, 1935, p. 127) revision and description with the exception that the teeth do not show very distinctly the "arrow-shaped tips."

Genus SYNODUS Scopoli

Synodus SCOPOLI, Introductio ad historiam naturalem . . . p. 449, 1777. (Genotype, *Esox synodus* Linnaeus.) (Reference copied.)

SYNODUS BINOTATUS, new species

FIGURE 8

Holotype.—U.S.N.M. No. 140801, Kwajalein Atoll, lagoon reef near south end, Ennylabegan Island, September 1, 1946, S–46–397, Herald, standard length 84.5 mm.

Paratypes.—U.S.N.M. No. 140802, 1 specimen, 51 mm., taken with the holotype, bearing same data; U.S.N.M. No. 140808, Bikini Atoll,

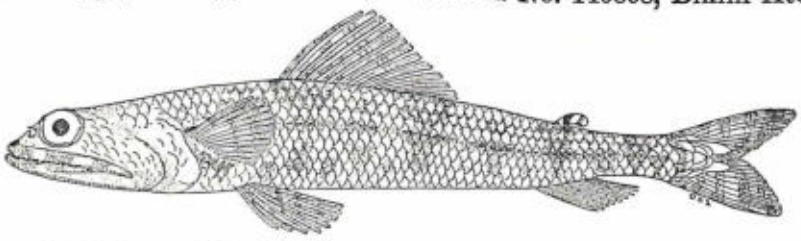

FIGURE 8.—Holotype of *Synodus binotatus*, new species (U.S.N.M. No. 140801), from Kwajalein Atoll. (Drawing by Dorothea B. Schultz.)

Erik Island, ocean reef, March 19, 1946, S–46–9, Schultz and Brock, 4 specimens, 37 to 129 mm.; U.S.N.M. No. 140811, Bikini Atoll, Eman Island, lagoon reef next to channel, July 17, 1947, S–46–405, Schultz, Brock, and Myers, 8 specimens, 32 to 96 mm.; U.S.N.M. No. 140810, Bikini Atoll, lagoon reef halfway between Bikini and Amen Islands, July 21, 1947, S–46–442, Brock, Hiatt, and Schultz, 1 specimen, 75 mm.; U.S.N.M. No. 140809, Bikini Atoll, Namu Island, lagoon reef, August 6, 1947, S–46–508, Schultz, Brock, and Hiatt, 1 specimen, 54 mm.; U.S.N.M. No. 140806, Rongelap Atoll, Arbor Island, June 16, 1946, S–46–213, Schultz, 2 specimens, 53 and 83 mm.; U.S.N.M. No. 140807, Rongelap Atoll, Eniaetok Island, lagoon reef, June 17, 1946, S–46–215, Schultz, 1 specimen, 69 mm.; U.S.N.M. No. 140805, Ronge-

lap Atoll, Mellu Island, lagoon reef, June 19, 1946, S–46–220, Schultz and Herald, 1 specimen, 77 mm.; U.S.N.M. No. 140804, Rongelap Atoll, between Eniaetok Island and Erapuotsu Island, lagoon reef, July 20, 1946, S–46–267, Herald and Brock, 1 specimen, 82 mm.; U.S.N.M. No. 140803, Rongelap Atoll, Yugui Island, ocean reef, July 31, 1946, S–46–304, Herald, 5 specimens, 58 to 72 mm.; U.S.N.M. No. 140812, Rongerik Atoll, Latoback Island, lagoon reef, August 14, 1947, S–1041, Brock, Schultz, and Donaldson, 4 specimens, 44 to 108 mm.; U.S.N.M. No. 140813, Johnston Island, ocean reef, northern side, August 28–29, 1947, Schultz, 5 specimens, 52 to 100 mm.

Description.—The following counts are recorded, first for the holotype, then for one paratype (additional counts are recorded in table 2): Dorsal rays ii,11; ii,11; anal viii,1; ix,1; pelvics i,7–i,7; i,7–i,7; pectoral ii,10–ii,10; ii,10–ii,10. Scale rows from upper edge of gill opening to midbase of caudal fin 54 and 56. Scales in an obliquely descending row from front part of base of dorsal fin to lateral line 3½ and 3½, then below lateral line to midventral line 7½ and 7½; predorsal scales 15 and 15.

Precision measurements were made on the holotype and one paratype. These are recorded in table 3 in thousandths of the standard length.

TABLE 3.—*Measurements made on certain species of* Synodus, *recorded in thousandths of the standard length*

Characters	*binotatus*		*englemani*			*ulae*		
	Holotype	Paratype	Holotype	Paratypes		Paratype	Holotype	Paratype
Standard length in mm	84.5	129	104.4	94.6	112	95.5	177	298
Greatest depth of body	156	147	144	143	174	157	158	171
Length of head to tip of fleshy operculum	291	301	290	313	295	303	297	322
Postorbital length of head	188	190	180	196	190	190	198	223
Length of snout	67	77	74	78	71	63	68	77
Diameter of orbit	52	50	58	63	55	66	52	39
Least bony width of interorbital	25	31	36	36	36	24	31	40
Tip of snout to rear edge of maxillary	186	206	181	204	185	178	186	211
Least depth of caudal peduncle	63	52	53	59	59	57	58	58
Length of caudal peduncle	124	119	136	144	140	123	124	124
Tip of snout to center of anus	740	748	748	754	755	780	756	771
Tip of snout to dorsal origin	428	464	408	429	424	418	419	416
Tip of snout to adipose origin	816	830	815	829	819	828	825	822
Tip of snout to anal origin	773	774	771	765	803	806	796	815
Tip of snout to pelvic insertion	360	358	350	351	330	346	347	382
Tip of snout to pectoral insertion	280	301	273	296	269	272	280	307
Longest dorsal ray	160	141	154	148	144	157	155	142
Longest anal ray	101	101	88	80	82	82	96	
Longest pectoral ray	130	124	108	104	104	105	116	115
Longest pelvic ray	213	244	225	213	232	241	243	228
Distance from pelvic insertion to center of anus	438	395	365	442	438	445	415	421

Greatest depth of body 6.5 to 7.1; length of head 3.5 to 3.7; snout tip to dorsal origin 2.4 to 2.5; snout tip to pelvic insertion 2.7 to 2.8; dorsal origin to adipose origin 2.4 to 2.5; length of caudal peduncle 7.3 to 7.6; all in the standard length. Snout 4.0 to 4.1; diameter of orbit 4.4 to 4.8; postorbital length of head 1.6 to 1.7; longest dorsal ray 1.7 to 2.0; longest pelvic ray 1.2 to 1.3; longest pectoral fin ray 2.1 to 2.2; length of maxillaries 1.5 to 1.6; least bony width of interorbital 9.0 to 10.0; all in the length of head from tip of snout to rear edge of fleshy operculum. Length of inner ray of pelvic fin in fifth branched pelvic ray 1.7 to 1.8, in first, or simple, pelvic ray 0.6 to 0.7.

Body somewhat tubular, head a little depressed, and caudal region nearly tubular; sides of caudal peduncle without keels; interorbital space narrow, concave; scales cycloid on body, cheeks and opercle, head otherwise naked; fins naked except scales basally on middle rays of caudal fin; adipose eyelids narrow; pectorals short, reaching about 4 scales past a vertical line through pelvic insertion; a vertical line through pelvic insertion passes through fifth predorsal scale; adipose fin base over middle of length of anal fin base; teeth caninelike in both jaws and on tongue and palatines and enlarged teeth with arrow-shaped tips; no inner patch of palatine teeth; lower jaw extending to or almost to tip of snout; outer pelvic ray shortest, contained about 1.7 times in inner ray, about 2.4 to 2.7 times in fifth branched ray, the latter longest; all but the two inner pelvic rays enlarged and swollen; longest, or fifth, pelvic ray contained 1.7 to 2.0 times in distance from pelvic insertion to anal origin; posterior bony processes of pelvics, broad, greatest width about 2½ times in their length.

Color in alcohol.—Background color whitish, with reticulated brown edges to the scales, intensified at upper and lower margins, forming 3 lengthwise streaks or lines above lateral line and another just above lateral line, more or less incorporated into the bars on sides; 10 vertical bars on back and sides, but not extending on ventral side, every other one intensified, the first dark bar over pectoral base, second at front of dorsal fin base, third behind dorsal base, fourth in front of adipose base, and last across caudal peduncle, all fins barred, front of adipose fin with a black spot, followed posteriorly with a second but less dark spot; the most characteristic color mark a pair of black spots at tip of snout, head otherwise lacks black spots; lips with four bars, one in front, one behind and one under eye, one at rear tip of maxillaries; three dark blotches on inner edges of mandibles, first near chin, second opposite third bar of lips, and third opposite isthmus.

Ecology.—This species was taken from areas with sandy bottoms.

Remarks.—We have compared this species carefully with the descriptions of all those species that possess 3½ scales between the dorsal

fin base and lateral line and believe *S. binotatus* is most closely related to *S. indicus*. It differs from that species in having all the fins barred, in the absence of black tips to middle caudal rays, and in having the dorsal origin equidistant between the tip of snout and the adipose fin base (the dorsal origin of *indicus* is equidistant between rear margin of orbit and adipose origin). This new species may be separated from other species of *Snyodus* by means of the key.

The name *binotatus* refers to the two black spots at the tip of the snout.

SYNODUS ULAE, new species

Synodus varius (in part) JORDAN and EVERMANN, Bull. U. S. Bur. Fish., vol. 23, pp. 63–65, pl. 2, 1905 (Japan and Hawaiian Islands).

Holotype.—U.S.N.M. No. 52671, Hawaiian Islands, field No. 03174, from Honolulu market, June 1901.

Paratypes.—U.S.N.M. No. 58525, Hawaiian Islands, Honolulu, June 26, 1906, E. L. Berndt, 1 specimen, 298 mm. (total length 13¾ inches); U.S.N.M. No. 55272, Hawaiian Islands, south coast Molokai, 43 to 66 fathoms, April 1902, *Albatross*, 3 specimens, 95.5 to 112 mm.; U.S.N.M. No. 55376, Laysan Island (Hawaiian chain), *Albatross*, 3 specimens, 108 to 141 mm.; U.S.N.M. No. 55437, Hilo, Hawaii, Jordan and Evermann, 2 specimens, 189 and 193 mm.; U.S.N.M. No. 59805, Kochi, Japan, 1903, H. M. Smith, 1 specimen, 260 mm.; U.S.N.M. No. 59778, Yamagawa, Japan, shore, June 16, 1903, H. M. Smith, 1 specimen, 72 mm.; U.S.N.M. No. 143701, Okinawa, Naha, 1906, *Albatross*, 1 specimen, 147 mm.; U.S.N.M. No. 143700, Hawaiian Islands, Honolulu, 1901, Jordan and Evermann, 1 specimen, 149 mm.

Description.—The following counts are recorded first for the holotype then for two paratypes (additional counts are recorded in table 2): Dorsal rays ii, 12; ii, 11; ii, 10; anal rays viii, 1; viii, 1; vii, 1; pectoral rays ii, 11–ii, 11; ii, 11–ii, 11; ii, 11–ii, 11; pelvic rays always i, 7. Scales from upper edge of gill opening to midbase of caudal fin 67; 66; 68; scale in an oblique posteriorly descending row from front of dorsal fin base to lateral line 5½; 5½ and 5½; 5½ and 5½; then from lateral line to midventral line 9½; 10½; 9½; predorsal median scales 20, 19, and 20.

Precision measurements made on the holotype and the two paratypes are recorded in table 3 in thousandths of the standard length.

Greatest depth of body 6.1 to 7.0; length of head 3.2 to 3.5; snout tip to dorsal origin 2.3 to 2.5; snout tip to pelvic insertion 2.8 to 2.9; dorsal origin to adipose origin 2.5 to 2.6; length of caudal peduncle (distance from base of last anal ray to midbase of caudal fin) 7.2 to 7.4; all in standard length. Snout 4.2 to 4.5; diameter of orbit 4.0 to 4.3; postorbital length of head 1.5 to 1.7; longest dorsal ray 1.7 to 2.2; longest pelvic ray 1.2 to 1.3; longest pectoral fin ray 2.3 to 2.4; length of maxillaries 1.5 to 1.6; least bony width of interorbital 8 to 11; all

in length of head. Length of inner ray of pelvic fin in fifth branched pelvic ray 1.6 to 1.7, and in first, or simple, pelvic ray 0.6 to 0.7.

Body somewhat tubular, head a little depressed, caudal region nearly tubular in shape; no keellike scales on sides of caudal peduncle; interorbital space concave, narrow; scales cycloid on body, cheeks and opercle, head otherwise naked; fins all naked, except that scales occur basally on middle rays of caudal; adipose eyelids narrow; pectorals short, reaching about four scales past vertical line through pelvic insertion; a vertical line through pelvic insertion passes through sixth or seventh predorsal scale; adipose fin base over middle of length of anal base; teeth caninelike in both jaws, enlarged ones with arrowhead-shaped tips; teeth present on palatines and tongue, no inner patch of palatine teeth; lower jaw a trifle shorter than upper; outer pelvic ray shortest, fifth branched ray longest; all but the two inner pelvic rays somewhat enlarged or swollen; posterior pelvic process broad, its greatest width about a third its length.

Color in alcohol.—Background color whitish or straw colored, with about 8 or 9 reticulated vertical bars, every other one more intense, extending below the lateral line but not on ventral side; centers of scales on back pale or silvery; all fins except pectorals probably barred; adipose fin with a dark spot basally and another somewhat out toward the tip; upper parts of head blotched with brownish; snout plain brownish or with traces of about 3 pairs of brownish spots; lips with about 7 to 9 narrow bars, dentary with about 5, these more or less continuous with those on lips.

Remarks.—This new species is closest to *S. variegatus* but differs in having 65 to 68 scales instead of 59 to 64. *S. ulae* has more scale rows crossing the lateral line than any other Indo-Pacific species of *Synodus*. Plate 2 in Jordan and Evermann undoubtedly represents a color drawing of this new species, probably the red color phase mentioned by them.

Named *ulae*, meaning red, after the Hawaiian common name for this species.

SYNODUS VARIEGATUS (Lacepède)

PLATE 3, B

Salmo variegatus LACEPÈDE, Histoire naturelle des poissons, vol. 5, p. 157, pl. 3, fig. 3, 1803 (type locality, Isle de France).

SPECIMENS STUDIED

Bikini Atoll: 10 stations, 32 specimens, 38 to 165 mm. in standard length.
Rongelap Atoll: 8 stations, 69 specimens, 50 to 143 mm.
Rongerik Atoll: 2 stations, 12 specimens, 49 to 108 mm.
Likiep Atoll: 1 station, 1 specimen, 103 mm.
Guam: 2 lots, 7 specimens, 45 to 117 mm.

Description.—Dorsal rays ii, 9 or 10; anal viii or viii,1; pectorals ii,10 (rarely, ii,11); pelvics i,7. Scale rows from upper edge of gill

opening to midbase of caudal fin 59 to 61; scales in a row from dorsal origin to midventral line 5½ to 6+1+8½ to 10. Additional counts and measurements are recorded in tables 2 and 3.

Greatest depth 5.5 to 6.7; length of head 3.4 to 3.6; snout tip to dorsal origin 2.5; snout tip to pelvic insertion 2.8 to 2.9; dorsal origin to adipose origin 2.4 to 2.6; length of caudal peduncle 7.1 to 7.2; all in standard length. Snout 4.5 to 4.7; diameter of orbit 4.5 to 7.3; postorbital length of head 1.4 to 1.6; longest dorsal ray 2.0 to 2.2; longest pelvic ray 1.3; longest pectoral fin ray 2.7 to 2.9; length of maxillaries 1.7; least width bony interorbital space 10 or 11; all in length of head (tip of snout to rear edge of fleshy operculum). Least depth of caudal peduncle in its length 2.6 to 2.9; length of inner ray of pelvic fin in fifth branched pelvic ray 1.5, in first, or simple, ray 0.5.

Body tubular, head depressed, caudal region somewhat depressed; sides of caudal peduncle without "keels"; interorbital space narrow, concave; scales cycloid, lacking on head, except on cheeks and operculum; adipose eyelids narrow; pectorals short, reaching about 4 scale rows past a vertical line through pelvic insertion; a vertical line through pelvic insertion passes through sixth or seventh scale row in front of dorsal origin; adipose fin base over middle of length of anal fin base; teeth canine in both jaws, moderately numerous, mostly covered with a broad lip, only tips of longer teeth exposed when mouth is closed; palatine teeth in a single band, caninelike, no inner patch present; probably no teeth on vomer; tongue with numerous caninelike teeth; lower jaw a little shorter than upper, not extending past tip of snout; outer pelvic ray short, about 1⅔ times in inner pelvic ray, about 2⅔ times in longest, or fifth, branched pelvic ray; longest pelvic ray from 1.9 to 2.0 in distance from pelvic insertion to anal origin.

Color in alcohol.—Background whitish to straw colored, somewhat silvery-white below, back and sides with 9 or 10 dark bars, every other one more intense, or darker, the darker bars or blotches occurring over pectoral insertions, in front of dorsal fin base, on tips of depressed dorsal fin, directly in front of adipose fin origin, and on caudal peduncle; dorsal and caudal fins faintly barred, others plain and pale; lower sides of head with 3 bars, more or less continuous on the lips; dorsal surface of head with scattered dark spots, those on dorsal surface of snout in 3 pairs, anterior pair on each side of tip of snout, middle pair nearer middorsal line and about halfway to nasal opening, third pair at margin of anterior nasal openings; distinct and persistent black spots at origins of dorsal and of adipose fins; middle of length of adipose fin with dark pigment sometimes in the form of a round spot.

Color when alive.—Dark bars brownish; fins and pale areas tinged with light orange.

Ecology.—This lizard fish inhabits sandy bottoms in the lagoon and along the ocean reefs.

SYNODUS ENGLEMANI, new species

FIGURE 9

Holotype.—U.S.N.M. No. 140815, Rongelap Atoll, Kieshiechi Island, lagoon coral head, depth 20 feet, July 24, 1946, S–46–285, Brock and Herald, standard length 104.4 mm.

Paratypes.—U.S.N.M. No. 140816, Bikini Atoll, off Amen Island, depth 30 feet, August 4, 1946, S–46–307, Herald and Brock, 2 specimens, 94.6 and 112 mm.; Bikini Atoll, Bikini-Amen reef, depth 30 feet, July 31, 1947, Univ. Washington, 3 specimens, 126 to 195 mm.; Bikini Atoll, Ion Island, August 7, 1946, Univ. Washington, 1 specimen, 166 mm.; Bikini Atoll, lagoon, hook and line, July 24, 1946, Donaldson and Welander, 1 specimen, 186 mm.

Description.—The following counts are recorded first for the holotype then for the two paratypes: Dorsal rays ii, 10; ii, 11; ii, 11; anal rays ix, 1; viii, 1; viii, 1; pectoral rays ii, 10–ii, 11; ii, 11–ii, 11; ii, 11–ii, 11; pelvic rays always i, 7. Scales from upper edge of gill

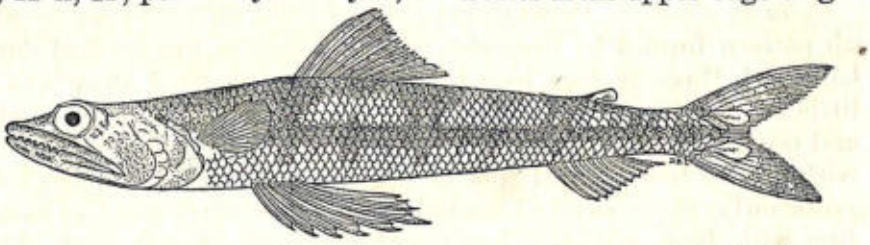

FIGURE 9.—Holotype of *Synodus englemani*, new species (U.S.N.M. No. 140815), from Rongelap Atoll. (Drawing by Dorothea B. Schultz.)

opening to midbase of caudal fin 62; 62 and 63; scales in an oblique posteriorly descending row from front of dorsal fin base to lateral line 5½; 5½; 5½; then from lateral line to midventral line 10½; 9½; 10½; predorsal median scales 19; 19; 19. (For additional counts see table 2.)

Precision measurements were made on the holotype and the two paratypes and these data are recorded in table 3 in thousandths of the standard length.

Greatest depth of body 5.5 to 6.5; length of head 3.3 to 3.4; snout tip to dorsal origin 2.3 to 2.4; snout tip to pelvic insertion 2.7 to 3.0; dorsal origin to adipose origin 2.6 to 2.7; length of caudal peduncle 7.0 to 7.5; all in the standard length. Snout 4.2 to 4.3; diameter of orbit 5.0 to 5.1; postorbital length of head 1.5 to 1.6; longest dorsal ray 2.1 to 2.2; longest pelvic ray 1.3 to 1.4; longest pectoral fin ray

2.8 to 2.9; length of maxillaries 1.6; least bony width of interorbi 8.1 to 8.4; all in length of head (tip of snout to rear edge of fles operculum). Length of inner ray of pelvic fin in fifth branch pelvic ray 1.6 to 1.7, in first, or simple, ray 0.6 to 0.7.

Body somewhat tubular, head a little depressed, caudal region near tubular in shape; sides of caudal peduncle without keels; interorbit space concave, narrow; scales cycloid, on body, cheeks, and operc head otherwise naked; fins all naked, except that scales occur basal on middle rays of caudal; adipose eyelids narrow; pectorals sho reaching about 5 scales past a vertical line through pelvic insertio a vertical line through pelvic insertion passes through the fifth pr dorsal scale; adipose fin base over middle of length of anal fin bas teeth caninelike in both jaws and on palatines and tongue, the e larged jaw teeth with arrow-shaped points. No inner patch of pal tine teeth; lower jaw nearly equal to or a little shorter than uppe not extending past tip of snout; outer pelvic ray shortest, the fif branched ray longest; all but the two inner pelvic rays enlarged swollen; posterior bony process of pelvic girdle broad, its greate width about 3 times in its length.

Color in alcohol.—Background color whitish, with reticular brow ish pattern formed by brownish edged scales and five vertical dar bars with three or four bars between; brownish band along and little below lateral line joining with the vertical bars; dorsal, caud and pectoral fins barred; anal and pelvics plain and pale; adipose f with a dark brown basal spot at its origin and a paler brown sp posteriorly; upper parts of head plain brown; no dark spots on snou lips with four indistinct bars; under side of dentary with thr brownish bars, the two anterior ones in the form of narrow streal mostly along the inner edges of the dentary next to the isthmus.

Ecology.—This species was taken only in water 20 to 30 feet dee and probably came from sandy deposits on the coral heads.

Remarks.—This species is close to *Synodus variegatus* but diffe in having a few more scales and a different color pattern. The dorsa surface of the snout is plain brown in *englemani*, whereas in *variegatu* there are three pairs of small black spots, the one at the base of th posterior nasal openings being especially persistent. The midd brown blotch on the dentary of *englemani* takes the form of a narro edging but in *variegatus* it is a broad blotch. There is no continuou brownish band or streak along the side of *variegatus* as in *engleman S. englemani* is sufficiently separated from all other species of *Synodu* in the key.

Named in honor of Capt. C. L. Engleman, U.S.N., who was i charge of the Bikini Scientific Resurvey in 1947.

Family MYCTOPHIDAE: Lanternfishes

By Leonard P. Schultz

Dr. Rolf Bolin kindly identified the lanternfishes, for which we express our sincere thanks. Since the species are too few to make a key practical or to permit a description, these are omitted.

Genus MYCTOPHUM Rafinesque

Myctophum Rafinesque, Indice d'ittiologia siciliana . . ., p. 56, pl. 2, fig. 5, 1810. (Genotype, *M. punctatum* Rafinesque.)

MYCTOPHUM BRACHYGNATHOS (Bleeker)

Scopelus brachygnathos Bleeker, Act. Soc. Sci. Indo-Neerl., vol. 1, p. 65, 1856 (type locality, Manado, Makassar).

SPECIMENS STUDIED

Bikini Atoll: Boro Channel, April 6, 1946, S–46–53, Schultz and Brock, 42 specimens, 23 to 65 mm.

Eniwetok Atoll: Southwest Passage, ⅘ mile south of Rigili Island, May 25, 1946, S–46–184, Schultz and Cali, 2 specimens, 54 and 56 mm.

Genus DIAPHUS Eigenmann and Eigenmann

Diaphus Eigenmann and Eigenmann, Proc. California Acad. Sci., ser. 2, vol. 3, p. 3, 1890. (Genotype, *Scopelus engraulis* Günther.)

DIAPHUS SCHMIDTI Tåning

Diaphus schmidti Tåning, Vidensk. Meddel. Dansk. Naturh. Foren., vol. 94, p. 139, fig. 11, 1932 (type locality, north of Samoa Island, lat. 7°46′ S., long. 167°10′ E).

SPECIMEN STUDIED

Eniwetok Atoll: Southwest Passage, ⅘ mile south of Rigili Island, May 25, 1946, S–46–184, Schultz and Cali, 1 specimen, 33.5 mm. (This specimen was doubtfully identified by Dr. Bolin.)

Order ANGUILLIDA: Eels

By Leonard P. Schultz

KEY TO THE FAMILIES OF EELS OF THE MARSHALL AND MARIANAS ISLANDS

1*a*. Body scaly, scales in patches arranged at right angles to adjoining patches; pectorals present; origin of dorsal far behind gill openings; median fins confluent with caudal; anus in front of middle of total length; posterior nostril in front of eye; teeth small, villiform or in cardiform bands on jaws and vomer (fig. 10, *a*); gill openings vertical slits in front of or below base of pectorals ..... Anguillidae (p. 45)

1*b*. Body not scaly.

2*a*. Dorsal and anal fins, if present, not reaching tip of tail, the latter projecting as a stiff point; caudal fin absent; posterior nostrils in upper lip, usually under eye, and directed ventrally; anterior nostrils tubular, usually under tip of snout at its sides; pectorals present or absent. Ophichthidae (p. 45)

2*b*. Tip of tail with a well-developed caudal fin or a rudimentary one, with which the dorsal and anal fins, if present, are confluent; tip of tail not sharp pointed.

3*a*. Posterior nasal opening, in upper lip, usually with a valvular flap, directed downward; anterior nostrils tubular, each side of tip of snout; pectorals present or absent---------- Echelidae (p. 60)

3*b*. Posterior nasal openings usually over or in front of eye, never in upper lip.

4*a*. Lower lip at sides of jaw folded downward and usually upper lip folded upward, folded parts of lips not continuous around tip of snout or tip of lower jaw; rear nasal opening in front eye; pectorals well developed; gill opening in front of pectoral fin.

Congridae (p. 83)

4*b*. Lower lip not folded downward on sides of jaw, anterior nostrils tubular near tip of snout.

5*a*. Posterior nasal opening in front of eye; pectorals well developed, vestigial or absent; body tubular in shape sometimes compressed near tip of tail, or wormlike; gill opening a pore in front of pectoral base and below it; dorsal and anal fins confined to tail or nearly so and sometimes reduced to low folds, or with an interruption a little in front of end of tail------ Moringuidae (p. 86)

5*b*. Posterior nasal opening usually above dorsal edge of eye or on dorsal surface of snout a little in advance of orbit; pectorals absent; body usually somewhat compressed, more so near end of tail; body not wormlike; gill opening a lengthwise slit on sides.

Muraenidae (p. 98)

Family ANGUILLIDAE: Fresh-water Eels

By Leonard P. Schultz

Genus ANGUILLA Shaw

Anguilla Shaw, General zoology, vol. 4, p. 15, 1803. (Genotype, *Muraena anguilla* Linnaeus.)

ANGUILLA MARMORATA Quoy and Gaimard

Anguilla marmorata Quoy and Gaimard, Voyage autour du monde . . . exécuté sur les corvettes de S. M. *L'Uranie* et La *Physicienne* . . . , 1818–20, Zool., p. 241, pl. 51, fig. 2, 1824 (type locality, Vaigiou).

SPECIMEN STUDIED

Saipan: 1 specimen, 710 mm. total length. The identification of this specimen was made on the basis of "A Revision of the Genus *Anguilla* Shaw," by Vilh. Ege (Dana Report, No. 16, pp. 1–256, 53 figs., 6 pls., 1939).

Description.—The following measurements are recorded in thousandths of the total length, which is 710 mm.: Snout tip to dorsal origin 275; snout tip to anus 458; head 161; length of pectoral fin 52; distance between verticals between dorsal and anal origins 183; greatest depth 70; tip of snout to rear of maxillary 65; snout 37; eye 13.

Color in alcohol.—Marbled color pattern of dark gray.

Family OPHICHTHIDAE: Snake Eels

By Leonard P. Schultz

The Ophichthidae are recognizable from all other eels by having the dorsal and anal fins, if present, ending in front of the tip of the

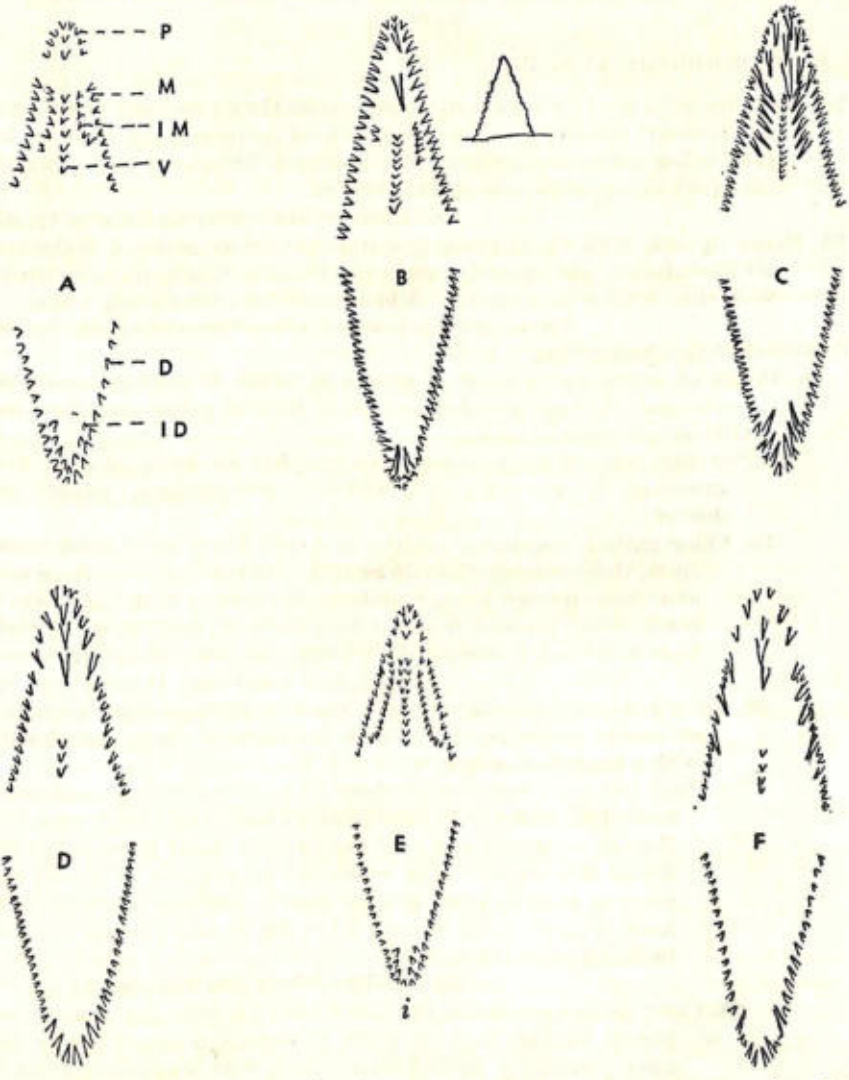

Figure 10.—*a*, Diagram illustrating the names used for the various groups of teeth in eels: (P) premaxillary, (M) maxillary, (IM) inner row of teeth on maxillary, (V) vomer; (D) dentary, (ID) inner row of teeth on dentary. Dental patterns of certain species of eels: *b*, *Gymnothorox moluccensis* (Bleeker); *c*, *Enchelynassa canina* (Quoy and Gaimard); *d*, *Gymnothorax petelli* (Bleeker); *e*, *G. thyrsoideus* (Richardson); *f*, *G. rupelli* (McClelland). (Sketches by author.)

tail, the latter projecting as a stiff point. However, in such forms as *Leptenchelys vermiformis* Myers and Wade and L. *pinnaceps*, new species, in the family Echelidae the tip of the tail is almost hard tipped and might be referred to this family, since they have, in common with *Leiuranus*, a median groove on the underside of the snout.

KEY TO THE OPHICHTHIDAE OF THE NORTHERN MARSHALL AND MARIANAS ISLANDS

1*a*. Upper lip with cirri, or papillae.

2*a*. Both lips with cirri; jaws nearly equal; snout blunt; pectoral and median fins present; dorsal fin origin a little behind pectorals; gill openings lateral, below pectoral fin base; color brownish dorsally, white ventrally, each pore along lateral line black bordered.

Brachysomophis sauropsis Schultz (p. 47)

2*b*. Upper lip only with cirri; lower jaw included, snout pointed, projecting; all fins absent; gill openings ventrally located, nearly parallel lengthwise slits, with a very narrow isthmus between; color plain white.

Cirricaecula johnsoni, new genus and species (p. 50)

1*b*. No cirri along edges of lips.

3*a*. Origin of dorsal fin in front of middle of length of head or nearly so; lower jaw scarcely reaching to rear of base of tubular anterior nostrils on underside of snout.

4*a*. Pectorals present, as long as or longer than diameter of eye; teeth granular, in two rows on maxillary, premaxillary, vomer, and dentary.

5*a*. Color pattern consisting mostly of round black or blackish-brown spots, these arranged in two or three alternating rows along back and sides; the row along middle of side usually with from 25 to 30 black spots; greatest depth of body 34 to 41, head 12 to 16, snout to anus 2.2 to 2.4, snout to dorsal origin 22 to 28, all in total length.

Myrichthys maculosus (Cuvier) (p. 51)

5*b*. Color pattern consisting of black rings or black saddles, encircling or partly encircling body, with interspaces white, occasionally with a black bar or spot.

6*a*. Color pattern consisting of about 26 to 33 black rings completely encircling body, with interspaces white; each black ring continuous on dorsal and anal fins to their distal edges; anal and dorsal fins disappearing somewhat in advance of tip of tail, more so than in other related species; greatest depth 51 to 63, head 17 to 20, snout to anus 2.1 to 2.3, snout to dorsal origin 35 to 41, all in total length.

Myrichthys colubrinus (Boddaert) (p. 52)

6*b*. Color pattern consisting of black rings or saddles that do not completely encircle body in front of anus, but may more or less meet posteriorly behind anus; black bars numbering from 26 to 31; greatest depth 52 to 69, head 18 to 21, snout to anus 2.0 to 2.3, snout to dorsal origin 39 to 45, all in total length.

7*a*. Black bars continuous on dorsal fin to distal edge so that dorsal fin is not white edged; usually a few round black spots or oblong black bars on sides, in white spaces.

Myrichthys elaps (Fowler) (p. 53)

7*b*. Black bars not quite continuous to edge of dorsal fin, distal edge white across the black bars; no round black spots in white spaces_____ Myrichthys semicinctus (Bleeker) (p. 54)

4*b*. Pectorals absent; teeth caninelike or conical, in a simple series on maxillary and on dentary, in one or two rows on vomer.

8*a*. Color pattern consisting of a single wide band along middle of body with white above and below; margin of dorsal fin black, becoming white near end of tail, basal two-thirds white; anal fin white.
Callechelys melanotaenia Bleeker (p. 55)

8*b*. Color pattern marbled or spotted with black-and-white areas; head with small black spots; dorsal fin spotted or marbled; tail region more uniform blackish than body anteriorly; tip of tail white__ Callechelys marmoratus (Bleeker) (p. 56)

3*b*. Origin of dorsal fin over or behind gill openings; pectoral fin present; teeth on maxillary and dentary conical, arranged in a single row; those on vomer, if present, in a single row; body with 22 to 39 black saddles alternating with white spaces; black bars do not meet in front of anus but some may meet behind anus along midventral line, coloration plain and pale on young specimens.
Leiuranus semicinctus (Lay and Bennett) (p. 57)

Genus BRACHYSOMOPHIS Kaup

Brachysomophis KAUP, Catalogue of the apodal fish in the collection of the British Museum, p. 45, 1856; Arch. Naturg., vol. 22, p. 9, 1856. (Genotype, *B. horridus* Kaup.)

BRACHYSOMOPHIS SAUROPSIS Schultz

FIGURE 11, *g*; PLATE 7

Brachysomophis sauropsis SCHULTZ, U. S. Nat. Mus. Bull. 180, p. 18, pl. 2, fig. 2, *h* 1943 (type locality, Samoan Islands).

SPECIMENS STUDIED

Bikini Atoll: 3 stations, 4 specimens, 60 to 262 mm. total length.
Eniwetok Atoll: 1 station, 2 specimens, 430 and 475 mm.
Rongelap Atoll: 1 station, 1 specimen, 357 mm.
Rongerik Atoll: 3 stations, 4 specimens, 288 to 350 mm.

Description.—Body elongate, somewhat cylindrical, squarish in cross section. Greatest depth 16.6 to 32; head 6.9 to 7.5; snout tip to anus 1.8 to 1.9, to dorsal origin 5.1 to 5.7; all in total length. Greatest depth 2.4 to 4.3; snout 14.8 to 17.3; length of pectoral fin 9.0 to 12.3; snout tip to cross row of pores near occiput 1.8 to 2.0; eye 19 to 21; all in length of head to upper edge of gill opening. Eye 1.1 to 1.4 in snout.

Posterior nasal opening in upper lip, under eye; anterior nostril tubular, on side of snout; snout short, dorsal surface flattish, bluntly rounded; eye diameter a little less than length of snout; eye without free border; dorsal fin origin a little less than or ⅓ length of head behind pectoral fin base; gill openings restricted to sides and extending below upper edge of pectoral base a distance equal to snout and eye, or 1½

times length of pectoral fin; pectoral fin well developed, with 10 to 12 rays; dorsal and anal fins not confluent around tip of tail, the latter projecting as a sharp point; anus a little closer to tip of tail than to snout; anal fin origin close behind anus; lateral line near middle of sides, with 51 or 52 pores between gill opening and anus and 96 to 99

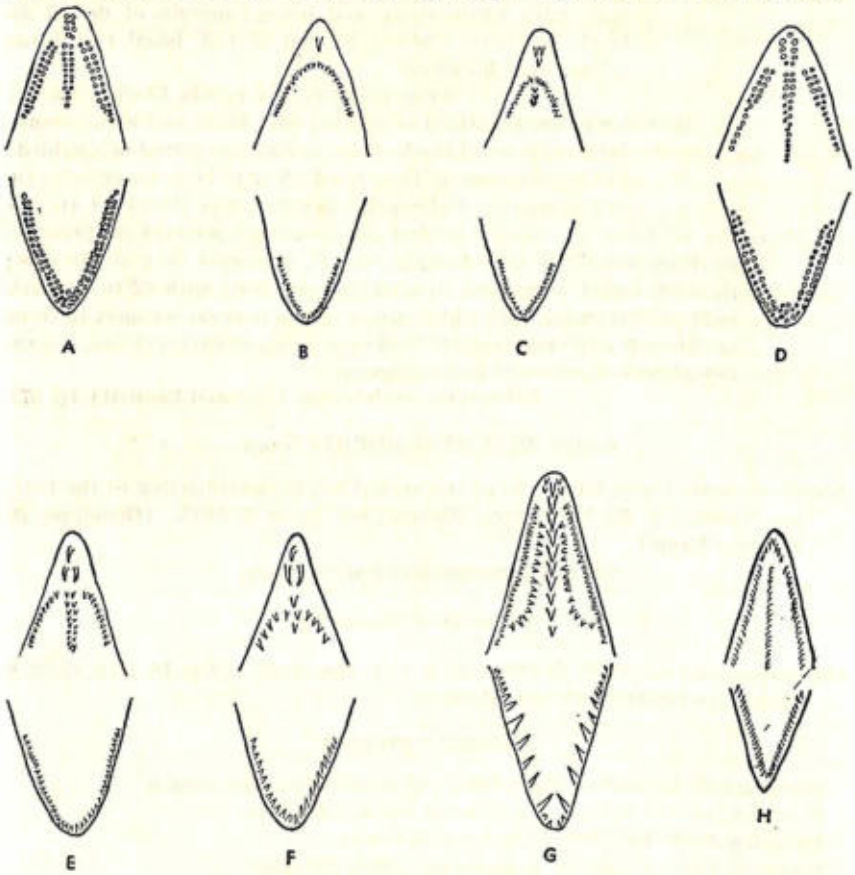

FIGURE 11.—Arrangement of teeth of certain species of Ophichthidae: *a, Myrichthys colubrinus* (Boddaert); *b, c, Leiuranus semicinctus* (Lay and Bennett); *d, Myrichthys maculosus* (Cuvier); *e, Callechelys marmoratus* (Bleeker); *f, C. melanotaenia* Bleeker; *g, Brachysomophis sauropsis* Schultz; *h, Cirricaecula johnsoni,* new genus and new species. (Sketches by author.)

from gill opening to point where pores end some distance before tip of tail; lips with an irregular row of branched cirri; tip of snout with cirri each side of midline; eye with or without short cirri; eyes and snout together form an elevated circular "platform" with a constriction behind orbits; teeth caninelike, strong, sharp pointed, arranged as in figure.

Color in alcohol.—Brown dorsally, abruptly pale or white below lateral line; each pore on head and along lateral line black bordered; one specimen has a few scattered black specks on back, others plain brownish; dorsal fin plain white throughout its length; anal and pectoral fins white; the raised "platform" composed of snout and orbital region dark brown on two specimens, sharply contrasting with light brown head.

Ecology.—Individuals of this species came from reef areas where loose sand occurred, and probably were living buried in it until driven out by the poison (see p. xv).

Remarks.—We cannot find any difference between *B. sauropsis* and the Marshall Island specimens. We believe *B. sauropsis* is different from *B. henshawi* Jenkins and *B. crocodilinus* (Bennett) as pointed out by Schultz (pp. 17–19).

CIRRICAECULA, new genus

Genotype.—Cirricaecula johnsoni, new species.

This new genus of ophichthid eel is characterized by the cirri on the edges of the upper lip, and the two cirri, or barbels, between the tubular anterior nostrils; by the very small eyes located on the dorsal surface of the depressed or flattened head; by the pointed snout with included lower jaw; by the absence of pectoral or median fins; and by gill openings that are parallel slits on the under side of the head.

This new eel is most closely related to *Caecula* Vahl=*Sphagebranchus* Bloch, and to *Lamnostoma* Kaup, both of which lack cirri on the lips. The genera *Cirrhimuraena* Kaup and *Brachysomophis* Kaup, with cirri on the lips, differ from *Cirricaecula* in having well-developed pectoral fins.

Named in reference to the cirri on the upper lips, otherwise very similar to the genus *Caecula*.

KEY TO GENERA CLOSELY RELATED TO CIRRICAECULA

1*a*. Upper lips with cirri; a pair of short barbels, or cirri, between anterior nostrils; anterior nostrils tubular; eyes small, located on dorsal surface of depressed head; gill openings parallel lengthwise slits, distance between anterior gill membrane at isthmus equal to that between them posteriorly; anus about equidistant between tip of snout and tip of tail; vomerine teeth uniserial; all fins absent---------- Cirricaecula, new genus

1*b*. Upper lips without cirri; no barbels between anterior nostrils on underside of snout; gill openings oblique or vertical slits; distance between posterior edges of gill membrane at least twice or more that between anterior or inner edges; dorsal and anal fins present or absent.

2*a*. Anterior nostril tubular; eyes somewhat lateral in position; vomerine teeth uniserial---------- CaeculaVahl

2*b*. Anterior nostril not tubular; eye somewhat lateral in position; vomerine teeth at head of bone in two pairs, then uniserial---- Lamnostoma Kaup

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CIRRICAECULA JOHNSONI, new species

FIGURES 11, *h*; 12

Holotype.—U.S.N.M. No. 141188, Rongerik Atoll, Bock Island, ocean reef, June 27, 1946, S–46–237, Schultz and Herald, total length 402 mm.

Paratypes.—U.S.N.M. No. 141189, taken with holotype and bearing same data, 3 specimens, 324 to 353 mm.

Description.—The following precision measurements, expressed in thousandths of the total length, are recorded first for the holotype, then for the paratypes, respectively. Total lengths 402; 333; 324; 353. Tip of snout to anus 498; 496; 500; 484. Length of head to anterior margin of gill opening 100; 97; 99; 98. Greatest depth 32; 30; 34; 28. Length of snout 22; 22; 23; 21. Diameter of eye 3; 3; 4; 3. Width of interobital space 9; 8; 9; 8. Length of gill opening 25; 26; 24; 24. Width of isthmus at anterior edge of gill opening 3; 1; 1; 1. Width at posterior edge 4; 2; 2; 3. Distance from anus to tip of tail 501; 502; 500; 516. Tip of snout to rictus 41; 39; 44; 38.

Greatest depth 31, 33, 29; 36; length of head 10, 10, 10, 10; snout to anus 2.01, 2.02, 2.00, 2.05; all in the total length. Greatest depth 3.1, 3.2, 2.9, 3.5; snout 4.4, 4.5, 4.3, 4.7; eye 33, 30, 27, 29; length of gill openings 4.0, 3.8, 4.1, 4.1; width of isthmus at rear of gill openings 27, 41, 40, 32; interorbital space 10.5, 12, 11, 12; tip of snout to rictus 2.4, 2.5, 2.2, 2.6; all in length of head to front edge of gill openings.

Posterior nasal opening in upper lip in front of eye; anterior nostril tubular, on underside of snout, just in front of tip of lower jaw; snout greatly depressed, pointed, much projecting beyond tip of lower jaw; dorsal surface of snout smooth; eye without free margin; dorsal, anal, pectoral, pelvic, and caudal fins absent; gill openings on ventral side parallel, or nearly parallel, lengthwise slits, with a very narrow isthmus only slightly wider posteriorly than anteriorly; no "duplicating fold" around gill openings; tip of tail projects as stiff point; anus equidistant between tips of snout and tail, or a trifle closer to latter; a series of lateral line pores along middle of sides, some irregular larger slitlike pores just above these, somewhat irregular in occurrence; teeth hooked posteriorly, short, somewhat conical, in a single row on maxillary and vomer, those on premaxillary Λ-shaped in a single row, as in the figure. Upper lip with about 11 to 14 cirri, these interrupted opposite nostrils and ending about two-thirds the way back along upper jaw; a pair of cirri, or short barbels, between anterior nostrils.

Color in alcohol.—Plan white.

Color when alive.—Plain white, somewhat translucent.

Ecology.—This new genus and species was taken from loose sand in about 7 feet of water at low tide along a rocky ledge, where the waves surged in and out.

Remarks.—This new genus and new species belongs to the *Sphagebranchus* group of eels, a group that lacks pectoral fins, has long pointed snouts, and has gill openings mostly on the ventral side; it

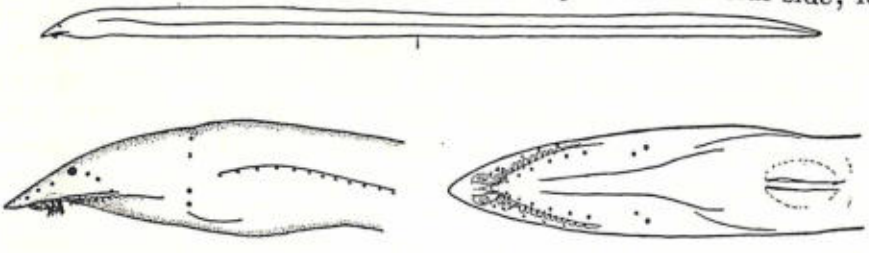

FIGURE 12.—Holotype of *Cirricaecula johnsoni*, new genus and new species (U.S.N.M. No. 141188), from Rongerik Atoll. (Drawing by Dorothea B. Schultz.)

differs from them, and from all other genera of ophichthid eels, in combining at the same time no fins, nearly parallel gill openings on the ventral side, with cirri on the upper lips, and with a pair of cirri, or barbels, between the anterior nostrils on the underside of the snout.

The species was named in honor of Dr. Martin Johnson, Scripps Institution of Oceanography, La Jolla, Calif., who participated in the 1946 field work.

Genus MYRICHTHYS Girard

Myrichthys GIRARD, Proc. Acad. Nat. Sci. Philadelphia, 1859, p. 58. (Genotype, *Myrichthys tigrinus* Girard.)

MYRICHTHYS MACULOSUS (Cuvier)

FIGURE 11, *d*; PLATE 8, C

Muraena maculosa CUVIER, Règne animal, vol. 2, p. 232, 1817 (on *Ophisurus ophis*, part, Lacepède, Histoire naturelle des poissons, vol. 2, pp. 195, pl. 6, fig. 2, 1800).

Ophichthys stypurus SMITH and SWAIN, Proc. U. S. Nat. Mus., vol. 5, p. 120, 1882 (type locality, Johnston Island; type, U.S.N.M. No. 26817).

Myrichthys rupestris SNYDER, Proc. U. S. Nat. Mus., vol. 42, p. 490, 1912 (type locality, Okinawa; type, U.S.N.M. No. 74048).

SPECIMENS STUDIED

Bikini Atoll: Tidal pond between Eman and Reer Islands, ocean reef, July 18, 1947, S–46–422, Brock, Hiatt, Schultz, and Myers, 5 specimens, 135 to 346 mm. total length.

Kwajalein Atoll: Ennylabegan Island, lagoon reef, September 1, 1946, S–46–397, Herald, 1 specimen, 316 mm.

Rongerik Atoll: Latoback Island, lagoon reef, August 14, 1947, S–1041, Brock, Schultz, and Donaldson, 1 specimen, 408 mm.

Description.—Body elongate, cylindrical. Greatest depth 34 to 41; head 12 to 16; snout tip to anus 2.2 to 2.4, to dorsal fin origin 22 to 28; anus to tip of tail 1.7 to 1.8; all in total length. Greatest depth 2.3 to 2.8; snout 4.5 to 5.5; snout to dorsal origin 1.6 to 1.8; eye 8.0 to 9.7; pectoral 7.7 to 14.0; width of gill opening 7.5 to 11.4; all in length of the head to upper edge of gill opening. Eye 1.7 and 1.9 in snout. Width between round black spots on sides 0.58 to 1.2 in diameter of black spot on side of body (measurements made over region of anus).

Posterior nasal opening in upper lip below front of eye; anterior nostril tubular, on underside of snout in front of tip of lower jaw; snout projecting beyond tip of lower jaw; dorsal surface of snout with fleshy ridges; eye without a free border; dorsal fin origin forward on head behind rictus about equidistant between snout tip and gill opening; gill opening restricted to side, the isthmus broad; pectoral fins present, small; dorsal and anal fins not confluent around tail, tip of tail projecting as a stiff point; anus a little closer to snout than to tip of tail; anal fin origin close behind anus; lateral line along middle of side; lips without papillae; teeth granular arranged in two rows as shown in the figure.

Color in alcohol.—Body usually with round black or blackish-brown spots, arranged in 3 alternating rows of 25 to 30 each, along back and extending onto dorsal fin, the latter being white edged; ventrally 1 or 2 more irregularly placed rows of smaller similar spots may occur, some of which may be lacking fore and aft; in addition, a black bar on head through eye, somewhat broken by white spaces; anal fin white, unspotted.

Color when alive.—Dark spots black or blackish brown, pale areas white.

Ecology.—This is a rare species of burrowing eel, occurring in loose gravel and sandy areas.

MYRICHTHYS COLUBRINUS (Boddaert)

FIGURE 11, a; PLATE 11, C

Muraena colubrina BODDAERT, Neue Nord. Beitr., vol. 2, p. 56, pl. 2, fig. 3, 1781 (type locality, Amboina).

SPECIMENS STUDIED

Rongerik Atoll: Latoback Island, June 28, 1946, S–46–238, Schultz and Herald, 1 specimen, 666 mm. total length.

Guam: Ylig Point, November 26, 1945, Frey and Gressitt, 5 specimens, 385 to 418 mm.; November 1945, Craighead, 2 specimens, 290 and 430 mm.

Description.—Body extremely elongate, cylindrical, greatest depth 51 to 63, head 17 to 20, snout to anus 2.1 to 2.3, snout to dorsal origin 35 to 41, all in total length. Greatest depth 2.6 to 3.2, snout 5.0 to 6.1, snout to dorsal origin 1.7 to 2.1, eye 10.3 to 12.5; width of gill opening

8.6 to 14.3; pectoral fin 16.1 to 18.7, all in length of head to upper edge gill opening. Eye 1.7 to 2.4 in snout. White space over anus in black ring (measured along middorsal line) 0.5 to 1.2.

Posterior nasal opening in the upper lip under front of eye, anterior nostril tubular, on underside of snout in front of tip of lower jaw; snout projecting beyond lower jaw, and dorsal surface convex with fleshy ridges; eye without a free border; dorsal fin origin far forward on head behind rictus of mouth; dorsal and especially anal fins ending notably a short distance from tip of tail. Gill openings restricted to lower sides, isthmus wide; pectoral fins small but obvious; dorsal and anal fins not confluent around tail, the latter projecting as a stiff point; anus a little closer to tip of snout than to tip of tail, the distance from anus to tip of tail contained 1.7 to 1.9 times in total length; anal fin origin close behind anus; lateral line along middle of side; lips without papillae; teeth granular, arranged in two rows on dentary, maxillary, vomer, and premaxillary as shown in the figure.

Color in alcohol.—Body encircled with black rings or bands alternating with white, these black rings varying in number from 26 to 33; white spaces usually a little wider than black ones but occasionally the latter are wider; first black band through eye and part of snout, the third one through pectoral and gill opening; each black ring continuous on dorsal and on anal fins; tip of snout and tail tip white; occasionally a black spot in the white spaces, but none was observed on specimens from Guam or the Marshall Islands.

Color when alive.—Dark rings black or dark brown, interspaces white.

Ecology.—This burrowing eel appeared over areas where there was loose sand or loose gravel.

MYRICHTHYS ELAPS (Fowler)

Chlevastes elaps FOWLER, Proc. Acad. Nat. Sci. Philadelphia, 1912, p. 13, fig. 13 (type locality, Philippine Islands).

SPECIMEN STUDIED

Rota Island: October 1945, Markley and Necker, 1 specimen, 650 mm. total length.

Description.—(A specimen 460 mm. total length is included in the following description.) Body extremely elongate, cylindrical. Greatest depth 52 to 69; head 20 or 21; tip of snout to anus 2.1 to 2.2; snout to dorsal origin 39 to 43; anus to tip of tail 1.8 to 1.9; all in total length. Greatest depth 2.4 to 3.3; snout 5.0 to 5.2; snout tip to dorsal origin 1.9 to 2.0; eye 12 to 14; pectoral fin 23.5 to 28; width of gill opening 7.8 to 11.7; all in length of head to upper edge of gill opening. Eye

2.4 to 2.8 in snout. White space measured along middorsal line over region of anus 0.20 to 0.22 in width of black space.

Posterior nostril opens in upper lip below front of eye; anterior nostril tubular opens on underside of snout in front of tip of lower jaw; snout projects beyond tip of lower jaw, dorsal surface of snout with fleshy ridges; eye without free border; dorsal fin origin forward on head, behind rictus, but closer to snout tip than to gill opening; gill openings restricted to lower sides, the isthmus wide; pectoral fins present, very small or minute; dorsal and anal fins not confluent around tail, latter projecting as a sharp free tip; anus closer to snout tip than to tip of tail; anal fin origin close behind anus; lateral line along middle of side; no papillae on lips; teeth granular, in two rows on maxillary and vomer.

Color in alcohol.—Body not completely encircled with black rings or bars, except two or three; black bars narrow, their width along middorsal line contained four or five times in white spaces; latter with a few round black spots or oblong black bars on sides and ventrally, usually located near middle of white space. Black bars continue on dorsal fin all the way to its edge, so that the distal margin is not white across black bar as in *M. semicinctus*.

First black bar passes in front of eye and is continuous around head dorsally, but somewhat interrupted on lower jaw. Snout tip white, tip of tail white or black.

Remarks.—We conclude that this species is a valid one, after having compared several specimens of *M. semicinctus* with it and having found no overlapping of color pattern.

MYRICHTHYS SEMICINCTUS (Bleeker)

Ophisurus fasciatus var. *semicincta* BLEEKER, Atlas ichthyologique des Indes Orientales Néerlandaises . . . , vol. 4, p. 64, 1864 (type locality, East Indies).

SPECIMENS STUDIED

Bikini Atoll: Erik Island, pondlike tidal pool, March 20, 1946, S–46–10, Schultz, 5 specimens, 310 to 395 mm. in total length.

Eniwetok Atoll: Lagoon at *Bowditch* anchorage off Eniwetok Island, light at night, May 23, 1946, S–46–182, Schultz, 1 specimen, 237 mm.

Description.—Body extremely elongate, cylindrical, greatest depth 53 to 68, head 18 to 20.3, snout tip to anus 2.0 to 2.3, snout to dorsal origin 35 to 45, anus to tip of tail 1.8 to 2.0, all in the total length. Greatest depth 2.7 to 3.7, snout 5.5 to 6.5, snout tip to dorsal origin 1.9 to 2.2, eye 9.4 to 11.9, length of pectoral fin 21.8 to 33.4, width of gill opening 10.8 to 11.8, all in length of head to upper edge of gill opening. Eye 1.7 to 2.2 in snout. White space measured along middorsal line over anus, 0.21 to 0.47 in width of black space.

Posterior nostril opens in upper lip below eye, anterior nostril tubular, opens on underside of snout in front of tip of lower jaw; snout projects beyond tip of lower jaw; dorsal surface of snout with fleshy ridges; eye without a free border; dorsal fin origin forward on head behind rictus, but closer to snout tip than gill opening; gill openings restricted to lower sides, the isthmus wide; pectoral fins present, but very small or minute; dorsal and anal fins not confluent around tail, tip of tail projecting as a stiff point; anus a little closer to snout than to tip of tail, distance from anus to tail tip contained 1.8 to 2.0 in total length; anal fin origin close behind anus; lateral line along middle of side; lips without papillae; teeth granular, mostly one row on maxillary and two rows on vomer, arranged as shown in the figure.

Color in alcohol.—Body only partly encircled with narrow black rings or bands alternating with broad white spaces; black rings vary in number from 26 to 31; white spaces from 3 to 5 times broader than black bars along middorsal line; none of the black bars meet ventrally; first black bar variously represented by one or more black blotches on interorbital space, or by smaller patches in front of or below eye; no round black spots in white spaces; black bars continuous on dorsal fin, distal edge of which is white, as are tip of tail and snout.

Color when alive.—Dark rings black or blackish brown and light spaces white.

Ecology.—This burrowing eel, which is rare, was found in loose gravel and sand, but one was attracted to a light at night.

Remarks.—Schultz, in his report on the Phoenix Island fishes (U. S. Nat. Mus. Bull. 180, 1943), did not separate *M. semicintus* (Bleeker) and *M. elaps* (Fowler). We now have additional specimens of both species and we find that *semicinctus* differs from *elaps* in having the distal margin of the dorsal fin white across the black bars and in lacking round or oblong spots between the black bars.

Genus CALLECHELYS Kaup

Callechelys KAUP, Catalogue of the apodal fish in the collection of the British Museum, p. 51, 1856. (Genotype, *Callechelys guichenoti* Kaup.)

CALLECHELYS MELANOTAENIA Bleeker

FIGURE 11, *f*

Callechelys melanotaenia BLEEKER, Atlas ichthyologique des Indes Orientales Néerlandaises . . . , vol. 4, p. 66, pl. 193, fig. 2, 1864 (type locality, Amboina); Nederl. Tijdschr. Dierk., vol. 2, p. 213, 1865 (Amboina).

SPECIMENS STUDIED

Bikini Atoll: Erik Island, pondlike tidal pool, March 20, 1946, S–46–10, Schultz, 8 specimens, 330 to 847 mm. total length; Romuk Island, ocean reef, April 1, 1946, S–46–47, Schultz, 2 specimens, 535 to 565 mm.

Eniwetok Atoll: Rujoru Island, lagoon reef, June 2, 1946, S–46–195, Schultz, 2 specimens, 379 to 560 mm. Teiteiripucchi Island, June 1, 1946, S–46–197, Schultz, 14 specimens, 420 to 650 mm.

Description.—Body extremely elongate, somewhat cylindrical. Greatest depth of body 44 to 63; head 16 to 18; snout to anus 1.4 to 1.5; snout to dorsal origin 38 to 56; all in total length. Greatest depth 2.6 to 3.6; snout 6.7 to 8.9; snout to dorsal origin 2.3 to 3.3, eye 14 to 25; width of gill opening 6.5 to 10.0; all in length of head to upper edge of gill opening. Eye 2.0 to 2.8 in snout. Posterior nasal opening in upper lip under eye, anterior nasal opening in a tube on under side of snout halfway between tips of jaw and snout; snout projecting beyond lower jaw, dorsal surface strongly convex; eye small, its front margin over tip of lower jaw; eye without free border; dorsal fin origin far forward on head, only a little behind a vertical line through rear of mouth or rictus; gill openings restricted to lower sides, isthmus narrow; no pectoral fin; dorsal and anal not confluent around tail, the latter projecting as a stiff point; anus very much closer to tip of tail than to snout, distance from anus to tip of tail about 3.1 to 3.5 in length; anal fin origin close behind anus; lateral line along middle of sides; lips without papillae; teeth conical, sharp, arranged as in the figure, the vomer with one to several teeth, sometimes in two rows forward.

Color in alcohol.—A single wide black band along middle of side of body, with a pale streak or band on each side of base of dorsal fin, the latter with its basal two-thirds white and distal third black; dorsal fin near its origin either pale or occasionally spotted with black distally; tip of tail white; head mostly white.

Ecology.—This species was taken in shallow water, from bottom with loose sand or fine gravel, although it may occur at greater depths where we did not work. Usually this eel exposed only about 6 to 8 inches of its head when driven out by the poison (see p. xv), and it was necessary to grasp this portion firmly with the hands and pull out the remaining part of the eel. Since eels are difficult to grasp, more were lost than were captured.

CALLECHELYS MARMORATUS (Bleeker)

FIGURE 11, *e*

Dalophis marmorata BLEEKER, Nat. Tijdschr. Nederl.-Indië, vol. 5, p. 247, 1853 (type locality, Ceram); Verh. Batav. Genootsch. (Muraenidae), vol. 25, p. 37, 1853.

SPECIMENS STUDIED

Bikini Atoll: Enyu Island, reef at entrance, lagoon, March 16, 1946, S–46–8, Schultz, Brock, and Marr, 1 specimen, 440 mm. total length.

Eniwetok Atoll: Rujoru Island, lagoon reef, June 2, 1946, S–46–195, Schultz, 6 specimens, 373 to 521 mm.; Teiteiripucchi Island, lagoon reef, June 1, 1946, Schultz, 8 specimens, 491 to 596 mm.

Rongelap Atoll: Kabelle Island, lagoon reef, June 20, 1946, S–46–231, Schultz and Herald, 1 specimen, 416 mm.

Description.—Body extremely elongate, nearly cylindrical. Greatest depth 40 to 44; head 14 to 16; snout to anus 1.5 to 1.6; snout to dorsal origin 42 to 52; all in the total length. Greatest depth 2.6 to 3.1; snout 7.4 to 7.7; snout to dorsal fin origin 3.0 to 3.3; eye 11 to 15; width of gill opening 6.6 to 8.5; all in the length of head from tip of snout to upper edge of gill opening. Eye 1.4 to 1.9 in snout.

Posterior nasal opening in upper lip under front of eye, anterior nostril tubular and about equidistant between tip of lower jaw and tip of snout; snout projecting beyond lower jaw, dorsal surface strongly convex with a middorsal ridge; eye small, its front margin behind a vertical line through tip of chin; eye without a free border; dorsal fin origin far forward on head, only a little behind a vertical line through rear of mouth, or rictus; gill openings restricted to lower sides, isthmus narrow; no pectoral fin; dorsal and anal fins not confluent around tail, the latter projecting as a stiff point; anus very much closer to tip of tail than to snout, distance between anus and tip of tail 2.7 to 2.9 in total length; anal fin origin close behind anus; lateral line along middle of sides; lips without papillae; teeth conical, sharp, arranged as in the figure, the vomer with a double row of teeth, at least anteriorly.

Color in alcohol.—Marbled black and white, white spaces more or less equal to back ones anteriorly, body becoming increasingly more blackish posteriorly; head with numerous small black specks or spots; dorsal fin sometimes blackish and sometimes marbled like body; tail uniformly white tipped; tip of snout white.

Ecology.—This species was taken from loose sand and gravelly areas on the reef. Like *C. melanotaenia*, it would thrust only a few inches of its head and body above the bottom after poisoning and had to be grasped with the hands. It is not a commonly seen species.

Genus LEIURANUS Bleeker

Leiuranus Bleeker, Verh. Batav. Genootsch. (Muraenidae), vol. 25, p. 36, 1853. (Genotype, *L. lacepedei* Bleeker.)

Machaerenchelys Fowler, Acad. Nat. Sci. Philadelphia Monogr. 2, pt. 3, p. 85, 1937. (Genotype, *M. vanderbilti* Fowler.)

LEIURANUS SEMICINCTUS (Lay and Bennett)

Figure 11, *b*, *c*; Plate 8, D, E

Ophisurus semicinctus Lay and Bennett, The zoology of Captain Beechey's voyage, Fishes, p. 66, pl. 20, fig. 4, 1839 (type locality, Oahu).

TABLE 4.—*Precision measurements, expressed in thousandths of the total length, for 16 specimens of* Leiuranus semicinctus

Character	Measurements															
Total length in mm	540	472	460	425	400	400	400	380	380	323	290	276	258	230	130	122
Tip of snout to front edge of gill opening	60	63	62	65	70	68	70	70	72	66	70	80	76.5	67	77	86
Greatest depth	19	19	16	21	19	19.5	14	19.5	18	19.5	25	27	29	20	17	19
Diameter of eye	7	5	5	8	8	7	.....	8	8	7	5	7	6	6.5	6	7
Length of snout	11	12	11	14	12.5	11.5	.....	13	13	11.5	.....	14.5	15	14	14	16
Length of pectoral fin	9	14	10	12	13	12.5	9.5	13	16	13	10	10	7	6	4	3
Tip of snout to dorsal origin	61	72	70	75	68	71	75	75	80	73	74	82	88	81	85	86
Tip of snout to anus	472	508	510	513	500	488	518	513	513	464	402	516	529	522	516	508
Greatest width of black bar, over anus	28	29	33	28	33.5	29	26	33	34	26	27.5	24	28	24	20	6.5
Greatest width of pale space, over anus	6	7	9	13	9	5	10	9	10.5	6	13	17	20	20	34	20.5

SPECIMENS STUDIED

Bikini Atoll: 21 stations, 303 specimens, 70 to 540 mm. total length.
Rongelap Atoll: 7 stations, 22 specimens, 107 to 400 mm.
Eniwetok Atoll: 3 stations, 26 specimens, 118 to 363 mm.
Rongerik Atoll: 3 stations, 3 specimens, 227 to 365 mm.
Arhno Atoll: *Albatross*, 1 specimen, 165 mm.
Guam: 3 lots, 5 specimens, 97 to 325 mm.

Description.—Precision measurements, expressed in thousandths of the total length, are given for 16 specimens in table 4. Body cylindrical or nearly so. Greatest depth 35 to 79 in total length.

Posterior nasal openings in upper lip below front of eye, and anterior nasal opening in the form of a tube on underside of snout; lower jaw included; tip of chin about halfway between front of eye and anterior nostrils; snout flat pointed as viewed from side and broadly pointed as viewed from dorsal side; eye without free border; dorsal fin origin over, or nearly over, pectoral fin; gill openings restricted, extending only slightly below pectoral fin base; pectoral fin well developed; dorsal and anal fins not confluent around tip of tail, the latter projecting as a sharp point; anus near middle of total length, anal fin origin close behind anus; lateral line along middle of side of body. Eye in snout 1.2 to 2.5; pectoral in head 4.4 to 11.5; pectoral in snout 0.5 to 2.4; width of white space (over anal region) along middorsal line 0.4 to 5.9 in black bar along middorsal line; teeth as illustrated in the figure.

Color in alcohol.—Body with 22 to 39 black bars alternating with white bars, width of black bar increasing with increase in length, although with considerable variation. Smallest specimen on which black bars could be detected 107 mm. in total length; at that size, white interspace several times width of black pigment. The first black bar counted passes through eye, usually with a blackish extension in front of eye across snout; underside of head with or without black pigment; pectoral base usually under third black bar or in third white space; black bars on tail (behind anus) all may meet along the midventral line, or none may meet; in the largest specimens these black bars on tail tend to meet, whereas in specimens up to about 300 mm. total length, only the last few meet at the midventral line.

Color when alive.—Black bars alternating with white spaces.

Ecology.—This is the commonest of the snake eels, and it occurs wherever the loose sand or gravel in which it burrows is present. In areas composed of fine gravellike deposits, such as the shallow tidal ponds, this eel occurs in countless numbers; more than one per square foot appeared at the surface after cubé root was used (see p. xv). At night numerous individuals were attracted to a light suspended at the surface both in the lagoon and on the ocean side of the leeward reefs. On outgoing tidal currents this eel is swept out to sea through the channels.

Remarks.—Machaerenchelys vanderbilti Fowler and *M. phoenixensis* Schultz (U. S. Nat. Mus. Bull. 180, p. 16, 1943) are two species that were recognized by the wide black bars separated by narrow white interspaces, the latter contained 4 or 5 times in the black bars. Both these species were based largely on that character and on the vomerine teeth. Neither author had large series for comparison when the species were described. However, the extensive material from the northern Marshall Islands has made possible this needed comparison.

With but a few specimens at hand one would conclude that the three species were valid, but with a few hundred individuals before us ranging in length from 107 to 540 mm. we must cast doubt on that interpretation and suggest that only one species is involved, one that shows much variability in regard to (1) color pattern, (2) vomerine teeth, (3) size of eye, (4) length of pectoral fin, and (5) number of black bars.

The precision measurements in table 4 are arranged in order of decreasing total length, from which it is observed that at different lengths no significant change occurs in length of pectoral fin, greatest depth of body, diameter of eye, length of snout, tip of snout to anus; however, the head is proportionately larger in small specimens, and the pale spaces wider. On the other hand, the black bars are extremely narrow in the smallest specimens, becoming wider in the large ones, but with great variability.

The vomerine teeth vary from none to three without any correlation with color pattern. This is not in agreement with Schultz (ibid.), who had but a single specimen of *M. phoenixensis* for study and found one tooth on the vomer. Both eye and pectoral fin length are variable and do not seem to agree with the number of vomerine teeth or color pattern. The number of black bars per specimen varies from 22 to 39, as follows:

Bars	*Specimens*	*Bars*	*Specimens*
22	1	32	6
24	4	33	4
25	7	34	6
26	15	35	3
27	22	36	2
28	28	37	1
29	16	38	1
30	9	39	1
31	10		

Family ECHELIDAE: Worm Eels

By Leonard P. Schultz

The worm eels referred to this family form a complex group of genera and species occurring in most of the warm seas of the world.

They are difficult to identify, and some genera appear to be allied to the Ophichthidae. No less than 22 genera have been placed in the family at various times. Among these the following have been assigned to other families: *Verma* Jordan and Evermann, 1896, appears to be related to the Ophichthidae. *Bathymyrus* Alcock, 1890, is referred to the Congridae by Myers and Storey, 1939, and these authors refer *Sinomyrus* Lin, 1933, to the Dyssomidae. *Merinthichthys* Rivero, 1934, may belong to the Moringuidae. *Heteromyrus* Pietschmann, 1935, redescribed in 1938 by him, probably belongs with the Muraenidae. *Chrinorhinus* Rivero, 1932, belongs in the family, Congridae and is a synonym of *Neoconger*, according to Isaac Ginsburg, who examined the holotype. This leaves 16 genera. There have been few attempts to compare them. Parr (Bull. Bingham Oceanogr. Coll., vol. 3, art. 4, p. 8, 1927) clearly demonstrated the advisability of referring *Ahlia* to the synonymy of *Myrophis*. After considering the variation in the position of the origin of the dorsal fin from anywhere from over the rear of the head to a little behind the anus, and also the variability of the dentition, we have gone still farther and referred four other genera to *Myrophis* (see p. 68). Myers and Storey, 1939, did not fully agree with this viewpoint; instead they described a new genus, *Hesperomyrus*. It is my opinion that the recognition of echelid genera must be done on a world-wide basis and not on a study of local fauna.

The numerous species centering around *Muraenichthys* Bleeker are all without pectoral fins, and in these, too, the dorsal fin origin may be located anywhere from over the rear of the head to 1⅘ head lengths behind the anus. Since there is much variability in the origin of the dorsal among the various species, that character, in my opinion, cannot be used generically with this group of species. The arrangement of teeth is variable, differing on the jaws and vomer from bands to a uniserial row, or they may be absent from the vomer. I believe the dentition to be an excellent specific character. I have concluded that *Muraenichthys* should include all those echelid eels with teeth on premaxillary, maxillary, dentary, and vomer but without pectoral fins and without the median groove under the snout, as defined in the key to genera. Myers and Wade, 1941, did not agree with this viewpoint; instead they recognized *Garmanichthys* Seale and described *Leptenchelys* as new, basing their generic separation largely on the pointed snout, the position of the dorsal origin, the uniserial vomerine teeth, and the short tail, all of which characters are highly variable among the known species of this group. *Leptenchelys* deserves generic status on the basis of a median groove on the underside of the snout, not mentioned by Myers and Wade for *Leptenchelys vermiformis*. This character, common to *Leiuranus* and certain other

genera of the family Ophichthidae, is found on very few species of echelid eels.

KEY TO THE GENERA OF ECHELIDAE

1*a*. Vomerine teeth arranged in two uniserial rows widely separated except where they divide anteriorly or may meet again posteriorly; teeth in lower jaw in 2 or 3 rows anteriorly, sometimes becoming uniserial posteriorly.

2*a*. Pectoral fin absent; lip at side of lower jaw folded downward; posterior nasal opening on inside of upper lip, below front of eye, without valvular flap; dorsal fin origin about ¼ to ⅓ head length behind gill opening; snout and tip of lower jaw broadly rounded; maxillary teeth uniserial.
Chilorhinus[7] **Lütken**

2*b*. Pectoral fin present; lips without folds; posterior nasal opening in upper lip under front of eye, with valvular flap; dorsal fin origin slightly behind gill opening; snout and tip of lower jaw bluntly rounded.
Kaupichthys Schultz (p. 63)

1*b*. Vomerine teeth, if present, arranged along midline of roof of mouth, represented as a single tooth or a uniserial row or a narrow to broad band.

3*a*. Pectoral fin present, sometimes represented by a tiny dermal flap near upper edge of gill opening.

4*a*. Vomerine teeth in a broad band, notably wider near middle of length than at ends; maxillary and dentary with teeth in a band; dorsal fin origin over tips of pectorals or nearly so; a transverse white line on nape---------- **Echelus**[8] **Rafinesque**

4*b*. Vomerine teeth, if present, in a narrow straight band or uniserial, never broadened near middle of length; teeth in jaws usually in 2 or 3 rows anteriorly, sometimes becoming uniserial posteriorly or uniserial throughout their length; dorsal fin origin between a vertical line through gill opening and one through a point slightly behind anus---------- **Myrophis Lütken** (p. 68)

3*b*. Pectoral fin absent.

5*a*. Ventral side of snout without a median groove, and upper lip continuous anteriorly, without incision.

6*a*. Teeth present on premaxillary, maxillary, dentary, and vomer.
Muraenichthys Bleeker (p. 70)

6*b*. No teeth on premaxillary or on vomer, those on maxillary and on dentary minute or villiform------ **Schultzidia Gosline** (p. 81)

5*b*. Ventral side of snout with a median groove, bordered by dermal folds, upper lip incised by the groove; 2 or 3 strong, sharp-pointed, hooked premaxillary teeth occur in the groove.
Leptenchelys Myers and Wade (p. 79)

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[7] *Chilorhinus* Lütken, Vid. Meddel. Naturh Fören, Kjøbenhavn, vol. 1, p. 16, 1851, 1852. (Genotype, *C. suensonii* Lütken.)

[8] *Echelus* Rafinesque, Caratteri de alcuni nouvi generi e nuove specie di animali . . . e pinate della Sicilia . . . , 1810, p. 63. (Genotype, *E. punctatus* Rafinesque, designated by Bleeker, Atlas Ichthyologique des Indes Orientales Néerlandaises . . . , vol. 4, p. 20, 1864.)

Myrus Kaup, 1856, Arch. Naturg., pt. 1, p. 53, 1856. (Genotype, *Muraena myrus* Linnaeus=*E. punctatus* Rafinesque.)

Genus KAUPICHTHYS Schultz

Kaupichthys SCHULTZ, U. S. Nat. Mus. Bull. 180, p. 50, pl. 6, fig. 5, *i*, 1943. (Genotype, *Kaupichthys diodontus* Schultz.)

This genus resembles *Chilorhinus* Lütken in regard to the dentition of the vomer, both having two uniserial rows widely separated, but in other characters they appear to be in different phyletic lines.

Gosline (Copeia, No. 3, pp. 195–202, 1951) discusses the relationships of this genus with *Chilorhinus*.

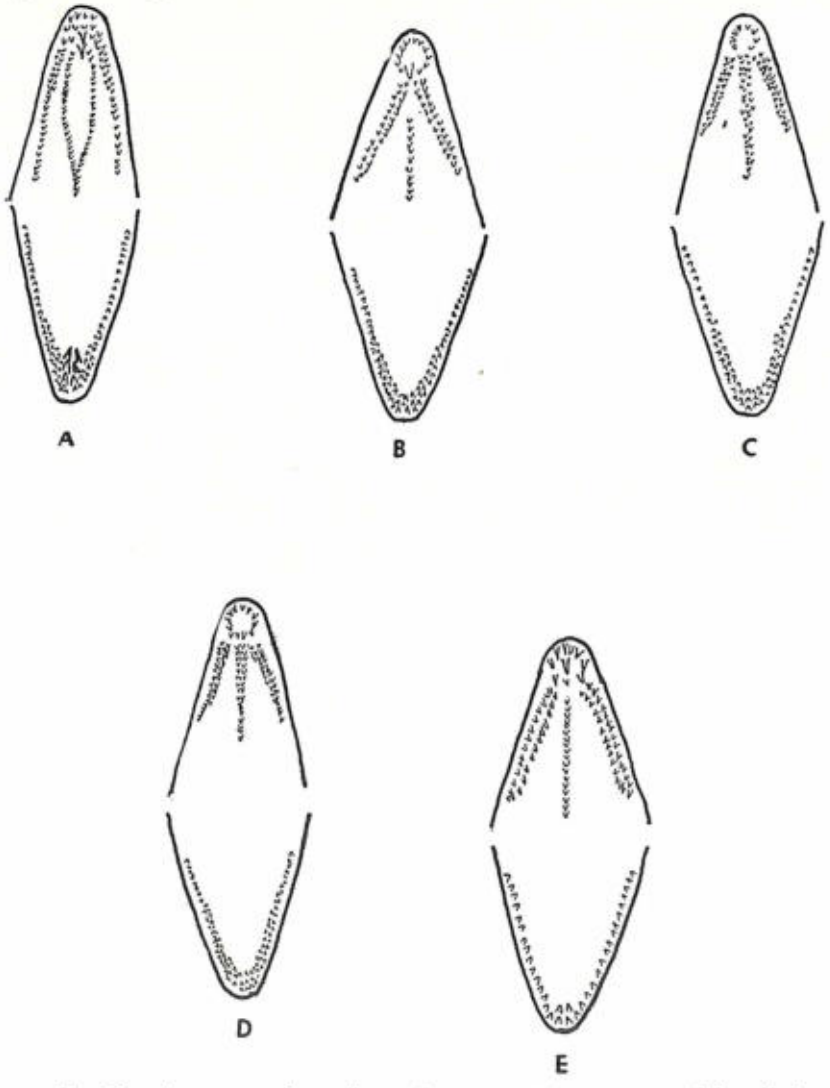

FIGURE 13.—Dental patterns of certain species of Echelidae: *a*, *Kaupichthys diodontus* Schultz; *b*, *Muraenichthys gymnotus* Bleeker; *c*, *M. macropterus* Bleeker; *d*, *M. schultzei* Bleeker; *e*, *M. laticaudata* (Ogilby). (Sketches by author.)

KEY TO THE SPECIES OF KAUPICHTHYS

1*a*. Pectoral fin well developed, notably longer than diameter of eye.

2*a*. Anterior nasal tube whitish, area around its base whitish or same color as head; tip of snout to anus 3.4 to 3.8 in total length; eye 9.5 to 12 and interorbital space 5.8 to 7.2, both in head.

Kaupichthys diodontus Schultz

2*b*. Basal part of anterior nasal tube black, and area around its base black; tip of snout to anus 3.2 to 3.4 in total length; eye 14 to 15, and interorbital space 7 to 10, both in length of head.

Kaupichthys atronasus, new species

1*b*. Pectoral fin small, its length shorter than half diameter of eye; anterior nasal tubes or their base pale or white, not black; tip of snout to anus 3.0 to 3.2 in total length; pectoral fin 21 to 30 times in head.

Kaupichthys brachychirus, new species

TABLE 5.—*Precision measurements made on species of* Kaupichthys *from northern Marshall Islands, expressed in thousandths of the total length*

Characters	*brachychirus*			*diodontus*			*atronasus*
	Holotype	Paratypes					Holotype
Total length in milimeters	128	115	93	138	121	82	93
Tip of snout to anus	310	316	336	262	297	297	312
Tip of snout to dorsal origin	145	134	141	142	155	151	140
Tip of snout to tip of lower jaw	5	4	3				3
Greatest depth	36	41	36	53	45	40	32
Length of head	137	130	127	133	149	149	132
Length of pectoral fin	6	6	4	20	27	27	22
Length of snout	28	28	28	33	36	38	29
Diameter of eye	14	12	12	13	16	12	7
Tip of snout to rictus	47	47	43	49	57	54	43
Distance between dorsal and anal origins	173	196	194	120	145	140	176
Interorbital space	14	16	11	20	26	21	13

KAUPICHTHYS DIODONTUS Schultz

FIGURE 13, *a*; PLATE 9

Kaupichthys diodontus SCHULTZ, U. S. Nat. Mus. Bull. 180, p. 50, pl. 6, fig. 5, *i*, 1943 (type locality, Tau and Rose Islands, Samoan group).

SPECIMENS STUDIED

Bikini Atoll: 7 stations, 15 specimens, 59 to 130 mm. total length.
Rongelap Atoll: 2 stations, 4 specimens, 77 to 112 mm.
Rongerik Atoll: 1 station, 1 specimen, 141 mm.

Description.—Precision measurements, expressed in thousandths of the total length, are recorded in table 5.

Greatest depth 19 to 28; head 6.7 to 7.5; distance from snout to anus 3.4 to 3.8; snout to dorsal origin 6.4 to 7.6; all in total length.

Greatest depth 2.5 to 3.7; eye 9.5 to 12.0; snout 3.9 to 4.1; interorbital space 5.8 to 7.2; snout to rictus 2.6 to 2.8; pectoral 5.5 to 7.7; all in length of head. (Proportions based on 4 specimens.)

Posterior nasal opening in upper lip under front of orbit, covered with a backward-directed valvular flap; anterior nostril tubular, at sides of tip of snout, slightly ventral in position, base of nostril just behind tip of lower jow; snout, depressed, smooth, rounded dorsally, sides somewhat straight, tip broadly rounded; eye moderately large, without free margin, its diameter much greater than distance from tip of snout to tip of chin; dorsal fin origin far forward, usually over pectoral fin base or a trifle behind it; anal fin origin just behind anus; both dorsal and anal fins rather high and confluent with caudal fin; minutely rayed caudal fin shorter than snout; anus in front of middle third of total length, distance from snout to anus about 3.4 to 3.8 in total length; gill openings in front of pectoral fin base, beginning opposite middle of pectoral base and ending at lower edge of base; pectoral fin well developed but a little shorter than length of snout; lateral line pores very minute, probably ending one or two head-lengths before tip of tail; lips without cirri; tongue adnate to floor of mouth; teeth conical, in a narrow band, inner row enlarged on maxillaries, in a circular patch on premaxillary, with two central teeth enlarged; vomer with two widely spaced uniserial rows of teeth; teeth on dentary in a narrow band, with inner row enlarged; (this dental description corrects that for the original description of *K. diodontus*); rear margin of eye slightly in front of rictus; a vertical line through front border of eye nearly ⅔ closer to rictus than to tip of lower jaw.

Color in alcohol.—Plain brownish, with distal parts of medium fins whitish; front border of eye with a short line of black pigment; pectoral fin paler than body; anterior nasal tube whitish, area around its base whitish or same color as head.

Ecology.—This eel appeared to prefer areas where the wave action is strong, since it was mostly taken on the ocean reef or in areas subjected to currents. We find no significant differences between the specimens from the Samoan and the Marshall Islands.

KAUPICHTHYS ATRONASUS, new species

FIGURE 14

Holoype.—U.S.N.M. No. 141260, Rongelap Atoll, Rongelap Island, north end, lagoon coral head at depth of 18 feet, July 25, 1946, S–46–286, Brock, Herald, and Kohler, 93 mm. total length.

Paratype.—U.S.N.M. No. 141696, Bikini Atoll, Namu Island, lagoon reef, August 6, 1947, S–46–508, Schultz, Brock, and Hiatt, 1 specimen, 54 mm.

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Description.—Precision measurements, expressed in thousandths of the total length, are recorded in table 5.

Greatest depth 27 to 31; head 7.5 to 7.7; snout tip to anus 3.2 to 3.4; snout to dorsal origin 6.6 to 7.2; all in the total length. Greatest depth 3.5 to 4.1; snout tip to tip of lower jaw 35 to 41; eye 14 to 15; snout 4.4 to 4.5; interorbital space 7 to 10; snout tip to rictus 2.5 to 3.0; length of pectoral fin 6.1 to 7.8; all in the length of head. Number of pectoral rays 10 and 11.

Posterior nasal opening in upper lip, under front of orbit, with valvular flap; anterior nostrils tubular, on front underside of snout opposite tip of lower jaw; snout depressed, broadly rounded dorsally, tip rounded; snout and lower jaw minutely papillate; eye small, without free margin, its diameter contained about 2½ times in snout; dorsal fin origin far forward over middle of length of pectorals; anal origin close

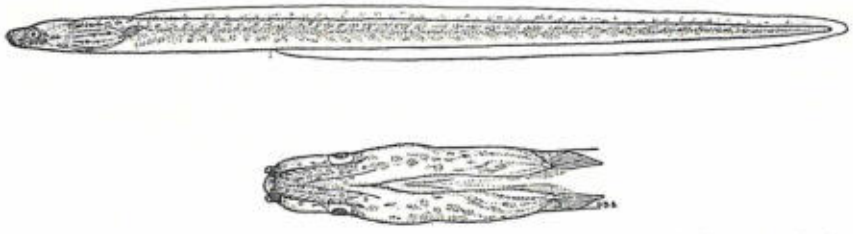

FIGURE 14.—Holotype of *Kaupichthys atronasus*, new species (U.S.N.M. No. 141260), from Rongelap Atoll. (Drawing by Dorothea B. Schultz.)

behind anus; dorsal and anal fins confluent with caudal, latter minutely rayed, short, 1½ in snout; anus slightly in front of middle third of total length; gill opening on sides, upper edge opposite middle of pectoral fin base and reaching a little below pectoral base; pectoral fin well developed, but not quite so long as snout; lateral line pores minute, scarcely discernible; lips without cirri; tongue adnate to floor of mouth; teeth conical, on maxillary about three rows forward becoming two posteriorly, on dentary in a band forward becoming a narrow band posteriorly; premaxillary teeth in a patch with the two central ones enlarged; vomerine teeth in two widely separated uniserial rows, these rows closest together posteriorly and farthest apart near their middle length; rear margin of eye about ¾ to ⅘ eye diameter in front of rictus, anterior margin of eye notably closer to rictus than tip of lower jaw.

Color in alcohol.—Dorsally speckled or mottled with small light brownish areas, a few along basal part of dorsal fin; all fins otherwise whitish; underside of head, isthmus, and ventrally nearly to anus, with brownish areas; basal part of anterior tubular nostrils black, area around their base black, tips white.

Remarks.—This worm eel is characterized by the blackish areas around the anterior nasal tubes, the basal part of which is black, whereas in *diodontus* and in *brachychirus* the basal parts are white.

Named *atronasus* in reference to the black anterior nostrils.

KAUPICHTHYS BRACHYCHIRUS, new species

FIGURE 15

Holotype.—U.S.N.M. No. 141261, Bikini Atoll, off Amen Island, lagoon, depth 30 feet, August 4, 1946, S–46–307, Kohler, Herald, and Brock, 128 mm. total length.

Paratypes.—U.S.N.M. No. 141263, Bikini Atoll, coral heads at eastern end of lagoon, depth 20 to 25 feet, March 26, 1946, S–46–42, Brock and Schultz, 1 specimen, 93 mm.; U.S.N.M. No. 141264, Bikini

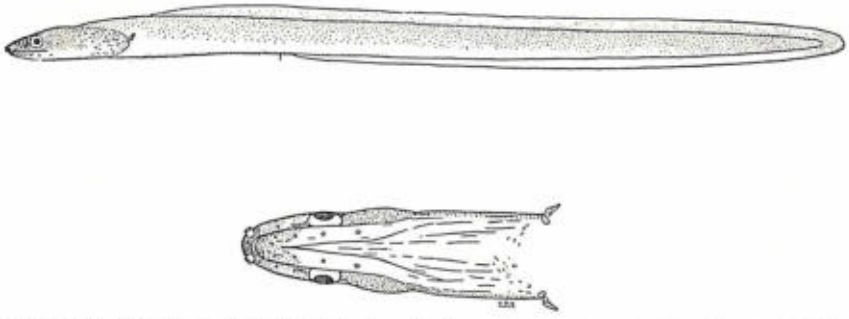

FIGURE 15.—Holotype of *Kaupichthys brachychirus*, new species (U.S.N.M. No. 141261) from Bikini Atoll. (Drawing by Dorothea B. Schultz.)

Atoll, Romuk Island, ocean reef, April 1, 1946, S–46–47, Schultz, 1 specimen, 86 mm.; U.S.N.M. No. 141262, Bikini Atoll, Amen Island, lagoon, August 4, 1946, S–46–307, taken with holotype and bearing same data, 2 specimens, 100 to 111 mm.; U.S.N.M. No. 141265, Eniwetok Atoll, Teiteiripucchi Island, lagoon reef, June 1, 1946, S–46–197, Schultz, 7 specimens, 78 to 107 mm.; U.S.N.M. No. 141266, Rongelap Atoll, Naen Island, lagoon reef, July 30, 1946, S–46–302, Herald, 1 specimen, 115 mm.; U.S.N.M. No. 141267, Rongerik Atoll, Bock Island, tidal pool, ocean reef, April 24, 1946, S–46–113, Brock and Marr, 4 specimens, 86 to 96 mm.

Description.—Precision measurements on the holotype and two paratypes, expressed in thousands of the total length, are recorded in table 5.

Greatest depth 24 to 28; head 7.3 to 7.9; snout to anus 3.0 to 3.2; snout to dorsal origin 6.9 to 7.5; all in the total length. Greatest depth 3.1 to 3.8; snout tip to tip of lower jaw when mouth is closed 29 to 37; eye 9.8 to 10.7; snout 4.5 to 4.9; interorbital space 8.3 to 11.8; snout to rictus of mouth 2.9 to 3.0; length of pectoral fin 21 to 30; all in length of head from snout tip to upper edge of gill opening.

Posterior nasal opening in upper lip under front of orbit, a little on exterior side of lip, with valvular flap; anterior nostril tubular, at front on ventral side of snout near its tip, base opposite tip of lower jaw; snout depressed, rounded dorsally, tip bluntly rounded; snout and lower jaw minutely papillate; eye moderately large, without free margin, its diameter greater than distance from tip of chin to tip of snout; dorsal fin origin far forward, slightly behind gill opening and pectoral fin tips; anal origin close behind anus; dorsal and anal fins rather high, confluent with short caudal fin, latter minutely rayed scarcely as long as snout; anus in front of middle third of total length, distance from snout to anus 3.0 to 3.2 in total length; gill openings on sides, upper edges opposite lower part of base of small pectoral fin and continuing a short distance below it; pectoral fin small, distinct, its length about 4 to 6 times in snout; lateral line pores minute, scarcely discernible; lips without cirri; tongue adnate to floor of mouth; teeth conical in a narrow band on maxillary and dentary, with inner row a little enlarged; premaxillary teeth in a small patch with one or two enlarged ones located centrally; vomerine teeth in two uniserial rows, diverging and widely separated anteriorly but closer together posteriorly; rear margin of eye a little in front of rictus; anterior margin of eye notably closer to rictus than to tip of lower jaw.

Color in alcohol.—Plain light brownish dorsally, paler ventrally; fins whitish, except near caudal, where some blackish pigment may occur.

Ecology.—This species was taken from areas, mostly on the ocean reef or in the lagoon, where coral heads and sandy bottoms occurred and the current or wave action was strong.

Remarks.—This is the third species referable to the genus *Kaupichthys*. It may be separated from *K. diodontus* and *K. atronasus* by the much shorter pectoral fins.

Named *brachychirus* in reference to its short pectoral fin.

Genus MYROPHIS Lütken

Myrophis LÜTKEN, Vid. Meddel. Naturh. Fören. Kjøbenhavn, 1851, vol. 1, p. 1, 1852. (Genotype, *Myrophis longicollis* Kaup=*Myrophis punctatus* Kaup.)

Paramyrus GÜNTHER, Catalogue of the fishes in the British Museum, vol. 8, p. 51, 1870. (Genotype, *Conger cylindroideus* Ranzani, designated by Jordan and Davis, Rep. U. S. Comm. Fish., vol. 16, p. 641, 1892.)

Holopterua COPE, Trans. Amer. Philos. Soc., vol. 16, p. 482, 1871. (Genotype, *Holopterua plumbea* Cope.)

Ahlia JORDAN and DAVIS, Rep. U. S. Comm. Fish., vol. 16, p. 641, 1892. (Genotype, *Myrophis egmontis* Jordan.)

Parabathymyrus KAMOHARA, On the offshore bottom-fishes of Prov. Tosa, Shikoku, Japan, p. 14, fig. 4, 1938. (Genotype, *Parabathymyrus macrophthalmus* Kamohara.)

Hesperomyrus MYERS and STOREY, Stanford Ichthyol. Bull., vol. 1, p. 156, 1939. (Genotype, *Hesperomyrus fryi* Myers and Storey.)

MYROPHIS UROPTERUS (Temminck and Schlegel)

Conger uropterus TEMMINCK and SCHLEGEL, Fauna Japonica, p. 261, 1842 (type locality, Japan).—BOESEMAN, Revision of the fishes collected by Burger and Von Siebold in Japan, p. 188, 1947 (Japan).

Myrophis uropterus BLEEKER, Act. Soc. Sci. Indo-Neerl., vol. 5, p. 12, pl. 1, fig. 3, 1858–59 (Japan).

Echelus microchir BLEEKER, Atlas ichthyologique des Indes Orientales Néerlandaises . . ., vol. 4, p. 30, pl. 189, fig. 4, 1864 (Celebes); Nederl. Tijdschr. Dierk., p. 40, 1865.

Paramyrus microchir WEBER and DE BEAUFORT, The fishes of the Indo-Australian Archipelago, vol. 3, p. 273, 1916 (Celebes).

SPECIMENS STUDIED

Eniwetok Atoll: Southwest Passage, 2 miles south of Rigili Island on leeward side of reef, light at night, May 24, 1946, S–46–183, Schultz, 1 specimen, 205 mm. total length; Aomon–Bijiri, light at night, Univ. Washington, August 12, 1949, 1 specimen, 71 mm.

Rongelap Atoll: Pass between Eniaetok Island and Erapuotsu Islands, July 20, 1946, S–46–267, Herald and Brock, 1 specimen, 209 mm.

Description.—Greatest depth 35 to 52; head 9.2 to 10.1; distance from snout to anus 2.6 to 2.9, to dorsal origin 7.3 to 8.2; all in total length. Greatest depth 3.5 to 5.7; snout tip to tip of lower jaw 20 to 38; eye 7.4 to 10.3; snout 4.0 to 5.4; interobital space 14 and 17; snout to rictus 2.8 to 3.5; pectoral 3.4 to 5.4; all in length of head. Proportions based on the two specimens.

Posterior nasal opening in upper lip under front of orbit, with valvular flap, anterior nasal opening tubular, on underside of snout opposite tip of lower jaw; snout smooth, rounded anteriorly, dorsal surface somewhat depressed; eye large, without free margin, its diameter more than twice distance from snout tip to tip of chin when mouth is closed; dorsal fin origin far forward, opposite rear of pectoral fins or a trifle behind a vertical line through their tips; anal fin origin close behind anus; both dorsal and anal fins rather high and confluent with caudal fin; minutely rayed caudal fin much shorter than snout; anus a little behind first third of total length but notably in front of middle of total length; gill openings in front of pectoral fin base, upper edge of gill opening a little below middle of base, opening extending a little below pectoral fin base; pectoral fin well developed, length equal to or a little greater than that of snout; lateral line along middle of side, incomplete, ending a head length or two in front of tip of tail; lips without cirri; tongue adnate to floor of mouth; teeth conical, in about 3 or 4 rows forward on maxillary and on dentary, becoming biserial posteriorly, the inner row largest; premaxillary teeth in a patch, with one or two central ones a little enlarged; vomerine teeth anteriorly a little enlarged in two rows, then uniserial posteriorly; rear margin of eye opposite rictus, anterior margin of eye slightly closer to tip of chin than to rictus.

Color in alcohol.—Light brownish dorsally, white ventrally; anal fin near caudal blackish distally for a distance about equal to a head length.

Remarks.—The measurements given in table 6 on characters of certain species of *Myrophis* of the tropical Pacific indicate that *E. microchir* Bleeker is synonymous with *uropterus*, whereas *M. heterognathus* Bleeker from Japan is distinct.

TABLE 6.—*Measurements made on species of* Myrophis, *expressed in thousandths of the total length*

Characters	*microchir* (after Bleeker, pl. 189, fig. 4)	*uropterus*			*heterognathus* (after Bleeker) [1]
		(After Bleeker, pl. 1, fig. 3)	Eniwetok	Rongelap	
Total length in millimeters	220	398	205	209	138
Tip of snout to anus	379	367	361	340	373
Tip of snout to dorsal origin	136	131	130	123	207
Tip of snout to tip of lower jaw	3	5	4	3	7
Greatest depth	24	28	26	19	60
Length of head	109	99	105	109	170
Length of pectoral fin	20	29	20	24	47
Length of snout	21	25	20	21	43
Diameter of eye	12	13	14	11	29
Tip of snout to rictus	32	35	31	31	53
Distance between dorsal and anal origins	243	241	234	223	152
Interorbital space	----	----	7	6	----

[1] Bleeker, Act. Soc. Sci. Indo-Neerl., vol. 5, pl. 3, fig. 1, 1858–59 (Japan).

Genus MURAENICHTHYS Bleeker

Muraenichthys BLEEKER, Nat. Tijdschr. Nederl.-Indië, vol. 4, p. 505, 1853; Verh. Batav. Genootsch., vol. 25 (Muraenidae), pp. 52, 64, 71, 1853. (Genotype, *M. gymnopterus* Bleeker, designated in Atlas ichthyologique des Indes Orientales Néerlandaises . . ., p. 20, 1864.)

Scolecenchelys OGILBY, Proc. Linn. Soc. New South Wales, vol. 22, pt. 2, p. 246, 1897. (Genotype, *Muraenichthys australis* Macleay.)

Myropterura OGILBY, Proc. Linn. Soc. New South Wales, vol. 22, pt. 2, p. 247, 1897. (Genotype, *M. laticaudata* Ogilby (not of Bleeker).)

Garmanichthys SEALE, Bull. Mus. Comp. Zool., vol. 61, No. 4, p. 80, 1917. (Genotype, *G. dentatus* Seale.)

Arenichthys BEEBE and TEE-VAN, Zoologica, vol. 23, p. 301, 1938. (Genotype, *A. apterus* Beebe and Tee-Van.)

Dr. William Gosline, University of Hawaii, suggested through correspondence that the genus *Muraenichthys* Bleeker as defined by Schultz and Woods (Journ. Washington Acad. Sci., vol. 39, pp. 169–174, 1949) should be broken up into genera or subgenera, and with that viewpoint I am in agreement, as indicated by the following key:

TENTATIVE KEY TO THE GENERA AND SPECIES CLOSELY RELATED TO MURAENICHTHYS OF THE INDO-PACIFIC

1*a*. Ventral side of snout with a median groove, bordered on each side by a dermal fold; premaxillary teeth occur in groove between dermal folds, which are extensions of upper lip; 2 or 3 sharp-pointed, posteriorly hooked, premaxillary teeth occur in groove (*Leptenchelys*).

2*a*. Caudal fin minute, or absent; tip of tail stiff; teeth uniserial on maxillary, dentary, and vomer.

3*a*. Dorsal fin scarcely discernible anteriorly, with its origin in front of gill opening, a little closer to latter than tip of snout; depth 53, snout to anus 1.7, snout to dorsal origin about 16, all in total length; eye 20 in head; caudal fin minute.

Leptenchelys vermiformis Myers and Wade

3*b*. Dorsal fin well developed anteriorly, its origin about equidistant between gill opening and tip of snout; depth 42 to 48, snout to anus 1.4, snout to dorsal origin 23 to 29, all in total length; eye 12 to 16 in head; caudal fin obsolete or absent.

Leptenchelys pinnaceps, new species (p. 79)

2*b*. Caudal fin well developed; dorsal origin a head length behind gill opening; anterior nostrils tubular, elongate, their bases in front of tip of chin; rear margin of eye over rictus; snout acute; snout tip to anus 2.5, snout tip to dorsal origin 5.0 to 5.9, all in total length; eye 9 to 10 in head.

Leptenchelys labialis (Seale) (p. 80)

1*b*. Ventral side of snout without a median groove containing 2 or 3 sharp-pointed, hooked teeth.

4*a*. Teeth absent or embedded on premaxillary and on vomer; dorsal origin 1.3 to 1.5 head lengths behind anus; snout tip to anus 2.4 to 2.7, snout tip to dorsal origin 1.8 to 1.9, both in total length; a narrow villiform band of teeth on maxillary (*Schultzidia*).

5*a*. A small median dermal papilla on edge of upper lip between anterior nostrils; greatest depth 45 to 54, head 10 to 10.5, both in total length---------- Schultzidia retropinnis (Fowler) (p. 81)

5*b*. No papilla on upper lip; greatest depth 24 to 30, head 7.9 to 10.2, both in total length.

Schultzidia johnstonensis (Schultz and Woods) (p. 82)

4*b*. Teeth present on premaxillary and on vomer (*Muraenichthys*).

6*a*. Dorsal fin origin more than one head length behind anus; teeth on vomer biserial, those on maxillary and on dentary uniserial; posterior nasal opening on outside of upper lip near lower front of eye; greatest depth 37, head 9.9 to 10.2, snout to dorsal origin 1.4, all in total length.

Muraenichthys philippinensis Schultz and Woods

6*b*. Dorsal fin origin less than a head length behind anus, or in advance of it.

7*a*. Dorsal fin origin over gill opening or a trifle in front of it; teeth in a narrow band on maxillary and on dentary, inner row largest; vomerine teeth biserial.

Muraenichthys bicollaris Myers and Wade

7*b*. Dorsal fin origin behind gill opening.

8*a*. Dorsal fin origin closer to gill opening than to anus (see also 8*b*, 8*c*, and 8*d*); teeth on maxillary and on dentary in a narrow band, inner row largest; vomerine teeth in 2 rows or an irregular row.

9*a*. Dorsal fin origin less than a snout length behind gill openings____ Muraenichthys apterus (Beebe and Tee-Van)

9*b*. Dorsal fin origin about 4 or 5 snout lengths behind gill openings.

Muraenichthys macropterus Bleeker (p. 73)

8*b*. Dorsal fin origin equidistant or nearly so between gill opening and anus (see 8*c*).

Muraenichthys thompsoni [9] Jordan and Richardson

8*c*. Dorsal fin origin closer to anus than gill opening, but notably in front of anus; tip of snout and of lower jaw bluntly rounded (see 8*d*).

10*a*. Teeth on vomer in a broad flattish patch forward, becoming one row posteriorly; those on maxillary and on dentary in a band.

11*a*. Dorsal fin origin ⅕ to ½ head length in front of anus.

Muraenichthys hattae Jordan and Snyder

11*b*. Dorsal fin origin ⅔ to ⅘ head length before anus.

Muraenichthys gymnopterus [10] Bleeker

10*b*. Teeth on vomer in one or two rows; teeth on maxillary and on dentary uniserial or biserial.

12*a*. Dorsal fin origin ⅔ to ⅘ head length in front of annus_____ Muraenichthys godeffroyi [11] Regan

12*b*. Dorsal origin from ⅕ to ½ head length in front of anus.

13*a*. Vomerine teeth biserial.

Muraenichthys sibogae Weber and de Beaufort (p. 74)

13*b*. Vomerine teeth uniserial.

Muraenichthys cookei Fowler

8*d*. Dorsal fin origin over anus or nearly so to less than a head length behind anus.

14*a*. Rear margin of eye notably in advance of rictus of mouth.

15*a*. Teeth on maxillary and on dentary uniserial, those on vomer in 1 or 2 rows; snout acute.

16*a*. Dorsal origin ¾ head length behind anus; greatest depth 40 to 45 in total length.

Muraenichthys tasmaniensis McCulloch

16*b*. Dorsal fin origin about ⅕ head length behind anus.

Muraenichthys iredalei Whitley

16*c*. Dorsal fin origin over anus or anal origin or nearly so.

17*a*. Greatest depth 27 to 30 in total length.

Muraenichthys macrostomus Bleeker

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[9] Probable synonym: *Muraenichthys malabonensis* Herre, Philippine Journ. Sci., vol. 23, p. 157, pl. 2, fig. 1, 1923 (Philippine Islands).

[10] Synonym: *Muraenichthys microstomus* Bleeker, Atlas ichthyologique des Indes Orientales Néerlandaises . . . , p. 32, pl. 150, fig. 2, 1864 (Celebes Sea).

[11] Synonym: *Muraenichthys clerae* Fowler, Proc. Acad. Nat. Sci. Philadelphia, vol. 85, pp. 277–8, fig. 38, 1934 (holotype, U. S. N. M. No. 92348).

17*b*. Greatest depth 40 to 50 in total length.
Muraenichthys australis [12] Macleay

15*b*. Teeth on maxillary and on dentary in at least two rows or in a narrow to wide band, sometimes becoming one row posteriorly; dorsal origin from nearly over anus to ½ head length behind anus.

18*a*. Snout bluntly rounded; bases of anterior nostrils opposite or a little behind tip of chin; teeth in bands on maxillary, dentary, and vomer.
Muraenichthys schultzei Bleeker (p. 75)

18*b*. Snout acute.

19*a*. Rear margin of eye only slightly in advance of rictus of mouth; tip of snout to rictus about 3.7 to 4.3 in head; eye diameter about equal to distance from tip of chin to tip of snout; anterior margin of eye about equidistant between rictus and tip of chin; snout moderately pointed.
Muraenichthys gymnotus Bleeker (p. 76)

19*b*. Rear margin of eye notably in advance of rictus; tip of snout to rictus about 3 in head; eye a little in front of middle of cleft of mouth; snout much pointed.
Muraenichthys acutirostris Weber and de Beaufort

14*b*. Rear margin of eye over rictus of mouth; dorsal fin origin from slightly in front of anus to ½ head length behind anus; snout bluntly rounded; greatest depth about 24 to 34 in total length; anterior nostrils opposite tip of chin; eye 13 to 16 in head.
Muraenichthys laticaudata (Ogilby) (p. 77)

MURAENICHTHYS MACROPTERUS Bleeker

FIGURE 13, *c*

Muraenichthys macropterus BLEEKER, Act. Soc. Sci. Indo-Neerl., vol. 2, p. 91, 1857 (type locality, Amboina).

Muraenichthys breviceps GÜNTHER, Ann. Mag. Nat. Hist., ser. 4, vol. 17, p. 401, 1876 (type locality, Tasmania).

Muraenichthys owstoni JORDAN and SNYDER, Proc. U. S. Nat. Mus., vol. 23, p. 862, fig. 11, 1901 (type locality, Yaeyama Island, Ishigaki group, Japan).

Echidna uniformis SEALE, Occ. Pap. Bishop Mus., vol. 1, No. 3, p. 62, 1901 (type locality, Guam).

[12] Probable synonym: *Muraenichthys oliveri* Waite, Trans. New Zealand Inst., vol. 42, p. 374, 1910.

SPECIMENS STUDIED

Bikini Atoll: Erik Island, pondlike tidal pool, March 20, 1946, S-46-10, Schultz, 4 specimens, 116 to 193 mm. (In addition we have compared these specimens with two lots from Okinawa and with a paratype of *E. uniformis* Seale, U.S.N.M. No. 109383.)

Description.—Greatest depth 36 to 53; head 9.4 to 9.9; snout to anus 2.6 to 2.7; snout to dorsal origin 5.1 to 5.2; all in the total length. Greatest depth 3.8 to 4.5; snout tip to tip of chin 23 to 26; eye 11 to 13; snout 5.8 to 6.2; interorbital space 16 to 19; snout to rictus 3.8 to 3.9; all in the length of head.

Posterior nasal opening in upper lip, with valvular flap, under front of orbit; anterior nostrils tubular, their bases opposite tip of chin; no groove under tip of snout; eye moderately large, without free margin; dorsal fin origin not quite a head length behind gill openings; anal fin origin close behind anus; both dorsal and anal fins confluent with the small, minutely rayed caudal fin; anus a little behind the anterior third of the total length; gill opening a rounded pore on sides; no pectoral fins; lateral line along middle of side, incomplete, ending a head length or two in front of tip of tail; lips without cirri; tongue adnate to floor of mouth; teeth short, conical in a narrow band on maxillary and dentary, in two rows or an irregular row on vomer, in a patch on premaxillary; rear margin of eye over rictus, anterior margin of eye a little closer to rictus than to tip of chin; snout and lower jaw bluntly or broadly rounded.

Color in alcohol.—Plain whitish below, with darkish pigment dorsally.

MURAENICHTHYS SIBOGAE Weber and de Beaufort

Muraenichthys sibogae Weber and de Beaufort, The fishes of the Indo-Australian Archipelago, vol. 3, p. 276, 1916 (type locality, south coast of Timor at Obi Major).

SPECIMEN STUDIED

Seale (Bull. Mus. Comp. Zool., vol. 61, No. 4, p. 79, 1917) described *Mauraenichthys labialis* from Arhno Atoll, Marshall Islands. He states, "A detailed description of the largest of these [two] specimens M.C.Z. 29500 (A), the type of *M. labialis*, is as follows:—" That leaves the shorter specimen, M.C.Z. 29500 (B), unmentioned and undescribed. My examination of both these specimens reveals that the shorter one, 74 mm. in total length, belongs to a different genus and species than the holotype of *Leptenchelys labialis* (Seale). I identify it as *M. sibogae*.

Description.—Greatest depth 53, head 8.7, snout to anus 2.7, snout to dorsal origin 3.1, all in total length. Greatest depth 6.1, snout tip to tip of chin 34, eye 28, snout 5.6, interorbital space 1.16, snout tip to rictus 4.0, all in length of head.

Posterior nasal opening under front of orbit in upper lip; anterior nostrils tubular, their bases opposite tip of chin; no groove under tip

of snout; dorsal fin origin between ¼ and ⅓ head length in front of a vertical line through anus; anal fin origin close behind anus, both dorsal and anal fins confluent with the small, minutely rayed caudal fin; gill opening a rounded pore a trifle below middle of side; teeth short, conical, in a biserial row on vomer, uniserial on maxillary, a few teeth on premaxillary; rear margin of eye a little in front of rictus; anterior margin of eye a little closer to rictus than to tip of chin.

Color in alcohol.—Uniform brownish.

MURAENICHTHYS SCHULTZEI Bleeker

FIGURE 13, *d*

Muraenichthys schultzei BLEEKER, Nat. Tijdschr. Nederl.-Indië, vol. 13, p. 366, 1857 (type locality, south Java).

SPECIMENS STUDIED

Bikini Atoll: 7 stations, 9 specimens, 47 to 109 mm. total length.
Rongelap Atoll: 4 stations, 5 specimens, 58 to 143 mm.
Eniwetok Atoll: 2 stations, 8 specimens, 86 to 97 mm.
Rongerik Atoll: 1 station, 1 specimen, 85 mm.

Description.—Greatest depth 27 to 42; head 8.0 to 8.9; distance from snout tip to anus 2.3 to 2.4; snout to dorsal origin 2.0 to 2.1; all in total length. Greatest depth 3.3 to 5.1; snout tip to tip of lower jaw 25 to 33; eye 15 to 25; snout 6.1 to 7.5; interorbital space 10.6 to 12.3; snout to rictus 3.3 to 3.8; all in length of the head. Proportions based on 4 specimens.

Posterior nasal opening in upper lip just in front of orbit, with valvular flap; anterior nostril short, tubular, base located opposite, or a little behind, tip of lower jaw; eye small, without free margin; dorsal fin origin behind a vertical line through anus by distance not exceeding a head length (usually about ⅔ to ⅘); anal fin origin close behind anus; both dorsal and anal fins confluent with short caudal fin, latter bluntly rounded; anus a little in front of middle of total length; gill openings restricted to a pore on middle of lower sides; no pectoral fin; lateral line along upper side anteriorly, incomplete, ending a short distance in front of anus or over it; lips without cirri, without folds extending on underside of snout; tongue adnate to floor of mouth; teeth short, conical, in a narrow band on maxillary and dentary, with inner row largest, in two rows on vomer, in a rounded patch on premaxillary; rear margin of eye notably in advance of rictus of mouth, anterior margin about equidistant between tip of lower jaw and rictus; snout broadly rounded, projecting only a little in front of broadly rounded tip of lower jaw; none of premaxillary teeth exposed.

Color in alcohol.—Plain whitish, except back above lateral line and thence posteriorly, finely speckled with black pigment cells, these covering tail posteriorly.

Ecology.—This sand-inhabiting species was attracted to a light at night.

Remarks.—*M. schultzei* is a more robust species than others of this genus. It is characterized by the location of the eye farther forward in reference to the rictus and by the broadly rounded snout and lower jaw. The larger specimens are females with numerous nearly mature eggs.

MURAENICHTHYS GYMNOTUS Bleeker

FIGURE 13, *b;* PLATE 10

Muraenichthys gymnotus BLEEKER, Atlas ichthyologique des Indes Orientales Néerlandaises . . . , vol. 4, p. 33, pl. 150, fig. 3, 1864 (type locality, Amboina).

Muraenichthys aoki JORDAN and SNYDER, Proc. U. S. Nat. Mus., vol. 23, p. 863, fig. 13, 1901 (type locality, Misaki, Japan).

Sphagebranchus huysmani MAX WEBER, *Siboga*-expeditie, vol. 57, p. 48, fig. 10, 1913 (type locality, Molo-Strasse).

Muraenichthys fowleri SCHULTZ, U. S. Nat. Mus. Bull. 180, p. 51, pl. 7, fig. 5,*e*, 1943 (type locality, Tau and Tutuila Islands, Samoan group).

SPECIMENS STUDIED

Bikini Atoll: 14 stations, 21 specimens, 57 to 142 mm. total length.
Eniwetok Atoll: 3 stations, 15 specimens, 60 to 124 mm.
Rongelap Atoll: 4 stations, 12 specimens, 57 to 119 mm.
Rongerik Atoll: 1 station, 9 specimens, 44 to 113 mm.

Description.—Greatest depth 30 to 50; head 9.3 to 10.9; distance from snout to anus 2.3 to 2.4; snout to dorsal origin 1.7 to 2.4; all in total length. Greatest depth 4.0 to 5.2; snout tip to tip of lower jaw (when closed) 15 to 20; eye 16 to 28; snout 5.6 to 5.8; interorbital space 14 to 16; snout to rictus 3.7 to 4.3; all in length of the head to upper edge of gill opening. Proportions based on 5 specimens, 81 to 122 mm. in total length.

Posterior nasal opening in upper lip, under front of orbit, covered with a valvular flap directed posteriorly; anterior nostril tubular, on underside of snout, base a little behind tip of lower jaw; snout tip smooth, bluntly pointed, without lobes or folds of skin; eye small, without free margin, its diameter about equal to distance from snout tip to tip of lower jaw; dorsal fin origin less than ½ head length behind a vertical line through anus (rarely, a little in front of that line); anal fin origin just behind anus; both dorsal and anal fins confluent with caudal fin; caudal fin very short, with minute rays similar to those in dorsal and anal fins; anus slightly in front of middle of total length;

gill opening a rounded pore restricted to middle of lower side; no pectoral fins, only a trace at rear rim of gill opening where fin is expected; lateral line along sides, ending about ½ to ⅔ the distance from anus to tail tip; lips without cirri; tongue adnate to floor of mouth; teeth short, conical, in two rows anteriorly on maxillary, becoming uniserial posteriorly, inner row largest; premaxillary teeth in an inverted U-shaped arrangement; those on vomer uniserial, on dentary a few biserial near tip (inner row largest), then uniserial posteriorly; rear margin of eye in front of rear corner (rictus) of mouth; vertical line through anterior border of eye passes about equidistant between tip of lower jaw and rictus.

Color in alcohol.—Plain pale or whitish.

Color when alive.—Translucent to whitish.

Ecology.—This eel was obtained in areas where there was loose sand or fine gravel.

Remarks.—The 57-mm. specimen was just metamorphosing from the leptocephalus stage, and is referred to this species with some doubt. Some of the larger specimens are females containing eggs that may be approaching maturity. This eel is characterized by its relatively sharp-pointed snout, viewed laterally.

MURAENICHTHYS LATICAUDATA (Ogilby)

FIGURE 13, *e;* PLATE 8, A, B

Myropterura laticaudata OGILBY, Proc. Linn. Soc. New South Wales, vol. 22, p. 247, 1897 (type locality, Fiji).

SPECIMENS STUDIED

Bikini Atoll: 13 stations, 33 specimens, 16 to 269 mm. total length.
Eniwetok Atoll: 2 stations, 7 specimens, 96 to 184 mm.
Rongelap Atoll: 5 stations, 6 specimens, 50 to 254 mm.
Rongerik Atoll: 3 stations, 14 specimens, 50 to 224 mm.
Guam: 2 lots, 3 specimens, 178 to 260 mm.

Description.—Greatest depth 24 to 34; head 8.9 to 10.2; distance from snout to anus 2.2 to 2.4, to dorsal origin 2.0 to 2.5; all in total length. Greatest depth 2.5 to 3.6; snout tip to tip of lower jaw (closed) 19 to 32; eye 13 to 16; snout 5.0 to 5.6; interorbital space 7.9 to 10.7; snout to rictus 3.9 to 4.7; gill opening 11.3 to 28; all in length of head. Proportions based on precision measurements made on 5 specimens from 97 to 253 mm. in total length.

Posterior nasal opening in upper lip under front of orbit, covered with a valvular flap, directed posteriorly, anterior nostrils tubular on underside of snout opposite tip of lower jaw; snout tip smooth, bluntly rounded, without lobes or folds of skin; eye small, without free margin, its diameter greater than distance from tip of lower jaw to tip of

snout; dorsal fin origin near a vertical line through anus, less than ⅓ head length behind, or just in front of, a vertical line through anus; anal fin origin just behind anus, both dorsal and anal confluent with caudal fins; caudal fin very short, bluntly rounded; anus slightly in front of middle of total length; gill opening a rounded pore, restricted to middle of lower side; no pectoral fin, only a low dermal rim along gill opening where fin is expected; lateral line along uppersides anteriorly, thence along middle of side, ending about halfway from anus to tail tip; lips without cirri or folds; tongue adnate to floor of mouth; teeth small, conical, in two rows on maxillary, in one row, sometimes irregular, on vomer, uniserial on dentary, except a few extra ones near tip of jaw; teeth on premaxillary in an irregular ring, sometimes around a slightly enlarged centrally located tooth; rear margin of eye over corner (rictus) of mouth, anterior border of eye notably ⅔ closer to rictus than tip of lower jaw.

Color in alcohol.—Whitish, sometimes light brownish or grayish dorsally.

Color when alive—Dorsal surface of head pale purplish red, back pale yellowish orange, ventral side pale yellowish.

Ecology.—This eel appeared over loose-sand and loose-gravel bottoms.

Remarks.—Only two specimens were observed that had the dorsal origin slightly in front of the anus; nearly all the larger female specimens contained well-developed eggs.

TABLE 7.—*Precision measurements made on certain genera and species of echelid eels, recorded in thousandths of the total length*

Characters	*Schultzidia retropinnis*				*Muraenichthys philippinensis*		*Schultzidia johnstonensis*			*Leptenchelys vermiformis*	*Leptenchelys pinnaceps*	
	Marshall Islands				Philippines		Johnston Island		Bikini	Costa Rica	Bikini	Eniwetok
	Holotype	Specimens			Paratype	Holotype	Holotype	Paratype	Paratype	Holotype	Holotype	Paratype
Total length in mm	114	111	107	105	119	92	145	81	122	116	97	174
Snout to anus	368	378	420	382	520	533	390	365	369	586	722	700
Snout to dorsal origin	544	558	560	518	739	696	569	558	549	56	45	34
Snout tip to tip of chin	7	7	6	7	2	2	8	11	8	8	13	11
Greatest depth	22	19	19	19	27	27	39	42	33	19	24	21
Tip of snout to front edge of gill opening	100	105	107	100	98	101	117	126	100	87	97	74
Length of snout	18	18	19	17	13	13	23	28	19	11	16	12
Diameter of eye	6	5	7	5	4	4	10	10	7	4	8	5
Snout to rictus	32	27	28	27	27	26	32	38	30	24	34	24
Anal origin to dorsal origin between verticals	158	153	127	128	183	163	169	170	140	530	680	655
Interorbital space	9	8	10	9	10	10	14	13	10	8	9	9

Genus LEPTENCHELYS Myers and Wade

Leptenchelys Myers and Wade, Allan Hancock Pacific Exped., Univ. Southern California, vol. 9, No. 4, p. 72, 1941. (Genotype, *L. vermiformis* Myers and Wade.)

LEPTENCHELYS PINNACEPS, new species

Figure 16

Holotype.—U.S.N.M. No. 141691, Bikini Atoll, Romuk Island, ocean reef, April 1, 1946, S–46–47, Schultz, 97 mm. total length.

Paratype.—Eniwetok Atoll, Rigili Island, August 10, 1949, Welander, 1 specimen, 174 mm.

Description.—Precision measurements were made on the holotype, and these data are recorded in table 7 in thousandths of the total length.

Greatest depth 42 and 48; head 10.3 and 13.6; snout to anus 1.4 and 1.4; snout to dorsal origin 23 and 29; all in the total length. Greatest depth 4.1 and 3.6; snout tip to chin tip 6.7 and 7.2; eye 16 and 12; snout 6.3 and 6.4; interorbital space 8.5 and 10.5; snout tip to rictus 2.9 and 3.1; all in length of head.

Posterior nasal opening in upper lip under eye; anterior nostrils tubular, their bases a little in front of tip of chin; a distinct median

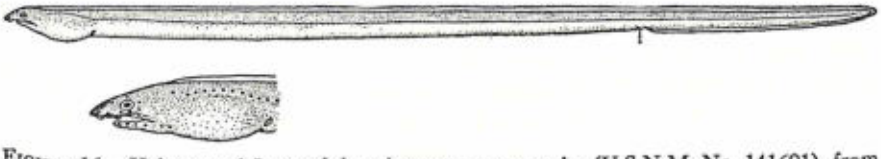

Figure 16.—Holotype of *Leptenchelys pinnaceps*, new species (U.S.N.M. No. 141691), from Bikini Atoll. (Drawing by Dorothea B. Schultz.)

groove on underside of snout extending nearly to tip of snout; eye moderately large, without free margin; dorsal fin origin on head, closer to tip of snout than to gill opening; anal fin origin close behind anus; dorsal and anal fins well developed forward, but so rudimentary posteriorly that the presence of a caudal fin is doubtful, although a very short membrane appears to be present; anus behind middle of total length; gill opening a slit or pore on lower sides; no pectoral fins; lateral line along side, not quite reaching tip of tail; lips without cirri; tongue adnate to floor of mouth; two premaxillary teeth in groove under snout, strongly hooked backward nearly at right angles, teeth on vomer probably lacking, those on dentary and maxillary probably present; anterior margin of eye much closer to tip of chin (nearly above it) than to rictus; snout moderately acute.

Color in alcohol.—Plain and pale except for traces of 11 faintly pigmented spots along ventral side of body. In adults these may develop into blackish vertical bars.

Remarks.—This new species is characterized by the location of the dorsal fin origin over the middle of the head, and the median groove or slit on the underside of the snout. The key (p. 71) will aid in distinguishing it from all related species.

Named *pinnaceps* in reference to the location of the dorsal fin origin on the head.

LEPTENCHELYS LABIALIS (Seale)

Muraenichthys labialis SEALE, Bull. Mus. Comp. Zool., vol. 61, No. 4, p. 79, 1917 (type locality, Arhno Atoll, Marshall Islands).

Muraenichthys macropterus (non Bleeker) EVERMANN and GOLDSBOROUGH, Mem. Mus. Comp. Zool., vol. 26, No. 7, p. 245, 1911 (Arhno Atoll, Marshall Islands).

SPECIMENS STUDIED

Bikini Atoll: 4 stations, 15 specimens, 68 to 193 mm. total length.
Eniwetok Atoll: 1 station, 4 specimens, 98 to 201 mm.
Rongelap Atoll: 1 station, 1 specimen, 174 mm.
Arnho Atoll: M. C. Z. No. 29500 (holotype) also examined.

Description.—Greatest depth 31 to 53; head 10 to 12; distance from snout tip to anus 2.5, to dorsal origin 5.0 to 5.9; all in the total length. Greatest depth 2.7 to 4.5; tip of snout to tip of lower jaw (when closed) 9.2 to 10.1; eye 9.1 to 10.0; snout 4.6 to 5.3; interorbital space 22 to 32; snout to rictus 3.3 to 4.1; all in length of head.

Posterior nasal opening in upper lip, under front of orbit, covered with valvular flap; anterior nasal opening on underside of snout, tubular, very long (about twice in snout and as long as diameter of pupil), base about equidistant between tip of snout and tip of lower jaw, or closer to latter; a groove separates a pair of dermal folds opposite premaxillary teeth, inner edges of folds free, groove continuing nearly to tip of snout; eye large, without free margin; origin of dorsal fin nearly a head length behind head, of anal fin just behind anus, both confluent with caudal fin; caudal fin very short, bluntly rounded; anus in front of middle of total length; gill opening a rounded pore restricted to middle of lower side; no pectoral fin; lateral line along upper side anteriorly, thence, beginning about over anus, along middle of side, incomplete, ending a head length or two in front of tail tip; lips without cirri, but continuing as a pair of folds under projecting snout; tongue adnate to floor of mouth; teeth short, conical, in a single row on dentary and on maxillary, in an irregular row or two rows on vomer, in an inverted V-shape on premaxillary; rear margin of eye over rictus, or corner of mouth, anterior border of eye about equidistant between rictus and tip of lower jaw; snout notably projecting in front of tip of lower jaw so that most of the premaxillary teeth are exposed; snout somewhat pointed.

Color in alcohol.—Plain whitish.

Ecology.—This eel appeared over loose sandy areas.

Remarks.—This species is easily distinguished from the other echelid eels by the long tubular anterior nostrils, the long, projecting, pointed snout, and the location of the origin of the dorsal fin a trifle less than a head length behind the head.

Genus SCHULTZIDIA Gosline

Schultzidia GOSLINE, Pacific Science, vol. 5, No. 4, p. 309, 1951. (Genotype, *Muraenichthys johnstonensis* Schultz and Woods.)

SCHULTZIDIA RETROPINNIS (Fowler)

Muraenichthys retropinnis FOWLER, Proc. Acad. Nat. Sci. Philadelphia, 1933, vol. 85, p. 277, fig. 37, 1934 (type locality, Taratara Island, Philippines; holotype, U. S. N. M. No. 92355).

Muraenichthys malaita SEALE, Proc. California Acad. Sci., vol. 21, p. 341, pl. 20, fig. 1, 1935 (type locality, Malaita Island, Solomon group).

SPECIMENS STUDIED

Bikini Atoll: Lagoon, *Bowditch* anchorage, light at night, April 25, 1946, S–46–114, Schultz, 2 specimens, 105 and 111 mm.

Rongerik Atoll: Bock Island, ocean reef, June 27, 1946, S–46–237, Schultz and Herald, 1 specimen, 107 mm.

Description.—Measurements based on Marshall Island specimens and holotype of species. Greatest depth 45 to 54; head 10 to 10.5; snout to anus 2.4 to 2.6; snout to dorsal origin 1.8 to 1.9; all in total length. Greatest depth 4.5 to 5.2; snout tip to tip of chin 13 to 15; eye 15 to 21; snout 5.2 to 5.7; interorbital space 9.5 to 11.8; snout to rictus 3.3 to 3.7; all in length of head. Precision measurements, expressed in thousandths of the total length, are given in table 7.

Posterior nasal opening in upper lip below front of eye, with valvular flap; anterior nostrils tubular, on underside of snout in front of tip of lower jaw; at edge of lip between them a short papilla; snout pointed; interorbital space strongly convex; eye small, without free margin, diameter equal to, or a little shorter than, distance from tip of snout to tip of chin; dorsal fin origin from 1⅓ to 1⅔ head lengths behind anus; anal fin origin close behind anus; dorsal and anal fins confluent with caudal; caudal fin very short, bluntly rounded; anus a little behind first third of total length; gill opening a rounded pore, restricted to middle of lower side; no pectoral fin; lateral line along middle of side, incomplete, ending a little in front of dorsal origin; lips without cirri; tongue adnate to floor of mouth; teeth villiform, in a single row anteriorly on maxillary, becoming a band posteriorly, in a villiform band on dentary, if present on premaxillary, embedded, not present on vomer; rear margin of eye notably in advance of rictus; anterior margin of eye equidistant between tip of chin and rictus.

Color in alcohol.—Dorsal half of body speckled with blackish pigment, ventrally white.

Remarks.—The dentition of this species, especially the lack of premaxillary and vomerine teeth, distinguishes it from others of the region and, perhaps, of the entire tropical Pacific.

SCHULTZIDIA JOHNSTONENSIS (Schultz and Woods)

FIGURE 17

Muraenichthys johnstonensis SCHULTZ and WOODS, Journ. Washington Acad. Sci., vol. 39, p. 172, fig. 1, 1949 (type locality, Johnston Island).

SPECIMENS STUDIED

Holotype.—U.S.N.M. No. 141268, Johnston Island, northern reef, August 28–29, 1947, Schultz, 145 mm. total length.

Paratypes.—U.S.N.M. No. 141269, taken with holotype and bearing same data, total length 81 mm.; U.S.N.M. No. 141692, Bikini Atoll, Arji Island, lagoon, depth 20 to 40 feet, August 7, 1946, Brock and Herald, 1 specimen, 122 mm.

Description.—Greatest depth 24 to 30; head 7.9 to 10.2; snout to anus 2.6 to 2.7, to dorsal fin origin 1.76 to 1.8; all in total length. Greatest depth 3.0; tip of snout to tip of chin 11 to 15; eye 11 to 13,

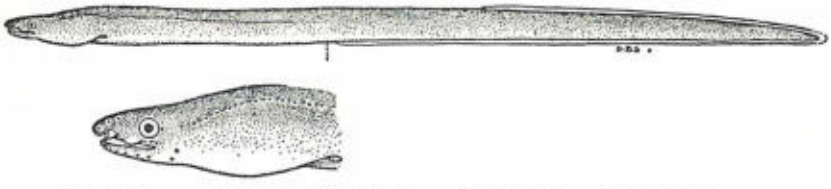

FIGURE 17.—Holotype of *Schultzidia johnstonensis* (Schultz and Woods) (U.S.N.M. No. 141268), from Johnston Island. (Drawing by Dorothea B. Schultz.)

snout 4.4 to 5.2; interorbital space 8.5 to 10; snout to rictus 3.3 to 3.7; all in length of head. Precision measurements, expressed in thousandths of the total length, are given in table 7.

Posterior nasal opening in upper lip below front of eye, with valvular flap; anterior nostrils tubular, their bases opposite tip of chin, no papilla between them on lip as in *retropinnis;* no groove on underside of snout between nostrils; eye small, without free margin; dorsal fin origin about 1.3 to 1.5 head lengths behind anus; anal origin close behind anus; both dorsal and anal fins confluent with small, minutely rayed caudal fin; anus a little behind front third of total length; gill opening a small pore on lower side; no pectoral fin; lateral line near middle of sides incomplete, ending a little in front of anus; lips without cirri; tongue adnate to floor of mouth; teeth on maxillary almost villiform, in one or two rows or a narrow band, broadening posteriorly opposite eye; those on dentary similar and in a band; no teeth on vomer; teeth either lacking on premaxillary or embedded; rear margin of eye over rictus or slightly behind it; front margin of eye closer to rictus than to tip of chin; snout bluntly rounded.

Color in alcohol.—Sides and back finely peppered with brown pigment; ventral side white; area below and behind eye white.

Remarks.—This species is closely related to *S. retropinnis* (Fowler) in its peculiar dentition, especially the long band of maxillary teeth that broadens opposite the orbit, and the complete lack of teeth on the vomer. It differs in having a robust body of a compressed shape, whereas *retropinnis* is more tubular.

Family CONGRIDAE: Conger Eels

By Leonard P. Schultz

This family is characterized by the location of the posterior nostril in front of, and slightly below the dorsal edge of the eye, by lips with free edges that fold upward along the side of the upper jaw and downward along the side of lower jaw but do not meet near symphyses; by the tubular anterior nostril; by the anus notably in front of the middle of the total length; by the well-developed median fins, confluent with the caudal fin, by the location of the dorsal fin origin over the pectoral fin, the latter being well developed; by the naked skin; and by gill openings that are restricted to the lower sides in front of the pectoral fins.

Genus CONGER Schaeffer

Conger Schaeffer, Epistola ad Regio-Borussican Societatem litterariam Duisburgensem, de studii ichthyologici faciliori ac tutiroi methodo . . . , p. 20, 1760. (Genotype, *Muraena conger* Linnaeus.)

CONGER NOORDZIEKI Bleeker

FIGURE 18

Conger noordziekii Bleeker, Act. Soc. Sci. Indo-Neerl., vol. 2, p. 86, 1857; Atlas ichthyologique des Indes Orientales Néerlandaises . . . , vol. 4, p. 26, pl. 167, fig. 2, 1862 (type locality, Amboina).

SPECIMENS STUDIED

Bikini Atoll: 9 stations, 22 specimens, 20 to 890 mm. total length.
Rongelap Atoll: 5 stations, 7 specimens, 56 to 222 mm.
Eniwetok Atoll: 4 stations, 5 specimens, 168 to 598 mm.
Rongerik Atoll: 1 station, 1 specimen, 368 mm.
Kwajalein Atoll: 1 station, 3 specimens, 312 to 323 mm.
Guam: 4 lots, 15 specimens, 67 to 865 mm.

Description.—Greatest depth 17 to 22; head 7.3 to 8.0; snout tip to anus 3.0 to 3.1; snout to dorsal origin 6.7 to 7.1; length of pectoral 26 to 29; all in total length. Greatest depth 1.3 to 2.8; pectoral 2.9 to 3.6; eye 5.6 to 7.6; snout 3.9 to 4.3; interorbital space 6.7 to 9.7; tip of snout to rictus 2.7 to 2.9; length of gill opening 6.6 to 8.5, all in length of head.

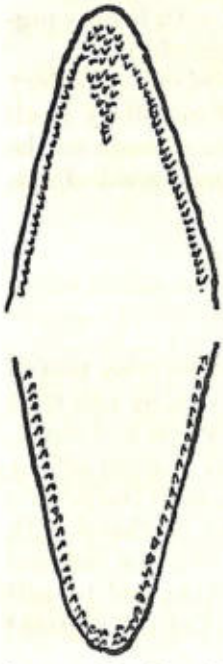

FIGURE 18.—Dental pattern of *Conger nordzieki* Bleeker (Sketch by author.)

Posterior nasal opening without raised rim, a pore just in front of eye and slightly below upper level of eye; anterior nasal openings tubular, on snout at each side of tip and in line with upper lip; tip of snout with a median lobe or fold and one on each side, all between the tubular nostrils; dorsal surface of snout convex, smooth; eye large, without free margin; dorsal fin origin a little behind a vertical line through rear of pectoral base, anal fin origin immediately behind anus; dorsal and anal continuing as rayed fins to caudal, with which they are confluent; caudal fin rayed, ending in a blunt or rounded point, its length about equal to diameter of eye; anus notably in front of middle of length, distance from snout tip to anus about 3 in total length; gill openings restricted to lower sides, isthmus a little longer than snout; dorsal edge of gill opening opposite middle of pectoral fin base, opening continuing below lower edge of pectoral base for a distance about ¾ width of latter; pectoral fin large, longer than snout, with about 17 or 18 rays; lateral line above level of pectoral base in anterior third of length, then along middle of sides posteriorly, the canal not quite reaching to caudal fin base; lips thick, without cirri, characteristically folded upward on upper jaw and downward on lower jaw except at tip of jaws; these folds do not meet; teeth short, conical, in a single row on dentary, except in a patch at symphysis, premaxillary teeth in a small patch, those on vomer in a wedge-shaped patch, maxillary teeth in a single row, all teeth arranged as in figure 18; tongue free.

Color in alcohol.—Light brownish dorsally, white ventrally; a dark streak under orbit opposite edge of upper lip; pectoral fins white in young and half grown, and sometimes with a black blotch or spot distally in pectoral fin, this black spot highly variable, sometimes very small, occasionally present on one side and absent on the other; dorsal and anal fins margined with a black band continuous around the caudal fin; this black band may be lacking anteriorly on young and half grown; on specimens between 59 and 125 mm. in total length the major part of the median fins are blackish posteriorly, the dark color just beginning to appear on the 59-mm. specimen. In some specimens the upper sides show traces of more or less distinct broad vertical bands.

Color when alive.—Under sides and anal fin light yellowish; snout pinkish.

Ecology.—This eel was seen commonly on the shallow parts of the reef at low tide, hiding in crevices, from which it was driven by the poison (see p. xv). At night it would come out and frequently it was seen in a few inches of water along the shore.

Remarks.—This species was identified by Robert H. Kanazawa, who is revising the genus.

Genus ARIOSOMA Swainson

Ariosoma SWAINSON, The natural history and classification of fishes . . ., vol. 1, p. 220, 1838; vol. 2, p. 196, 1839. (Genotype, *Ophisoma acuta* Swainson= *Muraena balearica* De la Roche, as restricted by Bleeker, replacing *Congermuraena* Kaup and *Congrellus* Ogilby.)

ARIOSOMA OBUD Herre

Ariosoma obud HERRE, Philippine Journ. Sci., vol. 23, p. 144, pl. 1, fig. 2, 1923 (type locality, Marinduque Island, P. I.).

SPECIMENS STUDIED

Rongelap Atoll: Tufa Island, depth 28 feet, July 28, 1946, S–46–300, Herald and Brock, 1 specimen, 83 mm. Rongelap Island, lagoon, depth 18 feet, July 25, 1946, S–46–286, Brock, Herald, and Kohler, 1 specimen, 129 mm.

Description.—Greatest depth 18 to 25; head 5.9 to 6.4; snout tip to anus 2.3 to 2.5; snout to dorsal origin 5.9 and 6.0; and length of pectoral 17 to 21; all in the total length. Greatest depth 3.1 to 3.9; pectoral 2.7 to 3.3; eye 3.8 to 4.4; snout 4.1 to 5.0; interorbital space 21 and 22; tip of snout to rictus 3.7 to 4.0; length of gill opening 10.5 and 16; all in length of head.

Posterior nostril without raised rim, a pore in front of eye on level of lower side of pupil and a pore above nostril on level of middle of pupil; anterior nostrils on each side of tip of snout and at front edge of folded part of upper lip; snout without lobes, rounded, dorsal surface convex; eye large, about equal to snout; dorsal fin origin over base of pectoral fin and anal origin close behind anus, both confluent with short caudal fin; length of caudal fin about equal to pupil; gill openings restricted to lower sides in front of base of pectoral fin, attached opposite fifth or sixth ray from dorsal edge, openings extending below base of pectoral; pectoral fin longer than snout, with 11 to 12 rays; lateral line above level of pectoral base, then near middle of side at mid-length, incomplete, ending about one-third head length in front of tail tip; upper lip folded upward on sides of mouth and lower lip folded downward, neither continuous around front of jaws; teeth minute, in narrow bands on vomer, maxillary, and dentary, in a patch on premaxillary; tip of tongue free, very short and thin.

Color in alcohol.—Plain and pale or white, without pigmentation.

Family MORINGUIDAE: Worm Eels

By Leonard P. Schultz

This family is characterized by slender, cylindrical, elongate eels with the anus far behind middle of length of body, or about two-thirds the way back from tip of snout to tip of tail; dorsal and anal fins membranous, sometimes rayed, their origins a short distance behind a vertical line through anus; these fins confluent with the short but rayed caudal fin; posterior nostril just in front of eye, with a slightly raised rim, anterior nostril tubular, at front side of snout; teeth uniserial on jaws, in one or two rows on vomer. Two eels referred to this family when described appear to belong elsewhere. B. L. Chaudhuri (Rec. Indian Mus., vol. 8, pt. 3, p. 255, pl. 9, figs. 3–3b, 1913) described *Moringua hodgarti* from "a shallow stream in Upper Rotung," India. It is our opinion that the species is a synbranchid eel. V. Franz (Akad. Wiss. München, IV Suppl., vol. 1 (Abh.), p. 15, pl. 3, fig. 11, 1910) described *Cryptophthalmus robustus* as a new genus and species from Japan. It is referred to the synbranchid eels.

Genus MORINGUA Gray

Moringua Gray, The illustrations of Indian zoology . . . Hardwicke, vol. 1, pt. 5, pl. 95, January 1831; Zool. Misc., pt. 1, p. 9, February 1831. (Genotype designated by Bleeker, Nederl. Tijdschr. Dierk., vol. 2, p. 114 (2), 1865, *Moringua raitaborua* Cantor=*Muraena raitaborua* Hamilton=Buchanan.)
Rataboura Gray, Zool. Misc., pt. 1, p. 9, February 1831.

In order better to compare various species of *Moringua*, detailed measurements are recorded in table 8.

TENTATIVE KEY TO THE SPECIES OF MORINGUA OF THE TROPICAL INDO-PACIFIC

1*a*. Lower jaw slightly longer or notably longer than upper, projecting beyond tip of snout.

2*a*. Dorsal and anal fins vestigial, their origins opposite or nearly so, and represented anteriorly by a shallow groove, in which may occur a non-rayed membrane that does not extend notably above the sides of the groove; this membrane may disappear and then reappear just in front of caudal fin, with which it is confluent; caudal fin with rounded posterior edge, never truncate.

3*a*. Pectoral fin minute or vestigial, 52 to 152 times in head.

4*a*. Greatest depth 50 to 63, head 10 to 16, both in total length; eye 34 to 51, pectoral 52 to 103, in head_____ Moringua abbreviata (Bleeker)

4*b*. Greatest depth 70 to 100, head 14 to 20, in total length; eye 38 to 68, pectoral 68 to 152, in head_____ Moringua javanica (Kaup)

3*b*. Pectoral fin 10 to 44 in head (see 2*b*).

2*b*. Dorsal and anal fins with origins opposite each other, represented anteriorly by a membrane that notably extends above the groove in which it arises; this membrane may be rayed anteriorly but disappears near middle part of its length, reappearing again as a rayed membrane near caudal fin,

TABLE 8.—*Precision measurements made on species of* Moringua, *expressed in thousandths of the total length*

Characters	*macrochir*						*bicolor*			*abbreviata*						
Total length in millimeters	161	150	148	169	134	128	321	315	233	314	291	289	270	265	226	223
Tip of snout to anus	683	687	669	692	686	688	684	698	700	682	688	682	697	702	700	695
Tip of snout to front edge of gill opening	115	109	107	98	101	109	65	79	76	69	70	68	69	69	69	75
Greatest depth	26	27	27	25	22	24	16	18	17	17	17	17	16	16	17	18
Length of snout	15.5	15	15	12	14	16	9	10	10	11	10	10	10	7	11	11
Diameter of eye	7.5	7.3	6.8	5.9	7.5	7	3.7	6	4.3	1.6	1.4	1.4	1.9	1.9	1.8	1.8
Length of pectoral fin	21	23	25	16	20	22	9	17	9.4	1.0	.7	.7	.7	1.1	1.3	1.3
Snout to rictus	22	21	21	16.6	19	20	12	14	14	13	13	13	13	11	14	13
Anus to tip of tail	317	313	331	308	313	303	297	301	300	318	312	318	303	298	300	305
Anus to anal origin	53	47	56	51	63	48	73	83	67	72	76	72	78	63	67	74
Tip of tail to end of lateral line	------	79	86	78	99	92	43	32	88	100	67	62	76	62	71	67
Interorbital space	15.5	12	11.5	11	13	12	7	10	8	9	8	8	8	6	8	9

Characters	*javanica*					*macrocephala*								
Total length in millimeters	850	658	595	505	235	293	270	269	261	257	230	169	164	154
Tip of snout to anus	712	724	706	724	736	700	700	695	678	704	696	692	683	682
Tip of snout to front edge of gill opening	51	52	55	67	65	70	67	71	72	67	73	79	83	86
Greatest depth	11	10	12	13	11	17	18	21	19	20	20	21	23	20
Length of snout	6	6	7	8	8	9	10	11	10	11	11	11	12	11
Diameter of eye	1.1	0.8	1.2	1.8	1.2	2.0	2.2	3	1.9	2.3	2.2	3.6	4.3	3
Length of pectoral fin	.7	.8	.5	.9	.4	2.0	3.0	6	2.3	2.3	1.7	4.7	3.1	2
Snout to rictus	9	9	9	11	10	13	11	14	13	15	13	15	16	14
Anus to tip of tail	300	277	294	275	264	300	300	305	322	292	304	307	312	318
Anus to anal origin	101	98	92	82	81	61	62	71	73	61	72	54	59	63
Tip of tail to end of lateral line	------	10	20	22	34	82	80	62	59	54	63	96	96	68
Interorbital space	5	5	6	7	6	7	7	7	8	7	7	9	10	10

with which dorsal and anal fins are confluent; caudal fin usually rounded; greatest depth 36 to 57, head 9 to 15, in total length; pectoral fin 13 to 44, and eye 20 to 38, in head_____ Moringua macrocephala (Bleeker)

2*a*. Dorsal and anal fins with rayed portion a short distance behind a vertical line through anus, then these fins may disappear for a short distance, or be represented by low-rayed or nonrayed membranes, reappearing again as a rayed membrane just in front of caudal fin, with which dorsal and anal fins are confluent; caudal fin truncate or spatulate in shape.

5*a*. Dorsal and anal fins beginning opposite each other; back dusky to blackish, ventrally white, caudal blackish, sometimes with outer edges and posterior tips white; eye 9 to 18.

6*a*. Depth 34 to 45, head 8 to 13, in total length, pectoral 3 to 6, in head; anal origin ¾ to 1 head length behind anus.

Moringua macrochir Bleeker

6*b*. Depth 43 to 63, head 12 to 15, in total length; pectoral 4.6 to 8, in head; anal origin ⅔ to 1½ head lengths behind anus.

Moringua bicolor Kaup

5*b*. Dorsal fin origin from ¼ to 1 head length behind a vertical line through anal fin origin.

7*a*. Dorsal and anal fins continuous as a rayed membrane to caudal fin.

8*a*. Pectoral fin very small, 1.7 to 2.0 in snout and 10 to 15 times in head; greatest depth 46 to 52, head 11 to 13, in total length; teeth as in figure 19, *a*. Moringua microchir Bleeker

8*b*. Pectoral fin large, 4 or 5 times in head; greatest depth 24 to 30, head 7.8 to 10, in total length.

Moringua floresiana Weber and de Beaufort

7*b*. Dorsal fin at greatest development continuous to caudal fin as a nonrayed membrane or vestigal; pectoral fin larger, equal to, or longer than snout, and from 4 to 9 times in head; head 8 to 13 in total length.

9*a*. Greatest depth 45 to 51 in total length.

10*a*. Eye 8 in head; lower jaw at middle of sides under orbit included in preorbital; vomerine teeth uniserial.

Moringua oculata (Fowler)

10*b*. Eye 18 to 19 in head; vomerine teeth arranged in an irregular or double row_____ Moringua cagayana Seale

9*b*. Greatest depth 34 or 35 in total length; eye 27 times in head.

Moringua robusta Herre

1*b*. Lower jaw not projecting beyond tip of snout, or equal to, or shorter than, snout.

11*a*. Pectoral fin present, with about 9 to 13 rays and visible under magnification; lower jaw about equal to upper, sometimes a trifle shorter, or a trifle longer, than upper jaw. Snout to anus 1.5 to 1.6; head 8 to 10; depth 26 to 40; all in total length.

12*a*. Pectoral fin 4.7 to 7.4 times in head; gill opening extends dorsally in front of pectoral base to a little above its middle or opposite base of 4 to 6 pectoral rays counting from dorsal edge; base of pectoral fin equals width of gill opening; eye 13 to 30 in head; anus to anal origin 26 to 74 in total length.

Moringua raitaborua [18] (Hamilton=Buchanan)

[18] *Muraena raitaborua* Hamilton=Buchanan. An account of the fishes found in the River Ganges and its branches, pp. 25, 364, 1822 (Ganges River).

12*b*. Pectoral fin about 15 in head; gill opening extends to upper edge of pectoral fin base; pectoral fin base 1.4 in width of gill opening; eye about 17 in head; anus to anal origin 20 times in total length.
Moringua latebrosa, new species

12*c*. Pectoral fin 25 to 36 in head; gill opening extends dorsally to opposite middle of base of pectoral fin; pectoral fin base 1.3 in width of gill opening; eye 27 to 63 times in head; anus to anal origin 44 to 61 times in total length---------- Moringua penni, new species

11*b*. Pectoral fin vestigial or absent, no rays present, pectoral fin, if present, represented by a tiny membranous fold.

13*a*. Caudal fin present, more or less rounded; pectoral fin represented by a dermal membrane; gill opening extends to upper edge of pectoral fin membrane and latter ends ventrally at middle of width of gill opening. Snout to anus about 1.4 to 1.5; head 9 to 14, depth 32 to 53, all in total length---------- Moringua linearis Gray

13*b*. Caudal fin vestigial, pointed; pectoral fin probably absent; snout to anus 1.1; head 10 or 11; depth about 47 to 53, all in total length.
Moringua gangeticus[14] (Fowler)

MORINGUA ABBREVIATA (Bleeker)

FIGURE 19, *b*; PLATE 11, B

Apthalmichthys abbreviatus BLEEKER, Nederl. Tijdschr. Dierk., vol. 1, p. 163, 1863; Atlas ichthyologique des Indes Orientales Néerlandaises . . . , vol. 4, p. 47, pl. 145, fig. 1, 1864 (type locality, Java; Batu; Celebes; Ternata; Amboina; Timor).

SPECIMENS STUDIED

Bikini Atoll: 20 stations, 116 specimens, 56 to 311 mm. total length.
Eniwetok Atoll: 5 stations, 49 specimens, 64 to 270 mm.
Rongelap Atoll: 8 stations, 48 specimens, 74 to 322 mm.
Rongerik Atoll: 4 stations, 34 specimens, 68 to 252 mm.
Kwajalein Atoll: 1 station, 1 specimen, 289 mm.
Likiep Atoll: Univ. Washington, 1 specimen, 143 mm.
Guam: 3 lots, 11 specimens, 110 to 330 mm.

Description.—Body extremely elongate, wormlike, cylindrical. Greatest depth 56 to 63; head 10 to 16; snout to anus 1.3 to 1.5; anus to anal origin 13 to 16; anus to tip of tail 3.1 to 3.9; end of lateral line canal to tip of tail 10 to 16; all in the total length. Depth 4.0 to 5.8; snout 6.4 to 7.3; eye diameter 34 to 51; length of pectoral fin 52 to 103; tip of snout to rictus 4.8 to 5.6; interorbital space 7.8 to 9.9; all in length of head to upper edge of gill opening. The above proportions were based on 7 specimens. Precision measurements on these specimens, in thousandths of the standard length, are given in table 8.

Posterior nostril opens in a pore just in front of eye, with a slightly raised rim; anterior nostril tubular, on side of snout near its front margin, about ⅓ snout length behind tip; lower jaw notably projecting in front of snout tip; dorsal surface of snout usually with traces

[14] *Aphthalmichthys gangeticus* Fowler, Proc. Acad. Nat. Sci. Philadelphia, 1912, p. 32, fig. 9 (Ganges River, India).

of low fleshy ridges, perhaps as a result of shrinkage in alcohol; eye very small, equal in diameter or a little larger than posterior nostril, its margin not free; anal and dorsal fin represented by a shallow groove or a very low membrane, their origin about 1½ head lengths behind a vertical line through anus; anal and dorsal membranes without rays, usually disappearing and beginning again about ⅘ head length in front of tip of caudal fin; both confluent with caudal fin, latter with fine fin rays; anus notably behind middle of length; distance from anus to tip of tail contained 3.1 to 3.9 times in total length; gill openings restricted to lower sides, isthmus a little narrower in width than length of snout; pectoral fin very small, almost vestigial, base extending about halfway down width of the gill opening; gill opening reaches to a point opposite upper basal edge of pectoral fin, distal edge of which broadly rounded; lateral line along middle of sides, canal ending a short distance in front of tip of tail; lips without

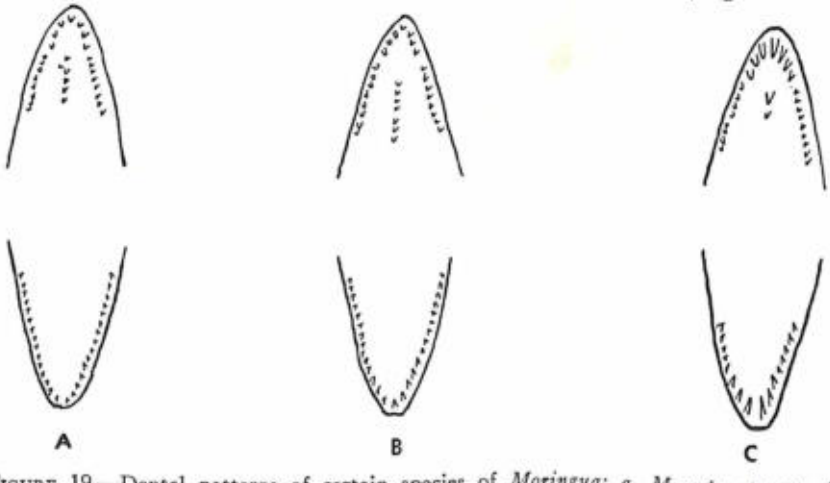

FIGURE 19.—Dental patterns of certain species of *Moringua: a, M. microchir* Bleeker (U.S.N.M. No. 52232), from Samoan Islands; *b, M. abbreviata* (Bleeker), from Guam; *c, M. javanica* (Kaup), from Bikini. (Sketches by author.)

papillae; teeth short, conical, pointing slightly backward, in a single row on vomer, maxillary, and dentary, those on premaxillaries arranged in an inverted U-shape.

Color in alcohol.—Plain brownish to brownish orange.

Color when alive.—Plain orange to brownish orange.

Ecology.—This worm eel burrows in loose sand and gravelly bottoms, where it is very numerous. It was taken in shallow tidal pools and ponds, and at depths to at least 20 feet; it probably occurs at much greater depths, but no thorough collecting was done below that depth.

Remarks.—This species has the smallest pectoral fin among those species of *Moringua* obtained in this area which have the lower jaw projecting, and the pectoral fin characteristically very broadly

rounded and scarcely as long as the diameter of the eye. The key gives the essential characters that separate *abbreviata* from the very closely related *macrocephala*, if indeed they are distinct.

MORINGUA JAVANICA (Kaup)

FIGURE 19, *c*

Aphthalmichthys javanicus KAUP, Catalogue of the apodal fish in the collection of the British Museum, p. 105, fig. 71, 1865 (type locality, Java).

SPECIMENS STUDIED

Bikini Atoll: Coral heads at east end of lagoon at depth of 20 to 25 feet, March 26, 1946, S–46–42, Brock and Schultz, 1 specimen, 850 mm. total length; Romuk Island, lagoon reef, May 14, 1946, S–46–128, Schultz, 1 specimen, 595 mm.; Amen Island, in lagoon at depth of 30 feet, August 4, 1946, S–46–307, Kohler, Herald, and Brock, 1 specimen, 235 mm.; Namu Island, lagoon reef, August 6, 1947, S–46–508, Schultz, Brock, and Hiatt, 1 specimen, 658 mm.

Eniwetok Atoll: Rujoru Island, lagoon reef, June 2, 1946, S–46–195, Schultz, 1 specimen, 505 mm.

Likiep Atoll: August 20–22, 1949, Univ. Washington, 2 specimens, 462 to 485 mm.

Description.—Body extremely elongate, wormlike, and cylindrical. Greatest depth 75 to 98; head 14.9 to 19.4; snout tip to anus 1.4; anus to anal origin 9.9 to 12; anus to tip of tail 3.4 to 3.8; end of lateral line to tip of tail 29 to 98; all in the total length. Greatest depth 4.6 to 5.8; length of snout 7.9 to 8.6; diameter of eye 38 to 68; length of pectoral fin 68 to 152; tip of snout to rictus 5.4 to 6.3; interorbital space 9.3 to 10.3; all in length of head to upper edge of gill opening. The above data based on precision measurements of 5 specimens. Other measurements, expressed in thousandths of the standard length, are given in table 8.

Posterior nostril opens in a pore just in front of very small eye, with a distinctly raised membranous rim, lower on posterior side; anterior nostril tubular, on side of snout near front; lower jaw notably projecting in front of snout tip; dorsal surface of snout with a shallow median groove, perhaps resulting from shrinkage in alcohol; eye much smaller than posterior nostril, margin of eye not free; anal and dorsal fins represented by shallow grooves, which contain vestigial membranes, their origins about 1½ to 2 head lengths behind a vertical line through anus; dorsal and anal fins reappear shortly in front of very short-rayed caudal fin and become confluent with it; anus notably behind middle of total length; distance from anus to tail tip contained 3.4 to 3.8 in total length; gill openings restricted to lower sides, isthmus not quite equal to snout length; pectoral fin very small, almost vestigial, smaller than eye; lateral line along middle of side, canal ending a short distance in front of tip of tail; lips without cirri; teeth short,

conical, in a single row on vomer, premaxillary, and dentary, in inverted U-shape on vomer.

Color in alcohol.—Plain brownish to brownish orange.

Color when alive.—Orange to brownish orange.

Ecology.—This uncommon eel burrows in loose sand and gravel.

Remarks.—This is the most elongate eel taken in the Marshall Islands, and by its slender wormlike body can be distinguished from its nearest relative, *M. abbreviata.* Also it has a more vestigial pectoral fin, and the rim around the posterior nostril is higher along the rear margin than in *abbreviata.*

MORINGUA MACROCEPHALA (Bleeker)

Aphthalmichthys macrocephalus BLEEKER, Nederl. Tijdschr. Dierk., vol. 1, p. 165, 1863 (type locality, Timor).

Moringua ferruginea BLISS, Trans. Soc. Roy. Arts Sci. Maurice, new ser., vol. 13, p. 57, 1883 (type locality, Mauritius; holotype, M.C.Z. No. 6156, examined by me.)

SPECIMENS STUDIED

Bikini Atoll: Reer Island, lagoon reef, August 12, 1946, S–46–332, Herald and Brock, 2 specimens 217 to 263 mm.; Boby Island, ocean reef, August 17, 1946, S–46–383, Herald, 1 specimen, 269 mm.; Tidal pond between Eman and Reer Islands, ocean reef, July 18, 1947, S–46–422, Brock, Hiatt, Schultz, and Myers, 10 specimens, 155 to 293 mm.; Enyu Island, ocean reef, channel entrance, August 1, 1947, S–46–483, Schultz, Brock, and Hiatt, 1 specimen, 230 mm.

Eniwetok Atoll: Teiteiripucchi Island, lagoon reef, June 1, 1946, S–46–197, Schultz, 1 specimen, 154 mm.

Description.—Body extremely elongate, wormlike, cylindrical. Greatest depth 44 to 57; head 12 to 15; snout tip to anus 1.4 to 1.5; anus to anal origin 13 to 19; anus to tip of tail 3.1 to 3.4; end of lateral line canal to tip of tail 10 to 18, all in total length. Greatest depth 3.4 to 4.3; length of snout 6.2 to 8.0; diameter of eye 20 to 38; length of pectoral fin 13 to 44; tip of snout to rictus 4.5 to 6; interorbital space 8.6 to 10.4; all in the length of head to upper edge of gill opening. The above proportions based on 9 specimens 154 to 293 mm. in total length. Other measurements, in thousandths of the standard length, are given in table 8.

Posterior nostril opens in a pore, just in front of eye, with a slightly raised rim; anterior nostril tubular, on side of snout near its front margin, about ⅓ snout length behind tip; lower jaw notably projecting in front of snout tip; dorsal surface of snout usually with traces of low fleshy ridges, perhaps from shrinkage in alcohol; eye very small, usually about twice size of rear nostril, its margin not free; anal and dorsal fins represented by a very low membrane beginning about a head length behind anus; these fins, with rays that are sometimes visible, disappear except as a groove and begin again near end of tail, where they become confluent with rayed caudal fin, the

latter very short and usually rounded; anus notably behind middle of length, distance from anus to tip of tail contained 3.1 to 3.4 in total length; gill openings restricted to lower sides, isthmus a little narrower than length of snout; pectoral fin very rounded, small, a little larger than, to two or three times diameter of eye, much shorter than snout; base of pectoral fin extending a little over halfway down gill opening; lateral line along middle of sides, canal ending a short distance in front of tip of tail; lips without cirri; teeth short, conical, in a single row on vomer, maxillary, and dentary, those on premaxillary in an inverted U-shape.

Color in alcohol.—Plain orange to reddish brown.

Color when alive.—Plain orange to brownish orange.

Ecology.—This rather uncommon eel burrows in loose sand and gravel, from which it was driven by the use of rotenone (see p. xv).

Remarks.—This species, scarcely distinguishable from *M. abbreviata*, has a slightly larger eye, a longer and more rounded pectoral fin, and dorsal and anal fins with a distinct membrane, and usually with slightly visible rays near their origins, whereas in *abbreviata* the dorsal and anal fins are represented by a shallow groove, with a fin membrane that is either vestigial or entirely lacking. It is highly probable that certain individuals of *abbreviata* cannot be separated with certainty from *macrocephala*.

With more specimens at hand it is now possible to correct my identification of Phoenix Island lots (U.S.N.M. Nos. 115902 and 115903), originally identified as *Moringua microchir* (U. S. Nat. Mus. Bull. 180, 1943), and to refer them to this species.

MORINGUA MACROCHIR Bleeker

Moringua macrochir Bleeker, Nat. Tijdschr. Nederl.-Indië, vol. 9, p. 71, 1855 (type locality, Batu); Atlas ichthyologique des Indes Orientales Néerlandaises . . ., vol. 4, p. 15, pl.147, fig. 4, 1864 (Batu).

Rataboura amphomelaena Fowler, Acad. Nat. Sci. Philadelphia, Monogr. 2, p. 190, fig. 25, 1938 (type locality, Christmas Island).

SPECIMENS STUDIED

Bikini Atoll: 3 stations, 7 specimens, 132 to 169 mm. total length.
Rongelap Atoll: 1 station, 1 specimen, 125 mm.
Kwajalein Atoll: 1 station, 1 specimen, 169 mm.
Guam: 4 lots, 6 specimens, 144 to 175 mm.

Description.—Body elongate, wormlike, cylindrical. Greatest depth 34 to 45; head 8.7 to 11; snout tip to anus 1.4 to 1.5; anus to anal origin 16 to 21; anus to tail tip 3.0 to 3.3; end of lateral line canal to tail tip 10 to 13; all in the total length. Greatest depth 3.8 to 4.5; length of snout 7.1 to 7.8; diameter of eye 11 to 16; length of pectoral 4.3 to 5.9; snout tip to rictus 5.1 to 6.1; interorbital space 7.4 to 9.3; all in length of head. Above proportions based on 6 specimens. Other

measurements, in thousandths of the standard length, are given in table 8.

Posterior nostril opens in a pore, just in front of eye, with a slightly raised rim; anterior nostril tubular, on side of snout near its front; lower jaw projecting a little in front of snout tip; eye small, at least 2 or 3 times larger than rear nostril; anal and dorsal fins represented by well-developed rayed membranes with rays somewhat visible, origins about ⅔ head length behind anus; both disappear, then begin again near tail, becoming confluent with small, rayed caudal fin; anus notably behind middle of length, distance from anus to tail tip 3.0 to 3.3 in total length; gill openings restricted to lower sides, isthmus a little narrower than length of snout; pectoral fin about twice or more longer than width across its base, and with 10 or 11 rays; pectoral fin as long as or longer than snout; base of pectoral fin behind gill opening, extending ventrally about two-thirds way down gill opening; lateral line along middle of side, canal ending a short distance in front of tail tip; lips without cirri; teeth short conical, in a single row on dentary and on maxillaries, but on the latter apparently only developed anteriorly; vomer usually without teeth, one tooth found on one specimen, premaxillary teeth in one row, arranged in an inverted U-shape.

Color in alcohol.—Dorsal half of body blackish or brownish, lower half white; caudal, dorsal, and anal fins blackish on tail, with outer tips and margins white.

Ecology.—This uncommon species came from loose sand and fine gravel.

Remarks.—This species has the longest pectoral fin of all the moringuid eels encountered in the Marshall and Marianas Islands. Important characteristics of the specimens studied are the large eyes, long pectoral fin, and, in some specimens, the tendency of the lower jaw to fit in between the sides of the upper lip under the orbit.

MORINGUA BICOLOR Kaup

Moringua bicolor KAUP, Catalogue of the apodal fish in the collection of the British Museum, p. 107, 1856 (type locality, Timor).—BLEEKER, Atlas ichthyologique des Indes Orientales Néerlandaises. . . , p. 15, pl. 147, fig. 1, 1864 (Timor).

SPECIMENS STUDIED

Bikini Atoll: 5 stations, 9 specimens, 146 to 320 mm. total length.
Eniwetok Atoll: 1 station, 11 specimens, 204 mm.
Rongelap Atoll: 2 stations, 2 specimens, 210 and 235 mm.
Likiep Atoll: Univ. Washington, 1 specimen, 244 mm.
Guam: 1 lot, 1 specimen, 248 mm.

Description.—Body elongate, wormlike, cylindrical. Greatest depth 43 to 63; head 12 to 15; snout tip to anus 1.4 to 1.5; anus to anal origin

1.2 to 1.7; end of lateral line canal to tail tip 10 to 32; all in total length. Greatest depth 3.7 to 4.5; length of snout 6.6 to 7.8; diameter of eye 13 to 18; length of pectoral fin 4.6 to 8.0; snout tip to rictus 5.0 to 5.5; interorbital space 7.3 to 9.8; all in length of head. (Above proportions based on 4 specimens.) Other measurements, expressed in thousandths of the total length, are given in table 8.

Posterior nostril opens in pore in front of eye, has slightly raised rim; anterior nostril tubular, near front of snout, on side; lower jaw projecting a little in front of snout; eye small, but twice or more size of rear nostril; margin of eye not free; anal and dorsal fins present, with rays, their origin about ¾ to 1 head length behind a vertical line through anus, both disappear then begin again near tail tip, becoming confluent with small, rayed caudal fin; anus far behind middle of length, distance from anus to tail tip 3.2 to 3.3 in total length; gill openings restricted to lower sides, isthmus a little narrower than length of snout; pectoral fin small, equal to or a little longer than snout; pectoral fin with about 9 to 12 rays, its base opposite and extending about ¾ of the way down gill opening; lateral line along middle of side, canal ending a short distance in front of tip of tail; lips without cirri; teeth conical, short, in a single row on maxillary, dentary, and vomer, teeth on vomer appear to vary in number from 2 to 7 or 8, those on premaxillary arranged in an inverted U-shape.

Color in alcohol.—Dorsal half of body brownish to blackish, lower half pale; end of tail blackish or fins blackish, with a white edge posteriorly.

Color when alive.—Back brownish or blackish.

Ecology.—This somewhat uncommon eel burrows in loose sand and gravel. It was seen at night swimming in a lagoon, and occasionally it was attracted to a light at night.

Remarks.—This species may be recognized by the moderate-sized pectorals, the larger eye, compared with other species, the elongate form in conjunction with the rayed dorsal and anal fins, and a blackish back that is in sharp contrast with the pale ventral part of the body.

MORINGUA LATEBROSA, new species

FIGURE 20, *a*

Holotype.—U.S.N.M. No. 76772, Kwandang, Celebes, October 1914, H. C. Raven, total length 200 mm.

Description.—Certain measurements on the holotype, expressed in thousandths of the total length, are recorded in table 9.

Body elongate, wormlike, cylindrical; greatest depth 38.5, head 8.1, snout to anus 1.6, anus to anal origin 20, anus to tip of tail 2.6, all in the total length. Depth 4.8, snout 8.5, eye 16.5, pectoral fin 15.5, snout tip to rictus 5.0, interorbital space 9.2, all in the head length.

Posterior nostril opens in a pore in front of eye, with raised rim, eye notably larger in diameter than pore; anterior nostril not tubular but with raised rim, about ⅓ snout length behind snout tip; eye moderately large, its posterior margin about opposite rictus of mouth; anal and dorsal fins rayed anteriorly, then becoming a low fold, expanding again into a rayed portion about a head length from tip of tail; median fins confluent with rayed caudal fin, which is truncate posteriorly; gill openings restricted to lower sides, width of isthmus a trifle narrower than snout length; pectoral fin moderately small, rays distinct under magnification, numbering about 11, its base extending nearly to lower edge of gill opening, the latter reaching dorsally to upper edge of pectoral fin base; lateral line present but not very distinct; lips without papillae; teeth short, conical, uniserial on maxillary, dentary and vomer, and in small patch on premaxillary; jaws nearly equal; caudal fin truncate.

Color in alcohol.—Plain light brownish.

Remarks.—Named *latebrosa* in reference to its hiding in the bottom materials.

MORINGUA PENNI, new species

FIGURE 20, *b*

Holotype.—U.S.N.M. No. 130660, Milne Bay, New Guinea, November 1943 to February 1944, Lt. G. H. Penn, total length 515 mm.

Paratype.—U.S.N.M. No. 52040, southern part of Negros Island, Philippine Islands, 1901, Bashford Dean, total length 284 mm.

Description.—Measurements on the types, expressed in thousandths of the total length, are recorded in table 9.

TABLE 9.—*Measurements made on certain species of* Moringua, *expressed in thousandths of the total length*

Characters	*linearis*	*raitaborua*				*penni*		*latebrosa*
	Bikini	Philippines				Philippines	New Guinea	Celebes
						Paratype	Holotype	Holotype
Total length in millimeters	187	310	310	302	174	284	515	200
Tip of snout to anus	719	662	674	692	638	665	640	610
Tip of snout to front edge of gill opening	72	117	123	120	125	113	97	124
Greatest depth	19	32	39	36	34	28	27	26
Length of snout	12	15	17	16	16	15	11	14
Diameter of eye	3	6	6	8	10	4	2	7
Length of pectoral	1	22	23	26	18	3	4	8
Snout to rictus	16	26	26	24	22	25	17	25
Anus to tip of tail	281	339	326	313	360	335	359	390
Anus to anal origin	51	14	38	18	18	23	17	50
Tip of tail to end of lateral line	77	----	----	----	----	32	----	63
Interorbital space	9	11	13	12	14	11	8	13
Width pectoral base	3	11	11	12	9	7	5	10
Width gill opening	6	11	11	13	12	5	4	6
Anus to dorsal origin	59	26	60	31	52	33	82	56

Body elongate, wormlike, cylindrical. Greatest depth 35 to 38; head 8.9 to 10.3; snout to anus 1.5 to 1.7; anus to anal origin 44 to 61; anus to tip of tail 2.8 to 3.0; all in total length. Depth 3.6 to 4.0; snout 7.4 to 8.6; eye 27 to 63; pectoral fin 25 to 36; snout tip to rictus 4.4 to 5.7; interorbital space 10.0 to 12.8; all in head length. Posterior nostril opens in a pore a little in front of eye, which is a little larger than pore; anterior nostril not tubular, with a low, raised rim, on side of snout a little less than ⅓ snout length behind snout tip; eye small, its posterior margin notably in front of corner of mouth; anal and dorsal fins anteriorly a membranous fold that becomes rayed about a head length in front of tip of tail; median fins confluent with rayed caudal fin; gill openings restricted to lower sides, width of isthmus equal to or a little greater than snout length; pectoral fin

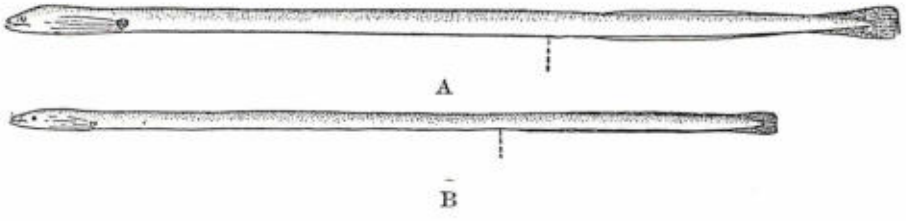

FIGURE 20.—*a*, Holotype of *Moringua latebrosa*, new species (U.S.N.M. No. 76772), from Kwandang, Celebes; *b*, Holotype of *M. penni*, new species (U.S.N.M. No. 130660), from Milne Bay, New Guinea. (Drawings by Aime M. Awl.)

small, with rays distinct under magnification and numbering about 10 to 12; pectoral fin base extends about halfway down gill opening, which ends dorsally opposite middle of base of pectoral fin; lateral line obsolete; lips without papillae; teeth short, conical, uniserial on maxillary and dentary, in a double row forward on vomer, but uniserial posteriorly; premaxillary teeth in a small patch; jaws equal, or nearly so; caudal fin rounded.

Color in alcohol.—Plain light brown, darker dorsally.

Remarks.—Named in honor of the collector, Lt. G. H. Penn, U. S. N.

MORINGUA LINEARIS Gray

Moringua linearis GRAY, Zool. Misc., 1831, p. 9 (type locality, India); The illustrations of Indian zoology . . . , Hardwicke, vol. 1, p. 95, fig. 3, 1830–32.
Moringua lumbricoidea RICHARDSON, The zoology of the voyage of H. M. S. *Sulphur* . . . , Ichthyology, p. 113, pl. 56, figs. 7–11, 1844 (no locality).

SPECIMEN STUDIED

Bikini Atoll: Bikini Island, June 28, 1946, Donaldson and Welander, 1 specimen, 187 mm. total length.

Description.—Certain measurements were made and these data are recorded in table 9 in thousandths of the total length.

Body elongate, wormlike, cylindrical. Greatest depth 53; head 13.7; snout to anus 1.4; anus to anal origin 5.3; anus to tip of tail 3.5; end of lateral line to tip of tail 13; all in the total length. Depth 3.9; snout 6.2; eye 27; pectoral membrane 68; snout tip to rictus 4.7; interorbital space 8.5; all in length of head to gill opening. Posterior nostril opens in pore with raised rim just in front of eye, anterior nostril tubular, on side of snout, about ⅓ snout length behind tip of snout; lower jaw notably shorter than upper; eye very small, about equal to diameter of posterior nostril; anal and dorsal fins a faint line anteriorly, becoming distinct about a head length in front of tip of tail; median fins rayed posteriorly, becoming confluent with caudal fin; gill openings restricted to the lower sides, width of isthmus about 1.1 in snout; pectoral fins vestigial, without rays; pectoral base opposite and extending about halfway down gill opening, upper end of latter opposite upper edge of pectoral fin base; lateral line along middle of sides; lips without papillae; teeth short, conical, somewhat hooked posteriorly, uniserial on maxillary, dentary, and vomer, and in a small patch on premaxillary; lower jaw notably shorter than upper.

Color in alcohol.—Plain light brownish.

Family MURAENIDAE: Moray Eels

By Leonard P. Schultz

This large and complicated family of eels is generally recognized to include those species that have a caudal fin, thought it may be rudimentary; gill openings restricted to a small porelike opening on the side of the body; the anterior nostrils tubular; the posterior nasal openings over the eye or somewhat in front of it; eyes mostly on the side of the head; the lower jaw as long as, or a little shorter than, the upper jaw, and bluntly rounded; dorsal and anal fins, though sometimes rudimentary, confluent with the very short caudal fin; the anus located near the middle of the total length, or sometimes a little in front of or behind it.

KEY TO THE GENERA OF MURAENIDAE FROM THE MARSHALL ISLANDS

1*a*. Tip of lower jaw with three fleshy, pointed prolongations; tip of snout ending in a fleshy, pointed projection; tubular anterior nostrils with a fanlike expansion ending in a pointed tip; dorsal origin about halfway between tip of snout and gill opening; anal well developed; tail pointed, snout to anus about 3, greatest depth 66 to 73, both in total length.

Rhinomuraena Garman (p. 99)

1*b*. Tip of lower jaw bluntly rounded, without fleshy elongations.

2*a*. Dorsal fin present, well developed, its origin over or a little in front of the gill opening.

3*a*. Some of the teeth molarlike or granular, usually, and at least on vomer; no canines---------- Echidna Forster (p. 100)

3*b*. Teeth not notably molarlike, even on vomer, although they may be short and conical; usually some caninelike teeth present.

4*a*. Anterior nostril tubular with a thickened, curled, bilobed projection or flap on posterior distal side of the low tube; notably very long canine teeth_____ Enchelynassa Kaup (p. 107)

4*b*. Anterior nostrils simple tubes without lobes or cirri. Teeth on maxillary and dentary with posterior edges finely serrate or not serrated. Gymnothorax Bloch (p. 108)

2*b*. Rayed dorsal fin origin more than one head length behind gill openings or reduced to rudiments at tip of tail (see p. 138 for key).

5*a*. A pair of pores or double posterior nasal openings over each eye; dorsal and anal fins absent except at tip of tail. Anarchias Jordan and Starks (p. 143)

5*b*. A single posterior nasal opening over each eye.

6*a*. Anal fin origin close behind anus; rayed dorsal fin origin more than a head length behind gill opening but in front of a vertical line through anus_____ Rabula Jordan and Davis (p. 147)

6*b*. Rayed dorsal and anal fins, if present, confined to end of tail. Uropterygius Rüppell (p. 151)

Genus RHINOMURAENA Garman

Rhinomuraena GARMAN, Bull. Essex Inst., vol. 20, p. 1, 1888. (Genotype, *Rhinomuraena quaesita* Garman.)

RHINOMURAENA QUAESITA Garman

Rhinomuraena quaesita GARMAN, Bull. Essex Inst., vol. 20, p. 1, 1888 (type locality, Ebon Island, Marshall group; holotype, M.C.Z. No. 9170).

Description.—Based on examination of holotype. Proportions in parentheses are my figures, others are from Garman's description. Greatest depth 66 (73), head 18 (19.5), snout to anus 3.0 (3.1), all in total length. The following measurements in mm. were made on March 5, 1951. Total length 840; greatest depth 11.5; snout (from base of barbel) to anus 265; snout to dorsal origin 21; head 43; eye 2.3; snout to rictus 14.6; snout 5.7; least width interorbital space 3.0; length anterior tubular nostril 6; length median nostril barbel 4.2.

Anterior nostrils at end of snout, tubular, each having appearance of being split on lower side for about half length, thus forming in front of tube a broad flap that terminates in an acute point; tip of snout ending in an acute flexible prolongation; at symphysis of lower jaw a sharp fleshy prolongation, similar to that on tip of snout, and at each side of it, another barbellike prolongation extending forward and downward; dorsal origin in front of gill openings about midway between tip of snout and gill opening. Teeth uniserial on vomer, maxillary and dentary; premaxillary teeth in three rows, those in middle row a little more enlarged than others.

Color in alcohol.—Black; median fins white.

Genus ECHIDNA Forster

Echidna Forster, Icones ineditae, p. 181, 1777. (Genotype, *Echidna variegata* Forster.)

Arndha Deraniyagala, Spolia Zeylanica, vol. 16, pt. 2, p. 131, 1931. (Genotype, *Gymnothorax zebra* Shaw.)

In this genus the dentition varies considerably with age. The vomer in the small eels may have only two rows of teeth, whereas in the largest specimens the rows increase to as many as seven, and the number of teeth in each also increases. The rows of maxillary teeth often decrease from two to one. The median row of premaxillary teeth may disappear in very large eels.

KEY TO THE SPECIES OF ECHIDNA FROM THE MARSHALL ISLANDS

1*a*. Anus notably behind middle of total length, anus to tip of caudal fin nearly two times in snout to anus; color pattern of black and white rings resembling markings of a zebra---------- Echidna zebra (Shaw)

1*b*. Anus near middle of total length or a little in front of it; color pattern not like that of a zebra.

2*a*. About 23 to 30 black or brownish rings, alternating with white rings, completely encircling body posteriorly; sometimes rings are apparent only posteriorly on tail, mostly on adults 10 inches long and larger; these dark rings more or less unite anteriorly, giving a somewhat mottled appearance; corner of mouth with blackish blotch, in front of which on both jaws usually a white area, sometimes part of white bar; posterior nostrils usually white based---------- Echidna polyzona (Richardson)

2*b*. No black-and-white rings encircling body.

3*a*. Two lengthwise rows of 24 to 30 starlike blotches, usually with pale centers, and more or less interconnected by broken or complete reticulated black lines or by a series of fine black specks or spots; upper row of blotches along back, lower row along lower part of side, each blotch more or less meeting ventrally one from opposite side; on small specimens black blotches usually lack white centers and have smooth unbroken edges; on largest specimens black blotches become more broken up by small white areas, and pale interspaces become more black speckled---------- Echidna nebulosa (Ahl)

3*b*. Color pattern not of dark, starlike blotches as above.

4*a*. Color brownish, with very fine reticulated pale lines in form of an irregular network; dorsal and anal fins as well as snout of same color as rest of body; dorsal fin origin in front of gill opening. Echidna delicatula [15] (Kaup)

4*b*. Color of body plain brownish or very light brown or tan; origin of dorsal nearly over gill opening or a little in front of it.

5*a*. Color plain dark brownish with edges of dorsal and anal fins white, sharply contrasting with brown color; snout white, lower jaw white with a brown blotch under eye, or in large specimens blotched with white and brown; corner of mouth dark brownish, with area in front white; mucus pores under eye white. Echidna leucotaenia Schultz

5*b*. Color plain light brown or plain straw color; no white area anywhere; a dark brown line around eye. Echidna unicolor, new species

[15] Not known by me from the northern Marshall Islands (see also Introduction).

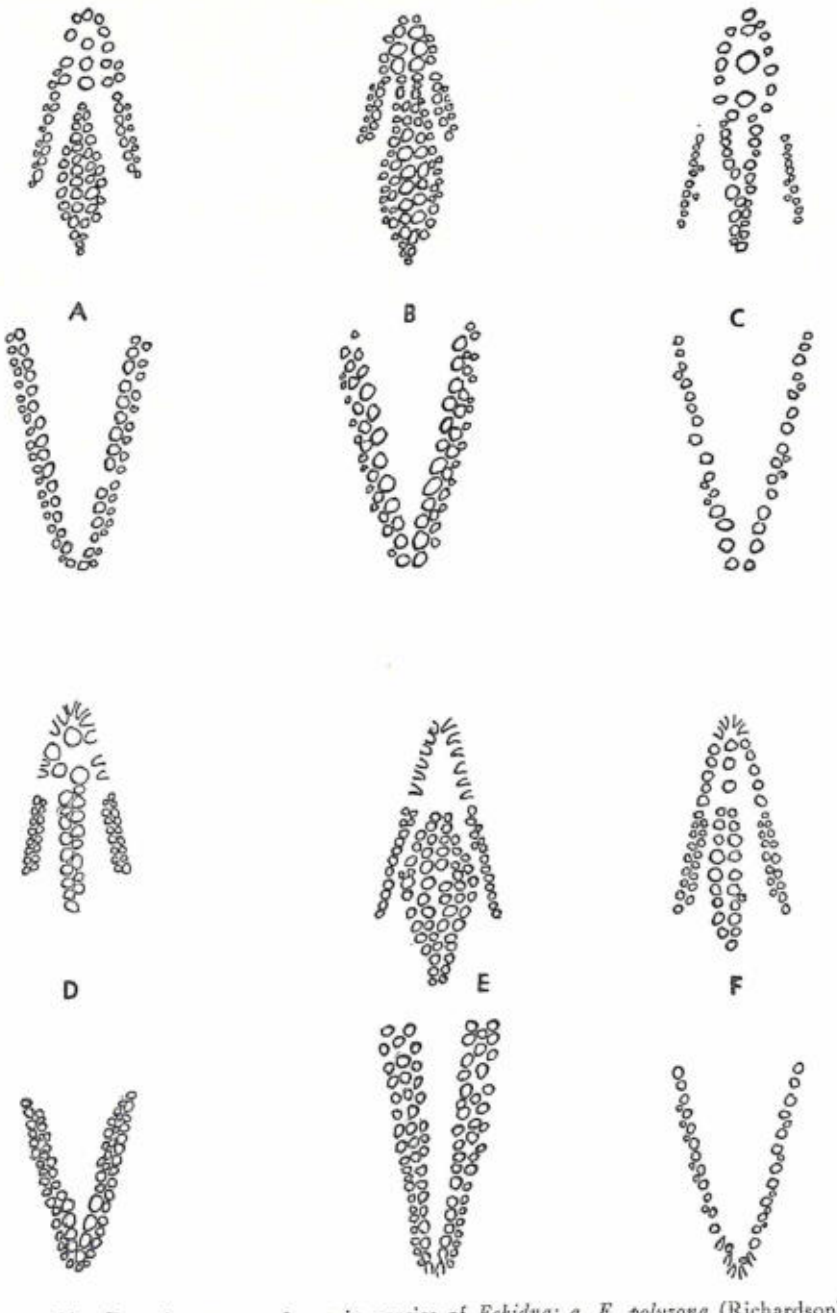

FIGURE 21.—Dental patterns of certain species of *Echidna: a, E. polyzona* (Richardson); *b, E. zebra* (Shaw); *c, E. nebulosa* (Ahl) (young); *d, E. unicolor*, new species; *e, E. leucotaenia* Schultz (total length, 530 mm.); *f, E. leucotaenia* Schultz (total length, 218 mm.). (Sketches by author.)

ECHIDNA ZEBRA (Shaw)

FIGURE 21, *b*; PLATE 6, C

Gymnothorax zebra SHAW, Nat. Misc., vol. 9, pl. 322, 1797.

SPECIMENS STUDIED

Bikini Atoll: 4 stations, 4 specimens, 395 to 645 mm. total length.
Rongerik Atoll: 1 station, 1 specimen, 635 mm.

Description.—Greatest depth 17 to 20; head 8.9 to 10.7; snout to anus 1.5; all in the total length. Greatest depth 1.6 to 1.9; eye 10.6 to 13; snout to rictus 2.8 to 3.1; snout 6.4 to 7.4; interorbital space 6.1 to 7.0; all in the length of head.

Dorsal fin origin not evident without dissection but probably beginning about over gill openings; anus about a third closer to tip of tail than to snout, notably behind middle of length; short anterior nostrils tubular, on each side of tip of snout; posterior nostrils tubular, located dorsally slightly above and in front of orbit; snout short and blunt; body compressed throughout its length; gill openings on middle of sides about on level of mouth; arrangement of molarlike teeth as illustrated in the figure.

Color in alcohol.—Body completely encircled by from 43 to 76 black bars separated by narrow white interspaces usually narrower than eye, many of these white interspaces incomplete (for this reason, only complete black rings were counted); anus in twenty-eighth to fifty-fifth black bar.

Color when alive.—Bars are black and pale interspace white.

Ecology.—This eel is rare in the shallow tidal zone of the reef but below that area it is not uncommon in crevices and among the corals.

Remarks.—*E. zebra* differs remarkably from all other eels of this genus in the northern Marshall Islands by reason of the zebralike color pattern and the location of the anus far posteriorly, near the beginning of the last third of the total length.

ECHIDNA POLYZONA (Richardson)

FIGURE 21, *a*

Muraena polyzona RICHARDSON, The zoology of the voyage of H. M. S. *Sulphur*, . . . Ichthyology, p. 112, pl. 55, figs. 11–14, 1844 (no locality given).

Echidna psalion JENKINS, Bull. U. S. Fish Comm., 1902, vol. 22, p. 431, fig. 12, 1903 (Honolulu, U.S.N.M. No. 50685, type).

Echidna obscura JENKINS, ibid., p. 430, fig. 11, 1903 (Honolulu, U.S.N.M. No. 50686 and 126011, types).

Echidna vincta JENKINS, ibid., p. 429, fig. 10, 1903 (Honolulu, U.S.N.M. No. 50687, type).

Echidna leihala JENKINS, ibid., p. 428, fig. 9, 1903 (Honolulu, U.S.N.M. No. 50844, type).

Echidna zonophaea JORDAN and EVERMANN, Bull. U. S. Fish Comm., 1902, vol. 22, p. 167, 1903 (Honolulu, U.S.N.M. Nos. 50621 and 125491, types).

Echidna zonata FOWLER, Proc. Acad. Nat. Sci. Philadelphia, 1900 p. 495, pl. 18, fig. 2 (type locality, Honolulu; A.N.S.P. No. 16484, holotype examined).

SPECIMENS STUDIED

Bikini Atoll: Reer Island, lagoon reef, August 12, 1946, S–46–332, Herald and Brock, 1 specimen, 162 mm.; Boby Island, ocean reef, August 17, 1946, S–46–383, Herald, 1 specimen, 52 mm. in total length; tidal pond between Eman and Reer Islands, ocean reef, July 18, 1947, S–46–422, Brock, Hiatt, Schultz, and Myers, 2 specimens, both 59 mm.

Eniwetok Atoll: Rigili Island, May 30, 1946, S–46–189, Schultz, 1 specimen, 370 mm.

Description.—Greatest depth 12.3 to 16; head 6.6 to 7.3; snout to anus 2.1, to dorsal origin 8.0 to 8.6; all in total length. Greatest depth 1.9 to 2.2; snout to dorsal origin 1.2 to 1.3; eye 8.6 to 9.2; snout to rictus 2.6 to 3.0; snout 5.5 to 6.6; interorbital space 9.1 to 9.3; all in length of head.

Dorsal fin origin on rear of head a little closer to gill opening than to rictus; anus just in front of middle of total length; anal fin origin close behind anus; anterior nostrils tubular, on each side of tip of snout, not quite long enough to reach opposite edge of upper lip; posterior nasal openings above dorsal level of eye behind a vertical line through front of eye, with raised, finely fringed rims; body compressed; gill openings on middle of sides, about on level of lower part of eye; arrangement of short blunt teeth as shown in the figure; rows of teeth on vomer increasing in number with larger sizes.

Color in alcohol.—About 23 to 30 brownish rings, separated by narrow white ones, completely encircle body behind anus; on adults 10 inches long, or larger, these rings may nearly vanish except on tail; body anteriorly brownish, with a somewhat mottled appearance; at corner of mouth a persistent dark spot, in front of which, on both upper and lower lips, is a white area; below eye a dark brown bar or blotch continuing on lips of lower jaw; posterior nasal openings white, anterior tubular nostrils with whitish bases; edge of both dorsal and anal fins white across the dark bars, except anteriorly; anus in eleventh to thirteenth black bar.

Ecology.—This reef-inhabiting species was extremely rare on the reefs of the northern Marshall Islands.

Remarks.—The intensity of the color pattern of this species varies greatly from one with distinct bars to one with only indistinct ones on the tail, and the anterior half of the body nearly plain in color. The number of rows of teeth varies with age, usually a greater number of teeth being found on large adults than on the small ones. Thus,

vomer varies from one or two rows on the 59-mm. specimen to five or more on large adults. The change in dentition may have influenced Jenkins, as well as Jordan and Everman, to describe an unusually large number of species from Honolulu.

ECHIDNA NEBULOSA (Ahl)

FIGURE 21, *c*; PLATE 6, B

Muraena nebulosa AHL, Specimen ichthyologicum de Muraena et Ophichtho (Thunberg), p. 7, pl., right fig., June 1789 (type locality, East India).

SPECIMENS STUDIED

Bikini Atoll: 4 stations, 12 specimens, 107 to 465 mm. total length.
Rongerik Atoll: 1 station, 1 specimen, 116 mm.
Rongelap Atoll: 1 station, 1 specimen, 319 mm.
Guam: 5 lots, 5 specimens, 190 to 318 mm.

Description.—Greatest depth 16.6 to 22; head 8.4 to 9.7; snout to anus 1.9 to 2.1; snout to dorsal origin 9.5 to 11.4; all in total length. Greatest depth 1.8 to 2.5; snout to dorsal origin 1.0 to 1.4; eye 9.2 to 14; snout to rictus 30 to 3.5; snout 6.3 to 6.9; interorbital space 7.9 to 10.8; all in length of head.

Dorsal fin origin usually over rear of head, a little in front of gill openings (on one specimen dorsal origin a head length behind gill opening); anus slightly in front of middle of total length; anal origin close behind anus; anterior nostrils tubular, each side of tip of snout, their length sufficient to reach just opposite edge of upper lip; posterior nostrils located a little dorsally and in front of orbit, with raised rims, body a little compressed throughout its length; gill openings near middle of side of head, about on level of rictus; arrangement of molarlike teeth as illustrated in the figure.

Color in alcohol.—Background color pale or whitish, with two lengthwise rows of about 24 to 30 starlike blotches with pale centers, these blotches more or less connected by broken or complete reticulated black lines, or by a series of fine black spots; upper row of blotches along the back, including dorsal fin, lower row along lower side, each blotch meets ventrally the one from the opposite side; both dorsal and anal fins have distal edges white, even extending across blackish blotches; in the young (100 mm. and shorter) black blotches have unbroken edges and lack white center; in large adults the pale interspaces become more and more finely speckled with black; anterior nostrils white.

Color when alive.—Dendritic blotches black, pale interspaces light brownish orange dorsally, becoming brighter toward tail, which is dull orange tipped; eye and anterior nasal tubes yellowish orange, pale centers of black blotches sometimes orange; ventrally pale interspaces are white.

Ecology.—This eel occurs commonly in the shallow reef area, where it inhabits crevices and coral heads.

Remarks.—It is easily recognized by its color pattern of dendritic black blotches with pale centers.

E. cocosa Garman, from Cocos Island, is very closely related to *E. nebulosa.* We have compared specimens from various parts of the tropical Pacific Ocean with the holotype of *cocosa* (M. C. Z. No. 28452) and find slight but persistent color differences in certain island groups. Those specimens from Cocos Island and Panama Bay are more solidly colored than those from the Phoenix Islands. The blackish bars meet more fully on the abdomen in specimens from the eastern Pacific, less so in those from Phoenix Island and still a little more broken in those from the Marshall Islands. We believe that subspecific designations would represent the variations observed but think this should not be done until a revision is made of the genus *Echidna.*

ECHIDNA LEUCOTAENIA Schultz

FIGURE 21, *e, f;* PLATE 12

Echidna leucotaenia SCHULTZ, U. S. Nat. Mus. Bull. 180, p. 22, pl. 3, 1943 (type locality, Phoenix and Samoa Islands).

SPECIMENS STUDIED

Bikini Atoll: 11 stations, 20 specimens, 123 to 530 mm. total length.
Eniwetok Atoll: 2 stations, 2 specimens, 121 to 384 mm.
Rongerik Atoll: 1 station, 1 specimen, 135 mm.
Rongelap Atoll: 2 stations, 5 specimens, 218 to 435 mm.
Kwajalein Atoll: 1 station, 2 specimens, 143 to 269 mm.
Guam: 1 lot, 1 specimen, 208 mm., Markley.
Saipan: 1 lot, 1 specimen, 38 mm.

Description.—Greatest depth 13 to 19; head 6.7 to 7.4; snout to anus 2.1 to 2.2, to dorsal origin 6.7 to 9.9; all in total length. Greatest depth 2.0 to 2.6; snout to dorsal origin 1.1 to 1.3; eye 8.1 to 10.5; snout to rictus 2.6 to 3.1; snout 5.3 to 6.3; interorbital space 8.8 to 8.9; all in length of head.

Dorsal fin origin on rear of head a little in front of gill opening; anus a little in front of middle of total length; anal origin close behind anus; anterior nostrils tubular, on each side of tip of snout, not long enough to extend to opposite edge of upper lip; posterior nostrils with slightly raised ciliated rims, located a trifle above level of dorsal edge of eye and slightly behind vertical line through front of eye; gill openings near middle of sides, slightly above level of mouth; body compressed, more so posteriorly; arrangement of teeth as shown in the figure; the lower jaw becomes progressively shorter in the largest specimens; jaws close.

Color in alcohol.—Plain brown with distal edges of median fins white; lower jaw white on young, becoming brownish and white blotched with age, the area around mucus pores always white; snout white in small ones, becoming brownish in large specimens; mucus pores white and posterior nostril white; area around mucus pores along upper jaw under eye white; sometimes anterior part of head and lower jaw white; corner of mouth dark brownish; area around gill opening slightly darkened in some specimens.

Ecology.—A common eel in the coral heads and in crevices of the shallow reef areas.

Remarks.—The dentition changes with age, the rows of teeth becoming more numerous; on the vomer the rows increase from 2 on the small ones to 5 or 6 rows on the largest specimens available.

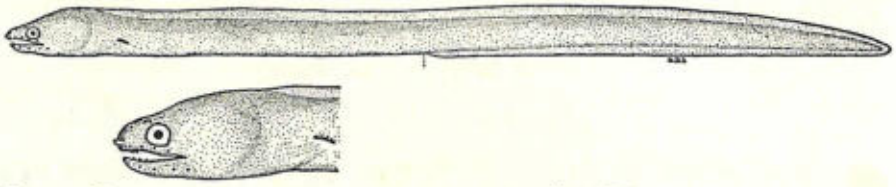

FIGURE 22.—Holotype of *Echidna unicolor*, new species (U.S.N.M. No. 141627), from Rongelap Atoll. (Drawing by Dorothea B. Schultz.)

ECHIDNA UNICOLOR, new species

FIGURES 21, *d*; 22

Holotype.—U.S.N.M. No. 141627, Rongelap Atoll, Eniaetok Island, lagoon reef, June 17, 1946, S–46–215, Schultz, 227 mm. total length.

Paratypes.—U.S.N.M. No. 141626, a specimen of 176 mm. total length, taken with holotype and bearing same data; U.S.N.M. No. 141625, Bikini Atoll, tidal pond between Eman and Reer Islands, ocean reef, July 18, 1947, S–46–422, Brock, Hiatt, Schultz, and Myers, 2 specimens, 125 and 135 mm.

Description.—Precision measurements were made on the holotype and paratypes. These data are expressed in thousandths of the total length respectively. Total lengths 227, 176, 135 and 125 mm.

Greatest depth 53; 57; 46; and 40. Snout to anus 467; 460; 385; and 376. Snout to dorsal fin origin 99; 80; 110; and 114. Length of head 120; 112; 106; and 104. Diameter of eye 15; 14; 11; and 15. Snout to rictus 40; 36; 38; and 37. Length of snout 17; 16; 19; and 21. Interorbital space 17; 16; 15; and 19.

Greatest depth 18 to 25; head 8.3 to 9.9; snout to anus 2.1 to 2.7, to dorsal origin 8.8 to 12.6; all in the total length. Greatest depth 2.0 to 2.6; snout to dorsal origin 1.0 to 1.4; eye 6.8 to 9.5; snout to

rictus 2.8 to 3.1; snout 5.0 to 7.2; interorbital space 5.4 to 7.2; all in the length of the head.

Dorsal fin origin nearly over gill openings; anus in front of middle of total length; anal origin close behind anus; anterior nostrils tubular, on each side of tip of snout, when depressed not long enough to reach to opposite edge of upper lip; posterior nasal openings with raised rims, slightly above dorsal edge of eye and about over front of pupil, notably behind a vertical line through front of eye; body compressed, more so posteriorly; gill openings on sides, about on level of lower part of eye; profile of head slightly concave over orbits; snout short, broad; lower jaw included, its width narrower than width of upper jaw; arrangement of short blunt teeth as shown in figure.

Color in alcohol.—Plain very light brownish or straw colored; a narrow dark brown line around eye. The mucus on the skin absorbed some of the copper ions from the copper tanks in which the specimens were preserved, giving two of them a somewhat greenish color.

Remarks.—This eel differs from all other species referred to the genus in being entirely plain tan or light brown, with a narrow dark brown line encircling the eye. The key to the species of *Echidna* separates *unicolor* from other species in the Marshall and Marianas Islands.

Genus ENCHELYNASSA Kaup

Enchelynassa KAUP, Arch. Naturg., vol. 21, p. 213, 1855. (Genotype, *Enchelynassa bleekeri* Kaup=*Muraena canina* Quoy and Gaimard.)

ENCHELYNASSA CANINA (Quoy and Gaimard)

FIGURE 10, *c;* PLATE 13, A

Muraena canina QUOY and GAIMARD, Voyage autour de monde . . . executé sur les corvettes de S. M. *L'Uranie* et *La Physicienne*, . . ., Poissons, p. 247, 1824 (type locality, Vaigiou and Rawak).

Gymnothorax vinolentus JORDAN and EVERMANN, Bull. U. S. Bur. Fish., 1902, vol. 22, p. 165, 1903 (Kailua, Hawaii; type, U.S.N.M. No. 50615).

SPECIMENS STUDIED

Bikini Atoll: 5 stations, 5 specimens, 162 to 780 mm. total length.
Eniwetok Atoll: 2 stations, 9 specimens, 181 to 660 mm.
Rongelap Atoll: 1 station, 2 specimens, 635 and 680 mm.
Kwajalein Atoll: 1 station, 1 specimen, 670 mm., Herald.

Description.—Greatest depth 12.4 to 17.0; head 7.4 to 8.1; snout to anus 2.0 to 2.1, to dorsal fin origin 7.1 to 10.1; all in total length. Greatest depth 1.7 to 2.2; snout to dorsal fin origin 1.0 to 1.3; eye 10 to 12; snout to rictus 2.0 to 2.4; snout 5.6 to 7.5; interorbital space 7.9 to 8.9; all in length of head.

Dorsal fin origin on rear of head, closer to gill opening than rictus of mouth; anus at middle or slightly in front of middle of total length;

anal fin origin close behind anus; anterior nostrils on side of snout tip, tubular, with a curled bilobed flap arising on posterior side of tube usually long enough to reach to opposite edge of upper lip, when depressed; posterior nasal opening just above and in front of dorsal and front edges of eye, rims notably elevated, with slightly fringed edges; body somewhat compressed, becoming robust with age; gill opening on middle of sides, a little above level of mouth; arrangement of teeth as shown in figure; teeth unusually long and caninelike, so long that the mouth cannot be closed; lower jaw curved dorsally at tip so that the toothed edge is a little concave.

Color in alcohol.—Dark brown to chocolate-brown; median fins posteriorly near tail white edged, this extending more anteriorly in small specimens; usually mucus pores under eye and on sides of lower jaw bordered by white; inside of mouth brownish; gill opening same color as body, not blackish. Median fins of 162-mm. specimen nearly white, underside of lower jaw white.

Ecology.—This voracious eel lives among the corals, in crevices of the surge channels, and along ledges. The larger ones occur in the deeper waters. Stomach contents indicate that they feed on fishes.

Remarks.—This eel may be recognized by the long canine teeth, the lower jaw that does not completely close, the plain brown color, and especially by the bilobed flap on the rear edge of the tubular anterior nostril. On the basis of my observations in the Phoenix Islands and those by Vernon Brock at Johnson Island, it would seem that *Enchelynassa canina* may reach a length in excess of 7 or 8 feet. (See Schultz, Nat. Hist., vol. 58, No. 1, pp. 42–43, 2 figs., 1948.)

Genus GYMNOTHORAX Bloch

Gymnothorax Bloch, Naturgeschichte der ausländischen Fische, vol. 9, p. 83, 1794. (Genotype, *Gymnothorax reticularis* Bloch as selected by International Commission Zoological Nomenclature, also restricted by Bleeker, Nederl. Tijdschr. Dierk., vol. 2, p. 121 (9), 1865. Bleeker (Nat. Verh. Holl. Maatsch. Wetensch., ser. 2, vol. 18, p. 130, 1863) did not designate any species as the type of *Gymnothorax* Bloch as indicated by Myers and Wade (Allan Hancock Pacific Exped., Univ. Southern California, vol. 9, p. 87, 1941).)

Lycodontis McClelland, Calcutta Journ. Nat. Hist., vol. 5, No. 18, pp. 173, 185, 1844. (Genotype, *Lycodontis literata* McClelland.) (Reference copied.)

Siderea Kaup, Übersicht der Aale, p. 59, 1856. (Genotype, *Muraena pfeifferi* Bleeker=*Muraena picta* Ahl.)

Neomuraena Girard, Proc. Acad. Nat. Sci. Philadelphia, vol. 10, p. 171, 1858. (Genotype, *Neomuraena nigromarginata* Girard.)

Priodonophis Kaup, Abh. Naturw. Verein Hamburg, vol. 4, 1859, p. 22, 1860. (Genotype, *Gymnothorax ocellatus* Agassiz.)

Both Isaac Ginsburg, of the U. S. Fish and Wildlife Service, and I have studied and compared a large number of the species of Moray

ells of the Atlantic, Pacific, and Indian Oceans, and we have concluded that there is so much variation in the fine serrations on the posterior edges of the maxillary and dentary teeth that the genera *Neomuraena* and *Priodonophis* cannot be recognized. Indeed, in certain species, i. e., *G. rupelli*, this character changes with age, the teeth becoming more serrated in large adults.

I have compared specimens of *G. reticularis* Bloch from Japan with specimens of *G. rupelli* from the Indo-Pacific and conclude that *reticularis* is distinct from *rupelli*.

KEY TO THE SPECIES OF GYMNOTHORAX FROM THE MARSHALL AND MARIANAS ISLANDS

1*a*. (See also 13*a*.) Teeth on dentary, with posterior edges minutely but distinctly serrate; color a uniform rich brown, darker posteriorly, no pale edges to fins---------- Gymnothorax moluccensis (Bleeker)

1*b*. Teeth on dentary, with posterior edges smooth or nearly so, not notably serrate.

2*a*. Premaxillary teeth with three inner rows in addition to outer row; these inner rows consist of enlarged fanglike teeth, especially the median row; anterior nostril tubular, without bilobed tip (as compared with *Enchelynassa canina*.)

3*a*. Background color black or dark brown, everywhere with numerous small white spots about size of pupil of eye; gill opening in a black blotch; tip of tail usually white; posterior nasal opening over front edge of eye or slightly in front of a vertical line through it.

Gymnothorax meleagris (Shaw and Nodder)

3*b*. Color pattern not of simple white spots on a dark background; gill opening not in a black blotch.

4*a*. Inner row of enlarged teeth on dentary extending along entire length, or nearly so, of toothed area; color brownish, without vertical bars or spots but with an indistinct or faded speckled appearance; posterior nasal openings oval in shape, becoming elongate in adults, with raised crenulated rims; posterior nasal opening a little in front of a vertical line through front of eye; mouth not completely closing; jaws very long and slender.

Gymnothorax bikiniensis, new species

4*b*. Inner row of enlarged teeth on dentary extending about ¼ to ⅓ length of toothed area from near symphysis; color gray to blackish, or various shades of brownish overlaid with narrow dendritic blackish bars most prominent on tail and especially extending obliquely on median fins; sometimes bars so much expanded that ground color is blackish and pale interspaces are very narrow lines; sometimes with black spots in more or less lengthwise rows; posterior nasal opening over front part of eye; mouth closes; jaws not notably long and slender---------- Gymnothorax buroensis (Bleeker)

2*b*. Premaxillary teeth with only a single inner, or median, row within the marginal series, or with median row lacking, especially on adults.

5*a*. Inner or median row of teeth, if present, not notably enlarged and never long and fanglike, about same size as marginal series; no fanglike teeth at symphysis of dentary; vomerine teeth usually biserial, often uniserial in young and halfgrown specimens.

6*a*. Gill opening in a black or dark brown blotch; background color plain light brown or tan, without any trace of light or dark spots; eye bordered by a narrow, dark brown line; teeth very short, blunt, somewhat approaching those found in the genus *Echidna;* numerous teeth in inner row of maxillary.

Gymnothorax melatremus, new species

6*b*. Gill opening not in a black or dark blotch.

7*a*. Color usually plain light brownish with indistinct mottlings of lighter color; margin of median fins white on small specimens, white more or less confined to tail on adults; snout and front half of lower jaw often white, shading into a darker colored middle third of head; snout white in young and more sharply contrasting than in adults; numerous teeth in inner row of maxillary.

Gymnothorax thyrsoideus (Richardson)

7*b*. Color pattern of a pale background with black lines or black specks or dark dendritic bars.

8*a*. Lower jaw and upper lip more or less barred; background color light brown or grayish, with numerous brownish bars interconnecting across paler background; these bars irregular and broken; abdomen finely mottled with brown and white or light gray. All dark spots without pale or white centers; inner row of teeth on maxillary few or lacking in adults.

Gymnothorax richardsoni (Bleeker)

8*b*. Lower jaw and upper lip with black specks or spots on a white background, not arranged to form bars; background color white, with head and body profusely covered with small black specks or spots, some of which usually have white centers; ventral region of abdomen in front of anus may be unspotted; small specimens, 100 mm. and shorter, may have solid black spots arranged in 4 to 6 regular to irregular rows, on specimens 150 to 200 mm. long these spots usually with pale centers; sometimes the black specks are expanded to form a mottled pattern; inner row of maxillary teeth lacking except in young.

Gymnothorax pictus (Ahl)

5*b*. Inner or median row of teeth on premaxillary notably enlarged, caninelike, or fanglike.

9*a*. Enlarged canines at intervals along entire toothed area of dentary; teeth on dentary more or less in a single row; posterior nasal opening oval to elongate, notably in advance of a vertical line through front of eye; jaws long and slender, not completely closing; snout long and slender; color plain brown, edges of median fins white.

Gymnothorax bayeri, new species

9*b*. Canine or fanglike teeth on dentary restricted to first fourth of the toothed area, next to symphysis.

10*a*. Definite rectangular black blotch extending about one eye diameter behind eye and forward so as to enclose eye in narrow black line; 4 or 5 mucus pores on lower jaw white, 2 or 3 on side of upper lip under eye also white; median fins white edged, broadly so posteriorly; no black blotch around gill opening; background color plain brown; posterior nasal openings white.

Gymnothorax monostigmus (Regan)

10*b*. No single black blotch just behind eye.

11*a*. Height of dorsal fin over anus more than ⅔ depth of body and higher than length of snout; body light brownish, mottled with pale specks on upper half of body and on high dorsal fin; ventral sides plain; head 7.1; depth 17.5; snout to anus 2.24; tail 1.8; all in total length. Head 3.17; depth 7.8; both in snout to anus. Snout 5.25; snout to rictus 2.4; depth 2.7; height of dorsal fin over anus 2.78; all in head.

Gymnothorax pseudothyrsoideus [16] (Bleeker)

11*b*. Height of dorsal fin over anus contained three or more times in depth of body at anus; dorsal fin height over anus shorter than or equal to length of snout.

12*a*. Coloration of head and body plain brown, no black spots, dark bars, black or white rings, or mottlings; gill opening not in a black spot.

13*a*. (See also 1*a*.) Posterior edges of teeth on maxillary and on dentary finely serrate; background coloration uniform rich brown, somewhat darker posteriorly; no pale edges to fins.

Gymnothorax moluccensis (Bleeker)

13*b*. Posterior edges of teeth not serrate.

14*a*. Median fins white edged.

15*a*. Cleft of mouth or snout to rictus 2 times in head; median teeth of premaxillary strongly fanglike; mouth does does not completely close.

Gymnothorax schismatorhynchus [17] (Bleeker)

15*b*. Cleft of mouth about 2⅔ in head; median teeth of premaxillary not notably fanglike; mouth closes.

Gymnothorax hepaticus (Rüppell)

14*b*. Median fins not white edged, brown throughout; snout to rictus about 2½ in head; median teeth of premaxillary fanglike, mouth not completely closing.

Gymnothorax monochrous Bleeker

12*b*. Color not plain brown.

16*a*. Gill opening in a black blotch, that may not appear until a length of 80 mm. is reached.

17*a*. Body with prominent black blotches, edges of which are even or unbroken, with pale or light brown interspaces; blotches arranged in about 3 irregular rows on each side, those on head fine, in large specimens numerous small black specks in pale interspaces; black spots on belly in front of anus; median fins not white edged, except that tip of caudal fin may be.

Gymnothorax javanicus (Bleeker)

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[16] Not known by me from this area (see also Introduction). Dental pattern shown in figure 23, *c*.

[17] *Muraena schismatorhynchus* Bleeker, Nat. Tidschr. Nederl.-Indië., vol. 4, p. 301, 1853 (type locality, Sumatra).

Gymnothorax schismatorhynchus Bleeker, Atlas Ichthyologique des Indes Orientales Néerlandaises . . . , pl. 184, fig. 1, 1864 (Sumatra; Java, Timor).

Rhinomuraena eritima Jordan and Seale, Bull. U. S. Bur. Fish., vol. 25 (1905), p. 196, fig. 6, 1906 (type locality; Pago Pago, Samoan Islands).

Not known by me from this area. It may be distinguished from *G. bayeri* and *G. bikiniensis* by the dentition of the lower jaw (see fig. 27, *b*). The inner row of caninelike teeth occur only near the tip and does not extend posteriorly beyond a third of the length of the toothed area; a vertical line through front of eye extends through the posterior nasal opening and not behind it.

17*b*. Ground color brown or blackish, everywhere finely mottled with light brown or whitish; sometimes coloration consists of very small, indistinct dark brown or blackish specks or white specks; the obscure lighter specks or mottling always visible anteriorly; black around gill opening not appearing before total length of 80 to 100 mm. is reached; margins of median fins white in alcohol, green or yellow-green in life.

Gymnothorax flavimarginatus (Rüppell)

16*b*. Gill opening not in a black spot, this region same color as adjoining area.

18*a*. A little behind eye 4 to 6 small black spots that may be more or less in rows or irregularly placed; background color pale to light brown, with black spots, about size of eye, arranged to form irregular black bars, especially distinct on fins; light interspaces of about same width as black bars; in general, pale coloration occupies larger area on body then do black spots; black spots on body more or less arranged in 3 rows; black bars on fins extend obliquely backward and outward; black spots nowhere white edged; front of snout and tip of lower jaw dark brown; no black spots on abdomen along ventral side in front of anus_____ Gymnothorax fimbriatus (Bennett)

18*b*. Area behind eye without small distinct black spots.

19*a*. From 16 to 22 black rings, separated by pale interspaces, encircle body, especially on tail or behind anus.

20*a*. Black rings completely encircle body, even under head and in front of anus; white interspaces in specimens over 200 mm. in total length may become brownish or mottled brown dorsally, paler ventrally, more or less obscuring black rings anteriorly; black rings extend to edges of fins.

Gymnothorax rupelli (McClelland)

20*b*. Black rings do not meet under head and in front of anus, or at least one or two black rings do not meet ventrally; black rings do not extend all the way to edge of fins posteriorly; fins white edged posteriorly_____ Gymnothorax petelli (Bleeker)

19*b*. Body not encircled with black and white rings.

21*a*. Lower jaw barred with white and light brown; dark brown band or blotch extending behind eye and gradually uniting with brown background color of body; this brown band bordered above and below by white; background color light brownish with darker brown spots on sides arranged in vertical bars, these bars continuing on fins as oblique dark brown or black oblong spots, bordered by white, and becoming more and more intensely brown or black posteriorly on tail.

Gymnothorax zonipectis Seale

21*b*. Lower jaw not barred with white and brown.

22*a*. Median dorsal edge of snout with white streak, becoming less prominent in adults.

23*a*. No series of brown blotches behind eye; body crossed with about 40 to 50 dendritic spots forming rather widely spaced narrow bars on a pale light brown background; lower jaw white; median fins edged with white; abdomen plain light brown; transverse dark brown bars or saddles characteristically more widely spaced anteriorly than posteriorly.

Gymnothorax gracilicaudus Jenkins

23*b*. Extending posteriorly from behind dorsal part of eye a series of 2 to 7 oblong dark brown or black blotches fading into general brown background color of body near gill opening; closeness of the dark brown bars gives appearance of light spots on a brown background; lower jaw pale or white ventrally; fins narrowly white edged, at least posteriorly; small young almost plain brown, except for white area on underside of head and white nasal streak.

Gymnothorax margaritophorus Bleeker

22*b*. No white streak on dorsal surface of snout or head; lower jaw not white but mucus pores on lower jaw and upper jaw are white; everywhere covered with large brown blotches separated by distinct, narrow white interspaces more or less interconnecting, these sometimes no more than white lines; on large adults white spaces become brown spotted; median fins white edged; brown blotches occur on median fins, extending obliquely backward and outward, more or less as narrow bars separated by white interspaces.

Gymnothorax undulatus (Lacepède)

GYMNOTHORAX MOLUCCENSIS (Bleeker)

FIGURE 10, *b*

Priodonophis moluccensis BLEEKER, Atlas ichthyologique des Indes Orientales Néerlandaises . . ., vol. 4, p. 108, pl. 187, fig. 1, 1864 (type locality, Amboina).

SPECIMENS STUDIED

Bikini Atoll: Arji Island, lagoon coral head, depth 20 to 40 feet, August 7, 1946, S–46–308, Brock and Herald, 5 specimens, 57 to 368 mm.

Description.—Greatest depth 16 to 19; head 6.4 to 7.3; snout to anus 2.3 to 2.4; snout to dorsal origin 8.1 to 9.9; all in total length. Greatest depth 2.5 to 2.6; snout to dorsal origin 1.3 to 1.5; eye 8.1

to 9.7; snout to rictus 2.6 to 2.8; snout 5.4 to 5.8; interorbital space 7.4 to 8.0; all in length of head.

Dorsal fin origin on rear of head a little in front of gill openings; anus notably in front of middle of length; anal fin origin close behind anus; anterior nostrils tubular, on each side of tip of snout, when depressed extend about to edge of upper lip; posterior nasal openings above level of dorsal edge of and about over front edge of eye, with slightly raised rims; body somewhat compressed; gill openings on middle of sides about on level of lower edge of eye; arrangement of teeth as shown in the figure, inner row of maxillary teeth disappearing on adults; vomerine teeth uniserial or biserial forward; mouth closes.

Color in alcohol.—Uniform rich brown, somewhat darker posteriorly; no pale edges to fins.

Ecology.—This rare species was taken only in water 20 to 40 feet in depth around coral heads.

Remarks.—This plain brown eel is best recognized by the finely serrated posterior edges of the maxillary and dentary teeth.

GYMNOTHORAX MELEAGRIS (Shaw and Nodder)

FIGURE 23, *a*; PLATE 14, A

Muraena meleagris SHAW and NODDER, Nat. Misc., vol. 7, p. A2, pl. 220, 1795 (type locality, "Southern Ocean").

Gymnothorax leucostictus JENKINS, Bull. U. S. Fish. Comm., 1902, vol. 22, p 425, fig. 5, 1903 (Honolulu, type U.S.N.M. No. 50681).

Gymnothorax meleagris HIYAMA, Report on the poisonous fishes of the South Seas, p. 22, pl. 1, fig. 2, 1943 (Marshalls).

SPECIMENS STUDIED

Bikini Atoll: 11 stations, 15 specimens, 102 to 620 mm. total length.
Rongerik Atoll: 5 stations, 8 specimens, 64 to 580 mm.
Eniwetok Atoll: 3 stations, 5 specimens, 185 to 550 mm.
Rongelap Atoll: 4 stations, 6 specimens, 102 to 570 mm.
Guam: 1 lot, 1 specimen, 174 mm.

Description.—Greatest depth 10.0 to 14.6; head 7.2 to 8.0; snout to anus 2.2 to 2.5; snout to dorsal origin 9.0 to 9.7; all in length of head. Greatest depth 1.4 to 1.8; snout to dorsal origin 1.2 to 1.4; eye 7.6 to 12.3; snout to rictus 2.3 to 2.7; snout 5.4 to 5.8; interorbital space 7.1 to 11.0; all in length of head.

A vertical line through dorsal origin about equidistant between gill opening and rictus; anus notably in front of middle of total length, anal origin close behind anus; anterior nostrils tubular, on each side of tip of snout, length not sufficient to extend to edge of upper lip when depressed; posterior nostrils located slightly above and in front of eye, with a distinctly raised rim; body a little compressed, especially in region of tail; gill openings on side, slightly above level of mouth; dentition as shown in figure.

Color in alcohol.—Background color black or dark brown, everywhere speckled with numerous small round spots about the size of pupil of eye; spots do not appear to increase in size with increase in size of specimen, but become more numerous; tip of tail usually white; inside of mouth white; area around gill opening black.

Color when alive.—Background color black, spots white; eye and tip of tail slightly tinged with orange.

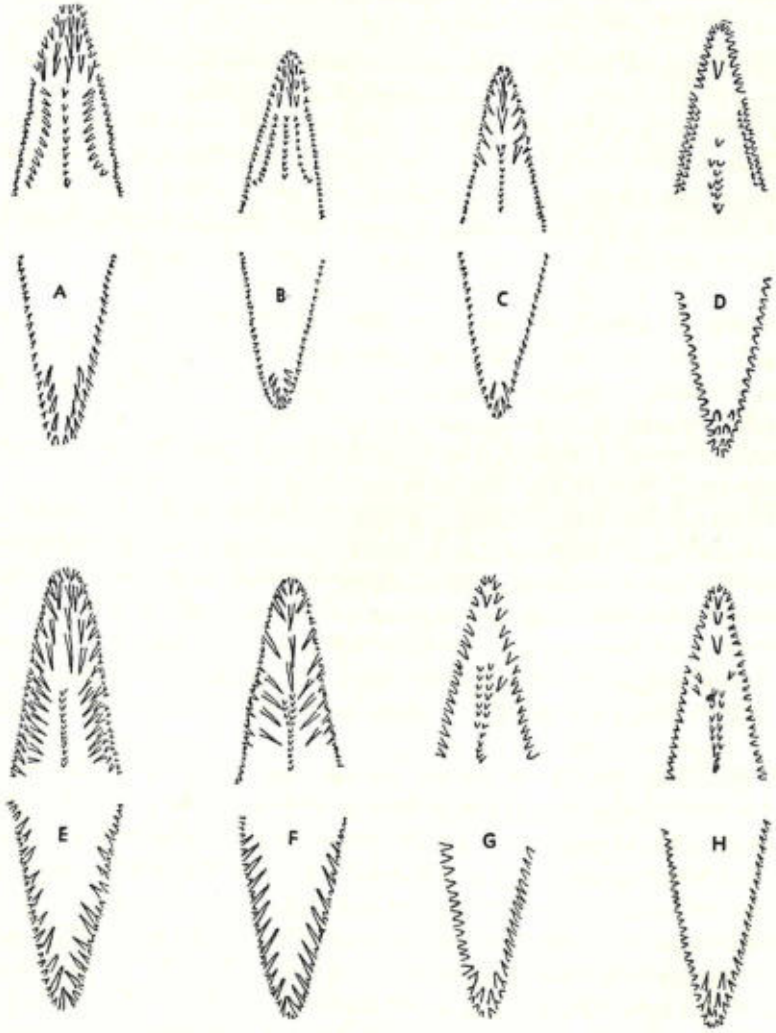

FIGURE 23.—Dental patterns of certain species of *Gymnothorax: a, G. meleagris* (Shaw and Nodder); *b, G. buroensis* (Bleeker); *c, G. pseudothyrsoideus* (Bleeker); *d, G. melatremus*, new species; *e, G. bikiniensis*, new species; *f, G. bayeri*, new species; *g, G. pictus* (Ahl); *h, G. richardsoni* (Bleeker). (Sketches by author.)

Ecology.—This reef-inhabiting species was not taken frequently in the shallow parts of the reef; it occurred more often among the corals and crevices below the low tidal zone, and the larger ones came from water more than 10 feet depth.

GYMNOTHORAX BIKINIENSIS, new species

FIGURES 23, *e*, 24

Gymnothorax schismatorhynchus (in part) SCHULTZ, U. S. Nat. Mus. Bull. 180, p. 41, 1943 (Rose Island).

Holotype.—U.S.N.M. No. 141575, Bikini Atoll, Cherry Island, April 18, 1946, S–46–98, Schultz, total length 555 mm.

Paratypes.—U.S.N.M. No. 141572, Bikini Atoll, Enyu Island, lagoon reef at channel entrance, March 16, 1946, S–46–8, Schultz, Brock, and Marr, 2 specimens, 215 and 303 mm. in total length; U.S.N.M. No. 141574, Bikini Atoll, Erik Island, ocean reef, March 19, 1946, S–46–9, Schultz and Brock, 1 specimen, 600 mm.; U.S.N.M. No. 141573, Bikini Atoll, Boro Island, ocean reef at channel, April 6, 1946, S–46–52, Schultz and Brock, 2 specimens, 318 and 570 mm.; U.S.N.M. No. 141576, Eniwetok Atoll, Mui Island, ocean reef, May 28, 1946, S–46–186, Schultz, 1 specimen, 303 mm.; U.S.N.M. No. 141571, Rongerik Atoll, Bock Island, April 24, 1946, S–46–113, Brock and Marr, 1 specimen, 113 mm.; U.S.N.M. No. 116054, Rose Island, Samoan group, ocean reef, June 11–14, 1939, Schultz, 1 specimen, 115 mm.

Description.—The following precision measurements, expressed in thousandths of the total length, are recorded first for the holotype, then for certain paratypes, respectively. Total length in mm. 555; 600; 570; 318; 303; 303; and 215 mm. Greatest depth 45; 58; 56; 41; 43; 43; 42. Snout to anus 432; 450; 435; 440; 436; 448; 442. Snout to dorsal origin 95; 111; 97; 112; 99; 106; 100. Length of head 101; 110; 100; 107; 104; 104; 107. Diameter of eye 11; 13; 11; 11; 13; 12; 11. Snout to rictus 50; 54; 47; 52; 51; 48; 46. Length of snout 21; 24; 19; 23; 21; 22; 20. Least interorbital space 9; 11; 9; 11; 11; 10; 8.

Greatest depth 17 to 24; head 9.1 to 10.9; snout to anus 2.2 to 2.3, to dorsal fin origin 9.0 to 10.5; all in total length. Greatest depth 1.8 to 2.6; snout to dorsal fin origin 0.96 to 1.1; eye 7.9 to 10.0; snout to rictus 2.0 to 2.3; snout 4.6 to 5.4; interorbital space 9.5 to 13.5; all in length of head. Length of posterior nasal opening 4.1 to 14; distance between vertical lines through front of eye and center of rear nasal opening 4.1 to 16; all in length of snout. Length of posterior nasal opening 0.5 to 1.4 in distance from latter to vertical line through front of eye.

Dorsal fin origin on rear of head, only slightly in front of, or over front of, gill openings; anus slightly in front of middle of total length, anal origin close behind anus; anterior nasal openings tubular, on each

side of tip of snout, without a modified tip, tubes just long enough to extend to edge of upper lip when depressed; posterior nasal openings oval, becoming more elongate in adults, with a slightly raised rim, edge of latter becoming fringed or crenulate in adults, rear edge a little in front of a vertical line through front of eye; pores around head with crenulate edges in adults; body somewhat compressed, robust in adults; gill opening near middle of side, slightly above level of mouth; arrangement of teeth as shown in the figure; teeth canine-like, so long that mouth cannot be completely closed; tips of both jaws curved toward each other, so that both toothed edges are a little concave, the lower jaw notably so.

Color in alcohol.—Light brown with a slightly speckled appearance; region of head behind eye to gill openings paler brown, lower jaw very

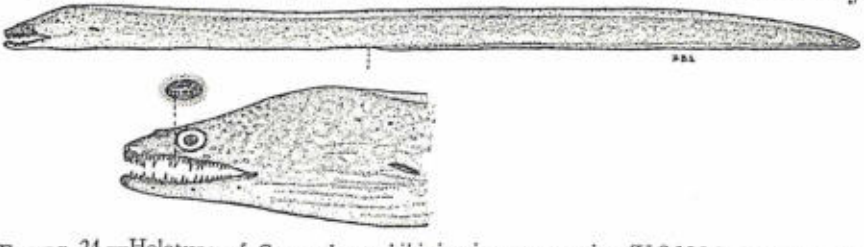

FIGURE 24.—Holotype of *Gymnothorax bikiniensis*, new species (U.S.N.M. No. 141575), from Bikini Atoll. (Drawing by Dorothea B. Schultz.)

light brown; edges of median fins very light brown posteriorly; anterior tubular nostrils and rim of posterior ones blackish; pores around upper jaw and on snout edged with dark brown or blackish; inside of mouth light brown; gill opening sometimes slightly dark brownish on edges; corner of mouth dark brownish.

Ecology.—This brownish eel, inhabiting crevices in the surge channels or coral growths, seemed to prefer the rugged, wave-swept ocean reefs.

Remarks.—*G. bikiniensis* may be recognized from all other moray eels of the Indo-Pacific region by its dental pattern, its plain brownish coloration, and the large, oval-shaped posterior nasal openings situated in front of the front margin of the eye. A species much like *G. bikiniensis* is *G. umbrosus* Poey from Cuba, but the latter differs in having the large canines of lower jaw confined to the front third of the toothed area as in *G. schismatorhynchus*. The nasal openings of *bikiniensis* and *umbrosus* are nearly identical. Another species closely related is *G. octavianus* Myers and Wade, from Colombia, Pacific coast; the type, of this species, U.S.N.M. No. 101801, has a total length of 294 mm., and its color, including the median fins, which are not white edged as in *bikiniensis*, is plain dark brown. *G. octavianus* and *G. bikiniensis* have identical dental patterns and might prove to be the

same species if a larger series were available for further comparisons.

Named *bikiniensis* in reference to Bikini Atoll.

GYMNOTHORAX BUROENSIS (Bleeker)

FIGURE 23, *b*

Muraena buroensis BLEEKER, Nat. Tidschr. Nederl.-Indië, vol. 13, p. 79, 1857; Atlas ichthyologique des Indes Orientales Néerlandaises . . ., vol. 4, p. 90, pl. 190, fig. 1, 1864 (type locality, Nova-Selma; Buro; Amboina; Ceram).

SPECIMENS STUDIED

Bikini Atoll: 29 stations, 278 specimens, 46 to 320 mm. total length.
Rongelap Atoll: 10 stations, 198 specimens, 52 to 287 mm.
Rongerik Atoll: 5 stations, 57 specimens, 50 to 280 mm.
Eniwetok Atoll: 6 stations, 58 specimens, 108 to 270 mm.
Likiep Atoll: Univ. Washington, 2 specimens, 162 and 180 mm.
Kwajalein: 1 station, 46 specimens, 61 to 326 mm.
Guam: 1 lot, 1 specimen, 90 mm.
(See under Remarks for additional specimens.)

Description.—Greatest depth 13 to 16.5; head 5.6 to 7.7; snout to anus 1.8 to 2.0, to dorsal origin 7.4 to 10.5; all in total length. Greatest depth 1.9 to 2.2; snout to dorsal origin 1.2 to 1.4; eye 6.1 to 9.2; snout to rictus 2.5 to 3.0; snout 5.6 to 6.8; interorbital space 6.7 to 9.2; all in length of head.

Dorsal fin origin on rear of head, about equidistant between rictus and gill opening; anus about midway between tip of snout and end of tail, anal origin close behind anus; anterior nostril tubular, on each side of tip of snout, when depressed about long enough to extend to edge of upper lip; posterior nasal openings a little above level of dorsal edge of, and opposite front edge of, eye, with slightly raised rims; body a little compressed; gill openings above mouth about on level of lower part of eye; arrangement of teeth as illustrated in the figure. Vomer consistently has a single row of teeth, even on largest specimens. Dorsal surface of snout flattish, slightly enlarged in front of eyes.

Color in alcohol.—Background color black, dark brownish, light brownish to grayish, with mottled or reticulated blackish spots forming narrow interconnected zigzaglike vertical bars, most prominent on posterior half of body. These bars separated by white interconnecting narrow streaks or lines. Background color sometimes so black or dark brown that dark markings cannot be seen except when specimen is held in front of a strong light.

In general there are four color phases with intermediate variations: (a) Blackish—specimens from about 46 mm. upward in length blackish with vertical bars scarcely distinguishable, on these ventral sides from anus forward plain brownish, rarely with some black spots; white margins of median fins posteriorly very distinct; (b) dark

brownish—very much like the black coloration except that head is brownish and eye is bordered by a blackish line slightly wider posteriorly; (c) Light brown—blackish or brownish vertical bars separated by white or pale interspaces, stand out clearly; distal edges of median fins are white posteriorly; region of head is light brownish; numerous specimens show black spots arranged in lengthwise streaks or rows, especially on the anterior half of body and head; some have black spots on abdominal region, whereas others are plain light brown; sometimes pores on head, especially on snout and around jaws, are ringed with a blackish line; nostrils dusky above, paler below; eye black lined; (d) grayish coloration—usually black spots and bars stand out clearly against the gray background; black spots tend to be in rows anteriorly.

Specimens from 46 to 65 mm. may be, and usually are, plain brown without any markings; on some specimens about 150 mm. and shorter underside of head below mouth whitish or very pale; inside of mouth white. Consistently, all pores on head are not margined with white or in any way whitish at any age. Gill openings are not blackish. One specimen from Eman Island reef at Bikini had a white head.

Ecology.—This was the most abundant species of eel on the reefs. It lived in crevices among the corals and in the algae.

Remarks.—Females and males 230 mm. and longer contained large eggs and mature testes, respectively. The females have more robust bodies than the males at maturity. This is a small species, probably spawning during late summer and probably not exceeding 400 mm. in total length.

We have examined a paratype of *Gymnothorax marquesensis* Seale, U.S.N.M. No. 109375, and must remove it from the synonymy of *G. buroensis* of earlier authors on the basis of its having two rows of teeth on the vomer.

The following three lots were separated from typical *buroensis* because they have more robust bodies and the area around the pores below the eye are white, otherwise these specimens agree in dentition and color pattern with *buroensis* as figured by Bleeker. (These might represent an undescribed species!)

Bikini Atoll: Bikini Island, ocean reef, July 16, 1946, S–46–253, Herald, 1 specimen, 191 mm. total length; lagoon reef halfway between Bikini and Amen Islands, July 21, 1947, S–46–442, Brock, Hiatt, and Schultz, 1 specimen, 316 mm.; Namu Island lagoon reef, August 6, 1947, S–46–508, Schultz, Brock and Hiatt, 3 specimens, 144 to 248 mm.

Gymnothorax ercodes, *G. buroensis*, *G. laysanus*, *G. marquesensis*, and *G. eurostus* have been referred to the synonymy of *G. meleagris* by various authors. However, after comparing the extensive series of

these eels we cannot agree that a single species could vary so much yet be so constant in characters as we have observed. The differences that seem to be important are summarized in table 10 on the basis of specimens from the Red Sea and the following island groups: Hawaiian, Phoenix, Samoan, Marshalls, Marianas, Philippines.

TABLE 10.—*Comparison of certain species of* Gymnothorax

Characters	*meleagris*	*eurostus, layzanus,* and *ercodes*	*buroensis*	*marquesensis*
Vomerine teeth	Uniserial.	Uniserial	Uniserial	Biserial.
Pores below eye surrounded by white.	Present	Present or absent	Rarely present	Absent.
Color pattern along sides of body.	Moderately large white spots on a black background at all ages; no bars.	Vertical narrow intercconnecting black or brown bars overlaid with tiny white spots more prominent on pale interspaces; body usually with black spots.	Vertical narrow interconnecting black or brown bars separated by pale interspaces; no tiny white spots; black spots on body.	Black more or less arranged in horizontal and vertical rows on a dark brown background; no white spots.
Color of inside of mouth.	White	Heavily pigmented	White or pigmented.	Heavily pigmented.
Color around gill opening.	Slightly blacker than body.	Same color as body	Same color as body.	Same color as body.
Color on under side of head and abdomen.	Spotted with white on black background.	Mottled with brown and white with black spots somewhat scattered.	Plain brown or gray rarely with black spots.	Plain dark brown with a few black spots.

GYMNOTHORAX MELATREMUS, new species

FIGURES 23, *d*; 25

Holotype.—U.S.N.M. No. 141610, Bikini Atoll, Boby Island, ocean reef, August 17, 1946, S–46–383, Herald, only known specimen, 176 mm. in total length.

Description.—The following precision measurements are recorded in thousands of the total length, 176 mm. Greatest depth 55; snout to anus 426; snout to dorsal fin origin 81; head to front edge of gill opening 107; diameter of eye 13; snout to rictus or corner of mouth 35; snout 18; interorbital space 14.

Greatest depth 18; head 9.4; snout to anus 2.3; snout to dorsal origin 12.3; all in the total length. Greatest depth 1.9; snout to dorsal origin 1.3; eye 8.5; snout to rictus 3.0; snout 6.1; interorbital space 7.8; all in length of head.

A vertical line through dorsal fin origin is equidistant between gill opening and rear of eye; anus a little in front of middle of total length, anal origin close behind anus; anterior nostrils tubular, on each side of tip of snout, when depressed extend slightly past edge of upper lip; posterior nasal openings, above level of dorsal edge of eye and over

front edge of pupil, notably behind front edge of eye; posterior nasal openings with the raised rims fringed, this fringe composed of tiny cirri; body scarcely compressed forward, more so posteriorly; gill opening on sides, about on level with lower edge of eye; arrangement of teeth as shown in the figure, teeth on vomer in about two rows.

Color in alcohol.—Plain light brown, with median fins white edged; gill openings surrounded by black or dark brown; eye bordered by a narrow, dark brown line.

Remarks.—This new species is characterized by its very light brown coloration and the gill opening surrounded by black, a color combination not yet described so far as we could find for any other species of

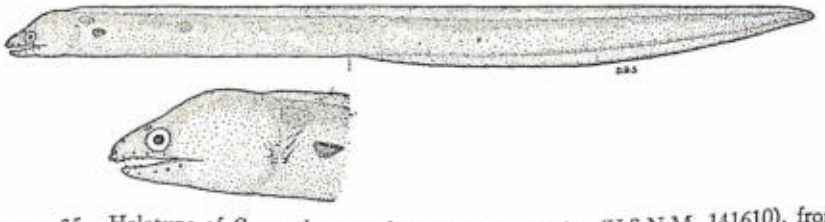

FIGURE 25.—Holotype of *Gymnothorax melatremus*, new species (U.S.N.M. 141610), from Bikini Atoll. (Drawing by Dorothea B. Schultz.)

Gymnothorax having very short conical teeth, none of which are fang-like. This eel, along with *Gymnothorax thyrsoideus*, approaches rather those eels usually placed in the genus *Echidna*, and it more or less bridges the gap between those two genera.

It is named *melatremus* in reference to the black blotch around the gill opening.

GYMNOTHORAX THYRSOIDEUS (Richardson)

FIGURE 10, *e*

Muraena thyrsoidea RICHARDSON, The zoology of the voyage of H. M. S. *Sulphur* . . . , Fishes, p. 111 (non pl. 49, fig. 1), 1844 (type locality, China Seas).

Gymnothorax prosopeion BLEEKER, Atlas ichthyologique des Indes Orientales Néerlandaises . . . , vol. 4, p. 88, pl. 183, fig. 3, 1864 (type locality, Cocos=Nova-Selma, Sumatra, Halmahera, Amboina, Timor).

Gymnothorax thyrsoideus HIYAMA, Report on the poisonous fishes of the South Seas, p. 25, pl. 2, fig. 6, 1943 (Marshalls).

SPECIMENS STUDIED

Bikini Atoll: Reer Island, lagoon reef, August 12, 1946, S–46–332, Herald and Brock, 1 specimen, 170 mm. total length.

Rongerik Atoll: Bock Island, ocean reef, April 24, 1946, S–46–113, Brock and Marr, 2 specimens, 117 and 140 mm.; Latoback Island, lagoon reef, June 28, 1946, S–46–238, Schultz and Herald, 1 specimen, 150 mm.

Guam: July 11, 1945, Markley, 1 specimen, 202 mm. total length.

Description.—Greatest depth 20 to 22; head 9.0 to 9.6; snout to anus 2.5; snout to dorsal origin 13.5 to 14.4; all in total length. Greatest

depth 2.1 to 2.5; snout to dorsal origin 1.5; eye 10.8 to 12.7; snout to rictus 3.1 to 3.8; snout 6.0 to 6.5; interorbital space 9.0 to 9.5; all in length of head.

Dorsal fin origin on rear of head, about equidistant between gill opening and rictus; anus notably in front of middle of total length; anal origin close behind anus; anterior nasal opening tubular, on each side of tip of snout, when depressed extend about to edge of upper lip; posterior nasal opening located notably above dorsal edge of eye, just behind a vertical line through front of eye, and with raised rims; body somewhat compressed; gill openings on sides, about on level with pupil; teeth short, conical, arranged as shown in the figure, those of middle row of premaxillary as short as those in the outside row; vomerine teeth usually biserial.

Color in alcohol.—Light brownish, finely mottled with darker brown and paler specks, or plain light brownish; snout and front half of lower jaw often white, shading into a darker colored middle third of head, or pale snout and jaw same color as rest of body; margins of median fins white on small specimens; snout of small specimens usually white, more sharply contrasting than that of larger ones.

Remarks.—Like *Echidna unicolor*, this species of eel, when preserved in the copper tanks, absorbed enough copper ions to cause the mucus to turn green.

GYMNOTHORAX RICHARDSONI (Bleeker)

FIGURE 23, *h*

Muraena richardsoni BLEEKER, Nat. Tijdschr. Nederl.- Indië, vol. 3, p. 296, 1852; Atlas ichthyologique des Indes Orientales Néerlandaises . . ., vol. 4, p. 100, pl. 186, fig. 2, 1864 (type locality, Bali, Sumatra, Borneo, Ternate, Goram, Timor).

SPECIMENS STUDIED

Guam: Oca Point, August 1945, Markley, 1 specimen, 237 mm. total length; Ulig Bay, July 24, 1945, Markley, 2 specimens, 240 to 300 mm.; Saupen Point, July 15, 1945, Markley, 1 specimen, 289 mm.; Tumon Bay, May 27, 1945, Gressitt, 1 specimen, 135 mm.

Description.—Greatest depth 13.0 to 14.4; head 6.4 to 7.2; snout to anus 1.9 to 2.1; snout to dorsal origin 6.1 to 9.3; all in total length. Greatest depth 1.9 to 2.1; snout to dorsal origin 1.0 to 1.3; eye 8.9 to 11.5; snout to rictus 2.9 to 3.3; snout 6.9 to 8.0; interorbital space 9.5 to 9.8; all in length of head.

Dorsal fin over, or a little in front of, gill opening; anus about in middle of total length, anal origin close behind anus; anterior nostrils tubular, on each side of tip of snout, long enough to extend a trifle past edge of lip when depressed; posterior nasal openings with distinctly raised rims or in a very low tube, located on level of dorsal edge of eye just behind a vertical line through front of eye and above

its front edge; body only slightly compressed forward, more so posteriorly; gill openings on sides, about on level of rictus; arrangement of teeth as illustrated in the figure; vomerine teeth usually in two rows or one irregular row; jaws close.

Color in alcohol.—Background color light brown or grayish, with numerous brownish bars interconnecting across paler background color, these bars irregular and broken; fins and lower jaw barred with brown and white, upper lip similarly barred; abdomen finely mottled with brown and white or light gray.

Remarks.—This eel may be recognized by its barred lower jaw and upper lips, numerous interconnecting dark bars on body, in combination with its biserial vomerine teeth.

GYMNOTHORAX PICTUS (Ahl)

FIGURE 23, *g;* PLATE 13, C

Muraena picta AHL, Specimen ichthyologicum de Muraena et Ophichtho, p. 8, 1789 (on Rüppell, type locality, East India).

Gymnothorax pictus HIYAMA, Report on the poisonous fishes of the South Seas, p. 24, pl. 2, fig. 5, 1943 (Marshalls).

SPECIMENS STUDIED

Bikini Atoll: 7 stations, 16 specimens, 103 to 650 mm. total length.
Eniwetok Atoll: 2 stations, 4 specimens, 470 to 740 mm.
Rongerik Atoll: 1 station, 1 specimen, 134 mm.
Rongelap Atoll: 2 stations, 3 specimens, 221 to 860 mm.
Kwajalein Atoll: 1 station, 1 specimen, 408 mm.
Guam: 2 lots, 2 specimens, 89 and 298 mm.

Description.—Greatest depth 10 to 20 (adults more robust); head 5.7 to 8.0; snout to anus 1.9 to 2.2; snout to dorsal origin 6.5 to 7.8; all in total length. Greatest depth 1.8 to 2.2; snout to dorsal origin 1.0 to 1.1; eye 9.8 to 14.0; snout to rictus 2.5 to 3.6; snout 5.5 to 7.6; interorbital space 7.7 to 10.0; all in length of head.

Dorsal origin over gill opening or nearly so; anus near middle of length of body, anal origin close behind anus; anterior nostrils tubular, on each side of tip of snout, length sufficient to extend to edge of lip when folded downward; posterior nostrils with slightly raised rims, on level of upper edge of orbit and over front of eye; body a little compressed; gill openings on middle of side of body about on level of rictus of mouth; dentition as shown in the figure.

Color in alcohol.—Background white, with head and body profusely covered with fine black specks or small broken black spots, except that ventral surface in front of anus may be white, or may have scattered black spots or specks, these usually evenly distributed and not arranged in bars or clear rows; in young specimens up to about 100 mm. total length, round black spots of same size as pupil arranged in 4 to 6 regular to irregular rows on side of body; in speci-

mens from 150 to 200 mm. these spots have pale centers; in those from about 200 to 300 mm. the blackish rings may become broken into small spots arranged more or less as a ring of irregular small spots, this change with age most irregular, the color patterns sometimes carrying over to greater sizes; another color phase shows these spots expanded to form a mottled pattern or with white dendritic specks between black spots but not arranged to form bars.

Color when alive.—Background color white, everywhere finely speckled with black except on belly, which may be white or slightly spotted.

Ecology.—This common eel lives in crevices of the reef and in coral heads. It is the one most frequently encountered at low tide cruising around on the reef out of water or nearly so, along the margin of the water at high tide, or in pools left at low tide. Often, while I was walking in the shallow water on the reef, *G. picta* would come toward my feet at considerable speed, circle them closely, apparently looking for a crevice in which to hide, then depart hastily. In my many such experiences it never attempted to bite. However, when I poked this moray with a dipnet handle while it was hiding in a crevice, the creature attacked the wooden handle, leaving on it deep imprints of its teeth.

GYMNOTHORAX BAYERI, new species

FIGURE 23, *f*; 26

Gymnothorax schismatorhynchus (in part) SCHULTZ, U. S. Nat. Mus. Bull. 180, p. 41, 1943 (Rose Island).

Holotype.—U.S.N.M. 141608, Rongelap Atoll, Kieschiechi Island, lagoon coral head, depth 20 feet, July 24, 1946, S–46–285, Brock and Herald, total length 398 mm.

Paratypes.—U.S.N.M. No. 141606, Bikini Atoll, Enyu Island, lagoon reef at channel entrance, March 16, 1946, S–46–8, Schultz, Brock, and Marr, 1 specimen, 310 mm.; U.S.N.M. No. 141604; Bikini Atoll, Erik Island, ocean reef, March 19, 1946, S–46–9, Schultz and Brock, 1 specimen, 225 mm.; U.S.N.M. No. 141605, Bikini Atoll, Amen Island, depth 20 to 30 feet, August 4, 1946, S–46–307, Herald, Kohler, and Brock, 1 specimen, 284 mm.; U.S.N.M. No. 141609, Bikini Atoll, Boby Island, ocean reef, August 17, 1946, S–46–383, Herald, 1 specimen, 159 mm.; U.S.N.M. No. 141607, Rongelap Atoll, taken with holotype and bearing same data, an adult female, swollen with eggs, 552 mm. total length; U.S.N.M. No. 116053, Rose Island, Samoan group, lagoon reef, June 12 to 20, 1939, Schultz, 1 specimen, 212 mm.; Bikini Atoll, Erik Island, July 13, 1948, Univ. Washington, 1 specimen, 355 mm.; Bikin Atoll, Bikini Island, July 29, 1946, Univ. Washington, 2 specimens, 350 and 358 mm.; Bikini Atoll, Eman Island, August 18, 1947, Univ. Washington, 1 specimen, 106 mm.

Description.—The following precision measurements, expressed in thousandths of the total length are recorded first for the holotype then for certain paratypes. Total length 398; 552; 310; 225 mm. Greatest depth 44; 76; 48; 37. Snout to anus 398; 417; 393; 410. Snout to dorsal origin 118; 122; 119; 111. Length of head 132; 146; 130; 128. Diameter of eye 11; 11; 10; 10. Snout to rictus 58; 60; 55; 53. Length of snout 30; 29; 28; 28. Least width interorbital space 10; 13; 10; 10. Greatest depth 12 to 27; head 6.9 to 7.8; snout to anus 2.4 to 2.5; to dorsal origin 8.2 to 9.0; all in total length. Greatest depth 1.9 to 3.4; snout to dorsal origin 1.1 to 1.2; eye 11.5 to 13.4; snout to rictus 2.3 to 2.4; snout 4.4 to 5.0; interorbital space 11.5 to 13.1; all in length of head. Length of posterior nasal opening 16 to 31; distance between vertical lines through front of eye and center of rear nasal opening 3.2 to 9; all in length of snout. Length of posterior nasal opening 3.3 to 5.4 in distance from latter to vertical line through front of eye.

Dorsal fin origin on rear of head, only slightly in front of a vertical line through front of gill opening; anus in front of middle of

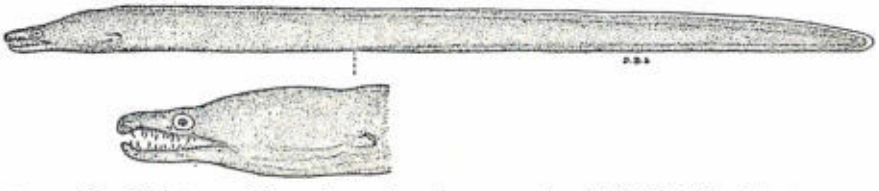

FIGURE 26.—Holotype of *Gymnothorax bayeri*, new species (U.S.N.M. No. 141608), from Rongelap Atoll. (Drawing by Dorothea B. Schultz.)

total length, anal origin close behind anus; anterior nostrils tubular, their tips not modified; posterior nasal openings oval, with slightly raised rims, notably in front of anterior margin of, and above level of, eye; pores under eye of large female with slightly crenulate edges; anterior nasal tube not quite long enough to reach to opposite edge of upper lip when depressed; body somewhat compressed, robust in adult female filled with eggs; gill opening near middle of side about on level of rear of mouth; arrangement of teeth as shown in the figure; teeth caninelike, some so long mouth scarcely closes; tips of both jaws curved toward each other, meeting only at tips; both toothed edges are a little concave, lower jaw notably so.

Color in alcohol.—Plain brownish; edges of dorsal, anal, and caudal fins white.

Color when alive.—Plain rich brown with distal edges of dorsal, anal, and caudal fins yellow; area over gills somewhat blotched.

Remarks.—This eel may be recognized by its plain brown coloration, its very long, slender jaws, and the location of the posterior nasal openings notably in advance of the front of the eye.

Species named in honor of Frederick M. Bayer, assistant curator, division of marine invertebrates, United States National Museum.

GYMNOTHORAX MONOSTIGMUS (Regan)

FIGURE 27, *c*

Muraena monostigma REGAN, Ann. Mag. Nat. Hist., ser. 8, vol. 4, p. 438, 1909 (type locality, Tahiti and Raiatea).—GÜNTHER, Journ. Mus. Godeffroy, vol. 9, pt. 17, p. 409, fig., 1910 (Tahiti and Raiatea; on types).

SPECIMENS STUDIED

Bikini Atoll: 5 stations, 14 specimens, 125 to 442 mm. total length.
Eniwetok Atoll: 1 station, 1 specimen, 212 mm.
Rongerik Atoll: 1 station, 3 specimens, 173 to 355 mm.

Description.—Greatest depth 16 to 20; head 8.2 to 9.0; snout to anus 2.0 to 2.3; snout to dorsal origin 7.9 to 9.1; all in total length. Greatest depth 1.9 to 2.4; snout to dorsal origin 0.96 to 1.0; eye 10 to 11; snout to rictus 2.8 to 3.4; snout 5.4 to 5.8; interorbital space 6.9 to 8.4; all in length of head.

Dorsal fin origin approximately over gill opening; anus near middle of total length or a little in front of it; anterior nasal opening tubular, on each side of tip of snout, when depressed extend only about halfway to edge of upper lip; posterior nasal opening with prominently raised rim, above dorsal edge of eye and over front edge of eye, or a trifle behind it; body only slightly compressed anteriorly, more so posteriorly; arrangement of teeth as shown in the figure; vomerine teeth in a single series; teeth on sides of lower jaw are very slightly serrate on rear edges.

Color in alcohol.—Plain brown, with a characteristic more or less rectangular black blotch extending about one eye diameter behind eye and forward so as to enclose eye in a narrow black line; 4 or 5 mucus pores on each side of lower jaw and 2 or 3 on side of upper lip under eye surrounded by white; posterior nasal opening white and in a small white blotch; median fins white edged, rather broadly so posteriorly, especially caudal fin; area around gill opening same color as rest of body; black blotch behind eye appears at a length of about 100 to 125 mm. total length.

Color when alive.—Plain dark brown with edges of median fins, especially caudal, reddish; area around mucus pores slightly pinkish; eye red; area behind eye black.

Ecology.—This eel seemed to prefer the more rugged conditions of the ocean reef, since all our specimens were collected there.

Remarks.—This species is easily recognized by its plain brown color, the black blotch just behind the eye, and the white spots surrounding the mucus pores under the eye and on the lower jaw.

GYMNOTHORAX HEPATICUS (Rüppell)

Muraena hepatica RÜPPELL, Atlas zu der Reise im nördlichen Afrika. Fische des Rothen Meers, p. 120, 1828 (type locality, Red Sea).

Gymnothorax albimarginata BLEEKER, Atlas ichthyologique des Indes Orientales Néerlandaises . . ., vol. 4, p. 107, pl. 187, fig. 2, pl. 184, fig. 3, 1864 (type locality, Amboina; Buro).

SPECIMEN STUDIED

Guam: Tumon Bay, Jan. 8, 1946, Gressitt and Ingram, 1 specimen, 90 mm. total length.

Description.—Greatest depth 23.7; head 7.0; snout to anus 2.1, to dorsal origin 10.0; all in total length. Greatest depth 3.4; snout to dorsal origin 1.4; eye 11.6; snout to rictus 2.7; snout 5.8; interorbital space 8.5; all in length of head.

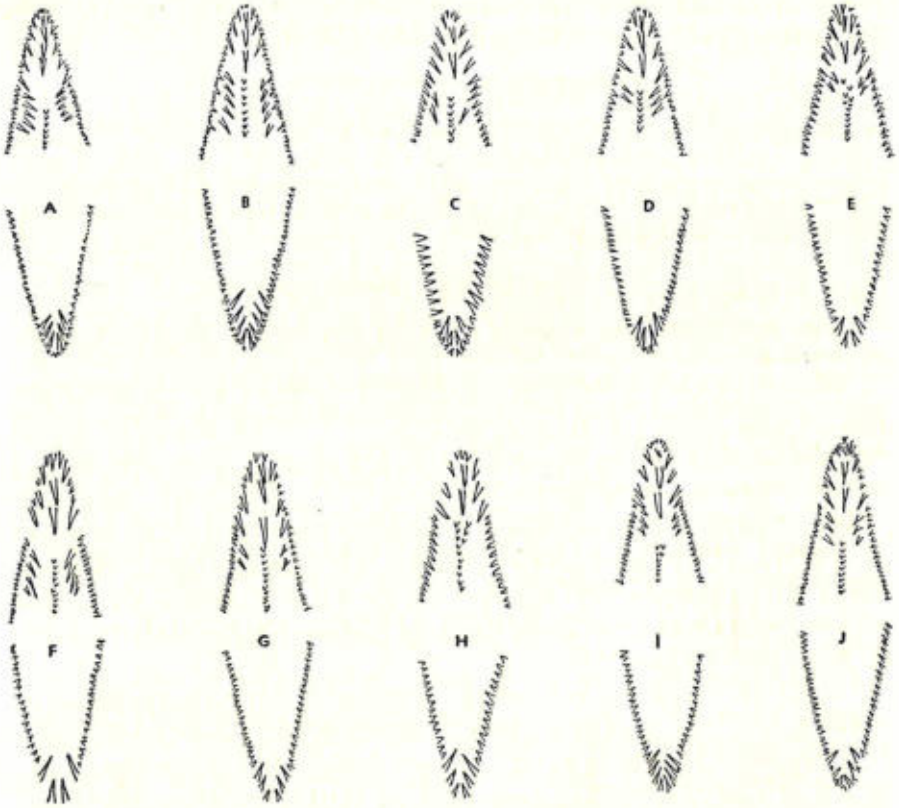

FIGURE 27.—Dental patterns of certain species of *Gymnothorax: a, G. monochrus* Bleeker; *b, G. schistmatorhynchus* (Bleeker) (drawn from holotype of *Rhinamuraena eritema* Jordan and Seale); *c, G. monostigmus* (Regan); *d, G. fimbriatus* (Bennett); *e, G. flavimarginatus* (Rüppell); *f, G. margaritophorus* Bleeker; *g, G. undulatus* (Lacepède); *h, G. javanicus* (Bleeker); *i, G. gracilicaudus* Jenkins; *j, G. zonipectis* Seale. (Sketches by author.)

Dorsal fin origin on rear of head, notably closer to gill opening than to rictus of mouth; anus slightly in front of middle of total length, anal fin origin close behind anus; anterior nasal openings tubular, on each side of tip of snout, when depressed extend to opposite edge of upper lip; posterior nasal openings above dorsal edge of eye, just behind a vertical line through front of eye, and with slightly raised rims; body compressed, more so posteriorly; gill openings on sides about on level with lower edge of eye; teeth on premaxillary in 3 rows, a median one of somewhat enlarged canines and irregular outer ones of smaller conical teeth; maxillary teeth in two rows, a short inner row of 3 to 5 caninelike teeth and an outer row of smaller conical teeth; vomerine teeth uniserial; teeth on dentary biserial near symphysis, the inner row of somewhat enlarged canines.

Color in alcohol.—Plain dark brown with median fins white or pale.

Remarks.—This small eel is identified with considerable uncertainty, but appears to be nearest those figured by Bleeker.

GYMNOTHORAX MONOCHROUS Bleeker

FIGURE 27, *a*

Gymnothorax monochrous BLEEKER, Atlas ichthyologique des Indes Orientales Néerlandaises . . ., vol. 4, p. 106, pl. 191, fig. 2, 1864 (type locality, Singapura; Sumatra; Ternata; Amboina).

SPECIMENS STUDIED

Bikini Atoll: Arji Island, depth 20 to 40 feet, August 7, 1946, S-46-30S, Herald and Brock, 1 specimen, 58 mm. total length (this specimen is referred to this species with much uncertainty); Ion Island, August 7, 1946, Univ. Washington, 2 specimens, 198 and 200 mm.; Bikini-Amen reef, depth 30 feet, July 31 1947, Univ. Washington, 1 specimen, 287 mm.

Rongelap Atoll: Kabelle Island, lagoon reef, June 20, 1946, S-46-231, Schultz and Herald, 1 specimen, 198 mm.

Description.—Greatest depth 17 to 20.4; head 6.7 to 7.9; snout to anus 2.3 to 2.4, to dorsal origin 8.3 to 9.9; all in total length. Greatest depth 2.2 to 2.6; snout to dorsal origin 1.3 to 1.4; eye 8.7 to 10; snout to rictus 2.4 to 2.6; snout 5.0 to 6.6; interorbital space 8.0 to 10.4; all in length of head.

Dorsal fin origin on rear of head, about equidistant between gill opening and rictus; anus notably in front of middle of total length; anal origin close behind anus; anterior nostrils tubular, on each side of tip of snout, extending past edge of upper lip when depressed; posterior nasal opening just above dorsal edge of eye and just behind a vertical line through front edge of eye, with slightly raised rims; body somewhat compressed, more so posteriorly; gill openings on sides, about on level of lower part of eye; arrangement of teeth as illustrated in figure; mouth not completely closing.

Color in alcohol.—Plain brown, including median fins, but posteriorly becoming blackish brown; no white edge on median fins; middorsal line of head slightly pale or whitish in smallest specimens, plain brown on largest specimen; corner of mouth slightly dusky.

GYMNOTHORAX JAVANICUS (Bleeker)

FIGURE 27, *h;* PLATE 11, A

Muraena javanicus BLEEKER, Nat. Tijdschr. Nederl. Indië, vol. 19, p. 347, 1859 (type locality, Java).

Gymnothorax javanicus BLEEKER, Atlas ichthyologique des Indes Orientales Néerlandaises . . . , vol. 4, p. 95, pl. 179, fig. 2, 1864 (Java).

Gymnothorax flavimarginatus HIYAMA, Report on the poisonous fishes of the South Seas, p. 20, pl. 1, fig. 1, 1943 (Marshalls).

SPECIMENS STUDIED

Bikini Atoll: 4 stations, 4 specimens, 438 to 590 mm. total length; Univ. Washington, 2 specimens, 150 and 190 mm.

Rongerik Atoll: 2 stations, 2 specimens, 317 and 470 mm.

Description.—Greatest depth 14 to 16; head 7.5 to 7.8; snout to anus 2.1 to 2.2, to dorsal origin 8.9 to 10.0; all in total length. Greatest depth 1.8 to 2.2; snout to dorsal origin 1.1 to 1.3; eye 9.3 to 12; snout to rictus 2.6 to 2.7; snout 5.6 to 6.1, interorbital space 7.5 to 8.3; all in length of head.

Dorsal fin origin on rear of head about equidistant between rictus and gill opening; anus slightly in front of middle of total length; anal fin origin close behind anus; anterior nostrils tubular, not long enough when depressed, to extend to opposite edge of upper lip; posterior nasal openings notably above dorsal edge of eye and over front edge of eye, with notably raised rims; body compressed; gill openings on sides about on level with lower part of eye, above level of mouth; arrangement of teeth as shown in the figure; anterior part of vomerine teeth usually in two rows forming a Y-shaped pattern; jaws moderately long and slender, the toothed edge of dentary very slightly concave.

Color in alcohol.—Background color light brown, with black blotches and spots separated by paler brown interspaces slightly narrower than blotches; spots on the body may be roundish or quadrate and arranged in two or three somewhat irregular lengthwise rows; gill opening bordered by black; corner of mouth usually blackish; edges of median fins not white, except posterior edge of caudal fin; inside of mouth brownish. A 150-mm. specimen has the belly black spotted and area around gill openings only a little dusky.

Color when alive.—Dark bloches are black and background color light reddish brown; eye pinkish.

Ecology.—This species was seldom taken on the reefs. In the stomachs of specimens were found fishes recently swallowed, probably those affected by the rotenone used for collection purposes.

Remarks.—This eel is easily recognizable by its gill opening bordered with black, and about three irregular rows of black blotches on a light brownish background.

GYMNOTHORAX FLAVIMARGINATUS (Rüppell)

FIGURE 27, *e*

Muraena flavimarginata RÜPPELL, Atlas zu der Reise im nördlichen Afrika. Fische des Rothen Meers, p. 119, pl. 30, fig. 3, 1828 (type locality, Red Sea).

SPECIMENS STUDIED

Bikini Atoll: 12 stations, 41 specimens, 99 to 635 mm. total length.
Rongelap Atoll: 3 stations, 4 specimens, 140 to 295 mm.
Eniwetok Atoll: 2 stations, 4 specimens, 132 to 219 mm.
Rongerik Atoll: 3 stations, 26 specimens, 69 to 465 mm.
Kwajalein Atoll: 1 station, 2 specimens, 245 and 525 mm.
Guam: 3 lots, 7 specimens, 155 to 467 mm.

Description.—Greatest depth 11 to 18.3; head 6.4 to 9.7; snout to anus 2.1 to 2.3; snout to dorsal origin 8.8 to 11.4; all in total length. Greatest depth 1.6 to 2.0; snout to dorsal origin 1.0 to 1.3; eye 7.7 to 12.4; snout to rictus 2.1 to 2.6; snout 5.0 to 5.8; interorbital space 6.8 to 7.9; all in length of head.

Dorsal fin origin on rear of head, notably closer to gill opening than to rictus of mouth; anus a little in front of middle of total length, anal origin close behind anus; anterior nostrils tubular, on each side of tip of snout, not quite long enough to extend to opposite edge of upper lip when depressed; posterior nasal opening above dorsal edge of eye and slightly behind a vertical line through front edge of eye, with slightly raised rims; body a little compressed; gill openings near middle of side a little above level of rictus; arrangement of teeth as shown in the figure; vomerine teeth in one or two rows or one irregular row.

Color in alcohol.—General color brown or blackish, everywhere mottled with light brown or whitish; sometimes the coloration appears to consist of more or less poorly defined mottlings or small spots of dark brown or blackish with whitish or light brown specks; an important characteristic of the coloration is the lighter areas, obscure but always visible anteriorly; gill opening margined with blackish, this black blotch not appearing until a total length of about 80 to 100 mm. is reached; in the black color phase the black gill opening is not easily distinguished, but there are traces of the lighter mottlings; margin of median fins white.

Color when alive.—Edges of dorsal and anal fins green or yellowish green, edge of caudal fin yellowish; eye reddish.

Ecology.—G. flavimarginatus occurs commonly in the crevices of the reef and in coral heads in the shallower parts of the reef, as well as in deeper water.

Remarks.—This species is easily recognized by its brown or black coloration with obscure small light brown or whitish markings, and by its black blotch around the gill opening. *Muraena viridipinna* Seale, M.C.Z. No. 6146, from Mauritius, was studied. It is probably a synonym of this species.

GYMNOTHORAX FIMBRIATUS (Bennett)

FIGURE 27, *d*; PLATE 13, B

Muraena fimbriata BENNETT, Proc. Zool. Soc. London, 1831, pt. 1, p. 168 (type locality, Mauritius).

Gymnothorax favigineus var. *isingteenus* HIYAMA, Report on the poisonous fishes of the South Seas, p. 24, pl. 2, fig. 4, 1943 (Marshalls).

SPECIMENS STUDIED

Bikini Atoll: 8 stations, 24 specimens, 132 to 402 mm. total length.
Rongelap Atoll: 1 station, 1 specimen, 178 mm.
Rongerik Atoll: 1 station, 1 specimen, 163 mm.
Guam: 2 lots, 6 specimens, 88 to 373 mm.

Description.—Greatest depth 15.2 to 18.2; head 6.8 to 7.4; snout to anus 2.0 to 2.2; snout to dorsal origin 8.3 to 10.0; all in total length. Greatest depth 2.2 to 2.7; snout to dorsal origin 1.2 to 1.4; eye 7.8 to 8.9; snout to rictus 2.4 to 2.6; snout 5.1 to 5.9; interorbital space 9.1 to 10.2; all in length of head.

Dorsal fin origin in rear of head and a little in front of a vertical line through gill opening; anus slightly in front of middle of total length, anal fin origin close behind anus; anterior nostrils tubular, on each side of tip of snout, sufficiently long to extend to opposite edge of upper lip when depressed; posterior nostrils with slightly raised rim, a trifle above level of dorsal edge of eye and slightly behind a vertical line through front edge of eye; body a little compressed, more so posteriorly; gill openings on sides, about on level of pupil; arrangement of teeth as shown in the figure; vomerine teeth uniserial; jaws moderately long, slender, lower jaw curved upward at tip, but the two jaws fit together fairly well.

Color in alcohol.—Background color pale to light brownish, with black spots or blotches about size of eye arranged to form somewhat irregular black bars, black spots about as wide as the light brown interspace, and occurring in three lengthwise rows, one along middle of side, one along lower side and near base of anal fin, and one along upper back, the back especially distinct, extending onto the dorsal fin obliquely backward; dorsal, anal, and caudal fins edged with white; eye usually narrowly edged with black, especially around anterior

margin; slightly behind the eye four to six small black spots that are present even in smallest specimens; corner of mouth blackish; abdomen, or ventral side of body in front of anus, unspotted; front of snout and tip of lower jaw dark brown; in smaller specimens, the mucus pores under eye and on lower jaw a little whitish.

Color when alive.—Background color light brownish, spots black.

Ecology.—A common eel in the coral heads and crevices of the reefs.

GYMNOTHORAX RUPELLI (McClelland)

FIGURE 10, *f*

Dalophis rupelliae McCLELLAND, Calcutta Journ. Nat. Hist., vol. 5, p. 213, 1845 (type locality, on Rüppell).

Gymnothorax reticularis BLEEKER, Atlas ichthyologique des Indes Orientales Néerlandaises . . . , vol. 4, pl. 183, fig. 2, 1864 (adult coloration).

SPECIMENS STUDIED

Bikini Atoll: 5 stations, 8 specimens, 80 to 580 mm. total length.
Eniwetok Atoll: 1 station, 2 specimens, 335 to 404 mm.
Rongerik Atoll: 1 station, 1 specimen, 158 mm.
Rongelap Atoll: 1 station, 1 specimen, 610 mm.
Guam: 1 lot, 1 specimen, 251 mm.
Likiep Atoll: Univ. Washington, 1 specimen, 289 mm.

Description.—Greatest depth 15 to 23; head 7.6 to 8.7; snout to anus 2.3 to 2.4, to dorsal origin 9.1 to 12.3; all in total length. Greatest depth 1.9 to 2.6; snout to dorsal origin 1.1 to 1.5; eye 8 to 9; snout to rictus 2.6 to 2.7; snout 6 to 6.5; interorbital space, about 10; all in length of head.

Dorsal fin origin on rear of head, about equidistant between rictus and gill opening; anus a little in front of middle of length, anal fin origin close behind anus; anterior nostrils tubular, on each side of tip of snout, their length sufficient to reach edge of lip when folded downward; posterior nasal openings located dorsally, over front of eye, with slightly raised rims; body a little compressed, more so near tail; gill openings on middle of side, slightly above level of rear corner of mouth; arrangement of teeth as illustrated in the figure. Maxillary teeth are acutely triangular.

Color in alcohol.—From 17 to 22 brown or black bars completely encircle body, even under head and in front of anus, their greatest width contained from 1½ to 3 times in pale interspaces; interspaces white in specimens not exceeding 200 mm. in total length, in those over 200 mm. becoming brownish or mottled brownish dorsally but paler ventrally; the 610-mm. specimen mottled brownish, so that dark bars dorsally break up into a more mottled pattern; inside of lower jaw brown or blackish, sometimes rear corner of mouth blackish; tip of tail white, snout white in young, somewhat pale brownish in adults; black bars extend all the way to edges of dorsal and anal fins, no

white edge on median fins; anus in seventh, eighth, or ninth black bar, usually in eighth or ninth; first dark bar includes orbit; second slightly behind rictus of mouth and third just in front of gill opening, or gill opening sometimes in white area in third dark ring; tip of snout may be brownish, as may base of nostrils, but tip of anterior nostrils are white; specimens 400 to 600 mm. and longer have on under side of head and behind eye 7 to 10 lengthwise brownish or blackish streaks that extend toward gill opening, these streaks separated by white or pale streaks.

Ecology.—This eel occurs in crevices, among coral heads, or wherever there is room to hide in the reef.

Remarks.—This species is characterized by its dentition and by the series of brown or black bars meeting ventrally on the body and extending all the way to the edges of the median fins.

GYMNOTHORAX PETELLI (Bleeker)

FIGURE 10, *d*

Muraena petelli BLEEKER, Nat. Tijdschr. Nederl.-Indië, vol. 11, p. 84, 1856 (type locality, Java).

SPECIMENS STUDIED

Bikini Atoll: 8 stations, 14 specimens, 70 to 515 mm. total length.
Eniwetok Atoll: 1 station, 3 specimens, 101 to 227 mm.
Rongerik Atoll: 3 stations, 10 specimens, 111 to 346 mm.
Rongelap Atoll: 3 stations, 13 specimens, 95 to 525 mm.
Kwajalein Atoll: 1 station, 9 specimens, 85 to 435 mm.

Description.—Greatest depth 16 to 22; head 7.6 to 9.3; snout to anus 2.1 to 2.3, to dorsal origin 9.9 to 11.6; all in total length. Greatest depth 2.2 to 2.3; snout to dorsal origin 1.2 to 1.4; eye 8.0 to 9.5; snout to rictus 2.4 to 2.8; snout 5.0 to 5.8; interorbital space 8.0 to 10.6; all in length of head.

Dorsal fin origin on rear of head, a vertical line through it is about equidistant between rictus and gill opening; anus a little in front of middle of total length, anal origin close behind anus; anterior nostrils tubular, on each side of tip of snout, their length sufficient to extend to edge of lip when folded downward; posterior nostrils placed above front of orbit, with slightly raised rims; body a little compressed, especially on tail; gill openings on sides, a little above level of corner of mouth; dentition as shown in the figure.

Color in alcohol.—From 16 to 21 brown or blackish bands; those behind anus completely encircle body but in front of anus one or two may or may not meet ventrally, and those forward and under head do not meet along midventral line but are distinctly separated; bands about as wide as white interspaces on smaller specimens, half as wide on the 560-mm. specimen; pale interspaces white in small specimens, somewhat pale brownish in adults; inside of lower jaw and rear of

roof of mouth blackish; tip of tail usually blackish, sometimes white; snout white or nearly so, with tubular nostrils and base blackish or brown; black bands extend all way to edge of dorsal fin anteriorly but posteriorly edge is white; edge of anal fin white, black bands not reaching quite to edge; anus in eighth, ninth, or tenth black band; first black band at rear of orbit may or may not extend ventrally to include some of lower jaw; dark brown or blackish spot is persistent at corner of mouth; third blackish band near rear of gill opening or through it or just behind it. Whole body becomes brownish with age, making the bands less distinct at 560 mm. total length.

Ecology.—This eel occurs in coral heads, crevices, or wherever there is room to hide on the reef.

Remarks.—This species is characterized by its dentition and the black bands that do not completely encircle the body anteriorly (they do not meet under head and in front of anal region), the distal edge of anal fin is white across the black bands, which do not reach the edge of the fin. I have examined *Gymnothorax pikei* Seale (Bull. Mus. Comp. Zool., vol. 61, No. 4, p. 90, 1917, holotype, M.C.Z. No. 6145) from Mauritius. Although it closely resembles this species, *G. pikei* has the gill opening in a black blotch, the brown bars do not meet ventrally in front of the anus, they do extend all the way to the edges of both dorsal and anal fins. I conclude that *G. pikei* is a valid species. *G. signifer* Bliss (Trans. Soc. Roy. Arts Sci. Maurice, new ser., vol. 13, p. 58, 1883), from Mauritius (M.C.Z. No. 6147, holotype studied), is a synonym of *G. petelli.*

GYMNOTHORAX ZONIPECTIS Seale

FIGURES 27, *j*; 28

Gymnothorax zonipectis SEALE, Occ. Pap. Bishop Mus., vol. 4, No. 1, p. 7, fig. 1, 1906 (type locality, Tahiti).

SPECIMENS STUDIED

Bikini Atoll: Boby Island, ocean reef, August 17, 1946, S–46–383, Herald, 4 specimens, 144 to 310 mm.

Description.—Greatest depth 18 to 20; head 7.3 to 7.9; snout to anus 2.2 to 2.3, to dorsal origin 8.7 to 10.3; all in total length. Greatest depth 2.3 to 2.7; snout to dorsal origin 1.1 to 1.4; eye 8.2 to 9.1; snout to rictus 2.3 to 2.7; snout 4.9 to 5.5; interorbital space 9.8 to 11.1; all in length of head.

Dorsal fin origin on rear of head, a vertical line through its origin passing notably closer to gill opening than to rictus of mouth; anus a little in front of middle of total length; anal fin origin close behind anus; anterior nostrils tubular, on each side of tip of snout, more elongate than usual; when depressed, their length sufficient to extend notably beyond edge of upper lip; posterior nasal openings with

slightly raised rims, located a little above dorsal edge of, and about over front edge of, eye; body a little compressed, more so posteriorly; gill opening on middle of sides about on level of lower edge of eye; arrangement of teeth as shown in the figure, vomerine teeth uniserial; jaws scarcely closing, tip of lower curved dorsally.

Color in alcohol.—Background color light brown with darker brown spots on sides arranged in vertical bars, these bars continuing on fins as oblique dark brown or black spots, bordered by white, becoming more intensely brown or black posteriorly; lower jaw

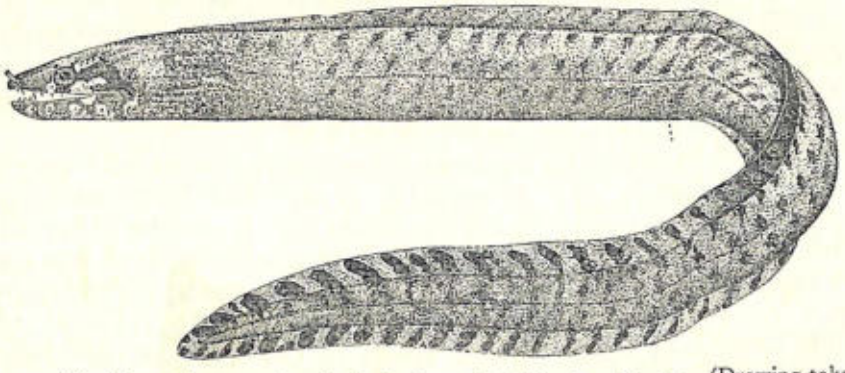

FIGURE 28.—*Gymnothorax zonipectis* Seale, from the Philippine Islands. (Drawing taken from *Albatross* Philippine collections.)

crossed with four or five white bars; a black or dark brown blotch extends behind eye a short distance, the area below white, then below eye one or two more white bars; dorsal surface of snout and head brown, with a white streak separating the brown dorsal surface of head from the dark brown bar behind eye; inside of mouth with some brown pigment posteriorly, otherwise mostly white.

Ecology.—This is a reef-inhabiting species of eel.

Remarks.—This eel is characterized by the white-bordered dark-brown or black bars in both fins, becoming more intense posteriorly.

GYMNOTHORAX GRACILICAUDUS Jenkins

FIGURE 27, *i*

Gymnothorax gracilicauda JENKINS, Bull. U. S. Fish. Comm., vol. 22, 1902, p. 426, fig. 6, 1903 (type locality, Honolulu, T. H.).

SPECIMENS STUDIED

Bikini Atoll: 5 stations, 24 specimens, 93 to 298 mm. total length.
Rongelap Atoll: 5 stations, 15 specimens, 121 to 288 mm.
Eniwetok Atoll: 2 stations, 3 specimens, 99 to 264 mm.
Kwajalein Atoll: 1 station, 3 specimens, 148 to 182 mm.

Description.—Greatest depth 17.5 to 23.2; head 7.5 to 9.1; snout to anus 2.2 to 2.3, to dorsal origin 9.3 to 10.8; all in total length. Greatest

depth 2.3 to 2.9; snout to dorsal origin 1.1 to 1.3; eye 7.2 to 9.1; snout to rictus 2.4 to 2.8; snout 5.4 to 6.4; interorbital space 9.2 to 10.8; all in length of head.

Dorsal fin origin on rear of head a little in front of a vertical line through gill opening; anus slightly in front of middle of total length; anal fin origin close behind anus; anterior nostrils tubular, on each side of tip of snout, when depressed scarcely reaching to edge of upper lip; posterior nasal openings with slightly raised rims, located a little above dorsal level of eye and slightly behind a vertical line through front of eye; body a little compressed, more so posteriorly; gill openings on sides about on level of lower edge of eye; teeth arranged as in the figure, vomerine teeth in one or two rows, usually one; jaws moderately long, slender; lower jaw curved upward at tip but the two jaws fit together fairly well.

Color in alcohol.—Background color pale brown to light grayish brown, with about 40 to 47 dendritic narrow dark-brown bars more or less interconnecting, sometimes somewhat alternating along sides and along back; these bars all with dark spotlike centers, arranged in three rows, one along back, one on middle of side, one ventrally; pale interspaces about 3 times width of brown bars; abdomen plain light brown. Middorsal surface of snout white from anterior nostrils to interorbital space, sides brownish, this white area crossed by a transverse brown bar at rear of eyes; a second transverse brown bar occurs halfway between eye and dorsal fin origin; corner of mouth with brown blotch; lower jaw white or very light brown with tip of chin brownish; edges of median fins whitish.

Ecology.—A common eel among the coral heads and in crevices. This species appears to be a small one.

Remarks.—Characteristic of this species is the white streak on the middorsal side of the snout, followed by a brown crossbar at the rear of the eyes and another halfway between the eyes and the dorsal fin origin. We have compared this eel with specimens of *G. kidako* Temminck and Schlegel from Japan and have found the latter species to be distinct.

GYMNOTHORAX MARGARITOPHORUS Bleeker

FIGURE 27, *f*

Gymnothorax margaritophorus BLEEKER, Nederl. Tijdschr. Dierk., vol. 2, 1864, p. 53, 1865; Atlas ichthyologique des Indes Orientales Néerlandaises . . . , vol. 4, p. 97, pl. 175, fig. 1, 1864 (type locality, Amboina).

SPECIMENS STUDIED

Bikini Atoll: 15 stations, 42 specimens, 57 to 355 mm. total length.
Rongerik Atoll: 3 stations, 16 specimens, 151 to 227 mm.
Rongelap Atoll: 9 stations, 34 specimens, 77 to 377 mm.
Eniwetok Atoll: 4 stations, 6 specimens, 59 to 387 mm.

Kwajalein Atoll: 1 station, 1 specimen, 232 mm.
Guam: 1 lot, 1 specimen, 135 mm.
Saipan: 1 lot, 1 specimen, 90 mm.

Description.—Greatest depth 18 to 23; head 7.5 to 7.9; snout to anus 2.2 to 2.3, to dorsal origin 8.4 to 10.4; all in the total length. Greatest depth 2.3 to 3.0; snout to dorsal fin origin 1.1 to 1.3; eye 8.0 to 9.0; snout to rictus 2.3 to 2.8; snout 5.0 to 6.3; interorbital space 9.2 to 10.9; all in the length of the head.

Dorsal fin origin on rear of head, a little closer to gill opening than to rictus of mouth; anus a little in front of middle of length; anal fin origin close behind anus; anterior nostrils tubular, on each side of tip of snout, when depressed long enough to reach to opposite edge of upper lip; posterior nasal openings with raised rims, on dorsal side of, about opposite front edge of, and a little above dorsal edge of eye; body a little compressed; gill openings on middle of sides, a little above level of mouth; arrangement of teeth as illustrated in the figure; vomerine teeth in one row or an irregular row; jaws long and slender, scarcely closing tightly when shut, lower jaw slightly curved dorsally or its lateral aspect slightly concave.

Color in alcohol.—Background color in adults, brownish with traces of mottling anteriorly and dendritic bars, separated by white or pale interspaces posteriorly; in the smaller and halfgrown specimens the vertical interconnecting brown bars continue to the head; margins of fins usually white edged; the most conspicuous color mark a white streak on dorsal surface of snout, more or less continuing posteriorly to dorsal fin origin, but usually brown spotted or mottled behind orbits; extending posteriorly from upper part of eye a dark brown streak or black blotch, followed by another under dorsal fin origin, then two to seven dark blotches gradually blending into the brown or brownish bars; lower jaw and underside of head white, except in large adults; corner of mouth brownish; anterior nostrils brown.

Color when alive.—Brownish markings appear reddish brown.

Ecology.—*G. margaritophorus* is a species commonly caught among crevices and coral heads. It does not reach a large size, the longest specimen taken by us being not quite 400 mm. Small fishes were found in the stomachs of several of the preserved specimens.

Remarks.—This species is characterized by the white streak on the dorsal surface of the snout, and from two to seven dark blotches in a line on upper sides of the head and extending posteriorly behind the upper edge of the eye.

GYMNOTHORAX UNDULATUS (Lacepède)

FIGURE 27, *g*; PLATE 14, B

Muraenophis undulatus LACEPÈDE, Histoire naturelle des poissons, vol. 5, pp. 629, 642, 644, pl. 641, fig. 2, 1803 (locality not given).

Gymnothorax undulatus HIYAMA, Report on the poisonous fishes of the South Seas, p. 23, pl. 1, fig. 3, 1943 (Marshall Islands).

SPECIMENS STUDIED

Bikini Atoll: 4 stations, 8 specimens, 314 to 690 mm. total length.
Enlwetok Atoll: 2 stations, 3 specimens, 288 to 295 mm.

Description.—Greatest depth 10 to 19 (large fish more robust); head 6.1 to 8.2; snout to anus 2.1 to 2.3, to dorsal origin 8.2 to 9.5; all in total length. Greatest depth 1.7 to 2.8; snout to dorsal origin 1.1 to 1.4; eye 7.8 to 10.3; snout to rictus 2.4 to 3.1; snout 4.9 to 6.9; interorbital space 9.0 to 11.8; all in length of head.

Dorsal fin origin on rear of head about equidistant between rictus and gill opening; anus a little in front of middle of total length; anal fin origin close behind anus; anterior nostrils tubular, on each side of tip of snout, when depressed reaching about to edge of upper lip; posterior nasal opening without distinct raised rims, slightly dorsal to and opposite front edge of eye; body compressed; gill openings on middle of side, slightly above level of mouth; arrangement of teeth as shown in the figure; vomerine teeth in one row or an irregular row; jaws long and slender, lower slightly curved dorsally at tip so that toothed edge is slightly concave.

Color in alcohol.—Everywhere covered with large brown blotches separated by distinct, narrow, white or pale interspaces more or less interconnecting and sometimes no more than lines; on large fishes white interspaces brown spotted; edges of dorsal, caudal, and anal fins white posteriorly; brown blotches continued on dorsal and anal fins more or less as narrow bars separated by white interspaces; rictus of mouth with a brownish spot; under side of head and thorax more uniformly brownish than rest of body; pores under orbit and on sides of lower jaw bordered by whitish, especially so in small ones, absent in large adults; inside of mouth brownish; gill opening not bordered by black.

Color when alive.—Brownish markings appear dark reddish brown; iris of eye slightly orange; pale interspaces nearly white, slightly tan colored; gill opening with slightly purplish tinge.

Ecology.—This eel was not very common in the shallower parts of the reefs; it came from crevices, ledges, and coral heads. In the stomachs of most specimens were recently swallowed fishes, indicating that the eels fed on the poisoned fishes.

Remarks.—This eel is characterized by its bold brown blotches separated by narrow white interspaces, more or less interconnecting, and by the absence of a black border on the gill openings.

KEY TO THE GENERA AND SPECIES RELATED TO UROPTERYGIUS

1*a*. A pair of pores or 2 posterior nasal openings over each eye; dorsal and anal fins, if present, confined to tip of tail; center of eye a little closer to rictus

of mouth than to tip of snout; lower jaw equal to, or slightly shorter than, upper (*Anarchias*).

2*a*. Tip of tail hard pointed, caudal fin rays rudimentary; dorsal and anal fins absent; rear nasal openings without raised rim in young, becoming slightly raised in those over 150 mm.; center of rear nostril over rear of pupil; caudal fin white; nostrils usually white; mucus pores white; color plain brown on those about 40 mm. in total length, becoming flecked or speckled with white ventrally on head and trunk on those up to a length of 100 to 150 mm., gradually changing to a color pattern on back and sides of about 50 interconnecting or somewhat reticulated narrow brown bars, with pale interspaces, meeting ventrally behind anus; lips barred except in young; a more or less evident pale band or blotch on midside of head behind rictus; snout to anus about 2.2 to 2.4 in total length_____ Anarchias galapagensis [18] (Seale)

2*b*. Tip of tail not sharp pointed but rounded; some rays evident, near tip of tail, in dorsal, anal, and caudal fins; longest ray of caudal fin 11 to 27 in head.

3*a*. Plain dark brown; caudal fin edged with white; mucus pores and rear nasal openings white; sometimes on head a paler area more or less in form of a pale bar behind eye; lower jaw sometimes slightly barred; depth 16 to 22 in total length; rear nasal openings without raised rims_____Anarchias allardicei Jordan and Starks (p. 143)

3*b*. Color pattern of irregular narrow brown bars or a network of wide brownish lines; lips barred; posterior nasal opening with a slightly raised rim.

4*a*. Numerous light brownish irregular bars, sometimes discontinued ventrally or replaced there with brownish specks; under side of head and trunk unspotted; occasionally brown bars so fully expanded they are indistinct; the 2 pores over each eye separated by a dermal partition; snout to anus 2.2 to 2.4 in total length; caudal fins 13 to 27 in head_____ Anarchias leucurus (Snyder) (p. 145)

4*b*. A network of wide brownish lines more or less arranged into irregular vertical reticulated bars, more obvious posteriorly; under side of head usually plain whitish; abdomen with brown specks; the two pores over each eye separated by dermal isthmus; snout to anus 2.1 to 2.2 in total length; caudal fin 11 to 14 in head.

Anarchias cantonensis (Schultz) (p. 146)

1*b*. A single pore or nasal opening over each eye.

5*a*. Anal fin origin close behind anus (*Rabula*).

6*a*. Rayed dorsal fin origin ½ to ⅔ head length in front of vertical line through anus, 1.7 to 2.1 head lengths behind gill opening; center of rear nasal opening over front of pupil; color pattern light brownish or brownish overlaid with numerous dark-brown or blackish-brown spots the size of pupil, these more or less interconnected by brown lines, more prominent posteriorly; mucus pores and posterior nasal opening white, anterior nostril brownish; snout to dorsal origin 2.4 to 2.7, snout to anus 2.0 to 2.3, both in total length.

Rabula fuscomaculata, new species (p. 147)

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[18] *Uropterygius necturus* (not of Jordan and Gilbert) Myers and Wade, Allan Hancock Pacific Exped., Univ. Southern California, vol. 9, No. 4, p. 85, 1941, is the young of *A. galapagensis* (Seale) (ibid., No. 1, p. 6, fig.). I have examined the specimens used by these authors and found the two pores over each eye. *U. necturus* has but one pore. Actually the specimens identified by these authors as *U. marmoratus* are the true *necturus*. *U. marmoratus* has not been found east of the central tropical Pacific.

6*b*. Rayed dorsal fin origin a head length in front of anus and 1⅔ head length behind gill opening.

7*a*. Posterior nasal opening notably in front of a vertical line through front of eye; mucus pore on middle of dorsal side of snout equidistant between one on dorsal base of anterior nostril and rear nostril; snout to dorsal origin 2.95; snout to anus 2.1, both in total length; color dark brown with traces of light mottlings or whitish spots the size of pupil_____ Rabula davisi Fowler

7*b*. Posterior nasal opening behind front of eye, a vertical line passing through front of pupil also passes through center of rear nasal opening; mucus pore on middle of dorsal side of snout notably closer to one on dorsal base of anterior nostril than to rear nostril; snout to dorsal origin 3.0 to 3.2, snout to anus 2.2, both in total length; plain brown, edges of dorsal and anal fins same color as body, mucus pores on head and rear nostrils white, anterior nasal tube brown; caudal fin whitish, or paler than body.

Rabula marshallensis, new species (p. 149)

5*b*. Anal fin present only at tip of tail (*Uropterygius*).

8*a*. Rayed dorsal origin just behind gill opening; caudal fin edged with blackish; mucus pores and nostrils brownish; coloration plain yellowish brown tinged with pale on ventral side anteriorly; posterior nasal opening without raised rim; center of eye equidistant between tip of snout and rictus; snout to anus 2.1 in total length.

Uropterygius insuetus Whitley

8*b*. Rayed dorsal fin present only at tip of tail, both anal and dorsal fins confluent with short caudal fin.

9*a*. Snout to anus longer than tail, about 1.45 to 1.9 in total length.

10*a*. Posterior nasal openings not tubular, at best development only a raised rim; vomerine teeth uniserial.

11*a*. Color pattern of finely mottled brown and violet (pale) markings not arranged in rows or bars; tail pale edged; nostrils white.

Uropterygius macrocephalus (Bleeker)

11*b*. Color pattern of 5 to 6 irregular rows of brown spots more or less joined to each other and about 8 or 9 somewhat broken, blackish-brown, lengthwise bands on sides of head; figure 29, *f*.

Uropterygius fijiensis Fowler

10*b*. Posterior nostrils tubular.

12*a*. Color pattern of large brown spots on a pale brown background but snout not white as in *polyspilus*; center of eye closer to rictus than to tip of snout; posterior tubular nostril as long as anterior one, or nearly so, and white; snout to anus 1.6 to 1.9, greatest depth 22 to 26, both in total length; caudal fin very short, about 29 in head_____ Uropterygius tigrinus (Lesson)

12*b*. Color pattern not of large brown spots.

13*a*. Color plain yellowish brown or brown without any markings; center of eye equidistant between tip of snout and rictus; jaws about equal; mucus pores and nostrils same color as head (based on U.S.N.M. No. 150552, cotype).

Uropterygius sealei [19] Whitley

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[19] *U. sealei* Whitley, Rec. Australian Mus., vol. 18, p. 330, footnote, 1932, is a new name for *Scuticaria unicolor* Seale 1917 (preoccupied).

13*b*. Coloration everywhere speckled with fine brown and fine white spots not arranged in bars or lengthwise streaks; tubular posterior nostril as long as tubular anterior nostril; mucus pores on head and nostrils white; greatest depth 13 to 20 in total length---- Uropterygius polystictus Myers and Wade

9*b*. Snout to anus equal to or shorter than tail (anus to tip of caudal fin), about 2.0 (rarely 1.95) to 2.91 in total length.

14*a*. Coloration of large blackish or dark brown spots on a pale background; tip of snout white; center of eye closer to rictus than to tip of snout; nostrils white; mucus pores on head same color as head; caudal fin same color as body; rear nostril in a very short tube or with a raised rim, located over pupil; snout to anus 2.0 to 2.1, greatest depth 23 to 27, both in total length; caudal fin length 17 to 27, mouth 2.9 to 3.9, both in head; teeth as in figure 29, *d*---------- Uropterygius polyspilus Regan

14*b*. Coloration not as above.

15*a*. Plain brown without any dark or light spots; center of eye closer to rictus than to snout tip; rear nostril with raised rim over pupil; caudal fin white; nostrils and mucus pores brown; gill opening slightly above middle of side on level of middle of eye; snout to anus 2.1 to 2.2, depth 29 to 31, both in total length. Uropterygius concolor Rüppell (p. 151)

15*b*. Coloration not plain brown, but with dark bars, or light or dark spots at least posteriorly.

16*a*. Gill opening notably closer to middorsal line than to middle of sides, opposite upper edge of eye; maxillary and dentary with numerous rows of slightly oblique small conical teeth on outside of inner row of caninelike teeth; body subtubular in shape anteriorly, a little compressed posteriorly; rear nostrils notably tubular in shape, nearly as long as anterior ones; center of eye closer to snout tip than to rictus; caudal fin same color as body, jaws barred, mucus pores same color as head.

17*a*. Brownish or grayish with small brown spots forming rather widely spaced dark bars; vomerine series of teeth continuous with those of premaxillary; both nostrils white. Uropterygius supraforatus (Regan) (p. 152)

17*b*. Mottled with dark and light spots rather closely set, arranged to form rather indistinct bars; vomerine series of teeth interrupted and not continuous with those of premaxillary; rear nostrils white, anterior ones brownish. Uropterygius dentatus, new species (p. 152)

16*b*. Gill opening closer to middle of side than to middorsal line of back; outer rows of teeth on maxillary and dentary parallel to the inner row of more enlarged teeth.

18*a*. Coloration plain brown or blackish brown overlaid with tiny white specks, these usually most prominent on sides of head and underside of abdomen, disappearing posteriorly in the largest specimens; snout and lower jaw uniform pale or light brown; tail, including dorsal, anal, and caudal fins, white; posterior nostrils tubular or nearly so, usually white

or partly white; anterior tubular nostrils brown; mucus pores same color as head; snout to anus 2.4 to 2.9, greatest depth 27 to 37, both in total length.

Uropterygius xanthropterus Bleeker (p. 154)

18*b*. Coloration not as above.

19*a*. Everywhere coloration mottled combination of gray, olive, brown, blackish, whitish, with small dark spots of brown or blackish, no bars anywhere; vomerine teeth biserial, at least in adults; rear nostril tubular, nearly as long as anterior tubular nostril; center of eye equidistant between tip of snout and rictus; jaws nearly equal; caudal fin nearly obsolete and same color as body; nostrils and mucus pores on head same color as head; snout to anus 2.3 to 2.4, greatest depth 19 to 23, both in total length.

Uropterygius marmoratus (Lacepède) (p. 155)

19*b*. Coloration not as above.

20*a*. Coloration brown or light grayish overlaid with a characteristic network of finely reticulated black lines not forming bars or lengthwise streaks; rear nostril with raised rim; center of eye equidistant between snout tip and rictus; nostrils and mucus pores same color as head; tail same color as body; snout to anus 2.1 to 2.2, greatest depth 16 to 22, both in total length.

Uropterygius micropterus (Bleeker) (p. 155)

20*b*. Coloration not as above.

21*a*. Plain brown anteriorly with dark brown spots posteriorly, sometimes arranged in bars; lower jaw, sometimes including area behind it, whitish or light brown, persistently paler than brown body; mucus pores on head same color as body; anterior nostril and most of rear nostril white; margin of caudal fin whitish; snout to anus about 2.0, greatest depth 17 to 25, both in total length.

Uropterygius fuscoguttatus, new species (p. 156)

21*b*. Color patterns predominantly of numerous irregular brown bars alternating with lighter interspaces; sometimes the color is so dark that the bars are difficult to observe; rear nostril with raised rim or nearly tubular.

22*a*. Lower jaw plain white or plain dark brown on the very darkest specimens, with scarcely any light areas; lower lips not barred; caudal fin white tipped or same color as body; nostrils and mucus pores same color as head.

Uropterygius reidi Schultz (p. 158)

22*b*. Lower jaw notably barred or reticulated with brown; lower lips barred; caudal fin, including rayed dorsal and anal fins, white; nostrils and mucus pores usually same color as head.

Uropterygius necturus (Jordan and Gilbert) and Uropterygius knighti (Jordan and Starks)

Genus ANARCHIAS Jordan and Starks

Anarchias JORDAN and STARKS, *in* Jordan and Seale, Bull. U. S. Bur. Fish., vol. 25 (1905), p. 204, 1906. (Genotype, *A. allardicei* Jordan and Starks.)

ANARCHIAS ALLARDICEI Jordan and Starks

FIGURE 29, *c*

Anarchias allardicei JORDAN and STARKS, *in* Jordan and Seale, Bull. U. S. Bur. Fish., vol. 25 (1905), p. 204, fig. 9, 1906 (type locality, Pago Pago, Samoa).

SPECIMENS STUDIED

Bikini Atoll: Namu Island, lagoon reef, April 3, 1946, Johnson, 1 specimen, 88 mm. in total length.

Rongerik Atoll: Bock Island, ocean reef, April 24, 1946, S–46–113, Brock and Marr, 1 specimen, 113 mm.; Bock Island, ocean reef, June 27, 1946, S–46–237, Schultz and Herald, 1 specimen, 50 mm.

Guam: June–July, 1945, McElroy and Markley, 3 specimens, 85 to 95 mm.

Saipan: Cloud, 1 specimen, 82 mm.

Description.—The first figure for each character is that of the holotype of *A. allardicei*, followed by proportions for 3 other specimens. Greatest depth 16.6 (18 to 22); head 7.6 (7.5 to 7.8); snout to anus 2.0 (2.0 to 2.1); all in total length. Greatest depth 2.2 (2.3 to 2.9); length of longest caudal fin rays 13 (11 to 17); eye 13 (10 to 11); snout tip to rictus 3.1 (2.9 to 3.5); snout 5.8 (6.0 to 6.4); interorbital space 7.6 (7.6 to 10.3); all in length of head.

Body a little compressed, more so on tail; rayed dorsal fin absent except near tip of tail, anal absent except near tip of tail, both confluent with short caudal fin; sometimes dorsal fin appears as a low fold along back but no rays have been found by dissection; center of eye nearly a third closer to rictus than to snout tip; anterior nostrils tubular, on each side of tip of snout, when depressed barely reaching to edge of upper lip; posterior nostrils with two openings above each eye, these two pores separated by a dermal septum; a vertical line through center of base of rear nasal pore passes through front edge of pupil; anus at or slightly in front of middle of total length; distance between pore above base of anterior nostril and the one on dorsal surface of snout contained about 1.9 to 2.1 times in distance between latter and rear nostril, all three nearly in a straight line; distance between rear nostrils about equal to eye; lower jaw a little shorter than upper jaw; teeth short, conical, inner row of dentary and maxillary somewhat enlarged, vomerine teeth uniserial.

Color in alcohol.—Plain dark brown; caudal fin edged with white; mucus pores and rear nasal openings white; sometimes a paler area on head, more or less in form of a pale bar, behind eye.

Ecology.—Two of the specimens were taken from a thick growth of algae on coral heads growing on the ocean side of the reef of Bock and Namu Islands.

Remarks.—This species is characterized by its plain dark brown coloration and its double rear nostrils.

Four specimens were described by Jordan and Starks, two from Pago Pago, Samoa, and two from Apia. The two from Pago Pago are of the same species; one, the holotype, has the U.S.N.M. No. 51715 tied to it, together with a metal tag "Drawn"; the other, a paratype bears the U.S.N.M. No. 144296. Of the two from Apia, one, U.S.N.M. No. 126338, is of a different species, probably *U. concolor* Rüppell. I have not seen the second specimen from Apia; it may be at Stanford University. The holotype, originally measured at 160 mm., has shrunken to 133 mm. in preservation, but this is not excessive for eels.

ANARCHIAS LEUCURUS (Snyder)

FIGURE 29, *b*

Uropterygius leucurus SNYDER, Bull. U. S. Fish. Comm., vol. 22 (1902), p. 521, pl. 6, fig. 12, 1904 (type locality, Maui and Lanai).

SPECIMENS STUDIED

Bikini Atoll: 11 stations, 30 specimens, 77 to 178 mm. total length.
Rongelap Atoll: 6 stations, 26 specimens, 123 to 220 mm.
Rongerik Atoll: 1 specimen, 70 mm.
Kwajalein Atoll: 1 station, 1 specimen, 118 mm.

Description.—Greatest depth 23 to 31; head 9.2 to 9.5; snout to anus 2.2 to 2.4; all in total length. Greatest depth 2.4 to 3.3; length of longest caudal fin ray 13 to 27; eye 11 to 13; snout to rictus 2.7 to 3.4; snout 5.3 to 6.7; interorbital space 6.5 to 9.5; all in length of head.

Body a little compressed; dorsal and anal fins not externally evident except near tip of tail, where they are confluent with caudal fin, otherwise more less represented as a low fold of skin; center of eye closer to rictus than to tip of snout; anterior nostrils tubular, on each side of tip of snout, tubes long enough to reach edge of upper lip, when depressed; posterior nostrils represented by a pair of openings above each eye, these separated by a dermal partition, the anterior opening with a slightly raised rim; a vertical line through middle of dermal partition of pair of openings passes through front of pupil; anus notably in front of middle of total length; distance between pore above base of anterior nostril and that on dorsal surface of snout contained about 1.7 to 2.0 times in distance between latter and rear nostril, all three about in a straight line; distance between rear nostrils about equal to eye; teeth conical, moderately long, pointed, inner row of maxillary and of dentary few in number and caninelike, vomerine teeth short, uniserial.

Color in alcohol.—Color pattern consists of numerous light brownish, broken or irregular bars, occasionally somewhat mottled, with very pale or whitish interspaces, sometimes bars discontinued ventrally and color consists of light brownish specks; underside of head and abdomen anteriorly unspotted; upper and lower lips barred; anterior nasal tubes usually white, margins of dorsal, anal, and tip of caudal fin white; occasionally brownish bars so fully expanded that white interspaces are indistinct. (This seems to be the color phase represented by the holotype of *leucurus*, which, after long preservation is brownish. The original figure of *leucurus* does not give a true color pattern for the species.)

Ecology.—This small species was common in the shallower reef where there was considerable wave action. It lives in crevices, rocky algal debris, and among coral heads.

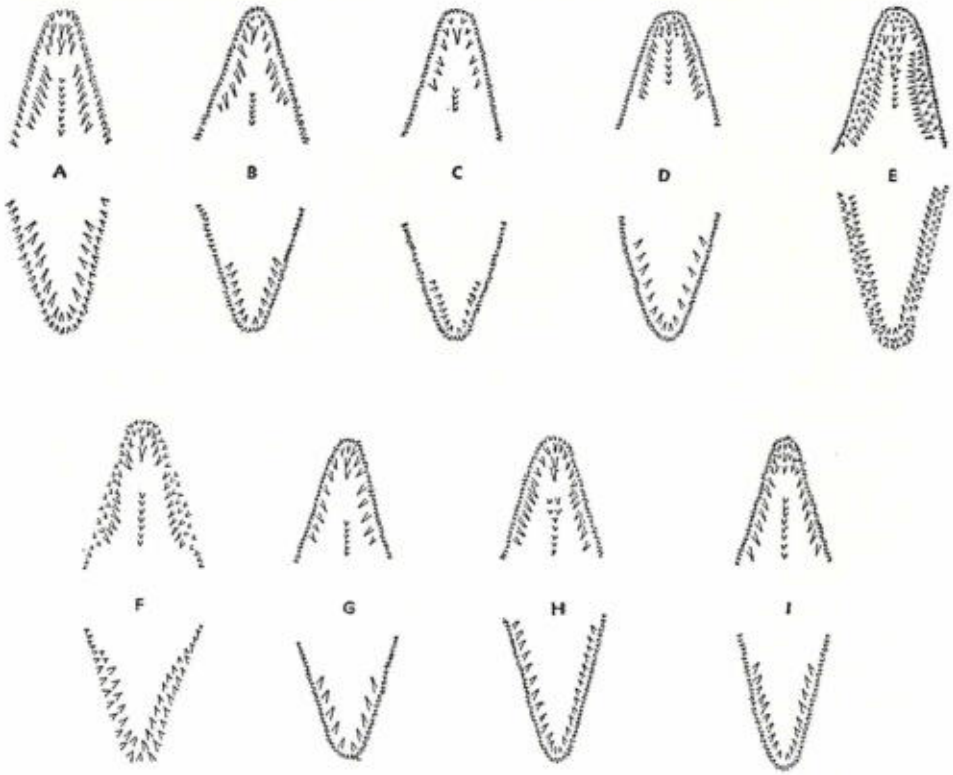

FIGURE 29.—Dental patterns of certain species of muraenid eels: *a*, *Anarchias cantonensis* (Schultz); *b*, *A. leucurus* (Synder); *c*, *A. allardicei* Jordan and Starks; *d*, *Uropterygius polyspilus* Regan; *e*, *U. marmoratus* (Lacepède); *f*, *U. fijiensis* Fowler; *g*, *U. concolor* Rüppell; *h*, *U. micropterus* (Bleeker); *i*, *U. xanthopterus* Bleeker. (Sketches by author.)

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Remarks.—We have compared our specimens with the type from the Hawaiian Islands, U.S.N.M. No. 50871, and are convinced that our material represents the same species. The type was not well preserved and is plain brownish.

ANARCHIAS CANTONENSIS (Schultz)

FIGURE 29, *a*; PLATE 15

Uropterygius cantonensis SCHULTZ, U. S. Nat. Mus. Bull. 180, p. 27, pl. 4, fig. 3a, 1943 (type locality, Canton Island, Phoenix group).

SPECIMENS STUDIED

Bikini Atoll: Romuk Island, lagoon reef, April 2, 1946, S–46–48, Schultz, 1 specimen, 190 mm. total length; Namu Island, April 3, 1946, S–46–49, Schultz, 1 specimen, 63 mm.

Rongelap Atoll: Enybarbar Island, tidal pool, June 18, 1946, S–46–217, Schultz, 1 specimen, 139 mm.

Description.—Greatest depth 20 to 28; head 7.2 to 8.0; snout to anus 2.1 to 2.2; all in total length. Greatest depth 2.5 to 3.5; longest caudal fin ray 11.6 to 13.3; eye 12.4 to 14.1; snout to rictus 2.8 to 3.1; snout 5.8 to 6.7; interorbital space 7.5 to 11; all in length of head.

Body a little compressed, more so posteriorly, nearly tubular anteriorly; dorsal and anal fins not externally evident except near tip of tail, where they are confluent with the short caudal fin; center of eye closer to rictus than to tip of snout; anterior nostrils tubular, on each side of tip of snout, just long enough to reach to edge of upper lip when depressed; posterior nasal openings double (over each eye two openings), rear one larger, with a slightly raised rim, separated by narrow isthmus of skin from a smaller pore a little in front; a vertical line through center of rear nasal opening passes through rear of pupil; anus a little in front of middle of total length; distance between pore above base of anterior nostril and pore on dorsal surface of snout contained about 2.0 to 2.9 times in distance between latter and rear pore of rear nostril, these pores not in a straight line; distance between real nasal openings a little greater than diameter of eye; lower jaw very slightly shorter than upper; teeth conical, in two rows on maxillary and on dentary, inner row caninelike, vomerine teeth uniserial.

Color in alcohol.—Color pattern a network of wide brownish lines, more or less arranged into irregular vertical reticulated bars, more obvious posteriorly; underside of head usually plain whitish, abdomen with brown specks; lips barred; front margin of eye with a line of black pigment; edge of rear nasal opening white, as are mucus pores on dorsal surface of head; caudal fin whitish.

Ecology.—This species was taken from the shallow reef area and probably came out of some of the crevices, or from coral growths.

Remarks.—We have compared the Marshall Islands specimens with the types from the Phoenix Islands and find no significant differences.

Genus RABULA Jordan and Davis

Rabula Jordan and Davis, Rep. U. S. Comm. Fish. and Fisheries, 1888, vol. 16, pp. 590, 598, 1892. (Genotype based on U.S.N.M. No. 6673, holotype of *R. davisi* Fowler, Proc. Acad. Nat. Sci. Philadelphia, vol. 64, p. 21, February 1912, as restricted by him, and not on *Gymnothorax aquae-dulcis* Cope, holotype, A.N.S.P. No. 14925, which is another species and came from Costa Rica.)

This genus is characterized by having an anal fin with its origin close behind anus (origin of the rayed dorsal fin is more than a head length behind the gill openings but in front of a vertical line through the anus) and by having a single posterior nasal opening.

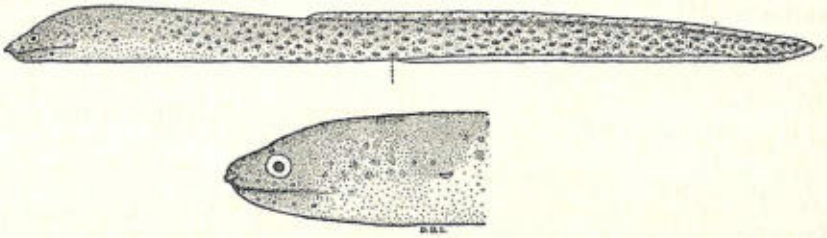

Figure 30.—Holotype of *Rabula fuscomaculata*, new species (U.S.N.M. No. 141639), from Rongerik Atoll. (Drawing by Dorothea B. Schultz.)

RABULA FUSCOMACULATA, new species

Figure 30

Holotype.—U.S.N.M. No. 141639, Rongerik Atoll, Latoback Island, lagoon reef, August 14, 1947, S–1041, Brock, Schultz, and Donaldson, total length 173 mm.

Paratypes.—U.S.N.M. No. 141644, Bikini Atoll, Erik Island, ocean reef, March 19, 1946, S–46–9, Schultz and Brock, 1 specimen, 125 mm. in total length; U.S.N.M. No. 141646, Bikini Atoll, lagoon, coral heads eastern end, depth 20 to 25 feet, March 26, 1946, S–46–42, Brock and Schultz, 1 specimen, 164 mm.; U.S.N.M. No. 141645, Bikini Atoll, Boro Island, channel reef, April 6, 1946, S–46–52, Schultz and Brock, 1 specimen, 61 mm.; U.S.N.M. No. 141643, Bikini Atoll, Cherry Island, April 18, 1946, S–46–98, Schultz, 2 specimens, 146 to 150 mm.; U.S.N.M. No. 141648, Bikini Atoll, Arji Island, lagoon, depth 20 to 40 feet, August 7, 1946, S–46–308, Brock and Herald, 2 specimens, 143 and 147 mm.; U.S.N.M. No. 141647, Bikini Atoll, Reer Island, lagoon reef, August 12, 1946, S–46–332, Herald and Brock, 1 specimen, 177 mm.; U.S.N.M. No. 141641, Bikini Atoll, Eman Island, channel reef, July 17, 1947, S–46–405, Schultz, Brock, Hiatt, and Myers, 1 specimen, 84

mm.; U.S.N.M. No. 141640, Bikini Atoll, tidal pond between Eman and Reer Islands, ocean reef, July 18, 1947, S–46–422, Brock, Hiatt, Schultz, and Myers, 9 specimens, 92 to 148 mm.; U.S.N.M. No. 141642, Bikini Atoll, Namu Island, lagoon reef, August 6, 1947, S–46–508, Schultz, Brock, and Hiatt, 3 specimens, 93 to 132 mm.; U.S.N.M. No. 141653, Eniwetok Atoll, Teiteiripucchi Island, June 1, 1946, S–46–197, Schultz, 6 specimens, 118 to 169 mm.; U.S.N.M. No. 141652, Rongerik Atoll, Latoback Island, June 28, 1946, S–46–238, Schultz and Herald, 5 specimens, 145 to 181 mm.; U.S.N.M. No. 141650, Rongelap Atoll, Mellu Island, lagoon reef, June 19, 1946, S–46–220, Schultz and Herald, 9 specimens, 93 to 148 mm.; U.S.N.M. No. 141649, Rongelap Atoll, Yugui Island, ocean reef, July 31, 1946, S–46–304, Herald, 18 specimens, 72 to 165 mm.; U.S.N.M. No. 141651, Kwajalein Atoll, Ennylabegan Island, lagoon reef, September 1, 1946, S–46–397, Herald, 2 specimens, 112 and 142 mm.; U.S.N.M. No. 141638, Johnston Island, ocean reef, northern side, August 28–29, 1947, S–42–569, Schultz, 16 specimens, 81 to 159 mm.

Description.—Precision measurements were made on the holotype and 3 paratypes, and these are recorded, in thousandths of the total length, in that order, respectively.

Total length in mm. 173; 156; 133; 72.

Greatest depth 61; 55; 60; 51; head 124; 126; 119; 121; snout to anus 474; 469; 503; 444; length of longest caudal fin rays 10; 6; 12; 11; eye 14; 12; 13; 11; snout 23; 22; 20; 22; snout to rictus 46; 37; 39; 39; interorbital space 20; 18; 16; 24; snout to dorsal origin 376; 393; 413; 388; distance between rear nostril and mucus pore on middorsal side of snout 14; 12; 13; 11; distance between mucus pores on middorsal side of snout 9; 9; 8; 8.

Greatest depth 16.5 to 19; head 7.9 to 8.8; snout to anus 2.0 to 2.3, to dorsal origin 2.4 to 2.7; all in total length. Greatest depth 2.0 to 2.4; eye 9.0 to 10.9; snout to rictus 2.7 to 3.5; snout 5.4 to 5.9; interorbital space 5.1 to 7.6; longest caudal fin ray 10 to 19; all in length of head.

Body a little compressed throughout its length; dorsal fin present, its origin about ½ to ⅔ head length in front of a vertical line through anus and 1.7 to 2.1 head lengths behind gill opening; anal fin present, its origin just behind anus, both fins confluent with short caudal fin; rays of dorsal and of anal fins visible only by dissection; center of eye notably closer to rictus than to tip of snout; anterior nostrils tubular, on each side of tip of snout, when depressed reaching to edge of upper lip; single pair of posterior nasal openings, slightly tubular, a vertical line through center of base of posterior nostril passes through front edge of pupil; anus usually a little in front of middle of total length; distance between pore above base of anterior nostril

and the one on dorsal surface of snout contained about 1.3 to 1.7 times in distance between latter and rear nostril, all three not quite in a straight line; distance between rear nostrils about equal to diameter of eye; lower jaw a little shorter than upper, tip of snout projecting a little; teeth very short, conical, no canines, arranged as shown in the figure, vomerine teeth uniserial or irregularly biserial.

Color in alcohol.—Background color light brownish or brownish overlaid with numerous dark-brown or blackish-brown spots the size of pupil and more or less interconnected by brown lines, this pattern more prominent posteriorly; median fins pale edged; abdomen usually unspotted; sides of head behind eye and lower jaw plain brownish or with white specks; mucus pores white below eye, on snout, and on lower jaw; posterior nostrils white; anterior tubular nostrils brownish; on some larger specimens, brown spots expanded to form a more mottled pattern; on smaller fish, brown spots not interconnected by brownish lines.

Ecology.—This new eel was common on the shallow areas of the reefs, among coral and debris. The finding of mature eggs indicates a spawning time during late summer.

Remarks.—A small species, since females contain mature eggs at total lengths of as short as 130 mm. These eggs measure 2 mm. in diameter. This new species differs from all other eels related to the genus *Uropterygius* in having the dorsal origin far behind the head, and a color pattern of brown spots more or less interconnected by brownish lines on a light brown background. (Dr. William Gosline, University of Hawaii, recently sent to the U. S. National Museum two specimens of this species from Oahu Island, T. H.)

This new species was named *fuscomaculata* in reference to the brown spots.

RABULA MARSHALLENSIS, new species

FIGURE 31

Holotype.—U.S.N.M. No. 141687, Kwajalein Atoll, Ennylabegan Island, lagoon reef, September 1, 1946, S–46–397, Herald, total length 179 mm.

Paratypes.—U.S.N.M. No. 141690, Bikini Atoll, Boro Island, channel reef, April 6, 1946, S–46–52, Schultz and Brock, 3 specimens, 136 to 161 mm.; U.S.N.M. No. 141689, Eniwetok Atoll, Jieroru Island, lagoon reef, May 21, 1946, S–46–174, Schultz, 2 specimens, 137 and 178 mm.; U.S.N.M. No. 141688, Kwajalein Atoll, Ennylabegan Island, lagoon reef, September 1, 1946, S–46–397, Herald, 4 specimens, 128 to 160 mm.

Description.—Precision measurements were made on the holotype and 3 paratypes and these, expressed in thousandths of the total length, are recorded in that order, respectively.

Total length in mm. 179, 178, 161 and 143.

Greatest depth 48; 39; 44; 38; head 121; 111; 109; 111; snout to anus 449; 450; 454; 448; longest midcaudal fin ray 8; 5; 9; 6; eye 12; 13; 12; 10; snout 23; 20; 19; 19; snout tip to rictus 44; 36; 40; 38; interorbital space 17; 12; 15; 16; snout to dorsal origin 324; 337; 311; 315.

Greatest depth 21 to 26; head 8.3 to 9.3; snout to anus 2.2, to dorsal origin 3.0 to 3.2; all in total length. Greatest depth 2.5 to 2.9; length of longest midcaudal fin ray 12 to 20; eye 8.2 to 10.5; snout to rictus 2.7 to 3.1; snout 5.1 to 5.9; interorbital space 6.9 to 9.0; all in length of head.

Body a little compressed throughout its length; dorsal fin present, its origin about 1¾ to 2 head lengths behind gill opening, only slightly more than 1 head length in front of vertical line through anus; anal fin present, its origin just behind anus, both fins confluent with short

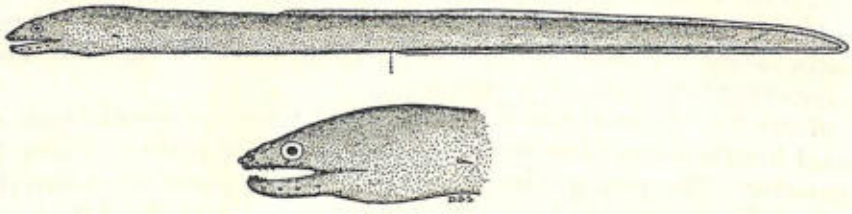

FIGURE 31.—Holotype of *Rabula marshallensis*, new species (U.S.N.M. No. 141687), from Kwajalein Atoll. (Drawing by Dorothea B. Schultz.)

caudal fin; rays of dorsal and anal fins visible upon dissection; center of eye about a third closer to rictus than to tip of snout; anterior nostrils tubular, on each side of tip of snout when depressed reaching to edge of upper lip; single pair of posterior nasal openings with slightly raised rims, a vertical line through center of base of posterior nasal openings passes through front of pupil; anus a little in front of middle of total length; distance between pore above base of anterior nostril and pore on dorsal surface of snout contained about 1.2 to 1.7 times in distance between latter and rear nostril, all three nearly in a straight line; distance between rear nostrils about equal to diameter of eye; lower jaw a little shorter than upper; teeth rather short, conical, arranged as illustrated; vomerine teeth uniserial; under magnification a few of the enlarged teeth on premaxillary have the posterior edge very slightly serrate on largest specimens.

Color in alcohol.—Plain brown, without any white edges on dorsal and anal fins; caudal fin somewhat paler than body, or even whitish; mucus pores under eye, on snout, and on lower jaw, white; rear nostril white; anterior nasal tube brown; lower jaw and region behind eye and underside of head paler than rest of brown body; front of eye with a blackish line.

Ecology.—This eel occurred among the coral heads and rocky debris of the reefs where the wave action was strong.

Remarks.—This new species may be distinguished from all other plain brown eels by the location of the origin of the dorsal fin (about two head lengths behind the gill opening), the location of the rear nasal pore over the eye, and the arrangement of the teeth. It is close to *Rabula davisi* Fowler. The latter, however, has the posterior nasal opening notably in front of a vertical line through front of eye.

Named in reference to the Marshall Islands.

Genus UROPTERYGIUS Rüppell

Uropterygius RÜPPELL, Neue Wirbelthiere . . . Abyssinien gehörig. Fische des rothen Meeres, p. 83, 1835. (Genotype, *U. concolor* Rüppell.)

UROPTERYGIUS CONCOLOR Rüppell

FIGURE 29, *g*

Uropterygius concolor RÜPPELL, Neue Wirbelthiere . . . Abyssinien gehörig. Fische des rothen Meeres, p. 83, pl. 20, fig. 4, 1835 (type locality, Red Sea).

SPECIMENS STUDIED

Bikini Atoll: 3 stations, 4 specimens, 107 to 311 mm. total length.
Guam: 2 lots, 3 specimens, 43 to 143 mm.
Saipan: 1 lot, 1 specimen, 141 mm.

Description.—Greatest depth 29 to 31; head 11.5 to 13; snout to anus 2.1 to 2.2; all in total length. Greatest depth 2.3 to 2.6; longest ray of caudal fin 14 to 16 or more in large adults; eye 10 to 16.3; snout to rictus 2.7 to 3.1; snout 4.6 to 5.2; interorbital space 6.7 to 8.2, all in length of head.

Body a little compressed, more so near tip of tail; rayed dorsal and anal fins absent except near tip of tail, where they are more or less evident, and confluent with caudal fin, no dermal fold where dorsal or anal fins might be expected; center of eye notably closer to rictus than to tip of snout; anterior nostril tubular, one each side of tip of snout, when depressed reaching to edge of upper lip; posterior nostrils with raised rims, fringed on adults, a single opening over each eye; a vertical line through base of posterior nasal opening passes through pupil; anus a little in front of middle of total length; distance between pore above base of anterior nostril and pore on dorsal surface of snout contained about 1.9 to 2.3 times in distance between latter and rear nostril, all three nearly in straight line; distance between rear nostrils slightly less than diameter of eye; teeth short, conical, vomerine teeth uniserial, arrangement as shown in the figure.

Color in alcohol.—Plain brown without any dark or light spots; tip of tail whitish; nostrils brown; mucus pores not white edged.

UROPTERYGIUS SUPRAFORATUS (Regan)

Gymnomuraena supraforata REGAN, Ann. Mag. Hist., ser. 8, vol. 4, p. 439, 1909 (type locality, Savay).—GUNTHER, Journ. Mus. Godeffroy, vol. 17, pt. 9, p. 426, fig. of head, 1910 (Savaii, Tahiti).

SPECIMENS STUDIED

Bikini Atoll: Arji Island, lagoon, depth 20 to 40 feet, August 7, 1946, S–46–308, Herald and Brock, 1 specimen, 300 mm. in total length. Tidal pond between Eman and Reer Islands, ocean reef, July 18, 1947, S–46–422, Brock, Hiatt, Schultz, and Myers, 1 specimen, 300 mm.

Rongelap Atoll: Yugui Island, ocean reef, July 31, 1946, S–46–304, Herald, 1 specimen, 217 mm.

Description.—Greatest depth 20; head 10 to 10.9; snout to anus 2.0; all in total length. Greatest depth 1.8 to 1.9; length of longest caudal rays 6.5 to 7.7; eye 7.4 to 8.3; snout to rictus 1.8, snout 5.8 to 5.9; interorbital space 5.7 to 6.0; all in length of head.

Body nearly tubular, somewhat compressed posteriorly; dorsal and anal fins not externally evident except near tip of tail, where they are confluent with short caudal fin; center of eye notably closer to tip of snout than to rictus; anterior nostrils very short, tubular, on each side of tip of snout, tubes scarcely longer than posterior nostrils; these latter tubular, single, on each side; a vertical line through center of base of rear nostril passes through a point between middle and rear of pupil; anus at middle of total length; distance between pore above base of anterior nostril and pore on dorsal surface of snout contained about 1.7 to 1.9 times in distance between latter and rear nostril, all three not quite in a straight line; distance between rear nostrils about equal to diameter of eye; jaws equal; teeth very numerous, long, pointed, some caninelike; teeth on maxillary in several slightly oblique rows, inner two or three rows caninelike and outer teeth very small; teeth on dentary similar but less oblique; vomerine teeth uniserial.

Color in alcohol.—Background color light brown to light grayish; everywhere with small brownish spots of irregular shape, more or less united into somewhat distinct vertical rows, spots more or less interconnected; sides of head with fine dark specks, more or less forming a barred pattern; both nasal openings whitish.

Remarks.—This characteristic species may be recognized by its dentition, by its color pattern of small brownish spots more or less arranged to form bars, and by the absence of a white edge on the caudal fin.

UROPTERYGIUS DENTATUS, new species

FIGURE 32

Holotype.—U.S.N.M. No. 141637, Johnston Island, northern ocean reef, August 28–29, 1947, S–42–569, Schultz, only known specimen, 373 mm.

Description.—Precision measurements, made on the holotype, are expressed in thousandths of the total length. Greatest depth 48; head 95; snout to anus 442; longest midcaudal fin rays 13; eye 8; snout 15; snout to rictus 54; interorbital space 16; distance from rear nostril to mucus pore on top of head 8, and from latter to anterior pore above front nostril 6.

Greatest depth 21; head 10.5; snout to anus 2.3, all in total length. Greatest depth 2.0; length of longest caudal fin rays 7.2; eye 12; snout to rictus 1.8; snout 6.3; interorbital space 6.1; all in length of head.

Body nearly tubular and somewhat compressed posteriorly; dorsal and anal fins not externally evident except near tip of tail, where they are confluent with short caudal fin; center of eye a third closer to tip of snout than to rictus; anterior nostrils very short, tubular, on each side of tip of snout, scarcely longer than posterior nostrils, these latter tubular, single, on each side; a vertical line through center of base of rear nostril passes through rear of pupil; anus a little in

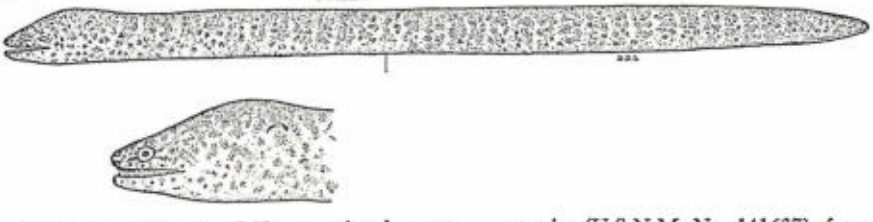

FIGURE 32.—Holotype of *Uropterygius dentatus*, new species (U.S.N.M. No. 141637), from Johnston Island. (Drawing by Dorothea B. Schultz.)

front of middle of total length; distance between pore above base of anterior nostril and pore on dorsal surface of snout contained about 1.4 times in distance between latter and rear nostril, all three not quite in line; distance between rear nostrils about equal to eye; jaws equal; teeth very numerous, long, pointed, those on maxillary in several slightly oblique rows, teeth in outer rows small, in inner rows canine-like; dentary with similar dentition; vomerine teeth uniserial, separated from the premaxillary teeth by a short edentulous area; gill openings notably nearer middorsal line than middle of sides.

Color in alcohol.—Background light gray, everywhere overlaid with numerous small brownish spots or dots more or less interconnecting and arranged to form somewhat indistinct broken or mottled bars; rear nostrils white, anterior ones brownish; jaws somewhat barred with brown specks.

Remarks.—This species is close to *U. supraforatus* Regan, but differs in having much more numerous close-set brown specks or spots arranged in more numerous bars of less distinct nature, the vomerine series of teeth, continuous in *supraforatus*, are interrupted in *dentatus*, and thus are not confluent with the premaxillary teeth.

This eel was named *dentatus* in reference to the characteristic dentition.

UROPTERYGIUS XANTHOPTERUS Bleeker

FIGURE 29, *i*

Uropterygius xanthopterus BLEEKER, Nat. Tijdschr. Nederl.-Indië, vol. 19, p. 350, 1859; Atlas ichthyologique des Indes Orientales Néerlandaises . . ., p. 114, pl. 164, fig.4, 1864 (type locality, Java, Amboina).

SPECIMENS STUDIED

Bikini Atoll: 10 stations, 26 specimens, 70 to 345 mm. total length.
Rongelap Atoll: 5 stations, 8 specimens, 165 to 341 mm.
Kwajalein Atoll: 1 station, 4 specimens, 165 to 286 mm.
Rongerik Atoll: 1 station, 1 specimen, 287 mm.
Eniwetok Atoll: 2 stations, 3 specimens, 107 to 182 mm.

Description.—Greatest depth 27 to 37; head 10 to 11; snout to anus 2.4 to 2.9; all in total length. Greatest depth 2.6 to 3.5; eye 10.8 to 12.4; snout to rictus 2.5 to 2.9; snout 5.4 to 6.5; interorbital space 6.9 to 7.6; longest caudal fin rays 6.1 to 8.3; all in length of head.

Body only a little compressed, more so posteriorly; dorsal and anal fins not externally evident, except near caudal fin; center of eye equidistant or slightly closer to tip of snout than to rictus; anterior nostrils tubular, on each side of tip of snout, when depressed reaching or nearly reaching to edge of upper lip; a single short, tubular posterior nasal opening over each eye; a vertical line through center of base of rear nostril passes through front part of pupil; anus notably in front of middle of total length; distance between pore above base of anterior nostril and pore on dorsal surface of snout contained about 1.6 to 2.0 times in distance between latter and rear nostril, all three in a line; distance between posterior nostrils greater than diameter of eye, jaws nearly equal, lower a little shorter; teeth conical, pointed, in two rows on maxillary and dentary, teeth in outer row very short, in inner row caninelike and widely spaced; vomerine teeth uniserial.

Color in alcohol.—Background color dark brown or blackish brown, somewhat mottled or overlaid with small white specks, these latter most prominent on sides of head and underside of abdomen; snout and lower jaw uniform pale or light brown; specks disappearing posteriorly in larger specimens; tail white edged; posterior nostrils usually white, or partly so; posterior half or more of body may have only scattered white specks; mucus pores same color as head; anterior nostrils brown.

Ecology.—This species was taken frequently from the shallow reefs, where it lived among corals and in the crevices.

Remarks.—This eel is best recognized by its slender body, the white specks prominent on the head, fewer on the body, and the white-edged

tail. A female 258 mm. in total length, taken August 7, contained large eggs apparently fully mature.

Specimens of *Gymnothorax dorsalis* Seale, M.C.Z. Nos. 31061 and 31062, were studied. Although *U. dorsalis* is probably a valid species, it is an elongate species similar to *U. xanthopterus*.

UROPTERYGIUS MARMORATUS (Lacepède)

FIGURE 29, *e*

Gymnomuraena marmorata LACEPÈDE, Histoire naturelle des poissons, vol 5, pp. 648, 649, 1803 (type locality, New Britain).

SPECIMEN STUDIED

Bikini Atoll: Erik Island, ocean reef, March 19, 1946, S–46–9, Schultz and Brock, 1 specimen, 499 mm.

Description.—Greatest depth 19 to 23; head 9.4 to 11; snout to anus 2.3 to 2.4; all in total length. Greatest depth 2.1 to 2.3; eye 12 to 17; snout to rictus 2.8 to 3.1; snout 5.8 to 7.4; interorbital space 8.1 to 10.6; longest midcaudal fin ray 17 to 21; all in length of head.

Body nearly tubular and only a little compressed; dorsal and anal fins not externally evident, caudal fin rudimentary; on young, median fins slightly indicated, more evident posteriorly; center of eye equidistant between snout tip and rictus; anterior nostrils tubular, on each side of tip of snout, when depressed not quite reaching to edge of upper lip; single pair of posterior nostrils tubular, more prominent in adults; a vertical line through center of base of posterior nostril passes through front of pupil; anus a little in front of middle of total length; distance between pore above base of anterior nostril and pore on dorsal surface of snout contained 1.4 to 1.7 times in distance between latter and rear nostril, all three in line; distance between posterior nostrils about equal to diameter of eye; jaws about equal; teeth conical, pointed on adults, usually 5 rows within marginal row on premaxillary and 2 rows within marginal row on maxillary, 2 rows on maxillary and 2 on dentary in young, 2 or 3 rows on vomer in large adults.

Color in alcohol.—Coloration a mottled combination of gray, brown, blackish, or whitish, adult appearing somewhat blotched, with irregular close-set dark spots; underside of head nearly plain white to dark, nostrils blotched with brownish or blackish.

Remarks.—This species appeared to be very rare in the northern Marshall Islands.

UROPTERYGIUS MICROPTERUS (Bleeker)

FIGURE 29, *h*

Muraena micropterus BLEEKER, Nat. Tijdschr. Nederl. Indië, vol. 3, p. 298, 1852; Atlas ichthyologique des Indes Orientales Néerlandaises . . ., p. 115, pl. 164, fig. 2, 1864 (type locality, Flores, Buro, Morotai, Amboina, Ceram, Aru, Timor).

Uropterygius tinkhami FOWLER, Proc. Acad. Nat. Sci. Philadelphia, vol. 97, p. 59, figs. 1, 2, 1945 (Saipan).

SPECIMENS STUDIED

Rota: 1 lot, 1 specimen, 242 mm. total length.
Guam: 13 lots, 48 specimens, 53 to 260 mm.

Description.—Greatest depth 16 to 22; head 8.6 to 9.8; snout to anus 2.1 to 2.2; all in total length. Greatest depth 1.6 to 2.6; eye 11.2 to 13.8; snout to rictus 2.9 to 3.4; snout 6.2 to 7.5; interorbital space 10.0 to 12.2; all in length of head.

Body nearly tubular, only a little compressed forward, more so near tail; dorsal and anal fins represented by rays only near tail, sometimes a fold of skin along middorsal line of back beginning on rear of head, caudal fin very small; center of eye about equidistant between tip of snout and rictus; anterior nostrils tubular, on each side of tip of snout, when depressed reaching to opposite edge of upper lip; single pair of posterior nasal openings represented by a slightly raised rim, not at all tubular, a vertical line through center of posterior nasal opening passes a little in front of pupil of eye; anus a little in front of middle of total length; distance between pore above base of anterior nostril and pore on dorsal surface of snout contained 1.1 to 1.4 times in distance between latter and rear nostril, all three in line; distance between posterior nostrils slightly less than diameter of eye; lower jaw equal to or slightly shorter than upper; teeth conical, pointed, arranged as shown in figure, vomer with but a single row of teeth.

Color in alcohol.—Background color brown or light grayish, overlaid with a fine pattern of reticulated black lines or a network of blackish or brownish lines; under side of head plain white or pale, sometimes sides of lower jaw have some black recticulated lines; ventral part of body a little lighter than dorsal.

Remarks.—This species, apparently very common in the Marianas Islands, was not found in the northern Marshall Islands, in spite of the extensive collecting. Schultz (U. S. Nat. Mus. Bull. 180, p. 33, 1943) placed the types of *Anarchias knighti* Jordan and Starks *in* Jordan and Seale with this species. Upon further study it was observed by him that the "145 mm." specimen is actually *Uropterygius micropterus*, now bearing the U.S.N.M. No. 147772. The "115 mm." is a different species and was designated as the type of *knighti* by Jordan and Starks. The latter is a valid species.

UROPTERYGIUS FUSCOGUTTATUS, new species

FIGURE 33

Holotype.—U.S.N.M. No. 141680, Bikini Atoll, off Amen Island, lagoon, depth 30 feet, August 4, 1946, S–46–307, Herald, Kohler, and Brock, total length 176 mm.

Paratypes.—U.S.N.M. No. 141679, Bikini Atoll, Bikini Island, ocean reef, July 16, 1946, S–46–253, Herald, 1 specimen, 185 mm. in total length; U.S.N.M. No. 141681, Bikini Atoll, Arji Island, lagoon, depth 20 to 40 feet, August 7, 1946, S–46–308, Herald and Brock, 2 specimens, 163 and 189 mm.; U.S.N.M. No. 141678, Bikini Atoll, Eman Island, channel reef, July 17, 1947, S–46–405, Schultz, Brock, Hiatt, Myers, 1 specimen, 140 mm.; U.S.N.M. 141676, Eniwetok Atoll, Jieroru Island, ocean reef, May 21, 1946, S–46–174, Schultz, 1 specimen, 63 mm.; U.S.N.M. No. 141677, Rongelap Atoll, Mellu Island, lagoon reef, June 19, 1946, S–46–220, Schultz and Herald, 2 specimens, 86

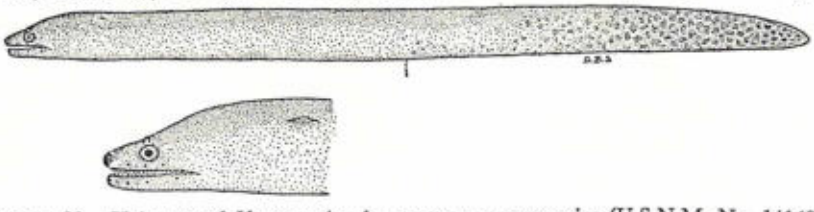

FIGURE 33.—Holotype of *Uropterygius fuscoguttatus*, new species (U.S.N.M. No. 141680), from Bikini Atoll. (Drawing by Dorothea B. Schultz.)

and 165 mm.; U.S.N.M. No. 141675, Johnston Island, northern ocean reef, August 28–29, 1947, S–42–569, Schultz, 1 specimen, 148 mm.

Description.—Precision measurements were made on the holotype and 4 paratypes and these, expressed in thousandths of the total length, are recorded in that order, respectively.

Total length in mm. 176; 165; 163; 148; 140.

Greatest depth 54; 48; 46; 57; 39 length of head 110; 101; 107; 103; 100; snout to anus 500; 497; 503; 493; 486; longest midcaudal fin ray 10; 11; 13; 13; 14; eye 11; 11; 10; 11; 10; snout 20; 19; 19; 19; 20; snout tip to rictus 49; 53; 48; 49; 48; interorbital space 14; 15; 15; 15; 15.

Greatest depth 17 to 25; head 9.1 to 10.0; snout to anus 1.99 to 2.03; all in total length. Greatest depth 1.8 to 2.5; longest midcaudal fin ray 7.0 to 11.4; eye 9.3 to 10.3; snout to rictus 1.9 to 2.2; snout 5.0 to 5.6; interorbital space 6.7 to 7.8; all in the length of the head.

Body a little compressed, more so near tip of tail; dorsal and anal fins absent except near tip of tail, with which they are confluent; center of eye equidistant between tip of snout and rictus; anterior nostrils tubular, on each side of tip of snout, when depressed not reaching edge of upper lip; a single posterior nasal opening over each eye, in a short tube, but only a raised rim in the smallest specimens; a vertical line through center of base of rear nostril passes through front of pupil; anus equidistant, or nearly so, between tip of snout and tip of tail; distance between pore above base of anterior nostril and pore on dorsal surface of snout contained about 1.9 to 2.1 times in distance between latter and rear nostril, all three in a straight line; distance between

rear nostrils a little greater than diameter of eye; lower jaw a little shorter than upper, tip of snout projecting a trifle; teeth conical, those in inner rows caninelike; vomerine teeth uniserial.

Color in alcohol.—Plain brown anteriorly, becoming dark-brown spotted posteriorly, these spots often irregular in shape, sometimes more or less arranged to form somewhat interconnecting narrow vertical bars, smaller specimens plain light brown without spots; lower jaw, sometimes including area behind it whitish or light brown, persistently paler than brown body; mucus pores on head brownish; anterior nostril and most of rear nostril white; margin of caudal fin whitish.

Ecology.—This new eel seemed to prefer the ocean reef and the deeper waters of the lagoon.

Remarks.—This new species differs from others in the genus by having a plain brown coloration anteriorly, with brown spots or interconnecting bars posteriorly, in combination with caninelike teeth, short tubular posterior nostrils, and no white around the mucus pores on the head.

Named *fuscoguttatus* in reference to its brown color and brown spots.

UROPTERYGIUS REIDI Schultz

PLATE 16

Uropterygius reidi SCHULTZ, U. S. Nat. Mus. Bull. 180, p. 32, pl. 5, 1943 (type locality, Tau Island, Samoan group).

SPECIMENS STUDIED

Bikini Atoll: Enyu Island, entrance reef, lagoon, March 16, 1946, S–46–8, Schultz, Brock, and Marr, 1 specimen, 147 mm. total length; Bokon Island, ocean reef, April 15, 1946, S–46–94, Schultz and Brock, 1 specimen, 90 mm.

Description.—Greatest depth 21 and 22; head 7.6 and 7.7; snout to anus 2.1 and 2.2; all in total length. Greatest depth 2.7 and 2.8; longest ray of caudal fin 15 and 27; eye 12 and 13; snout tip to rictus 2.9 and 3.0; snout 5.6 and 9.1; interorbital space 6.9 and 7.6; all in length of head.

Body a little compressed, more so posteriorly; dorsal and anal fins restricted to near tip of tail; center of eye notably closer to rictus than to tip of snout; anterior nostril tubular, on each side of tip of snout, when depressed not long enough to reach edge of upper lip; single posterior nasal opening over each eye, in a short tube, only a raised rim on smaller specimen; vertical line through center of rear nostril passes through middle of pupil; anus a little closer to tip of tail than to snout; distance between pore above base of anterior nostril and pore on dorsal surface of snout contained about 1.5 to 1.6 times in distance between latter and rear nostril, all three in a straight line; distance between rear nostrils about equal to diameter of eye; lower jaw slightly

shorter than upper, or equal; teeth conical, those in inner rows canine-like; vomerine teeth uniserial.

Color in alcohol.—Numerous brownish bars, irregular in shape and somewhat reticulated, with pale or light brown interspaces; lower jaw usually uniform pale brown or nearly white; lower lip not barred. Since describing *reidi* I have changed my conception of the species somewhat to include another color phase, which is very dark, almost blackish, yet the vertical bars can be seen when the specimen is examined closely. These have the same shape as those on the types of *reidi* and on the two specimens listed above, all five of which represent the light color pattern. To this species I refer the following lots: U.S.N.M. No. 115930, 115932, and 115933. These were reported by me as *U. marmoratus* in U. S. Nat. Mus. Bull. 180, 1943.

Remarks.—This species is close to *U. necturus* of the Gulf of California and the west coast of Central America, but it can be distinguished by a slight difference in color pattern. The dark or blackish color phase is indeed confusing, but it probably is the same species as *reidi*.

Order SYNENTOGNATHIDA

Suborder SCOMBERESOCINA

Family BELONIDAE: Needlefishes

By LEONARD P. SCHULTZ

KEY TO THE GENERA OF BELONIDAE OF THE NORTHERN MARSHALL ISLANDS

1*a*. Gill rakers not rudimentary, but distinct on first gill arch, at least near its posterior angle; caudal peduncle strongly depressed, with lateral scaly keels that continue on basal half of middle caudal fin rays; lateral line complete and rising to extend close under lateral keel; greatest width of body a little greater than greatest depth ---------- Belone Cuvier (p. 160)

1*b*. Gill rakers rudimentary.

2*a*. Body strongly compressed, greatest width about twice in greatest height; lower pectoral rays notably and abruptly shorter than upper ones; jaws notably arched in front of eyes, or "swollen" so that they do not completely close ---------- Ablennes Jordan and Fordice (p. 161)

2*b*. Body not strongly compressed, greatest width contained less than 1½ times in greatest height; pectoral rays graduated, lower ones not abruptly shorter than upper rays; jaws not notably arched near their bases.

3*a*. Upper jaw equal to or not over ⅘ shorter than lower jaw; caudal peduncle nearly round in cross section; caudal fin forked or with truncate or concave posterior margin ---------- Strongylura Van Hasselt (p. 161)

3*b*. Upper jaw ⅔ length of lower jaw; caudal peduncle depressed, with a pseudo keel; caudal fin more or less rounded with lower rays a little longer ---------- Rhaphiobelone (Fowler (p. 163)

Genus BELONE Cuvier

Belone CUVIER, Règne animal, ed. 1, p. 185, 1817. (Genotype, *Esox belone* Linnaeus.)

BELONE PLATYURA Bennett

Belone platyura BENNETT, Proc. Zool. Soc. London, 1831, pt. 1, p. 168 (type locality, Mauritius).

SPECIMENS STUDIED

Bikini Atoll; 5 stations, 16 specimens, 325 to 380 mm. standard length.
Guam; 1 lot, 1 specimen, 335 mm.

Description.—Dorsal rays i, 12 to 14; anal ii, 15 or 16; pectoral i, 10 or 11; pelvic 6; gill rakers on first arch 4 or 5+15 to 17. Lateral line along lower lateral edge of body; head about 2.8 to 3.0 in standard length; greatest depth about ⅔ to ¾ greatest width of body; caudal peduncle strongly depressed, with lateral keels; caudal fin forked; postorbital length of head contained about 1.2 in longest pectoral fin ray; scales very small, cycloid; teeth on jaws in bands, outer band broad, villiform, along inner edge of band a row of enlarged, conical teeth, not strong canines; upper pharyngeals with 2 pairs of patches of villiform teeth; gill rakers developed and obvious, not rudimentary; diameter of eye contained from 1.5 to 1.8 times in postorbital length of head, and the latter contained from 2.0 to 2.2 in distance between pelvic insertion and anal origin; diameter of eye in distance between pelvic insertion and anal origin 3.1 to 3.6; dorsal origin a little behind a vertical line through anal origin.

Color in alcohol.—Brownish above, silvery below; a dark brown band, its width about equal to height of pupil, along middorsal line of back; dark streak along middle of sides; a silvery area on cheek and a large one in front of and below pectoral base.

Color when alive.—The lateral streak was blue.

Ecology.—This needlefish was seen swimming near the surface in the lagoon and along the ocean side of the reefs.

Remarks.—In my report on the fishes of the Phoenix and Samoan Islands (U. S. Nat. Mus. Bull. 180, 1943), I stated that *B. platyura* and *B. persimilis* were the same species. Since collecting four specimens of *B. persimilis* from Johnston Island, I am able to separate the two species as follows:

1*a*. Eye 1.5 to 1.8 in postorbital length of head and 3.1 to 3.6 in distance between pelvic insertion and anal origin; postorbital length of head 2.0 to 2.2 in distance between pelvic insertion and anal origin.
Belone platyura Bennett

1*b*. Eye 1.8 to 2.1 in postorbital length of head and 4.0 to 5.1 in distance between pelvic insertions and anal origin; postorbital length of head 2.3 to 2.5 times in distance between pelvic insertions and anal origin.
Belone persimilis Günther

Genus ABLENNES Jordan and Fordice

Athlennes JORDAN and FORDICE, Proc. U. S. Nat. Mus., vol. 9, p. 342, 1887. (Genotype, *Belone hians* Cuvier and Valenciennes; changed to *Ablennes; Athlennes* is a misprint, according to the International Commission on Zoological Nomenclature.)

ABLENNES HIANS (Cuvier and Valenciennes)

Belone hians CUVIER and VALENCIENNES, Histoire naturelle des poissons, vol. 18, p. 432, pl. 548, 1846 (type locality, Bahia, Brazil).

SPECIMEN STUDIED

Bikini Atoll: *Chilton* anchorage, 1 mile off Bikini Island, lagoon, July 20 and August 10, 1947, Smith and Schultz, 1 specimen, 835 mm.

Description.—Dorsal rays ii, 22; anal ii, 25; pectoral ii, 12–ii, 13; pelvic i, 5–i, 5. Lateral line along ventral lateral edge of body but rising on rear of caudal peduncle to end on midlateral part of caudal fin. Head 4; snout tip to dorsal origin 1.30, to anal origin 1.35; all in standard length. Greatest width of body about 2.1 in greatest height; body and caudal peduncle strongly compressed, without lateral keels; caudal fin forked; lower 7 rays of pectoral fin nearly ¼ shorter than others; postorbital length of head contained about 1.8 or 1.9 in longest pectoral fin ray; scales very small, cycloid; teeth on jaws in a band, outer ones villiform, along inner edge a row of enlarged, conical, caninelike teeth; rear third of jaws not completely closing; upper pharyngeals with two pairs of patches of villiform teeth; gill rakers rudimentary; dorsal origin a little behind a vertical line through anal origin; orbit around its margins enclosed by an adipose eyelid. Eye 9.4; postorbital length of head 4.3; snout 1.5; bony interorbital space 8.4; all in length of head. Diameter of eye contained 2.2 times in postorbital length of head and 6.5 times in distance from pelvic insertion to anal origin; postorbital length of head 2.97 times in distance from pelvic insertion to anal origin.

Color in alcohol.—Dark brownish dorsally, paler ventrally, the back blackish; all fins dusky.

Ecology.—This species of needlefish grows to a large size. Specimens were occasionally seen swimming near the surface in the lagoon.

Genus STRONGYLURA van Hasselt

Strongylura VAN HASSELT, Alg. Konst. Letterbode, No. 35, 1823; Bull. Sci. Nat. (Férussac), vol. 2, p. 374, 1824. (Genotype, *S. caudimaculata* van Hasselt= *Belone strongylura* van Hasselt, 1823.) (References copied.)

Tylosurus Cocco, Giorn. Sci. Sicilia, vol. 42, No. 124, 1833. (Genotype, *Tylosurus cantraini* Cocco.)

KEY TO THE SPECIES OF STRONGYLURA COLLECTED IN THE NORTHERN MARSHALL ISLANDS

1*a*. Lateral line not rising to midlateral part of caudal peduncle, not forming a lateral dermal keel, and ending about opposite tip of last dorsal fin ray, thus incomplete; canines of upper jaw directed straight downward.

Strongylura incisa (Cuvier and Valenciennes)

1*b*. Lateral line complete, rising to near midside of caudal peduncle and forming a ridge or keel near rear part of peduncle, ending at posterior edge of scaled area of base of caudal fin; canines of upper jaw notably slanting or curved a little forward.

Strongylura gigantea (Temminck and Schlegel)

STRONGYLURA GIGANTEA (Temminck and Schlegel)

Belone gigantea TEMMINCK and SCHLEGEL, Fauna japonica, pt. 5, p. 245, 1846 (type locality, Japan).

Belone annulata CUVIER and VALENCIENNES, Histoire naturelle des poissons, vol. 18, p. 447, pl. 550, 1846 (type locality, Celebes, Seychelles).

SPECIMENS STUDIED

Bikini Atoll: Lagoon, March 11–31, 1946, S–46–2, Brock, Marr, and Schultz, 1 specimen, 960 mm. in standard length.

Rota: October 1945, Necker, 1 specimen, 318 mm.

Description.—Dorsal rays ii,21; anal ii,18 and 20; pectoral i,13 or 14; pelvic i,5. Lateral line along ventral lateral edge of body but rising to near midside on caudal peduncle, forming a ridge or keel near rear part of peduncle and ending at posterior edge of scaled area of base of caudal fin; thus lateral line is complete. Head 2.9 to 3.8; snout tip to dorsal origin 1.30 to 1.31; snout to anal origin 1.31 to 1.32; all in standard length. Greatest width of body 1.1 to 1.3 in greatest depth; body rounded, not notably depressed or compressed; caudal fin broken but probably forked; lower pectoral fin rays not abruptly shorter than dorsal ones; postorbital length of head contained about 0.9 times in longest pectoral fin ray; scales small, cycloid; teeth on jaws in a villiform band, with inner row of enlarged canines; upper pharyngeals with two pairs of patches of villiform teeth; gill rakers rudimentary; dorsal origin very slightly behind a vertical line through anal origin; eye without adipose eyelid. Eye 9.9 to 10.2; postorbital length of head 3.3 to 4.4; snout 1.67 to 1.72; bony interorbital space 5.7 to 8.7; all in length of head. Postorbital length of head 1.9 to 2.1 in distance between pelvic insertion and anal origin. Eye 2.2 to 3.1 in postorbital length of head and 4.2 to 6.9 times in distance from pelvic insertion to anal origin; interorbital space nearly flat.

Color in alcohol.—Back brownish, undersides pale; middorsal line with a blackish or brownish band, on each side of which is a black line.

Ecology.—This large specimen was caught in the lagoon by trolling with an artificial lure.

STRONGYLURA INCISA (Cuvier and Valenciennes)

Belone incisa CUVIER and VALENCIENNES, Histoire naturelle des poissons, vol. 18, p. 451, 1846 (type locality, Indian Ocean).

SPECIMENS STUDIED

Bikini Atoll: 3 stations, 7 specimens, 205 to 710 mm. in standard length.
Eniwetok Atoll: 1 station, 1 specimen, 690 mm.
Rongelap Atoll: 1 station, 3 specimens, 550 to 595 mm.

Description.—Dorsal rays i,18 or 19; anal i or ii,20 or 21; pectoral i,10 or 11; pelvic i,5. Lateral line along ventral lateral edge of body but not rising to midlateral part of caudal peduncle, not forming a lateral keel, and ending a little distance in front of base of caudal fin or about opposite tip of last dorsal fin ray. Head 2.1 to 2.8; snout tip to dorsal origin 1.25 to 1.26; snout tip to anal origin 1.28 to 1.29; all in standard length. Greatest width of body about 1.4 in greatest depth; body a little compressed, caudal peduncle nearly round; caudal fin with concave margin, not strongly forked; lower pectoral fin rays not abruptly shorter than upper rays; postorbital length of head contained about 0.9 to 1.0 times in longest pectoral fin ray; scales small, cycloid; teeth on jaws in a band, outer ones villiform, inner row of enlarged, conical, caninelike; upper pharyngeals with 2 pairs of patches of villiform teeth; gill rakers rudimentary; dorsal origin about over second branched ray of anal fin; eye without adipose eyelid.

Eye 9 to 14; postorbital length of head 3.1 to 5.4; snout 1.6 to 1.8; bony interorbital space 8 to 12; all in length of head. Diameter of eye contained 2.6 to 3.2 times in postorbital length of head and 4.5 to 7.3 times in distance from pelvic insertion to anal origin; postorbital length of head 1.8 to 1.9 times in distance from pelvic insertion to anal origin; interorbital space with middle part strongly concave.

Color in alcohol.—Background light tan or straw color; middorsal line of back with a dark streak, each side of which is a black line; dorsal lateral side with a black streak; bases of pectoral rays blackish; area under maxillary on dentary blackish; cheeks with numerous brownish spots, sometimes absent.

Ecology.—This species was seen near the surface in the lagoon, and on the ocean side of the reef.

Genus RHAPHIOBELONE Fowler

Rhaphiobelone FOWLER, Proc. Acad. Nat. Sci. Philadelphia, vol. 85, p. 322, 1933. (Genotype, *Rhaphiobelone dammermani* Fowler.)

KEY TO THE SPECIES OF RHAPHIOBELONE

1*a*. Eye in postorbital length of head 2.9 and in distance from pelvic insertion to anal origin 5.3; dorsal fin origin over base of 7th or 8th anal fin ray; eye

diameter in distance between vertical lines through origins of dorsal and anal fins about 1.7_____ Rhaphiobelone dammermani Fowler

1b. Eye in postorbital length of head 2.1 to 2.2, and in distance from pelvic insertion to anal origin 3.8 to 4.3; dorsal fin origin over base of 4th or 5th anal fin ray; eye diameter in distance between vertical lines through origins of dorsal and anal fins 0.5 to 0.6_____ Rhaphiobelone robusta, new species

RHAPHIOBELONE ROBUSTA, new species

PLATE 17, A

Holotype.—U.S.N.M. No. 141749, Rongelap Atoll, off Yugui Island, light at night, July 30, 1946, S–46–303, Herald, standard length 124.5 mm.

Paratypes.—U.S.N.M. No. 141750, Bikini Atoll, Enyu Island, ocean reef, channel entrance, August 1, 1947, S–46–483, Schultz, Brock, and Hiatt, 1 specimen, 165 mm. (tips of jaws broken off during preservation); U.S.N.M. No. 139774, Guam, November 26, 1945, Frey, 1 specimen, 170 mm. (tips of jaws broken off); U.S.N.M. No. 93064, Philippines, Luzon Island, Port Dupon, March 17, 1909, *Albatross*, 1 specimen; U.S.N.M. No. 93067, Philippines, Pandanon Island, March 24, 1909, *Albatross*, 1 specimen; U.S.N.M. No. 93072, Philippines, Maculabo Island, southern Luzon, June 13, 1909, *Albatross*, 1 specimen; U.S.N.M. No. 93073, Philippines, Mindoro Island, Varadero Bay, July 23, 1908, *Albatross*, 1 specimen. (Tips of jaws of all Philippine specimens have been broken off.)

Description.—Dorsal rays i or ii, 17 to 20; anal ii, 19 or 20; pectoral usually i, 11.

Precision measurements were made on the holotype and one paratype and these data are expressed in thousandths of the standard length, respectively. Standard length in mm. 124.5 and 165. Length of head 397 and 394; tip of chin to front of eye 400 and 362; distance from rear of eye to midbase of caudal fin 671 and 691; diameter of eye 34 and 38; interorbital space 34 and 36; snout 297 and 279; postorbital length of head 75 and 78; snout to dorsal origin 784 and 800; snout to anal origin 775 and 742; pectoral insertion to pelvic insertion 233 and 230; pelvic insertion to anal origin 146 and 142; greatest depth 40 and 42; greatest width of body or head 38 and 41; distance between vertical lines through dorsal and anal origins 17 and 24.

Head 2.5; snout to dorsal origin 1.28; snout to anal origin 1.29, all in standard length. Eye 10.5 to 11.8; postorbital length of head 5.1 to 5.3; snout 1.4; bony interorbital space 10.8 to 11.8, all in length of head. Greatest width 1.0 to 1.1 in greatest depth. Eye 2.1 to 2.2 in postorbital length of head and 3.8 to 4.3 in distance between pelvic insertion and anal origin. Postorbital length of head 1.8 to 2.0 in distance from pelvic insertion to anal origin. Eye 0.5 to 0.6 in distance between vertical lines through dorsal and anal origins.

Lateral line along ventral lateral edge of body but not rising to mid-lateral side of caudal peduncle, not forming a lateral keel, and incomplete or ending about opposite tip of last anal ray; caudal peduncle depressed to form a pseudokeel a little in front of base of caudal fin; greatest depth of body only slightly greater than greatest width; body not compressed; caudal fin with truncate margin or lower rays a little longer than upper; posterior rays of dorsal and anal fins not expanded into separate lobes; pectoral fin rays graduated, lower ones not notably abruptly shorter than upper ones; postorbital length of head about equal to longest pectoral fin ray; scales small, cycloid; teeth on jaws in a band, outer ones villiform, inner row canines; upper pharyngeals with 2 pairs of patches of villiform teeth; gill rakers rudimentary; dorsal origin over base of fourth or fifth anal ray or second or third branched anal ray; no adipose eyelid; interorbital space with central area flat, concave with respect to portion over orbits; projecting part of lower jaw beyond tip of snout contained about 2½ times in snout; sides of lower jaw distally with a broad free dermal membrane that hangs downward, widest below free part of lower jaw.

Color in alcohol.—Back brownish; undersides white or silvery; a blackish-blue lateral streak along side, separating brown back from white sides and belly; midline of back with a black line, and another a little distance each side along back; free dermal membrane of lower jaw black; fleshy tip of lower jaw black; area below maxillary blackish; bases of upper pectoral fin rays blackish.

Color when alive.—Notes taken from Kodachrome picture: Back blackish; lateral streak bluish; pectorals light yellowish.

Remarks.—This new species is referred to the genus *Rhaphiobelone* because it lacks gill rakers and has a depressed caudal peduncle similar to that of *Belone*, but differs in having an upper jaw notably shorted than the lower jaw. It may be distinguished from *Rhaphiobelone dammermani* Fowler (U.S.N.M. No. 93065, holotype) in having a larger eye, a shorter postorbital part of the head, and a more robust body; *R. dammermani* has a distinctly compressed body, whereas *robusta* has a nearly squarish body. Both species are adequately separated in the key.

Named *robusta* in reference to its heavy, short body.

Suborder EXOCOETINA

Family HEMIRAMPHIDAE: Halfbeaks

By LOREN P. WOODS and LEONARD P. SCHULTZ

In addition to the specimens described under the species of this family are five postlarvae, too small to identify without considerable additional study, from Eniwetok Atoll.

KEY TO THE GENERA OF HEMIRAMPHIDAE OF THE NORTHERN MARSHALL ISLANDS AND ADJOINING REGIONS [19a]

1*a*. Body extremely elongate, extremely compressed, bandlike; back with low but prominent median ridge; pectoral fins very long, longer than head (tip of upper jaw to hind margin of opercular flap).
Euleptorhamphus Gill (p. 166)

1*b*. Body moderately elongate, moderately compressed, or rounded; not bandlike; back flattened or rounded; pectoral fin equal to or shorter than head.

2*a*. Upper jaw naked; nasal fossa rounded, deeply depressed, its greatest diameter one-fourth to one-third that of orbit; posterolateral border of nasal fossa without prominent bony rim; sensory canal on preorbital branched, with a pore at end of posterior branch (which terminates in a bony ridge near front of orbit) and a pore at end of anterior branch near anteroventral margin of nasal fossa; inner pelvic ray elongate, longer than outer pelvic ray---------- Hemiramphus Cuvier (p. 168)

2*b*. Upper jaw scaled; nasal fossa broad and little depressed, its greatest inner diameter more than one-half that of orbit; posterolateral border of nasal fossa surmounted by a prominent bony rim; sensory canal on preorbital unbranched, with an exposed pore on side and another pore at termius of canal near anterior margin of nasal fossa; inner pelvic ray not longer than outer pelvic ray---------- Hyporhamphus Gill (p. 169)

Genus EULEPTORHAMPHUS Gill

Euleptorhamphus GILL, Proc. Acad. Nat. Sci. Philadelphia, May 1859, p. 156. (Genotype, *Euleptorhamphus brevoortii* Gill.)

EULEPTORHAMPHUS VIRIDIS (van Hasselt)

Hemiramphus viridis VAN HASSELT, Bull. Sci. Nat. (Férussac), vol. 2, p. 374, 1824 (on Kuddera C. Russell, Descriptions of two hundred fishes collected at Vizagapatam on the coast of Coromandel, vol. 2, p. 67, pl. 178, 1803) (type locality, Vizagapatam, India).

[19a] The characters used in this key to distinguish between *Hemiramphus* and *Hyporhamphus* are chiefly from R. R. Miller, Proc. U. S. Nat. Mus., vol. 96, p. 187, 1945.

Hemiramphus macrorhynchus CUVIER and VALENCIENNES, Histoire naturelle des poissons, vol. 19, p. 54, pl. 556, 1846 (long. 177° E. (Paris), lat. 7° S.) (type locality, Peyster Island, Polynesia).

Hemiramphus longirostris CUVIER, Règne animal, ed. 2, vol. 2, p. 286, 1829 (type locality, warm seas, both hemispheres).

Euleptorhamphus longirostris MYERS, Copeia, No. 4, p. 320, 1950 (Bikini).

SPECIMEN STUDIED

Eniwetok Atoll: Southwest Passage, leeward side of reef 2 miles south of Rigili Island, surface light at night, May 24, 1946, S–46–183, Schultz, 1 specimen, 293 mm.

Description.—Dorsal rays ii or iii,19 or 20; anal iii,19 or 20; pectoral i,7 or i,8; pelvic i,5; branched caudal 6+7; scales in lateral line about 126, from dorsal origin diagonally to lateral line 4, from anal origin to lateral line 3; predorsal scale rows 60 to 65; gill rakers 7 or 8 + 19 and 22 on first arch; teeth in jaws small, close set, in 4 regular rows in lower jaw, 4 or 5 irregular rows in upper; large patch of teeth present on vomer.

Depth of body 14.5, greatest width (just anterior to pectoral fins) 25.7; head length (tip of upper jaw to posterior margin of opercular flap) 6.8; length of lower jaw extending beyond upper jaw 3.0; all in standard length (tip of upper jaw to base of middle caudal rays). Snout 3.0; least depth of caudal peduncle 5.5; length of pectoral fin 0.58; postorbital part of head 2.7; caudal fin lobes broken; diameter of eye 3.3; all in length of head. Head width across preorbitals 1.45, across preopercles 1.05; length of maxillary plate (movable part of upper jaw) 2.45, width 1.55; all in length of snout (tip of upper jaw to anterior margin of orbit).

Maxillary plate of upper jaw bluntly pointed, with prominent median ridge, upper surface scaled; interorbital deeply concave; body extremely compressed, back with a slight median ridge; dorsal and anal fins high anteriorly, concave; anal fin originates under fourth dorsal ray, no scales on dorsal or anal fins; pelvic insertion nearer caudal base than opercular opening by half length of head.

Color in alcohol.—Top of head and back light brown; lateral stripe broad, silvery, lower sides of head and body silvery; dorsal fin with membranes pale, each ray with a thin black line on anterior and posterior sides; anal pale; caudal fin with upper lobe membranes black, lower lobe dusky with fine black lines between the rays; pectoral fin base dusky, rest of fin pale; pelvic fin pale.

Ecology.—Some members of this species were observed by Schultz actually to fly both in Bikini Channel and at Eniwetok, where one was seen flying for a distance of about 50 feet, with its tail completely out of water. On July 19, 1947, Schultz and Myers saw this species fly, making two taxis. The flight lasted several seconds and

covered about 150 feet into the wind. The greatest height above the crests of the 6-foot-high waves was about 8 feet. The flight position is one in which the posterior half of the length sags notably downward, and the anterior half of the head and body, including beak, is straight forward. The flight is a steady one. Schultz and Stern (The Ways of Fishes, p. 18, 1948) and Myers (Copeia, No. 4, p. 320, 1950) give an account of this species in flight.

Remarks.—The remains of five specimens of this species were recovered from the stomach of the wahoo, *Acanthocybium solandri*, caught in Aran Pass, Bikini Atoll, July 21, 1947, by Marr and O. Smith. This material was so nearly digested that it was discarded.

Genus HEMIRAMPHUS Cuvier

Hemi-Ramphus Cuvier, Règne animal, ed. 1, vol. 2, p. 186, 1817. (Genotype, *Esox brasiliensis* Linnaeus.)

HEMIRAMPHUS MARGINATUS (Forskål)

Esox marginatus Forskål, Descriptiones animalium . . ., p. 67, 1775 (type locality, Djedda, Arabia).

SPECIMENS STUDIED

Saipan: Obtained from fishermen, October 8, 1945, Simon, 3 specimens, 179.3 to 192 mm.; Harbor near Garapan, hook and line at surface, February 2, 1945, McBurney, 4 specimens, 220.5 to 237 mm.

Description.—Dorsal rays ii,11 or 12; anal ii,10; pectoral i,9 to 11; pelvic i,5; branched caudal 6+7; scales in lateral line 51 to 57, from origin of dorsal diagonally to lateral line 5½, from anal origin to lateral line 2; predorsal scale rows 40 to 42; gill rakers 10 to 13+29 to 33; teeth in both jaws in 2 rows anteriorly, 3 posteriorly (sometimes 4 posteriorly in lower jaw).

Depth of body 6.4 to 6.8, width 9.9 to 11.3; head length (from tip of upper jaw) 4.2 to 4.35; length of lower jaw extending beyond upper jaw 3.3 to 3.8; all in standard length (tip of upper jaw to base of middle caudal rays). Snout 2.75 to 2.85; least depth of caudal peduncle 3.85 to 4.5; length of pectoral fin 1.05 to 1.1; postorbital part of head (hind margin of eye to upper edge of gill opening) 2.65 to 2.9; lower lobe of caudal 0.9 to 1.0, upper lobe 1.25 to 1.35; eye 4.3 to 4.6; all in length of head (tip of upper jaw to hind margin of opercular flap). Interorbital space in eye 1.0 to 1.03. Head width across preorbitals 1.6 to 1.68, across preopercles 1.0 to 1.13; length of maxillary plate (movable part of upper jaw) 2.35 to 2.5, width 1.75 to 2.0; all in length of snout (tip of upper jaw to anterior margin of orbit).

Maxillary plate of upper jaw convex, with prominent median ridge, bluntly pointed; interorbital area flat; back rounded, sides straight; anal origin opposite insertion of fifth branched caudal ray; dorsal and

anal fins concave, last ray of dorsal produced, though not so long as first branched dorsal ray, length of anal base 1.5 in that of dorsal.

Color in alcohol.—Upper part of head, back and sides of body light grayish brown to dark greenish brown; lower sides of head and of body and belly silvery white; silvery lateral band rather indistinct; dorsal part of lower jaw and its lateral membrane dark brown proximally, tip of lower jaw light yellow, underside of lower jaw speckled

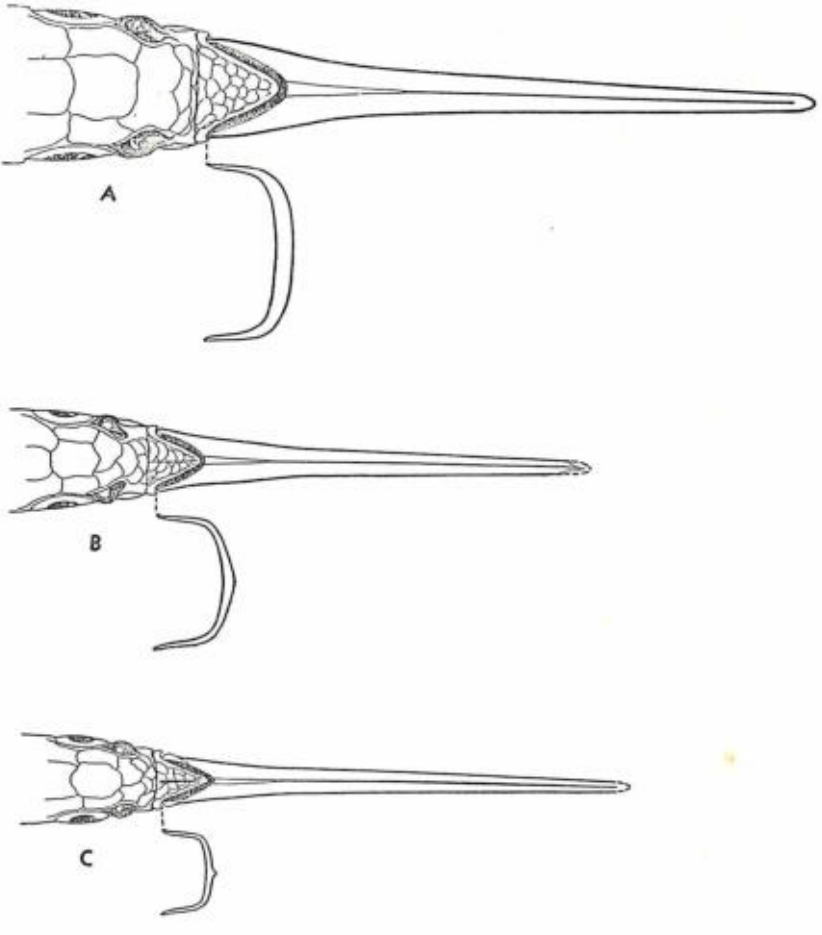

FIGURE 34.—Dorsal view of head of three species of *Hyporhamphus: a, H. laticeps* (Günther); *b, H. dussumieri* (Valenciennes); *c, H. acutus* (Günther). (Drawing by Aime M. Awl.)

with very fine dark brown punctations; dorsal fin anterior rays dark brown; anal fin pale; caudal fin dusky, with fine dark lines outlining rays; pectoral fin pale; pelvic fin dusky at base and through middle.

Color in life.—Greenish brown to iridescent blue on back; underside silvery; caudal fin rays blue.

Genus HYPORHAMPHUS Gill

Hyporhamphus GILL, Proc. Acad. Nat. Sci. Philadelphia, 1859 (April), p. 131. (Genotype, *Hyporhamphus tricuspidatus* Gill=*Hyporhamphus unifasciatus* Ranzani.)

The members of this genus occur in fairly large schools. They commonly come to a light at night.

KEY TO THE SPECIES OF HYPORHAMPHUS OF THE NORTHERN MARSHALL ISLANDS

1*a*. Base of dorsal fin longer than base of anal fin.

2*a*. Gill rakers on first arch 10 to 14+28 to 33=39 to 46; upper jaw much broader than long, bluntly rounded (bluntly pointed in young), flat or smoothly convex; depth of body equal to width, greatest width of body 10.5 to 11.5 in standard length; dorsal fin rays ii,13 or 14; anal rays ii,12 or 13_____ Hyporhamphus laticeps Günther

2*b*. Gill rakers on first arch 8 to 11+22 to 28=30 to 39; upper jaw broader than long, bluntly pointed, prominent median ridge; depth of body greater than width, greatest width of body 12.1 to 15.1 in standard length; dorsal fin rays ii,14 or 15; anal rays ii,14 or 15.

Hyporhamphus dussumieri (Valenciennes)

1*b*. Base of dorsal fin equal to or shorter than base of anal fin; gill rakers on first arch 8 to 11+24 to 29=32 to 40; upper jaw sharply pointed, flat; in adults teeth occur on upper surface of beak, in half-grown specimens only in patches laterally, in young absent; depth of body greater than width; greatest width 13.7 to 19.7 in standard length; dorsal fin rays ii,13; anal rays ii,15 or 16_____ Hyporhamphus acutus Günther

HYPORHAMPHUS LATICEPS (Günther)

FIGURE 34, *a*

Hemirhamphus laticeps GÜNTHER, Catalogue of the fishes in the British Museum, vol. 6, p. 267, 1866 (type locality, Fiji Islands).

SPECIMENS STUDIED

Bikini Atoll: 13 stations, 154 specimens, 20 to 296 mm. standard length.
Rongerik Atoll: 2 stations, 14 specimens, 80 to 270 mm.
Eniwetok Atoll: 2 stations, 6 specimens, 44 to 267 mm.
Rongelap Atoll; 6 stations, 18 specimens, 24 to 194 mm.
Kwajalein Atoll: 1 station, 1 specimen, 77 mm.
Mille Atoll: *Albatross*, 1 lot, 1 specimen, 72 mm.
Guam: 4 lots, 9 specimens, 74 to 215 mm.

Description.—Dorsal rays ii, 13 or 14; anal ii, 12 or 13; pectoral i, 11; pelvic i, 5; branched caudal 6+7; scales in lateral line 59 or 60, from origin of dorsal diagonally to lateral line 5½, from anal origin to lateral line 2; predorsal scale rows 40 or 41; gill rakers 10 to 14+28 to 33 on first gill arch (see also table 11); teeth in jaws in 3 or 4 rows in upper jaw, 4 to 6 rows in lower.

Depth of body 10.0 to 11.2, greatest width 10.0 to 12.7, head length (tip of upper jaw to hind margin of opercular flap) 4.25 to 4.6; length of lower jaw extending beyond upper jaw 3.7 to 5.2; all in standard

TABLE 11.—*Distribution of counts of gill rakers, first gill arch,* Hyporhamphus dussumieri, H. laticeps, *and* H. acutus

Species	Upper arch							Lower arch												Total number on both arches														
	8	9	10	11	12	13	14	22	23	24	25	26	27	28	29	30	31	32	33	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46
dussumieri	2	14	9	4	----	----	----	2	----	3	11	4	4	5	----	----	----	----	----	1	1	----	3	7	4	6	3	4	2	----	----	----	----	----	----	----
laticeps	----	----	5	27	23	9	1	----	----	----	----	----	----	1	15	15	18	10	6	----	----	----	----	----	----	----	----	----	3	6	14	13	10	11	6	2
acutus	4	18	18	3	----	----	----	----	----	6	9	9	9	7	3	----	----	----	----	----	----	1	4	8	6	11	4	5	2	2	----	----	----	----	----	----

length (tip of upper jaw to base of middle caudal rays). Length of lower jaw 0.81 to 1.2; snout 2.7 or 2.75; least depth of caudal peduncle 4.9 to 5.3; length of pectoral fin 1.7 or 1.8; postorbital part of head (hind margin of eye to upper edge of gill opening) 2.85 to 3.6; lower lobe of caudal 1.1, upper lobe 1.3; diameter of eye 3.35 to 4.0; all in length of head (tip of upper jaw to hind margin of opercular flap). Interorbital space in eye 0.9 to 1.03. Head width across preorbitals (just anterior to nostrils) 1.39 to 1.47, across preopercles 0.99 to 1.05; length of maxillary plate (movable part of upper jaw) 2.0 to 2.3, width 1.4 to 1.6; all in length of snout (tip of upper jaw to anterior margin of orbit).

Maxillary plate flat or slightly convex (in young), bluntly pointed; interorbital area flat or slightly concave; back flat; sides straight; belly flat or slightly concave; anal origin opposite insertion of third branched dorsal ray; dorsal and anal fins convex; anal fin base shorter than dorsal base, length of anal base 1.2 to 1.4 in that of dorsal; dorsal fin scaled in specimens 150 mm. long and larger; anal fin usually scaled. Pelvics inserted nearer caudal base than opercular opening by slightly more than eye diameter.

Color in alcohol.—Top of head and back light brown, pigment being arranged in a large spot in center of each scale; a broad dark stripe down midline of back with a thin gray line on each side; silvery lateral stripe, narrow anteriorly, broadest between dorsal and anal fins, narrowing again on anterior part of caudal peduncle then spreading fan shaped over base of middle caudal fin rays, a black line along dorsal margin of silver stripe; lateral line scales pigmented with a lengthwise streak (along the canal) and a few scattered dots ventrally; dorsal fin black on distal part of anterior rays, rest of fin dusky; anal fin pale basally, dusky distally; caudal fin with fine black lines along fin membranes, posterior margin of fin pale; pectoral fin colorless, translucent; pelvic fin dusky on basal three-quarters, pale on distal one-quarter.

HYPORHAMPHUS DUSSUMIERI (Valenciennes)

FIGURE 34, *b*

Hemiramphus dussumieri VALENCIENNES, *in* Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 19, p. 33, pl. 554, 1846 (type locality, Seychelles).

Hemiramphus erythrorinchus var. B. LESUEUR, Journ. Acad. Nat. Sci. Philadelphia, vol. 2, p. 138, 1821 (type locality, near Timor and Mauritius).

? Hemirhamphus affinis GÜNTHER, Catalogue of the fishes in the British Museum, vol. 6, p. 267, 1866, (type locality, South Seas).

Hemiramphus affinis JORDAN and SEALE (non Günther), Bull. U. S. Bur. Fisheries, vol. 25, 1905, p. 207, 1906 (in part, U.S.N.M. No. 126609).

Hemirhamphus affinis SCHULTZ (non Günther), U. S. Nat. Mus. Bull. 180, p. 56, 1943 (in part, U.S.N.M. No. 115203).

Hemiramphus pacificus JORDAN and SEALE (non Steindachner), Bull. U. S. Bur Fisheries, vol. 25, 1905, p. 207, 1906 (in part, U.S.N.M. No. 52530).

SPECIMENS STUDIED

Bikini Atoll: 3 stations, 5 specimens, 29 to 225 mm. standard length.
Eniwetok Atoll: 2 specimens, 50 and 71 mm.
Rongelap Atoll: 3 stations, 18 specimens, 22 to 104 mm.
Rongerik Atoll, 2 stations, 13 specimens, 129 to 247 mm.
Likiep Atoll: Univ. Washington, 10 specimens, 82 to 112 mm.
Arhno Atoll: *Albatross*, 13 specimens, 23 to 30 mm.
Wotje Atoll: *Albatross*, 2 specimens, 97 to 105 mm.
Guam: 2 lots, 3 specimens, 85 to 117 mm.

Description.—Dorsal rays ii,14 or 15; anal ii,14 or 15; pectoral i,11; pelvic i,5; branched caudal 6 plus 7; scales in lateral line 59 or 60 (plus 3 to 7 more to caudal base, from origin of dorsal diagonally to lateral line 5; from anal origin to lateral line 2; predorsal scale rows 41 to 44; gill rakers 8 to 11 + 24 to 28 on first gill arch; teeth in jaws in 3 rows in upper jaw, 4 in lower.

Depth of body 9.4 to 11.8, greatest width 12.1 to 15.1; head length (tip of upper jaw to posterior margin of opercular flap) 4.3 or 4.4; length of lower jaw extending beyond upper jaw 3.4 to 5.0; all in standard length (tip of upper jaw to base of middle caudal rays). Length of lower jaw 0.75 to 1.05; snout 2.55 to 2.8; least depth of caudal peduncle 5.66 to 6.15; length of pectoral fin 1.8 or 1.9; postorbital length of head (hind margin of eye to upper edge of gill opening) 3.2 to 3.4; lower lobe of caudal 1.1, upper lobe 1.6; diameter of eye 3.7 to 4.1; all in length of head (tip of upper jaw to hind margin of opercular flap). Interorbital space in eye 1.06 to 1.1. Head width across preorbitals 1.6 or 1.7, across preopercles 1.1 or 1.2; length of maxillary plate (movable part of upper jaw) 2.05 to 2.2, width 1.7 or 1.75; all in length of snout (tip of upper jaw to anterior margin of orbit).

Maxillary plate convex, with median ridge, bluntly pointed; interorbital area slightly concave; back flattened, sides straight, belly flat; anal origin opposite insertion of third branched dorsal ray; dorsal and anal fins convex; anal base shorter than dorsal base, length of anal base 1.09 to 1.15 in that of dorsal; dorsal and anal fins usually scaled in specimens larger than 150 mm; pelvics inserted nearer caudal base than opercular opening by slightly more than eye diameter.

Color in alcohol.—Top of head and back dark brown, pigment being arranged in broad semicircular bands around posterior rim of each scale, center of scales pale; narrow black stripe down middle of back with thin black line on each side terminating at dorsal origin; broad silvery or blackish stripe along sides from upper edge of pectoral insertion to middle caudal base, continuing as two wedge-shaped spots on basal portion of middle caudal fin rays; lateral line scales pigmented with thin black line; dorsal fin pale basally, distal portion of anterior rays intensely black; anal fin pale; caudal fin dusky, with

fine black lines along rays, broad posterior margin dusky, darker than rest of fin; pectoral fin with narrow black basal line, rest of fin pale, translucent; pelvic fin dusky at base and on basal portion of outer rays.

HYPORHAMPHUS ACUTUS (Günther)

FIGURE 34, *c*

Hemirhamphus acutus GÜNTHER, Proc. Zool. Soc. London, 1871, p. 671 (type locality, Rarotonga, Cook Islands).

Odontorhamphus chancellori WEED, Publ. Field Mus. Nat. Hist., zool. ser., vol. 20, p. 52, 1933 (type locality, Aitulaki, Cook Islands).

Odontorhamphus chancellori SCHULTZ, U. S. Nat. Mus. Bull. 180, p. 56, 1943.

SPECIMENS STUDIED

Bikini Atoll: 13 stations, 139 specimens, 57 to 153 mm. standard length.
Eniwetok Atoll: 3 stations, 3 specimens, 56 to 75 mm.
Rongelap Atoll, 5 stations, 9 specimens, 17 to 125 mm.

Description.—Dorsal rays ii,13; anal ii,15 or 16; pectoral i,10 or 11; pelvic i,5; branched caudal 6+7; scales in lateral line 57 to 61 (+3 to 5 more to midcaudal base), from origin of dorsal diagonally to lateral line 6 or 6½, from anal origin to lateral line 2; predorsal scale rows 41 to 43; gill rakers 8 to 11+23 to 29 on first gill arch; teeth in jaws in 2 or 3 irregular rows in upper jaw, 3 or 4 irregular rows in lower; teeth extending along upper surface of beak; in more or less incomplete bands along sides in large specimens; in lengthwise patches, scattered, in medium-sized specimens; and in one or two small patches, or absent, in small specimens.

Depth of body 9.2 to 13.9, greatest width 13.7 to 19.7; head length (tip of upper jaw to posterior margin of opercular flap) 4.4 to 5.7; length of lower jaw extending beyond upper jaw 3.0 to 4.6; all in standard length (tip of upper jaw to base of middle caudal rays). Snout 2.2 to 2.8; least depth of caudal peduncle 4.6 to 6.6; length of pectoral fin 1.35 to 1.9; postorbital length of head (hind margin of eye to upper edge of gill opening) 2.3 to 3.4; lower lobe of caudal .97 to 1.0 upper lobe 1.25 to 1.5; diameter of eye 3.4 to 4.7; all in length of head (tip of upper jaw to hind margin of opercular flap). Interorbital in eye 1.0 to 1.08. Head width across preorbitals (just anterior to nostrils) 1.6 to 1.8, across preopercle 1.25 to 1.35; length of maxillary plate (movable part of upper jaw) 1.6 to 1.9, width 1.7 to 1.95; all in length of snout (tip of upper jaw to anterior margin of orbit).

Maxillary plate flat, pointed, about as long as wide; interorbital area flat to slightly convex; back rounded; sides straight; belly flat, narrower than back; dorsal and anal fins convex, dorsal base sometimes equal to but usually shorter than anal base, length of dorsal base 1.0

to 1.23 in that of anal; dorsal and anal fins scaled on anterior basal portion in specimens 150 mm. long and larger. Dorsal fin origin over, or a little anterior to, that of anal; pelvics inserted nearer midcaudal base than opercular opening by diameter of pupil.

Color in alcohol.—Top of head and back light grayish brown to dark brown, pigment arranged in broad bands under posterior margin of each scale, anterior part of each scale with thin light yellow line; narrow dark brown or black stripe down midline of back, with a thin black line on each side, terminating at dorsal insertion; broad silvery stripe along sides from upper edge of pectoral insertion to caudal, where it ends without dividing but with a slight widening; lateral line scales pigmented with rows of 2 to 4 small dots on each scale; dorsal fin pale basally, distal portion dusky, color most intense on anterior rays, fading posteriorly; anal fin colorless, translucent; caudal fin outer rays dusky, middle rays pale, posterior margin dusky; pectoral fin with narrow black basal line, pale distally; pelvic fin dusky at base, along outer unbranched ray, and on distal margin, inner and middle part of fin pale.

Remarks.—Weed established the genus *Odontorhamphus* on one specimen of 170 mm. standard length, from the Cook Islands; this had the upper surface of the mandible well toothed along its lateral margins almost to the tip of the beak. The series collected by Schultz in 1939 in the Phoenix and Samoan Islands were of various sizes, showing all gradations from completely toothed mandibles to those with elongate patches of teeth, and those many small specimens with one or two small patches of teeth bearing only 1 to 3 teeth per patch. Since this species otherwise bears all the characteristic features of *Hyporhamphus*, we do not believe a separate genus is required. Steindachner's type of *H. pacificus* was 237 mm. long, large enough to have teeth on the mandible; these are not mentioned in his description, but they are small, easily rubbed off or overlooked. Otherwise the specimens described above match Steindachner's description of *pacificus* very well.

Family EXOCOETIDAE: Flyingfishes

By Loren P. Woods and Leonard P. Schultz

Flyingfishes were numerous in the western two-thirds of the lagoons of the atolls visited by us, and in the ocean all around the atolls. Nearly all those collected in the northern Marshalls were taken at night with the aid of a surface light and dipnet. All but three of the specimens collected were adults, many of these with eggs.

A quart-sized flattened bottle, covered with a close network of eggs, most of which had reached the eyed stage, and which are prob-

ably of flyingfishes, drifted over the reef on the outer side of Romuk Island, Bikini Atoll, April 1, 1947; it is U.S.N.M. No. 140285.

The first flyingfish were observed about 400 miles east and a little northeast of Oahu, T. H., with the water temperature about 72° to 73° F. There were both large and small ones. Observations of hundreds of flights, noted by Schultz on several succeeding days, show that the usual taxi is into the wind at an angle away from the ship. When the flyingfish hit the water for another taxi, it invariably turned again to taxi into the wind, straight or at an angle. The length of flight appeared to be longer in strong winds, the flyingfish almost always curving with the wind as it sailed along. On both sides of the ship, the reaction to ship and wind was similar.

A sandspit, projecting nearly into the channel on the leeward side of Airy Island at Bikini, was a hazard for flyingfishes. Several were observed stranded at night. They were immediately devoured by crabs.

Table 12 summarizes the observations on the flight of flyingfishes:

TABLE 12.—*Length of flight of flyingfishes in wind velocities of 10 to 15 miles per hour*

Number of takeoffs for each flight	Length of flight in seconds																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	9	7	5	10	8	3	4	....	1	1	....	....	....	....	....	....	....	....	....	....
2	....	....	....	1	3	3	1	1	3	....	1	....	2	....	1	....	1	....	....	....
3	....	....	....	1	....	....	1	....	1	....	....	1	2	1	....	....	....	....	....	....
4	....	....	....	....	....	....	....	2	....	1	....	....	....	1	1	....	....	....	....	....
5	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1

KEY TO THE GENERA OF EXOCOETIDAE OF THE NORTHERN MARSHALLS AND ADJOINING REGIONS [20]

1*a*. Pectoral short, scarcely reaching pelvic origin_____ Oxyporhamphus [21] Gill

1*b*. Pectoral long, reaching at least to dorsal origin.

2*a*. Pectoral not quite reaching to end of dorsal base; dorsal mostly black, with its central rays longest; pelvic fins not, or scarcely, reaching anal origin; lower jaw prominent, with symphyseal knob.

3*a*. Snout long and pointed, longer than eye; no teeth on tongue; [22] pelvics not reaching anal origin_____ Fodiator Jordan and Meek

3*b*. Snout short and blunt, shorter than eye; teeth present on tongue, vomer, palatines and pterygoids; pelvics reaching to anal origin, or just beyond origin_____ Parexocoetus Bleeker (p. 177)

[20] Modified after Breder, Bull. Bingham Oceanogr. Coll., vol. 6, art. 5, p. 2, 1938.

[21] Regarded as a separate family, Oxyporhamphidae, by Bruun (Dana Report No. 6, p. 84, 1935) and Breder (op. cit., p. 91), but here included in the key because the adult resembles an exocoetid.

[22] The original description of the genus states that the teeth are similar to those of *Parexocoetus*, but we failed to locate any on tongue after examination of numerous specimens. There are small teeth on vomer and palatines.

2*b*. Pectoral reaching well beyond end of dorsal base, usually to caudal base.
4*a*. Pelvic fins very short, failing to reach anal origin by at least their own length, inserted anteriorly, nearer tip of snout than base of caudal---------- Exocoetus Linnaeus (p. 178)
4*b*. Pelvic fins very long, reaching well beyond anal origin, frequently to end of its base or beyond; inserted posteriorly, nearer caudal base than tip of snout.
5*a*. First pectoral ray simple, the second branched; anal fin shorter than dorsal and with fewer rays; anal inserted under or posterior to fourth dorsal ray---------- Cypselurus Swainson[23] (p. 179)
5*b*. First and second pectoral rays simple, the third branched; anal fin as long as or longer than dorsal, usually with as many or more rays; anal inserted under or anterior to third dorsal ray---------- Prognichthys Breder[24] (p. 189)

Genus PAREXOCOETUS Bleeker

Parexocoetus BLEEKER, Nederl. Tijdschr. Dierk., vol. 3, p. 126, 1866. (Genotype, *Exocoetus mento* Cuvier and Valenciennes.)

PAREXOCOETUS MENTO (Valenciennes)

Exocoetus mento VALENCIENNES, *in* Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 19, p. 124, 1846 (type locality, Pondicherry).

SPECIMEN STUDIED

Rongelap Atoll: *Bowditch* anchorage, ½ mile from Rongelap Island, surface light at night, July 22–25, 1946, S–46–259, Herald, 1 specimen, 71 mm.

Description.—Dorsal rays 10; anal 11; pectoral i,12; pelvic 6; branched caudal 6 + 7; scale rows from upper edge of gill opening to base of caudal rays 34, from insertion of dorsal to lateral line 4½, between lateral line and insertion of anal 1½; predorsal scale rows (from occiput to insertion of dorsal fin) 20; gill rakers on first arch 7 + 18. (Measurements in table 14.)

Pectoral fin reaches to about fourth dorsal ray; pelvic fin does not reach anal insertion, inserted midway between base of caudal and anterior margin of eye; first anal ray inserted under insertion of fourth dorsal ray; interorbital space flat; teeth present on tongue, vomer, palatines, and pterygoids; lower jaw projecting beyond upper, with prominent tubercle at symphysis.

Color in alcohol.—Top of head, back and upper sides of body dark grayish brown; sides of head and lower sides anterior to pelvic insertion silvery; tip of lower jaw blackish; lower sides posterior to pelvic insertion light olive-brown with scattered minute dark-brown dots; dorsal fin pale at base, first nine rays and membranes dusky, color deepening just above base to become black on distal half, membrane

[23] We follow Hubbs and Kampa (Copeia, No. 4, p. 205, 1946) in regarding *Chilopogon* Lowe and *Hirundichthys* Breder as subgenera.
[24] *Danichthys* Bruun is considered a subgenus of *Prognichthys*.

between ninth and tenth rays white; pectoral and pelvic fins pale, colorless, membranes transparent, in some specimens membranes plain brownish purple, in others speckled with close-set rectangular spots or dashes (–); occasionally pelvics are dusky on outer distal part; anal fin pale, sometimes close-set reddish streaks on membranes near base; caudal fin with dark brown spot at base, upper lobe pale, lower lobe dusky distally.

Genus EXOCOETUS Linnaeus

Exocoetus LINNAEUS, Systema naturae, ed. 10, p. 316, 1758. (Genotype, *Exocoetus volitans* Linnaeus.)

EXOCOETUS VOLITANS Linnaeus

Exocoetus volitans LINNAEUS, Systema naturae, ed. 10, p. 316, 1758 (type locality, Atlantic Ocean).

SPECIMENS STUDIED

West of Johnson Island: Lat. 17° N., long. 176° W., May 9, 1946, F. C. Ziesenhenne, 1 specimen, 148 mm.

Bikini Atoll: Boro Channel, surface light at night, April 6–7, 1946, S–46–53, Schultz and Brock, 1 specimen, 29.5 mm.

Description.—Dorsal rays 14; anal 13 or 14; pectoral i,14; pelvic 6; branched caudal 6+7; scale rows from upper edge of gill opening to base of caudal rays 48, from insertion of dorsal fin to lateral line 7, between lateral line and insertion of anal 2½; predorsal scales (from occiput to insertion of dorsal fin) 18; gillrakers on first arch 8+24.

The following measurements are given in thousandths of the standard length: Head length 250 to 271; greatest depth of body 170 to 189; width in front of pectorals 149 to 163; predorsal length 651 to 676, preanal 685 to 696, prepectoral 257 to 265, prepelvic 426 to 427; length of dorsal base 213 to 230, anal base 220 to 227; length of longest pectoral ray 634 to 787, longest pelvic ray 138 to 142, longest dorsal ray 101 to 132, longest anal ray 101 to 115, snout 58 to 61; eye diameter 68 to 102; interorbital width 78 to 102; postorbital length of head (hind margin of eye to upper edge of gill opening) 103 to 115; least depth of caudal peduncle 68 to 78.

Pectoral fin reaches to last dorsal ray in small specimen, beyond caudal base in large specimens; pelvic fins inserted nearer snout than base of caudal, extend half the distance from pelvic insertion to anal insertion; first anal ray inserted under insertion of third dorsal ray; interorbital area flat; no teeth evident on palate or in jaws; upper jaw rounded, lower jaw rounded and slightly projecting beyond upper.

Color in alcohol.—ADULT: Top of head, back, and upper part of sides grayish brown; lower sides of head and body silvery white; breast and belly silvery white; dorsal fin with membranes faintly

dusky; anal fin pale, silvery white at base; caudal fin uniform light brown; pectoral fin membranes dusky brown, rays darker brown, posterior margin narrowly white; pelvic fin pale. JUVENILE: Top of head, back, and sides with small, close-set brown dots arranged in lengthwise rows; ground color light yellowish; faint dark brown saddle across back between pectoral insertions; light indistinct saddle across back including anterior half of dorsal fin, followed by a darker band of about the same width on posterior part of fin, then a second lighter band; posterior part of caudal peduncle and base of caudal fin dark, pectoral fin pale on basal two-thirds, outer one-third of membranes dusky brown on anterior part; pelvic fin with a few minute scattered brown dots on median basal portion; dorsal, anal, and caudal fins colorless.

Genus CYPSELURUS Swainson

Cypsilurus SWAINSON, The natural history and classification of fishes . . ., vol. 1, p. 299, 1838. (Spelling changed to *Cypselurus* Lowe, Proc. Zool. Soc., London, vol. 8, p. 38, 1841, by the International Commission on Zoological Nomenclature.) (Genotype, *Exocoetus appendiculatus* Wood.)

KEY TO THE SPECIES OF CYPSELURUS REPORTED FROM THE NORTHERN MARSHALLS

1*a*. Dorsal fin with large black blotch covering distal portion of membranes between third to ninth (or sometimes twelfth) rays; pectoral membranes purplish brown to black (reddish in life), posterior margin narrowly white; lower jaw rounded, as long as, or slightly longer than, upper; dorsal rays 13 or 14; anal 9 to 11; pectoral i,12 or 13; gill rakers about 24; predorsal scales 26 to 31_____ Cypselurus spilonotopterus (Bleeker)

1*b*. Dorsal fin without large black blotch on distal portion of membranes, but with anterior rays dusky brown.

2*a*. Lower jaw pointed, projecting beyond upper; pectoral membranes transparent, colorless; least depth of caudal peduncle less than length of snout; dorsal rays 12 or 13; anal 9 to 11; pectoral i,13 to 15; gill rakers 21 to 24; predorsal scales 29 to 34__ Cypselurus antoncichi, new species

2*b*. Lower jaw rounded, even with upper or slightly projecting; pectoral membranes uniform light grayish purple on outer part; inner part with rays pale and membranes transparent; least depth of caudal peduncle equals length of snout; dorsal rays 12 to 14; anal 8 to 10; pectoral i,13 or 14; gill rakers 21 or 22; predorsal scales 26 to 31.

Cypselurus unicolor (Valenciennes)

CYPSELURUS SPILONOTOPTERUS (Bleeker)

Exocoetus spilonotopterus BLEEKER, Nederl. Tijdschr. Dierk., vol. 3, p. 113, 1866 (type locality, Padang, Sumatra).

Exocoetus bahiensis BLEEKER, Atlas ichthyologique des Indes Orientales Néerlandaises . . ., vol. 6, pl. 249, fig. 2, 1866–72.

SPECIMENS STUDIED

Bikini Atoll: Off south side; flew on board ship at night, April 16, 1946, Marr, 1 specimen, 258 mm.

Rongerik Atoll: Bock Pass, surface light at night, April 27, 1946, S–46–394, Marr, 2 specimens, 264 and 269 mm.

Eniwetok Atoll: Southwest Passage, leeward edge of reef, 2 miles south of Rigili Island, surface light at night, May 24, 1946, S–46–183, Schultz, 11 specimens, 261 to 317 mm.

Description.—Dorsal rays 13 or 14; anal 9 to 11; pectoral i,12 or 13; pelvic 6; branched caudal 6 + 7; scale rows from upper edge of gill opening to base of caudal rays 47 to 50, from origin of dorsal to lateral line 7 or 8, from origin of anal to lateral line 3; predorsal scales 26 to 31. (Other counts in table 13.)

The following measurements are expressed in thousandths of the standard length: Head length 249 to 267; greatest depth of body 173 to 198; width of body in front of pectorals 131 to 157; predorsal length 697 to 728, preanal 798 to 811, prepectoral 256 to 274; prepelvic 578 to 587; length of dorsal base 170 to 190, anal base 107 to 118; length of longest pectoral ray (second) 656 to 722, longest pelvic ray (third) 250 to 277, longest dorsal ray (second) 111 to 131, longest anal ray 69 to 83, snout 76 to 79; eye diameter 69 to 82; interorbital width 82 to 93; postorbital part of head (hind margin of eye to upper edge of gill opening) 95 to 101; least depth of caudal peduncle 71 to 77. (Other measurements in table 14.)

Pectoral fin reaches past rear of dorsal base, sometimes to rudimentary caudal rays; pelvics reach to about fourth anal ray, inserted midway between hind margin of eye and base of caudal rays; first anal ray inserted under sixth to eighth dorsal rays; shape of upper jaw rounded, lower jaw rounded, even with upper, or slightly protruding in large specimens; teeth small, simple, conic, in bands in jaws, palatines toothed.

Color in alcohol.—Top of head and back down to middle of sides dark purplish brown or grayish brown, tip of lower jaw dusky; opercle and preopercle silvery, opercular flap pale; lower sides light brown; belly white or silvery; pectoral fin membranes very dark purplish brown to black, rays lighter, outer unbranched ray white, narrow hind margin of fin white; dorsal fin with a large dark blackish spot on distal part of fin, extending usually from fourth to ninth rays but sometimes to twelfth; caudal fin grayish brown, its posterior margin somewhat darker; pelvic fin with outer four rays dusky, inner two white, dusky color extending onto membranes in center of fin near its base.

Remarks.—This is the species that has usually been called, in the Pacific area, *Cypselurus bahiensis* Ranzani by most authors (see Fowler, Fishes of Oceania, p. 84, 1928 for synonomy). However, the name *bahiensis* of Ranzani is no longer available as Breder (Bull. Bingham Oceanogr. Coll., vol. 6, art. 5, pp. 39 and 51, 1938) has shown *bahiensis*

to be a synonym of *C. comatus* (Mitchill). This Pacific species is apparently most closely related to *C. lineatus* (Cuvier and Valenciennes) of the Atlantic, from which it differs in having fewer predorsal scales (39 to 46 for *lineatus*, 26 to 30 for *spilonotopterus*) and in having stronger, always present, palatine teeth; *lineatus* has more scale rows (58±) and fewer dorsal rays.[25] There are slight differences in the coloration of the pectoral fin (that of *lineatus* has a broader white posterior margin and sometimes a faint light cross band). As for the other recognized Atlantic species having a dark dorsal spot, *spilonotopterus* differs from *C. cyanopterus* Cuvier and Valenciennes in having fewer predorsal scales (35 to 40), and from *C. exsiliens* Linnaeus in having the distal margin of pectoral fin white instead of black as in *exsiliens*. In both species there is an overlap or agreement in the number of scale rows, number of dorsal and anal rays, and number of predorsal scales.

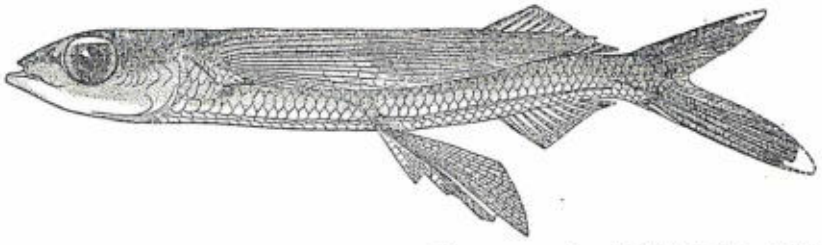

FIGURE 35.—Holotype of *Cypselurus antoncichi*, new species (U.S.N.M. No. 140291), from Eniwetok Atoll. (Drawing by Aime M. Awl.)

CYPSELURUS ANTONCICHI, new species

FIGURE 35

Cypselurus bahiensis (not Ranzani) KENDALL and GOLDSBOROUGH, Mem. Mus. Comp. Zool., vol. 27, No. 7, p. 253, 1911 (Arhno, Marshall Islands, U.S.N.M. No. 65809).

Holotype.—U.S.N.M. No. 140291, Eniwetok Atoll, southwest passage, leeward side of reef 2 miles south of Rigili Island, surface light at night, May 24, 1946, S–46–183, Schultz, female, 251 mm.

Paratypes.—U.S.N.M. No. 140293, same data as holotype, 18 specimens, 237 to 289 mm.; U.S.N.M. No. 140288, Bikini Atoll, Boro Channel, surface light at night, April 6–7, 1946, S–46–53, Schultz and Brock, 2 specimens, 240 and 279 mm.; Bikini Atoll, July 4, 1948, Welander, 1 specimen, 260 mm.; U.S.N.M. No. 140289, Bikini Atoll, Erik Island, western end, ocean reef, March 19, 1946, S–46–9, Schultz and Brock, 1 specimen, 251 mm.; U.S.N.M. No. 65809, Marshall Islands, Arhno Atoll, 1899–1900, *Albatross*, 1 specimen, 251 mm.

[25] The figures quoted for *C. lineatus* and *C. cyanopterus* are all from Breder (op. cit.).

Description.—Counts and measurements of holotype are given first, followed by those for two paratypes; all measurements are expressed in thousandths of the standard length. Additional counts and measurements are recorded in tables 13 and 14.

Dorsal rays 12; 12; 12; anal 10; 11; 11; pectoral i,14; i,14 i,14; pelvic 6; 6; 6; branched caudal 7+7; 6+7; 6+7. Scale rows in lengthwise series from upper edge of gill opening to midbase of caudal rays 51; 54; 54; from origin of dorsal to lateral line 7; 7; 6; from lateral line to origin of anal 3; 3; 3. Predorsal scale rows 30; 31; 30. Gill rakers on first gill arch 5+15; 6+18; ?+18.

Head 250; 242; 244. Greatest depth of body 155; 167; 158. Width of body in front of pectoral fins 130; 127; 120. Predorsal length 721; 714; 720; preanal 785; 760; 810; prepectoral 259; 244; 251; prepelvic 592; 604; 584. Length of dorsal base 171; 167; 179 anal base 123; 127; 124. Length of longest pectoral ray 666; 647; 610; longest pelvic ray 295; 304; 283; longest dorsal ray 100; 83; 93; longest anal ray 76; 56; 61. Snout 80; 77; 75. Eye diameter 84; 75; 77. Interorbital width 84; 79; 77. Postorbital part of head (hind margin of eye to upper edge of gill opening) 90; 95; 93. Least depth of caudal peduncle 64; 65; 61. Length of caudal peduncle 118; 123; 116.

Pectoral fin reaches slightly beyond middle of dorsal; pelvic fin reaches to about the middle of anal fin, inserted midway between eye and base of caudal rays but nearer opercular opening than to latter; base of first anal ray under base of sixth dorsal ray; interorbital area concave; teeth of jaws very small; palate edentate; upper jaw rounded in some specimens, or with an elongated, rounded, median portion in others; lower jaw somewhat pointed, longer than upper, projecting beyond upper.

Color in alcohol.—Top of head and back dark bluish gray to dark brown; anterior sides beneath pectoral fin light reddish brown with an indistinct dark purplish streak; sides of head below level of eye silvery; lower sides and belly silvery white; pectoral fin rays dusky brown, membranes clear, transparent; pelvic fin rays with minute scattered dusky dots basally, membranes clear, transparent; dorsal fin membranes smoky colored on basal portion, clear distally; anal fin pale; caudal fin dark grayish brown; posterior margin paler than middle part of fin.

Remarks.—This species differs from all other Pacific members of the genus *Cypselurus* in possessing the combined characters of a projecting, pointed lower jaw, large eye, slender caudal peduncle, and clear transparent membranes in the pectoral and pelvic fins; it resembles *C. gregori* Pietschmann in the projecting lower jaw but differs from this species in the length of the pectoral fin. It is probably most nearly related to *C. simus* Cuvier and Valenciennes and *C. spilonotopterus.*

Named *antoncichi* (pronounced ăntón′-sĭch-ĭ) for Michael Antoncich, of Monterey, Calif., commercial fisherman on the operation Crossroads project.

CYPSELURUS UNICOLOR (Valenciennes)

Exocoetus unicolor VALENCIENNES, *in* Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 19, p. 97, 1846 (type locality, Vanikoro).

SPECIMENS STUDIED

Bikini Atoll: Boro Channel, surface light at night, April 6–7, 1946, S–46–53, Schultz and Brock, 2 specimens, 194 and 226 mm.

Eniwetok Atoll: Southwest Passage, leeward side of reef, 2 miles south of Rigili Island, surface light at night, May 24, 1946, S–46–183, Schultz, 6 specimens, 176 to 214 mm.

Description.—Dorsal rays 12 to 14; anal 8 to 10; pectoral i,12 or 13; pelvic 6; branched caudal 6+7; scale rows from upper edge of gill opening to base of caudal rays 43 to 53, from origin of dorsal diagonally to lateral line 7 or 8, between lateral line and origin of anal 2 or 3; predorsal scales 26 to 30; gill rakers 5 or 6+16. (Additional counts in table 13.)

Depth 5.1 to 5.9; head 3.8 to 4.05; length of pectoral fin 1.5 or 1.6, of pelvic 3.2 to 3.8; all in standard length. Snout 3.3 to 3.7; eye 3.0 to 3.3; least depth of caudal peduncle 3.4 to 4.0; postorbital part of head (hind margin of eye to upper edge of gill opening) 2.45 to 2.8; upper lobe of caudal 1.0, lower lobe 0.85 or 0.9; all in length of head. Interorbital width in eye 1.0; depth of caudal peduncle in its length 1.4 to 1.95; angle of snout profile with lengthwise axis of body 26° or 27°. (See table 14 for measurements in thousandths of standard length.)

Pectoral fin reaches to insertion of last dorsal ray (second branched ray longest); pelvics reach to fourth anal ray (third ray longest); pelvic inserted midway between hind margin of eye and base of caudal rays, nearer gill opening than caudal fin; dorsal fin with its second and third rays of equal length, about 2.8 in head; first anal ray inserted under bases of sixth to eighth dorsal rays; upper jaw broadly U-shaped, smoothly curved, lower jaw rounded, equal to upper; teeth in jaws small, simple; palatine teeth when present, weak, covering small area.

Color in alcohol.—Top of head and back dark purplish brown, almost black, upper sides light brown with reddish tinge; cheeks and lower parts of head silvery; breast and belly yellowish white; pectoral fin membranes uniform light grayish purple, narrow white margin on posterior part of fin, inner part with rays pale and membranes transparent; pelvic fin with dusky rays, transparent membranes; dorsal fin membranes dusky, rays pale; caudal fin dark grayish brown, narrow posterior margin lighter.

TABLE 13.—*Counts made on certain species of Pacific Exocoetidae*

Species	Dorsal rays							Anal rays							Pectoral rays										
	9	10	11	12	13	14	15	8	9	10	11	12	13	14	i,11	i,12	i,13	i,14	i,15	i,16	i,17	i,18	ii,14	ii,15	ii,16	ii,17
Cypselurus:																										
antoncichi				10	12				3	11	9						6	13	2							
unicolor				1	3	1		2	2	1						2	2	2								
spilonotopterus					2	2			1	2	1					2	2									
simus					1	1		1	1										2							
agoo					1	1		1		1							1	1								
spilopterus							2			1	1					2										
atrisignis							2			1	1						2									
poecilopterus				2				2										1		1						
callopterus		1		1				2											2							
altipennis					1	1				1	1						2									
oligolepis			1	1				1	1								1	1								
opisthopus			2					1	1								1	1								
sultoni [1]				2	1					3																
californicus [2]	1	23	80	12					24	74	17															
speculiger			2									1	1							1		1				
Prognichthys:																										
gilberti [3]		1								1														1		
albimaculatus [4]			5								3	2												1	2	2
rufipinnis			1	2							1	2												1	2	
Parexocoetus:																										
brachypterus				10	3							11	2		6	5	2									
brevipinnis		19	2							2	13	1				11	6									

TABLE 14.—*Measurements, expressed in thousandths of the standard length, of certain species of Pacific Exocoetidae in the U. S. National Museum*

Characters	*Cypselurus antoncichi*		*Cypselurus unicolor*		*Cypselurus spilonotopterus*		*Cypselurus simus*		*Cypselurus agoo*		*Cypselurus spilopterus*		*Cypselurus atrisignis*	
	(Paratypes)						51072	55514	50736	50736	55171	92583	50713	115274
	Bikini Atoll	Eniwetok Atoll	Eniwetok Atoll		Rongerik	Eniwetok	Hawaii	Hawaii	Japan	Japan	Hawaii	Hawaii	Honolulu	7° N. 165 W.
	♂	♀	♀	♂	♂	♀	♂	♀	♀	♀	♂	♂	♂	♀
Standard length in millimeters	240	284	209	212	270	317	251	266.5	215	246	273.5	280	262	243.5
Length of head	263	239	244	248	260	249	251	233	219	215	252	247	244	242
Greatest depth	183	165	175	179	193	173	183	109	186	171	194	191	187	193
Width of body in front of pectorals	138	116	139	127	157	131	143	143	144	138	147	147	139	150
Predorsal length	708	736	685	704	708	728	726	698	716	699	695	693	691	686
Preanal length	763	810	800	788	800	804	845	814	809	797	841	795	809	760
Prepectoral length	263	243	259	260	267	256	259	240	228	220	256	250	260	246
Prepelvic length	508	606	618	614	586	578	618	597	600	586	548	572	578	544
Base of dorsal length	188	169	211	189	182	170	199	210	181	179	223	207	210	222
Base of anal length	125	116	96	94	115	114	84	109	88	110	143	132	126	150
Length of longest pectoral ray	608	638	657	656	678	656	709	679	644	708	702	714	655	676
Length of longest pelvic ray	304	260	287	274	257	250	283	261	293	352	300	282	256	304
Length of longest dorsal ray	117	102	96	87	111	122	106	98	107	100	128	129	118	136
Length of longest anal ray	79	67	77	71	82	69	68	71	56	65	.....	68	61	68
Snout length	81	71	77	73	78	76	74	68	60	61	73	71	76	74
Eye diameter	83	76	81	85	82	69	88	75	65	65	80	75	76	70
Bony interorbital width	88	74	86	85	93	82	92	90	74	73	91	86	94	.....
Postorbital length	90	85	91	85	96	95	90	86	88	81	91	91	84	99
Least depth of caudal peduncle	66	63	72	71	74	71	78	75	65	65	75	71	73	74

TABLE 14.—*Measurements, expressed in thousandths of the standard length, of certain species of Pacific Exocoetidae in the U. S. National Museum*—Continued

Characters	*Cypselurus californicus*	*Cypselurus speculiger*		*Prognichthys gilberti*	*Prognichthys albimaculatus*		*Prognichthys rufinpinnis*		*Parexocoetus mento*		*Parexocoetus brachypterus*	
	8140	42345	17985	Type 50872	65810	115276	127848	118684	140296	138131	55118	55123
	(Type) Catalina Id., Calif.	Tasmanian Sea	Hawaii	Lat. 28°30′ N., Long. 140° W.	(Type) Guam	Lat. 10° N., Long. 165° W.	Callao, Peru	Off Chile	Rongelap Atoll	Jolo Id., P. I.	Hawaii	
	–	♂	♂	♂	–	♂	♂	♀	–	–	–	–
Standard length in millimeters	311	221	221	212	218	205	243	258	71	110.5	135	139
Length of head	209	249	235	210	241	249	206	213	254	235	237	230
Greatest depth	145	172	163	137	170	175	160	163	204	226	207	187
Width of body in front of pectorals	122	145	131	130	140	136	132	128	121	136	133	122
Predorsal length	756	747	751	719	748	761	749	720	719	730	719	695
Preanal length	788	733	738	740	738	746	753	733	755	744	728	720
Prepectoral length	222	249	251	215	248	244	222	229	275	253	259	241
Prepelvic length	566	602	606	594	564	586	564	590	535	575	534	533
Base of dorsal length	138	158	167	137	165	141	160	155	183	181	185	216
Base of anal length	152	158	158	118	151	154	154	145	161	154	193	209
Length of longest pectoral ray	653	742	643	731	684	708	770	764	528	584	571	561
Length of longest pelvic ray	286	285	290	193	298	307	305	310	190	190	215	212
Length of longest dorsal ray	----------	83	95	108	----------	83	103	105	256	244	282	324
Length of longest anal ray	----------	84	97	75	----------	71	88	81	169	99	104	115
Snout length	64	82	72	61	69	73	66	66	70	72	57	65
Eye diameter	64	77	75	66	73	78	66	62	85	83	78	77
Bony interorbital width	71	77	82	80	78	78	82	81	90	83	78	79
Postorbital length	84	95	86	82	92	93	78	85	80	81	89	82
Least depth of caudal peduncle	58	63	63	61	67	68	62	62	70	70	59	60

Genus PROGNICHTHYS Breder

Prognichthys Breder, Bull. Bingham Oceanogr. Coll., vol. 2, No. 2, p. 20, 1928. (Genotype, *Exocoetus gibbifrons* Cuvier and Valenciennes.)

PROGNICHTHYS ALBIMACULATUS (Fowler)

Cypselurus (*Exonautes*) *albimaculatus* Fowler (on *Cypselurus speculiger* Kendall and Goldsborough, 1911), Proc. Acad. Nat. Sci. Philadelphia, vol. 85, p. 327, fig. 81, 1933 (1934) (type locality, Guam).

Cypselurus rubescens Fowler, Proc. U. S. Nat. Mus., vol. 80, art. 6, p. 6, 1932.

Danichthys gilberti Schultz (not Snyder), U. S. Nat. Mus. Bull. 180, p. 58, 1943 (part) (U.S.N.M. No. 115276).

SPECIMENS STUDIED

U.S.N.M. No. 65810, Marianas Islands, off Guam, 1899–1900, *Albatross* [type], 218 mm.; U.S.N.M. No. 89734, lat. 7° S., long. 124° W., September 7, 1929, A. K. Fisher, 1 specimen, ♂, 230 mm. (approx.); U.S.N.M. No. 115276, latitude 10° N., longitude 165° W., April 20, 1939, L. P. Schultz, 1 specimen, ♂, 205 mm.; uncataloged, from Bishop Museum, Honolulu, lat. 13° N., long. 165°30′ W., flew on board U.S.C.G. *Taney*, July 18–19, 1938, G. C. Munro, E. B. Brier, E. H. Bryan, Jr., 1 specimen, ♂, 230 mm.

Description.—Dorsal rays 11; anal 11 or 12; pectoral ii, 16 or 17; pelvic 6; branched caudal 6+7; scale rows from upper edge of gill opening to base of caudal rays 48 or 49, from dorsal origin diagonally to lateral line 6; between lateral line and origin of anal 3; predorsal scales 28 to 31; gill rakers on first arch 6 to 8+17 to 20. (Additional counts in table 13.)

Head 3.9 to 4.2; depth of body 5.6 to 6.2; width in front of pectorals 7.1 to 7.4; length of pectoral fin 1.4 to 1.55, of pelvic 3.2 to 3.55; all in standard length. Snout 3.1 to 3.5; eye 3.1 to 3.3; least depth of caudal peduncle 3.6 to 3.7; postorbital length of head (hind margin of eye to upper edge of gill opening) 2.6 to 2.9; all in length of head. Interorbital width in eye 0.94 to 1.05; depth of caudal peduncle in its length 1.5 to 1.7; palatines toothless; anal fin originates slightly in advance of dorsal, latter usually originates over second or third anal ray. (See table 14 for measurements in thousandths of standard length.)

Color in alcohol.—Upper part of head, back, and upper sides dark brown to light grayish brown; cheeks, opercles, sides of body, and belly silvery or whitish; pectoral fin dark brown at base, upper six rays and membrane blackish, center of lower half of fin crossed by large oblique hyaline band, wide submarginal dark band on posterior part, tips of rays white; pelvic fin with second, third, and fourth rays dusky brown on basal half, rest of fin pale; dorsal and anal fins pale; caudal fin dusky brown with a pale but not white margin.

Remarks.—The specimens listed above have been compared carefully with the type of *Exonautes gilberti* Snyder, from which they differ in the coloration of the pectoral fin; the relative positions of the dorsal and anal fins; the number of dorsal, anal, and pectoral fin rays; and the

number of scales. The most striking differences are the longer head, larger eye, and thicker caudal peduncle.

PROGNICHTHYS sp. ? (juv.)

PLATE 17, B

SPECIMEN STUDIED

Eniwetok Atoll: Southwest Passage, leeward edge of reef, ⅘ mile south of Rigili Island, surface light at night, May 25, 1946, S–46–184, Schultz, 1 specimen, 46 mm.

Description.—Dorsal rays 11; anal 12; pectoral ii,15; pelvic 6; caudal 6+7; scales missing (scars not evident enough to count); gill rakers on first arch 6+18.

Depth (greatest just behind head) 7.0; head 4.8; length of pectoral fin 1.5, of pelvic 2.6; all in standard length. Snout 4.0; eye 2.3; least depth of caudal peduncle 4.0; postorbital length of head (hind margin of eye to upper edge of gill opening) 3.5; (upper and lower lobes of caudal fin broken); all in length of head. Interorbital width in eye 0.9; depth of caudal peduncle in its length 2.3.

Pectoral fin reaches almost to end of dorsal base, membrane between first and second unbranched rays much wider than that between other rays; pelvics extend to about midway between end of anal and base of caudal, inserted midway between hind margin of pupil and base of caudal; dorsal fin rather high, its longest ray (second), 1.7 in head, its base 1.5 in head; first anal ray inserted slightly in advance of base of first dorsal ray; upper and lower jaws of equal length, upper jaw rounded, lower somewhat pointed, teeth not evident on palatines.

Color in alcohol.—Head and body light tan, minute dark-brown pigment spots arranged to follow myomeres on back and sides, a double row lengthwise down middorsal line to dorsal fin; dark brown area at base of upper lobe of caudal fin; dorsal fin with black pigment spot on outer one-third to one-half extending from second to ninth rays; anal white; pectoral fin black at base, upper rays largely dusky, fin crossed by three irregular pale areas, tips of upper rays and membranes black, those of lower pale; pelvic fin dusky; an intense line of black following fifth ray and broadening toward tip of fin; caudal fin upper lobe pale, lower dusky.

Remarks.—This Eniwetok Atoll specimen is obviously a juvenile form, as shown by the weakly developed scales, large eyes, and enlarged mucus channels and pores of the head. It is very similar in general shape and color to the figure and description of *Exonautes marginatus* Nichols and Breder (Zoologica, vol. 8, p. 429, fig. 165, 1928), described from a specimen 45 mm. in standard length, but differs from that specimen in depth, head, and paired fin proportions. It is possibly the young of *E. gilberti*, or it is new, but as no intermediate stages are available and the species of Pacific flyingfishes are so little known, definite assignment must await further study and revision.

Order BERYCOMORPHIDA

Family HOLOCENTRIDAE: Soldierfishes, or Squirrelfishes

By Loren P. Woods

KEY TO THE GENERA OF HOLOCENTRIDAE OF THE NORTHERN MARSHALL ISLANDS

1*a*. Angle of preopercle without heavy, long spine.
  2*a*. Dorsal spines XII, the last about same length as preceding one, not part of soft dorsal fin; opercle with two slender spines; scales of body rough with long slender spines almost as long as exposed part of scale. Holotrachys Günther (p. 191)
  2*b*. Dorsal spines X–I or XI–I, the last spine longer than preceding one, separated from it and closely adhered to first dorsal ray; opercle with a single short, flattened triangular spine, scales of body relatively smooth, their spines short ..... Myripristis Cuvier (p. 192)
1b. Angle of preopercle with long, heavy spine ..... Holocentrus Scopoli (p. 208)

Genus HOLOTRACHYS Günther

Holotrachys Günther, Journ. Mus. Godeffroy, vols. 2–3, pts. 5–6, p. 93, 1874. (Genotype, *Myripristis lima* Valenciennes.)

HOLOTRACHYS LIMA (Valenciennes)

Plate 17, C

Myripristis lima Valenciennes, *in* Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 7, p. 493, 1831 (type locality, Mauritius).

SPECIMENS STUDIED

Bikini Atoll: 9 stations, 20 specimens, 53 to 112 mm. standard length.
Eniwetok Atoll: 1 station, 1 specimen, 78 mm.
Rongelap Atoll: 4 stations, 5 specimens, 45 to 98 mm.
Rongerik Atoll: 3 stations, 3 specimens, 65 to 79 mm.

Description.—Dorsal fin rays XII,14 to 16 (usually 15); anal IV,10 or 11 (usually 11); pectoral ii,15 (rarely 13 or 14); pelvic I,7; branched caudal 9+8; scales in lateral line 40 to 42, between lateral line and base of dorsal 4½, between lateral line and origin of anal 9½ or 10½; gillrakers on first arch 8 or 9+1+13 to 15=22 to 25.

Depth of body 2.36 to 2.45, length of head 2.47 to 2.55, both in standard length (tip of snout to base of middle caudal rays); snout 5.5 to 6.0, eye 3.0 to 3.63, interorbital 6.0 to 7.0, postorbital part of head (hind margin of eye to upper edge of gill opening) 3.15 to 3.82, least depth of caudal peduncle 4.2 to 5.25, length of pectoral fin 1.55

to 2.15, length of middle caudal rays 1.75 to 2.03, length of third dorsal spine 2.8 to 3.15, length of longest dorsal rays 2.21 to 2.88, length of longest anal spine 2.56 to 3.25; length of longest anal rays 2.3 to 2.38, all in length of head; depth of caudal peduncle in its length 1.43 to 2.05; angle of upper profile with lengthwise axis of body 42 to 46 degrees.

Scales of sides extremely rough, with long, thin spines; prefrontals projecting beyond premaxillaries, premaxillaries notched with tip of mandible fitting its notch; mouth nearly horizontal, maxillary reaching posteriorly past hind margin of eye; preopercle lacking enlarged spine at angle, opercle with two short spines, subequal; dorsal spines short and heavy; third anal spine usually longest and strongest; soft dorsal and anal fins rounded, their middle rays longest; pectoral rounded; lobes of caudal broadly rounded, caudal not deeply forked.

Color in alcohol.—Upper sides of head and body yellowish, whitish, or light orange-red; scales of back and upper sides of some specimens with very thin vertical submarginal dusky line just at base of spiny projections; scales below lateral line with bright red median spot, forming 7 or 8 faint lengthwise rows (not evident in some specimens); all fins pale yellowish or white; spiny dorsal of young (53 mm.) with dusky streak on membranes from base to margin just before each spine.

Color when alive.—Head, body, all fin rays deep, bright blood red; indistinct golden or coppery blotch just behind eye, in middle of opercle, and on scaly basal portion of pectoral; centers of scales below lateral line paler than back and head; darker narrow red lines between scale rows very distinct; spiny dorsal membrane same deep red as body, but membranes of soft dorsal, anal, and posterior half of caudal pale pinkish or white; iris orange-red.

Genus MYRIPRISTIS Cuvier

Myripristis Cuvier, Règne animal, ed. 2, vol. 2, p. 150, 1829. (Genotype, *Myripristis jacobus* Cuvier and Valenciennes.)

It is very likely that some of our species from Oceania are the same as those described by Cuvier and Valenciennes and by Sauvage, from Mauritius, but since their descriptions in many cases have omitted the essential characters and since we cannot examine their types, it is impossible for us to correlate our fish with their names. As previously noted by Schultz (U. S. Nat. Mus. Bull, 180, 1943), Jordan and Evermann, Jordan and Seale, Günther, and others have failed completely to distinguish between the various species of this genus in the Hawaiian and Samoan Islands. We have carefully compared the types and paratypes of Jordan and Evermann and of Jordan and Seale with our large series from the Marshall Islands, and have drawn

the following conclusions: One paratype of *Myripristis berndti* Jordan and Evermann (U.S.N.M. No. 125645) is actually the same as *M. argyromus* Jordan and Evermann, as are the type and one paratype of *M. symmetricus* Jordan and Evermann, these latter being small specimens about half the size of the type of *argyromus; M. sanguineus* Jordan and Seale is a synonym of *M. pralinius* Cuvier and Valenciennes; *M. sealei* Jenkins is the young of *M. chryseres* Jordan and Evermann.

Although the species of this genus are very closely related, it has been possible to separate certain of them on the basis of the number of gill rakers (*murdjan, chryseres*), others by the number of dorsal and anal fin rays, and some by the number of lateral line scales; but always these characters have been found to overlap two or more species, so that they have had to be considered in combination with snout length, eye or interorbital width, body depth, or with some color character, particularly the degree and pattern of color on the opercular flap. The dusky or black markings on the rays of the median fins show so much variation within a species, even within a single lot, that it has not been considered useful as a taxonomic character unless combined with some meristic character. It is only by considering the characters in combination that we have been able to separate the several species.

We have also observed that specimens of *Myripristis jacobus* of the Atlantic have scales extending nearly to the tips of the rays on their soft dorsal and anal fins. None of the Pacific species examined by us have such scales, there being simply a row forming a narrow sheath along the base. On this basis it is likely that the Pacific species not having scales should be separated as a subgenus. We have carefully compared the skeletons of *M. jacobus* and *M. murdjan* but have failed to discover any differences of sufficient importance to consider making them two genera. The oldest generic name available for the Pacific species in which the dorsal and anal are not scaled is *Rhamphoberyx* Gill.

Four lots of larvae just in the transition stage have not been assigned to any species.

KEY TO THE SPECIES OF MYRIPRISTIS OF THE NORTHERN MARSHALL ISLANDS AND ADJOINING REGIONS[26]

1*a*. Perforated scales in lateral line 27 to 33.

2*a*. Gill rakers on lower limb of first gill arch 27 to 30, with total number of gill rakers 42 to 48.

3*a*. Diameter of eye equal to or less than postorbital part of head (hind margin of eye to tip of opercular spine); length of head in greatest depth of body 1.31 to 1.36; anterior rays of dorsal and anal fins pale

[26] Caution: It is necessary to use the combination of all characters given under any single heading because the counts and other characters used overlap in nearly all cases.

or slightly dusky, but without black markings on distal portion of any branched rays; scales of back with broad dark-brown margin, base with dark-brown line and vertical narrow pearl-white bar on scales; general appearance of back a dark-brown network with white openings; dorsal fin rays X–I,15 or 16; anal IV,13; perforated scales in lateral line 27 to 29_____ Myripristis microphthalmus Bleeker

3*b*. Diameter of eye slightly greater than postorbital part of head (hind margin of eye to tip of opercular spine); length of head in greatest depth of body 1.15 to 1.22; anterior rays of dorsal and anal fins colorless, with intense black spot or at least a trace of dusky color on distal portion of next few branched rays; scales of back with narrow marginal bands of pale pink, reddish, or light brown, scale bases pale reddish or yellowish, general appearance of back light reddish or straw colored; dorsal fin rays usually X–I,14 (rarely 13 or 15); anal IV,12 (rarely 11 or 13); perforated scales in lateral line usually 31 or 32 (rarely 29, 30, or 33)____ Myripristis murdjan (Forskål)

2*b*. Gill rakers on lower limb of first gill arch 23 to 26, with total number of gill rakers 37 to 41.

4*a*. Snout length equal to or greater than interorbital width; lower jaw strongly projecting beyond upper jaw in specimens 100 mm. or longer (even with upper jaw in specimens 100 mm. or shorter); opercular membrane broad, black, color ending abruptly at notch below opercular spine; anterior rays of dorsal and anal pale or dusky; dorsal fin rays X–I,14 or 15 (usually 14); anal IV,12 or 13 (usually 12); perforated lateral line scales 28 to 30.

Myripristis berndti Jordan and Evermann

4*b*. Snout length less than interorbital width.

5*a*. Tips of caudal fin rays with broad black band, distal portion of anterior, dorsal, and anal fin rays with broad black spot; distal half or one-third of spiny dorsal membranes black, tip of snout very dark or black, tips of pelvics black in young but pale in adults; scales of back with narrow very dark brown or black margin, scale centers pale; dorsal rays X–I,14 or 15; anal IV,13; perforated scales in lateral line 28 or 29.

Myripristis adustus Bleeker

5*b*. Tips of caudal fin rays without broad black band.

6*a*. Perforated scales in lateral line 28 to 31; opercular flap very dark brown or black; scales above lateral line with dark-brown margin and pale or golden centers, scales below lateral line with faint yellowish lines down centers and usually 5 or 6 broad dark lengthwise body lines where scale rows meet; dorsal fin rays X–I,14 or 15; anal IV,12 or 13.

Myripristis bowditchae, new species

6*b*. Perforated scales in lateral line 32 to 36, usually 32 to 34; opercular flap colorless, pale dusky, or black; scales above lateral line with light-brown margins, pale centers, scales below lateral line usually with indistinct yellow lengthwise bands following centers of scales, and light-gray lengthwise body lines where scale rows meet; dorsal rays X–I,14 or 15 (rarely 16); anal IV,12 (rarely 13).

Myripristis argyromus Jordan and Evermann

1*b*. Perforated scales in lateral line 32 to 41.

7*a*. Dark color of opercular membrane extending onto opercular bone and onto exposed portions of shoulder bones, giving appearance of broad rectangular bar (width of pupil) running from upper edge of gill opening and posttemporal bone into axil of pectoral; caudal peduncle dusky on dorsal and posterior portions; base of all caudal rays dark brown, dusky almost to tips, dorsal fin rays X–I,16 to 18; anal IV,15 or 16; perforated scales in lateral line 38 to 41.

Myripristis multiradiatus Günther

7*b*. Dark color of opercular membrane not extending onto opercular bone.

8*a*. Opercular membrane dark brown or black above spine, color abruptly ending at opercular spine, or 1 mm. or less below spine, rest of opercular membrane pale; outermost branched caudal fin rays with narrow black line extending from near base to tip (this sometimes completely faded), rest of caudal rays pale; dorsal fin rays X–I,14 to 16; anal IV,14 or 15; perforated scales in lateral line 36 to 38.

Myripristis pralinius Cuvier

8*b*. Dark color on opercular membrane not ending abruptly at opercular spine but fading gradually ventrally to lower margin of notch below opercular spine, or opercular membrane very pale.

9*a*. Gill rakers on first gill arch total 32 to 36 (10 to 12+1+21 to 23); enlarged teeth of lower jaw almost in contact, separated by width of base of enlarged tooth patch or less; in adult specimens these tooth patches fitting into deep notch in upper jaw; pectoral axil light brown or colorless no definite spot in axil; dorsal fin rays X–I,14; anal IV,12 or 13; perforated scales in lateral line 34 to 37.

Myripristis chryseres [27] Jordan and Evermann

9*b*. Gill rakers on first gill arch total 37 to 41 (12 to 14+1+24 to 26); enlarged teeth of lower jaw separated by a distance about twice that of diameter of tooth patch; in adult specimens enlarged teeth protruding, not fitting into deep notch in upper jaw; definite spot present in axil; dorsal fin rays X–I,14 or 15 (rarely 16); anal IV,12 (rarely 13); perforated scales in lateral line 32 to 36.

Myripristis argyromus [28] Jordan and Evermann

MYRIPRISTIS MICROPHTHALMUS Bleeker

Myripristis microphthalmus BLEEKER, Nat. Tijdschr. Nederl.-Indië, vol. 3, p. 261, 1852 (type locality, Amboina).

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[27] We consider *M. scalei* Jenkins to be the young of this species, since types of both have similar kind of enlarged teeth on lower jaw and a lower number of gill rakers than counted in any other species.

[28] Since scales of lateral line appeared to be the best character on which to divide the species in this key into two groups, and since *argyomus* fell across the line of separation, it was necessary to place this species in the key under both sections.

SPECIMENS STUDIED

Bikini Atoll: 1 station, 1 specimen, 170 mm. standard length.
Eniwetok Atoll: 1 station, 4 specimens, 127 to 141 mm.
Rongelap Atoll: 2 stations, 3 specimens, 52 to 154 mm.

Description.—Dorsal rays X–I,15 or 16 (usually 15); anal IV,13; pectoral ii,13; pelvic I,7, branched caudal 9+8; perforated scales in lateral line 27 to 29 (usually 28), between lateral line and base of dorsal 2½, between lateral line and origin of anal 7; gill rakers on first arch 12 to 15 (usually 14) +1+27 to 29=42 to 45; (additional counts in table 15).

Depth of body 2.1 to 2.33, head 2.6 to 3.12, both in standard length; snout 4.6 to 5.7, eye 1.96 to 2.51, interorbital space 3.5 to 4.05, postorbital part of head (hind margin of eye to tip of opercular spine) 2.57 to 3.03, least depth of caudal peduncle 3.05 to 4.25, length of pectoral fin 1.27 to 1.42, length of lower caudal lobe 1.05 to 1.19, of upper caudal lobe 0.97 to 1.16, length of longest dorsal spine (fourth) 1.9 to 2.0, of longest dorsal ray 1.31 to 1.39, length of longest anal spine (fourth) 2.27 to 2.38, of longest anal ray 1.34 to 1.37, all in length of head; depth of caudal peduncle in its length 1.6 to 1.8; angle of snout profile with lengthwise axis of body 34 degrees.

Dorsal spines long, slender, third anal spine strongest; pectoral fin extending to below ninth or tenth lateral line scale, maxillary with small rounded teeth near its lower posterior angle; opercle with three rows of scales, opercular spine broad, triangular, not strong.

Color in alcohol.—Top of head and back light reddish brown, scales above lateral line and those in lateral line with broad dark-brown margin and dark reddish-brown base, median portion of scales with narrow vertical pearly white line; lower sides yellowish silver, with dark (sometime yellowish) margins of scales very faint but still evident. Upper and lower jaws dusky, cheeks silvery; opercular flap not black but dark brown or dark grayish, below spine paler, with dusky dots fading ventrally; pectoral axil dark brown or black; dorsal spines and basal portion of anterior rays dusky, anal fin paler but slightly dusky on anterior rays, basal portion of outer caudal rays dusky, inner four rays and distal one-fourth of outer rays pale; upper ray of pectoral usually dusky, rest of rays pale, pelvics pale.

Remarks.—This species has been considered a synonym of *M. murdjan* by Weber and de Beaufort (The Fishes of the Indo-Australian Archipelago, vol. 5, pp. 259–262, 1929); *M. microphthalmus* is readily distinguished from *murdjan* by its coloration, particularly of the scales of the back and on the vertical fins. As may be seen in table 15 *microphthalmus* differs in dorsal and anal soft rays and in number of gill rakers.

TABLE 15.—*Counts made on certain species of* Myripristis

Species	Soft dorsal rays						Soft anal rays							Perforated lateral line scales														
	13	14	15	16	17	18	11	12	13	14	15	16	17	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41
microphthalmus			6	2					8					1	7	1												
murdjan	1	30	1				1	30	1							1	1	11	16	3								
berndti		20	5					20	5						2	20	12											
adustus		1	5						6						5	1												
bowditchae		10	7					3	14						27	40	23	11										
argyromus		8	16	7				24	1										20	20	17	7	2					
multiradiatus				23	18	2				1	30	11	1												1	8	11	8
pralinius		1	15	3						11	8												4	11	5			
chryseres		3						2	1												1		1	1				

Species	Number of gill rakers on first gill arch																																
	Upper part of arch								At angle	Lower part of arch										Total														
	10	11	12	13	14	15	16	17	1	21	22	23	24	25	26	27	28	29	30	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
microphthalmus			1		6	1			8							2	1	5												3	1	3	1			
murdjan					4	10	4	4	22							1	7	9	5												4	6	4	4	3	1
berndti		3	15	2					20			1	9	6	3								1	2	6	7	4								
adustus			2	3	1				6			1	3	1	1										2	4								
bowditchae		1	5	8	2				16				4	7	5										3	3	5	5						
argyromus			7	6	1				14				3	6	3	2									3	2	4	2	1					
multiradiatus			3	4					7			1	3	2	1										1	4	1	1						
pralinius		1	5	3	2				11				3	8									1	2	3	3	2							
chryseres	1		2						3	1	1	1								1			1	1									

murdjan	*microphthalmus*
1. Caudal fin pale,	1. Outer caudal rays dusky on basal three-fourths,
2. Anterior dorsal and anal soft rays pale basally dark distally,	2. Anterior dorsal and anal soft rays dark basally pale distally,
3. No brown streaks on base of scales above lateral line,	3. Brown streak present on base of scales above lateral line,
4. Body shape elongate.	4. Body short, oval.

MYRIPRISTIS MURDJAN (Forskål)

PLATE 17, D

Sciaena murdjan FORSKÅL, Descriptiones animalium . . ., pp. xii, 48, 1775 (type locality, Arabia).

SPECIMENS STUDIED

Bikini Atoll: 12 stations, 43 specimens, 53 to 177 mm., standard length.
Eniwetok Atoll: 4 stations, 22 specimens, 55 to 191 mm.
Rongelap Atoll: 1 specimen, 115 mm.
Rongerik Atoll: 1 station, 2 specimens, 72 and 129 mm.
Rota Island: 2 lots, 2 specimens, 140 and 142 mm.

Description.—Dorsal rays X–I,14 (rarely 13 or 15); anal IV,12 (rarely 11 or 13); pectoral ii,13 (occasionally 14); pelvic I,7; branched caudal 9+8; perforated scales in lateral line 29 to 33 (usually 31 or 32), between lateral line and base of dorsal 2½, between lateral line and origin of anal 7; gill rakers on first arch 14 to 17+1+27 to 30=43 to 48; (additional counts in table 15).

Depth of body 2.45 to 2.85, length of head 2.78 to 3.0, both in standard length; snout 4.71 to 5.8; eye 2.13 to 2.34, interorbital space 3.85 to 4.42, postorbital part of head (hind margin of eye to tip of opercular spine) 2.37 to 2.71, least depth of caudal peduncle 3.05 to 4.02, length of pectoral fin 1.24 to 1.45, length of lower caudal lobe 1.1 to 1.28, of upper caudal lobe 1.1 to 1.25, length of longest dorsal spine (third) 1.95 to 2.48, of longest dorsal ray 1.47 to 1.63, length of third anal spine 2.22 to 2.73, of longest anal ray 1.47 to 1.69, all in length of head; angle of profile of snout with lengthwise axis of body 29 to 40 degrees, profile convex.

Second, third, and fourth dorsal spines about equal in length, long and slender; third and fourth anal spines about equal in length, third strongest; soft dorsal and anal fins somewhat falcate; caudal lobes rounded.

Color in alcohol.—Back and sides pale reddish yellow, sometimes whitish; scales above lateral line with pale or reddish centers and darker margins, scattered scales sometimes black, lower lip white along sides, cheeks dusky silver or reddish; opercular bone not especially

darker but opercular flap dusky, the dusky area fading ventrally before reaching level of upper base of pectoral; pectoral axil completely dusky or silvery or black; anterior margin of soft dorsal and anal fin rays pale, then two or three rays black on distal half, basal portion and rest of fin pale; caudal usually completely pale but sometimes with dusky flecks on outer two or three rays forming faint streaks.

Young (55 to 57 mm.) with same coloration as adults, except a small black spot distally on anterior four or five membranes of spiny dorsal, and tips of inner pelvic rays black. In our smallest specimen the entire spiny dorsal is dusky but color more intense on anterior membranes, and a black bar across base of caudal rays.

Color when alive.—Head and back brick red, margins of scales dark and centers pale; sides pinkish with a tinge of yellow; sides of lower lip white, upper lip red; iris red but eyeball almost completely ringed with white; opercular membrane dark red (not purple or blackish); pectoral axil dark purplish red; dorsal spines reddish, membranes whitish or reddish on basal two-thirds, distal one-third dark brick red; soft dorsal and anal with two anterior rays white distally, next two or three rays deep blackish red; outer margin of pelvic spine white; unbranched caudal rays milk white, median caudal rays all dark brick red, outer two or three darker than median.

Remarks.—As pointed out by Schultz (U. S. Nat. Mus. Bull. 180, p. 62, 1943), there is considerable misunderstanding concerning this species. We have placed here the specimens having a large number of gill rakers (see table 15) and exhibiting the dark bar on the distal portion of the soft dorsal and anal fins.

MYRIPRISTIS BERNDTI Jordan and Evermann

PLATE 18, A

Myripristis berndti JORDAN and EVERMANN, Bull. U. S. Fish Comm., vol. 22, 1902, p. 170, 1903 (type locality, Honolulu, Hawaii).

SPECIMENS STUDIED

Bikini Atoll: 13 stations, 43 specimens, 48 to 189 mm. standard length.
Rongelap Atoll: 3 stations, 14 specimens, 76 to 140 mm.
Rongerik Atoll: 1 station, 5 specimens, 91 to 164 mm.
Guam: *Albatross*, 2 specimens, 161 and 188 mm.

Description.—Dorsal rays X–I,14 or 15 (usually 14); anal IV,12 or 13 (usually 12); pectoral ii,13; pelvic I,7; branched caudal 9+8; perforated scales in lateral line 28 to 30, between lateral line and base of dorsal 2½, between lateral line and origin of anal 7; gill rakers on first arch 11 to 13 (usually 12)+1+23 to 26=35 to 39; (additional counts in table 15).

Depth of body 2.45 to 2.57, head 2.68 to 2.83, both in standard length; snout 4.5 to 5.52, eye 2.22 to 2.57, interorbital space 4.85 to 5.72, post-

orbital part of head (hind margin of eye to tip of opercular spine) 2.6 to 2.86, least depth of caudal peduncle 3.37 to 3.87, length of pectoral fin 1.45 to 1.63, length of lower caudal lobe 1.14 to 1.3, of upper caudal lobe 1.15 to 1.27, length of longest dorsal spine (third) 2.16 to 2.83, of longest dorsal ray 1.64 to 1.84, length of longest anal spine (third) 2.43 to 2.9, of longest anal ray 1.61 to 1.82, all in length of head; depth of caudal peduncle in its length 1.47 to 1.92; angle of snout profile with lengthwise axis of body 35 degrees, profile slightly concave in interorbital area.

Dorsal spines long, slender; third anal spine strongest; pectoral fin extending to below tenth lateral line scale, lower jaw equal to or slightly projecting beyond upper in specimens up to 100 mm., strongly projecting in larger specimens (175–180 mm.); opercular flap broad.

Color in alcohol.—Tip of snout whitish, top of head yellowish, cheeks pink with silvery markings on scales; opercular flap black from upper edge to lower edge of notch below opercular spine, here intense black ends abruptly; below this, opercular flap light or dusky brown in some specimens; axil pectoral brown in upper half, sprinkled with silver in lower half; body light pink above lateral line, with scale margins slightly yellow and centers pale, below lateral line large specimens are white with silvery, brassy dots on scales, small specimens have margins of scales light brown with faint broad yellow lengthwise bands below lateral line; first unbranched ray of dorsal and anal and outer unbranched caudal rays pale or white; distal portions of first two or three branched dorsal and anal rays sometimes black; on basal portion of outer caudal rays usually light pink; pectoral and pelvic fins pale. Young with black markings on dorsal, anal, and on distal part of branched caudal rays; in postlarvae tips of pelvics black.

Color when alive.—Tip of lower jaw deep brownish red, top of head red, sides of head yellowish pink, iris yellowish red; opercular flap intense purplish black from upper edge of gill opening down to lower margin of notch just below opercular spine, below this pink or red; scales on body above lateral line with red margins and yellow or white centers, below lateral line yellow with silvery white centers; spiny dorsal membrane pink basally, distal one-third bright yellow; anterior unbranched rays of soft dorsal and anal pure white distally, basal portion and first four or five branched rays deep blood red; caudal with outer unbranched rays pure white, rest of fin deep red with basal portion and outer branched rays darkest; pectoral red on upper part, pelvic spine and first ray white, next two rays deep red, inner rays white.

Remarks.—This species is characterized by having a proportionately longer snout, narrow, slightly concave interorbital, and lower jaw projecting beyond the upper. The amount of dusky or black coloration on the distal parts of the anterior rays of soft dorsal and anal fins of preserved specimens varies considerably, often being completely absent.

MYRIPRISTIS ADUSTUS Bleeker

Myripristis adustus BLEEKER, Nat. Tijdschr. Nederl.-Indië, vol. 4, p. 108, 1853 (type locality, Amboina).

SPECIMEN STUDIED

Guam: 1945, D. G. Frey, 1 specimen, 71 mm.

Description.—Dorsal rays X–I, 15; and IV, 13; pectoral ii,14; pelvic I, 7; branched caudal 9+8; perforated scales in lateral line 28, between lateral line and base of dorsal 2½, between lateral line and origin of anal 6; gill rakers on first arch 12+1+24=37; (additional counts in table 15).

Depth of body 2.45, head 2.67, both in standard length; snout 5.94, eye 2.04, interorbital space 4.5, postorbital part of head (hind margin of eye to tip of opercular spine) 2.75, least depth of caudal peduncle 4.15, length of pectoral fin 1.53, length of lower caudal lobe 1.49, of upper caudal lobe 1.27, length of longest dorsal spine (third) 2.23, of longest dorsal ray 1.29, length of longest anal spine 2.9, of longest anal ray 1.35, all in length of head; depth of caudal peduncle in its length 1.78; angle of snout profile with lengthwise axis of body 32 degrees.

Dorsal spines long, slender; maxillary without teeth near lower posterior angle in young, a few small denticulations in large specimens; pectoral fin extending to below the tenth or eleventh lateral line scale.

Color in alcohol.—Tip of lower jaw and tip of snout black, top of head dark brown to black; scales above lateral line each with very dark brown or black marginal line, below lateral line black marking on scales faint, narrower, submarginal; opercular flap intense black just above and just below opercular spine, black coloration on opercular bone in region of spine; pectoral axil black; dorsal spines gray or light brown, membranes black on distal one-third, dusky on basal two-thirds, soft dorsal and anal fins dusky basally on anterior rays, distal tips of fins intense black, median portion of posterior rays white; caudal dusky basally and on outer rays, broad distal margin black, light submarginal area on median rays; spine, first branched ray, and tips of pelvics dusky or black in young (71 mm.), pale in large specimens; pectorals dusky basally, pale distally.

MYRIPRISTIS BOWDITCHAE, new species

PLATE 18, B

Holotype.—U.S.N.M. No. 140839, Bikini Atoll, lagoon reef halfway between Bikini and Amen Islands, July 21, 1947, S–46–442, Brock, Hiatt, and Schultz, 177 mm.

Paratypes.—U.S.N.M. No. 140840, same data as holotype, 4 specimens, 94 to 181 mm.; U.S.N.M. No. 140845, Bikini Atoll, Enyu Island, lagoon reef at channel entrance, poison, diving and spear to depth to 20 feet, March 16, 1946, S–46–8, Schultz, Brock, and Marr, 19 specimens, 126 to 166 mm.; U.S.N.M. No. 140853, Bikini Atoll, Romuk Island, lagoon reef, April 2, 1946, S–46–48, Schultz, 17 specimens, 58 to 149 mm.; U.S.N.M. No. 140852, Bikini Atoll, Romuk Island, east end, lagoon reef, May 14, 1946, S–46–128, Schultz, 1 specimen, 68 mm.; U.S.N.M. No. 140848, Bikini Atoll, Bikini Island, ocean reef, July 16, 1946, S–46–253, Herald, 1 specimen, 162 mm.; U.S.N.M. No. 140850, Bikini Atoll, Bikini Island, near northwest tip, ocean reef, Aug. 14, 1946, S–46–349, Herald, 1 specimen, 101 mm.; U.S.N.M. No. 140849, Bikini Atoll, Boby Island, north end, ocean reef, Aug. 17, 1946, S–46–383, Herald, 2 specimens, 75 and 99 mm.; U.S.N.M. No. 140851, Bikini Atoll, Namu Island, 1 mile southeast, lagoon reef, poison and spear at depth of 30 to 45 feet, Aug. 9, 1946, S–46–390, Brock and Herald, 3 specimens, 156 to 162 mm.; U.S.N.M. No. 140841, Bikini Atoll, Bikini Island, lagoon reef, western end of sandspit, Aug. 18, 1947, S–46–533, Brock and Schultz, 1 specimen, 77 mm.; U.S.N.M. No. 140854, Eniwetok Atoll, Giriinien Island, ocean reef in surf, May 29, 1946, S–46–187, Schultz, 7 specimens, 48 to 168 mm.; U.S.N.M. No. 140847, Rongelap Atoll, Eniaetok Island, north end, lagoon reef, July 20, 1946, S–46–267, Herald and Brock, 1 specimen, 111 mm.; U.S.N.M. No. 140846, Rongelap Atoll, Rongelap Island near north end, lagoon coral head at depth of 18 feet, July 25, 1946, S–46–286 (293), Brock, Herald, and Kohler, 1 specimen, 118 mm.; U. S. N. M. No. 140844, Rongerik Atoll, Bock Island, ocean reef, high tidal pool, April 24, 1946, S–46–113, Brock and Marr, 2 specimens, 49 and 69 mm.; U.S.N.M. No. 140843, Rongerik Atoll, Bock Island, ocean reef, June 27, 1946, S–46–237, Schultz and Herald, 1 specimen, 87 mm.; U.S.N.M. No. 140842, Rongerik Atoll, Latoback Island, lagoon, Aug. 14, 1947, S–1041, Schultz, Brock, and Donaldson, 1 specimen, 105 mm.; Likiep Atoll, Univ. Washington, 1 specimen, 72 mm.; U.S.N.M. No. 139829, Marianas Islands, Guam Island, November 25, 1945, D. G. Frey, 2 specimens, 41 and 46 mm.; U.S.N.M. No. 139823, Marianas Islands, Guam Island, November 26, 1945, D. G. Frey, 4 specimens, 39 to 63 mm.; U.S.N.M. No. 139819, Marianas Islands, Guam Island, November 26, 1945, D. G. Frey, 1 specimen, 130 mm.; U.S.N.M. No. 139821,

Marianas Islands, Guam Island, November 26, 1945, D. G. Frey, 11 specimens, 49 to 72 mm.; U.S.N.M. No. 143703, Marianas Islands, Guam Island, tidal pools near mouth of Ylig River, December 23, 1945, Frey and Gressitt, 6 specimens, 49 to 113 mm.; U.S.N.M. No. 143704, Marianas Islands, Guam Island, Tumon Bay, December 10, 1945, L. Gressitt, 2 specimens, 67 and 69 mm.; U.S.N.M. No. 143705, Marianas Islands, Guam Island, Tumon Bay, Nov. 29, 1945, L. Gressitt, 8 specimens, 43 to 68 mm.; U.S.N.M. No. 143706, Marianas Islands, Guam Island, Tumon Bay, Jan. 6, 1946, Gressitt and Ingram, 4 specimens, 41 to 64 mm.; Marianas Islands, Rota Island, Sosan Isthmus, Oct. 31, 1945, W. L. Necker, 1 specimen, 80 mm.

Description.—Counts and measurements of holotype are given first, followed by the range of counts for paratypes in parentheses. Dorsal rays X–I,15 (14 or 15); anal IV,13 (12 or 13, usually 13); pectoral ii,13 (13 or 14, usually 13); pelvic I,7 (I,7); branched caudal 9 (9) +8 (8); perforated scales in lateral line 31 (28 to 31, usually 29), between lateral line and base of dorsal 2½ (2½), between lateral line and origin of anal, 7 (7); gill rakers on first arch 13 (11 to 14) +1 (1) +25 (24 to 26) =39 (37 to 40) (additional counts in table 15). Measurements of the holotype and two paratypes, respectively, expressed in thousandths of standard length, follow: Standard length in mm. 176; 118; 68.4; depth of body 398; 414; 424; head 347; 359; 359; snout 70; 72; 64; eye 152; 166; 183; interorbital space 89; 76; 95; postorbital length of head 136; 128; 131; least depth of caudal peduncle 106; 98; 96; length of pectoral fin 256; 257; 249; length of longest dorsal spine 171; 183; 177; length of caudal peduncle 160; 173; 170.

Depth of body 2.5 (2.18 to 2.56), head 2.9 (2.54 to 2.97), both in standard length; snout 4.9 (4.64 to 5.12), eye 2.33 (1.97 to 2.39), interorbital space 3.9 (3.8 to 4.39), postorbital part of head (hind margin of eye to tip of opercular spine) 2.54 (2.70 to 2.87), least depth of caudal peduncle 3.26 (3.12 to 3.65), length of pectoral fin 1.34 (1.28 to 1.45), length of lower caudal lobe (broken in type) (1.07 to 1.13), of upper caudal lobe (broken in type) (1.05 to 1.1), length of longest dorsal spine (third or fourth) 2.16 (1.95 to 2.35), length of longest dorsal ray 1.6 (1.27 to 1.57), length of longest anal spine (fourth) 2.52 (2.38 to 2.8), length of longest anal ray 1.6 (1.33 to 1.55), all in length of head; depth of caudal peduncle in its length 1.5 (1.46 to 1.77); angle of snout profile with lengthwise axis of body about 35 degrees, profile convex.

Dorsal spines long, slender; pectoral fin extending to below eleventh lateral line scale, lower jaw equal to upper; teeth in upper jaw short and conical, those in anterior part enlarged; in lower jaw, small round clusters of 5 or 6 short heavy teeth on each side of symphysis.

Color in alcohol.—Tip of snout light grayish to dark grayish brown; top of head reddish brown; cheeks silvery with many dusky flecks on scales; opercular flap black from upper edge of opercular opening to notch below opercular spine, below this dusky; pectoral axil entirely dusky or black in upper three-fourths or with a pale extension along base of rays, dark area usually hidden when pectoral fin is laid flat but in some specimens it extends dorsally onto clavicle; scales above lateral line with dark brown margin and pale or golden centers, below lateral line dark scale margins obscured except along top and bottom of scales, forming 5 or 6 more or less distinct lengthwise lines, bases of scales red, centers and midposterior margins light yellow forming indistinct yellow lines, dorsal spines dusky, membranes pale; soft dorsal and anal usually dusky on distal portion of anterior rays, but on some specimens one or the other of these fins or both entirely pale, dusky areas usually more extensive and distinct in small specimens (below 100 mm.); caudal fin dusky except tips of rays, in a few specimens almost black. One or two specimens with intensely black spots on tips of anal and on median caudal rays.

Color when alive (not of type).—Tip of snout and top of head light coppery red; lips on sides of mouth dusky; iris bright copper color; cheeks silvery with dark-brown margins on scales; opercular membrane deep reddish brown to upper edge of pectoral axil; color extending above pectoral axil onto posterior part of clavicle; scales of back and sides with dark margins, pale centers; spiny dorsal membrane pink basally, distal margin with triangular brick-red spot; soft dorsal and anal with anterior unbranched rays white, next five or six rays deep blood red from base to tip (these fins entirely colorless in preserved specimens); outer unbranched caudal rays white, outer branched rays deep blood red, median rays yellowish.

Remarks.—This species is apparently most closely related to *Myripristis argyromus* Jordan and Evermann, from which it is distinguished by a lower number of scales in the lateral line (28 to 31 in *bowditchae* and 32 to 36 in *argyromus*) and by the darker coloration of the scales and opercular membrane; from other members of the genus having 28 to 31 scales in the lateral line it is distinguished as follows: From *M. berndti* by having an interorbital distance broader than the length of snout; from *M. murdjan* by having a lower number of gill rakers; from *M. adustus* by not having a broad black band on the tips of the caudal fin rays; and from *M. macrolepis* by lacking the row of teeth on the ramus, below the enlarged circular patch. Some specimens from Hawaii, called *M. murdjan* by Jordan and Evermann, are apparently of this species.

Named *bowditchae* after the U. S. Navy survey ship *Bowditch*.

MYRIPRISTIS ARGYROMUS Jordan and Evermann

PLATE 18, C

Myripristis argyromus JORDAN and EVERMANN, Bull. U. S. Fish Comm., vol. 22, 1902, p. 172, 1903 (type locality, Hilo, Hawaii).

Myripristis symmetricus JORDAN and EVERMANN, Bull. U. S. Fish Comm., vol. 22, 1902, p. 173, 1903 (type locality, Honolulu and Hilo, Hawaii).

Myripristis berndti JORDAN and EVERMANN (part), Bull. U. S. Fish Comm., vol. 22, 1902, p. 170, 1903 (cotype U.S.N.M. No. 125645) (Honolulu, Hawaii).

SPECIMENS STUDIED

Hawaii, Hilo: 1901, Jordan and Evermann, holotype of *argyromus*, 198 mm.; 1901, Jordan and Evermann, holotype of *M. symmetricus*, 109 mm.; 1901, Jordan and Evermann, cotype of *M. symmetricus*, 104 mm.; 1901, Jordan and Evermann, cotype of *M. berndti*, 138 mm.

Bikini Atoll: 12 stations, 52 specimens, 44 to 175 mm. standard length.

Eniwetok Atoll: 1 station, 1 specimen, 129 mm.

Rongelap Atoll: 2 stations, 3 specimens, 49 to 100 mm.

Rongerik Atoll: 2 stations, 3 specimens, 50 to 168 mm.

Guam: 2 lots, 2 specimens, 55 and 59 mm.

Description.—Dorsal rays X–I,14 or 15 (rarely 16); anal IV,12 (rarely 13); pectoral ii,13 or 14; pelvic I,7; branched caudal 9+8; perforated scales in lateral line 32 to 36, between lateral line and base of dorsal 2½, between lateral line and origin of anal 7; gill rakers on first arch 12 to 14+1+24 to 27=37 to 41; (additional counts in table 15).

Depth of body 2.42 to 2.57, head 2.81 to 3.1, both in standard length; snout 4.83 to 5.26, eye 2.22 to 2.37, interorbital space 3.8 to 4.15, postorbital part of head (hind margin of eye to tip of opercular spine) 2.44 to 2.82, least depth of caudal peduncle 3.11 to 3.33, length of pectoral fin 1.25 to 1.37, length of lower caudal lobe 1.19, of upper caudal lobe 1.09, length of longest dorsal spine (third or fourth) 2.18 to 2.36, of longest dorsal ray 1.48, length of longest anal spine (third) 2.66 to 2.9, of longest anal ray 1.5, all in length of head; depth of caudal peduncle in its length 1.64 to 1.85; angle of snout profile with lengthwise axis of body about 35 degrees, profile slightly convex.

Dorsal spines long and slender; third anal spine strongest; pectoral fin extending to below tenth to twelfth lateral line scale; lower jaw equal to or slightly projecting beyond upper, opercular flap narrow, large specimens with 2 or 3 enlarged caninelike teeth on anterior parts of upper jaw, at tip of lower jaw two patches of teeth on each side of symphysis.

Color in alcohol.—Tip of lower jaw dusky, lower lip white on sides, top of head pale pink or yellow, cheeks silvery, usually flecked with bronze; opercular flap typically dusky brown in region of spine, not black, color fading below notch of opercle; pectoral axil light brown

in upper half, lighter below, scales above lateral line with faint brown, narrow, vertical, submarginal bar, base of scales pale or pinkish, lower sides with five or six faint yellow lengthwise lines following middle of scales, dorsal spines dusky, membranes pale, soft rays usually entirely pale but sometimes with anterior rays dusky on distal portion; outer unbranched caudal rays pale, outer branched rays dusky and bases of inner rays dusky.

Color when alive.—Lips, snout, and upper parts of head red, eye white with coppery iris and purple bar extending from pupil dorsally, cheeks silvery; narrow distal margin of opercular membrane dusky or black above opercular spine; pectoral axil brown in upper half, bright-red spot below; general body color bright pink or red, narrow darker red lines near margins of scales above lateral line, these lines faint on scales below lateral line, lower sides silvery with flecks of bronze; spiny dorsal membrane bright red distally, pink basally, anterior unbranched dorsal and anal rays white, next few rays red, posterior rays lighter; caudal fin deep blood red except on outer rays.

Remarks.—We have had great difficulty in separating this species from those we have called *M. bowditchae*. In general, *M. argyromus* has a paler opercular membrane and pectoral axil, fainter and narrower bars on scales and more perforated scales in the lateral line than *M. bowditchae*. A few specimens of the former with larger numbers of scales (33 to 34), have the coloration of *bowditchae*, and one or two of the latter have the paler coloration of *argyromus*. In one lot, S–46–390, all of the 7 specimens are colored as in *bowditchae* but 4 have 33 or 34 scales while 3 have 28 or 29 scales. As can be seen in table 15 under these two species the counts overlap completely except in the number of lateral line scales, and there are probably specimens of both species represented under the wrong name. Our experience with other species of this genus indicates that the range of number of lateral line scales is usually only 4 but sometimes 5.

The body proportions show an almost complete overlap when specimens of the same size are compared, and a careful search for other characters for separation has revealed none other than those mentioned above.

MYRIPRISTIS MULTIRADIATUS Günther

Myripristis multiradiatus GÜNTHER, Journ. Mus. Godeffroy, vol. 1, p. 93, 1874 (type locality, Vavau, Tonga Islands).

SPECIMENS STUDIED

Bikini Atoll: 7 stations, 36 specimens, 56 to 118 mm. standard length.
Eniwetok Atoll: 1 station, 31 specimens, 95 to 132 mm.
Rongelap Atoll: 1 station, 5 specimens, 96 to 110 mm.

Description.—Dorsal rays X-I,16 to 18; anal IV,15 to 17 (usually 15); pectoral ii,13; pelvics I,7; branched caudal 9 + 8; perforated

scales in lateral line 38 to 41, between lateral line and base of dorsal 2½; between lateral line and origin of anal 7; gill rakers on first arch 12 or 13 + 1 + 23 to 26 = 37 to 40; (additional counts in table 15).

Depth of body 2.35 to 2.58, head 2.81 to 3.03, both in standard length; snout 4.92 to 5.91, eye 2.06 to 2.43, interorbital space 3.65 to 4.48, postorbital part of head (hind margin of eye to tip of opercular spine) 2.43 to 3.04, least depth of caudal peduncle 3.71 to 4.42, length of pectoral fin 1.25 to 1.42, length of lower caudal lobe 1.05 to 1.31, of upper caudal lobe 1.04 to 1.34, length of longest dorsal spine (second or third) 1.96 to 2.24, of longest dorsal ray 1.54 to 1.9, length of longest anal spine (fourth) 2.69 to 3.45, of longest anal ray 1.55 to 1.84, all in length of head; angle of snout profile with lengthwise axis of body 35 degrees, profile convex.

Dorsal spines long, slender, flexible; third anal spine strongest.

Color in alcohol.—Back and upper sides pale yellowish pink; scales in rows above lateral line with faint dusky margin, scale rows below lateral line usually with five faint lengthwise yellow lines following middle of scales; belly silvery or white with varying amount of dusky puncticulations; dusky area on top of caudal peduncle, usually extending onto base of caudal rays; posttemporal scale, posterior margin of opercle, and opercular flap brown, almost black, the black bar extending ventrally to axil of pectoral, which is very dark in upper half, fading in lower half; fins pale except for faint dusky lines on bases of dorsal and anal rays in some specimens; young (57 mm.) with tips of anterior dorsal and anal soft rays and tips of outer caudal rays black.

Ecology.—This species is apparently an inhabitant of deeper waters (20 to 40 feet), usually being taken about large coral heads and only once on the intertidal zone of the reef.

MYRIPRISTIS PRALINIUS Cuvier

Myripristis pralinius Cuvier, *in* Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 3, p. 170, 1829 (type locality, Port Praslin, New Ireland).

Myripristis sanguineus Seale, Occ. Pap. Bishop Mus., vol. 4, p. 26, fig. 7, 1906 (type locality, Apia, Samoa).

Myripristis sanguineus Schultz, U. S. Nat. Mus. Bull. 180, p. 63, 1943 (Apia, Samoa, including type).

SPECIMENS STUDIED

Bikini Atoll: 4 stations, 34 specimens, 50 to 103 mm. standard length.
Eniwetok Atoll: 1 station, 1 specimen, 95 mm.
Rongelap Atoll: 1 station, 1 specimen. 98 mm.

Description.—Dorsal rays X–I,14 to 16 (usually 15); anal IV,14 or 15 (usually 14); pectoral ii,13 (rarely ii,14); pelvic I,7; branched caudal 9+8; perforated scales in lateral line 36 to 38 (usually 37), between lateral line and base of dorsal 2½, between lateral line and

origin of anal 7; gill rakers on first arch, 11 to 14 (usually 12 or 13) +1+24 or 25=36 to 40; (additional counts in table 15).

Depth of body 2.39 to 2.47, head 2.86 to 3.06, both in standard length; snout 5.2 to 5.99, eye 2.01 to 2.2, interorbital space 3.59 to 3.91, postorbital part of head (hind margin of eye to tip of opercular spine) 2.77 to 2.99, least depth of caudal peduncle 3.44 to 3.65, length of pectoral fin 1.17 to 1.24, length of lower caudal lobe 1.01 to 1.15, of upper caudal lobe 1.03 to 1.12, length of longest dorsal spine (second, third, or fourth) 1.83 to 1.99, of longest dorsal ray 1.49 to 1.57, length of longest anal spine (fourth) 2.52 to 3.13, length of longest anal ray 1.46 to 1.72, all in length of head; angle of snout profile with lengthwise axis of body 35 degrees, snout profile convex.

Dorsal spines long, slender; pectoral fin extending to below the fourteenth to sixteenth lateral line scale.

Color in alcohol.—Head and body pale pink; back darker; lower sides with about five faint lengthwise orange or pink or silvery stripes, narrowing and fading posteriorly; posterior margin of upperpart of opercular bone pale, membrane intense black down to opercular spine or just below spine, rest of opercular membrane pale without dusky dots; upper third to half of pectoral axil brown, lower portion pale; first two or three rays of soft dorsal and anal fins black on distal margin (this coloration more evident in small specimens, only a trace in large); caudal pale except for first outer branched rays, which are black, sometimes outer unbranched rays slightly dusky, rest of caudal pale.

Genus HOLOCENTRUS Scopoli

Holocentrus Scopoli, Introductio ad historiam naturalem . . ., p. 449, 1777. (No type designated, but after Gronow's *Holocentrus maxilla*).

The genus *Holocentrus* may be divided into two subgenera. The first, *Flammeo*, includes *sammara* Forskål, *laevis* Günther, *opercularis* Valenciennes, and *scythrops* Jordan and Evermann, all of which have the last dorsal spine longer than the tenth and separated from it by a deep incision. The last dorsal spine closely adheres to the first soft dorsal ray and forms part of that fin. The rest of the species considered here fall naturally into the subgenus *Holocentrus*, in which the eleventh dorsal spine is shorter than the tenth, and is separated from the first soft dorsal ray by a deep incision to the base of the rays. This latter group may eventually be subdivided on the basis of whether or not the otolith chamber is tubelike, with a posterior opening, as in *H. ascenscionis* Osbeck.

Starks (Science, new ser., vol. 28, p. 614, 1908) established the genus *Adioryx* for *H. suborbitalis* Gill, because this species lacks the tubelike

prominence and posterior opening to the otolith chamber; an examination of *H. microstomus* shows that it is like *H. suborbitalis* in this respect. Until all species of *Holocentrus* are examined for these characters we can hardly consider adopting the subdivision *Adioryx*. Included in this genus are two specimens, one from Rota Island, the other from Eniwetok. Both are in the "Rhyncichthys" stage and have pointed overhanging snouts, black spiny dorsal, brown back, and silvery sides and belly.

KEY TO THE SPECIES OF HOLOCENTRUS OF THE NORTHERN MARSHALL ISLANDS AND ADJOINING REGIONS

1*a*. Dorsal spines X,I, eleventh dorsal spine slightly longer than tenth, last spine closely adhering to first soft dorsal ray and forming part of second dorsal fin, but spiny and soft dorsal fins not completely separated (subgenus *Flammeo*).

2*a*. Pectoral rays ii,12; intense black on spiny dorsal fin.

3*a*. Anal rays IV,8; dorsal rays X,I,i,11 perforated scales in lateral line 40 to 43; dorsal fin with a large black blotch between first to fourth spines; anterior edges of soft dorsal and soft anal black; upper and lower edges of caudal fin black; body with about 10 horizontal rows of close-set black spots; cheeks usually with 5 or 6 rows of black spots. Holocentrus sammara (Forskål)

3*b*. Anal rays IV,9 dorsal rays X,I,i,11 or 12 (rarely 11); perforated scales in lateral line 37 or 39; spinous dorsal with wide black band, tips of membranes white, basal third of membranes white, rest of fins plain. Holocentrus opercularis Valenciennes

2*b*. Pectoral rays ii,11; anal rays IV,8; dorsal rays X,I,i,10 or 11 (rarely 10); scales in lateral line 37 to 42; dorsal fin plain, no black mesial band or black blotch anteriorly; anterior edges of soft dorsal and soft anal without or with only a trace of black pigment; upper and lower edges of caudal fin black; 10 or 11 horizontal rows of black spots on body; cheeks usually with 5 rows of black spots—Holocentrus laevis Günther

1*b*. Dorsal spines XI (rarely X or XII), last spine shorter than tenth, separated from first soft dorsal ray by a deep incision.

4*a*. Perforated scales in lateral line 45 or fewer.

5*a*. Dorsal rays XI, i,12 (sometimes 13); anal rays IV,9.

6*a*. Perforated scales in lateral line 32 or 35, pectoral rays ii,12; anal rays IV,9; body with longitudinal stripes; anterior margin of soft dorsal and usually of soft anal black, upper and lower margins of caudal black; pectoral fin with outer soft ray black on its entire length; membranes between dorsal spines black basally and on distal portion— Holocentrus praslin (Lacepède)

6*b*. Perforated scales in lateral line 42 to 47.

7*a*. Pectoral rays ii,13; perforated scales in lateral line 43 to 47; body profusely speckled with brown or black pigment; back usually brown, lower sides silvery; dorsal spines mottled with brown, membranes between spines pale basally, a speckled brown oblong spot on median portion, anterior part of distal margin dusky; snout shorter than eye; maxillary shorter than eye———— Holocentrus lacteoguttatus Cuvier

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7*b*. Pectoral rays ii,12; perforated scales in lateral line 42; maxillary usually slightly longer than eye, sometimes equals eye; body red, with 10 distinct lengthwise light lines following scale centers; fins all pale without any distinct pattern.
Holocentrus tieroides Bleeker

5*b*. Dorsal rays XI,i,13 or 14; anal rays IV,9 or 10; pectoral rays ii,12 or 13; perforated scales in lateral line 40 to 44; depth 2.5 to 2.7 in standard length; spiny dorsal fin high, spines almost as long as dorsal rays, head and body red, with usually indistinct lengthwise lines; a distinct gray or brown spot on dorsal side of caudal peduncle just posterior to base of soft dorsal; spinous dorsal membranes pale in adults (112 mm. and over), dark spot basally between first and second spines in specimens 66 to 111 mm.; dark spots between first and second and second and third spines in specimens 42 to 62 mm_____ Holocentrus spinifer (Forskål)

4*b*. Perforated scales in lateral line 47 or more.

8*a*. Maxillary longer than eye, spiny dorsal fin low, its longest spine 2.8 to 3.2 in head; pectoral rays ii,12, perforated scales in lateral line 47 to 51; body with distinct broad lengthwise dark lines along centers of scales; spiny dorsal fin membranes usually with round white, opaque, or dusky spot on median portion of each, membranes often partly dusky or black in small specimens (48 to 58 mm.).
Holocentrus tiere Cuvier and Valenciennes

8*b*. Maxillary equal to or shorter than eye, third dorsal spine 1.65 to 2.15 in head.

9*a*. Pectoral rays ii,12 or 13 (usually ii,13); perforated scales in lateral line 49 to 52; membranes of spiny dorsal fin mostly pale, a black blotch distally between first to third dorsal spines, then a light brown or gray blotch distally between each spine (stronger in young), with additional dusky spot basally; no black pigment on anal fin, axil of pectoral mostly pale.
Holocentrus microstomus Günther

9*b*. Pectoral rays usually ii,12; perforated scales in lateral line 47 to 49; membranes of spiny dorsal fin mostly black, middle of fin with a white line, nearer base anteriorly, usually broken about middle, near distal portion posteriorly; membrane of anal fin between third and fourth spines, and fourth spine and first soft ray, black; axil of pectoral fin black_____ Holocentrus diadema Lacepède

HOLOCENTRUS SAMMARA (Forskål)

PLATE 19, A

Sciaena sammara FORSKÅL, Descriptiones animalium . . ., p. 1248, 1775 (type locality, Djedda, Red Sea).

Holocentrus fuscostriatus SEALE, Occ. Pap. Bishop Mus., vol. 1, No. 3, p. 69, 1901 (type locality, Marianas).

SPECIMENS STUDIED

Bikini Atoll: 14 stations, 82 specimens, 47 to 168 mm. standard length.
Eniwetok Atoll: 1 station, 1 specimen, 35 mm.

Rongelap Atoll: 4 stations, 10 specimens, 31.5 to 158 mm. (the 31.5-mm. specimen is in the "Rhyncichthys" stage).
Guam: 8 lots, 51 specimens, 35 to 152 mm.
Rota Island: 1 lot, 2 specimens, 87 and 133 mm.

Description.—Dorsal rays X,I, i,11; anal IV,8; pectoral ii,11 or 12 (rarely 11); pelvic I,7; branched caudal 9+8; gill rakers on first arch 7+1+9 or 10=17 or 18; perforated scales in lateral line 40 to 43, between lateral line and dorsal base 3½, between lateral line and base of anal 7 or 8; (additional counts in table 16).

Depth of body 3.1 to 3.5, length of head 2.6 to 2.85, both in standard length; snout 3.65 to 4.9, eye 2.35 to 3.0, interorbital space 3.9 to 4.65, postorbital part of head 3.55 to 4.4, length of upper jaw 2.25 to 2.5, least depth of caudal peduncle 3.75 to 4.45, length of fourth dorsal spine 1.8 to 2.15, of longest dorsal soft ray 1.6 to 1.9, length of third anal spine 1.3 to 1.8, length of pectoral fin 1.55 to 1.7, length of pelvic fin 1.45 to 1.65, all in length of head; depth of caudal peduncle in its length 2.05 to 2.45; angle of snout profile with lengthwise axis of body 36 to 48 degrees, profile convex.

Lower jaw projecting beyond upper; interorbital area flat in small specimens (34 mm.), concave in those of 100 mm. and larger; upper jaw extending posteriorly as far as middle of eye; spine at angle of preopercle extending just to edge of opercular membrane or slightly beyond; last dorsal spine longer than tenth, close to first soft dorsal ray; soft dorsal fin pointed; caudal lobes rounded.

Color in alcohol.—Ground color of head and body usually silvery white, this sometimes obscured by red coloration; tip of lower jaw black, top of snout and dorsal surface of head grayish brown; upper part of eye black; cheeks silvery, usually with 5 or 6 horizontal rows of spots (these may be faint or absent); back and sides above lateral line usually darker than lower sides, each scale of back and sides with a dark brown square spot in center, these spots forming about 10 lengthwise rows, sometimes the center of these spots silvery with brown margins. Spinous dorsal fin with large black blotch of varying size on membranes between first 4 spines, membranes between other spines dusky medially, often a white spot basally and distal margin white, or these areas pale, anterior 2 or 3 rays of soft dorsal and anal fin and outer rays of caudal fin dusky, posterior rays of dorsal and anal fins and median rays of caudal pale or white; pectoral fin colorless.

Color when alive.—Ground color of head and body silvery white or red, tips of lips of both jaws silvery, lips white or pale yellow, upper part of snout, head and opercle dark reddish brown; cheeks with black or brown spots; back and sides above lateral line green; spots forming rows along sides dark reddish brown; spot on anterior membranes of spinous dorsal dark purplish brown to intense black, rest of mem-

TABLE 16.—*Distribution of counts on certain species of* Holocentrus

Species	Dorsal rays								Anal rays				Pectoral rays				Perforated scales in lateral line																				
	X	XI	I	i,10	i,11	i,12	i,13	i,14	IV	8	9	10	ii	11	12	13	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52
sammara	5	----	5	----	5	----	----	----	5	5	----	----	27	2	25	----	----	----	----	----	----	----	1	2	1	1	----	----	----	----	----	----	----	----	----
laevis	6	----	6	1	5	----	----	----	5	5	----	----	28	28	----	----	----	----	----	1	----	1	1	1	1	----	----	----	----	----	----	----	----	----	----
operculatis	10	----	10	----	1	9	----	----	10	----	10	----	10	----	10	----	----	----	----	1	2	----	----	----	----	----	----	----	----	----	----	----	----	----	----
lacteoguttatus	----	8	----	----	----	8	----	----	8	----	8	----	8	----	----	8	----	----	----	----	----	----	----	----	----	1	2	1	1	1	----	----	----	----	----
tieroides	----	2	----	----	----	2	----	----	2	----	2	----	2	----	2	----	----	----	----	----	----	----	----	----	2	----	----	----	----	----	----	----	----	----	----
praslin	----	5	----	----	----	5	----	----	5	----	5	----	5	----	5	----	8	8	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
spinifer	----	27	----	----	----	----	2	25	26	----	2	24	27	----	2	25	----	----	----	----	----	----	1	----	3	12	10	----	----	----	----	----	----	----	----
tiere	----	10	----	----	----	----	10	----	5	----	5	----	10	----	10	----	----	----	----	----	----	----	----	----	----	----	----	----	----	1	4	4	2	1	----
microstomus	----	7	----	----	----	7	----	----	7	----	7	----	36	----	3	33	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	1	5	5	1
diadema	----	10	----	----	----	6	4	----	10	----	10	----	27	1	25	1	----	----	----	----	----	----	----	----	----	----	----	----	----	3	3	6	----	----	----

branes coffee brown on median portion, white spot basally and distal margin white; anterior soft rays of dorsal and anal fins reddish brown rest of fin pale yellow; outer rays of caudal fin dark purplish brown, median rays bright yellow; pectoral fin red at base, rest of fin pale.

HOLOCENTRUS OPERCULARIS Valenciennes

PLATE 19, B

Holocentrum operculare VALENCIENNES, *in* Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 7, p. 501, 1831 (type locality, Carteret Harbor, New Ireland).

SPECIMENS STUDIED

Bikini Atoll: 6 stations, 23 specimens, 164 to 262 mm. standard length.

Description.—Dorsal rays X,I, i,11 or 12 (usually 12); anal IV,9; pectoral ii,12; pelvic I,7; branched caudal 9+8; gill rakers on first arch 6 or 7+1+11=18 or 19; perforated scales in lateral line 37 to 39 (usually 38), between lateral line and dorsal fin base, 3½, between lateral line and anal fin base 7½ or 8; (additional counts in table 16).

Depth of body 3.05 to 3.25, length of head 2.55 to 2.75, both in standard length; snout 3.05 to 3.6, eye 3.1 to 3.35, interorbital space 5.35 to 6.25, postorbital part of head 4.2 to 4.65, length of upper jaw 2.1 to 2.2, least depth of caudal peduncle 4.5 to 4.9, length of third dorsal spine 2.55 to 2.85, of longest dorsal soft rays 1.7 to 2.15, length of third anal spine 1.55 to 1.95, length of pectoral fin 1.7 to 1.8, length of pelvic fin 1.7 to 1.9, all in length of head; depth of caudal peduncle in its length 2.0 to 2.2; angle of snout profile with lengthwise axis of body 39 to 41 degrees, profile straight or slightly convex.

Lower jaw projecting beyond upper; interorbital area flat, with median groove; upper jaw extending posteriorly to below middle of eye; spine at angle of preopercle broad at base, flat, scarcely extending beyond opercular flap in some specimens, not reaching beyond flap in others; opercular spines about equal; last dorsal spine longer than tenth spine, close to first ray of soft dorsal.

Color in alcohol.—Ground color of head and body silvery; lips and snout pale, cheeks silvery, opercle coppery on middle portion; each scale of body with a large reddish-brown spot in its center, margins of scales silvery, scale spots above lateral line darker and more distinct than those below, fading on lower sides and belly; spiny dorsal membranes with large milk-white round spot at base, distal margin with triangular white wedge just behind each spine, middle portion broadly black, black extending to margin just in front of each spine; soft dorsal, anal, pectoral, and pelvic fins all pale, caudal fin pale or with outer rays pale brown.

Color when alive.—Head and body bright silvery, head suffused with red on upper parts, lips red near tips, opercle reddish brown,

throat and opercular membranes white; back light bluish; each scale with small brown spot in center, margins of scales light bluish, breast and belly silvery white; spiny dorsal fin membranes with dark-brown spot at base on anterior portion, large square white spot just distal to brown basal spot, one corner of white spot reaching to base, middle portion of fin broadly black, distal tip on anterior portion of each membrane with hyaline triangular spot; anterior one or two soft dorsal and soft anal rays bright red, rest of fin yellow; pectoral fin red at base, rest of fin faintly red along rays; pelvic spine red; outer caudal rays deep red to tips of lobes, median and distal portion of fin bright yellow.

HOLOCENTRUS LAEVIS Günther

Holocentrum laeve GÜNTHER, Catalogue of the fishes in the British Museum, vol. 1, p. 47, 1859 (type locality, Louisiade Archipelago; Guadalcanal, Solomon Islands; Amboina).

SPECIMENS STUDIED

Bikini Atoll: 5 stations, 8 specimens, 43 to 140 mm. standard length.
Eniwetok Atoll: 1 station, 1 specimen, 103 mm.
Rongelap Atoll: 4 stations, 20 specimens, 80 to 135 mm.
Rongerik Atoll: 1 station, 7 specimens, 116 mm.
Likiep Atoll: Univ. Washington, 2 specimens, 56 and 64 mm.
Guam: 1 lot, 3 specimens, 125 to 148 mm.

Description.—Dorsal rays X,I,i,10 or 11; anal IV,8 pectoral ii,11; pelvic I,7; branched caudal 9+8; gill rakers on first arch 6 or 7+1+9 or 10=16 to 18; perforated scales in lateral line 37 to 42, between lateral line and dorsal base 3½, between lateral line and anal base 7 or 8; (additional counts in table 16).

Depth of body 3.35 to 3.6, length of head 2.6 to 3.0, both in standard length; snout 4.15 to 4.35, eye 2.7 to 2.9, interorbital space 4.15 to 4.4, postorbital part of head 3.85 to 4.1, length of upper jaw 2.3 to 2.45, least depth of caudal peduncle 4.0 to 4.3, length of third dorsal spine 2.0 to 2.2, of longest dorsal soft rays 1.75 to 2.05, length of third anal spine 1.45 to 1.55, length of pectoral fin 1.65 to 1.7, length of pelvic fin 1.5 to 1.65, all in length of head; depth of caudal peduncle in its length 2.15 to 2.5; angle of snout profile with lengthwise axis of body 35 to 43 degrees, profile convex.

Lower jaw projecting slightly beyond upper; interorbital flat or slightly concave, upper jaw extending posteriorly to middle of eye or hind margin of pupil; spine at angle of preopercle flat, broad at base, tapering, reaching just to or slightly beyond margin of opercular flap; last dorsal spine longer than tenth and close to first soft dorsal ray; soft dorsal fin pointed, caudal lobes rounded.

Color in alcohol.—Ground color of head and body silvery or white, sometimes a faint tinge of red on back or anterior part of body; tip of lower jaw and anterior part of upper jaw dusky; snout and interorbital

area grayish brown; cheeks with 7 horizontal rows of brown spots 1 to 4 spots to the row, a vertical row of brown spots just behind margin of preopercle, opercle dusky ventrally; back and sides above lateral line darker than sides below lateral line; sides with 10 lengthwise rows of brown spots, 1 spot in center of each scale; spiny dorsal membrane dusky, no black spot on anterior portion; anterior rays of dorsal and anal fins pale or faintly dusky; outer rays of caudal fin dusky grayish brown; base of pectoral fin spotted or dusky, rest of fin pale.

Remarks.—This species has sometimes been considered to be the same as *H. sammara* Forskål, or only a color variety of that species (see Weber and de Beaufort, The Fishes of the Indo-Australian Archipelago, vol. 5, pp. 233–235, 1929). However, there are several structural differences to separate the two, even though color is not considered. *H. laevis* always has 11 branched pectoral rays, whereas of 27 specimens of *H. sammara* counted, only 2 had 11 branched pectoral rays, the rest 12; *H. sammara* has a longer snout; and *H. laevis* has weaker spines.

HOLOCENTRUS PRASLIN (Lacepède)

Perca praslin LACEPÈDE, Histoire naturelle des poissons, vol. 4, pp. 397, 418, 1802 (type locality, New Britain).

SPECIMENS STUDIED

Guam: 6 lots, 70 specimens, 31 to 162 mm. in standard length.
Rota Island: 2 lots, 4 specimens, 38 to 44 mm.

Description.—Dorsal rays XI,i,12 or 13 (usually 12); anal IV,9; pectoral ii,12; pelvic I,7; branched caudal 9+8; gill rakers on first arch 6 or 7+1+9=16 or 17; perforated scales in lateral line 32 to 35, between lateral line and base of dorsal fin 2½, between lateral line and base of anal fin 7 or 7½; (additional counts in table 16).

Depth of body 2.75 to 2.85, length of head 2.5 to 2.85, both in standard length; snout 4.9 to 10.2, eye 2.35 to 3.1; interorbital space 3.05 to 4.8, postorbital part of head 3.35 to 3.75, length of upper jaw 2.4 to 2.5, least depth of caudal peduncle 3.6 to 4.8, length of fourth dorsal spine 1.8 to 2.15, of longest soft dorsal ray 1.85 to 2.5, length of third anal spine 1.45 to 2.35, length of pectoral fin 1.3 to 1.55, length of pelvic fin 1.35 to 1.55, all in length of head; depth of caudal peduncle in its length 1.75 to 1.95; angle of snout profile with lengthwise axis of body 49 to 51 degrees, profile convex.

Lower jaw not projecting beyond upper; interorbital area flat, with median groove; upper jaw extending posteriorly to below posterior margin of pupil; spine at angle of preopercle scarcely extending beyond opercular flap in smallest specimens (31.4 and 39.5 mm.), extending beyond for one-third of its length in largest specimens; upper opercular spine slightly longer and stronger than lower.

Color in alcohol.—Ground color light silvery gray to light pink or bright red with scale borders silvery; upper lip black, lower lip dusky near tip, iris bright red, large black spot on upper part of orbit, cheeks silvery, top of snout and head dark brown; axil of pectoral fin intense black; each scale of back and sides with large pale spot in center (red in life) spots forming about six lengthwise pale broad lines, spaces between these pale lines dark brown to black; spiny dorsal fin membrane completely black or dusky in smallest specimens, in adults basal third of membrane pale or white, oblong black spot on posterior part of each membrane distally to margin; anterior ray of soft dorsal fin black, rest of fin pale; anal fin membranes black between second and third spines and between third spine and second soft ray, rest of fin pale; outer caudal rays black, median rays pale or slightly dusky; pelvic spine white, first (and sometimes tip of second) soft rays black, rest of fin light yellow; pectoral fin dusky on scaly sheath, rest of fin pale.

Remarks.—We have examined numerous specimens of *Holocentrus ruber* Forskål, from New Guinea, Japan, Sumatra, and the Philippine Islands. Bleeker figures this species accurately in his Atlas, vol. 9, pl. 357, fig. 4, and describes it in Nederl. Tijdschr. Dierk., vol. 4, p. 224, 1871. His figure shows no black on the membranes of the spiny dorsal fin, and has the distal third of all the pelvic fin rays black.

The specimens described above from the Marianas Islands all differ from Bleeker's figure of *H. ruber* in having the membranes of the dorsal fin black on the distal portion and the entire length of the outer first soft ray of the pelvics black, agreeing with the figure and description given by Jordan and Seale (Bull. U. S. Bur. Fisheries, vol. 22, p. 225, fig. 26, 1906).

HOLOCENTRUS LACTEOGUTTATUS Cuvier

PLATE 21, B

Holocentrum lacteo-guttatum CUVIER, *in* Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 3, p. 214, 1829 (type locality, Mer des Indes).

SPECIMENS STUDIED

Bikini Atoll: 20 stations, 119 specimens, 47 to 105 mm. standard length.
Eniwetok Atoll: 5 stations, 21 specimens, 49 to 101 mm.
Rongelap Atoll: 4 stations, 11 specimens, 60 to 101 mm.
Rongerik Atoll: 3 stations, 23 specimens, 49 to 93 mm.
Kwajalein Atoll: 1 station, 3 specimens, 40 to 82 mm.
Guam: 7 lots, 124 specimens, 42 to 109 mm.
Rota Island: 2 lots, 8 specimens, 50 to 93 mm.

Description.—Dorsal rays XI,i,12; anal IV, 9, pectoral ii,13; pelvic I,7; branched caudal 9+8; gill rakers on first arch 6 or 7+1+10

or 11=17 to 19; perforated scales in lateral line 43 to 46 (usually 44), between lateral line and base of dorsal fin 3½, between lateral line and base of anal fin 8; (additional counts in table 16).

Depth of body 2.8 or 2.9, length of head 2.7 to 2.95, both in standard length; snout 4.65 to 5.4, eye 2.5 to 2.7, interorbital space 3.6 to 3.9, postorbital part of head 2.8 to 3.4, length of upper jaw 2.8 to 3.05, least depth of caudal peduncle 4.0 to 4.1, length of third dorsal spine 2.25 to 2.3, of longest dorsal ray 1.85 to 2.05, length of third anal spine 1.4 to 1.55, length of pectoral fin 1.35 to 1.4, length of pelvic fin 1.45 to 1.5, all in length of head; depth of caudal peduncle in its length 1.9 to 2.25; angle of snout profile with lengthwise axis of body 49 to 51 degrees, profile convex, but tip of snout concave.

Lower jaw not projecting beyond upper, interorbital area flat; upper jaw extending posteriorly to below middle of eye; spine at angle of preopercle projecting beyond margin of opercular flap for one-fourth its length in small specimens, one-third in large specimens, two opercular spines short, about the same size.

Color in alcohol.—Ground color of cheeks, lower sides, and belly silvery white; lips pale; top of head, cheeks, and opercles profusely sprinkled with minute brown dots; back and upper sides, to middle of scale row below lateral line, light brown; some specimens with faint yellow or pink lengthwise lines following middle of scales on lower sides; back and sides with many minute, close-set brown dots, some larger and sometimes black on caudal peduncle, fewer on lower sides and belly; spiny dorsal fin mottled, with brown lines forming a network, or covered with close-set brown dots, membranes pale basally, speckled brown oblong spot on median portion, anterior part of distal margin dusky; soft dorsal fin dusky basally, rest of fin pale; third anal spine sometimes with minute brown dots, rest of fin pale; caudal, pectoral, and pelvic fins pale.

Color when alive.—Ground color of lower jaw, cheeks, opercles, sides, and belly silvery white, silvery area on back darker; tip of snout and top of head light brown with flush of pink; iris bright yellow; spinous dorsal fin membranes with broad brick-red band on distal margin, small oval or round white spot on each membrane just below red band, faint red spot on basal portion of each membrane; soft dorsal fin pink, anal fin with fourth spine and first soft ray pinkish orange; caudal fin with basal portion and outer rays pink, median rays yellow; pectoral and pelvic fins pale, colorless.

HOLOCENTRUS TIEROIDES Bleeker

Holocentrus tieroides BLEEKER, Nat. Tijdschr. Nederl. Indië, vol. 5, p. 334, 1853 (type locality, Amboina).

SPECIMENS STUDIED

Marshall Islands: Jaluit Atoll, January 1900, *Albatross*, 1 specimen, 109 mm.; Bikini Atoll: Arji Island, 100 yards off shore, lagoon coral area at depths from 0 to 40 feet, poison and spear, August 7, 1946, S–46-308, Brock and Herald, 1 specimen, 113 mm.

Description.—Dorsal rays XI,i,12; anal IV, 9; pectoral ii,12; pelvic I,7; branched caudal 9+8; perforated scales in lateral line 42, between lateral line and dorsal fin base 3½, between lateral line and anal fin base 8; gill rakers in first arch 8+1+12=20; (additional counts in table 16).

Depth of body 2.7 or 2.75, length of head 2.7 or 2.8, both in standard length; snout 3.7 to 3.9, eye 2.8 or 2.9, interorbital space 4.7 to 5.0, postorbital part of head 3.35 to 4.3, length of upper jaw 2.45 to 2.5, least depth of caudal peduncle 4.4 to 4.55, length of third dorsal spine 2.3 or 2.4, longest dorsal rays 1.6, length of third anal spine 1.5 or 1.6, length of pectoral fin 1.25, length of pelvic fin 1.3 or 1.4, length of preopercular spine 3.65 or 4.05, all in length of head; depth of caudal peduncle in its length 1.9 to 2.1; angle of snout profile with lengthwise axis of body 37 or 38 degrees, profile slightly convex.

Lower jaw about even with upper; upper jaw extending posteriorly to below anterior margin of pupil, upper opercular spine larger than lower, one-fourth to one-half of preopercular spine extending beyond margin of opercular flap, soft anal rays longer than third anal spine.

Color in alcohol.—Ground color light yellow or red, lips pale; scales of body each with whitish or light red spot in center forming about 10 lengthwise distinct light lines white in one specimen, light reddish in the other. All fins pale without any distinct pattern.

Remarks.—The specimen from Bikini differs somewhat in coloration from that from Jaluit, as well as from numerous others from the Philippines, in having a lighter ground color and darker lengthwise lines along the centers of the scales. However, it agrees with *H. tieroides* in fin ray counts and scale counts and differs in these respects from all other species of *Holocentrus* examined by us.

HOLOCENTRUS SPINIFER (Forskål)

PLATE 20, A

Sciaena spinifera FORSKÅL, Descriptiones animalium . . . , pp. 12, 49, 1775 (type locality, Djedda, Arabia).

Holocentrus spinifer RÜPPELL (not Rüppell, Atlas), Neue Wirbelthiere . . . Abyssinien gehörig, Fische des rothen Meeres, p. 97, pl. 25, fig. 1, 1835.

Holocentrum binotatum QUOY and GAIMARD, Voyage de découvertes de *L'Astrolabe* . . . , vol. 3, p. 679, pl. 14, fig. 4, 1834 (type locality, New Guinea; Guam).

Holocentrum unipunctatum GÜNTHER, Journ. Mus. Godeffroy, vol. 1, p. 95, pl. 65, fig. A, 1873 (type locality, Solomon and Tonga Islands).

SPECIMENS STUDIED

Bikini Atoll: 12 stations, 36 specimens, 42 to 302 mm. standard length.
Eniwetok Atoll: 3 stations, 7 specimens, 58 to 226 mm.
Rongelap Atoll: 6 stations, 8 specimens, 67 to 264 mm.
Rongerik Atoll: 3 stations, 5 specimens, 102 to 266 mm.
Guam: 10 lots, 68 specimens, 38 to 184 mm.
Rota Island: 3 lots, 9 specimens, 36 to 97 mm.

Description.—Dorsal rays XI,i,13 or 14 (usually 14); anal IV,9 or 10 (usually 10); pectoral ii,12 or 13; pelvic I,7; branched caudal 9+8; gill rakers on first arch 6 or 7+1+11 or 12=18 to 20; perforated scales in lateral line 40 to 44, between lateral line and base of dorsal fin 3½, between lateral line and base of anal fin 8; (additional counts in table 16).

Depth of body 2.5 to 2.7, length of head 2.6 or 2.7, both in standard length; snout 3.4 to 4.7, eye 2.75 to 3.85, interorbital space 5.75 to 8.55, postorbital part of head 3.35 to 4.55, length of upper jaw 2.5 to 2.65, least depth of caudal peduncle 4.0 to 4.25, length of third dorsal spine 2.05 to 2.35, of longest dorsal soft rays 1.85 to 1.95, length of third anal spine 1.65 to 2.0, length of pectoral fin 1.4 to 1.5, length of pelvic fin 1.5, length of preopercular spine 3.75 to 4.7, all in length of head; depth of caudal peduncle in its length 1.75 to 1.95; angle of snout profile with lengthwise axis of body 36 to 41 degrees, profile convex in smallest specimens, slightly convex in those of medium size, straight in largest.

Lower jaw not projecting beyond upper in specimens under 100 mm. standard length, projecting beyond upper in specimens over 100 mm.; upper jaw extending posteriorly to below middle of eye; upper opercular spine slightly longer than lower, preopercular spine extending beyond margin of opercular flap in specimens of all sizes, shorter in small specimens, gradually increasing in length with increased size of fish.

Color in alcohol.—In specimens 112 to 297 mm., head and body light reddish yellow, back darker, cheeks, breast, and lower sides silvery; each scale margin with thin silvery line; center of each scale pale or red, forming lengthwise lines. Scales forming dorsal sheath silvery; lips and fins uniformly pale; a white or silvery spot (usually distinct, but in some specimens not so evident) on tip of caudal peduncle just behind posterior base of soft dorsal fin.

In specimens 66 to 111 mm. head and body brown or reddish brown, back darker, lips white, cheeks whitish, dusky brown, or red; breast, belly, and lower sides white; dorsal fin with small black spot near base of membrane between first and second spines; rest of fins pale or

faintly yellow; distinct dark brown spot on dorsal surface of caudal peduncle just behind posterior base of soft dorsal fin.

In specimens 42 to 65 mm. head and body light grayish brown to dark reddish brown, lips and snout pale to slightly dusky; cheeks, breast, and lower sides usually dusky; dorsal fin with two intense black spots near base of membrane between first and second spines, and between second and third spines; membranes between other spines may be more or less dusky in smallest specimens (under 45 mm.).

The patterns of these three size groups gradually merge with those of the next size group near the upper and lower limits given here.

Color when alive.—Head and body ranging from deep blood red, with very little silvery color, to light red with a great deal of silvery; lips light pink, deep red spot just behind eye on upper part of preopercle, axil of pectoral fin also deep red; each scale on back and upper-sides with dark red spot in middle, margin of scales silvery; spiny dorsal fin membrane deep blood red, rest of fins reddish yellow or light yellow; barely visible silvery or pigmented spot on dorsal surface of caudal peduncle just behind posterior base of soft dorsal fin.

Remarks.—After carefully studying several large series of specimens from both the Marshall and Marianas Islands (the type locality for *H. binotatus*) ranging in size from 42 to 297 mm., and after comparing them with Rüppell's plate 25, figure 1, Günther's plate 65, figure A, and Quoy and Gaimard's plate 14, figure 4, we have concluded that the color differences noted in the three nominal species *H. binotatus* Quoy and Gaimard, *H. unipunctatus* Günther, and *H. spinifer* Forskål, as described and figured by Rüppell, 1835, result from differences in age, as we have noted the pigment spots of the dorsal fins gradually diminishing with increase in size. The morphological characteristics of proportionate decrease in width of interorbital, change of dorsal profile from convex to straight, and increased proportionate length of preopercular spine are gradual with increased size in the series studied. No differences in fin ray or scale counts were noted (see table 17).

TABLE 17.—*Fin ray and scale counts made on three size groups of* Holocentrus spinifer

Nominal species	Size range in mm.	Dorsal rays			Anal rays			Pectoral rays (both sides counted)			Scales in lateral line				
		XI	i,13	i,14	IV	9	10	ii	12	13	40	41	42	43	44
spinifer	112–175	7	....	7	7	1	6	7	1	6	....	....	1	3	2
(*unipunctatus*)	66–111	9	1	8	8	....	8	9	1	8	....	....	2	3	4
(*binotatus*)	42–62	11	1	10	11	1	10	11	....	11	1	....	....	6	4

HOLOCENTRUS TIERE Cuvier and Valenciennes

PLATE 20, B

Holocentrum tiere CUVIER and VALENCIENNES (on Lesson), Histoire naturelle des poissons, vol. 3, p. 202, 1829 (type locality, Tahiti).

Holocentrum tiere LESSON, Voyage autour du monde . . . sur la corvette . . . *La Coquille* . . . : Zoologie, vol. 2, p. 221, pl. 25, fig. 1, 1830 (type locality, Tahiti).

Holocentrum erythraeum GÜNTHER, Catalogue of the fishes in the British Museum, vol. 1, p. 32, 1859 (type locality, Sea of San Christoval, Solomons); Journ. Mus. Godeffroy, vol. 1, p. 99, pl. 63, fig. B, 1874.

SPECIMENS STUDIED

Bikini Atoll: 15 stations, 35 specimens, 48 to 190 mm. standard length.
Rongerik Atoll: 3 stations, 5 specimens, 69 to 188 mm.
Eniwetok Atoll: 3 stations, 9 specimens, 51 to 186 mm.
Kwajalein Atoll: 1 station, 1 specimen, 105 mm.
Guam: 1 lot, 1 specimen, 48 mm., Frey.

Description.—Dorsal rays XI (rarely X), i,13; anal IV,9; pectoral ii,13; pelvic I,7; gill rakers on first arch 7 to 9+1+13=21 to 23; perforated scales in lateral line 47 to 51 (usually 48 or 49), between lateral line and base of dorsal fin 3½, between lateral line and base of anal fin 8; (additional counts in table 16).

Depth of body 2.7 or 2.8, length of head 2.65 to 2.8, both in standard length; snout 3.7 to 4.58, eye 2.75 to 3.45, interorbital space 4.2 to 5.85, postorbital part of head 3.35 to 3.95, length of upper jaw 2.2 to 2.3, least depth of caudal peduncle 3.9 to 4.45, length of third dorsal spine 2.8 to 3.2, of longest dorsal rays 1.8 to 2.05, length of third anal spine 1.7 to 2.05, length of pectoral fin 1.4 or 1.45, length of pelvic fin 1.6 or 1.65, length of preopercular spine 3.9 to 7.6, all in length of head; depth of caudal peduncle in its length 1.85 to 2.0; angle of snout profile with lengthwise axis of body in specimens of over 150 mm. 37 degrees, in specimens under 100 mm. 44 degrees or 45 degrees, profile smoothly convex and rounded in specimens of all ages.

Lower jaw even with upper in large specimens, shorter than upper in small (48 to 50 mm.); upper jaw extending posteriorly to beneath middle of eye; upper opercular spine slightly larger than lower; preopercular spine proportionately shorter in small specimens, about half its length projecting beyond margin of opercular flap; soft dorsal falcate, its rays much longer than longest dorsal spines; soft anal rays longer than third anal spine in specimens over 79 mm.

Color in alcohol.—Ground color of head and body light yellowish or reddish white; each scale with dark red or brown spot in its center, these spots forming 10 (usually quite distinct) lengthwise lines; scales forming sheath, usually dark reddish purple or brown, along base of spinous dorsal; snout and lips whitish; cheeks white, silvery or dusky;

all fins uniformly dusky in specimens over 150 mm., usually membranes of spinous dorsal each with a round white or dusky spot smaller than pupil in middle; in specimens measuring 48 to about 80 mm. dorsal spines slightly dusky, the membranes between first and third spines black; in specimens 48 to 58 mm. membranes with black line before each spine; rest of membrane more or less dusky, coloration in specimens about 80 mm. long persisting as round spot in median portion.

Color when alive.—In specimens over 80 mm., ground color of head and body yellowish red to deep blood red, upper lip dark red, lower posterior edge of upper jaw white, lower lip red on median portion, inner lateral parts white; preopercular scales red with coppery colored margins, preopercular spine yellowish red; each scale of body with dark blue spot in its center, these spots forming indistinct dark lengthwise lines; spines of dorsal deep red, membranes each with a rounded white spot on median portion, their anterior distal margins milk white, soft dorsal rays red, membranes pale, transparent; first three anal spines white, fourth spine and soft rays red, membranes pale; pectoral fin rays pale, membranes red; pelvic fin spine with white outer margin, rest of fin red; caudal fin deep red, narrow distal margin yellow.

In a specimen about 69 mm., head and body deep red with numerous minute brown dots, the lengthwise lines following each scale row iridescent purple; areas of lips and of anal and pelvic spines, that are white in adults, merely pale; dorsal spines red, membranes each with a round brown or black pigmented spot on its median portion, distal margin narrowly black, small pale submarginal area on anterior portion of each membrane; rest of fins red.

Remarks.—All our specimens from the Marshall Islands except one have XI dorsal spines; this one has X. One of two examples from Johnston Island has XII dorsal spines. Günther's original description of *H. erythraeus* states that "from *Hol. tiere* it may be distinguished by XI dorsal spines," and in his later description he says, in comparing *H. tiere* with *H. erythraeus*, that it has nearly the same body form, coloration, and particularly the low dorsal fin. He further states that the snout of *tiere* is much shorter than in *erythraeus*. We have carefully measured the snout lengths of our two Johnston Island specimens and find the 220-mm. specimen (XI spines) has a snout length of 20.4 mm., and the 217-mm. specimen (XII spines) snout length 19.7.

The coloration of our specimen with XII spines does not exhibit more than the normal variation found in those with XI spines. We can find no description of *H. tiere* based on specimens with XII dorsal spines other than that of Lesson. Since we have found one specimen in the Marshall Islands with X dorsal spines, we are not surprised to find one with XII dorsal spines in the slightly colder water of

Johnston Island. Hence, we conclude that *H. tiere* was based on a specimen with a normal variation of one additional spine, and, after our careful study of about a hundred specimens from the tropical Pacific, that *H. tiere* and *H. erythraeus* are identical.

HOLOCENTRUS MICROSTOMUS Günther

PLATE 21, A

Holocentrum microstoma GÜNTHER, Catalogue of the fishes in the British Museum, vol. 1, p. 34, 1859 (type locality, Amboina).

SPECIMENS STUDIED

Bikini Atoll: 23 stations, 196 specimens, 54 to 143 mm. standard length.
Rongerik Atoll: 3 stations, 7 specimens, 59 to 114 mm.
Eniwetok Atoll: 4 stations, 28 specimens, 53 to 130 mm.
Rongelap Atoll: 8 stations, 92 specimens, 52 to 113 mm.
Kwajalein Atoll: 1 station, 3 specimens, 51 to 55 mm.
Likiep Atoll: Univ. Washington, 16 specimens, 58 to 96 mm.
Guam: 3 lots, 37 specimens, 50 to 136 mm.

Description.—Dorsal rays XI,i,12; anal IV,9; pectoral ii,12 or 13; pelvic I,7; branched caudal 9+8; gill rakers on first arch 6 or 7+1+12 or 13=19 to 21; perforated scales in lateral line 49 to 52, between lateral line and dorsal fin base 3, between lateral line and anal fin base 9; (additional counts in table 16).

Depth of body 3.0 to 3.3, length of head 2.75 to 3.05, both in standard length; snout 4.05 to 4.95, eye 2.5 to 3.15, interorbital space 4.65 to 5.3, postorbital part of head 3.9 to 4.35, length of upper jaw 2.75 to 3.0, least depth of caudal peduncle 3.95 to 4.6, length of third dorsal spine 1.85 to 2.05, of longest dorsal soft rays 1.7 to 1.9, length of third anal spine 1.15 to 1.25, length of pectoral fin 1.35 to 1.45, length of pelvic fin 1.3 to 1.4, all in length of head; depth of caudal peduncle in its length 2.05 to 2.2; angle of snout profile with lengthwise axis of body 39 to 48 degrees, profile straight or slightly convex.

Lower jaw protruding slightly beyond upper, slightly shorter than upper in specimens of 65 mm. and less; interorbital flat or slightly concave; upper jaw extending to below anterior half of pupil; spine at angle of preopercle flat, broad at base, extending slightly beyond margin of opercular flap; upper opercular spine longer, stronger than lower.

Color in alcohol.—Ground color of head and body silvery reddish brown or yellowish brown; body with about 11 white or yellow lengthwise stripes, each stripe following center of scale row; in many specimens the third line from the dorsal is broader and very much whiter under the posterior half of the spinous dorsal fin than the rest of the lines; lips and snout light yellow, sometimes faintly dusky on dorsal portion, cheeks pale, silvery, sometimes dusky on upper posterior por-

tion; dorsal fin with membrane between distal two-thirds of first three spines black, most specimens with additional black or dusky coloration submarginally, some with dusky spots on membranes basally; most specimens with anterior rays of anal fin pale, but a few with some dusky coloration; a bright yellow spot often present on scaly sheath at base of anal fin; soft dorsal, caudal, pectoral, and pelvic fins all pale; sometimes dorsal and ventral caudal base with small round yellow spots.

Color when alive.—Ground color of head and body brick red with faint tinge of brown; lips and lower jaw light yellow; eye dark brown, with white margin; lower part of cheeks silvery white, posterior margin of preopercle forming white vertical bar; body with six or seven lengthwise white lines, narrower above lateral line than below, belly white; a large blackish blotch distally between first and third spiny dorsal rays, surrounded by deep red; distal tip of membranes white; broad submarginal blood-red band, basal portion suffused with red, median portion pale or white; soft dorsal fin with distal half red, basal half pale or yellowish; first three anal spines white, fourth spine and first one or two soft rays red, rest of fin pale or yellow; outer caudal rays deep red, median rays suffused with red or yellow; pectoral fin and pelvic fins pale.

HOLOCENTRUS DIADEMA Lacepède

PLATE 21, C

Holocentrus diadema LACEPÈDE, Histoire naturelle des poissons, vol. 4, pp. 335, 372, 1802; vol. 3, pl. 33, fig. 3, 1802 ("manuscrits chinois") (type locality, South Seas).

SPECIMENS STUDIED

Bikini Atoll: 10 stations, 82 specimens, 61 to 110 mm. standard length.
Eniwetok Atoll: 2 stations, 10 specimens, 78 to 94 mm.
Rongelap Atoll: 8 stations, 31 specimens, 64 to 100 mm.
Rongerik Atoll: 2 stations, 21 specimens, 49 to 101 mm.
Likiep Atoll: Univ. Washington, 15 specimens, 45 to 73 mm.

Description.—Dorsal rays XI,i,12 or 13; anal IV,9; pectoral ii,11 to 13, usually ii,12; pelvic I,7; branched caudal 9+8; gill rakers on first arch 5 or 6+1+11 or 12=17 to 20; perforated scales in lateral line 48 or 49, between lateral line and dorsal fin base 3, between lateral line and anal fin base 8 or 8½; (additional counts in table 16).

Depth of body 2.95 to 3.05; length of head 2.85 to 3.1, both in standard length; snout 4.3 to 5.1, eye 2.4 to 2.75, interorbital space 4.25 to 4.75, postorbital part of head 3.7 to 3.95, length of upper jaw 2.75 to 2.95, least depth of caudal peduncle 4.2 to 4.5, length of fourth dorsal spine 1.65 to 2.15, of longest dorsal soft rays 1.6 to 1.8, length of third anal spine 1.0 to 1.4, length of pectoral fin 1.25 to 1.35, length of pelvic

fin 1.1 to 1.25, all in length of head; depth of caudal peduncle in its length 1.9 to 2.3; angle of snout profile with lengthwise axis of body 45 to 50 degrees, profile slightly convex.

Lower jaw not protruding beyond upper, interorbital flat or slightly concave; upper jaw extending to below anterior margin of pupil or to below middle of pupil; spine at angle of preopercle in large specimens extending beyond opercular flap for a third of its length in small specimens, reaching just beyond edge of opercular flap; upper opercular spine longer and stronger than lower.

Color in alcohol.—Ground color whitish, or light orange to brownish red; lips pale; head silvery or brown; each scale with a white spot in its center, these spots forming 9 or 10 lengthwise white lines, each white line bordered above and below by a narrow dark-reddish-brown line; breast silvery or heavily sprinkled with dark reddish brown dots, sometimes these dots arranged in rows; pectoral axil dark reddish brown to almost black; dorsal fin spines pale, membranes black with lengthwise narrow white line on basal third in anterior half of fin, and on distal third in posterior half, usually these two lines separated in middle of fin by 2 or 3 completely black membranes, but in the smallest specimen (60.5 mm.) the white line is continuous; soft dorsal fin pale; anal fin membrane between third and fourth spines, fourth spine, and first soft ray, black or dusky, rest of fin pale; caudal, pectoral, and pelvic fins pale.

Color when alive.—Ground color deep blood red to light orange red; lips red, snout red; white line extending from tip of snout, beneath eye to ventral margin of preopercle; throat white, breast pale; body with nine lengthwise dark-bordered white lines, the two above the lateral line very narrow, one running from below the tip of the preopercular spine beneath the pectoral insertion and above the anal fin base the widest; dorsal fin spines purple, membranes black, a white lengthwise line starting near base of first spine crossing membranes of first 6 spines, membrane between sixth and seventh spines completely black, a white submarginal line on membrane between seventh to eleventh spines; soft dorsal bright red on anterior and posterior rays, middle of fin paler; anal fin deep red or purplish black between third anal spine and first soft ray, rest of fin light red; pectoral fin pale; pelvic fin spine milk white, rest of fin light red; outer caudal fin rays deep red, other rays light orange-red, membranes pale.

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Order ANACANTHIDA

Family BREGMACEROTIDAE

By LEONARD P. SCHULTZ

Munro (Proc. Roy. Soc. Queensland, vol. 61, No. 5, pp. 37–53, figs. 1–10, 1950) revised the genus *Bregmaceros*, and by means of his keys and descriptions I have tentatively identified the Marshall Island specimens.

Genus BREGMACEROS Thompson

Bregmaceros THOMPSON, Mag. Nat. Hist., vol. 4, p. 184, 1840. (Genotype, *Bregmaceros mcclellandi* Thompson.)

BREGMACEROS MCCLELLANDI Thompson

Bregmaceros mcclellandi THOMPSON, Mag. Nat. Hist., vol. 4, p. 184, text fig., 1840 (type locality, Ganges Delta).

SPECIMENS STUDIED

Bikini Atoll: 5 stations, 7 specimens, 13 to 46 mm. standard length
Rongelap Atoll: 1 station, 4 specimens, 12 to 38 mm.
Rongerik Atoll: 1 station, 1 specimen, 21 mm.

Description.—Dorsal rays I–43 to 45; anal 44 or 45; pectoral 15 to 17; pelvic 7; branched caudal 6+6.

Body compressed, greatest depth 5.5 to 6.0, head 5.0 to 5.3, both in standard length; insertion of pelvic fins in front of a vertical line through pectoral insertion, about equidistant between rear of eye and posterior edge of head; all pelvic rays long, tips filamentous, longest ray about half of standard length; first dorsal consists of a single long filamentous spine, its insertion on top of head a little in front of a vertical line through pelvic insertion; distance from snout tip to second dorsal origin contained about 2.4 in standard length, second dorsal with elevated rays anteriorly and posteriorly, middle third with short rays; anal fin similar to second dorsal; origin of anal slightly behind a vertical line through origin of second dorsal; body covered with thin scales, head naked; lateral line along each side of midline of back, ending behind dorsal fin on upper edge of caudal peduncle; each side of midventral line of belly with a dermal fold ending at about end of first third of length of anal base; premaxillary

protractile; one or two rows of short conical teeth in jaws; a few teeth on vomer and palatines; gill membranes joined with each other forward over isthmus with a free fold; gill rakers represented by very fine denticles.

Color in alcohol.—Plain grayish, or with a dark pigmented area along back, including all of second dorsal fin except the short rays.

Ecology.—This species was attracted to a light at night. It was not seen over the reefs.

Order SYNGNATHIDA

Suborder SYNGNATHINA

Family AULOSTOMIDAE: Trumpetfishes

By LEONARD P. SCHULTZ

Genus AULOSTOMUS Lacepède

Aulostomus LACEPÈDE, Histoire naturelle des poissons, vol. 3, p. 356, 1803. (Genotype, *Aulostomus chinensis* Lacepède=*Fistularia chinensis* Linnaeus.)

AULOSTOMUS CHINENSIS (Linnaeus)

PLATE 21, D

Fistularia chinensis LINNAEUS, Systema naturae, ed. 12, p. 515, 1766 (type locality, India).

SPECIMENS STUDIED

Bikini Atoll: 4 stations, 7 specimens, 181 to 368 mm. standard length.
Rongelap Atoll: 1 station, 1 specimen, 233 mm.
Likiep Atoll: Univ. Washington, 4 specimens, 159 to 230 mm.
Guam: *Albatross*, 1 specimen, 181 mm.

Description.—Dorsal rays X to XII–V, 23 to 24; anal iv or v, 24 to 26; pectoral xvii; pelvic 6; scales in a vertical row between spiny dorsal and pelvic insertion 20 above lateral line and 14 below.

Head 2.9 to 3.1; pectoral insertion to pelvic insertion 3.6 to 3.9; pectoral insertion to dorsal origin 2.1 to 2.2; all in standard length. Snout 1.4 to 1.5; bony orbit 9.4 to 13.1; tip of snout to rear of maxillary 5.1 to 7.1; bony interorbital 13.4 to 16.4; all in length of head.

Head and body notably compressed; snout long, tubular, with jaws at end; maxillaries about twice diameter of eye; pelvic insertions far behind head, much closer to dorsal and anal origins than to head; interorbital space flat; gill membranes free from isthmus, joined far forward; upper edge of gill opening above dorsal edge of pectoral base; origins of dorsal and of anal fins opposite each other; caudal fin rounded, without a filament; anus far in advance of anal origin, about opposite tips of pelvic fins; chin with a barbel.

Color in alcohol.—Ground color light brownish, sometimes with traces of alternating slightly dark and paler bars; more or less regularly a black bar across maxillary, sometimes one in front of eye, one at insertion of each pelvic fin; a dark streak along bases of dorsal and anal fins; usually a dark spot in upper and lower lobes of caudal fin; sometimes light silvery spots on sides of head and on body in region of dorsal and anal fins.

Ecology.—This species was not commonly taken. The specimens collected came from the ocean reef or in the lagoon, where wave action was severe.

Family FISTULARIIDAE: Cornetfishes

By Leonard P. Schultz

Although two species in this family might be expected to occur in the northern Marshall Islands, only one was collected. *Fistularia villosa* Klünzinger may be distinguished from *F. petimba* by the occurrence, on the former, of a single median row of narrow keeled scales in front of and behind both dorsal and anal fins, whereas in *petimba* the middorsal and midventral lines are naked.

Genus FISTULARIA Linnaeus

Fistularia Linnaeus, Systema naturae, ed. 10, p. 312, 1758. (Genotype, *Fistularia tabacaria* Linnaeus.)

FISTULARIA PETIMBA Lacepède

Fistularia petimba Lacepède, Histoire naturelle des poissons, vol. 5, pp. 349, 350, vol. 2, pl. 18, fig. 3, 1803 (type locality, New Britain; Union Island).

SPECIMENS STUDIED

Bikini Atoll: 15 stations, 106 specimens, 117 to 1,000 mm. standard length.
Eniwetok Atoll: 3 stations, 11 specimens, 124 to 238 mm.
Rongerik Atoll: 2 stations, 11 specimens, 115 to 222 mm.
Rongelap Atoll: 3 stations, 4 specimens, 241 to 485 mm.
Guam: 4 lots, 15 specimens, 137 to 680 mm.

Description.—Dorsal fin rays xv to xvii, anal xv; pectoral xiii to xvi; pelvic i, 5.

Head 2.6 to 2.7; pectoral insertion to pelvic insertion 7.4 to 10.1; pectoral insertion to dorsal origin 2.3 to 2.5; all in standard length. Snout 1.3 to 1.4; bony orbit 9.7 to 11.5; bony interorbital space 34 to 38; maxillaries 10.4 to 13; all in length of head.

Head and body notably depressed; snout long, tubular, with jaws at end; maxillaries about equal to eye; pelvic insertions far behind head but notably a little more than a third closer to head than to dorsal origin; interorbital space concave; gill membranes free from

the isthmus, joined to it far forward; upper edge of gill opening opposite about fifth or sixth pectoral ray from the dorsal edge; origins of dorsal and anal fins opposite; caudal fin forked, with a long median filament of variable length, but usually longer than one-fourth the standard length; anus and eye diameter or less in front of anal fin origin.

Color in alcohol.—Plain light brownish; tips of dorsal, anal, and caudal fins sometimes dusky. Silvery spots or blotches on cheeks, pectoral base, and around nasal openings.

Ecology.—The cornetfish was an abundant species off the leeward side of the atolls and in the lagoon. It was seen swimming close to the surface almost daily. At night small ones from about 123 to 180 mm. in standard length were attracted to a light at night in considerable numbers.

Remarks.—The small specimens from about 123 to 180 mm. in standard length are covered with tiny villous "scales," which begin to disappear at about 180 to 200 mm. These "villi" occur in rows, or lines, running lengthwise.

Suborder SYNGNATHINA

Family SOLENOSTOMIDAE

By LEONARD P. SCHULTZ

Genus SOLENOSTOMUS Lacepède

Solenostomus LACEPÈDE, Histoire naturelle des poissons, vol. 5, pp. 360, 361, 1803. (Genotype, *S. paradoxus* Lacepède.)

SOLENOSTOMUS ARMATUS Weber

PLATE 22, A

Solenostomus armatus WEBER, *Siboga*-Expeditie, vol. 57, p. 103, fig. 33c, 1913 (type locality, lat. 2°25′ S., long. 131°26′ E., in Arafura Sea).

SPECIMENS STUDIED

Off Bikini Atoll, lat. 11°30′ N., long. 165°11′ E., taken in an open plankton net lowered from surface to 175 fathoms and hauled open again to surface, August 6, 1946, M. Johnson, 1 specimen, 27.5 mm. standard length.

Description.—Dorsal rays 5–19; anal 20, caudal 14; pectoral 26–28; pelvic 7–7; all rays flexible and unbranched except that second to sixth of pelvic fins are branched.

Interorbital space concave, with 5 keeled plates between orbital plates and first dorsal origin; a spinelet on plate under first dorsal followed by 11 more spinelets along dorsal lateral row to origin of second dorsal, then 5 under second dorsal with 10 on caudal peduncle;

the median lateral row has 13 spinelets; the ventrolateral row similar to dorsolateral; middorsal line of head near nape with a spiny keel; a paired denticulate keel over orbits that meet on snout and continue forward as a low median denticulate keel; near where the two orbital ridges meet on snout a pair of spines occurs on each side; in front and behind orbit spiny points; under side of head with spiny points.

Detailed measurements were made and these are recorded below in thousandths of the standard length. Tip of snout to upper edge of gill opening 430; snout 291; orbit 55; bony interorbital space 29; tip of snout to rear edge of maxillary 43; tip of snout to first dorsal origin 582, to second dorsal origin 775; to anal origin 775, to pectoral insertion 462, to pelvic insertion 568; length of caudal peduncle 160; least depth of caudal fin 33; longest ray of dorsal fin 255, of caudal fin 473.

Membrane of dorsal fin ends about halfway to distal tips, rays free and filamentous.

Color in alcohol.—Whitish.

Color when alive.—Transparent or nearly so.

Ecology.—The specimen was taken in a plankton net and must have been living a pelagic existence.

Remarks.—Our identification is uncertain, but because of the small size of the specimen we are not describing it as a new species, although it differs somewhat from *armatus*.

Family SYNGNATHIDAE: Pipefishes

By EARL STANNARD HERALD [29]

The syngnathids collected in 1946 during Operation Crossroads (47 specimens representing 10 species and taken at 26 different stations), one-half, or 5 of the species (3 of which are new) were taken only at depths below 15 feet. Of the rest 4 species were taken in the intertidal area at less than 10 feet, and one additional new species came from plankton hauls in the lagoon. This vertical habitat distribution is important. The demarkation area between the two habitats seems to lie between 10 and 15 feet, and none of the intertidal forms was ever found in deeper water, nor, with one exception, were any of the deep-water forms ever found at the surface. The exception, *Corythoichthys schultzi*, is attracted to lights, and two of the paratypes of the species were taken in this manner.

As many new Indo-Pacific pipefishes have been described since the publication of Duncker's revision (Mitteil. Naturh. Mus. Hamburg, vol. 32, pp. 9–120, pl. 1, figs. 10, 1915), the following list presents the author's opinion in regard to the new species (except Australian) that are synonyms:

Corythoichthys matterni Fowler 1918=*Bombonia djarong* (Rüppell) 1840.

Doryichthys philippinus Fowler 1918=*Oostethus brachyurus* (Bleeker) 1853.

Leptonotus tristriatus Fowler 1922=status uncertain; type in very poor condition when examined by author in 1943; eyes and part of tail missing from specimen.

Corythoichthys balli Fowler 1925=*Syngnathus balli* (Fowler).

Ichthyocampus philippinus Fowler 1938=no change.

Ichthyocampus edmondsoni Pietschmann 1930=*Microgнathus edmondsoni* (Pietschmann).

Parabelonichthys kellersi Fowler 1943=*Belonichthys fluviatilis* (Peters) 1852.

[29] I wish to thank the following individuals for their help and cooperation in the preparation of this report: Dr. Wilbert M. Chapman, Research Director, Tuna Boat Association, San Diego, Calif., for the loan of the pipefishes collected by him in the tropical southwestern Pacific during World War II; officials of the U. S. National Museum for opportunity to study the extensive collections in that institution; Dr. Leonard P. Schultz, Curator of Fishes, John S. Lea, Editor, and Gladys O. Visel, Assistant Editor, U. S. National Museum, for considerable aid in fitting this manuscript into the style adopted for this report; A. C. Weed and Loren P. Woods for kindly permitting me to include a description of their new subspecies *Doryrhamphus melanopleura cooki;* the authorities of the following museums for opportunity to study their collections—Museum of Comparative Zoology (M.C.Z.) at Harvard University, University of Michigan Museum of Zoology (U.M.M.Z.), Chicago Natural History Museum (C.N.H.M.), and the Academy of Natural Sciences of Philadelphia (A.N.S.P.).

Syngnathus micronotopterus Fowler 1938=*Micrognathus brevirostris* (Rüppell) 1840.

Dunckerocampus pessuliferus Fowler 1938=no change.

Corythoichthys serrulifer Fowler 1938=*Corythoichthys flavofasciatus conspicillatus* (Jenyns) 1842.

Pristidoryrhamphus jacksoni Fowler 1944=*Doryrhamphus negrosensis* Herre 1934.

Yozia bicoarctata melanesiae Fowler 1945=*Yozia bicoarctata* (Bleeker) 1857.

Bombonia luzonica Herre 1927=*Bombonia djarong* (Rüppell) 1840.

Micrognathus magdamoi Herre 1932=*Micrognathus dunckeri* Chabanaud 1929.

Doryrhamphus negrosensis Herre 1934=no change.

Micrognathus suvensis Herre 1935=*Doryichthys suvensis* Herre.

Bombonia uxorius Herre 1935=*Bombonia djarong* (Rüppell) 1840.

Syngnathus marteni Herre 1936=*Syngnathus peckianus* Storer (or *S. fuscus* Storer). *S. peckianus* is a common Atlantic American species. This specimen was undoubtedly described as new from Manila Bay as a result of having been placed in the wrong bottle after the San Francisco earthquake.

Micrognathus dunckeri Chabanaud 1929=no change.

Acanthognathus caulleryi Chabanaud 1929=*Dunckerocampus caulleryi caulleryi*.

The primary classification within the Syngnathidae is based upon the brood pouch of the male, which carries the incubating eggs. There are two principal subfamilies, the abdominal-pouch forms (Gastrophorini) and the tail-pouch forms (Urophorini). These are divided into four subgroups based upon the method of attachment of the eggs: (1) Loosely attached but not isolated from one another; (2) eggs imbedded singly, isolated from each other by a spongy mass with no protecting plates or covering membranes; (3) eggs imbedded in a spongy matrix with lateral protecting plates or pouch folds or both; and (4) eggs completely covered by pouch folds fused in the center, leaving a single pouch opening just posterior to the anus. Among the abdominal pouch syngnathids there are representatives in the first three subgroups, but none in the last. Among the tail-pouch syngnathids, there are representatives of the last three subgroups, but none in the first.

The nomenclature used for the ridge systems in the key to genera is shown in figure 36. Special attention should be given to the lateral tail ridge, which is short and is a forward extension of the superior tail ridge. This lateral tail ridge is important in that its presence or absence is usually very significant in generic determination.

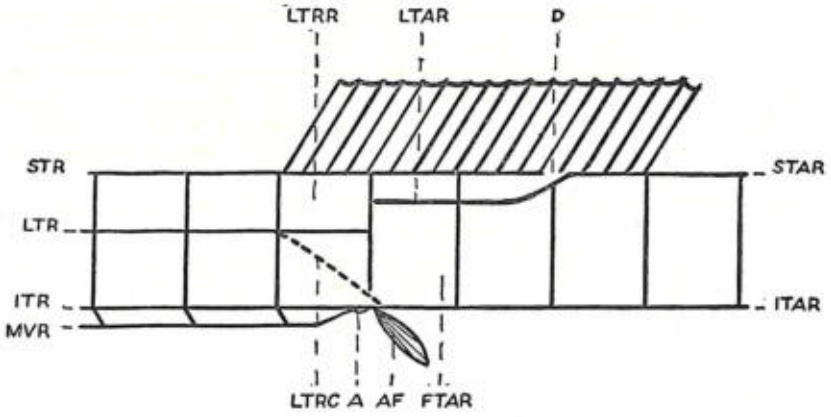

FIGURE 36.—Diagram of the middle part of the body of a hypothetical syngnathid illustrating the terms used in describing this family: (A) anus; (AF) anal fin; (D) discontinuous part of superior tail ridge; (FTAR) first tail ring; (ITAR) inferior tail ridge; (ITR) inferior trunk ridge; (MVR) midventral abdominal ridge; (LTAR) lateral tail ridge; (LTR) lateral trunk ridge; (LTRC) lateral trunk ridge continuous with inferior tail ridge; (LTRR) last trunk ring; (STAR) superior tail ridge; (STR) superior trunk ridge.

KEY TO THE CENTRAL AND WESTERN PACIFIC GENERA OF SYNGNATHIDAE (HAWAII TO JAPAN, EXCEPT AUSTRALIA AND NEW ZEALAND)

1*a*. Dorsal, pectorals, and anal absent; rings 12 to 19+37 to 43.
Penetopteryx Lunel

1*b*. Dorsal and anal present; pectorals absent; dorsal 10 to 16; rings 15 to 19+32 to 50---------- Nannocampus Günther

1*c*. Dorsal and pectorals present; anal present or absent.

2*a*. Dorsal placed entirely upon tail, usually beginning about 6 to 8 rings behind anus; anal present or absent; dorsal 12 to 16; rings 8 to 10+49 to 55.
Urocampus Günther

2*b*. Dorsal placed over or near the anal ring.

3*a*. Caudal fin absent.

4*a*. Tail prehensile.

5*a*. Head at right angles to the body; dorsal based raised.
Hippocampus Rafinesque

5*b*. Head slightly bent or in line with the body; dorsal base raised or not raised.

6*a*. Lateral trunk ridge absent; inferior trunk ridge continuous with superior tail ridge; eggs deposited on widely expanded abdominal surface; brood-pouch protecting plates and folds absent; dorsal 37 to 50; rings 15 to 17+40 to 50.
Syngnathoides Bleeker

6*b*. Lateral trunk ridge present.

7*a*. Lateral tail ridge absent; brood pouch under tail and sealed except for small opening behind anus; dorsal base raised; dorsal 15 to 17; rings 12 to 13+38 to 45__ Acentronura Kaup

7*b*. Lateral tail ridge present; dorsal base raised or not raised.

8*a*. Lateral trunk ridge continuous with inferior tail ridge; dorsal base raised; brood pouch under tail with eggs completely covered by brood pouch folds; dorsal 24 to 26; rings 19+44 or 45---------- Haliichthys Gray

8*b*. Lateral trunk ridge continuous with superior tail ridge; dorsal base not raised; eggs exposed, attached to underside of tail; brood pouch folds and protecting plates absent; dorsal 35 to 58; rings 22 to 26+50 to 58.-- Solegnathus Swainson

4*b*. Tail not prehensile; dorsal 36 to 55; rings 16 to 20+68 to 89. Stigmatophora Kaup

3*b*. Caudal fin present.

9*a*. Lateral and tail ridge absent; superior trunk and superior tail ridges continuous; eggs under abdomen or tail.

10*a*. Trunk and tail rings about equal in number; dorsal placed mostly upon trunk; eggs attached to abdomen; protecting plates present but brood pouch folds absent; dorsal 21 to 35; rings 14 to 19+18 to 24---------- Choeroichthys Kaup

10*b*. Trunk rings usually equal to about one-half the number of tail rings; dorsal placed mostly upon tail; eggs attached to tail and covered by brood pouch folds with or without protecting plates; dorsal 13 to 27; rings 13 to 20+27 to 47. Ichthyocampus Kaup (p. 236)

9*b*. Lateral tail ridge present; superior trunk and superior tail ridges discontinuous; eggs under abdomen.

11*a*. Lateral tail ridge extending forward over about 9 or 10 trunk rings; dorsal 64 to 70; rings 19+23 to 26. Belonichthys Peters

11*b*. Lateral tail ridge extending forward over maximum of 4 or 5 trunk rings, usually fewer.

12*a*. Trunk rings more numerous than tail rings; dorsal 17 to 29; rings 15 to 19+11 to 17----- Doryrhamphus Kaup (p. 244)

12*b*. Trunk rings less numerous than tail rings.

13*a*. Head and body ringed with many distinct dark bars; eggs attached to abdomen without benefit of lateral protecting plates or pouch folds; dorsal 21 to 30; rings 15 to 17+16 to 21---------- Dunckerocampus Whitley (p. 249)

13*b*. Head and body without many-barred ring pattern; eggs and brood pouch under abdomen or tail.

14*a*. Lateral trunk ridge continuous with inferior tail ridge.

15*a*. Dorsal base slightly or conspicuously raised; brood pouch under tail.

16*a*. Dorsal 19 to 22; rings 17 to 18+33 to 36. Halicampus Kaup

16*b*. Dorsal 24 to 29; rings 17 to 24+36 to 63.

17*a*. Snout short, about equal to one-third of head; median spiny snout crest present; dorsal 25 to 29; rings 21 to 23+44 to 50.-- Trachyrhamphus Kaup

17*b*. Snout elongate, smooth, about equal to one-half of head; no median snout crest; dorsal 24 to 29; rings 17 to 24+36 to 63----- Yozia Jordan and Snyder

15*b*. Dorsal base not raised; broad pouch under abdomen or under tail.

18*a*. Ridges of trunk and tail very smooth and usually difficult to distinguish.

19*a*. Dorsal 51 to 60; rings 16 to 18+32 to 39; superior ridges of trunk and tail conspicuous; others very

inconspicuous; eggs attached under abdomen, protected laterally by plates, but without pouch folds.
Coelonotus Peters

19*b*. Dorsal 27 to 30; rings 12 to 14+56 to 58; position of ridges usually extremely difficult to determine; brood pouch position unknown.
Siokunichthys, new genus (p. 254)

18*b*. Ridges of trunk and tail distinct.

20*a*. Dorsal 15 to 25; rings 13 to 21 (usually 13 to 17)+28 or 29; brood pouch under tail with eggs covered by brood pouch folds.
Micrognathus Duncker (p. 256)

20*b*. Dorsal 24 to 66; rings 15 to 22+20 to 32; eggs attached to abdomen; protecting plates present but pouch folds absent.

21*a*. Snout long, 1.5 in head; eggs small with about 6 to 10 rows across width of pouch; anus generally behind middle of length; dorsal 25 to 48; rings 19 to 22+20 to 27.
Oostethus Hubbs

21*b*. Snout short, 2.0 or more times in head; eggs large with usually fewer than 6 rows across width of pouch; anus generally before middle of length; dorsal 24 to 66; rings 15 to 20+24 to 32 Doryichthys Kaup

14*b*. Lateral trunk ridge deflected ventrally at anal ring, but not continuous with inferior tail ridge; brood pouch beneath tail with eggs covered by brood pouch folds; dorsal 23 to 31; rings 14 to 16+39 to 43.
Bombonia Herre

14*c*. Lateral trunk ridge subcontinuous with lateral tail ridge not deflected ventrally at anal ring.

22*a*. Dorsal 47 to 68; rings 21 to 26+30 to 40; anus generally posterior to middle of length; brood pouch under abdomen Oostethus Hubbs

22*b*. Dorsal 21 to 45; rings 13 to 20+30 to 44; anus generally forward of middle of length; brood pouch under abdomen or under tail.

23*a*. Brood pouch under abdomen; lateral protecting plates present, but pouch folds absent; dorsal 30 to 36; rings 15 to 20+31 to 37 Doryichthys Kaup

23*b*. Brood pouch under tail; protecting plates present or absent; pouch folds present; dorsal 21 to 45; rings 13 to 19+30 to 44.

24*a*. Brood pouch protecting plates absent; pouch folds incompletely covering eggs, usually only outermost row of eggs being covered by folds; eggs in 4 to 6 rows across pouch, 1 layer in depth; profile of head with abrupt rise in front of eyes; dorsal 22 to 35; rings 15 to 18+30 to 40.
Corythoichthys Kaup (p. 265)

24*b*. Brood pouch protecting plates present with pouch folds completely covering eggs; dorsal profile of

snout and head with or without abrupt rise in front of eyes.

25*a*. Snout and head profile forming an angle in front of eyes; eggs in pouch usually arranged in 2 longitudinal rows (rarely with two additional rows squeezed ventrad to primary pair); dorsal 30 to 33; rings 14 to 15+40 to 42.

Bhanotia Hora

25*b*. Snout and head in line usually without angle in front of eyes; eggs in pouch usually arranged in 4 to 6 longitudinal rows and 2, rarely 3, layers in depth; dorsal 21 to 45; rings 13 to 19+30 to 44---------- Syngnathus Linnaeus (p. 278)

Genus ICHTHYOCAMPUS Kaup

Ichthyocampus KAUP, Catalogue of the lophobranchiate fishes in the collection of the British Museum, p. 29, 1856. (Genotype, *Syngnathus carce* Hamilton by Duncker, 1912).—DUNCKER, Jahrb. Wiss. Anstalt Hamburg, vol. 29, p. 234, 1912; vol. 32, p. 92, 1915.

Festucalex WHITLEY, Australian Zool., vol. 6, pt. 4, p. 312, 1931. (Genotype, *Syngnathus cinctus* Ramsey, 1882.)

Campichthys WHITLEY, Australian Zool., vol. 6, pt. 4, p. 313, 1931. (Genotype, *Ichthyocampus tryoni* Ogilby, 1890.)

Hippichthys WHITLEY, Australian Zool., vol. 11, pt. 3, p. 268, 1948. (Genotype, *H. heptagonus* Bleeker=*Syngnathus carce* Hamilton.)

Larvicampus WHITLEY, Rec. Australian Mus., vol. 22, No. 1, p. 75, 1948. (Genotype, *Festucalex runa* Whitley=*Ichthyocampus filum* Günther.)

Stipecampus WHITLEY, Rec. Australian Mus., vol. 22, No. 1, p. 75, 1948. (Genotype, *Ichthyocampus cristatus* McCulloch and Waite.)

This genus of tail-pouch pipefishes is characterized by absence of lateral tail ridge; superior trunk ridge and superior tail ridge continuous; lateral trunk ridge either continuous with inferior tail ridge, or lateral trunk ridge ending free (sometimes deflected ventrally), in which case inferior trunk and tail ridges are continuous; snout and head short, operculum usually higher than long, sometimes with small primary ridge; dorsal, pectoral, and caudal fins present but usually small and weakly developed; anal fin present or absent; dorsal base usually not raised, usually placed upon 1 or 2 trunk rings, with remainder upon tail; brood-pouch folds completely covering incubating eggs; pouch protecting plates present or absent.

All the species of *Ichthyocampus* are marine in habitat with the exception of *I. carce*, which occurs in brackish and fresh water. There is one species in the American Caribbean, and the remaining species are chiefly confined to the Indo-Australian area including Australia, New Zealand, the Central Pacific, and Hawaii. No species is known from the Pacific coast of North or South America.

The genus *Ichthyocampus* is in need of revision, but such study must await the availability of more specimens of each species. A study of the data in table 18 indicates that *Ichthyocampus cristatus*

and *I. scalaris* and that *I. townsendi* and *I. philippinus* may be synonyms.

I consider *Ichthyocampus* phylogenetically an offshoot of the evolutionary line that leads from certain pipefishes to the seahorses. Most of this evolutionary line is characterized by an everted brood pouch closure in which one flap of the brood pouch is turned back upon itself and the other flap overlaps it. Occasionally in the genus *Ichthyocampus* this everted brood pouch closure is replaced by the more primitive overlapping type in which the under flap is not turned back upon itself. Probably an *Ichthyocampus*-like pipefish has given rise to the pseudo-seahorse, *Acentronura*, and to the peculiar *Urocampus*. Certain fairly distinct subgeneric trends in this genus have not been recognized here because of the lack of sufficient specimens for the proper study of this problem.

KEY TO THE SPECIES OF ICHTHYOCAMPUS OF THE PACIFIC (EXCLUDING AUSTRALIA)

1*a*. Anterior and posterior nostrils in separate lobes, separated by considerable distance; anal fin absent; 43 tail rings; dorsal insertion on third tail ring.
Ichthyocampus davaoensis, new species

1*b*. Nostrils normal, not as in 1*a*; anal fin present; 27 to 37 tail rings; dorsal insertion anterior to anal fin.

2*a*. Dorsal fin covering 7 or 7½ rings; dorsal base raised.
Ichthyocampus bikiniensis, new species

2*b*. Dorsal fin covering 4¾ to 6 rings; dorsal base not raised.

3*a*. Lateral trunk ridge extending over 14 to 17 tail rings in both sexes.
Ichthyocampus kampeni[80] Weber

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[80] *Ichthyocampus kampeni* Weber, *Siboga*-Expeditie, vol. 57, p. 114, fig. 40, 1913 (lectotype designated below).

Ichthyocampus belcheri Duncker, Mitt. Naturh. Mus. Hamberg, vol. 32, p. 95, 1915 (in part).—Weber and de Beaufort, Fishes of the Indo-Australian Archipelago, vol. 4, p. 93, fig. 38, 1922 (in part).

Specimens studied include 7 from the Philippine Islands. A recent collection of pipefishes received from Jose Domantay, of Zamboanga, Minandao, Philippine Islands, has clarified the relationship of *I. kampeni* and *belcheri*. To review the matter, it should be noted that Kaup (1856) described a new *Ichthyocampus* under the specific name of *belcheri*. This species was characterized by a lateral trunk ridge that extended over three tail rings. In 1913 Weber described *I. kampeni* as a dimorphic species with the males having the lateral trunk ridge extending over 3 tail rings and the females having the ridge extending over 16 or 17 tail rings. Duncker in his revision (1915) considered *kampeni* as a synonym of *belcheri*. Actually, two valid species were involved, neither of which was dimorphic. In other words Weber's type series consisted of females of a previously unknown species having the lateral ridge covering 17 tail rings, but his males were of Kaup's species *belcheri*. This is shown by the Zamboanga collection mentioned above, which contained males of both species. The type illustration that Weber used for *kampeni* is actually a specimen of *belcheri*. This figure is reproduced in Weber and de Beaufort (op. cit., vol. 4, p. 91).

Dr. de Beaufort (September 1949) has kindly reexamined the type series of *Ichthyocampus kampeni* and selected the 56-mm. female from Atjatuning, New Guinea, as a typical specimen, which I herewith designate as a lectotype.

As indicated in table 18 the meristic differences between *Ichthyocampus kampeni* and *I. belcheri* are slight, but when compared the former is found to have a thicker trunk than *I. belcheri*. The difference in the length of the lateral trunk ridge is the chief character that distinguishes the two species. The presence of the brood-pouch protecting plates in the males of *kampeni* and the absence of these plates in the males of *belcheri* is noteworthy.

TABLE 18.—*Ranges of counts and proportional measurements, and comparison of other characters for the species of* Ichthyocampus

Characters	*bikiniensis*	*kampeni*	*belcheri*	*diacanthus*	*erythraeus*		*philippinus*	*davaoensis*
	Marshall Islands	Indonesia; Philippines	West Africa to New Caledonia	Bikini Atoll; Guam	Hawaii (Holotype)	Japan	Philippines	Philippines
Lateral trunk ridge	Continuous with inferior tail ridge	Ends between fourteenth and seventeenth tail ring	Ends on third or fourth tail ring	Ends over anus	Ends over anus	Ends over anus	Ends over anus	Ends over anus
Number of fin rays:								
Dorsal	24	20 to 22	20 to 22	22 or 23	22	20	18 or 19	25
Pectoral		12 to 14	12 or 13	14 or 15	14	11 or 12	11 or 12	11
Anal	4	3	3	4	4	4	3	0
Caudal	10	10	10	10	10	10	10	10
Number of trunk rings	16	16	16	15 or 16	16	16	16 or 17	16
Number of tail rings	36	29 or 30	29 to 31	27	36	36 or 37	32 or 33	43
Dorsal fin occurs on:								
Trunk rings	1 to 1½	1½ to 2	½ to 1½	1¾ to 2	¾	½ to 1	¾	—2; begins on third
Tail rings	6	3 to 4	4 to 5	3 to 3½	4¾	4 to 5	4	7¾
Total rings	7 to 7½	5 to 5½	5 or 6	4¾ to 5½	5¼	5 to 5¾	4¾	7¾
Dorsal fin base	Raised	Not raised	Not raised	Not raised	Not raised	Not raised	Not raised	Slightly raised
Number of tail rings involved in formation of brood pouch.		14	13			17		
Length of head in standard length	Head at right angle	7.5 to 7.9	7.8 to 8.8	7.2 to 7.6	7.2	8.4 to 8.8	7.6 to 8.8	13.2
Length of snout in head length	2.0 to 2.2	2.4 to 2.8	2.5 to 3.0	2.0 to 2.3	2.32	2.0 to 2.36	2.4 to 2.55	3.12
Length of dorsal fin base in head length.	1.33	1.3 to 1.45	1.2 to 1.4	1.2 to 1.4	1.8	1.31 to 1.38	1.35 to 1.42	0.595
Number of specimens examined	2	7	10	3	1	3	2	1

TABLE 18.—*Ranges of counts and proportional measurements, and comparison of other characters for the species of* Ichthyocampus

Characters	*bikiniensis*	*kampeni*	*belcheri*	*diacanthus*	*erythraeus*		*philippinus*	*davaoensis*
	Marshall Islands	Indonesia; Philippines	West Africa to New Caledonia	Bikini Atoll; Guam	Hawaii (Holotype)	Japan	Philippines	Philippines
Lateral trunk ridge	Continuous with inferior tail ridge	Ends between fourteenth and seventeenth tail ring	Ends on third or fourth tail ring	Ends over anus	Ends over anus	Ends over anus	Ends over anus	Ends over anus
Number of fin rays:								
Dorsal	24	20 to 22	20 to 22	22 or 23	22	20	18 or 19	25
Pectoral		12 to 14	12 or 13	14 or 15	14	11 or 12	11 or 12	11
Anal	4	3	3	4	4	4	3	0
Caudal	10	10	10	10	10	10	10	10
Number of trunk rings	16	16	16	15 or 16	16	16	16 or 17	16
Number of tail rings	36	29 or 30	29 to 31	27	36	36 or 37	32 or 33	43
Dorsal fin occurs on:								
Trunk rings	1 to 1½	1¼ to 2	½ to 1½	1⅜ to 2	¾	½ to 1	¾	—2; begins on third
Tail rings	6	3 to 4	4 to 5	3 to 3½	4¾	4 to 5	4	7¾
Total rings	7 to 7½	5 to 5¼	5 or 6	4¾ to 5½	5¼	5 to 5¾	4¾	7¾
Dorsal fin base	Raised	Not raised	Not raised	Not raised	Not raised	Not raised	Not raised	Slightly raised
Number of tail rings involved in formation of brood pouch.		14	13			17		
Length of head in standard length	Head at right angle	7.5 to 7.9	7.8 to 8.8	7.2 to 7.6	7.2	8.4 to 8.8	7.6 to 8.8	13.2
Length of snout in head length	2.0 to 2.2	2.4 to 2.8	2.5 to 3.0	2.0 to 2.3	2.32	2.0 to 2.36	2.4 to 2.55	3.12
Length of dorsal fin base in head length.	1.33	1.3 to 1.45	1.2 to 1.4	1.2 to 1.4	1.8	1.31 to 1.38	1.35 to 1.42	0.595
Number of specimens examined	2	7	10	3	1	3	2	1

TABLE 18.—*Ranges of counts and proportional measurements, and comparison of other characters for the species of* Ichthyocampus—Cont.

Characters	*scalaris*	*cristatus*	*cinctus*	*pictus*	*townsendi*
	West Australia	South Australia	Southeast Australia	Ceylon, India	Persian Gulf, Maldives
Lateral trunk ridge	Ends on first to third tail ring	Ends on second tail ring	Ends on third tail ring	Ends over anus	Ends over anus
Number of fin rays:					
Dorsal	23 to 26	26 to 27	23	18	16 to 18
Pectoral	11 to 13	12	----------	5	10 or 11
Anal	3	"minute"	----------	0	2
Caudal	10	8	----------	9	8 to 10
Number of trunk rings	19 or 20	19 or 20	17	14	16
Number of tail rings	38 to 40	40 or 41	40	38	33 or 34
Dorsal fin occurs on:					
Trunk rings	2 to 3	1 to 2	----------	1	1
Tail rings	4	5	----------	4	4
Total rings	6 or 7	6 or 7	----------	5	5
Dorsal fin base	----------	----------	----------	Not raised	----------
Number of tail rings involved in formation of brood pouch	----------	13	----------	13	----------
Length of head in standard length	----------	13.3 to 15.3	----------	13.3 to 14.3	----------
Length of snout in head length	----------	3.4	----------	3.0 to 3.5	----------
Length of dorsal fin base in head length	----------	----------	----------	.94 to .98	----------
Number of specimens examined	----------	----------	----------	3	----------

3*b*. Lateral trunk ridge extending over 4 or fewer tail rings.
4*a*. Lateral trunk ridge extending to the third or fourth tail ring; snout 2.5 to 3.0 in head.....Ichthyocampus belcheri [31] Kaup
4*b*. Lateral trunk ridge extending only to last trunk ring; snout 2.0 to 2.5 in head.
5*a*. Tail rings 27; dorsal fin covering 1⅔ or 2 trunk rings and 3 or 3½ tail rings..... Ichthyocampus diacanthus Schultz
5*b*. Tail rings 32 to 37; dorsal fin covering ½ or 1 trunk ring and 4 or 5 tail rings.
6*a*. Dorsal rays 18 or 19; tail rings 32 or 33; snout 2.4 to 2.55 in head. Ichthyocampus philippinus [32] Fowler
6*b*. Dorsal rays 20 to 22; tail rings 36 or 37; snout 2.0 to 2.4 in head. Ichthyocampus erythraeus [33] Gilbert

BULBONARICUS new subgenus

Genotype.—Ichthyocampus davaoensis, new species.

This new monotypic subgenus is proposed because of the anatomical nature of the nostrils. The nostrils of the genotype are lobe-shaped, a unique character not found in other species referable to the genus *Ichthyocampus*.

Anterior and posterior nostrils separated by considerable distance; both anterior nostrils in one distinct lobe just posterior to snout, both posterior nostrils in another distinct lobe just anterior to the eye; superior trunk and superior tail ridges continuous, inferior trunk and inferior tail ridges continuous; anal fin absent; dorsal insertion on third tail ring.

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[31] *Ichthyocampus belcheri* Kaup, Catalogue of the lophobranchiate fishes in the collection of the British Museum, p. 30, 1856 (type locality, China).

Ichthyocampus nox Snyder, Proc. U. S. Nat. Mus., vol. 36, p. 598, 1909 (type locality, Nafa, Okinawa, Luchu Islands, Japan, holotype U.S.N.M. No. 62945).

Ichthyocampus kampeni Weber, *Siboga*-Expeditie, vol. 57, p. 114, fig. 40, 1913 (part only; 4 of 5 types of *kampeni* from Beo, Karakelang Islands, are actually *belcheri*).

Specimens studied include the holotype of *I. nox* from Japan; six specimens from the Philippine Islands; one each from New Caledonia, Solomons Islands, and the Fiji Islands. This species is discussed under 3, *a*, in connection with *I. kampeni*.

[32] *Ichthyocampus philippinus* Fowler, Proc. U. S. Nat. Mus., vol. 85, p. 43, 1938 (type locality, Tinakta Island, Sulu Archipelago, Philippine Islands, lat. 5°12.66′ N., long. 119°55.16′ E.).

Specimens studied include two specimens from the Philippine Islands. *Ichthyocampus philippinus* is distinguished from the other species of the genus that have the lateral trunk ridge ending at the anus by the number of dorsal rays and tail rings in combination with the snout-head proportion. This species is similar to *I. townsendi*, of the Persian Gulf. When more material is available, the two species may prove to be the same.

[33] *Ichthyocampus erythraeus* Gilbert, Bull. U. S. Fish. Comm., vol. 23, p. 238, 1903 (type locality, 23 to 24 fathoms, off south coast of Molokai, Hawaiian Islands).

Specimens studied include one specimen (the holotype) from the Hawaiian Islands and three from Japan. The three specimens from Japan are so similar to the holotype that tentatively they are identified as *I. erythraeus*. However, since they differ slightly from the Hawaiian specimen the data on the specimens from the two localities are recorded separately in table 18.

The Hawaiian and Japanese material differs most in the proportions of head in standard length and dorsal base in head. Part of this difference may be because of the size of the specimens, since the holotype is 51 mm., whereas the other specimens range from 62 to 79 mm. When more material is available, it may be possible to distinguish different subspecies in these two localities.

Named *Bulbonaricus* in reference to the bulblike lobes in which the nostrils are contained.

ICHTHYOCAMPUS DAVAOENSIS, new species

FIGURE 37

Holotype.—U.S.N.M. No. 112295, from the Philippine Islands, Mindanao, Gulf of Davao (lat. 6°44′ N., long. 125°46′ E.), surface plankton tow, February 26, 1948, by the *Spencer F. Baird*, 33 mm. standard length.

Description.—The measurements of the holotype are as follows: Total length 34.5 mm.; standard length 33 mm.; head 2.5 mm.; snout 0.8 mm.; dorsal fin base 4.2 mm.; trunk 6.5 mm.; tail, less caudal fin, 24 mm.; caudal 1.5 mm. Dorsal fin rays 25; pectoral 11; anal 0; caudal 10; dorsal covers 7¾ rings, beginning at anterior edge of third tail ring; trunk rings 16; tail rings 43; head 13.2 in standard length; snout 3.12, dorsal base 0.595 both in head; lateral trunk ridge ending free, without curvature, on first third of first tail ring; mouth superior; head smooth, no indication of opercular or pectoral cover-plate ridges; nostrils contained in bulbous structure divided into an anterior lobe, just posterior to snout and a posterior lobe, just anterior to eye; a conspicuous bulge at anterior ventral end of trunk extending over first 8 rings; trunk and tail ridges distinct; scutella absent.

Color in alcohol.—Uniformly light tan with a black pigment in the membranes between the rays of the caudal fin.

Remarks.—*I. davaoensis* is distinguished from all other members of the genus by means of the peculiar bilobed nasal structure, the absence of the anal fin, and the increased number of tail rings.

Named *davaoensis* in reference to Davao Gulf, where the holotype was collected.

ICHTHYOCAMPUS BIKINIENSIS, new species

Holotype.—U.S.N.M. No. 140244, Bikini Lagoon, near middle, plankton net, vertical haul, from 60 feet to surface, May 1, 1946, S–46–153, Johnson, 1 specimen, 9.5 mm.

Paratype.—U.S.N.M. No. 140243, Bikini Lagoon, 5 miles northwest of Enyu Island, plankton net at 6 feet, May 3, 1946, S–46–212, Johnson, 1 specimen, 7.3 mm.

Description.—Counts and measurements are recorded in table 18. Dorsal base raised; body extremely spinose; lateral tail ridge absent; lateral trunk ridge ending either free or becoming continuous with inferior tail ridge (ridges themselves do not show between the spinous projections); head at right angles to body axis. The following measurements (in mm.) were made on the holotype and paratype, respectively: Head to most posterior edge of cervical flexure 8.5, 6.5; anterior edge of head flexure to hypural vertebra 9.5, 7.3; head length

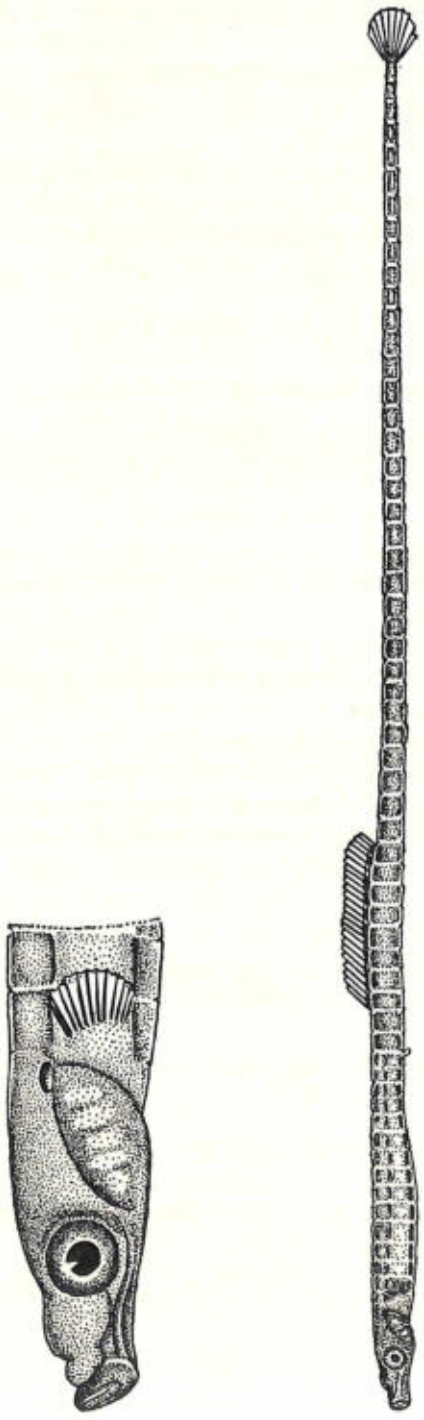

FIGURE 37.—Holotype of *Ichthyocampus davaoensis*, new species (U.S.N.M. No. 112295), from Davao Gulf, Mindanao, Philippine Islands. (Drawing by Pablo Bravo.)

2.0, 2.0; snout length 0.9, 1.0; dorsal fin base 1.5, —; caudal fin length 1.0, —.

Color in alcohol.—Both specimens whitish, larger with 8 narrow dark pigment bars around tail, smaller with 7 bars, all bars nearly equally separated by pale interspaces.

Remarks.—It is probable that when this species reaches the juvenile and adult stages, the head straightens and becomes parallel with the body. Other syngnathids are known in which the newly hatched young has the head at an angle with the body but later becomes straightened.

Named *bikiniensis* in reference to Bikini Atoll.

ICHTHYOCAMPUS DIACANTHUS Schultz

Ichthyocampus diacanthus SCHULTZ, U. S. Nat. Mus. Bull. 180, p. 75, pl. 8, 1943 (type locality, Tutuila Island, Samoa; holotype examined, U.S.N.M. No. 116091).

SPECIMENS STUDIED

Bikini Atoll: Airy Island, lagoon reef, April 17, 1946, S–46–97, Schultz, female, 68 mm.; Eman Island, surf, reef, July 19, 1947, S–46–441, Schultz, Brock, Myers, and Hiatt, female, 87.5 mm.

Description.—Counts and measurements are shown in table 18. Lateral trunk ridge ending free on last trunk ring or on first tail ring; dermal cirri present on head.

Color in alcohol.—Background color whitish to light brown. Spots and indefinite bars may be present. Airy Island specimen differs from holotype by having a diffuse blackishly pigmented area on underside of head; Eman Island specimen has indistinct narrow dark brown bars, one-half ring in width, on the third, seventh, and twelfth trunk rings and on the first, sixth, tenth, fifteenth, nineteenth, and twenty-fifth tail rings; between each of these dark pigment rings usually an undeveloped color bar represented only by a dark-brown spot dorsally and another ventrolaterally; last three tail rings whitish on holotype.

Remarks.—Distinguished from all central Pacific species in the genus by the low tail ring counts.

Genus DORYRHAMPHUS Kaup

Doryrhamphus KAUP, Catalogue of the lophobranchiate fishes in the collection of the British Museum, p. 585, 1856. (Genotype, *Doryrhamphus excisus* Kaup.)

Pristidoryrhamphus FOWLER, Proc. Acad. Nat. Sci. Philadelphia, vol. 96, p. 158, figs. 8, 9, 1944. (Genotype, *Pristidoryrhamphus jacksoni* Fowler = *D. negrosensis* Herre.)

These spinose abdominal-pouch pipefishes, consisting of 3 species and 6 forms restricted to the Indo-Pacific regions, are characterized

by having lateral trunk ridges continuous with inferior tail ridges, superior trunk and superior tail ridges discontinuous; inferior trunk and inferior tail ridges discontinuous; brood-pouch folds present but protecting plates absent; eggs large, socketed in abdominal matrix of male; trunk rings more numerous than tail rings (like *Dunckerocampus*), the first trunk ring is nearly twice as long as any of the remaining trunk rings, but it should be counted only as a single ring); dorsal base not raised and placed mostly upon trunk; dorsal rays 17 to 29, pectoral 17 to 23; trunk rings 15 to 19, tail rings 11 to 17.

KEY TO THE SPECIES OF DORYRHAMPHUS

1*a*. Trunk rings 15; tail rings 14; dorsal rays 17 to 19; dorsal fin covers 2 or 3 trunk rings, 2 tail rings; pectoral rays 17 to 20.
Doryrhamphus negrosensis[34] Herre

1*b*. Trunk rings 16; tail rings 11 or 12; dorsal rays 19 to 21; dorsal fin covers 4 or 5 trunk rings, 2 tail rings; pectoral rays 20.
Doryrhamphus excisus Kaup[35]

1*c*. Trunk rings 16 to 19, usually 17 or 18; tail rings 14 to 17, usually 14 to 16; dorsal rays 22 to 29; dorsal fin covers 3 to 5 trunk rings, 3 or 4 tail rings; pectoral rays 19 to 23 ——— Doryrhamphus melanopleura (Bleeker)

2*a*. Trunk rings usually 18, rarely 19.

3*a*. Dorsal rays 23 to 26; usually 24 or 25; tail rings usually 15, occasionally 14 or 16 ——— Doryrhamphus melanopleura melanopleura (Bleeker)

3*b*. Dorsal rays 26 to 29, usually 28 or 29; tail rings 16, occasionally 17.
Doryrhamphus melanopleura cooki Weed and Woods, new subspecies

2*b*. Trunk rings usually 17, rarely 16 to 18; dorsal fin rays 22 to 26; tail rings 14 or 15 ——— Doryrhamphus melanopleura pleurotaenia (Günther)[36]

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[34] *Doryrhamphus negrosensis* Herre, Notes on fishes in the zoological museum of Stanford University, p. 28, 1934, privately printed (type locality, Dumaguete, Philippine Islands). *Doryrhamphus melanopleura* Herre, Mid-Pacific Mag., April–June 1935, p. 164 (Pelew). *Pristidoryrhamphus jacksoni* Fowler, Proc. Acad. Nat. Sci. Philadelphia, vol. 96, p. 158, figs. 8, 9, 1944 (type locality, New Hebrides).

Doryrhamphus negrosensis seems to be the Philippine representative of the widespread *D. melanopleura*.

Pristidoryrhamphus jacksoni, described by Fowler from the New Hebrides, is synonymous with *negrosensis*. There is one difference that should be mentioned, i. e., the pectoral-ray count is given as 10 (which probably is an error) for *jacksoni*, in contrast with the normal 17 to 20 rays for *negrosensis*.

[35] *Doryrhamphus excisus* Kaup, Catalogue of the lophobranchiate fishes in the collection of the British Museum, p. 54, 1856 (type locality, Massaua, Red Sea).—Dücncker, Jahrb. Wiss. Anstalt Hamburg, vol. 32, p. 62, 1915.

Doryrhamphus excisus is more closely related to *D. negrosensis* than to *D. melanopleura*. According to Dücncker, *D. excisus* is the smallest known member of the family Syngnathidae, the males becoming sexually mature at 23 to 27 mm. However, a 24.5-mm. male of *D. melanopleura*, from Socorro Island, Mexico, had eggs in its pouch.

[36] *Doryichthys pleurotaenia* Günther, Zoology of the voyage of H. M. S. *Challenger*, vol. 1, pt. 6, p. 62, pl. 26, fig. d, 1880 (type locality, Hawaii).

Specimens studied include 17 specimens from Oahu, Hawaiian Islands; 3 from the Solomons Islands; and 1 from Socorro Island, Revillagigedo Islands. The holotype of *Microphis extensus* Snyder, 1911, U.S.N.M. No. 68226, and 2 paratypes, S.N.H.M. No. 21418, from Naha, Okinawa, are referred to this subspecies as a synonym.

DORYRHAMPHUS MELANOPLEURA MELANOPLEURA (Bleeker)

Syngnathus melanopleura BLEEKER, Nat. Tijdschr. Nederl.-Indië, vol. 15, p. 464, 1858 (type locality, Cocos Island).

Doryrhamphus californiensis GILL, Proc. Acad. Nat. Sci. Philadelphia, vol. 14, p. 284, 1863 (type locality, Cape San Lucas, Baja California).

SPECIMENS STUDIED

Bikini Atoll: 8 stations, 12 specimens, 28 to 53 mm.
Rongerik Atoll: 2 stations, 4 specimens, 29 to 50 mm.
Rongelap Atoll: 4 stations, 4 specimens, 31 to 39.5 mm.
In addition, 9 specimens from the eastern Pacific, from Sonora, Mexico to Port Utria, Colombia, and the Galápagos Islands, were examined. Four specimens, 2 from Honolulu, Oahu, and 2 from Tutuila Island, Samoa, are referred to this subspecies with uncertainty.

Description.—Dorsal fin rays 23 to 26 (usually 24 or 25); pectoral 19 to 23 (usually 20 or 21); anal 4; caudal 10; dorsal covering 3 to 5 trunk rings (usually 4) and 2½ to 4 tail rings (usually 3); trunk rings 18 or 19 (usually 18); tail rings 14 to 16 (usually 15); head 3.8 to 4.8 in standard length; snout 2.0 to 2.4, dorsal fin base 1.5 to 1.9, both in head; maximum size 56 mm. (male); smallest sexually mature male, 48 mm.

Three snout ridges, a median ridge, heavily serrated, and one serrated ridge on each side of the median ridge (there seems to be no definite pattern to these serrations although they tend to be similar in specimens from the same population); top of head almost flat, nuchal and prenuchal ridges hardly evident; along upper part of opercle a single complete horizontal ridge, beneath this usually 3 distinct ridges radiating lateroventrally from its anterior edge, on each side of these may be indistinct tertiary ridges; trunk and tail ridges considerably raised, each ring having a posteriorly directed spine at junction of individual ring with dorsal, ventral, and lateral ridges; lateral tail ridge extends forward over 3 or 4 trunk rings; all fins of normal length except caudal, which is quite long, its length usually slightly more than that of snout.

Color in alcohol.—Background color light tan, a wide black band extends from tip of snout laterally along side of snout through eye and along side of trunk above lateral trunk ridge; most of tail usually blackish; dorsal, pectoral, and anal fins clear; caudal fin densely pigmented, blackish.

Remarks.—The variation shown in table 19 and the key to the 3 subspecies of *Doryrhamphus melanopleura* indicate the basis for their separation. The definite break between the group having 17 and that having 18 or 19 trunk rings seems important, and since the peculiar distributional patterns of each of these two groups are not typical of

TABLE 18.—*Counts made on the subspecies of Doryrhamphus melanopleura from various localities*

Subspecies and localities	Dorsal fin rays												Trunk rings				Tail rings				
	18	19	20	21	22	23	24	25	26	27	28	29	16	17	18	19	13	14	15	16	17
D. melanopleura:																					
melanopleura:																					
Cocos Island,[1] lat. 12° S.							1									1		1			
Marshall Islands, lat. 6° to 12° N.						1	7	8	3						19	1		4	14	2	
Eastern Pacific: American Coasts, lat. 2° S. to 31° N.								7	2						6	3			8	1	
cooki:																					
Samoan and Cook Islands, lat. 14° to 19° S.									1		3	1			5					4	1
pleurotaenia:																					
Revillagigedo Islands, lat. 19° N.								1	1				1	1				2			
Honolulu, T. H., lat. 18½° N.						2	1	11	3					17				13	4		
Solomon Islands, lat. 8° S.					1	1		1						3				3			
Okinawa, Ryukyu Islands, lat. 26° N.	1[2]				1	1								1	2			1	2		

Subspecies and localitites	Total number of rings						Dorsal fin rays added to total number of rings													
	30	31	32	33	34	35	50	51	52	53	54	55	56	57	58	59	60	61	62	63
D. melanopleura:																				
melanopleura:																				
Cocos Island,[1] lat. 12° S.						1								1						
Marshall Islands, lat. 6° to 12° N.			4	13	3								1	9	6	3				
Eastern Pacific: American Coasts, lat. 2° S. to 31° N.				5	4										4	4	1			
cooki:																				
Samoan and Cook Islands, lat. 14° to 19° S.					4	1												1	3	1
pleurotaenia:																				
Revillagigedo Islands, lat. 19° N.	1	1										1		1						
Honolulu, T. H., lat. 18 ½° N.		13	4								2		10	4	1					
Solomon Islands, lat. 8° S.		3								1	1		1							
Okinawa, Ryukyu Islands, lat. 26° N.				2	1						1		1							

[1] Data recorded from original description of type.

[2] This count may be in error, or may have resulted from a fin injury. (See text.)

true subspecies, I believe that it will eventually be possible to demonstrate that these groups represent distinct species.

The over-all distribution of this species provides an interesting enigma, for *melanopleura* has never been collected in the Philippines. This is quite remarkable when it is considered that the species occurs in Japan and in the areas south, east, and west of the Philippines. The east-west range is from the Pacific coast of North and South America to Mauritius in the Indian Ocean. Perhaps with more material the distribution of the *melanopleura* complex will form a more logical pattern than it does at present.

D. m. pleurotaenia is usually more slender than *D. m. melanopleura*, otherwise the two subspecies are similar except in meristic characters.

Table 19 demonstrates that specimens from 3 of the 4 localities grouped under *pleurotaenia* have the mode of the trunk-ring counts at 17. The fourth locality, Okinawa, has trunk-ring counts that seem to be intermediate between *pleurotaenia* and the 18 mode trunk-ring counts of *melanopleura*. It should also be pointed out that although 2 of the Okinawa specimens (types of *Microphis extensus* Snyder) have dorsal fin counts of 22 and 23, the third has a count of 18. Whether this last specimen (28 mm. ♀) is aberrant can be determined only by examination of a considerable series of Okinawa specimens. When such material is available, it may then be necessary to remove these specimens from the synonymy of *pleurotaenia*. However, it seems best to assign them tentatively to that subspecies.

Two specimens of *D. m. pleurotaenia*, from Socorro Island, in the Revillagigedo group off the west coast of Mexico, should be mentioned (S.N.H.M. No. 36442). They represent the most eastward extension of range of the 17 trunk-ring *pleurotaenia*. Socorro Island is approximately 275 miles from Cape San Lucas, Baja California, and 350 miles from the nearest point on the west coast of Mexico. Both of these latter localities are within the range of the subspecies *melanopleura*. The Socorro specimens are noteworthy because of their small size. The female is 31 mm. in standard length and the male, 24.5 mm., with 15 eggs in its brood pouch, is one of the smallest male pipefishes known to be sexually mature. According to Duncker (1915, p. 62) *Doryrhamphus excisus* males are sexually mature at 23 to 27 mm.

One male (*D. m. pleurotaenia*), 56 mm. long, from Oahu had the brood pouch extremely crowded with 137 eyed eggs averaging 1.2 mm. in diameter. The brood-pouch folds were so distended that they scarcely met at the midline. Three rows of eggs occurred on each side of the pouch. The first eggs were placed on the second trunk ring and the last eggs on the penultimate trunk ring.

DORYRHAMPHUS MELANOPLEURA COOKI Weed and Woods, new subspecies

Doryrhamphus melanopleura SCHULTZ, U. S. Nat. Mus. Bull. 180, p. 73 (in part only), 1943.

Holotype.—C.N.H.M. No. 16220, Cook Archipelago, Aitutaki Island, 1930, Philip M. Chancellor, Field Expedition, 1 male, 51 mm.

Paratypes.—C.N.H.M. No. 16221, same data as holotype, 1 female, 47.5 mm.; U.S.N.M. No. 116089, Samoa, Tau Island, reef at Siulagi Point, June 27, 1939, Schultz, 2 males, 45.5 and 46 mm. and 1 female, 47 mm.

Description.—Dorsal fin rays 26 to 29; pectoral 20 to 22; anal 4; caudal 10; dorsal fin covers 4 trunk rings and 3½ to 4 tail rings; trunk rings 18; tail rings 16 or 17, usually 16; head 4.7 to 4.9 in standard length; snout 2.10 to 2.16, dorsal base 1.29 to 1.36, both in head. Lateral tail ridge extends forward over 3 or 4 trunk rings.

Remarks.—Messrs. Weed and Woods have the complete description of this subspecies in manuscript form. They have kindly allowed me to publish a preliminary diagnosis. Briefly *cooki* may be characterized as a slender subspecies of the *melanopleura* complex, principally with 18 trunk rings and a high dorsal-fin count (see table 19).

Two specimens from Tutuila Island, Samoa (U.S.N.M. Nos. 84164 and 116090) have been referred questionably to the subspecies *melanopleura*. The former was collected in 1921 and the latter in 1939. Both agree in their characters and are sufficiently different in meristic counts that they should not be assigned to *cooki*. A full understanding of the relationship of these two specimens to the typical *cooki* from nearby Tau Island must await the collection of more material.

Named *cooki* in reference to Cook Archipelago.

Genus DUNCKEROCAMPUS Whitley

Acanthognathus DUNCKER, Mitt. Naturh. Mus. Hamburg, vol. 29, 1911, p. 228, 1912. (Genotype, *Syngnathus dactyliophorus* Bleeker.)

Dunckerocampus WHITLEY, Rec. Australian Mus., vol. 19, p. 67, 1933. (*Acanthognathus* of Duncker preoccupied by *Acanthognathus* Mayr, 1887.)

This genus of abdominal-pouch pipefishes is characterized by having the eggs embedded in a gelatinous matrix, but without brood-pouch folds or protective plates; lateral trunk ridge continuous with inferior tail ridge, superior trunk and superior tail ridges discontinuous, inferior trunk and inferior tail ridges discontinuous, these ridges extending posteriorly as sharp spines at the juncture of each ring; dorsal fin over anus, with base mostly upon tail; snout very long, between 1.4 and 1.85 in head; head and trunk longer than tail; trunk rings 15 to 17; tail rings 16 to 21; dorsal fin rays 21 to 30, pectoral 19 to 22, anal 4, caudal 10; caudal fin extremely long; head, trunk, and tail banded with vertical pigment rings.

There has been confusion in regard to the method of counting the trunk rings in the genera *Dunckerocampus* and *Doryrhamphus*, both of which has a first trunk ring, i. e., the ring bearing the pectoral fins nearly twice as long as any of the other trunk rings. Despite its size this ring should be counted as a single and not as a double ring. When counted as one ring, the number of trunk rings in *Dunckerocampus dactyliophorus*, for example, becomes constant at 16.

KEY TO THE SPECIES OF DUNCKEROCAMPUS

1*a*. Dorsal rays 30; dorsal fin covers 3 trunk rings, 4 tail rings; trunk rings 17; dorsal fin base 2.58 in head---- Dunckerocampus pessuliferus [27] Fowler

1*b*. Dorsal rays 21 to 25; dorsal fin covers ½ to 2 trunk rings, 3 to 4 tail rings; trunk rings 15 or 16, usually 16.

2*a*. Opercle barred with 2 vertical pigment rings (posterior one may be incomplete).

3*a*. Tail rings 19------ Dunckerocampus caulleryi caulleryi [28] Chabanaud

3*b*. Tail rings 16 or 17.

Dunckerocampus caulleryi chapmani, new subspecies

2*b*. Opercle barred with 1 or 4 or 5 vertical pigment rings.

4*a*. Opercle with 1 vertical crossbar.

Dunckerocampus dactyliophorus (Bleeker)

4*b*. Opercle with 4 or 5 parallel vertical crossbars, pectoral ring with 7 to 9 crossbars, remaining trunk rings with 1 or 2 vertical crossbars each---------- Dunckerocampus multiannulatus [29] (Regan)

DUNCKEROCAMPUS CAULLERYI CHAPMANI, new subspecies

Holotype.—C.A.S. No. 19942, New Caledonia, Noumea, Ducos Peninsula, on rocky ledge, April 6, 1944, Chapman, Cheyne, and Smith, female, 78.2 mm.

Paratypes.—S.N.H.M. No. 16118, New Caledonia, Noumea, Anse Vata, October 7, 1949, Ida Catala-Stucki, female, 82 mm., and male, 78 mm.

Description.—Counts and proportional measurements are given in table 20.

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[27] *Dunckerocampus pessuliferus* Fowler, Proc. U. S. Nat. Mus., vol. 85, p. 41, fig. 13, 1938 (type locality, Sulade Island, Philippine Islands).

The holotype, U.S.N.M. No. 93501, the only known specimen, was examined. It will be noted that some of the counts given in table 20 for this species are much different from those given in the original description.

[28] *Acanthognathus caulleryi* Chabanaud, Bull. Soc. Zool. France, vol. 54, p. 166, fig. 1, 1929 (type locality, Amboina).

Professor Bertin, of the Paris Museum, kindly examined the holotype of *caulleryi* and found that the original tail-ring count of 19 is correct. It differs from the other species in the genus by the presence of the double color bars around the opercle and from *chapmani* by the difference in the tail-ring count.

[29] *Doryichthys multiannulatus* Regan, Rev. Suisse Zool., vol. 11, p. 413, pl. 13, fig. 3, 1903 (type locality, Mauritius).

Acanthognathus multiannulatus Duncker, Jahrb. Wiss. Anstalt Hamburg, vol. 32, p. 42, 1915 (Mauritius).

Dunckerocampus multiannulatus is closely related to *D. dactyliophorus*, but differs in the color pattern.

TABLE 20.—*Certain counts and proportional measurements on various species referred to the genus* Dunckerocampus

Characters	*D. pessuliferus*	*D. caulleryi caulleryi* [1]	*D. caulleryi chapmani*	*D. dactyliophorus*		*D. multi-annulatus* [2]
	Sulade Island, Philippines	Amboina	Noumea, New Caledonia	Philippine and Solomon Islands	Northern Marshall Islands	Mauritius
Dorsal rays	30	24	24 or 25	23 to 25	21 or 22	22 or 23
Pectoral rays	21	21	21 or 22	19 to 21	19 to 21	20 to 22
Anal rays	4	4	4	4	4	4
Caudal rays	10	10	10	10	10	10
Trunk rings	17	16	15 or 16	16	16	16
Tail rings	20	19	16 or 17	19 to 21	20	19
Dorsal position on trunk and tail	3+4	1+3	1 to 2+3½ to 4	½ to 1+3 to 4	½ to 1+2½ to 3	1+3 to 4
Total dorsal rings	7	4	5 to 5¾	3½ to 4¾	3½ to 3¾	4 or 5
Head in standard length	3.74	----------	3.56 to 4.08	3.69 to 4.1	4.15 to 4.63	----------
Snout in head	1.52	----------	1.51 to 1.62	1.42 to 1.48	1.39 to 1.83	----------
Dorsal base in head	2.58	----------	2.48 to 3.14	3.46 to 4.85	3.46 to 4.73	----------
Specimens examined	1	----------	3	8	4	----------

[1] Data recorded from original description.
[2] Data from Duncker (op. cit., 1915).

A very minute serrated ridge on top of snout; preorbital ridges reach from in front of nostrils posteriorly over top of eye, whence they are further extended as short postorbital ridges; opercular keel near dorsal edge of operculum, extends over its entire length; nuchal and prenuchal head crests only faintly visible; pectoral cover plate with two horizontal ridges, one dorsad and one ventrad on plate; heavy posteriorly directed spines on individual rings of trunk and tail at junctures of the superior, lateral, and inferior ridges; lateral trunk and inferior tail ridges continuous; superior trunk and superior tail ridges discontinuous, as are inferior trunk and inferior tail ridges.

Color in alcohol.—Background color whitish with dark bars on the body; 5½ bars on snout in front of eyes, one vertical bar through eye, two on opercle, one at anterior edge and in nearly the same position as on *D. dactyliophorus*, posterior one incomplete in holotype, extending dorsad only to the upper edge of the opercle (in paratypes it extends over top of head), a single bar on pectoral ring; from pectoral fin to anus 9 pigment rings on female holotype and paratype, 11 on male paratype between pectoral color bar and anus, then 1 anal color bar followed by 10 tail color bars, a total of 17 or 18 postpectoral color bars on females, 22 on male.

Color when alive.—Mrs. Ida Catala-Stucki studied the two paratypes as they swam in her aquarium shortly after collection and noted that the tail coloration was extremely conspicuous, with the center of the caudal fin a bright yellow surrounded by a circle of orange and the edge of the fin banded with dark pigment. After death the yellow and orange disappeared.

Remarks.—Dunckerocampus caulleryi chapmani is disinguished from the other species in the genus by the presence of the two color bars about the opercle. From *D. c. caulleryi* it differs in the tail-ring count. In March 1950, Professor Bertin, of the Paris Museum, kindly examined the holotype of *caulleryi* and found that the original count of 19 tail rings is correct. In other genera of pipefishes the difference of only 2 tail-ring counts (16 or 17 as compared with 19) would not be worthy of subspecific recognition. But in *Dunckerocampus* this difference is significant, and I am convinced that when more material is available *chapmani* will be accorded the status of a full species.

Named *chapmani*, in honor of Dr. Wilbert M. Chapman, Research Director, American Tunaboat Association, San Diego, Calif.

DUNCKEROCAMPUS DACTYLIOPHORUS (Bleeker)

PLATE 22, B

Syngnathus dactyliophorus BLEEKER, Nat. Tijdschr. Nederl.-Indië, vol. 4, p. 506, 1853 (type locality, Onrust Island, Batavia, Java).

Acanthognathus dactyliophorus DUNCKER, Jahrb. Wiss. Anstalt Hamburg, vol. 32, p. 41, pl. 1, 1915.—WEBER and DE BEAUFORT, Fishes of the Indo-Australian Archipelago, vol. 4, p. 42, fig. 20, 1922.

SPECIMENS STUDIED

Bikini Atoll: Arji Island, at 20 to 40 feet, August 7, 1946, S–46–308, Brock and Herald, 3 females, 121 to 139 mm.

Rongelap Atoll: Kiesiechi Island, lagoon, depth, 20 feet, July 24, 1946, S–46–285, Brock and Herald, 1 female, 56.5 mm.

In addition the following specimens were studied: 5 from the Philippines, 1 from Celebes, and 2 from the Solomon Islands.

Description.—Counts and proportional measurements are given in tables 20 and 21.

Brood pouch of mature males usually covers one less than number of trunk rings; under microscope, median snout ridge very slightly developed, chiefly on anterior half of snout; median head ridges entirely lacking as are supraopercular and postocular ridges; orbit completely surrounded by extended and serrated orbital ridge; two small nasal ridges extend from internasal area to interorbital area; some specimens with small basal opercular keel, but usually lacking; pectoral plate without ridges.

TABLE 21.—*Counts made on* Dunckerocampus dactyliophorus *from three island groups*

Locality	Characters counted										
	Trunk rings			Tail rings			Dorsal rays				
	15	16	17	19	20	21	21	22	23	24	25
Marshalls		4			4		3	1			
Philippines and Solomons		8		2	5	1			2	3	3

Entire body extremely roughened and covered with numerous minute, closely spaced, conelike projections; along ridges these take form of serrations; first trunk ring, or pectoral ring, extremely long, nearly twice length of second trunk ring; each ridge of trunk and tail ends in a large posteriorly directed spine; this may be preceded by a small spine just anterior to it; fins all of moderate length except caudal, which is exceptionally long; for example, specimens of the following standard lengths have tails as indicated: 88 mm., caudal 10 mm.; 123 mm., 9 mm.; 144.5 mm., 12.5 mm.; 159 mm., 12 mm.

Color in alcohol.—Tip of snout usually dark, but may show this pigment only dorsally; blackish bars include usually 4 or 5 on snout, more often 5; 1 around head at interorbital area (in some specimens not too evident on ventral surface), 1 on opercle, 1 prepectoral, 8 to 10 from pectoral to and including anal ring, and 9 to 13 on tail rings.

I suspect that the trunk-color character may be sexually dimorphic, with the males having 8 or 9 rings and the females 10 rings. However, more material will be required to fully determine this point.

Color when alive.—Background color whitish, rings bright vermilion (after death fading slowly so that in 3 months red becomes blackish); caudal fin partly bright vermilion, as is probably dorsal; pectorals colorless; color description based on Kodachrome picture made of 129.5-mm. female.

Ecology.—The Bikini collections, as well as the Philippine material, indicate that in northern latitudes *Dunckerocampus dactyliophorus* is a subtidal and deeper water species. The Bikini specimen, taken at Kieschiechi Island, was found at the base of an overhanging coral head in 20 feet of water; the Arji Island specimens were taken at a depth of 30 feet; and the two specimens from the Solomons Islands were taken at shallow-reef stations. Although the data are far from adequate, there may be a possibility of a north-south depth gradient.

Remarks.—The data in table 21 indicate little locality variation in trunk or tail-ring counts but that there is a marked variation in dorsal-ray counts. When more material becomes available it is possible that the central Pacific forms may prove worthy of subspecific recognition.

SIOKUNICHTHYS, new genus

Genotype.—*Siokunichthys herrei*, new species.

Surfaces of head and body smooth; trunk and tail ridges rounded and nearly impossible to observe; under reflected light vestige of lateral trunk ridge bends ventrad at anal ring and is continuous with inferior tail ridge, superior trunk and superior tail ridges continuous; dorsal, pectoral, and caudal fins present, anal absent, dorsal placed entirely upon tail beginning at anterior edge of third or fourth ring after anus and containing 27 to 30 rays; trunk rings few (12 to 14), tail rings many (56 to 58). Males unknown.

Named *Siokunichthys* in reference to Siokun Bay, where it was first collected by the author.

SIOKUNICHTHYS HERREI, new species

FIGURE 38

Holotype.—U.S.N.M. No. 112296, Philippine Islands, Mindanao, northwest Zamboanga Peninsula, north end of Siokun Bay (lat. 7°43.4′ N., long. 122°04.7′ E.), light at night, 20 fathoms anchorage, February 18, 1948, Herald, 73.5 mm. standard length.

Paratypes.—U.S.N.M. No: 112297, with same data as holotype, 1 specimen, 72.5 mm.; U.S.N.M. No. 112297, Philippines, southwest corner of Panay Island, Visayas (lat. 10°28.5′ N., long. 121°54.3′ E.),

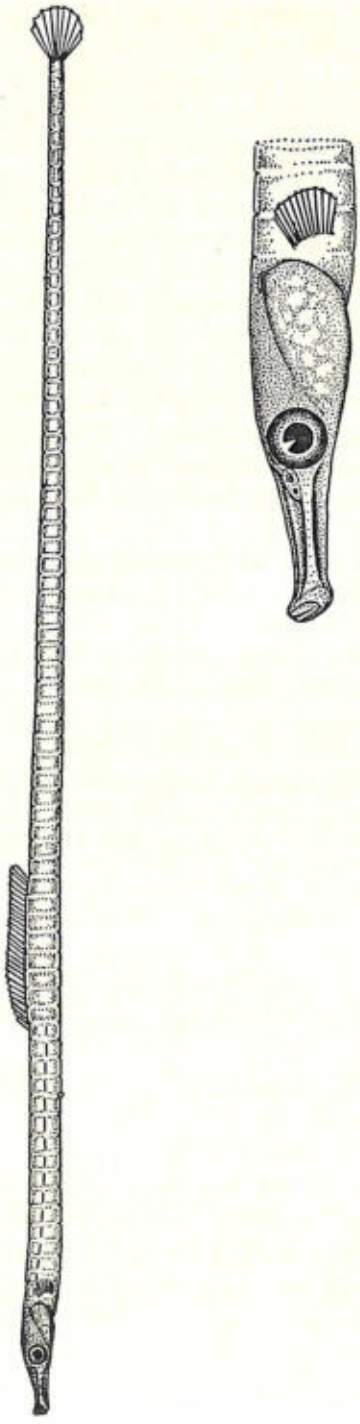

FIGURE 38.—Holotype of *Siokunichthys herrei*, new species (U.S.N.M. No. 112296) from Mindanao, Philippine Islands. (Drawing by Pablo Bravo.)

light at night, 12 fathoms anchorage, April 3, 1948, Kauffman, 2 specimens, 69.5 and 72 mm.; C.A.S. No. 5910, Fiji, Suva, April 20, 1933, Crocker Expedition, 7 specimens, 69 to 73.5 mm.

Description.—Dorsal rays 27 to 30; pectoral 12; anal 0; caudal 10; dorsal fin covers 6½ to 8 rings beginning at anterior edge of third or fourth tail ring; trunk rings 12 to 14; tail rings 56 to 58; head 11.8 to 14.4 in standard length; snout 2.0 to 2.5, dorsal base 0.63 to 0.79, both in head; males and position of brood pouch unknown.

The only ridge on the entire body is a small internasal elevation. On the Philippine specimens the lateral trunk ridge is so indistinct that it is nearly impossible to determine its exact position. The paratypes from Fiji, perhaps because of a longer period of preservation, have the lateral trunk ridge faintly visible; thus its connection with the inferior tail ridge may be determined. The opercle is long, narrow, and without striations. The pectoral and caudal fins are very small but the dorsal rays are long. Scutella are present but are slender and indistinct.

Color in alcohol.—The color of preserved specimens is a uniform light tan. (From my field notes there is apparently little change from this color in that of the living fish.)

Remarks.—Named *herrei* in honor of Dr. Albert W. Herre, School of Fisheries, University of Washington, Seattle.

Genus MICROGNATHUS Duncker

Micrognathus DUNCKER, Mitth. Naturh. Mus. Hamburg, vol. 29, p. 228, 1912. (Genotype, *Syngnathus brevirostris* Rüppell 1840.)

Anarchopterus HUBBS, Occas. Pap. Mus. Zool. Univ. Michigan, No. 320, 1935. (Genotype, *Siphostoma crinigerum* Bean and Dressel.)

Simosyngnathus FOWLER, Proc. Acad. Nat. Sci. Philadelphia, vol. 92, p. 12, 1940. (Genotype, *Siphostoma crinigerum* Bean and Dressel.)

The genus *Micrognathus* is intermediate in the evolutionary scale which leads from the *Syngnathus*-like pipefishes to the *Hippocampus*-like seahorses. The majority of the pipefishes of this evolutionary line are characterized by the everted brood-pouch closure. This genus of tail-pouch pipefishes is further characterized by having lateral trunk ridge continuous with inferior tail ridge; superior trunk and superior tail ridges discontinuous; inferior trunk and inferior tail ridges discontinuous; dorsal fin base usually not raised; dorsal fin mostly on tail with rays few in number, 15 to 25; anal present or absent; brood pouch closure usually everted (free end of one pouch flap turns back upon itself, and free end of the opposite pouch flap extends over turned back section); brood-pouch protecting plates slightly developed. As considered herein, it is composed of 10 species representing 2 subgenera. Three of the species are limited to the

Atlantic American region, and the other 7 to the Indo-Pacific. Of this latter group, 2 are described as new.

The most obvious distinction within the genus *Microgmathus* is that of the absence of the anal fin shown by the two species *M.* (*Anarchopterus*) *crinigerus* (Bean and Dressel) and *M.* (*Anarchopterus*) *crinitus* (Jenyns) both of the Atlantic American coasts. These two species are similar in appearance and closely related to *M.* (*Microgmathus*) *brevirostris*, which has the anal fin and is found from Madagascar to the central Pacific.

Two additional relationships should be noted. One of these is the almost identical color bars shown by the Pacific *M. nitidus* and the Atlantic *M. vittatus* (Kaup) (for illustrations see the original description of *Doryichthys elegans* Steindachner, 1901, as compared with that of *Corythoichthys ensenadae* Sylvester, 1918). No other species in the genus is known to show this type of coloration. The other relationship of interest is that shown by the dorsal fin base of *M. dunckeri*, for in this species there is a very slight indication of a raised dorsal base. This fits neatly into line with my concept of the phylogenetic position of *Microgmathus*. The last-named species would be the most advanced of the genus and closest in the evoluntionary sequence to those species that gave rise to the *Hippocampus*-type of syngathid.

The snout crests of the Indo-Pacific *Microgmathus* are so distinctive that figure 39 could almost be used to the exclusion of other characters in specific identifications. Each species shows a certain amount of variation in this character, but in all specimens examined the fundamental pattern has always been apparent. In *Microgmathus brevirostris* the snout is always smooth. *M. nitidus* has one to three spines along the center snout ridge, and *M. dunckeri* has a single crest, which may be more or less rounded on the edges. *M. brachyrhinus* has the single spine and *M. edmondsoni* the single indentation. *M. mataafae* and *M. brocki* both conform to the same pattern, each having three snout crests, the anterior one platelike, the second and third heavily toothed. In some specimens of *M. mataafae* the second and third crests may be so close together as to appear as a single crest, but careful examination, often requiring a microscope, will show the line of demarcation between them. Gilbert P. Whitley has kindly furnished a sketch of a specimen of *M. mataafae* from Malekula, New Hebrides, which has an atypical snout ridge.

KEY TO THE SUBGENERA AND TO THE INDO-PACIFIC SPECIES OF MICROGNATHUS

1*a*. Anal fin absent; body ridges rounded and indistinct.
Subgenus Anarchopterus Hubbs

1*b*. Anal fin present; body ridges usually not rounded, and usually very distinct---------- Subgenus Microgmathus Duncker

2*a*. Trunk rings 19 to 21; dorsal fin rays 23 to 25; anterior supraorbital ridge confluent with median snout ridge.

Micrognathus brachyrhinus, new species

2*b*. Trunk rings 13 to 17; dorsal fin rays 17 to 23; anterior supraorbital ridge not confluent with median snout ridge.

3*a*. Tail rings 28 to 36.

4*a*. Trunk rings 13 or 14.

5*a*. Dorsal snout ridge with 1 to 3 conical spines; trunk and tail segments with deeply cut indentations between each ring; head 8.0 to 9.5 in standard length; tail rings 29 to 32.

Micrognathus nitidus [40] (Günther)

5*b*. Dorsal snout ridge composed of a single high plate; trunk and tail without deeply cut indentations between rings; head 11.4 to 14.9 in standard length; tail rings 34 to 36.

Micrognathus dunckeri [41] Chabanaud

4*b*. Trunk rings 15 to 17.

6*a*. Tail rings 28 to 32; head about 8.0 in standard length; dorsal base about 1.4 in head; dorsal snout ridge smooth.

Micrognathus brevirostris (Rüppell)

6*b*. Tail rings 34 or 35; head 11.6 to 12.8 in standard length; dorsal base 0.83 to 0.97 in head; dorsal snout ridge heavily toothed before eyes---- Micrognathus mataafae (Jordan and Seale)

3*b*. Tail rings 37 or 38.

7*a*. Body ridges accentuated with pronounced tendency toward serration; median snout ridge with 3 broad extensions, the second ⅓ higher than first, third ⅓ higher than second; pectoral rays 13-------- Micrognathus brocki, new species

7*b*. Body ridges rounded, no tendency toward serration; median snout ridge slightly developed, indentation in center; pectoral rays 10-- Micrognathus edmondsoni [42] (Pietschmann)

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[40] *Syngnathus nitidus* Günther, Journ. Mus. Godeffroy, vol 1, pt. 2, p. 103, 1873 (type locality, Bowen, Queensland, Australia).

Doryichthys elegans Steindachner, Abh. Senckenb. nat. Ges., vol. 25, p. 459, pl. 18, fig. 2, 1901 (type locality, Ternate).

Halicampus elegans Weber and de Beaufort, Fishes of the Indo-Australian Archipelago, vol. 4, p. 104 (after Steindachner).

Specimens studied include two females from the Philippine Islands. The one to three tubercles on the dorsal surface of the snout, together with the indentations between the rings and the color pattern, all serve to separate *M. nitidus* from the other six species in the genus in the Pacific area. (See fig. 39, *c*.)

[41] *Micrognathus dunckeri* Chabanaud, Bull. Soc. Zool. France, vol. 54, p. 167, figs. 2, 3, 1929 (type locality, Amboina).

Micrognathus magdamoi Herre, Copeia, No. 3, p. 141, 1932 (type locality, Dumaguete, Negros Oriental, Philippine Islands).

Specimens studied include one from the Solomon Islands, four from the Philippines, and one from Waigiu. *Micrognathus dunckeri* is unique among the species within the genus in the possession of the rectangular snout flange; consequently this character provides the quickest means of specific identification. (See fig. 39, *d*.)

[42] *Ichthyocampus edmondsoni* Pietschmann, Bernice P. Bishop Mus., Bull. 73, p. 24, 1930 (type locality, Waikiki Reef, Honolulu, holotype, Bishop Museum No. 3467).

Specimens studied include two from Oahu, one of them the holotype. *Micrognathus edmondsoni* is similar to *M. brocki* in some of its meristic characters. A most useful criterion for separation is that the latter species is extremely spinose, with many crenulations along the head and body ridges, whereas the former has entirely smooth ridges. (See fig. 39, *b*.)

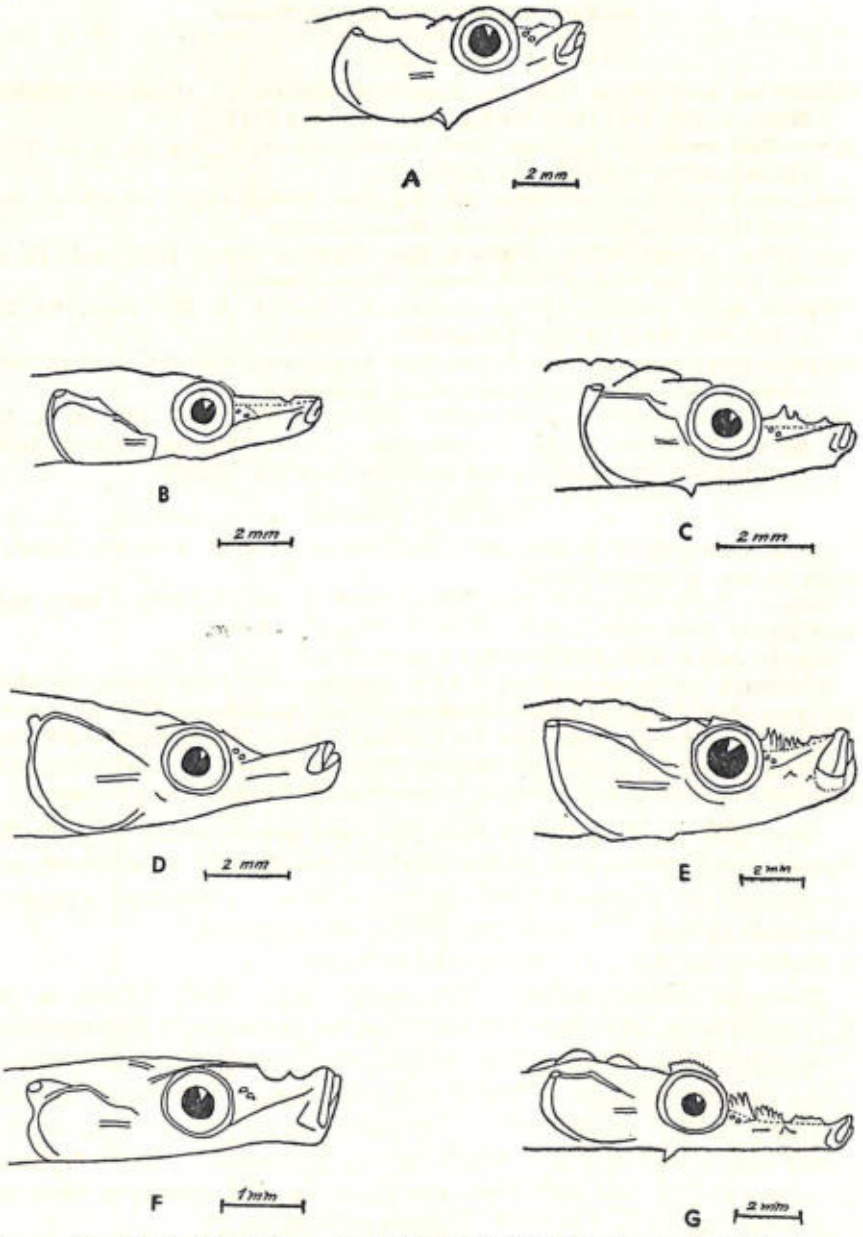

FIGURE 39.—Heads of certain species of *Microgmathus* from the tropical Indo-Pacific: *a*, *M. brevirostris* (Rüppell); *b*, *M. edmondsoni* (Pietschmann), holotype; *c*, *M. nitidus* (Günther); *d*, *M. dunckeri* Chabanaud; *e*, *M. mataafae* (Jordan and Seale), holotype; *f*, *M. brachyrhinus*, new species, holotype; *g*, *M. brocki*, new species, holotype. (Sketches by Olivia Herald.)

MICROGNATHUS BREVIROSTRIS (Rüppell)

FIGURE 39, *a*

Syngnathus brevirostris RÜPPELL, Neue Wirbelthiere . . . Abyssinien gehörig Meers, p. 144, 1840 (type locality, Massaua, Red Sea).

Syngnathus sundaicus BLEEKER, Verh. Batav. Genootsch., vol. 25, p. 21, 1853 (type locality, "Anjer," west Java).

Syngnathus andersonii BLEEKER, Nat Tijdschr. Nederl.-Indië, vol. 15, p. 465, 1858 (type locality, "Nova Selma," Cocos Islands).

Syngnathus tetrophthalmus BLEEKER, Nat. Tijdschr Nederl.-Indië, vol. 15, p. 467, 1858 (type locality, "Nova Selma," Cocos Islands).

Corythroichthys tanakae JORDAN and STARKS, Proc. U. S. Nat. Mus., vol. 30, p. 696, 1906 (type locality, Tanegashima, Japan).

Corythoichthys spinicaudatus OGILBY, Ann. Queensland Mus., No. 9, p. 16, 1908 (type locality, Cape York, Queensland, Australia).

Syngnathus micronotopterus FOWLER, Proc. U. S. Nat. Mus., vol. 85, p. 42, fig. 14, 1938 (type locality, Canino Island, Luzon, Philippine Islands, holotype U.S.N.M. No. 94082; paratypes 94083 to 94087, 99007).

SPECIMENS STUDIED

Bikini Atoll: Bikini Island, ocean reef, August 16, 1947, S–42–565, Bayer, 1 male, 25 mm., 1 female, 26 mm.

Saipan: Northwest coast, June 1945, Ducoff, 1 female, 24 mm.; north end, west lagoon, September 3, 1945, Marshall, 1 female, 51 mm.

Guam: July 2, 1923, Hornbostel, 1 female, 38 mm.

Additional specimens studied: 9 from Singapore; 84 from Japan, including the types of *M. tanakae*; 3 from Okinawa; 3 from the Solomon Islands; a paratype of *M. micronotopterus* from the Celebes; 1 from Java; 8 from the Philippines, including the remaining types of *M. micronotopterus;* 1 from the New Hebrides; 21 from New Caledonia; 1 from Suva, Fiji; and 1 from Tongatabu.

Description.—Counts and measurements are recorded in table 22. Brood-pouch protective plates slightly developed; nasal crest entirely smooth; largest known specimens 75 mm.; smallest reproductive male 25 mm. Dermal appendages often present.

Color in alcohol.—Color invariably brown.

Remarks.—This species, which occurs from West Africa to the Fiji and Tonga Islands and from Japan to Australia, is distinguished from all other members of the genus by the smooth snout crest as well as by the combination of trunk and tail rings. Because of its wide distribution the species has been described as new on at least six different occasions, the last of which was as *Syngnathus micronotopterus* Fowler (1938). As indicated, the types of this synonym were examined in the U. S. National Museum collections.

The two specimens collected during the 1947 resurvey represent a considerable range extension, for this is the first time that the species has been taken in the tropical north-central Pacific. Most important, however, is the small size of the two specimens (male, 25 mm., with eggs in pouch, and a female, 26 mm.). This is as small as sexual maturity is known to occur in the genus and nearly as small as it is known to occur in the family!

TABLE 22.—*Ranges of counts and proportional measurements made on the species of the genus* Microgнathus

Characters	*brevirostris*	*mataafae*	*dunckeri*	*nitidus*	*brocki*	*edmondsoni*	*brachyrhinus*
	West Africa to Fiji and Tonga Islands	Samoan and Marshall Islands	Tulagi; Waigiu; Zamboanga; Dumaguete; Amboina	Bowen, Queensland, Australia; Ternate; Tataan, P. I.	Bikini, Marshall Islands	Honolulu, Hawaii	Oahu, Hawaii; Ticao, P. I.
Number of fin rays:							
Dorsal	17 to 22	22 or 23	18 or 19	18 to 20	22	20 or 21	23 to 25
Pectoral	9 to 12	12 or 13	11 or 12	12 or 13	13	10 or 11	9 or 10
Caudal	10	10	----------	----------	10	----------	8(?)
Anal	2 to 4	2 or 3	3 or 4	3	3	2	3
Number of trunk rings	15 to 17	15	14	13 or 14	14	14	19 to 21
Number of tail rings	28 to 32	34 or 35	34 to 36	29 to 32	37	38	37 to 39
Dorsal fin occurs on:							
Trunk rings	0 to 2	1	½ to 1½, (usually 1)	0 or 1	¼	½ to ½	1½ to 2
Tail rings	3 to 5	4	3 or 4 (usually 3)	4	4½	4¾ to 5	5¼ to 6
Number of tail rings involved in formation of brood pouch	10 to 17	12 or 13	13 to 15	----------	----------	15½	----------
Length of head in standard length	±8.0	11.6 to 12.8	11.4 to 14.9	8.0 to 9.5	12.6	13.2 to 13.6	5.8 to 8.8
Length of snout in head length	±2.79	2.8 to 3.6	3.2 to 3.9	2.8 to 3.4	2.38	2.6 to 2.8	3.17 to 3.18
Length of dorsal fin base in head	±1.4	.83 to .97	1.0 to 1.2	1.2 to 1.3	1.01	.85	.97 to 1.05
Number of specimens examined	98	6	6	2	1	2	2

MICROGNATHUS BREVIROSTRIS (Rüppell)

FIGURE 39, *a*

Syngnathus brevirostris RÜPPELL, Neue Wirbelthiere . . . Abyssinien gehörig Meers, p. 144, 1840 (type locality, Massaua, Red Sea).

Syngnathus sundaicus BLEEKER, Verh. Batav. Genootsch., vol. 25, p. 21, 1853 (type locality, "Anjer," west Java).

Syngnathus andersonii BLEEKER, Nat Tijdschr. Nederl.-Indië, vol. 15, p. 465, 1858 (type locality, "Nova Selma," Cocos Islands).

Syngnathus tetrophthalmus BLEEKER, Nat. Tijdschr Nederl.-Indië, vol. 15, p. 467, 1858 (type locality, "Nova Selma," Cocos Islands).

Corythroichthys tanakae JORDAN and STARKS, Proc. U. S. Nat. Mus., vol. 30, p. 696, 1906 (type locality, Tanegashima, Japan).

Corythoichthys spinicaudatus OGILBY, Ann. Queensland Mus., No. 9, p. 16, 1908 (type locality, Cape York, Queensland, Australia).

Syngnathus micronotopterus FOWLER, Proc. U. S. Nat. Mus., vol. 85, p. 42, fig. 14, 1938 (type locality, Canino Island, Luzon, Philippine Islands, holotype U.S.N.M. No. 94082; paratypes 94083 to 94087, 99007).

SPECIMENS STUDIED

Bikini Atoll: Bikini Island, ocean reef, August 16, 1947, S–42–565, Bayer, 1 male, 25 mm., 1 female, 26 mm.

Saipan: Northwest coast, June 1945, Ducoff, 1 female, 24 mm.; north end, west lagoon, September 3, 1945, Marshall, 1 female, 51 mm.

Guam: July 2, 1923, Hornbostel, 1 female, 38 mm.

Additional specimens studied: 9 from Singapore; 84 from Japan, including the types of *M. tanakae;* 3 from Okinawa; 3 from the Solomon Islands; a paratype of *M. micronotopterus* from the Celebes; 1 from Java; 8 from the Philippines, including the remaining types of *M. micronotopterus;* 1 from the New Hebrides; 21 from New Caledonia; 1 from Suva, Fiji; and 1 from Tongatabu.

Description.—Counts and measurements are recorded in table 22. Brood-pouch protective plates slightly developed; nasal crest entirely smooth; largest known specimens 75 mm.; smallest reproductive male 25 mm. Dermal appendages often present.

Color in alcohol.—Color invariably brown.

Remarks.—This species, which occurs from West Africa to the Fiji and Tonga Islands and from Japan to Australia, is distinguished from all other members of the genus by the smooth snout crest as well as by the combination of trunk and tail rings. Because of its wide distribution the species has been described as new on at least six different occasions, the last of which was as *Syngnathus micronotopterus* Fowler (1938). As indicated, the types of this synonym were examined in the U. S. National Museum collections.

The two specimens collected during the 1947 resurvey represent a considerable range extension, for this is the first time that the species has been taken in the tropical north-central Pacific. Most important, however, is the small size of the two specimens (male, 25 mm., with eggs in pouch, and a female, 26 mm.). This is as small as sexual maturity is known to occur in the genus and nearly as small as it is known to occur in the family!

TABLE 22.—*Ranges of counts and proportional measurements made on the species of the genus* Micrognathus

Characters	*brevirostris*	*mataafae*	*dunckeri*	*nitidus*	*brocki*	*edmondsoni*	*brachyrhinus*
	West Africa to Fiji and Tonga Islands	Samoan and Marshall Islands	Tulagi; Waigiu; Zamboanga; Dumaguete; Amboina	Bowen, Queensland, Australia; Ternate; Tataan, P. I.	Bikini, Marshall Islands	Honolulu, Hawaii	Oahu, Hawaii; Ticao, P. I.
Number of fin rays:							
Dorsal	17 to 22	22 or 23	18 or 19	18 to 20	22	20 or 21	23 to 25
Pectoral	9 to 12	12 or 13	11 or 12	12 or 13	13	10 or 11	9 or 10
Caudal	10	10	----------	----------	10	----------	8(?)
Anal	2 to 4	2 or 3	3 or 4	3	3	2	3
Number of trunk rings	15 to 17	15	14	13 or 14	14	14	19 to 21
Number of tail rings	28 to 32	34 or 35	34 to 35	29 to 32	37	38	37 to 39
Dorsal fin occurs on:							
Trunk rings	0 to 2	1	½ to 1½, (usually 1)	0 or 1	¼	½ to ½	1½ to 2
Tail rings	3 to 5	4	3 or 4 (usually 3)	4	4½	4¾ to 5	5¼ to 6
Number of tail rings involved in formation of brood pouch	10 to 17	12 or 13	13 to 15	----------	----------	15½	----------
Length of head in standard length	±8.0	11.6 to 12.8	11.4 to 14.9	8.0 to 9.5	12.6	13.2 to 13.6	5.8 to 8.8
Length of snout in head length	±2.79	2.8 to 3.6	3.2 to 3.9	2.8 to 3.4	2.38	2.6 to 2.8	3.17 to 3.18
Length of dorsal fin base in head	±1.4	.83 to .97	1.0 to 1.2	1.2 to 1.3	1.01	.85	.97 to 1.05
Number of specimens examined	98	6	6	2	1	2	2

MICROGNATHUS BRACHYRHINUS, new species

FIGURE 39, *f*

Holotype.—U.S.N.M. No. 118082, Hawaiian Islands, south coast of Oahu, plankton net at 75 fathoms, April 1, 1902, *Albatross* station 3825 (a juvenile specimen, 31 mm. standard length).

Paratype.—U.S.N.M. No. 137269, San Miguel Harbor, Ticao Island, Philippine Islands, April 21, 1908, *Albatross* (a juvenile specimen 22 mm. standard length).

Description.—Counts and measurements are given in table 22. Other measurements in millimeters for the holotype and paratype are, respectively: Total length 32.0, 31.0; standard length 31.0, 22.0; snout 1.1, 1.2; head 3.5, 3.8; dorsal fin base 3.6, 3.6.

Head smooth, rounded, with nuchal and posterior supraorbital crests faintly visible; opercular ridge visible over ¾ of length of opercle; anterior supraorbital ridges extend forward, meeting over nostrils, to form a single ridge, which is depressed but immediately rises to form a sharp elevation just posterior to mouth; mouth extremely superior, angle being approximately 10 degrees from vertical; pectoral cover plate smooth; trunk and tail ridges distinct but rounded, ridges separating individual rings well developed, lateral trunk ridge continuous with inferior tail ridge, superior trunk ridge discontinuous with superior tail ridge; superior trunk ridge slightly raised in area of dorsal fin so that dorsal base is in bottom of V-shaped trough; scutella present but very indistinct; snout thick, equal in depth to ¾ of greatest depth of the head; all fins very short, with pectoral, dorsal, and caudal rays being equal in length to width of 1½ trunk rings, anal length equal to width of 1 ring.

Color in alcohol.—Uniformly light brown, no distinctive marks of any kind.

Remarks.—This species is distinct from all other members of the genus by reason of the greater number of trunk rings and by the number of rings covered by the dorsal fin.

Named *brachyrhinus* in reference to the impressive thickness of the snout in relation to the head.

MICROGNATHUS MATAAFAE (Jordan and Seale)

FIGURE 39, *e*

Corythoichthys mataafae JORDAN and SEALE, Bull. Bur. Fisheries, vol. 25, 1905, p. 213, 1906 (type locality, Upolu Island, Samoa; holotype U.S.N.M. No. 51724).

SPECIMENS STUDIED

Bikini Atoll: Enyu Island, lagoon reef at channel entrance, March 16, 1946, S–46–8, Schultz, Brock, and Marr. 1 male, 127 mm., and 1 female, 129 mm.

Rongelap Atoll: Coral head at northwest end of Rongelap Island, depth 18 feet, July 25, 1946, S–46–286, Brock, Herald, and Kohler, 1 female, 96 mm.

Additional specimens studied: Three from Samoa, including the holotype of *M. mataafae;* and one from the New Hebrides Islands.

Description.—Counts and proportional measurements are recorded in table 22. In holotype eggs arranged in a single layer across pouch, in 4 rows of approximately 30 eggs each; brood-pouch protecting plates weakly developed; snout crests in 3 sections, first near tip of snout, low, short and usually unserrated, next two higher, heavily toothed, and usually separated by a more or less indistinct indentation; cirri usually present on head and body; largest known specimen 129 mm. female.

Remarks.—The three snout crests in combination with the count of trunk and tail rings serve to distinguish *Micrognathus mataafae* from other members of the genus. Data on an Australian Museum specimen from the New Hebrides, with a drawing, were kindly forwarded to me by Gilbert P. Whitley. One other specimen from this same locality (Australian Museum 1A.778x5, 104 mm., female) has the counts and characters of *M. mataafae* but is atypical in the arrangement of snout crests, these being more typical of *M. nitidus.* In addition *M. mataafae* has been reported from Timor and Salomakiee Island.

MICROGNATHUS BROCKI, new species

FIGURES 39, *g;* 40

Holotype.—U.S.N.M. No. 140235, Bikini Atoll, Amen Island, in lagoon, depth 30 feet, August 4, 1946, S–46–307, Brock, Herald, and Kohler, 1 female, 110.5 mm.

Description.—Counts and measurements are recorded in table 22.

Nearly all ridges of head, trunk, and tail sharply accentuated, superior trunk and superior tail ridges markedly so, median snout ridge with three distinct sections, each serrated, first just posterior to snout, low, with 10 serrations, second much higher, with 6 definite teeth, third just in front of nostril, 3 times as high as first, with 3 well-developed teeth; lateral snout ridge extremely well-developed, in form of a sharp spinelike tooth located on each side dorsolaterally at about center of snout; supraorbital ridges represented by no more than serrated tufts over each eye; the supraopercular ridge restricted to well-developed flange extending outwardly over each opercle; opercular ridge not greatly developed, extends posteriorly for only about one-fourth length of opercle; frontal and prenuchal ridges accentuated, nuchal slight; area of external opening of gill cavity extended in a short bony crest; pectoral cover plate smooth. On posterior half of each ring along superior ridges of trunk and tail a series of serrations, 4 to 6 on each trunk ring, 3 or 4 on each tail ring; median trunk ridge and inferior trunk and tail ridges lack these serrations; lateral ridge continuous with the inferior tail ridge; superion trunk and su-

FIGURE 40.—Holotype of *Micrognathus brocki*, new species (U.S.N.M. No. 140235), from Bikini Atoll. (Drawing by Aime M. Awl.)

perior tail ridges discontinuous; inferior trunk and inferior tail ridges discontinuous; scutella small, indistinct, equal in width to approximately ⅓ to ¼ widest trunk rings; cirri present only on head, a large unbranched cirrus above and beneath each eye, another large one on frontal crest, and a small one on prenuchal crest.

Color in alcohol.—Background color whitish gray; ground color of trunk rings 6 through 14 light reddish brown; anterior part of ventral body surface beneath pectoral fins and second and third trunk rings mottled blackish, some blackish mottlings on head, one quite distinct area between eye and opercle and directly in line with opercular crest, another extending forward from eye onto underside of snout; pigment strikingly absent from area beneath dorsolateral snout spines, so that ventral surface of snout appears to have a light color bar connecting lateral snout spines.

Remarks.—The count of the trunk and tail rings in combination with the long snout serves to distinguish *M. brocki* from other Pacific species of the genus. Although some of the counts of this species are similar to those of *M. edmondsoni*, the relatively smooth head and body of the latter species distinguish it from the former.

Named *brocki*, in honor of Vernon E. Brock, Director of the Division of Fish and Game, Honolulu, Territory of Hawaii.

Genus CORYTHOICHTHYS Kaup

Corythoichthys KAUP, Arch. Naturg., vol. 19, pt. 1, p. 231, 1853. (Genotype, *Syngnathus fasciatus* Gray by Whitley, 1948.)—DUNCKER, Jahrb. Wiss. Anstalt Hamburg, vol. 29, p. 232, 1912; vol. 32, p. 72, 1915.—HERALD, Allan Hancock Pacific Exped., Univ. Southern California, vol. 9, No. 3, p. 52, 1940.—WHITLEY, Australian Zool., vol. 11, pt. 3, p. 268, 1948.

Corythroichthys JORDAN and EVERMANN, U. S. Nat. Mus. Bull. 47, p. 761 (typographical error), 1896.—JORDAN, Copeia, No. 106, p. 34 (emendation), 1922.

Bhanotichthys PARR, Bull. Bingham Oceanogr. Coll., vol. 3, No. 4 p. 27, 1930. (Genotype, *Syngnathus fasciatus* Gray.)

Tail-pouch pipefishes without pouch protecting plates (Pacific area) or with protecting plates (Atlantic American area); brood-pouch folds short so that it is usually agape when pouch is filled; eggs in single layer, 3 to 7 rows in width; dorsal profile of head rising sharply from snout; eyes usually large and prominent, ridges of head and body sharp, distinct, and usually crenulated, opercular ridge usually complete; superior trunk and superior tail ridges discontinuous; inferior trunk and inferior tail ridges continuous; lateral trunk ridge subcontinuous with lateral tail ridge at area of anus; dorsal, pectoral, anal, and caudal fins present; dorsal base placed mostly upon tail.

Among 8 species, 6 are in the Indo-Pacific area and 2 in the Atlantic American area.

Whitley states that the genotype of *Corythoichthys* must rest either upon *C. fasciatus* (Gray) or *C. brevirostris* (Rüppell), an opinion

based on Kaup 1853 rather than Kaup 1856 (the latter has been referred to by most authors). Since *brevirostris* belongs in *Micrognathus*, Whitley designated the type of *Corythoichthys* as *C. fasciatus* (Gray).

Corythoichthys crenulatus (Weber) is tentatively referred to *C. i. intestinalis* as a synonym. In his revision Duncker (1915) placed *crenulatus* as a synonym of *fasciatus* (=*intestinalis*). Weber and de Beaufort (Fishes of the Indo-Australian Archipelago, vol. 4, pp. 72–73, 1922) accepted *crenulatus* as valid, pointing out that they had compared the types of *crenulatus* with a series of 30 juvenile *intestinalis* of the same sizes, and had found that the latter had no serrations along the body ridges and none of the juvenile characters so apparent on the types of *crenulatus*.

I have found that different populations of pipefishes of the same species or subspecies may lose the juvenile characters, such as body serration, at different growth stages. For this reason I believe that, since young *intestinalis* are definitely serrated along the trunk and tail ridges, Weber and de Beaufort's juvenile *intestinalis* series came from a population in which the juvenile characters were lost at an early age.

KEY TO THE INDO-PACIFIC SPECIES REFERABLE TO CORYTHOICHTHYS

1*a*. Dorsal fin rays 22 to 24; tail rings 30 or 31.
Corythoichthys ocellatus, new species

1*b*. Dorsal fin rays 26 to 35; tail rings 34 to 40.

2*a*. Head 6.03 to 7.05 in standard length; snout 1.59 to 1.77, dorsal base 1.87 to 2.24, both in head---------- Corythoichthys schultzi, new species

2*b*. Head 7.0 to 10.0 in standard length; snout 1.90 to 2.4, dorsal base 0.80 to 1.50, both in head.

3*a*. Ventral surface of anal ring of adult male bright cobalt blue (color usually remains for at least 50 years in preservative); female without anal color; dorsal fin rays 28 to 35; dorsal base 0.80 to 1.05 in head; head with 2 broad pigmented bands horizontally along side, 1 through center of eye posteriorly across operculum, another beginning beneath nostril and running posteriorly under eye and across ventral half of opercle to pectoral base.

4*a*. Tail rings 36 to 40, usually 38 or 39; trunk rings 15 to 17, usually 16; dorsal fin rays 28 to 35, usually 31 to 35.
Corythoichthys flavofasciatus conspicillatus (Jenyns)

4*b*. Tail rings 35 to 37; trunk rings 16; dorsal fin rays 30.
Corythoichthys flavofasciatus flavofasciatus [43] (Rüppell)

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[43] *Syngnathus flavofasciatus* Rüppell, Neue Wirbelthiere . . . Abyssinien gehörig Fische des rothen Meeres, p. 144, 1835 (type locality, Djedda, Red Sea).

Corythoichthys conspicillatus Duncker, Publ. Marine Biol. Sta. Ghardaqua (Red Sea), No. 3, p. 83, 1940.

Specimens studied include four from the Red Sea, collected by Donald Erdman, formerly of the U. S. National Museum. These specimens from the type locality have enabled me to clarify the confusion concerning the identity and relationships of this species. Data in the key and in tables 23 and 24 furnish the basis for the separation of the species and subspecies previously confused with *C. flavofasciatus*.

3*b*. Ventral surface of anal ring without blue color; dorsal fin rays 26 to 31, usually 27 to 31; dorsal base 1.05 to 1.40 in head; head without the broad bands described for *flavofasciatus*.

5*a*. Tail rings 38 or 39; brood pouch covering 11 to 13 rings, its folds fairly long, probably nearly covering entire egg area; side of head without fine lines forming reticulated chain or other pattern; ventral surface of first, second, and third trunk rings of both sexes usually with diffusely defined pigmented areas.

Corythoichthys nigripectus, new species

5*b*. Tail rings 34 to 36; brood pouch covering 13 to 18 rings, its folds very short, barely covering outermost rows of eggs; side of head usually with series of fine longitudinal lines usually forming reticulated pattern; ventral surface of first, second, and third trunk rings of female usually with well-defined pigmented areas.

6*a*. Trunk rings usually 16, occasionally 15 or 17.

Corythoichthys intestinalis waitei (Jordan and Seale)

6*b*. Trunk rings usually 17, occasionally 16 or 18 (see fig. 44).

Corythoichthys intestinalis intestinalis [“] (Ramsey)

CORYTHOICHTHYS OCELLATUS, new species

FIGURE 41, *a*

Holotype.—C.A.S. No. 20029, Upper Purvis Bay, Florida Island, Solomons Group, May 3, 1944, Chapman, 1 male with eggs in pouch, 66.5 mm.

Paratypes.—C.A.S. No. 19936, 1 male 66 mm. and 2 females 60 and 65 mm., with same data as holotype; C.A.S. No. 19932, Upper Purvis Bay, Florida Island, Solomons Group, May 4, 1944, Chapman and Cheyne, 1 male 59 mm.; C.A.S. No. 19933, 1 male 68 mm., with same locality data as holotype; C.A.S. No. 19936, Munda Lagoon, New Georgia Island, Solomons Group, June 15, 1944, Chapman, 1 male 54 mm.; C.A.S. No. 19935, Munda Reef, New Georgia, Solomons Group, May 12, 1944, Chapman, 1 male 67 mm.; S.N.H.M. No. 15432, Manokwari, Dutch New Guinea, May 31, 1929, Herre, 2 specimens 57 and 60 mm.

Description.—Certain counts and measurements are recorded in table 23. Dorsal rays 22 to 24, pectoral 14 to 16; and 3; caudal 10;

[“] *Syngnathus fasciatus* Gray, The illustrations of Indian zoology . . . Hardwicke, vol. 1, pl. 89, figs. 2, 2a, 1832 (preoccupied by *Syngnathus fasciatus* Risso, 1810; type locality, India).

Syngnathus intestinalis Ramsey, Proc. Linn. Soc. New South Wales, vol. 5, p. 494, 1881 (type locality, Bougainville Island, Solomons; Duke of York Island).

Corythroichthys isigakius Jordan and Snyder, Proc. U. S. Nat. Mus., vol. 24, p. 7, pl. 5, 1901 (type locality, Ishigaki Island, Ryukyu Group; types, U.S.N.M. No. 49835; S.N.H.M. No. 6736).

Corythroichythys elerae Evermann and Seale, Bull. U. S. Bur. Fisheries, vol. 26, 1906, p. 57, fig. 2, 1907 (type locality, Bacon, Sorsogon Province, Luzon, Philippine Islands; types, U.S.N.M. Nos. 53908, 55921, 126383).

†*Syngnathus crenulatus* Weber, *Siboga*-Expeditie, vol. 57, p. 109, fig. 35, 1913 (type locality, Binongka Island).

Specimens studied were 23 from the Ryukyu Islands, Okinawa, and Japan, including the types of *C.isigakius*; 154 from the Philippine Islands, including the types of *C. elerae*; and 33 from the New Hebrides Islands.

TABLE 23.—*Counts and other data recorded for the species and subspecies of* Corythoichthys

Species and subspecies	Number of dorsal rays														Number of trunk rings				Number of tail rings										
	22	23	24	25	26	27	28	29	30	31	32	33	34	35	15	16	17	18	30	31	32	33	34	35	36	37	38	39	40
intestinalis																													
intestinalis	----	----	----	1	2	6	12	18	19	7	----	----	----	----	----	7	103	1	----	----	----	----	9	26	16	----	1	----	----
waitei	----	----	----	----	----	4	11	18	10	2	----	----	----	----	7	123	9	----	----	----	----	----	13	15	7	1	----	----	----
flavofasciatus																													
flavofasciatus	----	----	----	----	----	----	----	----	4	----	----	----	----	----	----	4	----	----	----	----	----	----	----	1	2	1	----	----	----
conspicillatus	----	----	----	----	----	----	1	1	2	7	23	11	1	4	3	45	2	----	----	----	----	----	----	----	3	6	18	10	3
schultzi	----	----	----	----	----	----	5	3	----	----	----	----	----	----	----	8	----	----	----	----	----	----	----	1	1	4	2	----	----
ocellatus	2	4	4	----	----	----	----	----	----	----	----	----	----	----	----	10	----	----	6	2	1	1	----	----	----	----	----	----	----
nigripectus	----	----	----	----	----	----	3	2	----	----	----	----	----	----	----	7	----	----	----	----	----	----	----	(1)	----	----	2	4	----

Characters	*intestinalis*		*flavofasciatus*		*schultzi*	*ocellatus*	*nigripectus*
	intestinalis	*waitei*	*flavofasciatus*	*conspicillatus*			
Geographical distribution	East Africa to New Hebrides	Central Pacific	Red Sea	Central Pacific	Bikini	Solomons; New Guinea	Bikini
Range in number of pouch rings	13 to 18	13 to 18	----------	13 to 16	11 to 13	13	11 to 13
Length of head in standard length	7.0 to 9.5	7.5 to 9.7	7.6 to 8.25	8.7 to 10.0	6.0 to 7.05	5.9 to 6.5	8.7 to 9.4
Length of snout in head length	1.9 to 2.3	1.98 to 2.28	2.15 to 2.3	2.15 to 2.4	1.59 to 1.77	1.7 to 1.9	2.0 to 2.11
Length of dorsal fin base in head length	1.05 to 1.5	1.05 to 1.40	1.15 to 1.23	.8 to 1.05	1.84 to 2.24	1.9 to 2.3	1.2 to 1.4
Number of rings along base of dorsal fin	0 or 1+5 or 6	0 or 1+5 or 6	0 or 1+5 or 6	0 or ¾+ 6 or 7	0+5 or 5½	0 or (−½) +4 or 4¾	0+5 or 6
Standard length in mm.							
Largest male	159	156	68 (immature)	104.5	122	68	95.5
Largest female	147	147	68 (immature)	98.5	111	65	86
Smallest mature male	105	87	----------	78	114.5	54	87
Number of specimens studied	211	139	4	50	8	10	7

dorsal fin covers first 4 or 5 tail rings (beginning either at anterior edge or center of first ring); trunk rings 16; tail rings 30 to 33; head 5.9 to 6.5 in standard length; snout 1.7 to 1.9, dorsal base 1.9 to 2.3, both in head; brood pouch extends over first 12 or 13 tail rings, protecting plates absent, folds fairly wide, eggs one layer deep, arranged in 3 to 6 rows across pouch.

Head and body ridges typical of *Corythoichthys*. Snout with slight median ridge beginning at about its center and extending posteriorly to interorbital area; anterior supraorbital ridge absent; posterior supraorbital ridge extends posteriorly ½ to ¾ diameter of eye; median head crest much elevated, divided into three distinct frontal, prenuchal, and nuchal ridges; supraopercular ridges absent; opercular ridge extends completely across opercle; pectoral cover plate ridges absent; superior trunk and superior tail ridges with a slight indentation between individual rings, but lateral and inferior ridges without marked indentations.

Color in alcohol.—The most striking coloration is the metameric arrangement of the irregular ocelli covering the trunk and especially the tail, except the ventral surfaces; usually several ocelli occur between each ring, one near the inferior trunk and inferior tail ridges, one near the superior trunk and superior tail ridges, another at the middle of the middorsal surface of each ring, two rows of ocelli along both sides of the trunk, and a single row along the side of the tail.

Near the head irregular ocelli elongate to form nearly parallel paired lines. They are not in the form of reticulations and do not anastomose as in *Corythoichthys intestinalis*. One pair of lines extends from beneath the eye backward to a patch of color on the underside of the first three or four trunk rings. A set of paired lines reaches from the lower posterior portion of the eye to the inferior trunk ridge, where they become ocellar in form. A set of parallel lines extends from the upper posterior border of the eye over the upper part of the opercle, downward to become the ocellar series on the area between the lateral and ventral trunk ridges. Another set of parallel lines extends from near the dorsal margin of the eye posteriorly over the top of the opercle and becomes the longitudinal ocellar series on the trunk between the lateral and superior trunk ridges. A set of parallel lines extends from the extreme top of the eye to the superior ridges, becoming ocelli on the trunk and abdomen. Paired lines in the interorbital area give rise posteriorly to the ocelli in the center of the dorsal surface of each trunk and tail ring. A few ocelli may appear on the snout in four or five vertical series. Ocelli cover the brood pouch folds.

The only pigmentation that appears on the ventral surface of the trunk or tail is that occurring on the undersurface of the first three

or four trunk rings. This is usually very distinct on both sexes, and is blackest from the second to the fourth rings. On one of the types the black ventral area was broken into three patches by lighter areas between the rings.

Named *ocellatus* in reference to the ocellate spots.

CORYTHOICHTHYS SCHULTZI, new species

FIGURE 42

Holotype.—U.S.N.M. No. 140233, Bikini Atoll, Arji Island, lagoon, depth 40 feet, 100 yards off shore, August 7, 1946, S–46–308, Brock and Herald, 1 male, 122 mm.

Paratypes.—U.S.N.M. No. 140234, 1 male 114.5 mm. and 3 females 85, 91, and 94 mm., with same data as holotype; U.S.N.M. No. 140241, Rongelap lagoon, ½ mile off Rongelap Island, surface light at night, July 22–25, 1946, S–46–259, Herald, 1 female 81 mm.; U.S.N.M. No. 140240, Rongelap Atoll, Kieschiechi Island, north end, lagoon, depth 20 feet, July 24, 1946, S–46–285, Brock and Herald, 1 female 111 mm.; uncataloged, Bikini Atoll, lagoon, light at night, July 15, 1947, S–46–402 Myers, Schultz, and O. Smith, 1 female 88.2 mm.

Description.—Certain counts and measurements are recorded in table 23. Dorsal rays 28 or 29; pectoral 14 to 16, usually 16; anal 3; caudal 10; dorsal fin covers first 5 to 5½ tail rings (in the 91-mm. female paratype dorsal started ½ ring behind anus); trunk rings 16; tail rings 35 to 38; head 6.03 to 7.05 in standard length; snout 1.59 to 1.77, dorsal 1.84 to 2.24, both in head; brood pouch begins on second ring behind anus, extends over 12 or 13 rings, folds extremely short, covering only outermost egg sockets, protecting plates absent, egg sockets begin on second ring behind anus and extend over 10 or 11 rings, eggs arranged in 3 to 5 rows across pouch, each row approximately 22 eggs long.

Head and body ridges moderately accentuated, with minute serrations visible only under fairly high magnification; median snout ridge begins at middle of snout, extends posteriorly to interorbital area; two small nasal ridges extend from nostrils to interorbital area; anterior supraorbital ridges entirely absent; posterior supraorbital ridges quite distinct but short, extend posteriorly only about as far as a vertical line through the beginning of the opercular ridge, which is complete over the entire length of the opercle; frontal, prenuchal, and nuchal crests the most developed body ridges, nuchal quite long, extends posteriorly to beyond base of pectoral; supraopercular ridge present in posterior position, small median ridge on pectoral cover plate; all other head ridges absent; trunk and tail ridges separated at juncture of each ring by an identation with its apex directed anteriorly, so that posterior

FIGURE 42.—Holotype of *Corythoichthys schultzi*, new species (U.S.N.M. No. 140233), from Bikini Atoll. (Drawing by Aime M. Awl.)

edge of each ring gives appearance of being equipped with a small spine; lateral ridge system typical of the genus *Corythoichthys*, lateral trunk ridge discontinuous with the lateral tail ridge, inferior trunk and inferior tail ridges continuous, superior trunk and superior tail ridges discontinuous; scutella quite small, equal in width to approximately ¼ to ⅕ widest trunk rings; fins of moderate length; cirri absent on all specimens examined.

Color in alcohol.—Pigment spots usually on side of snout; in some specimens, especially males, these coalesce into a blackish bar, just before eye, that may extend backward through eye and continue from posterior edge of orbit as a ventrally deflected band passing over opercle to initial point of inferior trunk ridge; two other more or less distinct bands on head, one, which may have an unpigmented center so that it appears as paired lines, extends from supraorbital area to upper part of pectoral cover plate; the other extends from suborbital area ventrally toward ventral surface of pectoral ring, where it usually unites with its fellow from the opposite side of the head; underside of pectoral ring may have some light pigment, as may underside of second and third trunk rings (in one specimen pigment on second and third rings appears as round dots about one-half width of ring in diameter); coloration of trunk and tail appears to be dominantly that of a series of wide diffuse dark rings about 6 or 7 on trunk and 16 to 18 on tail. The ventral surfaces of trunk and tail lack pigmentation behind first three trunk rings. The brood-pouch folds are covered with a number of elongate ocelli.

Remarks.—The ocelli on the brood pouch of this species are similar to those of *Corythoichthys ocellatus*. The resemblance is so marked that I am led to suspect that the two species are northern and southern representatives of a more widely distributed common ancestral form.

Named *schultzi* in honor of Dr. Leonard P. Schultz, curator of fishes, U. S. National Museum.

CORYTHOICHTHYS FLAVOFASCIATUS CONSPICILLATUS (Jenyns)

FIGURE 43

Syngnathus conspicillatus JENYNS, The zoology of the voyage of H.M.S. *Beagle*, Fish, p. 147, pl. 27, fig. 4, 1842 (type locality, Tahiti; holotype in British Museum No. 1917.7.14.27).

Corythroichthys sealei JORDAN and STARKS, *in* Jordan and Seale, Bull. U. S. Bur. Fisheries, vol. 25, 1905, p. 213, 1906 (type locality, Apia, Samoa; 2 types, U.S.N.M. No. 51722).

Corythoichthys serrulifer FOWLER, Acad. Nat. Sci. Philadelphia Monogr. 2, p. 136, 1938 (type locality, Papeete).

SPECIMENS STUDIED

Bikini Atoll: 3 stations, 4 specimens, 57 to 79 mm.
Rongerik Atoll: 1 station, 2 specimens, 93 and 99 mm.

Rongelap Atoll: 1 station, 4 specimens, 81 to 96 mm.
Guam: 1 lot, 2 specimens, 75 and 76 mm.
In addition, specimens examined include 1 from the Phoenix Islands and 34 from the Society Islands.

Description.—Certain counts and measurements are recorded in table 23. Dorsal rays 28 to 35, usually 31 to 33; pectoral 13 to 15, usually 14 or 15; anal 3; caudal 10; dorsal fin covers first 6 or 7 tail rings, usually 6½, sometimes also last trunk ring; trunk rings 15 to 17, usually 16; tail rings 36 to 40, usually 38 or 39; head 8.7 to 10.0 in standard length; snout 2.15 to 2.4, dorsal base 0.80 to 1.05, both in head; brood pouch extends over 13 to 16 tail rings, often beginning on second.

Color in alcohol.—Males with brilliant cobalt blue area about anus, turning black usually after 30 to 50 years in preservative. The anal spots of *Corythoichthys f. conspicillatus* serve to demonstrate its close relationship to *C. intestinalis*. The males of both species have three spots, one that surrounds the anus and the other two posterolaterally of the anus, one on each side. In both species these posterolateral

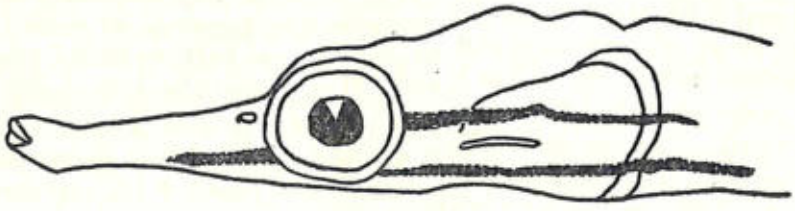

FIGURE 43.—*Corythoichthys flavofasciatus conspicillatus* (Jenyns). (Drawing by Olivia Herald.)

spots are bright yellow in life, but fade rapidly after death. In *C. intestinalis* the color about the anus is yellow, but in *C. f. conspicillatus* this perianal region is bright cobalt blue. This blue is one of the few pigments other than black or brown known to remain for any length of time in fishes preserved in alcohol. The females of *C. intestinalis* lack the perianal spot, but have the two posterolateral spots. It is not known whether the females of *C. f. conspicillatus* have the two posterolateral yellow spots.

Remarks.—In the areas where both *C. flavofasciatus* and *C. intestinalis* occur, it is possible that they may be confused. However, the arrangement of the lines on the head is a ready means of distinguishing the two species. Figures 43 and 44 demonstrate the conspicuous paired opercular lines of *flavofasciatus* as compared with the numerous lines of *intestinalis*.

Since our 57-mm. specimen of this species resembles closely Fowler's illustration of *conspicillatus*, and in addition counts and measurements are the same, I refer *serrulifer* to the synonymy of *conspicillatus*.

The largest known specimen, 120 mm. total length, was reported by Duncker. The smallest male with eggs in its pouch is 78 mm.

Most noteworthy is the break in distribution between the two subspecies of *Corythoichthys flavofasciatus*, with *C. f. flavofasciatus* no closer to *C. f. conspicillatus* than 6,000 miles away in the Red Sea. If the species had been represented in the intermediate region, it should have appeared among some of the collections examined.

CORYTHOICHTHYS NIGRIPECTUS, new species

FIGURE 41, *b*

Holotype.—U.S.N.M. No. 140230, Bikini Atoll, Arji Island, 100 yards offshore, lagoon, depth 25 to 40 feet, August 7, 1946, S–46–308, Brock and Herald, 1 male 87 mm., with eggs in its pouch.

Paratypes.—U.S.N.M. No. 140231, with same data as holotype, 6 specimens, 4 males 89, 95.5, 86, and 83.5 mm. and 2 females 75 and 86 mm.

Description.—Certain counts and measurements are recorded in table 23. Dorsal rays 28 to 30; pectoral 13 to 16; anal 3; caudal 10; dorsal covers first 5⅓ or 6 tail rings (beginning either at front edge or center of first ring); trunk rings 16; tail rings 38 or 39 (holotype has only 35 rings, but the 8 caudal fin rays indicate regeneration); head 8.7 to 9.4 in standard length; snout 2.0 to 2.11, dorsal base 1.2 to 1.4, both in head; brood pouch of holotype covering 13 rings, with eggs to end of tenth ring (95.5 mm. male has immature pouch, covering 11 rings and with only 3 eggs in it), protecting plates absent, closure by brood-pouch folds much greater in holotype than in any other Pacific member of *Corythoichthys* (folds lack only ¼ mm. of closing at anterior and posterior ends of pouch and 1¾ mm. in center), eggs arranged one layer in depth with eyes of embryos turned toward dorsal section of male, as is characteristic of genus.

Slight, smooth ridge on posterior half of snout, anterior supraorbital ridge absent, posterior supraorbital ridge extends caudally only a very short distance, three head ridges (prefrontal, frontal, and nuchal), distinct membranous connections between the sections very flexible, so that head can be bent downward at a marked angle; opercular ridge complete, a small supraopercular ridge present, pectoral cover plate without definite ridges; superior trunk and superior tail ridges slightly serrated (under microscopic examination) with marked indentations between each ring but the lateral and ventral ridges not accentuated thus; lateral trunk ridge subcontinuous in anal area, with lateral tail ridge.

Color in alcohol.—Background color very light tan; only outstanding color characteristic a blackish pigmented area on underside of the

first 3 or 4 trunk rings; in holotype this ends laterally in an abrupt but irregular line just dorsal and parallel to the ventral trunk ridge; in two paratypes it is in form of a narrow V with its open part directed caudally; in another specimen, a paratype, it is a series of three indistinct circular blotches, one laterally on each side of ventral surface of second, third, and fourth trunk ring; in still another, it is a series of very indistinct diffuse darkish bars around body, 5 on trunk and 4 or more on tail; in one paratype this area absent.

Remarks.—Normally it is considered poor policy to designate a specimen with a regenerated tail as a holotype. However, the magnificent clutch of eggs and the development of the brood pouch in U.S.N.M. No. 140230 and the lack of such in the other members of the type series seemed in this case to constitute sufficient reason for the selection.

Named *nigripectus* in reference to the blackish pigmentation appearing on the ventral surface of the anterior trunk rings.

CORYTHOICHTHYS INTESTINALIS WAITEI (Jordan and Seale)

?Syngnathus haematopterus Bleeker, Nat. Tijdschr. Nederl.-Indië, vol. 2, p. 151, 1851 (type locality, Banda).

?Ichthyocampus papuensis Sauvage, Bull. Soc. Philom., ser. 7, vol. 3, p. 228, 1880 (type locality, Dorey, New Guinea).

Corythroichthys waitei Jordan and Seale, Bull. Bur. Fish., vol. 25, 1905, p. 212, 1906 (type locality, Samoa; types, U.S.N.M. No. 51723).

SPECIMENS EXAMINED

Marshall Islands: Jaluit Atoll, 2 lots, 2 specimens, 129 and 140 mm.
Saipan: 1 lot, 2 specimens, 125 and 156 mm.
Guam: 1 lot, 1 specimen, 47 mm.
In addition the following specimens were studied: 8 from Samoa, 1 from Pelew Island, 23 from the Caroline Islands, 25 from the Solomon Islands, 3 from the New Hebrides Islands, 58 from New Caledonia at Noumea, and 4 from Suva, Fiji Islands.

Description.—Certain counts and measurements are recorded in table 23. Dorsal rays 27 to 31, usually 28 to 30; pectoral 14 to 17, usually 15 or 16; anal 3 or 4; caudal 10; trunk rings 16 or 17, usually 16; tail rings 34 to 36; dorsal fin covers 0 to ½ trunk rings and 5⅓ to 6 tail rings; head 7.1 to 9.7 in standard length; snout 1.98 to 2.28, dorsal base 1.05 to 1.40, both in head; brood pouch covers 13 to 18 rings, eggs arranged in rows one layer deep, up to 12 rows wide, and up to 40 rows long, folds cover only outer first or second rows on each side, eggs up to ¾ mm. in diameter, first eggs of pouch usually on second tail ring.

Dorsal ridges of head and body sharply accentuated, lateral and inferior ridges less distinct; median snout ridge small, beginning at

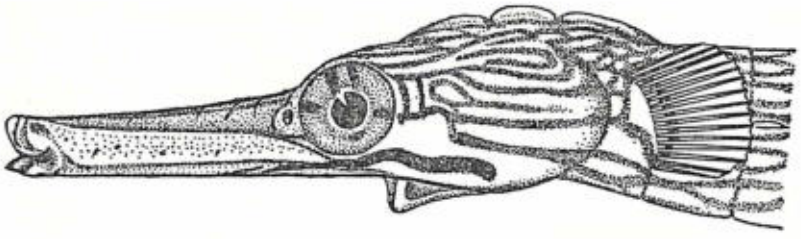

FIGURE 44.—*Corythoichthys intestinalis intestinalis* (Ramsey). (Drawing by Pablo Bravo.)

middle of snout and extending posteriorly to interorbital area; two small nasal ridges extend from nostrils to interorbital area; anterior supraorbital ridges entirely lacking; posterior supraorbital crest well defined, extends posteriorly to a vertical passing through first one-fourth of opercle; a single supraopercular ridge present; opercular ridge extends from three-fourths to full length of opercle; frontal, prenuchal, and nuchal crests raised and conspicuously evident; pectoral cover-plate ridges absent; superior ridges of trunk and of tail concave between individual rings, giving these surfaces a scalloped appearance.

Color in alcohol.—Most obvious marking consists of blackish pigment bars, 2 to 4 rings in width and 4 to 6 on trunk, 7 to 11 on tail, composed of small lines forming a reticulated chainlike pattern, these most apparent on lateral surfaces, less apparent on dorsal surface, usually absent on ventral surface.

Color when alive.—No observations are available on the color of *waitei* in life.

Remarks.—The subspecies *waitei* has been found in the central Pacific from the Samoan and Fiji Islands northwest through the Caroline and Marianas Islands. It has been taken at Jaluit in the southern Marshall Islands but not in the northern Marshall Islands. It occurs in the New Hebrides and New Caledonia, and from Mr. Whitley's unpublished data (table 24) occurs in southern New Guinea (Port Moresby, 3 specimens), Queensland (Port Douglass, 3 specimens), and along the Great Barrier Reef (Maori Reef, 1 specimen).

Duncker and Mohr (Zool. Mus. Hamburg Mitteil., vol. 41, p. 108, 1925) reported on 179 specimens from New Britain and New Ireland in the Bismarck Archipelago and from Fredrich Wilhelm Harbor in New Guinea; 109 of these had 16 or fewer trunk rings, 70 had 17 or more trunk rings. The majority of the 109 are probably *waitei* whereas the 70 are *intestinalis* (see table 24 and figure 44).

The largest specimen known is a male of 156 mm., whereas the smallest sexually mature male is 87 mm.

TABLE 24.—*The number of trunk rings recorded for the subspecies of* Corythoichthys intestinalis

Subspecies and localities	Number of trunk rings				Authority who recorded the counts [1]
	15	16	17	18	
i. intestinalis:					
Duke of York Island	------	4	40	------	Whitley.
Solomons, Bougainville Island	------	2	17	------	Whitley.
Solomons, Guadalcanal	------	------	8	------	Whitley.
New Hebrides	------	2	17	1	Whitley.
Australia; Queensland, Cairns reef	------	------	2	------	Whitley.
i. intestinalis mixed with *waitei:* Bismarck Archipelago and New Guinea.	4	105	66	4	Duncker and Mohr (1925).
i. waitei: New Guinea, Port Moresby	------	3	------	------	Whitley.
i. waitei?:					
Australia, Queensland, Batt reef, Port Douglas	------	2	1	------	Whitley.
Australia, Queensland, Maori reef, Great Barrier reef	------	1	------	------	Whitley.

[1] Counts by Whitley kindly supplied in a letter.

Genus SYNGNATHUS Linnaeus

Syngnathus LINNAEUS, Systema naturae, ed. 10, p. 336, 1758. (Genotype, *S. acus* Linnaeus.)

SYNGNATHUS MAXWEBERI Whitley

Syngnathus punctatus WEBER, *Siboga*-Expeditie, vol. 57, p. 113, fig. 39, 1913 (type locality, Sumbawa, 36 meters, on sand and coral bottom).—WEBER and DE BEAUFORT, The fishes of the Indo-Australian Archipelago, vol. 4, p. 86, fig. 36, 1922.

Syngnathus maxweberi WHITLEY, Rec. Australian Mus., vol. 29, p. 66, 1933 (new name for *S. punctatus* Weber, preoccupied by *S. punctatus* Rafinesque, 1810).

SPECIMEN STUDIED

U.S.N.M. No. 140242, Bikini lagoon, eastern end, coral heads at depths of 20 to 25 feet, March 26, 1946, S–46–42, Brock and Schultz, female, 73 mm. in standard length.

Description.—Dorsal rays 25; pectoral 16–16; anal 3; caudal 10; dorsal fin covers 1 trunk ring and 5 tail rings; trunk rings 15; tail rings 32; head 10.7 mm.; snout 6.0 mm.; dorsal fin base 7.7 mm.; head 6.82 in standard length; snout 1.78, dorsal base 1.36, both in head; otherwise quite similar to the type description of *S. punctatus* Weber.

Color in alcohol.—Over-all color light brown with only two outstanding blackish markings, the first a pair of sharply defined small rhomboids beneath cover plate of each pectoral fin base, and the second a series of narrow pigmented bars, located on fourth, eighth, and twelfth trunk rings and on second, seventh, and eleventh tail rings, these extending from dorsal surface of ring to part way down side.

Remarks.—The specimen from Bikini, the second one known, was taken, as was the holotype, in waters too deep for ordinary reef collecting; this suggests a habitat below the intertidal zone.

Order PERCOMORPHIDA

Suborder SPHYRAENINA

Family SPHYRAENIDAE: Barracudas

By LEONARD P. SCHULTZ

No revision of the fishes of this family was found in the literature, and in order to identify the barracudas from the northern Marshall Islands and Guam it was necessary to make up a key to the species of *Sphyraena*. Since specimens of many of the forms described were not available, I am not certain that the tentative key will work for the barracudas of the world. It should be used with caution. The length of the head has been measured from the tip of the snout to the posterior fleshy edge of the operculum, and the diameter of the eye between the edges of the adiposelike lid.

Genus SPHYRAENA Walbaum

Sphyraena WALBAUM, Petri Artedi sueci genera piscium: Ichthyologiae, pp. 94, 584, 1792.—BLOCH and SCHNEIDER, Systema ichthyologiae, p. 109, 1801. (Genotype, *Esox sphyraena* Linnaeus.)

Agrioposphyraena FOWLER, Proc. Acad. Nat. Sci. Philadelphia, vol. 55, p. 749, 1903. (Genotype, *Esox barracuda* Walbaum.)

Australuzza WHITLEY, Australian Zool., vol. 11, No. 2, p. 136, 1947. (Genotype, *Sphyraena novaehollandiae* Günther.)

In the following key we have not been able to place *S. dentatus* Saville-Kent, 1893; *S. branneri* Ribeiro, 1915; *S. pinguis* Günther, 1874; and *S. putnamiae* Jordan and Seale, 1905.

KEY TO THE SPECIES OF SPHYRAENA, TOGETHER WITH PROBABLE SYNONYMS

1*a*. Posterior lower margin of preopercle rounded, the lower angle not produced.

2*a*. Pores in lateral line from dorsal edge of gill opening to base of caudal fin 76 to 85; maxillary reaches to between vertical lines through rear nostril (young) to posterior edge of pupil (large adults); two flat opercular spines; no elongate gill raker on first gill arch; teeth on dentary vertical; a vertical line through first dorsal origin passes near tips of appressed pectorals and behind or through rear of base of pelvics; pelvic insertion under a point one-half to two-thirds length of pectoral from its base; distance between vertical lines through insertions of paired fins 3.5 to 5.0 in length of head; central areas of dorsals, anal, pelvic, and sometimes caudal fins dusky; first rays of depressed soft dorsal and anal fins reaching past tip of last rays in young, equal in halfgrown, and shorter than last ray in large adults.

Sphyraena barracuda (Walbaum)

2*b*. Pores in lateral line more than 100.

3*a*. Middle to posterior teeth on dentary notably directed posteriorly or slanting posteriorly, anterior edge notably longer than posterior edge; vertical line through first dorsal origin passes through or a little behind base of pelvics; last ray of soft dorsal and of anal elongate, extending notably behind first rays when fins are depressed; no elongate gill raker on first gill arch.

4*a*. (See also 4*b* and 4*c*.) Vertical line through first dorsal origin passes a little behind or through tips of pectorals and notably behind base of pelvics; pelvics inserted under a point from two-thirds to three-fourths length of pectoral from its base.

5*a*. Lower half of first gill arch with small but distinctly projecting setae or small spiny points, these contrasting sharply with the rough condition of upper half of the arch; pores in lateral line 110 to 124; opercular margin with only lower spine pointed; eye 1.5 to 2.2 in postorbital length of head; last soft ray of both dorsal and of anal fins contained fewer than 1½ times in base of that fin; dark blotch in axil of pectoral; tip of lower jaw with prominent and projecting fleshy tip.

Sphyraena forsteri Cuvier and Valenciennes

5*b*. Lower half of first gill arch without projecting spinules, rough to touch like upper half of arch; tip of lower jaw a little enlarged, without free fleshy tip.

6*a*. Pores in lateral line about 122 to 130; opercular margin with two spiny points, the upper one rather broad, however; last soft ray of both dorsal and anal fins contained 2 times in base of that fin; eye 1.8 (young) to 5.7 (adults) in postorbital length of head---------- Sphyraena jello [45] Cuvier and Valenciennes

6*b*. Pores in lateral line 110 to 122; only lower opercular spine pointed; eye 2.2 to 2.3 in postorbital length of head; no black blotch in axil of pectoral and no bars on sides.

Sphyraena guachancho [46] Cuvier and Valenciennes

4*b*. Vertical line through first dorsal origin passes notably in front of tips of pectorals and through rear of base of pelvics or behind it.

7*a*. Pores in lateral line about 128; no elongate gill raker; opercle with one weak spine-------- Sphyraena altipinnis [47] Ogilby

7*b*. Pores in lateral line 108 to 122; interorbital space convex or flattish; dark bars on sides.

Sphyraena ensis [48] Jordan and Gilbert

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[45] *Sphyraena jello* Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 3, p. 349, 1829 (on Russell, pl. 174, from Vizagapatam).

[46] *Sphyraena guachancho* Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 3, p. 342, 1829 (Cuba).

Probable synonym: *S. guntheri* Haly, Ann. Mag. Nat. Hist., ser. 4, vol. 15, p. 270, 1875 (Colón, Panama).

[47] *Sphyraena altipinnis* Ogilby, Proc. Roy. Soc. Queensland, vol. 23, p. 8, 1910 (Aru Islands, northern Australia).

[48] *Sphyraena ensis* Jordan and Gilbert, Bull. U. S. Fish. Comm., vol. 2, p. 106, 1882 (Mazatlán, Mexico).

4*c*. Vertical line through dorsal origin passes a little in front of tips of pectorals and in front of pelvic insertion; pores in lateral line about 120---------- Sphyraena acutipinnis [49] Day

3*b*. Teeth on dentary directed vertically.

8*a*. All fins black; pores in lateral line 122 to 145; maxillary reaches to under front of eye to under pupil.

9*a*. Vertical line through first dorsal origin passes just behind tip of pectoral and behind base of pelvics (based on pl. 13, fig. 1, Temminck and Schlegel).

Sphyraena nigripinnis [50] Temminck and Schlegel

9*b*. Vertical line through first dorsal origin passes in front of tips of pectoral and just behind base of pelvics; last ray of anal white, sharply contrasting with black part of anal fin.

Sphyraena qenie Klünzinger

8*b*. At least pectoral and pelvic fins not black, others may be dusky; maxillary usually not reaching quite to eye.

10*a*. Vertical line through first dorsal origin passes in front of or through tips of pectorals and a little behind pelvic base; pores in lateral line about 105 (based on pl. 25, fig. 2, of Rüppell).

Sphyraena agam [51] Rüppell

10*b*. Vertical line through first dorsal origin passes notably behind tips of pectorals; pores in lateral line 110 to 170.

11*a*. Single elongate gill raker at angle of first gill arch; pores in lateral line about 125 to 135.

12*a*. Vertical line through first dorsal origin passes in front of pelvic insertion---------- Sphyraena waitii [52] Ogilby

12*b*. Vertical line through first dorsal origin passes through base of pelvics; sides usually with two yellowish or golden stripes when alive---------- Sphyraena helleri Jenkins

11*b*. No elongate gill raker at angle of first gill arch.

13*a*. Pores in lateral line 115 to 129; eye 1.6 to 2.0 in postorbital length of head; greatest depth 1.8 to 2.1 in distance between dorsal origins and 7 to 8½ in standard length.

Sphyraena picudilla [53] Poey

13*b*. Pores in lateral line 125 to 170.

14*a*. Vertical line through first dorsal origin passes through pelvic insertion, or in front of it; vertical scale rows above lateral line 142 (in one count); greatest depth of body about equal to postorbital length of head, and

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[49] *Sphyraena acutipinnis* Day, The fishes of India . . . , vol. 2, p. 342, pl. 79 fig. 1, 1878 (Sind, India).

Probable synonyms: *S. africana* Gilchrist and Thompson, 1909 (South Africa), and *S. natalensis* Von Bonde, 1923 (Natal coast).

[50] *Sphyraena nigripinnis* Temminck and Schlegel, Fauna Japonica, p. 34, pl. 13, fig. 1, 1843 (Japan).

[51] *Sphyraena agam* Rüppell, Neue Wirbelthiere . . . Abyssinien gehörig. Fische des rothen Meeres, p. 99, pl. 25, fig. 2, 1835 (Red Sea) (not *S. agam* Klünzinger, Die Fische des rothen Meeres, pt. 1, pp. 128–129, 1884 (Red Sea)).

Probable synonym: *S. affinis* Rüppell, 1835.

[52] *Sphyraena waitii* Ogilby, Ann. Queensland Mus., No. 9, pt. 1, p. 29, 1908 (Port Jackson district of New South Wales).

[53] *Sphyraena picudilla* Poey, Memorias sobre la historia natural de la isla de Cuba . . . vol. 2, p. 162, 1861 (Habana, Cuba).

7½ to 9 in standard length, and 2.1 to 2.5 in distance between dorsal origins; eye 2.2 (in young) to 2.7 (in half grown) in postorbital length of head.

Sphyraena sphyraena [54] (Linnaeus)

14*b*. Vertical line through first dorsal origin passes through base of pelvics.

15*a*. Vertical scale rows above lateral line, before spiny dorsal, nearly twice as numerous as scales in lateral line, the latter numbering about 165 to 170; greatest depth about 9 in standard length.

Sphyraena argentea [55] Girard

15*b*. Vertical scale rows approximately equal in number to those in lateral line, throughout its length.

16*a*. Pores in lateral line 145 to 150.

Sphyraena idiastes [56] Heller and Snodgrass

16*b*. Pores in lateral line 125 to 138.

17*a*. Distance between vertical lines through pectoral insertion and first dorsal origin about 2.1 to 2.2 in head; eye 2.5 in postorbital length of head; scales about 125 to 135.

Sphyraena borealis [57] DeKay

17*b*. Distance between vertical lines through pectoral insertion and first dorsal origin about 1.4 to 1.9 in head; eye 2.2 in postorbital length of head, scales about 135 to 138.

Sphyraena novaehollandiae [58] Günther

1*b*. The posterior margin at lower angle of preoperculum is produced, forming a somewhat projecting membranous lobe; posterior margin of opercle membranous, without spines.

18*a*. Pores in lateral line 110 to 130; a vertical line through first dorsal origin passes through pelvic insertion, or just in front of it and a little behind tips of pectorals; a single elongate gill raker at angle of first gill arch, none in front of it____ Sphyraena japonica [59] Cuvier and Valenciennes

18*b*. Pores in lateral line 76 to 90; usually two bronze or golden streaks on sides, one along lateral line and another below it; two elongate gill rakers on first gill arch, one at angle and one (rarely two) a little in front of it, on lower limb of arch.

19*a*. Line through first dorsal origin passes a little behind tips of pectorals; distance between vertical lines through insertions of paired fins 3.6

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[54] *Esox sphyraena* Linnaeus, Systema naturae, ed. 10, p. 313, 1758 (Mediterranean Sea).

Probable synonyms: *Esox spet* Haüy, 1787; *S. vulgaris* Cuvier and Valenciennes, 1829 (Mediterranean); *S. viridensis* Cuvier and Valenciennes, 1829 (Cape Verde Islands).

[55] *Sphyraena argentea* Girard, Proc. Acad. Nat. Sci. Philadelphia, vol. 7, p. 144, 1854 (San Diego, Calif.).

Synonym: *S. lucasana* Gill, 1863 (Cape San Lucas).

[56] *Sphyraena idiastes* Heller and Snodgrass, Proc. Washington Acad. Sci., vol. 5, p. 190, pl. 2, 1903 (Galápagos Islands).

[57] *Sphyraena borealis* DeKay, Zoology of New York, or the New York fauna, pt. 4, Fishes, p. 39, pl. 60, 1842 (New York).

[58] *Sphyraena novae-hollandiae* Günther, Catalogue of the fishes in the British Museum, vol. 2, p. 335, 1860 ("New Holland," Hobsons Bay, Port Phillip).

[59] *Sphyraena japonica* Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 3, p. 354, 1829 (Japan).

to 5.2, and between vertical lines through pectoral insertion and first dorsal origin 2.2 to 3.0, both in head; eye 1.8 (young) to 2.4 (half grown) in postorbital part of head.

Sphyraena chinensis [80] Lacepéde

19*b*. Line through first dorsal origin passes a little in front of or through tips of pectorals; distance between vertical lines through insertions of paired fins 6 or 7, and between vertical lines through pectoral insertions and first dorsal origin 3.6 to 3.9, both in head.

Sphyraena chrysotaenia [81] Klünzinger

SPHYRAENA BARRACUDA (Walbaum)

PLATE 23, A

Esox barracuda WALBAUM, Petri Artedi sueci genera piscium: Ichthyologiae, vol. 3, p. 94, 1792 (type locality, West Indies).

Sphyraena sphyraena var. *picuda* BLOCH and SCHNEIDER, Systema Ichthyologiae, p. 110, pl. 29, 1801 (type locality, southern America, West Indies).

Sphyraena becuna LACEPÈDE, Histoire naturelle des poissons, vol. 5, p. 325, pl. 9, fig. 3, 1803 (type locality, Martinique).

Sphyraena snodgrassi JENKINS, Bull. U. S. Fish Comm., vol. 22, 1902, p. 438, fig. 50, 1903 (type locality, Hawaiian Islands, holotype U.S.N.M. No. 49693).

Sphyraena akerstromi WHITLEY, Australian Zool., vol. 11, No. 2, pp. 131–133, pl. 11, fig. 1, 1947 (type locality, Lowendal Island, western Australia, female only, 1,445 mm.).

SPECIMENS STUDIED

Bikini Atoll: 1 station, 2 specimens, 765 and 820 mm. standard length.
Eniwetok Atoll: 1 station, 1 specimen, 1,240 mm.
Rota Island: 1 lot, 1 specimen, 535 mm.
Guam: 1 lot, 1 specimen, 208 mm.

Description.—Dorsal rays V–I,i,8; anal I,i,7; pectoral ii,11 or 12; pelvic I,5; branched caudal rays 8+7; pores in lateral line about 78 to 81; no elongate gill raker on first gill arch.

Body fusiform, greatest depth 5½ to 7; head 3.2 to 3.4; snout to first dorsal origin 2.3; distance between dorsal origins 3.6; all in the standard length. Snout 2.2; eye 6.0 to 9.0; least width of bony interorbital space 3.6 to 6.4; postorbital length of head 2.5 to 2.6; length of maxillaries 1.8 to 2.2; least depth of caudal peduncle 4.3 to 4.5; distance between vertical lines through insertions of paired fins 4.3 to 4.4; all in the length of the head. Eye in postorbital length of

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[80] *Sphyraena chinensis* Lacepède, Histoire naturelle des poissons, vol. 5, p. 324, pl. 10, fig. 2, 1803=*S. obtusata* Cuvier and Valenciennes, 1829 (Pondicherry).

Probable synonyms: *S. flavicauda* Rüppell, 1835 (Red Sea); *S. grandisquamis* Steindachner, 1866 (New South Wales); *S. lineata* Stead, 1908 (New South Wales); *S. strenua* De Vis, 1883 (Queensland); *S. commersonii* Cuvier and Valenciennes, 1829, on Lacepède, 1803, pl. 8, fig. 3; *S. brachygnathus* Bleeker, 1854 (Batavia); *S. langsar* Bleeker, 1854 (Batavia).

[81] *S. chrysotaenia* Klünzinger 1884, Die Fische des rothen Meeres, pt. 1, pp. 128–129 pl. 9, fig. 3, 1884 (Red Sea).

Synonym: *S. aureoflamma* Seale, 1909 (Philippines).

head 2.3 to 3.7. Distance between vertical lines through insertions of paired fins in postorbital length of head 1.6 to 1.8. Distance between vertical lines through pectoral insertion and first dorsal origin 1.5 to 2.0 in greatest depth.

Interorbital space slightly concave in young and flattish in large adults; maxillary reaches to front of eye in young, and to rear edge of pupil in adults; a vertical line through first dorsal origin passes near tips of pectorals and notably behind base of pelvics, the latter inserted under from half to two-thirds the way out pectoral fin from its base; teeth in lower jaw vertical; lower jaw projecting, but without an elongate fleshy tip.

Color in alcohol.—Bluish black to brownish above, paler to whitish ventrally; central area of soft dorsal, anal, and caudal fins dusky, with distal tips of dorsal and anal sometimes paler; adults usually with several black scales or patches of black scales irregularly placed on sides; under side of head white; sides above lateral line with about 20 or 21 dark bars or blotches.

Color when alive.—Soft dorsal, anal, and caudal purplish black; tips of dorsal and anal whitish; spiny dorsal dusky to pale brownish; upperpart of pectoral fin purplish black, lower rays white; dorsal blackish, pale ventrally.

Remarks.—Tentatively we are identifying this Indo-Pacific form with *S. barracuda* of the West Indian region. However, a very careful comparison is needed between the populations in the two oceans. This barracuda was taken by trolling in the lagoon, in the passes, and off the atoll reefs.

SPHYRAENA FORSTERI Cuvier and Valenciennes

Sphyraena forsteri CUVIER and VALENCIENNES, Histoire naturelle des poissons, vol. 3, p. 353, 1829 (type locality, Otaiti).

Sphyraena toxeuma FOWLER, Journ. Acad. Nat. Sci. Philadelphia, vol 12, p. 502, 1904 (type locality, Padang, Sumatra),

SPECIMENS STUDIED

Bikini Atoll: 5 stations, 16 specimens, 422 to 605 mm. standard length.

Description.—Dorsal rays V–I,i,8; anal II,i,7 or 8; pectoral ii,12 or 13; pelvic I,5; branched caudal fin rays 8+7; pores in lateral line 111 to 122; no elongate gill raker at angle of first gill arch.

Body fusiform, its greatest depth 7.0 to 7.2; head 3.0 to 3.4; snout to first dorsal origin 2.3 to 2.4; distance between dorsal origins 3.3 to 3.4; all in the standard length. Snout 2.1 to 2.2; eye 5.8 to 6.2; least width of bony interobital space 5.3 to 6.2; postorbital length of head 2.8 to 3.0; length of maxillaries 2.1 to 2.3; least depth of caudal peduncle 4.8 to 5.1; distance between vertical lines through insertions

of paired fins 3.3 to 3.4; all in length of head. Eye in postorbital length of head 2.0 to 2.1. Distance between vertical lines through insertions of paired fins in postorbital length of head 1.3 to 1.4. Distance between vertical lines through pectoral insertion and first dorsal origin 1.2 to 1.3 in greatest depth.

The middle area of interorbital space flat to a little concave; maxillary reaches to between nostrils but not quite to eye; a vertical line through first dorsal origin passes through tips or a little behind tips of pectoral, and notably behind pelvic base, pelvic fin inserted at a point posterior to pectoral base by from two-thirds to three-quarters the length of pectoral fin; teeth in lower jaw slanting posteriorly; projecting lower jaw with an elongate pointed fleshy tip; opercle with only the lower spine pointed; preopercle rounded; last ray of soft dorsal and of anal greatly elongate, so that first rays do not reach tips of last rays when dorsal fin is depressed.

Color in alcohol.—Back blackish, undersides whitish to silvery; axil of pectoral fin blackish on base of fin and on body; soft dorsal and anal blackish with tips of rays white; caudal dusky.

Ecology.—These voracious barracuda occur mostly along the ocean side of the reefs and in the passes, but some are caught in the lagoon.

Remarks.—The identification of species of barracuda by means of the old descriptions is a very uncertain procedure. This is true of *forsteri.* My understanding of this species is based on that of Bleeker and of Weber and de Beaufort (The Fishes of the Indo-Australian Archipelago, vol. 4, p. 223, 1922), as diagnosed in the key.

SPHYRAENA QENIE Klünzinger

Sphyraena qenie KLÜNZINGER, Synopsis der Fische des rothen Meeres, vol. 1, p. 823, 1870 (type locality, Red Sea)=*S. kenie* Klünzinger (new name), Die Fische des rothen Meeres, pt. 1, p. 129, pl. 9, fig. 2, 2a, 1884 (Red Sea).

SPECIMEN STUDIED

Bikini Atoll: Ruji Island, July 25, 1947, Univ. Washington, 1 specimen, 816 mm. standard length.

Description.—Dorsal rays V–I,i,8; anal II,i,7; pectoral ii,13–ii,13; pelvics I,5; no elongate gill raker on first gill arch; pores in lateral line to base of caudal fin 125.

Body elongate, greatest depth 7.1; head 3.6; snout to first dorsal origin 2.7; distance between dorsal origins 3.2; all in the standard length. Snout 2.2; eye 7.6; least width of bony interorbital space 4.2; postorbital length of head 2.4; length of maxillaries 2.1; least depth of caudal peduncle 4.2; distance between vertical lines through insertions of paired fins 4.1; all in the length of the head. Eye in postorbital length of head 3.1. Distance between vertical lines through insertions of paired fins in postorbital length of head 1.7. Distance be-

tween vertical lines through pectoral insertion and first dorsal origin 1.4 in greatest depth.

Interorbital space slightly concave, nearly flattish, maxillary reaches to a vertical line through front of eye; a vertical line through first dorsal origin passes in front of tips of pectorals and only a trifle behind base of pelvics; pelvic fin inserted under pectoral fin and posterior to its base by about two-thirds the length of pectoral fin; teeth in lower jaw vertical or nearly so; lower jaw projecting but without an elongate fleshy tip. No gill rakers, first gill arch rough only.

Color in alcohol.—Dorsally black, ventral side light brown; sides with about 22 or 23 vertical blackish bars that extend to lower sides, these dark bars about as wide as paler interspaces; both dorsal fins black; anal fin black except that last 2 rays are white, contrasting sharply with black part of fin; pectoral fins dusky to brownish on outer side, black on inner side; distal half of pelvics blackish, basal half light brownish; caudal fin blackish, especially the middle rays; oral membrane of mouth blackish, tongue brownish; peritoneum white.

Remarks—Table 25 gives a comparison between the figures of *S. nigripinnis* Temminck and Schlegel, *S. genie* Klünzinger, and the Bikini specimen. The chief difference is the larger size of the eye figured by Klünzinger for *genie* and slight differences in the position of the first dorsal in reference to pectoral and pelvic fins. The Bikini specimen has a black anal fin with the last two elongate rays white, sharply contrasting with the black, but Klünzinger's figure does not show this character. Without any specimen of *S. genie* from the Red Sea for comparison I hesitate to name this specimen as new.

TABLE 25.—*Comparison of two species of* Sphyraena *with black fins*

Characters	*nigripinnis*	*genie*	
	Temminck and Schlegel pl. 13, fig. 1	Klünzinger pl. 9, fig. 2	Bikini
In standard length:			
Greatest depth	7.4	7.6	7.1
Head length	4.5	3.7	3.6
Snout to first dorsal origin	2.9	2.7	2.7
Distance between dorsal origins	2.9	3.4	3.2
In length of head:			
Snout	2.7	2.2	2.2
Eye	9.5	5.7	7.6
Postorbital length of head	2.0	2.8	2.4
Snout tip to rear edge of maxillary	2.5	2.0	2.1
Least depth of caudal peduncle	4.5	4.0	4.2
Distance between vertical lines through insertions of paired fins	3.8	5.7	4.1
Eye in postorbital length of head	4.8	2.1	3.1
Distance between vertical lines through insertions of paired fins, in postorbital length of head	1.9	2.1	1.7
Distance between vertical lines through pectoral insertion and first dorsal origin into greatest depth	1.3	1.7	1.4

SPHYRAENA HELLERI Jenkins

Sphyraena helleri JENKINS, Bull. U. S. Bur. Fish., vol. 19 (1899), p. 387, fig. 1, 1901 (type locality, Honolulu).

SPECIMENS STUDIED

Eniwetok Atoll: Southwest Passage, ⅘ miles south of Rigili Island, light at night, May 25, 1946, S–46–184, Schultz and Cali, 3 specimens, 43 to 103 mm.

Rongerik Atoll: trolling, August 22, 1947, S–46–568, Marr. 2 specimens, 410 to 450 mm.

Description.—Dorsal rays V–I,i,8; anal II,i,7; pectoral ii,11 or 12; pelvic I,5; pores in lateral line about 130 to 132, scales from spiny dorsal base to lateral line 15, from lateral line to pelvic insertion 17; a single elongate gill raker at angle of first gill arch;

Body fusiform, greatest depth 8.5 to 9.0; head 2.9 to 3.2; snout to first dorsal origin 2.2; distance between dorsal origins 3.5 to 3.7; all in standard length. Snout 2.2 to 2.3; eye 5.0 to 5.8; least width of bony interorbital space 7.0 to 7.8; postorbital length of head 2.6 to 2.7; length of maxillaries 2.7 to 2.9; least depth of caudal penducle 6.2 to 6.5; distance between vertical lines through insertions of paired fins 2.3 to 2.9; all in length of head; eye in postorbital length of head 1.8 to 2.2. Distance between vertical lines through paired fins into postorbital length of head 0.8 to 1.0 (in young). Distance between vertical lines through pectoral insertion and first dorsal origin 0.7 to 0.8 in greatest depth.

Interorbital space convex at sides, and flattish medially; maxillary does not quite reach to nostrils; a vertical line through first dorsal origin passes far behind tip of pectorals and through rear of base of pelvics; the latter inserted notably behind pectoral fin tips; teeth in lower jaw vertical; tip of chin produced as an elongate fleshy lobe.

Color in alcohol.—Back blackish, below lateral line whitish or silvery, a trace of a dark streak along lateral line. The small specimens are somewhat barred on the back.

Color when alive.—Sides with two orange-yellow or golden streaks.

Ecology.—This species was taken on the leeward side of the atoll reefs, by trolling and with a light at night.

Remarks.—Although this species resembles *Sphyraena chrysotaenia* Klünzinger in coloration, it is different, as indicated in the key.

Family ATHERINIDAE: Silversides

By LEONARD P. SCHULTZ

Recently I revised the genera of Atherinidae (Schultz, Proc. U. S. Nat. Mus., vol. 98, pp. 1–48, figs. 1–9, pls. 1, 2, 1948), except those with elongate first dorsal fins or with flexible first dorsal spines. That

TABLE 26.—*Counts made on various genera and species of* Atherinidae

Genus and species	Number of fin rays																														
	Dorsal											Anal										Pectoral									
	IV	V	VI	VII	VIII	I, i, 6	I, i, 7	I, i, 8	I, i, 9	I, i, 10	I, i, 11	I, i, 7	I, i, 8	I, i, 9	I, i, 10	I, i, 11	I, i, 12	I, i, 13	I, i, 14	I, i, 15	I, i, 16	I, i, 17	I, i, 9	I, i, 10	I, i, 11	I, i, 12	I, i, 13	I, i, 14	I, i, 15	I, i, 16	I, i, 17	I, i, 18
Atherion:																															
elymus elymus		3							3											3				1	2						
elymus freyi	24	7					3	24	4								1	23	6					15	5						
elymus asper	4	2					5	1									4	2						6	2						
elymus aphrozoicus	8	7					3	10	2								3	10	2				4	4	1						
maccullochi [1]	X							X	X										X	X											
villosa [1]	X								X	X	X					X	X	X							X	X					
Stenatherina temminckii		1	8	1			1	8	1						10	1													12	2	
Hypoatherina:																															
panatela			3					3							2	1													4	2	
tsurugae			3	4				4	3						1	4	2												3	8	2
uisila		1	9	1			1	10							2	8	1											3	18	1	
lacunosa		2	1					3								3													5		
barnesi			14	4			2	25	3							1	20	11								4	7	7			
Allanetta:																															
bleekeri		1	6	5			1	9	1						1	6	4											5	4		
woodwardi		1	1						1	1						1	1										1	3			
ovalaua		5	20	14	3			35	3					30	10														9	3	
valenciennesi	1	19	1				1	6							1	6												3	1		
balabacensis	1	1	11				2	13	15	1						20	13											5	7	1	
regina		9	6	4				1	10				1	8	2													2	1	2	3	
crenolepis	4					3	10					2	11	1														1	5	4		
forskali			2	1				2	1							2	1												2	4		
Pranesus:																															
endrachtensis	3	16				2	17							2	12													3	5	1		
ogilbyi		3	11	1			9	6								5	6	3	1									2	10	6	1	
insularum insularum		12	3						7	8	2								4	8	5							13	7			
insularum whitei		3	2						5											3	1	1							4	6		
morrisi		2	1						3								1	2												4	2	
pinguis (=*vaigiensis* Quoy and Gaimard)		28	14	1			1	22	22							1	13	23	9	1								1	10	25	6		
lineatus [2]	2						2								2													1	1			

TABLE 26.—*Counts made on various genera and species of* Atherinidae—Continued

Genus and species	Number of scales																								
	Upper edge gill opening to midbase of caudal fin																		Median predorsal						
	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	14	15	16	17	18	19	20	21	22
Atherion:																											
elymus elymus													X								X						
elymus freyi												1	9	6							5	5	4				
elymus asper													3	3								3	3				
elymus aphrozoicus											1	6									1	6					
macullochi [1]																	X								X	X	X
villosa [1]														X								X					
Stenatherina temminckii																3	6							5	4	1	
Hypoatherina:																											
panatela											1	2									1	2					
tsurugae																1	5	1					1	3	1		
nisila														8	3								4	7			
lacunosa													2	1									1	2			
barnesi													5	5							1	1	2				
Allanetta:															1	2	5	3				1		3	5		
bleekeri												2									2						
woodwardi										2	2	10	10	2	1					2	15	5					
ovalaua												3		1								1	1	2			
valenciennesi							1	4	6	3	4	1									10	6	1				
balabacensis							2	4	2	2										4	6	1					
regina					6	5													1	3	7						
crenolepis											1	1	1								2	1					
forskali																											
Pranesus:					2	6	3														5	3					
endrachtensis											1	4	4	3								7	5				
ogilbyi															2	10	3							3	6	3	
insularum insularum																	5								2	3	
insularum whitei															3								1	2			
morrisi																											
pinguis (=*vaigiensis* Quoy and Gaimard)											2	6	16	8	3	1					5	7	14	7	1	1	
lineatus [2]	1	1																				2					

[1] Data recorded from the literature.

[2] Data recorded from types in British Museum through courtesy of Dr. N. B. Marshall.

study revealed a great confusion in regard to the species of silversides in the tropical Pacific. During the examination of the Crossroads collections, it was necessary to make counts (table 26) and measurements on material from the vast Indo-Pacific area. This work indicated a great variety of species and subspecies, some of which appear to be restricted to certain of the island groups, whereas others are widely distributed.

I believe that it is necessary to point out that Weber and de Beaufort's treatment of the Atherinidae in volume 4 of the "The Fishes of the Indo-Australian Archipelago" is inadequate because for the kinds of silversides represented by such names in that work as *Pranesus endrachtensis*, *Allanetta forskali*, and *P. duodecimalis*, five or six valid species undoubtedly exist in the area treated.

Since the branched caudal fin rays are 8+7 and the pelvic rays I,5 for all species in this family, these counts are omitted in the descriptions.

KEY TO GENERA OF ATHERINIDAE FROM THE NORTHERN MARSHALL ISLANDS

1*a*. Spinules in more or less parallel rows on head, especially under and in front of eye; premaxillary and dentary with shagreenlike denticles covering outer surfaces---------- Atherion Jordon and Starks (p. 292)

1*b*. No spinules on head.

2*a*. Ascending median premaxillary process long, slender, notably longer than diameter of pupil, equal to or almost equal to diameter of eye, reaching considerably into the interorbital space; side of premaxillary with first lateral process slender, its length notably greater than width of its base; rami of mandibles elevated posteriorly; premaxillary dentition not reflected as shagreen on outer face of that bone; anus a little behind tips of pelvic fins, and under first dorsal origin; a characteristic crescent-shaped blackish spot always present in front of orbit on level of pupil. Stenatherina Schultz (p. 297)

2*b*. Ascending median premaxillary process short, about equal to diameter of pupil or to ¾ eye diameter, or scarcely extending into the interorbital space; first lateral process, if present, with its base wider than its height; no crescent-shaped blackish spot in front of eye.

3*a*. Posteriorly the rami of mandibles are distinctly elevated at rear of toothed area.

4*a*. Posterior margin of anterior bony edge of preopercle truncate, without concavity, a short but distinct lateral process on premaxillary; anus between pelvics---------- Taeniomembras [a] Ogilby

4*b*. Posterior margin of anterior bony edge of prepercle with a concavity near its lower corner.

5*a*. Anus in front of, or opposite, tips of pelvic fins, usually in front of a vertical line through first dorsal origin. Allanetta Whitley (p. 298)

5*b*. Anus behind tips of pelvic fins and under base of spiny dorsal fin. Hypoatherina Schultz (p. 303)

3*b*. Rami of mandibles not elevated, anus in front of tips of pelvic fins; bases of dorsal, anal, and pectoral fins naked---- Pranesus Whitley (p. 306)

[a] This genus is found in Australia.

Genus ATHERION Jordan and Starks

Atherion JORDAN and STARKS, Proc. U. S. Nat. Mus., vol. 24, p. 203, 1901. (Genotype, *Atherion elymus* Jordan and Starks.)

KEY TO THE SPECIES AND SUBSPECIES OF ATHERION

1*a*. Scale rows from upper edge of gill opening to midbase of caudal fin 47; median predorsal scales 20 to 22 (Lord Howe Island).
Atherion maccullochi Jordan and Hubbs

1*b*. Scale rows from upper edge of gill opening to midbase of caudal fin 41 to 44; median predorsal scales 16 to 18 (see table 26 for counts).

2*a*. Second dorsal with I,i,9 to 11 rays; anal I,i,11 to 13; pectoral I,i,11 or 12; scale rows 44 (New Guinea and New Pommern Island).
Atherion villosa (Duncker and Mohr)

2*b*. Second dorsal rays I,i,7 to 9; pectoral rays I,i,9 to 11; scale rows 40 to 44.

3*a*. Second dorsal rays I,i,9; anal I,i,15; pectoral I,i,10 or 11; scale rows usually 43 (Japan)---- Atherion elymus elymus Jordan and Starks

3*b*. Second dorsal rays I,i,7 to 9; anal I,i,12 to 14; pectoral I,i,10 or 11; scale rows usually 43 or 44 (Marianas Islands).
Atherion elymus freyi, new subspecies

3*c*. Second dorsal rays I,i,7 or 8; anal I,i,12 or 13; pectoral rays I,i,10 or 11; scale rows 43 or 44 (northern Marshall Islands).
Atherion elymus asper, new subspecies

3*d*. Second dorsal rays I,i,7 to 9; anal I,i,12 to 14; pectoral rays I,i,9 or 10, rarely 11; scale rows 41 or 42 (Philippines).
Atherion elymus aphrozoicus, new subspecies

ATHERION ELYMUS FREYI, new subspecies

FIGURE 45

Holotype.—U.S.N.M. No. 134083, 29.3 mm. in standard length, Marianas Islands, Guam, Oca Point, November 24, 1945, D. G. Frey.

Paratypes.—U.S.N.M. No. 124100, Guam, Amantes Point, June 11, 1945, L. P. McElroy, 8 specimens, 20 to 29 mm.; U.S.N.M. No. 124250, Guam, Tumon Bay, November 10, 1945, J. L. Gressitt, 2 specimens, 24 mm.; U.S.N.M. No. 124263, Guam, Point Oca, June 20, 1945, J. L. Gressitt, 1 specimen, 32 mm.; U.S.N.M. No. 124128, Guam, Ylig Point, June 24, 1945, D. H. Johnson, 13 specimens, 18 to 31 mm.; U.S.N.M. No. 124198, Guam, Ylig Point, November 26, 1945, L. L. Gressitt, 1 specimen, 28 mm.; U.S.N.M. No. 123954, Guam, Oca Point, June 26, 1945, McElroy and Markley, 3 specimens, 32 to 36 mm.; U.S.N.M. No. 139866, November 24, 1945, D. G. Frey, 24 specimens, 17 to 30 mm., taken with the holotype; U.S.N.M. No. 139864, Guam, November 25, 1945, D. G. Frey, 1 specimen, 23 mm.; U.S.N.M. No. 139865, Guam, November 25, 1945, D. G. Frey, 57 specimens, 22 to 34 mm.; U.S.N.M. No. 123864, Marianas Islands, Saipan, June 1945, T. D. White and F. B. Shroyer, 4 specimens, 32 to 36 mm.

Description.—Counts made on the holotype are: Dorsal rays IV–I,i,8; anal I,i,13; pectoral i,10–i,10; scale rows from upper edge

of gill opening to midbase of caudal fin 44, from first dorsal origin to midventral line 12; median predorsal scales 18; scales in zigzag row around least depth of caudal peduncle 12. Additional counts are recorded in table 26.

Precision measurements were made on the holotype and one paratype and these data are recorded in thousandths of the standard length in table 27.

Depth 6.8 to 7.0; head 3.8 to 4.1; snout to first dorsal origin 1.8 to 1.9, to center of anus 1.7 to 1.8, to anal origin 1.6; all in standard length. Snout 3.8 to 4.2; eye 2.8 to 3.0; tip of snout to rear of maxillary 3.7 to 4.0; least depth of caudal peduncle 3.6 to 3.7; postorbital

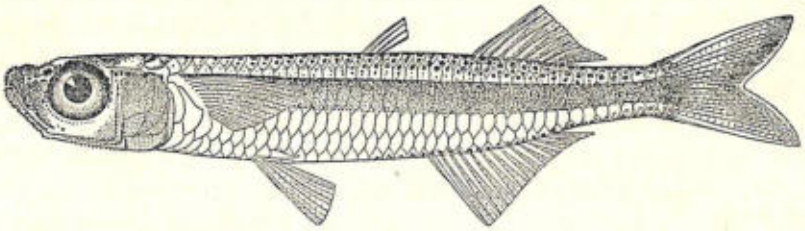

FIGURE 45.—Holotype of *Atherion elymus freyi*, new subspecies (U.S.N.M. No. 134083) from Guam. (Drawing by Aime M. Awl.)

length of head 2.3 to 2.4; distance between dorsal origins 1.5; length of longest ray of pectoral fin 1.4 to 1.5; interorbital space 3.0 to 3.1; all in length of head. Least depth of caudal peduncle in its length 3.0.

Premaxillary with front margin concave; teeth minute, premaxillary, dentary, snout, and head generally covered by rows of denticles that appear similar to shagreen; vomer with a few teeth, palatines toothless; air bladder and body cavity ending bluntly in front of anal origin, and not extending into the haemal arches; anterior bony edge of preopercle truncate, without a concavity, posterior bony edge of preopercle with a concave notch; gill rakers moderately long and slender, a little shorter than diameter of pupil; maxillary short, not reaching to a vertical line through front of orbit, upper and lower jaws restricted at sides by a membrane between them and attached far forward near front of dentary; scales on opercle and in front of base of pectoral greatly enlarged; anus a little closer to anal origin than to tips of pelvics, notably in advance of anal origin; anus slightly behind a vertical line through first dorsal origin or under it; anal fin origin far in advance of second dorsal origin, about under tips of depressed dorsal spines; posterior edges of scales smooth, not crenulate; ascending premaxillary process very short and broad based, premaxillary only a little protractile.

Color in alcohol.—Each scale pocket above lateral band with a few black dots, or black spots, lateral band widest above anal fin base,

about equal to diameter of pupil, thence narrower on caudal peduncle, widening again on caudal fin base; ventral side of body with black to silvery pigment from anus posteriorly; a line of dark pigment at upper edge of opercle; side of dentary blackish; premaxillary, front of snout, dorsal surface of head and dorsal surface of eye blackish; inner side of operculum blackish; peritoneum blackish.

Ecology.—This species apparently occurs on Guam in the tidal pools exposed to the surf, since Professor Frey's notes state, "Fish collected in very small rocky tide pools. . . . This coast is normally beaten by high waves. Shelf to edge of coral reef is quite narrow."

Remarks.—Unfortunately we do not have available the several large series of *Atherion*, both from Bikini and from Japan, needed to obtain enough counts to give a clear picture of the variation in the number of fin rays in each of these localities. We believe that the population of *Atherion* from the Marianas at Guam and Saipan, with its usual number of I,i,8 dorsal and I,i,13 or 14 anal rays, averaging one or two fewer than at Japan, justifies the naming of this race as a new subspecies. The difference in number of fin rays, recorded in table 26, forms the chief basis on which all three subspecies are separated. *A. maccullochi* Jordan and Hubbs differs in having 47 vertical scale rows. *Atherion villosa* (Duncker and Mohr) differs from this new subspecies in having I,i,9 to 11 second dorsal rays and I,i,11 or 12 pectoral rays instead of I,i,7 to 9 and I,i,10 or 11, respectively.

Doubt must be cast on my identification of the single specimen from Saipan referred to *Atherion elymus*. It may be an extreme variation of *Atherion elymus freyi* in the direction of *elymus elymus*. I cannot make satisfactory comparison since all the paratypes of the latter available to me have been dried and the color pattern has disappeared.

Named *freyi* in honor of the collector, Dr. David G. Frey of the University of North Carolina.

ATHERION ELYMUS ASPER, new subspecies

Holotype.—U.S.N.M. No. 140330, 37.0 mm. standard length, from Bikini Atoll, Bokon Island, ocean reef, at edge of channel, April 15, 1946, S–46–94, Schultz and Brock.

Paratypes.—U.SN.M. No. 140331, taken with the holotype, 37.2 mm. standard length. U.S.N.M. No. 140476, Bikini Atoll, Eman Island, surf, July 19, 1947, S–46–441, Schultz, Brock, Myers, and Hiatt, 4 specimens, 35 to 40 mm.

Description.—Counts made on the holotype are recorded first, followed by those for a paratype. Dorsal rays V–I,i,7 and IV–I,i,7; anal I,i,13 and I,i,12; pectoral i,10–i,10 and i,10–i,10; scale rows from upper edge of gill opening to midcaudal fin base 44 and 43, from first dorsal origin to midventral line 12 and 12; median predorsal scales

17 and 18, scales in zigzag row around least depth of caudal peduncle 12 and 12. (See table 26 for additional counts.)

Precision measurements made on the holotype and one paratype are recorded in table 27 in thousandths of the standard length.

Since we find no significant differences in shape, size, or proportions of head, body, and fins, the proportions for *A. e. freyi* apply to this subspecies.

Color in alcohol.—Only the three rows of scale pockets on back with black spots, the scale row just above lateral band unpigmented, lateral band widest over rear of anal fin base, about equal to diameter of pupil, then narrower on caudal peduncle, expanding again on base of caudal fin as in *freyi;* ventral side of body with a row on each side of anal base and from anus to base of caudal fin; the line of black pigment at upper edge of opercle in *freyi* is lacking in *asper;* side of dentary blackish; premaxillary, front of snout, dorsal surface posteriorly and between eyes, and dorsal surface of eyes blackish; inner side of operculum blackish; peritoneum blackish.

Ecology.—This species was captured at the outer edge of the reef where the surf breaks at high tide.

Remarks.—A new name was given to the population of *Atherion* at Bikini Atoll on the basis of slight differences in color pattern and the lower average number of dorsal fin rays, usually I,i,7 in *asper* and I,i,8 in *freyi*, and the lower average number of anal fin rays, I,i,12 or 13 in *asper* and usually I,i,13 or 14 in *freyi*. We are fully aware of the overlapping of these characters and that we have but six specimens from Bikini. However, because latitudinal variation from Japan, the Bonin, Marianas, and northern Marshall Islands is established in the key and in table 26, we think the naming of subspecies of *Atherion* is justified, since it expresses our concept of the geographical change of *Atherion* from Japan to Bikini and the Philippines.

*A. macculloch*i Jordan and Hubbs differs from this new subspecies in having 47 instead of 43 or 44 vertical scale rows from the head to the midbase of the caudal fin. *Atherion villosa* (Duncker and Mohr) differs in having I,i,9 to I,i,11 rays in the second dorsal fin instead of I,i,7, and also in having I,i,11 or 12 pectoral rays instead of I,i,10.

Named *asper* in reference to the shagreenlike denticles.

ATHERION ELYMUS APHROZOICUS, new subspecies

Holotype.—U.S.N.M. No. 143305, 31 mm. in standard length, Tara Island, Philippines, December 15, 1908, *Albatross.*

Paratypes.—U.S.N.M. 140303, collected with the holotype and bearing same locality data, 14 specimens, 25.5 to 33 mm.

Description.—Certain measurements made on the holotype are recorded in table 27, and counts on the paratypes in table 26.

TABLE 27.—*Measurements made on certain subspecies of* Atherion elymus *expressed in thousandths of the standard length*

Characters	*A. elymus aphrozoicus*	*A. elymus freyi*		*A. elymus asper*	
	Holotype	Paratype	Holotype	Holotype	Paratype
Total length in millimeters	----	34.5	36.1	45.3	45.0
Standard length in millimeters	31	28.3	29.3	37.2	37.0
Length of head	252	258	259	253	249
Greatest depth of body	152	170	157	129	143
Length of snout	58	60	61	62	59
Diameter of orbit	94	92	96	89	95
Postorbital length of head	110	110	106	105	100
Least bony interorbital width	90	92	85	89	81
Length of caudal peduncle	203	193	205	207	192
Least depth of caudal peduncle	71	64	68	65	57
Greatest width of head	126	124	126	121	127
Pelvic insertions to anal origin	219	258	259	218	257
Snout tip to first dorsal origin	548	565	560	538	571
Snout tip to second dorsal origin	716	742	718	715	738
Snout tip to anal origin	597	658	636	613	653
Snout tip to pectoral insertion	223	258	256	242	265
Snout tip to pelvic insertion	368	410	395	382	403
First dorsal origin to second dorsal origin	161	187	167	175	173
Length of longest ray of first dorsal fin	110	67	51	75	62
Length of longest ray of second dorsal fin	113	106	96	94	105
Length of longest ray of anal fin	----	124	126	121	124
Length of longest ray of pectoral fin	168	166	181	180	176
Length of longest ray of pelvic fin	129	120	109	121	124
Length of depressed first dorsal fin	110	81	68	77	73
Length of depressed second dorsal fin	178	163	171	161	151
Length of depressed anal fin	235	233	253	220	219
Length of anal base	190	180	194	178	170
Length of soft dorsal base	129	99	126	113	111
Length of pelvic scale	----	46	35	----	38

Since we find no significant differences in shape, size, or proportions of head and body, those proportions recorded for *A e. freyi* apply to this subspecies, except for the length of the spiny dorsal fin, which is longer in *aphrozoicus* than in the other subspecies, and is contained from 2.5 to 2.9 times in head, whereas in *elymus*, *freyi*, and *asper* it is contained 3 or more times.

Color in alcohol.—Dorsal rows of scales have blackish pigment spots, row above lateral band has 2 or 3 black pigment cells on each scale; dorsal base of pectoral with a black spot, a little black pigment in upper rays of pectoral; gill cover, gill membranes, and isthmus silvery, upper part of snout brownish; sides of mandible brownish or silvery.

Ecology.—This subspecies apparently, as in the case of other members of the genus, lives in the surf around rocky pools at the outer edge of the reef. Females have enlarged eggs indicating that *Atherion* combines a group of small species.

Remarks.—A. elymus aphrozoicus differs from the other species and subspecies of *Atherion* in having 41 or 42 scales, whereas all the others have 43 to 47, and only rarely 42; the spiny dorsal fin is a little longer, being contained in the head from 2.5 to 2.9 times, whereas in the other species it is contained more than 3 times.

Named *aphrozoicus* in reference to its habit of living in the ocean surf.

Genus STENATHERINA Schultz

Stenatherina SCHULTZ, Proc. U. S. Nat. Mus., vol. 98, pp. 7, 20, figs. 1a, 2b, 3b, 1948. (Genotype, *Atherina temminckii* Bleeker.)

STENATHERINA TEMMINCKII (Bleeker)

Atherina temminckii BLEEKER, Nat. Tijdschr. Nederl.-Indië, vol. 5, p. 506, 1853 (type locality, Sumatra). (Reference copied.)

SPECIMENS STUDIED

Bikini Atoll: 7 stations, 32 specimens, 24 to 87 mm. standard length.
Eniwetok Atoll: 1 station, 2 specimens, 33 to 35 mm.
Rongerik Atoll: 1 station, 4 specimens, 76 to 86 mm.
Rongelap Atoll: 4 stations, 32 specimens, 48 to 89 mm.
Kwajalein Atoll: 1 station, 8 specimens, 49 to 75 mm.

Description.—Dorsal rays V to VII–I,i,7 to 9, usually VI–I,i,8; anal I,i,10 or 11, occasionally 11; pectoral I,i,17 or 18, usually I,i,17; vertical scale rows from upper edge of gill opening to midbase of caudal fin 46 or 47; scales from first dorsal origin to midline of belly 6; median predorsal scales 19 to 21; scales in zigzag row around caudal peduncle 12; gill rakers on first gill arch 5+1+20 to 22; vertebrae in two counts 24 and 21. (Additional counts are given in table 26.)

Depth 6.5 to 7; head 3.7 to 4; snout to first dorsal origin 1.8 to 1.9, to center of anus 1.8 to 1.9, to anal origin 1.4; all in standard length; snout 3.6 to 3.8; eye 2.6 to 2.9; tip of snout to rear of maxillary 3.2 to 3.4; least depth of caudal peduncle 4.2 to 4.7; postorbital length of head 2.5 to 2.7; distance between dorsal origins 1.4 to 1.5; length of longest ray of pectoral fin 2.0 to 2.2; interorbital space 3.2 to 3.3; all in length of head; least depth of caudal peduncle in its length 3.2 to 3.5.

Premaxillary a little convex; teeth villiform in a narrow band on premaxillary and dentary, those on vomer arranged in a T-shaped pattern, and on palatines in a narrow band; air bladder and body cavity ending bluntly in front of anal origin and not entering the haemal arches; anterior bony edge of preopercle with a distinct concavity above lower corner; gill rakers long, slender, nearly equal to diameter of pupil; maxillary reaches to a vertical line through front of orbit; scales on opercle and in front of base of pectoral fin greatly

enlarged; anus behind tips of pelvics, and under or nearly under first dorsal origin; anal fin origin notably in front of a vertical line through second dorsal origin, behind tips of depressed first dorsal spines; posterior edges of scales smooth, not crenulate; ascending premaxillary processes long, slender, extending well into the interorbital space, and excessively protractile.

Color in alcohol.—Each scale pocket above lateral band posteriorly outlined with black pigment or silvery coloration; lateral band distinct, its greatest width over anal fin base, narrowing on caudal peduncle to two-thirds its greatest width, thence extending on caudal fin base as two pointed areas separated by a pale interspace, that on dorsal lobe more intense, narrower, and a little longer than that on ventral half of caudal fin; base of soft rays of pectoral, anal, and dorsal black; just in front of upper edge of pectoral fin base a persistent triangular black spot; another elongate one occurs on upper edge of opercle, opercle dusky; persistent black blotch in front of eye; snout and lips blackish; supraorbital area blackish; inside of operculum blackish; peritoneum dusky to blackish.

Ecology.—This is a common species in lagoon waters and one of the largest species of silversides encountered in the northern Marshall Islands. At night large schools gathered around the light but were just too deep to permit catching with nets. Stragglers occurred on the reefs but typically stayed in or over the deeper waters of the lagoon.

Remarks.—This species ranges widely in the tropical western Pacific. *Atherina brachyptera* Bleeker apparently is a synonym of this species.

Genus ALLANETTA Whitley

Allanetta Whitley, Proc. Linn. Soc. New South Wales, vol. 68, p. 135, 1943. (Genotype, *Atherina mugiloides* McCulloch, Proc. Roy. Soc. Queensland, vol. 24, p. 47, fig. 1, from Cape York, 1912=*Atherinichthys punctatus* de Vis, 1885.)

KEY TO CERTAIN SPECIES OF TROPICAL PACIFIC ALLANETTA RELATED TO THE MARSHALL ISLANDS ATHERINDAE

1*a*. Greatest depth of body 5 to 6¼ in standard length.
  2*a*. Posterior margins of scales distinctly crenulate.
    3*a*. Scales from upper edge of gill opening to base of caudal fin 45 to 48; greatest width of lateral band 1.7 to 2.0 in postorbital length of head (Japan and China coast)---------- Allanetta bleekeri (Günther)
    3*b*. Scales from upper edge of gill opening to base of caudal fin 42 to 44; greatest width of lateral band 2.1 to 2.4 in postorbital length of head (tropical Indo-Pacific)---------- Allanetta valenciennesi (Bleeker)
  2*b*. Posterior margins of scales smooth, not crenulate.
    4*a*. Greatest width of lateral band 2.1 to 2.4 in postorbital length of head; anal rays I,i,11 or 12; pectoral usually I,i,13 or 14 (Riukiu Islands). Allanetta woodwardi (Jordan and Starks)

4*b*. Greatest width of lateral band 2.5 to 3.2 in postorbital length of head; anal rays I,i,9 or 10; pectoral usually I,i,15 or 16 (tropical western Pacific)---------- Allanetta ovalaua (Herre)

4*c*. Greatest width of lateral band 2.5 in postorbital length of head; anal rays I,i,11 or 12; pectoral usually I,i,15 or 16 (Western Indian Ocean)---------- Allanetta forskali (Ruppell)

1*b*. Greatest depth of body 4⅕ to 4⅘ in standard length.

5*a*. Anal rays I,i,11 or 12; posterior margins of scales smooth, not crenulate; greatest width of lateral band 2.1 to 2.8 in postorbital length of head (Philippines)---------- Allanetta balabacensis (Seale)

5*b*. Anal rays I,i,7 to 9.

6*a*. Posterior margins of scales smooth, not crenulate; anal rays usually I,i,9, occasionally 8 or 10; second dorsal usually I,i,9; greatest width of lateral band 2.5 to 3.2 in postorbital length of head---------- Allanetta regina (Seale)

6*b*. Posterior margins of scales crenulate; anal rays I,i,7 or 8, occasionally I,i,9; second dorsal I,i,6 or 7; greatest width of lateral band 2.9 to 3.2 in postorbital length of head.

Allanetta crenolepis, new species

ALLANETTA OVALAUA (Herre)

Atherina ovalaua HERRE, Publ. Field Mus. Nat. Hist., zool. ser., vol. 18, No. 12, p. 401, 1935 (type locality, Fiji Islands, 8 paratypes examined).

SPECIMENS STUDIED

Bikini Atoll: 1 station, 8 specimens, 66 to 77 mm. standard length.

Rongelap Atoll: 3 stations, 48 specimens, 15 to 53 mm.

Arhno Atoll: *Albatross*, 3 specimens, 34 to 36 mm.

Likiep Atoll: *Albatross*, 1 specimen, 32 mm.; Univ. Washington, 3 specimens, 40 to 60 mm.

Guam: *Albatross*, 1 specimen, 56 mm.

Description.—The following description is based on the Rongelap specimens (additional counts are given in table 26): Dorsal rays usually VI or VII–I,i,8; anal I,i,9 or 10; pectoral I,i,15 or 16; vertical scale rows from upper edge of gill opening to midbase of caudal fin 42 or 43; scales from first dorsal origin to midline of belly 6½; median predorsal scales 16; scales in zigzag row around least depth of caudal peduncle 12; gill rakers on first gill arch 4 to 6+1+18 to 23.

Depth 5¾ to 6; head 3½ to 3⅔; snout to first dorsal origin 1.9; snout to center of anus 1.9; snout to anal origin 1.4 to 1.5; all in standard length. Snout about 4; eye 3.5 to 3.6; tip of snout to rear of maxillary 2.7; least depth of caudal peduncle 4.0; postorbital length of head 2.6 to 2.7; distance between dorsal origins 1.4 to 1.5; length of longest ray of pectoral fin 1.7 to 1.8; interorbital space 3.3; all in length of head. Least depth of caudal peduncle in its length 2.5 to 2.8. Greatest width of lateral band 2.5 to 3.2 in postorbital length of head.

Premaxillary with front margin a little convex; teeth minute, in a narrow band on premaxillary, dentary, and palatine, in a patch on the vomer; air bladder and body cavity ending bluntly in front of anal origin; anterior bony edge of preopercle with a concavity near lower posterior corner; gill rakers long, slender, longest about equal to diameter of pupil; maxillary reaching past a vertical line through front of orbit; anus between tips of depressed pelvics, and under or a little in front of first dorsal origin; a vertical line through anal fin origin passes through third median dorsal scale in front of second dorsal fin; posterior margins of scales smooth, not crenulate; ascending median processes of premaxillary moderately long but not notably entering interorbital space.

Color in alcohol.—Dorsal rows of scales with broad blackish posterior margins; bases of dorsal fins darkly pigmented; opercle, dorsal surface of orbit, tip of snout, and side of dentary blackish; base of pectoral fin rays blackish, but fin itself unpigmented.

Ecology.—This species was attracted to a light at night in the lagoon. It was not found over the reefs, at least during the day.

ALLANETTA REGINA (Seale)

Atherina regina SEALE, Philippine Journ. Sci., vol. 4, No. 6, p. 496, pl. 3, fig. 1, 1909 (type locality, Culion and Busuanga Islands, Philippines).

Neotype.—U.S.N.M. No. 136806, 67.5 mm., Marinduque, Santa Cruz Island, Philippines, April 24, 1908, *Albatross.*

With the neotype were 30 other specimens, 32 to 68 mm., U.S.N.M. No. 112752, bearing the same data.

Since it appears certain that the fish types at Manila were destroyed during World War II, I am setting up this neotype in order to fix the species *A. regina* (Seale) so that it may be distinguished by ichthyologists in the future without the confusion that has previously existed. The selection of a neotype was undertaken only after a great amount of detailed work had been done on the species of Atherinidae of the tropical Pacific region.

Description.—Counts and measurements are recorded in tables 26 and 28.

Depth 4½ to 4.9; head 3.4 to 3.5; snout to first dorsal origin 1.8 to 1.9; to center of anus 1.9 to 2.1; to anal origin 1.4 to 1.5; all in standard length. Snout 4.1 to 4.2; eye 2.3 to 2.4; tip of snout to rear of maxillary 2.6; least depth of caudal peduncle 3.5 to 4.0; postorbital length of head 2.4 to 2.7; distance between dorsal origins 1.4 to 1.5; length of longest ray of pectoral fin 1.4 to 1.5; interorbital space 2.5 to 2.8; all in length of head. Least depth of caudal peduncle in its length 2.3 to 2.4. Greatest width of lateral band in postorbital length of head 2.5 to 3.2.

TABLE 28.—*Counts and measurements, expressed in thousandths of the standard length, on certain species of* Allanetta *and* Hypoatherina

Character	*A. crenolepis*		*A. regina*			*H. barnesi*	
	Holotype	Paratype	U. S. N. M. No. 136806	U. S. N. M. No. 112752	From figure of type	Holotype	Paratype
Total length in millimeters	62.5	67				62	50.5
Standard length in millimeters	50.5	54.5	67.5	58	69	52	41.5
Length of head	291	290	296	300	290	246	241
Greatest depth of body	226	229	193	198	193	169	152
Length of snout	75	81	89	84		62	63
Diameter of orbit	127	130	120	126	112	88	89
Postorbital length of head	109	106	118	112	110	100	96
Least width of bony interorbital	125	128	99	102		77	75
Length of caudal peduncle	206	180	187	191	203	202	207
Least depth of caudal peduncle	77	70	76	79	80	62	63
Greatest width of head	170	171	156	160		115	116
Pelvic insertion to anal origin	307	294	323	324	326	283	277
Snout tip to first dorsal origin	564	570	560	526	529	530	514
Snout tip to second dorsal origin	739	752	755	724	735	692	708
Snout tip to anal origin	723	706	734	718	742	648	665
Snout tip to pectoral insertion	270	273	274	279	284	248	250
Snout tip to pelvic insertion	432	426	410	422	419	387	402
First dorsal origin to second dorsal origin	168	191	195	181	203	164	173
Length of longest ray of first dorsal	110		130	128	116	94	89
Length of longest ray of second dorsal	158		135		141	96	89
Length of longest ray of anal fin	167		135	148	139	112	108
Length of longest ray of pectoral fin	266	266	192	207	210	133	137
Length of longest ray of pelvic fin	167	167	138	153	167	104	108
Length of depressed first dorsal	122	118	135	126		104	84
Length of depressed second dorsal	178		145			150	169
Length of depressed anal fin	174		145	155		196	205
Length of anal fin base	116	116	113	121	110	156	154
Length of soft dorsal fin base	102	97	98	95	110	112	123
Dorsal rays	V–I,i,7	IV–I, i,7	VII–I, i,8	V–I,i,8		V–I,i,9	V–I,i,9
Anal rays	I,i,8	I,i,9	I,i,9	I,i,9		I,i,11	I,i,12
Pectoral rays	I,i,14–I, i,14	I,i,14–I, i,15	I,i,15–I, i,15	I,i,15–I, i,15		I,i,13–I, i,13	I,i,13–I, i,13
Median predorsal scales	15	15	16	16		18	18
Scale rows from gill opening to base of caudal fin	37	36	39	39		43	44

Premaxillary with front margin a little convex; teeth minute on dentary, vomer, and premaxillary, those on latter reflected as shagreen on outer surface of that bone; no teeth on palatines; air bladder and body cavity ending bluntly in front of anal fin origin; bony edge of preopercle with concavity near lower posterior corner; gill rakers long, slender, about equal to diameter of pupil; mouth oblique, the maxillary reaching to a vertical line through front of orbit; posterior margins of all scales smooth, not with crenulate edges; anus between depressed pelvic fins and opposite beginning of last third of fin length, a vertical line through the anus passes through second or third median predorsal scale; a vertical line through anal fin origin passes through second median dorsal scale in front of second dorsal fin; ascending

median premaxillary process short and broad, not reaching to interorbital space.

Color in alcohol.—Posterior margins of dorsal rows of scales, sides of dentary, snout, upper surface of eye, dorsal part of gill cover with dark pigmentation; gill membranes and isthmus silvery; a row of black specks on scales along lateral band and two shorter rows below this one.

ALLANETTA CRENOLEPIS, new species

FIGURE 46

Holotype.—U.S.N.M. No. 143304, Philippine Islands, Tara Island, December 15, 1908, *Albatross*, 50.5 mm. in standard length.

Paratypes.—U.S.N.M. No. 136803, 67 specimens, 34 to 57.8 mm. in standard length, taken with the holotype and bearing the same locality data; U.S.N.M. No. 138065, Philippine Islands, Papatog Island, Tawi Tawi, February 23, 1908, *Albatross*, 11 specimens, 33.5 to 54.5 mm.

Description.—Counts and measurements made on the holotype and a paratype are recorded in table 28, and additional counts are recorded in table 26.

Depth 4.2 to 4.5; head 3.3 to 3.5; snout to first dorsal origin 1.8, to center of anus 1.7 to 1.8, to anal origin 1.4 to 1.5, all in standard length. Snout 4.2 to 4.3; eye 2.3; tip of snout to rear of maxillary 2.8 to 2.9; least depth of caudal peduncle 3.7 to 3.9; postorbital length of head 2.6 to 2.7; distance between dorsal origins 1.6; length of longest ray of pectoral fin 1.2; interorbital space 2.3; all in length of head. Least depth of caudal peduncle in its length 2.3 to 2.5.

Premaxillary with front a little convex; teeth minute on dentary and premaxillary, those on latter reflected as shagreen along narrow outer edge of that bone; no teeth on palatines; vomer with a few minute teeth; air bladder and body cavity ending abruptly in front of anal fin origin; bony edge of preopercle with a concavity near lower posterior corner; gill rakers long, slender, a little shorter than pupil diameter; mouth oblique, maxillary reaches to a vertical line through front of orbit; all scales crenulate, enlarged scales on operculum and around base of pectoral fin strongly so; anus between depressed pelvic fins and opposite beginning of last third of fin length, a vertical line through anus passes a trifle in front of first dorsal origin, and closer to caudal base than snout tip; anal fin origin about under second or third scale in front of second dorsal origin; ascending median process of premaxillary short, broad based, not entering interorbital space. There are 12 scales in a zigzag row around caudal peduncle and 6½ from first dorsal origin to midventral line.

Color in alcohol.—Dorsal rows of scales with darkish pigment on margins, two rows of dark specks below lateral band; greatest width

of silvery lateral band 2.8 to 3.2 in postorbital length of head. Snout, dentary, and dorsal surface of eye with heavy dark pigmentation; opercle silvery, and upper part of gill cover with dark pigment.

Remarks.—This new species of *Allanetta* differs from all other robust species referred to the genus in having all the scales with strongly crenulate posterior edges. *A. crenolepis*, with I,i,7 or 8 anal rays, has fewer than any other species in the genus *Allanetta* so far observed. Named *crenolepis* in reference to the crenulate scales.

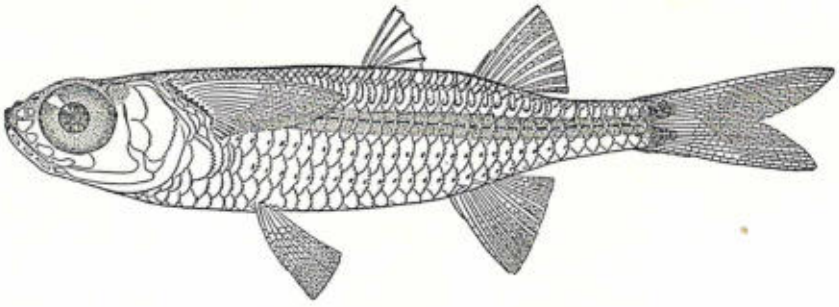

FIGURE 46.—Holotype of *Allanetta crenolepis*, new species (U.S.N.M. No. 143304), from Tara Island, Philippine Islands. (Drawing by Aime M. Awl.)

Genus HYPOATHERINA Schultz

Hypoatherina SCHULTZ, Proc. U. S. Nat. Mus., vol. 98, pp. 8, 23, fig. 3c, 1948. (Genotype, *Atherina uisila* Jordan and Seale.)

In my revision of the Atherine fishes (loc. cit., p. 23) I referred *A. gobio* Klünzinger to this genus but upon further study I find that it appears to belong to *Allanetta*. *Hypoatherina* is very close to *Allanetta*, and these two genera may need to be combined after more species have been studied; in general, members of the genus have slender spines, with the anus notably behind the tips of the pelvic fins.

KEY TO THE SPECIES OF HYPOATHERINA

1*a*. Pectoral fin rays I,i,12 to 14; gill rakers 3 to 5+1+15 to 17; dorsal rays V to VII–I,i,7 to 9; anal rays usually I,i,12 or 13, rarely I,i,11; scales from upper edge of gill opening to caudal fin base 43 or 44; median predorsal scales 16 to 18; greatest width of lateral band 1.2 to 1.6 in postorbital length of head ..... Hypoatherina barnesi, new species

1*b*. Pectoral fin rays I,i,15 to 18; gill rakers 5 to 7+1+20 to 23; greatest width of lateral band 1.7 to 2.8 in postorbital length of head.

2*a*. Scales from upper edge of gill opening to caudal fin base 46 to 48; median predorsal scales 18 to 20; pectoral rays I,i,16 to 18 (Japan). Hypoatherina tsurugae (Jordan and Starks)

2*b*. Scales from upper edge of gill opening to caudal fin base 41 to 45.

3a. Scales from upper edge of gill opening to caudal fin base 41 or 42; median predorsal scales 16 or 17 (From the Philippines.)
Hypoatherina panatela (Jordan and Richardson)

3b. Scales from upper edge of gill opening to caudal fin base 43 to 45 (see table 28 for counts)---------- Hypoatherina lacunosa[82] (Forster)
and Hypoatherina uisila (Jordan and Seale)

HYPOATHERINA BARNESI, new species

FIGURE 47

Holotype.—U.S.N.M. No. 140470, 52 mm. in standard length, Rongelap Atoll, ½ mile off Rongelap Island in lagoon, surface light at night, July 17 to 27, 1946, S–46–259, Herald.

Paratypes.—U.S.N.M. No. 140459, Bikini Atoll, *Bowditch* anchorage off Bikini Island, surface light at night, March 30, 1946, S–46–46, Schultz and Brock, 33 specimens, 20 to 41 mm.; U.S.N.M. No. 140460, Bikini Atoll, Boro channel, surface light at night, April 6–7, 1946, S–46–53, Schultz and Brock, 2 specimens, 24 and 31 mm.; U.S.N.M. No. 140464, Bikini Atoll, *Bowditch* anchorage, surface light at night, April 23, 1946, S–46–111, 103 specimens, 21 to 42 mm.; U.S.N.M. No. 140465, Bikini Atoll, lagoon, *Bowditch* anchorage, light at night, April 24–26, 1946, S–46–112, –114, and –116, 220 specimens, 17 to 43 mm.; U.S.N.M. No. 140463, Bikini Atoll, Boku Pass, in channel, light at night, July 8, 1946, S–46–245, Herald, 13 specimens, 20 to 36 mm.; U.S.N.M. No. 140461, Bikini Atoll, lagoon, 3 miles northwest of Enyu Island, July 11, 1946, S–46–249, 2 specimens, 37 and 39 mm.; U.S.N.M. No. 140462, Bikini Atoll, off Yuro Island, light at night, July 12, 1946, S–46–250, 14 specimens, 21 to 37 mm.; U.S.N.M. No. 140469, Rongelap Atoll, one half mile off Rongelap Island, surface light at night, July 17 to 27, 1946, S–46–259, Herald, 18 specimens, 24 to 54 mm. taken with holotype; U.S.N.M. No. 140467, Rongelap Atoll, Yugui Island, light at night, July 30, S–46–303, Herald, 2 specimens, 15 and 19 mm.; U.S.N.M. No. 140468, Rongelap Atoll, Lomuilal Island, lagoon, light at night, July 31, 1946, S–46–305, Herald, 13 specimens, 20 to 48 mm.; U.S.N.M. No. 140466, Rongelap Atoll, Naen Island, light at night, July 29, 1946, S–46–301, Herald, 107 specimens, 13 to 27 mm.; U.S.N.M. No. 140458, Eniwetok Atoll, *Bowditch* anchorage, surface light at night, May 23, 1946, S–46–182, Schultz, one specimen, 23 mm.; U.S.N.M. No. 140457, Rongerik Atoll, off Eniwetok Island, June 28, 1946, S–46–242, Schultz and Herald, 200 specimens, 22 to 46 mm.; U.S.N.M. No. 65749, Marshall Islands, Wotje Atoll, *Albatross*, 16 specimens, 18 to 50 mm.; U.S.N.M. No.

[82] Ogilby (Mem. Queensland Mus., vol. 1, p. 4, pl. 12, fig. 2, 1912) restricted *Atherina lacunosa* Forster (*in* Bloch and Schneider, Systema ichthyologiae, p. 112, 1801) to 2 specimens from Moreton Bay, Queensland. This leaves no doubt as to the identity of *lacunosa* and my definition herein presented is based on 3 specimens, U.S.N.M. No. 132607 from Queensland. *Atherina uisola* from Samoa may not be distinct from *lacunosa*. I have not thoroughly investigated that problem.

140471, Bikini Atoll, lagoon ½ mile off Bikini Island, surface light at night, July 15, 1947, S–46–402, Myers, Schultz, and O. Smith, 5 specimens, 25 to 47 mm.

Description.—Measurements made on the holotype and one paratype are recorded in table 28. Additional counts are presented in table 26.

Depth 5¾ to 7; head 3¾ to 4⅓; snout to first dorsal origin 1.9 to 2.0, to center of anus 1.8 to 1.9, to anal origin 1.7 to 1.8; all in standard length. Snout 3.7 to 3.8; eye 2.5 to 2.8; tip of snout to rear of maxillary 3.0 to 3.3; least depth of caudal peduncle 3.6 to 3.8; postorbital length of head 2.4 to 2.5; distance between dorsal origins 1.4 to 1.5; length of longest ray of pectoral fin 1.7 to 1.8; interorbital space 1.8 to 3.0; all in length of head. Least depth of caudal peduncle in its length 2.8 to 3.0. Greatest depth of lateral band in postorbital length of head 1.2 to 1.6.

Premaxillary with front margin a little convex; minute teeth on dentary and premaxillary, scarcely reflected on outer surface of latter

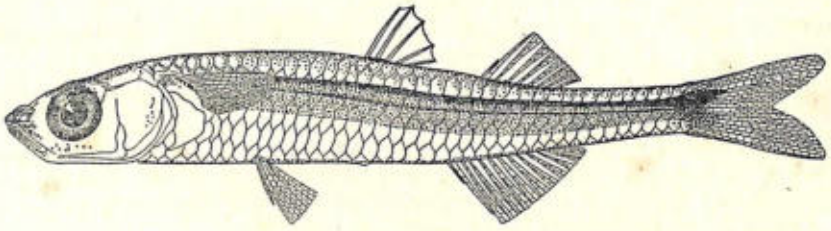

FIGURE 47.—Holotype of *Hypoatherina barnesi*, new species (U.S.N.M. No. 140470), from Rongelap Atoll. (Drawing by Aime M. Awl.)

bone; vomer with one or two very minute teeth; palatines toothless; air bladder ending bluntly in front of anal fin origin; bony edge of preopercle with concavity near lower posterior corner; gill rakers on first arch, long, slender, about equal to diameter of pupil; mouth moderately oblique, maxillary reaching to a vertical line through front of orbit; posterior margins of scales smooth, not crenulate; anus behind tips of pelvic fins, under base of spiny dorsal fin; anal fin origin under third or fourth median dorsal scale in front of second dorsal fin; ascending median premaxillary process moderately long but not reaching to interorbital space.

Color in alcohol.—Posterior margins of scale pockets of dorsal scale rows with a series of blackish pigment cells; bases of pectoral, anal, and dorsal fins with black pigment; side of mandible black and tip of snout blackish; inside of opercle blackish; peritoneum dusky to blackish. Lateral band widest opposite anus to anal fin base, constricted a little on caudal peduncle, then wider on base of caudal fin, where it ends.

Ecology.—This new species was one of the most abundant silversides in the lagoon and was attracted to the light at night. It occurred in schools during the daytime and often jumped as a unit, or nearly so, when pursued by predatory fishes. This is a small species, females with mature eggs occurring at lengths of about 40 to 44 mm. in standard length.

Remarks.—*Hypoatherina barnesi* may be distinguished from all other species referred to the genus *Hypoatherina* in having 12 to 14 branched pectoral fin rays instead of 15 to 18 as do the other species.

Named *barnesi* in honor of Dr. Clifford A. Barnes, project officer of the U.S.S. *Bowditch* during Operations Crossroads in 1946.

Genus PRANESUS Whitley

Pranesus WHITLEY, Mem. Queensland Mus., vol. 10, pt. 1, p. 9, 1930. (Genotype, *P. ogilbyi* Whitley, based on Ogilby's figure (Mem. Queensland Mus., vol. 9, p. 38, pl. 12, fig. 1, 1912) of *Atherina pinguis* (not of Lacepède), from Moreton Bay, Queensland.)—SCHULTZ, Proc. U. S. Nat. Mus., vol. 98, pp. 8, 23, figs. 2e, 3e, 1948.

KEY TO CERTAIN SPECIES OF PRANESUS FROM THE WESTERN TROPICAL PACIFIC RELATED TO MARSHALL ISLAND ATHERINIDAE

1*a*. Lateral band narrow (measured above anal fin origin), its width 2.5 to 3.2 times in postorbital part of head.

2*a*. Dorsal rays IV or V–I,i,6 or 7; anal I,i,9 or 10 (usually 10); scales from upper edge of gill opening to base of caudal fin 35 to 37; gill rakers on lower part of first arch 19 or 20; median predorsal scales 16 or 17; depth 4 to 4½ in standard length.

Pranesus endrachtensis [64] (Quoy and Gaimard)

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[64] Since there was lack of agreement on the characters for the type of *Atherina endrachtensis* Quoy and Gaimard, I wrote to Dr. Bertin, Muséum National d'Histoire Naturelle, Paris, and received a reply from Rolande Esteve stating that the type No. A.4385 has the following characters: Mandible without raised rami, posterior edge of preopercle with notch; ascending median premaxillary process short, blunt and broad based; greatest depth of body 4.6 in standard length; width of lateral band 2.5 into postorbital length of head; anus in advance of first dorsal origin and in advance of tips of pelvic fins. The following counts were made: dorsal rays V–I,i,7; anal I,i,9; pectoral I,i,15; gill rakers on first arch 5–1+19; scale rows from upper edge of gill opening to midbase of caudal fin 37; and 16 median predorsal scales.

Atherina lineatus Günther is a distinct species with fewer scales (31 or 32) as recorded from the types in the British Museum in a letter from Dr. N. B. Marshall. In addition Dr. Marshall kindly supplied the following data: Rami of mandibles without elevation; median ascending premaxillary processes short, blunt and broad based; greatest depth of body 4.2 and 4.3, head 3.5 and 3.6, both in standard length; greatest width of lateral band 1.3 and 1.6 in postorbital length of head; dorsal rays IV–I,i,7 and IV–I,i,7; anal I,i,10 and I,i,10; pectoral I,i,13 and I,i,15; gill rakers 6+1+21 and 5+1+21; scales from upper edge of gill opening to base of caudal fin 31 and 32; median predorsal scales 17 and 17.

For another distinct species referrable to *Pranesus*, Rolande Esteve informs me that the type, No. A4382, of *Atherina duodecimalis* Cuvier and Valenciennes, from Ceylon, has the following characters: Rami of mandibles without elevation; median ascending premaxillary process short, blunt, and broad based; greatest depth of body 3.5, and head 3.5, both in standard length; greatest width of lateral band 2.2 in postorbital length of head; dorsal rays V–I,i,8; anal I,i,7; pectoral I,i,12; gill rakers 5+1+20; scales from upper edge of gill opening to base of caudal fin 31; median predorsal scales 17; anus in front of a vertical line through first dorsal origin, and in front of tips of pelvic fins.

2*b*. Dorsal rays V to VII–I,i,7 or 8; anal I,i,11 to 14; median predorsal scales 17 or 18; depth 4¾ to 5¼; scales from upper edge of gill opening to base of caudal fin 41 to 44; gill rakers on lower part of arch 22 to 26.
Pranesus ogilbyi (Whitley)

1*b*. Lateral band broad (measured above anal fin origin), its greatest width 1.3 to 2.0 times in postorbital length of head.

3*a*. Anal rays I,i,14 to 17; scales 45 to 47; predorsal scales 19 to 21.

4*a*. Gill rakers on lower part of first gill arch 20 to 22; branched rays of second dorsal 9 to 11 and branched anal rays 14 to 16.
Pranesus insularum insularum (Jordan and Evermann)

4*b*. Gill rakers 18 to 20; branched rays of second dorsal 9 and of anal 15 to 17---------- Pranesus insularum whitei, new subspecies

3*b*. Anal rays I,i,11 to 14 (rarely I,i,15)---- Pranesus pinguis (Lacepède)

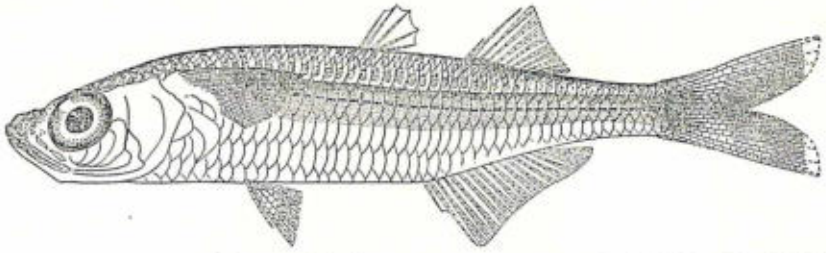

FIGURE 48.—Holotype of *Pranesus insularum whitei*, new subspecies (U.S.N.M. No. 143306), from Saipan. (Drawing by Aime M. Awl.)

PRANESUS INSULARUM WHITEI, new subspecies

FIGURE 48

Holotype.—U.S.N.M. No. 143306, 63 mm. in standard length from Saipan, June 1945, collected by Brig. Gen. T. D. White and Lt. F. B. Shroyer.

Paratypes.—U.S.N.M. No. 143307, 4 specimens 43 to 49 mm. taken along with the holotype and bearing same data.

Description.—Counts and measurements made on the holotype and one paratype are recorded in table 29. Additional counts are given in table 26.

Depth 4.7 to 5.1; head 3.7 to 3.9; snout to first dorsal origin 1.7 to 1.8, to center of anus 2.0, to anal origin 1.6 to 1.7; all in standard length. Snout 3.8 to 3.9; eye 2.6 to 2.7; tip of snout to rear of maxillary 2.2 to 2.3; least depth of caudal peduncle 3.1 to 3.2; postorbital length of head 2.3 to 2.4; distance between dorsal origins 1.5 to 1.6; length of longest ray of pectoral fin 1.5; interorbital space 2.6 to 2.7; all in length of head. Least depth of caudal peduncle in its length 2.0 to 2.1.

Premaxillary with front margin nearly straight; teeth minute on dentary, vomer, and palatines, on premaxillary reflected as shagreen

on outer surface; air bladder and body cavity ending bluntly in front of anal origin; bony edge of preopercle with concavity near lower posterior corner; gill rakers long and slender, the longest nearly equal to diameter of pupil; maxillary long, reaching nearly to a vertical line through front margin of pupil; enlarged scales on opercle and around base of pectoral fin; anus between tips of pelvic fins, and nearly equidistant between tip of snout and caudal fin base; a vertical line through anus passes through fourth predorsal scale; anal fin origin about under tip of depressed spiny dorsal fin; posterior margins of scales smooth not crenulate; ascending premaxillary process short, broad, not reaching into interorbital space. There are 12 scales in a zigzag row around caudal peduncle and 6½ scales from base of spiny dorsal fin to mid-ventral line.

TABLE 29.—*Counts and measurements, expressed in thousandths of the standard length, on* Pranesus insularum whitei *and* P. insularum insularum

Character	*insularum*		*whitei*	
	U.S.N.M. No. 103473	U.S.N.M. No. 55145	Paratype	Holotype
Total length in millimeters	78	----	58.5	77
Standard length in millimeters	63.7	82	46.7	63
Length of head	264	254	265	265
Greatest depth of body	180	199	210	194
Length of snout	71	67	64	72
Diameter of orbit	91	95	103	100
Postorbital length of head	105	101	111	108
Least width of bony interorbital space	91	85	94	94
Length of caudal peduncle	180	174	188	175
Least depth of caudal peduncle	71	73	86	76
Greatest width of head	129	130	133	132
Pelvic insertion to anal origin	295	284	242	256
Snout tip to first dorsal origin	528	543	567	548
Snout tip to second dorsal origin	700	707	717	701
Snout tip to anal origin	666	662	636	660
Snout tip to pectoral insertion	251	254	268	262
Snout tip to pelvic insertion	399	390	407	383
First dorsal origin to second dorsal origin	173	158	150	154
Length of longest ray of first dorsal	94	101	96	100
Length of longest ray of second dorsal	126	122	118	119
Length of longest ray of anal fin	146	140	124	127
Length of longest ray of pectoral fin	196	196	167	180
Length of longest ray of pelvic fin	140	132	118	121
Length of depressed first dorsal	104	100	101	103
Length of depressed second dorsal	174	175	188	170
Length of depressed anal fin	235	240	266	238
Length of anal fin base	179	180	193	177
Length of soft dorsal fin base	123	122	124	113
Length of pelvic scale	58	----	----	56
Dorsal rays	V-I,i,9	V-I,i,9	V-I,i,9	V-I,i,9
Anal rays	I,i,14	I,i,14	I,i,15	I,i,15
Pectoral rays	I,i,14–I,i,14	I,i,14–I,i,15	I,i,14–I,i,15	I,i,14–I,i,15
Median predorsal scales	20	20	21	21
Scale rows from gill opening to base of caudal fin	46	46	46	47
Gill rakers on first gill arch	6+1+20	6+1+21	5+1+19	6+1+20

Color in alcohol.—Margins and centers of scales with brown pigmentation above lateral band; pectoral fin dusky throughout its length; upper surface of head and sides of mandible with brown pigmentation; caudal dusky; peritoneum blackish.

Remarks.—This new subspecies appears to be nearest *P. insularum insularum*, of the Hawaiian Islands. It differs from *P. i. insularum* in averaging about one or two fewer gill rakers on the lower arch and about one fewer branched soft dorsal rays, about one more scale in the lateral line. *P. i. whitei* may be distinguished from other members of the genus by the key on page 307. Named *whitei* in honor of Brig. Gen. T. D. White, USA, one of its collectors.

PRANESUS PINGUIS (Lacepède)

Atherina pinguis LACEPÈDE, Histoire naturelle des poissons, vol. 5, p. 373, pl. 372, fig. 1, 1803 (type locality, Mauritius).—KLÜNZINGER, Die Fische des rothen Meeres, pt. 1, p. 130, pl. 11, fig. 2, 1884 (Red Sea).

SPECIMENS STUDIED

Bikini Atoll: *Chilton* anchorage off Bikini Island, lagoon, light at night, July 15, 1947, S–46–402, Myers, Schultz, and O. Smith, 1 specimen, 46 mm.; Lagoon reef, halfway between Bikini and Amen Islands, July 21, 1947, S–46–442, Brock, Hiatt, and Schultz, 1 specimen, 55 mm.

Guam: Ladrone Island, *Albatross*, 1900, 6 specimens, 31 to 43 mm.; Bijia Point, 1945, 1 specimen, 43 mm., McElroy and Markley.

In addition to the above listed specimens I have examined others from Zanzibar, Tuamotou Islands, Queensland, Fiji, Phoenix Islands, and the Philippines and have found some significant variations in counts, indicating that *pinguis* will need to be broken up into various subspecies and races. Most of these forms have names already available, but the working out of this problem is beyond the scope of this report.

Description.—Dorsal rays V to VII–I,i, 7 to 9 usually I,i,8; anal I,i,12 or 13; pectoral usually I,i,14 or 15; vertical scale rows from upper edge of gill opening to midbase of caudal fin usually 42 to 44; scales from first dorsal origin to midline of belly 6½; median predorsal scales about 18; zigzag scales around caudal peduncle 12; gill rakers on first gill arch usually 4 to 6+1+18 to 21. (Additional counts are given in table 26.)

These measurements were made on U.S.N.M. No. 124030: Depth 5 to 5¼; head 3¾; snout to first dorsal origin 1.9, to center of anus 2.0, to anal origin 1.6; all in standard length. Snout 3.5; eye 2.8; tip of snout to rear of maxillary 2.5; least depth of caudal peduncle 3.5; postorbital length of head 2.5; distance between dorsal origins 1.6; length of longest ray of pectoral fin 1.5; interorbital space 2.5; all in length of head. Least depth of caudal peduncle in its length 2.5. Greatest width of lateral band in postorbital length of head 1.7.

Premaxillary slightly convex, with a narrow band of shagreenlike teeth reflected on outer surface; narrow band of minute teeth on

dentary, vomer, and palatines; anterior bony edge of preopercle with a distinct concavity above lower corner, gill rakers long and slender, about equal to diameter of pupil; maxillary reaches a little past a vertical line through front of orbit; anus between tips of pelvic fins; vertical line through anus passes through fourth scale in front of first dorsal origin; anal fin origin under fourth scale in front of second dorsal origin; posterior margins of scales smooth, not denticulate; ascending premaxillary process short, broad based, not entering interorbital space; dentary without elevation posteriorly on each ramus.

Color in alcohol.—Each scale above lateral band with brownish pigment; black pigment at bases of rays of pectorals, anal and dorsal fins; side of dentary and anterior side of maxillary with dark brown pigment; a streak of black pigment at dorsal side of gill cover. Distal third of pectoral fins dusky to blackish.

Remarks.—This species ranges widely in the tropical Pacific and Indian Oceans.

The identity of *Atherina vaigiensis* Quoy and Gaimard has been uncertain for over a century. Recently I wrote to Dr. Bertin, Curator of the Muséum National d'Historie Naturelle at Paris, for data on the type of *A. vaigiensis*. Rolande Esteve examined the type (specimen No. 6397) and stated that the mandibles lack the elevated rami, the preopercle has the notch in posterior lower corner, the median ascending premaxillary process is short, blunt, and broad based, the greatest width of the lateral band is contained 1.7 times in postorbital length of head; anus is in advance of first dorsal origin and in front of tips of pelvics. The following counts were made—dorsal rays V–I,i,9; anal I,i,13; pectoral I,i,13 [possibly a ray or two is lacking or was not counted, as this count is low]; gill rakers on first gill arch 5+1+19; scales from upper edge of gill opening to midbase of caudal fin 43; median predorsal scales 17.

These counts correspond with those made for specimens of *pinguis* from the Indian and tropical Pacific Oceans (see table 26).

It is my opinion that silversides centering around *pinguis* will form several subspecies more or less confined to large island groups in the Pacific. As this bulletin goes to press Nichols (Marine Life, Occas. Pap., vol. 1, No. 9, pp. 55–57, fig., 1951) described *Hepsetia pinguis mineri* from Pago Pago, Samoa.

Family MUGILIDAE: Mullets

By Leonard P. Schultz

In my revision of the genera of mullets (Proc. U. S. Nat. Mus., vol. 96, pp. 377–395, 1946) I attempted to define 13 genera and pointed out that those species centering around *Mugil* and *Chelon* needed

further investigation. *Chelon* especially is a "catch-all" genus and needs further refinement. I did not list all the species referable to each genus because to do so would have first required an examination of the types of these species in the various museums of the world, owing to inadequate descriptions and figures. In the United States National Museum collections I examined more than three dozen species and my conclusions were based on those as a background. These included practically all the species of the New World and of the Indo-Pacific region, along with species from Africa, Australia, East Asia, and Europe.

Dr. J. L. B. Smith (Ann. Mag. Nat. Hist. ser. 11, vol. 14, No. 120, pp. 833–843, 1947) published a generic revision of the mugilid fishes of South Africa. He did not recognize the genus *Chelon* Röse, which is listed by Neave (Nomenclator zoologicus, vol. 1, p. 683, 1939) and which I believe is a valid name. In its place he used *Liza* without comment. Again I have examined the genotypes of *Chelon* and of *Liza* Jordan and Swain and I find *Mugil chelo* Cuvier and Valenciennes and *Mugil capito* Cuvier, to be very closely related.

Smith proposed the genus *Strializa* and named *Mugil canaliculatus* Smith as its genotype. I have compared two of Smith's paratypes in the U. S. National Museum with specimens of *chelo* and *capito*, and have found them to agree in each character listed by Smith for his genus except with respect to the occurrence of numerous fine grooves on the exposed area of the dorsal scales. This latter character I consider of specific significance only. Thus I assign both *Liza* and *Strializa* to the synonymy of *Chelon*.

In his revision Smith also recognized *Ellochelon* Whitley, with *Mugil vaigiensis* Quoy and Gaimard as its genotype, and characterized this genus "mainly by the broad head, truncate caudal and dark fins." *M. vaigiensis* is very close to *C. chelo;* both lack the adipose eyelids; both have the maxillary curved downward with its rear tip exposed when mouth is closed; and both have minute teeth embedded in the upper lip (those on *vaigiensis* are obvious if the lip is dried a little). I do not believe that the rather low number of scale rows, 26 to 28, is of generic significance, since those on various species referable to *Chelon* vary from that number to as many as 50 without any clearly defined group of species having a constant number. Coloration in the mullets in my opinion is of specific significance only. Therefore I again refer *Ellochelon* to the synonymy of *Chelon*.

This leaves one additional genus, *Valamugil* Smith, with *Mugil seheli* Forskål 1775 as the genotype. I have examined a series of *Mugil seheli* Forskål from the Philippine Islands. This species dif-

fers from *C. chelo* and *C. capito* only in degree of development of the mouth parts. The maxillary, though distinctly bent downward in *seheli*, is not so angular as to expose its posterior tip. The fine setiform teeth are embedded in the upper lip and can be found by drying or by dissection. *Mugil seheli* Forskål agrees with *chelo* and *capito* in regard to the absence of adipose eyelids, thin lower lip, lips without papillae, concave front margin of preorbital, dorsal origin over front part of anal base, among other characters. Again I must refer *Valamugil* Smith to the synonymy of *Chelon*.

Dr. Smith's idea of breaking up the genus *Chelon* as defined by me in 1946 has my approval. I believe that a few of the species falling in that group should be removed and recognized generically if they show outstanding deviation and no intermediate species occur, for example *Crenimugil* and *Heteromugil*. It is my opinion that the adipose eyelid is not a specially significant generic character alone and probably was given too much significance in my key. For example, in *Mugil* it is useful along with other characters, but its "absence" in *Chelon* is one of degree. On *C. chelo* it is absent but on *C. engeli* (Bleeker) of the Indo-Pacific the adipose eyelid is partly developed, covering as much as one-third of the iris. Thus the adipose eyelid in *Chelon* looses much of its significance because the amount of its development varies considerably.

However, if a species shows outstanding development of the mouth parts or other characters that do not overlap those of other species, in my opinion that species deserves to be recognized by a generic name. Such recognition should be given to *Mugil labeo* Cuvier and to *Mugil labiosus* Cuvier and Valenciennes.

I referred *Oedalechilus* Fowler to the synonymy of *Chelon* Röse in my revision. This problem has been investigated further and I herewith recognize the genus *Oedalechilus*.

Genus OEDALECHILUS Fowler

Oedalechilus Fowler, Proc. Acad. Nat. Sci. Philadelphia, vol. 55, p. 748, 1903. (Genotype, *Mugil labeo* Cuvier.)

The following diagnosis is based largely on U.S.N.M. No. 124480, a specimen from Venezia, Italy. Both lips have extremely fine plicae or fringes along their edges, the lower lip is folded downward, not projecting as a thin edge horizontally forward; the upper lip is very broad, over half diameter of eye; below the symphyseal knob at tip of lower jaw is a V-shaped notch; scales cycloid, perorbital with a concave notch in its front margin to accommodate corner of lips; premaxillary and maxillary bent downward at an angle, with tip of latter exposed when mouth is closed; nostrils on level of upper edge

of orbit, close together, the anterior a trifle closer to posterior than anterior is from groove behind upper lip, no adipose eyelid; upper lip several times wider than distance between nostrils; posterior edge of preorbital wider than distance between nostrils; margin of lower jaw angular; gill membranes extending far forward, not broadly connected across isthmus.

This genus with the lower lip folded downward would fall under section 5*a* of my key (op. cit., p. 379); thence under a new section, 6*c*.

These corrections, along with the proposal of a new genus for *Mugil labiosus* Cuvier and Valenciennes, are presented in the following key:

KEY TO THE GENERA OF MUGILIDAE COLLECTED IN THE NORTHERN MARSHALL ISLANDS, AND TO THOSE RELATED TO CHELON

1*a*. Lower lip thick edged, not directed forward horizontally but folded or directed downward so that lower lip fits more or less snugly behind upper lip when mouth is closed; margin of lower jaw angular.

2*a*. Lower lip bearing setiform teeth externally on edges, these arranged in a narrow or wide band.

3*a*. Both lips with broad edges bearing externally a band of minute teeth in several close-set rows, most teeth having bifid tips; lower lip directed but not folded downward and without free inner edge; teeth minute, slender, with bifid tips, arranged in numerous close-set rows on upper pharyngeals; nostrils very close together; no adipose eyelid; rear end of preorbital bone several times wider than space between nostrils; scales ctenoid (marine, in Pacific ocean of tropical New World).

Chaenomugil Gill

3*b*. Both lips with narrow edges bearing externally a narrow band of setiform teeth in 2 or 3 rows; lower lip folded downward and largely free along its inner edge.

4*a*. Margin of lips of both jaws with characteristic 3-pointed setiform teeth set in 2 or 3 rows; adipose eyelid obsolete or undeveloped; nostrils moderately separated, much closer together than anterior is from edge of snout, lip excluded; maxillary not reaching past rear edge of preorbital bone; scales cycloid (marine, Oceania).

Neomyxus Steindachner (p. 315)

4*b*. Margins of both lips with a uniserial row (occasionally a few in an outer or second row) of setiform teeth with unbranched curved tips; adipose eyelid well developed (except nearly absent in young) in adults, reaching almost to pupil; nostrils about as far apart as anterior is from edge of snout, lip excluded; scales cycloid (marine, Galápagos Islands)---------- Xenomugil Schultz

2*b*. Lower lip bearing several rows of fleshy papillae, both externally and internally, with their tips crenulate, becoming more so in adults a foot long or longer; upper lip very broad, bearing papillae, the crenulate edge continuous around rictus; lower lip also crenulate; nostrils close together, anterior one as close to premaxillary groove as to posterior nostril; front edge of preorbital with an angular or concave notch; premaxillary and maxillary bent downward posteriorly, but tip of maxillary not exposed as in *Chelon;* adipose eyelid undeveloped or absent; scales cycloid (marine, Oceania and Indian Ocean).

Crenimugil Schultz (p. 317)

2a. Upper lip very broad, edge thick, bearing numerous extremely fine plicae or a fringe; lower lip turned downward, also fringed; nostrils close together, anterior one about as close to premaxillary groove as to posterior nostril; front edge of preorbital with a concave notch; premaxillary and maxillary bent downward, posterior tip of maxillary exposed when mouth is closed; adipose eyelid absent; scales cycloid (marine, tropical European seas)---------- Oedalechilus Fowler (p. 312)

1b. Lower lip with a thin edge, directed horizontally forward or nearly so, not folded downward and not bearing teeth externally on lips, although fine teeth may occur along edge of lip; upper lip with a band of teeth or with a uniserial row of setiform, or ciliform, or small incisorlike teeth, sometimes more or less firmly set.

5a. Distance between nostrils wide, equal to or greater than width of upper lip; anterior and posterior nostrils widely separated, farther apart than anterior nostril is from groove that separates upper lip from rest of snout; posterior edge of preorbital narrower than distance between nostrils, its posterior tip scarcely or not reaching past front of eye; maxillary and premaxillary not hooked downward, maxillary not notably exposed, both in line with front edge of preorbital; adipose eyelid well developed, reaching to or nearly to pupil except on young (50 mm. in standard length or shorter), in which case posterior edge of preorbital narrower than space between nostrils; no teeth on vomer or palatines; scales cycloid (marine, along coasts of Europe, Africa, Asia, North and South America, West Indies, Oceania to Red Sea, islands of Atlantic and Pacific Oceans in temperate and tropical waters).

Mugil Linnaeus

5b. Distance between nostrils narrow, equal to or narrower than upper lip; anterior nostril much closer to posterior nostril than anterior is from groove that separates upper lip from rest of snout; width of posterior edge of preorbital wider than distance between nostrils. No adipose eyelid, or at most one, covering less than half the iris.

6a. Upper lip with simple unfolded edges, no folds or lobe at corner of mouth.

7a. Teeth setiform or ciliform, in upper lip with simple undivided tips.

8a. Teeth numerous in upper jaw in a single row, with simple tips rather coarse and incisorlike, firmly set, not ciliform, and not forming part of upper lip, but exposed; anterior edge of preorbital straight or nearly so; maxillary nearly straight, not notably exposed or hooked downward over premaxillary, and not extending past rear edge of preorbital bone; premaxillary with its anterior margin evenly curved, nondentate posterior part in line with toothed portion, not at sharp angle to it; narrow band of teeth on vomer and palatines; scales cycloid (marine and fresh waters, Australian region and tropical western Pacific).

Myxus Günther

8b. Teeth in upper jaw ciliform, flexible, extremely fine and numerous, forming part of upper lip.

9*a*. Anterior edge of preorbital concave or angular; maxillary with its posterior part notably exposed, sharply curved downward over posterior part of premaxillary and extending below preorbital a distance greater than width between nostrils; premaxillary with its front margin sharply angular, nondentate posterior portion hooked backward and downward almost at right angles to toothed portion; villiform patches of teeth on vomer and palatines present or absent; scales cycloid (marine, tropical and temperate Atlantic, Pacific, and Indian Oceans of Old World, not yet found in New World).

Chelon Röse (p. 318)

9*b*. Anterior margin of preorbital evenly curved or nearly straight; maxillary with its posterior part somewhat exposed but in line with posterior part of premaxillary and not curved downward, but ending about opposite posterior edge of preorbital; premaxillary with its front margin evenly curved; a narrow band of villiform teeth present on vomer and palatines; scales ctenoid (fresh waters, possibly brackish too, Australia, Burma, and South Africa).

Trachystoma Ogilby

7*b*. Teeth in upper lip setiform, rather firmly set, with trifid or bifid tips; teeth in lower jaw ciliform and embedded more or less in thin-edged lower lip; anterior edge of preorbital concave; maxillary with its posterior part notably exposed, sharply curved downward over posterior part of premaxillary and extending below preorbital a distance greater than width between nostrils; premaxillary with its front margin sharply angular, nondentate posterior portion hooked backward and downward at a sharp angle; villiform patches of teeth on vomer and palatines; scales cycloid (marine, South Africa).

Heteromugil Schultz

6*b*. Upper lip with 2 paired lobes ventral to edge, 4 more at corner of mouth on each side, 2 large and 2 small, all these lobes fleshy and distinct; lower lip at symphysis with a broad V-shaped edentulous notch, each side of which lower lip with a lobe similar to those of upper lip; edges of lips and lobes with fine papillae, each supplied with one or two rows of minute curved fine setiform teeth; front edge of preorbital with a deep notch into which the lobes of the lip at corner of mouth fit, when mouth is closed (marine, tropical western Pacific).

Plicomugil, new genus (p. 320)

Genus NEOMYXUS Steindachner

Neomyxus Steindachner, Sitz. Akad. Wiss. Wein, vol. 78, p. 348, 1878. (Genotype, *Myxus* (*Neomyxus*) *sclateri* Steindachner.)

NEOMYXUS CHAPTALII (Eydoux and Souleyet)

Plate 24, A, B

Mugil chaptalii Eydoux and Souleyet, Voyage autour de monde . . . sur la corvette *La Bonite*, vol. 1, p. 171, pl. 4, fig. 1, 1841 (type locality, Hawaiian Islands).

SPECIMENS STUDIED

Bikini Atoll: 17 stations, 249 specimens, 25 to 215 mm. standard length.
Eniwetok Atoll: 5 stations, 18 specimens, 38 to 238 mm.
Rongelap Atoll: 4 stations, 61 specimens, 27 to 143 mm.
Rongerik Atoll: 3 stations, 48 specimens, 34 to 215 mm.
Saipan: 1 lot, 4 specimens, 23 to 27 mm.
Guam: 1 lot, 431 specimens, 25 to 32 mm.

Description.—Dorsal rays IV–ii,8; anal III,10; pectoral ii,13 or 14 (usually ii,14) pelvic I,5; branched caudal 6+6; scale rows from upper edge of gill opening to midbase of caudal fin 45 to 48; scales in a row from anal origin to base of second dorsal fin 12 or 13; gill rakers on first gill arch (apparently increasing in number with age) about 35 to 63+49 to 66=85 to 129 or more.

Greatest depth of body (opposite base of spiny dorsal fin) 4.0 to 4.1, head 3.6 to 3.8, both in standard length; pectoral fin 1.2 to 1.3 in head; pelvic fins not quite reaching halfway to anal origin on adults; second dorsal origin over middle third of anal fin base; posterior margins of soft dorsal and anal fins concave, except on young; caudal fin with posterior margin deeply concave; first dorsal spine longest, when depressed reaching a trifle past second spine; first anal spine short, third longest; pelvic spine length three-fourths that of longest soft ray; scales cycloid; basal one-half to two-thirds of pectoral and pelvic fins scaled; basal two-thirds to four-fifths of caudal, soft dorsal, and anal fins scaled; accessary pelvic scale 2.2 to 2.8 in longest pelvic ray; upper lip thick, broad, bearing along its edge numerous trifid setiform teeth arranged in 2 or 3 rows; lower lip folded downward with 2 or 3 rows of trifid setiform teeth; premaxillary protractile; preorbital with anterior edge nearly straight and posterior edge nearly truncate.

Color in alcohol.—Dusky dorsally, nearly white ventrally; fins all a little dusky, except pelvics, which are whitish; upper edge of preorbital with a little dark pigment; peritoneum black.

Color when alive.—Plain grayish dorsally, silvery on sides, white below; base of pectoral fin at its dorsal edge with a bright yellow spot.

Ecology.—This mullet was the most abundant species in the lagoon and along the ocean reefs; at night it came inshore at the surface in water only 2 inches deep, where it was caught with a dipnet and a light. Sometimes it could be followed out over deep water with the light. If disturbed, *Neomyxus chaptalii* would suddenly leap a few yards and disappear in a splash of water. When close in to shore it was most frequently found along sandy stretches of the beach or where the reef was not rugged and channeled.

Remarks.—*N. chaptalii* may be recognized by its trifid setiform teeth in 2 or 3 rows on the lips of both jaws, with lower lip folded downward.

Genus CRENIMUGIL Schultz

Crenimugil SCHULTZ, Proc. U. S. Nat. Mus., vol. 96, p. 387, 1946. (Genotype, *Mugil crenilabis* Förskal.)

CRENIMUGIL CRENILABIS (Förskal)

Mugil crenilabis FÖRSKAL, Descriptiones animalium . . ., pp. xiv, 73, 1775 (type locality, Red Sea).

SPECIMENS STUDIED

Bikini Atoll: 3 stations, 53 specimens, 76 to 300 mm. standard length.
Eniwetok Atoll: 16 specimens, 122 to 155 mm.
Guam: 6 lots, 19 specimens, 28 to 49 mm.

Description.—Dorsal rays IV–I,i,7; anal III,9; pectoral ii,15 or 16; pelvic I,5; branched caudal 6+6; scale rows from upper edge of gill opening to midbase of caudal fin 37 to 39; scales in a row from anal fin origin to base of second dorsal 10 or 11; gill rakers very numerous, increasing in number with increase in size.

Greatest depth of body (opposite base of spiny dorsal fin) 3.5 to 3.6, head 3.7 to 4.0, both in standard length; pectoral fin 1.1 in head; pelvic fins reaching nearly to or halfway to anal origin; second dorsal origin over rear of first third of anal fin base; posterior margins of soft dorsal and of anal fins concave; caudal fin deeply forked; first dorsal spine same length as second; first anal spine short, third longest; pelvic spine reaches out two-thirds length of longest pelvic ray; scales cycloid; basal three-fourths to four-fifths of all fins scaled, except spiny dorsal fin, which is naked; accessory pelvic scale 1.5 to 2.0 in longest pelvic ray; upper lip thick, broad, blunt anteriorly, edged with numerous rows of papillae; lower lip edge finely folded, continuous around corner of mouth with upper lip; front edge of preorbital angular, posterior edge truncate; eye without adipose eyelid; lips without teeth; posterior tip of maxillary not exposed.

Color in alcohol.—Dusky to blackish dorsally, silvery on sides and whitish below; upper edge of base of pectoral fin with a black spot; all fins dusky; peritoneum black.

Ecology.—The halfgrown specimens all were taken from high tidal pools or ponds over the reefs; the largest specimen, however, was speared by Vernon Brock in a surge channel on the ocean side of the reef of Erik Island.

Remarks.—Characteristic of this mullet are the papillae on the outer surface of the upper lip and the folded edge of the lower lip, features that make it unlike any other species of Mugilidae yet found.

Genus CHELON Röse

Chelon RÖSE, Petri Artedi Angermannia-Sueci synonymia nominum piscium . . ., ed. 2, p. 118, 1793. (Genotype, *Mugil chelo* Cuvier and Valenciennes.)
Oxymugil WHITLEY, Australian Zool., vol. 11, pt. 3, p. 271, fig. 7, 1948. (Genotype, *Mugil acutus* Cuvier and Valenciennes.)

KEY TO SPECIES OF CHELON COLLECTED IN THE NORTHERN MARSHALL ISLANDS

1*a*. Dorsal posterior part of pectoral fin black; scale rows from upper edge of gill opening to midbase of caudal fin 26 to 28.
Chelon vaigiensis (Quoy and Gaimard)

1*b*. Pectoral fin not blackish; scale rows 30 to 33_____ Chelon engeli (Bleeker)

CHELON VAIGIENSIS (Quoy and Gaimard)

PLATES 23, B; 24, C

Mugil vaigiensis QUOY and GAIMARD, Voyage autour du monde executé sur les corvettes de S. M. *L'Uranie* et *La Physicienne*, . . . , Poissons, Zool., p. 337, pl. 59, fig. 2, 1825 (type locality, Waigiou).

SPECIMENS STUDIED

Bikini Atoll: 2 stations, 18 specimens, 53 to 125 mm. standard length.
Rongelap Atoll: 1 station, 1 specimen, 236 mm.
Guam: 5 lots, 61 specimens, 13 to 111 mm.

Description.—Dorsal rays IV–I,i,6 or 7; anal III,8; pectoral ii,14, pelvic I, 5; branched caudal 6+6; scale rows from upper edge of gill opening to midbase of caudal fin 26 to 28; scales in a row from anal origin to base of second dorsal fin 9.

Greatest depth of body (opposite base of spiny dorsal fin) 3.4 to 4.2, head 3.3 to 3.6, both in standard length; pectoral fin 1.2 to 1.4 in head; pelvic fins reaching from one-half to two-thirds way to anal fin origin; second dorsal fin origin over rear half of anal base; posterior margins of soft dorsal and anal fins concave, that of caudal slightly concave; first and second dorsal spines of about same length; pelvic spine length two-thirds to three-fourths that of longest pelvic ray; scales cycloid; basal three-fourths to four-fifths of all fins scaled, except spiny dorsal, which is naked; accessory pelvic scale 2.3 to 3.0 in longest pelvic ray; upper lip moderately thick, smooth edged, no papillae or plicae, lower lip thin edged, smooth, without papillae or plicae, not folded downward; anterior edge of preorbital angular, posterior edge truncate; eye without adipose eyelid; posterior tip of maxillary a little exposed when mouth is closed.

Color in alcohol.—Dusky to blackish dorsally, belly whitish; center of each row of scales darkish, resulting in about six lengthwise dusky streaks, these lacking on small specimens; upper half of pectoral fin blackish, increasing to cover all but posterior margin on large adults

(200 mm. or longer in standard length); both dorsal fins black in young; all fins, except pectoral, dusky in adults.

Color when alive.—Back greenish black, sides silvery, belly white; upper half to four-fifths of pectoral black, lower part yellowish orange; lips and cheek tinted with orange; caudal fin yellowish.

Ecology.—The young of this species, often found in tidal pools at low tide, were not encountered in the northern Marshall Islands. It was not often seen at Bikini.

Remarks.—This species may be recognized at a glance by the black pectoral fins. It differs from *C. engeli* in having 26 to 28 scales instead of 30 to 33.

CHELON ENGELI (Bleeker)

Mugil engeli BLEEKER, Nat. Tijdschr. Nederl.-Indië, vol. 15, p. 385; 1858; vol. 16, p. 277, 1858–59 (type locality Batavia, Java).

SPECIMENS STUDIED

Bikini Atoll: 2 stations, 16 specimens, 81 to 169 mm.
Guam: 5 lots, 100 specimens, 23 to 103 mm.

Description.—Dorsal rays IV–I,i,7; anal III,9; pectoral ii,14; pelvic I,5; branched caudal 6+6; scale rows from upper edge of gill opening to midbase of caudal fin 30 to 33; scales from anal origin to base of second dorsal fin 10.

Greatest depth (opposite base of spiny dorsal) 3.2 to 3.5, head 3.5 to 4.0, both in standard length; pectoral fin 1.1 to 1.2 in head; pelvic fins reaching ½ to ⅔ the way to anal origin; second dorsal origin over front third of base of anal fin; posterior margins of soft dorsal and of anal fins concave, that of caudal moderately concave; first two dorsal spines about equal; pelvic spine ⅔ to ¾ length of longest pelvic ray; scales cycloid; basal ½ to ⅔ of all fins scaled, except spiny dorsal, which is naked; pelvic scale 2.2 in longest pelvic ray; upper lip moderately narrow, its width about equal to distance between anterior and posterior nasal openings; upper lip profile continuous with that of lower jaw when closed, or nearly so; lips smooth, without papillae, plicae, or teeth; lower lip thin-edged, extending horizontally forward; anterior edge of preorbital concave or angular, its posterior edge rounded in young, becoming truncate in adults; eye with a moderately developed adipose eyelid; posterior tip of maxillary not exposed when mouth is closed; origin of spiny dorsal equidistant between base of caudal and tip of snout, or slightly closer to base of caudal.

Color in alcohol.—Dusky dorsally, sides silvery, under sides white; fins all light dusky; peritoneum black.

Remarks.—This species, with III, 9 and rays and 30 to 33 scale rows, has a pectoral fin a little shorter than the head. In the roof of

the mouth of specimens 100 mm. in standard length and longer is a pair of blackish fleshy lobes, each of which is free anteriorly, just behind upper lip, and which do not join across the middle line of the mouth; also, arising on the tip of the lobe near the midline, is a small lobular projection attached to the midline of the premaxillary. The significance of these is not known.

PLICOMUGIL, new genus

Genotype.—*Mugil labiosus* Cuvier and Valenciennes.

This new genus is a *Chelon* with characteristically folded and lobed lips, as illustrated in the figure and description of *P. labiosus*. It may be separated from all related genera by the key on page 315.

Named *Plicomugil* in reference to the folded lips.

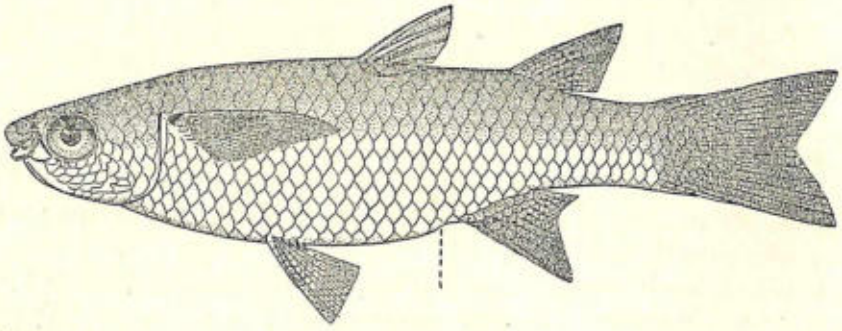

FIGURE 49.—*Plicomugil labiosus* (Cuvier and Valenciennes), from Bikini Atoll. (Drawing by Aime M. Awl.)

PLICOMUGIL LABIOSUS (Cuvier and Valenciennes)

FIGURES 49, 50

Mugil labiosus CUVIER and VALENCIENNES, Histoire naturelle des poissons, vol. II, p. 125, 1836 (type locality, Red Sea).

Mugil joloensis SEALE, Philippine Journ. Sci., vol. 4, p. 500, 1909 (type locality, Jolo, Jolo Island, Philippine Islands).—ROXAS, Philippine Journ. Sci., vol. 54, p. 421, 1934.

SPECIMENS STUDIED

Bikini Atoll: Romuk Island, lagoon reef, April 2, 1946, S–46–48, Schultz, 1 specimen, 115 mm. standard length; Reer Island, lagoon reef, August 12, 1946, S–46–332, Herald and Brock, 1 specimen, 150 mm.

Bikini or Rongelap or Kwajalein Atolls: August 17 to September 28, 1946, Univ. Washington, 1 specimen, 175 mm.

In addition, specimens from the Red Sea and Philippine Islands have been examined.

Description.—Dorsal rays IV–ii,6; IV–i,7; IV–ii,6; anal III,9; III,9; III,9; pectoral ii,14–ii,15; ii,14–ii,14; ii,14–ii,14; pelvic I,5; I,5; I,5; branched caudal 6+6; 6+6; 6+6; scale rows from upper edge

of gill opening to midbase of caudal fin 35; 34; 34; scales in a row from anal origin to base of second dorsal fin 10; 11; 11; gill rakers on first gill arch 18 + 35 = 53 and 18 + 39 = 57.

Precision measurements were made and these are recorded in table 30 in thousandths of the standard length for the two Bikini specimens.

Greatest depth of body at origin of spiny dorsal fin, 3.3 to 3.5; head 3.9 to 4.2, both in standard length; pectoral fin a little longer than head, pelvic fins reaching just a trifle over halfway to anal origin; second dorsal origin over rear of base of anal fin; posterior margins of second dorsal and of anal concave, outer lobe longer than inner one;

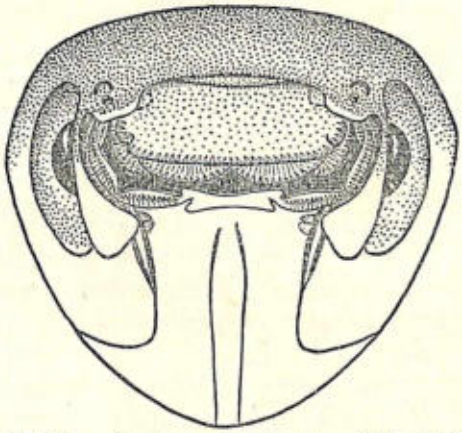

FIGURE 50.—*Plicomugil labiosus* (Cuvier and Valenciennes), from Bikini Atoll, front view showing mouth parts. (Drawing by Aime M. Awl.)

caudal fin with posterior margin concave; first dorsal spine longest, when depressed reaching just past tips of other three spines; first anal spine short, third spine notably longest; pelvic spine reaching out about two-thirds the length of longest soft pelvic ray; scales cycloid; basal half of pectoral and pelvic fins covered with small scales, basal three-fourths of soft dorsal, anal, and caudal fins scaled; accessory pelvic scale contained 2.5 times in longest pelvic ray; upper lip thick, broad, its width over half eye diameter, edge with papillae each having two minute teeth; ventrally to edge of upper lip two paired lobes, median lobe broadest and separated from upper lip, outer lobe small and connected to outer corner of upper lip; corner of mouth with four paired lobes, upper one narrow, second broad, third narrow, and fourth (or ventral one) broad; each of these lobes or folds of lips joined posteriorly, but upper one less so; lower lip at center or symphysis with a broad V-shaped edentulus, or angularly concave area, without papillae or fine teeth, the lip somewhat folded down or thickened; outer half of lower lip with a lobe similar to that on upper

lip; lobes on both upper and lower lips supplied with papillae, each with a minute curved tooth; gill rakers rather long and numerous; adipose eyelid lacking; preorbital deeply notched; maxillary sharply curved downward and with its posterior part notably exposed; lips at corner of mouth fitting snugly into the deep notch of preorbital; premaxillary protactile; nasal openings close together; posterior edge of preorbital a little rounded; small patches of teeth on vomer and palatines.

TABLE 30.—*Measurements made on species of* Plicomugil *expressed in thousandths of the standard length*

Characters	*labiosus* Bikini Atoll		*joloensis* neotype [1] U.S.N.M. No. 137047
Standard length in millimeters	115	150	51.5
Head length	246	240	291
Snout length	77	76	72
Diameter of eye	76	57	93
Interorbital space	120	117	130
Width of upper lip	35	33	23
Greatest depth of body	300	297	311
Least depth of caudal peduncle	129	130	128
Length of caudal peduncle	201	203	198
Snout tip to first dorsal origin	561	550	563
Snout tip to second dorsal origin	790	794	784
Snout tip to anal origin	715	713	732
Longest pectoral ray	257	248	270
Longest pelvic ray	169	169	181
Longest or first dorsal spine	150	145	184
Longest second dorsal ray	146	147	179
Longest anal ray	177	173	195
Longest caudal ray	----------	267	322
Shortest or midcaudal ray	204	213	233

[1] Since the holotype was destroyed, I herewith select U.S.N.M. No. 137047 as the neotype of *Mugil joloensis* Seale. This lot came from Port Caltom, Philippines. Additional specimens are U.S.N.M. No. 154084.

Color in alcohol.—Brownish above, whitish below, pectoral fin at upper edge of its base with a small black spot; anterior two-thirds of dorsal surface of pectoral fins blackish, rear third white; median fins dusky with rear margins a little paler; peritoneum black.

Remarks.—The specimens from the Marshall and Philippine Islands have III,9 anal rays and the two that I have seen from the Red Sea have III,8 and III,9 anal rays. I have compared the Marshall Island specimens with *Mugil joloensis* Seale from the Philippines and *Mugil labiosus* Cuvier and Valenciennes from the Red Sea, and cannot find any characters that definitely separate them. Therefore I conclude that *joloensis* is a synonym of *labiosus*.

The gill rakers appear to increase in number with increased age, varying from 16+29 to 18+39 or more.

Suborder POLYNEMINA

Family POLYNEMIDAE: Threadfins

By LEONARD P. SCHULTZ

Genus POLYDACTYLUS Lacepède

Polydactylus LACEPÈDE, Histoire Naturelle des poissons, vol. 5, p. 419, 1803. (Genotype, *Polydactylus plumierii* Lacepède=*Polynemus virginicus* Linnaeus.)

POLYDACTYLUS SEXFILIS (Cuvier and Valenciennes)

Polynemus sexfilis CUVIER and VALENCIENNES, Histoire naturelle des poissons, vol. 7, p. 515, 1831 (type locality, Isle de France).

SPECIMENS STUDIED

Bikini Atoll: 3 stations, 85 specimens, 51 to 77 mm. standard length.
Eniwetok Atoll: 1 station, 2 specimens, 66 to 69 mm.
Rongelap Atoll: 1 station, 1 specimen, 68 mm.
Rongerik Atoll: 1 station, 1 specimen, 39 mm.

Description.—Dorsal rays VII–I,13; anal III,11; pectoral 14 to 17–6; pelvic I,5; gill rakers 11 to 13+1+15 to 17; scales rows 61 to 63, above lateral line to second dorsal origin 9, below to anal origin 11 or 12. In 92 counts there were 6 free pectoral rays without any variation in number.

Greatest depth 3.4 to 3.6, head 3.0 to 3.3, both in standard length; eye 3.8 to 4.0, snout 4.1 to 5.5, tip of snout to rear edge of maxillary 1.6 to 1.7, interorbital space 3.0 to 4.0, all in length of head. Least depth of caudal peduncle 1.5 to 1.8 in its length.

Greatest depth at origin of first dorsal, the latter a little behind a vertical line through pectoral base; a vertical line through soft dorsal origin passes a little in front of anal origin; pelvic insertion equidistant between anal origin and pupil or closer to latter; anus opposite or slightly in advance of tips of pelvics; free pectoral rays reaching to or a little past tips of pelvic fins; lateral line running a straight course from upper edge of gill opening to midside of caudal peduncle; scales ctenoid; maxillary naked; gill membranes free from isthmus, joined far forward; teeth villiform, in a band on jaw and palatines, in a patch on vomer; eye enclosed in an adipose sheath.

Color in alcohol.—Large adults very light brownish, with fins a little dusky. Smaller specimens (less than 100 mm. in standard length) strikingly marked, as follows: Three broad dark bars, one on head ending behind jaws, second from between dorsals to pelvics (these two separated by wedge-shaped silver area behind head), third on caudal peduncle; first dorsal blackish; second dorsal and anal blackish basally, with broad white margin; caudal fin white basally, distal two-thirds blackish; a white spot at origins of both dorsal fins.

Ecology.—This threadfin was not taken over the reefs but did occur in schools in the lagoon, and sometimes along sandy shores that were nearly free of coral heads. Infrequently, small ones were attracted to a light at night.

Suborder PERCOMORPHINA: Perches and Basses

Family KUHLIDAE

By LEONARD P. SCHULTZ

Genus KUHLIA Gill

Kuhlia GILL, Proc. Acad. Nat. Sci. Philadelphia, 1861, p. 48. (Genotype, *Perca ciliata* Cuvier.) (*Dules* Cuvier is restricted to the Serranidae because Jordan and Gilbert, U. S. Nat. Mus. Bull. 16, p. 542, 1882, restricted the genus by designating the genotype *Dules auriga* Cuvier and Valenciennes, and not as designated by Fowler, Proc. Acad. Nat. Sci. Philadelphia, 1906, p. 510, and U. S. Nat. Mus. Bull. 100, vol. 10, p. 165, 1930, to *Centropomus rupestris* Lacepède).

Various counts for central Pacific species of *Kuhlia* are recorded in table 31. *Kuhlia sandvicensis* appears to be restricted to the Hawaiian Islands and the records for *K. sandvicensis* by Schultz (U. S. Nat. Mus. Bull., 180, p. 101, 1943) for the Phoenix and Samoan Islands appear to be those of *K. marginata.*

KEY TO THE SPECIES OF KUHLIA FROM THE CENTRAL TROPICAL PACIFIC

1*a*. Scale rows from upper edge of gill opening to midbase of caudal fin 40 to 44; dorsal rays X,10 or 11.

2*a*. Anal rays III,10 ; gill rakers on first gill arch 7 to 9+1+16 to 19; about one-fourth of tips of upper and lower lobes of caudal fin whitish, upper and lower margins white; outer middle third of upper and lower caudal lobes with a large black blotch; just beyond tip of lateral line and on middle caudal fin rays a black spot, more evident in young and half grown than in large adults; anterior tip of soft dorsal fin white; dorsal part of soft dorsal pale, distally blackish (Indo-Pacific).

Kuhlia rupestris (Lacepède)

2*b*. Anal rays III,11 or 12, usually 12; gill rakers 9 or 10+1+22 to 25; caudal fin plain pale, without large black blotches in the lobes, posterior margin blackish (Samoan Islands)_____ Kuhlia salelea Schultz

1*b*. Scale rows from upper edge of gill opening to midbase of caudal fin 50 to 55.

3*a*. Caudal fin with five black bars, a median one and two oblique ones in each lobe, areas between black bars white or colorless; soft anal fin with dark pigment, none on rays; tip of chin and snout blackish; peritoneum black. Dorsal rays X,9 to 11; anal III,10 or 11; pectoral ii,11 or 12, usually 12; gill rakers usually 10+1+23 or 24 (tropical Indo-Pacific)_____ Kuhlia taeniura (Cuvier and Valenciennes)

3*b*. Caudal fin not colored as in 3*a*.

4*a*. Posterior margin of caudal fin blackish, a wide pale band bordering it anteriorly; top of head mottled with black and yellow, especially between eyes.

5*a*. Pectoral rays ii,11 or 12; dorsal X,11; anal III,11, rarely III,12; (Indo-Pacific)---- Kuhlia marginata (Cuvier and Valenciennes)

5*b*. Pectoral rays ii,13, rarely ii,12 or ii,14; dorsal X,11 or 12; anal III,11 (Hawaiian Islands)- Kuhlia sandvicensis (Steindachner)

4*b*. Caudal fin with outer third of upper and lower lobes blackish, this area narrowing into a wide band at tips of midcaudal fin rays; central portion of upper and lower halves of caudal fin with a large blackish blotch, bordered by pale area; sometimes area between central dark spots whitish, especially on young, darker on adults; tip of chin black; pectoral rays usually ii,12, rarely ii,13; dorsal X,11 or 12; anal III,12 (Phoenix Islands)---------- Kuhlia petiti Schultz

TABLE 31.—*Certain counts recorded for species of* Kuhlia *from the Central Pacific area*

Species	Number of fin rays													
	Dorsal					Anal					Pectoral			
	X	9	10	11	12	III	9	10	11	12	ii,11	ii,12	ii,13	ii,14
taeniura (Marshall Islands)	7	1	5	2	----	7	----	1	6	----	2	11	----	----
rupestris (Marianas Islands)	9	----	----	9	----	9	----	9	----	----	6	10	----	----
marginata:														
(Marshall Islands)	10	----	----	10	----	10	----	----	10	1	5	12	----	----
(Johnston Island)	2	----	----	2	----	2	----	----	2	----	----	3	----	----
sandvicensis (Oahu Island)	9	----	----	4	5	9	----	----	9	----	----	1	15	1
salelea (Samoan Islands)	4	----	----	4	----	4	----	----	2	2	2	2	----	----
petiti (Phoenix Islands)	7	----	----	4	3	7	----	----	----	7	----	6	1	----

KUHLIA RUPESTRIS (Lacepède)

Centropomus rupestris LACEPÈDE, Histoire naturelle des poissons, vol. 4, pp. 252, 273, 1802 (type locality, Isle de la Réunion).

SPECIMENS STUDIED

Guam: Merizo River, ¾ mile above mouth, November 29, 1945, Frey, 95 specimens, 18 to 245 mm. in standard length.

Rota: rock pool at mouth of stream, November 14, 1945, Frey, 8 specimens, 17 to 29 mm.

Saipan: Talofofo River, Cloud, 1 specimen, 157 mm.

Description.—Dorsal rays X,11; anal III,10; pectoral ii,11 or 12; pelvic always I,5; scales from upper edge of gill opening to midbase of caudal fin 40 to 42, above lateral line to spiny dorsal base 5, from lateral line to anal fin origin 8; about 11 predorsal median scales and about 24 in a zigzag row around least depth of caudal peduncle; gill rakers on first gill arch 7 to 9+1+16 to 19.

Body somewhat compressed, its greatest depth 2.5 to 2.6, head 2.7 to 3.0, length of pectoral fin 4.6 to 5.2; all in standard length. Snout 3.9 to 4.1; eye 3.2 to 4.6; postorbital length of head 1.9 to 2.1; length of anal fin base 1.4; length of pectoral fin 1.8 to 1.9; length of maxillary 2.2 to 2.3; least width of interorbital space 3.4 to 3.0; all in length

of head. Least depth of caudal peduncle in distance from base of last anal ray to midbase of caudal fin 1.3 to 1.4; length of caudal peduncle in length of base of anal fin 1.3 to 1.4. Orbit 1.5 to 1.9 in postorbital length of head.

Lower opercular spine longest and strongest; teeth in villiform band on jaws, vomer, and palatines; maxillary reaches to a point under center of pupil in small adults, to rear margin of pupil, or a trifle beyond, in large adults; pectoral fin reaches to eighth or ninth row of scales behind cleithrum; caudal fin emarginate in young, scarcely so in adults, shortest middle rays 1.2 to 1.4 in longest ones, lobes rounded; dorsal origin a trifle behind a vertical line through pelvic insertions; pelvics not reaching to anus.

Color in alcohol.—Background color grayish, margins of scales blackish, forming a spotted pattern; caudal fin with the posterior third of upper and lower lobes blackish, with the outer tips of these rays pale or whitish, less so in large adults, basal part of fin dusky; distal part of rays of dorsal dusky; anal fin pale except for a few darker blotches sometimes present basally; a blackish area above orbit; peritoneum silvery, with numerous black spots. In the young shorter than 30 mm. the dark color on the fins is intensely black, with an additional black area just behind midbase of caudal fin.

Ecology.—This species enters fresh-water streams, and occurs in the sea.

KUHLIA TAENIURA (Cuvier and Valenciennes)

Dules taeniurus Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 3, p. 114, 1829 (type locality, Java).

SPECIMENS STUDIED

Bikini Atoll: 10 stations, 104 specimens, 17 to 159 mm. standard length.
Eniwetok Atoll: 1 station, 23 specimens, 79 to 121 mm.
Rongelap Atoll: 4 stations, 47 specimens, 16 to 142 mm.
Rongerik Atoll: 2 stations, 17 specimens, 17 to 51 mm.
Agrihan Atoll: 1 lot, 13 specimens, 18 to 28 mm.
Ahrno Atoll: *Albatross*, 5 specimens, 22 to 62 mm.
Saipan: 1 lot, 6 specimens, 21 to 64 mm.
Guam: 1 specimen, 23 mm.

Description.—Dorsal rays X,9 to 11, usually 10 or 11; anal III,10 or 11, usually 11; pectoral rays ii,11 or 12; pelvics always I,5; scales from upper edge of gill opening to midbase of caudal fin usually 53 or 54, with 6 scales from lateral line to spiny dorsal fin base, exclusive of scaly sheath, and 10 below lateral line to anal origin; median predorsal scales about 11 or 12; about 24 scales in a zigzag row around least depth of caudal peduncle; gill rakers on first gill arch about 10+1+23 or 24.

Body somewhat compressed; greatest depth 2.6 to 2.8, head 3.1 to 3.3, length of pectoral fin 4.7 to 5.0, all in the standard length. Snout 4.0 to 4.2; eye 2.8 to 3.0; postorbital length of head 2.3 to 2.5; length of anal fin base 1.4; length of pectoral fin 1.4 to 1.6; length of maxillary 2.5 to 2.8; least width of interorbital space 3.2 to 3.3; all in length of head. Least depth of caudal peduncle in distance from base of last anal ray to midbase of caudal fin 1.7 to 1.9; length of caudal peduncle in length of base of anal fin 1.0 to 1.1. Orbit 1.1 to 1.2 in postorbital length of head.

Lower opercular spine longest and strongest, villiform band of teeth on jaws, vomer, and palatines; maxillary not quite reaching to a vertical line through front of pupil; pectoral fin reaches to twelfth or thirteenth scale behind cleithrum; caudal fin deeply forked, shortest middle rays 1.8 to 2.0 in longest rays; lobes pointed posteriorly; dorsal origin a little behind a vertical line through insertion of last, or inner, pelvic ray; pelvics not quite reaching to anus.

Color in alcohol.—Brownish to blackish dorsally, paler ventrally; back sometimes with a few wavy brown streaks, dorsal surface sometimes with interconnecting dark wavy streaks; caudal fin with 5 dark bars, a central one and two oblique ones in each lobe; soft dorsal distally with a black streak edged with white; spiny dorsal dusky, darker edged distally; anal fin rays with blackish pigment in basal ¾; tip of snout and of lower jaw blackish; peritoneum black.

Ecology.—This widely distributed species is common on the reefs in the higher pools that are left at low tide, in which the young congregate. At night young *K. teniura* are attracted to a light. Some of these were taken at a considerable distance from the reefs, in situations where the current would carry them far from the reefs out to sea. Undoubtedly the more or less pelagic nature of the immature has been a major factor in the wide distribution of this species.

KUHLIA MARGINATA (Cuvier and Valenciennes)

Dules marginatus CUVIER and VALENCIENNES, Histoire naturelle des poissons, vol. 3, p. 116, pl. 52, 1829 (type locality, Java).

SPECIMENS STUDIED

Bikini Atoll: 5 stations, 19 specimens, 17 to 150 mm. standard length.
Eniwetok Atoll: 1 station, 1 specimen, 42 mm.
Rongerik Atoll: 2 stations, 2 specimens, 26 to 55 mm.

Description.—Dorsal rays, X,11; anal III,11, rarely III,12; pectoral ii,11 or 12; pelvic I,5; scales from upper edge of gill opening to midbase of caudal fin usually 51 or 52, from lateral line to spiny dorsal base 6, from lateral line to anal origin 12, predorsal scales about 12; gill rakers on first gill arch 9 to 12+1+24 to 28.

Body compressed; greatest depth 2.5 to 2.6, head 3.0 to 3.5, length of pectoral fin 4.6 to 4.7, all in the standard length. Snout 3.7 to 4.0; eye 2.8 to 3.1; postorbital length of head 2.3 to 2.4; length of anal fin base 1.2 to 1.3; length of pectoral fin 1.4 to 1.5; length of maxillary 2.3 to 2.4; least width of interorbital space 3.2 to 3.6; all in the length of the head. Least depth of caudal peduncle in distance from base of last anal ray to midbase of caudal fin 1.6 to 1.7; length of caudal peduncle in length of base of anal fin 1.2 to 1.3. Orbit 1.1 to 1.2 in postorbital length of head.

Lower opercular spine only a little longer and stronger than upper one; villiform band of teeth on jaws, vomer, and palatines; maxillary not quite or reaching a vertical line through front of pupil; pectoral fin reaches to the thirteenth to fifteenth rows of scales behind cleithrum; caudal fin deeply forked, lobes pointed posteriorly, the shortest middle rays twice in longest caudal rays; dorsal origin about over pelvic insertions; pelvics reaching to or not quite to anus.

Color in alcohol.—Background color grayish, darker above, paler below; caudal fin dusky, margined with blackish posteriorly; distal part of dorsal fin dusky; sometimes the rays of anal fin have black pigment; in young about 40 to 50 mm. in standard length there may be an area with dark pigment about halfway out the upper and lower caudal fin rays. Peritoneum is profusely black pigmented.

Ecology.—Specimens of lengths up to about 55 mm. were taken in high tidal pools on the reef. Larger specimens came from deeper water.

Family SERRANIDAE: Groupers, Sea Basses

By Leonard P. Schultz

My study of this remarkable group of fishes has revealed several surprises.

I have based my conclusions on large series of specimens from nearly all the large island groups of the tropical Indo-Pacific oceans and I believe that the resulting opinions should carry considerable weight in untangling some of the commoner species of groupers of that vast region. I have concluded that the color pattern of the groupers is of the utmost importance in distinguishing the various species, but that not too much value should be placed on the presence or absence of the dark vertical bands; these appear to vary in intensity with age, more or less disappearing in adults of certain species. The dark blotches along the back, as well as the distribution of black spots elsewhere on the head and body, are very important characters. Since the pelvic rays are normally I,5 and the branched caudal rays 8+7, these counts are omitted in the descriptions. The species usually referred to the *Epinephelus merra* and *E. hexagonatus* complex have

received very careful attention and my studies have clearly shown several species to exist, some of which are new.

KEY TO THE SERRANIDAE FROM THE NORTHERN MARSHALL ISLANDS AND MARIANAS ISLANDS IN THE U. S. NATIONAL MUSEUM

1*a*. Opercular membrane notably with free area dorsally, not fused along the dorsal edge of operculum; scales ctenoid, not deeply embedded in the thickish skin.

2*a*. Scaly membrane or dermal process at dorsal edge of pectoral base connecting with body; supplementary maxillary bone present; dorsal fin single, sometimes a little emarginate near last dorsal spine but never deeply notched to base.

3*a*. Dorsal spines XI, rarely X or XII, vomerine teeth in a Λ-shaped narrow band.

4*a*. Palatine teeth present; anal rays III,8, very rarely III,9, or III,7; no canines on sides of mandible besides the usual ones near symphysis.

5*a*. Interorbital space notably convex; soft dorsal rays notably shorter than longest dorsal spine; middle opercular spine equidistant between upper and lower ones; no distinct dark blotches along base of dorsal fin or on caudal peduncle.

6*a*. Two rows of teeth on middle of sides of dentary in adult; longest gill raker on first gill arch longer than gill filaments, greatest depth 2.8 to 3.0 in standard length and 1.1 in head; pectoral 1.7 in head; background color brownish with numerous roundish black spots on head, body, and fins; maxillary groove not dark edged_____ Epinephelus medurensis (Günther) (p. 334)

6*b*. Three rows of teeth on middle of sides of dentary in adult; longest gill raker on first gill arch about equal to length of gill filaments; greatest depth 2.4 in standard length and 0.8 to 0.9 in head; pectoral 2.0 to 2.1 in head; background color light tan, lighter ventrally; head, body, and fins profusely covered with tiny dark brown spots, then with much larger, scattered, irregularly shaped blackish spots; maxillary groove dark edged dorsally. Epinephelus kohleri, new species (p. 336)

5*b*. Interorbital space flattish or nearly so, sometimes slightly concave or slightly convex.

7*a*. Background color brownish, with more or less evident vertical bars, and everywhere, except on lower sides and on underside of head, profusely covered with small whitish spots; pectoral plain dusky with white spots basally; pelvics blackish distally; maxillary groove black; median fins submarginally with blackish, but edged with white line; usual dark blotches along back lacking except as part of vertical dark bars; middle opercular spine notably closer to lower than upper one; 2 or 3 rows of teeth on middle of sides of dentary. Epinephelus summana (Forskål) (p. 338)

7*b*. Background color brownish or pale, overlaid with darker brown spots.

8*a*. No prominent black blotch or black saddlelike spot on dorsal edge of caudal peduncle; if body is brown spotted or black spotted, these may occur on caudal peduncle but are not notably intensified as a black blotch there; 3 or more rows of teeth at middle of side of dentary on adults.

9*a*. Body and head profusely covered with tiny black spots, except on ventral side of belly and chest, and only a few on underside of head; soft dorsal and caudal fins with pale spots; paired fins plain dusky; all fins broadly white edged; vertical bars sometimes faintly developed as are the usual dark dorsal blotches along base of dorsal fin; black blotch on dorsal edge of caudal peduncle slightly evident; soft dorsal rays longer than longest dorsal spines; middle opercular spine equidistant between upper and lower ones; greatest depth 2.9 to 3.4 in standard length and 1.3 in head; pectoral 1.7 to 1.9 in head. Epinephelus socialis (Günther) (p. 339)

9*b*. Color pattern not as above.

10*a*. No dark blotch along base of dorsal fin; longest gill raker equal to or longer than gill filaments; middle opercular spine equidistant between upper and lower ones.

11*a*. Background color plain light brownish, without round dark spots; sometimes a color phase occurs in the young in which vertical bars show in combination with large white or silvery blotches; a black ring posteriorly around eye; tips of spiny dorsal rays black, a black line with short side branchings along base of dorsal fin; soft dorsal rays longer than longest dorsal spine; greatest depth 2.8 to 3.2 in standard length and 1.3 in head; least depth of caudal peduncle about 2.0 in snout tip to rear of maxillary; pectoral fin 1.7 to 1.8 in head; longest dorsal spine 2.0 to 2.1 in postorbital length of head_____ Epinephelus emoryi, new species (p. 340)

11*b*. Color pattern largely of brown spots; greatest depth 3.2 to 3.4 in standard length and 1.3 to 1.4 in head; longest dorsal spine 1.5 to 1.9 in head.

12*a*. Background color light grayish to whitish, with large, round, more or less hexagonal, dark-brown to blackish spots everywhere on fins, head, and body, those ventrally more widely spaced; paired fins spotted all the way to their tips, pectorals without white edge; (spots orange-brown in life); pectoral 1.5 to 1.7 in head; third or fourth dorsal spine longest; soft dorsal rays notably longer than dorsal spines. Epinephelus merra Bloch (p. 343)

12*b*. Background color light yellowish tan or light grayish, everywhere with scattered roundish, brown or blackish spots; pectoral with or without black spots basally, plain dusky distally with posterior margin broadly white edged as is caudal fin; body on ventral side unspotted except in young; pelvics dusky, white edged; pectoral 1.7 to 2.0 in head; soft dorsal rays equal in length to longest or fifth or sixth dorsal spine. Epinephelus macrospilos (Bleeker) (p. 344)

10*b*. From 1 to 4 black blotches or spots along base of dorsal fin and usually extending a short way up on dorsal fin; longest gill raker on first arch equal to or shorter than gill filaments; greatest depth 3.0 to 3.6 in standard length.

13*a*. Background color light gray to light brownish with numerous scattered dark-brown or blackish spots on body, head, and median fins; base of pectoral brown spotted, distal three-fourths plain brownish, seldom with spots discernible except in young, but underside of pectoral spotted to its distal edge except for narrow white margin; a single black dorsal blotch below bases of dorsal spines VIII and IX and on basal part of membranes between these spines; rarely is the pigmentation intensified to indicate dark vertical bars; dark spots on live fish are brick red to brownish red and pectoral is yellowish or olive; least depth of caudal peduncle in snout tip to rear of maxillary 1.9 to 2.3; greatest depth 1.4 to 1.6 and pectoral 1.9 to 2.5, both in head; longest dorsal spine 2.2 to 3.2 times in postorbital length of head; middle opercular spine a little closer to lower than to upper one.

Epinephelus elongatus, new species (p. 345)

13*b*. Background color light gray or tan, with hexagonal brown spots on sides and back, gradually becoming on lower sides and ventrally roundish brown spots widely separated, as contrasted with the hexagonal ones, which are separated by white lines; no tiny triangular white specks between brown spots; paired fins brown spotted, those on pectoral usually forming bars; a large black blotch below bases of dorsal spines VIII to XI, and on basal half or three-fourths of membranes between these spines; no other distinct black blotches along bases of dorsal fin; posterior margins of pectoral, caudal, soft dorsal, and soft anal fins white edged; least depth of caudal peduncle in snout tip to rear of maxillary 1.6 to 1.7; greatest depth 1.3 to 1.4, pectoral 1.7 to 1.8, both in head; longest dorsal spine 1.5 to 1.8 in postorbital length of head; middle opercular spine equidistant or nearly so between upper and lower ones.

Epinephelus melanostigma, new species (p. 348)

8*b*. A distinct black spot, blotch, or black saddlelike spot on dorsal edge of caudal peduncle.

14*a*. Teeth at middle of side of dentary in two rows in adults; none of the dark spots hexagonal, instead dark spots are rounded.

15*a*. Background color light gray or light brownish or brownish, with about 7 irregular dark-brown bars on sides, the last of which is a characteristically shaped black saddle on dorsal edge of caudal peduncle; lower sides and ventrally, profusely covered with small dark-brown spots, soft dorsal and caudal fin with light spots (yellowish in life); sometimes there is a color phase in which the head is barred and the bars dorsally are composed of small brown spots; the usual dark blotches along base of dorsal fin are absent except as represented by the vertical brown bars; soft dorsal rays usually 14, sometimes 15; middle opercular spine slightly closer to lower than to upper one;

opercular flap broadly rounded dorsally, not tapering to a symmetrical point.

Epinephelus fuscoguttatus (Forskål) (p. 351)

15*b*. Background color light gray to tan with scattered, small, roundish, dark-brown or blackish spots more or less in rows on head, body, dorsal, and caudal fins, and on anal and pectoral fins in young; pelvics, pectoral, and anal fins dusky; all fins white edged; a single black blotch at base of VIII to XI dorsal spines, and one on dorsal edge of caudal peduncle; soft dorsal rays usually 16 or 17; middle opercular spine equidistant or a little closer to upper than lower spine. Epinephelus spilotus, new species (p. 352)

14*b*. Teeth in 3 or more rows at middle of side of dentary; dark spots hexagonal at least dorsally, middle opercular spine equidistant between upper and lower ones.

16*a*. Background color whitish to light tan, everywhere covered with distinct hexagonal brown spots, separated by a narrow white line, angles between brown spots with tiny white to silvery triangular specks; the dark spots may be darkened opposite the 4 or more blackish dorsal blotches to form more or less evident dark bars; all dorsal dark blotches of about equal intensity; pectoral fins plain light tan or dusky or with indistinct markings even on young; on the young and halfgrown the dark spots on fins have pale centers; (dark spots reddish brown in life).

Epinephelus hexagonatus) (Bloch and Schneider) (p. 355)

16*b*. Background color light gray to tan with hexagonal brownish spots on sides, more uniform dorsally where they are separated by a narrow white line, ventrally these spots become roundish and more widely spaced; no triangular white specks between dark spots; no pale centers to dark spots; the most characteristic color mark consists of scattered but numerous small black or brown spots on dorsal surface of snout, interorbital space, and on sides of head below eye.

Epinephelus spilotoceps, new species (p. 357)

4*b*. Palatine teeth absent; anal rays usually III,9; occasionally III,8; dorsal rays XI,14 or 15 usually 15; background color brownish, darker dorsally, sides and back with numerous pale spots, which sometimes have brownish centers; they are close together on head, less so on body; median soft fins and ventral and posterior part of body with small dark-brown spots, rather sparsely spaced; on halfgrown and young specimens, usually 2 or 3 pale streaks (white in life) along sides; (reddish brown in life, with bright orange or brownish-red spots, the latter becoming pale in alcohol).

Anyperodon leucogrammicus (Cuvier and Valenciennes) (p. 360)

3*b*. Dorsal spines VIII or IX; palatine teeth present; vomerine teeth in a Λ-shaped band.

17*a*. Sides of mandible with strong canines.

18*a*. Dorsal rays IX,14 occasionally 13; anal spines strong, rays III,8; one or two fixed curved canines on sides of mandible; vertical scale rows above lateral line about 125 to 145; caudal fin deeply

concave with dorsal and ventral lobes greatly elongate; background color light brownish to grayish (orange in life) everywhere spotted with numerous small pale spots (red or pink in life, those on back margined with purple or blue line); undersides dark red---------- Variola louti (Forskål) (p. 361)

18*b*. Dorsal rays VIII,11; anal spines weak, flexible, rays III,8; caudal fin truncate or a little concave (body usually blue spotted in life, these becoming brownish or pale in alcohol).

19*a*. Caudal fin truncate, with dorsal and ventral tips or corners of fin rounded; in life diameter of many of the black-edged blue spots on middle of sides equal to the paler space between them; usually 1 or 2 pairs of strong canines on middle of sides of lower jaw; background color in life light brown or dusky.

Plectropomus truncatus Fowler (p. 363)

19*b*. Caudal fin slightly concave, with dorsal and ventral corners pointed; in life diameter of many of the black-edged blue spots on middle of sides contained 2 or 3 or more times in the pale space between them; usually 3 or 4 pairs of strong canines on middle of sides of lower jaw; background color in life bright orange or reddish.

Plectropomus leopardus (Lacepède) (p. 364)

17*b*. Sides of mandible without canines; dorsal spines IX, rarely X; anal spines strong, not flexible, III,9; all fins rounded or nearly so posteriorly.

20*a*. Dorsal rays IX,14; 1 or 2 black spots or blotches on dorsal side of caudal peduncle, the spot just behind dorsal base most intense black, both spots surrounded by white; an oblique black streak on upper lobe of caudal fin bordered dorsally by a white streak, then dorsal edge dusky; head and body sometimes with numerous pale spots (bright red in life); background color brownish (orange or red in life)--- Cephalopholis leopardus (Lacepède) (p. 365)

20*b*. Dorsal rays IX,15 or 16; color patterns not as above.

21*a*. Background color dark brownish or purplish black, speckled everywhere with scattered small pale spots (dazzling bright blue in life), these on all fins; posterior edges of soft dorsal, anal, pectoral, and caudal fins white edged (yellowish in life); some specimens have from 5 to 7 broad dark vertical bands.

Cephalopholis argus Bloch and Schneider (p. 367)

21*b*. Coloration not as above.

22*a*. A pair of oblique white streaks on dusky caudal fin do not quite meet posteriorly; background color dark brown to light brown, posteriorly much darker than anterior half; small specimens may have fins blackish posteriorly; a black blotch on upper part of operculum on its posterior flap; head, body, and fins may be speckled with small white spots (orange in life); opposite each small canine on each side of symphysis of lower jaw a blackish spot on lip.

Cephalopholis urodelus (Bloch and Schneider) (p. 368)

22*b*. No white oblique streaks on caudal fin; background color light brown; head, body, and median fins covered with small brown spots; breast and belly unspotted; soft dorsal and anal edged with dusky---- Cephalopholis miniatus (Forskål) (p. 369)

opercular flap broadly rounded dorsally, not tapering to a symmetrical point.

Epinephelus fuscoguttatus (Forskål) (p. 351)

15*b*. Background color light gray to tan with scattered, small, roundish, dark-brown or blackish spots more or less in rows on head, body, dorsal, and caudal fins, and on anal and pectoral fins in young; pelvics, pectoral, and anal fins dusky; all fins white edged; a single black blotch at base of VIII to XI dorsal spines, and one on dorsal edge of caudal peduncle; soft dorsal rays usually 16 or 17; middle opercular spine equidistant or a little closer to upper than lower spine. Epinephelus spilotus, new species (p. 352)

14*b*. Teeth in 3 or more rows at middle of side of dentary; dark spots hexagonal at least dorsally, middle opercular spine equidistant between upper and lower ones.

16*a*. Background color whitish to light tan, everywhere covered with distinct hexagonal brown spots, separated by a narrow white line, angles between brown spots with tiny white to silvery triangular specks; the dark spots may be darkened opposite the 4 or more blackish dorsal blotches to form more or less evident dark bars; all dorsal dark blotches of about equal intensity; pectoral fins plain light tan or dusky or with indistinct markings even on young; on the young and halfgrown the dark spots on fins have pale centers; (dark spots reddish brown in life).

Epinephelus hexagonatus) (Bloch and Schneider) (p. 355)

16*b*. Background color light gray to tan with hexagonal brownish spots on sides, more uniform dorsally where they are separated by a narrow white line, ventrally these spots become roundish and more widely spaced; no triangular white specks between dark spots; no pale centers to dark spots; the most characteristic color mark consists of scattered but numerous small black or brown spots on dorsal surface of snout, interorbital space, and on sides of head below eye.

Epinephelus spilotoceps, new species (p. 357)

4*b*. Palatine teeth absent; anal rays usually III,9; occasionally III,8; dorsal rays XI,14 or 15 usually 15; background color brownish, darker dorsally, sides and back with numerous pale spots, which sometimes have brownish centers; they are close together on head, less so on body; median soft fins and ventral and posterior part of body with small dark-brown spots, rather sparsely spaced; on halfgrown and young specimens, usually 2 or 3 pale streaks (white in life) along sides; (reddish brown in life, with bright orange or brownish-red spots, the latter becoming pale in alcohol).

Anyperodon leucogrammicus (Cuvier and Valenciennes) (p. 360)

3*b*. Dorsal spines VIII or IX; palatine teeth present; vomerine teeth in a Λ-shaped band.

17*a*. Sides of mandible with strong canines.

18*a*. Dorsal rays IX,14 occasionally 13; anal spines strong, rays III,8; one or two fixed curved canines on sides of mandible; vertical scale rows above lateral line about 125 to 145; caudal fin deeply

concave with dorsal and ventral lobes greatly elongate; background color light brownish to grayish (orange in life) everywhere spotted with numerous small pale spots (red or pink in life, those on back margined with purple or blue line); undersides dark red---------- Variola louti (Forskål) (p. 361)

18*b*. Dorsal rays VIII,11; anal spines weak, flexible, rays III,8; caudal fin truncate or a little concave (body usually blue spotted in life, these becoming brownish or pale in alcohol).

19*a*. Caudal fin truncate, with dorsal and ventral tips or corners of fin rounded; in life diameter of many of the black-edged blue spots on middle of sides equal to the paler space between them; usually 1 or 2 pairs of strong canines on middle of sides of lower jaw; background color in life light brown or dusky.

Plectropomus truncatus Fowler (p. 363)

19*b*. Caudal fin slightly concave, with dorsal and ventral corners pointed; in life diameter of many of the black-edged blue spots on middle of sides contained 2 or 3 or more times in the pale space between them; usually 3 or 4 pairs of strong canines on middle of sides of lower jaw; background color in life bright orange or reddish.

Plectropomus leopardus (Lacepède) (p. 364)

17*b*. Sides of mandible without canines; dorsal spines IX, rarely X; anal spines strong, not flexible, III,9; all fins rounded or nearly so posteriorly.

20*a*. Dorsal rays IX,14; 1 or 2 black spots or blotches on dorsal side of caudal peduncle, the spot just behind dorsal base most intense black, both spots surrounded by white; an oblique black streak on upper lobe of caudal fin bordered dorsally by a white streak, then dorsal edge dusky; head and body sometimes with numerous pale spots (bright red in life); background color brownish (orange or red in life)--- Cephalopholis leopardus (Lacepède) (p. 365)

20*b*. Dorsal rays IX,15 or 16; color patterns not as above.

21*a*. Background color dark brownish or purplish black, speckled everywhere with scattered small pale spots (dazzling bright blue in life), these on all fins; posterior edges of soft dorsal, anal, pectoral, and caudal fins white edged (yellowish in life); some specimens have from 5 to 7 broad dark vertical bands.

Cephalopholis argus Bloch and Schneider (p. 367)

21*b*. Coloration not as above.

22*a*. A pair of oblique white streaks on dusky caudal fin do not quite meet posteriorly; background color dark brown to light brown, posteriorly much darker than anterior half; small specimens may have fins blackish posteriorly; a black blotch on upper part of operculum on its posterior flap; head, body, and fins may be speckled with small white spots (orange in life); opposite each small canine on each side of symphysis of lower jaw a blackish spot on lip.

Cephalopholis urodelus (Bloch and Schneider) (p. 368)

22*b*. No white oblique streaks on caudal fin; background color light brown; head, body, and median fins covered with small brown spots; breast and belly unspotted; soft dorsal and anal edged with dusky---- Cephalopholis miniatus (Forskål) (p. 369)

2*b*. No scaly membrane at dorsal edge of pectoral fin base.

23*a*. Two dorsal fins, first spiny, second of one spine followed by soft rays; usually 5 to 7 rows of scales cross the back, separating the first and second dorsal fins; supplemental maxillary bone present.

24*a*. Dorsal rays VIII–I,ii,8; anal II,8; fins naked; vomerine patch of teeth rounded to a little angular in shape but not Λ-shaped; sixth to eighth (counting down from dorsal edge) pectoral rays longest; edge of preopercle strongly serrate; scale rows about 85 to 88; coloration plain dark brown to blackish; fin rays dark brown, sharply contrasting with clear membranes.

Belonoperca chabanaudi Fowler and Bean (p. 370)

24*b*. Dorsal spines fewer than VIII–I; anal III,8.

25*a*. Dorsal rays VI–I,i,11; anal III,8; scales about 45 to 48; predorsal scales 10 to 13 to occiput; vomerine patch of teeth Λ-shaped, or at least with a concave notch posteriorly; fourth pectoral ray from dorsal edge longest; preopercular edge finely serrate.

Ypsigramma, new genus (p. 372)

25*b*. Dorsal rays IV–I,9; anal II,8; pectoral 17, with sixth to eighth from dorsal edge longest; scales about 80, pores in lateral line 46; vomer with a curved band of minute teeth, rear ones longest; preopercular edge serrate; opercular edge serrate.

Rainfordia [65] McCulloch

23*b*. A single dorsal fin, spiny part continuous with soft dorsal; spines fewer than X; last few short spines may have a sheath of scales along sides but no scaled area completely separating spines and soft rays.

26*a*. Dorsal spines VIII, soft rays 11 to 14____ Chorististium Gill (p. 372)

26*b*. Dorsal spines IX, soft rays 12 to 14_____ Liopropoma Gill (p. 373)

23*c*. A single dorsal fin with X,14 rays; supplemental maxillary bone absent, preopercular edge serrate; teeth nondepressible; interorbital convex; postorbital length of head, about 2.2 in head; anal III,8; 47 to 50 pores in lateral line and 65 to 71 vertical rows of scales above lateral line from upper edge of gill opening to base of caudal fin; gill rakers long, slender about 7 or 8+1+18 or 19 on first gill arch.

Anthias heraldi, new species (p. 381)

1*b*. Opercular membrane at dorsal edge of opercle joined posteriorly to the supracleithrum; no scaly membrane at dorsal edge of pectoral; scales very small, cycloid, deeply embedded in the skin; maxillary with supplemental bone; tongue smooth; dorsal spines II or III, or VI to VIII; anal spines 0 or II or III_____ Grammistinae (p. 384)

Subfamily SERRANINAE

Genus EPINEPHELUS Bloch

Epinephelus BLOCH, Naturgeschichte der ausländischen Fische, vol. 7, p. 11, 1793. (Genotype, *Epinephelus marginalis* Bloch=*Perca fasciatus* Forskål.)

Among the postlarval and very young serranids occur 11 lots from the northern Marshall Islands, totaling 25 specimens, measuring between 23 and 32 mm., that I am unable to identify with certainty.

EPINEPHELUS MEDURENSIS (Günther)

Serranus medurensis GÜNTHER, Fische der Südsee, Journ. Mus. Godeffroy, pt. 1, p. 8, pl. 9, fig. A, 1873 (type locality, Meduro Island, Marshall Islands).

[65] *Rainfordia* McCulloch, Rec. Australian Mus., vol. 14, No. 2, p. 119, 1923.

SPECIMENS STUDIED

Eniwetok Atoll: Off Eniwetok Island, lagoon, May 20, 1946, S–46–154, Welsh and Schaefer, 1 specimen, 315 mm.; Aaraanbiru Island, ocean reef, June 3, 1946, S–46–198, Schultz, 1 specimen, 320 mm.

In addition we have a single small specimen, 51 mm. in standard length, with convex interorbital space, brown spotted, that we refer to this species with uncertainty. It was taken by J. R. Simon at Eniwetok Atoll, June 16, 1945, from the lagoon reef.

Description.—Precision measurements were made on the two large specimens recorded above and these data are expressed in thousandths of the standard length. Standard length 320 mm. and 315 mm. Greatest depth 347 and 349; head 393 and 390; snout 101 and 102; bony interorbital space 47 and 44; eye 61 and 60; postorbital length of head 238 and 232; least width of preorbital 42 and 44; length of maxillaries 178 and 172; least depth of caudal peduncle 125 and 114; length of caudal peduncle 200 and 205; length of first dorsal spine 63 and 57, third 150 and 168, last 109 and 117, longest (fourth or fifth) 172 and 181; length of first anal spine 38 and 35, second 78 and 76, third 94 and 89; length of longest soft dorsal ray 134 and 146, pectoral 225 and 219, pelvic 213 and 194, caudal 233 and 238.

The following counts were made: Dorsal rays XI,16 and X1,16; anal III,8 and III,8; pectoral ii,17–ii,17 and ii,17–ii,16; nearly vertical scale rows above lateral line 117 and 125; scales in a row from anal origin to lateral line 30 and 33, from lateral line to soft dorsal base 13 and 13; gill rakers on first gill arch 9+1+16 and 8+1+15. Greatest depth 2.8 to 3.0; head 2.6 to 2.7; length of pectoral fin 4.3 to 4.5; all in standard length. Greatest depth 1.1; length of pectoral fin 1.7; snout 3.9 to 4.0; postorbital length of head 1.7; eye 6.1 to 6.5; tip of snout to rear of maxillary 2.3; least depth of caudal peduncle 3.2 to 3.3; all in the length of head. Interorbital (fleshy) space notably convex, about 0.9 to 1.0 in eye; least depth of caudal peduncle in its length 1.7 to 1.8; teeth on dentary in two rows at middle of side, those on premaxillary in a villiform band; a pair or two of short canines each side of symphysis in each jaw; teeth on palatines in a narrow band, those on vomer in a Λ-shaped narrow band; preopercular edge rounded, but with usual shallow concavity and finely serrate; greatest depth of body at origin of dorsal fin; posterior margins of all fins except caudal rounded, the caudal fin truncate with very slightly convex posterior margin; fourth or fifth dorsal spine longest, 1.3 in postorbital length of head; longest soft dorsal rays notably shorter than dorsal spines; second anal spine a little stronger than others, not reaching to tip of third when depressed; gill rakers notably elongate, heavy, longer than gill filaments; maxillary scaled; middle preopercular spine about equidistant between upper and lower; a vertical line through rear of eye passes through rear edge of maxillary.

Color in alcohol.—Background color brown with numerous blackish spots on head, body, and fins; no dorsal blackish blotches; a very faint slightly paler blotch through last dorsal spines and on adjoining part of back.

Remarks.—Although several authors have referred *medurensis* to the synonymy of *E. maculatus* (Bloch) or to that of *E. fario*, I am of the opinion that *medurensis* is distinct. It may be recognized by the dark brown ground color with numerous blackish spots, the absence of white margins or edges on any fins, the presence of black spots on all fins, the long gill rakers (longer than filaments), fourth and fifth dorsal spines that are notably longer than the longest soft dorsal rays, the strongly convex interorbital space, a middle opercular spine longer than but equidistant from the upper and lower ones, and the absence of a black streak on the maxillary groove.

EPINEPHELUS KOHLERI, new species

FIGURE 51

Serranus flavocaeruleus (non Lacepède) H. HIYAMA, Report on the poisonous fishes of the South Seas, p. 81, pl. 18, fig. 49, 1943 (Marshall Islands).

Holotype.—U.S.N.M. No. 141922, Rongerik Atoll, Bock Passage, depth 60 feet, hook and line, July 20, 1946, S–46–276, Kohler, standard length 405 mm., total length 475 mm. (when alive, standard length was 420 mm.).

Paratype.—Bikini Atoll, lagoon, 1 mile off Bikini Island, July 22, 1947, Univ. Washington, standard length 323 mm.

Description.—The following measurements, expressed in thousandths of the standard length, are recorded first for the holotype, then for the paratype. Standard length 405 and 323 mm. Greatest depth 462 and 430; head 418 and 411; snout 122 and 118; bony interorbital space 68 and 84; eye 65 and —; postorbital length of head 241 and 238; least width of preorbital 52 and 46; length from snout tip to rear edge of maxillary 198 and 198; least depth caudal peduncle 128 and 127; length caudal peduncle 206 and 217; length of first dorsal spine 70 and 62, third 166 and 161, last 111 and 124, longest 177 (fourth) and 161 (third); length of first anal spine 41 and 40, second 73 and 77, third 98 and 99; length of longest soft dorsal ray 163 and 145, pectoral 212 and 189, pelvic 198 and 201, caudal 204 and 238.

The following counts were made: Dorsal rays XI,17 and XI,17; anal III,8 and III,8; pectoral ii,17–ii,18 and ii,17–ii,17. Vertical scale rows above lateral line about 138 and 137; scales in a row from anal origin to lateral line about 38 and 41, from lateral line to base of soft dorsal 16 and 18; gill rakers on first gill arch 10 or 11+1+16 and 10+1+15.

Greatest depth 2.4 and 2.4; head 2.6 and 2.5; length of pectoral fin 5.0 and 5.3; all in standard length. Greatest depth 0.8 and 0.9; pectoral 2.0 and 2.1; snout 3.4 and 3.5; postorbital length of head 1.7 and 1.7; eye 6.3 and 6.8; snout tip to rear of maxillary 2.0 and 2.1; least depth of caudal peduncle 3.2 and 3.1; all in length of head. Least depth of caudal peduncle in distance from snout tip to rear of maxillary 1.7 and 1.6. Fleshy interorbital space strongly convex, 0.8 and 0.7 in eye; least depth of caudal peduncle in its length 1.6 and 1.7.

Teeth on dentary in 2 rows posteriorly, 3 at middle of side, and several anteriorly; maxillary teeth in a villiform band, jaw teeth depressible, a narrow band of villiform teeth on palatines, a similar Λ-shaped

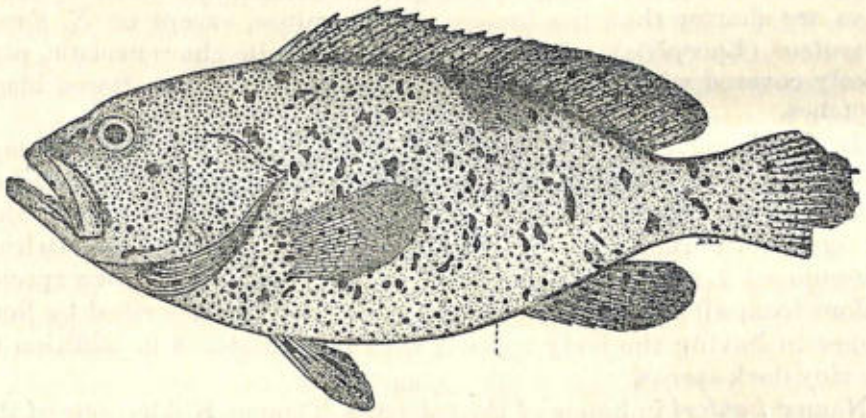

FIGURE 51.—Holotype of *Epinephelus kohleri*, new species (U.S.N.M. No. 141922), from Rongerik Atoll. (Drawing by Dorothea B. Schultz.)

band on vomer; a pair or two of small canines each side of symphysis in each jaw; middle opercular spine farther back than upper and lower, about equidistant between them; preopercular edge somewhat truncate, with the usual shallow concavity, finely serrate; greatest depth of body opposite front of spiny dorsal; posterior margins of all fins rounded except caudal, which is slightly concave; third or fourth dorsal spines longest, contained about 1.6 or 1.7 in postorbital length of head; soft dorsal rays notably shorter than longest dorsal spines; second anal spines strongest, notably not reaching to tip of third when depressed; gill rakers moderately long, the longest at the angle, about equal to length of gill filaments; a vertical line through rear of orbit passes near posterior tip of maxillary; angle of snout profile same as that from orbits to dorsal origin.

Color in alcohol.—Background color light brownish or tan, pale ventrally; body, head, and fins profusely covered with very small dark brown or black spots; larger blackish blotches are scattered on body, head, and fins; median fins white edged, the spots occur all

the way to edges of median fins; pectoral fin with basal two-thirds spotted, distal third plain tan, underside of pectoral spotted all way to rear tip; pelvics with small spots and two or three black streaks on inner side, outer side indistinctly spotted, rear edge pale; underside of head and breast scarcely spotted; a dusky streak on preorbital groove dorsally; maxillary and premaxillary with black spots; no blackish blotches along back or on caudal peduncle as is usual in certain species of *Epinephelus*.

Remarks.—This unusual grouper differs from all other species in the genus *Epinephelus* in its deep body, 2.4 in standard length and 2.7 in total length, the greatest depth being greater than the length of head; the gill rakers are as long as the gill filaments and the soft dorsal rays are shorter than the longest dorsal spines, except on *E. flavocaeruleus* (Lacepède). The color pattern is quite characteristic, profusely covered with tiny black spots, and with larger scattered black blotches.

In Bleeker (Atlas Ichthyologique des Indes Orientales Néerlandaises, vol. 7, pl. 333, fig. 2, 1864) is an illustration of *E. hoedti* Bleeker that is undoubtedly the same species as *E. flavocaeruleus* (Lacepède) as figured by Boulenger (Catalogue of the Fishes in the British Museum, ed. 2, vol. 4, pp. 198–199, pl. 4, fig. A, 1895). This new species differs from all of the "varieties" of *flavocaeruleus* described by Boulenger in having the body spotted with dark blotches in addition to the tiny dark specks.

Named *kohleri* in honor of the collector, Thomas Kohler, one of the commercial fishermen at Bikini during 1946.

EPINEPHELUS SUMMANA (Forskål)

Perca summana Forskål, Descriptiones animalium . . . , pp. xi, 42, 1775 (type locality, Arabia).

SPECIMENS STUDIED

Bikini Atoll: Namu Island, lagoon reef, depth 30 to 45 feet, August 9, 1946, S–46–390, Brock and Herald, 1 specimen, 196 mm. standard length.

Rongelap Atoll: Tufa Island, in lagoon, depth 28 feet, July 29, 1946, S–46–300, Brock and Herald, 1 specimen, 198 mm.

Description.—Dorsal rays XI,15; anal III,8; pectoral ii,15 or ii,16; oblique scale rows 102 to 107; scales in a row from anal origin to lateral line 30 to 32, from lateral line to base of soft dorsal 11 or 12; gill rakers on first gill arch 9 or 10+1+17 or 18.

Greatest depth 2.8 to 3.0; head 2.5; length of pectoral fin 3.4 to 4.0; all in standard length. Greatest depth 1.2 to 1.3; length of pectoral fin 1.4 to 1.5; snout about 4.7; postorbital length of head 1.7; eye 4.8 to 5.0; tip of snout to rear of maxillary 2.1 to 2.2; least depth of caudal peduncle 3.4 to 3.7; all in length of head. Fleshy interorbital space flattish, contained 1.4 to 1.5 in eye; least depth of caudal peduncle

in its length 1.3 to 1.4; teeth on dentary at middle of sides in 2 or 3 rows, those on premaxillary in a villiform band; a narrow band on palatines, and on vomer a Λ-shaped narrow band; usual pair or two of short canines on each side of symphysis in each jaw; propercular edge rounded, with usual shallow concavity, finely serrate; greatest depth opposite dorsal origin; posterior margins of all fins rounded; third or fourth dorsal spine longest, 1.6 to 1.9 in postorbital length of head; soft dorsal rays notably longer than dorsal spines; second anal spine strongest, reaching to tip of third when depressed; gill rakers short, thick, not so long as gill filaments; maxillary naked; middle opercular spine longest, notably closer to lower than to upper one; vertical line through rear of eye passes through rear tip of maxillary.

Color in alcohol.—Background color brownish, with about 6 more or less distinct vertical bars; body profusely covered with white or pale spots, or oblong white spots, more or less forming lengthwise rows on body, these white spots also occur on dorsal, anal, and caudal fins; pectoral fin dusky, sometimes with tiny white specks or spots on inner side; pelvics blackish distally, dusky basally; head dorsally with white spots, body laterally and ventrally unspotted; a large black streak in maxillary groove; the usual dark blotches along base of dorsal fin and on caudal peduncle not clearly developed, except as forming part of the vertical bars when present; all fins narrowly edged with white.

Ecology.—This species was taken only in the deeper waters of the lagoon and was not seen over the shallower waters of the reef.

Remarks.—This grouper may be recognized by the profusion of white spots on the median fins and body, in combination with a naked maxillary, black maxillary groove, blackish pelvics distally, and the unspotted sides and ventral part of the head.

EPINEPHELUS SOCIALIS (Günther)

Serranus socialis GÜNTHER, Journ. Mus. Godeffroy, vol. 1, pt. 1, p. 7, pl. 8, fig. B, 1873 (type locality, Paumotu, Kingsmill, Hervey, and Samoan Islands).

SPECIMENS STUDIED

Bikini Atoll: 8 stations, 11 specimens, 21 to 315 mm. standard length.
Eniwetok Atoll: 1 station, 1 specimen, 385 mm.
Rongerik Atoll: 2 stations, 2 specimens, 47 and 205 mm.
Rongelap Atoll: 2 stations, 4 specimens, 60 to 213 mm.

Description.—Dorsal rays XI,15; anal III,8; pectoral ii,17 or ii,18; oblique scale rows above lateral line 106 to 114; scales in a row from anal origin to lateral line 25 or 26, from lateral line to base of soft dorsal 11 or 12; gill rakers on first gill arch 9 or 10+1+17 or 18.

Greatest depth 2.9 to 3.4; head 2.4 to 2.7; length of pectoral fin 4.2 to 4.7; all in standard length. Greatest depth 1.3; length of pectoral

fin 1.7 to 1.9; snout 4.0 to 4.2; postorbital length of head 1.7, eye 4.5 to 6.0; tip of snout to rear of maxillary 2.0 to 2.1; least depth of caudal peduncle 3.2 to 3.3, all in length of head. Fleshy interorbital space flattish, contained about 0.8 to 1.7 in eye; least depth of caudal peduncle 1.5 to 1.6 in its length; teeth on middle of side of dentary in three or more rows in young and adults, those on premaxillary in a villiform band, inner row of jaw teeth longest, depressible, a narrow band of teeth on palatines, those on vomer similar but in a Λ-shaped band; a pair or two of short canines each side of symphysis of each jaw; preopercular edge rounded, with usual shallow concavity, finely serrate; greatest depth opposite dorsal origin; posterior margins of all fins rounded, that of caudal less so in large adults; fourth or fifth dorsal spine longest, 1.8 to 2.5 in postorbital length of head; soft dorsal rays notably longer than dorsal spines; second anal spine strongest, reaching or not quite reaching to tip of third when depressed; gill rakers short, thick, shorter than gill filaments; maxillary scaled; middle opercular spine longest, about equidistant between upper and lower ones; a vertical line through rear of eye passes a little in front of posterior tip of maxillary.

Color in alcohol.—Background color light grayish tan, or light brownish, profusely spotted with small dark-brown or blackish spots, on head and body except ventrally; fins mostly dusky, brownish, or blackish, all with broad white edge posteriorly, contrasting sharply with blackish submarginally; pectoral spotted or barred basally, plain dusky distally; soft dorsal, anal, and caudal fins with pale or whitish spots; four dusky or brownish blotches along base of dorsal fin and dusky blotch on dorsal part of caudal peduncle; maxillary groove below eye with a brown or blackish streak; a characteristic black line along base of dorsal fin with black lines branching up between the rays a short distance; tips of dorsal spines blackish.

Ecology.—This reef-inhabiting species was taken around coral heads, but it never occurred in abundance. Usually only one or two were collected during several hours' work on the reefs.

Remarks.—This grouper may be best recognized by the numerous small brown or black spots everywhere on the body and head, except ventrally, and on the fins; by the broad white edges on the fins, set off by blackish submarginal areas; and by the brown or black line along the base of the dorsal fin, with short side lines of black or brown branching from it.

EPINEPHELUS EMORYI, new species

FIGURE 52

Holotype.—U.S.N.M. No. 141929, Bikini Atoll, lagoon coral head, depth 30 to 45 feet, lat. 11°33′13″ N., long. 165°28′39″ E., July 13,

1946, S–46–252, Brock, Emory, and Kohler, 235 mm. standard length (when alive, 250 mm.), 291 mm. total length.

Paratypes.—U.S.N.M. No. 139695, Marianas Islands, Rota Island, November 15, 1945, D. G. Frey, 6 specimens, 168 to 203 mm.

Description.—The following precision measurements, expressed in thousands of the standard length, are recorded for the holotype and one paratype, respectively. Standard length 235 and 171 mm. Greatest depth 345 and 322; head 430 and 413; snout 102 and 94; bony interorbital space 40 and 38; eye 81 and 91; postorbital length of head 260 and 228; least width of preorbitals 37 and 33; length of maxillaries (tip of snout to rear of maxillary) 196 and 193; least depth of caudal peduncle 98 and 100; length of caudal peduncle 187 and 181. Length of first dorsal spine 43 and 56; third (longest) 126 and 134; last 113

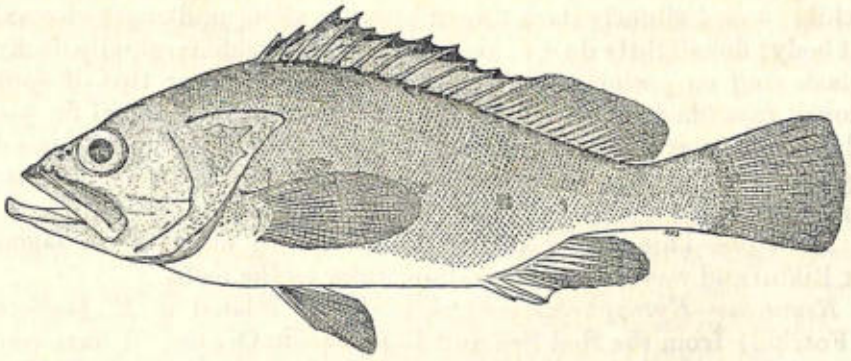

FIGURE 52.—Holotype of *Epinephelus emoryi*, new species (U.S.N.M. No. 141929), from Bikini Atoll. (Drawing by Dorothea B. Schultz.)

and 108. Length of first anal spine 60 and 61; second 100 and 123; third 106 and 135. Longest soft dorsal ray 153 and 152; pectoral 247 and 243; pelvic 173 and 175; caudal 223 and 222.

The following counts were made: dorsal rays XI,16; anal III,8; pectoral ii,17 or ii,18; vertical scale rows counted above lateral line 111 to 125; scales in a row from anal origin to lateral line about 27 or 28, from lateral line to base of soft dorsal 11 or 12; gill rakers on first gill arch 7+1+15 or 16. Greatest depth 2.8 to 3.2; head 2.3 to 2.5; length of pectoral fin 3.9 to 4.1; all in standard length. Greatest depth 1.3; length of pectoral fin 1.7 to 1.8; snout 4.2 to 4.3; postorbital length of head 1.7; eye 4.2 to 5.3; snout tip to rear of maxillary 2.1 to 2.2; least depth of caudal peduncle 4.0 to 4.3; all in length of head. Least depth of caudal peduncle in snout tip to rear of maxillary 2.0; fleshy interorbital space flattish, contained 1.3 to 1.5 in eye; least depth of caudal peduncle in its length 1.7 to 1.8; teeth on dentary at middle of sides in 3 or more rows; maxillary teeth in a villiform band; jaw teeth depressible; inner row with longest teeth; a band

of teeth on palatine, a similar Λ-shaped band on vomer; a pair or two of short canines each side of symphysis in each jaw; middle opercular spine farthest back, equidistant between upper and lower opercular spines; preopercular edge rounded, finely serrate, with usual shallow concavity; greatest depth opposite dorsal origin; posterior margin of fins rounded, that of caudal only slightly rounded or truncate; third dorsal spine, rarely fourth, longest, contained about 2.0 to 2.1 in postorbital length of head; soft dorsal rays longer than dorsal spines; second anal spine strongest, not quite reaching tip of third when depressed; gill rakers moderately long, longest at angle of first arch longer than gill filaments; a vertical line through rear of orbit passes through rear edge of maxillary.

Color in alcohol.—Background color plain light brownish, darker dorsally, belly whitish; center of each scale brownish, margined with white; 3 or 4 slightly dark brown blotches along midlengthwise axis of body; fins slightly dusky; anal margin white, submarginally dusky; black ring on posterior half of eye; membranes near tips of spiny dorsal rays black; a black streak or line along base of dorsal fin with short side lines branching from it onto basal part of membranes of spiny dorsal fin; base of pectoral dusky; color phases of vertical bars and large white blotches also occur in this species.

Ecology.—This new species occurred in deep water in the lagoon at Bikini and was not seen in shallow water on the reefs.

Remarks.—*Epinephelus emoryi* is closely related to *E. fasciatus* (Forskål) from the Red Sea and Indo-Pacific Oceans. I have compared *E. emoryi* with 2 specimens of *fasciatus* from the Red Sea, 3 from the Philippines, 1 from Japan, 2 from the Marquesas Islands, and 1 from an unknown locality. *E. emoryi* has a black streak along base of dorsal fin with short side branches extending into the membranes at the base of the spiny dorsal fin, and the black margin of eye occurs only posteriorly, whereas in *fasciatus* there is no black streak along the base of the dorsal fin and the eye is margined with black except anteriorly. I have made several counts and have found the number of vertical scale rows above the lateral line between the upper edge of the gill opening and the midbase of the caudal fins to be for *emoryi* 111 to 127 scales and for *fasciatus* 98 to 114. These counts include a few specimens, from an unknown locality, that appear to be closely related to the new species, but are not considered as paratypes, even though they have a black line at base of dorsal fin. I believe they represent another population intermediate between *emoryi* and *fasciatus* (see pl. 30, C).

Named *emoryi* in honor of K. O. Emory, who participated in the oceanographic work at Bikini during 1946.

EPINEPHELUS MERRA Bloch

PLATE 25, A

Epinephelus merra BLOCH, Naturgeschichte der ausländischen Fische, vol. 7, pt. 10, p. 17, pl. 329, 1793 (type locality, Japan Sea).

Serranus hexagonatus GÜNTHER (Fische der Südsee), Journ. Mus. Godeffroy, vol. 1, pl. 7, fig. A, 1873.

SPECIMENS STUDIED

Bikini Atoll: 24 stations, 325 specimens, 30 to 172 mm. standard length.
Eniewetok Atoll: 7 stations, 57 specimens, 34 to 159 mm.
Rongerik Atoll: 4 stations, 114 specimens, 32 to 154 mm.
Rongelap Atoll: 11 stations, 354 specimens, 38 to 193 mm.
Likiep Atoll: Univ. Washington, 37 specimens, 38 to 119 mm.
Guam: 12 lots, 79 specimens, 28 to 210 mm.
Rota: 3 lots, 3 specimens, 32 to 142 mm.

Description.—Dorsal rays XI,15 to 17; anal III,8; pectoral usually ii,16; oblique scale rows above lateral line about 100 to 110, scales in a row from anal origin to lateral line about 24 to 27, from lateral line to base of soft dorsal 9 or 10.

Greatest depth 3.2 to 3.4; head 2.4 to 2.5; length of pectoral fin 3.6 to 4.2; all in standard length. Greatest depth 1.3 to 1.4; length of pectoral fin 1.5 to 1.7; snout 4.5 to 4.9; postorbital length of head 1.6 to 1.7; eye 4.0 to 5.2; tip of snout to rear of maxillary 2.1; least depth of caudal peduncle 3.8 to 4.2; all in length of head. Interorbital (fleshy) space flattish, sometimes slightly concave, contained 1.3 to 2.3 in eye; least depth of caudal peduncle its length 1.6 to 1.8; teeth on dentary and on premaxillary in a villiform band with inner rows longest and depressible (in young dentary has but 2 rows of teeth); a pair of short canines each side of symphysis in each jaw; teeth on palatines, in a narrow band, those on vomer in a Λ-shaped narrow band; preopercular edge finely serrate, greatest depth of body opposite front of base of spiny dorsal; posterior marigns of all fins rounded; third or fourth dorsal spine longest, 1.5 to 1.8 in postorbital length of head; soft dorsal rays longer than dorsal spines; second anal spine strongest, when depressed reaching about opposite tip of third spine.

Color in alcohol.—Background color light grayish to whitish, with large, round to more or less hexagonal dark brown to blackish spots everywhere on fins, head, and body, those on belly and ventrally on sides more widely spaced than dorsally; spots on fins usually notably smaller than on body; paired fins black or brown spotted all the way to their tip, pectorals without a white edge; soft dorsal, soft anal and caudal fins sometimes with a narrow white margin, especially anal and lower rear edge of caudal fin; membrane behind tip of each

dorsal spine with a small white-edged black spot that is constant on smallest to largest specimens examined.

Color when alive.—Background color white below, very light yellowish above, dark spots orange-brown; pectoral fin light yellowish; iris brown.

Ecology.—This sea bass was one of the most abundant species on the reefs, occurring in the higher pools on the reefs as well as in the deeper lagoon waters. Wherever there was a place to hide among the crevices and in the corals, *E. merra* was likely to be found.

Remarks.—*E. merra* lacks the usual dark blotches along the base of the dorsal fin and on the upper edge of the caudal peduncle, and the pectoral fin has very distinct dark or black spots all the way to its edge. I wish to correct my wrong interpretation of this species in U. S. Nat. Mus. Bull. 180, p. 107, 1943. The specimens U.S.N.M. Nos. 115378 to 115382 and 115386 there identified as *E. hexagonatus* are *E. merra.*

EPINEPHELUS MACROSPILOS (Bleeker)

PLATE 25, B

Serranus macrospilos BLEEKER, Nat. Tijdschr. Nederl.-Indië, vol. 9, p. 499, 1855 (type locality, Batjan).

Epinephelus macrospilus BLEEKER, Atlas ichthyologique des Indes Orientales Néerlandaises, vol. 7, p. 52, pl. 290, fig. 2, 1873–76 (Java; Celebes; Batjan; Solor).

Serranus howlandi GÜNTHER (Fische der Südsee), Journ. Mus. Godeffroy, vol. 1, p. 8, pl. 9, fig. B, 1873 (type locality, Howland Island).

SPECIMENS STUDIED

Bikini Atoll: 12 stations, 21 specimens, 104 to 320 mm. standard length.
Rongelap Atoll: 3 stations, 4 specimens, 69 to 280 mm.
Rongerik Atoll: 2 stations, 2 specimens, 206 and 227 mm.
Eniwetok Atoll: 2 stations, 2 specimens, 49 and 270 mm.
Kwajalein Atoll: 1 station, 3 specimens, 87 to 198 mm.

Description.—Dorsal rays XI,16; anal III,8; pectorals ii,17 or ii,18; gill rakers on first gill arch 8+1+14 or 15; scale rows above lateral line about 100 to 110, scales in a row from anal origin to lateral line about 26, from lateral line to base of soft dorsal 11 or 12.

Greatest depth 3.3 to 3.4; head 2.5 to 2.6; length of pectoral fin 4.1 to 4.8; all in standard length. Greatest depth 1.3 to 1.4; length of pectoral fin 1.7 to 2.0; snout 4.4 to 5.1; postorbital length of head 1.6; eye 4.5 to 6.0; tip of snout to rear of maxillary 2.0 to 2.2; least depth of caudal peduncle 3.7 to 3.8; all in length of head. Least depth of caudal peduncle in snout tip to rear of maxillary 1.6 to 1.8. Interorbital space (fleshy) concave, 1.0 to 1.8 in eye; least depth of caudal peduncle 1.6 to 1.9 in its length; teeth on dentary at middle of sides in two or three rows on young but in a band in largest specimens;

one or two pairs of canines on each side of symphysis in each jaw; teeth on palatines in a narrow band, those on vomer similar, in a Λ-shaped band; middle opercular spine equidistant between upper and lower ones; preopercular edge notably convex, finely serrate; greatest depth of body opposite origin of dorsal fin; posterior margins of all fins rounded; fifth or sixth dorsal spines longest, about 1.5 to 1.9 in postorbital length of head and a little longer than last spine; soft dorsal rays about same length as longest dorsal spine; second anal spine strongest, when depressed not quite reaching to tip of third; gill rakers short, thick; maxillary reaches to or a little past a vertical line through rear of eye; angle of profile of snout about 30 degrees steeper than that of head from behind orbits to dorsal fin origin.

Color in alcohol.—Background color very light yellowish tan or light grayish white, everywhere with scattered brown or blackish spots; pectoral fin with or without black spots basally, plain dusky distally with posterior margin usually white edged, as is caudal fin; ventrally usually unspotted, except in young; pelvics dusky, white edged; no black blotches along base of dorsal fin or on caudal peduncle.

Color when alive.—Background white or yellowish white; dark spots dark brown; pectoral dusky brown; posterior edges of fins white.

Ecology.—Although this grouper was sometimes taken in the deeper channels of the reefs, it was more often taken on the shallower parts of the reefs. Its habitat like that of other groupers is around coral heads and ledges.

Remarks.—This species, among the brown-spotted epinephelids, lacks the dark blotches along the base of the dorsal fin. It has a relatively short maxillary compared with *E. elongatus*. *E. macrospilos* lacks dark spots on the outer surface of the pectoral fin but they are evident on the underside; the pectoral is dusky, with a white edge. I believe that Bleeker correctly separated *E. corallicola* from *E. macrospilos*, as illustrated (Atlas Ichthyologique des Indes Orientales Néerlandaises . . ., vol. 7, 1873–76, pl. 308, fig. 1). *E. altivelioides*, a synonym of *E. corallicola*, shows a spotted pectoral. *E. megachir* Richardson is a closely related species but has XI,17 dorsal rays whereas *E. macrospilos* usually has XI,16 rays.

EPINEPHELUS ELONGATUS, new species

FIGURE 53; PLATE 25, C

? *Serranus malabaricus* (non Bloch and Schneider) DAY, Fishes of India, vol. 1, pl. 4, fig. 2, 1876 (one specimen from Calcutta).

Holotype.—U.S.N.M. No. 141844, Eniwetok Atoll, Giriinien Island, ocean reef, May 29, 1946, S–46–187, Schultz, standard length 310 mm.

Paratypes.—U.S.N.M. No. 141838, Bikini Atoll, Enyu Island, March 16, 1946, S–46–8, Schultz, Brock, and Marr, 1 specimen, 305

mm.; U.S.N.M. No. 141932, Bikini Atoll, Erik Island, March 19, 1946, S–46–9, Schultz and Brock, 1 specimen, 275 mm.; U.S.N.M. No. 141839, Bikini Atoll, Bikini Island, March 22, 1946, S–46–15, Schultz and Brock, 2 specimens, 41 and 244 mm.; U.S.N.M. No. 141840, Bikini Atoll, Romuk Island, April 2, 1946, S–46–48, Schultz, 5 specimens, 96 to 252 mm.; U.S.N.M. No. 141931, Bikini Atoll, Airy Island, April 16, 1946, S–46–96, Schultz, 1 specimen, 355 mm.; U.S.N.M. No. 141841, Bikini Atoll, Romuk Island, May 14, 1946, S–46–128, Schultz, 1 specimen, 161 mm.; U.S.N.M. No. 141930, Bikini Atoll, Enyu Island, August 6, 1946, S–46–325, Brock and Kohler, 1 specimen, 295 mm.; U.S.N.M. No. 141842, Bikini Atoll, Enyu Island, August 13, 1946, S–46–333, Herald, 2 specimens, 215 mm.; U.S.N.M. No. 141843, Bikini Atoll, Boby Island, August 17, 1946, S–46–383, Herald, 2 specimens 80 to 109 mm.; U.S.N.M. No. 141836, Bikini Atoll, Eman Island, July 19, 1947, S–46–441, Schultz, Brock, Myers, and Hiatt, 1 specimen, 335 mm.; U.S.N.M. No. 141837, Bikini Atoll, lagoon reef halfway between Bikini and Amen Islands, July 21, 1947, S–46–442, Brock, Hiatt, and Schultz, 2 specimens, 50 and 165 mm.; U.S.N.M. No. 141847, Rongelap Atoll, Tufa Island, July 18, 1946, S–46–260, Herald and Brock, 2 specimens, 200 and 260 mm.; U.S.N.M. No. 141848, Rongelap Atoll, Yugui Island, July 31, 1946, S–46–304, Herald, 1 specimen, 48 mm.; U.S.N.M. No. 141852, Rongerik Atoll, Bock Island, April 24, 1946, S–46–113, Brock and Marr, 1 specimen, 180 mm.; U.S.N.M. No. 141851, Rongerik Atoll, Bock Island, June 27, 1946, S–46–237, Schultz and Herald, 2 specimens, 49 and 167 mm.; U.S.N.M. No. 141845, Eniwetok Atoll, Mui Island, May 28, 1946, S–46–186, Schultz, 1 specimen, 98 mm.; U.S.N.M. No. 141846, Eniwetok Atoll, Teiteiripucchi Island, June 1, 1946, S–46–197, Schultz, 1 specimen, 180 mm.; U.S.N.M. No. 141850, Kwajalein Atoll, Ennylabegan Island, September 1, 1946, S–46–397, Herald, 6 specimens, 73 to 152 mm.; U.S.N.M. No. 139694, Guam, 1945, Frey, 2 specimens, 175 and 225 mm.; U.S.N.M. No. 141853, Phoenix Islands, Hull Island, reef, July 12–15, 1939, Schultz, 1 specimen, 72 mm; U.S.N.M. No. 141854, Phoenix Islands, Canton Island, April 25–28, 1939, Schultz, 1 specimen, 160 mm.; U.S.N.M. No. 141856, Phoenix Islands, Hull Island, channel, July 8–12, 1939, Schultz, 2 specimens, 30 to 71 mm.; U.S.N.M. No. 141855, Samoan group, Swains Island, reef, May 3–9, 1939, Schultz, 7 specimens, 67 to 158 mm.; U.S.N.M. No. 115371, Samoan group, Tutuila Island, June 2, 1939, Schultz, 1 specimen, 137 mm.; U.S.N.M. No. 115384, Samoan group, Tutuila Island, reef at Alofau, June 3, 1939, Schultz, 2 specimens, 101 to 121 mm.

Description.—The following measurements, expressed in thousandths of the standard length, were made on the holotype and one

paratype, respectively. Standard lengths in mm. 310 and 166. Greatest depth 329 and 274; head 452 and 432; snout 105 and 96; bony interorbital space 47 and 33; eye 67 and 73; postorbital length of head 287 and 268; least width of preorbital 29 and 27; length from tip of snout to rear edge of maxillary 225 and 222; least depth of caudal peduncle 110 and 103; length of caudal peduncle 181 and 190; length of first dorsal spines 39 and 57; third 87 and 115; last 87 and 103; longest (fifth or sixth) 97 and 117. Length of first anal spine 32

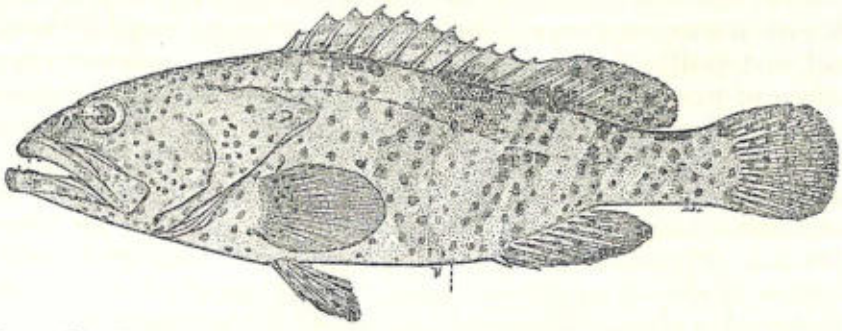

FIGURE 53.—Holotype of *Epinephelus elongatus*, new species (U.S.N.M. No. 141844), from Eniwetok Atoll. (Drawing by Dorothea B. Schultz.)

and 54; second 71 and 111; third 77 and 108. Longest soft dorsal ray 132 and 145; pectoral 181 and 223; pelvic 148 and 163; caudal 192 and 229.

The following counts are recorded for the holotype and a paratype, respectively: Dorsal rays XI,15 and XI,14; anal III,8 and III,8; pectoral ii,17–ii,18 and ii,18–ii,18; vertical scale rows above lateral line 103 and 101; scales in a row from anal origin to lateral line 28 or 29 and 25; from lateral line to base of soft dorsal fin 11 and 11; gill rakers on first gill arch (counting all rudiments) 9 + 1 + 17 and 9 + 1 + 19.

Dorsal rays usually XI,15, seldom XI,14; anal rays III,8; pectoral rays usually ii,18, seldom ii, 17; gill rakers 9+1+16 to 19.

Greatest depth 3.1 to 3.6; head 2.2 to 2.4; length of pectoral fin 4.5 to 5.3; all in standard length. Greatest depth 1.4 to 1.6; length of pectoral fin 1.9 to 2.5; snout 4.2 to 5.0; postorbital length of head 1.6 to 1.7; eye 4.8 to 7.0; tip of snout to rear of maxillary 1.9 to 2.1; least depth of caudal peduncle 4.0 to 4.2; all in length of head. Least depth of caudal peduncle in snout tip to rear of maxillary 1.9 to 2.3.

Interorbital space (fleshy) flattish to a little concave, contained about 1.1 to 2.0 in eye; least depth of caudal peduncle in its length 1.6 to 1.7; teeth on dentary at middle of sides in 3 or more rows, even on young; a pair or two of short canines each side of symphysis in each jaw; teeth on palatines in a narrow band, those on vomer in a narrow Λ-shaped band; middle opercular spine equidistant or a little closer to lower than upper spine; preopercular edge notably convex,

finely serrate; greatest depth of body opposite origin of spiny dorsal; posterior margins of all fins rounded; fifth and sixth dorsal spines longest, about same length as last one, contained about 2.2 to 3.2 in postorbital length of head; soft dorsal rays longer than dorsal spines; second anal spines strongest, when depressed about same length as third; gill rakers short, thick; maxillary reaches notably behind a vertical line through rear of eye; angle of profile of snout 10° to 15° steeper than that of head from behind orbits to dorsal fin origin.

Color in alcohol.—Background color light gray to very light brownish with numerous scattered dark-brown or blackish spots on body, head, and median fins; pectoral fin with a few brown spots on outer surface of base, the distal three-fourths plain dusky brown, seldom with spots clearly evident, except in young; under surface of pectoral with blackish or dark-brown spots all the way to edge of fin; pelvics spotted, outer rays blackish with white edge distally; a black dorsal blotch below bases of and on basal part of membranes of dorsal spines VIII–XI. Pigmentation rarely intensified to the point of forming dark bars on sides of body; membranes at tips of dorsal spines blackish.

Color when alive.—Background color very slightly light brownish to pale yellowish white, the dark spots brick red to brownish red; edges of median fins white; pectoral yellowish to olive, with distal edge white.

Ecology.—This brown-spotted grouper was a common species in the lagoon and in the deeper channels at low tide on the shallow reefs.

Remarks.—This new species differs from its two closest relatives, *E. tauvina* (Forskål) and *E. fario* (Thunberg), in having long jaws. The least depth of caudal peduncle is contained from 1.9 to 2.3 in distance from the tip of the snout to the rear edge of the maxillary, whereas in *tauvina* and *fario* it is contained fewer than 1.9. Certain definite color characteristics distinguish this new species from its close relatives: A black blotch occurs at base of rear of the dorsal spines; the distal three-fourths of the outer surface of the pectoral fin is unspotted in adults but spotted in young, whereas the under surface of the pectoral is spotted all over. This new species is more fully separated in the key (p. 331) from other related species of *Epinephelus*. It was named *elongatus* in reference to its elongate body form and its elongate maxillary.

EPINEPHELUS MELANOSTIGMA, new species

FIGURE 54

Serranus merra var. *stellans* (non Bloch and Schneider) FOWLER, U. S. Nat. Mus. Bull. 100, vol. 10, p. 272, fig. 17, 1930 (Philippines).

Holotype.—U.S.N.M. No. 115375, Samoan group Swains Island, reef, May 3–9, 1939, Schultz, 176 mm. standard length.

Paratypes.—U.S.N.M. No. 148966, collected with holotype and bearing same data, 18 specimens, 54 to 166 mm. standard length; U.S.N.M. No. 115376, Hull Island, channel, 18 specimens, 45 to 120 mm.; U.S.N.M. No. 115374, Canton Island, 4 specimens, 108 to 153 mm.; U.S.N.M. No. 148965, Hull Island, reef, July 12–15, 1939, Schultz, 5 specimens, 38 to 43 mm.; U.S.N.M. No. 148967, Rose Island, reef, June 11–14, 1939, Schultz, 2 specimens, 40 mm.; U.S.N.M. No. 148968, Tutuila Island, reef at Alofau, June 3, 1939, Schultz, 1 specimen, 100 mm.; U.S.N.M. No. 115385, Tutuila Island, June 5, 1939, Schultz, 6 specimens, 84 to 181 mm.; U.S.N.M. No. 141868, Bikini Atoll, Namu Island, lagoon reef, August 6, 1947, S–46–508, Schultz, Brock, and Hiatt, 1 specimen, 69 mm. (this specimen is referred to this species with some uncertainty, and is not a paratype).

Description.—The following measurements expressed in thousandths of the standard length were made on the holotype and one

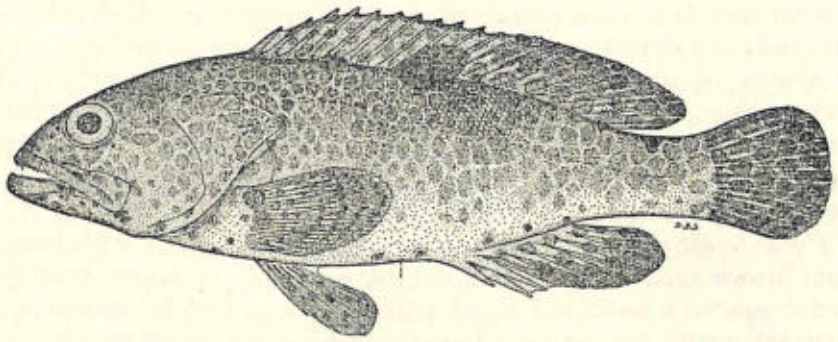

FIGURE 54.—Holotype of *Epinephelus melanostigma*, new species (U.S.N.M. No. 115375), from Swains Island, Samoan group. (Drawing by Dorothea B. Schultz.)

paratype, respectively. Standard lengths in mm. 176 and 115. Greatest depth 293 and 291; head 410 and 431; snout 87 and 85; interorbital space 51 and 49; eye 74 and 85; postorbital length of head 261 and 267; least width of preorbital 28 and 26; length from tip of snout to rear edge of maxillary 187 and 193; least depth of caudal peduncle 119 and 106; length of caudal peduncle 176 and 191; length of first dorsal spines 63 and 61; third 125 and 143; last 125 and 139; longest (fifth) 145 and 157. Length of first anal spine 66 and 80; second 117 and 145; third 119 and 141. Longest soft dorsal ray 170 and 178; pectoral 221 and 257; pelvic 191 and 191; caudal 233 and 248.

The following counts were recorded for the holotype and the paratype, respectively. Dorsal rays XI,15 and XI,15; anal III,8 and III,8; pectoral ii,17–ii,17 and ii,17–ii17; vertical scale rows above lateral line 94 and 92; scales in a row from anal origin to lateral line 24 and 23; scales from lateral line to base of soft dorsal fin 10 and 9;

gill rakers in first gill arch (counting all rudiments) 8+1+17 and 8+1+18.

Greatest depth 3.0 to 3.4; head 2.4 to 2.5; length of pectoral fin 4.2 to 4.3; all in standard length. Greatest depth 1.3 to 1.4; length of pectoral fin 1.7 to 1.8; snout 4.7 to 5.0; postorbital length of head 1.6 to 1.7; eye 4.5 to 5.6; tip of snout to rear of maxillary 2.1 to 2.2; least depth of caudal peduncle 3.2 to 3.5; all in length of head. Least depth of caudal peduncle in snout tip to rear of maxillary 1.6 to 1.7. Interorbital space (fleshy) flattish to slightly concave, about 1.2 to 2.0 in eye; least depth of caudal peduncle in its length 1.5 to 1.6; teeth on middle of side of dentary in three or more rows, even on the young; a pair or two of short canines each side of symphysis in each jaw; teeth on palatines in a narrow band, those on vomer in a narrow Λ-shaped band; preopercular edge notably convex, finely serrated; greatest depth of body opposite origin of spiny dorsal; posterior margins of all fins rounded; fifth or sixth dorsal spine longest, slightly longer than last spine, contained about 1.5 to 1.8 in postorbital length of head; soft dorsal rays longer than dorsal spines; second anal spine strongest, equal to or a little shorter than third when depressed; gill rakers short, thick, longest at angle about equal to gill filaments; maxillary reaches a little beyond a vertical line through rear of eye; angle or profile of snout 10 degrees steeper than that of head from behind orbits to dorsal fin origin.

Color in alcohol.—Background color light gray or tan with hexagonal brown spots on sides and on back gradually becoming roundish brown spots on lower sides and ventrally, these widely separated as contrasted with the hexagonal ones, which are separated by a narrow whitish line, no triangular tiny white specks anywhere; pectoral, pelvic, and anal fins brown spotted; dorsal and caudal fins spotted with hexagonal brown spots, under side of pectoral brown spotted, brown spots on pectoral usually more or less arranged to form transverse rows; a large black blotch at bases of eighth to eleventh dorsal spines extending on back and on fin from half to three-fourths the way out to tips of spines; no other black blotches along base of dorsal fin or on dorsal edge of caudal peduncle; posterior margins of pectoral, caudal, soft dorsal, and anal fins white edged; membranes at tips of dorsal spines dusky, then white tipped.

Remarks.—This new species differs from its close relatives by having these characters in combination: A single blackish blotch at the base of the dorsal fin; hexagonal brown blotches separated by white lines dorsally, these becoming round brown spots ventrally; and 90 to 95 vertical scale rows above the lateral line. The key (p. 331) separates *melanostigma* from related species of *Epinephelus*. The description of *Serranus stellans* Richardson (non Bloch and Schneider) (Ann.

Mag. Nat. Hist., vol. 9, p. 23, 1842), from Melville Island, clearly places that species as a synonym of *Epinephelus hexagonatus* (Bloch and Schneider).

Named *melanostigma* in reference to the single black spot at the base of the dorsal fin.

EPINEPHELUS FUSCOGUTTATUS (Forskål)

PLATE 26, A

Perca summana fusco-guttata FORSKÅL, Descriptiones animalium . . ., pp. 11, 42, 1775 (type locality, Suerens, Djedda).

Serranus fuscoguttatus RÜPPELL, Atlas zu der Reise im nordlichen Afrika. Fische des rothen Meers, p. 108, pl. 27, fig. 2, 1828 (Red Sea).

SPECIMENS STUDIED

Bikini Atoll: 8 stations, 8 specimens, 117 to 360 mm. standard length.
Eniwetok Atoll: 1 station, 2 specimens, 202 to 320 mm.
Rongelap Atoll: 3 stations, 4 specimens, 295 to 365 mm.
Rongerik Atoll: 1 station, 1 specimen, 230 mm.

Description.—Dorsal rays XI,14 or 15; anal III,8; pectoral ii,15 or ii,16; oblique scale rows above lateral line about 96 to 105, scales in a row from anal origin to lateral line 24 to 27, from lateral line to base of soft dorsal 10 or 11; gill rakers on first gill arch 9+1+15 or 16.

Greatest depth 3.1 to 3.2; head 2.4 to 2.5; length of pectoral fin 4.2 to 4.5; all in standard length. Greatest depth 1.3; length of pectoral fin 1.7 to 1.8; snout 4.0 to 4.6; postorbital length of head 1.6; eye 5.2 to 6.1; tip of snout to rear of maxillary 1.9 to 2.1; least depth of caudal peduncle 3.4 to 3.8; all in length of head. Interorbital (fleshy) space flattish to slightly convex, contained 1.0 to 1.4 in eye; least depth caudal peduncle 1.3 to 1.4 in its length; teeth on middle of side of dentary in 2 rows in young and adults, those in premaxillary in a villiform band, inner row longest; a narrow band of villiform teeth on palatines, those on vomer similar but in Λ-shaped band; one or two pairs of short canines each side of symphysis of each jaw; preopercular edge rounded, with slight concavity, finely serrate; greatest depth of body at dorsal fin origin; posterior margins of all fins rounded, caudal fin less rounded in large adults; fourth dorsal spine longest, 1.7 to 2.2 in postorbital length of head; soft dorsal rays notably longer than dorsal spines; second anal spine strongest, not quite reaching tip of third when depressed; gill rakers short, thick, shorter than gill filaments; maxillary scaled; middle preopercular spine closer to lower one (if lower one is developed) than to upper; a vertical line through rear of eye passes notably in front of posterior tip of maxillary.

Color in alcohol.—Background color light gray or light brownish to brownish; a large black saddle on upper half of caudal peduncle, but no distinctly isolated dark blotches along back, these replaced by

seven irregular dark brown bars, three in front of dorsal fin, two under spiny dorsal, and two under soft dorsal, the last four bars extending more or less part way out on dorsal fin; lower sides and ventral part of head and body profusely covered with small dark-brown spots, these also occurring on anal, pelvic, and pectoral fins, being arranged to form a barred pattern on distal half of pectoral; soft dorsal and caudal with light spots; fins generally dusky to brownish, the pelvics more or less blackish distally; snout at maxillary groove with a black spot on each side of midline and another black blotch or spot under nostrils. One specimen from station S–46–383, Bikini Atoll, 117 mm., has on the dorsal part of head a color pattern of broken bars, with dark brown spots in these bars, the under side of head being barred. With only a few specimens of this color phase I am unable to decide at this time if two species are currently passing under the name *fuscoguttatus*. This problem needs further study.

Color when alive.—In a discarded specimen, 20 inches long, from Romuk Island, the background color was olive-yellow on sides, darker dorsally; soft median fins were orange-brown, distally with large round olive-yellow blotches; pectoral fin orange; dentary with orange on sides.

Ecology.—This brown grouper was caught on hook and line very frequently in the lagoons of the various atolls, and specimens as much as two feet in total length were not uncommon at depths of 100 feet, although no specimen that long was preserved. On the shallower parts of the reef it was an uncommon species, but at depths of 20 feet and more it occurred around coral heads.

Remarks.—This species may be recognized by the following combination of characters: A large black saddle on the dorsal edge of the caudal peduncle; five to seven distinct dark-brown bars on the upper sides, the lower sides and ventral part of the body being profusely covered with small dark-brown spots; pale spots on the soft dorsal and caudal fins; and only two rows of teeth on the middle of the side of the dentary.

EPINEPHELUS SPILOTUS, new species

FIGURE 55

Holotype.—U.S.N.M. No. 141895, Eniwetok Atoll, Rujoru Island, lagoon reef, June 2, 1946, S–46–195, Schultz, standard length 191 mm.

Paratypes.—U.S.N.M. No. 141896, collected with holotype and bearing same data, 2 specimens, 51 and 61 mm.; U.S.N.M. No. 150001, Saipan, lagoon west of Susupe, April 24, 1949, H. S. Ladd, 4 specimens, 80 to 170 mm.; Likiep Atoll, Likiep Island, August 22, 1949, Univ. Washington, 1 specimen, 295 mm.

Description.—Precision measurements were made on the holotype and paratypes and these data, expressed in thousandths of the standard length, are recorded in table 32.

The following counts were made on the holotype and paratypes, repectively: dorsal rays XI,16; XI,17; XI,17; XI,16; XI,16; XI,17; XI,17; XI,16; anal rays III,8 in all paratypes; pectoral ii,16–ii,17; ii,16–ii,17; ii,17–ii,16; ii,15; ii,16; ii,16; ii,16; ii,17–ii,17; vertical scale rows above lateral line 100; 97; 95; 91; 95; 96; 90; 102; scales in a row from anal origin to lateral line 24; 26; 24; 25; 26; 24; 25; from lateral line to soft dorsal 11; 12; 12; 11; 11; 13; gill rakers on first gill arch 8+1+16; 8+1+16; 8+1+15; 8+1+15; 8+1+16; 8+1+16; 8+1+16; 8+1+14.

Greatest depth 2.9 to 3.0; head 2.3 to 2.5; length of pectoral fin 3.8 to 4.3; all in standard length. Greatest depth 1.3 to 1.4; pectoral 1.6

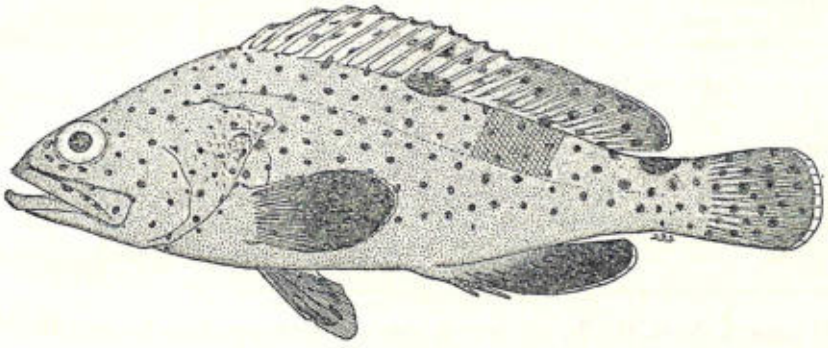

FIGURE 55.—Holotype of *Epinephelus spilotus*, new species (U.S.N.M. No. 141895), from Eniwetok Atoll. (Drawing by Dorothea B. Schultz.)

to 1.9; snout 5.1 to 5.7; postorbital length of head 1.6 to 1.7; eye 4.2 to 5.1; tip of snout to rear of maxillary 2.2; least depth of caudal peduncle 3.8 to 4.2; all in length of head. Least depth of caudal peduncle in snout tip to rear of maxillary 1.7 to 1.8. Interorbital (fleshy) space flattish to slightly concave, about 1.3 to 1.7 in eye; least depth of caudal peduncle 1.7 to 1.8 in its length; teeth on middle of side of dentary in two rows in young and two rows in the holotype; a pair or two of short canines on each side of symphysis in each jaw; teeth on palatines in a narrow band, those on vomer in a narrow Λ-shaped band; preopercular edge notably convex, finely serrated; greatest depth of body opposite origin of spiny dorsal; posterior margins of all fins rounded; fourth or fifth dorsal spine longest, slightly longer than last dorsal spine and contained about 1.7 to 1.8 times in postorbital length of head; soft dorsal rays longer than dorsal spines; second anal spine equal to or shorter than third, when depressed;

TABLE 32.—*Measurements made on certain species of* Epinephelus, *recorded in thousandths of the standard length*

Characters	*spilotus*		*fario*
	Eniwetok		U.S.N.M. No. 64627, Japan
	Holotype	Paratype	
Standard length in millimeters	191	61	178
Greatest depth of body	335	320	360
Length of head	414	418	388
Length of snout	79	77	82
Bony interorbital space	42	38	37
Diameter of eye	84	98	61
Postorbital length of head	257	254	245
Least preorbital width	31	20	31
Tip of snout to rear of maxillary	191	189	181
Least depth of caudal peduncle	115	107	121
Length of caudal peduncle	191	189	194
Length of fin rays:			
First dorsal spine	60	74	65
Third dorsal spine	136	152	133
Last dorsal spine	126	135	147
Longest or fourth dorsal spine	141	141	156
First anal spine	60	39	65
Second anal spine	100	156	126
Third anal spine	115	167	138
Longest soft fin ray:			
Dorsal	173	172	169
Pectoral	235	254	239
Pelvic	194	197	174
Caudal	235	238	245

gill rakers short, thick, longest at angle about equal to length of gill filaments: maxillary reaches a little past a vertical line through rear of eye; angle of profile of snout about 20 degrees steeper than that of head from behind orbits to dorsal fin origin.

Color in alcohol.—Background color light gray to tan, with scattered small dark-brown or blackish spots more or less in rows, these occurring on dorsal and caudal fins, a few on base of pectoral; anal, pectoral, and pelvic fins of holotype dark-brown or blackish with a white margin distally; on the two small paratypes pectoral, anal, and pelvic fins dusky to brownish, but a few black spots discernible, those on pectoral forming bars; distal posterior edges of soft dorsal and caudal fins white; black streak along rear part of edge of maxillary groove, opposite dorsal edge of maxillary when mouth is closed; only two black dorsal blotches occur, the first at bases of ninth to eleventh dorsal spines and extending on about the basal third of dorsal fin, the second on dorsal edge of caudal peduncle.

Ecology.—This new species was taken from among coral heads in water in which wave action was strong.

Remarks.—E. spilotus may be best distinguished by the black or dark-brown round spots, rather widely spaced and more or less in rows, occurring in combination with only two very black dorsal blotches and a small black streak on the edge of the maxillary groove. From other species it may be separated by the key on page 332. This new species might be confused with *E. fario* except that the latter has three blackish dorsal blotches and no black maxillary streak.

Named *spilotus* in reference to the blackish spots.

EPINEPHELUS HEXAGONATUS (Bloch and Schneider)

PLATE 26, B

Holocentrus hexagonatus BLOCH and SCHNEIDER, Systema ichthyologiae, p. 323, 1801 (type locality, Tahiti).

Serranus hexagonatus RICHARDSON, The zoology of the voyage of the *Sulphur*, Fishes, pl. 38, fig. 1, 1844–45.—GÜNTHER, (Fische de Südsse), Journ. Mus. Godeffroy, vol. 1, pl. 7, fig. B, 1873.

Epinephelus hexagonatus BLEEKER, Atlas ichthyologique des Indes Orientales Néerlandaises . . ., pl. 301, fig. 2, 1873–76.

Serranus stellans RICHARDSON, Ann. Mag. Nat. Hist., vol. 9, p. 23, 1842 (type locality, Melville Island, Torres Strait).

SPECIMENS STUDIED

Bikini Atoll: 21 stations, 218 specimens, 32 to 170 mm. standard length.
Eniwetok Atoll: 6 stations, 53 specimens, 38 to 167 mm.
Rongelap Atoll: 4 stations, 30 specimens, 32 to 128 mm.
Rongerik Atoll: 3 stations, 37 specimens, 35 to 132 mm.
Kwajalein Atoll: 1 station, 52 specimens, 44 to 149 mm.
Rota: 3 lots, 6 specimens, 39 to 147 mm.

Description.—Dorsal rays usually XI,16, occasionally XI,15; pectoral ii,16 to ii,18, usually ii,17; gill rakers on first gill arch 6 to 8+1+16 or 17; scale rows above lateral line about 95 to 100; scales in a row from anal origin to lateral line about 22 to 25, from lateral line to base of soft dorsal usually 10.

Greatest depth 3.2 to 3.5; head 2.4 to 2.6; length of pectoral fin 4.0 to 4.6; all in standard length. Greatest depth 1.2 to 1.4; length of pectoral fin 1.5 to 1.8; snout 4.5 to 5.4; postorbital length of head 1.6 to 1.7; eye 4.2 to 5.5; tip of snout to rear of maxillary 2.0 to 2.1; least depth of caudal peduncle 3.5 to 4.0; all in length of head.

Interorbital space (fleshy) flat, 1.3 to 1.9 in eye; least depth of caudal peduncle 1.6 to 1.8 in its length; teeth on dentary at middle of sides, in three or more rows in small ones, in a band in adults; one or two pairs of canines each side of symphysis in each jaw; teeth on palatines in a narrow band, those on vomer, in a narrow Λ-shaped band; middle opercular spine equidistant between upper and lower ones; preopercular edge notably convex, with the usual small concave

notch near lower angle finely serrate; greatest depth of body opposite front of spiny dorsal; posterior margins of all fins rounded; fourth to sixth dorsal spines longest, about 1.6 to 2.1 in postorbital length of head, and equal to or slightly larger than last dorsal spine; soft dorsal rays a little longer than dorsal spines; second anal spine strongest, when depressed equal to or longer than second; gill rakers short, thick; maxillary reaches a little past a vertical line through rear of eye; angle of profile of snout about 10 to 15 degrees steeper than that of head from behind orbits to dorsal fin origin.

Color in alcohol.—Background color whitish to light tan, everywhere covered with distinct hexagonal brown spots separated by a narrow white line, angles between brown spots with tiny white to silvery triangular specks, the dark spots may be darkened opposite the blackish blotches to form more or less evident dark bars; brown spots occur on median fins; pectoral fins plain light tan or dusky with indistinct markings, even on young; pelvics dusky, with outer edge white and inner rays with some brown spots; anal dusky to blackish distally with outer edge white; caudal spotted, with lower half dusky and lower edge white; five dark blotches along back are evident, two along base of spiny dorsal, two along base of soft dorsal, and one on dorsal edge of caudal peduncle, all of about equal intensity, otherwise the first palest, and first two extending a short way up on the spiny dorsal fin; on young and on halfgrown the centers of the dark spots on the fins are paler than the margins; usually a dusky streak occurs behind the eye.

Color when alive.—Background color white or light tan; dark spots reddish brown or blackish dorsally; pectoral dusky orange; upper distal edge of caudal fin orange tinted; the dark blotch behind eye continues as a yellowish streak or band on opercle; iris orange.

Ecology.—This species was one of the most abundant fishes on the reefs in shallow water. It occurred among coral heads, in crevices, under rocky debris, and in the deeper waters of the lagoon.

Remarks.—Among the brown-spotted groupers of the genus *Epinephelus* this one is best recognized by the following combination of characters: Hexagonal brown spots, separated by white lines and tiny triangular white spots; five black blotches along the back, starting at the base of and in front of the spiny dorsal fin, the one behind and at the base of the soft dorsal fin with the least intensive coloration; and a pectoral fin that is indistinctly dark spotted and mostly plain dusky. I wish to correct my wrong interpretation of this species in U. S. Nat. Mus. Bull. 180, pp. 106–107, 1943. The specimens U.S.N.M. Nos. 115370, 115372, 115373, seven of 115375, and 115377, originally identified as *E. merra*, are *E. hexagonatus*.

EPINEPHELUS SPILOTOCEPS, new species

FIGURES 56, 57

Holotype.—U.S.N.M. No. 141901, Bikini Atoll, Namu Island, lagoon reef, April 3, 1946, S–46–50, Schultz, standard length 121 mm.

Paratypes.—U.S.N.M. No. 141902, Bikini Atoll, Romuk Island, lagoon reef, April 2, 1946, S–46–48, Schultz, 3 specimens, 66 to 128 mm.; U.S.N.M. No. 141911, Bikini Atoll, Boro Island, April 6, 1946, S–46–52, Schultz and Brock, 1 specimen, 81 mm.; U.S.N.M. No. 141904, Bikini Atoll, Bokon Island, ocean reef, April 15, 1946, S–46–95, Schultz, 1 specimen, 72 mm.; U.S.N.M. No. 141905, Bikini Atoll, Romuk Island, lagoon reef, May 14, 1946, S–46–128, Schultz, 2 specimens, 41 to 75 mm.; U.S.N.M. No. 141906, Bikini Atoll, Yuro Island, ocean reef, July 13, S–46–251, Herald, 1 specimen, 210 mm.; U.S.N.M. No. 141907, Bikini Atoll, Bikini Island, ocean reef, July 16, 1946, S–46–253, Herald, 1 specimen, 92 mm.; U.S.N.M. No. 141910, Bikini Atoll, Reer Island, lagoon reef, August 12, 1946, S–46–332, Herald and Brock, 1 specimen, 121 mm.; U.S.N.M. No. 141909, Bikini Atoll, Enyu Island, ocean reef, August 13, 1946, S–46–333, Herald, 9 specimens, 99 to 233 mm.; U.S.N.M. No. 141908, Bikini Atoll, Oruk Island, ocean reef, August 16, 1946, S–46–382, Herald, 1 specimen, 39 mm.; U.S.N.M. No. 141913, Bikini Atoll, Eman Island, lagoon reef, July 17, 1947, S–46–405, Schultz, Brock, Hiatt, and Myers, 1 specimen, 45 mm.; U.S.N.M. No. 141914, Bikini Atoll, lagoon reef halfway between Bikini and Amen Islands, July 21, 1947, S–46–442, Brock, Hiatt, and Schultz, 2 specimens, 47 and 48 mm.; U.S.N.M. No. 141912, Bikini Atoll, Bikini Island, west end, August 18, 1947, S–46–533, Brock and Schultz, 3 specimens, 47 to 67 mm.; U.S.N.M. No. 141915, Bikini Atoll, Namu Island, ocean reef, August 7, 1947, S–1019, Brock, Hiatt, and Schultz, 1 specimen, 129 mm.; U.S.N.M. No. 141919, Rongerik Atoll, Bock Island, ocean reef, June 27, 1946, S–46–237, Schultz and Herald, 1 specimen, 68 mm.; U.S.N.M. No. 141920, Rongerik Atoll, Eniwetak Island, ocean reef, June 29, S–46–241, Schultz and Herald, 1 specimen, 180 mm.; U.S.N.M. No. 141916, Eniwetok Atoll, Rujoru Island, ocean reef, June 2, 1946, S–46–196, Morrison and Cali, 2 specimens, 35 and 109 mm.; U.S.N.M. No. 141917, Eniwetok Atoll, Aaraanbiru Island, ocean reef, June 3, 1946, S–46–198, Schultz, 1 specimen, 30 mm.; U.S.N.M. No. 141918, Rongelap Atoll, Enybarbar Island, June 18, 1946, S–46–217, Schultz, 7 specimens, 37 to 102 mm.; U.S.N.M. No. 141921, Kwajalein Atoll, lagoon reef, Ennylabegan Island, September 1, 1946, S–46–397, Herald, 1 specimen, 95 mm.

Description.—The following measurements, expressed in thousandths of the standard length, were made on the holotype and one paratype, respectively. Standard length in mm. 121 and 205. Great-

est depth 306 and 293; head 446 and 424; snout 91 and 83; interorbital space 33 and 44; eye 99 and 75; postorbital length of head 260 and 271; least width of preorbital 23 and 25; length from tip of snout to rear edge of maxillary 194 and 188; least depth of caudal peduncle 99 and 107; length of caudal peduncle 184 and 178; length of first dorsal spine 60 and 59, third 141 and 122, last 141 and 120, longest (sixth) 148 and 127; length of first anal spine 78 and 63, second 173 and 127, third 136 and 132. Longest soft dorsal ray 181 and 146; pectoral 248 and 200; pelvic 194 and 173; caudal 231 and 205.

The following counts were recorded for the holotype and the paratype, respectively. Dorsal rays XI,15 and XI,15; anal III,8 and

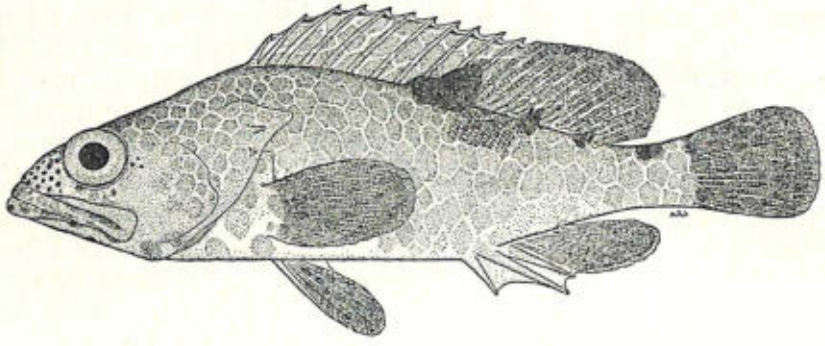

FIGURE 56.—Holotype of *Epinephelus spilotoceps*, new species (U.S.N.M. No. 141901), from Bikini Atoll. (Drawing by Dorothea B. Schultz.)

III,8; pectoral ii,17-ii,17 and ii,17-ii,17; vertical scale rows above lateral line 97 and 95; scales in a row from anal origin to lateral line 23 and 24, from lateral line to base of soft dorsal fin 10 and 11; gill rakers on first gill arch counting all rudiments 8+1+16 and 8+1+16.

Greatest depth 3.1 to 3.5; head 2.2 to 2.5; length of pectoral fin 4.1 to 4.8; all in standard length. Greatest depth 1.3 to 1.4; length of pectoral fin 1.7 to 2.0; snout 4.9 to 5.0; postorbital length of head 1.6 to 1.7; eye 4.0 to 5.5; tip of snout to rear of maxillary 2.2 to 2.3; least depth of caudal peduncle 3.7 to 3.9; all in length of head. Least depth of caudal peduncle in snout tip to rear of maxillary 1.7 to 1.8. Interorbital (fleshy) space flattish to slightly concave, about 1.3 to 1.9 in eye; least depth of caudal peduncle in its length, 1.7 to 1.8; teeth on middle of side of dentary in 2 or 3 rows in young, in 3 or more in halfgrown and adults; a pair or two of short canines on each side of symphysis of each jaw; teeth on palatines in a narrow band, those on vomer in a narrow Λ-shaped band; preopercular edge notably convex, finely serrate; greatest depth of body opposite dorsal origin; posterior margins of all fins rounded; sixth dorsal spine longest, about same length as fifth and a little longer than last, contained about 1.6 to 2.2 in postorbital length of head; soft dorsal rays longer than dorsal

spines; second anal spine strongest, usually slightly projecting past tip of third when depressed; gill rakers short, thick; maxillary reaches a little beyond a vertical line through rear of eye; angle of profile of snout 12 degrees to 15 degrees steeper than that of head from behind orbits to dorsal fin origin.

Color in alcohol.—Background color light tan or gray with hexagonal brownish spots on sides, these most uniform caudally and dorsally, where they are separated by a narrow whitish line, ventrally these roundish in shape and separated by white interspaces. No triangular tiny white specks anywhere; pectoral, pelvic, and anal fins with brown spots, posterior margins of all fins white edged, inside the white edge on anal a submarginal dusky streak, and on ventral

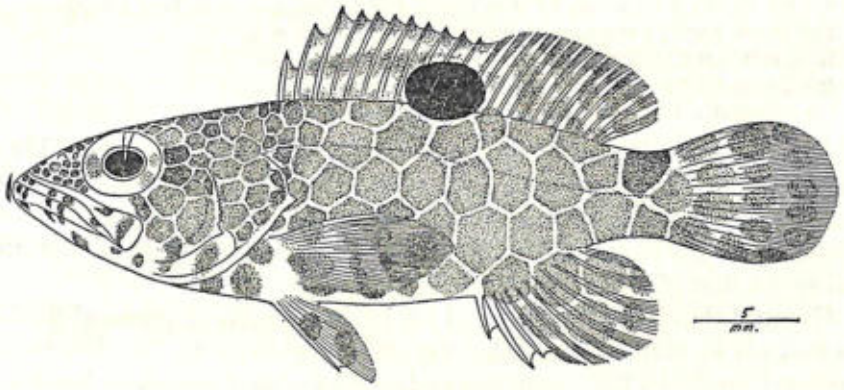

FIGURE 57.—Young specimen of *Epinephelus spilotoceps*, new species, from the Philippine Islands. (Drawing by H. W. Fowler.)

side of caudal fin a little dusky submarginally but not notably so as in *hexagonatus*; centers of brown spots on fins without pale centers; two to four intensely black blotches on back, first largest, equal to eye, most intensely colored, and extending on basal third of dorsal fin between spines VIII and XI; along base of soft dorsal two smaller black spots, the last often absent on half-grown specimens, both may be lacking on those shorter than 100 mm.; last blotch intensely black on dorsal edge of caudal peduncle, lacking on specimens shorter than 50 mm.; a black spot near tips of dorsal spines, with the tip white; most characteristic color markings are the scattered but numerous small black or brown spots on dorsal surface of snout and sometimes on interorbital space and on sides of head below eye, these occurring in specimens as small as 30 mm. in standard length.

Remarks.—This new species is closest to *hexagonatus*, with which it has been confused, but differs in the presence of the two to four intensely black dorsal blotches, and in the small black spots dorsally on the front part of the head.

Named *spilotoceps* in reference to the characteristic spots on the front part of the head.

Genus ANYPERODON Günther

Anyperodon GÜNTHER, Catalogue of the fishes in the British Museum, vol. 1, p. 95, 1859. (Genotype, *Serranus leucogrammicus* Cuvier and Valenciennes.)

ANYPERODON LEUCOGRAMMICUS (Cuvier and Valenciennes)

PLATE 27

Serranus leucogrammicus CUVIER and VALENCIENNES, Histoire naturelle des poissons, vol. 2, p. 347, 1828 (type locality, Moluccas and Seychelles).

SPECIMENS STUDIED

Bikini Atoll: 5 stations, 16 specimens, 103 to 330 mm. standard length.
Eniwetok Atoll: 2 stations, 3 specimens, 133 to 283 mm.
Rongerik Atoll: 3 stations, 4 specimens, 93 to 320 mm.
Rongelap Atoll: 2 stations, 2 specimens, 260 and 288 mm.
Likiep Atoll: Univ. Washington, 3 specimens, 81 to 100 mm.

Description.—Dorsal rays XI,14 or 15, usually XI,15; anal III,8 or 9, rarely III,8; pectoral ii,15 or ii,16; vertical scale rows above lateral line 120 to 125; scales in a row from anal origin to lateral line about 27 or 28, from lateral line to base of soft dorsal 16 to 18; gill rakers on first gill arch about 8 to 11+17 or 18.

Greatest depth 3.2 to 3.3; head 2.5 to 2.6; length of pectoral fin 4.9 to 5.3; all in standard length. Greatest depth 1.3 to 1.4; length of pectoral fin 2.0 to 2.2; snout 3.8 to 4.0; postorbital length of head 1.6 to 1.7; eye 5.3 to 6.8; tip of snout to rear of maxillary 2.0 to 2.1; least depth of caudal peduncle 3.5 to 3.8; all in length of head. Fleshy interorbital space flattish, contained 1.2 to 1.3 in eye; least depth of caudal peduncle 1.5 in its length; teeth on middle of sides of dentary in 2 or more rows, those on premaxillary in a villiform band; no teeth on palatines; vomer with a narrow Λ-shaped band of teeth; usual pair or two of short canines each side of symphysis in each jaw; preopercular edge rounded, rather coarsely serrate; greatest depth opposite front of spiny dorsal; posterior margins of all fins rounded; third dorsal spine longest, 1.8 to 2.3 in postorbital length of head; soft dorsal rays notably longer than dorsal spines; second anal spine strongest, not quite reaching tip of third when depressed; gill rakers short, thick, longest about equal to length of gill filaments; maxillary scaled; middle opercular spine a little closer to lower than to upper one; a vertical line through rear of eye passes notably in front of tip of maxillary.

Color in alcohol.—Background color brownish, darker dorsally, paler brown ventrally; sides and back with numerous pale spots, these absent or indistinct ventrally, sometimes with brownish centers, very

close together on head, but less so on body, especially posteriorly; median soft fins and ventral and posterior parts of body with small dark-brown spots sparsely scattered, usually lacking on specimens less than 200 mm. long; scattered small brown spots may occur on gill membranes and usually on lower side of head; pelvics dusky; pectorals pale; the soft rays in the fins characteristically dusky and membranes hyaline; on halfgrown specimens usually two or three pale streaks on side, the most prominent beginning under eye; these fade on large individuals.

Color when alive.—Background color reddish brown with bright orange or brownish-red spots (these usually pale or white in alcohol); dorsal fin yellowish basally; pale streaks on sides of halfgrown specimens silvery or white and may number from none to four or five or be broken into elongate blotches dorsally.

Ecology.—This species was occasionally taken over the shallower parts of the reefs but was more abundant around the coral heads in the lagoon in deeper waters.

Remarks.—This characteristically colored serranid lacks palatine teeth, has a very pointed profile of head. In life it is brownish with orange spots. Although two of the specimens have III,8 anal rays they have normal color patterns and could not be referred to *A. urophthalmus* Bleeker as defined by Boulenger and as illustrated by Bleeker (Atlas ichthyologique des Indes Orientales Néerlandaises . . ., 1865, pl. 290, fig. 3, 1876).

Genus VARIOLA Swainson

Variola SWAINSON, The natural history and classification of fishes, . . ., vol. 2, p. 202, 1839. (Genotype, *Variola longipinna* Swainson.) (Ref. copied.)

VARIOLA LOUTI (Forskål)

PLATE 28

Perca louti FORSKÅL, Descriptiones animalium . . . , pp. xi, 40, 1775 (type locality, Red Sea).

SPECIMENS STUDIED

Bikini Atoll: 6 stations, 6 specimens, 168 to 415 mm. standard length.
Eniwetok Atoll: 1 station, 1 specimen, 415 mm.
Rongelap Atoll: 1 station, 1 specimen, 355 mm.
Rongerik Atoll: 3 stations, 6 specimens, 39 to 395 mm.
Rota Island: 1 station, 1 specimen, 172 mm.

Description.—Dorsal rays usually IX,14; anal III,8; pectoral ii,17; scale rows above lateral line 125 to 143; scales in a row from anal origin to lateral line about 35 to 40, from lateral line to base of soft dorsal fin 12 to 15.

Greatest depth 3.1 to 3.2, head 2.6 to 2.7, length of pectoral fin 3.9 to 4.3, all in standard length. Greatest depth 1.1 to 1.2, pectoral fin

1.5 to 1.6, snout 3.3 to 4.0, postorbital length of head, 1.7, eye 4.7 to 7.0, tip of snout to rear of maxillary 2.0 to 2.1, least depth of caudal peduncle 3.2 to 3.7, all in length of head. Interorbital space slightly convex, its width 0.7 to 1.3 in eye; least depth of caudal peduncle 1.5 to 1.6 in distance from base of anal fin to midbase of caudal fin; teeth on dentary and on premaxillary in a villiform band, with depressible teeth in the inner rows longest, and with one or two pairs of strong canines each side of symphysis, and with one or two pairs of canines at middle of side of dentary only; palatine teeth in a narrow villiform band; villiform band of teeth on vomer broadly Λ-shaped; greatest depth of body under spiny dorsal; paired fins bluntly pointed posteriorly; all median fins end in long points; caudal fin deeply concave with dorsal and ventral lobes greatly elongate; seventh dorsal spine longest, about 1.8 in postorbital length of head; soft dorsal rays much longer than dorsal spines; when depressed third anal spine notably longer than second.

Color in alcohol.—Background coloration grayish to light brownish, everywhere speckled with small pale spots, sometimes more or less arranged in irregular rows; on some specimens these spots lighter than background, depending on preservation; pectoral fin basally and centrally dusky, distal third whitish; pelvics dusky distally; posterior margin of caudal fin whitish, this band widest on shortest rays, outer lobes dusky; center of each scale usually with a tiny brown speck; the 99-mm. specimen has a series of black blotches more or less forming a black streak from behind eye to upper edge of caudal peduncle, where it is interrupted, and ending in a large black blotch on upper base of caudal fin. A 43-mm. specimen is white, except for a series of black blotches marked with white spots along upper side.

Color when alive.—Background yellowish brown or orange, everywhere spotted profusely with small reddish or pinkish spots, those on back and dorsal fin margined with a purple or bluish line; posterior margin of dorsal, anal, and caudal fins bright yellow; posterior third of pectoral orange; dorsal, anal, and caudal fins, except rear margins, purplish brown, spotted like body with pinkish or bluish spots; iris bright red; underside of head and body dark red.

Ecology.—Although this brilliantly colored species was taken occasionally on the shallower parts of the reefs it was common in the deeper waters of the lagoon, being caught by line fishing and sometimes by trolling. It reaches a total length of about 3 feet, although the largest specimens were not preserved.

Remarks.—This species is best recognized by the deeply concave caudal fin with elongate pointed lobes, pointed soft dorsal and anal fins, everywhere with small red or pinkish spots on a background of yellowish brown or orange.

Genus PLECTROPOMUS Oken

Plectropomus OKEN, Isis, p. [1182] 1782 (on "Les Plectropomes" Cuvier, Règne animal, vol. 2, p. 277, 1817). (Genotype, *Bodianus maculatus* Bloch.) (Ref. copied.)

Apparently two species in this genus were taken in the northern Marshall Islands, but only one species reached the United States National Museum. Specimens of the other one were discarded or lost when the small ship went aground in Halfmoon Bay, Calif. (see p. XXI).

PLECTROPOMUS TRUNCATUS Fowler

PLATE 29, A

Plectropomus truncatus FOWLER, U. S. Nat. Mus. Bull. 100, vol. 10, p. 196, fig. 5, 1930 (type locality, Atulayan Island, off east coast of Luzon, Philippine Islands, holotype, U.S.N.M. No. 89984).

SPECIMENS STUDIED

Bikini Atoll: Erik Island, March 19, 1946, S–46–9, Schultz and Brock, 1 specimen, 385 mm. standard length; Enyu Island, ocean reef channel entrance, August 1, 1947, S–46–483, Schultz, Brock, and Hiatt, 1 specimen, 425 mm.

Rongelap Atoll: Naen Island, lagoon reef, July 30, 1946, S–46–302, Herald, 2 specimens, 355 and 390 mm.

Description.—Dorsal rays VIII,11; anal III,8, pectoral I,i,14 or I,i,15; probably about 100 vertical scale rows above lateral line, but there are so many accessory small scales that an accurate count on these large specimens is very uncertain.

Greatest depth 3.3 to 3.4, head 1.7 to 1.9, length of pectoral fin 5.9 to 6.8, all in standard length. Greatest depth 1.1 to 1.2, pectoral 2.0 to 2.1, snout 3.3 to 3.5, postorbital length of head 1.6 to 1.7, eye 6 to 7.5, tip of snout to rear of maxillary 2.0 to 2.1, least depth of caudal peduncle 2.5 to 2.7, all in length of head. Interorbital space slightly convex to flattish centrally, contained 0.5 to 0.7 in eye; least depth of caudal peduncle 1.3 to 1.5 in distance from anal base to midbase of caudal fin; teeth on premaxillary in a villiform band, with inner rows longest and teeth depressible on premaxillary and dentary, an outer row of nondepressible teeth, with one or two pairs of enlarged canines, usually one pair on each side of symphysis in each jaw, and other enlarged canines at sides of jaws; a narrow band of villiform teeth on palatines, and a similar band broadly Λ-shaped on vomer; preopercular edge denticulate, with a few retrorse short spines on its ventral edge; greatest depth of body under spiny dorsal base; pectoral fin rounded; distal edges of soft dorsal and anal fins rounded; pelvics nearly truncate, or slightly rounded when fully spread; caudal fin truncate, with dorsal and ventral tips slightly rounded; fourth or fifth dorsal spine longest, 2.0 in postorbital length of head, soft dorsal rays notably longer than dorsal spines; anal spines very small, flexible, scarcely discernible without dissection.

Color in alcohol.—Brownish to dusky, darker dorsally, everywhere with dusky black or brown-edged spots; pectoral with spots basally, usually plain dusky distally except for a broad whitish margin; pelvics blackish especially distally, caudal fin with a white margin posteriorly; soft dorsal also with a white margin.

Color when alive.—Light brownish with black-edged bright-blue spots covering head, body, and caudal fins, and fewer on dorsal and anal fins; all fins nearly blackish with white edges to soft dorsal and caudal fins; distal margin of pectoral fin light orange.

Ecology.—This species was taken only from reefs adjoining moderately deep water. Only adults were captured.

PLECTROPOMUS LEOPARDUS (Lacepède)

PLATE 29, B, C

Holocentrus leopardus LACEPÈDE, Histoire naturelle des poissons, vol. 4, pp. 332, 367, 1802 (no locality).

SPECIMENS STUDIED

At Rongelap Atoll, Tufa Island, on July 18, 1946, S–46–260, a specimen 3 feet in length was collected but discarded because of its large size. Fortunately two photographs in color were made and these are in sufficient detail to permit identification.

Another photograph taken of a specimen caught by Marr when trolling is of this species. Probably it was lost when the small ship went aground in Halfmoon Bay, Calif. (see p. XXI).

Bikini Atoll: Off southeast end Enyu Island in Channel, caught by trolling, August 3, 1946, Univ. Washington, 1 specimen, 525 mm. standard length.

Description.—Dorsal rays VIII,11, and III,8, pectoral I,i,15–I,i,14, pelvic I,5, branched caudal ray 8+7; vertical scale rows above lateral line from upper edge of gill opening to base of caudal fin about 165; from lateral line to base of spiny dorsal about 18 to 20, and from lateral line to anal origin about 35.

Greatest depth 3.8, head 2.8, length of pectoral 6.7, all in standard length. Greatest depth 1.3, pectoral 1.6, snout 3.1, postorbital length of head 1.7, eye 7.8, tip of snout to rear of maxillary 2.0, least depth of caudal peduncle 3.0, all in length of head. Interorbital space nearly flattish, a little concave medially, contained 0.7 in eye; least depth of caudal peduncle 1.9 in its length; premaxillary with a villiform band of depressible teeth, a single pair of enlarged canines near front of jaw; dentary with a row of nondepressible enlarged canine teeth along front and sides; a narrow band of villiform teeth on vomer and palatines; preopercular edge denticulate, a few retrorse spines on its ventral edge; greatest depth of body under spiny dorsal base; pectoral fin rounded; soft dorsal fin with an elongate rounded lobe posteriorly, anal similar, distal edges truncate; caudal fin with con-

cave posterior edge and tips of outer lobes pointed or nearly so; fourth dorsal spine longest, 2.2 in postorbital length of head; anal spines small, flexible.

Color in alcohol.—Background coloration light brown, a little lighter brown ventrally; head and body with scattered but numerous small dark-brown spots, the diameter of these spots contained two or three times or more in the interspaces; a few dark spots on pectoral basally, distally this fin is blackish with narrow white margin; brown spots occur on the median fins; caudal fin edges posteriorly with a broad blackish band; pelvics blackish.

Color when alive.—Background coloration red to dark red; head, body, and median fins with numerous very small dark-edged bright-blue spots, a few on the almost blackish pectoral fin; pelvics blackish; a narrow yellow-white band around distal margin of pectoral fin; dorsal, anal, and caudal fins without a trace of a white band on their posterior edges. On a color-drawing of this species from the Philippine *Albatross* collection the spiny dorsal is pale blue distally, otherwise very much like the color photographs at hand.

Genus CEPHALOPHOLIS Bloch and Schneider

Cephalopholis BLOCH and SCHNEIDER, Systema ichthyologiae, p. 311, 1801. (Genotype, *Cephalopholis argus* Bloch and Schneider.)

CEPHALOPHOLIS LEOPARDUS (Lacepède)

PLATE 30, A

Labrus leopardus LACEPÈDE, Histoire naturelle des poissons, vol. 3, pp. 450, 518, pl. 30, fig. 1, 1802 (type locality, Great Equatorial Ocean=Indo-Pacific Ocean).

Epinephelus zanana BLEEKER, Atlas ichthyologique des Indes Orientales Néerlandaises, vol. 7, pl. 298, 1873–1876.

SPECIMENS STUDIED

Bikini Atoll: 9 stations, 59 specimens, 42 to 113 mm. standard length.
Rongelap Atoll: 3 stations, 23 specimens, 26 to 99 mm.
Rongerik Atoll: 4 stations, 6 specimens, 29 to 107 mm.
Likiep Atoll: Univ. Washington, 2 specimens, 80 and 92 mm.
Arhno Atoll: *Albatross*, 1 specimen, 111 mm.

Description.—Dorsal rays IX,14; anal III,9; pectoral ii,15 to ii,17; gill rakers about 8+1+14 or 15; oblique scale rows above lateral line 82 to 89; scales in a row from anal origin to lateral line about 20 to 22, from lateral line to base of soft dorsal 7 or 8.

Greatest depth 2.7 to 2.9, head 2.3 to 2.5, length of pectoral fin 3.2 to 3.5, all in standard length. Greatest depth 1.1 to 1.2, pectoral 1.3 to 1.5, snout 4.4 to 4.8, postorbital length of head 1.6 to 1.8, eye 3.9 to 5.0, tip of snout to rear of maxillary 1.9, least depth of caudal peduncle

3.2, all in length of head. Interorbital space nearly flat, 1.5 to 2.1 in eye; least depth of caudal peduncle 1.3 in distance from base of anal to midbase of caudal fin; teeth on dentary and on premaxillary in a villiform band with inner rows longest and depressible, a pair of short but strong canines each side of symphysis of each jaw; teeth on palatines in a narrow band, those on vomer in a narrow Λ-shaped band; preopercular edge finely denticulate; greatest depth of body at dorsal origin; posteriorly all fins rounded; next to last dorsal spine longest, about 1.6 in postorbital length of head; soft dorsal rays longer than dorsal spines; second anal spine strongest and longest, reaching past third when depressed.

Color in alcohol.—Background coloration light brownish below to dark brownish dorsally; sometimes with five to seven more or less distinct dark and pale vertical bands; one or two black spots or blotches on dorsal side of caudal peduncle, the spot just behind dorsal fin base most intense, both spots surrounded by white, an oblique black streak on upper lobe of caudal fin, bordered dorsally by a white streak, then dorsal edge of fin dusky, sometimes, but rarely, a similar dusky streak can be seen in lower lobe of caudal fin; lower side of head and body sometimes with numerous pale spots; a blackish or brownish opercular spot, usually distinct; a dark streak from eye through opercular spot, distinct on certain specimens to wholly lacking on others. Two specimens from station S–46–308 were nearly plain white in color.

Color when alive.—Orange to reddish, the pale spots bright red; pectoral fin yellowish orange, distal edges of dorsal and anal fins with a bright-red streak, below this a white streak, then a dark-red one; iris red; the dark streak from eye through opercular spot purplish brown.

Ecology.—A moderately common species around the coral heads in the lagoon adjoining deep water, also taken from the surge channels along the ocean reef.

Remarks.—One specimen had fatty tumors along the bases of the median fins. In none of the specimens from the Marshall Islands does the black oblique streak in the caudal fin form a submarginal band as figured by Lacepède and Bleeker. In my report on the fishes from the Phoenix and Samoan Islands (U. S. Nat. Mus. Bull. 180, p. 109, 1943) U.S.N.M. Nos. 115364 and 115365 are identified as *Cephalopholis leopardus* and not *C. urodelus*.

I have reexamined the holotype of *Epinephelus urodelops* Schultz and have concluded that the soft dorsal fin rays have been damaged when the individual was young, because the rays are not evenly spaced. I am inclined, therefore, to consider it a synonym of *Cephalopholis leopardus*.

CEPHALOPHOLIS ARGUS Bloch and Schneider

PLATES 30, B; 31, A

Cephalopholis argus BLOCH and SCHNEIDER, Systema ichthyologiae, p. 311, pl. 61, 1801 (type locality, East Indies).

SPECIMENS STUDIED

Bikini Atoll: 7 stations, 18 specimens, 50 to 260 mm. standard length.
Rongerik Atoll: 4 stations, 14 specimens, 53 to 201 mm.
Eniwetok Atoll: 2 stations, 4 specimens, 66 to 175 mm.
Rongelap Atoll: 4 stations, 4 specimens, 43 to 237 mm.
Rota Island: 2 lots, 2 specimens, 22 and 151 mm.
Guam: 2 lots, 12 specimens, 27 to 163 mm.

Description.—Dorsal rays IX,15 or 16, usually 16; anal III,9; pectoral i or ii,15 to 17; scale rows above lateral line 95 to 100; scales in a row from anal origin to lateral line 24 to 26, from lateral line to base of soft dorsal fin 10 or 11.

Greatest depth 2.8 to 3.3, head 2.4 to 2.7, pectoral fin 4.4 to 4.6, all in standard length. Greatest depth 1.2 to 1.3, pectoral fin 1.7 to 1.9, snout 3.7 to 3.8, postorbital length of head 1.6 to 1.8, eye 5.4 to 7.5, tip of snout to rear of maxillary 1.8 to 2.0, least depth of caudal peduncle 2.7 to 3.0, all in length of head; interorbital space slightly convex, its width equal to diameter of eye; least depth of caudal peduncle 1.2 to 1.3 in distance from base of anal fin to midbase of caudal fin; teeth on dentary and on premaxillary moderately long, conical, in a band, all depressible, inner ones longest, no canines; teeth on vomer and palatines in a narrow villiform band, the band on vomer broadly Λ-shaped; greatest depth of body under spiny dorsal; posteriorly all fins rounded except pelvics, which are somewhat pointed; fifth dorsal spine longest, about 2.1 in postorbital length of head; soft dorsal rays longer than dorsal spines; when depressed, second and third anal spines equal, or third extends past second.

Color in alcohol.—Background coloration dark brownish or purplish black, speckled everywhere with scattered small pale spots, these also on fins; posterior edges of soft dorsal, anal, pectoral, and caudal fins white edged; some specimens with from 5 to 7 broad dark vertical bands between pectoral base and caudal fin base, these bands usually narrower than the paler interspaces; sometimes area around and below pectoral fin base whitish or grayish.

Color when alive.—On head, body, and fins dark background color usually deep purplish black, sometimes dark brown, pale specks dazzling light-purplish blue; posterior pale edges of fine white or light yellowish; tip of membrane of dorsal spines dark purplish red; iris brownish red.

Ecology.—This species was not very common on the shallow parts of reefs of the northern Marshall Islands, where it occurred hiding

among coral growths. The largest individuals came from the deeper waters of the surge channels, or from the deeper waters of the lagoon.

CEPHALOPHOLIS URODELUS (Bloch and Schneider)

PLATE 31, B

Percam urodetam (Forster) BLOCH and SCHNEIDER, Systema ichthyologiae, p. 333, 1801 (type locality, St. Christina, Waitaho) (=*Serranus urodelus* Cuvier and Valenciennes, from Tahiti).

SPECIMENS STUDIED

Bikini Atoll: 9 stations, 31 specimens, 66 to 167 mm. standard length.
Eniwetok Atoll: 2 stations, 2 specimens, 84 and 139 mm.
Rongelap Atoll: 2 stations, 4 specimens, 70 to 88 mm.
Rongerik Atoll: 2 stations, 4 specimens, 95 to 175 mm.
Likiep Atoll: Univ. Washington, 1 specimen, 41 mm.
Kwajalein Atoll: 1 station, 1 specimen, 131 mm.
Jaluit Atoll: *Albatross*, 1 specimen, 16 mm.
Rota: 1 lot, 8 specimens, 125 to 168 mm.

Description.—Dorsal rays IX,15 or 16; anal III,9; pectoral ii,16 to 19; scale rows above lateral line about 93 to 105; scales in a row from anal origin to lateral line about 25 to 30, from lateral line to base of soft dorsal fin 10 to 12.

Greatest depth 2.8 to 3.1, head 2.5 to 2.7, length of pectoral fin 3.6 to 4.0, all in standard length. Greatest depth 1.1 to 1.3, pectoral fin 1.3 to 1.4, snout 4.3 to 4.5, postorbital length of head 1.5 to 1.6, eye 4.2 to 6.5, tip of snout to rear of maxillary 1.9 to 2.1, least depth of caudal peduncle 2.7 to 3.2, all in length of head. Interorbital space slightly convex, its width contained from 1.2 to 2.0 in eye; least depth of caudal peduncle 1.3 to 1.4 in distance from anal base to midbase of caudal fin; teeth on dentary and on premaxillary in a villiform band, inner rows longest and depressible, outer row non-depressible; a pair of short but strong canines (sometimes an extra canine occurs) each side of tips of both jaws; narrow band of villiform teeth on palatine and on vomer, that on vomer Λ-shaped; preopercular edge finely denticulate; greatest depth of body under front of spiny dorsal base; posteriorly all fins rounded; next to last dorsal spine usually longest, 1.5 to 1.7 in postorbital length of head; soft dorsal rays longer than dorsal spines; second anal spine heaviest; when anal spines are depressed either second or third spine is longest.

Color in alcohol.—Background color dark brown to light brown, posteriorly much darker than anterior half, on small specimens posteriorly the body and fins may be blackish; black blotch on upper part of operculum, on its posterior flap, present or absent; pair of oblique white streaks on caudal fin, not quite meeting posteriorly; white streak distally on soft dorsal and anal fins, edges of these fins blackish or brownish; head, body, and fins may be speckled with very

small white spots; distal third of pectoral fin whitish; pelvic fins margined with blackish, dusky posteriorly. Opposite each canine on lower jaw is black spot on lip. (One specimen from station S–46–332 is nearly plain brownish, without the usual color pattern.)

Color when alive.—Background coloration purplish to orange-brown, pale spots orange to brownish orange; white streaks sometimes pale bluish. Occasionally four to six reddish-brown vertical bars occur on sides, but these seem to disappear upon preservation.

Ecology.—This common species occurred among the coral heads, and in surge channels, as well as in the lagoon.

Remarks.—This species may be recognized by the oblique white streaks on the caudal fin, and by the occurrence of a black spot on the lower lip opposite each canine tooth.

CEPHALOPHOLIS MINIATUS (Forskål)

PLATE 31, C

Perca miniata FOSKÅL, Descriptiones animalium . . ., pp. xii, 41, 1775 (type locality, Red Sea).

SPECIMEN STUDIED

Bikini Atoll, Arji Islands, lagoon coral head, depth 20 to 40 feet August 7, 1946, S–46–308, Brock and Herald, 1 specimen, 215 mm. standard length.

Description.—Dorsal rays IX,15; anal III,9; pectoral ii,17–ii,17; vertical scale rows above lateral line 111; scales in a row from anal origin to lateral line about 25, from lateral line to base of soft dorsal 11 or 12; gill rakers on first gill arch 8 + 1 + 14; lateral line with 52 pores and 3 more on caudal fin base.

Greatest depth 2.9; head 2.5; pectoral fin length 3.5; all in standard length. Greatest depth 1.2; pectoral 1.4; snout 3.4; postorbital length of head 1.8; eye 6.0; snout tip to rear of maxillary 2.0; least depth of caudal peduncle 2.9; all in length of head. Interorbital space flattish, 1.0 in eye; least depth of caudal peduncle 1.3 in distance from anal base to midbase of caudal fin; teeth on middle of side of dentary in 3 or more rows, on premaxillary in a villiform band, an outer row in both jaws, more rigid and a little enlarged, on palatines in a very narrow band, on vomer in a Λ-shaped very narrow band; preopercular edge rounded, finely serrate; greatest depth of body near front of spiny dorsal; posteriorly all fins rounded; fifth dorsal spine longest, 1.9 in postorbital length of head; soft dorsal rays longer than dorsal spines; second anal spine strongest, reaching about to tip of third when depressed, gill rakers moderately long, longest about equal to length of gill filaments.

Color in alcohol.—Background color light brown; head, body, and median fins covered with small brown spots; maxillary, premaxillary,

and dentary with a few brown spots, underside of head unspotted except for a few brown spots on gill membranes; breast and belly unspotted; pelvics dusky, edged with black, unspotted; pectoral plain pale with a few spots basally; soft dorsal and anal with edge slightly dusky.

Color when alive.—Background reddish to reddish orange, covered with blue spots, which turned dark brown when preserved; fins reddish; dorsal edge of pectoral yellowish; distal edge of anal edged with bright blue; outer edges of pelvics edged with bright blue; iris reddish; posterior edge of caudal light yellowish.

Remarks.—This species seemed to be rare and only one specimen was recovered. It was reddish orange with blue spots and when preserved these blue spots turned to dark brown. Apparently the blue spots may be preserved as pale or white spots under certain conditions.

Genus BELONOPERCA Fowler and Bean

Belonoperca Fowler and Bean, U. S. Nat. Mus. Bull. 100, vol. 10, p. 181, 1930. (Genotype, *Belonoperca chabanaudi* Fowler and Bean.)

BELONOPERCA CHABANAUDI Fowler and Bean

Figure 58

Belonoperca chabanaudi Fowler and Bean, U. S. Nat. Mus. Bull. 100, vol. 10, p. 182, 1930 (type locality, Binang Unang, Gulf of Tomini, Celebes; Birabirakan Island, off Borneo).

SPECIMEN STUDIED

Bikini Atoll: Arji Island, depth 20 to 40 feet in lagoon, August 7, 1946, S-46-308, Herald and Brock, 1 specimen, 112 mm. standard length.

Description.—Certain counts were made and these are recorded, respectively, first for the Bikini specimen then for the holotype (U. S. N. M. 89982) and the paratype (U. S. N. M. 93363). Dorsal rays VIII–I,ii,8; VIII–I,ii,8; VIII–I,ii,8; anal II,8; II,8; II,8; pectoral (total rays) 14 —; 13 —; 13–13; vertical scale rows above lateral line 85; 88; 88; scales in a row from anal origin to lateral line 28; 27; 28; from lateral line to rear base of soft dorsal 13; 13; 13; scales in a row from origin of second dorsal fin to lateral line 15; 16; 15; scale in a zigzag row around least depth of caudal peduncle 56; 53; 54; scale rows on opercle about 17 or 18; gill rakers on first gill arch 8+1+14; 7+1+13; 7+1+13.

Greatest depth 3.1 to 3.8; head 2.6 to 2.7; pectoral 7.0 to 7.9; all in standard length. Greatest depth 1.2 to 1.5; pectoral 2.5 to 2.9; snout 2.3 to 2.9; postorbital length of head 2.0 to 2.1; eye 5.2 to 5.3; snout tip to rear of maxillary 2.0 to 2.1; least depth of caudal peduncle 2.4 to 2.6; all in length of head. Interorbital space a little convex, bony,

its width equal to eye; least depth of caudal peduncle 1.4 to 1.5 in its length; teeth villiform in bands on jaws and palatines, those on vomer in an angular patch; bony edge of preopercle rather strongly toothed and not covered by fleshy membrane; opercle with the usual three spines; interopercle and subopercle with posterier edges denticulate; scales ctenoid, small, on head and body except dorsal surface of head, snout, maxillaries, dentary, and underside of head; all fins naked except caudal, which is scaled nearly to the tips of the rays, the membranes between the caudal fin rays mostly naked; the orbital ring is bony and unscaled; lips thick; premaxillary protractile; distal edges

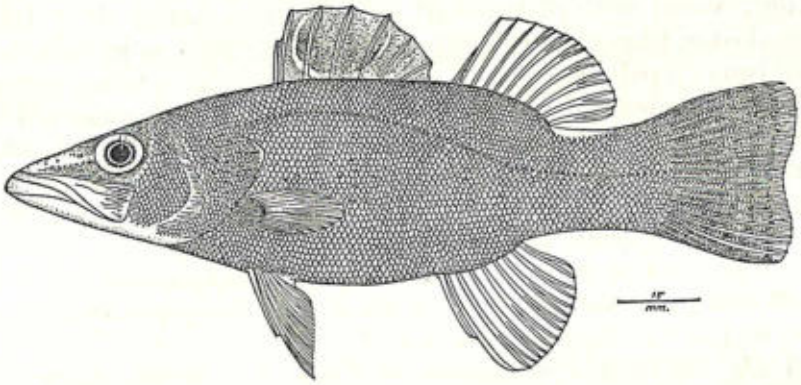

FIGURE 58.—Holotype of *Belonoperca chabanaudi* Fowler and Bean. (Drawing by H. W. Fowler.)

of soft dorsal, anal, and pectoral fins rounded, those of caudal and pelvics truncate; about fifth to seventh pectoral ray from dorsal edge longest; second branched pelvic ray longest; first dorsal spine from one-half to one-third length of second, the third or fourth longest; anal spines weak, second longest; about nine rows of scales between anus and anal origin; lateral line arched, the highest part of arch below rear of base of spiny dorsal or a little behind tip of pectorals; lateral line descends to midside of caudal peduncle; greatest depth opposite spiny dorsal base; longest gill raker longer than gill filaments.

Color in alcohol.—Dark brown or blackish; a white blotch on dorsal edge of caudal peduncle just behind base of soft dorsal fin; soft rays of dorsal, anal, pectoral, and caudal fins dark brown or blackish, the membranes between them clear and colorless; spiny dorsal with a large ocellate dark brown blotch; pelvic fin with blackish spot on rays about two-thirds way out, tip of pelvic fin blackish; tip of chin and tip of premaxillary blackish or dark brownish; operculum a little speckled with black dots.

Remarks.—This species may be recognized by its combination of a strongly serrate preopercle, interopercle, and subopercle; its divided

dorsal fin; its angular patch of villiform teeth on the vomer; its dark brown coloration; and its very dark fin rays that contrast sharply with the clear fin membranes.

YPSIGRAMMA, new genus

Genotype.—Ypsigramma lineata, new species.

This interesting new genus of rare little fishes occurs in the tropical Pacific.

As herein understood *Ypsigramma* may be briefly defined as follows: Spiny dorsal and second dorsal fins separated by a few rows of scales; second or third branched pectoral ray, counting down from dorsal edge, longest; teeth villiform, in a broad band on jaws, in narrow band on palatines and on vomer; posterior and anterior nostrils widely separated, anterior one in short tube; basal half or more of all soft median fins scaled; pelvics scaled halfway out and pectorals only basally; maxillary scaled and with a small supplemental bone; lateral line arched high over pectoral fin; preopercular edge partly serrate; opercle with 3 spines, sometimes upper and lower ones not very well developed; anal rays III,8; pectoral rays ii,12 to 14; scales in about 45 to 48 rows; gill membranes free forward to under eye, without broad free fold across isthmus; scales ctenoid.

Table 33 records measurements made on various species of *Ypsigramma*.

KEY TO THE SPECIES OF LIOPROPOMA, CHORISTISTIUM, AND YPSIGRAMMA

1*a*. Spiny dorsal fin continuous with soft dorsal by a ridge of scales along sides of connecting dorsal spines; no scaled area separating spiny and soft dorsal rays; 4½ to 5½ scales in a row from lateral line to base of last dorsal spine; 16 to 21 predorsal scales to occiput.

2*a*. Dorsal spines VIII (*Chorististium* Gill).

3*a*. Anal rays III,10; dorsal rays VIII,14; pectoral ii,14 (Japan). Chorististium japonicum (Döderlein, *in* Steindachner and Döderlein)

3*b*. Anal rays III,9; dorsal rays VIII,13; pectoral ii,13; pores in lateral line 48 or 49 (Hawaiian Islands). Chorististium aurora (Jordan and Evermann)

3*c*. Anal rays III,8.

4*a*. Pores in lateral line 43 to 47.

5*a*. Soft dorsal rays 12; pectoral ii,11; pores in lateral line 43 (Bermuda)_____ Chorististium mowbrayi (Woods and Kanazawa)

5*b*. Soft dorsal rays[66] 11 in paratype; pectoral ii,12; pores in lateral line 46 or 47; predorsal scales 19 to 21 to occiput (Philippines; plate 32, B)_____ Chorististium swalesi Fowler and Bean

[66] The soft dorsal fin has its rays partly regenerated from an injury and a few rays are lacking on holotype.

4*b*. Pores in lateral line 49 to 70.

6*a*. Pores in lateral line 49 to 55.

7*a*. Pectoral rays ii,13 or 14; soft dorsal rays 12; pores in lateral line 49 to 52 (Reunion Island and Mauritius).

Chorististium lunulata [67] Guichenot

7*b*. Pectoral rays i,13; soft dorsal rays 13; pores in lateral line about 54 or 55 (Panama).

Chorististium longilepis (Garman)

7*c*. Pectoral rays ii,11; soft dorsal rays 12; pores in lateral line 50 to 52; each side with 5 or 6 lengthwise brown streaks; tips of posterior lobes of median fins with black spots (Cuba).

Chorististium rubre (Poey)

6*b*. Pores in lateral line 67 to 70; soft dorsal rays 12; pectoral ii,13 (Japan).

Chorististium maculata (Döderlein *in* Steindachner and Döderlein)

2*b*. Dorsal spines IX (*Liopropoma* Gill=*Bathyanthias* Günther).

8*a*. Dorsal rays IX,12, pores in lateral line 45 (Cuba).

Liopropoma aberrans (Poey)

8*b*. Dorsal rays IX,14; pores in lateral line 58 (Pernambuco, Brazil).

Liopropoma roseus (Günther)

1*b*. Spiny dorsal and soft dorsal fins completely separated by a scaled area of 5 to 7 rows across the back; 3 or 4 scales in a row from lateral line to origin of second dorsal; gill rakers 5 to 7+1+11 to 13 on first gill arch; predorsal scales 10 to 13 to occiput; dorsal rays VI–I,i,11; anal III,8 (*Ypsigramma*, new genus).

9*a*. Coloration plain pale, no stripes or dark pigment marks on sides or on fins; pectoral rays ii,14–ii,14; greatest width of maxillary 2 in length of second dosal spine---------- Ypsigramma pallida (Fowler)

9*b*. Coloration of alternating dark and pale streaks, or of dark wavy lines on sides.

10*a*. Sides of body with 7 or 8 distinct, nearly straight, lengthwise, dark brown streaks, a short lengthwise dark brown streak on pectoral fin base.

11*a*. Five brown streaks on each side of caudal peduncle; 4 scales between lateral line and second dorsal origin; predorsal scales to occiput 12 or 13---------- Ypsigramma lineata, new species

11*b*. Four brown streaks on each side of caudal peduncle; 3 scales between lateral line and second dorsal origin; predorsal scales to occiput 10.

Ypsigramma susumi (Jordan and Seale)

10*b*. Sides of body with brown pigment specks, a few arranged in irregular lines on middle of side; an oblique short dark brown streak on pectoral base; predorsal scales to occiput 13. Ypsigramma brocki, new species

YPSIGRAMMA PALLIDA (Fowler)

Chorististium pallidum FOWLER, Acad. Nat. Sci. Philadelphia, Monogr. 2, pp. 199–280, fig. 20, 1938 (type locality, Christmas Island).

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[67] *Glaucosoma semilunifera* Steindacher, *in* Bliss, Trans. Roy. Soc. Mauritius, new ser., vol. 13, p. 47, 1883 (Mauritius) is the same species as *Grystes lunulatus* Guichenot (Faunae ichthyologique, p. C–4, 1863; type locality, Reunion Island). *Aulacocephalus temminckii* Temminck and Schlegel (Fauna Japonica, p. 15, pl. 5, fig. 2, 1844; type locality, Japan) probably belongs with this group of genera, too.

SPECIMEN STUDIED

Bikini Atoll: Arji Island, lagoon, depth 20 to 40 feet, August 7, 1946, S-46-308, Herald and Brock, 1 specimen, 55 mm.

Description.—Dorsal rays VI–I,i,11; anal III,8; pectoral ii,14–ii,14; scale rows above lateral line 46, scales in a row from anal origin to lateral line 13, from lateral line to base of soft dorsal 6; predorsal scales 12 to occiput; 4 scales between lateral line and origin of second dorsal; 32 or 33 scales in a zigzag row around least depth of caudal peduncle; 4 rows of scales on opercle; 6 or 7 scales between dorsal fins; gill rakers 6+1+12 on first gill arch. Counts are given in table 34.

Precision measurements, expressed in thousandths of the standard length, are given in table 33.

TABLE 33.—*Measurements made on certain species of* Ypsigramma *expressed in thousandths of the standard length*

Characters	*lineata*, new species			*brocki*, new species	*susumi*	*swalesi*		*pallida*
						Philippine Islands		
	Holotype, Bikini	Paratype, Rongelap	Paratype, Philippines	Holotype, Rongelap	Holotype, Samoa	Holotype	Paratype	Bikini
Standard length in millimeters	65	63	66.7	40.2	65	47.6	44.5	54
Greatest depth of body	294	302	295	306	286	336	310	296
Length of head	369	386	376	423	390	399	427	407
Length of snout	86	84	88	82	89	82	92	89
Interorbital space	71	68	75	62	77	63	65	69
Diameter of eye	89	89	79	102	89	90	90	96
Postorbital length of head	209	213	214	229	231	221	236	220
Least preorbital width	8	6	7	7	8	10	9	7
Length of maxillaries	168	168	163	179	171	170	173	176
Least depth of caudal peduncle	140	148	151	139	149	156	146	157
Length of caudal peduncle	222	224	217	209	215	208	191	230
Length of longest fin ray:								
Dorsal spine (third)	135	135	138	132	154	139	146	130
Soft dorsal	166	164	165	182	182	----------	191	172
Anal spine (second)	108	111	114	112	119	149	168	117
Soft anal	165	175	173	189	179	189	211	187
Pectoral	246	254	252	271	269	293	305	259
Pelvic	188	210	180	204	222	218	213	185
Caudal	200	203	205	231	211	221	202	204

Greatest depth 3.3, head 2.5, pectoral fin 3.8, all in standard length. Greatest depth 1.4, pectoral 1.4, snout 5.0, postorbital length of head 1.9, eye 4.0, snout tip to rear of maxillary 2.2, least depth of caudal peduncle 2.6, all in length of head. Interorbital space flattish, 1.3 to 1.4 in eye; least depth of caudal peduncle 1.3 in its length; teeth in a villiform band in jaws, and in palatines and vomer; preopercular

edge rough, the membranous edge extending beyond bony part, with crenulate edge; scales ctenoid, occurring on body, on bases of fins, and halfway or more out on all soft median fins; operculum, maxillary dentary, cheeks, suborbitals and preorbitals, and interorbital space scaled; lower jaw projects a little beyond tip of upper jaw; lips thick; premaxillary protractile; distal edges of soft dorsal and anal fins rounded; caudal fin truncate posteriorly; pectoral and pelvic fins pointed, second or third branched pectoral ray from dorsal edge longest; second branched pelvic ray longest; first dorsal spine very short, third longest; second anal spine strongest and longest, reaching notably beyond third when depressed; 3 or 4 rows of scales between anus and anal origin; lateral line arched high over pectoral fin, reaching its greatest height opposite sixth dorsal spine then descending to midside of caudal peduncle; longest gill raker about equal to length of gill filaments.

Color in alcohol.—Plain pale, without any pigment spots.

Color when alive.—Probably red.

Remarks.—Fowler gives only V dorsal spines. I believe that he did not see the very small first one, since it could be overlooked in an examination using only a hand lens. Otherwise my specimen agrees very well with his description and diagrammatic figure. Now known from Christmas Island and Bikini Atoll.

YPSIGRAMMA LINEATA, new species

FIGURE 59

Chorististium susumi (in part) FOWLER and BEAN, U. S. Nat. Mus. Bull. 100, vol. 10, p. 185, 1930 (Philippines).

Holotype.—U.S.N.M. No. 141872, Bikini Atoll, Namu Island, lagoon reef, August 6, 1947, S–46–508, Schultz, Brock, and Hiatt, 65 mm. standard length.

Paratypes.—U.S.N.M. No. 141873, taken with holotype and bearing same data, 1 specimen, 63 mm. standard length; U.S.N.M. No. 142311, Bikini Atoll, Yuro Island, July 13, 1946, S–46–251, Herald, 1 specimen, 50 mm.; U.S.N.M. No. 141874, Baganga Bay, eastern Mindanao, Philippine Islands, May 13, 1908, *Albatross*, 1 specimen, 66.7 mm.; U.S.N.M. No. 141875, Paluan Bay, Mindoro Island, December 11, 1908, *Albatross*, 1 specimen, 36.5 mm., in bad condition (no counts were made).

Description.—The following counts were made, respectively, on the types listed above. Dorsal rays VI–I,i,11; VI–I,i,11; VI–I,i,11; VI–I,i,11; anal III,8; III,8; III,8; III,8; pectoral ii,13–ii,13; ii,13–—; ii,13–ii,13; ii,13–ii,13; vertical scale rows above lateral line 46; 47; 45; 46; scales in a row from anal origin to lateral line 11; 11; 11; 12;

SPECIMEN STUDIED

Bikini Atoll: Arji Island, lagoon, depth 20 to 40 feet, August 7, 1946, S–46–308, Herald and Brock, 1 specimen, 55 mm.

Description.—Dorsal rays VI–I,i,11; anal III,8; pectoral ii,14–ii,14; scale rows above lateral line 46, scales in a row from anal origin to lateral line 13, from lateral line to base of soft dorsal 6; predorsal scales 12 to occiput; 4 scales between lateral line and origin of second dorsal; 32 or 33 scales in a zigzag row around least depth of caudal peduncle; 4 rows of scales on opercle; 6 or 7 scales between dorsal fins; gill rakers 6+1+12 on first gill arch. Counts are given in table 34.

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TABLE 33.—*Measurements made on certain species of* Ypsigramma *expressed in thousandths of the standard length*

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						Philippine Islands		
	Holotype, Bikini	Paratype, Rongelap	Paratype, Philippines	Holotype, Rongelap	Holotype, Samoa	Holotype	Paratype	Bikini
Standard length in millimeters	65	63	66.7	40.2	65	47.6	44.5	54
Greatest depth of body	294	302	295	306	280	336	310	296
Length of head	369	386	376	423	399	399	427	407
Length of snout	86	84	88	82	89	82	92	89
Interorbital space	71	68	75	62	77	63	65	69
Diameter of eye	89	89	79	102	89	90	90	96
Postorbital length of head	209	213	214	229	231	221	236	220
Least preorbital width	8	6	7	7	8	10	9	7
Length of maxillaries	168	168	163	179	171	170	173	176
Least depth of caudal peduncle	140	148	151	139	149	156	146	157
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Dorsal spine (third)	135	135	138	132	154	139	146	130
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Pelvic	188	210	180	204	222	218	213	185
Caudal	200	203	205	231	211	221	202	204

Greatest depth 3.3, head 2.5, pectoral fin 3.8, all in standard length. Greatest depth 1.4, pectoral 1.4, snout 5.0, postorbital length of head 1.9, eye 4.0, snout tip to rear of maxillary 2.2, least depth of caudal peduncle 2.6, all in length of head. Interorbital space flattish, 1.3 to 1.4 in eye; least depth of caudal peduncle 1.3 in its length; teeth in a villiform band in jaws, and in palatines and vomer; preopercular

edge rough, the membranous edge extending beyond bony part, with crenulate edge; scales ctenoid, occurring on body, on bases of fins, and halfway or more out on all soft median fins; operculum, maxillary dentary, cheeks, suborbitals and preorbitals, and interorbital space scaled; lower jaw projects a little beyond tip of upper jaw; lips thick; premaxillary protractile; distal edges of soft dorsal and anal fins rounded; caudal fin truncate posteriorly; pectoral and pelvic fins pointed, second or third branched pectoral ray from dorsal edge longest; second branched pelvic ray longest; first dorsal spine very short, third longest; second anal spine strongest and longest, reaching notably beyond third when depressed; 3 or 4 rows of scales between anus and anal origin; lateral line arched high over pectoral fin, reaching its greatest height opposite sixth dorsal spine then descending to midside of caudal peduncle; longest gill raker about equal to length of gill filaments.

Color in alcohol.—Plain pale, without any pigment spots.

Color when alive.—Probably red.

Remarks.—Fowler gives only V dorsal spines. I believe that he did not see the very small first one, since it could be overlooked in an examination using only a hand lens. Otherwise my specimen agrees very well with his description and diagrammatic figure. Now known from Christmas Island and Bikini Atoll.

YPSIGRAMMA LINEATA, new species

FIGURE 59

Chorististium susumi (in part) FOWLER and BEAN, U. S. Nat. Mus. Bull. 100, vol. 10, p. 185, 1930 (Philippines).

Holotype.—U.S.N.M. No. 141872, Bikini Atoll, Namu Island, lagoon reef, August 6, 1947, S–46–508, Schultz, Brock, and Hiatt, 65 mm. standard length.

Paratypes.—U.S.N.M. No. 141873, taken with holotype and bearing same data, 1 specimen, 63 mm. standard length; U.S.N.M. No. 142311, Bikini Atoll, Yuro Island, July 13, 1946, S–46–251, Herald, 1 specimen, 50 mm.; U.S.N.M. No. 141874, Baganga Bay, eastern Mindanao, Philippine Islands, May 13, 1908, *Albatross*, 1 specimen, 66.7 mm.; U.S.N.M. No. 141875, Paluan Bay, Mindoro Island, December 11, 1908, *Albatross*, 1 specimen, 36.5 mm., in bad condition (no counts were made).

Description.—The following counts were made, respectively, on the types listed above. Dorsal rays VI–I,i,11; VI–I,i,11; VI–I,i,11; VI–I,i,11; anal III,8; III,8; III,8; III,8; pectoral ii,13–ii,13; ii,13– —; ii,13–ii,13; ii,13–ii,13; vertical scale rows above lateral line 46; 47; 45; 46; scales in a row from anal origin to lateral line 11; 11; 11; 12;

TABLE 34.—*Counts recorded for species of* Liopropoma, Chorististium, *and* Ypsigramma

Genus and species	Number of gill rakers on first gill arch																Predorsal scales to occiput														
	Above					At angle	Below																								
	4	5	6	7	8	1	10	11	12	13	14	15	16	17	18	19	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Chorististium																																
rubre (Poey)		1				1			1														1									
japonicum (Döderlein)			1			1					1															1						
aurora (Jordan and Evermann)			1			1					1																	2	1			
mowbrayi (Woods and Kanazawa)	[1]X					X	X																									
swalesi (Fowler and Bean)					2	2										2										1		1				
lunulata (Guichenot)			2			2		1	1																	1	1					
longilepis (Garman)		1				1			1																							1
Ypsigramma																																
lineata, new species		1	2			3			2	1									3													
brocki, new species			1	1		2				2									1	1												
susumi (Jordan and Seale)		1				1		1									1															
pallida (Fowler)			1			1			1										1													

from lateral line to base of soft dorsal 7; 7; 6; 6; predorsal scales to occiput 12; 12; 13; 12; scales between lateral line and second dorsal origin 4; 4; 4; 4; scales in a zigzag row around least depth of caudal peduncle 32; 32; —; 32; opercle with 4 rows of scales; scales between dorsal fins 6; 6; —; 6; gill rakers on first gill arches 6+1+13; 5+1+12; 6+1+13; 6+1+12. Counts are given in table 34.

Precision measurements were made and these are recorded in table 33.

Greatest depth 3.3 to 3.5; head 2.7 to 2.8; pectoral fin 3.8 to 4.0; all in standard length. Greatest depth 1.2 to 1.3; pectoral 1.3 to 1.5; snout 4.2 to 4.3; postorbital length of head 1.7 to 1.8; eye 4.2 to 4.5; snout tip to rear of maxillary 2.2; least depth of caudal peduncle 2.5 to 2.6; all in length of head. Interorbital space flattish, 1.0 to 1.2 in eye; least depth of caudal peduncle 1.5 in its length; teeth in a villiform band on jaws, palatines, and vomer; preopercular edge finely denticulate dorsally, covered ventrally with a membrane with crenulate edge; scales ctenoid, occurring on body, on bases of fins, and halfway or more out on all soft fins except pectorals; operculum, maxillary, dentary, cheeks, suborbitals, preorbitals, and interorbital space scaled; lower jaw projects a little beyond tip of upper; lips thick; premaxillary protractile; distal edges of soft dorsal and anal rounded, that of caudal truncate; pectoral and pelvic fins pointed, second or third branched pectoral ray from dorsal edge longest; second branched pelvic ray longest; first dorsal spine very short, third spine longest; second anal spine longest, strongest, projecting past third when depressed; about four rows of scales between anus and anal origin; lateral line arched high over pectoral fin, reaching its greatest height opposite rear of base of spiny dorsal fin, then descending to midside of caudal peduncle; longest gill raker longer than gill filaments.

Color in alcohol.—Background color light brownish, with eight narrow lengthwise dark-brown streaks on sides; first above arch of lateral line ending at rear of soft dorsal fin base; second along arch of lateral line running along dorsal side of caudal peduncle; next three beginning behind eye and running above pectoral base to base of caudal fin; sixth, a lengthwise streak on base of pectoral fin, reappearing behind base of pectoral, thence continuing along lower ventral side of caudal peduncle; seventh beginning at lower edge of eye and continuing along ventral edge of pectoral base to rear of base of anal fin; eighth, and most ventral, beginning halfway between bases of pectoral and pelvic fins and extending to front of base of anal fin; a dark streak (sometimes two) barely discernible on snout, in front of eye; fins plain

pale, except caudal, which is slightly dusky; eye narrowly margined with a black line, mostly anteriorly.

Remarks.—This species is most closely related to *Y. susumi* (Jordan and Seale), from the Samoan Islands. *Y. lineata* differs from *Y. susumi* in color pattern. In *susumi* the second and third brown streaks join at a point opposite the rear of the soft dorsal base and continue as a single dark streak on the dorsal side of the caudal peduncle, and the lower two join opposite the anal origin, to continue as a broad streak along the anal fin base; in *lineata* all these dark streaks remain separate. From the other species of *Ypsigramma*, *lineata* may be separated by means of the key.

Named *lineata* in reference to the lengthwise dark streaks.

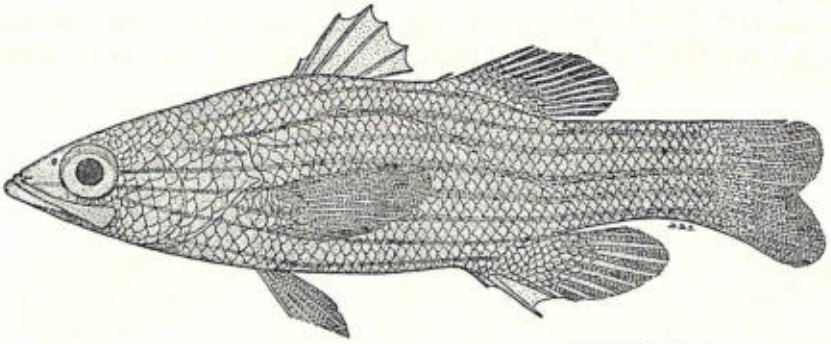

FIGURE 59.—Holotype of *Ypsigramma lineata*, new species (U.S.N.M. No. 141872), from Bikini Atoll. (Drawing by Dorothea B. Schultz.)

YPSIGRAMMA BROCKI, new species

FIGURE 60

Holotype.—U.S.N.M. No. 141876, Rongelap Atoll, Kieshiechi Island, lagoon coral head, depth 20 feet, July 24, 1946, S–46–285, Brock and Herald, standard length 40.2 mm.

Paratype.—U.S.N.M. No. 154675, Gilbert Islands, Onotoa Atoll, near edge of ocean reef, leeward side, depth 5 to 8 feet, August 1, 1951, Randall, 1 specimen, 56.5 mm.

Description.—The following counts were made: Dorsal rays VI–I,i,11; anal III,8; pectoral ii,12–ii,13; vertical scale rows above lateral line 48 and 46; scales in a row from anal origin to lateral line 11 and 12, from lateral line to base of soft dorsal 7 and 6; predorsal scales 13 to occiput; 4 scales between lateral line and second dorsal origin; 32 scales in a zigzag row around least depth of caudal peduncle; opercle with 4 rows of scales; scales between dorsal fins 5 or 6; gill rakers on first arch 7+1+13. Additional counts recorded in table 34.

Precision measurements were made and these are recorded in table 33.

Greatest depth 3.3 or 3.4; head 2.5; pectoral fin 3.7; all in total length. Greatest depth 1.3 to 1.4; pectoral 1.4; snout 4.5 to 4.9; postorbital length of head 1.8; eye 3.8 to 4.0; snout tip to rear of maxillary 2.1 to 2.2; least depth of caudal peduncle 2.8; all in length of head. Interorbital space flattish, 1.5 in eye; least depth of caudal peduncle 1.4 in its length; teeth in a villiform band on jaw, palatines, and vomer; preopercular edge finely denticulate dorsally, with a membranous extension beyond bony edge ventrally; scales ctenoid, occurring on body, bases of fins, and more than halfway out on caudal, pelvics, soft dorsal, and soft anal fins; operculum, maxillary, dentary, cheeks, suborbitals and preorbitals, and interorbital space scaled; lips thick; premaxillary protractile; distal edges of soft dorsal and anal fins rounded, that of caudal truncate; pelvic and pectoral fins pointed, second or third

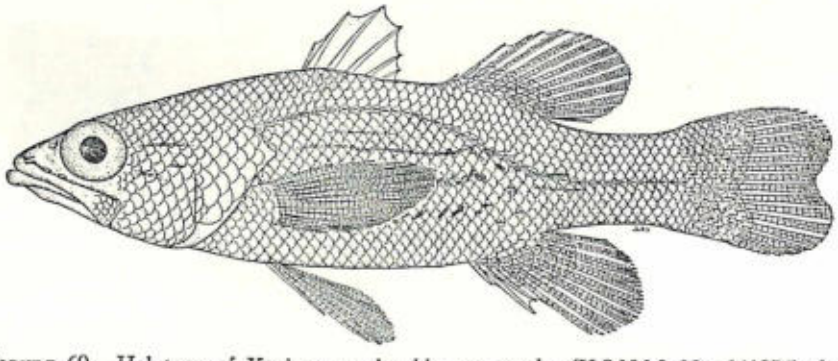

FIGURE 60.—Holotype of *Ypsigramma brocki*, new species (U.S.N.M. No. 141876), from Rongelap Atoll. (Drawing by Dorothea B. Schultz.)

branched ray of pectoral longest (counting down from dorsal edge), second branched ray of pelvics longest; first dorsal spine very short, third spine longest; second anal spine strongest, when depressed reaching to tip of third but not beyond; 4 or 5 rows of scales between anus and anal origin; lateral line arched high over pectoral fin, greatest height opposite rear of base of spiny dorsal, then descending to midside of caudal peduncle; longest gill raker a little longer than gill filaments.

Color in alcohol.—Background color light tan, sides of body and head speckled with small brownish spots, arranged in three irregular rows behind eye, and one or two above and behind pectoral fin; eye narrowly margined with black line except dorsally; an oblique short brown bar on base of pectoral fin; fins all plain white or pale.

Color when alive.—The following color description was recorded from a Kodachrome picture taken by John Randall, University of Hawaii: Body and head light grey with wavy brown streaks or lines

on sides, three of which extend forward to rear of eye; median and paired fins pinkish; snout pinkish; iris yellowish.

Remarks.—This new species resembles *Y. susumi*, but differs in having more predorsal scales. In regard to coloration it is characterized by brown specks more or less arranged in wavy streaks on upper and lower sides of body. The middle 2 or 3 streaks begin behind eye and continue to above anal fin whereas in *susumi* all of the streaks on the sides are straight and even all the way to the caudal fin. It may be distinguished from other species in the genus by means of the key.

Named in honor of Vernon Brock.

Subfamily ANTHIINAE

Genus ANTHIAS Bloch

Anthias BLOCH, Naturgeschichte der ausländischen Fische, vol. 6, pt. 9, p. 97, 1792. (Genotype, *Labrus anthias* Linnaeus.)

ANTHIAS HERALDI, new species

FIGURE 61

Holotype.—U.S.N.M. No. 141963, Kwajalein Atoll, lagoon reef, Ennylabegan Island, September 1, 1946, S–46–397, Herald, 33.8 mm. standard length and total length 42.5 mm.

Paratypes.—U.S.N.M. No. 141964, taken with holotype and bearing same data; 2 specimens, standard length 31 and 33.5 mm., total lengths 39 and 42.2 mm.

Precision measurements were made and these data, expressed in thousandths of the standard length, are recorded for the holotype and two paratypes, respectively. Standard length 33.8; 31; 33.5 mm. Greatest depth 343; 351; 310; head 343; 351; 352; snout 95; 100; 96; interorbital space (fleshy) 77; 77; 84; eye 98; 97; 101; postorbital length of head 151; 142; 143; least width of preorbital 12; 13; 15; length of maxillaries 133; 142; 131; least depth of caudal peduncle 115; 113; 107; length of caudal peduncle from base of last anal ray to midbase of caudal fin 222; 213; 209; length of longest dorsal spine (third) 180; 190; 182; longest soft dorsal ray 118; 136; 119; longest anal spine (second) 154; 161; 155; longest soft anal ray 121; 132; 128; longest pectoral ray 198; 207; 191; and longest caudal ray 251; 265; 287.

The following counts were made, respectively; dorsal rays X,14; X,14; X,14; anal III,8; III,8; III,8; pectoral i,16; i,16; i,16; vertical scale rows above lateral line 70; 65; 71; scales in a row from anal origin to lateral line 16; 17; 17; from lateral line to rear base of soft dorsal 5; 5; 5; from lateral line to base of first soft dorsal ray 8; 8;

8, and to base of first dorsal spine 8; 8; 8; scales in a zigzag row around least depth of caudal peduncle 25; 26; 26; pores in lateral line 50; 47; 50; gill rakers on first gill arch 8+1+18, 7+1+19; 8+1+19.

Greatest depth 2.8 to 3.0; head 2.9; length of pectoral fin 4.4 to 4.8; all in standard length. Greatest depth 1.0 to 1.1; pectoral 1.5 to 1.7; snout 3.5 to 3.6; postorbital length of head 2.2 to 2.3; eye 3.2 to 3.3; snout tip to rear of maxillary 2.3 to 2.4; least depth of caudal peduncle 2.8; all in length of head. Least depth of caudal peduncle in snout tip to rear of maxillary 1.2; fleshy interorbital space rounded, convex, 1.0 to 1.1 in eye; least depth of caudal peduncle 1.7 to 1.8 in distance from base of last anal ray to midbase of caudal fin; teeth on dentary in two or three rows forward, in a single row on sides posteriorly; teeth on premaxillary in two or three rows forward, in a single row on sides, about three caninelike teeth on premaxillary on each side of symphysis; a narrow band of villiform teeth on palatines, those on vomer similar but in a Λ-shaped band; a single short opercular spine; preopercular edge finely serrate, truncate, the posterior lower corner a little produced, with a moderately strong spine, several smaller spines on ventral edge of preopercle, none antrorse; greatest depth of body opposite front of spiny dorsal; caudal fin with shallowly forked posterior margin; third dorsal spine longest, only a little longer than second, contained 0.8 to 0.9 times in postorbital length of head; longest soft dorsal rays shorter than longest dorsal spine; second anal spine much stronger and a little longer than third, its length when depressed equal to or a little longer than postorbital length of head; third or fourth branched pectoral rays, from dorsal edge, longest; gill rakers, long, slender, longer than gill filaments; a vertical line through front of orbit passes just in front of rear tip of maxillary; scales small, ctenoid, occurring on body but not on fins, except basal third of caudal; scales forward to occiput, dorsal surface of head naked; cheeks and operculum scaled; pelvic fins attached to belly by a membrane; tongue with minute teeth.

Color in alcohol.—Plain pale except a dusky area on side of caudal peduncle at base of caudal fin, and extending dorsally somewhat on caudal peduncle; membrane between first three dorsal spines blackish.

Remarks.—I have searched the literature for a species allied to *Anthias* that might be close to this new species but have found none. The following species differ from *A. heraldi* in having X,16 or more soft rays in the dorsal fin: *Franzia affinis* Tanaka, *F. nobilis* (Franz), *F. pectoralis* Tanaka, *F. ruber* Tanaka, *F. ardens* Jordan and Thompson, *Anthias huchtii* Bleeker, *A. mooreanus* Herre, *A. pulchra* Döderlien, *A. elongatus* Franz, *A. squamipinnis* Peters, *A. gibbosus* Klünzinger, *A. taeniatus* Klünzinger, *A. mortoni* MacLeay, *A. pulchellus*

Waite, *A. fuscipinnis* Jenkins, *A. margaritaceus* Hilgendorf, *Pseudanthias hypselosoma* Bleeker, *P. venator* Snyder, *P. cichlops* Bleeker, *P. manadensis* Bleeker, *P. lepidolepis* Bleeker, *P. chirospilus* Bleeker, *P. pleurotaenia* Bleeker, *Sphenanthias dorianus* Borodin, and *Sacura pulchra* (Döderlein). Species with fewer soft dorsal rays than *A. heraldi* are: *Pseudanthias taira* Schmidt, with X,11 to 13, and *Novanthias accraensis* (Norman), with X,12; both of these species have III,6 or 7 anal rays instead of III,8.

A. heraldi, with 47 to 50 pores in the lateral line, differs strikingly from the following species: *Anthias albofasciatus* Fowler and Bean,

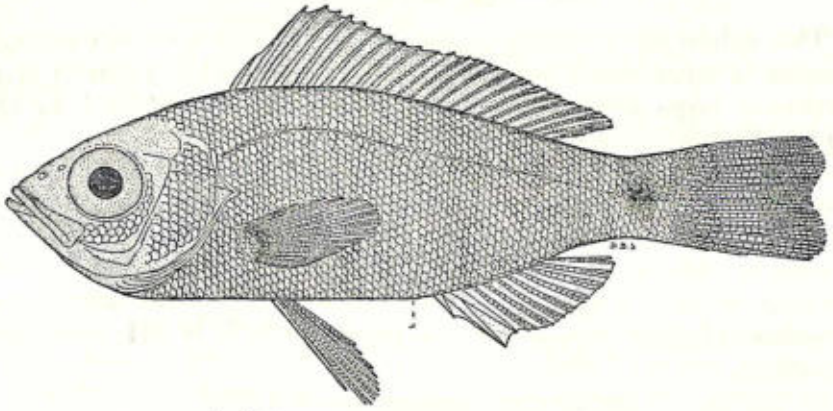

FIGURE 61.—Holotype of *Anthias heraldi*, new species (U.S.N.M. No. 141963), from Kwajalein Atoll. (Drawing by Dorothea B. Schultz.)

A. unimaculatus Tanaka, *Zalanthias azumanus* Jordan and Richardson, *Tosana niwae* Smith and Pope, all of which have 38 or fewer pores. *Planctanthias preopercularis* Fowler, from the Natal coast, differs in having X,15 or 16 dorsal, III,7 anal, and 22 pectoral rays; whereas *A. heraldi* has X,14 dorsal, III,8 anal and 17 pectoral rays. *Entoanthias pascalus* Jordan and Tanaka has X,15 dorsal, III,6 or 7 anal, and 18 pectoral rays, and 10+23 gill rakers; whereas *A. heraldi* has X,14 dorsal, III,8 anal, and 17 pectoral rays, and 7 or 8+1+18 or 19 gill rakers on the first arch. *Naurua waitei* Whitley and Colefax has X,15 dorsal rays, III,7 anal, 22 pectoral, 72 pores in lateral line, and greatest depth 4.6 in standard length; whereas the new species has X,14 dorsal rays, III,8 anal, 17 pectoral, 47 to 50 pores in the lateral line, and greatest depth 2.8 to 3.0. *Anthias gordensis* Wade and *Holanthias sechurae* Barton, both with X,15 dorsal, III,7 anal, and 26 or 27 gill rakers on lower part of first gill arch, are unlike *A. heraldi*. Although *Odontanthias elizabethae* Fowler has X,14 dorsal rays it has III,7 anal rays, and only 40 or 41 pores in the lateral line; whereas *A. heraldi* has III,8 anal rays and 47 to 50 pores. In addition, *O. elizabethae* has 3 opercular spines, whereas the new species has but one.

Searching through the literature I was unable to find any named species referable to the Anthiinae with X,14 dorsal rays, III,8 anal, 17 pectoral rays, 47 to 50 pores in the lateral line, 7 or 8+1+18 or 19 gill rakers, and 65 to 71 vertical scale rows along the lateral line from upper edge of gill opening to base of caudal fin; thus I concluded that it was necessary to name this new species, in spite of the great confusion of species often referred to the ill-defined genus *Anthias*.

Named *heraldi* in honor of the collector, Dr. Earl S. Herald, who was at Bikini in 1946.

Subfamily GRAMMISTINAE

This subfamily is herein recognized as a matter of convenience, because it represents a natural group of closely related genera from among a large group of diverse genera usually referred to the Epinephelinae.

These genera have the following characters: Oblong body covered with very small, embedded, cycloid scales; gill membranes joined far back at dorsal edge of opercle to supracleithrum; lateral line single; maxillary exposed, with supplemental bone; tongue smooth; no scaly process at base of pelvics; scaly membrane at dorsal edge of pectoral base not developed; anal spines 0 to II or III, sometimes embedded.

KEY TO THE GENERA OF GRAMMISTINAE

1*a*. Dorsal spines II or III, short, more or less embedded (dissection needed for counting); anal spines lacking; preopercular spines 3 or 4; dorsal rays II or III,21 to 27; anal rays 14 to 18; pectoral rays (total) 14 to 17; vertical fins fleshy, tissue between rays spongy near their bases; these fins with embedded scales about three-quarters to four-fifths their length; chin without dermal appendage------ Rypticus Cuvier and Valenciennes

1*b*. Dorsal spines VI to VIII.

2*a*. Chin with a dermal appendage, sometimes small.

3*a*. Preopercle with 3 to 5 spines on its posterior edge; tip of chin with large dermal appendage having fringed edges; dorsal rays VII or VIII,12 or 13; anal III,8, spines short but strong. Pogonoperca Günther

3*b*. Preopercle with 1 to 3 small spines on its posterior edge; tip of chin with a very small dermal appendage; dorsal rays VII,13 to 15; anal II,9, the spines embedded, visible by dissection; pectoral rays about i,17---------- Grammistes Bloch and Schneider (p. 384)

2*b*. No dermal appendage at tip of chin; preopercular edge without or with a single blunt spine; dorsal rays VII,12; anal III,9, the spines short but strong; pectoral rays about i,13---- Grammistops, new genus (p. 386)

Genus GRAMMISTES Bloch and Schneider

Grammistes BLOCH and SCHNEIDER, Systema ichthyologiae, p. 182, 1801. (Genotype, *Grammistes orientalis* Bloch and Schneider=*Perca sex-lineata* Thünberg.)

GRAMMISTES SEXLINEATUS (Thünberg)

PLATE 32, A

Perca sexlineata THÜNBERG, Kongl. Vet. Akad. Nya Handl., vol. 13, p. 142, pl. 5, 1792 (type locality, East Indies).

SPECIMENS STUDIED

Bikini Atoll: 8 stations, 12 specimens, 23 to 79 mm. standard length.
Eniwetok Atoll: 4 stations, 8 specimens, 33 to 73 mm.
Rongerik Atoll: 2 stations, 2 specimens, 37 to 53 mm.
Rongelap Atoll: 3 stations, 4 specimens, 11 to 66 mm.
Kwajalein Atoll: 1 station, 1 specimen, 84 mm.
Guam: 4 lots, 11 specimens, 24 to 107 mm.

Description.—Dorsal rays VII–13 or 14; anal II,9; pectoral i,17; pelvic I,5; branched caudal 8+7.

Greatest depth 2.5 to 2.7; head 2.5 to 2.7; length of pectoral fin 4.2 to 4.8; all in standard length. Greatest depth 0.9 to 1.0; pectoral fin 1.6 to 1.8; snout 4.3 to 5.0; postorbital length of head 1.7; eye 3.8 to 4.9; tip of snout to rear of maxillary 1.9 to 2.0; least depth of caudal peduncle 2.2 to 2.7; all in length of head. Interorbital space slightly convex, 1.2 to 2.5 in eye; least depth of caudal peduncle 1.0 to 1.1 in its length; teeth on dentary and premaxillary in a villiform band, inner rows of teeth longest, depressible; villiform teeth in a narrow band on palatines, and on vomer in a Λ-shaped band; no canine teeth; greatest depth of body under spiny dorsal fins; all fins bluntly rounded; third dorsal spine longest, 1.6 to 1.7 in postorbital length of head; spiny dorsal separated from soft dorsal; rays of soft dorsal notably longer than dorsal spines; anal spines very short, mostly embedded; preopercular edge with two or three spines.

Color in alcohol.—Tip of snout with a distinct black spot; background color dark brown or blackish. A specimen 10.5 mm. in standard length has 2 rows of large white spots, upper row of 5 spots along back and lower row on lower part of side with 5 spots, one spot each on head in each row; fins white except for spiny dorsal, which is brown basally. At 27 mm. there are 3 white streaks or bands. At 50 mm. there are 4 paired lateral white streaks, the fourth appearing along base of spiny dorsal fin above the broad one along upper side; a median fifth white streak along midventral line of abdomen, and a sixth median one in front of dorsal fins. At 57 mm. there are 6 paired lateral white streaks and 2 median ones. At 107 mm. there are 11 or 12 paired lateral white streaks, some incomplete, and often one or more may be lacking on one side; fins dusky, with white posterior margins.

Color when alive.—Background color black or dark brown; pale streaks light yellowish.

Ecology.—This small, strikingly colored species was seen around coral heads and in surge channels, usually alone or in groups of two or three. It appeared as if suspended in the water, moving back and forth with the surge of the water near the corals, but it would dart into crevices if disturbed.

GRAMMISTOPS, new genus

Genotype.—Grammistops ocellatus, new species.

Body oblong, covered with small, oblong, cycloid scales, embedded in the skin, fins mostly naked except base of caudal fin; lateral line single, supplemental maxillary bone present; preopercular edge without or with one blunt spine; opercle with 3 spines; teeth in villiform bands on jaws, palatines, and Λ-shaped on vomer; gill membranes separate, free from isthmus; dorsally the opercular membrane is attached posteriorly to the supracleithrum; no scaly process at base of pelvics and no scaly membrane at dorsal edge of pectoral as in *Epinephelus;* no dermal flap on tip of chin, maxillary naked; dorsal divided to base; gill rakers moderately long; other characters are those of the new species.

Named *Grammistops* in reference to its relationships with *Grammistes.*

GRAMMISTOPS OCELLATUS, new species

FIGURE 62

Holotype.—U.S.N.M. No. 141871, Bikini Atoll, Arji Island, lagoon, depth 20 to 40 feet, August 7, 1946, S–46–308, Herald and Brock, standard length 85.5 mm.

Description.—Dorsal rays VII,12; anal III,9; pectoral i,13–i,13; vertical scale rows along lateral line 90, vertical rows from upper edge of opercular opening to midbase of caudal fin 82; scales in a row from anal origin to lateral line 22 or 23, from lateral line to base of soft dorsal 15 or 16; gill rakers about 6 or 7+1+12 or 13 on first gill arch.

The following precision measurements were made on the holotype and are recorded in thousandths of the standard length, which is 85.5 mm: Greatest depth 298; head 386; snout 78; interorbital space 29; eye 85; postorbital length of head 228; least width of preorbital 19; length of maxillaries 175; least depth of caudal peduncle 140; length of caudal peduncle 182; longest dorsal spine (second) 111; longest soft dorsal ray 163; longest anal spine (second) 47; longest soft anal ray 158; pectoral 236; soft pelvic 175; caudal 257.

Greatest depth 3.4; head 2.6; pectoral 4.1; all in standard length. Greatest depth 1.3; pectoral 1.5; snout 4.9; postorbital length of head 1.6; eye 4.7; snout tip to rear of maxillary 2.1; least depth of caudal peduncle 2.6; all in length of head. Interorbital space a little

convex, about 2.1 in eye, naked, as is dorsal surface of head; least depth of caudal peduncle 1.3 in its length; teeth in villiform bands in jaws, on palatines and vomer, the latter Λ-shaped; no teeth on tongue; bony edge of preopercle smooth, except for a blunt spine on the right side, absent on the left; no spines on interopercles or subopercle; opercle with three spines, middle one farther back and a little closer to upper than lower one; scales cycloid, small, mostly embedded in the skin and present on body, sides of head, and base of caudal fin, but absent on dorsal surface of head, and on orbitals; mouth, underside of head, dorsal, anal, pelvic, and base of pectoral fins scaly; no scaly membrane at upper edge of pectoral base; lips thick, lower jaw projecting and entering profile; premaxillary protractile; posterior or distal edges

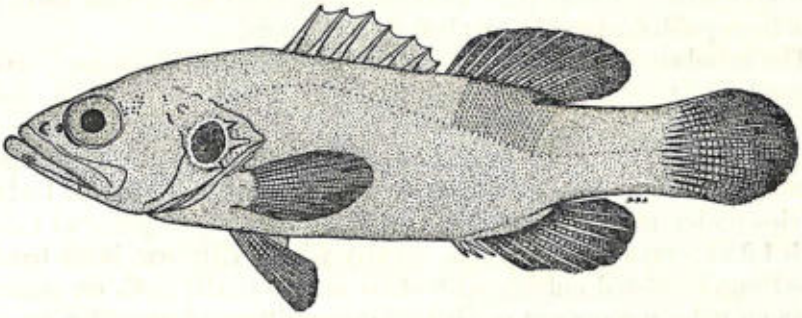

FIGURE 62.—Holotype of *Grammistops ocellatus*, new species (U.S.N.M. No. 141871), from Bikini Atoll. (Drawing by Dorothea B. Schultz.)

of all fins rounded; middle rays of pectoral fin longest; second branched pelvic ray longest; first dorsal spine two-thirds length of second or longest spine; dorsal fin notched to base between last dorsal spine, which is very short, and first soft dorsal ray; anal spines short but strong, second heaviest; about five or six rows of scales between anus and anal origin; lateral line single, a little arched over pectoral fin, highest part of arch opposite about base of second or third dorsal spine, then lateral line follows a course along midside of caudal peduncle; greatest depth opposite dorsal origin; gill rakers longer than gill filaments.

Color in alcohol.—Background color plain dark brown posteriorly, becoming lighter brown forward, and head tan or yellowish; a large ocellate spot on opercle; anterior side of eye margined with a blackish line; each side of symphysis of lower jaw with a dusky spot;

Color when alive.—Unknown, except the head, which is lighter than the rest of the body and still retains a little of the yellowish coloration.

Remarks.—This unusual species represents the fourth genus referable to the serranid subfamily Grammistinae. It differs from the others in lacking scales on base of saft dorsal and anal fins and in

other characters as given in the key to the genera (p. 384). A characteristic possessed by no other species in the subfamily is the sharp contrast between the dark soft rays of all fins and the clear membranes between the rays.

Named *ocellatus* in reference to the large ocellate black spot on opercle.

Family PSEUDOCHROMIDAE

By Leonard P. Schultz

Under this family I am uniting those aberrent serranidlike genera usually placed in the families Pseudochromidae, Acanthoclinidae, Plesiopidae, and Pseudoplesiopidae as recognized by various authors who have published on the tropical Pacific fauna.

The members of this group are small reef fishes with oblong, compressed bodies covered with ctenoid or cycloid scales; lateral lines one to three or none, often a dorsal lateral line interrupted opposite base of dorsal fin and beginning again along midaxis of caudal peduncle, sometimes three lateral lines extending entire length of body; pelvics under pectoral bases or a little in advance of pectoral base, with I,2 to 5 rays; teeth on jaws usually with a villiform inner band, sometimes bordered outside with short canine teeth; teeth on vomer, those on palatines present or absent; premaxillary protractile; dorsal fin elongate, of spines and soft rays, or the spines may be reduced to simple flexible rays; anal spines 0 toXIV and dorsal spines 0 to XXV; anal fin base much shorter than dorsal; anus close to and in front of anal origin; branchiostegals six; gill membranes extending far forward where they join to form a moderately wide to narrow free fold across isthmus, or broadly joined across isthmus with a broad free fold; pseudobranchiae present; gill rakers short, not very numerous; fourth gill free; various counts made on the genera and species of this family are recorded in tables 35, 36, and 37; additional characters of the genera will be found in the following key:

KEY TO THE GENERA AND SPECIES OF PSEUDOCHROMIDAE OF THE NORTHERN MARSHALL ISLANDS

1*a*. Dorsal spines fewer than XV; anal spines fewer than V.

2*a*. Dorsal and anal spines stiff or pungent, sometimes very small and slender; anal with III spines; palatine teeth present.

3*a*. Pelvic fin rays, I,5, reaching from one-third to one-half the way to the anal fin origin, but not to the anus; pectoral rays i,15 to 18.

4*a*. Dorsal spines III, slender; maxillary reaching only to under front of eye; no spine on rear margin of preopercle; two lateral lines present (*Pseudochromis* Rüppell).

5*a*. Background color plain brownish, no white dots on scales or any place on body; adult males with a white or pale streak along dorsal lateral line usually ending opposite about halfway along base of dorsal fin; dorsal rays III,22; gill rakers 3 to 5+1+9 or 10; scales 35 or 36___ Pseudochromis tapeinosoma Bleeker (p. 390)

5*b*. Background color plain brownish with a white dot in center of nearly every scale (these spots may be very faint), and sometimes the dorsal fin has traces of minute whitish specks; dorsal rays III,25 or 26; gill rakers 4+1+10 or 11; scales 40 to 43.
Pseudochromis aurea marshallensis, new subspecies (p. 392)

4*b*. Dorsal spines VII (rarely VIII), stiff; maxillary reaches past a vertical line through rear edge of orbit; a strong spine on rear margin of preopercle.

6*a*. An enlarged pair of pores in interorbital space and several smaller pores around edge of orbit; only dorsal lateral line present; dorsal rays usually VII,19 to 22; anal III,15 to 18; scales 50 to 54; gill rakers 6+1+10 or 11; background color light brown with a reticulated pattern of dark-brown bands; opercular spot blackish or dark brown.
Pseudogramma polyacantha (Bleeker) (p. 395)

6*b*. No pore in the interorbital space and no series of pores around edge of orbit; dorsal and peduncular lateral lines present; dorsal rays VII,23 or 24; anal III,19 to 21; scales 59 to 71; gill rakers 5 or 6+1+10 or 11; background color light brown, with numerous scattered dark brown blotches or spots on body and head; no opercular spot; chin usually dark brown.
Aporops bilinearis Schultz (p. 396)

3*b*. Pelvic fin rays I,4, reaching anal fin origin; dorsal rays XI or XII,7, rarely 8; anal III,8; pectoral rays i,20 to 22; scales 27 or 28; gill rakers 3 to 6+1+6 to 12; color blackish to brownish (purplish black when alive), with tips of dorsal spines white; distal margin of pectoral pale, basal four-fifths brownish; opercular spot blackish; each scale usually dark brown posteriorly, giving the appearance of dark spots; when fish is alive each scale with a light-blue center, and opercular spot rich purple_____ Plesiops nigricans (Rüppell) (p. 399)
Plesiops melas Bleeker (p. 402)

2*b*. Dorsal and anal rays all soft and flexible, nonpungent, the first several simple, the last several branched; pelvics long, reaching to anus or anal fin origin; palatine teeth present or absent, if present usually reduced to a small patch; maxillary reaches only to front of eye; a pair of enlarged pores in interorbital space and a series of numerous smaller pores around margin of orbit; no spine on preopercle (*Pseudoplesiops* Bleeker).

7*a*. Dorsal rays 22; anal 13; pelvics I,3; scales 29 to 31; color plain light brown, margins of dorsal and anal fins pale; sides of body with a few indistinct pale streaks or lines; no lateral lines present; palatine teeth absent; intermandibular space without a projecting keel; no black opercular spot.
Pseudoplesiops rosae Schultz (p. 401)

7*b*. Dorsal rays 24 to 28; anal rays 15 to 18; scales 35 to 39.

8*a*. Pelvic rays I,3; dorsal and peduncular lateral lines present; teeth on palatines; color plain brownish.
Pseudoplesiops annae (Weber)

8*b*. Pelvic rays I,4; orbits with a narrow black ring.

9*a*. Dorsal lateral line present, peduncular one absent; palatine teeth present; intermandibular space without a projecting fleshy keel; no black opercular spot.

Pseudoplesiops typus Bleeker

9*b*. No lateral lines present.

10*a*. Intermandibular space with a strongly projecting fleshy keel; no palatine teeth; black ocellate spot on opercle.

Pseudoplesiops revellei, new species (p. 404)

10*b*. No fleshy keel in intermandibular space; palatine teeth present in a very small patch; no black opercular spot.

Pseudoplesiops sargenti, new species (p. 405)

1*b*. Dorsal rays XIX to XX,4 or 5; anal VIII to X,4 or 5; pelvics I,2; scales 28 to 30; opercle with 2 pungent spines; a single dorsal lateral line with 9 to 13 pores, pectoral rays ii,14 to ii,16; color blackish-brown with tips of median fin rays and pelvics white; a white spot on pectoral base.

Acanthoplesiops hiatti, new species (p. 407)

Genus PSEUDOCHROMIS Rüppell

Pseudochromis RÜPPELL, Neue Wirbelthiere . . . Abyssinien gehörig. Fische der rothen Meeres, 1835, p. 8. (Genotype, *Pseudochromis olivaceus* Rüppell.)

PSEUDOCHROMIS TAPEINOSOMA Bleeker

Pseudochromis tapeinosoma BLEEKER, Nat. Tijdschr. Nederl.-Indië, vol. 4, p. 115, 1853 (type locality, Amboina).

SPECIMENS STUDIED

Bikini Atoll: 11 stations, 30 specimens, 15 to 42 mm. standard length.
Rongerik Atoll: 1 station, 4 specimens, 20 to 41 mm.
Eniwetok Atoll: 3 stations, 7 specimens, 27 to 39 mm.
Rongelap Atoll: 2 stations, 2 specimens, 23 to 35 mm.
Rota Island: 1 station, 1 specimen, 38 mm.
Guam: 4 lots, 15 specimens, 25 to 42 mm.

Description.—Dorsal rays III,22; anal III,13; pectoral i,17 or 18; pelvic I,5 branched caudal 8+7; scale rows from beginning of lateral line to caudal fin base 35 or 36; scales in a row from anal origin upward and forward to dorsal base 14; gill rakers on first gill arch 3 to 5+1+9 or 10; (additional counts in table 35).

Head 2.8 to 3.3; greatest depth 3.5 to 3.7; snout to anal origin 1.6 to 1.7; length of pelvic fins 4.4 to 5.3; all in standard length. Snout 4.5 to 5; eye 3.0 to 3.4; tip of snout to rear edge of maxillary 2.8 to 3.4; fleshy interorbital space 6.5 to 7.0; postorbital length of head 1.9; longest ray of pectoral fin 1.5; least depth of caudal peduncle 1.9 to 2.0; all in length of head. Least depth of caudal peduncle in its length 1.0 to 1.1. Scales ctenoid, occurring on head, body, and two-thirds of the way out caudal fin rays, but absent on rays of other fins; snout and jaws naked; three rows of scales on cheek; premaxillary teeth anteriorly in a villiform band and with five canines on outside, sides

with an inner row of minute teeth and an outer row of strong canine-like teeth; dentary with a villiform band of teeth anteriorly becoming a single row laterally, and with about four canines on outer side of villiform band; sometimes a canine tooth occurs at the point on side of dentary where teeth change to a single row; short conical teeth on vomer and palatines; pectoral and median fins rounded, pelvics pointed, the second and third rays longest; greatest depth of body at dorsal origin; maxillary reaches a trifle past a vertical line through front of eye; gill membranes joined at an acute angle, moderately far forward and forming a broad free fold across isthmus; interorbital space with a row of minute pores around orbits but no pore enlarged; pelvic fins reach a little over halfway to anus; pectoral fins without free silky rays; no spine on posterior margin of preopercle; dorsal lateral line ending a few scale rows in front of rear of base of dorsal fin, beginning again on midaxis of caudal peduncle; pelvics inserted under pectoral fin base; dorsal and anal spines not pungent, but flexible; gill rakers short and thick; anterior nostril tubular, separated from posterior by a dermal isthmus; dorsal edge of opercle without traces of serrations; premaxillary protractile; dentary projects a little in front of tip of snout.

Color in alcohol.—Background color plain brownish, fins plain dusky, usually paler than body. Adult males are blackish, including dorsal and caudal fins, the latter with dorsal and ventral edges white, posteriorly margined by a narrow white line; a white or pale streak occurs along the dorsal lateral line, usually ending about halfway along the length of dorsal fin base.

Color when alive.—Adult males dark purplish black posteriorly, brownish, tinged with orange anteriorly; center of scales with a bluish dot posteriorly.

Ecology.—This is a very common species among growths of coral and algae in the surf and in the lagoon and ocean reefs.

Remarks.—This widely distributed species was beautifully figured by McCulloch (Report on Some Fishes Obtained by the F. I. S. *Endeavour* . . ., vol. 5, pt. 4, pl. 51, 1926).

PSEUDOCHROMIS AUREA MARSHALLENSIS, new subspecies

FIGURE 63

Holotype.—U.S.N.M. No. 140629, a specimen 43 mm. in standard length from Rongelap Atoll, Rongelap Island, lagoon coral head, depth 18 feet, July 25, 1946, S–46–286, Brock, Herald, and Kohler.

Paratypes.—U.S.N.M. No. 140631, Bikini Atoll, Enyu Island, lagoon, channel reef, March 16, 1946, S–46–8, Schultz, Brock, and Marr, 1 specimen, 43 mm.; U.S.N.M. No. 140632, Bikini Atoll, Bikini Island, ocean reef, March 22, 1946, S–46–15, Schultz and Brock, 3 specimens,

32 to 40 mm.; U.S.N.M. No. 140633, Bikini Atoll, Romuk Island, ocean reef, April 1, 1946, S–46–47, Schultz, 1 specimen, 37 mm.; U.S.N.M. No. 140634, Bikini Atoll, Yuro Island, ocean reef, July 13, 1946, S–46–251, Herald, 3 specimens, 42 to 47 mm.; U.S.N.M. No. 142278, Bikini Atoll, Arji Island, depth 20 to 40 feet, August 7, 1946, S–46–308, Herald and Brock, 1 specimen, 30 mm.; U.S.N.M. No. 140635, Bikini Atoll, Boby Island, ocean reef, August 17, 1946, S–46–383, Herald, 2 specimens, 33 to 47 mm.; U.S.N.M. 140636, Bikini Atoll, Namu Island, lagoon reef, August 6, 1947, S–46–508, Schultz, Brock, and Hiatt, 6 specimens 13 to 42 mm.; U.S.N.M. No. 141731, Rongelap Atoll, Mellu Island, June 19, S–46–220, Schultz and Herald, 1 specimen, 38.5 mm.; U.S.N.M. No. 140630, Rongelap Atoll, Rongelap Island, lagoon coral head, depth 18 feet, July 25, 1946, S–46–286, Brock,

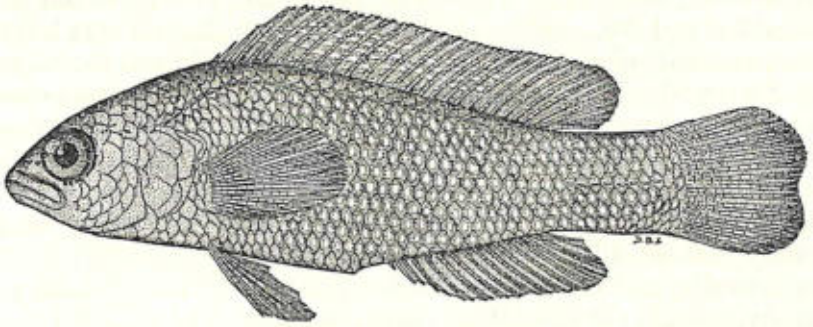

FIGURE 63.—Holotype of *Pseudochromis aurea marshallensis*, new subspecies (U.S.N.M. No. 140629), from Rongelap Atoll. (Drawing by Dorothea B. Schultz.)

Herald, and Kohler, 18 specimens, 15 to 44 mm. taken along with the holotype; U.S.N.M. 140627, Rongelap Atoll, Yugui Island, ocean reef at boat passage, July 31, 1946, S–46–304, Herald, 5 specimens, 27 to 44 mm.; U.S.N.M. 140628, Rongelap Atoll, Lomuilal Island, lagoon reef, August 1, 1946, S–46–306, 3 specimens, 24 to 42 mm.; U.S.N.M. 140626, Rongelap Atoll, Naen Island, lagoon reef, July 30, 1946, S–46–302, Herald, 2 specimens, 19 and 41.5 mm.; U.S.N.M. 140640, Rongerik Atoll, Bock Island, ocean reef, April 24, 1946, S–46–113, Brock and Marr, 3 specimens 37 to 44 mm.; U.S.N.M. No. 140639, Rongerik Atoll, Bock Island, ocean reef, June 27, 1946, S–46–237, Schultz and Herald, 21 specimens, 19 to 46 mm.; U.S.N.M. 140638, Rongerik Atoll, Latoback Island, lagoon reef, June 28, 1946, S–46–238, Schultz and Herald, 7 specimens, 23 to 41 mm.; U.S.N.M. No. 140637, Rongerik Atoll, Latoback Island, lagoon reef, August 14, 1947, S–1041, Brock, Schultz, and Donaldson, 4 specimens, 38 to 41 mm.

Description.—Dorsal rays III,25 or 26; anal III,13 or 14; pectoral i,16 or 17; pelvic always I,5; branched caudal 8+7; scale rows from beginning of lateral line to caudal fin base 40 to 43; scales in an

oblique row from anal origin forward to lateral line 11 or 12, above lateral line 2; gill rakers on first gill arch 4+1+10 or 11; (additional counts in table 35.)

Detailed measurements were made on the holotype and one paratype, and these data are recorded in thousandths of the standard length, first for the holotype then the paratype. Standard lengths 43 and 34 mm. Head 312 and 341; greatest depth of body 293 and 283; length of snout 65 and 73; diameter of eye 81 and 97; tip of snout to rear edge of maxillary 107 and 109; postorbital length of head 177 and 177; snout tip to dorsal origin 353 and 377; snout tip to anal origin 626 and 671; anal origin to middle of base of caudal fin 414 and 374; least depth of caudal peduncle 153 and 147; length of caudal peduncle (base of last anal ray to midbase of caudal fin) 163 and 162; longest ray of pectoral 214 and 209, pelvic 205 and 194, caudal 251 and 238, soft dorsal 163 and 159, anal 151 and 147; length of second anal spine 65 and 74, of third anal spine 72 and 68; length of third dorsal spine 81 and 76; scales ctenoid, edges finely denticulate, occurring on body, head, basal half of caudal fin, but lacking on bases of other fins; snout and jaws naked; four rows of scales on cheek; premaxillary teeth in a villiform band, narrowing posteriorly, and with 4 (usually) canines anteriorly on outer edge of villiform teeth; dentary with a villiform band of teeth anteriorly, becoming a single row laterally, and with two canines on outside of villiform band anteriorly, a single row of teeth on vomer, and a patch of villiform teeth on palatines; median fins and pectoral fin rounded posteriorly, pelvic fins pointed, the second soft ray longest; greatest depth of body at dorsal origin; maxillary reaches past a vertical line through front of eye but not quite to one through front of pupil; gill membranes joined at an acute angle moderately far forward and forming a broad free fold across isthmus; interorbital space with a row of minute pores around edge of orbit but no enlarged pore; pelvic fins reach a little over halfway to anus; no free, silky, pectoral fin rays; no spine on posterior margin of preopercle; dorsal lateral line ending under two-thirds the way along dorsal fin base and continued again on median axis of caudal peduncle with about 24 to 26 pores in dorsal lateral line and 8 or 9 in peduncular one; pelvic fins inserted under base of pectoral fins; third dorsal spine contained about two times in longest soft dorsal ray, first three rays of both dorsal and anal fins represented by stiff spines; second anal spine thick and stronger than others, but not projecting quite so far as third anal spine; gill rakers short and thick; anterior nostril a short tube, separated from posterior one by a dermal isthmus; dorsal edge of opercle sometimes with traces of minute serrations; premaxillaries protractile; lower jaw projecting a little in front of tip of snout.

Color in alcohol.—Background color plain brownish with all fins light dusky; nearly every scale with a light or whitish dot in center; sometimes the dorsal fin has traces of minute whitish specks but the anal and other fins plain light dusky; in some specimens the caudal fin is nearly whitish.

Color when alive.—Anterior part of body, including head, chrome-yellowish, grading into the purplish posterior half of body and fins; pale spots on scales grayish pink.

Ecology.—This fish was taken from coral heads and crevices in the reef to a depth of 18 feet. It was encountered both on the ocean and lagoon sides of the atoll reef.

Remarks.—This subspecies was described as new because the Marshall Island specimens do not exactly fit the description of *Pseudochromis aurea* Seale (Philippine Journ. Sci. vol. 4, p. 528, 1909), type locality, Sitanki Island, Jolo Archipelago, P. I.

P. aurea marshallensis differs from *P. a. aurea* in having one or two fewer gill rakers on the lower limb of the first gill arch and in averaging one fewer dorsal and anal soft rays.

Named after the island group in which it was collected.

Genus PSEUDOGRAMMA Bleeker

Pseudogramma BLEEKER, Verh. Akad. Amsterdam, vol. 15, p. 24, 1875. (Genotype, *Pseudochromis polyacanthus* Bleeker.)

PSEUDOGRAMMA POLYACANTHA (Bleeker)

Pseudochromis polyacanthus BLEECKER, Nat. Tidschr. Nederl.-Indië, vol. 10, p. 375, 1856 (type locality, Ternate).

SPECIMENS STUDIED

Bikini Atoll: 22 stations, 166 specimens, 13 to 59 mm. standard length.
Rongelap Atoll: 11 stations, 133 specimens, 18 to 62 mm.
Rongerik Atoll: 3 stations, 4 specimens, 16 to 49 mm.
Eniwetok Atoll: 3 stations, 11 specimens, 21 to 61 mm.
Kwajalein Atoll: 1 station, 3 specimens, 39 to 49 mm.
Likiep Atoll: Univ. Washington, 2 specimens, 41 to 63 mm.

Description.—Dorsal rays VII (rarely VIII), 19 to 22; anal III,15 to 18; pectoral i,16 or 17; branched caudal 8+7; pelvic I,5; gill rakers on first gill arch 6+1+10 or 11; scales from beginning of lateral line to midbase of caudal fin about 50 to 54; scales in an oblique row from anal origin anterodorsally to dorsal fin base about 26 to 29; (additional counts in table 35).

Head 2.4 to 2.7; greatest depth 3.3 to 3.5; snout to anal origin 1.6 to 1.7; length of pelvics 7.0 to 7.5; all in standard length. Snout 5.3 to 5.6; eye 4.0 to 4.6; tip of snout to rear edge of maxillary, 2.0 to 2.1; fleshy interorbital space 10 to 14; postorbital length of head 1.5 to 1.7; length of longest ray of pectoral fin 1.5 to 1.8; least depth of caudal peduncle 2.8 to 3.4; longest dorsal spine (sixth) 3.5 to 5.8; all

in length of head. Least depth of caudal peduncle in its length 1.0 to 1.2. Scales ctenoid, very numerous and becoming much smaller on dorsal part of head; maxillaries and snout naked; scales covering from a third to a half of basal part of median fins and about a third of the pectoral and pelvic fins; villiform band of teeth on jaws, vomer, and palatines; caudal, anal, and dorsal fins rounded posteriorly, other fins pointed; greatest depth of body near origin of dorsal fin; maxillary reaches notably past a vertical line through rear of orbit; gill membranes free from isthmus, extending far forward, but with a narrow fold across isthmus; interorbital space with a pair of enlarged pores; second and third pelvic rays longest, but not reaching halfway to anus; none of lower pectoral fin rays with free silkylike tips; upperpart of preopercle with a short, strong spine, directed obliquely downward; dorsal lateral line ending a little in front of rear base of soft dorsal fin; no lateral line on caudal peduncle; pelvic fins inserted opposite front of pectoral base; third dorsal spine about 1½ in longest soft dorsal ray; gill rakers short, thick; anterior nostril tubular, the posterior one next to anterior margin of eye, both separated by a wide dermal isthmus; premaxillaries protractile; second anal spine longer than third.

Color in alcohol.—Background color light brown, with a reticulated dark-brown pattern of bands; opercular spot dark brown or blackish; sometimes a pale streak extends from ventral part of eye posteriorly across preopercle, most evident in the smaller specimens; anterior margin of eye bordered by a dark brown line; the 16-mm. specimen lacked the opercular spot.

Ecology.—This species was everywhere abundant on the lagoon and ocean reef in shallow water, as well as in moderate depths of the lagoon.

Remarks.—Counts and measurements made on specimens from Johnston Island, and from the Phoenix, Samoan, and Philippine Islands, indicate no significant races or populations differing from those of the northern Marshall Islands. Schultz (U. S. Nat. Mus. Bull. 180, pp. 114–115, 1943) restricted the name *P. polyacanthus* (Bleeker) to the species described herein and discussed the problem of related genera and species.

Genus APOROPS Schultz

Aporops SCHULTZ, U. S. Nat. Mus. Bull. 180, p. 112, 1943. (Genotype, *Aporops bilinearis* Schultz.)

APOROPS BILINEARIS Schultz

FIGURE 64

Aporops bilinearis SCHULTZ, U. S. Nat. Mus. Bull. 180, p. 112, fig. 9, 1943 (type locality, Hull Island, Phoenix group).

SPECIMENS STUDIED

Bikini Atoll: 7 stations, 36 specimens, 28 to 90 mm. standard length.
Eniwetok Atoll: 2 stations, 5 specimens, 31 to 49 mm.
Rongerik Atoll: 1 station, 1 specimen, 44 mm.

Description.—Dorsal rays VII,23 or 24; anal III,19 to 21; pectoral i,15 to 17; branched caudal 8+7; pelvic I,5; gill rakers on first gill arch 5 or 6+1+10 or 11; scales from beginning of lateral line to mid-base of caudal fin about 59 to 71; scales from anal origin obliquely upward and forward to dorsal fin base about 30 to 32; (additional counts in table 35).

Head (tip of snout to rear of opercular flap) 2.6 to 2.7; greatest depth 3.1 to 3.6; snout to anal origin 1.6 to 1.7; length of pelvics 7.9 to 8.1; all in standard length. Snout 5.2 to 5.8; eye 4.5 to 5.2; tip of

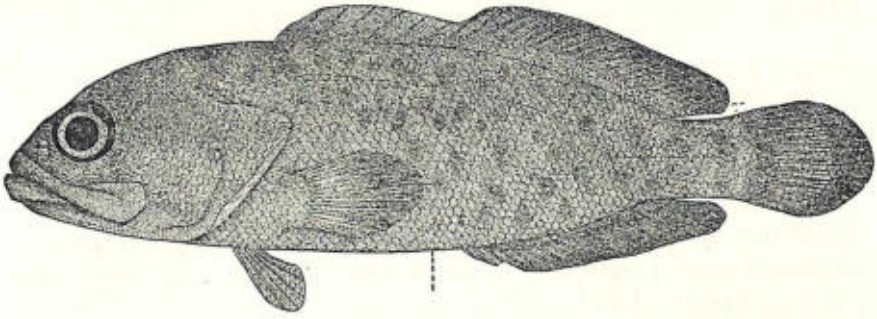

FIGURE 64.—Holotype of *Aporops bilinearis* Schultz (U.S.N.M. No. 115336), from Hull Island, Phoenix group. (Drawing by Aime M. Awl.)

snout to rear edge of maxillary 2.1 to 2.2; fleshy interorbital space 13 to 15; postorbital length of head 1.6; length of longest ray of pectoral fin 1.7 to 1.8; least depth of caudal peduncle 3.5 to 3.6; longest dorsal spine (third to fifth) 5.2 to 5.5; all in length of head. Least depth of caudal peduncle in its length 1.0 to 1.1. Scales ctenoid, very numerous, and becoming much smaller on dorsal part of head; maxillaries, snout, and lips of lower jaw naked; scales covering from half to about a third of basal part of all fins; a villiform band of teeth on premaxillaries, dentary, vomer, and palatines; posteriorly the margins of all fins are rounded; greatest depth at origin of spiny dorsal fin; maxillary reaches notably past a vertical line through rear of orbit; gill membranes attached far forward, free from isthmus, but a narrow free fold crosses isthmus far forward; no enlarged pore in the interorbital space; second pelvic ray longest; tip of lower pectoral rays not free and hairlike or silky; upper posterior corner of preopercle with a short stout spine directed posterodorsally; dorsal lateral line extends to a point about opposite middle of length of anal fin base; lateral line on midaxis of caudal peduncle begins over anal origin;

pelvic fins inserted under front part of pectoral fin bony base; third dorsal spine contained about twice in longest soft dorsal ray; gill rakers short, broad, thick; anterior nostril tubular, separated by a wide dermal isthmus from posterior pore next to margin of eye; premaxillaries protractile; second anal spine longer than third, a membrane closing the space along dorsal edge of operculum.

Color in alcohol.—Background light brown, with numerous scattered dark-brown blotches on body and head; no dark opercular spot; basal part of median fins darker than pale distal portions; anterior margin of eye with a dark brown line; chin usually dark brown.

Ecology.—*Aporops bilinearis* occurs among corals in areas where the wave action is strong.

Remarks.—There does not appear to be any significant difference between the Marshall Island specimens and those from the Phoenix Islands.

Genus PLESIOPS Oken

Plesiops OKEN, Isis, App. p. 1182a, 1817. (Genotype, *Plesiops nigricans* (Rüppell), designated by Bleeker.) (Reference copied.)

The following characters are the same for both species of *Plesiops* from the Marshalls and Marianas.

Scales ctenoid along middle of sides, more so posteriorly, smooth elsewhere; opercle with 2 rows of scales, preopercle with 5 rows, head otherwise naked; teeth in a villiform band on both jaws, vomer, and palatines; pectoral and caudal fin rounded, other fins pointed posteriorly; greatest depth of body near front of spiny dorsal fin; maxillary reaches to or past a vertical line through rear of orbit; gill membranes free from isthmus, and joined to it far forward; no enlarged pore in interorbital space; second pelvic soft ray longest, reaching past anal origin; no spine on preopercle or opercle; two lateral lines, dorsal one extending to base of last dorsal soft ray, posterior one beginning along midaxis of body; pelvic fin inserted opposite front of pectoral fin bony base; third dorsal spine contained 2 or 3 times in longest soft dorsal ray; gill rakers short, thick; anterior nostril tubular, posterior one a pore behind anterior one and close to edge of eye; premaxillaries protractile.

Although I follow Weber and de Beaufort in recognizing *nigricans* and *melas*, it is obvious after examining several hundred specimens in our collections that the genus *Plesiops* is in need of revision. Time does not permit me to make further investigations now, but the true *nigricans* may be restricted to a species having no black opercular spot and coming from the western Indian Ocean. It will be observed that my counts of soft rays in both anal and dorsal fins are one less than those given by Weber and de Beaufort. I have assumed that

they counted the last soft ray, split to the single base, as two rays, whereas I count them as one ray.

The two species of *Plesiops* found in this region may be distinguished by the key.

1*a*. Dorsal spines XII; opercle usually with a blackish ocellate spot; no pale streak on dorsal fin; lower rays of pectoral fin double-branched and distinctly separated at half their length---- Plesiops nigricans (Rüppell)

1*b*. Dorsal spines XI; no black spot on opercle; tips of dorsal spines white or orange, middle of fin below white tips with a narrow bright blue line or streak, at least on adult males; lower rays of pectoral not double branched, except possibly near tips, and not separated as above. Plesiops melas Bleeker

PLESIOPS NIGRICANS (Rüppell)

PLATE 33, A

Pharopteryx nigricans RÜPPELL, Atlas zu der Reise im Nördlichen Afrika, Fische des rothen Meeres, p. 15, pl. 4, fig. 2, 1828 (type locality, Red Sea).

SPECIMENS STUDIED

Bikini Atoll: 2 stations, 6 specimens, 40 to 109 mm. standard length.
Eniwetok Atoll: 1 station, 4 specimens, 38 to 88 mm.
Guam: 5 lots, 17 specimens, 11 to 111 mm.
Saipan: 2 lots, 8 specimens, 22 to 58 mm.
Rota Island: 2 lots, 5 specimens, 16 to 94 mm.

Description.—Dorsal rays XII,7; anal III,8; pectoral i,20 to 22; branched caudal rays 8 or 9+7 or 8; pelvics, I,4; gillrakers on first gill arch 5 or 6+1+10 to 12; scales from upper edge of gill opening at start of lateral line to midbase of caudal fin 25 to 28; scales in an oblique row from anal origin anterodorsally to dorsal fin base 11 to 13; (additional counts in table 35).

Head 2.4 to 2.8; greatest depth 2.9 to 3.2; snout to anal origin 1.7; length of pelvics 2.5 to 2.8; all in standard length. Snout 4.6 to 5.0; eye 3.2 to 4.5; tip of snout to rear edge of maxillary 2.0 to 2.1; fleshy interorbital space 6.3 to 7.1; postorbital length of head 1.6 to 1.7; length of longest ray of pectoral fin 1.7 to 1.9; least depth of caudal peduncle 2.1 to 2.3; longest dorsal spine 1.9 to 2.2; all in length of head. Least depth of caudal peduncle in its length 1.0 to 1.1.

Posterior lateral line beginning a little in front of a vertical line through anal fin origin, with about 13 to 16 pores, not including the two on base of caudal fin; lowermost 7 or 8 pectoral rays double-branched with exserted tips free.

Color in alcohol.—Brownish or blackish, with tips of dorsal spines white, without a white submarginal streak at lower edge of pale tips of dorsal spines as in *melas;* opercular spot blackish; distal margin of pectoral pale, basal four-fifths brownish; fins generally dark brownish on young; sometimes about 5 or 6 vertical dark brown bars are present, alternating with paler interspaces.

Color when alive.—Tip of pectoral yellow; on center of each scale a light blue spot, forming bars; dark bars on body brownish black; opercular spot dark purplish blue, margined with brownish orange.

PLESIOPS MELAS Bleeker

Plesiops melas Bleeker, Verh. Batav. Genootsch., vol. 22, p. 9, 1849 (type locality, Bali).

SPECIMENS STUDIED

Bikini Atoll: 13 stations, 30 specimens, 10 to 48 mm. standard length.
Rongelap Atoll: 10 stations, 82 specimens, 10 to 47 mm.
Rongerik Atoll: 3 stations, 4 specimens, 10 to 51 mm.
Kwajalein Atoll: 1 station, 1 specimen, 34 mm.
Eniwetok Atoll: 6 stations, 15 specimens, 9 to 52 mm.
Guam: 3 lots, 21 specimens, 9 to 47 mm.
Saipan: 2 lots, 12 specimens, 9 to 23 mm.

Description.—Dorsal rays XI,7, rarely XI,8; anal III,8; pectoral i or ii, 19 to 22; branched caudal rays 8 or 9+7 or 8; pelvics I,4; gill rakers on first gill arch 3+1+7 to 9; scales from upper edge of gill opening to midbase of caudal fin 25 to 27; scales in an oblique row from anal origin anterodorsally to dorsal fin base about 11; posterior lateral line with about 9 to 12 pores, not including scales on caudal fin base; (additional counts in table 35).

Head 2.3 to 2.5; greatest depth 3.2 to 3.5; snout to anal origin 1.7; length of pelvics 2.0 to 2.5; all in standard length. Snout 5.5 to 6.0; eye 3.1 to 4.2; tip of snout to rear edge of maxillary 2.1 to 2.2; fleshy interorbital space 7 to 9; postorbital length of head 1.7; length of longest ray of pectoral fin 1.7 to 2.0; least depth of caudal peduncle 2.5 to 3.0; longest dorsal spine 1.3 to 1.5; all in length of head. Least depth of caudal peduncle in its length 1.0 to 1.2.

Posterior lateral line beginning a little behind a vertical line through anal fin origin, with 9 to 12 pores, not including those on base of caudal fin; lower pectoral rays not notably double-branched except possibly near their tips.

Color in alcohol.—Brownish to blackish, with distal edge of dorsal fin white, below which, at least on adult males, is a pale streak that continues from spiny dorsal to outer edge of soft dorsal; pectoral fin pale, except basal fifth brownish; center of each scale brownish.

Color when alive.—Tips of membranes of spiny dorsal bright orange; basal part of dorsal fin separated from orange tips by a narrow bright blue line that is continuous on outer edge of soft dorsal rays; body bluish black; pectoral translucent but distally orange; iris orange; caudal margined with orange posteriorly.

Ecology.—This gorgeously colored fish appears to prefer the rugged condition of the ocean reef or the lagoon where wave action is strong.

Genus PSEUDOPLESIOPS Bleeker

Pseudoplesiops BLEEKER, Nat. Tidjschr. Nederl.-Indië, vol. 15, p. 215, 1858. (Genotype, *Pseudoplesiops typus* Bleeker.)

Nematochromis WEBER, *Siboga*-Expeditie, vol. 57, Fische, p. 264, 1913. (Genotype, *Nematochromis annae* Weber).

The species referable to the genus *Pseudoplesiops* need much clarification, but they seem sufficiently similar in regard to certain characters to indicate that the five species, *typus* Bleeker, *annae* (Weber), *rosae* Schultz, and the two new ones, *revellei* and *sargenti*, belong together. This is done on the basis of an absence of spines in the median fins, with the first several rays of the dorsal and anal fins simple or unbranched; the reduced number of soft rays in the pelvics (I,4 or

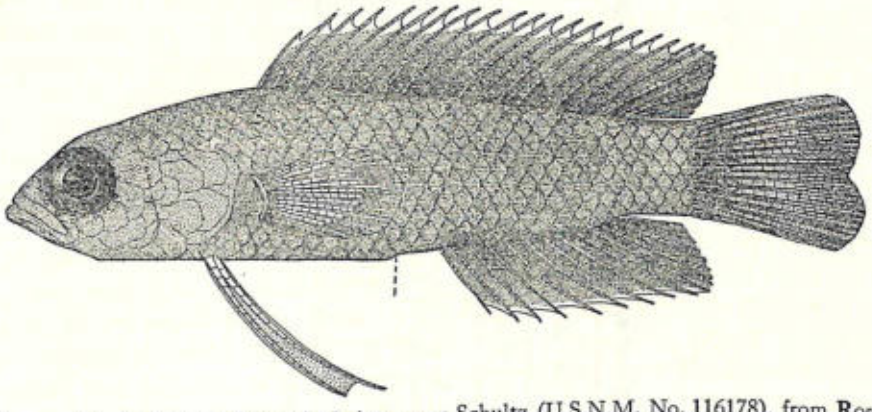

FIGURE 65.—Holotype of *Pseudoplesiops rosae* Schultz (U.S.N.M. No. 116178), from Rose Island, Samoan group. (Drawing by Aime M. Awl.)

I,3) and their great elongation (reaching past the anus or anal origin); the usual occurrence of cycloid scales, although a few specimens may have ctenii along the upper part of the back; a ring or series of pores around the edge of the orbit, with an enlarged pore in the interorbital space; and three or four rows of scales on the cheeks. The presence or absence of lateral lines is variable and the reduced dentition on the palatines, in which teeth may be present in certain species and absent in others, suggests characters of less significance generically. Other characters common to this genus are the few short gill rakers; similarity of dentition on jaws; gill membranes that extend far forward, where they join each other and form a narrow fold across the isthmus.

PSEUDOPLESIOPS ROSAE Schultz

FIGURE 65

Pseudoplesiops rosae SCHULTZ, U. S. Nat. Mus. Bull. 180, p. 117, fig. 11, 1943 (type locality, Rose Island of Samoan group).

TABLE 36.—*Counts made on various species of* Pseudoplesiops

Species	Total number of dorsal rays							Total number of anal rays						Pelvic rays		Pectoral rays			Scales from upper edge of gill opening to base of caudal fin										
	22	23	24	25	26	27	28	13	14	15	16	17	18	I, 3	I, 4	16	17	18	29	30	31	32	33	34	35	36	37	38	39
rosae	6	----	----	----	----	----	----	7	----	----	----	----	----	6	----	3	5	----	1	2	1	----	----	----	----	----	----	----	----
sargenti	----	----	1	4	2	----	----	----	----	----	4	3	----	----	10	1	4	5	----	----	----	----	----	----	----	2	2	1	1
revellei	----	----	----	----	----	----	4	----	----	----	----	2	2	----	4	4	3	----	----	----	----	----	----	----	1	2	1	----	----
typus	----	----	----	----	[1] X	----	----	----	----	X	X	----	----	----	X	X	----	----	----	----	----	----	----	----	----	X	----	----	----
annae	----	----	----	----	X	X	----	----	----	X	----	----	----	X	----	----	X	----	----	----	----	----	----	----	----	X	----	----	----

[1] Counts recorded from figures of the type or from the literature are indicated by an X.

SPECIMENS STUDIED

Bikini Atoll: 4 stations, 7 specimens, 19 to 23 mm. standard length.
Rongelap Atoll: 2 stations, 2 specimens, 22 and 23 mm.

Description.—Dorsal rays 22 (including simple and branched); anal 13 (simple and branched); pelvic I,3; pectoral 16 or 17 (simple and branched); branched caudal probably 7+7; scales from upper edge of gill opening to base of caudal fin 29 to 31; scales from anal origin to dorsal fin base 10; gill rakers on first arch about 3+1+9; (additional counts in table 36).

Head 2.8 to 3.0; greatest depth 3.6 to 3.9; snout to anal origin 1.6 to 1.7; length of pelvic fins 3.0; all in standard length. Snout 5.5 to 6.0; eye 3.1 to 3.2; tip of snout to rear edge of maxillary 3.0 to 3.1; fleshy interorbital space 7 to 8; postorbital length of head 1.8 to 1.9; longest ray of pectoral fin 1.8 to 1.9; least depth of caudal peduncle 2.2 to 2.3, all in length of head. Least depth of caudal peduncle in its length 0.9 to 1.0. Scales ctenoid, occurring on head and body, and not over a fifth the way out the caudal fin; scales lacking on bases of other fins and on snout and jaws; two rows of scales on cheek; operculum scaled but this not shown in drawing of holotype as published; premaxillary teeth in a villiform band anteriorly, becoming narrower laterally and about one row, at front of premaxillary on each side four short canine teeth; dentary similar, but laterally the teeth are in a single row; teeth present on vomer, in a single row, absent on palatines; fins rounded except pelvics; the latter with three soft rays, the second longest; greatest depth at front of dorsal fin; maxillary reaches to under pupil; gill membranes joined at an acute angle forward, forming a narrow free fold across isthmus; interorbital space with an enlarged pair of pores; pelvic fins with second soft ray elongate, reaching to anus or to anal fin origin; pectoral fins without silky rays; no spine on preopercular margin; no lateral lines evident; pelvics inserted under pectoral fin base; all rays of dorsal and of anal fins flexible, no pungent spines; gill rakers short; anterior nostril tubular, separated from posterior one by a wide dermal isthmus; no serration on opercle; a series of pores around orbit; premaxillary protractile; tip of dentary slightly projecting beyond tip of snout.

Color in alcohol.—Plain light brown on body and head; area behind orbit sometimes with blackish pigment; margins of dorsal and of anal fins pale, rest of fins light brownish; sides of body with a few indistinct pale streaks or lines formed by brown pigmented areas on the scales.

Ecology.—This species appears to prefer those reefs next to moderately deep water where currents or the wave actions are strong.

PSEUDOPLESIOPS REVELLEI, new species

FIGURE 66

Holotype.—U.S.N.M. No. 140696, Bikini Atoll, Eman Island, western end at channel and lagoon reef, July 17, 1947, S–46–405, Schultz, Brock, Hiatt, and Myers, standard length 30.5 mm.

Paratypes.—U.S.N.M. No. 140695, Bikini Atoll, northwest side Reer Island, lagoon reef, August 12, 1946, S–46–332, Herald and Brock, 1 specimen, 32 mm.; Bikini Atoll, Arji Island, August 5, 1947, Univ. Washington collection, 2 specimens, 28 and 29 mm.

Description.—Counts and measurements are recorded first for the holotype, then a paratype. Dorsal rays xxii,6 (tips of rays broken in paratype but total 28); anal xii,5; xii,6; pectoral ii,14– —; and ii,15–ii,14; pelvic always I,4; scale rows from upper edge of gill opening to midbase of caudal fin 36 and 35; scales from anal origin to base of dorsal in a forward ascending row 13 and 13; gill rakers on first gill arch of paratype 2 + 1 + 8 (additional counts in table 36).

Detailed measurements of the holotype and a paratype are recorded, respectively, in thousandths of the standard length. Standard length 30.5 and 32 mm.

Head 315 and 303; greatest depth of body 248 and 256; length of snout 59 and 65; diameter of eye 88 and 88; tip of snout to rear edge of maxillary 102 and 106; fleshy interorbital space 23 and 31; postorbital length of head 174 and 166; snout tip to dorsal origin 308 and 291; snout tip to anal origin 584 and 578; anal origin to middle of caudal fin base 456 and 456; least depth of caudal peduncle 134 and 131; length of caudal peduncle 115 and 117; longest ray of pectoral fin 193 and 188, pelvic 285 and 285, of caudal 236 and —, of soft dorsal 213 and 169, of soft anal 197 and 200. Scales both ctenoid and cycloid on body; about 4 rows of scales on the cheeks; upper surface of head, snout, and jaws naked; scales lacking on bases of all fins except about 4 rows on caudal; both jaws with two or three pairs of canine teeth anteriorly, inside of which occurs a band of villiform teeth; laterally jaws have a single row of enlarged conical teeth; teeth on vomer, none on palatines; caudal and pectoral fins rounded; posterior ends of soft dorsal and anal fins pointed; second soft ray of pelvics greatly produced, reaching anal fin origin; greatest depth of body opposite middle of length of pectoral fins; maxillary reaches nearly to a vertical line through middle of pupil; gill membranes joined moderately far forward with a wide free fold across isthmus; forward along midventral line of intermandibular space a thin fleshy plicate keel with somewhat crenulated edge; interorbital space with a pair of pores, about 11 others around eye, and others on dentary and on sides of head posteriorly; pelvic fins elongate; second soft ray elongate, reaching anal fin origin; pelvics inserted a little in advance of pectoral base; no spine on preopercular margin; no lateral lines pres-

ent; gill rakers short; anterior nostril a short tube, separated from posterior one by a dermal isthmus; no serrations on operculum; premaxillaries protractile; lower jaw same length as upper, not projecting.

Color in alcohol.—Head, body, and fins light brown; upper part of opercle with a black ocellate spot; tip of fleshy keel under lower jaw with margins blackish; orbit posteriorly with a narrow blackish line.

Ecology.—This species was taken only from the lagoon reefs.

Remarks.—From all other species of pseudochromids *Pseudoplesiops revellei* may be distinguished by the lack of spines in the median fins combined with the fleshy keel on the under side of the lower jaw, and from all other species referred to *Pseudoplesiops* by the possession of a black spot on the operculum. Named *revellei* in

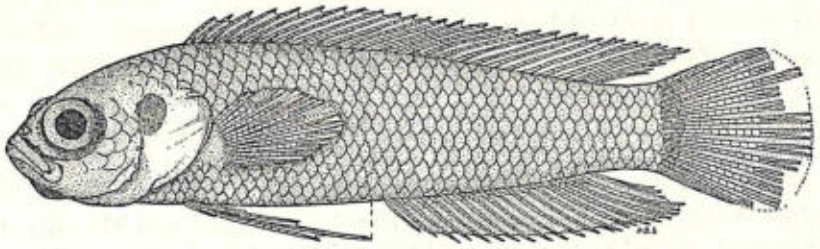

FIGURE 66.—Holotype of *Pseudoplesiops revellei*, new species (U.S.N.M. No. 140696), from Bikini Atoll. (Drawing by Dorothea B. Schultz.)

honor of Commander Roger Revelle, U. S. N. R., who was in charge of oceanographic studies during Operation Crossroads and the Bikini Scientific Resurvey.

PSEUDOPLESIOPS SARGENTI, new species

FIGURE 67

Pseudoplesiops typus (not of Bleeker) FOWLER, U. S. Nat. Mus. Bull. 100, vol. 11, p. 42, 1931 (all Philippine specimens).

Holotype.—U.S.N.M. No. 140683, a specimen 40.3 mm. in standard length, from Bikini Atoll, coral heads eastern end of lagoon, depth 20 to 25 feet, March 26, 1946, S–46–42, Brock and Schultz.

Paratypes.—U.S.N.M. 140684, Rongelap Atoll, Tufa Island, depth 28 feet, July 28, 1946, S–46–300, Herald and Brock, 1 specimen, 45.5 mm; Likiep Atoll, Likiep Island, August 20, 1949, Univ. Washington, 1 specimen, 37 mm. The following paratypes are all from the Philippine Islands, collected by the *Albatross*: U.S.N.M. No. 146515, Caracaran Bay, Batan Island, June 8, 1909; U.S.N.M. No. 146516, Endeavor Straits, December 23, 1908; U.S.N.M. No. 146517, Port Matalvi, Luzon Island, November 23, 1908; U.S.N.M. No. 146518, Rasa Island, April 1, 1909; U.S.N.M. No. 146519, Port Palapag, Samar, June 23, 1909; U.S.N.M. No. 146520, Biri Channel, June 1, 1909; U.S.N.M. No. 146521, Romblon reef, Romblon Island, March 25, 1908.

Description.—Detailed counts and measurements were recorded for the holotype and the paratype, respectively, from Rongelap Atoll. Dorsal rays xvii,9 and xiii,13; anal x,7 and vi,11 (there is considerable variation in number of unbranched and branched rays in the dorsal and anal fins making it more important to list total number of rays); pectoral ii,16–ii,16 and total rays 18–18 in paratype (tips broken off); pelvic I,4–I,4 and I,4–I,4; branched caudal 8+7; scale rows from upper edge of gill opening to base of caudal 38 and 37; scales in a forward ascending row from anal origin to dorsal base 16 and 17; gill rakers on first gill arch 3+1+10 and 3+1+9; (additional counts in table 36).

The following detailed measurements are expressed in thousandths of the standard length, which is 40.3 and 45.5 mm. Head 352 and 356; greatest depth of body 330 and 317; length of snout 74 and 83; diameter of eye 97 and 97; tip of snout to rear edge of maxillary 117 and 132; fleshy interorbital space 41 and 42; postorbital length of head 186 and 191; snout tip to dorsal origin 367 and 358; snout tip to anal origin 616 and 622; anal origin to midbase of caudal fin 416 and 426; least depth of caudal peduncle 161 and 156; length of caudal peduncle 104 and 112; longest ray of pectoral fin 253 and 242, of pelvic — and 363, of caudal 273 and 281, of soft dorsal 233 and 226, of anal 211 and 216. Head 2.8 to 2.9; greatest depth 2.9 to 3.2; snout to anal origin 1.7; length of pelvic fins 2.7 to 3.0; all in standard length. Snout 4.1 to 4.2; eye 3.3 to 3.5; tip of snout to rear edge of maxillary 2.7 to 3.0; fleshy interorbital space 8 to 11; postorbital length of head 1.9 to 2.0; longest ray of pectoral fin 1.4 to 1.5; least depth of caudal peduncle 2.0 to 2.2; all in length of head. Least depth of caudal peduncle in its length 0.6 to 0.7. Scales cycloid, on head and body, lacking on fins except on base of caudal; scales lacking on snout, interorbital space, and jaws; 3 or 4 rows of scales on cheek; 3 pairs of canines at front of premaxillary, then inside a wide band or patch of villiform teeth, becoming a narrow band laterally and bordered externally by a single row of enlarged conical teeth; lower jaw similar; villiform teeth on vomer and palatines; caudal and pectoral fins rounded posteriorly; dorsal, anal, and pelvics posteriorly pointed; last rays of dorsal and anal fins longest; second soft pelvic ray longest, reaching past anal origin; greatest depth of body somewhat behind dorsal origin; maxillary reaches a trifle past a vertical line through front of pupil; gill membranes joined forward at an acute angle and forming a narrow fold across isthmus; interorbital space with an enlarged pair of pores and a series of pores around margin of orbit; pectoral fins without silky rays; no spine on preopercular margin; no lateral lines; pelvics inserted a little in advance of base of pectorals; all rays of dorsal and of anal fins flexible except possibly the first dorsal ray, which appears to be a rudimentary spine in certain speci-

mens; gill rakers short; anterior nostril tubular, separated from posterior one by a wide dermal isthmus; no serrations on opercle; premaxillary protractile; tip of dentary not projecting, or projecting only a trifle, beyond tip of snout.

Color in alcohol.—Plain light brown with the fins a little darker brown; a ring of dark pigment around eye.

Ecology.—This species was taken only among coral heads at depths of 20 to 28 feet in the northern Marshall Islands. It did not occur in shallow water on the reefs.

Remarks.—This new species was described because Bleeker's figures of *Pseudoplesiops typus* show a distinct dorsal lateral line, as does that

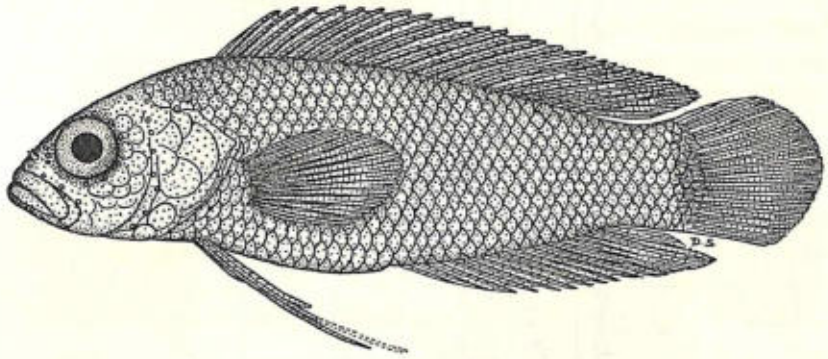

FIGURE 67.—Holotype of *Pseudoplesiops sargenti*, new species (U.S.N.M. No. 140683), from Bikini Atoll. (Drawing by Dorothea B. Schultz.)

of Weber and de Beaufort (The Fishes of the Indo-Australian Archipelago, vol. 5, p. 380, 1929). The latter authors state they have examined one of Bleeker's types of *P. typus*, and in the generic and specific description the dorsal lateral line is mentioned. Since none of our specimens has a lateral line it is necessary to give this species a name. *P. sargenti* may be separated from the other members of the genus by means of the key.

Named *sargenti* in honor of Lt. Comdr. Marsden C. Sargent, U.S.N.R., in charge of biological work on the U. S. S. *Bowditch*.

Genus ACANTHOPLESIOPS Regan

Acanthoplesiops REGAN, Ann. Mag. Nat. Hist., ser. 8, vol. 10, p. 266, 1912 (genotype, *Acanthoclinus indicus* Day); Ann. Mag. Nat. Hist., ser. 8, vol. 12, p. 114, 1913 (key to genera).

ACANTHOPLESIOPS HIATTI, new species

FIGURE 68

Holotype.—U.S.N.M. No. 140758, standard length 16.8 mm., from Rongerik Atoll, Eniwetok Island, ocean reef in surf, June 29, 1946, S-46-241, Schultz and Herald.

TABLE 37.—*Counts recorded for species in the genera* Acanthoplesiops, Acanthoclinus, *and* Belonepterygion

Genera and species	Dorsal spines								Soft dorsal rays			Anal spines							Soft anal rays		Pectoral rays			
	XVIII	XIX	XX	XXI	XXII	XXIII	XXIV	XXV	4	5	6	VIII	IX	X	XI	XII	XIII	XIV	4	5	16	17	18	19
Acanthoplesiops:																								
indicus	-----	-----	-----	[1]XX	-----	-----	-----	-----	X	-----	-----	-----	-----	X	-----	-----	-----	-----	X	-----	X	-----	-----	-----
hiatti	-----	6	2	-----	-----	-----	-----	-----	5	3	-----	3	5	-----	-----	-----	-----	-----	6	2	1	6	6	-----
Acanthoclinus:																								
quadridactylus	-----	1	X	-----	-----	-----	-----	-----	X,1	-----	-----	-----	X,1	-----	-----	-----	-----	-----	X,1	-----	X	X	2	-----
trilineatus	-----	-----	-----	-----	-----	-----	-----	X	X	-----	-----	-----	-----	-----	-----	-----	-----	X	X	-----	-----	-----	-----	X
Belonepterygion:																								
fasciolatum	X	-----	-----	-----	-----	-----	-----	-----	-----	-----	X	-----	-----	X	-----	-----	-----	-----	-----	X	-----	-----	-----	-----

[1] X indicates data recorded from the literature.

Paratypes.—U.S.N.M. No. 140757, collected with the holotype and bearing same data, 3 specimens, 13 to 20.6 mm.; U.S.N.M. No. 140753, Bikini Atoll, Boro Island, reef next to Boro channel, April 6, 1946, S–46–52, Schultz and Brock, 1 specimen, 14 mm.; U.S.N.M. No. 140754, Bikini Atoll, Airy Island, ocean reef in surf, April 16, 1946, S–46–96, Schultz, 1 specimen, 20 mm.; U.S.N.M. No. 140755, Bikini Atoll, ocean reef, on northwest side Oruk Island, August 16, 1946, S–46–382, Herald, 1 specimen, 15.5 mm.; U.S.N.M. No. 140756, Bikini Atoll, Eman Island, ocean reef and in surf, July 19, 1947, S–46–441, Schultz, Brock, Myers, and Hiatt, 1 specimen, 10 mm.; U.S.N.M. No. 141370, Rongelap Atoll, Arbor Island, ocean reef, June 16, 1946, S–46–213, Schultz, 1 specimen, 16 mm.

Description.—Detailed counts and measurements are recorded, first for the holotype then for one paratype, as follows: Dorsal rays

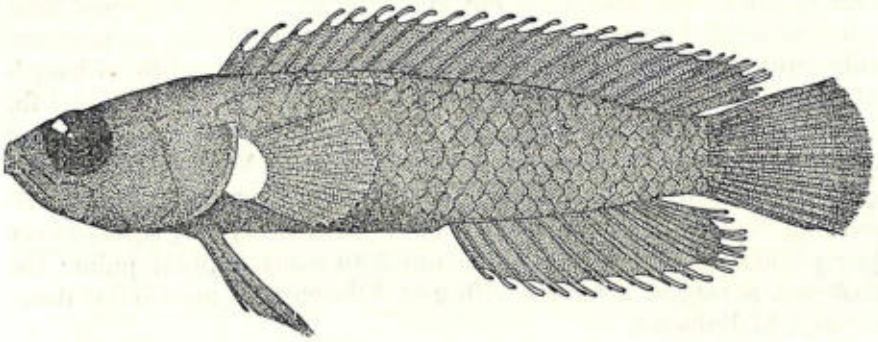

FIGURE 68.—Holotype of *Acanthoplesiops hiatti*, new species (U.S.N.M. No. 140758), from Rongerik Atoll. (Drawing by Aime M. Awl.)

XIX,4 and XIX,5; anal IX,4 and VIII,5; pectoral ii,16–ii,16 and ii,16–ii,16; pelvic I,2–I,2 and I,2–I,2; scale rows from upper edge of gill opening to midbase of caudal fin 29 and 28; scales in forward ascending row from anal origin to dorsal fin base 10 or 11 and 10; dorsal lateral line with 9 to 11 and 11 or 12 pores, with one or two skipped on each side; in another paratype the gill rakers numbered 2+1+6; (for additional counts see table 37). The following measurements are expressed in thousandths of the standard length, which is, respectively, 16.8 and 20.6 mm. Head 321 and 325; greatest depth of body 226 and 252; length of snout 65 and 58; diameter of eye 77 and 78; tip of snout to rear edge of maxillary 149 and 131; fleshy interorbital space 36 and 34; postorbital length of head 179 and 184; snout tip to dorsal origin 316 and 306; snout tip to anal origin 613 and 665; anal origin to midbase of caudal fin 393 and 330; least depth of caudal peduncle 113 and 121; length of caudal peduncle 95 and 97; longest ray of pectoral fin 167 and 151, of pelvic fins 268 and 243, of

caudal 244 and 243; longest soft dorsal ray 167 and 175, anal ray 167 and 204; longest dorsal spine 149 and 160, anal spine 161 and 155.

Scales finely ctenoid, on cheeks, opercle, and on body, but lacking on fins; dorsal and ventral parts of head naked, breast naked; teeth in villiform bands on both jaws, on vomer, and on palatines, but no canines or enlarged conical teeth present; pectoral and caudal fins rounded posteriorly; soft dorsal and anal somewhat pointed posteriorly; few last dorsal and anal spines longest; inner half of first soft pelvic ray longest, reaching not quite to anus; greatest depth of body opposite tips of pectoral fin rays; maxillary reaches to a vertical line through rear of pupil; gill membranes joined over isthmus, forming a broad free fold across it; interorbital space flattish, with an enlarged pair of pores, and several other pores around margin of orbit; anterior nasal opening with a very short tube, posterior one next to orbit, separated from anterior pore by a narrow dermal isthmus; pectoral fin rays not silky; two opercular spines; no preopercular spine; a short dorsal lateral line ending under middle of length of spiny dorsal fin; pelvics inserted a little in front of pectoral fin base; the first XVIII to XX rays of dorsal stiff spines, the last 4 or 5 rays branched soft rays; anal similar but with VIII or IX spines; gill rakers short, not numerous; premaxillary protractile; the ascending median processes reach into interorbital space; tip of lower jaw projecting, the fleshy tips forming an acute angular point; the 20.6-mm. paratype, a female with 2 or 3 dozen eggs measuring about 0.7 mm. in diameter.

Color in alcohol.—General background dark brown to blackish; all median fin rays with tips white, basally brownish black; pelvic fin rays blackish brown with tips white; pectoral fins plain pale; base of pectoral fin with a white spot; a pale band from dorsal surface of snout along dorsal surface of head to dorsal fin origin widest behind orbital region.

Remarks.—This new species may be distinguished from related genera and species with XVIII to XXV dorsal spines and VIII to XV anal spines by the following key:

1*a*. Three lateral lines on the sides; opercle without pungent spines.

2*a*. Dorsal rays XVIII,6; anal X,5; palatines toothless.

Belonepterygion [61] McCulloch

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[61] Genus *Belonepterygion* McCulloch, Mem. Queensland Mus., vol. 3, p. 51, 1915. (Genotype *Acanthoclinus fasciolatus* Ogilby.)

Ernogrammoides Chen and Liang, Quart. Journ. Taiwan Mus., vol. 1, No. 3, p. 32, fig. 1, 1948. (Genotype, *E. fasciatus* Chen and Liang.)

Belonepterygion fasciolatum (Ogilby)

Acanthoclinus fasciolatus Ogilby, Mem. Australian Mus., No. 2, p. 63, pl. 3, fig. 3, 1889, (type locality, Lord Howe Island).

Acanthoclinus litoreus Waite, Rec. Australian Mus., vol. 5, pt. 3, p. 184, 1904 (type locality, Lord Howe Island; color description).—McCulloch, Proc. Linn. Soc. New

2*b*. Dorsal rays XX to XXV,4; anal rays IX to XIV,4; palatines with or without villiform teeth ..... Acanthoclinus [68] Jenyns

1*b*. One lateral line present, incomplete, close to base of spiny dorsal fin, or lateral line may be absent; two pungent opercular spines; palatine teeth present; dorsal rays XVIII to XXI,4 or 5; anal rays VIII to X,4 or 5. Acanthoplesiops Regan

3*a*. Scale rows from upper edge of gill opening to base of caudal fin 40; lateral line absent; dorsal XXI,4; anal X,4; scales cycloid. Acanthoplesiops indicus [70] (Day)

3*b*. Scale rows 28 to 30; dorsal lateral line present with 9 to 13 pores; dorsal rays XIX to XX,4 or 5; anal VIII or IX,4 or 5. Acanthoplesiops hiatti, new species

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South Wales, vol. 35, pt. 2, p. 431, 1915 (Great Barrier Reef, Queensland).—Ogilby, Mem. Queensland, Mus., vol. 2, p. 92, 1913 (Moreton Bay).

Belonepterygion fasciolatum McCulloch, Mem. Queensland Mus., vol. 3, p. 51, 1915 (New Zealand; comparison of species); Mem. Australian Mus., vol. 5, p. 166, 1929 (Lord Howe Island).

Ernogrammoides fasciatus Chen and Liang, Quart. Journ. Taiwan Mus., vol. 1, No. 3, p. 32, fig. 1, 1948 (type locality, Keelung).

[68] Genus *Acanthoclinus* Jenyns, The zoology of the voyage of the H.M.S. *Beagle*, pt. 4, Fish, p. 91, 1842. (Genotype, *Acanthoclinus fuscus* Jenyns.)—Weber and de Beaufort, Fishes of the Indo-Australian Archipelago, vol. 5, p. 372, 1929 (discussion of genera).

Acanthoclinus quadridactylus (Forster)

Blennius quadridactylus Forster, *in* Bloch and Schneider, Systema ichthyologiae, p. 177, 1801 (type locality, New Zealand).

Acanthoclinus fuscus Jenyns, The zoology of the voyage of the H.M.S. *Beagle*, pt. 4, Fish, p. 91, pl. 18, fig. 2, 1842 (type locality, New Zealand).—Bleeker, Verh. Akad. Amsterdam, vol. 2, p. 12, 1855 (Van Diemenland).

Acanthoclinus littoreus Günther, Catalogue of the fishes in the British Museum, vol. 3, p. 298, 1861 (New Zealand).—Hutton, Fishes of New Zealand, p. 34, 1872.—Regan, British Antarctic *Terra Nova* Expedition, 1910, Zool., vol. 1, No. 1, p. 17, 1914 (New Zealand).—Oliver, Trans. New Zealand Inst., vol. 54, p. 510, pl. 42, 1923 (reference copied from Griffin).

Acanthoclinus taumaka Clarke, Trans. New Zealand Inst., vol. 11, p. 293, 1879 (reference copied from Griffin).

Acanthoclinus quadridactylus Phillips, Marine Dept. New Zealand Fisheries Bull. No. 1, p. 49, 1927.

Acanthoclinus trilineatus Griffin

Acanthoclinus trilineatus Griffin, Trans. New Zealand Inst., vol. 63, p. 332, pl. 34, 1933 (type locality, New Zealand).

?*Clinus littoreus* (non Forster) Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 11, p. 389, 1836 (New Zealand).

[70] *Acanthoclinus indicus* Day, The fishes of India, Suppl., p. 798, fig. 1, 1888 (type locality, Colombo; The fauna of British India, vol. 2, p. 325, fig. 105, 1889 (Madras, India).

Family APOGONIDAE: Cardinal Fishes

By Ernest A. Lachner

The characters distinguishing this family have been reviewed and more or less broadly considered by Weber and de Beaufort (Fishes of the Indo-Australian Archipelago, vol. 5, pp. 275–276, 1929) and by Fowler and Bean (U. S. Nat. Mus. Bull. 100, vol. 10, p. 2, 1930). The most recent review of the genera was presented by Schultz (Proc. U. S. Nat. Mus., vol. 88, pp. 403–423, 1940).

Certain genera are only tentatively recognized here, since the phyletic lines are not satisfactorily understood. Certain characters require additional investigation and evaluation in order to establish their stability and position in the scale of organization. The characters of various complex and doubtful genera are evaluated in the discussions that follow the genera in the text.

In view of the restricted occurrence of some characters, it may be convenient in the future to recognize from 3 to 5 subfamilies. If this is undertaken, the following characters are considered important: The presence or absence of canine teeth in the jaws; the anterior position of the vent in the genera *Acropoma* and *Desmoamia* in contrast with its more posterior position in all other genera; the presence or absence of a preopercular spine and membranous flap (present only in *Gymnapogon*); and the presence or absence of a silvery, ventral gland (present only in *Siphamia*).

The Apogonidae, or cardinal fishes, are chiefly small species found in the tropical and subtropical waters of both hemispheres. The tropical Indo-Pacific, with its exceptionally rich fish fauna, has a large population of many of the species. These fishes are chiefly shallow-water, marine forms, but some are found in brackish and fresh water. They are abundant in coral reef areas, and there their exotic colors often blend with those of the environment. The habit of the males of carrying the eggs in the mouth cavity has been observed in some of the species by several authors and appears to be characteristic rather than unusual in this family. The compactly grouped eggs apparently cause the head of the male to become swollen or distorted. In those forms that mature at a small size, such as the species of *Siphamia*, the males have noticeably larger and deeper heads than the females. Of 15 species taken in the Marshall Islands, representing the genera *Apogon*, *Archamia*, *Paramia*, *Cheilodipterops*,

Cheilodipterus, and *Siphamia*, only the males were found exercising oral incubation.

The method of counting and recording the number of gill rakers described in the introductory pages of this bulletin was modified for the genera *Siphamia*, *Apogon*, and *Archamia*. Since the species of *Siphamia* are small (adult specimens studied usually ranged in length between 20 and 30 mm.), it is necessary to remove the arch and make the count under a microscope. The last raker on the lower limb of most of the species of *Siphamia* studied was a tiny, specklike rudiment, and often was not found. It could have been cut off or damaged beyond recognition, although great care was taken in dissecting this limb. The upper limb could be easily dissected and the rudiments could always be counted. For these reasons the developed-raker count only is included in the descriptions of the species of *Siphamia*, but in table 38 it was found useful to include the rudiments in the raker counts for the upper limb. In the genera *Apogon* and *Archamia* it is important to tabulate separately the number of rudiments and the number of developed rakers. The raker counts for these genera are recorded in the following order: For the upper limb the number of rudiments precedes the number of developed rakers and is separated from it by a comma; for the lower limb the rudiment count follows the developed-raker count. Between these is given the raker at the angle, preceded and followed by a plus sign (2,4+1+15,3, or, in terms of total rakers, 6+1+18). A raker was considered developed when its length exceeded the diameter of its base. In most species this distinction could be readily made by superficial examination. In *Apogon exostigma* and closely related forms occasionally two rudiments were found grown together. These united rudiments were counted as one. Gill raker counts for the genus *Apogon* are recorded in table 39.

KEY TO THE GENERA OF APOGONIDAE FROM THE NORTHERN MARSHALL ISLANDS

1*a*. No canine teeth in jaws; villiform teeth present and may have round or pointlike tips.

2*a*. A silvery gland present, extending as a hollow canal from beneath tongue to abdomen, passing on each side of vent and anal fin, and nearly reaching caudal fin on lower part of peduncle..... Siphamia Weber (p. 414)

2*b*. No gland as above.

3*a*. Anal rays II,8 to II,13; dorsal rays VI–I,9 or I,10, or VII or VIII–I,9; vomer with arrangement of villiform teeth ranging from a single row in some species to a broad patch in others; anterior margin of preopercle smooth or serrated; posterior margin of preopercle smooth or serrated; total number of gill rakers range from 14 to 30; lateral line complete or incomplete; caudal fin forked, emarginate, or rounded. Apogon Lacepède (p. 429)

3*b*. Anal rays II,12 to II,18; dorsal rays VI–I,9; vomer with villiform teeth arranged in a single row; anterior margin of preopercle smooth;

posterior margin of preopercle serrated; total number of gill rakers range from 19 to 23; lateral line complete; caudal find emarginate to moderately forked, never rounded---------- Archamia Gill (p. 476)

1*b*. Canine teeth present in jaws.

4*a*. Body with scales; minute sensorylike papillae on head or body almost always absent; no preopercular spine or preopercular membranous flap; maximum size large, most mature specimens over 70 mm. in standard length; body with horizontal stripes, usually intensely developed.

5*a*. Tip of lower jaw on each side of symphysis with 1 or 2 enlarged canine teeth in addition to 2 to 6 canines on each side of jaw; band of villiform teeth in lower jaw present or absent.

6*a*. Villiform teeth in lower jaw in a band, replaced by the canines at each side of symphysis; anterior third of each side of upper jaw with a narrow patch of villiform teeth interrupted by 2 to 4 enlarged canines, posterior two-thirds with a broad patch of villiform teeth---------- Cheilodipterops Schultz (p. 479)

6*b*. No band of villiform teeth in lower jaw; anterior third of each side of upper jaw without narrow patch of villiform teeth, posterior two-thirds as above.

Cheilodipterus Lacepède (p. 481)

5*b*. Tip of lower jaw without enlarged canines but with 2 to 6 canines on each side of jaw; a band of villiform teeth extends from symphysis posteriorly on each side of jaw, interrupted by the enlarged canines---------- Paramia Bleeker (p. 488)

4*b*. Body scaleless; minute papillae present on head or body (except one species) in a network or linear arrangement; a preopercular spine and thin, transparent preopercular membranous flap present (except one species); maximum size probably small, known only by a few specimens of each species, all under 35 mm. in standard length; body without horizontal stripes----- Gymnapogon Regan (p. 490)

Genus SIPHAMIA Weber

Siphamia Weber, Notes Leyden Mus., vol. 31, No. 2, p. 168, 1909. (Genotype, *Siphamia tubifer* Weber.)

Examination of collections in the U. S. National Museum revealed 5 new species. The 13 species now recognized are known only from the Indo-Pacific region. There is no evidence at present to suggest that any species of *Siphamia* occupies a wide geographical range such as is known for certain other members of the family. Considerable endemism is suspected, at least between island groups. Of the 13 species, 4 are known only from the East Indies, 5 from the Philippines, 3 from the Australian faunal area, and 1 from the Marshall Islands.

Table 38 shows the small length attained at maturity, and the differences in length exhibited by species from the Philippine and Marshall Islands. It also shows that sexual dimorphism is developed in varying amounts with different characters. Adult females average larger in size, while adult males have a deeper body and a longer and deeper head, this difference with respect to size and body propor-

TABLE 38.—*Frequency distribution of various characters in mature specimens of* Siphamia

[When the class interval exceeds 1, the numbers, to the next interval, are included.]

Species	Sex	Standard length in millimeters													Body depth in percent of standard length											Head length in percent of standard length												Head depth in percent of standard length [1]								
		20	22	24	26	28	30	32	34	36	38	40	42	44	30	32	34	36	38	40	42	44	46	48	36	38	40	42	44	46	48	50	52	54	56	24	26	28	30	32	34	36	38	40
argentea	♂							1												1																										
	♀				1	1			1	1			1	1					4		1	1						4	2												1	1	3			1
cuprea	♂	2		6	1	1														2	5	2	1							2	2	4		1		1				2	4	3	1
	♀		1	1	2	1													2	2	2							4	2											1	3	1		1
elongata	♂		1	6	1											1	1	3	2								1	1	5		1								2	2	3	1			
	♀				1		3	1	4	1					6	4									9	1											2	6	2						
ovalis	♂			1	1	2														2		1		1					1	2	1											1	3	
	♀					1	1													1	1								1	1											1	1		
versicolor	♂	3	3	1	1														2	3	1								1	3	2		2							1		3	2		
	♀				1		3											1	1	2							1	3												4				
fuscolineata	♂	1	5	1													2		2		2	1				1		1	2	2	1									1		1	1	3	1	
	♀			1	4	2	1									1	4	3									2	3	3										1	6	1				

Species	Gill rakers [2]						Pectoral fin rays							In percent of standard length												In percent of head depth											
	Lower limb [3]				Upper limb [4]									Tip of snout to origin of spiny dorsal fin									Diameter of eye					Diameter of eye										
	6	7	8	9	3	4	10	11	12	13	14	15	16	38	40	42	44	46	48	50	52	54	10	12	14	16	18	32	34	36	38	40	42	44	46	48	50	52	54
argentea	--	3	3	--	--	4	--	--	--	5	--	--	--	--	--	1	4	2	--	--	--	--	3	3	1	--	--	2	--	5	--	--	--	--	--	--	--	--	--
cuprea	--	14	--	--	--	5	--	--	--	--	2	9	1	--	--	--	7	5	2	1	--	1	--	1	9	6	--	--	--	--	--	2	6	1	2	2	--	--	--
elongata	6	10	--	--	3	6	1	10	5	--	--	--	--	4	5	3	5	1	--	--	--	--	7	7	4	--	--	--	--	--	1	3	2	8	2	--	2	--	--
ovalis	--	6	--	--	4	--	--	--	--	--	--	5	1	--	--	--	2	3	1	--	--	--	--	--	4	2	--	--	--	2	1	1	1	--	1	--	--	--	--
versicolor	1	10	1	--	8	1	--	--	--	--	--	6	2	--	1	3	2	5	1	--	--	--	--	3	7	1	1	--	--	--	1	1	2	3	3	1	--	--	--
fuscolineata	--	5	11	1	7	--	--	--	--	4	10	4	--	--	--	4	11	--	1	--	1	--	--	1	9	5	1	--	--	--	--	3	--	5	2	--	6	--	1

[1] Only a few male specimens contained ova in the mouth cavity.

[2] Gill raker at angle of arch not included.

[3] Excluding rudiments.

[4] Including rudiments.

tions being most pronounced in *S. elongata*, n. sp. The swollen head of the males in all species may be entirely associated with buccal incubation. This pronounced dimorphism has not been observed in the larger species of the family.

Frequency distributions of the more significant meristic and proportional characters of species from the Philippine and Marshall Islands are also illustrated by the table. Of these, the number of pectoral fin rays is most important, the 6 species being divisible, more or less, into low, medium, and high categories. Gill raker counts are of interest in illustrating the tendency for some species to develop an extra raker on the upper or lower limb. Extremes are attained in other characters by certain species, such as the size of eye in relation to head depth in *S. argentea*. These characters aid in segregating nearly all specimens.

The lower count of the spinous dorsal (VI), the higher (10) or lower (7 or 8) number of soft dorsal rays, and the more elongate and slender bodies are the salient characters that distinguish the Australian species of this genus (*cuneiceps*, *woodi*, *roseigaster*) and make them a group wholly distinct from those of the East Indies, the Philippines, and the Marshall Islands.

KEY TO THE SPECIES OF SIPHAMIA

1*a*. Dorsal rays VI–I,7; VI–I,8; or VI–I,10.

2*a*. Soft dorsal rays I,7 or 8; anal II,8.

3*a*. Snout long and pointed, 3 times in head; 6 long gill rakers on lower limb of first arch; eye shorter than snout in adults; body with three faint horizontal stripes; middle stripe widest and most evident. Siphamia cuneiceps [71] Whitley

3*b*. Snout conical, over 4 times in head; 14 slender gill rakers on lower limb of first arch; eye longer than snout in adults; body profusely speckled with dark dots---------- Siphamia woodi [72] (McCulloch)

2*b*. Soft dorsal fin rays I,10; anal II,10. Siphamia roseigaster [73] (Ramsey and Ogilby)

1*b*. Dorsal rays VII–I,9.

4*a*. Anal rays II,9; pectoral rays 15; caudal fin truncate; fourth dorsal spine longest; color brownish above to silvery laterally; size larger, type apparently a male with buccal ova, about 50 mm. in standard length---------- Siphamia argyrogaster [74] (Weber)

4*b*. Anal rays II,8; pectoral rays 10 to 16; caudal fin emarginate to moderately forked; third or fourth dorsal spine longest; size smaller, less than 50 mm. in standard length.

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[71] *Siphamia cuneiceps* Whitley, Australian Zool., vol. 10, p. 29, fig. 20, 1941. (Specimens not available for study.)

[72] *Adenapogon woodi* McCulloch, Rec. Australian Mus., vol. 13, No. 4, p. 134, pl. 21, fig. 3, 1921.

[73] *Apogon roseigaster* Ramsey and Ogilby, Proc. Linn. Soc. New South Wales, vol. 2, p. 1101, 1886.

[74] *Apogon argyrogaster* Weber, Notes Leyden Mus., vol. 31, p. 159, 1909.

5*a*. Body silvery to light tan, lacking horizontal stripes and spotting; pectoral fin rays range from 10 to 13.

6*a*. Second spine of spinous dorsal about three-fourths to four-fifths length of third spine; pectoral rays range from 10 to 12.
Siphamia elongata, new species

6*b*. Second spine of spinous dorsal one-half length of third spine, or less; pectoral rays range from 12 to 13.

7*a*. Lateral line incomplete on caudal peduncle; pectorals with 13 rays; body silvery on belly to yellowish laterally and dorsally; free edge of preopercle slants ventrocaudally; mouth very oblique, angle between line along upper jaw and horizontal through middle of eye and midbase of caudal fin about 48 degrees; caudal emarginate, lobes rounded; fourth dorsal spine longest---------- Siphamia fistulosa [15] (Weber)

7*b*. Lateral line complete; pectorals with 12 rays; body silvery below to yellowish above with faint body mottling or bands; free edge of preopercle slants ventrocaudally; mouth moderately oblique, angle between line along upper jaw and horizontal through middle of eye and midbase of caudal fin about 35 degrees; caudal fin deeply incised with pointed lobes; third dorsal spine apparently equal to fourth spine.
Siphamia tubulata [16] (Weber)

7*c*. Lateral line complete; pectorals with 13 rays; body silvery on belly, varying to yellow-brown on dorsal side; no evidence of mottling or banding; some faint dark spots present at origin of spinous dorsal and at origin and posterior base of soft dorsal; free edge of preopercle nearly vertical or slants slightly ventroanteriorly; mouth oblique, angle between line along upper jaw and horizontal through middle of eye and midbase of caudal fin ranging from 42 to 48 degrees; caudal fin emarginate; third dorsal spine slightly longer than fourth spine---------- Siphamia argentea, new species

5*b*. Body with one to three tan to dusky horizontal stripes, with or without black spotting on body and head, or if stripes are absent, body and head copperish; pectoral fin rays 13 to 16.

8*a*. Body and head deep bronze to copperish; sometimes a faint copperish horizontal median stripe is present, passing through eye, and bordered above and below by silvery bands; median copper stripe on body at a point just beyond head wider than silvery band bordering it dorsally; no spotting on snout; body sometimes with diffuse pepperlike pigmentation but no black spotting; no black pigmentation on body at base of spinous and soft dorsal; stripe on middorsal side absent.

9*a*. Second spine of spinous dorsal about two-thirds length of third spine; rays and membranes of spinous dorsal, soft dorsal, and anal fins uniformly clear to light brown; pectoral rays

[15] *Foa fistulosa* Weber, Notes Leyden Mus., vol. 31, p. 162, 1909. (Specimens not available for study.)

[16] *Apogon tubulatus* Weber, Notes Leyden Mus., vol. 31, p. 160, 1909.

14; anal rays II,8 to 9; body less deep, about 2.6 in standard length---------- Siphamia tubifer [77] (Weber)

9*b*. Second spine of spinous dorsal one-half length of third spine; basal portion of dorsal spines dark brown with small fine dusky spots; basal portion of soft rays of dorsal and anal fins with dark brown coloration, the membrane light brown; pectoral fin rays 14 to 16, average 15; anal rays II,8; body deeper, 1.9 to 2.5, average 2.2, in standard length.

Siphamia cuprea, new species

8*b*. Body and head silvery to light dusky brown; horizontal stripes on body well developed, most evident stripe passes through middle of eye and midside of body, this stripe usually narrower than silvery stripe bordering it dorsally.

10*a*. Median stripe on body dusky; black pigmentation surrounding base of spinous and soft dorsal; pectoral rays range from 13 to 15, average 14; developed gill rakers on lower limb range from 7 to 9, average 7.7; fins transparent to whitish.

Siphamia fuscolineata, new species

10*b*. Median stripe on body brown to tan; no black pigmentation surrounding base of dorsal fin, this area silvery to light brown; pectoral rays range from 15 to 16, average 15.2; developed gill rakers on lower limb range from 6 to 8, average 7; fins with pepperlike spots, especially dorsals; spinous dorsal light brown; all fins never whitish to transparent.

11*a*. Snout with black spots (easily seen with unaided eye), body with pronounced black spotting in more or less regular horizontal rows, sometimes not well developed in adult females; contour of snout more conical, upper jaw more horizontal, angle between line along upper jaw and line through middle of eye to midbase of caudal fin ranges from 32 to 45 degrees; stripes on body dusky brown, more diffuse in larger specimens; body depth less, males 38 to 42, average about 39, in percent of standard length; females 36 to 40, average about 38; head depth at occiput less in percent of standard length, males 30 to 36, average 34, females 32.

Siphamia versicolor [78] (Smith and Radcliffe)

11*b*. Snout and body with minute, scattered, blackish pepperlike spots (barely visible with unaided eye); contour of snout less conical, more bluntly rounded, upper jaw more oblique, angle between line along upper jaw and line through middle of eye to midbase of caudal fin ranges from 50 to 55 degrees; stripes on body tan to light brown, sharply defined; body depth greater, males 40 to 48, average 43, in percent of standard length, females 40 to 42, average 41; head depth at occiput greater in percent of standard length, males 36 to 38, average 37.5, females 34 to 36, average 35.

Siphamia ovalis, new species

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[77] *Siphamia tubifer* Weber, Notes Lyden Mus., vol. 31, p. 168, 1909. (Specimens not available for study.)

[78] *Amia versicolor* Smith and Radcliffe, Proc. U. S. Nat. Mus., vol. 41, p. 257, fig. 3, 1911 (type locality, Canmahala Bay, Luzon). The original description chiefly concerns the holotype, and the discussion on the variability of color and form of the body involves data from specimens representing more than one species (see fig. 69).

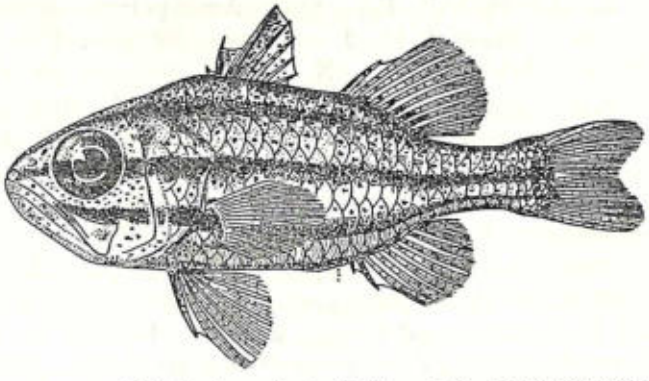

FIGURE 69.—Holotype of *Siphamia versicolor* (Smith and Radcliffe) (U.S.N.M. No. 68401), from Masbate Island, P. I.

SIPHAMIA ELONGATA, new species

FIGURE 70

Amia versicolor SMITH and RADCLIFFE, Proc. U. S. Nat. Mus., vol. 41, pp. 257–259, fig. 3, 1911 (in part).

Siphamia versicolor FOWLER and BEAN, U. S. Nat. Mus. Bull. 100, vol. 10, pp. 142–144, 1930 (in part).

Holotype.—U.S.N.M. No. 112045, Canmahala Bay, between Burias and Luzon, March 11, 1909, *Albatross*, 1 female, 36 mm. standard length.

Paratypes.—U.S.N.M. No. 112099, from same collection and bearing same data as holotype, 32 specimens, 16 to 36 mm. U.S.N.M. No. 112096, Jolo Light, S. 17° E., 5.5 miles (6°09′ N., 120°58′ E.) Sulu Archipelago, February 15, 1908, *Albatross* Station 5151, 1 specimen, 24 mm. U.S.N.M. No. 112097, Jolo Light, S. 50° W., 3.4 miles

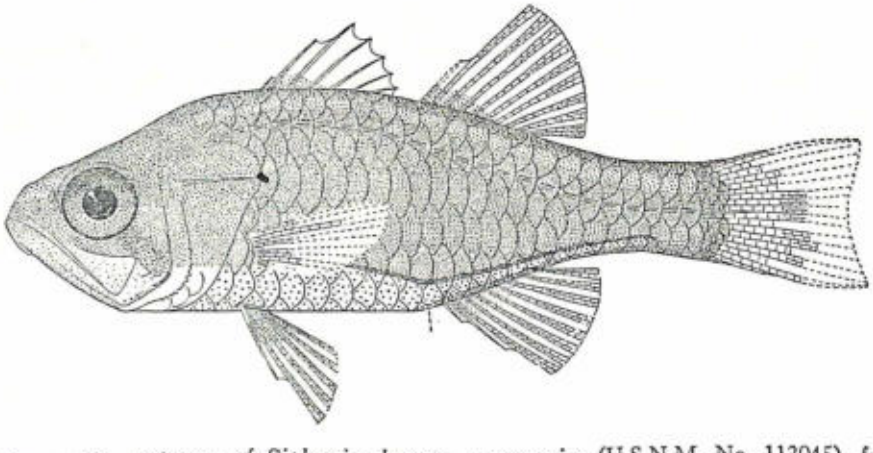

FIGURE 70.—Holotype of *Siphamia elongata*, new species (U.S.N.M. No. 112045), from Canmahala Bay, between Burias and Luzon Islands, P. I. (Drawing by Aime M. Awl.)

(6°05′50″ N., 121°02′15″ E.) Sulu Archipelago, February 15, 1908, *Albatross* Station 5142, 1 specimen, 32 mm. U.S.N.M. No. 112095, Sibutu Island (S. E.), N. 38° E., 8 miles (4°32′15″ N., 119°22′45″ E.) Sulu Archipelago, February 27, 1908, *Albatross* Station 5169, 1 specimen, 24 mm. U.S.N.M. No. 112098, Tagola Light, S. 83° W., 10.5 miles (8°45′30″ N., 123°33′45″ E.) Mindanao Sea, August 9, 1909, *Albatross* Station 5517, 1 specimen, 31 mm.

Description.—Based on the holotype and paratypes listed above. Counts are recorded for the holotype, followed in parentheses by the range of data from seven paratypes. Measurements, expressed in thousandths of the standard length, are recorded for the holotype, followed in parentheses by data, respectively, from three paratypes (a female, 31 mm. in standard length, a female, 26.5 mm., and a male, 26.5 mm.). When data for the paratypes are identical with that of the holotype, but one number is given.

Dorsal rays VII–I,9; anal rays II,8; pectoral rays 11; vertical scale rows 23 (22 to 23); scale rows above lateral line 2, below lateral line 6 (5 to 6).

Greatest body depth 320 (306, 320, 377); head length 361 (370, 377, 435); head depth at occiput 250 (275, 283, 340); length of caudal peduncle 222 (242, 226, 226); least depth of caudal peduncle 125 (129, 113, 113); length of longest pectoral ray (about 194); length of third spine of spinous dorsal 167 (—, 151, 169); length of second spine of anal 111 (—, 113, 132); diameter of eye 111 (113, 113, 132); length of upper jaw 208 (210, 226, 246); length of snout 83 (97, 94, 113); least width of bony interorbital 97 (97, 94, 132); tip of snout to origin of spinous dorsal fin 404 (370, 396, 452); tip of snout to origin of anal fin 638 (646, 642, 642); tip of snout to insertion of pectoral fins 377 (356, 358, 435); tip of snout to insertion of pelvic fins 376 (356, 377, 416); tip of snout to center of anus (580, 584, 641); developed gill rakers 1+1+7 (1+1+6, or 1+1+7).

First spine of spinous dorsal about one-fourth to one-third length of second spine, second about three-fourths to four-fifths as long as third; jaws, vomer, and palatines with villiform teeth; posterior margin of preoperculum serrated; scales ctenoid; ctenii usually in a single row on posterior edge of scale, sometimes with an incomplete row before posterior edge, near median portion of scale; genital papillae short and pointed; upper jaw reaches or passes just beyond vertical drawn through middle of eye; angle between line along upper jaw and horizontal through midbase of caudal fin and center of eye about 28 to 40 degrees; snout short, rounded in males, somewhat pointed in females; longest gill raker about 1.8 to 2 times longer than longest filaments, 1.7 to 2.2 in eye; rakers long and slender, tapering

nearly to a pointed tip; peritoneum silvery with black pigment spots; operculum with one spine; lateral line complete.

Body somewhat compressed laterally, greatest body depth more than 2 times greatest width; sexual dimorphism pronounced with respect to size; females exceed males in length (5 largest females average 33.6 mm., 13 mature females range from 24.5 to 35.5 mm., 5 largest males average 25.9, 15 mature males—8 with eggs in mouth cavity—range from 23.5 to 27 mm.); females with body less deep (7 largest females average 318 in standard length, range 294 to 343, 6 largest males average 360, range 333 to 378); least width of bony interorbital narrower in females (7 females average 109 in standard length, range 97 to 118, 6 males average 131, range 111 to 143); least depth of caudal peduncle greater in females (7 females average 134, range 125 to 143 in standard length, average 416, range 376 to 454 in body depth; 6 males average 127, range 113 to 144 in standard length, average 353, range 300 to 400 in body depth).

Color in alcohol.—Body and head brownish above, becoming silvery to brown laterally; cheeks and opercles silvery; silvery gland extending from area beneath tongue onto belly, dividing before vent, and passing to ventrolateral portion of caudal peduncle; some small, diffuse, scattered brownish pigment spots over gland; slight traces of perhaps vertical banding (silvery to brown) in males; a diffuse light-brown bar near base of pelvic fins; other fins transparent; some blackish pigmentation just at dorsal edge of silvery gland on caudal peduncle; a dark diffuse brownish blotch at origin and posterior bases of spinous and soft dorsal fins; a diffuse brownish nearly vertical bar below eye.

Remarks.—Named *elongata* because of its comparatively slender body.

SIPHAMIA ARGENTEA, new species

FIGURE 71

Amia versicolor SMITH and RADCLIFFE, Proc. U. S. Nat. Mus., vol. 41, pp. 257–259, fig. 3, 1911 (in part).

Siphamia versicolor FOWLER and BEAN, U. S. Nat. Mus. Bull., 100, vol. 10, pp. 142–144, 1930 (in part).

Holotype.—U.S.N.M. No. 112042, Balabac Light, S. 61° W., 16.6 miles (8°08′10″ N., 117°19′15″ E.), North Balabac Strait, Philippine Islands, January 5, 1909, *Albatross* Station 5356, 1 specimen, 41.5 mm. standard length.

Paratypes.—U.S.N.M. No. 112088, Jolo Light, E. 2.6 miles (6° 03′45″ N., 120°57′ E.) vicinity of Jolo, Sulu Archipelago, March 5, 1908, *Albatross* Station 5174, 3 specimens, 32 to 43.5 mm.; U.S.N.M. No. 112089, Jolo Light, S. 61° E., 1.3 miles (6°06′ N., 120°58′50″ E.)

vicinity of Jolo, Sulu Archipelago, February 14, 1908, *Albatross* Station 5137, 2 specimens, 20.5 and 28 mm.; U.S.N.M. No. 112087, Jolo Light, S. 16° E., 0.85 mile (6°04′30″ N., 120°59′30″ E.) vicinity of Jolo, Sulu Archipelago, February 15, 1908, *Albatross* Station 5145, 1 specimen, 34.5 mm.; U.S.N.M. No. 112090, Antonia Island (S.) N., 43° W., 3.7 miles (11°30′40″ N., 123°23′20″ E.) off eastern Panay Island, March 27, 1908, *Albatross* Station 5182, 1 specimen, 25.5 mm.

Description.—Based on the holotype and paratypes listed above. Counts and measurements are recorded for the holotype, followed in

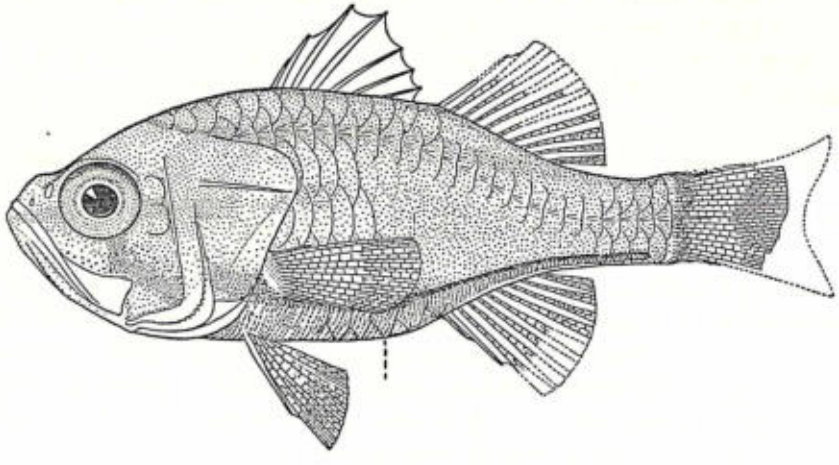

FIGURE 71.—Holotype of *Siphamia argentea*, new species (U.S.N.M. No. 112042), from North Balabac Strait, P. I. (Drawing by Aime M. Awl.)

parentheses by data from three paratypes (U.S.N.M. No. 112088), their standard length ranging from 32 to 43.5 mm. Measurements are expressed in thousandths of the standard length. The range of counts for the paratypes are given, but if identical with that of the holotype, but one number is recorded.

Dorsal rays VII–I,9; anal rays II,8; pectoral rays 13; vertical scale rows about 23; scale rows above lateral line 2, below lateral line 5 (5 to 6).

Greatest body depth 422 (391 to 406); head length 422 (402 to 454); head depth at occiput 338 (321 to 345); length of caudal peduncle 229 (230 to 234); least depth of caudal peduncle 132 (104 to 125); length of longest pectoral ray 241 (188 to 217); length of third spine of spinous dorsal 180 (172 to 189); length of second spine of anal 108 (103 to 125); diameter of eye 120 (108 to 125); length of upper jaw 253 (206 to 235); length of snout 108 (92 to 121); least width of bony interorbital 108 (104 to 125); tip of snout to origin of spinous dorsal fin 435 (434 to 452); tip of snout to origin of anal fin 676 (666 to 705); tip of snout to insertion of pectoral fins 385 (379 to 433); tip of snout to insertion of

pelvic fins 410 (391 to 428); tip of snout to anal opening 614 (599 to 610); developed gill rakers (1+1+7 or 1+1+8).

First spine of spinous dorsal about one-third length of second spine, second almost one-half as long as third; jaws, vomer, and palatines with villiform teeth; posterior margin of preoperculum serrated; scales ctenoid, usually a single row of ctenii at posterior margin of scale; ctenii fairly well developed and comparatively strong, on some scales developed only on posterior margin near midpart of scale; genital papilla short and conical, less than one-fourth length of first spine of anal fin; upper jaw reaches vertical drawn through middle of eye; angle between line along upper jaw and horizontal through midbase of caudal fin and center of eye, about 42 to 48 degrees; snout short; body compressed laterally; lateral line complete; longest gill rakers about 1.9 to 2 times longer than longest filaments, 1.5 to 1.9 in eye, with denticulations on the inner edge; gill rakers, long, slender, tapering from base to tip; peritoneum silvery, with small black pigment spots; operculum with one spine; eye in depth of head at occiput 2.8 to 3.1; largest female 43.5 mm., largest male 32 mm.

Color in alcohol.—Body and head of uniform light brown above, becoming more silvery and iridescent laterally; cheeks and opercles silvery to light tan; prominent silvery gland under tongue, on breast and belly, dividing before vent and extending on ventrolateral part of caudal peduncle; pigmentation on gland light brown, irregularly arranged on belly and tending to form somewhat parallel lines on caudal peduncle, directed toward midventral region. A little dark-brown pigmentation on body at origin of spinous dorsal, at origin of soft dorsal, and at posterior base of soft dorsal.

Remarks.—Named *argentea* in reference to the silvery lateral body color.

SIPHAMIA CUPREA, new species

FIGURE 72

Amia versicolor SMITH and RADCLIFFE, Proc. U. S. Nat. Mus., vol. 41, pp. 257–259, fig. 3, 1911 (in part).

Siphamia versicolor FOWLER and BEAN, U. S. Nat. Mus. Bull. 100, vol. 10, pp. 142–144, 1930 (in part).

Holotype.—U.S.N.M. No. 112043, Philippine Islands, Cataingan Bay, Masbate Island, April 18, 1908, *Albatross*, male specimen, 23.5 mm. in standard length.

Paratypes.—U.S.N.M. No. 112094, from same collection and bearing same data as holotype, 34 specimens, 16 to 29 mm.; U.S.N.M. No. 112093, Pangasinan Island, vicinity of Jolo, February 13, 1908, *Albatross*, 2 specimens, 27 and 28 mm.; U.S.N.M. No. 112091, Jolo Light, S. 19° E., 2.5 miles (6°06′ N., 120°58′50″ E.) February 14, 1908, *Albatross* sta-

tion 5138, 2 specimens, 24 and 27 mm.; U.S.N.M. No. 112092, Usada Island, south end, vicinity of Jolo, March 5, 1908, *Albatross*, 2 specimens, 24 and 28 mm.

Description.—Based on the holotype and paratypes listed above. Counts are recorded for the holotype, followed in parentheses by the range of data from five paratypes. Measurements, expressed in thousandths of the standard length, are recorded for the holotype, followed in parentheses by the range of data from 15 paratypes, 9 males 20 to

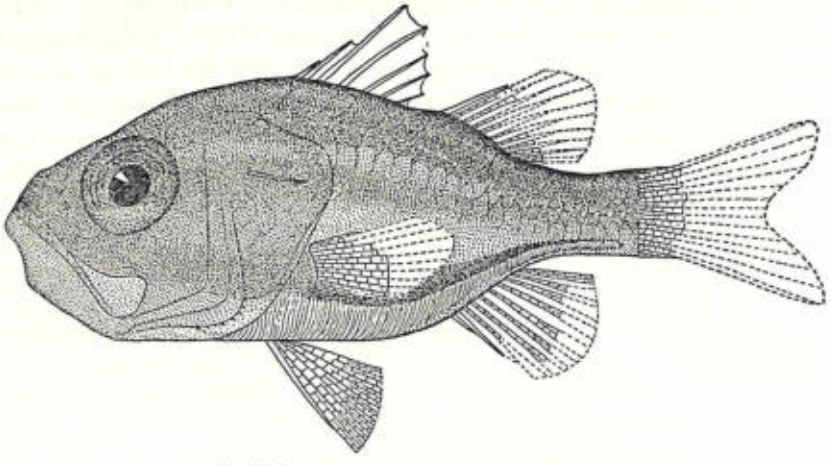

FIGURE 72.—Holotype of *Siphamia cuprea*, new species (U.S.N.M. No. 112043), from Masbate Island, P. I. (Drawing by Aime M. Awl.)

27.5 mm. in standard length and 6 females 21 mm. to 29 mm., with or without sexes separated.

Dorsal rays VII–I,9 (VII–I,9); anal rays II,8 (II,8); pectoral rays 14 (14 to 15); vertical scale rows 24 (21 to 23); scale rows above lateral line 2 (2), below lateral line 6 (6).

Greatest body depth 426 (males, 400 to 459; females 390 to 420); head length 532 (439 to 521; 406 to 442); head depth at occiput 383 (355 to 383; 333 to 372); length of caudal peduncle 213 (180 to 208; 185 to 241); least depth of caudal peduncle 128 (106 to 146; 111 to 130); length of longest pectoral ray about 256 (—); length of third spine of spinous dorsal 192 (both sexes, 167 to 224); length of second spine of anal fin 106 (both sexes, 60 to 95); diameter of eye 149 (145 to 170; 130 to 167); length of upper jaw 276 (236 to 318; 238 to 255); length of snout 128 (77 to 120; 92 to 103); least width of bony interorbital 106 (both sexes, 93 to 120); tip of snout to origin of spinous dorsal fin 468 (442 to 540; 440 to 483); tip of snout to origin of anal fin 690 (both sexes, 690 to 720); tip of snout to insertion of pectoral fins 468 (379 to 521); tip of snout to insertion of pelvic fins 467 (357 to 458); developed gill rakers (1+1+7).

First spine of spinous dorsal about one-fifth length of second spine, second about two-fifths to one-half length of third; jaws, vomer, and palatines with villiform teeth; posterior margin of preoperculum serrated; scales ctenoid; ctenii usually in a single row at posterior margin of scale, absent on many scales; genital papillae small and pointed; upper jaw reaches or passes just beyond vertical drawn through middle of eye; angle between line along upper jaw and horizontal through middle of eye and midbase of caudal fin about 28 to 45 degrees; lateral contour of snout rounded; longest gill raker 1.7 to 2 times longer than longest filament, about 2 in eye; rakers slender and taper toward tip; inner edge of raker with small denticulations; peritoneum silvery, densely brownish spotted; operculum with one spine; lateral line complete.

Color in alcohol.—Head and body copperish brown. Some specimens have two faint silvery copper stripes on body, separated by a copperish median stripe, its width equal to diameter of pupil; opercles, cheeks, and snout copperish; chin light copper with a few diffuse dusky brown spots; gland silvery copper with border on body edged in copperish to red; fine, dusky-brown, irregular striae on gland directed toward midbelly line; membrane of spinous and soft dorsal transparent to light brown, rays and spines brown; spines of spinous dorsal with some small darker brown spots; pectorals transparent; membranes of pelvic, anal, and caudal fins transparent to whitish, the rays transparent to light brown; base of caudal with two light brown, more or less round spots, just above and below midbase of fin.

Remarks.—The sexual dimorphism (females attain the larger size) may be significant. The four largest males average 25.5 mm., four largest females average 27 mm.

Named *cuprea* in reference to its copperish brown color.

SIPHAMIA FUSCOLINEATA, new species

FIGURE 73

Holotype.—U.S.N.M. No. 142231, Bikini Lagoon, 4 miles south of Bikini Island, April 25, 1946, S–46–115, Morrison and Ladd, 1 specimen, 22 mm. in standard length.

Paratypes.—U.S.N.M. No. 142281, from same collection and bearing same data as holotype, 37 specimens, 13 to 28 mm.; U.S.N.M. No. 142282, Bikini Island, 4 miles south of west end, April 25, 1946, Morrison, 16 specimens, 13 to 29 mm.

Description.—Based on the holotypes and paratypes listed above. Counts and measurements are recorded for the holotype followed by data in parentheses for three paratypes from the same locality as the holotype; a juvenile, 15.5 mm.; a male, 22.5 mm.; and a female, 27 mm. Measurements are expressed in thousandths of the standard length.

The range of counts for the paratypes is given, and if identical with holotype, but one number is recorded. Specific data for each specimen, in the size sequence presented above, is recorded for the measurements.

Dorsal rays VII–I,9; anal rays II,8; pectoral rays 14 (13 to 15); vertical scale rows (about 23); scale rows above lateral line (2).

Greatest body depth 410 (387, 377, 340); head length 500 (450, 467, 447); head depth at occiput 386 (354, 377, 297); length of caudal peduncle 227 (257, 222, 222); least depth of caudal peduncle 113 (129, 111, 111); length of longest pectoral ray 208 (—, 178, 167); length of longest (third) spine in spinous dorsal 208 (161, —, 185); length of second spine of anal 114 (—, 88, 111); diameter of eye 159 (161, 155, 129); length of upper jaw 297 (225, 244, 222); length of snout 136 (100, 111, 111); least width of bony interorbital 91 (97, 88, 93); tip of snout to origin of spinous dorsal fin 524 (450, 444, 446); tip of snout to origin of anal fin 704 (710, 690, 666); tip of snout to insertion of pectoral fins 454 (387, 400, 370); tip of snout to insertion of pelvic fins 476 (420, 444, 406); tip of snout to anal opening 658 (645, 645, 628); developed gill rakers 1 + 1 + 8 (1 + 1 + 8).

Fins frayed at edges, their contours not determinable; first spine of spiny dorsal about one-fifth length of second spine; second spine of spiny dorsal about one-half as long as third spine; jaws, vomer, and palatines with villiform teeth; posterior margin of preoperculum serrated; scales ctenoid, apparently in a single row at posterior margin of scale; ctenii often absent (probably due to erosion or friction; these specimens lack scales over most of the body); genital papillae conical, tapering to a point, about one-third length of first spine of anal fin; upper jaw touches or passes just beyond vertical drawn through middle of eye; angle between line along upper jaw and horizontal through midbase of caudal fin and center of eye about 40 to 50 degrees; snout short; body laterally compressed; lateral line apparently complete; longest gill rakers about 2 to 2.2 times longer than longest filaments, 1.8 to 2 in eye, with fairly prominent denticulations on the inner edge; gill rakers slender, taper considerably from base to tip; tips of rakers nearly pointed; peritoneum silvery with black pigment spots; operculum with one spine; females probably exceed males in size, largest female (gravid), 3 specimens, 26 to 28 mm.; males, 3 specimens, with eggs in mouth cavity, 21 to 22 mm.

Color in alcohol.—Body light brownish over a silvery background; silvery gland beneath tongue, on breast, dividing before vent and extending on lower portion of caudal peduncle; gland with numerous blackish small lines directed toward a line along midbelly region; a prominent brown median stripe; its width about 2⅓ to 2¾ in eye, extending from near tip of snout through middle of eye and to midbase of caudal fin; a fainter and narrower brown stripe, variable in

width and intensity, sometimes almost absent, located dorsolaterally, beginning just above eye and extending to rear base of soft dorsal fin; a third stripe, almost as wide as median stripe, blackish brown, extending from head, below eye, on lower cheeks and opercles through bases of pectorals and on body bordering edge of silvery gland, becoming obscure as body narrows in the caudal peduncle area, variable in size, sometimes faintly developed or absent; chin and branchiostegals vary from transparent white to scattered brownish black; characteristic

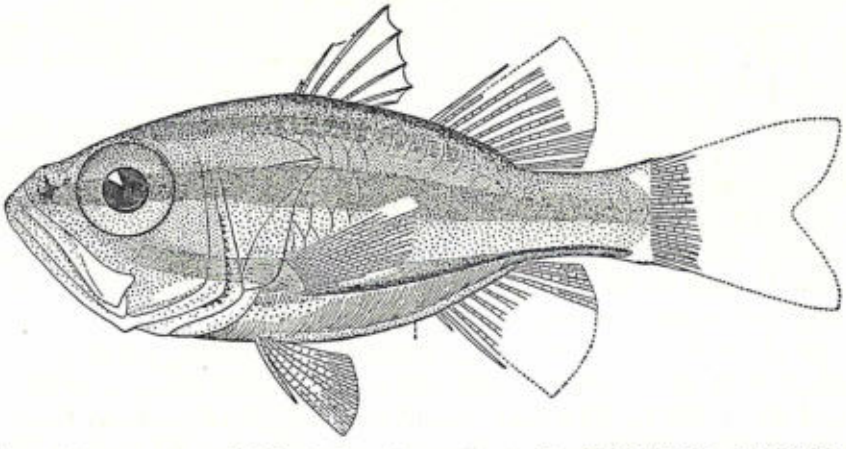

FIGURE 73.—Holotype of *Siphamia fuscolineata*, new species (U.S.N.M. No. 142231), from Bikini lagoon. (Drawing by Aime M. Awl.)

blackish pigmentation surrounding dorsal fin, sometimes passing on dorsal portion of caudal peduncle; a concentration of blackish pigmentation at edge of silvery gland on body and caudal peduncle; base of pelvics blackish; some blackish pigment spots before vent, surrounding vent and at base of anal fin; all fins translucent white.

Ecology.—This species was not seen in the shallow reef waters of the tidal zone but was taken in the lagoon in deep water among corals by means of a small dredge.

Remarks.—The name *fuscolineata* refers to the dark brown stripes on the body.

SIPHAMIA OVALIS, new species

FIGURE 74

Amia versicolor SMITH and RADCLIFFE, Proc. U. S. Nat. Mus., vol. 41, pp. 257–259 fig. 3, 1911 (in part).

Siphamia versicolor FOWLER and BEAN, U. S. Nat. Mus. Bull. 100, vol. 10, pp. 142–144, 1930 (in part).

Holotype.—U.S.N.M. No. 112044, Philippine Islands, Bubuan Island, Mindoro Sea (6°08′45″ N., 121°03′ E.), February 14, 1908, *Albatross*, 1 specimen, 28 mm. in standard length.

Paratypes.—U.S.N.M. No. 112101, from same collection as holotype and bearing same data, 3 specimens, 23.5 to 28 mm.; U.S.N.M. No. 112100, Sirun Island, N. 39° E., 2.40 miles (5°33′ N., 120°42′10″ E.) Sulu Archipelago, *Albatross*, station 5149, February 18, 1908, 2 specimens, 29 and 30.5 mm. in length.

Description.—Based on the holotype and paratypes listed above. Measurements, expressed in thousandths of the standard length, are recorded for the holotype, followed by the range of data for the paratypes, in parentheses. Counts are similarly recorded.

Dorsal rays VII–I,9 (VII–I,9); anal rays II,8 (II,8); pectoral rays 15 (15); vertical scale rows 23 (23); scale rows above lateral line 2 (2), below lateral line 6? (6?).

Greatest body depth 483 (405 to 446); head length 483 (463 to 464); head depth at occiput 394 (370 to 394); length of caudal peduncle 215 (192 to 232); least depth of caudal peduncle 125 (125 to 130); length of longest pectoral ray 232 (222 to 234); length of longest (third) spine in spinous dorsal 161 (148 to 192); length of second spine in anal fin 89 (108 to 111); diameter of eye 143 (143 to 149); length of upper jaw 250 (250 to 259); length of snout 161 (161 to 170); least width of bony interorbital 107 (93 to 107); tip of snout to origin of spinous dorsal fin 446 (462 to 481); tip of snout to origin of anal fin 77 (69 to 72); tip of snout to insertion of pectoral fins 446 (425 to 463); tip of snout to insertion of pelvic fins 463 (406 to 446); tip of snout to anal opening 69 (61 to 68); developed gill rakers 1+1+7 (1+1+7).

Fins frayed at edges, their exact contours and size not determinable; first spine of spiny dorsal one-fifth length of second spine; second about one-half as long as third; jaws, vomer, and palatines with villiform teeth; posterior margin of preoperculum serrated; scales ctenoid, ctenii in a single row at posterior margin of scale; absent on many scales; genital papillae elongate and pointed, about two-thirds as long as first spine of spiny dorsal; upper jaw touches vertical drawn through middle of eye; angle between line along upper jaw and horizontal through midbase of caudal and center of eye 50 to 55 degrees; snout rounded; head and body deep; body slab sided, oval; lateral line complete; longest gill rakers about 1.2 to 1.5 times longer than longest filaments, 2.5 in eye, with tiny denticulations on the inner edge, tapering only slightly from base to tips, tips blunt and rounded; peritoneum silvery with black pigment spots; operculum with one spine.

Color in alcohol.—Head and body with a silvery cast; silvery gland with brownish striations almost perpendicular to line along midventral area; dorsal portion of head and body light brown; three

narrow, brown, lateral stripes on head and body; median body stripe just behind head only half as wide as silvery bands bordering it; dorsolateral stripe begins on snout, passing over eye and extending dorsolaterally to area of last ray of dorsal fin, where it joins stripe from opposite side to form a dorsal caudal peduncle stripe, and ending at first procurrent caudal ray; middle stripe begins on snout, passing through middle of eye, on cheeks and opercles, extending medially

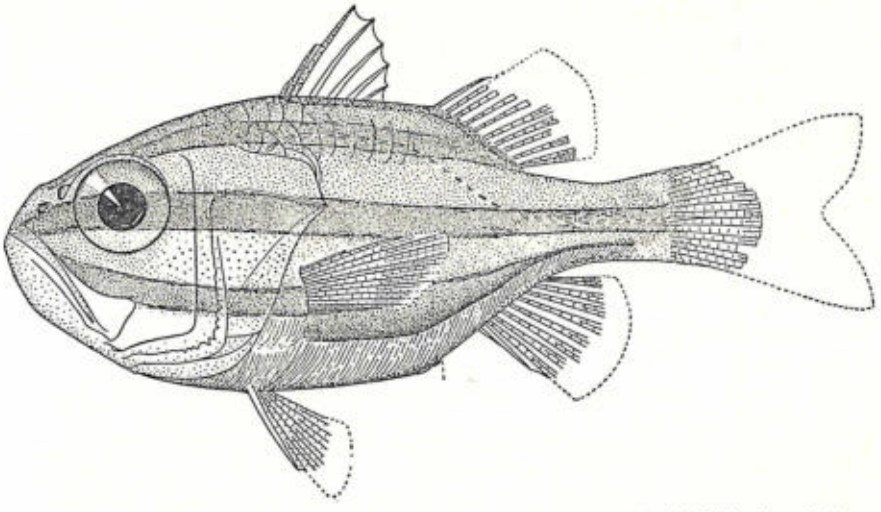

FIGURE 74.—Holotype of *Siphamia ovalis*, new species (U.S.N.M. No. 112044), from Bubuan Island, P. I. (Drawing by Aime M. Awl.)

to base of caudal fin; ventrolateral stripe begins on snout about middle of maxillary, extends over lower cheeks and opercles bordering upper edge of ventral gland, becoming narrow and indistinct on caudal peduncle; head and body pigmented with tiny, fine black flecks; some black pigmentation before, around, and behind vent; anterior portion of spiny dorsal brownish; some black pepperlike spots on pelvics; other fins transparent.

Remarks.—Named in reference to the deep, oval-shaped body.

Genus APOGON Lacepède

Apogon LACEPÈDE, Histoire naturelle des poissons, vol. 3, p. 411, 1802. (Genotype, *Apogon ruber* Lacepède.)

Papillapogon SMITH, The sea fishes of southern Africa, p. 209, 1949. (Genotype, *Apogon auritus* Cuvier and Valenciennes.)

Apogonichthyoides SMITH. The sea fishes of southern Africa, p. 209, 1949. (Genotype, *Amia uninotata* Smith and Radcliffe.)

For a list of synonyms for *Apogon* see Schultz (Proc. U. S. Nat. Mus., vol. 88, pp. 409–412, 1940). To these must be added two genera described by Smith since that paper was published. The concept of

TABLE 39.—*Frequency distributions of total number of gill rakers, including all rudiments, in certain species of* Apogon *from northern Marshall and southern Marianas Islands, and from other areas of the Indo-Pacific*

Species [1] and locality	Total number of gill rakers																	
	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
trimaculatus:																		
Northern Marshalls									1					*				
Philippines							2	4	4	1	1							
Samoa										3								
lateralis:																		
Marianas										2	4	3	1					
Philippines									6	4	2							
erythrinus:																		
Northern Marshalls			4	4														
Phoenix and Samoa [2]	1	1	6	1	2													
Johnston			3															
Marianas		1																
Manga Reva			1															
Red Sea					3	4												
Hawaii [2]			3															
leptacanthus:																		
Northern Marshalls																		1
Philippines															4	4	6	8
compressus: Philippines [2] and East Indies														4	8	7	5	
mentalis: Philippines [2]															1			
gracilis:																		
Northern Marshalls													5	3				
Philippines															2	3		
cypselurus:																		
Northern Marshalls					1													
Philippines and East Indies				9	4	3												
raenatus:																		
Northern Marshalls					4	4												
Philippines and East Indies					10	2												
exostigma: Northern Marshalls						6	5											

TABLE 39.—*Frequency distributions of total number of gill rakers, including all rudiments, in certain species of* Apogon *from northern Marshall and southern Marianas Islands, and from other areas of the Indo-Pacific*—Continued.

Species and locality	Total number of gill rakers																	
	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
ocellatus	----	2	6	4	----	----	----	----	----	----	----	----	----	----	----	----	----	----
sostigma:																		
Northern Marshalls	----	----	----	2	1	1	----	----	----	----	----	----	----	----	----	----	----	----
Phoenix and Samoa	----	----	2	1	2	----	----	----	----	----	----	----	----	----	----	----	----	----
marmoratus: Northern Marshalls	----	3	1	1	----	----	----	----	----	----	----	----	----	----	----	----	----	----
variegatus:																		
Marianas	----	----	1	2	3	----	----	----	----	----	----	----	----	----	----	----	----	----
Samoa	----	1	2	1	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Red Sea	----	2	2	4	----	----	----	----	----	----	----	----	----	----	----	----	----	----
auritus: Red Sea	----	1	2	4	----	----	----	----	----	----	----	----	----	----	----	----	----	----

TABLE 40.—*Frequency distribution and total number of rudimentary and developed gill rakers on upper and lower limbs of the first gill arch in* Apogon fasciatus *and closely related species*

Species	Combination of rudiments and developed rakers[1]																							Total rakers									
	Upper limb rudiments, rakers							Lower limb rakers, rudiments																Upper limb				Lower limb					
	2,2	3,2	4,2	2,3	3,3	4,3	1,4	9,3	9,4	10,2	10,3	10,4	10,5	11,2	11,3	12,2	12,3	12,4	13,1	13,2	13,3	13,4	14,2	14,3	4	5	6	7	12	13	14	15	16	17
angustatus	8	7	----	----	----	----	----	5	2	4	3	----	----	----	1	----	----	----	----	----	----	----	----	----	8	7	----	----	9	5	1	----	----	----
aroubiensis	----	----	----	15	5	----	1	----	----	----	----	----	1	----	----	4	4	----	1	10	----	----	1	----	----	16	5	----	----	----	5	15	1	----
fasciatus	----	----	----	1	1	1	----	----	----	----	----	----	----	2	----	1	----	----	----	----	----	----	----	----	----	1	1	1	----	2	1	----	----	----
nigrofasciatus	----	----	----	3	14	----	----	----	----	----	----	----	----	----	----	----	2	1	----	2	4	1	6	1	----	3	14	----	----	----	----	4	11	2
novemfasciatus	----	1	----	12	6	----	----	----	----	----	1	----	----	1	6	4	3	----	1	1	----	----	----	----	----	13	6	----	----	2	11	6	----	----
robustus	4	28	2	----	----	----	----	11	8	8	6	1	----	----	----	----	----	----	----	----	----	----	----	----	4	28	2	----	19	14	1	----	----	----

[1] The number of rudiments appears first in each column for the upper limb, and last for the lower limb. The raker at the angle of the arch is not included.

The following young specimens were identified to the genus *Apogon* only:

Bikini Atoll: Boro Island, reef next to Boro Channel, April 6, 1946, S–46–52, Schultz and Brock, 1 specimen, 16 mm.; off Bikini Island in lagoon, May 11, 1946, S–46–126, Emory, 4 specimens, 12 to 14 mm.; Arji Island, deep poison, 20 to 40 feet, 100 yards off shore, lagoon, August 7, 1946, S–46–308, Herald and Brock, 1 specimen, 23 mm.: Bikini Island, 4 miles south of west end, 30 fathoms, dredging, April 25, 1946, 1 specimen, 18 mm.

Rongelap Atoll: Arbor Island, June 16, 1946, S–46–213, Schultz, 3 specimens, 12 to 14 mm.; north end of Eniaetok Island, lagoon reef, June 17, 1946, S–46–215, Schultz, 2 specimens, 15 to 18 mm.; Kabelle Island, lagoon reef, June 20, 1946, S–46–231, Schultz and Herald, 1 specimen, 17 mm.

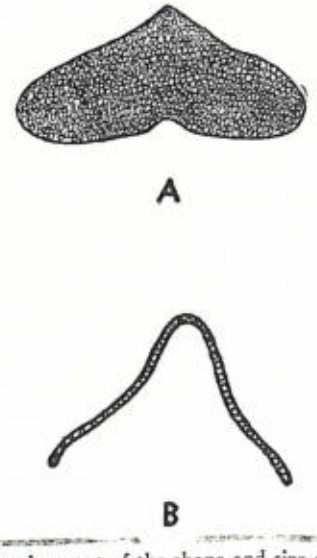

FIGURE 75.—Extremes in development of the shape and size of the vomerine tooth patch: *a*, From a specimen of *Apogon isostigma* (Jordan and Seale) 70 mm. in standard length; *b*, from a specimen of *A. compressus* (Smith and Radcliffe) 75 mm. in standard length. (Sketches by author.)

KEY TO SPECIES OF APOGON OCCURRING IN MARIANAS AND MARSHALL ISLANDS, INCLUDING CERTAIN SPECIES FOUND ELSEWHERE IN THE INDO-PACIFIC

1*a*. Dorsal rays VI–I,9 or I,10; anal rays II,8 to II,13; villiform teeth on palatines.

2*a*. Anterior and posterior margins of preopercle and suborbitals serrated; second spine of spiny dorsal longer than third; anal rays II,8; lateral line complete_____ Apogon trimaculatus [79] Cuvier and Valenciennes

[79] Also included in this division is *Apogon unicolor* Doderlein, *in* Jordan and Snyder, Proc. U. S. Nat. Mus., vol. 23, p. 749, pl. 32, 1901 (holotype, U.S.N.M. No. 49708, Yokohama, Japan). This species is characterized further by a total gill raker count of about 18, and a count of about 27 lateral line scales, with 2 above and 8 below the lateral line. This is higher than that of *trimaculatus*, which has a scale formula averaging 2–24–6, and characteristic also of many other apogonids.

2*b*. (See 2*c*.) Anterior margin of preopercle and suborbitals not serrated, posterior margin of preopercle serrated; second or third spine of spiny dorsal longest; anal rays II,8 or II,9 to II,10; lateral line complete or incomplete.

3*a*. Anal rays II,8.

4*a*. Lateral line complete.[50]

5*a*. Third spine of spiny dorsal equal to or slightly longer than second; total number of gill rakers 22 to 25; a brownish black blotch on body just posterior to opercular flap and below lateral line; body with a very narrow blackish lateral stripe on midbody region, extending from blotch to the small, circular, black spot at base of caudal fin---------- **Apogon lateralis** Valenciennes

5*b*. Second spine of spiny dorsal longer than third; total number of gill rakers 14 to 18; body without stripes or spots; some pigmentation dorsally, especially before dorsal fin, but variable in intensity and amount---------- **Apogon erythrinus** Snyder

4*b*. Lateral line incomplete---- **Apogon parvulus**[51] (Smith and Radcliffe)

3*b*. Anal rays II,9 or II,10.

6*a*. Total number of gill rakers 24 to 30.[52]

7*a*. Anal rays II,9 to II,10; second spine of spiny dorsal greatly elongate and filamentous, more than 2 times longer than third; caudal fin forked; body lacking horizontal stripes; body lacking evident spotting and color marks; maximum size small, 30 mm. or less. **Apogon leptacanthus** Bleeker

7*b*. Anal rays II,9; second spine of spiny dorsal not elongate and filamentous, only slightly longer than third; caudal fin emarginate; body traversed laterally from head to base of caudal fin by three broad, dark brown horizontal stripes, and also by an evident middorsal and two less distinct ventrolateral stripes; the three lateral stripes break into four irregularly shaped spots at base of caudal fin; maximum size large, over 100 mm. (See pl. 37, A.) **Apogon compressus**[53] (Smith and Radcliffe)

6*b*. Total number of gill rakers less than 15. **Apogon blanchardi**[54] (Whitley)

2*c*. Anterior and posterior margins of preopercle and suborbitals not serrated; second spine of spiny dorsal longer than third; anal rays II,8 or 11,9 or II,12 or 13; lateral line complete (questionable in *mentalis*).

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[50] The following species are also included in this division. The total number of gill rakers, including rudiments, averages about 21 or 22 in these species:

Apogon kiensis Jordan and Snyder, Proc. U. S. Nat. Mus., vol. 23, p. 905, fig. 9, 1901 (type locality, Wakanoura, Province of Kii, Japan; paratype, U.S.N.M. No. 49881).

Apogon evermanni Jordan and Snyder, ibid., vol. 28, p. 123, 1904 (Honolulu; type U.S.N.M. No. 51487).

[51] *Amia parvula* Smith and Radcliffe, Proc. U. S. Nat. Mus., vol. 41, p. 432, pl. 34, fig. 2, 1912 (Tawi Tawi Group, P. I.; type, U.S.N.M. No. 70244).

[52] Also occurring at this point in the key is *Amia gilberti* Jodan and Seale, Proc. U. S. Nat. Mus., vol. 28, p. 777, fig. 3, 1905 (Negros; type, U.S.N.M. No. 51941). It is characterized by having a small brown spot on the opercle and one at the midbase of the caudal fin.

[53] *Amia compressa* Smith and Radcliffe, Proc. U. S. Nat. Mus., vol. 41, pp. 246–248, pls. 20, 21, 1911 (type locality, Biscuay Island, Cuyos Group, P. I.; type, U.S.N.M. No. 68398).

[54] *Kurandapogon blanchardi* Whitley, Occ. Pap. Mus. Zool. Univ. Michigan, No. 405, pp. 1–4, pl. 1, 1939 (Kuranda, Queensland; paratype, U.S.N.M. No. 109466).

8*a*. Anal rays II,12 or II,13; total number of gill rakers 25 to 28; caudal fin moderately forked, or rounded; bar extending from tip of snout to eye never intensely developed.

9*a*. Two black horizontal stripes on body extending from head to area below end of soft dorsal fin; caudal fin apparently rounded; body deeper, about 3.5 in standard length (fig. 76).

Apogon mentalis [85] **(Evermann and Seale)**

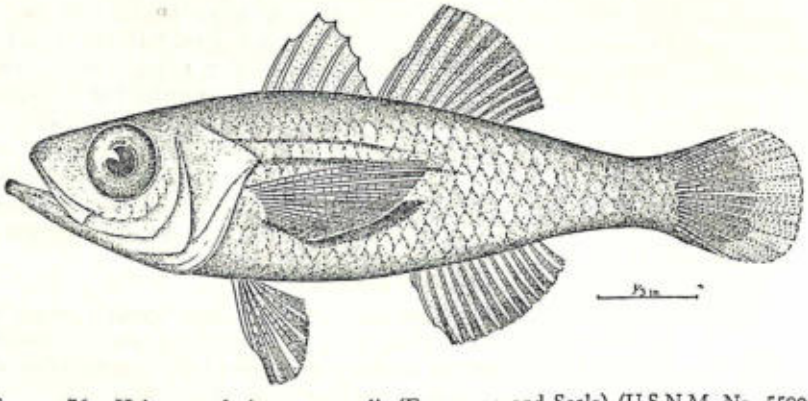

FIGURE 76.—Holotype of *Apogon mentalis* (Evermann and Seale) (U.S.N.M. No. 55905), from Luzon Island, P. I.

9*b*. No horizontal stripes on body; caudal moderately forked; body less deep, 3.7 to 4.1 in standard length..... Apogon gracilis (Bleeker)

8*b*. Anal rays II,9; total number of gill rakers 16 to 17; caudal fin deeply forked; dark brown or blackish mark or bar from tip of snout to eye intensely developed..... Apogon cypselurus (Weber)

8*c*. Anal rays II,8; total number of gill rakers 15 to 17; no bar or mark from snout to eye.[86]

1*b*. (See 1*c* and 1*a*.) Dorsal rays VII–I,9; anal rays II,8; villiform teeth on palatines present or absent; third spine of spiny dorsal longest.

10*a*. (See 10*b* and 10*c*.) Anterior and posterior margins of preopercle and suborbitals serrated; lateral line complete; caudal fin forked; palatine teeth either present or absent; total number of gill rakers 17 to 24; villiform teeth of vomer blunt to pointed, arranged in 1 to 3 irregular rows; never forming a triangular patch.

11*a*. Palatine teeth present; total number of gill rakers 17 to 21.[87]

12*a*. (See 12*b* and 12*c*.) A distinct blackish brown circular spot at mid-base of caudal fin, with the lateral line passing through its center in small to large sizes; caudal spot of moderate size, its greatest diameter in least depth of caudal peduncle about 3.0 to 3.5, 0.8 in pupil; a dusky brown lateral stripe on head and body tapering in width from the head, where its width equals two-thirds diameter

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[85] *Apogonichthys mentalis* Evermann and Seale, Bull. U. S. Bur. Fish., vol. 26, 1906, p. 74, fig. 10, 1907 (type locality, Bacon, Sorsogon, P. I.: type, U.S.N.M. No. 55905).

[86] *Apogon diencaea* Smith and Radcliffe, Proc. U. S. Nat. Mus., vol. 41, p. 431, pl. 34, fig. 1, 1911 (Jolo Island, P. I.; type, U.S.N.M. No. 70243).

Apogon campbelli Smith, Ann. Mag. Nat. Hist., ser. 12, vol. 2, No. 14, p. 100, 1949 (Inhaca Island, Delagoa Bay, Africa; paratype, U.S.N.M. No. 112207).

[87] *Amia nigrocincta* Smith and Radcliffe, Proc. U. S. Nat. Mus., vol. 41, p. 435, pl. 37, fig. 2, 1911 (Jolo Island, P. I.; type, U.S.N.M. No. 70247).

of pupil, to a narrow streak on side of caudal peduncle, less than one-half as wide as on side of head; stripe developed in young from snout to base of caudal fin, but only on head and forepart of body in the adults; stripe distinct in young, diffuse or greatly faded in adults; serrations on anterior margin of preopercle broader and longer than those on posterior margin; adults with 1 to 3 large suborbital serrations---------- Apogon fraenatus Valenciennes

12*b*. A distinct blackish brown circular spot at base of caudal fin, above lateral line and not touching lateral line in adults, about 50 percent of young and juveniles (under 60 mm. in length) with this spot just touching lateral line, viewed from above; caudal spot small, variable in size with age; greatest diameter of spot in least depth of caudal peduncle about 3 to 4 in young and juveniles, 4 to 5 in adults, greatest diameter of spot in pupil about 0.6 in adults; a dusky brown lateral stripe, its width tapering from head to a narrow streak on side of caudal peduncle, less than one-half as wide on caudal peduncle as on side of head; stripe developed in young from snout to base of caudal fin, but only on head and forepart of body in adults, sometimes faded in adults; serrations on anterior margin of preopercle equal in size and shape to those on posterior margin; adults with one or two large suborbital serrations. Apogon exostigma (Jordan and Starks)

12*c*. A circular to oval, more diffuse, dark brown spot at base of caudal fin, lower edge of spot touching lateral line in all sizes, distinct in young, diffuse in adults; caudal spot larger, less variable with age, greatest diameter in least depth of caudal peduncle about 2.5 in small specimens (under 40 mm.) and 3 in larger specimens (over 70 mm.), greatest diameter of spot in pupil averages about 0.9; spot becomes part of a band or bar in largest specimens; dusky brown lateral stripe from head to base of caudal fin of uniform width, evident on all young, frequently faded on adults; serrations of anterior margin of preopercle stouter and longer than those on posterior margin; suborbital serrations in a size gradient from small serrations to large ones. Apogon snyderi Jordan and Evermann

11*b*. Palatine teeth absent: total number of gill rakers 22 to 24.

13*a*. Dense, blackish pigmentation on the caudal fin just posterior to the last scale row forms a well-defined vertical bar or arc with the pigmentation on the outer rays of fin. Apogon menesemus[88] Jenkins

13*b*. Dense, blackish pigmentation on caudal fin limited to outer 2 to 3 branched rays; this pigmentation is directed inward to include the outer 4 or 5 branched rays at a point on about middle of the fin, but not extending over entire base to form a bar or arc. Apogon menesemops, new species

10*b*. Anterior margin of preopercle smooth, posterior margin serrated; suborbitals smooth; lateral line complete; caudal fin round, emarginate or moderately forked; palatine teeth present; total number of gill rakers 15 to 30; villiform teeth of vomer pointed to blunt or round, in about 1 to 3 irregular rows, not forming a broad triangular patch.

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[88] *Apogon menesemus* Jenkins, Bull. U. S. Fish. Comm., vol. 22, 1902, p. 448, fig. 19, 1904 (type locality, Honolulu).

14*a*. (See 14*b* and 14*c*.) A conspicuous oblique mark, triangular or narrow and elongate, extending from eye to angle of anterior margin of preopercle; no horizontal stripes on body; at most, body with three dark saddles; vomer with pointed villiform teeth arranged in one or two rows; total number of gill rakers 23 to 30.

15*a*. A narrow, elongate, black mark extending from eye to angle of anterior margin of preopercle; a diffuse dark spot above midbase of caudal fin on caudal peduncle in adults, proportionately larger in smaller specimens (under about 50 mm.) and forms a saddle over dorsal portion of caudal peduncle; caudal fin almost uniform dusky; total number of gill rakers (76 specimens) 23 to 29, average 25.2---------- Apogon nubilus Garman

15*b*. A triangular mark extending from eye to angle of anterior margin of preopercle, the triangular base bordering eye; a distinct saddle over dorsal half of caudal peduncle or a band encircling or nearly encircling peduncle at base of caudal fin; caudal fin uniform dusky, or outer rays blackish, edged with white.

16*a*. (See 16*b* and 16*c*.) A black band completely encircling caudal peduncle at base of caudal fin in all size groups; no dark saddles on dorsal side of body passing through base of spiny and soft dorsal fin; caudal fin dusky, outer rays not edged in white; total number of gill rakers (23 specimens) 25 to 30, average 27.5 (see pl. 38, C)---------- Apogon erdmani [89] Lachner

16*b*. A dark saddle over caudal peduncle at base of caudal fin in adults, reaching down to lateral line; saddle forms a band almost encircling peduncle in smaller specimens (usually under 40 mm.); band faintly present in some adults; two dark saddles over dorsal part of body, passing through base of spiny and soft dorsal fin; outer rays of caudal fin blackish edged in white; total number of gill rakers (45 specimens) 24 to 28, average 25.8 (see pl. 38, B). Apogon bandanensis [90] Bleeker

16*c*. Dark saddle over caudal peduncle reaching down to lateral line in adults; saddle extends below lateral line in smaller specimens (usually under 50 mm.), forming a band almost encircling peduncle; band never faintly present in adults; no dark saddles over body; outer rays of caudal fin blackish edged in white; total number of gill rakers (63 specimens) 26 to 30, average 27.8. Apogon savayensis Günther

14*b*. No triangular or elongate oblique mark below eye; three or more horizontal stripes on body; vomer with pointed or rounded villiform teeth in one to three irregular rows; total number of gill rakers 15 to 24.

17*a*. With a horizontal ventrolateral stripe extending from opercle, above base of pectoral fin and below stripe on midbody region to base of caudal fin on lower portion of caudal peduncle; this stripe probably variable in its intensity, being a faded pale-dusky color in our specimens; no horizontal stripe passing through base of pectoral or touching base; a faint horizontal postocular stripe, just above

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[89] *Apogon erdmani* Lachner, Proc. U. S. Nat. Mus., vol. 101, pp. 595–596, pl. 18, *a*, 1951 (type locality, Jidda, Red Sea).

[90] *Apogon bandanensis* Bleeker, Nat. Tijdschr. Nederl.-Indië, vol. 6, p. 95, 1854 (type locality, Banda Island).

median stripe, extends on body to area below end of soft dorsal, where it appears to unite with median stripe just below; median and dorsolateral stripes dark brown and easily discernible, former extending to tips of middle caudal fin rays (see pl. 35, A, B).

Apogon fasciatus [91] (White)

17*b*. Without a horizontal stripe on body above base of pectoral fin and below median stripe but with a ventrolateral stripe passing through base of pectoral fin; this stripe usually well developed; postocular stripe present or absent; when present, shorter, not reaching area below middle of soft dorsal fin and not uniting with any stripe; median and dorsolateral stripes well developed and forming various color patterns on peduncle at base of caudal or on caudal fin with the ventrolateral stripe.

18*a*. Body with a black stripe extending obliquely from lower portion of the base of pectoral fin to origin of anal fin.

Apogon saipanensis [92] (Fowler)

18*b*. Body without a stripe extending from base of pectoral fin to origin of anal fin.

19*a*. (See 19*b* and 19*c*.) Dark brown dorsolateral and ventrolateral stripes converging toward median stripe on caudal fin well beyond base; base of pectoral fin black; median dark stripe enlarged and more dense just posterior to opercle and midway on body below soft dorsal, forming blotches; no dark spot at base of caudal fin; total number of gill rakers 19 to 22; no postocular stripe.

Apogon novemfasciatus Cuvier and Valenciennes

19*b*. Light-brown to brown dorsolateral and ventrolateral stripes partially converging toward base of caudal fin, and either ending at or extending onto caudal fin in horizontal streaks that are parallel to a median streak; stripe on midbody not forming enlarged blotches; dark spot at base of caudal fin present; total number of gill rakers 17 to 20; postocular stripe may be distinct, faint, or absent.

20*a*. Spot at base of caudal fin nearly circular in adults, more oval in young, its horizontal diameter almost equal to vertical diameter in adults; this spot brown to blackish brown, sharply outlined and distinct; base of pectoral fin and opercular edge adjacent to pectoral base without color other than that of ventrolateral stripe that passes through these areas (see fig. 77)_____ Apogon angustatus [93] (Smith and Radcliffe)

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[91] *Mullus fasciatus* White, Journal of a voyage to New South Wales, p. 268, fig. 1, 1790 (type locality, Port Jackson). The location of the type of *A. fasciatus* has been unknown for years. To avoid future conflicts and intrepretations, I designate as a neotype of *Apogon fasciatus* (White) a gravid female specimen, U.S.N.M. No. 59972, 80.5 mm. in standard length, collected at Port Jackson, New South Wales, by D. G. Stead. Its description is given by Radcliffe (Proc. U. S. Nat Mus., vol. 41, p. 249, pl. 22, lower figure, 1911). Stead (Fishes of Australia, p. 107, 1906) considered this species common about Port Jackson.

[92] *Lovamia saipanensis* Fowler, Proc. Acad. Nat. Sci. Philadelphia, vol. 97, p. 63, figs. 5 and 6, 1945 (type locality, Saipan Island). H. W. Fowler could not locate the type or paratypes for me. This species is not known by any other specimens. Fowler did not give the gill raker count and consequently it is only tentatively placed in division 14*b*. It is further characterized by lacking the black spot at the base of the caudal fin.

[93] *Amia angustata* Smith and Radcliffe, Proc. U. S. Nat. Mus., vol. 41, p. 253, fig. 1, 1911 (type locality, Malanipa Island, east of Zamboanga, P. I.).

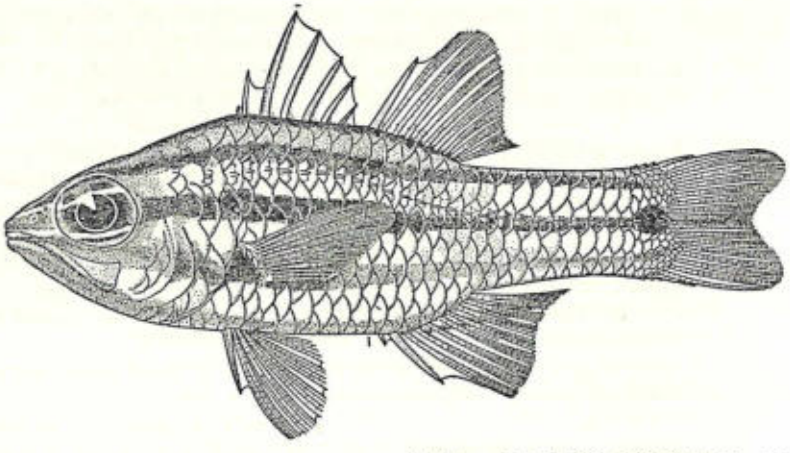

FIGURE 77.—Holotype of *Apogon angustatus* (Smith and Radcliffe) (U.S.N.M. No. 68399) from Malanipa Island, P. I.

20*b*. Caudal spot elongate in adults, elliptical to rectangular, horizontal diameter about 2 times vertical diameter, very long in young, appearing as a widening of median stripe; caudal spot dusky tan, not sharply outlined, diffuse in adults, generally indistinct in young; base of pectoral fin and opercular edge adjacent to pectoral base usually brown to blackish brown, somewhat heavier colored than ventrolateral stripe.
Apogon robustus (Smith and Radcliffe)

19*c*. Dusky to dark brown dorsolateral and ventrolateral stripes converging upon spot at base of caudal; only median stripe passing on to caudal rays to form streak; median stripe not with enlarged blotches; dark spot at base of caudal fin present; total number of gill rakers 20 to 24; postocular stripe absent.

21*a*. Width of median dark stripe on body below end of base of spiny dorsal fin not more than twice as wide as light stripes above and below it, usually only slightly wider, sometimes narrower; width of light stripes near middle of body, above and below median dark stripe, less than 3 in eye, averages about 2, and equals diameter of pupil; total number of gill rakers averages about 23---------- **Apogon nigrofasciatus**, new species

21*b*. Width of median dark stripe more than twice as wide as light stripes above and below it, usually more than 3 times; width of light stripes near the middle of the body above and below median dark stripe more than 4 in eye, averages about 4.8, and about 2 in pupil, total number of gill rakers averages about 21 (see pl. 38, A).
Apogon aroubiensis[94] Hombron and Jacquinot

19*d*. Blackish dorsolateral and ventrolateral stripes become faint on caudal peduncle, do not extend to caudal fin; median stripe becomes narrower on caudal peduncle, appears to fade out

[94] Apogon *aroubiensis* Hombron and Jacquinot, Voyage au Pôle Sud et dans l'Océanie sur les corvettes l'*Astrolabe* et la *Zelée* . . ., vol. 3, Poissons, p. 31, pl. 1, fig. 1, 1853 (Aroub, Malaysia).

before reaching spot at midbase of caudal fin; median stripe lacks enlarged blotches; spot at base of caudal fin large, slightly larger than pupil, equal to width of spaces between stripes on caudal peduncle and more than 4 times width of median stripe on caudal peduncle; total number of gill rakers 18 to 19; postocular stripe absent; horizontal stripes narrower and spaces between stripes wider, compared with those species in *a*, *b*, and *c*, above_____ Apogon doederleini [95] Jordan and Snyder

14*c*. No triangular or elongate-oblique mark below eye; no horizontal stripes on body; vomer with pointed or round villiform teeth, usually in a single irregular row, in 2 to 3 irregular rows at most; total number of gill rakers 23 to 24 [96]_____ Apogon novae-guineae Valenciennes

10*c*. Anterior and posterior margins of preopercle and suborbitals without serrations; lateral line complete or incomplete; palatine teeth present or absent; caudal fin round; total number of gill rakers 13 to 20; villiform teeth of vomer rounded or blunt, in more than two rows, in most species they form a medium to broad triangular patch (except those species marked in this key by an asterisk).

22*a*. No palatine teeth.

23*a*. Lateral line complete;[97] spiny dorsal fin with a black ocellus; no spot present on operculum; head mottled in brownish, body dusky to light brown; median fins dusky, edged in white; cheek with dark brown bar from eye to angle of anterior margin of preopercle, another smaller bar located from middle of posterior margin of eye to upper edge of gill opening_____ Apogon ocellatus Weber

23*b*. Lateral line incomplete;[98] no black ocellus on spiny dorsal fin, but may have at midbase a dusky, flecky spot or blotch, which may be completely faded; operculum with a dark spot or ocellus, sometimes faded; body and fins of various color patterns.

24*a*. Body with distinct circular, large, dark spots more or less arranged in 8 to 9 horizontal rows; head brown, body dark brown to light

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[95] *Apogon doederleini* Jordan and Snyder, Proc. U. S. Nat. Mus., vol. 23, p. 901, fig. 6, 1901 (Nagasaki; paratype, U.S.N.M. No. 49959).

[96] This group could be further expanded to include the following species, all of which were found to have spots, bars, or other marks on the body, the caudal fin rounded or forked, and a gill raker count ranging from 15 to 26:

Amia jenkinsi Evermann and Seale, Bull. U. S. Bur. Fish., vol. 26, 1906, p. 73, fig. 9, 1907 (Bulan; holotype, U.S.N.M. No. 55907).

Amia striata Smith and Radcliffe, Proc. U. S. Nat. Mus., vol. 41, p. 437, pl. 35, fig. 1, 1912 (Luzon; five paratypes, U.S.N.M. No. 93410).

Amia albomarginata Smith and Radcliffe, Proc. U. S. Nat. Mus., vol. 41, p. 438, pl. 35, fig. 2, 1912 (Luzon; holotype, U.S.N.M. No. 68402).

Amia atrogaster Smith and Radcliffe, Proc. U. S. Nat. Mus., vol. 41, p. 439, pl. 35, fig. 3, 1912 (Luzon; holotype, U.S.N.M. No. 70249).

Amia diversa Smith and Radcliffe, Proc. U. S. Nat. Mus., vol. 41, p. 434, pl. 37, fig. 1, 1912 (Luzon; holotype, U.S.N.M. No. 70246).

Apogon maculiferus Garrett, Proc. California Acad. Nat. Sci., vol. 3, p. 105, 1863 (Hawaiian Islands; paratype, U.S.N.M. No. 126509).

[97] In this division, but further distinguished by color would occur *Apogonichthys waikiki* Jordan and Evermann, Bull. U. S. Fish. Comm., vol. 22, 1902, p. 179, 1903 (Waikiki, Hawaiian Islands; holotype, U.S.N.M. No. 50639).

[98] In this group, at this point, among other species, the following are placed:

Foa valulae Jordan and Seale, Bull. U. S. Bur. Fish., vol. 25, 1905, p. 249, fig. 43, 1906 (Apia, Samoa; holotype, U.S.N.M. No. 51734).

Apogonichthys nafae Snyder, Proc. U. S. Nat. Mus., vol. 36, p. 599, 1909 (Okinawa; type, U.S.N.M. No. 62947).

brown; fins dusky, not mottled; two narrow black horizontal lines on cheek; black horizontal line on opercle just above ocellus.
Apogon isostigma (Jordan and Seale)

24*b*. Body without spots but with 7 to 8 more or less vertical brown bars nearly encircling it; head and body light tan; fins nearly transparent on outer half, with faint brownish mottling on lower portion near base, especially the spiny dorsal; pelvic fins with brownish mark near middle; caudal fin with some brownish.
Apogon marmoratus (Alleyne and Macleay)

24*c*. Head, body, and all fins except pectoral greatly mottled with brown and whitish; body with diffuse vertical bars in smaller specimens, nearly obscure in adults; diffuse, dark brown spots scattered irregularly over body, more evident in smaller than larger specimens---------- Apogon variegatus Valenciennes

24*d*. Head, body, and fins dusky to dark brown in adult males, without mottling, spots, or bars; head and body, spiny and soft dorsal, pelvic and anal fins slightly mottled with brown in females, the pectoral and caudal fins dusky.
Apogon auritus[99] Cuvier and Valenciennes

22*b*. With palatine teeth.

25*a*. Lateral line complete-- Apogon uninotatus[1] (Smith and Radcliffe)

25*b*. Lateral line incomplete.[2]

1*c*. Dorsal fin rays VII–I,9; anal rays II,9; villiform teeth on palatines; third spine of spiny dorsal longest------ Apogon mydrus[3] (Jordan and Seale)

1*d*. Dorsal fin rays VIII–I,9; anal rays II,8; no teeth on palatines; third spine of spiny dorsal longest------ Apogon octospinus[4] (Smith and Radcliffe)

APOGON TRIMACULATUS Cuvier and Valenciennes

Apogon trimaculatus CUVIER and VALENCIENNES, Histoire naturelle des poissons, vol. 2, p. 156, 1828 (type locality, Buru, an island of the Moluccas group).—SCHULTZ, U. S. Nat. Mus. Bull. 180, p. 94, 1943.

Apogon rhodopterus BLEEKER, Nat. Tijdschr. Nederl.-Indië, vol. 3, p. 62, 1852 (type locality, Singapore).

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[99] *Apogon auritus* Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 7, p. 443, 1831 (type locality, Mauritius).

[1] *Amia uninotata** Smith and Radcliffe, Proc. U. S. Nat. Mus., vol. 41, p. 436, pl. 34, fig. 3, 1911 (Bisucay Island, P. I.: holotype, N.S.N.M. No. 70248).

[2] The following species are not further considered:

*Fowleria brachygrammus** Jenkins, Bull. U. S. Fish Comm., vol. 22, 1902, p. 448, fig. 20, 1903 (Honolulu; holotype, U.S.N.M. No. 50699).

Amia hyalina Smith and Radcliffe, Proc. U. S. Nat. Mus., vol. 41, p. 433, pl. 36, fig. 3, 1912 (Talissee Island, north of Celebes: holotype, U.S.N.M. No. 10245).

Foa fo Jordan and Seale, Bull. U. S. Bur. Fish., vol. 25, 1905, pp. 248–249, fig. 42, 1906 (Apia, Samoa; holotype, U.S.N.M. No. 51735).

Jordan and Seale (ibid., 1906) noted small denticulations on both margins of the preopercle of *Apogon fo*. Examination of the holotype revealed no denticulations. Although but 27 mm. in standard length, this specimen is probably a mature one, for eggs were found in the mouth cavity. The denticulations of the ctenoid scales on the preopercle may have been misinterpreted as preopercular serrations.

[3] *Mionorus mydrus* Jordan and Seale, Proc. U. S. Nat. Mus., vol. 28, p. 778, fig. 4, 1905 (Negros; type, U.S.N.M. No. 51946). This species is further characterized by the low lateral-line scale count of 19 and but 1 scale above lateral line instead of the usual 2.

[4] *Neamia octospina* Smith and Radcliffe, Proc. U. S. Nat. Mus., vol. 41, p. 441, pl. 36, fig. 2, 1912 (Rasa Island, Palawan; holotype, U.S.N.M. No. 70251).

Apogon koilomatodon BLEEKER, Nat. Tijdschr. Nederl.-Indië, vol. 4, p. 134, 1853 (type locality, Ternate).

Amia koilomatodon JORDAN and SEALE, Bull. U. S. Bur. Fisheries, vol. 25, 1905, p. 240, 1906.—FOWLER and BEAN, U. S. Nat. Mus. Bull. 100, vol. 10, p. 37, 1930.

Amia rhodoptera FOWLER and BEAN, U. S. Nat. Mus. Bull. 100, vol. 10, p. 34, 1930.

SPECIMENS STUDIED

Bikini Atoll: Bikini lagoon, July 19, 1946, Univ. Washington, 1 specimen, 93 mm.

In addition to this single specimen from Bikini the following collections in the U. S. National Museum were studied: U.S.N.M. No. 122263, Port Uson, P. I.; U.S.N.M. No. 122270, Palawan Island, P. I.; many uncataloged *Albatross* collections from the East Indies and Philippines (reported on under *Amia rhodoptera* by Fowler); U.S.N.M. No. 51733 (reported on under *Amia koilomatodon* by Jordan and Seale and under *Apogon trimaculatus* by Schultz; U.S.N.M. No. 122268, Mindanao, P. I.; U.S.N.M. No. 122266, Monpog Island, P. I.; U.S.N.M. No. 56151, Luzon, P. I.; many uncataloged collections (reported on under *Amia koilomatodon* by Fowler and Bean).

Description.—Counts are recorded for the single specimen from Bikini followed by the range of counts of 12 specimens, in parentheses, from the Philippine Islands. The proportional measurements refer to the Bikini specimen only. Dorsal rays VI–I,9, (VI–I,9); anal rays II,8 (II,8); pectoral rays 14 (14 to 15); vertical scale rows 24 (23 to 24); scale rows above lateral line 2 (2); scale rows below lateral line 7 (6 to 7).

Body depth 2.4, head length 2.3, head depth 3.0, length of caudal peduncle 4.0, longest pectoral ray 3.5, all in standard length. Eye 3.2, length of upper jaw 2.2, least depth of caudal peduncle 2.5, length of snout 3.7, all in length of head. Eye in snout 1.0; soft dorsal slightly higher than spiny dorsal; second spine of spinous dorsal longest, about 4 times as long as first spine and 1.9 times longer than eye; gill rakers, 4 or 5+1+14 to 16, total 19 to 23; longest raker about 2 times longest filament, 2.7 in eye; a wide band of villiform teeth in the jaws; vomer and palatines with 2 to 3 somewhat irregular rows of villiform teeth.

Pelvic fins reach vent but not touching origin of anal fin; both margins of preoperculum serrated; suborbitals serrated; lower posterior edge of maxillary with some denticulations; exposed portion of cleithrum, at junction of opercle and body, with denticulations; caudal fin forked; upper jaw reaches vertical drawn along anterior margin of pupil; lateral line complete; ctenoid scales with 15 to 21 radii.

Color in alcohol.—Based on specimens from the East Indies, Philippine Islands, Samoa, and the northern Marshall Islands. Body and head light tan to brownish, the larger specimens, especially males, usually a darker brown; scales in some larger specimens (75 to 112 mm. in standard length) darker brown in central portion, coloration form-

ing 6 to 7 faint horizontal stripes, these more pronounced in males; a vertical dark-brown band extending from anterior portion of base of spiny dorsal fin to area just posterior to base of pectoral fin, sometimes divided at midbody to form a spot, sometimes reaching only below lateral line; this band has a width extending from the second to the fourth spines in smaller specimens, wider in larger males, extending from second to fifth spines and somewhat divided vertically; a second characteristic dark-brown dorsal band located at end of soft dorsal fin base, extends anteriorly and obliquely to about two scale rows below lateral line; this band also varies in width, sometimes much wider and blotchlike in larger specimens, often divided at lateral line, resulting in a spot below; this spot present in smaller specimens (40 to 70 mm.) but usually faint or absent in larger ones; a third dorsal mark about one scale row in width extends vertically downward from soft dorsal origin to lateral line; this mark well developed and of a dark brown to blackish color in most large males, faint or absent in most large females and in smaller specimens of both sexes (no specimen under 70 mm. in standard length shows this mark; it is slightly developed on one side only in the single female specimen from the northern Marshall Islands); a midcaudal dark brown to black caudal spot situated just anterior to end of hypural present in smaller specimens and most adult females, often faint or completely obscure in adult males, its diameter varying from 0.5 to 1.0 in pupil; an oval to circular brown spot with a diameter equal to that of pupil located in middle of opercle, anterior to and above pectoral base, and just below the flat opercular spine; this opercular spot faint or obscure in specimens under 70 mm. and in many larger female specimens, but well developed in almost all large males; membrane of spiny dorsal dusky to white, blackish near tip of membrane between second and third spine; soft dorsal dusky with a narrow blackish band parallel to and just above base, present in smaller specimens and in most adult females, absent or completely faded in many adult males; caudal fin dusky, the outermost rays of the lobes usually edged in dusky, but may be faint or completely faded in some specimens; anal fin transparent to dusky, with tips of rays blackish in the specimen from Bikini Atoll; a dark brown or blackish spot on body, encircling base of last three anal rays, often completely faded; pectoral fin transparent; a faint brown, elongate, narrow mark from lower margin of eye to angle of anterior margin of preopercle.

Remarks.—Bleeker's descriptions of *Apogon rhodopterus* and *A. koilomatodon* added confusion to the understanding of *A. trimaculatus* Cuvier and Valenciennes. He related *rhodopterus*, with *trimaculatus* and *A. bifasciatus* Rüppell (Neue Wirbelthiere . . .

Abyssinien gehörig. Fische des rothen Meeres, p. 86, pl. 22, fig. 2, 1835). Rüppell described and figured the latter as having seven spines in the spiny dorsal fin, whereas I find the number to be consistently six in *trimaculatus*. More recently Fowler and Bean recognized *rhodopterus* and *koilomatodon*, distinguishing the former species by the presence of a caudal spot, absent in the latter. In an examination of the collections reported on by them I find the caudal spot to be absent or faint, or well developed in some specimens of both species, but I also find that the specimens referred to as *rhodopterus* (of a smaller average size and containing more female specimens) have the highest number of well-developed caudal spots. The differences in color pattern related to sex and size were not recognized. They further expressed *A. rhodopterus* to be "greatly like *Apogon taeniatus* as figured and described by Day" (The fishes of India, vol. 1, p. 59, pl. 8, fig. 4, 1876). *Apogon taeniatus*, as does *bifasciatus*, has seven spines in the spiny dorsal fin, and although the color pattern in these species is superficially like that of *trimaculatus*, they are not closely related to the latter, but only to each other.

It was not possible to work out all the details of variation in the color pattern of *trimaculatus*, for all but one of our specimens were collected about 50 years ago, and these were preserved under different conditions and in different preservatives. In some specimens all color marks are gone, and it has not been possible to associate the differences in color specifically to sex, size, or conditions of preservation. Also, small specimens (under 60 mm.) were not available. A large series of freshly preserved material is required to record all the details of coloration. However, our material does show all degrees of variation between the two forms generally recognized as *rhodopterus* and *koilomatodon*, or between the two figures illustrated by Bleeker (Atlas Ichthyologique des Indes Orientales Néerlandaises . . ., vol. 7, 1865; Atlas tab. 312, fig. 1; Atlas tab. 307, fig. 1, 1873–1876). Since no distinction can be drawn between Bleeker's accounts of *rhodopterus* and *koilomatodon* and Cuvier and Valencienne's description of *trimaculatus*, the latter name is used. The type localities of two, *trimaculatus* and *koilomatodon*, are in the Moluccas area, while the type of *rhodopterus* was taken at Singapore, all in the East Indies faunal area. There are no accounts indicating that *trimaculatus* occurs in the East African, Red Sea, or Indian faunal areas. Recent collecting in the Red Sea and Persian Gulf by Donald Erdman, formerly of the U. S. Fish and Wildlife Service, did not reveal this species. *Apogon trimaculatus* is represented in the U. S. National Museum collections from the East Indies, the Philippines, Samoa, and the northern Marshalls. No references indicate that it occurs in the Hawaiian Islands.

more pronounced in males; a vertical dark-brown band extending from anterior portion of base of spiny dorsal fin to area just posterior to base of pectoral fin, sometimes divided at midbody to form a spot, sometimes reaching only below lateral line; this band has a width extending from the second to the fourth spines in smaller specimens, wider in larger males, extending from second to fifth spines and somewhat divided vertically; a second characteristic dark-brown dorsal band located at end of soft dorsal fin base, extends anteriorly and obliquely to about two scale rows below lateral line; this band also varies in width, sometimes much wider and blotchlike in larger specimens, often divided at lateral line, resulting in a spot below; this spot present in smaller specimens (40 to 70 mm.) but usually faint or absent in larger ones; a third dorsal mark about one scale row in width extends vertically downward from soft dorsal origin to lateral line; this mark well developed and of a dark brown to blackish color in most large males, faint or absent in most large females and in smaller specimens of both sexes (no specimen under 70 mm. in standard length shows this mark; it is slightly developed on one side only in the single female specimen from the northern Marshall Islands); a midcaudal dark brown to black caudal spot situated just anterior to end of hypural present in smaller specimens and most adult females, often faint or completely obscure in adult males, its diameter varying from 0.5 to 1.0 in pupil; an oval to circular brown spot with a diameter equal to that of pupil located in middle of opercle, anterior to and above pectoral base, and just below the flat opercular spine; this opercular spot faint or obscure in specimens under 70 mm. and in many larger female specimens, but well developed in almost all large males; membrane of spiny dorsal dusky to white, blackish near tip of membrane between second and third spine; soft dorsal dusky with a narrow blackish band parallel to and just above base, present in smaller specimens and in most adult females, absent or completely faded in many adult males; caudal fin dusky, the outermost rays of the lobes usually edged in dusky, but may be faint or completely faded in some specimens; anal fin transparent to dusky, with tips of rays blackish in the specimen from Bikini Atoll; a dark brown or blackish spot on body, encircling base of last three anal rays, often completely faded; pectoral fin transparent; a faint brown, elongate, narrow mark from lower margin of eye to angle of anterior margin of preopercle.

Remarks.—Bleeker's descriptions of *Apogon rhodopterus* and *A. koilomatodon* added confusion to the understanding of *A. trimaculatus* Cuvier and Valenciennes. He related *rhodopterus*, with *trimaculatus* and *A. bifasciatus* Rüppell (Neue Wirbelthiere . . .

SPECIMENS STUDIED

Bikini Atoll: 21 stations, 118 specimens, 11 to 35 mm. in standard length.
Eniwetok Atoll: 5 stations, 29 specimens, 16 to 34 mm.
Kwajalein Atoll: 1 station, 2 specimens, 14 to 19 mm.
Rongelap Atoll: 6 stations, 15 specimens, 19 to 34 mm.
Rongerik Atoll: 5 stations, 43 specimens, 14 to 33 mm.
Guam: 1 lot, 1 specimen, 30 mm.

Description.—Measurements were taken from 3 specimens, 31 to 34 mm. in standard length, and counts from 6 specimens. Dorsal rays VI–I,9; anal rays II,8; pectoral rays 13; vertical scale rows 23; scale rows above lateral line 2; scale rows below lateral line 6.

Body depth 2.5 to 2.7, body width 6.1 to 6.9, head length 2.4 to 2.5, head depth 3.3 to 3.8, caudal peduncle length 3.7 to 3.8, longest pectoral ray 3.7 to 3.8, all in standard length; diameter of eye 3.4 to 3.7, length of upper jaw 2.0, least depth of caudal peduncle 3.0, length of snout 4.3 to 5.0, least width of bony interorbital 4.0 to 4.9, all in length of head; eye in snout 0.7; gill rakers (8 specimens) 2 or 3, 1+1+5 or 6, 5 or 6, total 15 to 16 (table 39); longest raker about 1½ times longest filament, 2.7 in eye; jaws, vomer, and palatines with small villiform teeth.

Pelvic fins reach origin of anal fin; posterior margin of preopercle finely serrated, anterior margin smooth; lateral line complete; ctenoid scales with 7 to 10 radii; upper jaw reaching or slightly passing vertical drawn through posterior margin of pupil; mouth terminal; first spine of dorsal small, about 3 in eye; second spine longest, 2.5 times diameter of eye, 1.3 in head.

Color in alcohol.—Body and head light tan, without color pattern, only a small amount of dark pigmentation near middle of scales on dorsal portion of body, especially anterior to spinous dorsal; fins transparent.

Color in life.—Body and head light reddish pink; rays of fins reddish, membranes clear.

Remarks.—Sufficient material is not on hand from many points of the Indo-Pacific to clarify the systematics of this widely ranging species. Specimens from the Red Sea attain a larger average size, a greater number of gill rakers, and have shorter spines in the fins than do specimens taken east of the Philippine Islands. *Apogon erythrinus* and *A. doryssa* ((Jordan and Seale), Bull. U. S. Bur. Fish., vol. 25, 1905, p. 245, fig. 39, 1906) are considered distinct. *A. doryssa* differs in having longer dorsal and anal spines, larger eyes, a pointed snout, terminal mouth, and a more slender, elongated body. Also, owing to lack of comparative specimens, the relationships of *Amia cardinalis* Seale (Philippine Journ. Sci., vol. 4, No. 6, p. 509, 1909, Palawan Island) and *Apogon kominatoensis* Ebina (Journ. Imper. Fish. Inst., vol. 30, p. 211, fig. 1, 1934, Kominato, Bosyu

APOGON LATERALIS Valenciennes

PLATE 34, A

Apogon lateralis VALENCIENNES, Nouv. Ann. Hist. Nat., vol. 1, p. 58, 1832 (type locality, Vanicolo).

SPECIMENS STUDIED

U.S.N.M. No. 123976, Guam, June 14, 1945, McElroy and Markley, 3 specimens, 39 to 41 mm.; U.S.N.M. No. 123986, Guam, July 16, 1945, Markley, 3 specimens, 43 to 45 mm.

Description.—Counts and measurements from 4 specimens 51 to 56 mm. in standard length range as follows: Dorsal rays VI–I,9; anal rays II, 8; pectoral rays ii,10,ii; vertical scale rows 23; scale rows above lateral line 2; scale rows below lateral line 6.

Body laterally compressed; depth 2.5 to 2.7, width 5.4 to 6.2, head length 2.4 to 2.5, head depth 3.5 to 3.7, caudal peduncle length 4.0 to 4.3, longest pectoral ray 3.5 to 4.0, all in standard length; diameter of eye 3.5 to 3.6, length of upper jaw 2.1 to 2.2, least depth of caudal peduncle 2.2 to 2.3, length of snout 4.0, least width of bony interorbital 5.0, all in length of head; eye in snout 0.95 to 1.0; spinous dorsal reaches origin of soft dorsal and about two-thirds as high as soft dorsal; third spine of spinous dorsal only slightly longer than second spine, about 2.3 in length of head; second spine stouter than third spine; first spine of spinous dorsal about one-fourth length of third spine; gill rakers 2 or 3, 3 or 4+1+14 or 15, 2 or 3; total, including rudiments, 22 to 25; longest raker 1.3 times longest filament, 2.5 in eye; jaws, vomer, and palatines with villiform teeth.

Pelvic fins reach and pass vent but not origin of anal; posterior margin of preoperculum weakly serrated, anterior margin smooth; upper jaw reaches vertical drawn through middle of eye; a pronounced interorbital depression; lateral line complete; ctenoid scales with 11 to 16 radii; mouth terminal.

Color in alcohol.—Body light tan; head light tan below, brownish above; brownish-black blotch just behind opercular flap and below lateral line; a narrow black lateral stripe beginning at lower edge of blotch and extending posteriorly, ending at the small, circular, black spot at base of caudal fin; diameter of caudal spot about three to four times in pupil; lateral stripe does not pass onto head; a black blotch on upper third of membrane between second and fourth spine of spiny dorsal fin, remainder transparent; pectoral and pelvic fins transparent; anal and soft dorsal fins with a dusky bar near and parallel to base, remainder transparent; caudal fin transparent to dusky, with outer two rays light brown.

APOGON ERYTHRINUS Snyder

Apogon erythrinus SNYDER, Bull. U. S. Fish. Comm. vol. 22, 1902, p. 526, pl. 9, fig. 17, 1904 (type locality, Puako Bay, Hawaii).

Apogan doryssa SCHULTZ, U. S. Nat. Mus. Bull. 180, p. 96, 1943.

SPECIMENS STUDIED

Bikini Atoll: 21 stations, 118 specimens, 11 to 35 mm. in standard length.
Eniwetok Atoll: 5 stations, 29 specimens, 16 to 34 mm.
Kwajalein Atoll: 1 station, 2 specimens, 14 to 19 mm.
Rongelap Atoll: 6 stations, 15 specimens, 19 to 34 mm.
Rongerik Atoll: 5 stations, 43 specimens, 14 to 33 mm.
Guam: 1 lot, 1 specimen, 30 mm.

Description.—Measurements were taken from 3 specimens, 31 to 34 mm. in standard length, and counts from 6 specimens. Dorsal rays VI–I,9; anal rays II,8; pectoral rays 13; vertical scale rows 23; scale rows above lateral line 2; scale rows below lateral line 6.

Body depth 2.5 to 2.7, body width 6.1 to 6.9, head length 2.4 to 2.5, head depth 3.3 to 3.8, caudal peduncle length 3.7 to 3.8, longest pectoral ray 3.7 to 3.8, all in standard length; diameter of eye 3.4 to 3.7, length of upper jaw 2.0, least depth of caudal peduncle 3.0, length of snout 4.3 to 5.0, least width of bony interorbital 4.0 to 4.9, all in length of head; eye in snout 0.7; gill rakers (8 specimens) 2 or 3, 1+1+5 or 6, 5 or 6, total 15 to 16 (table 39); longest raker about 1½ times longest filament, 2.7 in eye; jaws, vomer, and palatines with small villiform teeth.

Pelvic fins reach origin of anal fin; posterior margin of preopercle finely serrated, anterior margin smooth; lateral line complete; ctenoid scales with 7 to 10 radii; upper jaw reaching or slightly passing vertical drawn through posterior margin of pupil; mouth terminal; first spine of dorsal small, about 3 in eye; second spine longest, 2.5 times diameter of eye, 1.3 in head.

Color in alcohol.—Body and head light tan, without color pattern, only a small amount of dark pigmentation near middle of scales on dorsal portion of body, especially anterior to spinous dorsal; fins transparent.

Color in life.—Body and head light reddish pink; rays of fins reddish, membranes clear.

Remarks.—Sufficient material is not on hand from many points of the Indo-Pacific to clarify the systematics of this widely ranging species. Specimens from the Red Sea attain a larger average size, a greater number of gill rakers, and have shorter spines in the fins than do specimens taken east of the Philippine Islands. *Apogon erythrinus* and *A. doryssa* ((Jordan and Seale), Bull. U. S. Bur. Fish., vol. 25, 1905, p. 245, fig. 39, 1906) are considered distinct. *A. doryssa* differs in having longer dorsal and anal spines, larger eyes, a pointed snout, terminal mouth, and a more slender, elongated body. Also, owing to lack of comparative specimens, the relationships of *Amia cardinalis* Seale (Philippine Journ. Sci., vol. 4, No. 6, p. 509, 1909, Palawan Island) and *Apogon kominatoensis* Ebina (Journ. Imper. Fish. Inst., vol. 30, p. 211, fig. 1, 1934, Kominato, Bosyu

Province, Japan) and *A. crassiceps* Garman (Bull. Mus. Comp. Zool., vol. 39, p. 230, 1903) with *A. erythrinus* cannot be determined. (See also discussion under *A. leptacanthus*.)

APOGON LEPTACANTHUS Bleeker

PLATE 34, B

Apogon leptacanthus BLEEKER, Nat. Tijdschr. Nederl.-Indië, vol. 12, p. 204, 1856 (type locality, Ternate).

Apogon graffei GÜNTHER, (Fische der Südsee), Journ. Mus. Godeffroy, vol. 1, p. 22, pl. 20, fig. E, 1873 (Boston Island, Marshall Islands).

Amia hypselonota FOWLER and BEAN, U. S. Nat. Mus. Bull. 100, vol. 10, p. 91, 1930 (in part).

Mionorus graeffei JORDAN and SEALE, Bull. U. S. Bur. Fish., vol. 25, 1905, p. 247, fig. 41, 1906.

SPECIMEN STUDIED

Guam: U.S.N.M. No. 124165, Merizo, August 28, 1945, Markley, 1 specimen, 30 mm. standard length.

Description.—Counts and measurements were taken from the above specimen. Dorsal rays VI–I, 9; anal rays II,9; pectoral rays 13; vertical scale rows about 23; scale rows above lateral line 1; scale rows below lateral line 6.

Body depth 2.3, body width 7.0, head length 2.5, head depth 2.8, length of caudal peduncle 4.2, longest pectoral ray 4.0, longest dorsal ray about 2.3, all in standard length; diameter of eye 2.5, length of upper jaw 2.2, least depth of caudal peduncle 2.3, length of snout 4.4, least width of bony interorbital 4.0, all in length of head; eye in snout 0.5; gill rakers 1, 6+1+22, 0; rakers long and slender, longest about 3 times longest filament, 2 in eye; jaws, vomer, and palatines with minute villiform teeth.

Pelvic fins reach origin of anal fin; posterior margin of preopercle finely serrated, anterior margin smooth; lateral line complete; ctenoid scales with about 9 to 11 radii, anterior margin deeply scalloped; scales on midside of body deep, about 1.5 in eye; upper jaw reaching vertical line drawn touching anterior margin of pupil.

Color in alcohol.—Body and head almost colorless; some fine, small, brownish spots on side and top of head; fins transparent.

Remarks.—Salient characters of this species are the long, thin, filamentous extension of the second spine of the spiny dorsal and the laterally compressed and deep body. In these and other respects no distinctive differences were found among many specimens examined from the East Indies, the Philippines, Samoa, and Guam; therefore, *A. graffei* Günther is treated in the synonymy of *A. leptacanthus* Bleeker.

No fundamental data have been found that would substantiate the application of the name *Apogon hypselonotus* Bleeker (Nat. Tijdschr.

Nederl.-Indië, vol. 8, p. 309, 1855, Batu Archipelago) to this species. It is questionable just what species Bleeker examined. He gave a dorsal ray count of VI or VII–I,9 or 10 and an anal ray count of II,8 or 9 (Atlas ichthyologique des Indes Orientales Néerlandaises . . ., vol. 7, p. 94, vol. 8, pl. 353, fig. 4, 1873–76). These data suggest that two or more species were involved in his counts. His illustration of *hypselonotus* shows a dorsal ray count of VII–I,9. In body proportions and general coloration it approaches *A. erythrinus*.

The synonymy presented by Fowler and Bean (U. S. Nat. Mus. Bull. 100, vol. 10, p. 91, 1930) is erroneous. Such forms as *A. gilberti* (Jordon and Seale), *A. erythrinus*, *A. leptacanthus*, and *A. hypselonotus* Bleeker are distinctly separable, and each may represent one or more species.

APOGON GRACILIS (Bleeker)

Apogonichthys gracilis BLEEKER, Nat. Tijdschr. Nederl.-Indië, vol. 10, p. 371, 1856 (type locality, Ternate).

SPECIMENS STUDIED

Bikini Atoll: 2 miles off western reef, coughed up by *Katsuwonus pelamis*, August 1, 1947, S–46–507, Marr and O. Smith, 44 specimens, 16 to 20 mm.

Kwajalein Atoll: from stern of *Prince Eugen*, August 3, 1947, S–46–506, Brock, Schultz, and Donaldson, 2 specimens, 26 and 35 mm.

Rongelap Atoll: ½ mile off Rongelap Island, in lagoon, July 17 to 27, 1946, S–46–259, Herald, 15 specimens, 31 to 39 mm.; Rongelap Island, near north end, lagoon coral head at depth of 18 feet, July 25, 1946, S–46–286, Brock, Herald, and Kohler, 1 specimen, 28 mm.

Rongerik Atoll: Latoback Island, lagoon reef, June 28, 1946, S–46–238, Schultz and Herald, 1 specimen, 25 mm.

Description.—Counts and measurements, unless otherwise stated, were taken from four specimens ranging in size from 31 to 38 mm. in standard length. Dorsal rays (6 specimens) VI–I,9; anal rays (6 specimens) II,12 and 1 specimen II,13; pectoral rays ii,9,ii.

Body depth 3.7 to 4.1, head length 2.7 to 2.8, head depth 4.2 to 4.5, length of caudal peduncle 4.6 to 5.0, longest pectoral rays 3.1 to 3.4, all in standard length; diameter of eye 3.0 to 3.1, length of upper jaw 2.3 to 2.4, least depth of caudal peduncle 3.5 to 3.7, length of snout 4.0 to 4.5, least width of bony interorbital 5.0 to 5.3, all in length of head; eye about 0.7 in snout; gill rakers (8 specimens) 1 or 2, 5+1+17 to 19, 0 or 1, total 25 to 26; rakers comparatively long and slender, longest about 2 times longest filament, 1.8 in eye; villiform teeth in jaws, vomer, and palatines.

Pelvic fins reach anus, not origin of anal; both margins of preopercle smooth; scales ctenoid; upper jaw reaches vertical touching anterior margin of pupil; second spine of spiny dorsal longest,

about 2½ to 2¾ in head length; caudal fin deeply forked, length from base to tip of longest lobe about twice length from hypural base to fork; one flat opercular spine; lateral line complete.

Color in alcohol.—Body and head light tan with no conspicuous colors or pigmentation; tip of snout and lower jaw with a little dusky brown; a very narrow, vertical, dusky line at base of caudal, about as long as depth of caudal peduncle; some small dusky brown spots on spines of spiny dorsal, the membrane clear; lobes of caudal tipped with black; fins otherwise transparent.

Remarks.—These specimens have a more slender body and slightly larger eye than specimens from the Philippine Islands reported by Fowler and Bean (U. S. Nat. Mus. Bull. 100, p. 120, 1930), and the gill raker count is slightly lower (table 39). None of our specimens were mature, a fact which may account for some of the proportional differences. The gill raker count of *Apogon mentalis* ((Evermann and Seale), Bull. U. S. Bur. Fish., vol. 26, 1906, p. 74, fig. 10, 1907, Bacon, Luzon) is 1,6+1+18,1 totaling 27, which is similar to the counts in our specimens of *A. gracilis*. *A. mentalis* was described as having a rounded caudal fin and with two faint lateral streaks present on the anterior part of the body. The specimens of *gracilis* examined, as well as the type of *mentalis*, are in poor condition. The lateral streaks of *mentalis* may be an adult character. From the figure it is clear that Evermann and Seale speculated on the shape of the caudal fin, since it was drawn with broken lines. The type specimen has only the basal portion of the caudal fin. Additional comparative material is needed to clarify the status of *gracilis*, *mentalis*, and the Marshall Islands specimens.

APOGON CYPSELURUS (Weber)

Rhabdamia cypselurus WEBER, Notes Leyden Mus., vol. 31, No. 2, p. 167, 1909 (type locality, Ceram, East Indies).

SPECIMENS STUDIED

Bikini Atoll: Near Bikini Island, lagoon, July 10, 1948, 1 specimen, 24 mm. (This specimen is in poor condition; the head is eroded and torn, the scales are gone, and the fins are almost all torn away.)

The following specimens, all from the East Indies and Philippine Islands, were also studied: U.S.N.M. No. 152110, Jolo Island, *Albatross*, 66 specimens; uncataloged *Albatross* collections from the East Indies and the Philippines (reported on by Fowler and Bean, U. S. Nat. Mus. Bull. 100, vol. 10, p. 107, 1930), over 100 specimens.

Description.—The following counts and measurements were taken from the single specimen from Bikini and are followed by data in parentheses from 3 specimens, 37 to 40 mm., taken at Jolo Island (U.S.N.M. No. 152110), unless indicated otherwise. Dorsal rays

VI–I,9 (4 specimens: VI–I,9); anal rays II,9 (4 specimens: II,9); pectoral rays 14 (15).

Body comparatively elongate; depth 4.0 (3.5 to 3.8), head length 2.5 (2.5 to 2.7), length of caudal peduncle 4.2 (4.2 to 4.5), all in standard length; eye 3.2 (3.3 to 3.5), length of upper jaw 2.0 (1.9 to 2.3), depth of caudal peduncle 3.4 (3.4 to 3.7), length of snout 4.3 (4.1 to 4.3), all in length of head; snout in eye 1.4 (1.3 to 1.5); gill rakers, 3,2+1+10, 1 totaling 17 (16 specimens: range 16 to 18); rakers comparatively long and slender, longest about 1.7 times longest filament, 2 in eye; villiform teeth in jaws, vomer, and palatines.

Pelvic fins reach anus, not origin of anal; both margins of preopercle and suborbitals smooth; upper jaw almost reaches vertical drawn through middle of eye; scales ctenoid (all eroded from Bikini specimen), ranging from 22 to 24 in 3 specimens from the Philippine Islands; second spine of spiny dorsal longest; caudal fin forked; lateral line complete.

Color in alcohol.—Bikini specimen flesh colored, with some black pigmentation at tip of snout and chin and dusky on outer rays of caudal fin. Specimens from East Indies and Philippines similarly colored but having in addition a conspicuous dark-brown or black bar from tip of snout to eye. These specimens are much larger (over 40 mm.) and in better condition and state of preservation than those from Bikini. The fins, other than caudal, which is described above, are transparent.

Remarks.—This species is here reported for the first time from an island of Oceania.

APOGON FRAENATUS Valenciennes

Apogon fraenatus VALENCIENNES, Nouv. Ann. Mus. Hist. Nat. Paris, vol. 1, p. 57, pl. 4, fig. 4, 1832 (type locality, New Guinea and Guam).

SPECIMENS STUDIED

Bikini Atoll: ¼ mile off Amen Island, in lagoon, poison, 30 feet, August 4, 1946, S–46–307, Herald, Kohler, and Brock, 6 specimens, 36 to 67 mm.

Rongelap Atoll: Rongelap Island, near north end, lagoon coral head at depth of 18 feet, July 25, 1946, S–46–286, Brock, Herald, and Kohler, 3 specimens, 38 to 43 mm.

Description.—Counts and measurements were taken from three specimens 35 to 67 mm. in standard length. I have indicated when more counts have been made. Dorsal rays VII–I,9; anal rays II,8; pectoral rays ii,10 or 11,ii, or iii, ranging from 14 to 16; vertical scale rows 23 or 24; scale rows above lateral line 2; scale rows below lateral line 6 or 7.

Body depth 3.0 to 3.4, body width 5.0 to 5.8, head length 2.3 to 2.5, head depth 3.9 to 4.4, length of caudal peduncle 3.3 to 3.6, longest

pectoral ray 4.0 to 4.1, all in standard length; diameter of eye 3.0 to 3.9, length of upper jaw 2.2 to 2.3, least depth of caudal peduncle 2.7 to 3.0, length of snout 4.0 to 4.4, least width of bony interobital 5.5 to 6.1, all in length of head; eye in snout 0.8 to 0.9; spinous dorsal nearly as high as soft dorsal; third spine of spinous dorsal longest, just slightly longer than fourth spine, about 2.5 in length of head; second spine one-half length of third and first spine one-fifth length of second spine of spinous dorsal; second anal spine about 3.5 in head; gill rakers (5 specimens) 2,2+1+8 or 9, 4 or 5; total 17 to 18; longest raker equals longest filament, about 4 in eye; jaws, vomer, and palatines with small villiform teeth.

Pelvic fins reach vent but not anal origin; both margins of preopercle serrated, the serrations on the anterior edge stouter, longer, and less numerous; no serrations on lower angle of anterior edge of preopercle; some serrations on suborbitals; caudal fin emarginate; upper jaw passes vertical drawn through middle of eye, nearly reaching vertical drawn through posterior margin of pupil; lateral line complete; mouth subterminal; ctenoid scales with 9 to 15 radii.

Color in alcohol.—Body and head light tan; a horizontal dark-brown stripe on midbody from tip of snout on upper jaw through middle of eye, on opercle, and laterally on body to base of caudal fin, ending in a conspicuous, round, dark-brown spot at midbase of caudal; lateral stripe about one-half diameter of pupil and better developed on snout, sometimes obsolete on caudal peduncle; caudal spot about three-fourths diameter of pupil, present in all specimens examined from the northern Marshall and Philippine Islands; outer tips of membranes of first three spines of spinous dorsal blackish; outer rays of lobes of caudal fin dark brownish; very faint dark narrow band just above base of soft dorsal fin and below base of anal, parallel to base; remainder of fins transparent; these specimens appear badly faded.

APOGON EXOSTIGMA (Jordan and Starks)

Amia exostigma Jordan and Starks, *in* Jordan and Seale, Bull. U. S. Bur. Fish. vol. 25, 1905, p. 238, fig. 31, 1906 (type locality, Apia, Samoa).

Apogon frenatus Schultz, U. S .Nat. Mus. Bull. 180 p. 94, 1943 (in part).—Weber and de Beaufort, Fishes of the Indo-Australian Archipelago, vol. 5, p. 295, 1929 (in part).

SPECIMENS STUDIED

Bikini Atoll: 10 stations, 162 specimens, 16 to 84 mm. standard length.
Rongelap Atoll: 4 stations, 100 specimens, 21 to 77 mm.
Rongerik Atoll: 1 station, 7 specimens, 21 to 33 mm.

Description.—Counts and measurements from 6 specimens 46 to 79 mm. in standard length range as follows: Dorsal rays VII–I,9; anal rays II,8; pectoral rays (10 specimens) ii,9,ii to ii,10,i; vertical scale

rows 24 to 25; scale rows above lateral line 2; scale rows below lateral line 7.

Body depth 2.5 to 3.5, body width 5.3 to 6.5, head length 2.5, head depth 3.5 to 3.9, caudal peduncle length 3.5 to 4.0, longest pectoral ray 3.8 to 4.4, all in standard length; diameter of eye 3.0 to 3.5, length of upper jaw 2.1 to 2.7, least depth of caudal peduncle 2.3 to 2.7, length of snout 3.2 to 3.6, least width of bony interorbital 5.0 to 6.5, all in length of head; eye in snout 0.9 to 1.0; soft dorsal slightly higher than spinous dorsal; third spine of spinous dorsal longest, about twice as long as second, 2.1 to 2.2 in length of head; second spine of anal 3.2 in head; gill rakers (11 specimens) 1 or 2, 2 or 3+1+8 to 10, 3 to 5; total 18 to 19; longest raker a little longer than longest filament, 3.5 to 4.0 in eye; jaws, vomer, and palatines with small villiform teeth.

Pelvic fins pass vent, longer in males, sometimes reaching anal origin; both margins of preopercle serrated, serrations developed equally on both edges; suborbitals serrated, one or two enlarged serrations in adults; upper jaw reaches vertical drawn through middle of eye; lateral line complete; ctenoid scales with 12 to 15 radii.

Color in alcohol.—Body and head light tan; underpart of chin and belly somewhat dusky; a dark-brown lateral band from tip of snout through middle of eye to base of caudal fin, narrowing in width posteriorly to a narrow streak on caudal peduncle, less than one-half its width on opercle; a sharp, round, dark-brown spot at base of caudal, above lateral line; lower edge of spot not touching lateral line in adults, but about half the young and juvenile specimens with spot just touching lateral line; upper portion of membranes of first 3 spines of spinous dorsal blackish; a narrow blackish bar above and parallel to base of soft dorsal, remainder of soft dorsal transparent to dusky; pectorals transparent; pelvics dusky to transparent, with outermost membrane dusky; a narrow blackish bar below and parallel with base of anal, remainder of fin transparent to dusky; caudal transparent to light dusky, usually with two outermost rays dusky brown.

Color in life.—From Kodachrome transparency; body and fins as above but with area below midline of body more silvery; lateral band blackish, widest on side of head, narrowing toward caudal peduncle; narrow band above base of soft dorsal and anal blackish and conspicuous.

Remarks.—See remarks on *Apogon snyderi.*

APOGON SNYDERI Jordan and Evermann

PLATE 33, B

Apogon snyderi JORDAN and EVERMANN, Bull. U. S. Fish Comm., vol. 22, 1902, p. 180, 1904 (type locality, Honolulu).

Amia fraenata, FOWLER and BEAN, U. S. Nat. Mus. Bull. 100, vol. 10, p. 72, 1930 (in part).

Apogon frenatus SCHULTZ, U. S. Nat. Mus. Bull. 180 p. 94, 1943 (in part).—WEBER and DE BEAUFORT, Fishes of the Indo-Australian Archipelago, vol. 5, p. 295, 1929 (in part).

Apogon frenatus yaeyamaensis AOYAGI, Coral fishes, pt. 1, p. 79, fig. 19, 1943.

SPECIMENS STUDIED

Bikini Atoll: 12 stations, 217 specimens, 26 to 93 mm. standard length.
Entiwetok Atoll: 2 stations, 46 specimens, 53 to 96 mm.
Kwajalein Atoll: 1 station, 2 specimens, 27 to 36 mm.
Rongelap Atoll: 7 stations, 66 specimens, 31 to 97 mm.
Likiep Atoll: Univ. Washington, 4 specimens, 54 to 73 mm.
Rongerik Atoll: 4 stations, 34 specimens, 28 to 97 mm.
Guam: 2 lots, 4 specimens, 45 to 60 mm.

Description.—Counts and measurements were taken from 5 specimens, 57 to 97 mm. in standard length, unless otherwise indicated. Dorsal rays VII–I,9; anal rays II,8; pectoral rays (7 specimens) ii,9,ii to ii,10,i; vertical scale rows 23 to 25; scale rows above lateral line 2; scale rows below lateral line 7.

Body depth 2.5 to 3.9, body width 5.6 to 6.2, head length 2.5, head depth 3.5 to 3.6, length of caudal peduncle 3.4 to 3.9, longest pectoral ray 3.8 to 4.4, all in standard length; diameter of eye 3.0 to 3.5, length of upper jaw 2.1 to 2.2, least depth of caudal peduncle 2.5 to 2.7, length of snout 3.8 to 3.9, least width of bony interorbital 5.0 to 6.0, all in length of head; eye in snout 0.9; soft dorsal slightly higher than spinous dorsal; third spine of spinous dorsal longest, twice as long as second, about 2.2 in length of head; second anal spine 3 in head; gill rakers (7 specimens) 1 to 3, 2 or 3+1+9 or 10, 3 to 5; total 18 to 19; longest raker about 1.2 to 1.5 times longest filament; jaws, vomer, and palatines with small villiform teeth.

Pelvic fins pass vent, sometimes reaching anal origin; both margins of preopercle serrated. Those on the anterior edge longer and stouter than those on posterior edge; suborbitals serrated; caudal fin moderately forked; upper jaw reaches vertical drawn through middle of eye; lateral line complete; ctenoid scales with 11 to 13 radii.

Color in alcohol.—Body and head dusky to tan, some specimens darker; a dark-brown lateral band, its width one-half diameter of eye, extends from tip of snout on side of head behind middle of eye and posteriorly to area of base of caudal fin, evident in young, sometimes not discernible in adults; a large, dark-brown spot, circular to oval, at base of caudal above lateral line, lower edge of spot touching lateral line; a diffuse, dark-brown band encircling base of caudal, passing through spot; a faint caudal spot just below lateral line present in some larger adults; sometimes a diffuse dark-brown blotch at base of soft dorsal; membrane between first and second spine of spinous dorsal, upper half of membrane between second and third

spine and upper third between third and fourth spine brownish black, remainder of spinous dorsal dusky; soft dorsal with a row of brownish spots on membranes just above and parallel to base, forming a bar; another group of spots on membranes near center of soft dorsal in a more or less irregular row and sometimes merging with basal band; remainder of fin transparent to dusky; outer two rays of caudal fin brownish to tips of fork, remainder dusky to transparent, anal fin with a brownish black band just below and parallel with base, remainder of fin transparent; pectorals transparent; membranes of outer first two rays of pelvics brownish, remainder dusky to transparent.

Remarks.—This species is remarkably similar to *A. exostigma* in body proportions and color pattern. No differences were found in meristic counts and only minor differences in certain measurements between them. The general color pattern of these species exhibits an interesting parallelism. Specific differences between these species among the young to adults are given in the key and in table 41.

A. snyderi is also represented in the U. S. National Museum collections from Johnston Island and the Hawaiian, Samoan, and Tuamotu Islands.

The broad, nontapering lateral stripe on the body, the spot above the midbase of the caudal fin, and the diffuse blotch at the base of the soft dorsal fin as shown on the figure by Aoyagi clearly demonstrate that *A. frenatus yaeyamaensis* and *A. snyderi* are identical.

APOGON MENESEMOPS, new species

FIGURE 78

Holotype.—A male specimen, U.S.N.M. No. 142232, Bikini Atoll, Enyu Island, ocean reef at channel entrance, August 1, 1947, S–46–483, Schultz, Brock, and Hiatt, 103 mm. standard length.

Paratypes.—U.S.N.M. No. 142283, same locality and bearing same data as for holotype, 2 specimens, 101 and 113 mm. standard length; U.S.N.M. No. 142284, Bikini Atoll, Enyu Island, reef at entrance just inside lagoon, March 16, 1946, S–46–8, Schultz, Brock, and Marr, 2 specimens, 108 and 115 mm. standard length.

Description.—Based on the holotype and paratypes listed above. Counts and measurements are recorded for the holotype, followed in parentheses by data from the paratypes. Measurements are expressed in thousandths of the standard length. The mean and range for the counts and measurements are given for the paratypes, and if similar to the holotype, only one number is recorded.

Dorsal rays VII–I,9; anal rays II,8; pectoral rays 13 (mean 13.3, range 13 to 14); vertical scale rows 25; scale rows above lateral line 2; scale rows below lateral line 7 (mean 7.5, range 7 to 8).

TABLE 41.—*Frequency distributions of body depth and diameter of caudal spot in three size ranges of two species of* Apogon *from the northern Marshall Islands*

Standard length in millimeters	Species	Body depth in percent of standard length						Greatest diameter of caudal spot in least depth of caudal peduncle				Greatest diameter of caudal spot in pupil		
		28–29	30–31	32–33	34–35	36–37	38–39	2	3	4	5	0.5–0.6	0.7–0.8	0.9–1.0
25–44	*exostigma*	2	5	3				2	4	5		5	3	3
	snyderi		1	8	4			6	6	1			5	8
45–64	*exostigma*	1	3	9					1	6	6	10	3	
	snyderi		1	4	3	5		1	9	2			6	6
65–84	*exostigma*	1		6	1					4	5	6	2	
	snyderi				2	6	4	1	10	1			4	8

Greatest body depth 334 (mean 354, range 338 to 374); length of head 393 (395, 387 to 407); head depth at occiput 266 (285, 268 to 296); length of caudal peduncle 266 (288, 278 to 301); least depth of caudal peduncle 156 (154, 148 to 161); length of longest pectoral ray 252 (251, 238 to 260); length of third spine of spinous dorsal 214 (186, 185 to 190); length of second spine of anal 117 (124, 120 to 129); diameter of eye 126 (123, 120 to 125); length of upper jaw 204 (208, 203 to 213); length of snout 106 (107, 100 to 120); least width of bony interorbital 83 (86, 83 to 89); tip of snout to origin of spinous dorsal fin 390 (400, 390 to 425); tip of snout to origin of anal fin 610 (623,

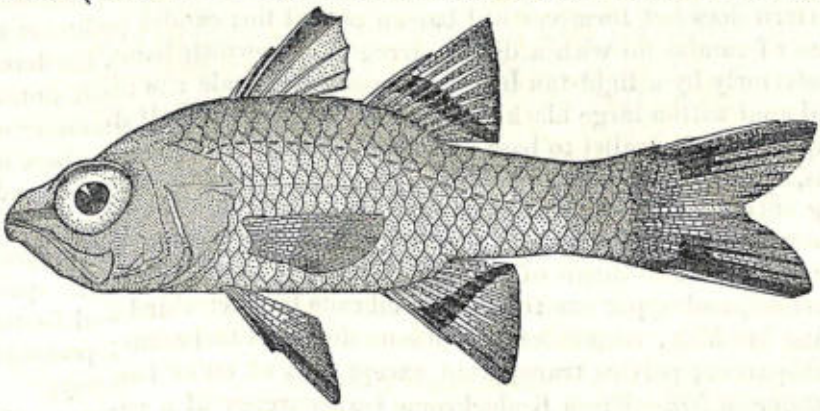

FIGURE 78.—Holotype of *Apogon menesemops*, new species (U.S.N.M. No. 142232), from Bikini Atoll. (Drawing by Aime M. Awl.)

610 to 633); tip of snout to insertion of pectoral fins 378 (384, 368 to 405); tip of snout to insertion of pelvic fins 379 (395, 380 to 435); tip of snout to anal opening 550 (562, 540 to 575); gill rakers 6+1+17 (5 or 6+1+16 or 17), total 22 to 24.

First spine of spinous dorsal about one-third length of second spine, second spine almost one-half length of third; jaws and vomer with small villiform teeth, none on palatines; both margins of preopercle serrated; serrations stronger and larger on anterior edge of preopercle; some serrations on lower edge of orbit; ctenoid scales with about 12 to 21 radii; fine ctenii limited to about 10 rows on posterior margin of scale; upper jaw reaches vertical through posterior margin of pupil; body slab sided; mouth terminal; lateral line complete; peritoneum silvery; operculum with one flat spine; gill rakers slender, longest raker about 1.2 times longest filament, about 2.2 to 2.7 in diameter of eye; no apparent sexual dimorphism in size, color, or body form; largest male 115 mm. in standard length, largest female 113 mm.

Color in alcohol.—Body light tan to light brown above, grading to a silvery tan to dark tan on belly; head dusky tan; some silvery blue iridescence laterally on body, on belly, and on parts of head, especially

the opercle; a blackish, broad, diffuse stripe from tip of snout to eye, its width about one-half diameter of pupil of eye, barely discernible or obsolete on head behind eye; a very narrow broken light-brown streak on midside of head on two specimens, obscure on caudal peduncle.

Characteristic of this species is the color pattern of the fins, particularly the caudal. Lobes of the caudal fin from tips of outer three rays (two are branched) to area almost to scaly basal portion of fin dense black, with heavy black pigmentation on third to fifth rays about midway between fork of caudal fin and last scales on fin; this blackish pattern does not form vertical bar on caudal fin; caudal peduncle at base of caudal fin with a diffuse, irregular brownish band, bordered posteriorly by a light-tan bar just beyond last scale row; soft dorsal and anal with a large black bar, its width about one-half diameter of pupil of eye, parallel to base and about 1½ that of bar from base of fins, slightly farther from soft dorsal base than anal base, and extending entire length of fins; remainder of dorsal and anal fins nearly transparent; all of membrane between first and second dorsal spine black, upper two-thirds of membrane between second and third spine blackish, and upper one-third of membrane between third and fourth spine blackish; remainder of spinous dorsal transparent; pectorals transparent; pelvics transparent except tips of outer two rays.

Color in life.—From Kodachrome transparency of a paratype 101 mm. in standard length: Body dark brown above midbody line; belly silvery to dusky tan; free edges of many scales above lateral line light colored; top of head, snout, and chin dark brown; slivery to brown behind eye on opercular area; some yellow in iris; pupil black; bar before eye on snout blackish; pectoral fin light pink; black bar of anal fin bordered above and below with milky white, remainder of fin transparent; black marking of soft dorsal bordered behind by white, and remainder of fin transparent; portion of fin between bar and base of spinous dorsal whitish, remainder of fin transparent; a black band encircling caudal peduncle at base of caudal; outer developed rays of caudal edged with some white; tips of rays and membranes of caudal blackish, remainder of caudal colored as described above.

Remarks.—This species is closely related to *A. menesemus* Jenkins (Bull. U. S. Fish Comm., vol. 22, 1902, p. 448, fig. 19, 1904). It portrays another example in the family where the differentiation has apparently been limited to the modification of an outstanding color mark. Meristic counts, measurements, and general color pattern agree closely with *A. menesemus*. Differentiation of the color pattern of the caudal fin has occurred. In *A. menesemus* the dense black markings of the caudal fin just posterior to the last scales unite to form a sharp vertical bar or arc with the markings of the outer lobe.

Apogon menesemus is represented in the U. S. National Museum by 10 collections from Johnston Island and the Hawaiian Islands. No accounts in the literature suggest its occurrence elsewhere in the Indo-Pacific region. Nearly all these specimens have dusky, irregular markings in about four horizontal rows on body.

Named *menesemops* in view of its great similarity to *A. menesemus*.

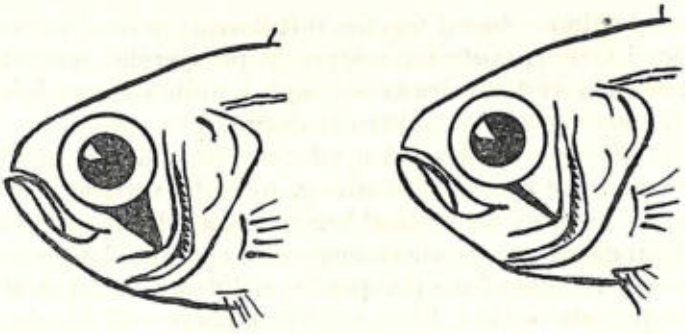

FIGURE 79.—Color mark below eye in certain species of *Apogon*: *a*, *A. savayensis* Günther; *b*, *A. nubilus* Garman. (Sketches by author.)

APOGON NUBILUS Garman

FIGURE 79, *b*; PLATE 35, C

Apogon nubilus GARMAN, Bull. Mus. Comp. Zool., vol. 39, pp. 229–230, pl. 1, fig. 1, 1903 (type locality, Suva, Fiji Islands).

SPECIMENS STUDIED

Bikini Atoll: 12 stations, 86 specimens, 13 to 72 mm. standard length.
Eniwetok Atoll: 4 stations, 177 specimens, 9 to 73 mm.
Rongelap Atoll: 6 stations, 34 specimens, 16 to 66 mm.
Rongerik Atoll: 4 stations, 9 specimens, 14 to 79 mm.
Guam: 5 lots, 82 specimens, 25 to 72 mm.
Likiep Atoll: Univ. Washington, 2 specimens, 61 to 63 mm.

Description.—Counts and measurements were taken from 4 specimens 33 to 67 mm. in standard length, unless indicated otherwise. Dorsal rays VII–I,9; anal rays II,8; pectoral rays (19 specimens) ii,9,ii; (8 specimens) ii,10,i; vertical scale rows 24 to 26; scale rows above lateral line 2; scale rows below lateral line 6.

Body depth 2.4 to 2.5, head length 2.2 to 2.5, head depth 3.1 to 3.3, caudal peduncle length 3.9 to 4.0, longest pectoral ray 3.5 to 4.0, all in standard length; diameter of eye 2.4 to 2.8, length of upper jaw 2.0 to 2.5, least depth of caudal peduncle 2.3 to 2.7, length of snout 4.1 to 5.0, least width of bony interorbital 4.0 to 4.1, all in length of head; eye in snout 0.4 to 0.5; spinous dorsal about one-half as high as soft

dorsal; third spine of spinous dorsal longest, 2.2 to 2.8 in length of head; second spine slightly less than one-half length of third spine; first spine small, about one-fifth length of second; gill rakers 1 to 3, 5 to 7+1+16 to 19, total 25 to 28; rakers long and slender, finely denticulated on inner surface; longest raker about 2 to 2.3 times longest filament, 2 in eye; jaws, vomer, and palatines with villiform teeth.

Depressed spinous dorsal touches soft dorsal; pelvic fins reach vent but not anal origin; posterior margin of preopercle serrated; upper jaw just reaches vertical drawn through middle of eye; lateral line complete; ctenoid scales with 10 to 14 radii.

Color in alcohol.—Body and head vary from dusky to silvery to dark brown; some specimens with six to eight vertical silvery bars separated by wider dusky vertical bars; dark mark extending from below eye to angle of preopercle elongate and narrow, about same width below eye as at angle of the preopercle; a diffuse dark spot at base of caudal fin just above lateral line in adults, never well developed over dorsal part of caudal peduncle to form a saddle; sometimes only faintly visible or obsolete; caudal spot diffuse in young and juveniles, located more nearly on central part of caudal base than in the adults; upper portion of membrane of spinous dorsal blackish, more so between third and fifth spines; remainder of spinous dorsal and other fins light dusky to clear.

Color in life.—From Kodachrome transparency, body laterally dark purple with irregular vertical silvery stripes; belly dusky to silvery, with some purple; head deep purple; pectoral fin transparent and colorless; membrane between third and fifth spine of spiny dorsal light bluish, remainder dusky to light brown; soft dorsal and anal fins transparent to light brown, darker brown near bases; anal light brown to transparent.

APOGON SAVAYENSIS Günther

FIGURE 79, *a*; PLATE 36

Apogon savayensis GÜNTHER, Proc. Zool. Soc. London, 1871, p. 656 (type locality, Savay, Samoa and Manado, Celebes).

SPECIMENS STUDIED

Bikini Atoll: 7 stations, 21 specimens, 17 to 73 mm. standard length.
Kwajalein Atoll: 1 station, 1 specimen, 19 mm.
Rongelap Atoll: 5 stations, 59 specimens, 13 to 61 mm.
Rongerik Atoll: 2 stations, 3 specimens, 27 to 33 mm.

Description.—Statistics refer to counts and measurements of three specimens, 44 to 57 mm. in standard length, unless stated otherwise. Dorsal rays (8 specimens) VII–I,9; anal rays (8 specimens) II,8;

pectoral rays (7 specimens) ii,9,ii; vertical scale rows 23 to 24; scale rows above lateral line 2; scale rows below lateral line 6.

Body depth 2.5 to 2.6, head length 2.3, head depth 2.9 to 3.0, length of caudal peduncle 3.7 to 4.0, longest pectoral ray 3.5 to 3.7, all in standard length; diameter of eye 2.4 to 2.6, length of upper jaw 2.0, least depth of caudal peduncle 2.5 to 2.8, length of snout 4.8 to 5.1, least width of bony interorbital 3.7 to 4.7, all in length of head; eye in snout 0.4 to 0.5; fourth spine of spinous dorsal longest, about 2.4 in length of head, slightly smaller than third spine; third spine about 2 times greater than second; gill rakers 3,5 to 0,7+1+17 to 20, total 26 to 29; rakers slender, longest raker twice length of longest filament, 2 to 2.2 times in eye; jaws, vomer, and palatines with villiform teeth.

Depressed spinous dorsal reaches origin of soft dorsal; pelvic fins usually reach vent but not origin of anal fin; posterior margin of preopercle serrated; upper jaw passes vertical drawn through middle of eye; lateral line complete; ctenoid scales with 12 to 16 radii.

Color in alcohol.—Body and head light to darkish tan, head more dusky; body sometimes with about six vertical narrow silvery bars laterally, separated by wider dusky bands; these vertical bands often irregular tending to be completely obscure; three characteristic markings are (1) a large triangular or wedge-shaped dark-brown mark extending from below the eye to angle of anterior margin of preoperculum; (2) a dark-brown saddle at base of caudal fin, not extending below lateral line in adults (in young and juveniles this saddle is almost a complete band that nearly encircles the caudal peduncle); and (3) a conspicuous dark brown streak in the outer two branched caudal rays; outermost unbranched caudal ray usually clear or white, contrasting with dark brown streak; pectoral, pelvic, soft dorsal, and anal fins clear to slightly dusky; anterior and outer portion of spinous dorsal blackish, remainder of fin dusky to clear; caudal, other than dark brown streak, light dusky to clear.

Remarks.—The relationships of this species with other closely related forms, as *Apogon bandanensis* Bleeker and *Apogon nubilus* Garman, have recently been discussed by Lachner (Proc. U. S. Nat. Mus., vol. 101, pp. 598–604, 1951). (See plate 38, B.)

APOGON NOVEMFASCIATUS Cuvier and Valenciennes

PLATE 37, B

Apogon novemfasciatus CUVIER and VALENCIENNES, Histoire naturelle des poissons, vol. 2, p. 154, 1828 (type localities, Timor and Guam).

Apogon novemfasciata SCHULTZ, U. S. Nat. Mus. Bull. 180, p. 95, 1943 (in part).

Apogon fasciatus Günther (in part), Journ. Mus. Godeffroy, p. 19, taf. 20, fig. B (not A), 1873.

SPECIMENS STUDIED

Bikini Atoll: 15 stations, 130 specimens, 17 to 73 mm. standard length.
Eniwetok Atoll: 4 stations, 18 specimens, 23 to 67 mm.
Rongelap Atoll: 1 station, 16 specimens, 17 to 66 mm.
Rongerik Atoll: 3 stations, 13 specimens, 17 to 69 mm.
Guam: 6 lots, 46 specimens, 18 to 62 mm.
Rota: 3 lots, 10 specimens, 14 to 62 mm.

Description.—Counts and measurements from four specimens, 49 to 74 mm. in standard length: Dorsal rays VII–I,9; anal rays II,8; pectoral rays 14; vertical scale rows 24 to 25; scale rows above lateral line 2; scale rows below lateral line 6.

Body depth 2.8 to 3.0, body width 6.1 to 6.8, head length 2.6 to 2.7, head depth 3.4 to 3.6, length of caudal peduncle 3.4 to 3.8, longest pectoral ray 4.0 to 4.1, all in standard length; diameter of eye 2.9 to 3.0, length of upper jaw 2.0, least depth of caudal peduncle 2.1 to 2.3, length of snout 4.0, least width of bony interorbital 5.3 to 6.0, all in length of head; eye in snout 0.7 to 0.8; soft dorsal slightly higher than spinous dorsal; third spine of spinous dorsal longest, about 1.9 in length of head; second spine of anal about 3.0 in length of head; gill rakers, 19 specimens, 2 or 3, 3 or 2+1+10 to 13, 2 or 3; total 19 to 22; longest raker about 1.4 times longest filament; jaws, vomer, and palatines with small villiform teeth.

Pelvic fins reach or pass vent, longer in males, sometimes reaching origin of anal; posterior margin of preopercle finely serrated; lateral line complete; ctenoid scales with 14 to 18 radii.

Color in alcohol.—Body and head light tan; chin to belly dusky to brown; head and body with five characteristic, wide, dark-brown stripes; dorsal stripe begins behind midinterorbital region and extends almost to first procurrent rays of caudal fin, dividing at origin of spinous dorsal, and uniting at end of base of soft dorsal, where it passes on dorsal side of caudal peduncle in linear arranged spots; dorsolateral stripe begins at tip of snout, passing dorsal edge of eye and extending posteriorly to area just beyond upper portion of midbase of caudal fin, where it proceeds at an angle in a straight line toward fork of caudal; a medium stripe passes from tip of snout through middle of eye and onto body and central part of caudal fin to fork; a ventrolateral stripe extends from snout beneath eye, through pectoral base and onto lower part of caudal peduncle where it proceeds at an angle inward at area of procurrent caudal rays, toward fork, uniting just before fork with median and dorsolateral stripes; a diffuse ventral stripe passes from tip of lower jaw to angle of jaw and through bases of pelvics, uniting before anal base, sometimes incompletely developed; spinous dorsal trasparent; soft dorsal with a dark brown bar, nearly parallel to base and touching anterior base of fin, remainder of fin transparent; pectoral fin transparent, its base dark brown,

forming a distinct spot; pelvics transparent; anal with blackish brown bar nearly parallel and touching anterior base, sometimes so diffuse as to be barely discernible; caudal transparent other than characteristic uniting of three body stripes just before fork, described above.

Remarks.—The dorsolateral, ventrolateral, and midbody stripes form a W-shaped marking on the caudal fin that chiefly distinguishes this species from several closely related forms.

The great similarity of the five species (see table 40) related to *Apogon fasciatus* in meristic counts, measurements, and color pattern has led to considerable differences of opinion and decisions by many authors on what may be considered valid species. Radcliffe's key characters (Proc. U. S. Nat. Mus., vol. 41, p. 246, 1911), size of eye and body depth, do not hold for these species.

With the abundance of specimens on hand for study of this group, I find no evidence to treat them as subspecies, as was done by McCulloch (Report on Some Fishes Obtained by the F. I. S. *Endeavour*, vol. 3, p. 115, 1915). Three species were found in the Marshall Islands and the distinguishing color patterns of the caudal fins showed no intergradations; this also holds true for at least five species known from the Philippine Islands. McCulloch states, "Radcliffe has drawn up a key in which structural differences between the several forms are noted, but I find these unreliable and variable with growth." I agree with these remarks in regard to such characters as size of eye and body depth. However, I find no variation in the dorsal count of VI–I,9 and the anal count of II,9 for specimens of *A. compressus* from the Philippines and East Indies, and I do not associate this species with the *fasciatus* group.

Apogon cooki Macleay (Proc. Linn. Soc. New South Wales, vol. 5, p. 344, 1881) is considered in the synonymy of *A. fasciatus*. It is unfortunate but I can reach no decision on the status of *Apogon endekataenia* Bleeker (Nat. Tidschr. Nederl.-Indië, vol. 3, p. 499, 1852). Bleeker's description is not sufficiently complete to segregate any one species in this group, and the location of the type is not known. His figure of this species (Atlas Ichthyologique des Indes Orientales Néerlandaises . . ., vol. 7, p. 85, pl. (32) 310, fig. 2, 1873–76) does not conform in color pattern with any of our specimens from the East Indies and the Philippine Islands. The figure is in disagreement with the species of this group in the key in having: Six narrow horizontal body stripes rather than five; two stripes passing through the pectoral base on the upper and lower portion, rather than one through the middle of the base; two dorsolateral stripes between the middorsal and midbody stripe through middle of eye rather than one stripe; and no narrow black to dark brown bar near and almost parallel with the base of the anal fin.

Among other species the following are undoubtedly closely related to the *fasciatus* group: *Apogon holotaenia* Regan (Journ. Bombay Nat. Hist. Soc., vol. 16, No. 2, p. 319, 1905), *A. melanotaenia* Regan (ibid., p. 320), and *Lovamia saipanensis* Fowler (Proc. Acad. Nat. Sci. Philadelphia, vol. 97, p. 63, figs., 5–6, 1945). The species of this group can be properly understood only when sufficient collections are available for critical study from the geographic ranges of all the species and when existing types can be compared. The counts and proportional measurements show little or no differences in the species I had available for study. The main differentiation is in the color pattern of the body, especially the development of the horizontal dark stripes and color pattern of the caudal fin. As may be seen from table 40, significant differences were found in the total number of gill rakers among six species and in the number and ratio of developed and rudimentary gill rakers on each limb. The diagnostic characters distinguishing the more closely related species of the *fasciatus* group occurring in the islands of Oceania and the Philippines are given in the key (p. 438).

APOGON ROBUSTUS (Smith and Radcliffe)

FIGURE 80

Amia robusta SMITH and RADCLIFFE, Proc. U. S. Nat. Mus., vol. 41, p. 254, fig. 2, 1911 (type locality, Jolo Reefs).

Amia fasciata stevensi MCCULLOCH, Report on some fishes obtained by the F. I. S. *Endeavour*, vol. 3, p. 118, pl. 16, fig. 2, 1915.

Amia novemfasciata (in part) JORDAN and SEALE, Bull. U. S. Bur. Fish., vol. 25 (1905), p. 242, fig. 37, 1906.

Apogon endekataenia (in part) WEBER and DE BEAUFORT, Fishes of the Indo-Australian Archipelago, vol. 5, p. 306, 1929.

Apogon novemfasciata (in part) SCHULTZ, U. S. Nat. Mus. Bull. 180, p. 95, 1943.

SPECIMENS STUDIED

Bikini Atoll: 15 stations, 59 specimens, 19 to 72 mm. standard length.
Eniwetok Atoll: 2 stations, 5 specimens, 54 to 70 mm.
Kwajalein Atoll: 20 specimens, 22 to 66 mm.
Rongelap Atoll: 5 stations, 14 specimens, 29 to 71 mm.
Rongerik Atoll: 21 specimens, 15 to 74 mm.
Guam: 5 lots, 89 specimens, 21 to 85 mm.
Rota: 1 lot, 5 specimens, 39 to 66 mm.

Description.—Counts and measurements from four specimens 44 to 63 mm. in standard length unless designated otherwise: Dorsal rays VII–I,9; anal rays II,8; pectoral rays 14, vertical scale rows 23 to 24; scale rows above lateral line 2; scale rows below lateral line 6.

Body depth 2.5 to 3.1, body width 4.9 to 6.8, head length 2.5 to 2.8, head depth 3.2 to 3.4, length of caudal peduncle 3.5 to 3.8, longest pectoral rays 3.8 to 4.1, all in standard length; diameter of eye 2.7 to 3.1, length of upper jaw 2.0, least depth of caudal peduncle 2.2 to 2.6, length of snout 4.0 to 4.2, least width of bony interorbital 4.5 to 5.3, all

in length of head; eye in snout 0.6 to 0.8; soft dorsal only slightly higher than spinous dorsal; third spine of spinous dorsal longest, about twice length of second spine, 2.0 in length of head; second anal spine 2.7 to 3.2 in head; gill rakers (34 specimens) 3 or 4, 2+1+9 or 10, 3 or 4; total 17 to 20; longest rakers about 2.3 in diameter of eye; longest filament two-thirds longest raker; jaws, vomer, and palatines with small villiform teeth.

Pelvic fins reach base of anal in some specimens; anterior margin of preopercle smooth, posterior margin finely serrated; lateral line complete; ctenoid scales with 9 to 16 radii.

Color in alcohol.—Body and head light tan, sometimes darker tan; chin and belly dusky to silver; five horizontal dusky brown stripes

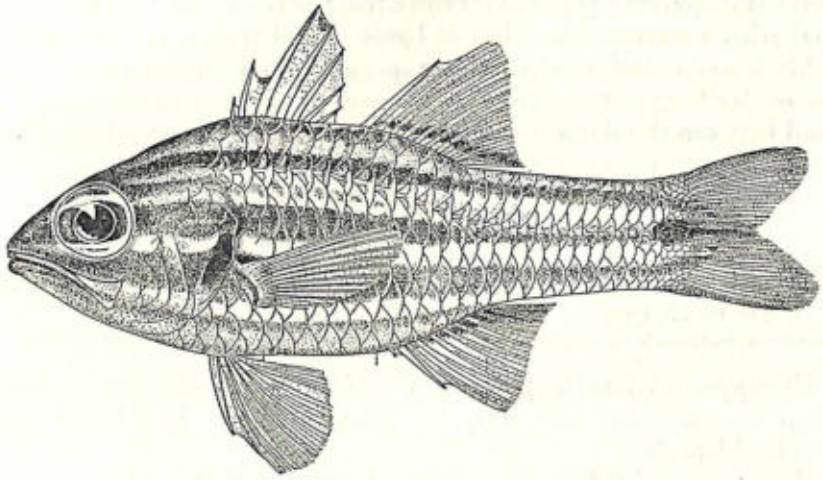

FIGURE 80.—Holotype of *Apogon robustus* (Smith and Radcliffe) (U.S.N.M. No. 68400), Jolo Island, P. I.

extend from head to caudal peduncle or caudal fin; dorsal, dorsolateral, and midbody stripes well developed and usually not faded; ventrolateral and ventral (belly) stripes faint, sometimes obscure; dorsal stripe begins at about the region of the midhead, between the eyes, and extends to base of spinous dorsal, dividing and passing around base of dorsal, uniting at end of soft dorsal and extending from dorsal side of caudal peduncle to tips of outer rays on lobes of caudal fin; dorsolateral stripe extends from snout, over eye on body just above lateral line to upper portion of caudal peduncle and ending on the lower fourth of the base of the rays of the caudal fin; median stripe passes from tip of snout through middle of eye and on midbody to midbase of caudal fin, where it is enlarged, forming an elongate, diffuse spot; horizontal diameter more than twice the vertical diameter and horizontal diameter about 1.2 to 1.5 in eye; a streak passes from spot to fork of caudal fin; caudal spot variable in its development from faintly pigmented to densely pigmented, and vary-

ing from rectangularly to elongate oval; occasionally not discernible from stripe; ventrolateral stripe extends from side of snout, below eye, through pectoral base and onto body and lower portion of caudal peduncle, passing onto caudal fin, as does dorsolateral stripe; a brown to dark-brown spot on edge of opercle adjacent to pectoral base, usually darker than stripe passing through this area; ventral or belly stripe begins at tip of lower jaw, passes between pectoral and pelvic bases on each side, to base of anal, unites and ends at base of last anal ray; spinous dorsal fin dusky, blackish at tips of membranes; soft dorsal with a black bar near base and almost parallel with base; anterior and widest portion of bar of soft dorsal about one-third as high as longest rays and nearly twice as wide in males as in females, remainder of fin transparent; pectorals transparent; pelvics with tips blackish; anal with a narrow black bar at base; caudal with outer rays edged in black and a blackish streak from spot at midbase of fin to fork; short postocular bar or stripe from upper part of eye posteriorly to end of head between the dorsolateral and midbody stripe, generally present, conspicuous to faint, sometimes obliterated.

APOGON NIGROFASCIATUS, new species

FIGURE 81; PLATE 37, C, D

Amia aroubiensis JORDAN and SEALE, Bull. U. S. Bur. Fisheries, vol. 25, 1905, p. 241, fig. 35, 1906.

Apogon aroubiensis SCHULTZ, U. S. Nat. Mus. Bull. 180, p. 95, 1943.

Holotype.—A female specimen, U.S.N.M. No. 142230, Bikini Atoll, Yuro Island, ocean reef, July 13, 1946, S–46–251, Herald, 61 mm. standard length.

Paratypes.—U.S.N.M. No. 142285, Bikini Atoll, Enyu Island, reef at entrance just inside lagoon, March 16, 1946, S–46–8, Schultz, Brock, and Marr, 9 specimens, 49 to 65 mm. in standard length; U.S.N.M. No. 142286, Bikini Atoll, Erik Island, west end, ocean reef, March 19, 1946, S–46–9, Schultz and Brock, 1 specimen, 51 mm.; U.S.N.M. No. 142289, Bikini Atoll, Namu Island, lagoon reef, April 3, 1946, S–46–50, Schultz, 1 specimen, 67 mm.; U.S.N.M. No. 142287, Bikini Atoll, Airy Island, ocean reef in surf, April 16, 1946, S–46–96, Schultz, 1 specimen, 66 mm.; U.S.N.M. No. 142298, Bikini Atoll, lagoon side, Airy Island, April 17, 1946, S–46–97, Schultz, 8 specimens, 40 to 62 mm.; U.S.N.M. No. 142295, same data as for holotype, 5 specimens, 37 to 62 mm.; U.S.N.M. No. 142296, Bikini Atoll, Bikini Island, ocean reef, July 16, 1946, S–46–253, Herald, 7 specimens, 24 to 58 mm.; U.S.N.M. No. 142288, Bikini Atoll, Arji Island, lagoon side, August 7, 1946, S–46–308, Brock, and Herald, 1 specimen, 47 mm.; U.S.N.M. No. 142297, Bikini Atoll, N.W. section Reer Island, lagoon reef, August 12, 1946, S–46–332, Herald and Brock, 6 specimens, 26 to 62 mm.; U.S.N.M. No. 142294, Bikini Atoll, Cherry Island, outer reef,

August 15, 1946, S–46–361, Herald, 2 specimens, 21 and 58 mm.; U.S.N.M. No. 142290, Bikini Atoll, Eman Island, ocean surf and reef, July 19, 1947, S–46–441, Schultz, Brock, Myers, and Hiatt, 1 specimen, 73 mm.; U.S.N.M. No. 142293, Bikini Atoll, shallow tidal pond between Eman and Reer Islands, ocean reef, July 18, 1947, S–46–422, Brock, Hiatt, Schultz, and Myers, 7 specimens, 23 to 68 mm.; U.S.N.M. No. 142292, Bikini Atoll, Namu Island, lagoon reef, August 6, 1947, S–46–508, Schultz, Brock, and Hiatt, 19 specimens, 21 to 70 mm.; U.S.N.M. No. 142291, Bikini Atoll, Namu Island, ocean reef and surf,

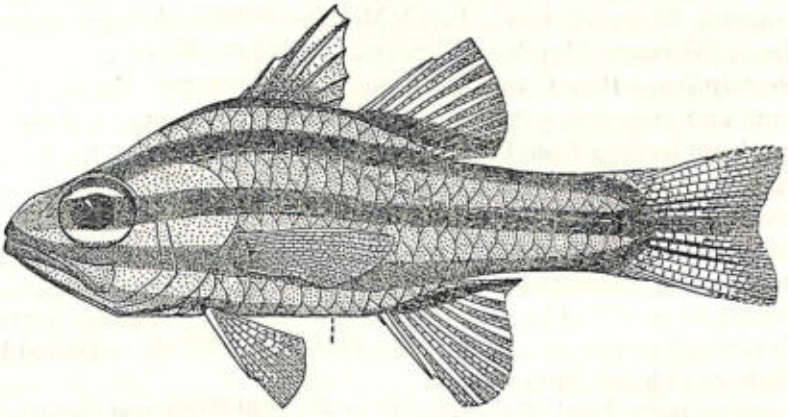

FIGURE 81.—Holotype of *Apogon nigrofasciatus*, new species (U.S.N.M. No. 142230), female, from Bikini Atoll. (Drawing by Aime M. Awl.)

August 7, 1947, S–1019, Brock, Hiatt, and Schultz, 1 specimen, 62 mm.; U.S.N.M. No. 142299, Eniwetok Atoll, reef, Jieroru Island, May 21, 1946, S–46–174, Schultz, 2 specimens, 60 and 65 mm.; U.S.N.M. No. 142300, Eniwetok Atoll, Teiteiripucchi Island, lagoon reef, June 1, 1946, S–46–197, Schultz, 3 specimens, 66 to 72 mm; U.S.N.M. No. 142301, Eniwetok Atoll, Aaraanbiru Island, ocean reef, June 3, 1946, S–46–198, Schultz, 7 specimens, 49 to 71 mm.; U.S.N.M. No. 142309, Rongelap Atoll, Eniaetok Island, lagoon reef, north end, June 17, 1946, S–46–215, Schultz, 10 specimens, 37 to 67 mm.; U.S.N.M. No. 142308, Rongelap Atoll, north end of Eniaetok Island at pass between Eniaetok Island and Erapuotsu Island, July 20, 1946, S–46–267, Herald and Brock, 12 specimens, 18 to 63 mm.; U.S.N.M. No. 142307, Rongelap Atoll, Rongelap Island, near north end, lagoon coral head at depth of 18 feet, July 25, 1946, S–46–286, Brock, Herald, and Kohler, 3 specimens, 24 to 34 mm.; U.S.N.M. No. 142305, Rongelap Atoll, west side of Naen Island, July 30, 1946, S–46–302, Herald, 4 specimens, 60 to 62 mm.; U.S.N.M. No. 142304, Rongelap Atoll, Yugui Island, west side, ocean reef next to small boat passage, July 31, 1946, S–46–304, Herald, 13 specimens, 31 to 40 mm.; U.S.N.M. No. 142306, Rongelap

Atoll, Lomuilal Island, west side lagoon reef, August 1, 1946, S–46–306, Herald, 6 specimens, 26 to 41 mm.; U.S.N.M. No. 142302, Rongerik Atoll, Latoback Island, lagoon reef, June 28, 1946, S–46–238, Schultz and Herald, 3 specimens, 19 to 31 mm.; U.S.N.M. No. 142303, Rongerik Atoll, Latoback Island, lagoon reef, August 14, 1947, S–1041, Brock, Schultz, and Donaldson, 2 specimens, 38 and 55 mm.; U.S.N.M. No. 112103, Marianas Islands, Guam, Tumon Bay, January 8, 1946, Gressitt and Ingram, 6 specimens, 38 to 49 mm.; U.S.N.M. No. 112102, Marianas Islands, Guam, November 26, 1945, Frey, 1 specimen, 52 mm.; U.S.N.M. No. 51813, Samoa, Apia, 1902, Jordan and Kellogg, 5 specimens, 52 to 72 mm.; U.S.N.M. No. 109397, Austral Islands, Tubuai, February–March 1902, Seale, 1 specimen, 69 mm.

Description.—Based on holotype and paratypes listed above. Counts and measurements are recorded for the holotype, followed in parentheses by data from four or more paratypes, U.S.N.M. No. 142292, ranging in standard length from 44 to 70 mm. Measurements are expressed in thousandths of the standard length. The mean and range for counts and measurements are given for the paratypes; if identical with those of the holotype only one number is given.

Dorsal rays VII–I,9; anal rays II,8; pectoral rays 14; vertical scale rows 24 (mean 24.3, range 24 to 25); scale rows above lateral line 2; scale rows below lateral line 6.

Greatest body depth 378 (373, 342 to 400); greatest body width 207 (184, 157 to 200); length of head 396 (384, 378 to 398); head depth at occiput 276 (299, 281 to 343); length of caudal peduncle 293 (297, 283 to 314); least depth of caudal peduncle 164 (166, 157 to 175); length of longest pectoral ray 276 (264, 250 to 281); length of third spine of spinous dorsal 224 (212, 193 to 227); length of second spine of anal fin 146 (149, 143 to 158); diameter of eye 147 (135, 122 to 159); length of upper jaw 198 (206, 200 to 210); length of snout 112 (96, 91 to 100); least width of bony interorbital 69 (61, 46 to 72); tip of snout to origin of spinous dorsal 440 (421, 398 to 449); tip of snout to origin of anal fin 620 (620, 610 to 630); tip of snout to insertion of pectoral fins 362 (374, 369 to 379); tip of snout to insertion of pelvic fins 370 (374, 366 to 386); tip of snout to anal opening 561 (545, 510 to 571); number of gill rakers 3,3+1+12,4 (2 or 3, 3+1+12 to 14, 2 to 4), total 21 to 24.

First spine of spinous dorsal about one-fourth to one-fifth length of second spine, second spine one-third length of third; jaws, vomer, and palatines with small villiform teeth; posterior margin of preopercle finely serrated, anterior margin smooth; ctenoid scales with 12 to 18 radii; fine ctenii in 8 to 10 rows on basal margin of scale, upper jaw extends beyond vertical drawn through posterior margin of pupil but not reaching vertical through posterior margin of eye;

body compressed laterally; mouth terminal; lateral line complete; operculum with one flat spine; gill rakers long and slender, longest rakers nearly 2 times longest filaments, 2 to 2.3 in eye; caudal fin moderately forked; anal fin slightly falcate.

Color in alcohol.—Body and head light tan to dark tan with five horizontal dark-brown to black stripes; a dorsal stripe begins just beyond midinterorbital area and extends to base of spinous dorsal, through which it extends posteriorly to about midbase of soft dorsal, there it appears as a bar at the base of fin anteriorly and on fin just above its base posteriorly, but not extending to dorsal side of caudal peduncle; dorsolateral stripe begins at tip of snout, passing posteriorly above, but just touching, dorsal edge of eye and anterior third of lateral line on body, extending to dorsolateral portion of caudal peduncle and base of caudal fin, where it proceeds at angles sharply toward black spot at midbase of caudal, and meets ventrolateral and midbody stripes at caudal spot; a midbody or median stripe passes through middle of eye from tip of snout, along head and body just below union of opercle with body, and on midbody to base of caudal, where it enlarges to form spot, then extends on rays of caudal as a dusky streak to its fork; a ventrolateral stripe begins at tip of snout, passing between lower margin of eye and upper jaw to body, through pectoral base on lower body to ventrolateral portion of caudal peduncle, sharply angling to midbase of caudal, uniting at end of peduncle with stripes described above; a ventral stripe, not too evident in most adults, extends from tip of lower jaw, through angle of jaw and base of pelvic fin to origin of anal, where the stripes from each side unite and extend onto lower portion of anal fin to form a black bar. These horizontal stripes about uniform in width throughout their length; dark brown midbody stripe generally about as wide as light stripes between interspaces of midbody stripe and dorsolateral and ventrolateral stripes, measured at a point on body below middle of spinous dorsal; lateral and midbody stripes below middle of spinous dorsal as wide as depth of scale, and almost twice in eye; head usually darker than body, owing to union of stripes toward the snout; chin dusky to black; pectoral and pelvic fins transparent; spinous dorsal dusky to blackish on lower two-thirds; soft dorsal and anal fins with dark brown to blackish bars described above, remainder of fins transparent; caudal with dusky streak from spot to fork and faint dusky streaks on inner third of fin at angles of dorsolateral and ventrolateral stripes, remainder transparent; spot at midbase of caudal more evident in young and juveniles than adults, and generally of a darker pigmentation than lateral stripes in these age groups.

Remarks.—This species is closely related to *Apogon aroubiensis* Hombron and Jacquinot (Voyage au Pôle Sud et dans l'Océanie sur

les Corvettes l'*Astrolabe* et la *Zelee* . . ., vol. 3, Poissons, p. 31, pl. 1, fig. 1, 1853, Aroub, Malaysia). Over 100 specimens of *A. aroubiensis* from Borneo, Celebes, and other islands of the East Indies and the Philippines were studied and compared with the specimens of *A. nigrofasciatus* listed here, and no significant differences were found in meristic counts and measurements. The color pattern of stripes as well as the union of the dorsolateral and ventrolateral stripes at the mid-base of the caudal are also similar. These two species differ in (1) the width of the horizontal lateral stripes and distance between them (see key, p. 440), a constant character over large geographical areas for both species; (2) the color of the stripes, brownish in *aroubiensis*, blackish brown to black in *nigrofasciatus*; (3) a somewhat lower gill raker count in *aroubiensis* (table 39); and (4) the larger size at maturity attained in *nigrofasciatus* (only one of 105 specimens, less than 1 percent, of *aroubiensis* from the East Indies and Philippine Islands attain a standard length greater than 65 mm., whereas over 10 percent of 135 specimens of *nigrofasciatus* from the Marianas and the northern Marshall, Samoan, and Austral Islands reach a length greater than 65 mm. and 4 percent of this sample are over 70 mm.). Male *aroubiensis* with ova in the buccal cavity were found under 50 mm. in standard length. (See pl. 38, A.)

There is no evidence at present of these two forms occurring together, *A. nigrofasciatus* is represented in our collections from the island chains listed above, east and southeast of the Philippine Islands. It is not possible to determine what species was on hand in the many published lists and descriptions in which *A. aroubiensis* was referred to.

Named *nigrofasciatus* by reason of the five horizontal black stripes.

APOGON NOVAE-GUINEAE Valenciennes

Apogon novae-guineae VALENCIENNES, Nouv. Ann. Mus. Hist. Nat., vol. 1, p. 53, pl. 4, fig. 1, 1832 (type locality, New Guinea).

SPECIMENS STUDIED

Bikini Atoll: ¼ mile off Amen Island in lagoon, poison, 30 feet, August 4, 1946, S–46–307, Herald, Koehler, and Brock, 2 specimens, 39 and 43 mm.; Bikini Atoll reef, between Amen and Bikini Islands, depth 30 feet, July 31, 1947, Donaldson and Welander, 1 specimen, 50 mm.; 4 miles S.W. end of Bikini Island, 28 fathoms, April 25, 1946, 1 specimen, 25 mm.

Kawajlein Atoll: from stern of *Prince Eugen*, August 3, 1947, S–46–506, Brock, Schultz, and Donaldson, 2 specimens, 28 and 40 mm.

Rongelap Atoll: Rongelap Island, near north end, lagoon coral head at depth of 18 feet, July 25, 1946, S–46–286, Brock, Herald, and Kohler, 1 specimen, 25 mm.; deep poison, 28 feet, Tufa Island, July 29, 1946, S–46–300, Herald and Brock, 5 specimens, 17 to 41 mm..

Description.—Counts and measurements were taken from three specimens 38 to 48 mm. in standard length. Dorsal rays VII–I,9;

anal rays II,8; pectoral rays 14; vertical scale rows 23 to 25; scale rows above lateral line 2; scale rows below lateral line 6.

Body depth 2.9 to 3.0, body width 5.7 to 6.0, head length 2.3 to 2.7, head depth 3.7 to 4.0, length of caudal peduncle 3.3 to 3.7, longest pectoral ray 3.7 to 4.0, all in standard length; eye 2.5 to 2.9, length of upper jaw 2.0 to 2.1, least depth of caudal peduncle 2.8 to 3.0, length of snout 4.1 to 4.9, least width of bony interorbital 4.8 to 5.7, all in length of head; eye in snout 0.5 to 0.6; gill rakers 2 or 3, 4+1+14 to 16, 0 to 2 total (5 specimens) 23 to 24; longest gill raker 2.5 times longest filament, 2.2 in eye; jaws, vomer, and palatines with villiform teeth.

Pelvic fins pass vent, not reaching anal origin; posterior margin of preoperculum finely serrated, anterior margin smooth; ctenoid scales with 7 to 13 radii; upper jaw reaches vertical through posterior margin of pupil; mouth nearly terminal, lower jaw slightly more forward; first dorsal spine small, about one-fourth to one-fifth length of second spine; second spine about one-fourth length of third; third spine longest and stoutest, about 2 in head; caudal fin emarginate; one flat opercular spine; lateral line complete.

Color in alcohol.—Body and head a very light tan with no prominent pigmentation; snout and tip of lower jaw with some faint dusky to brown color; some dusky coloration on body near base of dorsal fin; a faint narrow horizontal bar on soft dorsal, almost completely faded in most specimens; remainder of soft dorsal and other fins transparent.

Color in life.—Lemon yellow with a silvery streak under eye to tip of snout.

Remarks.—This name is tentatively applied to these specimens until better preserved material from Oceania is collected. Valenciennes (op. cit.) figures a slightly rounded caudal fin. Bleeker (Atlas Ichthyologique des Indes Orientales Néerlandaises . . ., vol. 7, p. 97, pl. (41) 319, fig. 5, 1873–76) figures the emarginate caudal fin found in our specimens. The amount of pigmentation on the dorsal portion of the body and head and the narrow dark bars of the soft dorsal and anal fins is variable in intensity, and the specimens appear to have lost through fading, their critical color pattern.

APOGON OCELLATUS Weber

Apogon ocellatus Weber, *Siboga*-Expeditie, p. 231, 1913 (type locality, Kwandang Bay, Celebes Island).

SPECIMENS STUDIED

Bikini Atoll: Boro Island, reef next to Boro channel, April 6, 1946, S–46–52, Schultz and Brock, 1 specimen, 32 mm.; Bikini Island, August 20, 1947, Univ. Washington, 1 specimen, 31 mm.

Guam: Tumon Bay, July 10, 1945, Baker, 1 specimen, 16 mm.; tidal pool near mouth of Ylig River, December 23, 1945, Frey and Gressitt, 1 specimen, 29 mm.; November 24, 1945, Frey, 4 specimens, 21 to 26 mm.; November 25, 1945, Frey, 2 specimens, 29 mm.; November 26, 1945, Frey, 1 specimen, 28 mm.

Rota Island, November 13, 1945, Frey, 1 specimen, 31.5 mm.

Description.—Counts and measurements taken from four specimens, 21 to 22 mm. in standard length. Dorsal rays VII–I,9; anal rays II,8; pectoral,rays i,14,i; vertical scale rows about 21; scale rows above lateral line 2; scale rows below lateral line 6.

Body depth 2.8 to 3.0, head length 2.2 to 2.3, head depth 3.3 to 3.9, caudal peduncle length 4.0 to 4.9, all in standard length; diameter of eye 3.2 to 3.7, length of upper jaw 2.0 to 2.1, least depth of caudal peduncle 2.8 to 3.0, length of snout 4.2 to 4.6, least width of bony interorbital 6.6 to 7.5, all in length of head; spinous dorsal not quite so high as soft dorsal; third spine of spinous dorsal longest, about 2.5 in length of head; first spine about one-fifth length of second; second spine one-half length of third; gill rakers 2, 0+1+4, 7 to 9, total 14 to 16; rakers short, denticulated on inner side, longest about one-half to two-thirds length of longest filament, about 4 to 6 in eye; villiform teeth in jaws and vomer, none on palatines.

Depressed spinous dorsal just touches soft dorsal; pelvics reach vent; both edges of preoperculum smooth; upper jaw not reaching vertical drawn through posterior margin of eye, but extends beyond middle of eye; lateral line complete; ctenoid scales with 12 to 19 radii; radii broadly convergent on focus.

Color in alcohol.—Head and body dark brown; a distinct dark brown bar on cheek from eye to angle of preopercle, another smaller bar from posterior middle margin of eye to about upper edge of gill opening; spinous dorsal fin with conspicuous black ocellus surrounded by a narrow white band, its diameter about two-thirds in eye; ocellus located between fourth and seventh spines; remainder of spinous dorsal fin dusky; soft dorsal dusky with a narrow whitish border, some specimens with a whitish band along base; caudal fin dusky with a narrow whitish border; anal fin dusky, edged in white, sometimes with whitish base; pelvics dusky; pectorals transparent with irregular brown mottling; pectoral base brown, sometimes white; fore part of snout, chin, and jaws mottled with brown.

APOGON ISOSTIGMA (Jordan and Seale)

FIGURE 75, *a*; PLATE 39, C

Apogonichthys isostigma JORDAN and SEALE, Bull. U. S. Bur. Fisheries, vol. 25, 1905, p. 251, 1906 (type locality, Samoa).

SPECIMENS STUDIED

Bikini Atoll: 4 stations, 7 specimens, 27 to 62 mm. standard length.
Eniwetok Atoll: 1 station, 1 specimen, 20 mm.
Rongelap Atoll: 5 stations, 18 specimens, 17 to 53 mm.
Guam: 1 lot, 1 specimen, 48 mm.

Description.—The following counts and measurements were taken from 3 specimens, a juvenile, 32.5 mm. in standard length, a male 52 mm., and a female 63 mm.

Dorsal rays VII–I,9; anal rays II,8; pectoral rays ii,10,ii; vertical scale rows 21 to 22; scale rows above lateral line 2; scale rows below lateral line 5 to 6.

Body depth 2.8 to 2.9, head length 2.4 to 2.5, head depth 3.6 to 3.7, caudal peduncle length 3.7 to 4.5, longest pectoral ray 3.4 to 3.6, all in standard length; diameter of eye 3.6 to 4.1, length of upper jaw 1.9 to 2.0, least depth of caudal peduncle 2.5 to 2.9, length of snout 4.2 to 4.5, least width of bony interorbital 8.3 to 8.7, all in length of head; third spine of spinous dorsal longest, about 2.2 in head; first spine of spinous dorsal about one-fourth to one-fifth length of second, second spine nearly one-half length of third; gill rakers 4,0+1+4 or 5, 7 to 9, total 16 to 18; gill rakers very short, longest about four-fifths of length of longest filament, about 4 to 5 in eye; gill rakers end in a denticulated knob.

Depressed spinous dorsal just touches soft dorsal; pelvic not reaching vent; caudal fin rounded, other fins more angular and pointed, a few rays in each fin being more elongate; mouth nearly terminal; both edges of preopercle smooth; upper jaw reaches or passes beyond vertical through rear margin of eye; lateral line tube reaches area midway below soft dorsal; lateral line pores extend on to caudal peduncle, not reaching base of caudal fin.

Color in alcohol.—Body and head dusky brown to light brown; body laterally, with 8 rows of circular black spots, each located near the center of the scale, only 5 rows of spots laterally on caudal peduncle; on opercle an oval black ocellus having a narrow white margin, its longest diameter about four-fifths that of eye; on cheeks two black, narrow horizontal lines touching lower posterior margin of eye; a black, narrow horizontal line on opercle just above ocellus; chin, snout, and top of head more dusky than body; fins of young dusky, with denser black in the outer half of the caudal; those of juveniles light dusky, body colored light brown; adult males more dusky than adult females.

Color in life.—From Kodachrome transparency, body purplish; snout and jaws light tan; spinous dorsal, soft dorsal, and anal light brown; caudal fin purplish.

APOGON MARMORATUS (Alleyne and Macleay)

Apogonichthys marmoratus ALLEYNE and MACLEAY, Proc. Linn. Soc. New South Wales, p. 268, pl. 5, fig. 2, 1876 (type locality, Cape Grenville, northern Australia).

SPECIMENS STUDIED

Bikini Atoll: Bikini Island, ocean reef, March 22, 1946, S–46–15, Schultz and Brock, 3 specimens, 27 to 28 mm.; Bikini Island, August 12, 1946, Univ. Washington, 1 specimen, 17 mm.

Description.—Measurements and counts taken from the three specimens listed above. Dorsal rays VI–I, 9; anal rays II, 8; pectoral rays about 12. (As the specimens were almost entirely devoid of scales, counts were not possible.)

Body depth 3.0 to 3.7, body width 5.8 to 6.3, head length 3.7 to 4.2, caudal peduncle length 3.8 to 4.2, longest pectoral ray 3.8 to 4.3, all in standard length; diameter of eye 2.5 to 3.0, length of upper jaw 1.9 to 2.0, least depth of caudal peduncle 2.5 to 3.3, length of snout 4.0 to 4.2, least width of bony interorbital 6.0 to 7.0, all in length of head; eye in snout 0.5 to 0.6; gill rakers 2,1+1+4 or 5,5 or 6, total 14 to 15; rakers comparatively short, about 4 in eye; jaws and vomer with small villiform teeth, none on palatines.

Pelvic fins just reach origin of anal fin; both margins of preopercle smooth (serrations may have been worn off, as the specimens show evidence of some harm); ctenoid scales with about 8 to 10 radii; upper jaw almost reaching vertical through posterior margin of eye; mouth terminal; first spine of spiny dorsal small, about one-fifth length of second, which is about one-half length of third; third dorsal spine longest, 1.9 to 2.0 in head; caudal fin slightly rounded; one flat opercular spine; lateral line extends to area below end of soft dorsal.

Color in alcohol.—Body and head light tan; body with 8 vertical brownish bars, more or less encircling body; brownish bars about 1.5 to 2 times wider than interspaces, about 2.5 to 3 in eye; cheeks with some brown pigmentation that suggests a posterior subocular bar; some pigmentation below spine on opercle that appears as if it were a brownish spot or ocellus; faint traces of a little brownish mottling in spiny dorsal; two faint blotches in pelvic fin; second dorsal, pectorals, anal, and caudal fins transparent.

Remarks.—These specimens are only tentatively named *A. marmoratus*. They agree closely with this species in fin-ray count, absence of palatines, faint mottling of the fins, incomplete development of lateral line, and the presence of vertical bars, but they are in such poor condition that it is impossible to determine exactly the original color pattern, or the nature and size of the opercular spot and cheek bar.

APOGON VARIEGATUS Valenciennes

Apogon variegatus VALENCIENNES, Nouv. Ann. Mus. Hist. Nat. Paris, vol. 1, p. 55, 1832 (type locality, Mauritius).

SPECIMENS STUDIED

Guam: U.S.N.M. No. 112321, 1945, D. G. Frey, 12 specimens, 15 to 29 mm.

Description.—The following counts and measurements were taken from 3 specimens 23 to 30 mm. in standard length. Dorsal rays VII–I,9; anal II,8; pectoral rays ii,10, ii; vertical scale rows about 21; scale rows above lateral line 2; scale rows below lateral line 6.

Body depth 2.8 to 2.9, head length 2.2 to 2.3, head depth 3.3. to 3.9, caudal peduncle length 3.9 to 4.2, all in standard length; diameter of eye 3.2 to 3.5, length of upper jaw 2.0 to 2.1, least depth of caudal peduncle 2.6 to 2.7, length of snout 4.2 to 4.6, least width of bony interorbital 7.3 to 8.0, all in length of head; third spine of spinous dorsal about 2.0 to 2.2 in head; first spine about one-fourth length of second, which is about one-half length of third; gill rakers 3 or 4,0+1+4,8 or 9 total 14 to 17; rakers short, longest raker about four-fifths length of longest filament; longest rakers not ending in denticulated knob in juveniles, but present in adult specimens from the Red Sea and Samoa; villiform teeth in jaws and vomer; no palatine teeth.

Depressed spinous dorsal touches soft dorsal; pelvics reach vent; mouth nearly terminal; both margins of preopercle smooth; upper jaw not quite reaching vertical drawn through posterior margin of eye; lateral line incomplete, extends to area below middle of soft dorsal; some lateral line pores on caudal peduncle; ctenoid scales with 9 to 13 radii; posterior margin of scale prominently scalloped; radii broadly convergent upon focus.

Color in alcohol.—Body and head dusky tan; deep black opercular spot, encircled with some white; a dusky dash above and to rear of opercular spot; about 9 faint, dusky vertical bands on body, more sharply defined in smaller than in larger specimens; fins, other than pectorals, sharply mottled in dark brown; snout, jaws, and chin mottled dusky to brown.

Remarks.—We have found from a study of recently collected material from the Red Sea two forms of the *auritus* group to be distinctly separable. In one form, the body and fins of the males are dusky, whereas the dorsal and anal fins are slightly mottled in the females. The second form is distinctly checkered and mottled on the body, head, snout, chin, and fins, with the exception of the pectoral fin. Faint dusky vertical bands and diffuse spots are also present on the body. The spots only slightly resemble those of *A. isostigma*, for they are of a smaller size, colored dusky brown, and are irregularly scattered over the body. We regard the former species as *Apogon auritus*

Cuvier and Valenciennes and the latter as *Apogon variegatus* Valenciennes. Mature specimens of *A. variegatus*, from the Samoan Islands, appear similar to those from the Red Sea. Meristic counts and measurements of *auritus* and *variegatus* are nearly similar.

Donald Erdman, formerly of the U. S. Fish and Wildlife Service, reports the colors in life of Red Sea specimens of *A. auritus* and *A. variegatus* to be dusky brown, which is in great contrast to the red described for *Apogon marmoratus* (Alleyne and Macleay). The status of *Apogonichthys polystigma* Bleeker (Nat. Tijdschr. Nederl.-Indië, vol. 6, p. 484, 1854, Wahai, Ceram; Priaman, Sumatra) and *Apogon punctulatus* Rüppell (Neue Wirbelthiere . . . Abyssinïen gehörig. Fische des rothen Meeres, p. 88, pl. 22, fig. 4, 1835, Massaua, Red Sea) are not determinable at this time. Lists of synonymy such as those of Weber and de Beaufort (Fishes of the Indo-Australian Archipelago, vol. 5, pp. 325–326, 1929) are not valid, and, indeed, are wholly misleading when unsupported by a general analysis and interpretation of the species.

Genus ARCHAMIA Gill

Archamia Gill, Proc. Acad. Nat. Sci. Philadelphia, p. 81, 1863. (Genotype, *Apogon bleekeri* Günther, 1859=*Apogon fucatus* Cantor, 1850, or *Apogon lineolatus* Cuvier and Valenciennes, 1828.)

My recent study of this genus (Proc. U. S. Nat. Mus., vol. 101, pp. 582–594, 1951) discusses its relationship to *Apogon*, and the relationships among the species. The genus is represented by forms from East Africa to the islands to Oceania but is not known in the Hawaiian faunal area.

KEY TO THE SPECIES OF ARCHAMIA

1*a*. Body with three narrow, horizontal stripes, situated along the middorsal line, dorsolaterally, and on midside of body; soft anal rays 12 to 13; a round, blackish spot at base of caudal fin about equal to size of pupil (see pl. 40, C)---------- Archamia buruënsis[5] (Bleeker)

1*b*. Body without horizontal stripes; sometimes vertical bars are present; soft anal rays 13 to 18; spot at base of caudal of various sizes, sometimes obsolete.

2*a*. A broad, brownish-black vertical band from soft dorsal to belly, its width about 1.5 to 2.5 in length of head; no humeral spot and no spot on body just posterior to operculum; soft anal rays 14 to 16, brownish-black caudal spot smaller than diameter of pupil (see pl. 41, A).
Archamia zosterophora[6] (Bleeker)

2*b*. Vertical band absent; a black humeral spot or dusky spot on body just posterior to operculum; soft anal fin rays 16 to 18.

3*a*. A black, diffuse spot or blotch, more or less irregular and deeper than wide, on body just posterior to opercular flap and below lateral line;

[5] *Apogon buruënsis* Bleeker, Nat. Tijdschr. Nederl.-Indië, vol. 11, p. 394, 1856 (type locality, Kajeli, Bouro).

[6] *Apogon zosterophora* Bleeker, Act. Soc. Sci. Indo-Neerl., vol. 1, p. 36, 1856 (type locality, Manado, Celebes).

a diffuse, blackish circular spot at base of caudal fin, its diameter about equal to diameter of eye (see pl. 41, C).

Archamia dispilus [7] Lachner

3*b*. An intense, round, black humeral spot at junction of gill opening and body, the lateral line passing through middle of spot; an intense, sharp, round, black spot at base of caudal fin, its diameter slightly larger than pupil and twice in that of eye (see pl. 41, B).

Archamia biguttata [8] Lachner

2*c*. No vertical band on body; no humeral spot or dusky spot on body just posterior to operculum; brownish black spot at base of caudal fin larger than diameter of pupil, but usually smaller than diameter of eye, sometimes diffuse to obsolete.

4*a*. Number of soft anal rays averages higher than 16, range from 15 to 18; total number of gill rakers averages fewer than 21; total number of gill rakers minus number of soft anal rays equals 5 or fewer; spot at base of caudal blackish brown, diffuse and large in adults, its depth about 1.5 in least depth of caudal peduncle.

Archamia fucata [9] (Cantor)

4*b*. Number of soft anal rays averages fewer than 14, range from 13 to 15; total number of gill rakers averages more, about 22; total number of gill rakers minus the number of soft anal rays equals 7 or more; spot at base of caudal fin intensely developed, blackish and smaller, about 2.0 to 2.5 in least depth of caudal peduncle, proportionately smaller in young (see pls. 39, A; 40, A).

Archamia lineolata [10] (Cuvier and Valenciennes)

ARCHAMIA FUCATA (Cantor)

PLATE 40, B

Apogon fucatus CANTOR, Journ. Asiatic Soc. Bengal, p. 986, 1850 (type locality, Sea of Pinang).

Apogon macropteroides BLEEKER, Nat. Tijdschr. Nederl.-Indië, vol. 3, p. 724, 1852 (type locality, Lepar Island).

Apogon bleekeri GÜNTHER, Catalogue of the fishes in the British Museum, vol. 1, p. 245, 1859 (type locality, Amboyna)=*Apogon lineolatus* Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 2, p. 160, 1828.

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[7] *Archamia dispilus* Lachner, Proc. U. S. Nat. Mus., vol. 101, p. 586, 1951.

[8] *Archamia biguttata* Lachner, op. cit., p. 588, new name, replacing *Amia macropterus* Bleeker, Nat. Verh. Holl. Maatsch. Wetensch., ser. 3, verz. 11, No. 1, pp. 72–74, 1874; Atlas ichthyologique des Indes Orientales Néerlandaises . . . , vol. 7, p. 103, 1873–1876 and vol. 8, tab. 346, Perc. tab. 68, fig. 2, 1876–1877, preoccupied by *Apogon macropterus* (non Bleeker) Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 2, p. 160, 1828=*Apogon lineolatus* Cuvier and Valenciennes, 1828.

Amia bleekeri Fowler U. S. Nat. Mus. Bull. 100, vol. 10, p. 110, 1930 (in part).

[9] See discussion of *A. fucata* for synonymy.

[10] *Apogon lineolatus* Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 2, p. 160, 1828 (anal fin rays, II,14; type locality, Red Sea).

Apogon macropterus Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 2, p. 160, 1828 (anal fin rays, II,13; Java).

Apogon zeylonicus Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 3, p. 491, 1829 (anal fin rays, II,14; Ceylon).

Apogon argenteus Valenciennes, Nouv. Ann. Mus. Hist. Nat. Paris, vol. 1, p. 60, 1832 (anal fin rays, II,14; Vanicolo).

Archamia bleekeri Günther, Catalogue of the fishes in the British Museum, vol. 1, p. 245, 1859 (anal fin rays II, 14 to 17; Amboyna) ?=*A. fucata*.

Apogon notata DAY, Proc. Zool. Soc. London, 1867, p. 936 (type locality, Madras).
Archamia kagoshimana DÖDERLEIN (MS), *in* Steindachner and Döderlein, Denkschr. Akad. Wiss. Wien, vol. 48, p. 3, 1884 (type locality, Kiusiu Island).—JORDAN and SNYDER, Proc. U. S. Nat. Mus., vol. 23, p. 907, 1901.
Apogon lineolatus WEBER and DE BEAUFORT, Fishes of the Indo-Australian Archipelago, vol. 5, pp. 347–349 (in part) 1929.—JORDAN and SEALE, Bull. U. S. Bur. Fish., vol. 25 (1905), p. 252, 1906.
Archamia lineolata FOWLER and BEAN, U. S. Nat. Mus. Bull. 100, vol. 10, pp. 113–117 (in part) 1930.—SCHULTZ, Proc. U. S. Nat. Mus., vol. 88, p. 412, 1940; U. S. Nat. Mus. Bull. 180, p. 94, 1943.

SPECIMENS STUDIED

Bikini Atoll: Lagoon, eastern end, dredge at depth of 180–200 feet, March 29, 1946, S–46–44, Schultz, 2 specimens 53 and 59 mm.; ¼ mile off Amen Island, in lagoon, poison, 30 feet, August 4, 1946, S–46–307, Herald, Kohler, and Brock, 89 specimens, 33 to 51 mm.

Rongelap Atoll: Tufa Island, poison, 28 feet, July, 28, 1946, S–46–300, Herald and Brock, 24 specimens, 37 to 47 mm.

Description.—Counts and measurements were taken from 3 specimens 35 to 47 mm. in standard length, unless indicated otherwise. Dorsal rays VI–I, 9 (10 specimens); anal rays 16 (6 specimens) or 17 (6 specimens); pectoral rays ii, 9, ii (5 specimens), ii, 9, ii (3 specimens), ii, 8, iii (1 specimen); vertical scale rows 22 to 24; scale rows above lateral line 2; scale rows below lateral line 6 or 7.

Body depth 2.5 to 2.6, head length 2.5 to 2.6, head depth 3.0 to 3.2, length of caudal peduncle 5.0 to 5.1, longest pectoral ray 3.1 to 3.4, all in standard length; diameter of eye 2.5 to 2.9, length of upper jaw 1.8 to 2.0, least depth of caudal peduncle 2.6 to 3.1, length of snout 4.0 to 4.8, least width of bony interorbital 4.0 to 4.6, all in length of head; eye large, 0.5 in snout; spinous dorsal not so high as soft dorsal; second spine of spinous dorsal longest, about 2.3 in length of head; first spine of spinous dorsal about one-half length of second; gill rakers 2, 3+1+13 or 14, 1; rakers lanceolate, finely denticulate on inner side; longest raker about 2 to 2.5 times longest filament, 1.8 to 2.1 in eye; villiform teeth in jaws, vomer, and palatines.

Depressed spinous dorsal touches soft dorsal; pelvic fins reach anal origin in some specimens; posterior margin of preopercule serrated at angle and on lower edge; upper jaw reaches vertical drawn through middle of eye; lateral line complete; ctenoid scales with 12 to 16 primary and secondary radii.

Color in alcohol.—Body and head light tan, with fine brown spots scattered on checks, opercles, and body; tip of jaws with a little blackish; small brown spots forming faint streak from tip of upper jaw to beneath eye; a large round blackish-brown blotch at base of caudal, sometimes diffuse to obsolete, variable in size, usually a little less in depth than least depth of caudal peduncle, in some specimens only one-half depth of caudal peduncle; spinous dorsal tipped with a little

blackish color; remainder of fins transparent; traces of about 20 brown and silvery, narrow, vertical bars in some specimens, usually obsolete.

Ecology.—This species was not taken in the shallow-reef waters but occurred in the deeper waters of the lagoon.

Genus CHEILODIPTEROPS Schultz

Cheilodipterops Schultz, Proc. U. S. Nat. Mus. vol. 88, pp. 405, 413, 1940. (Genotype, *Cheilodipterops isostigma* Schultz.)

This monotypic genus is characterized chiefly by having usually one enlarged canine tooth at each side of the symphysis of the lower jaw; sometimes two canines may be on either the right or left side; each

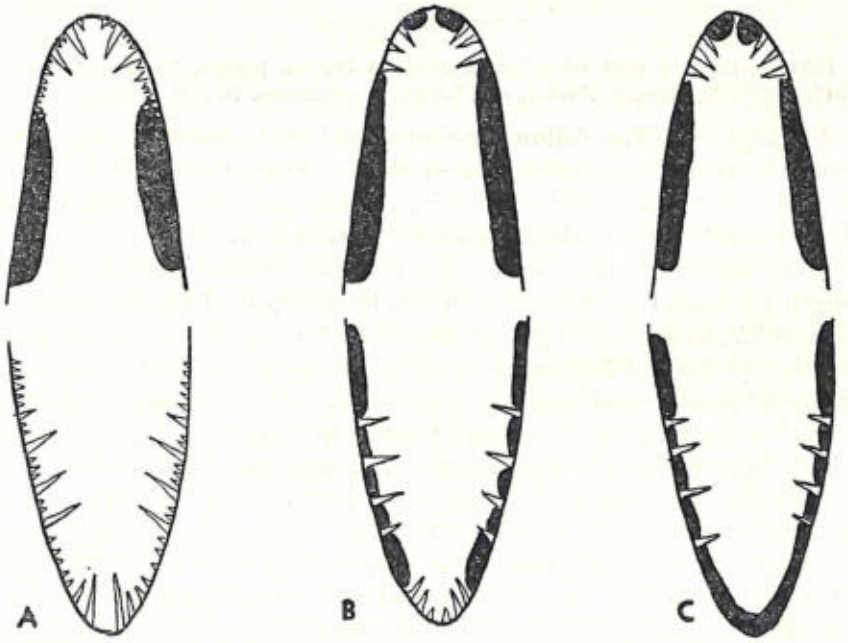

Figure 82.—Dental pattern of certain genera of Apogonidae: *a, Cheilodipterus; b, Cheilodipterops; c, Paramia.* (After Schultz.)

side of the lower jaw averages from three to four, ranging from two to six, additional canines spaced at about equal distances on the middle half of the jaw; villiform teeth on the lower jaw extend posteriorly from the symphyseal canines and are interrupted by the enlarged canines; each side of tip of the upper jaw has a small patch of villiform teeth followed usually by two canines, varying from two to four, on each side, and the remainder of jaw with a band of villiform teeth. The difference between *Cheilodipterops* and *Paramia*, with which it is most closely related, is that the symphyseal canines of *Cheilodipterops* replace the villiform teeth of *Paramia* in that area. The size and

number of canines in both jaws and the development of villiform patches are, otherwise, identical. *Cheilodipterus* is compared in the generic key (p. 414) and the dentition pattern is illustrated by figure 82.

CHEILODIPTEROPS ISOSTIGMA Schultz

PLATE 42, A

Cheilodipterops isostigma SCHULTZ, Proc. U. S. Nat. Mus., vol. 88, pp. 405, 413, 1940 (type locality, New Guinea).—FOWLER, Mem. Bishop Mus., vol. 12, No. 2, suppl. 3, p. 181, 1949.

Cheilodipterus quinquelineatus FOWLER and BEAN, U. S. Nat. Mus. Bull. 100, vol. 10, pp. 127 to 131 (in part), 1930.

SPECIMENS STUDIED

Bikini Atoll: ¼ mile off Amen Island, in lagoon, poison, 30 feet, August 4, 1946, S–46–307, Herald, Kohler, and Brock, 2 specimens, 76 and 85 mm.

Description.—The following counts and measurements were taken from the two specimens indicated above. Dorsal rays VI–I,9; anal rays II,8; pectoral rays i and ii,9,ii; vertical scale rows 25; scale rows above lateral line 2; scale rows below lateral line 7.

Body depth 3.5, head length 2.4 and 2.5, head depth 4.3 and 4.5, length of caudal peduncle 3.8 to 4.0, least depth of caudal peduncle 7.5 and 7.7, length of longest pectoral ray 5.1 and 5.4, all in standard length; eye 3.5 and 3.9, length of premaxillary 2.1 and 2.2, least depth of caudal peduncle 3.0 and 3.3, snout 3.1 and 3.5, width of bony interorbital 6.3 and 6.7, all in length of head; first spine of spinous dorsal a little longer than one-half length of second; second almost as long as distance from origin of dorsal to occiput; second anal spine about equal to anal base; gill rakers 5+1+12 or 13, the longest about equal to longest gill filament, about 4.0 in eye.

Caudal fin slightly forked; outline of soft dorsal and anal somewhat convex; canines in jaws moderately developed; symphyseal canines of lower jaw not so large as largest canines; free edge of preopercle serrated; scales ctenoid on body and head, some irregular, regenerated head scales without ctenii; vent located about two-fifths distance from origin of anal fin to base of pelvic fin.

Color in alcohol.—Body and head light tan, with 6 prominent dark brown, horizontal stripes extending from snout to base of caudal fin; stripes located laterally, on body, about one-fourth width of lateral line scale from midbody area, and about four in eye; width of area between stripes at side of body about three times width of stripe; dorsal stripe begins at area just before occiput and extends dorsally, posteriorly to procurrent rays of caudal fin, dividing at origin of spinous dorsal and uniting at end of base of soft dorsal; dorsolateral stripe begins on snout, passes over head, just touching dorsal margin of

eye and anterior lateral line pores on body, and extending posteriorly on dorsolateral portion of caudal peduncle; midbody stripe begins on snout, passes over middle of eye and onto midbody almost to spot at base of caudal fin; a ventrolateral stripe extends from tip of lower jaw, along anterior half of dentary, over upper jaw and below eye, through base of pectoral and ventrolaterally to caudal base; another ventrolateral stripe extends from symphysis of lower jaw ventrally along inner edge of mandibular bones and lower edge of interopercle, passing just above base of pelvic fin and posteriorly near anal base, uniting with stripe of opposite side at rear of anal base to form a common ventral caudal peduncle stripe; the ventral stripe extends from the isthmus, where it is sometimes divided on each side of the inner branchiostegals, extending from the isthmus on midbelly between the base of the pelvics to vent and thence to origin of anal fin; spot at middle of base of caudal fin prominent, dark brown, circular, about as wide as a lateral stripe and surrounded by an unpigmented area; stripes more intensely developed on head; less developed on caudal peduncle; anterior spinous dorsal tipped in black, remainder of median and paired fins transparent.

Remarks.—This species is interesting in that it parallels *Paramia quinquelineata* in meristic counts and in body proportions, size, and coloration, in which characters there is essentially no difference between the two. The three lateral, horizontal stripes on the body and the stripes on the middorsal and midventral sides are in identical parts of the body and are of similar widths and intensities. In both a blackish caudal spot of nearly the same diameter is present, varying in both with body size. *Paramia quinquelineata*, however, usually has more brownish pigmentation on the outer rays of the caudal fin. These two species cannot be identified with certainty in preserved specimens without referring to their generic characters (the presence or absence of the symphyseal canines).

As a result of an examination of the specimens of *Paramia quinquelineatus* studied by Fowler and Bean, *Cheilodipterops isostigma*, heretofore known only by one specimen from New Guinea, was found to be widely distributed in the East Indies and Philippine Islands.

Genus CHEILODIPTERUS Lacepède

Cheilodipterus LACEPÈDE, Histoire naturelle des poissons, vol. 3, p. 539, 1802. (Genotype, *Cheilodipterus lineatus* Lacepède, designated by Jordan and Evermann, Genera of fishes, pt. 1, p. 63, 1917=*Cheilodipterus octovittatus* Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 2, p. 163, 1828=*Centropomus macrodon* Lacepède, Histoire naturelle des poissons, vol. 4, pp. 252 and 273, 1802.)

The species of *Cheilodipterus*, as here understood, consist of six from the Indo-Pacific region and one from the western Atlantic. *C. lineatus*

and *C. arabicus* are apparently restricted to the faunas of East Africa, the Red Sea, and the Persian Gulf, whereas two others, *C. singapurensis* and *C. truncatus*, and one questionable species, *C. subulatus*, are found in the East Indies and the Philippines. The other species of this genus found in the Indo-Pacific, *C. macrodon*, has a wide geographical range, being represented in the collections of the U. S. National Museum from Mauritius to Manga Reva. None has been reported in the Hawaiian faunal area.

KEY TO THE SPECIES OF CHEILODIPTERUS FROM THE INDO-PACIFIC REGION

1*a*. Body with eight or more prominent, dark, horizontal stripes, some of which are markedly visible on head in all size groups (young 30 mm. in length with five stripes).

2*a*. About 14 nearly straight, parallel, black stripes on body, counting those on middorsal and midventral sides if present and about 4 irregular or wavy stripes dorsolaterally from dorsal fin to lateral line; stripes narrow, variable in width, widest stripe about 8 to 9 times or more in anal base; 6 or 7 stripes on body extend onto opercle and cheek; width of area between stripes much greater than width of stripes; stripe not present below eye to tip of dentary; midventral stripe on lower side of caudal peduncle absent; no prominent stripe present on belly below pectoral base (2 very faint narrow streaks may be present); spot at midbase of caudal fin diffuse, black, circular, large, diameter about 2.5 to 3.5 in least depth of caudal peduncle in adults (no young specimens available); conspicuous, black band encircling caudal peduncle passing through caudal spot, wider than spot, separated from caudal rays by about 3 irregular scale rows and not extending to tips of outer caudal rays; diameter of eye (in adults) more than 3.5 in head (see pl. 43, C).

Cheilodipterus lineatus [11] (Linnaeus)

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[11] *Perca lineata* Linnaeus, Systema naturae, ed. 10, p. 293, 1758, as restricted by Forskål, Descriptiones animalium . . ., pp. 42–43, 1775 (Arabia).

Cheilodipterus arabicus Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 2, p. 165, pl. 23, 1828 (Lohaja).

Cheilodipterus lineatus Günther, Catalogue of the fishes of the British Museum, vol. 1, p. 248, 1859.—Day, The fishes of India, vol. 1, p. 66, pl. 18, fig. 9 (?), not fig. 8, 1876.

Cheilodipterus caninus Smith, The sea fishes of southern Africa, p. 205, pl. 22, fig. 472, 1949 (Inhaca Island, Delagoa Bay).

The determination of *Perca lineata* Linnaeus remains arbitrary. Forskål's account of *lineatus* lists a greater number of dark lateral stripes, 16 to 17, a significant character in distinguishing this species. Cuvier and Valenciennes give an account of *arabicus* from material from the Red Sea. Their figure shows a diffuse, circular spot at the base of the caudal fin, 12 distinct horizontal dark stripes on the body, 6 of which pass onto the opercle and cheeks, and a diffuse band at the base of the caudal fin. These characters refer to *lineatus* and not *arabicus*. Day recognized two closely related forms but apparently included characters of both in his figure 9. I agree with his concept of *arabicus* having a prominent, black, oval-shaped spot at the base of the caudal fin encircled with yellow. This he illustrated, however, in his figure 8, which he considered to be *lineatus*, as well as in figure 9. His figure 9 shows 14 horizontal stripes on the body, 6 or 7 of which pass onto the opercle and cheek, characteristic of *lineatus*. His figure 8, as compared with figure 9, shows a distinct oval-shaped spot at the base of the caudal fin but has a reduction in the number of stripes passing between the dorsal fin and lateral line, a reduction of lateral stripes on the body, and a reduction of stripes extending over the opercle

2*b*. Ten black parallel stripes on body in adults (young with about 7 stripes); no wavy or irregular stripes dorsolaterally from dorsal fin to lateral line; stripes narrow, variable in width, more than 8 to 9 in length of anal fin base; 5 body stripes extend onto opercle and cheek; width of area between stripes much greater than width of stripes; a stripe not present from below eye to tip of dentary; midventral stripe on lower side of caudal peduncle absent; no prominent stripe present on belly below pectoral base (a faint narrow streak present in adults, broken in young); spot at midbase of caudal fin conspicuous, intense black, oval, large, the horizontal diameter about 2.2 to 2.8 in least depth of caudal peduncle in young to adults; spot encircled by yellow in young living specimens; diffuse, black band encircling caudal peduncle, narrower than caudal spot, passing through spot, separated from caudal rays by about 4 to 5 irregular scale rows and not extending to tips of outer rays of caudal fin; eye more than 3.5 in head in adult; (see pl. 43, B).

Cheilodipterus arabicus[12] (Gmelin)

2*c*. Eight brown, parallel stripes on body in juveniles and adults (sometimes only 5 in young); no wavy or irregular stripes dorsolaterally from dorsal fin to lateral line; stripes wide, all nearly the same width, about 6 in length of anal fin base; 5 body stripes extend onto free edge of opercle and cheek; width of area between stripes less than width of stripes; stripe present just below eye extending to tip of dentary; midventral stripe on lower side of caudal peduncle present; a broad, prominent stripe between pectoral and pelvic bases; caudal spot obscure in adults and some juveniles (blackish, nearly circular, and small in young and some juveniles, about 3 to 4 times in least depth of caudal peduncle); diffuse, brown, broad band encircling caudal peduncle, varying in intensity, begins just beyond area of least depth of caudal peduncle and covers all scales to caudal rays, extending to tips of procurrent and outer 2 to 3 developed rays, forming a semilunar outline on caudal fin (present or absent in juveniles, absent in young); eye less than 3.5 in head in adults_____ Cheilodipterus macrodon (Lacepède)

1*b*. Body with 5 or fewer faint, horizontal stripes; 3 very faint diffuse lateral stripes at most, usually present in freshly preserved specimens, these generally indistinct in older specimens; stripes not evident on head.

3*a*. Preopercle weakly serrated.

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and cheek. In these, it agrees with my concept of *arabicus*. Although Gmelin's account of *arabicus* may be interpreted as a redescription of *Perca lineata* Forskål, I prefer to restrict this name to the species with a distinct, black, oval caudal spot encircled with yellow (in life) as Day had done, rather than to propose a new name. The 8 wide, horizontal stripes on the body and the relatively more slender body easily distinguish *C. macrodon* from the above two species.

The range of *lineatus* apparently extends from the Persian Gulf and west coast of India (Day) and the Red Sea (U.S.N.M. Nos. 49287 and 147514), southward along the east coast of Africa (Smith). *C. arabicus* is known from the Persian Gulf (U.S.N.M. Nos. 147942 and 147943) and the west coast of India (Day) southward along the east coast of Africa (Smith). It is not certain if it occurs in the Red Sea. *C. macrodon* has a great geographical range, extending from Mauritius (U.S.N.M. No. 19957) eastward through the East Indies, the Philippines, and the islands of Oceania to Manga Reva (U.S.N.M. No. 65604).

[12] *Perca arabica* Gmelin, Systema naturae, ed. 13, p. 1312, 1788, as restricted by Day, The fishes of India, vol. 1, p. 66, pl. 18, figs. 8 and 9 (?), 1876.

Cheilodipterus lineatus Smith, The sea fishes of southern Africa, p. 205, pl. 22, fig. 471, 1949.

4*a*. Vent surrounded by a conspicuous round black spot, larger in adults, from 2 to 4 in eye ..... Cheilodipterus truncatus Günther

4*b*. No black spot or pigmentation about vent.
Cheilodipterus singapurensis [13] Bleeker

3*b*. Preopercle smooth ..... Cheilodipterus subulatus [14] Weber

CHEILODIPTERUS MACRODON (Lacepède)

PLATE 43, A

Centropomus macrodon LACEPÈDE, Histoire naturelle des poissons, vol. 4, p. 252, 273, 1802 (type locality, Reunion Island).

Cheilodipterus lineatus LACEPÈDE, Histoire naturelle des poissons, vol. 3, pp. 539, 543, pl. 34, fig. 1, 1802.—FOWLER and BEAN, U. S. Nat. Mus. Bull. 100, vol. 10, p. 131, 1930.—SCHULTZ, U. S. Nat. Mus. Bull. 180, p. 97, 1943.

Cheilodipterus octovittatus CUVIER and VALENCIENNES, Histoire naturelle des poissons, vol. 2, p. 163, 1828.

Cheilodipterus heptazona BLEEKER, Nat. Geneesk. Arch. Ned.-Ind., vol 2, p. 526, 1845.

Paramia octolineata BLEEKER, Atlas ichthyologique des Indes Néerlandaises, vol. 7, pl. (27) 305, fig. 2, 1873–76.

Paramia macrodon JORDAN and SEALE, Bull. U. S. Bur. Fish., vol. 25, 1905, p. 252, 1906.

Cheilodipterus macrodon WEBER and DE BEAUFORT, Fishes of the Indo-Australian Archipelago, vol. 5, p. 363, 1929.

SPECIMENS STUDIED

Bikini Atoll: 8 stations, 83 specimens, 33 to 150 mm. standard length.
Rongelap Atoll: 2 stations, 19 specimens, 30 to 132 mm.

Description.—Counts and measurements were taken from five specimens, 65 to 133 mm. in length. Dorsal rays VI–I,9; anal rays II,8; pectoral rays ii,9,ii; vertical scale rows 23 to 26; scale rows above lateral line 23; scale rows below lateral line 8 to 10.

Body depth 3.1 to 3.9, head length 2.4 to 2.7, head depth 3.6 to 4.6, length of caudal peduncle 3.6 to 4.0, length of longest pectoral ray 4.3 to 5.4, all in standard length; eye 2.9 to 3.5, length of premaxillary 1.9 to 2.2, least depth of caudal peduncle 2.9 to 3.1, length of snout 2.9 to 3.2, width of bony interorbital 5.2 to 6.1, all in length of head; third spine of spinous dorsal longest, 2.3 to 3.0 in head; first spine of spinous dorsal one-half to three-fourths length of second; second anal spine long, longer than base of anal fin; gill rakers 5 or 6+1+14 or 15, the longest raker equals length of longest gill filament, about 3.0 in eye.

Caudal fin moderately forked; outline of anal rays slightly concave; mouth terminal with strong, enlarged canines, those near sym-

[13] *Cheilodipterus singapurensis* Bleeker, Nat. Tijdschr. Nederl.-Indië, vol. 20, pp. 7–8, 1860; Atlas ichthyologique des Indes Néerlandaises, vol. 7, pp. 104–106, pl. (35) 313, fig. 4, 1873–76. See remarks under *C. truncatus* for a discussion of the relationship of these two species.

[14] *Cheilodipterus subulatus* Weber, Notes Leyden Mus., vol. 31, p. 164, 1909, Makassar; *Siboga*-Expeditie, Fische, p. 239, pl. 8, fig. 1, 1913.

physis largest; free edge of preopercle weakly serrated; scales ctenoid on body and head; vent near origin of anal fin, about one-fourth distance from origin of anal to posterior base of pelvic fins.

Color in alcohol.—Body dusky to brown, generally browner in older specimens; head light tan to brown in adults; body with eight horizontal brown stripes in adults (counting from midbelly to spinous dorsal), but only five in some young (about 30 mm. in length); these stripes wide, straight (not wavy), of uniform width, about six in base of anal fin, spaces between them less than their width; dorsal stripe extends from midinterorbital area to origin of dorsal fin, dividing and passing on each side of dorsal fin, uniting at end of soft dorsal to form a single stripe on dorsal side of caudal peduncle; a dorsolateral stripe extends from tip of snout, just above eye to anterior portion of lateral line on body and extends dorsolaterally to caudal peduncle and base of caudal fin; 3 parallel, lateral stripes extend from upper half, middle, and lower half of eye, respectively, and pass posteriorly between upper free edge of opercular flap and pectoral base to caudal base, these frequently the best developed stripes; another stripe commences at tip of lower jaw extending posteriorly just at lower base of eye, on cheek and through base of pectoral, ventrolaterally, to caudal base; another ventrolateral stripe starts on the chin, passing midway between pectoral and pelvic bases to caudal base; a ventral stripe extends from each side of the pelvic base to end of anal fin, where they join to form ventral caudal peduncle stripe; this stripe usually faintly developed; midsection of abdomen from anal fin to isthmus sometimes with a faint pigmented streak; in young a black spot at midbase of caudal fin, over end of hypural, nearly circular, small, about 3 to 4 in least depth of caudal peduncle, in many juveniles spot diffuse to obscure, in adults obscure; a diffuse brownish band encircles caudal peduncle, sometimes with color intensity of a horizontal stripe; band begins just beyond the area of least depth of the caudal peduncle and covers all scales to caudal rays, extending to tip of procurrent rays and outer 2 to 3 fully developed rays, forming a semilunar outline on caudal fin; band is variable, present to absent in juveniles; absent in young; sometimes band is obscure other than pigmentation of outer caudal rays; spinous dorsal, entire first ray and lower one-third of remaining rays of soft dorsal blackish; pelvics blackish, sometimes concentrated near tips of rays; first ray of anal fin with some dark color; fins otherwise transparent; dark coloration of dorsal, pelvics, and anal fins absent in young, generally absent in juveniles.

Color when alive.—From Kodachrome transparency, dorsolateral stripes of body light tan to grayish; ventrolateral stripes brown to blackish; stripes diffuse.

Ecology.—This species, although taken in shallow reef waters, appeared to be more abundant in the deeper waters of the lagoon.

Remarks.—This is the most abundant species of *Cheilodipterus* represented in the collections of the U. S. National Museum. A widely distributed species, it is represented by specimens from Mauritius eastward to Manga Reva and shows extremely little variation.

CHEILODIPTERUS TRUNCATUS Günther

Cheilodipterus truncatus GÜNTHER, *in* Brenchley, Jottings during the cruise of H. M. S. *Curaçoa* . . . , p. 418, pl. 30, 1873 (type locality, Misol Island).
Cheilodipterus pseudosubulatus HARDENBURG, Treubia, pt. 3, vol. 19, p. 414, 1948 (type locality, southern Sumatra).

SPECIMEN STUDIED

Eniwetok Atoll: Aaraanbiru Island, ocean reef, June 3, 1946, S–46–198, Schultz, 1 specimen, 91 mm.

Description.—Dorsal rays VI–I,9; anal rays II,9; pectoral rays ii,9,ii; vertical scale rows 25; scale rows above lateral line 2; scale rows below lateral line 7.

Body depth 3.5, head length 2.5, head depth 3.9, least depth of caudal peduncle 6.2, caudal peduncle length 4.0, longest pectoral ray 5.0, all in standard length; diameter of eye 3.5, upper jaw 2.0, least depth caudal peduncle 2.5, length of snout 3.5, least width of bony interorbital 7.3, all in length of head; longest spine of first dorsal 2.5 in head and first spine less than half length of second; gill rakers 4+1+14, longest about 4.0 in eye.

Caudal fin slightly emarginate, depressed first dorsal fin not touching second dorsal; outline of rays of first dorsal, second dorsal, and anal fins convex; mouth terminal, with enlarged canines of jaws quite strong, those in lower jaw at symphysis largest; free edge of preopercle weakly serrated; premaxillary long, nearly touching vertical line through rear margin of eye.

Color in alcohol.—Body brown to blackish; head blacker than body, especially from top of head to snout, and on chin; body and head with three very faint horizontal stripes; first beginning on head above eye, passing dorsolaterally to lateral line on body to area of spinous dorsal and on dorsolateral area of caudal peduncle; second intersecting midsection of eye, passing posteriorly on midside of body, ending at base of caudal fin in a more prominent black spot than stripe; third beginning on snout under eye, passing through base of pectoral fin on body and ventrolateral portion of caudal peduncle; these stripes about half width of a lateral line scale from midbody section; caudal spot about one-half width of a lateral stripe; posterior dorsal edge of maxillary below eye with a black streak; area of vent heavily pigmented, with black, about half diameter of eye; spinous dorsal fin

blackish, soft dorsal fin dusky, pectoral nearly transparent, base of pectoral blackish, pelvics dusky, more so on outer rays, anal somewhat dusky near base, caudal fin dusky with the procurrent and outer two developed rays black.

Remarks.—Some counts and measurements of specimens of *C. truncatus* from the Philippine Islands were, in five specimens ranging in length from 48 to 153 mm.: Dorsal rays VI–I,9; anal rays II,8; pectoral rays ii,8 or 9, i or ii; vertical scale rows 23 to 25; scale rows above lateral line 3, scale rows below lateral line 7 to 9; predorsal scales 7 to 10.

Head length 2.3 to 2.5; head depth 4.0 to 3.7; width of head 6.3 to 7.3; caudal peduncle length 4.0 to 4.5, all in standard length; diameter of eye 3.5 to 4.2; length of upper jaw 2.0 to 1.7; length of snout 3.9 to 3.5; width of interorbital 5.5 to 7.8, all in length of head; gill rakers 4 to 6+1+13 to 15. Statistics for specimens of *C. singapurensis* from the same area have almost the same ranges.

Cheilodipterus truncatus closely resembles *C. singapurensis* Bleeker. Upon examination of the specimens of the latter reported on by Fowler and Bean (U. S. Nat. Mus. Bull. 100, vol. 10, pp. 125–127, 1930) it became evident that two species were involved. The salient character differentiating them is the presence of a distinct black spot about the vent in the former species and its absence in the latter. This spot is comparatively larger in the larger specimens, its diameter in the eye ranging from 4 to 2 times in specimens 48 to 153 mm. standard length. No intermediacy of this character was found in an examination of 38 specimens of both sexes of *C. truncatus* and 47 specimens of *C. singapurensis* from the Philippine Islands. In his description and figure of *C. singapurensis*, Bleeker did not mention this character. Although Günther does not describe this spot, his figure illustrates its location and relative size and leaves no question as to which species he examined.

The smaller specimens of *C. truncatus* from the Philippine Islands have, in addition to the three horizontal stripes described above, two other body stripes: one originating in the interorbital area, passing posteriorly on dorsal side to origin of spinous dorsal, bisecting into parallel stripes on each side of dorsal fin and uniting at end of last ray of soft dorsal and passing on caudal peduncle, dorsally, to procurrent rays of caudal fin; the other extending from lower jaw, passing above base of pelvics, uniting with stripe of opposite side at end of anal base into a common ventral caudal peduncle stripe. Young specimens of *C. singapurensis* have similar stripes. In both species the stripes are only faintly visible in adult specimens, and the caudal spot is diffuse to obscure. Sexual dimorphism appears characteristic in both forms, the female attaining the larger size. The largest male *C. trun-*

catus examined from the Philippine Islands was 113 mm. in standard length; largest female, 153 mm.

One recently collected specimen of *C. singapurensis* (U.S.N.M. No. 123381, taken in December 1944, by Lt. Otis Barton in Tanamera Bay, New Guinea) has a dusky caudal but lacks the dark coloration on the procurrent rays and outer two developed caudal rays described for *C. truncatus*. The pelvic fins have a greater concentration of dark color near the tips of the rays rather than spread along the first ray from its base to the tip.

Although *C. pseudosubulatus* was compared by Hardenberg with *C. subulatus*, a doubtful species, he made no attempt to relate it with *C. truncatus* or *C. singapurensis*. Among other characters, the following and more important ones clearly show which species he had: "Caudal feebly incised, anal opening in a black spot, . . . resembling *Cheilodipterus subulatus* but differing . . . in the serrated preoperculum, color of alcohol specimens blackish." For these reasons *C. pseudosubulatus* is placed in the synonomy of *C. truncatus*.

C. subulatus was described and figured by Weber (Notes Leyden Mus., vol. 31, p. 164, 1909; *Siboga*-Expeditie, Fische, vol. 57, p. 239, pl. 8, fig. 1, 1913) from a single specimen, 220 mm., taken from a market at Makassar in 1888. Herre (Copeia, No. 4, p. 217, 1943) reported it from the Sulu Archipelago. It is otherwise not recorded. A smooth preopercle, characteristic of this species, is found in *C. singapurensis*, especially in the largest specimens, which may have most of the serrations on one or both sides of the free edge of the preopercle missing. In *singapurensis*, as in *truncatus*, the denticulations are small and weak and frequently can be observed only under magnification. Herre did not describe this character in his specimens. Counts, measurements, dentition, and body coloration of *C. subulatus* as given by Weber and by Weber and de Beaufort (Fishes of the Indo-Australian Archipelago, pp. 360 and 365–366, fig. 87, 1929) are strikingly similar to *C. singapurensis*. Thus, *C. subulatus* should probably be placed in the synonymy of *C. singapurensis*.

Genus PARAMIA Bleeker

Paramia Bleeker, Nederl. Tijdschr. Dierk., vol. 1, p. 233, 1863. (Genotype, *Cheilodipterus quinquelineatus* Cuvier and Valenciennes.)

This genus is represented by two species found only in the Indo-Pacific region.

KEY TO THE SPECIES OF PARAMIA

1*a*. A black circular spot on dorsal side of caudal peduncle just anterior to procurrent rays of caudal fin, diameter about 6 in least depth of caudal peduncle; 5 horizontal body stripes, counting dorsally from stripe on midventral area between pelvic bases to and including stripe on middorsal side; snout shorter, length 2.8 to 3.0 in length of dorsal fin base; caudal

peduncle depth greater than length of snout; eye smaller, about 1.0 in snout, 3.2 to 3.5 in head, 2.9 to 3.0 in length of dorsal fin base; black spot at base of caudal fin oval, larger, greatest diameter less than 2.5 in least depth of caudal peduncle (see pl. 42, C)___ Paramia bipunctata [15] Lachner

1b. No spot on dorsal side of caudal peduncle; 6 horizontal body stripes; snout longer, length less than 2.5 in length of dorsal fin base; caudal peduncle depth approximately equals length of snout; eye larger, about 0.9 in snout, 3.0 to 3.3 in head, 2.2 to 2.8 in length of dorsal fin base; black spot at base of caudal fin, nearly circular, smaller, diameter more than 3.0 in least depth of caudal peduncle.

Paramia quinquelineata (Cuvier and Valenciennes)

PARAMIA QUINQUELINEATA (Cuvier and Valenciennes)

PLATES 39, B; 42, B

Cheilodipterus quinquelineatus CUVIER and VALENCIENNES, Histoire naturelle des poissons, vol. 2, p. 167, 1828 (type locality, Borabora, Society Islands).—FOWLER and BEAN, U. S. Nat. Mus. Bull. 100, vol. 10, p. 127, 1930 (in part).

SPECIMENS STUDIED

Bikini Atoll: 4 stations, 103 specimens, 16 to 75 mm. standard length.
Eniwetok Atoll: 1 station, 1 specimen, 75 mm.
Kwajalein Atoll: 1 station, 1 specimen, 43 mm.
Rongelap Atoll: 3 stations, 27 specimens, 23 to 60 mm.

Description.—The following counts and measurements taken from five specimens, 40 to 75 mm. in length. Dorsal rays VI–I,9; anal rays II,8; pectoral rays ii, 8 or 9, ii; vertical scale rows 24 or 25; scale rows above lateral line 2; scale rows below lateral line 6 or 7.

Body depth 3.4 to 3.7, head length 2.4 to 2.5, head depth 4.1 to 4.3, length of caudal peduncle 3.7 to 4.1, length of longest pectoral ray 4.5 to 4.9, all in standard length; eye 3.0 to 3.3, length of upper jaw 2.0 to 2.1, least depth of caudal peduncle 3.0 to 3.2, snout 3.5 to 3.6, width of bony interorbital 6.3 to 7.1, all in length of head; eye in snout 0.9; second spine of spinous dorsal longest, about 3.2 to 3.4 in length of head; first spine of spinous dorsal 0.4 to 0.6 in length of second spine; second anal spine longer than length of anal base; gill rakers 4 or 5+1+12, the longest raker about equal to longest filament, 3.5 to 3.8 in eye.

Caudal fin moderately forked; outline of rays of soft dorsal and anal fins slightly convex; canines in jaws comparatively weak; free edge of preopercle serrated; scales ctenoid on body and head; vent located about two-fifths distance from origin of anal fin to posterior base of pelvic fin.

Color in alcohol.—Body and head light tan with six sharply defined, brownish-black, horizontal stripes extending from areas of snout to base of caudal fin; stripes located laterally on body about one-third

[15] *Paramia bipunctata* Lachner, Proc. U. S. Nat. Mus., vol. 101, p. 604, fig. 18,*d*, 1951. Known only from the Persian Gulf.

width of lateral line scale taken from midbody area, and 5.5 to 7 in eye; width of area between stripes on lateral side of body 1.5 to 2 times width of stripes; first, a dorsal stripe, begins just posterior to interorbital area of midhead and extends dorsally to procurrent rays of caudal fin, dividing at origin of spinous dorsal and uniting at end of base of soft dorsal fin; second, a dorsolateral, stripe extends from snout dorsally, just touching dorsal margin of eye and anterior lateral line pores on body, and passes posteriorly on dorsolateral portion of caudal peduncle; third, a midbody stripe, begins on tip of snout, passes through middle of eye and along midbody, extending almost to spot at base of caudal fin; fourth, a ventrolateral stripe, extends from tip of lower jaw along anterior portion of dentary, thence through upper jaw and just below eye, through base of pectoral fin and ventrolaterally to caudal base; fifth, another ventrolateral stripe, passes from symphysis of lower jaw ventrally along inner edge of mandibular bones and lower edge of interopercle, passing just above base of pelvic fin and posteriorly near anal base, uniting with stripe of opposite side at rear of anal base to form common ventral caudal peduncle stripe; sixth, a ventral stripe, extends from the isthmus just posterior to tip of lower jaw, touching inner branchiostegals of both sides, and extends on midbelly through bases of pelvics to vent; stripes wider, more intense, and more sharply outlined on head, tapering very gradually from head to caudal peduncle, where they are less intense and have the least width; first two spines of spinous dorsal blackish; procurrent and outer two developed caudal rays with some black pigment, remainder of median and paired fins nearly transparent; a conspicuous round, brownish black spot at midbase of caudal fin, its diameter about 5 in least depth of caudal peduncle, surrounded by a clear, nearly circular area, the diameter of this area almost equal to least depth of the caudal peduncle.

Remarks.—P. quinquelineata ranges from the east African coast to the islands of Polynesia and Micronesia. It has not been reported from the Hawaiian Islands.

Genus GYMNAPOGON Regan

Gymnapogon Regan, Ann. Mag. Nat. Hist., ser. 7, vol. 15, p. 19, 1905; ser. 11, vol. 6, pp. 527–9, 1940; Copeia, No. 3, pp. 173–4, 1940. (Orthotype, *Gymnapogon japonicus* Regan.)

Henicichthys Tanaka, Zool. Mag., 27, No. 325, p. 568, 1915. (Orthotype, *Henicichthys foraminosus* Tanaka.)

Australaphia Whitley, Mem. Queensland Mus., vol. 11, pt. 1, p. 49, fig. 6, 1936. (Orthotype, *Australaphia annona* Whitley.)

Acanthapogon Fowler, Proc. Acad. Nat. Sci. Philadelphia, No. 2, pp. 197–8, pl. 8, fig. 18, 1938. (Orthotype, *Acanthapogon vanderbilti* Fowler.)

This interesting group has been placed at various times in at least four families, the Apogonidae, Gymnapogonidae, Gobiidae, and

Henicichthyidae, and has been associated with two others, the Pomatomidae and Trichodontidae. Six species are now recognized, two of which are here described as new from the Marshall Islands.

Regan placed *Gymnapogon japonicus* in the Apogonidae chiefly on the basis of its possession of two anal spines, a similar canine dentition, the gill membranes free from the isthmus, and a similarity in certain skeletal relationships. He noted the thin preopercular flap but did not call attention to the stout preopercular spine, a character not as yet known in any species of Apogonidae. Tanaka apparently overlooked the Regan reference when he described a new genus and species, *Henicichthys foraminosus*, and a new family, Henicichthyidae. Tomiyama (Jap Journ. Zool., vol. 7, p. 50–51, fig. 9, 1936) reported additional specimens of *H. foraminosus* and figured a specimen but placed this species in the Gobiidae. Neither Tanaka nor Tomiyama noted the preopercular spine and flap. I consider *H. foraminosus* in the synonymy of *G. japonicus* as Regan had done. Jordan (Stanford Univ., Publ. Biol. Sci., vol. 3, No. 2, pp. 188 and 203, 1923) placed *Gymnapogon* in the Apogonidae and *Henicichthys* in the Henicichthyidae, not recognizing their similarities. Whitley placed *Australaphia annona* in the Gobiidae, and later placed it in the Gymnapogonidae (Australian Zool., vol. 10, pt. 1, 1941), which he related to the apogonids. Whitley did not discuss the preopercular flap or spine although his figure indicates these structures. Fowler recalled none of this previous work when he described as a new genus and species *Acanthapogon vanderbilti* (Cheilodipterinae). Although he amply described the spine on the preopercle, the thin, transparent preopercular flap was not recorded. Fowler placed *vanderbilti* in the Apogonidae on the basis of the similarity of their detentions, but the fact that *vanderbilti* lacks the small papillae characteristic of *japonicus* may have been the reason why certain relationships existing between these species were overlooked. When Herre (Copeia, No. 4, p. 199, 1939) described *Henicichthys philippinus*, he differentiated it from *foraminosus*, recognized Tanaka's Henicichthyidae, and discussed the possible association of *philippinus* with the gobies, but omitted the work of Regan and Fowler, perhaps because he likewise did not note the preopercular spine and flap. *Gymnapogon* was included in the Apogonidae by Schultz (Proc. U. S. Nat. Mus., vol. 88, pp. 406, 422, 1940) and *Acanthapogon* was placed in the synonymy of *Cheilodipterus* (Schultz, ibid., p. 413), and this was later adhered to by Fowler (Mem. Bishop Mus., vol. 12, No. 2, suppl. 3, p. 81, 1949).

The species of this group, including those described as new, other than *vanderbilti*, resemble the Gobiidae, somewhat, in general body shape and in having tiny papillae arranged in more or less definite patterns over the head and body. They all differ from the Gobiidae

in having two anal spines rather than one. The longer outer pectoral rays and the gill membranes free from the isthmus are additional characters that differentiate them from many of the gobies. They resemble the Apogonidae in having two anal spines; a similar number, arrangement, and development of canine teeth; and free dorsal fins. They differ from all apogonids in having a stout preopercular spine, below which is found an elongate, thin, transparent preopercular flap (except in *G. gracilicauda*, see p. 498) and from most apogonids in having papillae on the head or body (present in *Apogon auritus*, *A. isostigma;* absent in *G. vanderbilti*), and in having no scales. No single character appears common to this group alone, and it therefore seems most appropriate to consider these exotic species as apogonids rather than to regard them as a distinct family. The following characters, considered collectively, distinguish the group: Two anal spines; papillae in a network or linear arrangement on the head and body; a preopercular spine and flap; gill membrane free from the isthmus; canine teeth present in the jaws and arranged in particular groups; body scaleless; and a total gill raker count, including rudiments, ranging from 11 to 12. Neither sufficient specimens nor time were available for skeletal preparation and study. Some of the osteological work that Regan (Copeia, No. 3, p. 173, 1940) did with *japonicus* must be done with all the species in order to establish better relationships. I follow Regan in the view that this group should be regarded as a separate subfamily in the Apogonidae.

The validity of recognizing a single genus may be questioned. There are certain differences in the dentition among the species and some may be of generic importance. A comparison of the dentition of five species is given in table 42. Our specimen of *japonicus* has no canines on each side of the symphysis of the lower jaw. This specimen has been injured and these teeth could have been torn out. These canines are variable in size in the other species and are often weakly developed. Regan did not mention their presence in his type specimens, although he gave an account of those in the upper jaw. Tomiyama states in his description of the dentition of *foraminosus* that a few canines are near the anterior tip of the lower jaw. Since Regan placed this species in the synonymy of *japonicus* chiefly by referring to Tomiyama's figure, one must assume that either (1) Regan overlooked the symphyseal canines of the lower jaw because of their small size, their insufficient development, or their injured condition; or (2) *foraminosus* is a distinct species and perhaps subgenerically different. I suspect that *japonicus* has canine teeth, and I follow the former reasoning at this time and place *foraminosus* in synonymy. Thus four species are included in the genus on the basis of having similar dentition, *japonicus*, *vanderbilti*, *philippinus*, and *urospilotus*.

A fifth species, *annona*, may be included with some question, for no specimens were available for study. For a consideration of the new species in these respects, see pages 494 and 497.

TABLE 42.—*Number and arrangement of canine teeth in 5 species of* Gymnapogon

Character	*japonicus*	*vanderbilti*	*philippinus*	*urospilotus*	*gracilicauda*
Canine teeth in anterior portion of upper jaw, on each side of symphysis.	2 to 3; erect.	3 to 4; erect.	3 to 4; erect.	4 to 7; erect.	1 to 3; directed inwardly.
Canine teeth along middle half of lower jaw, each side.	5 to 7	6 to 8	6 to 7	4 to 7	10 to 12.
Canine teeth on each side of symphysis of lower jaw.	7	2 to 3; erect.	2 to 3; erect.	1 to 2; erect.	1; directed inwardly.
Teeth of vomer	1; caninoid.	4; caninoid.	3; caninoid.	3; caninoid.	10 to 20; pointed villiform.

The species probably have a comparatively restricted range. The two new forms are known only from the Marshall Islands, while each of the other four is known from one of the following localities: The China Sea (*japonicus*), the Philippine Islands (*philippinus*), the east Australian coast (*annona*), and Christmas Island (*vanderbilti*).

KEY TO THE SPECIES OF GYMNAPOGON

1*a*. Preopercular spine and flap present; soft dorsal rays I,9 or I,10; anal rays II,8 to II,10; pectoral rays 13 to 15; teeth erect or moderately recurved on each side of symphysis of upper and lower jaw; one to four enlarged canine-like teeth on vomer; posterior margin of preopercle smooth; caudal rounded, emarginate, or forked; caudal peduncle of moderate length and depth.

2*a*. Soft dorsal rays I,9 and anal rays II,9 or II,10; caudal fin deeply forked.

3*a*. Maxillary shorter, nearly touches, or touches, a vertical line through posterior margin of eye; distinct black mark at base of caudal fin, faded in some specimens, sometimes separated into two half discs.

Gymnapogon urospilotus, new species

3*b*. Maxillary longer, extends well beyond vertical drawn through posterior margin of eye; caudal fin without any marks, transparent.

Gymnapogon annona Whitley

2*b*. Soft dorsal and anal fin rays in various combinations, but not as above; caudal fin moderately forked or emarginate.

4*a*. Soft dorsal rays I,10; anal rays, II,9; outer one-third of interradial membrane of caudal fin brownish; caudal peduncle, tip of snout, tip of lower jaw, and nape with fine brown spots.

Gymnapogon japonicus Regan

4*b*. Soft dorsal rays I,9; anal II,8; caudal fin transparent; no pigmentation on caudal peduncle; tip of snout, lower jaw, and other parts of head with or without pigmentation.

5*a*. Small papillae on head and body conspicuous, arranged in a network; pelvic fins transparent; caudal fin deeply forked.

Gymnapogon philippinus (Herre)

5*b*. No papillae on head or body; pelvic fins with a light-brown area near base; caudal fin moderately forked.

Gymnapogon vanderbilti (Fowler)

1b. Preopercular spine and flap absent; soft dorsal rays I,8; anal rays II,8; pectoral rays 15 to 16; teeth on each side of symphysis of upper and lower jaw basally directed inward; about 10 to 20 small pointed villiform teeth on vomer; posterior margin of preopercle very finely serrated; caudal rounded; caudal peduncle long and slender.

Gymnapogon gracilicauda, new species

GYMNAPOGON UROSPILOTUS, new species

FIGURE 83

Holotype.—U.S.N.M. No. 142404, Kwajalein Atoll, northern Marshall Islands, in lagoon reef near south end of Ennylabegan Island; September 1, 1946, S–46–397, collected by E. S. Herald, a specimen 27 mm. in standard length.

Paratypes.—The paratypes listed below were all collected from the northern Marshall Islands: U.S.N.M. No. 142405, taken with the holotype and having the same data, 2 specimens, 23 and 23.5 mm. in standard length; U.S.N.M. No. 142407, Bikini Atoll, Arji Island, in

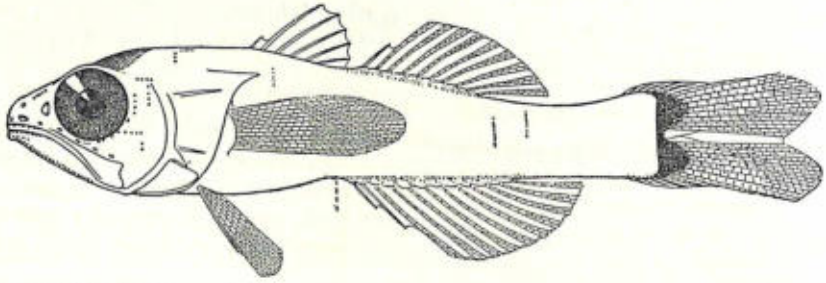

FIGURE 83.—Holotype of *Gymnapogon urospilotus*, new species (U.S.N.M. No. 142404), from Kwajalein Atoll. (Drawing by Aime M. Awl.)

water 20 to 40 feet deep, 100 yards off shore using deep poison, August 7, 1946, S–46–308, Herald and Brock, 1 specimen, 17 mm.; U.S.N.M. No. 142410, Bikini Atoll, in shallow tidal pond between Eman and Reer Islands, July 18, 1947, S–46–422, Brock, Hiatt, Schultz, and Myers, 3 specimens, 14 to 20 mm.; U.S.N.M. No. 142409, Bikini Atoll, northwest section of Reer Island in lagoon reef, August 12, 1946, S–46–332, Herald and Brock, 1 specimen, 20 mm.; U.S.N.M. No. 142406, Bikini Atoll, Bikini Island in ocean reef, March 22, 1946, S–46–15, Schultz and Brock, 1 specimen, 21 mm.; U.S.N.M. No. 142413, Rongelap Atoll, Mellu Island, lagoon reef, June 19, 1946, S–46–220, Schultz and Herald, 1 specimen, 13 mm.; U.S.N.M. No. 142412, Rongerik Atoll, Latoback Island, lagoon reef, June 28, 1946, S–46–238, Schultz and Herald, 1 specimen, 17 mm.; U.S.N.M. No. 142411, Rongerik Atoll, Latoback Island, lagoon reef, August 14, 1947, S–1041, Brock, Schultz, and Donaldson, 2 specimens, 18 and 27 mm.; U.S.N.M. No. 112376, Bikini Atoll, Airy Island, on lagoon side, April

17, 1946, S–46–97, Schultz, 2 specimens, 16.5 and 18.5 mm.; U.S.N.M. No. 112377, Bikini Atoll, in shallow tidal pond between Eman and Reere Islands, ocean reef, July 18, 1947, S–46–422, Brock, Hiatt, Schultz, and Myers, 1 specimen, 21 mm.; U.S.N.M. No. 112375, Bikini Atoll, Romuk Island, in ocean reef, April 1, 1946, S–46–47, Schultz, 1 specimen, 19 mm.; Bikini Atoll, Ion Island, August 1, 1947, Univ. Washington, 2 specimens, 19 to 25 mm.; Eniwetok Atoll, Rigili Island, July 24, 1948, Univ. Washington, 1 specimen, 23 mm.

Description.—This description is based on the specimens listed above. The counts are recorded for the holotype followed in parentheses by the number of paratypes examined, and the range of counts (see also table 43) : Dorsal rays VI–I,9 (15: VI–I,9) ; anal rays II,10 (14: II,9 to II,10) ; pectoral rays 14 (11: 13 to 14) ; pelvic rays I,5 (5: I,5) ; branched caudal rays 8,7 (4: 8,7) ; gill rakers including rudiments 2+1+9 (2: 2+1+9). Measurements, expressed in thousands of the standard length, are given for the holotype and two paratypes in table 44.

TABLE 43.—*Certain fin ray counts in 5 species of* Gymnapogon

Species	Soft dorsal rays			Anal rays			Pectoral rays			
	I,8	I,9	I,10	II,8	II,9	II,10	13	14	15	16
gracilicauda	5			5					2	1
nrospilotus		15			11	4	8	3		
japonicus			1		1		1			
philippinus		1		1				1		
vanderbilti		2		2					1	

Head and body scaleless; lateral line not evident; upper jaw elongate, touching vertical through posterior margin of eye; operculum with two flat spines; a stout triangular spine at posterior margin of preoperculum near a horizontal line through lower edge of eye; just below preopercular spine a thin, transparent preopercular flap, overlapping the lower portion of the operculum and extending to its edge; minute papillae most evident on top of head and on lower jaw, some on cheeks, opercles, and sides of body, some also on fins; those on caudal fin most numerous, arranged irregularly; those on head arranged linearly, but not in discernible squarish networks as in *gracilicauda*, those along side of body in vertical rows.

Villiform teeth on posterior three-fourths of upper jaw, about 4 to 7 pairs of canines along anterior fourth; 8 to 11 pairs of canine teeth along posterior three-fourths of lower jaw, villiform teeth in anterior fourth, 1 to 2 pairs of canines just opposite symphysis; vomer typically with 3 caninelike teeth; palatines with 4 to 7 pointed villiform teeth, considerably smaller and weaker than those of vomer.

TABLE 44.—*Measurements of species of* Gymnapogon, *expressed in thousandths of the standard length*

Character	*urospilotus*			*gracilicauda*			*japonicus*	*philippinus*	*vanderbilti*
	Holotype U.S.N.M. No. 142404	Paratypes U.S.N.M. No. 142405		Holotype U.S.N.M. No. 112378	Paratypes U.S.N.M. Nos. 142408 and 112381		Paratype U.S.N.M. No. 108821 Japan, Inland Sea	Paratype U.S.N.M. No. 151464 Batangas, Philippines	Paratype U.S.N.M. No. 107180 Christmas Island, South Pacific
Standard length in millimeters	27	23	23.5	33.5	20.5	19	31	26.8	15.8
Greatest body depth	222	283	234	245	180	195	190	224	215
Head length	389	391	383	364	322	332	381	410	317
Head depth at occiput	222	239	234	164	185	190	187	224	205
Length of caudal peduncle	241	261	255	278	204	207	242	243	285
Least depth of caudal peduncle	130	130	106	92	88	95	103	112	108
Length of longest pectoral ray	259	239	277	209	263	----------	----------	299	----------
Diameter of eye	111	109	106	86	83	84	74	93	89
Length of upper jaw	185	196	170	173	180	174	174	210	152
Length of snout	74	87	85	78	68	79	103	90	69
Tip of snout to origin of spinous dorsal fin	389	392	404	349	380	347	406	422	348
Tip of snout to insertion of pectoral fins	334	348	362	328	341	370	372	382	348
Tip of snout to insertion of pelvic fins	296	304	319	328	351	316	387	365	285
Tip of snout to anal opening	500	478	510	460	478	510	580	541	538
Tip of snout to origin of anal fin	518	478	532	519	560	526	600	552	560

Color in alcohol.—Head and body light tan; two black half-circle marks at end of caudal peduncle on base of caudal fin in smaller specimens, these united into a B-shaped mark in the larger specimens; remainder of caudal and other fins transparent; tip of snout, chin, and occiput with scattered melanophores.

Remarks.—Named *urospilotus*, in reference to the spots at the end of the caudal peduncle.

GYMNAPOGON GRACILICAUDA, new species

FIGURE 84

Holotype.—U.S.N.M. No. 112378, Bikini Atoll, northern Marshall Islands, Arji Island, deep poison, 20–40 feet, 100 yards off shore in lagoon, August 7, 1946, S–46–308, collected by Herald and Brock, a specimen 33.5 mm. in standard length.

Paratypes.—The following paratypes were all taken from the northern Marshall Islands, U.S.N.M. No. 142408, Bikini Atoll, Enyu

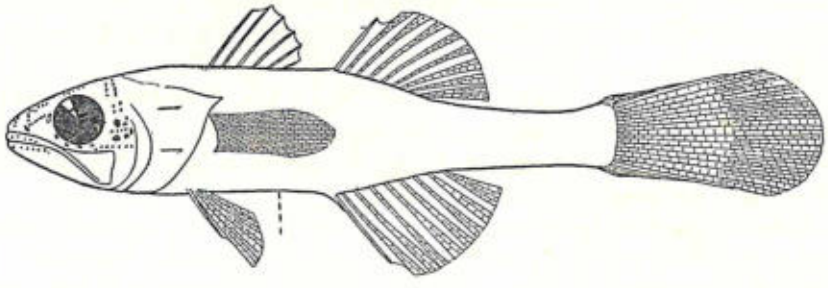

FIGURE 84.—Holotype of *Gymnapogon gracilicauda*, new species (U.S.N.M. No. 112378), from Bikini Atoll. (Drawing by Aime M. Awl.)

Island, reef at entrance just inside lagoon, March 16, 1946, S–46–8, Schultz, Brock, and Marr, 2 specimens, 13.5 and 20.5 mm.; U.S.N.M. No. 112379, Bikini Atoll, lagoon side Airy Island, April 17, 1946, S–46–97, Schultz, 1 specimen, 18 mm.; U.S.N.M. No. 112380, Bikini Atoll, Namu Island, lagoon reef, August 6, 1946, Schultz, Brock, and Hiatt, 1 specimen, 17 mm.; U.S.N.M. No. 112381, Rongerik Atoll, Latoback Island, lagoon reef, August 14, 1947, Brock, Schultz, and Donaldson, 1 specimen, 19 mm.

Description.—This description is based on the holotype and paratypes listed above. The counts are recorded for the holotype followed in parentheses by the number of paratypes examined and the range of counts: Dorsal rays VI–I,8 (5: VI–I,8); anal rays II,8 (5: II,8); pectoral rays 16 (2: 15); pelvic rays I,5 (5: 1,5); branched caudal rays 8, 7 (2: 8, 7); gill rakers, including rudiments, 3+1+7 (1: 3+1+7). (For other counts see table 42.) Measurements, expressed in thou-

sands of the standard length, are given for the holotype and two paratypes in table 44.

Head and body without scales; upper jaw long, passes vertical through posterior margin of eye; no evidence of lateral line; two weak spines on operculum; dorsal portion of head from snout to occiput with minute papillae arranged, more or less, in a squarish network, some arranged linearly along lower jaw, a few on cheeks and opercles, none observed on body (the number, arrangement, and distribution of papillae on head and body cannot be worked out, for the larger specimens are not in good condition, and many papillae undoubtedly have been eroded away).

Small, pointed, villiform teeth in upper jaw, in two rows posteriorly, widening into a broader band anteriorly about symphysis, one to three enlarged canines directed inwardly on each side of symphysis; lower jaw with several irregular rows of pointed villiform teeth posteriorly, forming a wider patch anteriorly, canines of lower jaw arranged in about 10 to 12 pairs extending along posterior two-thirds, a smaller canine on each side of symphysis directed inwardly; vomer V-shaped, with a row of about 20 pointed villiform teeth; pointed villiform teeth on palatines in single row.

Color in alcohol.—Head and body light tan, fins transparent; 6 scattered melanophores on cheek of holotype; smallest specimen (13.5 mm.) with 11 enlarged scattered melanophores at base of caudal fin; all other specimens show no pigmentation.

Remarks.—This species is characterized externally by its slender, elongate caudal peduncle (hence the name *gracilicauda*), and the relatively large, long, fan-shaped caudal fin, with a series of about eight simple, procurrent rays above and below.

G. gracilicauda appears to differ from the other species of this genus in having (1) the teeth on each side of the symphysis of the upper and lower jaw directed inwardly, rather than erect, (2) a higher number of teeth in the lower jaw, (3) many pointed villiform teeth on the vomer rather than a few (1 to 4) caninoid teeth, and (4) no preopercular spine and flap (because the specimens examined were in very poor condition, no evidence of these structures was seen; better material is needed for absolute certainty). These characters combined would certainly denote that *gracilicauda* is generically distinct, but I prefer to place it tentatively in *Gymnapogon* until more specimens are taken. Otherwise it is remarkably similar to certain other genera of the Apogonidae, with the exception of the presence of the papillae. The absence of papillae in *vanderbilti* may be regarded as a specific difference. According to Isaac Ginsburg, U. S. Fish and Wildlife Service, who has studied the Gobiidae extensively, the degree of development of papillae may differ greatly, only a few developing on certain species.

Family PRIACANTHIDAE: Big Eyes

By Leonard P. Schultz

Genus PRIACANTHUS Oken

Priacanthus Oken, Isis, 1817, p. 1183. (Genotype, *Anthias macrophthalmus* Bloch.) (Reference copied.)

KEY TO THE PRIACANTHIDS TAKEN IN THE NORTHERN MARSHALL ISLANDS

1*a*. Greatest depth of body more than 2 in standard length; scales more than 60 from head to caudal fin base.

2*a*. Dorsal rays X,14; anal III,15 (rarely 14), usually a black spot on inner side of base of pelvic fins; caudal fin with concave posterior margin. Priacanthus hamrur (Forskål)

2*b*. Dorsal rays X,13; anal III,14; no dark spots on pelvic fins; dorsal, anal, and caudal with small blackish specks; caudal fin with truncate or a little rounded posterior margins.. Priacanthus cruentatus (Lacepède)

1*b*. Greatest depth of body less than 2 in standard length; scales fewer than 60 from head to caudal fin base..... Pseudopriacanthus Bleeker

PRIACANTHUS HAMRUR (Forskål)

Sciaena hamrur Forskål, Descriptiones animalium, . . . , pp. xi, 45, 1775 (type locality, Red Sea).

Priacanthus hamrur Bleeker, Atlas ichthyologique des Indes Orientales Néerlandaises . . ., vol. 17, p. 113, 1873–76; vol. 8, pl. 353 fig. 3, 1876–77 (Java, Sumatra; Batu; Celebes; Sangi; Ternata; Batjan; Buro; Amboina).

Priacanthus helvolus Jordan, Evermann, and Tanaka, Proc. California Acad. Sci., vol. 16, No. 20, p. 664, pl. 23, fig. 2, 1927 (type locality, Honolulu).

SPECIMENS STUDIED

Rongelap Atoll: Rongelap Island, lagoon, depth 42 feet, hook and line, July 21, 1946, S–46–280, Kohler, 2 specimens, 204 and 230 mm.; Rongelap Island, lagoon, depth 60 feet, hook and line, July 25, 1946, S–46–331, Kohler, 3 specimens, 197 to 203 mm.

Eniwetok Atoll: south of Rigili Island, May 25, 1946, S–46–184, Schultz and Cali, 1 specimen, 35 mm.

Description.—Dorsal rays X,14; anal III,15 (rarely 14); pectoral rays ii,16 or 17; gill rakers 4 to 6+1+16 to 19; scale rows from upper edge of gill opening below lateral line to midcaudal fin base 81 to 90. For detailed counts, see table 45.

Depth 2.9 to 3.0; head 2.8 to 3.2; longest pelvic ray 3.8 to 4.0; all in standard length. Depth 0.9 to 1.0; eye 2.2 to 2.5; longest pelvic ray 1.25 to 1.3; snout 3.0 to 3.1; interorbital width 3.9 to 4.1; all in length of head. Body moderately elongate, compressed, covered with small

sands of the standard length, are given for the holotype and two paratypes in table 44.

Head and body without scales; upper jaw long, passes vertical through posterior margin of eye; no evidence of lateral line; two weak spines on operculum; dorsal portion of head from snout to occiput with minute papillae arranged, more or less, in a squarish network, some arranged linearly along lower jaw, a few on cheeks and opercles, none observed on body (the number, arrangement, and distribution of papillae on head and body cannot be worked out, for the larger specimens are not in good condition, and many papillae undoubtedly have been eroded away).

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2*a*. Dorsal rays X,14; anal III,15 (rarely 14), usually a black spot on inner side of base of pelvic fins; caudal fin with concave posterior margin. **Priacanthus hamrur** (Forskål)

2*b*. Dorsal rays X,13; anal III,14; no dark spots on pelvic fins; dorsal, anal, and caudal with small blackish specks; caudal fin with truncate or a little rounded posterior margins.— **Priacanthus cruentatus** (Lacepède)

1*b*. Greatest depth of body less than 2 in standard length; scales fewer than 60 from head to caudal fin base.———— **Pseudopriacanthus** Bleeker

PRIACANTHUS HAMRUR (Forskål)

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TABLE 45.—*Frequency distribution of counts recorded for certain species of* Priacanthus

Species	Dorsal rays			Anal rays			Pectoral rays				Gill rakers on first gill arch											
											Above				At angle	Below						
	X	13	14	III	14	15	ii,15	ii,16	ii,17	ii,18	4	5	6	7	1	16	17	18	19	20	21	22	23
meeki	7	.....	7	7	1	6	.....	.....	9	4	.....	3	2	2	7	.....	.....	.....	.....	1	1	3	3
hamrur	7	.....	7	7	1	6	.....	6	3	.....	3	2	1	.....	6	1	2	1	2	.....	.....	.....	.....
cruentatus	12	12	.....	12	12	.....	1	7	5	.....	3	6	.....	.....	9	3	4	2	.....	.....	.....	.....	.....

Species	Scale rows from head to midbase of caudal fin																					
	80 to 81	82 to 83	84 to 85	86 to 87	88 to 89	90 to 91	92 to 93	94 to 95	96 to 97	98 to 99	100 to 101	102 to 103	104 to 105	106 to 107	108 to 109	110 to 111	112 to 113	114 to 115	116 to 117	118 to 119	120 to 121	122 to 123
meeki	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3	1	.....	2	1	.....	1
hamrur	1	.....	2	1	1	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
cruentatus	.....	.....	1	.....	1	1	1	4	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

ctenoid scales that do not extend on the fin rays except basally on caudal fin; lateral line high on side, arched opposite pectoral fin, then continuing along upper side, descending to midside of caudal peduncle at rear edge of scaled area; eye large, nearly equal to length of pectoral fin; two nasal openings, first with raised rim, second close behind, in an elongate slit; lower posterior angle of preopercle with a very short, flat spine; teeth on palatines villiform and on vomer in a V-shaped pattern; teeth on lower jaw in a single row laterally, becoming a band anteriorly; those on upper jaw in a band; all teeth on jaws small, conical; pelvic fins reach a trifle past anal origin; caudal fin with concave posterior margin.

Color in alcohol.—Light brownish above, a little paler ventrally; membranes of pelvics dusky, usually a dark blotch on inside of pelvic fin basally; outer part of soft dorsal and of anal fins dusky.

Ecology.—This species was taken only by hook and line in deep water in the lagoon.

Remarks.—I have studied a series of *meeki* from the Hawaiian Islands and find it differs from *hamrur* of the Indo-Pacific oceans as follows:

1*a*. Gill rakers on first gill arch 4 to 6+1+16 to 19; pectoral fin rays ii,16 or 17; scale rows from upper edge of opercular opening counted below lateral line, to midbase of caudal fin 81 to 90, greatest depth 2.9 to 3.0 in standard length ..... Priacanthus hamrur (Forskål)

1*b*. Gill rakers on first gill arch 5 to 7+1+20 to 23; pectoral fin rays ii,17 or 18, scale rows from upper edge of opercular opening counted below lateral line, to midbase of caudal fin 110 to 123, greatest depth 2.4 to 2.8 in standard length ..... Priacanthus meeki Jenkins

PRICANTHUS CRUENTATUS (Lacepède)

PLATE 44, A

Labrus cruentatus LACEPÈDE, Histoire naturelle des poissons, vol. 3, pp. 452, 522, 1800 (type locality, Martinique).

SPECIMENS STUDIED

Bikini Atoll: 6 stations, 8 specimens, 67 to 148 mm. standard length.
Rongerik Atoll: 2 stations, 3 specimens, 66 to 100 mm.
Eniwetok Atoll: 1 station, 1 specimen, 77 mm.
Guam: *Albatross*, 1 specimen, 180 mm.

Description.—Dorsal rays X,13; anal III,14; pectoral ii,15 to 17; gill rakers on first gill arch 4 or 5+1+16 to 18; scale rows from upper edge of gill opening below lateral line to midcaudal fin base 88 to 96. For detailed counts see table 45.

Depth 2.4 to 2.6; head 2.9 to 3.2; longest pelvic ray 4.0 to 4.3; all in standard length. Depth 0.8 to 0.9; eye 2.2 to 2.6; longest pelvic ray 1.4 to 1.5; snout 3.2 to 3.3; interorbital width 3.2 to 3.5; all in length of head.

Body moderately elongate, compressed, covered with ctenoid scales, but not on fin ray, except at base of caudal fin; lateral line following a dorsal course to end of scaled area of caudal fin base, but descending to midside of caudal peduncle; eye larger, about 1.2 in length of pectoral fin; two nasal openings, close together, first with raised rim, second close behind, in an elongate slit; lower rear angle of preopercle with a somewhat projecting flat spine; narrow band of villiform teeth on palatines and in a V-shaped pattern on vomer; teeth on jaws short, small, conical, in one row on sides of dentary, becoming a band anteriorly; premaxillary teeth similar, in a narrow band laterally, wider at symphysis; pelvic fins reach a little past anal origin; caudal fin a little rounded or nearly truncate in adults.

Color in alcohol.—Light gray or white; dorsal, anal, and caudal fins usually with scattered blackish specks; occasionally a specimen is marked with large dusky blotches as follows: There are seven dark saddles on back and upper sides that extend a little below the lateral line; these are about as wide as the pale interspaces, the latter having fainter, shorter, and narrower dusky saddles in their centers; lower sides with several scattered dark blotches about size of pupil; fins all dusky to blackish, except pelvic spines are white.

Color when alive.—Body and head mostly very light purplish pink; basal part of membranes of soft dorsal and soft anal fins bright with red spots; basal half of caudal fin membranes bright red; dorsal spines pinkish or red; pectoral pale pink, its base dark red; sides and undersides of head touched with reddish; iris bright red.

Ecology.—This species was taken only where deep water prevailed along the reefs. It was never seen in the shallow water over the reefs at low tide.

Family CORYPHAENIDAE: Dolphins

By Leonard P. Schultz

Genus CORYPHAENA Linnaeus

Coryphaena Linnaeus, Systema naturae, ed. 10, p. 261, 1758. (Genotype, *C. hippurus* Linnaeus.)

CORYPHAENA HIPPURUS Linnaeus

Coryphaena hippurus Linnaeus, Systema naturae, ed. 10, p. 261, 1758 (type locality, open seas).

SPECIMENS STUDIED

Bikini Atoll: Lagoon and channels, April 1–24, 1946, S–46–72, crew of *Bowditch* and Schultz, 2 specimens, 760 and 770 mm. to base of caudal fin.

Description.—Dorsal rays 64; anal 28; pectoral ii,18; pelvics I,5; gill rakers 1+1+9. Depth 4.8 to 4.9; head 4.5 to 4.6; length of pectoral

fin 6.5 to 6.7; length of base of anal fin 2.4; snout tip to dorsal origin 8.0 to 8.4; all in standard length. Eye 6.0 to 6.5; snout 2.9 to 3.0; snout tip to rear of maxillary 2.1 to 2.2; postorbital length 2.0; length of pectoral fin 1.4 to 1.5; least depth of caudal peduncle 4.0; longest dorsal ray 1.3, anal 2.8, pelvic 1.3; all in the length of head.

Body elongate, compressed, greatest depth near rear of head, then gradually tapering to caudal peduncle; skin with minute scales; jaws strong, broad, with small conical teeth in a broad patch anteriorly, becoming a single row on sides, posteriorly; vomer, palatines, and tongue with a patch of small teeth; lateral line arched over pectoral fin, then running a straight course along midaxis of body to base of caudal fin; dorsal origin over eye, from which point fin extends nearly to base of caudal fin; anal origin about equidistant between snout tip and base of tail fin; maxillary reaches to under rear half of eye; preopercular margin truncate; pelvics inserted under base of pectorals and reaching past tips of pectoral fins.

Color in alcohol.—Blackish blue dorsally, silvery ventrally; lower sides with numerous, small, black spots; paired fins black on dorsal side, white to dusky on ventral sides.

Family CARANGIDAE: Jacks

By Loren P. Woods

Many of the species of this family have circumtropical ranges, the representatives in various places showing only slight differences from those in a different ocean or the opposite side of the world. This situation with respect to many of the species, particularly of the genus *Caranx*, has been observed and discussed by Nichols in various papers from 1920 to the present. In our studies we have, when possible, compared northern Marshall Islands specimens with those of the Red Sea, Hawaii, Panama, and the Atlantic Ocean to try to determine the differences between populations. Most of the distinguishable populations appear to have broad areas of intergradation. Because of this we have preferred to recognize the distinguishable populations as subspecies of widely ranging species and to consider Pacific species the same as Atlantic where no morphological differences were noted.

Since the pelvic rays are always I,5, and the branched caudal rays 8+7, these counts are omitted in the descriptions.

KEY TO GENERA AND SPECIES OF CARANGIDAE IN THE REGION OF THE NORTHERN MARSHALL ISLANDS

1*a*. Dorsal and anal fins followed by a single finlet.

2*a*. Lateral line with about 28 to 32 scutes on straight portion; soft dorsal and anal fins about the same length; dorsal rays about VIII–I,30 to 32–1; anal about II–I,29–1.

Decapterus muroadsi (Temminck and Schlegel) (p. 505)

2*b*. Lateral line without scutes on straight portion; anal fin much shorter than soft dorsal; dorsal rays VI–I,23 to 25–2; anal 0 or I–I,17–2.

Elagatis bipinnulatus (Quoy and Gaimard) (p. 507)

1*b*. Dorsal and anal fins not followed by finlets.

3*a*. Shoulder girdle deeply furrowed, with fleshy projection above it; dorsal rays VIII–I,25 to 27; anal II–I,20 to 22.

Trachurops crumenophthalmus (Bloch) (p. 508)

3*b*. Shoulder girdle without furrow or fleshy projection.

4*a*. Lateral line without scutes on straight portion; teeth on both jaws multiserial in bands.

5*a*. Scales normal, small, rounded; depth of body 2.0 to 2.6; dorsal rays VI–I,22 to 25; anal II–I,21 to 23.

Trachinotus bailloni (Lacepède) (p. 509)

5*b*. Scales small, lanceolate or needle shaped, somewhat embedded; depth of body 3.2 to 4.2, dorsal rays VI or VII–I,19 or 20 (each of the first VI or VII spines separate, not connected by membrane); anal II–I,17 or 18---------- Scomberoides sancti-petri (Cuvier) (p. 511)

4*b*. Lateral line with scutes on straight portion.
6*a*. Teeth in band on upper jaw, lower jaw teeth larger, caninelike, usually in single row, if more than one row outer teeth longer; breast entirely scaled or naked with median patch just anterior to insertion of pelvic fins; soft dorsal rays never more than 24.
7*a*. Breast completely scaled.
8*a*. 38 to 44 scutes and scales as counted along straight portion of lateral line; dorsal rays VIII–I,21 to 23 (usually 22); anal II–I,18 to 20 (usually 19); gill rakers 8+1+18 or 19; depth of body 2.39 to 2.93_____ Caranx melampygus Cuvier (p. 512)
8*b*. 26 to 34 scutes and scales on straight portion of lateral line.
9*a*. Depth of body 2.3 to 2.7; dorsal rays VIII–I,21 or 22; anal II–I,17 to 20 (usually 18 or 19); gill rakers 7+1+19 or 20; scutes 29 to 33_____ Caranx lugubris Poey (p. 514)
9*b*. Depth of body 2.9 to 3.3; dorsal rays VIII–I,19 or 20; anal II–I,15 or 16; gill rakers 7+1+16; scutes 26 to 34.
Caranx sexfasciatus Quoy and Gaimard (p. 515)
7*b*. Breast naked except for small median patch of scales; dorsal rays VIII–I,21 or 22; anal II–I,18 or 19; gill rakers, 9+1+18; scutes 35_____ Caranx ignobilis (Forskål) (p. 517)
6*b*. Teeth in bands on both jaws, those on outer portion of band scarcely larger than inner; breast completely naked in front of pelvic fins; soft dorsal rays 30 to 33.
10*a*. Depth of body 2.5 to 2.75; dorsal rays VII–I, or VIII–I,30 to 32; anal II–I,24 or 25; scutes 27 to 31; gill rakers 9 or 10+1+21 or 22.
Carangoides ferdau jordani Nichols (p. 518)
10*b*. Depth of body 2.35; dorsal rays VII–I,33; anal II–I,27; scutes 29; gill rakers 7+1+17.
Carangoides gilberti (Jordan and Seale) (p. 519)

Genus DECAPTERUS Bleeker

Decapterus Bleeker, Nat. Tijdschr. Nederl.-Indië, vol. 1, p. 352, 1851. (Genotype, *Caranx kurra* Cuvier and Valenciennes.)

DECAPTERUS MUROADSI (Temminck and Schlegel)

Caranx muroadsi Temminck and Schlegel, Fauna Japonica, p. 108, pl. 58, fig. 1, 1844 (type locality, Japan).

SPECIMENS STUDIED

Bikini Atoll: Western side of Atoll, August 1–5, 1947, S–46–507, Marr and Smith, 2 specimens, 200 and 205 mm.

Description.—Dorsal rays VIII–I,30 or 32–1; anal II–I,29–1; pectoral I,i,21 or 22; scutes in lateral line 28 to 32; gill rakers on first gill arch, 11+1+37 to 39, total 49 to 51.

The following measurements and proportions are approximate (both specimens broken in two, ends partly digested): Depth 4.43 to 4.46; head 3.9; both in standard length; snout 2.8; eye 3.5; length of upper jaw 2.92; interorbital width 3.5; postorbital length 2.28; length of pectoral fin 1.31, of pelvic 2.22; length of fourth dorsal spine 2.1; upper caudal lobe, 1.18, lower 1.2; all in length of head.

Teeth of jaws exceedingly minute or absent, none noted on vomer (no backward median line of teeth) and palatines, a few very small teeth on tongue; adipose covering of eye well developed, only a slit open over pupil; maxillary not reaching anterior margin of orbit; scales on head extending forward to anterior margin of pupil.

Color in alcohol.—Tip of snout, tip and sides of lower jaw dark brown; area around eye dark brown, cheek and lower limb of preopercle silvery; dark spot on opercular membrane in notch of opercle; back and upper sides light grayish brown, lower sides, breast, and belly silvery yellowish-white; dorsal and anal fin rays dusky basally, membranes pale; caudal fin faintly yellowish, dusky; pelvics pale; pectorals dusky basally on inner side, a small though distinct black margin on upper edge of base of upper pectoral ray.

Ecology.—These specimens were the only two taken in the northern Marshall Islands and both were regurgitated by a *Gymnosarda nuda.*

Remarks.—I have compared these broken Marshall Islands specimens with some of similar size belonging to the species *Decapterus muroadsi* (Temminck and Schlegel) from Japan and *D. pinnulatus* (Eydoux and Souleyet) from Hawaii (see table 46). Although I can detect no difference between *muroadsi* and *pinnulatus* in these old, soft, and faded specimens, the Marshall Islands specimens are not as slender as *muroadsi.* They approach *Caranx maruadsi* Temminck and Schlegel in having a more robust body, but differ in having fewer scutes in the straight portion of the lateral line (37 or 38 in *maruadsi*, 28 to 32 in the Marshall Islands specimens). Because of their poor condition, I hesitate to assign the specimens to any of the species discussed above, except tentatively. Were they in perfect condition, and given the depth and lateral line count found for them, I should call them *muroadsi.*

TABLE 46.—*Data recorded for Pacific species of* Decapterus

Species and locality	Greatest depth of body in standard length	Number of scutes	Standard length in millimeters
maruadsi:			
Japan: U.S.N.M. No. 22605	4.38	38	214
Hong Kong, China: U.S.N.M. No. 6425	4.07	37	165
Hawaiian Islands: U.S.N.M. No. 82823	4.85	37	167
muroadsi:			
Japan: U.S.N.M. No. 71143	5.08	32	213
Japan: U.S.N.M. No. 38796	6.15	32	170
Bikini Atoll: S-46-507	4.6	32	209
Bikini Atoll: S-46-507	4.43	28?	198
pinnulatus:			
Hawaiian Islands: U.S.N.M. No. 52666	5.12	32	220
Hawaiian Islands: U.S.N.M. No. 83127	5.45	----	265
Pacific Ocean: Hawaiian Islands?	5.18	----	273
Mauritius: U.S.N.M. No. 61696	5.64	33	201.5

Genus ELAGATIS Bennett

Elagatis BENNETT, Narrative of a whaling voyage around the globe, vol. 2, p. 283, 1840. (Genotype, *Seriola bipinnulata* Quoy and Gaimard.)

ELAGATIS BIPINNULATUS (Quoy and Gaimard)

PLATE 45, A

Seriola bipinnulata QUOY and GAIMARD, Voyage autour du monde . . . executé sur les corvettes de S. M. L'*Uranie* et La *Physicienne*, . . . Zool., p. 363, pl. 61, fig. 3, 1825 (type locality, "Iles des Papous").

SPECIMENS STUDIED

Bikini Atoll: 3 stations, 4 specimens, 410 to 670 mm. standard length.
Northern Marshall Islands: 1 lot, 1 specimen, 610 mm.

Description.—Dorsal rays VI–I, 23 to 25–2; anal I or 0–I, 17–2; pectoral I,i,16 to 18; gill rakers on first gill arch upper limb 10 or 11+1+26, total 37 or 38.

Depth 4.38 to 5.44; head 3.90 to 4.15; both in standard length. Snout 2.51 to 2.63; eye 4.43 to 5.59; upper jaw 2.86 to 3.03; interorbital width 3.22 to 3.42; postorbital length 2.55 to 2.73; depth of caudal peduncle 4.86 to 6.27; length of caudal peduncle 2.17 to 2.26; length of pectoral fin 1.77 to 2.09, of pelvic fin 1.86 to 2.14; longest dorsal spine 4.57, anterior dorsal ray 2.45 to 2.64, anterior anal ray 3.63 to 4.13; length of upper caudal lobe 0.81 to 1.05, lower 0.89 to 1.02; all in length of head. Depth of caudal peduncle in its length 2.24 to 2.78; angle of upper profile with lengthwise axis of body 21 to 23 degrees.

Teeth of jaws villiform, in bands; present on vomer, palatines, and tongue; scales on cheek, rest of head naked; nostrils very small; lower jaw projects beyond upper; dorsal and anal fins low, scarcely falcate anteriorly; shallow groove on dorsal and ventral surfaces of caudal peduncle at base of caudal fin. Caudal peduncle with low keel in large specimen.

Color in alcohol.—Top of head and back dark grayish brown; lips dusky; cheeks silvery, preopercular bones faintly pinkish; lower sides dirty yellowish, belly whitish yellow with faint silvery tinge; vertical fin dark gray, dorsal and anal rays with white tips, caudal rays light tipped, usually with yellow; pectoral dusky brown, indistinct yellow-white spot near base of lower rays; pelvic rays dusky to dark gray distally, pale whitish basally. The only remaining indication of the lengthwise banding so distinct in fresh specimens is a narrow black line along middle of posterior portion of sides following caudal peduncle keel.

Genus TRACHUROPS Gill

Trachurops GILL, Proc. Acad. Nat. Sci. Philadelphia, 1862, p. 238. (Genotype, *Scomber plumieri Bloch=Scomber crumenophthalmus* Bloch.)

TRACHUROPS CRUMENOPHTHALMUS (Bloch)

Scomber crumenophthalmus BLOCH, Naturgeschichte der ausländischen Fische, vol. 7, pt. 10, p. 77, pl. 343, 1793 (type locality, Acara Bay, west Africa).

SPECIMENS STUDIED

Bikini Atoll: 1 mile southwest of Boro Island, coughed up by ocean skipjack, August 1–5, 1947, S–46–507, Marr and O. Smith, 4 specimens, 45 to 59 mm.

Eniwetok Atoll: Lagoon, off southeast end of Eniwetok Island, *Bowditch* anchorage, hook and line, May 20 to June 6, 1946, S–46–154, Welsh and Schaefer, 35 specimens, 194 to 233 mm.

Guam: October 16, 1945, D. G. Frey, 3 specimens, 168 and 170 mm.

Description.—Dorsal rays VIII–I, 25 to 27 (usually 26); anal II–I, 20 to 22 (usually 22); pectoral I, i, 19 or 20; scales in lateral line 81 to 95, of these 28 to 37 modified into scutes; gill rakers on first gill arch 10+1+27 or 28, total 38 or 39.

Depth 3.4 to 4.06; head 3.02 to 3.45; both in standard length. Snout 3.25 to 3.58; eye 2.83 to 3.24; upper jaw 2.12 to 2.38; least suborbital width 16.9 to 20.6; greatest preorbital width 4.28 to 4.72; interorbital width 3.89 to 4.01; postorbital length 2.95 to 3.46; length of pectoral fin 1.15 to 1.17; length of pelvic fins 2.04 to 2.28; length of third dorsal spine 2.16 to 2.78; length of upper caudal lobe 1.30 to 1.45, lower 1.33 to 1.55; all in length of head. Curved portion of lateral line in straight portion 0.94 to 1.0; angle of snout profile with lengthwise axis of body 21 to 25 degrees.

Teeth uniseriate in both jaws; present on vomer, palatines, and tongue; posterior edge of maxillary concave; adipose covering of eye well developed, filling orbital area anterior to nostrils and covering posterior half of eye; pectoral girdle with deep notch; soft dorsal and anal fins only slightly elevated anteriorly, not falcate; lateral line with long, low, very slight arch anteriorly, arched portion about as long as straight portion, scutes weak.

Color in alcohol.—Tip of snout and tip of lower jaw black, posterior part of lower lip dusky, cheeks silvery, opercular bone black along edge at notch and dorsally to edge of opercular opening; interorbital area, top of head, and back dark brownish or grayish, dark color extending ventrally on sides to about level of pectoral axil and straight portion of lateral line; axil dark grayish to blackish with some silver-white on lower half; spiny dorsal membranes dusky, blackish at tips, soft dorsal dusky anteriorly and on anterior portion of rays distally; in larger specimens caudal with outer edges of outer rays blackish, a black submarginal band on posterior edge with tips of rays white, this dark band covering tips of rays in smaller specimens, in smallest specimens caudal pale; anal fin pale sometimes with dark dashes basally; pectorals and pelvics pale.

Genus TRACHINOTUS Lacepède

Trachinotus LACEPÈDE, Histoire naturelle des poissons, vol. 3, p. 78, 1802. (Genotype, *Scomber falcatus* Forskål.)

TRACHINOTUS BAILLONI (Lacepède)

Caesiomorus bailloni LACEPÈDE, Histoire naturelle des poissons, vol. 3, p. 93, pl. 3, 1802 (type locality not given).

Trachynotus cuvieri WAKIYA, Ann. Carnegie Mus., vol. 15, p. 220, 1924 (Misaki).

Trachynotus quadripunctatus WAKIYA (not Rüppell), Ann. Carnegie Mus., vol. 15, pl. 34, fig. 2, 1924 (Kii).

Trachynotus jordani WAKIYA, Ann. Carnegie Mus., vol. 15, pl. 35, fig. 1, 1924 (type locality, Bonin Island).

SPECIMENS STUDIED

Bikini Island: Off western end, lagoon side, April 29, 1946, S–46–119, Cali, 9 specimens, 38 to 129 mm.

Eniwetok Atoll: Southwest Passage, leeward edge of reef, 4/5 mile south of Rigili Island, surface light at night, May 25, 1946, S–46–184, Schultz, 1 specimen, 18.6 mm.

Rongelap Atoll: Lagoon, *Bowditch* anchorage, 1 mile off Rongelap Island, hook and line, June 16–28, 1946, S–46–222, crew of *Bowditch*, 1 specimen, 253 mm.

Rongerik Atoll: Lagoon, off Latoback Island, hook and line at depth of 60 feet, June 28, 1946, S–46–239, crew of *YMS 463*, 2 specimens, 237 and 273 mm.

Guam: Tumon Bay, June 27, 1945, Markley and McElroy, 1 specimen, 23.3 mm.

Description—Dorsal rays VI–I,22 to 25; anal II-I,21 to 23; pectoral I,i,15 or 16; scale rows just below lateral line 89 to 97; gill rakers on first gill arch upper limb 8 or 9+1+15 or 16, total 24 to 26.

Depth 2.19 to 2.54; head 3.16 to 4.07; both in standard length. Snout 3.66 to 4.0; eye 2.9 to 3.16; upper jaw 2.24 to 2.90; interorbital width 2.68 to 3.1; postorbital length 2.15 to 2.72; length of pectoral fin 1.25 to 2.35, of pelvic fin 1.89 to 3.59; longest dorsal ray 0.61 to 1.31, anal ray 0.54 to 1.31; length of upper caudal lobe 0.44 to 0.82, lower 0.47 to 0.79; all in length of head. Angle of upper profile with lengthwise axis of body 24 to 38 degrees.

Teeth on both jaws multiserial, in band of about four rows of small teeth, those of outer row scarcely larger than those of inner; teeth present on vomer and palatines but not on tongue; snout blunt, rounded; maxillary and premaxillary curved; lower jaw not extending beyond upper; preorbital and suborbital narrow; strong antrorse dorsal spine (more or less embedded in large specimens); lobes of median fins proportionately much longer with increase of size, pelvics proportionately shorter; lateral line only slightly arched over pectorals; scales present on cheeks, rest of head naked.

Color in alcohol.—Head and back light grayish tan in specimens up to 129 mm., silvery bluish black in specimens 237 mm. or larger; lips pale in small specimens, blackish in large; opercular membrane faintly dusky in most specimens, but 253-mm. specimen with distinct black

margin on opercular membrane at upper edge of membrane. Most striking feature of coloration (present in specimens above 70 mm., lacking in those 57 mm. and smaller) is presence of five more or less round black spots, largest about size of pupil, along sides just above and on lateral line; first and last sometimes very indistinct, second, third, and fourth largest and usually quite distinct (in young, the third, located between soft dorsal and anal origin, is largest and most distinct); there is some variation in the position and size of these spots; elongate lobes of dorsal and anal fins and outer rays of caudal fin black in all sizes, in largest specimens the black areas broader covering more of the fins; pectorals of young pale yellowish, of largest three specimens with upper rays black; pelvics pale in all sizes.

Remarks.—I believe that Wakiya's attempt to separate the species *T. quadripunctatus* Rüppell, *T. cuvieri* Wakiya, and *T. jordani* Wakiya is based on nothing more than normal variation within this species, in view of (1) the variation in spots along the sides (the area of greatest development is somewhere about the middle, tapering off anteriorly and posteriorly); (2) the fact that the lobes of the dorsal, anal, and caudal fins increase in length with size, while the paired fins apparently do not increase in the same proportion; and (3) the variation in nostril size in our series (the size of the posterior nostril varies in relation to that of the anterior, while one specimen with a much larger posterior nostril has the lower jaw slightly protruding).

Genus SCOMBEROIDES Lacepède

Scomberoides LACEPÈDE, Histoire naturelle des poissons, vol. 3, p. 50, 1802. (Genotype, *Scomberoides commersonianus* Lacepède, figure only=*Scomber lysan* Forskål.)

Chorinemus CUVIER and VALENCIENNES, Histoire naturelle des poissons, vol. 8, p. 367, 1831. (Genotype, *Scomberoides commersonianus* Lacepède.)

Barnard (Ann. South African Mus., vol. 21, p. 562, 1925–27) has rejected the name *Scomberoides* on the grounds "that the words in the caption of the figure were used in a popular sense, were not Latinized, and are not comparable with e. g. 'Les Trachinotes,' which latter term was used with definite generic conception." Weber and de Beaufort, (Fishes of the Indo-Australian Archipelago, vol. 6, p. 275, 1931) have called attention to Barnard's decision and have followed him. Smith (Copeia, 1932, p. 156) discussed these two names and concluded that *Scomberoides* as used by various authors based on Lacepède "fully conforms to modern nomenclatorial propriety."

Changing the name of a genus established and used for 75 years, on grounds such as those cited above, seems to be deliberately introducing confusion into the system of nomenclature.

SCOMBEROIDES SANCTI-PETRI (Cuvier)

Chorinemus sancti-petri CUVIER, *in* Cuvier and Valenciennes, Histoire naturelle des poissons, vol 8, p. 379, pl. 236, 1831 (type locality, Malabar Coast).

SPECIMENS STUDIED

Bikini Atoll: Lagoon off Bikini Island to entrance at Enyu Island, hook and line, March 11 to 31, 1946, S–46–2, Brock, Marr, Schultz, and crew of *Bowditch*, 1 specimen, 555 mm.; Oruk Pass, dip net, surface light at night, May 24, 1946, Marr and Brock, 2 specimens, 27 and 27.5 mm.

Rongelap Atoll: Lagoon, *Bowditch* anchorage, ½ mile from Rongelap Island, surface light at night, July 22–27, 1946, S–46–259, Herald, 2 specimens, 25 and 29.6 mm.

Description.—Dorsal rays VI–I or VII–I,19 or 20 (each of the first VI or VII spines are isolated); anal II–I,17 or 18; pectoral I,i,14; gill rakers on first gill arch 10+1+18, total 29.

Depth 3.25 to 4.20; head 3.13 to 4.78; both in standard length. Snout 3.07 to 3.52; eye 2.66 to 4.64; upper jaw 1.88 to 1.94; interorbital width 3.26 to 3.63; postorbital length 2.27 to 2.42; length of pectoral fin 1.66 to 1.82, of pelvic fin 1.78 to 1.92; length of fifth dorsal spine 2.42 to 7.6; length of upper caudal lobe 1.3 to 0.92, lower 1.26 to 1.33; least depth of caudal peduncle 4.40 to 4.94; length of caudal peduncle 2.4 to 2.96; all in length of head. Depth of caudal peduncle in its length 1.5 to 2.06; angle of upper profile with lengthwise axis of body 26 or 27 degrees.

Teeth in jaws in bands, small, sharp-pointed, slender, slightly curved; teeth present on vomer, palatines, pterygoids, and tongue; vomerine patch with oval posterior extension; maxilla extending to or just beyond posterior margin of eye; well-developed supplemental maxillary present; scales lanceolate, about six or seven times longer than broad; no scales on head.

YOUNG.—Dorsal spines of small specimens (25 to 29.6 mm.) proportionately much longer than those of large specimens; young with two divergent spines at angle of preopercle, not present in adults; maxilla in young reaching midway between posterior margin of pupil and hind margin of eye; scales apparently not developed on specimens under 30 mm.

Color in alcohol.—ADULT: Tip of lower jaw and median portion of upper lip blackish; upper parts of snout, head, and back grayish brown; lower sides, breast, and belly yellowish; several small round dots, smaller than pupil, on anterior sides about midway between lateral line and dorsal margin, indistinct gray blotches more or less in row just above lateral line, a large steel-blue oval spot on shoulder, nearly filling space between pectoral axil and upper edge of gill opening, a series of about 10 dark blotches fairly distinct, becoming smaller posteriorly, on sides just below lateral line; soft dorsal fin

with large black spot covering anterior rays except basally, where there is an orange line, rest of rays merely dusky; anal fin with black blotches between second and third rays and between third and fourth rays; middle caudal rays with broad, pale yellowish band distally; pelvics colorless; pectorals pale, dusky, with clear pale margin.

YOUNG: Tip of snout dusky, some small round pigment dots on lips and head; back light reddish brown to dark grayish brown, a double row of small round spots only slightly smaller than pupil on sides above lateral line; membrane of spiny dorsal blackish; soft dorsal and anal fins pale anteriorly but membranes black posteriorly; rest of fins pale hyaline.

Genus CARANX Lacepède

Caranx LACEPÈDE, Histoire naturelle des poissons, vol. 3, p. 57, 1802. (Genotype, *Scomber carangus* Bloch=*Caranx hippos* Linnaeus, as restricted by Bleeker, the first reviser.)

CARANX MELAMPYGUS Cuvier

PLATE 45, B

Caranx melampygus CUVIER, *in* Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 9, p. 116, 1833 (type locality, Waigiu, Rawak, Buru, Vanicolo, Mauritius).

Caranx stellatus EYDOUX and SOULEYET, Voyage autour du monde . . . sur la corvette La *Bonite*, Zoology, vol. 1, p. 167, pl. 3, fig. 2, 1841 (type locality, Hawaiian Islands).

SPECIMENS STUDIED

Bikini Atoll: 8 stations, 29 specimens, 70 to 203 mm. standard length.
Eniwetok Atoll: 2 stations, 4 specimens, 198 to 247 mm.
Rongelap Atoll: 2 stations, 2 specimens, 80 to 439 mm.
Rongerik Atoll: 2 stations, 7 specimens, 77 to 645 mm.
Guam: 2 lots, 5 specimens, 78 to 84 mm.
Rota Island: 1 lot, 1 specimen, 217 mm.

Description.—Dorsal rays VIII–I,21 to 23 (usually 22); anal II–I,18 to 20 (usually 19); pectoral I,i,17 to 20; scales in straight part of lateral line 40 to 44 (rarely 38 or 39), of these 30 to 36 developed into scutes; gill rakers on first gill arch upper limb 8=1+18 or 19.

Depth 2.39 to 2.93; head 2.39 to 3.46; both in standard length. Snout 2.35 to 3.47; eye 3.31 to 7.44; length of premaxillary 2.27 to 2.58; least suborbital width (measured vertically from lower margin orbit) 4.9 to 8.35; greatest preorbital width 3.31 to 4.90; interorbital width 3.31 to 3.83; postorbital length 2.54 to 2.93; length of pectoral fin 0.85 to 1.0, of pelvic 2.29 to 2.96; longest dorsal spine (third) 2.2 to 4.0; longest dorsal ray 1.34 to 1.92, anal ray 1.60 to 2.25; upper caudal lobe 1.02 to 1.18, lower 1.05 to 1.08; all in length of head. Arched portion of lateral line in straight portion 1.04 to 1.53; angle

of snout profile with lengthwise axis of body 44 to 50 degrees, profile convex.

Teeth of jaws biserial in upper jaw, outer teeth enlarged, conical, slightly curved, widely spaced, inner row of small teeth directed inward, forming narrow band, lower jaw teeth in single row, all enlarged, conical; vomer, palatines, and tongue with teeth; cheeks and upper part of opercles scaled, rest of head naked; adipose covering of eye slightly developed on anterior portion of eye, posteriorly its width about half or a little more than half diameter of eye; breast completely scaled, lateral line with 4 to 10 scales in straight portion, not modified into scutes; anterior rays of dorsal and anal fins elongate, somewhat falcate; caudal fin lobes pointed; pelvics short extending just beyond anal opening; pectorals long falcate.

Color in alcohol.—Smallest specimens (under 80 mm.) with backs brown, sides and belly silvery, trace of blackish on anterior dorsal rays, usually none or very little on anal (one specimen of 77 mm., taken at night, had on its back 7 broad black bands, of which only the posterior two extended below midline of sides, these very faint ventrally); specimens 90 to 198 mm. usually silvery; only specimens above 180 mm. occasionally with a few scattered small brown spots on upper sides and back; snout dusky, midline of back light brown; anterior lobe of soft dorsal pale or dusky; anterior lobe of anal usually black, though in smaller specimens merely black tipped; posterior margin of caudal dusky or with broad black margin, pelvics dusky tipped; above 200 mm., an increasing amount of dark spotting generally, back becoming brown, an increasing amount of black pigment in vertical and paired fins; at 400 mm. coloration is dark brown on upper sides, middle of back and base of dorsal and anal fins very dark brown (blue in life), lower sides bronze; numerous dark reddish-brown spots scattered all over head and body, thickest on uppersides and back; dorsal and anal fins very dark brown to black, tips of rays white; caudal with posterior three-fourths dark brown to black; pelvics streaked and spotted with black; pectorals brown basally, dusky distally.

Remarks.—The number of fin rays, scales, and gill rakers are the same in *C. melampygus* Cuvier and *C. stellatus* Eydoux and Souleyet. The proportions noted in these forms are the same except for the usual variation because of size. The only difference noted is in color, and the series of specimens contains individuals that completely bridge the gap in color difference. This series, plus a few specimens from various other parts of the Pacific (Cocos Island; Costa Rica; and the Marquesas, Society, Cook, and Solomon Islands), give a fairly complete size range from 70 to 280 mm. and from 439 to 645 mm. On the basis of careful examination and comparison of color and pattern on

specimens of various sizes I have found that the silvery, immaculate, *C. melampygus* changes into the dark-colored, spotted *C. stellatus*. The critical size range in which this color change takes place is between 180 and 280 mm.

No specimens under 180 mm. that I have examined possess the dark spots on dorsal and anal fins found on specimens larger than 187 mm. At 187 mm. a few spots are present, all fins are darker than in the smaller specimens, as are the midline of the back and the base of the dorsal fin. Two specimens, both 198 mm., are good intermediates in coloration, one being light, as in smaller specimens, though with a few scattered spots, the other light brown with more and larger body spots and darker fins. From 203 to 280 mm. a gradual darkening and increased spotting occurs on the body; spots appear on the head and on the midline of the back; a distinct brown stripe develops that divides and widens along the base of the dorsal fin; another occurs on the anal fin base; and all fins, particularly the median fins, darken until the coloration assumed by 280-mm. specimens is unmistakably that of *C. stellatus*, though somewhat lighter.

In view of this gradual color change that accompanies an increase in size, I have no hesitation in combining the two species *melampygus* and *stellatus* under the older name *melampygus*.

CARANX LUGUBRIS Poey

PLATE 46, A

Caranx lugubris POEY, Mem. Hist. Nat. Cuba, vol. 2, p. 222, 1861 (type locality, Cuba).

Scomber ascensionis BLOCH and SCHNEIDER, Systema ichthyologiae, p. 33, 1801 (not of Osbeck).

Caranx ascensionis CUVIER and VALENCIENNES, Histoire naturelle des poissons, vol. 9, p. 102, 1833.

SPECIMENS STUDIED

Bikini Atoll: 4 stations, 9 specimens, 383 to 535 mm. standard length.
Eniwetok Atoll: 2 stations, 2 specimens, 343 and 440 mm.

Description.—Dorsal rays VIII–I,21 or 22; anal II–I,17 to 20 (usually 18 or 19); pectoral I,i,18 to 20 (usually 19); scutes 29 to 33 (scutes occupy entire straight portion of lateral line); gill rakers on first gill arch 7+1+19 or 20, total 27 or 28 (in two specimens).

Depth 2.30 to 2.65; head 3.42 to 3.66; both in distance from tip of snout to tip of last scute; snout 2.73 to 2.97; eye 4.12 to 4.70; upper jaw 2.33 to 2.54, least suborbital width 5.06 to 5.90; greatest preorbital width 3.84 to 4.12; least interorbital width 3.33 to 3.79; postorbital length 2.51 to 2.58; length of pectoral fin 0.56 to 0.79, of pelvic fin 2.09 to 2.39, length of third dorsal spine 2.85 to 3.65; length of anterior dorsal rays 0.69 to 0.83, anterior anal rays 0.89 to 1.20; length of upper

caudal lobe 0.99 to 1.12, lower 0.99 to 1.09; all in length of head. Curved part of lateral line in straight part 1.36 to 1.70; angle of snout profile with lengthwise axis of body 51 to 56 degrees, concave anterior to eye.

Teeth of jaws uniserial, strong, conical, widely spaced, somewhat caninelike on each side of symphysis but not enlarged; vomer, palatines, and tongue with teeth; nuchal ridge, interorbital space, snout, lower jaw, and posterior margins of opercles naked; breast fully scaled; anterior rays of soft dorsal and anal fins elongate; pectorals long, falcate; scutes occupying entire straight portion of lateral line.

Color in alcohol.—Body light to dark grayish brown, naked portions of head very dark brown or black; soft dorsal and anal fins and posterior margin of caudal black, anterior edges of caudal yellowish brown; pelvics black; pectoral black basally, median portion grayish, tips of rays yellowish; axil of pectoral very dark brown or black; scutes black, median raised portion gray.

Remarks.—These Marshall Islands specimens have been compared with a large specimen (635 mm.) from Bermuda, and the only difference noted is the greater length of the anterior dorsal and anal fin rays of the former. As these rays apparently are shorter in larger specimens this difference does not seem very important.

J. T. Nichols, Curator of Fishes, American Museum of Natural History, has informed me in a letter that "there are two specimens of this species in the American Museum of Natural History, one 420 mm. from S. Trinidad islet, So. Atlantic; one of 340 mm. from Tuamotus . . . the former has blunt dorsal and anal lobes and pectoral fins, the latter elongate and pointed lobes and pectorals, the former head and eye are also appreciably larger." This is essentially the same as my findings and I am considering them to be the same in both oceans. Günther (Fische der Südsee, vol. 4, p. 132, 1876) compared a specimen from the Kingsmill Islands (Gilberts) 13 inches long and found it agreed in every respect with a specimen from St. Helena.

Nichols also states, "Jordan and Evermann (Bull. 47, pt. 1, p. 925) synonomize *C. ascensionis* Bloch and Schneider and *ascensionis* Cuvier and Valenciennes (neither of Osbeck) with *lugubris* Poey, and consider *ascensionis* Osbeck certainly different though otherwise unidentifiable. Hence they refer one circumtropical form to *lugubris*." I agree with the above quoted authors and follow them in calling the National Museum specimens *lugubris*.

CARANX SEXFASCIATUS Quoy and Gaimard

Caranx sexfasciatus Quoy and Gaimard, Voyage autour du monde . . . executé sur les corvettes de S. M. L'*Uranie* et La *Physicienne*, . . . Zool., p. 358, pl. 65, fig. 4, 1825 (type locality, Îles des Papous).

SPECIMENS STUDIED

Bikini Atoll: Namu Island, lagoon reef, April 3, 1946, S–46–50, Schultz, 2 specimens, 327 and 331 mm.; off Bikini Island, lagoon, light at night, July 27, 1949, Univ. Washington, 1 specimen, 45 mm.

Description.—Dorsal fin rays VIII–I,19 or 20; anal II–I,15 or 16; pectoral I,i,18 or 19; scales in straight portion of lateral line 27 to 34, of these 26 to 31 are scutes; gill rakers on first gill arch 7+1+16, total 24.

Depth 2.99 to 3.27; head 3.33 to 3.52, both in standard length. Snout 3.82 to 3.96, eye 3.86 to 4.08, upper jaw 2.08 to 2.14, suborbital width 7.86 to 9.4, greatest preorbital width 6.18 to 6.27, least interorbital width 3.51 to 4.03, preorbital length 2.40 to 2.69; length of pectoral fin 0.85 to 0.93, of pelvic fin 2.09 to 2.46; longest dorsal spine (third) 2.64 to 3.48; longest dorsal ray 1.47 or 1.48, anal ray 1.53; length upper caudal lobe 1.12 to 1.37, lower 1.17; all in length of head. Curved portion of lateral line in straight portion 1.37 to 1.41; angle of snout profile with lengthwise axis of body 49 or 50 degrees.

Teeth of upper jaw biserial, an outer row of slender caninelike teeth widely spaced, an inner narrow band of small teeth, teeth in lower jaw uniserial, close together, size not uniform; vomer, palatines, and tongue toothed; eye large, adipose covering developed on posterior part of eye, not covering pupil, extending behind rim of orbit a distance of about half diameter of eye; upper jaw extending to below posterior rim of orbit; breast completely scaled; dorsal and anal fins elevated and falcate anteriorly; pectorals long and falcate.

Color in alcohol.—Back grayish silvery, greenish along middle of sides, lower sides silvery yellowish white; scutes blackish along median ridge; snout dusky grayish, a round black spot slightly smaller than pupil at upper edge of gill opening; elevated portion of soft dorsal dusky yellowish basally, blackish distally, rest of fin dusky with indistinct dark margin; caudal yellowish brown basally, a distinct broad black band along posterior margin, anal fin paler than dorsal, elevated portion dusky tipped, rest of fin slightly dusky; pelvics whitish; pectoral axil blackish, dusky coloring on upper dorsal rays, pale ventrally and distally.

The 45-mm. specimen has 6 vertical dark bars a little wider than pale interspaces, first over rear of head, last on caudal peduncle.

Remarks.—Nichols (Amer. Mus. Nov. No. 998, 1938) discusses the various races of *Caranx sexfasciatus*, pointing out that *C. s. elecate* Jordan and Evermann is the best marked of these races in the Pacific, being distinguished by fewer scutes (25 to 29, average 26.2) and a more slender body (3.4). One of our specimens from the Marshall Islands falls into this *elecate* group with only 26 scutes, while the

other two have 31 scutes. A specimen from the Hawaiian Island has 35 scutes and a depth of 2.8 in standard length.

CARANX IGNOBILIS (Forskål)

Scomber ignobilis Forskål, Descriptiones animalium . . . pp. 12, 55, 1775 (type locality, Djidda, Red Sea).

SPECIMENS STUDIED

Rota: 1 specimen, 540 mm., November 15, 1945, Frey.
Guam: 2 specimens, 50 and 135 mm., October 16, 1945, Frey.

Description.—Dorsal rays VIII–I,21 or 22; anal II–I,18 or 19; pectoral I,1,17 to 19; scales on straight portion of lateral line 35 to 37 (all scutes); gill rakers on first gill arch 8 or 9+1+18, total 27 or 28.

Depth 2.47 to 3.28; head 2.07 to 3.62; both in standard length. Snout 3.17 to 3.38; eye 3.66 to 5.32; upper jaw 2.19 to 2.54; least suborbital width 5.36 to 8.15, greatest preorbital width 4.14 to 5.0; width interorbital 3.73 to 3.79; postorbital length 2.50 to 2.64; length of pectoral fin 0.83 to 0.92; length of third dorsal spine 2.64 to 2.66; length of anterior dorsal rays 1.39 to 1.40; length of anal lobe 1.55 to 1.66; all in length of head. Curved portion of lateral line in straight portion 1.02 to 1.15; angle of upper profile with lengthwise axis of body 45 to 51 degrees.

Teeth of jaws in two rows; teeth in outer row enlarged, widely spaced, conical; those in inner row minute, closely set; no canines developed in outer row; teeth present on vomer, palatines, and tongue; lower and upper jaw equal in length, neither especially protruding; maxillary reaches to middle or to posterior edge of pupil; head longer than deep; cheeks and postorbital area scaled, rest of head naked; breast naked except for round patch of scales about size of pupil located just anterior to pelvic bases; scutes cover entire straight portion of lateral line; dorsal and anal fins with elevated falcate lobes anteriorly; pectoral fin longer than head, strongly curved.

Color in alcohol.—General head and body color pale golden yellow, upper sides and back with numerous small black or brown dots, some on opercular and parietal regions of head; dorsal fin lobe dusky on its distal portion, rest of this fin and other fins pale; no distinct opercular spot, the membrane being pale above the opercular notch.

Remarks.—One of these is an unusually large specimen of this species and does not agree with other representatives in depth, being much more slender than the smaller ones, or in the eye, being relatively smaller (eye 4.2 in head in 226 mm. specimen, and 3.66 in 135 mm. specimen).

Genus CARANGOIDES Bleeker

Carangoides BLEEKER, Nat. Tijdschr. Nederl.-Indië, vol. 1, p. 352, 1851. (Genotype, *Caranx praeustus* Bennett.)

CARANGOIDES FERDAU JORDANI Nichols

PLATE 46, B

Scomber ferdau FORSKÅL, Descriptiones animalium . . . , p. 55, 1775 (type locality, Djidda, Red Sea).

Carangoides jordani NICHOLS, Amer. Mus. Nov., No. 50, p. 2, 1922 (type locality, Hawaiian Islands).

SPECIMENS STUDIED

Bikini Atoll: 2 stations, 3 specimens, 255 to 275 mm. standard length.
Eniwetok Atoll: 2 stations, 2 specimens, 290 and 291 mm.
Rongelap Atoll: 1 station, 1 specimen, 183 mm.
Rongerik Atoll: 1 station, 1 specimen, 175 mm.

Description.—Dorsal fin rays VII– or VIII–I,30 to 32; anal II–I,24 or 25; pectoral I,i,21 to 23; keeled scutes on straight portion of lateral line 27 to 31; gill rakers on first gill arch 9 or 10+1+21 or 22, total 31 to 33.

Depth 2.5 to 2.75; head 3.27 to 3.46; both in standard length. Snout 2.78 to 2.91; eye 3.82 to 4.4; upper jaw 2.29 to 2.46; least suborbital width 7.93 to 8.7; greatest preorbital width 3.63 to 3.94, interorbital width 3.03 to 3.28; postorbital length 2.86 to 3.24; length of pectoral fin 0.77 to 0.85, of pelvic 2.21 to 2.42; length of third dorsal spine 4.05 to 5.5; length of anterior dorsal rays 0.81 to 1.38, anterior anal rays 1.31 to 1.53; length of upper caudal lobe 1.15, lower 0.93 to 1.08; all in length of head. Straight portion of lateral line in curved portion 1.25 to 1.44; angle of upper profile with lengthwise axis of body 42 to 50 degrees.

Teeth in bands in both jaws, outer row slightly larger, teeth in inner row very small embedded; teeth on vomer, palatines, and tongue. Breast naked in front of pelvic fins, naked patch about width of pelvic bases, widening anteriorly but not extending up sides of breast to pectoral base as described in *C. gymnostethodes* Bleeker; anterior dorsal and anal fins elevated, falcate; scutes developed on posterior part of lateral line.

Color in alcohol.—Naked portions of snout, interorbital, nape, and midline of back blackish brown; cheeks and sides of head silvery yellowish, a dark spot, sometimes indistinct, at notch of opercle; back reddish brown, sides and belly silvery yellow, naked spot on breast silvery white; anterior dorsal and anal fin rays dark brown to black; caudal yellow brown, its posterior margin with narrow black band; pectoral pale yellowish, pelvic rays dusky distally, their membranes pale.

Remarks.—The number of fin rays on specimens of *Carangoides ferdau* from the northern Marshall Islands agrees with that of specimens from Hawaii. We have examined specimens from the Gulf of Aden and find the dorsal rays to be 24 to 28 and the anal rays 22. Weber and de Beaufort (Fishes of the Indo-Australian Archipelago, vol. 6, p. 228, 1931) give 29 or 30 dorsal rays and 24 to 26 anal. In this respect the East Indian representatives appear to be intermediate. Further, we note that our Marshall Islands specimens are slightly deeper in body and have proportionately longer anterior dorsal rays, these being 1.02 to 1.72 in depth of body.

CARANGOIDES GILBERTI (Jordan and Seale)

Caranx gilberti Jordan and Seale, Bull. U. S. Bur. Fisheries, vol. 25, p. 234, fig. 29, (1905) 1906 (type locality, Pago Pago, Tutuila, Samoa).

Caranx ferdu Schultz, U. S. Nat. Mus. Bull. 180, p. 87, 1943 (not Forskål) (including type of *Caranx gilberti*).

SPECIMEN STUDIED

Rongerik Atoll: Bock Island, ocean reef, June 27, 1946, S–46–237, Schultz and Herald, 1 specimen, 276 mm.

Description.—Dorsal rays VII–I,33; anal II–I,27 (first two spines embedded), pectoral I,i,21; scutes in lateral line 29; gill rakers on first gill arch, 7+1+17, total 25.

Depth 2.35; head 3.4; both in standard length. Snout 3.16; eye 3.52; upper jaw 2.5; least suborbital width 8.7; greatest preorbital width 3.85; interorbital width 2.89; postorbital length 2.88; length of pectoral fin 0.64, of pelvic 2.18; length of third dorsal spine 5.4; length of anterior dorsal rays 1.37, anterior anal rays 1.38; (both caudal lobes broken); all in length of head. Straight portion of lateral line in curved portion 1.41; angle of upper profile with lengthwise axis of body 50 degrees.

Teeth in bands in both jaws, all teeth small, those of outer row slightly larger than inner; teeth present also on vomer, palatines, and tongue; naked area in front of pelvic fins, broadening anteriorly; sides of breast between pectoral base and just above lower edge scaled; dorsal and anal fins elevated anteriorly, falcate but not filamentous; scutes well developed only on posterior half of straight part of lateral line.

Color in alcohol.—Tip of snout, interorbital area, scaleless portion of nape and midline of back dark gray; preorbitals and cheek silvery, whitish, no opercular spot, membrane dusky at upper edge of gill opening, exposed portion of maxillary grayish brown, back silvery blue, middle of sides yellowish white, lower sides and belly dirty brownish white; naked portion of breast silvery white; dorsal rays with dusky submarginal line, tips of rays white; anal find darker than

dorsal, grayish black, tips of rays white; caudal dirty yellowish white basally, with an indistinct dusky marginal band; pectoral dusky basally, rest of fin pale; pelvics pale basally, dusky distally.

Remarks.—This species has been synonymized with *C. ferdau* Forskål by Fowler (Fishes of Oceania, p. 150, 1928), from which it is certainly distinct. We have compared this specimen with several from the Gulf of Aden and find it to be much deeper bodied, and to have more dorsal and anal rays and fewer gill rakers. Furthermore, this specimen differs from *C. ferdau jordani* in having a deeper body and fewer gill rakers, but the type of *C. gilberti* has only one more dorsal and anal ray than noted on any specimen of *C. f. jordani.*

Caranx laticaudis Alleyne and Macleay (Proc. Linnean Soc. New South Wales vol. 1, p. 325, pl. 10, fig. 2, 1877) as described and figured from Papua by McCulloch (Mem. Queensland Mus., vol. 8, pt. 1, p. 74, pl. 12, 1924) appears to be very closely related to, if not identical with, *Carangoides gilberti.* It differs only in having slightly deeper body (2.05), 3 fewer dorsal rays and in lacking the anterior falcate lobe of the dorsal fin. *C. laticaudis* has also been synonymized with *C. ferdau* by Fowler (loc. cit.).

Family LUTJANIDAE: Snappers

By Leonard P. Schultz

When I had examined only a few genera of fishes related to the snappers the recognition of the various families and subfamilies as sometimes accepted in the literature seemed logical. But as the number of genera studied increased, and the field broadened to various regions of the Atlantic, Pacific, and Indian Oceans, the definitions of the families and subfamilies overlapped so much that I concluded that the genera usually placed in the Lutjanidae, Pomadasyidae, Haemulidae, Sparidae, Teraponidae, Lethrinidae, Emmelichthyidae [16] and others need a careful revision and new diagnoses.

I am not the first to cast doubt on the separation of the percomorph fishes of this relationship into several families. Weber and de Beaufort have included under the Lutjanidae the subfamilies Lutjaninae, Nemipterinae, Pomadasyinae, and Lethrininae. Jordan and Thompson included under the Lutjanidae the subfamilies Glaucosomatinae, Doderleiniinae, Lutjaninae, Apriorinae, Etolinae, and Aphareinae. The combination of these doubtfully recognized subfamilies under one family, in view of their great variability and overlapping of generic characters, appears to be a sound procedure. For example, the presence of scales on the cheeks in most of the genera referable to the Lutjanidae, and their absence on the cheek in *Lethrinus* is not enough of a difference, in my opinion, to justify the recognition of even a subfamily. Likewise, the presence or absence of molar teeth has been used as the basis for recognizing families or subfamilies in this relationship. However, I have observed that the young of *Monotaxis* do not have molar teeth; instead they have short, heavy, and conical teeth that develop into molars as the adult stage is reached.

To render the key more practical, I have omitted the subfamilies belonging to the Lutjanidae and have prepared a key to the genera and species.

Since the pelvic rays are always I,5 and the branched caudal rays 8+7, these counts are omitted in the descriptions. The frequency distributions of other counts are shown in tables 46, 47, and 48.

KEY TO THE LUTJANIDAE AND RELATED GENERA AND SPECIES FROM THE NORTHERN MARSHALL ISLANDS

1*a*. Cheeks with 3 or more rows of scales.

2*a*. Preopercular edge hard, bony, never membranous; preopercular edge, preorbital edge, or both, serrated; or subocular with a posteriorly directed spine.

[16] Schultz, Journ. Washington Acad. Sci., vol. 35, pp. 132–136, 1945.

3*a*. Preorbital naked, the scales of cheek not extending anteriorly beyond a vertical line through rear of maxillary.

4*a*. Subocular with a distinct spine below eye, directed posteriorly, usually with a few smaller points ventrally; no canines.

Scolopsis cancellatus (Cuvier and Valenciennes) (p. 527)

4*b*. No subocular spine.

5*a*. Preorbital serrated; lower opercular spine strong, upper minute; postcleithral with spiny projections numbering 5 or 6 points; jaws with small canines; dorsal fin deeply emarginate; caudal fin emarginate; first four dorsal spines graduated__ Terapon Cuvier

5*b*. Preorbital smooth, without serrae; maxillary naked, partly shielded by preorbital.

6*a*. Dorsal spines X, palatine teeth present; mouth with a pair or two of short, conical, caninelike teeth near front; preopercle often with a characteristic notch, into which fits a knoblike projection of the preopercle.

7*a*. Gill rakers on first arch slender, few to moderately numerous, not fine and leaflike; lengthwise rows of scales above lateral line obliquely ascending toward middorsal line; vomerine patch of teeth ^-shaped; anal rays III,8.

8*a*. Lengthwise rows of scales below lateral line obliquely ascending to lengthwise axis of body; dorsal rays X,13 to 15; soft dorsal rounded; preopercular notch very deep, narrow; profile of snout concave in adults; posterior part of caudal peduncle and base of caudal dark brown in young; caudal fin dark brownish in adults; sides sometimes along each row of scales a more or less distinct dark streak; pectorals grayish (in life light yellowish).

Lutjanus gibbus (Forskål) (p. 529)

8*b*. Lengthwise rows of scales below lateral line parallel with lengthwise axis of body, or nearly so.

9*a*. Scales on head beginning above middle of orbit, or nearly so; supratemporal band of scales meeting on dorsal surface of head; dorsal rays usually X,15; 4 lengthwise light-blue bands on sides (brownish in preserved specimens), bordered above and below by a dark line; first band from interorbital space to middle of base of spiny dorsal, second from rear of orbit to base of soft dorsal, third from opercle to rear edge of base of soft dorsal; fourth from below eye on preorbital, thence just below opercular spine to below lateral line on caudal peduncle.

Lutjanus kasmira (Forskål) (p. 530)

9*b*. Scales on head beginning behind a vertical line through rear of obits or nearly so, interorbital space naked.

10*a*. A large black blotch on sides located on lateral line and under front part of base of soft dorsal; dorsal rays X,13 (rarely 12 or 14); scales above lateral line to base of spiny dorsal 7 (6½); pectoral rays ii,14.

Lutjanus monostigmus (Cuvier and Valenciennes) (p. 531)

10*b*. Sides without dark blotch.

11*a*. Two large silvery white blotches on back, the one at rear of base of soft dorsal most conspicuous, the one under base of seventh dorsal spine smaller, sometimes wholly lacking on large adults; conspicuous black streaks on pelvics and anal fins, margined with white; black streaks on outer rays of each caudal fin lobe, margined with white; tip of chin and snout blackish; dorsal rays X,14, seldom X,13; pectoral rays ii,15; scales above lateral line to base of spiny dorsal 8 or 9.
Lutjanus bohar (Forskål) (p. 532)

11*b*. No white blotches on back or on sides; caudal fin dusky to blackish, with a narrow white marginal band; marginal area of dorsal fin blackish; scales from lateral line to base of spiny dorsal 7 (6½); dorsal rays X,13 or 14; pectoral ii,13 or 14,
Lutjanus vaigiensis (Quoy and Gaimard) (p. 532)

7*b*. Gill rakers leaflike, very long, extending into mouth cavity, resembling "whalebone," very numerous, about 36 above and 68 to 75 below angle of first gill arch; anal rays III,10; dorsal X,13; pectoral ii,14 or 15; teeth on vomer in Λ-shaped patch; interorbital space naked.. Macolor niger (Forskål) (p. 533)

6*b*. Dorsal rays usually XIV,15 or 16; anal III,7; pectoral about ii,14; vertical scale rows above lateral line about 55 to 58; gill rakers short, about 8+1+17; no teeth on palatines or on vomer; dorsal spines strong, basally with a sheath of scales; bases of soft dorsal and of anal fins scaled; color dark brown; pectoral white; in young caudal white distally and margins of soft dorsal and anal fins; chin with 2 pores near tip and with 4 more pores just behind front of lower lip.
Plectorhinchus nigrus (Cuvier and Valenciennes) (p. 534)

3*b*. Preorbital scaled; mucus caverns along lower part of preopercle to dentary, ending near tip of chin; chin usually with two pores.
Pomadasys Lacepède

2*b*. Preopercular edge not notably hard and bony, either stiff and rough (weakly serrated), or membranous; no spine below eye; preorbital edge smooth.

12*a*. Outer or lower edge of maxillary denticulate and naked; gill rakers short stubs or knobs, few in number; canines in both jaws; basal sheath of scales on dorsal and anal fins; last ray of dorsal and of anal fins, not elongated; caudal fin deeply emarginate.

13*a*. No molar teeth at any size; vertical scale rows crossing lateral line (about 70 to 72).. Gnathodentex aureolineatus (Lacepède) (p. 535)

13*b*. Molar teeth in both jaws in half-grown and adults but not developed in small young; vertical scale rows crossing lateral line about 45 to 47.. Monotaxis grandoculis (Forskål) (p. 537)

12*b*. Maxillary not denticulate, its outer or lower edge smooth; gill rakers slender, moderately numerous; last ray of dorsal and of anal fins elongated; caudal fin deeply forked.

14*a*. Cheeks with about 7 or 8 rows of scales; lateral process on side of premaxillary represented by a low, broadly curved elevation; no scales on dorsal or anal fins; supratemporal band of scales not meeting its fellow on dorsal surface of head.

15*a*. Pectoral fin short, about equal to postorbital length of head; strong canine teeth in both jaws; scale rows crossing lateral line about 46 to 50; pectoral usually ii,15 or 16.

Aprion virescens Cuvier and Valenciennes (p. 538)

15*b*. Pectoral fin contained 1.0 to 1.3 in head; villiform band of teeth in both jaws, no canines; scale rows crossing lateral line about 70 to 75; pectoral usually ii,14, occasionally ii,13.

Aphareus furcatus (Lacepède) (p. 539)

14*b*. Cheeks with about 4 rows of scales; pectoral fin more than half length of head, much longer than postorbital length of head.

16*a*. Premaxillary with a single process on the side in addition to the median ascending process; premaxillary teeth in two rows, the outer a single row of small conical teeth, the inner a narrow band or irregular row of very small villiform teeth; vomer with teeth; nasal openings closer together than posterior is from edge of orbit; dorsal fin covered with scales except distally (*Caesio* Bleeker).

17*a*. Each caudal lobe with a lengthwise blackish streak or band, that of upper lobe continuous with dark color of body; palatines toothless; dorsal rays X,15 or 16; anal rays III,12 or 13; pectoral rays usually ii,19 or 20; depth about 3.2 or 3.3; supratemporal band of scales across middorsal line of head separated a little at midline; symphyseal canines undeveloped.

Caesio caerulaureus Lacepède

17*b*. Each caudal lobe without a black band as above, instead plain in color or with tips of caudal lobes dusky; palatines generally with a few villiform teeth in a very narrow band or row; dorsal rays X,13 to 15; anal III,10 to 12; pectoral ii,15 to 19; a pair of small symphyseal caninoids usually developed on premaxillary.

18*a*. Supratemporal band of scales covering the middorsal line; dorsal fin edged with black; caudal fin tips not blackish; base of pectoral fin usually dusky, axil blackish.

Caesio cuning (Bloch)[11]

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[11] *Sparus cuning* Bloch, Naturgeschichte der ausländischen Fische, vol. 5, p. 31, pl. 263, fig. 1, 1791 (type locality, East Indies).

Caesio erythrogaster Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 6, p. 442, pl. 166, 1830 (type locality, Java).

The following description is included for purposes of comparison (see table 49 for counts). The proportional measurements were made on a 142-mm. specimen taken at Tulagi Island in the Solomons, February 1945: Length of head 3.3; depth 2.5; longest pectoral fin ray 3.3; length of anal fin base 4.2; length of dorsal fin base 1.9; tip of snout to dorsal origin 2.8, to anal origin 1.6, to pelvic insertion 2.7; all in standard length. Orbit 3.3.; snout 3.9; length of maxillaries 3.1; fleshy interorbital space 3.3; least depth of caudal peduncle 2.8; longest dorsal spine 2.3; length of last dorsal ray 4.6; postorbital length of head 2.0; all in length of head.

This species is somewhat compressed, with a long pectoral fin equal to length of head and equal to distance from belly to lateral line; gill rakers long, slender; maxillary naked, only its dorsal edge slipping under preorbital; the supratemporal band of scales crosses middorsal line without interruption; premaxillary with only one lateral process in addition to the ascending median processes, the latter reaching only to a vertical line through front of eye; premaxillary with an outer row of enlarged but small conical teeth, inside which is a narrow row of villiform teeth; in the adults of this species a pair of enlarged, short, conical teeth or canines occurs near symphysis. Vomer with a patch of villiform teeth, palatines probably each with a few fine teeth along its narrow edge.

The color in alcohol is dusky dorsally, paler below; margin of dorsal fin edged with blackish; axil of pectoral base black, anterior part of base dusky.

18*b*. Supratemporal band of scales interrupted by tiny scales somewhat embedded, at middorsal line; dorsal edged with black; tip of each caudal lobe blackish; upper part of pectoral base dusky or blackish, axil blackish_____ Caesio lunaris Cuvier

18*c*. Supratemporal band of scales interrupted by a naked area at middorsal line; no black edging on dorsal; caudal fin not tipped with black_____ Caesio xanthonotus Bleeker (p. 540)

16*b*. Premaxillary with two processes on each side in addition to the median process; premaxillary teeth small, conical, in a single row; vomer and palatines toothless; nasal openings as far apart as posterior one is from edge of orbit or even farther apart.

19*a*. Dorsal fin with scales on membranes and on rays basally (*Pterocaesio* Bleeker).

20*a*. Dorsal rays XI to XIII,18 to 22; anal III,13 or 14; pectoral i or ii,20 to 23; middle of each lobe of caudal fin with a lengthwise black streak; axil of pectoral base black, usually with upper edge of pectoral base black anteriorly; scales in lateral line about 73 to 78.

Pterocaesio tile (Cuvier and Valenciennes) (p. 543)

20*b*. Dorsal rays X or XI,13 to 15; anal rays III,11 or 12.

21*a*. Dorsal rays XI,13 or 14; anal III,12; pectoral rays i or ii,20 to 22; tips of each lobe of caudal fin blackish; scales above lateral line at dorsal origin 9, below it to anal origin 15 or 16; scales in lateral line 76 to 80; a slight trace of a pale streak on back along base of dorsal fin.

Pterocaesio marri, new species (p. 545)

21*b*. Dorsal rays X,15, rarely X,14; anal rays III,11 or 12; pores in lateral line about 67 to 82.

22*a*. Pectoral rays ii,21; anal rays III,11; scales above lateral line to dorsal origin 9, below to anal origin 16; back plain dusky without pale streak; tips of each caudal lobe with a black blotch.

Pterocaesio kohleri, new species (p. 547)

22*b*. Pectoral rays ii,17 to 19; anal rays usually III,12 (occasionally III,11); pores in lateral line about 67 to 77.

23*a*. Scales above lateral line to dorsal origin 7, below it to anal origin 13 to 15 (usually 14); back plain dusky, without pale streaks__ Pterocaesio pisang (Bleeker)

23*b*. Scales above lateral line 8, below it to anal origin 16 or 17; a pale streak below lateral line anteriorly, bordered above by a black line that crosses pale streak in front of caudal peduncle, above pectoral fin base this pale streak as broad as orbit, on caudal peduncle narrower than pupil; another pale streak on back along base of dorsal fin.

Pterocaesio chrysozona (Cuvier and Valenciennes)

23*c*. Scales above lateral line 9, below it 15 or 16; pores in lateral line about 73 to 78; upper sides of body with 2 narrow pale streaks on each side, the lower one a little below lateral line anteriorly, crossing it just in front of caudal peduncle, the upper one extending along side of back 2 or 3 scale rows away from base of dorsal fin_____ Pterocaesio diagramma (Bleeker)

19*b*. Dorsal fin without scales; axil of pectoral black; caudal fin plain dusky; dorsal rays IX or X,15, anal III,12, pectoral ii,18 or 19; scales in lateral line about 80 to 83; scales above lateral line at dorsal origin 7, below it to anal origin 13; gill rakers 6+1+25.
Gymnocaesio gymnopterus (Bleeker)

1*b*. Cheeks naked.

24*a*. Between base of seventh dorsal spine and lateral line 4 to 4½ scales.

25*a*. Posterior edge of maxillary reaching to a vertical line through front of eye or through posterior nostril in young; base of soft anal fin contained about 1.4 times in longest anal ray; head 2.5 to 2.6, depth 2.5 to 2.7, both in standard length; profile of snout forming an angle of 61 to 66 degrees with that of lower edge of upper jaw and an angle of 95 to 100 degrees with a line extending from upper edge of pectoral base through center of pupil.
Lethrinus kallopterus Bleeker (p. 548)

25*b*. Posterior edge of maxillary not reaching past a vertical line through anterior nasal opening in small ones or past posterior nasal opening in large adults; base of soft anal fin longer than longest soft anal ray.

26*a*. Nasal openings close together, the distance between anterior and posterior pores contained about 7 or 8 times in distance between the two posterior ones; posterior nasal opening a vertical slit, its long axis at an angle of about 65 degrees with lengthwise axis of body; interorbital convex but flattish; profile of snout forming an angle of 52 to 55 degrees with that of lower edge of upper jaw, and 128 to 136 degrees with a line extending from upper edge of pectoral base through center of pupil; color pattern reticulated; dark brown bar below eye, another on preopercle and one on preorbital; head 2.8, depth 3.4, in standard length.
Lethrinus semicinctus[18] Cuvier and Valenciennes

26*b*. Nasal openings separated by a dermal isthmus of moderate width, distance between anterior and posterior openings contained 3.0 to 4.5 times in distance between two posterior nasal openings; posterior nasal pore rounded in shape, its longest axis parallel, or nearly so, to lengthwise axis of body; (second dorsal spine not longer than third as in *L. nematacanthus* Bleeker).

27*a*. Interorbital space slightly convex, with moderate swelling above the nasal openings; an oblong black blotch on sides from near tip of pectoral fin and extending obliquely upward and a little across lateral line, background coloration brownish; depth 3.0 to 3.2; pectoral 1.3 to 1.4 in head; least depth of caudal peduncle in its length 2.0 to 2.1; angle of snout profile with edge of upper jaw 47 degrees to 52 degrees; head in greatest depth of body 0.8 to 0.9.
Lethrinus reticulatus Cuvier and Valenciennes (p. 549)

27*b*. Interorbital space flattish medially, with scarcely any swelling above and in front of nasal openings; no black blotch as in *reticulatus*, but sides may have two or three dark blotches; background color in alcohol usually milky white; depth 3.1 to 3.3; pectoral 1.5 to 1.6 in head; least depth of caudal peduncle in its length 2.0 to 2.2; angle of snout profile with edge of upper jaw 52 to 56 degrees; head in greatest depth of body 0.7 to 0.8.
Lethrinus variegatus Cuvier and Valenciennes (p. 551)

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[18] See under *L. variegatus* (p. 551) for discussion of this species.

27*c*. Interorbital space evenly convex, with the area over and in front of nasal openings enlarged and swollen; no black blotch as in *reticulatus*, sides with two or three dark blotches; dorsal fin dusky; young with dark bar or blotch under eye and a trace of one on preorbital; head typically brownish as contrasted with lighter colored body; background color usually brownish; depth 3.2 to 3.5; pectoral 1.4 to 1.7 in head; least depth of caudal peduncle 2.2 to 2.5 in its length; angle of snout profile with edge of upper jaw 51 to 58 degrees; head into greatest depth of body 0.7 to 0.8.... Lethrinus microdon Cuvier and Valenciennes (p. 552)

24*b*. Between base of seventh dorsal spine and lateral line 5 to 5½ scales.

28*a*. Head elongate pointed, about 2.4 to 2.8 in standard length; least depth of caudal peduncle in length of snout about 2.8; angle of snout profile with edge of upper jaw about 43 degrees; depth about 2.8 to 3.2 in standard length; body, head and all fins dark brown; scales usually with white centers; sometimes body with incomplete dark crossbands.

Lethrinus miniatus (Forster) Bloch and Schneider (p. 553)

28*b*. Head not notably elongate and pointed, about 2.7 to 3.0 in standard length; least depth of caudal peduncle 1.2 to 1.5 in snout; angle of snout profile with lower edge of upper jaw 59 to 65 degrees; depth of body 2.6 to 2.8 in standard length.

29*a*. A large dark blotch just below lateral line opposite tip of pectoral fin; snout 2.1 to 2.4 in head; length of base of soft anal in longest anal ray about 0.8; profile of snout forms an angle of 104 to 110 degrees with a line extending from upper edge of pectoral base through center of pupil.... Lethrinus rhodopterus Bleeker (p. 554)

29*b*. No dark blotch opposite tip of pectoral fin; snout 1.8 to 2.1 in head; length of base of soft anal in longest anal ray about 1.0 to 1.1; profile of snout forms an angle of 103 to 115 degrees, with a line extending from upper edge of pectoral base through center of pupil; soft dorsal and caudal fins with traces of dark bars; center of scales often with a pearly white spot.

Lethrinus nebulosus (Forskål) (p. 554)

29*c*. No dark blotch opposite tip of pectoral fin; snout 1.9 to 2.0; length of base of soft anal in longest anal ray about 1.1; profile of snout forms an angle of 94 to 97 degrees with a line extending from upper edge of pectoral base through center of pupil; traces of lengthwise streaks on sides of body.

Lethrinus ornatus Cuvier and Valenciennes (p. 556)

Genus SCOLOPSIS Cuvier

Scolopsis CUVIER, Bull. Soc. Philom. Paris, 1814, p. 90; Règne animal, vol. 2, p. 280, 1817. (Genotype *Scolopsides kurite* Cuvier=*Anthias vosmeri* Bloch, designated by Bleeker.) (Reference copied.)

SCOLOPSIS CANCELLATUS (Cuvier and Valenciennes)

Scolopsides cancellatus CUVIER and VALENCIENNES, Histoire naturelle des poissons, vol. 5, p. 351, 1830 (type locality, Hawaii; Waigiou; Rawac; northeast New Guinea; Vanicolo; Ulea).

SPECIMENS STUDIED

Guam: 5 lots, 183 specimens, 38 to 103 mm. standard length.

Description.—Dorsal rays X,9; anal III,7; pectoral usually ii,14 (ii,13 to 15); gill rakers about 4+5; scales above lateral line to front of dorsal 3½, below to anal region 12 to 14; usually about 43 pores in lateral line to base of caudal fin.

TABLE 47.—*Counts made on species of* Monotaxis, Gnathodentex, *and* Scolopsis

Species	Dorsal rays			Anal rays				Pectoral rays			
	Spines	Soft rays		Spines	Soft rays						
	X	9	10	III	7	8	9	ii,12	ii,13	ii,14	ii,15
M. grandoculis	8	------	8	8	------	------	8	15	------	------	------
G. aureolineatus	3	------	3	3	------	------	3	------	5	------	------
S. cancellatus	3	3	------	3	3	------	------	------	------	4	1

Head 2.8 to 3.2; depth 2.9 to 3.0; longest pectoral ray 3.7 to 4.2; length of anal fin base 7.0 to 7.5, of dorsal fin base 2.0 to 2.1; tip of snout to dorsal origin 2.4 to 2.8, to anal origin 1.5 to 1.6, to pelvic insertions 2.4 to 2.5, all in standard length. Orbit 2.4 to 2.8; snout 3.5 to 3.6; tip of snout to rear of maxillary 3.2; fleshy interorbital space 3.0 to 3.3; least depth of caudal peduncle 2.7 to 2.9; longest dorsal spine 2.0 to 2.1; postorbital length of head 2.3 to 2.5; all in length of head. Least depth of caudal peduncle in its length 1.5

Posterior edge of preopercle serrated, bony ring around posterior part of orbit denticulate; a strong posteriorly projecting spine below eye with 1 to 4 shorter ones below, the number increasing with increase in size; teeth in both jaws fine, conical, numerous, in a band decreasing in width posteriorly; vomer and palatines toothless; dorsal surface of head fully scaled as far forward as a vertical line through front of pupil but not to a point opposite nostrils; caudal fin deeply emarginate; dorsal and anal fins naked, only a sheath along their bases; pectorals and caudal fins scaly; gill rakers short, thickish.

Color in alcohol.—Upper part of body and head with three brownish bands separated by three narrow white streaks; first white streak passes along middorsal line of head to dorsal origin; second passes from dorsal edge of orbit posteriorly above lateral line, ending near midbase of soft dorsal fin; third passes from rear of upper part of orbit to point below lateral line, then crosses it and becomes narrower as it more or less meets its fellow just behind base of soft dorsal; dark band below this third white streak ends on basal part of upper caudal fin rays; lower half of body and head white; dorsal surface of eye

blackish; snout blackish; lips white; all fins pale; a black blotch between first to third dorsal spines, basally.

Genus LUTJANUS Bloch

Lutjanus BLOCH, Naturgeschichte der Ausländischen Fische, vol. 4, pt. 7, p. 105, 1790. (Genotype *Lutjanus lutjanus* Bloch.)

LUTJANUS GIBBUS (Forskål)

Sciaena gibba FORSKÅL, Descriptiones animalium, . . ., p. xl, 46, 1775 (type locality, Arabia).

SPECIMENS STUDIED

Bikini Atoll: 3 stations, 3 specimens, 215 to 315 mm. standard length.

Description.—Dorsal rays X,13 or 14; anal III,8; pectorals ii,15 in both fins; scales above lateral line to spiny dorsal 8, below to anal origin 15 to 17; gill rakers about 8 or 9+1+15 to 17.

TABLE 48.—*Counts made on certain species of* Lutjanus *and* Macolor

Species	Dorsal rays					Anal rays					Pectoral rays		
	Spines	Soft rays				Spines	Soft rays						
	X	12	13	14	15	III	7	8	9	10	ii,13	ii,14	ii,15
L. kasmira	9				9	9		9				14	
L. monostigmus	11	1	10			11	1	10				12	
L. bohar	5		1	4		5		5					8
L. vaigiensis	6		1	5		6		6			1	7	
L. gibbus	3		1	3		4		4					8
M. niger	1		1			1				1		1	1

Head 2.4 to 2.5; depth 2.4 to 2.5; longest pectoral ray 3.0 to 3.3; length of anal fin base 6.2 to 6.5, of dorsal fin base 1.9 to 2.0; tip of snout to dorsal origin 2.3 to 2.4, to pelvic insertion 2.2 to 2.4; all in standard length. Orbit 4.3 to 5.0; snout 2.3 to 2.5; tip of snout to rear of maxillary 2.7 to 2.8; fleshy interorbital space 4.2 to 4.5; least depth of caudal peduncle 3.5 to 3.7; longest dorsal spine 3.2 to 3.3; postorbital length of head 2.3 to 2.4; all in length of head. Least depth of caudal peduncle in its length 1.7 to 1.8.

Preopercular notch narrow and deep, knob of interopercle long, fitting into the notch; vomerine patch of teeth broad Λ-shaped; scale rows above lateral line ascending obliquely toward middorsal line, those below lateral line also ascending and not parallel with axis of body; caudal fin forked; interorbital area naked; supratemporal band of scales not meeting its fellow at middorsal line; profile of head concave in adults.

Color in alcohol.—Pale brownish above, somewhat milky white ventrally; along each row of scales a more or less distinct dark line or streak, contrasting with pale central area of scales to form alternating dark and pale streaks; margin of dorsal white, with submarginal blackish band; anal fin similar but paler; caudal fin dark brownish posteriorly; side of pectoral fin dusky to blackish and axil of pectoral grayish; pelvics a little dusky to lead colored.

Color when alive.—Pectorals light yellowish. Upper parts of head and body brownish.

Ecology.—This species was taken only in moderately deep water. It did not occur over the shallow parts of the reefs.

Remarks.—The concave profile of the head in adults and the ascending scale rows below the lateral line are characteristic.

LUTJANUS KASMIRA (Forskål)

Sciaena kasmira Forskål, Descriptiones animalium, . . ., pp. xi, 46, 1775 (type locality, Arabia).

SPECIMENS STUDIED

Bikini Atoll: 2 stations, 3 specimens, 180 to 218 mm. standard length.
Rongelap Atoll: 1 station, 5 specimens, 173 to 300 mm.
Rongerik Atoll: 1 station, 5 specimens, 122 to 151 mm.
Rota Island: 1 lot, 1 specimen, 190 mm.

Description.—Dorsal rays X,15; anal III,8; pectoral ii,14; gill rakers at first gill arch 7+1+14; scales above lateral line 8 or 9, below to anal origin 17 to 19; lateral line with about 47 to 49 pores.

Head 2.5 to 2.7; depth 2.9 to 3.1; longest pectoral ray 3.7 to 3.8; length of anal fin base 7.0 to 7.7, of dorsal fin base 2.0 to 2.1; tip of snout to dorsal origin 2.5 to 2.6, to anal origin 1.3 to 1.4, to pelvic insertion 2.1 to 2.5; all in standard length. Orbit 3.5 to 4.0; snout 3.0; tip of snout to rear of maxillary 2.4 to 2.6; fleshy interorbital space 4.7 to 5.0; least depth of caudal peduncle 3.7 to 3.9; longest dorsal spine 2.6 to 2.8; postorbital length of head 2.2 to 2.3; all in head. Least depth of caudal peduncle in its length 1.8 to 1.9.

Preopercle with notch into which fits a knob of interopercle; vomer with a broad Λ-shaped patch of villiform teeth: scale rows above lateral line running obliquely to base of dorsal fin, those below lateral line nearly parallel to lengthwise axis of body; caudal fin emarginate.

Color in alcohol.—Body with four lengthwise pale streaks bordered above and below by a dark line, first beginning in interorbital space extending to midbase of spiny dorsal, second from upper rear edge of eye to midbase of soft dorsal fin, third from behind eye to rear edge of base of soft dorsal fin, fourth from lower edge of eye to caudal peduncle just below lateral line, but not extending onto caudal fin; margin of dorsal fin blackish; dorsal surface of head dusky.

Color when alive.—Streaks light blue and bordered by a brownish line above and below; fins and body yellowish.

Ecology.—This snapper is very abundant in deep water and was caught down to a depth of 100 feet on hook and line. Apparently one, at least, had been feeding on garbage from the ship as the stomach contained string beans.

LUTJANUS MONOSTIGMUS (Cuvier and Valenciennes)

Mesoprion monostigma CUVIER and VALENCIENNES, Histoire naturelle des poissons, vol. 2, p. 446, 1828 (type locality, Seychelles).

SPECIMENS STUDIED

Bikini Atoll: 3 stations, 9 specimens, 59 to 327 mm. standard length.
Rongelap Atoll: 2 stations, 4 specimens, 108 to 320 mm.
Eniwetok Atoll: 1 station, 2 specimens, 92 to 145 mm.
Rota Island: 2 lots, 2 specimens, 57 to 69 mm.
Guam: 2 lots, 5 specimens, 25 to 70 mm.

Description.—Dorsal rays X,13 (rarely 12 or 14); anal III,8 rarely 7; pectoral ii,14; gill rakers 7+1+11 or 12; scales above lateral line 7 (6½), below to anal fin 14 or 15; pores in lateral line about 47 or 48.

Head 2.5 to 2.7; depth 2.8 to 3.2; longest pectoral ray 3.6 to 4.2; length of anal fin base 6.7 to 7.9, dorsal fin base 2.0 to 2.1; tip of snout to dorsal origin 2.2 to 2.3, to anal origin 1.4 to 1.6, to pelvic insertion 2.4 to 2.5; all in standard length. Orbit 3.5 to 4.2; snout 2.9 to 3.0; tip of snout to rear of maxillary 2.2 to 2.3; fleshy interorbital space 4.8 to 6.1; least depth of caudal peduncle 3.0 to 3.5; longest dorsal spine 2.9 to 3.1; postorbital length of head 2.1 to 2.2; all in length of head. Least depth of caudal peduncle in its length 1.5 to 1.8.

Preopercle scarcely or not notched, at most only a shallow concavity; vomer with a broad Λ-shaped patch of villiform teeth; scale rows above lateral line running obliquely upward to base of dorsal fin, those scale rows below lateral line extending parallel to lengthwise axis of body; caudal fin emarginate; supratemporal band of scales lacking, or nearly so, along dorsal surface of head; preorbital area naked.

Color in alcohol.—Back brownish to blackish, lighter below, each scale with a pale center; a black blotch a little smaller than orbit at lateral line below base of soft dorsal fin, this spot becoming smaller on the large adults, occupying only 3 or 4 scales; peritoneum white.

Color when alive.—Fins yellowish to reddish; sides of body yellowish.

Ecology.—This species was taken on the reef only where it had been trapped the night before in rather large tidal pools that were completely isolated at low tide. During the day it occurred in the deeper waters of the lagoon.

LUTJANUS BOHAR (Forskål)

PLATE 44, B

Sciaena bohar FORSKÅL, Descriptiones animalium, . . ., pp. 46, xl, 1775 (type locality, Arabia).

SPECIMENS STUDIED

Bikini Atoll: 1 station, 2 specimens, 158 to 221 mm. standard length.
Rongelap Atoll: 3 stations, 3 specimens, 57 to 247 mm.
Guam: 1 lot, 1 specimen, 525 mm.

Description.—Dorsal rays X,13 or 14, seldom 13; anal III,8; pectoral ii,15; gill rakers 8 or 9+1+16 or 17; scales above lateral line to dorsal origin 8 or 9, below to anal origin 15 or 16.

Head 2.6 to 2.7; depth 2.6 to 2.8; longest pectoral ray 3.4 to 3.7; length of anal fin base 6.5 to 6.7, of dorsal fin base 2.0 to 2.2; tip of snout to dorsal origin 2.4 to 2.6, to anal origin 1.5, to pelvic insertions 2.4; all in standard length. Orbit 3.8 to 4.2; snout 2.7 to 3.1; tip of snout to rear of maxillary 2.1 to 2.2; fleshy interorbital space 3.9 to 4.3; least depth of caudal peduncle 3.1 to 3.2; longest dorsal spine 2.3 to 2.5; postorbital length of head 2.1 to 2.3; all in length of head. Least depth of caudal peduncle in its length 1.9 to 2.0.

Preopercle with a moderate notch; vomer with a broad Λ-shaped patch of teeth; scale rows above lateral line running obliquely upward to middorsal line, those below lateral line parallel to lengthwise axis of body; caudal fin emarginate; supratemporal band of scales not extending on dorsal surface of head; preorbital area naked; soft dorsal, anal, and caudal fin scaly; preopercle serrate.

Color in alcohol.—Dusky to blackish dorsally, pale to whitish ventrally; pectorals pale; pelvics and caudal fin edged with white, below which is a black streak, then rest of fin pale; anal spines white, membranes black, a black streak covering first few soft rays of anal fin, remainder of anal fin pale; spinous dorsal black, soft dorsal anteriorly blackish, posteriorly pale; above lateral line two white silvery spots, one below rear edge of base of soft dorsal fin, another smaller, less distinct, and often lacking in young specimens, under spiny dorsal; both may be lacking on very large specimens; tip of upper and lower jaws blackish.

Color when alive.—Pale spots on back silvery white, disappearing in large adults; general color brownish, with reddish tinge, and yellow tinge on head and sides anteriorly.

Ecology.—This species lived in the deeper waters of the lagoon and was not seen in the shallow waters of the reefs.

LUTJANUS VAIGIENSIS (Quoy and Gaimard)

Diacope vaigiensis QUOY and GAIMARD, Voyage autour du monde . . . executé sur les corvettes *L'Uranie* et *La Physicienne*, . . . Zool., pt. 7, p. 307, 1824 (type locality, Waigiou).

SPECIMENS STUDIED

Guam: 8 lots, 82 specimens, 23 to 248 mm. standard length.

Description.—Dorsal rays X,13 or 14; anal III,8; pectoral rays ii,13 or 14, usually 14; gill rakers 6+1+10 to 12; scale rows above lateral line to dorsal base 7, below to anal origin 13 or 14; about 47 or 48 pores in lateral line.

Head 2.5 to 2.6; depth 2.5 to 2.8; longest pectoral ray 3.3 to 3.4; length of anal fin base 6.7 to 7.4, of dorsal fin base 1.9; tip of snout to dorsal origin 2.3 to 2.4, to anal origin 1.4 to 1.5, to pelvic insertion 2.4 to 2.6; all in standard length. Orbit 4.0 to 4.5; snout 2.8 to 3.0; tip of snout to rear of maxillary 2.5 to 2.7; fleshy interorbital space 4.7 to 4.9; least depth of caudal peduncle 3.1 to 3.4; longest dorsal spine 2.4 to 2.7; postorbital length of head 2.0 to 2.1; all in length of head. Least depth of caudal peduncle in its length 1.4 to 1.6.

Preopercle with a distinct notch into which fits a knob of the interopercle; vomer with a broad Λ-shaped patch of teeth; scale rows above lateral line ascending obliquely toward middorsal line, those below lateral line parallel with lengthwise axis of body, caudal fin emarginnate; interorbital area naked, the supratemporal band of scales narrow but continuous across middorsal line.

Color in alcohol.—Light brown to yellowish brown dorsally, white ventrally; each scale with a pale or silvery center, giving sides the appearance of having pale streaks; marginal area of dorsal fin blackish, margin edged with a white line; caudal fin dusky to blackish, with a narrow white marginal band; pectoral, pelvics, and anal fins white.

Color when alive.—Pale areas on scales yellowish; fins mostly yellowish.

Genus MACOLOR Bleeker

Macolor BLEEKER, Act. Soc. Sci. Indo-Neerl., vol 8, p. 25, 1860. (Genotype, *Macolor typus* Bleeker=*Diacope macolor* Cuvier=*Sciaena nigra* Forskål.) (Reference copied.)

MACOLOR NIGER (Forskål)

PLATE 47

Sciaena nigra FORSKÅL, Descriptiones animalium, . . . , pp. xi, 47, 1775 (type locality, Djedda, Red Sea).

SPECIMEN STUDIED

U.S.N.M. No. 140261. Bikini Atoll, Enyu Island, lagoon reef at channel entrance, poison to depth of 20 feet, March 16, 1946, S-46-8, Schultz, Brock, and Marr, 1 specimen, 410 mm.

Description.—Dorsal rays X,13; anal III,10; pectoral ii,14 or 15; about 50 pores in lateral line; scales above lateral line to front of dorsal 8 or 9, below to anal origin about 19 to 22; gill rakers on first gill arch 36+68 to 72.

Head 2.5; depth 2.4; longest pectoral ray 2.8; length of anal fin base 6.0, of dorsal fin base 2.1; tip of snout to anal origin 2.2, to pelvic insertions 2.5; all in standard length. Longest gill raker 3.2; eye 5.0; snout 2.6; tip of snout to end of maxillary 2.2; fleshy interorbital space 2.7; least depth of caudal peduncle 3.1; longest dorsal spine 2.8; postorbital length of head 2.1; all in length of head. Least depth of caudal peduncle in its length 1.6.

Preopercle deeply notched, with a long bony projection of interopercle fitting into notch; posterior edge of preopercle above notch denticulate and ventral edge below notch denticulate; both jaws with short conical canines, inside of which occurs a band of villiform teeth, the conical teeth at front of lower jaw more or less directed forward, as are the two enlarged canines at front of upper jaw; canines at sides of jaw irregular in direction, a few more or less outward, or forward, especially those at posterior extremity; vomer and palatines with a narrow band of villiform teeth, those of vomer in a very broad Λ-shape; gill rakers on first gill arch long, slender, and fine, closely set (like those in the menhaden); about 7 rows of scales on cheeks; interorbital naked; supratemporal band of scales confined to an elongate patch at sides; scales above lateral line obliquely running to middorsal line, those below lateral line parallel to lengthwise axis of body; caudal fin emarginate; lips finely papillate.

Color in alcohol.—Dark brownish or blackish on head, body, and all fins; centers of scales a little lighter than rest of body. Philippine specimens of *Macolor macularies* Fowler, when a foot in length or shorter, are variously blotched with large white spots and broad lengthwise bands. However, as they increase in size white markings become reduced and at sizes over a foot in length they become plain blackish.

Color when alive.—Plain blackish.

Ecology.—This specimen was poisoned at the channel entrance adjacent to deep water, and came up to the surface about 100 feet off the reef. This species, with its numerous fine gill rakers, is adapted to feed on planktonic organisms.

Remarks.—I cannot agree with Weber and de Beaufort that this species should remain in the genus *Lutjanus*. If on the basis of no other character, the long leaflike gill rakers, numbering about 36+68 to 72, warrant the recognition of a separate genus.

Genus PLECTORHINCHUS Lacepède

Plectorhinchus LACEPÈDE Histoire naturelle des poissons, vol. 3, p. 134, 1802. (Genotype, *Plectorhinchus chaetodonoides* Lacepède.)

PLECTORHINCHUS NIGRUS (Cuvier and Valenciennes)

Pristipoma nigrum CUVIER and VALENCIENNES, Histoire naturelle des poissons, vol. 5, p. 258, 1830 (type locality, Manila).

SPECIMENS STUDIED

Guam: 2 lots, 3 specimens, 42 to 56 mm., McElroy and Markley.

Description.—Dorsal rays XIV,15 or 16; anal III,7; pectoral ii,14; pores in lateral line about 51; vertical scale rows above lateral line 57 or 58; scales in a row from lateral line to dorsal origin 13, from anal origin to lateral line about 13 or 14; gill rakers about 8+1+17.

Head 2.5; depth 2.0; longest pectoral ray 4.3; length of anal fin base 5.5, of dorsal fin base 1.5; tip of snout to dorsal origin 2.2, to anal origin 1.4; to pelvic insertion 2.5; all in the standard length. Longest gill raker 33; eye 3.2; snout 3.0; length of maxillaries 3.1; fleshy interorbital space 4.0; least depth of caudal peduncle 2.9; longest dorsal spine (fourth) 1.9; postorbital length of head 2.1; all in length of head. Least depth of caudal peduncle in its length 2.3.

Preopercle, without a notch, serrated along posterior and ventral edges; no canines in jaws; teeth on jaws short, conical, probably in one row or a narrow band; vomer, palatines, and tongue toothless; gill rakers very short, smooth; cheek with numerous rows of small scales; interorbital scaled to a line connecting across rear of nasal openings; scale rows above lateral line obliquely running to middorsal line, those below lateral line not quite parallel with lateral line, running a little dorsally to lateral line; caudal fin a little rounded; lips thick; profile of head steep.

Color in alcohol.—Dark brown; pectoral white or pale; caudal white in young; margins of soft dorsal and anal fins white in young; pelvics dark brown or blackish; sometimes a dark band appears through soft dorsal and anal fins.

Genus GNATHODENTEX Bleeker

Gnathodentex BLEEKER, Versl. Akad. Amsterdam, ser. 2, vol. 7, p. 41, 1873. (Genotype, *Pentapus aurilineatus* Bleeker.)

GNATHODENTEX AUREOLINEATUS (Lacepède)

Sparus aureolineatus LACEPÈDE, Histoire naturelle des poissons, vol. 4, pp. 42, 132, 1802 (no locality).

SPECIMENS STUDIED

Bikini Atoll: 12 stations, 130 specimens, 52 to 206 mm. standard length.
Eniwetok Atoll: 1 station, 13 specimens, 114 to 141 mm.
Rongelap Atoll: 3 stations, 11 specimens, 33 to 151 mm.
Rongerik Atoll: 1 station, 8 specimens, 107 to 139 mm.

Description.—Dorsal rays X,10; anal III,9; pectoral ii,13; gill rakers 5+6 or 7; scale rows crossing lateral line 70 to 72, scales above lateral line to front of spiny dorsal 6 or 7, below lateral line to anal origin 16 or 17.

Length of head 2.9 to 3.1; depth about 2.8; longest pectoral ray 3.7 to 3.8; length of anal fin base 5.1 to 6.3; length of dorsal fin base 2.2 to 2.3; tip of snout to dorsal origin 2.6 to 2.7, to anal origin 1.6 to 1.7, to pelvic insertion 2.6 to 2.7; all in standard length. Orbit 2.2 to 2.9; snout 2.7 to 3.2; length of maxillaries 3.3 to 3.6; fleshy interorbital space 2.8 to 3.2; least depth of caudal peduncle 3.0 to 3.2; longest dorsal spine 2.3 to 2.7; postorbital length of head 2.8 to 3.1; all in length of head. Least depth of caudal peduncle in its length 2.0 to 2.1.

Preopercular edge rough or finely denticulate, no notch as in *Lutjanus;* vomer and palatines toothless; both jaws with an outer row of conical canines and anteriorly inside this row a patch of villiform teeth; at front of upper and lower jaws three pairs of enlarged canines; gill rakers small, knoblike; about five rows of scales on the cheeks; scale rows above lateral line parallel with it, those below lateral line parallel with lengthwise axis of body; lower edge of maxillary serrated as in *Monotaxis;* interorbital area naked; the supratemporal band of scales restricted to sides of head, forming a patch, not meeting at dorsal midline; caudal fin forked; lips finely papillate.

Color in alcohol.—Light brownish above, paler below, each scale with pale center, edges dark, giving the appearance of alternating pale and brown streaks, the lower ones wider than those above lateral line; a silvery blotch on back opposite posterior end of dorsal fin; all fins more or less dusky; preorbital with a wide silvery stripe.

Color when alive.—Pale streaks golden yellow; caudal, anal, and soft dorsal reddish, with distal margin of dorsal reddish orange; pectorals and pelvics yellowish orange; lips golden yellow; pale blotch opposite rear of dorsal fin yellowish; iris yellowish; sides below lateral line silvery.

Ecology.—This species is more common in relatively deep water and did not occur in the shallow water over the reef at low tide; at night it would come into shallow water and was therefore trapped in a large pondlike tidal pool on Erik Island at Bikini. The typical habitat during the daytime was in moderately deep to deep water in the lagoon and in the surge channels along the outer edges of the reefs. Specimens were taken along ledges and from crevices at depths of 6 feet and deeper along the lagoon reefs.

Remarks.—The denticulate edge of the maxillary appears to have been overlooked by Weber and de Beaufort (Fishes of the Indo-Australian Archipelago, vol. 7, p. 347–348, 1936).

Genus MONOTAXIS Bennett

Monotaxis BENNETT, Memoir of the life and public service of Sir Stamford Raffles, p. 688, 1830. (Genotype, *Monotaxis indica* Bennett=*Sciaena grandoculis* Forskål.)

MONTAXIS GRANDOCULIS (Forskål)

PLATE 48, A

Sciaena grandoculis FORSKÅL, Descriptiones animalium, . . ., pp. xii, 53, 1775 (type locality, Djedda, Red Sea).

SPECIMENS STUDIED

Bikini Atoll: 7 stations, 12 specimens, 27 to 295 mm. standard length.
Rongelap Atoll: 2 stations, 8 specimens, 38 to 148 mm.
Rongerik Atoll: 3 stations, 6 specimens, 96 to 171 mm.
For additional specimens, see *Remarks*.

Description.—Dorsal rays X,10; anal III,9; pectoral ii,12; gill rakers on first gill arch, 5+5 or 6; vertical scale rows crossing lateral line about 45 to 47, from lateral line to dorsal origin 5, below to anal origin 13; about 45 to 47 pores in lateral line.

Length of head 3.0 to 3.3; depth 2.5 to 2.8; longest pectoral fin ray 3.3 to 3.5; length of anal fin base 5.0 to 5.1; length of dorsal fin base 2.0 to 2.1; tip of snout to dorsal origin 2.4, to anal origin 1.6 to 1.7, to pelvic insertion 2.7 to 2.8; all in standard length. Orbit 2.6 to 3.1; snout 2.5 to 2.6; length of maxillaries 2.3 to 2.7; fleshy interorbital space 2.8 to 3.0; least depth of caudal peduncle 2.4 to 2.6; longest dorsal spine 2.1 to 2.2; postorbital length of head 2.4 to 2.8; all in length of head. Least depth of caudal peduncle in its length 1.8 to 1.9.

Preopercular edge rough, sometimes finely denticulate, but not notably serrated, no notch as in *Lutjanus:* vomer and palatines toothless; both jaws with a single row of molar teeth, numbering six or seven, the last three or four teeth very broad; anteriorly in both jaws an outer row of strong conical canines six in upper and four in lower jaw, inside of these, on each side of symphysis, scarcely or not separated at midline, a patch of villiform teeth; gill rakers small knobs; about five rows of scales on cheeks; scale rows above lateral line parallel with lateral line, those below lateral line parallel with lengthwise axis of body; lower edge of maxillary serrated as in *Gnathodentex;* interorbital area naked; supratemporal band of scales not meeting at middorsal line; caudal fin forked; lips finely papillate; pectoral fin about equal to length of head.

Color in alcohol.—Center of each scale pale, edge of scale brownish; back and upper sides reddish brown, lower parts pale or silvery; two pale bands on back and sides, first near front of spiny dorsal fin, the second at rear of base of spiny dorsal fin, both of these pale bands sometimes difficult to discern; caudal fin dusky or with a dusky to dark streak submarginally along outer edge of each caudal fin lobe. Axil of pectoral base blackish; pelvics, soft dorsal, and anal fins dusky sometimes pale; pectoral fin pale. (See *Remarks.*)

Color when alive.—Dorsal, anal, and caudal fins yellowish orange to reddish; pectorial and pelvics yellowish; occasionally a few scales

blackish on sides; area over and around eye yellowish to orange; general color above bluish gray, paler ventrally; centers of scales silvery.

Ecology.—Monotaxis grandoculis is not found over the shallow reefs at low tide. It was taken along ledges close to deeper water. At depths of 10 feet or more in the lagoon it is a common species.

Remarks.—A 21-mm. specimen in the University of Washington collections was also examined. This and the 38-mm. specimen belong to this species without doubt. On the latter there are four vertical pale bars, the first from occiput past rear of orbits, the second under front of spiny dorsal, the third at rear of spine and beginning of soft dorsal, the fourth just behind base of soft dorsal; body otherwise dusky; upper and lower submarginal edges of caudal fin with a dusky streak; the dusky spaces between the second and third narrow pale bars and the third and fourth extend on dorsal fins to form a dusky to blackish blotch; the most remarkable character of this small specimen is the lack of molar teeth in both jaws; the outer row of conical ones continues along the sides; in the 72-mm. specimen the molar teeth are small, appearing to have developed from this row of conical teeth. The 21-mm. specimen is plain whitish, with well-developed scales and a maxillary having well-developed dentae. In many respects *Monotaxis*, except for the molar teeth of the adult, is similar to *Gnathodentex*. Similar characters include denticulate edge of maxillary, position of teeth in jaws, large orbit, nearly same numbers of fin rays, structure and number of gill rakers and their position on gill arches. Now, with the discovery of the change in form of teeth in *Monotaxis* from the conical ones in the young to molar teeth in adults, the gap between the two genera is partially bridged. However, the two genera should remain distinct, in my opinion.

Genus APRION Cuvier and Valenciennes

Aprion CUVIER and VALENCIENNES, Histoire Naturelle des poissons, vol. 6, p. 543, 1830. (Genotype, *Aprion virescens* Cuvier and Valenciennes.)

APRION VIRESCENS Cuvier and Valenciennes

PLATE 48, C

Aprion virescens CUVIER and VALENCIENNES, Histoire naturelle des poissons, vol. 6, p. 544, pl. 168, 1830 (type locality, Seychelles).

SPECIMENS STUDIED

Bikini Atoll: Lagoon and Oruk Pass, July 18, 1947, Marr and Smith, 2 specimens, 440 and 455 mm.

Northern Marshall Islands: 3 specimens, rescued from beach after the ship sank (see p. xxi), are in very bad condition; they measure 530 to 600 mm.

Description.—Dorsal rays IX or X,ii,9; anal III,8 or 9; pectoral ii,15 or ii,16; gill rakers on first arch 5+1+13 or 14; scale rows cross-

ing lateral line about 46 to 50, scales in a row above lateral line to soft dorsal origin 7, below in an oblique posteriorly extending row to anal origin 12 or 13.

Length of head 3.4; depth 4.2 to 4.3; longest pectoral ray 8.5 to 8.7; length of anal fin base 7.0; length of dorsal fin base 2.2; tip of snout to dorsal origin 2.9, to anal origin 1.7, to pelvic insertion 3.2; all in standard lengths. Eye 5.0 to 5.1; snout 2.3; length of maxillaries 2.3; fleshy interrorbital space 3.0 to 3.1; least depth of caudal peduncle 4.0; longest dorsal spine 2.5 to 2.6; postorbital length of head 2.5; all in length of head. Least depth of caudal peduncle in its length 3.1 to 3.3.

Preopercular edge smooth, stiff, without notch; vomer and palatines with very fine villiform teeth; both jaws with an outer row of low canine teeth and the usual pair of enlarged canines each side of the tip of both jaws, inside of outer row of canines at front of jaws a broad band of villiform teeth; gill rakers moderately slender; scale rows on cheek 7 or 8; scale rows above and below lateral line parallel with it and lengthwise axis of body; edges of maxillary smooth; supratemporal band of scales not meeting its fellow at middorsal line; caudal fin deeply forked; pectoral fin about equal to postorbital length of head.

Color in alcohol.—Brownish above, lighter below.

Ecology.—This species was an active game fish in the lagoon and passages, where it was taken by means of trolling. No specimen was seen or taken from the shallow waters of the reefs.

Genus APHAREUS Cuvier and Valenciennes

Aphareus Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 6, p. 485, 1830. (Genotype, *Aphareus caerulescens* Cuvier.)

APHAREUS FURCATUS (Lacepède)

Plate 48, B

Labrus furcatus Lacepède, Histoire naturelle des poissons, vol. 3, pp. 429, 477, pl. 21, fig. 1, 1802 (type locality, The Great Ocean [Mauritius]).

Aphareus manillae Borodin, Bull. Vanderbilt Mar. Mus., vol. 1, art. 2, p. 51, 1930 (type locality, Luzon, Manila, Philippines).

SPECIMEN STUDIED

Bikini Atoll: Ruji Pass, August 2, 1949, Univ. Washington, 1 specimen, 280 mm.

Description.—Dorsal rays X,11; anal III,8; pectoral ii,14–ii,13; gill rakers on first arch 8+1+15; scale rows crossing lateral line 74, scales in a row above lateral line to soft dorsal origin 9, below in an oblique row to anal origin 18.

Head 3.3; depth 3.7; longest pectoral ray 4.1; length of anal fin base 5.6; length of dorsal fin base 2.4; tip of snout to dorsal origin 2.7, to

anal origin 1.6, to pelvic insertion 2.8; all in standard length. Eye 4.2, snout 3.0; length of maxillaries 1.8; fleshy interorbital space 3.0; least depth of caudal peduncle 3.3; longest dorsal spine 2.3; postorbital length of head 2.2 all in head length. Least depth of caudal peduncle in its length 2.3.

Preopercular edge smooth, stiff, membranous, without notch; vomer and palatines edentulous; both jaws with a band of villiform teeth; gill rakers moderately slender; scale rows on cheek 8; scale rows above and below lateral line parallel with it and with lengthwise axis of body; edges of maxilliary smooth; supratemporal band of scales not meeting its fellow at middorsal line; caudal fin deeply forked; pectoral fin long, contained about 1.2 in head.

Color in alcohol.—Light brownish, with naked areas of head dark brown; posterior margin of caudal fin pale.

Remarks.—This species, in addition to the single specimen preserved, was recorded by photograph. It was frequently taken by trolling by the group of fishermen working under Brock and Marr, but when their ship sunk on the California coast all their specimens of this species were lost.

The gill rakers on the first gill arch of Hawaiian specimens of this species have been counted with the following results: 7+1+15; 7+1+16; 7+1+17; 8+1+15; 8+1+16; 8+1+17 (2 specimens); and 9+1+17. I have not seen a specimen of *A. rutilans*, said by Fowler to have 16 to 19+32 to 34 gill rakers.

Genus CAESIO Bleeker

Caesio LACEPÈDE, Histoire naturelle des poissons, vol. 3, p. 85, 1802. (Genotype *Caesio caerulaureus* Lacepède.)

Odontonectes GÜNTHER, Catalogue of the fishes in the British Museum, vol. 1, p. 265, 1859. (Genotype, *Caesio erythrogaster* Cuvier and Valenciennes= *Sparus cuning* Bloch.)

Fowler has referred *Paracaesio* Bleeker, with *Caesio xanthurus* Bleeker as its type, to this genus. I have not examined the species.

CAESIO XANTHONOTUS Bleeker

Caesio xanthonotus BLEEKER, Nat. Tijdschr. Nederl.-Indië, vol. 4, p. 466, 1853 (type locality, Batavia).

SPECIMENS STUDIED

U.S.N.M. No. 140245, Bikini Atoll, Ruji Channel, surface trolling, April 6, 1946, S-46-90, Brock and Schultz, 1 specimen, 212 mm. (regurgitated by the "dog-toothed tuna"); U.S.N.M. No. 140250, Bikini Atoll, Amen Island, lagoon, diving at depth of 30 feet, August 4, 1946, S-46-307, Brock, Herald, and Kohler, 1 specimen, 49 mm.

Description.—Dorsal rays X,15; anal III,12; pectoral ii,19; scale rows from upper edge of gill opening to midbase of caudal fin 69

TABLE 49.—*Counts made on species of* Caesio, Pterocaesio, *and* Gymnocaesio

Species	Dorsal rays														Anal rays						Pectoral rays										
	Spines				Soft rays										Spines	Soft rays															
	X	XI	XII	XIII	13	14	15	16	17	18	19	20	21	22	III	10	11	12	13	14	I	II	III	15	16	17	18	19	20	21	22	23
C. xanthonotus	1						1								2			2				4						4				
C. cuning	9					1	8								15	1	14					27	2	2	19	10					
C. lunaris	1						1								2		1	1				3			1		2				
C. caerulaureus	7						6	1							6			6	1			16						8	8		
P. tile		2	11	1						1	3	4	4	2	16				13	3	1	23							1	18	4	1
P. kohleri	1						1								1		1					2								2		
P. marri		4			2	2									4			4			1	7							3	4	1	
P. pisang	7					1	6								6			6				8				3	3	2				
P. chrysozona	1						1								1			1				2				2						
P. diagramma	2						2								3			3				9				1	2	6				
G. gymnopterus	1						1								1			1				2					1	1				

Species	Number of gill rakers on first arch														Number of scales									
	Above angle								At angle	Below angle					Above lateral line				Below lateral line					
	6	7	8	9	10	11	12	13	1	23	24	25	26	27	28	7	8	9	10	13	14	15	16	17	18
C. xanthonotus			1		1				2			1	1					2						1	1
C. cuning			2		3	1		1	7	3		2	2			6	2				4	2	2		
C. lunaris			1	1					2	1	1						1						1		
C. caerulaureus		1	3	1	1				6		1	2	1	2			7					6	1		
P. tile		5	7	1					13		1	6	1	4	1	13						9	1		
P. kohleri			1						1					1				1					1		
P. marri			2	2					4		1	2	1					3	1			1	3		
P. pisang																6				1	4	1			
P. chrysozona																	1					1	1		
P. diagramma																		4				1	3		
G. gymnopterus	1								1			1				1				1					

and 73; scales above lateral line to dorsal origin 9, below to anal origin 17 or 18; gill rakers on first gill arch 8 to 10+1+25 or 26. Precision measurements, expressed in thousandths of the standard length, are given in table 50.

TABLE 50.—*Measurements, expressed in thousandths of the standard length, for certain species of* Caesio *and* Pterocaesio *from the northern Marshall Islands*

Characters	*P. marri*		*P. kohleri*	*P. tile*		*C. xanthonotus*	
Standard length in millimeters	87	84	193	126	110	212	49
Greatest depth of body	230	226	247	238	218	317	286
Length of head	293	291	280	275	273	292	343
Length of snout	69	77	68	75	73	66	78
Diameter of orbit	90	95	78	82	77	77	108
Postorbital length of head	144	137	140	119	127	148	163
Least width of fleshy interorbital space	72	78	78	87	77	83	92
Distance from snout tip to rear of maxillary	102	107	98	98	96	92	118
Distance anterior nostril to tip of snout	46	48	47	45	45	42	53
Distance posterior nostril to edge of orbit	16	24	24	21	19	24	27
Distance between nostrils	20	22	16	21	20	19	18
Length of caudal peduncle	178	179	168	163	168	174	178
Least depth of caudal peduncle	75	71	64	75	73	64	84
Pelvic insertion to anal origin	295	305	334	332	320	304	265
Anus (center) to anal origin	55	60	72	53	51	68	59
Tip of snout to dorsal origin	361	373	366	371	.....	343	374
Tip of snout to anal origin	638	635	670	667	647	650	624
Tip of snout to pectoral insertion	282	286	267	276	273	281	335
Tip of snout to pelvic insertion	350	342	347	355	336	367	396
Tip of snout to center of anus	584	584	600	613	588	580	578
Longest gill raker	35	49	36	37	30	34	41
Longest spine of dorsal fin	126	155	135	101	118	118	149
Longest spine of anal fin	81	105	88	71	75	78	94
Length of pelvic spine	92	105	104	100	103	109	120
Length of pectoral fin	201	203	228	217	209	325	215
Length of pelvic fin	144	157	140	158	161	153	180
Length of caudal fin	241	250	244	238	245	311	298
Length of accessory pelvic appendage	64	65	72	72	77	.....	53
Length of base of dorsal fin	486	493	492	508	504	510	480
Length of base of anal fin	203	197	193	222	209	220	223
Length of second dorsal spine	107	116	99	111	118	97	129

Length of head 2.9 and 3.4; depth 3.4 to 3.5; length of longest pectoral fin ray 3.2 and 4.0; length of anal fin base 4.3 to 4.5; length of dorsal fin base 1.9 to 2.0; tip of snout to dorsal origin 2.7 and 3.0, to anal origin 1.5 and 1.7, to pelvic insertion 2.5 and 2.7; all in standard length. Orbit 2.8 and 3.7; snout 4.1 and 4.5; length of maxillaries 2.8 and 2.3; fleshy interorbital space 3.8 and 4.0; least depth of caudal peduncle 4.0; longest dorsal spine 2.0 and 2.3; length of last dorsal ray 5.8 to 6.5; postorbital length of head 2.0 and 2.3; all in length of head.

This species less compressed than *C. cuning;* pectoral fin a little longer than head and slightly longer than greatest depth of body; gill rakers long and slender; maxillary naked, its dorsal edge slipping a little under preorbital; supratemporal band of scales notably in-

terrupted at middorsal line, naked area continuous with two posteriorly extending naked sheaths at rear of head; interorbital space strongly convex in larger specimens, nearly flat in small one; premaxillary with one lateral process in addition to median processes; these latter reaching to a vertical line at front of orbit; outer row of teeth enlarged, conical, with a narrow band of villiform teeth inside (in the larger specimen, a pair of slightly enlarged conical teeth occurs at symphysis of premaxillary); vomer with a few villiform teeth, but palatines probably lack teeth.

Color in alcohol.—Blackish dorsally, white ventrally; axil of pectoral base black, upper edge of pectoral base black but lower three-fourths or more of anterior side pale; tip of lower jaw dusky.

Color when alive.—Caudal fin orange-yellowish; back and upper sides dark bluish purple.

Remarks.—The tunas were feeding heavily on this species and other related forms of the *Caesio* group.

The small specimen identified as this species may possibly belong to another, since its pectoral fin is shorter and the interorbital space is flatter. We are considering these characters juvenile in view of the lack of specimens of intermediate sizes.

Genus PTEROCAESIO Bleeker

Pterocaesio BLEEKER, Versl. Akad. Amsterdam, ser. 2, vol. 9, p. 153, 1875. (Genotype, *Caesio multiradiatus* Steindachner=*Caesio tile* Cuvier and Valenciennes.)

Liocaesio BLEEKER, Versl. Akad. Amsterdam, ser. 2, vol. 9, p. 153, 1876. (Genotype, *Caesio cylindricus* Günther.)

Clupeolabrus NICHOLS, Amer. Mus. Nov., No. 94, p. 2, 1923. (Genotype, *Clupeolabrus dubius* Nichols.)

PTEROCAESIO TILE (Cuvier and Valenciennes)

Caesio tile CUVIER and VALENCIENNES, Histoire naturelle des poissons, vol. 6, p. 428, 1830 (type locality, Caroline Archipelago).

Clupeolabrus dubius NICHOLS, Amer. Mus. Nov., No. 94, pp. 2–3, fig. 2, 1923 (type locality, Kamako, Mangareva Island, Tuamotu Archipelago).

Dipterygonotus leucogrammicus SCHULTZ (in part), Journ. Washington Acad. Sci., vol. 35, No. 4, p. 136, 1945 (U.S.N.M. No. 56238 Bacon, Philippine Islands).

SPECIMENS STUDIED

Bikini Atoll: 3 stations, 29 specimens, 67 to 159 mm. standard length.
Rongelap Atoll: 1 station, 2 specimens, 110 and 126 mm.

Description.—The following counts are recorded: Dorsal rays XII,22; XII,19; XI,17?; XII,18. Anal rays III,14; III,14; III,13; III,13. Pectoral rays ii,21-ii,22; ii,21-ii,21; i,21-ii,21. Scales 78, 77, 77, 77; above lateral line to dorsal origin 7, 7, 6, 6; below to anal origin 16, 16, 15, 14. Zigzag scales around caudal peduncle 27, 26, —, 25. Gill

rakers on first gill arch 7+1+27; 8+1+27, 8+1+25, 7 or 8+1+25?. Precision measurements, expressed in thousandths of the standard length are given in table 50.

The following proportions based on 110 and 126 mm. specimens. Length of head 3.6 to 3.8; depth 4.1 to 4.4; longest ray of pectoral fin ray 4.8 to 5.0; length of anal fin base 4.7 to 4.8; length of dorsal fin base 1.9 to 2.0; tip of snout to dorsal origin 2.7 to 2.8, to anal origin 1.6 to 1.7, to pelvic insertion 3.0 to 3.1; all in standard length. Eye 3.4 to 3.7; snout 3.7 to 3.8; maxillaries 2.6 to 2.7; fleshy interorbital space 3.1 to 3.2; least depth of caudal peduncle 3.6 to 3.8; longest dorsal spine 2.2 to 2.4; length of last dorsal ray 3.0 to 3.2, last anal ray 3.3 to 3.4; postorbital length of head 2.1 to 2.2; all in length of head.

Body fusiform, greatest depth through base of spiny dorsal; head bluntly pointed, with a concave notch in tip of premaxillary, into which the tip of lower jaw fits; caudal peduncle slender, its least depth about 1.2 in fleshy interorbital space; dorsal and ventral profiles about evenly curved; interorbital space convex; lateral line complete, following upper profile of body, then along middle of caudal peduncle; body covered with weakly ctenoid scales, these occurring on sides of head but lacking on lower part of preopercle, anterior half of interorbital space, snout, gill membranes, and jaws; caudal fin scaled two-thirds of way out; accessory pelvic appendage or scale reaching a little over halfway out length of pelvic fins; base of pectoral fins fully scaled and extending on rays a short distance; base of dorsal and of anal fins with a narrow, scaly sheath; origin of dorsal fin a little behind a vertical line through pelvic insertions; pectorals extending past tips of pelvics but not reaching point opposite anus; last rays of soft anal and of soft dorsal considerably elongate; tips of caudal fin lobes pointed, as are tips of pectoral fins; spiny dorsal without an emargination between spiny and soft parts; gill rakers slender, longest nearly two-thirds diameter of eye; teeth small, in a single row on premaxillaries, absent on vomer, palatines; lower jaw with a single row of teeth on sides, edentulous anteriorly; dentary with elevated ramus at side or a raised thin crest; premaxillaries excessively protractile, ascending median processes reaching a little past a vertical line through front of pupil; preopercle with a thin membranous edge, the lower corner expanded, naked, forming a rounded lobe; opercle with a membranous edge and apparently without a spine; nostrils paired, separated by a wide dermal isthmus, distance between them contained 4 to 4.5 in fleshy interorbital space and 1.7 times in distance between anterior nostril and edge of premaxillary groove; anus in front of anal origin a distance about equal to half of interorbital space, and far back of tips of pelvic fins.

Color in alcohol.—Plain blackish above, white below; with a black streak in middle of each caudal lobe; rear of base of pectoral fin black, and this black on upper front edge, the lower two-thirds of pectoral fin pale; tip of lower jaw dusky.

Color when alive.—Back dark blue to light blue; sides above lateral line light blue; undersides rose colored, this color caused by center of each scale being rose tinted, with margins white; a yellowish brown streak along lateral line anteriorly, then running a straight course to fuse with and continue as black streak in upper lobe of caudal fin; lower lobe with black streak; eye pinkish.

Remarks.—I note several differences between our specimens and Nichols' figure of *Clupeolabrus dubius*, such as insertion of pelvics in relation to dorsal origin, depth of caudal peduncle, and course of lateral line. These differences may be due to inaccuracies in his drawing.

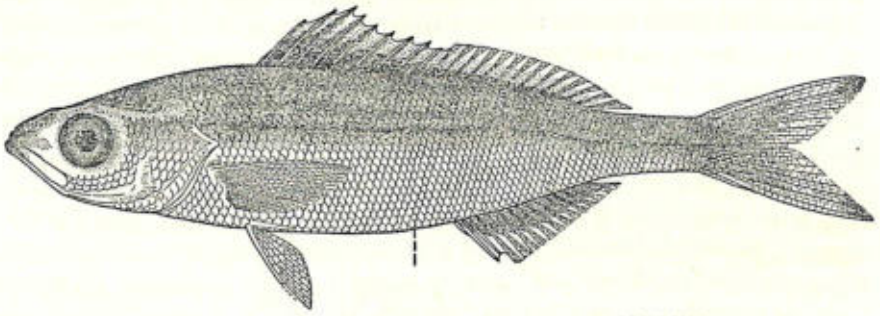

FIGURE 85.—Holotype of *Pterocaesio marri*, new species (U.S.N.M. No. 140248), from Bikini Atoll. (Drawing by Aime M. Awl.)

PTEROCAESIO MARRI, new species

FIGURE 85

Holotype.—U.S.N.M. No. 140248, Bikini Atoll, ¼ mile off Amen Island, in lagoon, depth 30 feet, August 4, 1946, S-46-307, Brock, Herald, and Kohler, 87 mm. standard length.

Paratypes.—U.S.N.M. No. 140249, bearing same data as holotype, 2 specimens, 81 and 84 mm.; Bikini Atoll, Romuk Island, August 4, 1946, Univ. Washington, 1 specimen, 85 mm.

Description.—The following counts were made, respectively, on the holotype and paratypes. Dorsal rays XI,13; XI,14; XI,14; XI,13. Anal rays III,12; III,12; III,12; III,12. Pectoral rays ii,20–ii,20; ii,20–ii,21; i,22–ii,21; ii,21–ii,21. Scale rows crossing lateral line 78, 80, 76, 78; scales above lateral line to dorsal origin 9, 9, 10, 9; below to anal origin 16, 15, 16, 16. Number of scales in a zigzag

row around least depth of caudal peduncle 28, 30, 29, 29. Gill rakers on first gill arch 9+1+24; 8+1+26; 9+1+25; 8+1+25.

Certain measurements made on the holotype and one paratype are recorded in thousands of the standard length in table 50.

The following proportions are based on the holotype and paratypes: Length of head 3.3; depth 4.4 to 4.5; longest pectoral fin ray 4.8 to 5.0; length of anal fin base 5.0 to 5.1; length of dorsal fin base 2.0 to 2.1; tip of snout to dorsal origin 2.6 to 2.7, to anal origin 1.7, to pelvic insertion 2.8 to 2.9; all in standard length. Orbit 3.0 to 3.1; snout 4.0; length of maxillaries 2.9 to 3.0; fleshy interorbital space 3.6 to 3.8; least depth of caudal peduncle 3.8 to 4.0; longest dorsal spine 2.2 to 2.3; length of last dorsal ray 5.1 to 5.4, last anal ray 5.6 to 5.8; postorbital length of head 2.0 to 2.1; all in length of head.

Body fusiform, greatest depth through base of spiny dorsal fin; head bluntly pointed, with a slight concavity at tip of snout; caudal peduncle slender, dorsal and ventral profiles about evenly curved; interorbital space convex; lateral line complete, a little above midaxis of body anteriorly, but along it on caudal peduncle; body covered with weekly ctenoid scales, scarcely or not rough to the touch; scales absent on snout, around orbit, mouth, lower jaws, gill membranes, and lower part of preopercle; caudal fin scaled about two-thirds of the way out its length; basal parts of pectoral, dorsal, and anal fins scaled; origin of dorsal fin a trifle behind a vertical line through pelvic insertion; pectoral fins extend only a trifle past tips of pelvics; last rays of dorsal and anal fins not notably elongate; tips of caudal fin lobes pointed; pectoral fins pointed; margin of spiny dorsal without an emargination between spiny and soft parts; gill rakers slender; teeth small, conical, in a single row in both jaws, none on vomer or on palatines; symphysis of premaxillary edentulous; dentary with elevated ramus at side; premaxillaries excessively protractile, the ascending median processes reaching a little past front of orbits into interorbital space; preopercular edge membranous, expanded at lower corner to form a small lobe; opercular edge membranous, with one thin flat spine; nostrils separated with a wide dermal isthmus between each pair; anus in front of anal origin a distance equal to diameter of orbit; sides of premaxillaries with two short processes.

Color in alcohol.—Dusky dorsally, whitish underneath; tips of each lobe of caudal fin with a black blotch; axil of pectoral base dusky, but anterior side of pectoral base pale; tip of lower jaw dusky; peritoneum white.

Remarks.—A great school of this species was observed just off a 30-feet-deep area over deep water, but no specimens could be obtained.

Named in honor of John C. Marr, of the Fish and Wildlife Service, who was in charge of the commercial fishing operations at Bikini.

PTEROCAESIO KOHLERI, new species

FIGURE 86

Holotype.—U.S.N.M. No. 140246, Bikini Atoll, in lagoon at lat. 11°33′13″ N., long. 165°28′39″ E., coral head at depth of 30 to 45 feet, July 13, 1946, S-46-252, Brock, Emory, and Kohler, only known specimen, 193 mm. in standard length.

Description.—Dorsal rays X,15; anal III,11; pectoral ii,21–ii,21; scale rows crossing lateral line 82, scales above lateral line to dorsal origin 9, below to anal origin 16; lateral line pores 74; scales in a zigzag row around least depth of caudal peduncle 29; gill rakers 8+1+27.

Certain measurements were made on the holotype and these are recorded in table 50 in thousandths of the standard length.

Length of head 3.6; depth 3.9; length of anal fin base 4.1; length of dorsal fin base 2.0 or 2.1; tip of snout to anal origin 2.7, to pelvic

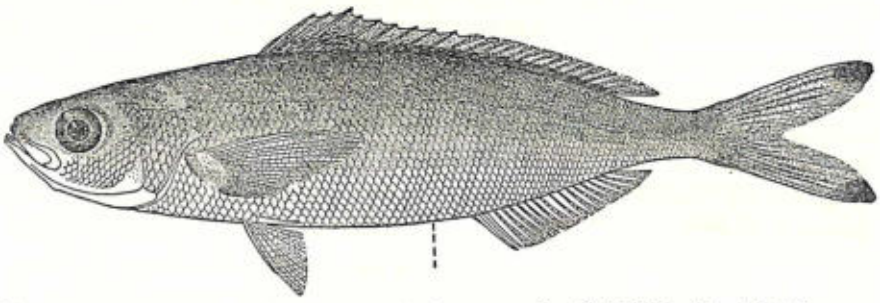

FIGURE 86.—Holotype of *Pterocaesio kohleri*, new species (U.S.N.M. No. 140246), from Bikini Atoll. (Drawing by Aime M. Awl.)

insertion 2.8; all in the standard length. Eye 3.9; snout 3.9; length of maxillaries 3.0; fleshy interorbital space 3.3; least depth of caudal peduncle 4.3; longest dorsal spine 2.3; length of last dorsal spine 4.6, of last and anal ray 5.2; postorbital length of head 2.0; all in length of head.

Body fusiform, greatest depth through base of spiny dorsal; head bluntly pointed, with a slight concavity at tip of premaxillary; caudal peduncle slender; dorsal and ventral profiles evenly curved; interorbital space convex; lateral line complete, a little above lengthwise axis of body anteriorly, but along it on caudal peduncle; body covered with weakly ctenoid scales, smooth to the touch; snout, area around orbit, lower part of preopercle, lower and upper jaw, gill membranes, naked; caudal fin scales between rays nearly to tips of lobes; accessory pelvic appendage about half length of pelvic fin; basal part of pectoral fin scaled; bases of dorsal and anal fins scaled, some scales on fin rays; origin of dorsal fin a trifle behind a vertical line through pelvic insertion; pectorals extending past tips of pelvics but not to point opposite

anus; last rays of dorsal and anal fins not notably elongate; tips of caudal lobes pointed, as are pectoral fins; margin of spiny dorsal without an emargination between spiny- and soft-rayed parts; gill rakers slender; teeth very small, conical, in a single row in both jaws, absent on vomer and palatines; premaxillary edentulous at symphysis; dentary with elevated ramus; premaxillaries excessively protractile, ascending median processes reaching point opposite interorbital space; lower posterior edge of preopercle thin, somewhat expanded, striated, naked; opercle with a membranous edge and a single thin spine; nostrils widely separated by a dermal isthmus; anus in front of anal origin a distance about equal to orbit; sides of premaxillary with two short processes in addition to the median ones; 6 pyloric caeca.

Color in alcohol.—Dusky dorsally, whitish ventrally; tips of each caudal lobe with a distinct roundish black blotch; axil of pectoral black but pale on anterior part of base.

Remarks.—None of this type of fish was ever seen over the shallow parts of the reefs, but in the lagoon in water 20 feet or more in depth great schools were seen. They form a favorite food of the tuna fishes. The excessively protractile mouth and long gill rakers suggest a more or less semipelagic habitat.

P. kohleri may be separated from other members of the genus by the key (p. 525).

Named in honor of T. F. Kohler, of Honolulu, who helped collect fishes at Bikini.

Genus LETHRINUS Cuvier

Lethrinus Cuvier, Règne animal, ed. 2, vol. 2, p. 184, 1829. (Genotype, *Sparus choerorhynchus* Bloch and Schneider) (reference copied).

I have followed Weber and de Beaufort in regard to nomenclature, with the exception of revalidating the species *Lethrinus semicinctus*. This seemed best, in view of the confusion and uncertainty of identifying a few closely related species. Since the fin rays are constant in number, dorsal X,9, anal III,8, pectorals ii,11, pelvics I,5, branched caudal 8+7, they are not repeated in the description of each species.

LETHRINUS KALLOPTERUS Bleeker

Lethrinus kallopterus Bleeker, Act. Soc. Sci. Indo-Neerl., vol. 1, p. 47, 1856 (type locality, Manado, Celebes).

SPECIMENS STUDIED

Bikini Atoll: 2 stations, 2 specimens, 290 to 355 mm. standard length.
Rongelap Atoll: 2 stations, 3 specimens, 299 to 347 mm.

Description.—Length of head 2.5 to 2.6; depth 2.5 to 2.7; both in standard length. Eye 4.0 to 4.7; snout 1.7 to 1.8; tip of snout to rear

of maxillary 1.9 to 2.1; length of pectoral fin 1.3; all in length of head. Least depth of caudal peduncle in its length 1.4 to 1.5, in length of snout 1.7 to 1.8; distance between edges of anterior and posterior nostrils in projected distance between centers of posterior nasal openings 3.7 to 4.0; length of maxillaries in length of snout 1.1 to 1.2; length of soft anal fin base in longest soft anal ray 1.4; head length in predorsal length 1.2, in greatest depth of body 1 to 1.1.

Profile of snut forms an angle of 61 to 66 degrees with that of lower edge of upper jaw, and 95 to 100 degrees with a line extending from upper edge of pectoral base through center of pupil.

Characteristic of this species are the following: Mouth long; body heavy; interorbital space convex; area over and in front of nostrils a little swollen, nostrils separated by moderately wide dermal isthmus, rounded posterior nasal opening with long axis parallel to lengthwise axis of body; 4½ scales from base of seventh dorsal spine to lateral line; rear edge of maxillary extends to a point between vertical lines through front of eye and posterior nostril; profile of snout a little convex.

Color in alcohol.—Head and body dark brown with centers of scales white; a few black scales scattered on sides of most specimens; dorsal and anal fins mottled or barred; pelvic fins dusky; pectorals plain pale.

Color when alive.—Fins orange; a few scales blackish, forming irregular scattered small blotches.

Ecology.—This species was caught on hook and line more often than the number of preserved specimens indicates. It was a species commonly taken by fishermen on the *Bowditch* when the ship was at anchor in the lagoons. No specimen was seen in the intertidal zone of the reefs.

LETHRINUS RETICULATUS Cuvier and Valenciennes

Lethrinus reticulatus CUVIER and VALENCIENNES, Histoire naturelle des poissons, vol. 6, p. 298, 1830 (type locality, New Guinea).

SPECIMENS STUDIED

Bikini Atoll: Eastern end of lagoon, March 11 to 31, 1946, S–46–2, Brock, Marr, and Schultz, 8 specimens, 100 to 182 mm.

Description.—Length of head 2.7 to 2.9; depth 3.0 to 3.2, both in standard length. Eye 3.2 to 4.0; snout 1.8 to 2.0; length from tip of snout to rear of maxillary 2.4 to 2.6; length of pectoral fin 1.3 to 1.4; all in length of head. Least depth of caudal peduncle in its length 2.0 to 2.1, in length of snout 1.9 to 2.0; distance between anterior and posterior nostrils in projected distance between centers of posterior nostrils 3.1 to 3.2; length of maxillaries in length of snout 1.3 to 1.4,

length of soft anal fin base in longest anal ray 0.7 to 0.8; length of head in predorsal length 1.2, in greatest depth of body 0.8 to 0.9.

Profile of snout forms an angle of 47 to 51 degrees with that of lower edge of upper jaw, and 106 to 110 degrees with a line extending from upper edge of pectoral base through center of pupil of eye.

This elongate species characterized by the following: Interorbital space slightly convex; moderate swelling above the nasal openings, each pair of nasal openings separated by wide dermal isthmus, posterior nasal pore rounded, its longest axis parallel to lengthwise axis of body; 4½ scales from base of seventh dorsal spine to lateral line; rear edge of maxillary extends to vertical line through anterior nostril; profile of snout convex above eyes and nostrils, becoming straight or a trifle concave above upper lip in some examples.

Color in alcohol.—Body brownish, centers of scales white, except in certain areas groups of blackish scales form blotches that have a more or less reticulated pattern; head generally darker brown than body; each of the eight specimens collected at Bikini with a slightly oblique blotch behind head above pectoral base, a black elongate blotch beyond tip of pectoral fin, at lengthwise axis of body extending to lateral line, in front of this prominent blotch two smaller and less distinct blotches; the 100-mm. specimen in addition retains traces of two or three brownish bars on cheeks under eye and on preopercle; dorsal, anal, and caudal fins show traces of bars; pectorals plain light brown; pelvics dusky with traces of bars; a small but constant dark blotch just behind eye. The color pattern closely resembles that of *L. moensi* Herre and Montalban (Philippine Journ. Sci., vol. 33, No. 4, fig. 1, pl. 1, 1927).

Ecology.—This species did not occur in the intertidal zone on the reef. It was taken in the lagoon, in water of 20 or more feet in depth, by hook and line from the *Bowditch*; bits of fish or meat scraps were used as bait.

Remarks.—The identification of these specimens as *reticulatus* was done on the basis of the inclusion by Weber and de Beaufort (Fishes of the Indo-Australian Archipelago, vol. 7, pp. 438–440, 1936) of examples with and without the oblong black blotch on the side. Also, the traces of two or three brown bars under the eye conform to the original description by Cuvier and Valenciennes. The identification of the elongate species of *Lethrinus* is very difficult and uncertain, not so much in distinguishing from each other the two species at hand, as in attaching the correct scientific name.

One specimen under U.S.N.M. No. 132690, from the Philippines, has a color pattern identical with that of the Bikini specimens. I believe the elongate blackish blotch is characteristic of this species. I can find no intermediates.

LETHRINUS VARIEGATUS Cuvier and Valenciennes

Lethrinus variegatus CUVIER and VALENCIENNES, Histoire naturelle des poissons, vol. 6, p. 287, 1830 (type locality, Massuah; Suez).

SPECIMENS STUDIED

Bikini Atoll: 3 stations, 4 specimens, 152 to 300 mm. standard length.
Rongelap Atoll: 2 stations, 2 specimens, 106 to 335 mm.

Description.—Length of head 2.8 to 3.1; depth 3.1 to 3.3; both in standard length. Eye 3.1 to 4.6; snout 1.7 to 2.1; tip of snout to rear of maxillary 2.5 to 2.8; length of pectoral fin 1.5 to 1.6; all in length of head. Least depth of caudal peduncle in its length 2.0 to 2.2, in length of snout 1.8 to 2.2; distance between edges of anterior and posterior nostrils in projected distance between centers of posterior nostrils 4.0 to 4.5; length of maxillaries in length of snout 1.3 to 1.5; length of soft anal fin base in longest soft anal ray 0.7 to 0.8; head length in predorsal length 1.1 to 1.4, in greatest depth of body 0.8 to 0.9.

Profile of snout forms angle of 52 to 56 degrees with that of lower edge of upper jaw, and 108 to 115 degrees with line extending from upper edge of pectoral base through center of pupil.

This elongate species is characterized by the following: interorbital space flattish medially, scarcely any swelling above and in front of nasal openings, each pair of nasal openings separated by wide dermal isthmus, posterior nasal openings rounded, with long axis parallel with lengthwise axis of body; 4½ scales above lateral line below base of seventh dorsal spine; rear edge of maxillary reaches a vertical line through anterior nostril; profile of snout a little convex in front of nasal openings, becoming a little concave anteriorly.

Color in alcohol.—Body silvery or milky white tinged brownish, edges of scales slightly darker; body and head often with several blackened scales; upper rear edge of opercle with a small ocellate spot; young with more or less reticulated color pattern consisting of darkened scales and with three indistinct dark blotches on sides of body above pectoral fin; this color pattern is almost identical with that of Bleeker's illustration (Atlas ichthyologique des Indes Orientales Néerlandaises . . ., vol. 9, pl. 328, fig. 3, 1877).

Ecology.—This species prefers the deeper waters of the lagoon, all specimens being taken there, or along the deeper water close to the ledge of the reef.

Remarks.—Weber and de Beaufort (Fishes of the Indo-Australian Archipelago, vol. 7, p. 435, 1936) include three nominal species of Cuvier and Valenciennes, *Lethrinus variegatus*, *L. elongatus*, and *L. semicinctus*. The description by Cuvier and Valenciennes of *variegatus* states that the body has black spots on the sides. I believe that Bleeker's plate 328, figure 3, represents the true *variegatus* and

I can find no reason to cast doubt on the six specimens recorded here as *variegatus*.

Upon examining *Albatross* Philippine specimens under U.S.N.M. Nos. 138157 to 138162, reported upon by Fowler as *L. variegatus*, I noted the vertical slit of the posterior nasal opening. Searching through the literature, I find in Bleeker's Atlas (pl. 317, fig. 1) a species named "L. variegatus" with the nostrils close together, a dark bar under the eye, and an elongate body, resembling the Philippine specimens. Since Cuvier and Valenciennes give a color description that fits Bleeker's figure 1, I have concluded that *semicinctus* is a distinct species, but it is not currently recognized.

My reasons for the revival of the name *Lethrinus semicinctus* Cuvier and Valenciennes are based on the nostrils and coloration. The shape of the posterior nostril is in the form of a nearly vertical slit close to the anterior nasal opening, whereas in *variegatus* the posterior nasal opening is separated from the first by a wide isthmus and in addition the posterior nostril is rounded, and its long axis is parallel with the lengthwise axis of the fish. Other characters are given in the key.

LETHRINUS MICRODON Cuvier and Valenciennes

Lethrinus microdon CUVIER and VALENCIENNES, Histoire naturelle des poissons, vol. 6, p. 295, 1830 (type locality, Bourou).

SPECIMENS STUDIED

Bikini Atoll: 2 stations, 3 specimens, 266 to 300 mm. standard length.
Eniwetok Atoll: 1 station, 5 specimens, 282 to 312 mm.
Rongelap Atoll: 1 station, 1 specimen, 273 mm.
Rota Island: 1 lot, 1 specimen, 237 mm.

Description.—Length of head 2.7 to 3.0; depth 3.2 to 3.5; both in standard length; eye 3.4 to 4.7; snout 1.8 to 2.1; length from snout tip to rear of maxillaries 2.5 to 2.7; length of pectoral fin 1.4 to 1.7; all in length of head. Least depth of caudal peduncle in its length 2.2 to 2.5, in length of snout 1.9 to 2.1; distance between edges of anterior and posterior nostrils in projected distance between centers of posterior nostrils 3.5 to 3.8; length of maxillaries in length of snout 1.3 to 1.4; length of soft anal fin base in longest soft anal ray 0.5 to 1.7; head length in predorsal length 1.2 to 1.3, and in greatest depth of body 0.7 to 0.8.

Profile of snout forms an angle of 51 to 58 degrees with that of lower edge of upper jaw, and one of 107 to 114 degrees with a line extending from upper edge of pectoral base through center of pupil.

This elongate species characterized by the following: Interorbital space convex; area over and in front of nasal openings enlarged and convex, each pair of nasal openings separated by a moderately wide dermal isthmus, the posterior nasal opening rounded, with long axis

parallel to lengthwise axis of body; 4½ scales above lateral line below base of seventh dorsal spine; rear edge of maxillary reaches to a vertical line through anterior nostril; the profile of snout usually convex, except sometimes just behind upper lip it is a trifle concave.

Color in alcohol.—Body light brownish, head dark brown; sometimes scales with centers white, edges brown; in smaller specimen a dark brown blotch below eye and a trace of one on preorbital; dorsal fin dusky or brown; sides with a few more or less reticulated blotches or streaks, a dark blotch over pectoral, another near its tip, one or two smaller ones behind it, all these dark blotches below lateral line; scales on opercle usually with white centers contrasting with brownish head; pelvics dusky.

Ecology.—This species prefers deeper lagoon waters. It was taken with baited hook and line at the *Bowditch* anchorages and did not occur on the shallow intertidal zone of the reefs.

Remarks.—My identification of this series of specimens as *microdon* is based largely on the convex interorbital space and on the swollen area over and in front of the nasal openings, along with its slender body. Weber and de Beaufort (Fishes of the Indo-Australian Archipelago, vol. 7, fig. 87, p. 437, 1936) unquestionably illustrate a specimen that resembles these specimens.

LETHRINUS MINIATUS (Forster) Bloch and Schneider

Sparus miniatus (Forster) BLOCH and SCHNEIDER, Systema ichthyologiae, p. 281, 1801 (type locality, Pacific Ocean).

SPECIMEN STUDIED

Bikini Atoll: Lagoon, eastern end, hook and line, March 11 to 31, 1946, S–46–2, Brock, Marr, and Schultz, 1 specimen, 585 mm.

Description.—Length of head 2.4; greatest depth of body 3.1; both in standard length. Eye 7.0; snout 1.7; snout tip to rear of maxillaries 2.7; length of pectoral fin 2.4; all in length of head. Least depth of caudal peduncle in its length 2.0, in length of snout 2.8; distance between edges of anterior and posterior nostrils in projected distance between centers of posterior nostrils 3.7; length of maxillaries in length of snout 1.7; length of soft anal fin base in longest soft anal ray 0.7; head length in predorsal length 1.1; in greatest depth of body 0.7.

Profile of snout forms angle of 43 degrees with that of lower edge of upper jaw, and 125 degrees with a line extending from upper edge of pectoral base through center of pupil.

This species is characterized by: Head elongate, pointed; interorbital space convex, not notably swollen over nasal openings, nasal openings separated by a dermal isthmus, posterior nasal opening rounded, its long axis parallel to lengthwise axis of body; 5 to 5½

scales from base of seventh dorsal spine to lateral line; rear edge maxillary reaches to a vertical line slightly behind two-thirds tance from snout tip to anterior nostril; profile of snout straight nearly so.

Color in alcohol.—Body, head, and all fins dark brown, scales w white centers.

Remarks.—This large specimen was taken off the *Bowditch* baited hook and line in nearly a hundred feet of water.

LETHRINUS RHODOPTERUS Bleeker

Lethrinus rhodopterus BLEEKER, Nat. Tijdschr. Nederl.-Indië, vol. 3, p. 65, 1 (type locality, Singapore).

SPECIMENS STUDIED

Guam: 4 lots, 12 specimens, 29 to 232 mm. standard length.

Description.—Length of head 2.7 to 3.0; depth 2.6 to 2.8; both standard length. Eye 3.0 to 3.6; snout 2.1 to 2.4; snout tip to rear maxillaries 2.5 to 2.7; length of pectoral fin 1.1 to 1.3; all in len of head. Least depth of caudal peduncle in length 1.6 to 1.8 and length of snout 1.2 to 1.5; distance between edges of anterior posterior nostrils in projected distance between centers of poster nostril 5.3 to 6.0; length of maxillaries in length of snout 1.1 to length of soft anal fin base in longest soft anal ray 0.8; head length predorsal length 1.2 to 1.3, in greatest depth of body 1.1.

Profile of snout forms an angle of 59 to 65 degrees with that lower edge of upper jaw, and 104 to 110 degrees with a line extend from upper edge of pectoral base through center of pupil.

Body moderately deep, interorbital space convex, area over na openings a little swollen and elevated; each pair of nasal openi separated by moderately wide dermal isthmus, posterior nasal op ing rounded, its long axis parallel to lengthwise axis of body; ty cally 5 to 5½ scales between lateral line and base of seventh dor spine; rear edge of maxillary reaches to a vertical line through terior nostril; profile of snout convex, except that on some specim it may be a little concave behind upper lip.

Color in alcohol.—Silvery or milky white with a large dark blotch below lateral line at tips of pectoral fins; operculum a li dusky; spiny dorsal dusky, pelvics dusky, a little darkish pigment base of pectoral in scaled area; a dark streak at dorsal part orbit extending forward and behind orbit a short distance.

LETHRINUS NEBULOSUS (Forskål)

Sciaena nebulosus FORSKÅL, Descriptiones animalium, . . ., pp. xii, 52, (type locality, Arabia).

SPECIMENS STUDIED

Guam: 3 lots, 42 specimens, 72 to 172 mm.

Description.—Length of head 2.8 to 2.9; depth 2.7 to 2.8, both in standard length. Eye 3.5 to 4.1; snout 1.8 to 2.1; length of maxillaries 2.6 to 2.7; length of pectoral fin 1.3; all in length of head. Least depth of caudal peduncle in its length 1.5 to 1.7, in length of snout 1.3 to 1.4; distance between edges of anterior and posterior nostrils in projected distance between centers of posterior nostrils 3.8 to 4.8; length of maxillaries in length of snout 1.3 to 1.4; length of base of soft anal fin in longest soft anal ray 1.0 to 1.1; head length in predorsal length 1.2, in greatest depth of body 1.1.

Profile of snout forms an angle of 60 to 65 degrees with that of lower edge of upper jaw, and 103 to 115 degrees with a line extending from upper edge of pectoral base through center of pupil.

This species moderately elongate; interorbital space convex, slightly swollen over nasal openings, latter separated by moderately wide dermal isthmus, the posterior nasal opening rounded, its long axis parallel to lengthwise axis of body; 5 to 5½ scales from base of seventh dorsal spine to lateral line; rear edge of maxillary reaches to a vertical line through anterior nostril; profile of head a little convex over orbits, becoming nearly straight on snout.

Color in alcohol.—Silvery to milky white with traces of darker reticulations on certain specimens, on most a trace of a dark blotch opposite middle of length of pectoral fin and below lateral line; soft dorsal and caudal with traces of darkish bars; center of scales with a pearly white spot.

Remarks.—I have examined most of the lethrinid specimens closely related to this species that are in the collections of the U. S. National Museum, and find in them the same differences portrayed by Bleeker (Atlas Ichthyologique, vol. 8, pl. 335, fig. 5, 1877) for *Lethrinus nebulosus=L. opercularis.* This figure is a fairly good representation of my specimens of *nebulosus*, as well as of those reported upon by me as *L. ramak*, from the Phoenix Islands (Schultz, U. S. Nat. Mus. Bull. 180, p. 122, 1943) and by Jordan and Seale (Bull. U. S. Bur. Fish., vol. 25, p. 269, 1906), from the Samoan Islands (U.S.N.M. Nos. 115666 and 52439). *L. ornatus* (Bleeker, ibid., pl. 350, fig. 4) has a much steeper dorsal profile of the head and deeper body than *nebulosus*, *leutjanus*, and *ramak*. *L. rhodopterus* Bleeker is recognizable by the large black blotch opposite tips of pectorals. *L. leutjanus* (Bleeker, ibid., pl. 354, fig. 5) is a more slender species than *ornatus* or *nebulosus*. *L. ramak* as described by Weber and de Beaufort (The Fishes of the Indo-Australian Archipelago, vol. 7, p. 451, 1936) is not distinguishable from *nebulosus* and *leutjanus*. I am unable to separate

an intermediate or third species of the general form of *nebulosus* and *leutjanus*.

LETHRINUS ORNATUS Cuvier and Valenciennes

Lethrinus ornatus CUVIER and VALENCIENNES, Histoire naturelle des poissons, vol. 6, p. 310, 1830 (type locality, Java).

SPECIMENS STUDIED

Guam: Tumon Bay, January 8, 1946, Gressitt and Ingram, 2 specimens, 138 and 143 mm.

Description.—Length of head 2.8; depth 2.4 to 2.5; both in standard length. Eye 3.3 to 3.5; snout 1.9 to 2.0; length of maxillaries 2.3 to 2.5; length of pectoral fin 1.2; all in length of head. Least depth of caudal peduncle in its length 1.5, in length of snout 1.4; distance between edges of anterior and posterior nostrils in projected distance between centers of posterior nostrils 3.5 to 4.5; length of maxillaries in length of snout 1.1 to 1.2; length of base of soft anal fin in longest soft anal ray 1.1; head length in predorsal length 1.3 to 1.4, in greatest depth of body 1.2 to 1.3.

Profile of snout forms an angle of 70 to 75 degrees with that of lower edge of upper jaw, and 94 to 97 degrees with a line extending from upper edge of pectoral base through center of pupil.

This species moderately robust; interorbital space convex, scarcely any swelling over region of nostrils, nasal openings separated by moderately wide dermal isthmus, posterior nasal openings oval with the long axis parallel with a line through dorsal edge of orbit and anterior nasal opening; five scales between base of seventh dorsal spine and lateral line; rear edge of maxillary reaches a vertical line through rear nostril; profile of head a little convex over orbits, becoming slightly concave behind tip of snout.

Color in alcohol.—Light brownish with traces of reticulated marks on rear of body; traces of lengthwise streaks on body.

Family LEIOGNATHIDAE: Silver Perch

By LEONARD P. SCHULTZ

We are recognizing Gerridae and Leiognathidae as a single family. Our material of this group is scanty; therefore not too much reliance should be placed on our identifications. Although about 15 species referable to the genus *Gerres* have been reported from the Philippine Islands, only two species were taken in the northern Marshall Islands. These two may be separated by the following key:

1*a*. Scales 41 to 43, with 5 above lateral line and 9 below it; greatest depth 2.6 to 2.8 in standard length and 0.7 to 0.9 in head.

Gerres argyreus (Bloch and Schneider)

1b. Scales 43 to 47, with 6 or 7 above lateral line and 9 or 10 below it; greatest depth 2.8 to 3.1 in standard length and 0.9 to 1.1 in head.
Gerres oblongus Cuvier and Valenciennes

Genus GERRES Quoy and Gaimard

Gerres QUOY and GAIMARD, Voyage *Uranie*, Zool., p. 292, 1824. (Genotype, *Gerres vaigiensis* Quoy and Gaimard).

Leiognathus obscura Seale (Occ. Pap. Bishop Mus., vol. 1, No. 3, p. 74. 1901) was described from Guam. It may be a synonym of *L. equula* (Forskål).

GERRES ARGYREUS (Bloch and Schneider)

Cichla argyrea BLOCH and SCHNEIDER, Systema Ichthyologiae, p. 344, 1801 (type locality, Tanna Island; Pacific Island).

SPECIMENS STUDIED

Bikini Atoll: Erik Island, lagoon tidal pool, March 20, 1946, S–46–10, Schultz and Brock, 4 specimens, 71 to 138 mm. standard length.
Saipan: June 1945, Schroyer and White, 5 specimens, 28 to 50 mm.

Description.—Dorsal rays IX,10; anal III,7; pectoral i,14 or i,15; pelvics I,5; branched caudal fin rays 8+7; scales in lateral line from upper edge of gill opening to base of caudal fin 41 to 43; scales between dorsal origin and lateral line 5, from lateral line to anal origin 9; gill rakers 5 or 6+1+7.

Head 3.0 to 3.5; depth 2.6 to 2.8; length of pectoral fin 3.2 to 3.8; length of longest dorsal spine 4.8 to 5.2; all in standard length. Postorbital length of head 2.3; eye 2.8 to 3.3; snout 3.0 to 3.2; length of mouth 2.7 to 2.8; interorbital space 2.7 to 3.1; depth of body 0.7 to 0.9; all in length of head. Least depth of caudal peduncle in its length 1.5. Length of accessory pelvic appendage in length of pelvic fin 1.4 in adults, 2 in young. Pectoral fin reaching to point opposite anus, the latter in front of anal origin a distance equal to length of mouth; 3 rows of scales on cheek, a fourth row of smaller scales near preopercular edge; premaxillary groove naked, the scales on top of head extending each side of groove nearly to nasal openings, the scales bordering this groove of notably smaller size than those posteriorly; second dorsal spine longest, about equal to third, last dorsal spine 1.5 in first soft dorsal ray; median fins with scaly bases, those of dorsal and anal forming a sheath into which rays are depressible; profile of mandibular part of head straight to a trifle concave; maxillary reaches to a vertical line through front of eye; teeth in a villiform band in both jaws; no teeth on vomer, palatines, or tongue; adipose eyelid developed around margin of

eye; fifth and sixth branched pectoral rays longest; pseudobranchiae small, not free; gill rakers short, thick; air bladder with a short hornlike projection each side of enlarged anal pterygiophores, ending opposite bases of anal spines.

Color in alcohol.—A little dusky dorsally, silvery on sides, whitish ventrally; margin of spiny dorsal dusky to blackish; peritoneum blackish.

GERRES OBLONGUS Cuvier and Valenciennes

FIGURE 87

Gerres oblongus CUVIER and VALENCIENNES, Histoire naturelle des poissons, vol. 6, p. 479, 1830 (type locality, Ceylon).

SPECIMENS STUDIED

Guam: 2 lots, 11 specimens (U.S.N.M. Nos. 123988 and 124041), 26 to 48 mm. standard length.

Description.—Dorsal IX,10; anal III,7, (II,i,7 in one); pectoral i,15 or 16; pelvics I,5; branched caudal fin rays 8+7; scales from

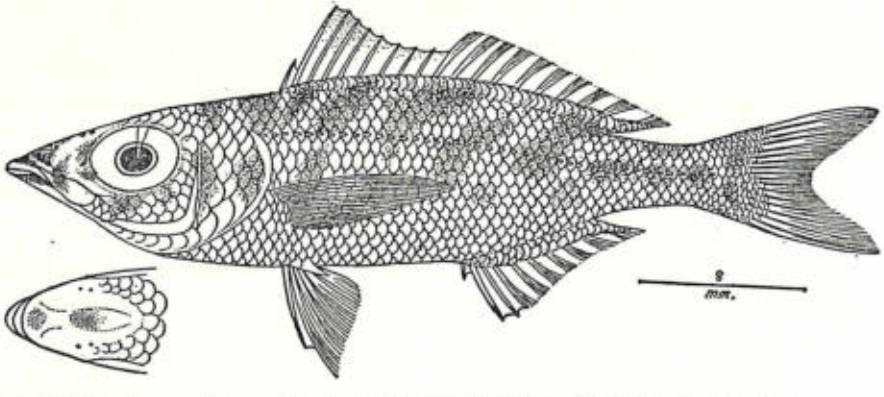

FIGURE 87.—*Gerres oblongus* Cuvier and Valenciennes. (Drawing by H. W. Fowler of a Philippine specimen.)

upper edge of opercular opening 43 to 47, to caudal fin base; 6 or 7 scales from dorsal origin to lateral line and 9 or 10 from lateral line to anal origin; gill rakers about 5 to 7+1+7.

Head 2.9 to 3.3; depth 2.8 to 3.1; length of pectoral fin 3.3 to 3.7; length of longest dorsal spine about 4.8 to 5.0; all in standard length. Postorbital length of head 2.5 to 2.7; eye 3.0 to 3.1; snout 2.8 to 3.3; length of mouth 2.7 to 2.8; interorbital space 3.2 to 3.8; greatest depth of body 0.9 to 1.1; all in length of head. Least depth of caudal peduncle 1.6 to 2.3 in its length; length of accessory pelvic appendage 1.4 to 2 in length of pelvic fin; pectoral fin reaching to anus or a little beyond, but not quite to opposite anal origin; anus about half length of maxillaries in front of anal origin; three rows of scales

below eye, no row of scales on margin of preopercle; premaxillary groove naked, bordered by smaller scales on sides and posteriorly; second and third dorsal spines nearly equal in length, second sometimes a little longer than third; last dorsal spine about 1.5 to 1.8 in first soft dorsal ray; median fins with scaly bases, those of dorsal and anal have a sheath of scales into which fin rays may be depressed; profile of mandibular part of head slightly concave; maxillary reaches a trifle past a vertical line through front of eye; teeth in a villiform band in both jaws; no teeth on vomer, palatines, or tongue; adipose eyelid only slightly developed; middle pectoral rays longest; gill rakers short, thick; air bladder with a short hornlike projection on each side of anal pterygiophores, ending opposite bases of anal spines.

Color in alcohol.—YOUNG: dorsal part of body with 5 to 7 obliquely slanting dusky bars; lower sides and belly silvery; peritoneum dusky. ADULTS: Dorsal part of body slightly tinged with brownish, everywhere with silver sheen; lower half milky white; no vertical bars.

Family PEMPHERIDAE

By LEONARD P. SCHULTZ

KEY TO THE SPECIES OF THE PEMPHERIDAE FROM THE NORTHERN MARSHALL ISLANDS

1*a*. Lateral line extending to tips of middle caudal fin rays; scales mostly cycloid on sides, ctenoid dorsally behind dorsal fin and in front of anal fin; anal fin base about ½ in standard length; dorsal rays VI,9; anal III,38 to 42, gill rakers on first arch 7 to 9+1+19 to 21; pores in lateral line to base of caudal fin 62 to 68----------Pempheris oualensis Cuvier and Valenciennes

1*b*. Lateral line not extending beyond basal third of length of caudal fin rays; scales ctenoid; anal fin base at least 3 in standard length.

2*a*. Dorsal rays V,9; anal rays IV,18; (Japan).
Parapriacanthus ransonneti Steindachner

2*b*. Dorsal rays V,8 rarely V,7; anal rays III,17 to 20, usually III,18 or 19.
Parapriacanthus beryciformes Franz

Genus PEMPHERIS Cuvier

Pempheris CUVIER, Règne animal, ed. 2, vol. 2, p. 195, 1829. (Genotype, *Pempheris touea* Cuvier=*Sparus? compressus* Shaw, designated by Jordan and Evermann, Genera of fishes, pt. 1, p. 128, 1917) (ref. copied).

PEMPHERIS OUALENSIS Cuvier and Valenciennes

PLATE 44, C

Pempheris oualensis CUVIER and VALENCIENNES, Histoire naturelle des poissons, vol. 7, p. 299, 1831 (type locality, Oualan).

Pempheris otaitensis CUVIER and VALENCIENNES, Histoire naturelle des poissons, vol. 7, p. 304, 1831.

Pempheris taitensis CUVIER and VALENCIENNES, Histoire naturelle des poissons, vol. 7, pl. 191, 1831.

SPECIMENS STUDIED

Bikini Atoll: 9 stations, 136 specimens, 9 to 178 mm. standard length.
Eniwetok Atoll: 2 stations, 7 specimens, 121 to 161 mm.
Rongerik Atoll: 1 station, 8 specimens, 17 to 34 mm.
Rota: 1 lot, 3 specimens, 150 to 160 mm.

Description.—Dorsal rays VI,9 (11 specimens); anal III,38 (2 specimens), III,39 (2 specimens), III,40 (2 specimens), III,41 (3 specimens), III,42 (3 specimens); pectoral ii,15 or 16; pelvics I,5; branched caudal fin rays 8+7; gill rakers on first gill arch 7+1+21 in one specimen, 8+1+19 in four, 8+1+21 in four, 9+1+20 in one; scales with pores in lateral line from upper edge of gill opening to base of caudal fin 62 to 68, scales from lateral line to dorsal origin 6 to 8, from anal origin to lateral line 15 or 16.

Greatest depth 2.2 to 2.4, head 3.2 to 3.5, length of pectoral fin 3.4 to 3.6, snout tip to dorsal origin 2.4 to 2.6, length of anal base 1.8 to 1.9, all in the standard length. Greatest depth 0.6 to 0.7; pectoral fin 1.1 to 1.2; postorbital length of head 2.2 to 2.3; snout 4.4 to 4.7; eye 2.1 to 2.7; interorbital 3.1 to 3.4; tip of snout to rear edge of maxillary 1.9 to 2.0; all in length of head. Least depth of caudal peduncle 1.0 to 1.2 in its length; snout tip to dorsal origin in length of anal fin base 1.3 to 1.4; longest dorsal ray 1.7 to 1.9 in anal fin base. Greatest depth opposite dorsal fin base; dorsal profile of snout convex, behind orbits slightly convex, behind dorsal base straight or nearly so; interorbital space convex; second or third branched dorsal ray longest; usually second branched pectoral ray from dorsal edge longest; posterior margin of dorsal a little concave, of pectoral nearly straight, of caudal concave or forked; accessory scales of pelvic 2½ in length of pelvic fin; gill membranes extending far forward, free from isthmus; preopercle with two or three short spines; usually more or less covered with scales; opercle without a spine; mouth oblique, lower jaw a little projecting; teeth in villiform bands on jaws, palatines and in a Λ-shaped band on vomer; teeth on premaxillary and dentary change into a broader band at maturity and are reflected or notably present externally when mouth is closed; scales occur on body, head, nearly to tips of anal rays, three-fourths way out caudal rays, scales increasingly very small along base of and on anal fin, absent on dorsal and paired fins; scales occur on maxillary but are absent on both lips; scales cycloid everywhere except above lateral line behind dorsal fin base, from in front of anal fin forward to isthmus on dentary, and on lower part of cheek; gill rakers long, slender; lateral line following contour of back and continuing to tips of middle caudal fin rays.

Color in alcohol.—Dark brown to light brown, centers of scales somewhat silvery; pectoral base black, rays pale; distal half of pelvics pale, basally somewhat dusky; outer margin of dorsal (first few

rays) blackish; first rays of anal blackish or dusky; distal one-half to two-thirds of anal fin dusky to whitish; outer margins of caudal rays dusky to blackish; peritoneum dusky to black.

Color when alive.—Dark brownish centers of scales pale or somewhat silvery; dorsal and caudal fins reddish brown, pectoral tinged with pinkish; pectoral base black.

Remarks.—The large series of this species has convinced me that the specimens I reported upon from the Phoenix and Samoan Islands (U. S. Nat. Mus. Bull. 180, p. 120, 1943) are the same species as that from the northern Marshall Islands, and I confirm Fowler's opinion that *otaitensis* is a synonym of *oualensis*.

The problem of the teeth occurring externally on the premaxillary and dentary has been studied. I have examined 133 specimens between 9 and 133 mm. in standard length, which do not have the teeth developed externally on the tip of the premaxillary or on the tip of the dentary. In two mature females (140 and 155 mm.) the teeth are a little developed; in a partly mature female (145 mm.) these teeth are moderately developed; in two mature females (151 and 157 mm.) and three mature males (161, 163, and 166 mm.) these teeth are strongly developed. In addition two other specimens (154 and 178 mm.) with viscera missing these external teeth are fully developed. I conclude that the villiform band of teeth broadens with maturity and is reflected as shagreenlike teeth on the external forward edges of the premaxillary and dentary, and that this character is one of age and not one that can be used to distinguish species.

Genus PARAPRIACANTHUS Steindachner

Parapriacanthus STEINDACHNER, Sitzb. Akad. Wiss. Wien, vol. 61, p. 623, 1870. (Genotype, *Parapriacanthus ransonneti* Steindachner.)

PARAPRIACANTHUS BERYCIFORMES Franz

Parapriacanthus beryciformes FRANZ, Abh. Bayer Akad. Wiss. München, suppl. 4, vol. 1, p. 33, pl. 6, fig. 46, 1910 (type locality, Yokohama).

SPECIMENS STUDIED

Bikini Atoll: Lagoon, *Bowditch* anchorage, 3 miles off Enyu Island, light at night, July 11, 1946, S–46–249, Herald, 1 specimen, 56 mm.

Rongerik Atoll: Off Eniwetak Island, light at night, June 28, 1946, S–46–242, Schultz and Herald, 1 specimen, 51 mm.

Rongelap Atoll: South Passage, light at night, May 16, 1946, Brock and Marr, 69 specimens, 43 to 63 mm.

Description.—Dorsal rays usually V,8, rarely V,7; anal III,17 to 20, usually III,18 or 19; pectoral ii,14; pelvic I,5; branched caudal 8+7; gill rakers on first arch 5+1+13 to 15; scales in lateral line from upper edge of gill opening to midbase of caudal fin 70 to 78,

in a row from dorsal origin to lateral line 6, from lateral line to anal origin 14.

Greatest depth 2.9 to 3.0; head 2.8 to 2.9; length of pectoral fin 3.9 to 4.0; snout tip to dorsal origin 2.3; length of anal base 3.5 to 4.0; all in standard length. Greatest depth 1.0 to 1.3; length of pectoral fin 1.4 to 1.5; postorbital length of head 2.3 to 2.5; snout 4.2 to 4.3; eye 2.6 to 2.8; interorbital 4.0 to 4.1; tip of snout to rear edge of maxillary 2.0; all in length of head. Least depth of caudal peduncle 1.2 in its length. Snout tip to dorsal origin in length of anal base 0.6. Longest dorsal ray 1.3 in anal fin base.

Greatest depth opposite dorsal origin; dorsal profile from snout tip to dorsal origin nearly straight, only a trifle convex, behind dorsal fins only slightly convex; interorbital space a little convex, but flattish near its middle; first branched dorsal ray longest; second branched pectoral ray longest; posterior margins of dorsal and pectoral fins straight or nearly so; caudal fin forked; accessory pelvic scale 3.0 to 3.5 in length of pelvic fin; gill membranes extending far forward, free from isthmus; preopercular edge without spines; opercle without a spine; mouth oblique, lower jaw a little projecting; teeth on premaxillary small, conical, in a narrow band anteriorly, becoming a single row posteriorly; those on dentary similar, in 2 rows on each side of symphysis, then a single row on sides; palatine teeth in a single row; vomer Λ-shaped, with teeth at posterior tips; scales ctenoid, on body and on head forward to middle of interorbital space; snout and lips naked; basal part of caudal fin scaled, other fins naked; a single row of scales on preorbital; maxillary scaled; lateral line following dorsal contour but not extending to tip of caudal fin rays; gill rakers long, slender.

Color in alcohol.—Plain light tan, with scattered small, brownish pigment cells anteriorly; lips brownish anteriorly; just in front of point where gill membranes meet between mandibles, a black spot, then a streak of blackish pigment all along bases of branchiostegals, hidden by mandibular bones; a small dark blotch opposite rear edge of maxillary; tip of chin blackish; on some specimens tips of caudal lobes black pigmented; inside of mouth blackish; pectoral "shield" brilliantly silvery; area around anus and lower edge of belly silvery; operculum and cheek silvery; anterior part of isthmus silvery; base of caudal fin with an embedded vertical black line.

Color when alive.—Translucent pinkish.

Ecology.—This pelagic species was taken only at night when attracted to bright light. A number of females were taken containing mature eggs of rather large size. Some mature males were taken.

Remarks.—These specimens are identified with *P. beryciformes* Franz on the basis of his figure, which shows V,8 dorsal rays and not

V,7, as indicated in the text. Coloration and other features indicate that the National Museum specimens are that species. *P. ransonneti* Steindachner is very close, but that species has V,9 dorsal rays. The counts on three species of *Parapriacanthus* indicate the extent of fin ray variation in our specimens.

TABLE 51.—*Counts on certain species of* Parapriacanthus

Species	Anal fin rays								Dorsal fin rays				
	III	17	18	19	20	21	22	23	V	VI	7	8	9
P. beryciformes:													
Marshall Islands	20	1	8	8	3	----	----	----	20	----	1	19	----
Yokohama	1	----	----	----	1	----	----	----	1	----	----	[1]1	----
P. ransonneti: Nagasaki	2	----	2	----	----	----	----	----	2	----	----	----	2
P. dispar: Solomon Islands	2	----	----	----	----	----	1	1	----	2	----	----	2

The counts of *P. dispar* (Herre) were made on two paratypes in the national collections. Dr. Herre referred this species to the genus *Pempheris*, but it belongs in the genus *Parapriacanthus*.

Family KYPHOSIDAE: Pilotfishes

By LEONARD P. SCHULTZ

Genus KYPHOSUS Lacepède

Kyphosus LACEPÈDE, Histoire naturelle des poissons, vol. 3, p. 114, 1802. (Genotype, *Kyphosus bigibbus* Lacepède=*Xyster fuscus* Lacepède.)

KEY TO THE TWO SPECIES OF KYPHOSUS FOUND IN THE NORTHERN MARSHALL ISLANDS AND IN GUAM

1*a*. Longest soft dorsal ray longer than longest dorsal spine; dorsal rays XI,12; anal III,11; greatest depth about 2.1 to 2.4 in standard length.
Kyphosus cinerascens (Forskål)

1*b*. Longest soft dorsal ray shorter than longest dorsal spine; dorsal rays XI,14; anal III,13; greatest depth about 2.5.
Kyphosus vaigiensis (Quoy and Gaimard)

KYPHOSUS CINERASCENS (Forskål)

Sciaena cinerascens FORSKÅL, Descriptiones animalium . . ., pp. xii, 53, 1875 (type locality, Arabia).

SPECIMENS STUDIED

Bikini Atoll: Lagoon, March 11–31, 1946, S–46–2, Schultz, 1 specimen, 260 mm. standard length.

Guam: 1945, Frey, 1 specimen, U.S.N.M. No. 124090, 135 mm.; June 14, 1945, McElroy and Markley, 1 specimen, 88 mm.

Description.—Dorsal rays XI,12; anal III,11 pectoral ii,17; pelvic I,5; branched caudal 8+7; vertical scale rows from upper edge of

opercular opening to base of caudal fin along upper edge of lateral line 62 to 66, above lateral line to dorsal origin 10, below to anal origin 17 or 18; gill rakers 8+1+18 or 19.

Greatest depth 2.1 to 2.4; head 3.2 to 3.5, length of pectoral fin 4.9 to 5.2; all in the standard length. Greatest depth 0.6 to 0.7; length of pectoral fin 1.4 to 1.5; postorbital length of head 2.3; eye 3.1 to 3.5; snout 2.7 to 3.0; length of mouth from snout tip to end of maxillary 3.0 to 3.1; interorbital space 2.3 to 2.9; all in length of head. Longest soft dorsal ray 0.7 to 0.8 in longest dorsal spine. Third anal spine 2.0 to 2.3 in longest soft anal ray. Least depth of caudal peduncle 1.3 to 1.4 in its length. Length of accessory pelvic scale 3 in pelvic fin length.

Median fins with very small scales to tip of rays; similar small scales on basal four-fifths of pectoral and pelvic fins, but inner side of paired fins naked; maxillary with a patch of scales; snout, mandible, and narrow band below eye naked; gill membranes naked; otherwise head and body covered with ctenoid scales; gill membranes united across isthmus with free fold; both jaws with a uniserial outer row of obtusely lanceolate incisors rising from a horizontal basal process, behind these a band of minute villiform teeth; similar villiform teeth on vomer, palatines, and tongue; gill rakers on first gill arch, moderately long, slender; seventh and eighth dorsal spines longest; third anal spine longest; third branched ray from dorsal edge of pectoral longest.

Color in alcohol.—Background color brownish, center of scales whitish, giving the appearance of rows of pale spots along sides; peritoneum black.

Ecology.—These fishes live along the reefs, where they feed on algae.

KYPHOSUS VAIGIENSIS (Quoy and Gaimard)

Pimelepterus vaigiensis Quoy and Gaimard, Voyage autour du monde . . . executé sur les corvettes de S. M. *L'Uranie* et La *Physicienne*, . . ., Zool., p. 386, pl. 62, fig. 41, 1825 (type locality, Îles des Papous and Bony).

SPECIMEN STUDIED

Guam: 1945, Frey, 1 specimen, 190 mm. standard length.

Description.—Dorsal rays XI,14; anal III,13; pectoral ii,17; pelvic I,5; branched caudal 8+7; vertical scale rows above lateral line from upper edge of opercular opening to base of caudal fin 68 or 69, scales above lateral line to dorsal origin 10, below to anal origin 16 or 17; gill rakers on first gill arch 9+1+21.

Greatest depth 2.5; head 3.5; length of pectoral fin 5.9; all in the standard length. Greatest depth 0.7; length of pectoral fin 1.7; postorbital length of head 2.3; eye 3.8; snout 2.9 to 3.0; length of mouth from snout tip to end of maxillary 3.3; interorbital space 2.8; all in

length of head. Longest soft dorsal ray 1.3 in longest dorsal spine. Third anal spine 2.0 in longest soft anal ray. Least depth of caudal peduncle 1.7 in its length. Length of accessory pelvic scale 3.0 in pelvic fin length.

Median fins with very small scales to tip of rays; similar small scales on basal 4/5 of pectoral and pelvic fins but lacking on inner sides of these paired fins; maxillary with patch of scales; snout, mandible, and narrow band below eye naked; gill membranes naked; otherwise head and body covered with ctenoid scales; gill membranes united across isthmus with free fold; both jaws with a uniserial outer row of obtusely lanceolate incisors arising from a horizontal basal process, behind them a band of minute villiform teeth; villiform teeth on vomer, palatines, and tongue; gill rakers on first arch moderately slender; third anal spine longest; seventh dorsal spine probably longest; third branched ray from dorsal edge of pectoral longest.

Color in alcohol.—Brownish, darker dorsally; centers of scales with pale area, these appearing as rows of whitish spots; peritoneum black.

Ecology.—A reef-inhabiting species living on algae.

Remarks.—The identification of this species is somewhat doubtful, but it appears to be close to *vaigiensis*, except its depth is not quite as great as that figured by Quoy and Gaimard, and as described by Weber and de Beaufort (Fishes of the Indo-Australian Archipelago, vol. 7, p. 227, 1936) and by Fowler (U. S. Nat. Mus. Bull. 100, vol. 12, p. 209, 1933). The kyphosids of the Indo-Pacific are in need of further careful study.

Family CHAETODONTIDAE: Butterflyfishes

Since the pelvic rays are always I,5 and the branched caudal fin rays always 8+7, these are omitted in the description of each species.

KEY TO THE SUBFAMILIES OF CHAETODONTIDAE OF THE NORTHERN MARSHALL ISLANDS AND ADJOINING REGIONS

1*a*. Preoperculum serrated or not, but in adult no strong spine near lower angle; pelvics with an axillary scale---------- Chaetodontinae

1*b*. Preoperculum strongly armed, with a long spine at lower angle; pelvics without an axillary scale---------- Pomacanthinae

Subfamily CHAETODONTINAE

By LOREN P. WOODS

KEY TO THE SPECIES OF CHAETODONTINAE OF THE NORTHERN MARSHALL ISLANDS AND ADJOINING REGIONS

1*a*. Snout produced into a long narrow tube; length 2 or 3 times postorbital length of head; pectorals long, falcate; nearly 3 times postorbital part of head; teeth minute; scale rows 69 to 76; body yellowish to bright golden with a large triangular brownish patch from origin of dorsal to just above base of pectoral, then forward through pupil of eye to tip of snout, most intense in front of eye; anal fin with an intense round black spot on last rays and narrow black submarginal line; dorsal XII or XIII,22 or 23; anal III,17 or 18-------- Forcipiger longirostris (Broussonet) (p. 575)

1*b*. Snout not produced into a long narrow tube, but more or less conical, its length about equal to postorbital length of head; pectoral not falcate; scales 55 or fewer; teeth setiform or brushlike.

2*a*. Dorsal spines VI. Four vertical black bands: One narrower than eye, from nape through eye to isthmus joining its fellow; another begins in front of dorsal, passes across pectoral fin base to pelvic fin base; third one passes from second and third dorsal spines to front of anal fin; fourth from last dorsal spines to base of first soft rays of anal fin. Black ring around caudal peduncle; top of snout blackish; a black spot as large as eye in dorsal-anal transverse band; dorsal fin base blackish, submarginal black band posteriorly; anal with dusky spot near its posterior base; pectoral, pelvics, and caudal pale, dorsal VI,28 to 30; anal III,19 to 20; scales 40 to 45---------- Parachaetodon ocellatus (Bloch)

2*b*. Dorsal spines XI to XIV.[19]

3*a*. Fourth dorsal spine prolonged, at least longer than any others, and in some species filamentous; pelvics jet black.

[19] *Microcanthus strigatus* (Cuvier and Valenciennes) has been omitted from this key because Fraser-Brunner (Ann. Mag. Nat. Hist., ser. 11, vol. 12, pp. 462–468, 1946) says its anatomy is different from any chaetodont and that it belongs in the family Scorpidae.

4*a*. Fourth and fifth dorsal spines longest but in adults shorter than head; all spines rigid and pungent; ground color of body blackish with a pale transverse band from origin of dorsal across operculum to breast and a second pale band from fifth to eighth dorsal spines to top of caudal peduncle; head and nape black; triangular black band from last dorsal spines to base of last soft rays; anal black, its narrow posterior margin pale; pectoral and caudal dusky; dorsal XI,22 or 23; anal III,17 or 18; scales 50 to 55.

Heniochus varius (Cuvier)

4*b*. Fourth dorsal spine prolonged longer than head in adults and in certain species flexible and produced into a filament.

5*a*. Two wide black transverse bands across body, one from front of spiny dorsal to pelvics and including them; the second from fifth to tenth spines downward and backward across lower anterior corner of caudal peduncle to posterior half of anal fin; a black band from supraorbital region to eye but not continued below it; upperpart of snout blackish; rest of head pale; pectoral fin base black but fin pale; caudal and soft dorsal pale; anal with anterior margin blackish; pectoral pale, base black; fourth spine produced, long, filamentous; dorsal XI or XII,24 to 27; anal III,16 to 19; scales 44 to 46_____ Heniochus acuminatus (Linnaeus) (p. 576)

5*b*. Three black transverse bands across head and trunk.

6*a*. A wide black band beginning just before origin of dorsal, passing across pectoral fin base to pelvics, front edge passing from front of eye to insertion of pelvics; second band extending from prolonged and flexible fourth dorsal spine downward and backward to soft anal rays; third extending across base of soft dorsal to top of caudal peduncle; midline of snout and tip of upper lip blackish; lip of prolonged fourth dorsal spine white; dorsal XII,21 to 23; anal III.18 or 19; scales 49 to 55.

Heniochus permutatus Cuvier (p. 576)

6*b*. A blackish band from origin of dorsal extending downward and covering front part of head, orbits, chin, and muzzle; lips and triangular patch in front of orbits white; a second transverse band extending from fifth to seventh dorsal spine and getting broader while descending to belly, reaching from origin of pelvics to vent; a third blackish band, narrower and less defined, extending from last dorsal spines to last anal rays; margin of anal fin including spines black; dorsal XII,25 or 26; anal III,18 or 19; scales 51 to 58___ Heniochus monoceros Cuvier (p. 577)

3*b*. None of dorsal spines prolonged, fourth and fifth not especially longer than other spines; no bony prominences on nape or over eyes.

7*a*. Anal spines IV (rarely V); dorsal and anal fins with middle rays prolonged to form an acutely angulate fin; ground color on lower half of body lighter than upper; upper half of body with 2 oval white spots, one posterior to other; 18 to 20 transverse dark lines following scale rows, meeting in broad angle just below lateral line; posterior rays of soft dorsal (anal also in young specimens) with large crescent-shaped black blotch bordered anteriorly with white; base of caudal fin black (caudal peduncle also in young), a vertical white band bordered posteriorly by a black line crossing fin just behind middle, broad margin colorless; white-bordered black band,

nearly as wide as eye, passes from nape through eye to breast where it joins its fellow; dorsal XIV,15 to 17; anal IV,15 or 16; scales 23 to 29_____ Megaprotodon strigangulus (Gmelin) (p. 578)

7*b*. Anal spines III (by exception IV); dorsal and anal fins with middle rays not especially prolonged, posterior margins of fins more or less evenly rounded.

8*a*. Pelvic fins black.

9*a*. Dorsal spines XII; a wide black band, bordered by yellow, passing from nape and interorbital through eye, narrower than eye at eye, broadening below eye to isthmus, thence backward including pelvic fins; broad pale band passes from origin of dorsal to black belly; posteriorly body blackish with 20 rows of light spots occupying center of scales; spots diminish in size and number of rows increases posteriorly; margin of last rays of anal fin pale (red in life); caudal with two submarginal black bands, basal third black; dorsal XII,26 or 27; anal III,20 or 21; scales 41 to 43___ Chaetodon reticulatus Cuvier (p. 579)

9*b*. Dorsal spines XIII, ocular band, narrower than eye, passes from nape to breast, then to pelvics; pelvics black but spines pale; about 15 longitudinal rows of spots, brownish in color, rather diffuse anteriorly, distinct posteriorly; two faint vertical color bars, the first extending from lateral line just behind pectoral to pelvics, the second from eleventh to thirteenth dorsal spines to origin of anal; area between these faint bars lighter; margins of dorsal and anal fins pale with a narrow black submarginal line, caudal fin entirely pale; dorsal XIII,21 or 22; anal III,18; scales 30 to 33__ Chaetodon kleinii Bloch (p. 580)

8*b*. Pelvic fins pale.

10*a*. Black ocular band continued onto isthmus or breast, forming dark patch there and often meeting the one from opposite side (in *C. bennetti* only one line barely extending onto side of breast).

11*a*. Large round black spot sometimes with a white ring on upper center of body; caudal fin pale without distinct transverse lines or bands.

12*a*. Body with two diverging brownish (blue in life) curved bands descending from near top of gill opening, one passing across base of pectoral to origin of anal and the other behind pectoral to front third of anal fin; a similar but wider vertical diffuse band across caudal peduncle; large, black, white-bordered, round spot near middle of body crossed by lateral line at its upper margin; a white-bordered brown band runs from nape through eye to isthmus (this band narrower than eye) where more distinct edges of this band can be seen on isthmus and breast; all fins pale; dorsal XIII or XIV,17 or 18; anal III,14 to 16; scales 45 or 46; (see pl. 53, A)_____ Chaetodon bennetti Cuvier

12*b*. Body without two diverging brownish curved bands; large dark-brown or black spot, in upper center of body, through middle of which passes lateral line; caudal peduncle with a black ring; posterior margins of soft dorsal and anal fins with broad black submarginal band, narrowing anteriorly; ocular band as broad as eye running from origin of dorsal

onto breast, where it joins its fellow from opposite side; dorsal XIII,21 to 23; anal III,18 or 19; scales 41 to 45.

Chaetodon unimaculatus Bloch (p. 581)

11*b*. No large black spot on upper center of body; caudal fin with one or two transverse blackish lines or bands.

13*a*. Two black lines or bands extending transversely across caudal fin.

14*a*. Black spot between pelvics; 6 curved black stripes on body, 2 or 3 more on head; the stripes around mouth and through eye bordered with white, other bands not white bordered; lower jaw black but lips pale; band through eye narrower than eye passing from nape to breast and ending in a large blackish patch; first black body band passing from origin of dorsal toward head but ending above head, dorsally this band uniting with another posteriorly near base of second and third dorsal spines and curving downward across preopercle, thence to just above base of pelvics, passing posteriorly near base of anal fin; next band beginning about tenth dorsal spine running forward along base of dorsal, curving downward below sixth dorsal spine across rear edge of opercle and base of pectoral, thence backward and across caudal peduncle; another band runs from base of eleventh dorsal spine to axil of pectoral; band from base of twelfth dorsal spine curving downward and backward, then forward to behind pectoral fin; band originating on first soft dorsal rays curving backward to base of last dorsal rays, thence forward to behind pectoral; soft dorsal with black submarginal band; anal with 2 black submarginal bands; caudal with 2 black transverse bands, 1 about middle, 1 submarginal; pectorals and pelvics pale; dorsal XII, 23 or 24; anal III,19 to 21; scales 50 to 55.

Chaetodon meyeri Bloch and Schneider (p. 581)

14*b*. No black spot between pelvics; about 6 broad yellowish bands extending obliquely backward and upward; chin black; a black ring around mouth; ocular band narrower than eye extending onto isthmus; narrow black line running from lower edge of preopercle behind eye upward and backward along base of spiny dorsal, becoming a submarginal band on soft dorsal where it curves downward and joins fourth yellow band; two vertical black lines on opercle; caudal with narrow pale margin, a black submarginal band and a second broader transverse black band crossing about middle of fin; soft dorsal and anal margins black except on last rays; dorsal XII,25 to 27; anal III,20 to 22; scales 50 to 58.

Chaetodon ornatissimus Cuvier and Valenciennes (p. 582)

13*b*. A single black line or band across caudal fin.

15*a*. Upperpart of body brownish with a large pale spot in center of brownish area, a smaller pale spot (sometimes lacking) posterior to first; caudal peduncle with larger black saddle above and a smaller one below (sometimes

meeting in young to form a ring); black blotch at base of spiny anal; about 16 rows of dark spots or lines on body, almost horizontal, radiate posteriorly and a little upward; ocular band without white margin ending in small spot on isthmus; caudal fin with narrow black transverse line about middle; dorsal XII,19 or 20; anal III,16 or 17; scales 35 to 40.

Chaetodon melannotus Bloch and Schneider (p. 583)

15*b*. Body with 14 to 18 horizontal dark-brown or blackish lines beginning behind head; all dorsal ones ending at a white line at base of soft dorsal, ventral ones fading out posteriorly; caudal peduncle with black blotch on top; ocular band bordered by white, ending in patch on isthmus; interorbital, snout, lips, and chin black, a narrow black line behind eye fading at base of spiny dorsal; broad black bar at base of soft dorsal, its anterior margin white; anal with white-bordered black band at base, and broad gray submarginal band; wide white-bordered (yellow when alive), black transverse band on caudal fin about middle; dorsal XIII or XIV,19 to 23; anal III,19 or 20; scales 38 to 44.

Chaetodon trifasciatus Mungo Park (p. 584)

10*b*. Black ocular band not reaching isthmus or breast, always ending above or on branchiostegal membranes.

16*a*. Caudal peduncle black or with a black spot dorsally or ventrally or with a black ring or saddle;[20]

17*a*. Posterodorsal part of body and dorsal fin with a broad black band extending from base of second dorsal spine obliquely across body and posterior part of anal fin a little behind tips of anal spines; margin of dorsal fin white, with a narrow black submarginal streak from tip of fourth dorsal spine to last dorsal soft ray; then below this on soft dorsal is a narrow white band somewhat broken or wavy; anal fin narrowly margined with white; background color of anteroventral part of body pale or white, with center of each scale marked with a small brownish spot; several of these spots are especially intense brown behind and above axil of pectoral fin (see pl. 51, D)--- Chaetodon tinkeri[21] Schultz

17*b*. Color not as in 17*a*.

18*a*. One or two black lines or bands across caudal fin; posterior margin of fin always hyaline.

19*a*. Body with 6 to 16 vertical lines or bars; soft dorsal margin pale without broad black band.

20*a*. Body with 6 vertical bars, the first originating under the fourth and fifth dorsal spines running downward just behind pectoral axil, fading just above belly; the second running from sixth and seventh dorsal spines behind pectoral fading on belly; the third from ninth to eleventh spines ending at anal base;

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[20] Young of *C. ephippium* have caudal peduncle black in specimens of 30 mm. and a small black spot thereon in 70-mm. specimens, caudal peduncle colorless in adults (see 16*b*).

[21] *Chaetodon tinkeri* Schultz, Proc. U. S. Nat. Mus., vol. 101, pp. 485–488, pl. 15, 1951 (Oahu Island, Hawaiian Islands).

the fourth from the membrane of the twelfth dorsal spine to a point below horizontal axis of body; fifth and sixth bars narrower running from front of soft dorsal slightly backward and downward to anal base; area between these bars lighter with small brown spots in the center of each scale; band about as wide as pupil running from origin of dorsal through eye to lower edge of preopercle, this ocular band white bordered above the eye, pale in center and darker bordered below the eye; upper lip brown or black; caudal peduncle with a black ring; caudal fin with crescent-shaped black bar across the middle, broad margin pale; dorsal and anal fin bases thickly spotted with small brownish or blackish dots, margins pale, thin black submarginal line; dorsal XIII,25; anal III,19; scales 44 to 47 (see pl. 58, A).

Chaetodon multicinctus Garrett

20*b*. Body with 15 or 16 thin vertical lines.

21*a*. Body with a large black crescent-shaped patch from base of soft dorsal and last dorsal spines to posterior half of soft anal, gradually narrowing toward anal, this patch extended on base of caudal peduncle; ocular bands broader than eye, the two joined together across interorbital; margin of anal fin with diffuse blackish line, rest of fin pale; soft dorsal pale; margin of caudal hyaline with a black submarginal line; dorsal XII,24 to 27; anal III,20 or 21; scales 20 to 22.

Chaetodon lineolatus Cuvier

21*b*. Body with 2 wide vertical bands, one from tips of third to seventh dorsal spines to below lateral line or to below pectoral, the second from front of soft dorsal including the last dorsal spines to about lateral axis (in young to spiny part of anal); caudal peduncle with a blackish ring; ocular band slightly narrower than eye, white-margined; interorbital area pale; margin of anal fin pale, a thin black submarginal line and 2 diffuse lines on scaly part of anal; soft dorsal pale with 2 indistinct lines basally converging at their ends; margin of caudal hyaline with a black submarginal line; dorsal XII,23 to 27; anal III,19 to 22.

Chaetodon falcula Bloch (p. 585)

19*b*. Body without vertical lines, soft dorsal margin with broad black band.

22*a*. Ocular band broader than eye in the form of a broad saddle across interorbital, extending width of pupil behind the eye and ending at ventral edge of preopercle; dorsal and anal fins with broad black marginal band; dorsal with a broad black basal band, margined anteriorly with white extending from last dorsal spines, broadening ventrally and ending in a broad saddle on caudal peduncle; caudal with broad

hyaline margin and broad black submarginal band, a second faint diffuse band crossing caudal about middle; broad yellow-margined black bar on body beginning at sixth or seventh dorsal spine, passing downward and forward, ending abruptly at gill opening (young specimens with black ocellated spot as large as eye on soft dorsal fin, caudal peduncle with black blotch on anterior part; shoulder patch not yet formed); body with 10 to 12 oblique brownish lines running backward and upward; dorsal XII,23 to 25; anal III,17 to 20; scales 34 to 40.

Chaetodon lunula (Lacepède) (p. 586)

22*b*. Ocular band running from origin of dorsal to ventral edge of preopercle, narrower than eye, above eye, and as broad as eye, below eye; anal fin with a pale margin and a thin submarginal black line broadening posteriorly; dorsal with a broad black marginal band, except on last rays, a broad black band starting on last dorsal spines across soft dorsal, forming a black ring around caudal peduncle and extending onto last 9 or 10 anal rays, narrower below caudal peduncle; caudal with hyaline margin and black submarginal band with a broad crescent-shaped band transversely across center of fin; body with 6 thin black lines running obliquely backward and upward from head; 11 or 12 similar black lines extending obliquely downward and backward fading on anal base; dorsal XIII,22 to 25; anal III,20 to 22; scales 30 to 35.

Chaetodon vagabundus Linnaeus (p. 587)

18*b*. Caudal fin pale without black transverse lines or bands.

23*a*. Color pattern on body not consisting of several blackish lines or rows of spots on scales, but upperpart of body blackish, the dark color extending onto dorsal fin sheath and caudal peduncle; white spot (as large or larger than eye) beneath insertion of eighth to twelfth dorsal spines; a second white area on anterior third of soft dorsal base joins light color of lower half of body; ocular band with pale center, narrower than eye; dorsal and anal fin with very thin margin dusky, below this a broad band of white then a thin black line; caudal fin pale or rarely with very thin black submarginal line; dorsal XIV (rarely XV),21 or 22; anal III,17 or 18; scales 39 to 45.

Chaetodon quadrimaculatus Gray (p. 588)

23*b*. Color pattern on body consisting of several dark lines or narrow rows of spots.

24*a*. Ventral margin of anal fin with broad black or brown band; caudal peduncle pale; color pattern of about 18 lengthwise rows of small brown or blackish spots radiating posteriorly from head; ocular band dark brown, slightly wider than pupil, white bordered, running from origin of dorsal to lower edge of preopercle; ocular band continues as a marginal narrow

line on spinous dorsal and as a submarginal line on soft dorsal; caudal fin completely pale or white; dorsal XIV,20 to 22; anal III,15 to 17; scale rows 34 to 42_____ Chaetodon citrinellus Cuvier (p. 589)

24*b*. Ventral margin of anal fin pale; caudal peduncle with a black band; color pattern of blue or dark spots on scales arranged in 10 or 11 distinct vertical or slightly inclined series, present only on anterior half of body and restricted to its upper part above a horizontal line through pectoral; a black band from nape and supraorbital region through eye, widest above eye, below eye much narrower and ending above isthmus on branchiostegals; anal fin pale; soft dorsal with a thin black marginal line; caudal fin completely pale; dorsal XIII,22 or 23; anal III,18 to 20; scales 40 to 44. Chaetodon miliaris Quoy and Gaimard

16*b*. Caudal peduncle pale without large black spots or bands in adults.

25*a*. Caudal fin without jet black transverse band across middle.

26*a*. Either a large black round spot on soft dorsal or a large subovate black patch occupying entire posterior dorsal area of body; fourth to sixth dorsal rays produced and threadlike in adults, middle part black.

27*a*. A large subovate black patch on dorsal posterior part of body extending onto dorsal fin, bordered ventrally with a broad white band; below this 5 or 6 diffuse horizontal gray or purple stripes; ocular band reduced to wedge-shaped spot just above orbit; not evident below eye (except in young); anal pale except for dusky marginal line and faint narrow line across middle of fin; dorsal fin white along dorsal surface, posterior margin with tips dusky, then a broad white band, then a narrow black line separated from black body patch by a yellow band; caudal peduncle pale in adults (young with black saddle gradually diminishing as adult coloration is assumed); caudal fin pale with thin black lines following rays; dorsal XIII,24 to 26; anal III,21 to 23; scales 34 to 38_____ Chaetodon ephippium Cuvier (p. 590)

27*b*. Soft dorsal with a large black oval to round spot (ringed with white in young) on sixth to thirteenth rays; body with five narrow gray stripes radiating upward and backward from head; at right angles to fifth line are 10 or 11 diagonal lines running downward and backward; ocular band narrow and faint above eye, broader than eye and jet black below eye (young have ocular band about as wide as eye from nape to lower edge of opercle); dorsal and posterior margins of dorsal fin jet black; anal fin with pale margin and narrow black submarginal line; caudal with 2 narrow faint submarginal lines; dorsal XIII (rarely XII),23 or 24; anal III,18 to 22; scales 29 to 36. Chaetodon auriga Forskål (p. 591)

26*b*. No large black round spot on soft dorsal; no large black patch occupying posterior dorsal area of body.

28*a*. Body with 13 or 14 more or less horizontal rows of small, round, brown dots extending onto base of soft dorsal but not onto anal; dorsal and anal fins with a black band at base, broadening posteriorly, and both fins with a thin submarginal black line; produced thread-like dorsal rays entirely white; ocular band extending from nape to branchiostegal membranes, narrower than eye above eye and broader than eye below eye; caudal fin pale with thin black lines following rays; dorsal XIII or XIV,21 to 25; anal III,20 to 22; scales 32 to 44.

Chaetodon semeion Bleeker (p. 592)

28*b*. Body with 4 to 10 narrow, chevron-shaped vertical bars, originating at base of dorsal inclined forward following scale rows, then inclined backward below midaxis of body, some of last 3 or 4 bands incomplete, reduced to spots; posterior part of body pale; ocular band white bordered above eye and wider than pupil, narrower than pupil below eye, fading on lower edge of preopercle; soft dorsal fin rounded; anal fin with first rays produced, making fin angulate; dorsal with narrow black submarginal line; anal fin with diffuse darkish area in anterior half, posterior margin pale with narrow black submarginal line; caudal pale with faint black submarginal line; dorsal XIII (rarely XII),21 to 23; anal III,16 or 17.

Chaetodon mertensii Cuvier (p. 593)

25*b*. Caudal fin with a jet-black transverse band across middle.

29*a*. Center of ocular band pale white or yellow, bordered by dark lines; width of band equal to pupil.

30*a*. About 6 black bands inclined obliquely upward across body and ending in soft dorsal, except ventral one, which ends in front of base of last anal rays; these bands begin in middle of body and are preceded by rows of blackish spots; between broader bands narrow lines are often evident; a black patch in front of origin of dorsal usually not continuous with ocular band; ocular band beginning about width of pupil above eye fading on lower margin of preopercle; dorsal and anal fin dark basally with pale margin and black submarginal line; caudal crossed about middle by black band; dorsal XIII,23; anal III,18; scales about 45.

Chaetodon pelewensis Kner

30*b*. Five or six vertical bands on upper posterior part of body, the first two very pale, the last very short; anterior and lower part of body with horizontal or oblique rows of spots; no narrow lines between bands, which do not extend below a line through the pectoral axil and center of caudal peduncle; caudal peduncle yellow; diffuse black spot on nape at origin of dorsal fin; ocular band beginning a short distance above eye fading just above lower edge of preopercle; broad base of

dorsal fin dark gray; margin pale; base of anal punctic-ulate, margin pale, black submarginal line; jet-black transverse bar across middle of caudal rays; dorsal XIII,22 to 25; anal III,17 or 18; scales 35 to 40.

Chaetodon punctato-fasciatus Cuvier (p. 594)

29*b*. Center of ocular band dark, width about equal to eye; body pale with faint pigment near edges of scales giving appearance of faint cross-pattern of lines following rows of scales; soft dorsal fin with pale margin and black submarginal band beginning narrowly on last dorsal rays broadening on posterior part of fin; anal with pale margin and thin black submarginal line; broad, black, crescent-shaped transverse bar across middle of caudal fin; ocular band beginning on nape, narrower than eye, above eye, and as broad as eye, below eye, ending on lower edge of interopercle; narrowly bordered with white below eye; dorsal XIII,21; anal III,19; scales about 29.

Chaetodon rafflesii Bennett

Genus FORCIPIGER Jordan and McGregor

Forcipiger Jordan and McGregor, *in* Jordan and Evermann, U. S. Nat. Mus. Bull. 47, pt. 2, p. 1671, 1898. (Genotype, *Chelmon longirostris* Cuvier and Valenciennes.)

FORCIPIGER LONGIROSTRIS (Broussonet)

Plate 49, A

Chaetodon longirostris Broussonet, Ichthyologia, sistens piscium descriptiones et icones, p. 6, pl. 7, 1782 (type locality, unknown). (Reference copied.)

SPECIMENS STUDIED

Bikini Atoll: 4 stations, 6 specimens, 77 to 102 mm. standard length.

Description.—Dorsal rays XII,22 or 23; anal III,17 or 18, pectoral I,i,14; scales 69 to 76 rows in lengthwise series, 14 or 15 from origin of dorsal to lateral line, 32 or 33 from origin of anal to lateral line.

Depth 2.4, head 2.2 or 2.3, both in standard length; snout 1.6 to 1.8, eye 5.1 to 5.3, least depth of caudal peduncle 5.6 to 6.3, length of pectoral 1.1 to 1.2, postorbital part of head 4.6 to 6.0 (hind margin of eye to upper edge of gill opening), lower lobe of caudal fin 2.0 to 2.4, upper lobe 1.7 to 1.9, all in length of head; interorbital in eye 1.1; length of caudal peduncle in its depth 1.0.

Teeth very small and close-set; pectoral fin long and falcate; lateral line smoothly arched, highest under VIII to Xth dorsal spines, extended onto caudal peduncle but not quite to end; snout produced and curved slightly upward; first and second outer rays on dorsal side of caudal peduncle produced and filamentous.

Color in alcohol.—Body bright golden to yellowish; a large triangular brown spot covering side of head from origin of dorsal to

just above base of pectoral, extending forward at level of middle of eye and continued before eye onto snout covering top to tip; dorsal fin golden at base, pale distally except dusky streaks following spines, soft dorsal with clear margin and thin black submarginal line; anal fin golden at base, pale distally, an intense black spot (not quite so large as eye) extending from rays 12 to 17 just below margin, an indistinct dusky submarginal line posteriorly; caudal fin with dark line across base, rest of fin with slightly dusky rays; pectoral fin clear except upper margin dusky; ventrals pale.

Color in life.—Not greatly different from preserved specimens described above.

Genus HENIOCHUS Cuvier

Heniochus Cuvier, Règne animal, ed. 1, vol. 2, p. 335, 1817. (Genotype, *Chaetodon macrolepidotus* Bloch.)

HENIOCHUS ACUMINATUS (Linnaeus)

Chaetodon acuminatus Linnaeus, Systema naturae, ed. 10, p. 272, 1758 (type locality, Indies).

Heniochus acuminatus Fowler, Bishop Mus. Mem., vol. 10, p. 258, 1928 (Ebon Island, Marshalls).

This species is included on the basis of Fowler's record of a specimen from Ebon Island. We have not seen a specimen from the Marshall Islands.

HENIOCHUS PERMUTATUS Cuvier

Plate 49, B

Heniochus permutatus Cuvier, *in* Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 7, p. 99, 1831 (on Bennett) (type locality, not given).

SPECIMENS STUDIED

Bikini Atoll: 5 stations, 15 specimens, 69 to 116 mm. standard length.
Rongerik Atoll: 1 station, 1 specimen, 104 mm.
Guam: 1 lot, 1 specimen, 76 mm.

Description.—Dorsal rays XII,21 or 22; anal III,18; pectoral I,i,13 or 14; scales 49 to 55 in lengthwise series, 10 or 11 between dorsal fin origin and lateral line, 25 to 28 between lateral line and anal fin origin.

Depth 1.4 or 1.5, head 2.8 to 3.1, both in standard length; snout 2.8 to 3.3, eye 2.8 or 2.9, least depth of caudal peduncle 3.0 to 3.2, length of pectoral fin 0.9, postorbital part of head 2.4 to 2.8, lower lobe of caudal fin 1.2 or 1.3, upper lobe 1.1 or 1.2, all in length of head; interorbital in eye 1.1 or 1.2; length of caudal peduncle in its depth 1.3 to 1.5; angle of snout profile with axis of body 57 to 60 degrees.

One or two small spines on interorbital margin above eye; fourth dorsal spine much longer than head, in 69-mm. specimen almost as

long as body, with a broad membrane on entire distal part; spinous dorsal longer than soft dorsal.

Color in alcohol.—Head and body with three broad, chocolate brown, transverse bands, first from origin of dorsal fin through eye, across cheek and pectoral base to belly, including pelvic fin base and covering belly almost as far posteriorly as anal opening; second, from third to fifth dorsal spines obliquely to soft anal rays; third, less distinct, covering scaly basal part of dorsal fin from tenth spine to posterior part of fin and extending across upper part of caudal fin base; area between bands pearly white; midline of snout and tip of upper lip blackish; dorsal fin from fourth to ninth spines, white distally; posterior anal fin soft rays with white tips; pectoral fin pale; pelvic fins black; caudal fin pale.

Color in life.—Not different from preserved specimens described above except lips bright golden yellow, and pectoral fin pale yellow along rays.

Ecology.—Found in deeper waters and around coral heads; not usually seen or taken on shore reefs.

HENIOCHUS MONOCEROS Cuvier

Heniochus monoceros CUVIER, *in* Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 7, p. 100, 176, 1831 (type locality, Isle de France).

SPECIMEN STUDIED

U.S.N.M. No. 140122, Enlwetok Atoll, Teiteiripucchi Island, lagoon reef, June 1, 1946, S-46-197, Schultz, 1 specimen, 97 mm.

Description.—Dorsal rays XII, 25 or 26; anal III,18 or 19; pectoral I,i,16; scales about 51 in lengthwise series, 10 between dorsal fin origin and lateral line, 24 between lateral line and anal fin origin.

Depth 1.4, head 2.7, both in standard length; snout 2.5, eye 3.2, least depth of caudal peduncle 3.1, length of pectoral fin 1.0, postorbital part of head 2.5, lower lobe of caudal fin 1.4, upper lobe 1.3, all in length of head; interorbital in eye 1.05; length of caudal peduncle in its depth 1.4; angle of snout profile with axis of body 56 degrees.

Fourth dorsal spine longer than head; a single small spine on upper rim of orbit; a median conical bony protuberance on nape nearer origin of dorsal fin than snout.

Color in alcohol.—Head with light brown triangular spot from origin of dorsal to eye; bony protuberance black, interorbital black; top and sides of snout with black spots; a black line almost as wide as eye from eye meeting its fellow just posterior to chin; lips and chin white; two broad vertical brown bands crossing body, the first starting at the sixth and seventh dorsal spines through pectoral base, broadening ventrally and including pelvic fin base posteriorly to anus,

the second starting on ninth to twelfth dorsal spines, passing diagonally through base of caudal peduncle to tips of last anal fin rays; space between brown bands pearly white; pectoral fins black at base, rest of fins white; pelvic fins entirely black; soft dorsal and caudal fins yellow on scaled base, white on unscaled portion; anal fin with black margin, pale basally on anterior part, black on posterior part.

Genus MEGAPROTODON Guichenot

Megaprotodon GUICHENOT, Rev. Zool., vol. 11, p. 12, 1848. (Genotype, *Chaetodon bifasciatus* Cuvier and Valenciennes.)

MEGAPROTODON STRIGANGULUS (Gmelin)

Chaetodon strigangulus GMELIN, Systema naturae, ed. 13, p. 1269, 1788 (on Broussonet) (type locality, not given).

SPECIMENS STUDIED

Bikini Atoll: 1 station, 2 specimens, 28 and 92 mm., standard length.
Rongelap Atoll: 1 station, 3 specimens, 40 to 63 mm.
Guam: 1 lot, 5 specimens, 43 to 60 mm.

Description.—Dorsal rays XIV,15 to 17; anal IV,15 or 16; pectoral I,i,13; scales in lengthwise series 25 or 26.

Depth 1.9, head 2.5 to 3.0, both in standard length; snout 2.8 to 3.0, eye 2.8 to 3.0, least depth of caudal peduncle 2.9 to 3.1, length of pectoral fin 1.2, postorbital part of head 2.5 to 2.9, lower lobe of caudal fin 1.3, upper lobe 1.2, all in length of head; interorbital in eye 1.0; length of caudal peduncle in its depth 1.2 or 1.3; angle of snout profile with axis of body 36 to 43 degrees.

Teeth massed in anterior part of jaws.

Color in alcohol.—Ground color whitish on lower half of body, upper half darker; a dark-brown band, about as wide as eye, starting on nape anteriorly to origin of dorsal passing through eye and joining with its fellow at anterior part of isthmus, this band bordered anteriorly and posteriorly by a narrow light line; lips pale; upper half of body with 2 oval white spots, one behind the other; body with 18 to 20 transverse dark lines following scale rows, meeting in a broad angle just below lateral line, these lines extending on base of dorsal fin but not on base of anal; spinous dorsal pale distally, posterior soft rays white tipped; caudal black basally, then a pale vertical band (which becomes more and more narrow as fish assumes adult coloration); then a black line, tips of rays colorless; anal fin pale brown basally, then a thin black line distally following outline of fin.

JUVENILE: The following coloration disappears at a length of about 65 to 72 mm. standard length: A broad crescent-shaped black band or bar across rear of soft dorsal and anal fins, with white border dorsally, broadest at length of 30 to 40 mm., gradually decreasing in

width and disappearing at a length of about 70 mm. At a length of about 50 mm. the pale or yellowish caudal fin begins to darken basally, and at a length of 70 mm. the basal three-fourths of caudal fin is black; pectoral and pelvic fins colorless.

Genus CHAETODON Linnaeus

Chaetodon LINNAEUS, Systema naturae, ed. 10, vol. 1, p. 272, 1758. (Genotype, *Chaetodon capistratus* Linnaeus.)

CHAETODON RETICULATUS Cuvier

PLATE 50, B

Chaetodon reticulatus CUVIER, *in* Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 7, p. 32, pl. 171, 1831 (type locality, Tahiti, Ulea).

SPECIMENS STUDIED

Bikini Atoll: 13 stations, 35 specimens, 40 to 112 mm. standard length.
Eniwetok Atoll: 2 stations, 2 specimens, 97 to 102 mm.
Rongelap Atoll: 1 station, 1 specimen, 92 mm.
Rongerik Atoll: 1 station, 1 specimen, 84 mm.

Description.—Dorsal rays XII,26 or 27; anal III,20 or 21; pectoral ray I,i,15 to 17; scale rows in lengthwise series from upper part of gill opening to base of caudal rays 41 to 43 in 4 counts.

Depth 1.4 or 1.5, head 3.2 to 3.4, both in standard length; snout 2.8 to 3.0, eye 3.1 to 3.5, least depth of caudal peduncle 2.3 to 2.8, length of pectoral fin 1.0 to 1.2, postorbital part of head (hind margin of eye to posterior margin of opercular flap) 2.1 to 2.4, lower lobe of caudal fin 1.3 or 1.4, upper lobe 1.2 to 1.3, all in length of head; interorbital in eye 0.7 or 0.8; length of caudal peduncle in its depth 1.3 to 1.6; angle of snout profile with axis of body 55 to 60 degrees; angle formed by corner of mouth, center of eye, and insertion of pectoral fin (with eye at apex) 92 to 100 degrees; line from middle of caudal peduncle to corner of mouth passes just above pectoral axis.

Teeth very fine, numerous, flexible, and brushlike, lower teeth slightly hooked at tips; caudal fin convex.

Color in alcohol.—A broad black band, bordered on each side by yellow, passing from origin of dorsal and interorbital through eye, narrower than eye at eye, broadening below eye to isthmus, thence passing posteriorly on belly, including base of pelvic fins to anal fin; upper lip pale; area around mouth black; a light-gray area on interorbital about as wide as eye; a broad pale vertical band passes from dorsal fin just back of eye, including pectoral fin base to black belly band; posterior part of body black with yellowish white spots, that occupy center of each scale, arranged in horizontal rows; dorsal fin spines dirty white, scaled part light brown, soft rays with broad pale margin, then a narrow submarginal dark-brown line, then a sec-

ond pale band; anal fin black on scaled part, then a light band, then a broad black band and a narrow pale margin; last anal rays with a broad pale margin (red in life); posterior part of caudal peduncle and base of caudal fin black, rest of caudal fin pale with 2 submarginal black bands; pectoral fin pale; pelvic fins black.

Color when alive.—Pattern as described for preserved specimens; line bordering broad black head band bright yellow; upper lip yellow; opercle dark gray; anterior part of back light gray; space between insertion of pectoral fin and breast bright yellow; soft dorsal fin with a broad yellow submarginal band, about as wide as pupil; anal fin with margin of last 6 or 7 soft rays bright red; caudal fin with a yellow band between the two submarginal black bands.

CHAETODON KLEINII Bloch

Chaetodon kleinii BLOCH, Naturgeschichte der ausländischen Fische, pt. 4, p. 7, pl. 218, fig. 2, 1790 (type locality, East Indies). (Reference copied.)

SPECIMENS STUDIED

U.S.N.M. No. 65790, Jaluit Atoll, January 6 to February 4, 1900, *Albatross*, 5 specimens, 70 to 91 mm.

Description.—Dorsal rays XIII,21 or 22; anal III,18; pectoral rays I,i,12 or 13; scales 33 rows in lengthwise series from upper edge of gill opening to base of caudal fin rays (5 counts).

Depth 1.5 or 1.6, head 3.4 or 3.5, both in standard length; snout 3.0 to 3.5, eye 2.8 to 3.0; least depth of caudal peduncle 2.6 to 3.0; length of pectoral fin 1.0 or 1.1, postorbital part of head (hind margin of eye to upper edge of gill opening) 3.1 or 3.2, all in length of head; interorbital in eye 1.0; angle of snout profile 58 to 62 degrees, concave; caudal fin straight; teeth setiform, nearly straight except curved at tip.

Color in alcohol.—A black band starts on nape and passes through eye to breast, then to pelvics; pelvics black but spines pale; about 15 longitudinal rows of brownish spots, rather diffuse anteriorly, distinct posteriorly; two faint vertical color bars, the first extending from lateral line just behind pectoral to pelvics, and the second from eleventh to thirteenth dorsal spines to origin of anal; area between these faint bars lighter, causing them to stand out clearer; pectoral fin pale; margins of soft anal and dorsal fins white, then a narrow submarginal black line about width of white margin; caudal fin pale; spiny dorsal pale; tip of snout black (copied from Schultz, U. S. Nat. Mus. Bull. 180, 1943, pp. 140–141, and checked with specimens).

Remarks.—These specimens have apparently been dried or have been preserved in too strong a solution of alcohol, as they are badly shrunken and very stiff and brittle. Nearly all the color and pattern are gone.

CHAETODON UNIMACULATUS Bloch

PLATE 51, B

Chaetodon unimaculatus BLOCH, Naturgeschichte der ausländischen Fische, pt. 3, p. 75, pl. 201, fig. 1, 1787 (type locality, East Indies). (Reference copied.)

SPECIMENS STUDIED

Bikini Atoll: 3 stations, 11 specimens, 60 to 103 mm. standard length.
Eniwetok Atoll: 2 stations, 2 specimens, 40 and 51 mm.
Rongelap Atoll: 2 stations, 2 specimens, 44 and 53 mm.
Rongerik Atoll: 1 station, 1 specimen, 53 mm.

Description.—Dorsal rays XIII,21 to 23; anal III,18 or 19; pectoral I,i,13 or 14 (usually 14); scales in lengthwise series from upper end of gill opening to base of caudal rays 41 to 44.

Depth 1.4 to 1.7, head 2.8 to 3.1, both in standard length; snout 2.6 to 3.2, eye 3.0 to 3.2, least depth of caudal peduncle 3.0 to 3.1, length of pectoral fin 1.0 to 1.3, postorbital part of head 2.4 to 2.6, lower lobe of caudal 1.3 to 1.7; upper lobe 1.2 to 1.5, all in length of head; interorbital in eye 0.9 to 1.0; angle of snout profile with axis of body 48 to 55 degrees; angle formed by corner of mouth, center of eye, and insertion of pectoral fin (with eye at apex) 93 to 105 degrees; a line through the center of the caudal peduncle to angle of jaws passes well above axil of pectoral and along the lower rim of the orbit.

Lateral line smoothly arched to center of black trunk spot, then straight following body outline and ending under insertion of last dorsal ray; teeth fine, blunt in adults, pointed and slightly hooked in young; caudal fin truncate.

Color in alcohol.—Head with a dark-brown band as wide as eye from origin of dorsal fin through eye to breast, where it meets band from opposite side; top of snout and upper lip dusky; body yellowish white with about 10 indistinct diagonal dusky lines on anterior uppersides; a large dark-brown or black spot about twice diameter of eye located under insertion of eighth to thirteenth dorsal spines, often with broad, tapering, dusky streak running straight downward from its lower edge; dorsal and anal fin yellow with broad submarginal black band across straight posterior part continuous with black band of equal width on caudal peduncle; pectoral, pelvic, and caudal fins pale yellowish white.

CHAETODON MEYERI Bloch and Schneider

Chaetodon meyeri BLOCH and SCHNEIDER, Systema ichthyologiae, p. 223, (type locality, Moluccas).—AHL, Arch. naturg., vol. 89, p. 49, 1923 (Jaluit Atoll, Marshall Islands).

This species is included on the basis of Ahl's record from Jaluit Atoll. We have not seen a specimen from the Marshall Islands.

CHAETODON ORNATISSIMUS Cuvier and Valenciennes

PLATE 52, A

Chaetodon ornatissimus CUVIER and VALENCIENNES, Histoire naturelle des poissons, vol. 7, p. 22, 1831 (type locality, Tahiti).

SPECIMENS STUDIED

Bikini Atoll: 4 stations, 4 specimens, 50 to 139 mm. standard length.

Description.—Dorsal rays XII,25 to 27; anal III,20 to 22; pectoral I,i,14 or 15; scales 50 to 58 in lengthwise series from top of opercular opening to base of caudal fin ray.

Depth 1.3 or 1.4, head 2.9 to 3.2, both in standard length; snout 3.0, eye 2.9 to 3.3, least depth of caudal peduncle 2.6 to 3.0, length of pectoral 1.0, postorbital part of head (from hind margin of eye to posterior edge of opercular flap) 2.1 to 2.8, lower lobe of caudal fin 1.4, upper lobe 1.3, all in length of head; interorbital in eye 0.8 to 1.0; angle of snout profile with axis of body 51 to 58 degrees; angle formed by corner of mouth, center of eye, and insertion of pectoral (with eye at apex) 101 to 110 degrees.

A line through center of caudal peduncle to angle of mouth passes about equal distance above axil of pectoral and below lower rim of orbit; teeth very long and fine, slightly bent at tips; lateral line almost straight on anterior portion, bending under insertion of third to fifth soft rays in a 135-degree angle following outline of body, and ending under the twentieth dorsal ray; caudal fin slightly convex.

Color in alcohol.—Six yellow bands lengthwise on body, slightly inclined dorsally extending from head to dorsal fin and onto caudal peduncle; ground color of body pale yellowish white; a line about as wide as pupil passing vertically through eye, this line broader on nape and isthmus where it joins one from opposite side; interorbital gray; a black ring encircling mouth; upper lip pale, lower lip black; a black line running upward from lower edge of preopercle along margin of scaly sheath of dorsal fin to hind margin, where it curves downward and joins a diagonal yellow band; a second vertical line across anterior part of opercle, and a third short one along anterior part of soft opercular flap; soft dorsal fin with thin black margin, except on posterior part; anal fin with a black margin, except on posterior part, then a white band, then a broad black band, base of fin with yellow body band extending onto soft portion; caudal fin with white margin and submarginal black band, a second broad black band crosses caudal about middle of fin; pectoral and pelvic fins white.

Color when alive.—Pattern as described for preserved specimens; diagonal body lines bright orange; ground color of head and nape yellow; black lines of head bordered by narrow lines of blue; breast

and belly yellow; spiny dorsal and scaled part of soft dorsal fin yellow, submarginal yellow band on soft dorsal fin, anal fin with spines yellow, soft portion with yellow submarginal band, then a thin blue line, basad to this a black line and below that a broad brown band; caudal fin yellow except for two vertical black bands and white margin; pectoral and pelvic fins yellow.

CHAETODON MELANNOTUS Bloch and Schneider

PLATE 52, B

Chaetodon melannotus BLOCH and SCHNEIDER, Systema ichthyologiae, p. 224, 1801 (type locality, Tranquebar).

SPECIMENS STUDIED

Bikini Atoll: Erik Island, western end, ocean reef, March 19, 1946, S-46-9, Schultz and Brock, 5 specimens, 88 to 106 mm.

Guam: Tumon Bay, January 8, 1946, Gressitt and Ingram, 2 specimens, 52 and 56 mm.

Description.—Dorsal rays XII,19 or 20; anal III,16 or 17; pectoral I,i,13; scales 36 to 38 rows in lengthwise series from upper edge of gill opening to base of caudal fin rays.

Depth 1.6 or 1.7, head 3.1 to 3.3, both in standard length; snout 3.0 to 3.2; eye 3.0 to 3.4, least depth of caudal peduncle 3.0 or 3.1, length of pectoral fin 1.1 to 1.2, postorbital part of head (hind margin of eye to upper edge of gill opening) 3.1 to 3.5, lower lobes of caudal fin 1.4 or 1.5, upper lobe 1.3, all in length of head; angle of snout profile with axis of body 46 to 50 degrees; angle formed by corner of mouth, center of eye, and insertion of pectoral fin (with eye at apex) 133 to 139 degrees; a line through center of caudal peduncle to corner of mouth passes well above axil of pectoral and through center of lower half of eye; caudal fin truncate to slightly convex; teeth long, round, curved over entire length, tapering to a fine sharp point.

Color in alcohol.—Back dusky to dark brown, a large pale spot larger than eye on upper side beneath insertion of fifth to seventh spines; lower part of body lighter; breast, sides, and back with about 21 dark-brown oblique striations; caudal peduncle with a large black saddle over top and a smaller one over ventral surface; a more or less distinct black blotch at base of soft anal fin; head pale except for a narrow stripe (width of pupil) running from nape through eye and ending in a small disconnected spot on anterior part of breast; soft parts of dorsal and anal fins with pale margin, then a dark line fading into a broad dusky area, bases yellow; caudal fin with posterior half pale, a black vertical line crossing fin halfway, base yellow; pectoral and pelvic fins pale (yellow in life).

CHAETODON TRIFASCIATUS Mungo Park

PLATE 51, A

Chaetodon trifasciatus MUNGO PARK, Trans. Linn. Soc. London, vol. 3, p. 34, 1797 (type locality, Sumatra).

SPECIMENS STUDIED

Bikini Atoll: 12 stations, 34 specimens, 49 to 96 mm. standard length.
Eniwetok Atoll: 1 station, 1 specimen, 93 mm.
Rongelap Atoll: 2 stations, 3 specimens, 67 to 88 mm.
Rongerik Atoll: 1 station, 1 specimen, 84 mm.
Guam: 2 lots, 57 specimens, 31 to 75 mm.
Likiep Atoll: Univ. Washington, 19 specimens, 53 to 87 mm.

Description.—Dorsal rays XIII or XIV,19 to 23; anal III,19 or 20; pectoral rays I,i,13 or 14; scales 38 to 44 rows in line between upper edge of gill opening and base of caudal rays.

Depth 1.6 or 1.7, head 3.0 to 3.6, both in standard length; snout 3.2 to 3.5, eye 2.7 to 3.2, least depth of caudal peduncle 2.7 to 3.0, length of pectoral fin 1.0 or 1.1, postorbital part of head 2.8 to 3.3 (hind margin of eye to upper edge of gill opening), lower lobe of caudal 1.4 to 1.7, upper lobe 1.1 to 1.4, all in length of head; interorbital in eye 0.9 to 1.0; angle of snout profile with axis of body 46 to 52 degrees; angle formed by corner of mouth, center of eye, and insertion of pectoral fin (with eye at apex) 121 to 127 degrees; a line through center of caudal peduncle to corner of mouth passes above axil of pectoral and across lower rim of orbit; caudal fin convex, rounded; teeth setiform, very fine.

Color in alcohol.—Body with 14 to 18 dark-brown or blackish, narrow, horizontal lines running from head to dorsal fin base on upper part, fading posteriorly below; interorbital, snout, lips, and chin black; a black band, bordered before and behind by a white line from nape to isthmus, passing through eye, this band a little broader than pupil; a second band running from lower margin of preopercle upward behind eye and curving posteriorly along base of dorsal; scaly sheath of spinous dorsal fin with 7 or 8 very fine, wavy horizontal black lines, soft dorsal with a broad black band bordered by white occupying basal third and extending onto caudal peduncle, distally 2 broad yellow bands separated by a diffuse black line, tip of rays dusky; anal fin with a broad black band bordered by yellow on basal part, then a broad grayish black band, tips of rays white; caudal fin gray at base, crossed about middle by a broad black band bordered widely on each side by yellow, distal third pale; pectoral and pelvic fins pale.

Color when alive.—Pattern as described above, except space between black parts of head including eye, except where crossed by black line,

bright yellow; anterior part of opercular flap orange, breast and belly yellow; base of pectoral and soft part of pelvics yellow; anal fin pink at base of spiny part.

CHAETODON FALCULA Bloch

PLATE 53, B

Chaetodon falcula BLOCH, Naturgeschichte der ausländischen Fische, pt. 7, p. 102, pl. 325, fig. 2, 1793 (no locality).—SEALE, Occ. Pap. Bishop Mus., vol. 1, No. 3, p. 101, 1901 (Guam).—AHL, Arch. Naturg., vol. 89, p. 171, 1923 (Jaluit Atoll).—FOWLER, Bishop Mus. Mem., vol. 10, p. 255, 1928 (Guam; Ebon Island).

SPECIMENS STUDIED

Bikini Atoll: Boby Island, at north end, ocean reef, August 17, 1946, S-46-383, Herald, 1 specimen, 19 mm.

Guam: Tidal pools near mouth of Ylig River, December 23, 1945, Frey and Gressitt, 1 specimen, 49 mm.

Description.—Dorsal rays XII,23 or 24; anal III,19; pectoral I,i,14; scales 31 to 33 rows in line from upper edge of gill opening to base of middle caudal rays.

Depth 1.63 to 1.73, head 2.2 to 2.52, both in standard length; snout 2.58 to 3.07, eye 2.78 to 3.32, least depth of caudal peduncle 3.74 to 3.77, length of pectoral fin 1.35 to 1.53, postorbital part of head 3.91 to 4.67, all in length of head; interorbital in eye 1.19 to 1.23; angle of snout profile with lengthwise axis of body 36 to 39 degrees, snout profile sigmoid; hind margins of dorsal and anal fins round; caudal convex and rounded.

Color in alcohol.—Snout, chin, and interorbital white in small specimen, tip of snout with thin black line over dorsal surface in large; a faint white line extending from nostrils forward along sides of snout; ocular band slightly narrower than diameter of eye, running from nape to lower margin of interopercle, bordered before and behind with narrow light line; body with 2 broad, dark-brown transverse bands, the first extending from tips of third to seventh dorsal spines downward to about on level with lower part of pectoral insertion, the second extending from near tips of membranes of last two dorsal spines and first four dorsal rays downward, fading ventrally but visible to edge of margin of scaly sheath of anal; spaces between bars dusky brownish gray in small specimen and with 4 distinct narrow vertical lines in larger; larger specimen has altogether 16 narrow vertical lines on body, these running from dorsal base to ventral margin and anal base, caudal peduncle completely black, pectoral fins pale, pelvic fins with very narrow black streaks along inner margins of rays and membranes with minute black dots; caudal fin pale translucent on base, a thin black transverse line about middle,

rest of fin pale, soft dorsal with narrow dusky margin, broad pale submarginal band and basal portion dusky; soft anal with margin pale, margin of scaly sheath with narrow dusky line and basal portion pale.

CHAETODON LUNULA (Lacepède)

PLATE 54, A

Pomacentrus lunula LACEPÈDE, Histoire naturelle de poissons, vol. 4, pp. 507, 511, 513, 1802 (on Commerson) (type locality not given).

SPECIMENS STUDIED

Bikini Atoll: 12 stations, 24 specimens, 19 to 162 mm. standard length.
Eriwetok Atoll: 2 stations, 2 specimens, 19 and 111 mm.
Rongerik Atoll: 3 stations, 3 specimens, 126 and 166 mm.
Guam: 9 lots, 48 specimens, 25 to 141 mm.
Saipan: 1 lot, 1 specimen, 39 mm.

Description.—Dorsal rays XII,23 or 24; anal III,17 or 18; pectoral I,i,15; scales 34 to 39 rows in a line from upper edge of gill opening to base of middle caudal rays.

Depth 1.5 to 1.8; head 2.2 to 3.2, both in standard length; snout 3.0 or 3.1; eye 2.3 to 3.2; least depth of caudal peduncle 2.8 to 3.3; length of pectoral fin 1.1 to 1.3, postorbital part of head 3.2 to 3.5 (from hind margin of eye to upper edge of gill opening); lower lobe of caudal fin 1.4 or 1.5, upper lobe 1.3, all in length of head; interorbital in eye 0.8 to 1.0; angle of snout profile with axis of body 50 to 56 degrees; anterior profile concave in specimens 49 to 147 mm., straight in specimens 25 mm., convex in specimens 19 mm. (tholichthys stage); angle formed by corner of mouth, center of eye, and insertion of pectoral fin (with eye at apex) 113 to 128 degrees; a line through the center of caudal peduncle to mouth passes over axil of pectoral and below lower rim of orbit in large specimens, across both in smaller; teeth long, slender, straight, bent at tip where they taper sharply to point; caudal fin slightly convex; suprascapular and humeral bony plates of tholichthys stage very well developed at 19 mm. but completely lacking in specimen 25 mm.

Color in alcohol.—A broad black band from ventral edge of preopercle through eye across interorbital, wider than eye, at eye; snout pale; head behind black band white; a white-bordered black band running from insertion of dorsal fin along its base to sixth spine where it turns downward and forward, broadening below, ending abruptly at head and axil of pectoral; body with 10 to 12 more or less distinct oblique yellowish or brownish lines running backward and upward, fading on breast and at base of scaly sheath of soft dorsal; breast and belly white; dorsal and anal fins with a broad black margin and a pale proximal band about the same width; base of dorsal fin with a

white-bordered black streak starting at base of soft rays, thence backward, broadening and darkening to form a black saddle over caudal peduncle; caudal fin with pale margin, then a submarginal black band about equal in width to pale margin; about halfway from base to margin a series of 14 spots arranged to make a vertical band with a spot on membrane between each ray; base of caudal fin yellow; pectoral and pelvic fins yellowish white.

Color when alive.—Pattern as described for preserved specimens; snout, breast, belly, and general ground color yellow; lines bordering black shoulder patch yellow, as are submarginal dorsal and anal fin bands; bases of caudal, anal, and pectoral fins yellow; pelvic fins entirely bright yellow; back and base of dorsal fin light yellowish brown.

CHAETODON VAGABUNDUS Linnaeus

PLATE 55, A

Chaetodon vagabundus LINNAEUS, Systema naturae, ed. 10, p. 276, 1758 (type locality, Indies).

SPECIMEN STUDIED

Guam: 1945, Frey, 1 specimen, 58 mm.

Description.—Dorsal rays XIII,24; anal III,20; pectoral I,i,14; scales 35 rows in line from upper edge of gill opening to base of middle caudal rays; gill rakers 15 on lower limb of first arch.

Depth 1.57, head 2.86, both in standard length; snout 3.08, eye 2.94, least depth of caudal peduncle 3.08, length of pectoral fin 1.15, postorbital part of head 4.0, all in length of head; interorbital in eye 1.23; angle of snout profile with lengthwise axis of body 47 degrees; snout profile concave just behind tip, then nearly straight to origin of dorsal fin; posterior margins of soft dorsal, anal, and caudal fins rounded.

Color in alcohol.—Snout and interorbital areas dusky, black ocular band slightly narrower than eye, running from origin of dorsal to ventral edge of interoperculum; body ground color dusky yellowish brown; body with 6 narrow dark lines radiating posterodorsally from head, about 12 narrow dark lines perpendicular to sixth dorsal line, running posteroventrally to base of soft anal fin; posterior half of tips of membranes of spiny dorsal black, this black margin continuing on soft dorsal, broadening to angle then running off fin at about twentieth ray, below this a broad pale area then a broad black band as wide as ocular band running from anterior margin of soft dorsal transversely across caudal peduncle and onto posterior base of soft anal, a narrow pale line along its anterior edge; anal fin with narrow margin pale, then a narrow submarginal line, basal to this a broad pale area; caudal fin pale basally then a black crescent-shaped band, a narrow pale area distal to this crossing about halfway along fin, then

a narrow transverse dark line, broad margin (about one-third of fin) pale, hyaline; pectoral and pelvic fins pale.

CHAETODON QUADRIMACULATUS Gray

PLATE 54, B

Chaetodon quadrimaculatus GRAY, Zool. Misc., p. 33, 1833 (type locality, Sandwich Islands).

SPECIMENS STUDIED

Bikini Atoll: 2 stations, 6 specimens, 59 to 100 mm. total length.
Eniwetok Atoll: 1 station, 1 specimen, 74 mm.
Rongelap Atoll: 1 station, 1 specimen, 54 mm.
Rongerik Atoll: 1 station, 2 specimens, 88 and 92 mm.

Description.—Dorsal rays XIV (rarely XV),21 or 22; anal III,17 or 18; pectoral rays I,i,13 to 15 (usually 14); scales 39 to 45 rows in line from upper edge of gill opening to base of caudal rays.

Depth 1.5, head 2.95 to 3.4, both in standard length; snout 2.8 to 3.0, eye 3.0 to 3.1, least depth of caudal peduncle 2.8 to 3.1, length of pectoral fin 1.0 or 1.1, postorbital part of head 3.0 to 3.5 (from hind margin of eye to upper edge of gill opening), lower lobe of caudal fin 1.3 or 1.4, upper lobe 1.2 to 1.4, all in length of head; interorbital in eye 0.9 to 1.0.

Angle of snout profile with axis of body 53 to 60 degrees; angle formed by corner of mouth, center of eye, and insertion of pectoral fin (with eye at apex) 116 to 123 degrees; a line through center of caudal peduncle to mouth passes above pectoral axil (by diameter of pupil) and slightly below lower rim of orbit; caudal fin convex; teeth setiform.

Color in alcohol.—Upperpart of body blackish, the dark color extending onto dorsal fin sheath; caudal peduncle black; a white spot, round in small specimens, oblong in larger ones, on back beneath insertion of eighth to twelfth dorsal spines, a second white oblong streak 7 scale rows behind the first, beginning below insertion of third soft dorsal ray and following outline of body downward and backward to blend into yellowish white of lower sides; lower sides yellowish white with obscure lengthwise rows of brown spots fading posteriorly; a broad white band as wide as eye running from insertion of dorsal downward behind eye and including posterior part of head; head with a black-bordered gray band about as wide as eye from nape to eye, below eye to interopercle band pale, black-bordered, and with a thin line of white before and behind; interorbital and snout pale with faint dusky brown on upper lip; breast white; soft dorsal fin with black tips anteriorly, pale posteriorly, below this a broad white band, then a submarginal black line with a faint gray band proximally; anal similarly colored except that base of anal is pale, while base of dorsal

is dark; caudal fin pale or with scarcely evident thin black submarginal line; pectoral and pelvic fins pale.

Color when alive.—Snout, posterior part of head, breast, belly, and lower sides yellow; center of band through eye orange below eye; base of pectoral fin dark brown; dorsal fin brown at base, then a narrow band of white bordered distally by a thin black line, a broad yellow submarginal band and tips black; anal fin yellow at base, otherwise colored as dorsal; caudal fin bright yellow with narrow white margin; otherwise fish is colored as described in preserved specimen.

CHAETODON CITRINELLUS Cuvier

PLATE 51, C

Chaetodon citrinellus (Broussonet) CUVIER, *in* Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 7, p. 27, 1831 (type locality, Guam; Tahiti).

SPECIMENS STUDIED

Bikini Atoll: 18 stations, 51 specimens, 30 to 85 mm. in standard length.
Eniwetok Atoll: 6 stations, 24 specimens, 26 to 86 mm.
Rongelap Atoll: 7 stations, 12 specimens, 41 to 83 mm.
Rongerik Atoll: 4 stations, 10 specimens, 65 to 81 mm.
Guam: 7 lots, 26 specimens, 31 to 74 mm.
Rota: 1 lot, 3 specimens, 27 to 40 mm.

Description.—Dorsal rays XIV (rarely XV),20 or 21; anal III,15 or 16; pectoral I,i,13 or 14; scales 34 to 39 rows in lengthwise series from upper edge of gill opening to base of caudal rays.

Depth 1.7 or 1.8, head 3.0 to 3.3, both in standard length; snout 2.9 or 3.0, eye 2.9 to 3.2; least depth of caudal peduncle 3.1 or 3.2, length of pectoral fin 1.1 to 1.2, postorbital part of head (hind margin of eye to upper edge of gill opening) 3.2 to 3.5, lower lobe of caudal fin 1.3, upper lobe 1.2, all in length of head; interorbital in eye 1.0 or 1.1; angle of snout profile with axis of body 47 to 55 degrees, convex in tholichthys stage, straight in specimens 30 to 40 mm. and concave in large specimens; caudal fin convex; teeth setiform, curved at tip.

Color in alcohol.—A dark brown or black ocular band, slightly wider than pupil, white bordered above the eye, running from anterior insertion of dorsal to lower margin of interopercle; interorbital yellow, top of snout black, chin white; body with about 18 wavy rows of brown or blackish dots (smaller than pupil), blue in life, running upward and backward, fading on base of dorsal fin, smaller dorsally and posteriorly, lower four rows horizontal, base of dorsal and caudal peduncle with faint orange spots the size of brown scale spots; spinous dorsal with anterior margin of spines dusky, continued posteriorly on soft dorsal as a thin submarginal black line; narrow margin of soft dorsal white, base of dorsal yellow with indistinct yellowish-white flecks; anal fin with intense black broad band distally, then a yellow submarginal

band of about the same width, base of anal light dusky brown; caudal fin pale or white; pectoral pale; pelvics yellowish white with light brown flecks along rays.

CHAETODON EPHIPPIUM Cuvier

PLATE 56, A

Chaetodon ephippium CUVIER, *in* CUVIER and VALENCIENNES, Histoire naturelle des poissons, vol. 7, p. 80, pl. 174, 1831 (type locality, Moluccas, Society Islands).

SPECIMENS STUDIED

Bikini Atoll: 11 stations, 16 specimens, 114 to 169 mm. standard length.
Eniwetok Atoll: 4 stations, 5 specimens, 69 to 149 mm.
Rongelap Atoll: 1 station, 1 specimen, 28 mm.
Guam: 4 lots, 30 specimens, 52 to 134 mm.

Description.—Dorsal rays XIII,24; anal III,21 to 23; pectoral I,i,14 or 15; scales 37 or 38 rows in lengthwise series from upper angle of gill opening to base of caudal fin rays.

Depth 1.6 to 1.8, head 2.6 to 3.3, both in standard length; snout 2.4 to 2.8, eye 2.8 to 4.3, least depth of caudal peduncle 3.0 or 3.1, length of pectoral fin 1.3 or 1.4; postorbital part of head (hind margin of eye to upper edge of gill opening) 3.0 to 3.5, upper lobe of caudal fin 1.3, lower lobe 1.4, all in length of head; interorbital in eye 0.8 to 1.1; angle of snout profile 48 to 57 degrees, concave; caudal fin convexly rounded in 28-mm. specimen, straight in 69-mm. specimen, concave in largest specimen, 169 mm.; fourth and fifth dorsal rays produced and threadlike in specimens over 100 mm., produced rays wanting in 69-mm. specimen, about as long as width of eye in 114-mm. specimen, as long as base of soft dorsal in 169-mm. specimen; snout more produced in adult than in juvenile specimens; teeth setiform, long, slender, bent at tips; lateral line smoothly arched to posterior base of dorsal fin.

Color in alcohol.—Ground color pale yellowish gray; lower sides with six or seven lengthwise stripes (not evident in all specimens), upper posterior part of back and basal part of spinous dorsal, beginning at eighth dorsal spine, with a large black patch, bordered ventrally with a wide white band; caudal peduncle white on upper half, yellow on lower half; a thin black line descending diagonally from fourth dorsal spine toward pectoral axil, following a scale row ending at level of eye, a second straight black line just behind opercular opening from insertion of pectoral to midway to insertion of dorsal, a black spot above and below eye (remnants of ocular band), a silvery brown blotch below eye, extending forward along side of snout; spinous dorsal with spines white, membranes with a black line starting at base of second spine, gradually becoming more distal until it joins black blotch; soft dorsal with a broad pale margin, a narrow submarginal black line, then a yellow band slightly wider than pale

margin, extended rays white on top, black proximally below; anal fin with a thin, black margin, a black-edged yellow line extending along edge of scaly sheath; caudal pale with thin black lines following rays, pectoral and pelvic fins pale; young (28 mm.) with strong black ocular band slightly wider than pupil, reaching from insertion of dorsal to lower edge of interopercle; caudal peduncle entirely black; scaly sheath of anal dusky; in 69-mm. specimen ocular band narrower, fainter, shorter, extending from a point about width of eye above eye to lower edge of preopercle; caudal peduncle with black blotch on upper half only; scaly sheath of anal much lighter than in 28-mm. specimen.

CHAETODON AURIGA Forskål

PLATE 56, B

Chaetodon auriga FORSKÅL, Descriptiones animalium, pp. XIII, 60, 1775 (type locality, Djidda, Lohaja, Arabia, Red Sea).

SPECIMENS STUDIED

Bikini Atoll: 11 stations, 33 specimens, 16 to 154 mm. standard length.
Eniwetok Atoll: 5 stations, 37 specimens, 18 to 155 mm.
Rongerik Atoll: 2 stations, 2 specimens, 140 to 143 mm.
Rongelap Atoll: 3 stations, 3 specimens, 136 to 163 mm.
Guam: 8 lots, 50 specimens, 32 to 132 mm.

Description.—Dorsal rays XIII (rarely XII),23 or 24; anal III,18 to 20; pectoral I,i,14 or 15; scales 29 to 36 in lengthwise series from top of opercular opening to base of caudal fin rays.

Depth 1.5 to 1.8, head 2.4 to 3.1, both in standard length; snout 2.3 to 3.0, eye 2.8 to 3.9, least depth of caudal peduncle 2.9 to 3.4, length of pectoral 1.2 to 1.5, postorbital part of head (from hind margin of eye to posterior edge of opercular flap) 2.2 to 2.8, lower lobe of caudal fin 1.4 to 1.6, upper lobe 1.3 to 1.5, all in length of head; interorbital in eye 0.9 to 1.1; angle of snout profile with axis of body 48 to 53 degrees; angle formed by corner of mouth, eye, and insertion of pectoral (with eye at apex) 118 to 130 degrees.

A line through center of the caudal peduncle to angle of mouth passes above pectoral axil and along lower margin of orbit; hind margin of caudal fin truncate; in adults fifth and sixth dorsal rays greatly elongated and filamentous; at 69 mm. these dorsal rays are just beginning to elongate; at 79 mm. elongated dorsal rays equal diameter of pupil; at 85 mm. these rays have elongated to equal diameter of eye; lateral line smoothly arched ending under fifteenth or sixteenth dorsal rays; teeth long, slender, smoothly curved to pointed tip.

Color in alcohol.—Ground color of head and body dirty grayish white flecked with light brown; a black band faint and narrow on nape, broadening below eye to wider than eye to ventral margin of opercle, where it meets its fellow; anterodorsal part of body with 5

oblique lines, broadening from head and bending posteriorly just below base of dorsal fin; at right angles to fifth line are 10 or 11 diagonal lines running posteroventrally, the uppermost 3 or 4 broader and not so distinct; dorsal fin with black margin, white submarginal area, filamentous dorsal rays with upper half black and lower half white; yellow at base; a large black oval to round spot on sixth to thirteenth dorsal rays, spot sometimes ocellated; anal fin with narrow white margin, a narrow submarginal black line, yellowish white basally; caudal fin pale yellow at base, margin pale, 2 black submarginal lines separated by a pale yellow vertical band as wide as diameter of pupil; pectoral and pelvic fins white.

Young of 20 mm. have a large black spot at base of first dorsal rays; body stripes as adult but very thin and faint, ocular band uniform width, slightly narrower than diameter of eye, from origin of dorsal fin through eye to lower edge of opercle; caudal peduncle pale; at 40 mm. dorsal fin spot round located just below margin of fin; ocular band more intense below eye than above; anterior body stripes very distinct.

Color when alive.—Pattern as described for preserved specimens. Top of snout yellow; anterior margin of subocular band narrowly bordered with bluish white line; bases of vertical fins and caudal peduncle bright golden yellow; a pink vertical submarginal bar with tapering ends on caudal between pale margin and posterior black vertical line.

CHAETODON SEMEION Bleeker

Chaetodon semeion BLEEKER, Nat. Tijdschr. Nederl. Indië, vol. 8, p. 450, 1855 (type locality, Cocos-Keeling).

SPECIMEN STUDIED

Rongerik Atoll: Bock Island, ocean reef, high-tidal pool, April 24, 1946, S–46–113, Brock and Marr, 1 specimen, 126 mm.

Description.—Dorsal rays XIII,25; anal III,21; pectoral I,i,14; scales 32 rows in lengthwise series from upper edge of gill opening to base of caudal fin rays.

Depth 1.6, head 3.2, both in standard length; snout 2.9, eye 4.0, least depth of caudal peduncle 3.0, length of pectoral 1.2, postorbital part of head (eye to upper edge of gill opening) 3.1, lower lobe of caudal fin 1.3, upper lobe 1.1, all in length of head (tip of snout to hind margin of opercular flap); interorbital in eye 0.9; angle of snout profile with axis of body 60 degrees; a line through the center of caudal peduncle to tip of snout passes about three-fourths of eye's diameter above axil of pectoral and through center of eye; snout concave and turned up at end; caudal truncate, slightly concave; dorsal fin with first three soft rays elongated and threadlike.

Color in alcohol.—Ocular band dark brown, extending from origin of dorsal fin to lower margin of interopercle, joined with band on opposite side across front of nape and interorbital extending onto top of snout; band broader than eye below eye; sides of snout, chin, posterior part of head and body yellowish white (orange in life); back and sides of body with small, round, brown dots in middle of each scale in 13 or 14 rows following scale rows, these dots extending onto base of soft dorsal fin but not onto base of anal or caudal peduncle; dorsal and anal fins with black band at base, broadening posteriorly, this band wider on dorsal than on anal fin; then a light area, broader on anal than dorsal; both fins with a thin submarginal black line on posterior part and a pale margin; extended rays of soft dorsal pale yellow; caudal, pectoral, and pelvic fins yellowish white at base, clear white distally except caudal with very fine, lengthwise black lines, following upper border of rays in upper half of fin and lower border of rays in lower half.

CHAETODON MERTENSII Cuvier

PLATE 57, A

Chaetodon mertensii CUVIER, *in* Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 7, p. 47 (on a figure by Mertens), 1831 (type locality unknown).

SPECIMENS STUDIED

Bikini Atoll: 3 stations, 6 specimens, 66 to 83 mm. standard length.
Rongelap Atoll, 1 station, 2 specimens, 60 to 75 mm.

Description.—Dorsal rays XIII (rarely XII),21 to 23; anal III,16 or 17; pectoral I,i,13; scales 32 to 36 rows in lengthwise series from upper edge of gill opening to base of caudal rays.

Depth 1.6 or 1.7, head 3.1 or 3.2, both in standard length; snout 2.7 to 2.9, eye 3.0 to 3.3, least depth of caudal peduncle 3.1 or 3.2, length of pectoral fin 1.1 or 1.2, postorbital part of head (hind margin of eye to upper edge of gill opening) 3.5 to 3.9, lower lobe of caudal fin 1.3 or 1.4, upper lobe 1.2 or 1.3, all in length of head; interorbital in eye 1.0 or 1.1; angle of snout profile with axis of body 50 to 54 degrees, profile concave; caudal fin straight; teeth setiform, curved; a line through center of caudal peduncle to tip of snout passes well above axil of pectoral fin and across lower rim of orbit; posterior margin of dorsal fin rounded, that of anal fin angulate.

Color in alcohol.—Ocular band dark brown, wider than pupil above eye and bordered with narrow white line, joining its fellow about midway between tip of snout and origin of dorsal fin, faint below eye, narrower than pupil, no white border, fading out at lower edge of preopercle; a large indistinct black nuchal blotch; anterior two-thirds of body with 6 or 7 very distinct, chevron-shaped, vertical

bars, originating at base of dorsal, inclined slightly forward, following scale rows, until reaching a line from upper edge of gill opening to center of caudal peduncle, then directed backward, fading on belly and at base of anal fin; behind these bars scale spots arranged to make up 3 or 4 more indistinct, narrower bars; posterior one-fourth of body, including posterior bases of dorsal and anal fins and caudal peduncle yellow; dorsal fin with brown base anteriorly, yellow base posteriorly, soft dorsal with narrow, black, submarginal line and narrow, colorless margin; caudal fin pale at base, a broad pale margin, and a yellow band across center of fin, this band wider in middle; anal fin base brown anteriorly, yellow posteriorly, posterior part only with a very thin, submarginal, black line and pale margin; pectoral and pelvic fins pale.

Remarks.—The specimens listed above have been compared with a specimen of *Chaetodon chrysurus* Desjardins from Mauritius (U.S. N.M. No. 43934). The only differences noticed are: In C. *chrysurus* the nuchal spot is very distinct, outlined in white and shaped like an inverted horseshoe; in *C. mertensii* the dark color on the nape does not have a regular form, is not outlined in white, and is usually quite indistinct; the chevron-shaped bars on the body are narrower and more numerous in *chrysurus* (6 complete and 8 incomplete or indistinct); in *mertensii* they are broader and less numerous (4 complete and 6 incomplete or indistinct); the fin counts in *chrysurus* are within the range of those of *mertensii*. Day (Fishes of India, p. 105, 1878–88), Jordan and Seale (Bull. Bur. Fisheries, vol. 25, 1905, p. 341, 1906), and Weber and de Beaufort (The fishes of the Indo-Australian Archipelago, vol. 7, pp. 113–14, 1936), have all recognized these two species as different.

CHAETODON PUNCTATO-FASCIATUS Cuvier

PLATE 58, B

Chaetodon punctato-fasciatus CUVIER, *in* Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 7, p. 28, 1831 (type locality unknown).

SPECIMENS STUDIED

Bikini Atoll: 2 stations, 2 specimens, 39 and 67 mm. standard length.
Eniwetok Atoll: 1 station, 2 specimens, 35 and 75 mm.
Rongelap Atoll: 3 stations, 6 specimens, 35 to 72 mm.

Description.—Dorsal rays XIII,22 to 25, usually 24; anal III,17 or 18; pectoral I,i,12 or 13; scales 35 to 40 in lengthwise series from upper edge of gill opening to base of caudal fin rays.

Depth 1.5 to 1.7, head 2.5 to 3.5 both in standard length; snout 2.4 to 3.0, eye 2.7 to 3.2, least depth of caudal peduncle 3.0 to 3.5, length of pectoral fin 1.0 to 1.2, postorbital part of head (from hind margin of eye to upper margin of gill opening) 3.1 to 3.4, lower lobe of caudal

fin 1.4, upper lobe 1.2, all in length of head; interorbital in eye 1.0 or 1.1; angle of snout profile with axis of body 47 to 63 degrees; caudal fin very slightly convex, nearly straight; teeth hooked.

Color in alcohol.—Ocular band as wide as pupil, short, extending above eye a little farther than diameter of pupil and below eye to base of preopercle, where it fades; center of band pale, bordered by narrow black lines; a black spot on nape just below insertion of dorsal; tip of snout, interorbital, and sides of head above eye dusky; body with brown spots in wavy lengthwise rows, one under each scale; posterior part of back with 6 narrow vertical brown bands not so wide as pupil, originating at base of dorsal fin, these not extending beyond a line through axil of pectoral and center of caudal peduncle, fading out ventrally and anteriorly, first originating under sixth or seventh dorsal spine and barely evident, last originating under fifteenth dorsal ray and extending to top of caudal peduncle; caudal peduncle entirely pale yellow; breast and belly white; dorsal fin dark grayish black at base, the color more intense distally with a thin dirty white line on its outer border, margin of fin white; anal fin pale at base with a black submarginal line and a white margin; caudal fin crossed about middle by a vertical, black, crescent-shaped bar; pectoral and pelvic fins pale.

Color when alive.—Ocular band yellow in center, black bordering lines very narrow; first dorsal spine bright yellow; space between vertical bars pale yellow with no brown spots showing between them; caudal peduncle bright yellow; margins of dorsal and anal fins pale yellow; otherwise color and pattern as described for preserved specimen.

Remarks.—The fish described as *Chaetodon multicinctus* by Garrett (Proc. California Acad. Sci., vol. 3, p. 65, 1863), based on 2 specimens from Honolulu, and figured by Günther (Fische der Südsee, Journ. Mus. Godeffroy, vol. 1, pt. 1, pl. 34, fig. B) is not the same species as our specimens from the Marshall Islands (see pl. 58, A). We have examined 4 specimens from Honolulu (U.S.N.M. Nos. 88199 and 55366) from 67 to 81 mm. and find them different from ours in several respects as shown in the key and in table 52.

TABLE 52.—*Counts made on* Chaetodon punctato-fasciatus *and* C. multicinctus

Species	Dorsal rays					Anal rays				Pectoral rays					Scale rows from upper angle of gill opening to base of caudal fin rays												
	XIII	22	23	24	25	III	17	18	19	I	1	12	13	14	35	36	37	38	39	40	41	42	43	44	45	46	47
punctato-fasciatus	10	1	2	6	1	9	4	6	--	10	10	2	6	--	1	--	2	2	2	2	--	--	--	--	--	--	--
multicinctus	9	--	--	1	7	9	--	3	6	9	9	--	5	4	--	--	--	--	--	--	--	--	--	1	2	4	2

The most striking differences are in color pattern. In *multicinctus* the ocular band above the eye is dark in the center and extends, tapering, to, or almost to, the nuchal spot. In *punctato-fasciatus* the band is always pale in the center and terminates a very short distance above the eye. In *multicintus* the first vertical bar is under the third dorsal spine, the bars are as broad as two-thirds of the diameter of the eye, with the spaces between them as wide as the diameter of the eye, and they extend downward to below a line from the center of the caudal peduncle to the axil of the pectoral. In *punctato-fasciatus* the first three bars are very faint; the first originates under the sixth or seventh dorsal spine, the bars are no broader than the diameter of the pupil, the spaces between them no wider than the bars, and they do not extend below a line from the center of the caudal peduncle to the axil of the pectoral. The caudal peduncle is entirely pale (yellow) in *punctato-fasciatus*, while in *multicinctus* the caudal peduncle has a narrow brown band around its middle. The body spots are smaller, more numerous, and not so distinct in *multicinctus*.

These two species have been mistakenly synonymized by Bleeker (Atlas ichthyologique des Indes Orientales Néerlandaises, vol. 9, p. 40, pl. 374, fig. 3, 1877) and by Jordan and Evermann (Bull. U. S. Fish Comm., vol. 23 (1903), pp. 369, 370, fig. 162, 1905). The statement of the latter that the Cuvier and Valenciennes specimen was probably from the Hawaiian Islands has no justification. Günther in his discussion of Garrett's figure (ibid., vol. 1, p. 44) says he believes Garrett's figure represents not *C. punctato-fasciatus* but a very closely related species. We have found no overlapping in the characters given. Our specimens verify Günther's opinion and we herewith resurrect the Hawaiian Island *C. multicinctus*.

Subfamily POMACANTHINAE

By LOREN P. WOODS and LEONARD P. SCHULTZ

KEY TO THE SPECIES OF POMACANTHINAE OF THE NORTHERN MARSHALL ISLANDS AND ADJOINING REGIONS

1*a*. Scales in about 90 to 100 irregular rows crossing side of body; hind margin of preorbital not free; young not colored as adults; specimens 16 to 93 mm., with the following color pattern: general color blackish with a wide white ring just in front of caudal peduncle, usually with a white bar or dot in center; around this a pale semicircular line; 3 to 7 additional vertical semicircular lines, alternating wider and narrower; caudal peduncle with 2 vertical lines; chin with white line in center; white lines in corner of mouth, across interorbital, behind eye and across opercle; body lines extending onto soft dorsal and anal fins, where they form a simple network; caudal fin dusky distally with a white-bordered wavy black line near its base; adults (over 200 mm.) with a black patch above pectoral that extends onto chest and throat, 15 to 23 narrow light bands on body running from black spot posteriorly including bases of soft dorsal and anal fins, nearly horizontal on lower part of body, inclined upward on upper sides; a dark stripe widening to width of eye running from angle of preopercle across eye and interopercle; dorsal XIV,19 to 21; anal III,18 or 19; scales 90 to 103---------- Pomacanthus imperator (Bloch) (p. 599)

1*b*. Scales in about 50 rows or fewer on side of body; lateral line terminating near end of soft dorsal.

2*a*. Interoperculum without spines,[22] posteriorly with a narrow branch reaching to suboperculum; preorbital convex, without spines, its hind margin not free, not serrated; interorbital width greater than eye; head and breast light brown; body with 7 or 8 black-bordered, white, nearly vertical bands; on head a narrow black-bordered blue band descending from near origin of dorsal around posterior margin of eye and extending forward below it; a second similar band descending from nape across operculum; faint median band on snout and curved one on interorbital; interorbital area black; soft dorsal fin black with a submarginal light line; soft anal with a pale margin and five or six alternting light and dark lines; caudal, pelvic, and pectoral fins pale; dorsal XIV,18; and III,17 or 18; scales 47 to 50.

Pygoplites diacanthus (Boddaert) (p. 600)

2*b*. Interoperculum serrated or with spines posteriorly,[22] remote from suboperculum; hind margin of preorbital free; serrated or with strong spines; interorbital width equal to or less than eye.

3*a*. Body uniformly yellowish on adults (black spot near center of body on young of *Centropyge flavissimus*); no black spot on base of pectoral fin.

4*a*. Margin of soft dorsal, anal, and caudal fins with a black marginal line; narrow dark ring surrounding eye; vertical black bar on hind margin of opercle (sometimes diffuse); chin and interopercles

[22] After Fraser-Brunner, Proc. Zool. Soc. London, 1933, pt. 3, p. 548.

usually dusky; pectoral and pelvic fins pale; dorsal XIV,15 or 16; anal III, 16; scales 44 to 50.

Centropyge flavissimus (Cuvier) (p. 601)

4*b*. Margin of soft dorsal, anal, and caudal fins lacking black marginal line; head mottled with dark brown, with wavy white lines between; dark color most intense behind orbit, which lacks a dark ring; soft dorsal with two faint submarginal dark lines; anal fin with two fairly distinct submarginal lines; pectoral and pelvic fins pale; dorsal XV,15; anal III,17; scales 46 to 48.

Centropyge heraldi, new species (p. 602)

3*b*. Body not uniformly colored as in 3*a*.

5*a*. No black spot at base of pectoral and none basally on soft dorsal.

6*a*. Anterior part of body yellowish, sharply contrasting with blackish posterior part of body; change of color occurring from sixth and seventh dorsal spines to just in front of anus; anterior margin of black area thinly bordered with white; a large black blotch on nape and interorbital running across anterior margin of profile from upper rim of each eye; soft dorsal and anal fins black; caudal yellow; pectorals and pelvics pale; dorsal XIV,15, anal III,17; scales about 46; plate 55, C.

Centropyge bicolor (Bloch)

6*b*. Anterior part of body paler than posterior part, pale coloration gradually changing to blackish posteriorly; posterior part of opercle blackish; pectoral and pelvics pale; submarginally the median fins have a black line, distally the edge of these fins is narrowly marked with a white line; dorsal XIV,16, anal III, 17; scales about 46 or 47. Centropyge vrolikii Bleeker (p. 603)

6*c*. Color not as in 6*a* or 6*b*.

7*a*. Body with about 18 to 20 narrow transverse streaks of bluish black separated by narrow light interspaces; head and back above lateral line dark brownish black; breast and belly dark yellowish brown; dorsal and anal edged with blue; caudal fin with a broad blue, submarginal stripe; dorsal, anal, caudal, and pelvic fins blackish; pectoral pale; dorsal rays XIV,16 or 17; anal III,15 to 17; scales 40 to 45.

Centropyge bispinosus (Günther) (p. 604)

7*b*. Body with about 6 or 7 intensely black bars on sides separated by pale interspaces; posteriorly both soft dorsal and anal fins blackish; background color when alive flame scarlet; dorsal XIV,16 or 17; anal III,16 to 18; scales 44 to 47.

Centropyge flammeus, new species (p. 604)

5*b*. A large black spot on base of pectoral and another black spot about same size basally on soft dorsal; body otherwise pale; dorsal rays XIII,15; anal III,15; scales 44.

Centropyge nigriocellus, new species (p. 607)

Genus POMACANTHUS Lacepède

Pomacanthus Lacepède, Histoire naturelle des poissons, vol. 4, p. 517, 1802. (Genotype, *Chaetodon arcuatus* Linnaeus, as restricted by Cuvier.)

POMACANTHUS IMPERATOR (Bloch)

PLATE 59, B

Chaetodon imperator BLOCH, Naturgeschichte der ausländischen Fische, vol. 3, p. 51, pl. 174, 1787 (type locality, Japan). (Reference copied.)

SPECIMENS STUDIED

Bikini Atoll: 4 stations, 5 specimens, 235 to 275 mm. standard length.
Guam: 3 lots, 9 specimens, 16 to 93 mm.

Description.—Dorsal rays XIV,19; anal III,18 or 19; pectoral I,i,16 to 18; scales about 90 to 103 rows in lengthwise series to base of caudal rays.

Depth 1.7 or 1.8, head 2.5 to 4.0, both in standard length; snout 2.1 to 3.0, eye 2.5 to 4.5, least depth of caudal peduncle 2.1 to 2.4, length of pectoral 1.0 to 1.6, postorbital part of head (hind margin of eye to upper edge of gill opening) 3.1 to 3.8, longest caudal ray 1.2 to 1.4, all in length of head; interorbital in eye 0.7 to 1.0; angle of snout profile with axis of body 50 (in nicobariensis stage) to 55 (in adults); caudal fin rounded; pectoral fin rounded in nicobariensis stage, angulate in adults; teeth setiform, strong, in a single row; interopercle without spines; interorbital free only on anterior margin; soft dorsal rays rounded in specimens up to 94 mm., produced in specimens 235 to 275 mm.

Color in alcohol.—ADULTS: Head and nape dark grayish brown, a black stripe widening to width of eye running from angle of preopercle to eye and across interorbital; a large black patch as wide and as long as pectoral, above pectoral fin; breast and belly black; 22 or 23 narrow yellowish-white lines commencing at hind margin of scapular spot, running posteriorly and obliquely upward onto base of soft dorsal and caudal peduncle, nearly horizontal on lower sides; dorsal spines and their membranes pale on distal one-third, soft dorsal with pale margin (very narrow on posterior part) and a narrow black submarginal line; anal fin black with 3 or 4 faint blue lines following outline of fin; caudal fin yellow; pectoral fin black on basal two-thirds, distal one-third pale; pelvics with grayish-brown rays and darker membranes.

YOUNG: Ground color brownish black; 3 to 7 vertical semicircular white lines on head and body; alternating lines wider and more distinct; line on anterior part of caudal peduncle forming a complete circle with a small white spot in center; caudal peduncle with two vertical lines; lines forming a simple network on soft dorsal and anal fins, very narrow margin of these fins pale; spiny dorsal with distal portion pale; caudal fin base with white-bordered, black, wavy line, rays dusky, membranes pale; pectoral fin base black, rays dusky, membranes pale; pelvic fin dusky.

Color when alive.—ADULT: Pattern as described from preserved specimen; black ocular band bordered with blue; anterior margin of black scapular patch blue; body lines bright yellow; body ground color dark purple; ground color of head olive-brown; spiny dorsal and dorsal margin of extended soft rays white, lower part of extended rays yellow; posterior part of soft rays with narrow, black, submarginal line and broad yellow area proximally; caudal fin orange.

Genus PYGOPLITES Fraser-Brunner

Pygoplites FRASER-BRUNNER, Proc. Zool. Soc. London, 1933, p. 587. (Genotype, *Chaetodon diacanthus* Boddaert.)

PYGOPLITES DIACANTHUS (Boddaert)

PLATE 55, B

Chaetodon diacanthus BODDAERT, Epistola . . . de *Chaetodonte diacantho* descripto, p. 19, 1772 (type locality, Amboina, Moluccas). (Reference copied.)

SPECIMENS STUDIED

Bikini Atoll: 3 stations, 3 specimens, 67 to 164 mm. standard length.

Description.—Dorsal rays XIV,18; anal III,17 or 18; pectoral I,i,15; scales 47 to 50 rows in lengthwise series from upper edge of gill opening to base of caudal rays.

Depth 1.7 to 2.0, head 3.3 to 3.9, both in standard length; snout 2.2 to 3.0, eye 2.8 to 4.3, least depth of caudal peduncle 2.0 to 2.2, length of pectoral 1.0 to 1.4, postorbital part of head (hind margin of eye to upper edge of gill opening) 3.0 to 3.4, longest caudal ray 1.0 to 1.1, all in length of head; interorbital in eye 0.9 to 1.1; angle of snout profile with axis of body 47 to 55 degrees, convex in young, straight in 116-mm. specimen, slightly concave in largest specimen; caudal fin convex and rounded; teeth in a single row, strong; lateral line terminates near posterior base of dorsal fin; preocular with 2 or 3 small, blunt teeth on lower margin, not free on hind margin; interoperculum scaled, not toothed; angle of preopercle with a long, strong spine and 2 small spines anteriorly very close to interoperculum.

Color in alcohol.—Head and breast light brown; body with 7 or 8 black-bordered, white, nearly transverse bands, bent backward at top and bottom and extending onto spiny dorsal and anal fins; interorbital area black, bordered posteriorly by a narrow, black-margined, blue line which originates just anterior to insertion of dorsal fin, descending to eye, curving around its posterior rim and extending forward below eye; a second black-margined, blue line descends from nape across hind margin of operculum; soft dorsal fin black with a submarginal light line; a faint blue band from anterior margin of eye across interorbital; snout with median light line; caudal fin yellow;

anal fin with a pale margin and 5 or 6 alternating light and dark lines more or less following outline of fin; pectoral and pelvic fins pale; 67-mm. specimen with a black ocellus about size of pupil on soft dorsal near base.

Color when alive.—Pattern as described for preserved specimens except area around mouth yellow; breast white; sides with 9 sets of vertical, white, black-bordered bars alternating with yellow, the black borders coming together at the top and bottom; margin of spiny dorsal and soft anal fins reddish orange; caudal and pelvic fins bright yellow; pectoral fin pale.

Genus CENTROPYGE Kaup

Centropyge KAUP, Arch. Naturg., vol. 26, pt. 1, p. 140, 1860. (Genotype, *Centropyge tibicen* Kaup.)

CENTROPYGE FLAVISSIMUS (Cuvier)

PLATE 57, B

Holacanthus flavissimus CUVIER, *in* Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 7, p. 197, 1831 (type locality, Ulia).

SPECIMENS STUDIED

Bikini Atoll: 13 stations, 75 specimens, 42 to 85 mm. standard length.
Eniwetok Atoll: 3 stations, 9 specimens, 48 to 70 mm.
Rongelap Atoll: 9 stations, 82 specimens, 25 to 67 mm.
Rongerik Atoll: 3 stations, 7 specimens 35 to 75 mm.
Kwajalein Atoll: 2 stations, 6 specimens, 19 to 73 mm.

Description.—Dorsal rays XIV,15 or 16; anal III,16; pectoral I,i,14 or 15; scales 44 to 50 rows in lengthwise series from upper edge of gill opening to base of caudal fin rays.

Depth 1.6 to 1.8, head 3.0 to 3.3, both in standard length; snout 2.6 to 3.7, eye 2.6 to 3.5, least depth of caudal peduncle 1.9 to 2.3, length of pectoral 1.0 or 1.1, postorbital part of head (hind margin of eye to upper edge of gill opening) 2.6 to 3.4, lower lobe of caudal fin 1.1, upper lobe 1.1, all in length of head; interorbital in eye 0.9 to 1.1; angle of snout profile 45 to 57 degrees, convex; caudal fin convex, rounded; teeth setiform, long, flattened, tricuspid, the middle lobe much larger, the two lateral lobes very small; lateral line ending at posterior base of dorsal fin.

Color in alcohol.—Head and body uniform yellow or yellowish white, back slightly darker than belly; some specimens with margins of scales along sides dusky brown, centers pale, so as to appear finely cross-hatched; a narrow dark ring surrounding orbit; a vertical black bar on hind margin of opercle, sometimes diffuse; chin and interopercles usually dusky; dorsal, caudal, and anal fins with a narrow, black, submarginal line, very narrow pale margin; pectoral and pelvic fins pale.

Young males up to 35 mm. standard length, according to Fraser-Brunner (Proc. Zool. Soc. London, p. 595, fig. 27, 1933), have a coloration similar to that of adults, except that a round ocellated spot, slightly larger than the eye, occurs on the middle of each side.

One specimen aberrantly colored with a round, black spot about the size of pupil above and behind eye, a small black bar across occiput; three faint bars across chest; soft dorsal and anal dusky black on posterior part; distal two-thirds of caudal dusky black; specimen otherwise colored as typical *flavissimus*.

Color when alive.—Head and body brilliant chrome yellow; top of snout and head reddish orange; ocular ring, opercular bar, chin and interopercles grayish blue to deep blue; submarginal line on vertical fins deep blue to black; pectoral and pelvic fins yellow. Young with an ocellate blue spot on middle of side.

CENTROPYGE HERALDI, new species

PLATE 59, A

Centropyge flavissimus AOYAGI (not Cuvier *in* Cuvier and Valenciennes), Coral fishes, p. 187, pl. 26, fig. 1, 1943 (Okinawa).

Holotype.—U.S.N.M. No. 140093, Bikini Atoll, Arji Island, 100 yards off shore, lagoon coral area at depths from 0 to 40 feet, poison and spear, August 7, 1946, S–46–308, Brock and Herald, 72 mm.

Paratypes.—U.S.N.M. No. 140094, same data as holotype, 13 specimens, 47 to 71 mm.; U.S.N.M. No. 140092, Bikini Atoll, Boby Island, at north end, ocean reef, August 17, 1946, S–46–383, Herald, 1 specimen, 74 mm.; U.S.N.M. No. 140096, Rongelap Atoll, Kabelle Island, north end, lagoon reef, June 20, 1946, S–46–231, Schultz and Herald, 1 specimen, 77 mm.; U.S.N.M. No. 140095, Rongelap Atoll, Tufa Island, lagoon coral heads at depth of 28 feet, poison and spear, July 28, 1946, S–46–300, Brock and Herald, 1 specimen, 56 mm.

Description.—Counts and measurements of holotype are given first, followed in parentheses by counts and measurements of two paratypes. All measurements expressed in thousandths of the standard length.

Dorsal rays XV,15 (XV,15; XV,15); anal III,17 (III,17; III,17); pectoral rays, I,i,15 (I,i,14; I,i,12); scales 46 (46, 48) rows in lengthwise series from upper edge of gill opening to base of caudal rays.

Depth 524 (554; 513); head 285 (309; 263); snout 101 (85; 92); eye 87 (117; 101) least depth of caudal peduncle 142 (149; 145); length of pectoral fin 264 (277; 258); postorbital part of head (hind margin of eye to upper edge of gill opening) 97 (100; 105); length of longest caudal ray 250 (255; 250); interorbital 83 (95; 92).

Angle of snout profile with lengthwise axis of body 46 to 52 degrees, profile convex; angle formed by corner of mouth, center of eye and insertion of pectoral fin (with eye at apex) 88 to 97 degrees; teeth tricuspid with center cusp long, strong, and slightly bent; preopercle denticulate with a single long and strong spine at the angle; two small spines anterior along the lower limb of the preopercle; interoperculum small with 3 or 4 small spines directed posteriorly; preorbital free along its lower margin and for a small portion of its hind margin with 6 to 10 small straight spines; lateral line ends near posterior margin of dorsal fin but scales along middle of caudal peduncle marked in center, although there is no apparent channel.

Color in alcohol.—Body uniform pale yellowish white; back with faint dusky brown in some specimens; head mottled with dark brown, with wavy white lines or irregular spots; dark color most intense behind eye; lower lip dusky; dorsal fin pale, soft dorsal with two faint, submarginal, dark lines; caudal fin entirely pale; anal fin pale with a fairly distinct dark, submarginal line running from base of second spine to posterior angle of soft rays; a second line proximally, often very faint; pectoral and pelvic fins entirely pale.

Remarks.—This species differs from all members of the genus *Centropyge* in regard to color pattern of the head and fins. It appears to be most closely related to *C. flavissimus* but does not have the thin, black, submarginal line around the vertical fins; soft rays of the dorsal and anal fins form a more acute angle, the body is also more slender. The greater number of dorsal spines (XV or XVI) separates *heraldi* from all species of the genus except *C. flavicauda*, *bispinosus* and *nox*, from which it differs in coloration.

Aoyagi has described and figured a specimen from Okinawa under the name *C. flavissimus*, which is certainly the same as our *heraldi*. He gave no fin ray counts, but his excellent black and white figure shows XVI dorsal spines, characteristic of *heraldi*, and two more than found in *flavissimus*. His description of coloration and the color pattern shown in his figure are very similar to those for our species.

Named for Earl S. Herald, head of the Steinhardt Aquarium, California Academy of Sciences, San Francisco.

CENTROPYGE VROLIKII Bleeker

Holacanthus vrolikii BLEEKER, Nat. Tiidschr. Ned. Ind. vol. 5, p. 339, 1853 (type locality, Amboina).

SPECIMENS STUDIED

Arno Atoll: Ine Island, lagoon reef, 1950, Strasburg and Hiatt, 2 specimens, 43 to 46 mm. standard length.

Description.—Dorsal rays XIV,16; anal III,17; pectoral I,i,14 or 15; scales about 46 or 47.

Depth 1.7 to 1.8, head 3.1 to 3.2, both in standard length; snout 2.8 to 3.0, eye 2.8 to 2.9, least depth of caudal peduncle 2.0, length of pectoral 1.1 to 1.2, postorbital length of head 2.2 to 2.3, all in length of head.

Color in alcohol.—Light brown anteriorly, changing to dark brown or blackish posteriorly, especially caudal fin and posterior part of dorsal and anal fins blackish; median fins narrowly edged with white line, then submarginally a black line; rear part of opercle blackish.

CENTROPYGE BISPINOSUS (Günther)

Holacanthus bispinosus GÜNTHER, Catalogue of the fishes in the British Museum, vol. 2, pp. 48, 516, 1860 (type locality, Sea of Amboyna; Aneiteum.)

SPECIMEN STUDIED

Bikini Atoll, Arji Island, 100 yards off shore, lagoon coral area, at depths from 0 to 40 feet, poison and spear, August 7, 1946, S–46–308, Brock and Herald, 1 specimen, 63 mm.

Description.—Dorsal rays XIV,16; anal III,17; pectoral I,i,14; scales 45 rows in lengthwise series from upper edge of gill opening to base of caudal rays.

Depth 1.7, head 3.4, both in standard length; snout 2.8, eye 2.8, least depth of caudal peduncle 2.0, length of pectoral fin 1.0, postorbital part of head (hind margin of eye to upper edge of gill opening) 2.6, longest caudal ray 1.0, all in length of head; interorbital in eye 1.1; angle of snout profile with lengthwise axis of body 50 degrees, profile convex; interorbital and snout flattened; edge of preopercle denticulate, an enlarged spine at angle, a second spine (as long as diameter of pupil) anterior; interopercle with two small slender spines; preorbital with 3 or 4 spines along lower margin; lateral line ending at posterior base of dorsal fin.

Color in alcohol.—Head and back (above lateral line) dark brownish black; breast and belly dark yellowish brown; dorsal, caudal, and anal fins black; sides of body with alternating scale rows dark and light so as to give the appearance of 20 or 21 light (more or less irregular ventrally) vertical lines; pectoral fin black at base, rest of fin pale; pelvics sooty black; no pattern or markings evident on head, back or vertical fins.

CENTROPYGE FLAMMEUS, new species

FIGURE 88

Holacanthus loriculus FOWLER (not Günther), Fishes of Oceania, p. 262, 1928 (Johnston Island).

Holotype.—U.S.N.M. No. 140521, Johnston Island reef along northern side of atoll, August 28–29, 1947, S–42–569, Schultz, Tuiasosopa, and Warner, 69 mm.

Paratypes.—U.S.N.M. No. 140522, same data as holotype, 5 specimens, 43.6 to 66.9 mm.

Description.—Counts and measurements of holotype are given first, followed in parentheses by range of counts and measurements of paratypes (see table 53 for measurements expressed in thousandths of standard length).

Dorsal rays XIV,17 (16 or 17); anal III,17 (16 to 18, usually 17); pectoral I,i,14 (14 or 15); scales 45 (44 to 47) rows in line from upper edge of gill opening to base of caudal rays.

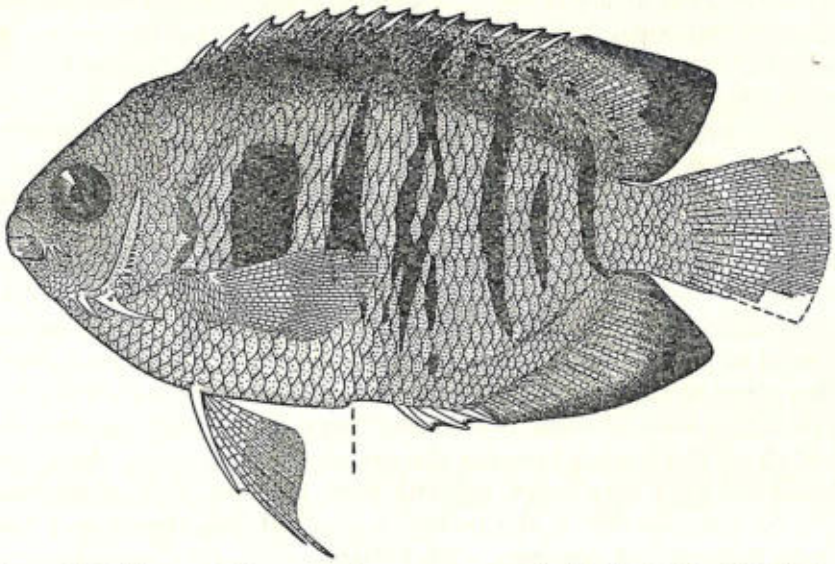

FIGURE 88.—Holotype of *Centropyge flammeus*, new species (U.S.N.M. No. 140521), from Johnston Island. (Drawing by Aime M. Awl.)

TABLE 53.—*Counts and measurements of* Centropyge flammeus *expressed in thousandths of the standard length*

Characters	Holotype	Paratype	Paratype	Paratype	Paratype	Paratype
Dorsal rays	XIV, 17	XIV, 17	XIV, 17	XIV, 17	XIV, 16	XIV, 17
Anal rays	III, 17	III, 17	III, 17	III, 18	III, 16	III, 17
Pectoral rays	I, i, 14	I, i, 15	I, i, 14	I, i, 14	I, i, 15	I, i, 15
Scale rows	45	47	45	47	46	44
Standard length in millimeters	69.0	66.9	65.6	65.5	55.8	43.6
Depth of body	588	550	578	534	538	528
Length of head	299	292	293	295	287	330
Length of snout	86	85	84	86	81	85
Diameter of eye	97	96	98	93	105	106
Least depth of caudal peduncle	136	144	145	141	134	138
Length of pectoral fin	300	302	299	278	295	∞17
Postorbital part of head	103	94	98	95	97	117
Interorbital space	96	91	92	90	90	85
Angle of snout profile in degrees	47	51	50	51	46	44

Depth 1.85 (1.73 to 1.87), head 3.35 (3.03 to 3.49), both in standard length; snout 3.49 (3.42 to 3.89), diameter of eye 3.22 (2.76 to 3.16), least depth of caudal peduncle 2.19 (2.02 to 2.4), length of pectoral fin 1.0 (0.97 to 1.06), postorbital part of head 2.9 (2.82 to 3.11), all in length of head; interorbital in eye 1.01 (1.03 to 1.21); angle of snout profile with lengthwise axis of body 47 (44 to 51) degrees; profile convex, preorbital with two small spines directed anteriorly on anterior margin, 3 or 4 spines, on ventral and posterior margins, slightly curved, directed ventrally and posteriorly; preoperculum serrated, one long spine at angle and one or two shorter spines below it; in holotype, interopercle with 3 spines, in paratypes, two to four spines; caudal fin convex and rounded, soft dorsal and anal fins pointed; outer pelvic ray elongated and filamentous.

Color in alcohol.—Lips pale; head reddish yellow, interorbital and nuchal areas mottled with brown, preopercular spine white, its upper margin with narrow bluish edge; opercular membrane black; body ground color yellowish red (flame scarlet in life), with about 6 or 7 vertical intensely black bars extending from base of dorsal almost to base of anal; the first bar located about diameter of eye behind upper edge of gill opening, about twice as wide as any of others, almond or crescent shaped; third and fourth bars very close to each other, may be partly joined, with upper and lower tips divided; seventh across base of caudal peduncle sometimes absent; usually vertical short black spots between the prominent bars; scaly sheaths of dorsal and anal usually spotted with large blackish spots; dorsal and anal fin margins black, the posterior parts of soft dorsal and anal black, the smallest specimen with a faint ocellus on dorsal, all with submarginal pale area; caudal fin pale with thin dusky streaks sometimes present along rays; pectoral fin pale; pelvics pale basally, tips of rays dusky in large specimens, black in small.

Remarks.—In coloration *Centropyge flammeus* is apparently most closely related to *C. loriculus* (Günther), from the Society Islands but is different from *loriculus* in numerous characteristics, as follows:

Character	*loriculus* [53]	*flammeus*
Dorsal rays	XIV,16	XIV,16 or 17 (usually 17).
Anal rays	III,17	III,16 to 18 (usually 17).
Pectoral rays	I,i,11 ?	I,i,14 or 15.
Scale rows	28	44 to 47.
Depth of body	About 2.37	1.73 to 1.87.
Snout	2.82	3.4 to 3.8.
Length of pectoral fin	2.0	About 1.0.
Angle of snout profile	74°	44° to 51°.
Hind margin of dorsal and anal fins.	Broadly rounded	Sharply pointed.

[53] Taken from Günther (Fische der Südsee), Journ. Mus. Godeffroy, pt. 5, pl. 40, fig. C, 1874.

Character	*loriculus* [a]	*flammeus*
Transverse black bars on body.	5, all about same width.	About 7, first much wider than the rest.
Posterior margins of dorsal and anal fins.	Same as ground color..	Intensely black.
Opercular membrane.....	Red when alive; pale in alcohol.	Black.

The scales of *loriculus* are much larger, the pectoral much shorter, and the body shape, particularly the dorsal profile, greatly different from *flammeus*. From all other known species of *Centropyge*, *C. flammeus* differs in coloration.

We can find no justification for the inclusion by Frazer-Brunner (Proc. Zool. Soc. London, 1933, pp. 592, 593) of *Centropyge loriculus* (Günther), and *Centropyge potteri* (Jordan and Metz), 1912, in the synonymy of *Centropyge bisipinosus* (Günther). *C. loriculus* differs from *bispinosus* in coloration, shape of dorsal and anal fins, and in number of scales; *potteri* differs from *bispinosus* in having dorsal rays XIV,19 instead of XIV or XV,16 or 17, as well as in coloration. We have not seen the type of *C. tutuilae* Jordan and Jordan, 1922, though it apparently differs from *bispinosus* in coloration.

Named *flammeus* in reference to the flaming scarlet coloration.

CENTROPYGE NIGRIOCELLUS, new species

FIGURE 89

Holotype.—U.S.N.M., No. 141312, Johnston Island, reef along northern side of atoll, Aug. 28–29, 1946, S–42–569, Schultz, Tuiasosopa, and Warner, 38.3 mm. in standard length.

Description.—Dorsal fin rays XIII,15; anal III,15; pectoral Ii,15; scales 44 rows from upper edge of opercular opening to base of caudal rays.

The following measurements are expressed in thousandths of the standard length: Depth of body 506, length of head 305, length of snout 97, diameter of eye 112, interorbital width 76, postorbital length 94, least depth of caudal peduncle 139, length of pectoral fin 282, length of pelvic fin 368, length of thirteenth dorsal spine 167, length of middle caudal rays 261, length of caudal peduncle 160. Angle of snout profile with lengthwise axis of body 48 degrees.

Body oblong; snout somewhat produced; two spines about as long as pupil on lower posterior edge of preorbital; preopercle strongly serrate on posterior margin, an enlarged spine at its lower angle with a shorter spine below it; opercle with 2 flat triangular spines and broad membrane; a small patch of spines on lower edge of subopercle and interopercle with 3 spines; scales of body small, each with 10 or 12

[a] Taken from Günther (Fische der Südsee), Journ. Mus. Godeffroy, pt. 5, pl. 40, fig. C, 1874.

spines on exposed portion; dorsal spines gradually increasing in length to last; dorsal, caudal, and anal outlines rounded, pelvics pointed, 2 outer soft rays produced and filamentous; pectorals rounded.

Color in alcohol.—Top of head and back light grayish brown; tip of snout dusky gray; chin, breast, belly, and lower sides pale yellow; a large intensely black spot about size of eye on base of pectoral fin

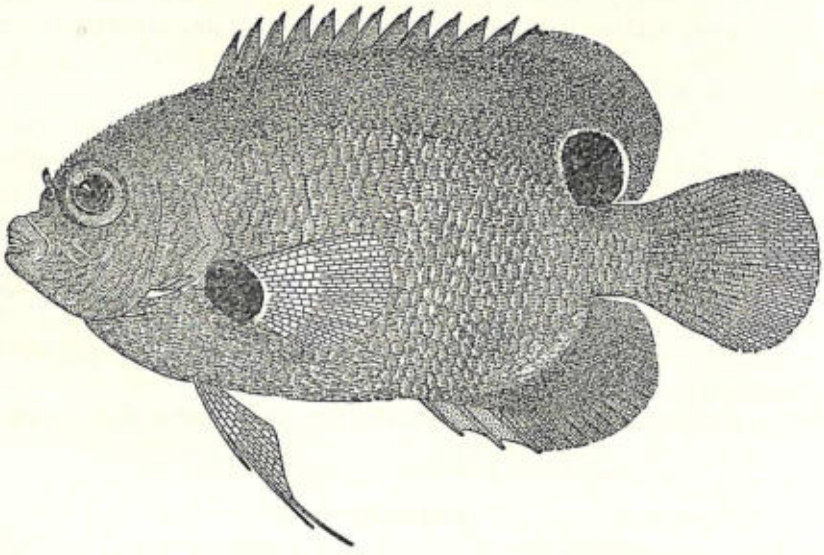

FIGURE 89.—Holotype of *Centropyge nigriocellus*, new species (U.S.N.M. No. 141312), from Johnston Island. (Drawing by Aime M. Awl.)

and a second spot of similar size, outlined by a narrow white ring on base of posterior soft dorsal rays; dorsal, caudal, and anal light dusky brown; pelvics pale, white; pectorals pale, transparent, with a thin black line along upper edge of unbranched rays.

Remarks.—This species is apparently most closely related to *Centropyge bispinosus* (Günther), *C. multispinis* Playfair, and *C. fisheri* Snyder, but it differs from these as well as from all other species of butterflyfishes in coloration and in the low number of dorsal and anal fin rays.

Named *nigriocellus* in reference to the two black ocellate spots.

Family PLATACIDAE

By LOREN P. WOODS

Genus PLATAX Cuvier

Platax CUVIER, Règne Animal, vol. 2, p. 334, 1817. (Genotype, *Chaetodon teira* Bloch.

PLATAX ORBICULARIS (Forskål)

Chaetodon orbicularis FORSKÅL, Descriptiones animalium, p. 59, 1775 (type locality, Jidda, Red Sea).

SPECIMENS STUDIED

Guam: November 26, 1945, Frey, 3 specimens, 92 to 98 mm.; tidal pools near mouth of Ylig River, December 23, 1945, Frey and Gressitt, 11 specimens, 84 to 123 mm.

Description.—Dorsal rays V,35 to 39; anal III,25 to 28; pectoral I,i,15 or 16; pelvic I,5; branched caudal 8+7; scale rows in lengthwise series from upper edge of gill opening to end of lateral line approximately 58 to 66; gill rakers on first arch 9+1+10; rakers short, fleshy, conical.

Depth of body (base of third dorsal spine to origin soft anal) 0.89 to 0.91, head 2.8 to 3.0, both in standard length; snout 2.5 to 2.6, eye 2.42 to 3.0, interorbital 2.64 to 2.87, postorbital part of head (hind margin of eye to upper edge of gill opening) 3.72 to 3.9, least depth of caudal peduncle 2.28 to 2.42, length of pectoral fin 1.26 to 1.35, upper caudal rays 0.91 to 0.95, lower caudal rays 0.93 to 0.97, all in length of head; angle of snout profile with lengthwise axis of body 67 degrees, convex in smallest specimen (84 mm.), straight in medium size specimen (97 mm.), and slightly concave in largest specimen (123 mm.); upper profile from origin of dorsal to interorbital area convex.

Body deeper than long; mouth small, hind edge of maxillary reaching just past anterior rim of orbit; teeth long, slender, with three cusps, of which median one is longest and strongest; caudal peduncle deeper than long, its depth increasing with age; pectoral fins short, pelvics very long, outer ray longest, filamentous; dorsal and anal slightly falcate; caudal truncate.

Color in alcohol.—Ground color dark grayish brown to light silvery; dark line about width of pupil running from nape through eye

to anterior base of pelvics, fading ventrally, usually with narrow, wavy, broken, black lines more or less outlining ocular band, a second indistinct vertical black band slightly wider than diameter of eye running from base of spiny dorsal to across posterior part of opercle and pectoral base to base of pelvics, joining its fellow between posterior pelvic base and anus, this band more intense below pectoral base and wedge-shaped, sometimes with small black dots distributed along it; dorsal and anal fins grayish basally, distal two-thirds of anterior rays black, distal margin of rest of rays dusky; caudal dusky basally, median portion with broad pale or yellowish crescent, distal third dusky in adults, in young basal third dusky, distal two-thirds pale or yellowish; pectoral yellowish, rays dusky basally, pelvics blackish.

Remarks.—Reported from Samoa as common by Jordan and Seale (Bull. U. S. Bur. Fish., vol. 25 (1905), p. 335, 1906).

Family ZANCLIDAE

By Loren P. Woods

Genus ZANCLUS Cuvier

Zanclus Cuvier, *in* Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 7, p. 102, 1831. (Genotype, *Chaetodon cornutus* Linnaeus.)

KEY TO THE SPECIES OF ZANCLUS FOUND IN THE NORTHERN MARSHALL ISLANDS

1*a*. Adult with two supraorbital horns (protuberances in young); no spine on anterior margin of preorbital above corner of mouth; white lines present on head between eyes, behind eye, across opercle and breast also along posterior part of second black body bar and anterior part of caudal lunate black bar; snout with black-edged saddle marking; posterior pale area of median fins with blackish edging; filamentous dorsal ray white; dorsal VII,40 to 43; anal III,33 to 35 ..... Zanclus cornutus (Linnaeus)

1*b*. No supraorbital horns but with a strong recurved spine on anterior margin of preorbital above corner of mouth; white lines barely evident below origin of dorsal fin, none between eyes or on body; snout without black-edged saddle mark; posterior pale area of median fins with edges pale; filamentous dorsal ray black; dorsal VII,40; anal III,32.
Zanclus canescens (Linnaeus)

ZANCLUS CORNUTUS (Linnaeus)

Plate 50, A

Chaetodon cornutus Linnaeus, Systema naturae, ed. 10, p. 273, 1758 (type locality, Indies).

SPECIMENS STUDIED

Bikini Atoll: 10 stations, 23 specimens, 64 to 138 mm. standard length.
Eniwetok Atoll: 2 stations, 2 specimens, 69 and 106 mm.
Pongelap Atoll: 1 station, 1 specimen, 138 mm.
Guam: 2 lots, 2 specimens, 62 and 77 mm.

Description.—Dorsal rays VII,40 to 43; anal III,33 to 35; pectoral I,i,16 or 17; pelvic I,5; branched caudal 7+7; outer row of teeth about 12 to 17 in upper jaw, 10 to 16 in lower jaw.

Depth 1.15 to 1.4, head 2.3; both in standard length; snout 1.5 or 1.6, eye 3.1 to 4.1, least depth of caudal peduncle 3.1 to 3.8, length of pectoral fin 1.4 or 1.5, postorbital part of head (eye to upper edge of gill opening) 7.2 to 7.9, lower lobe of caudal fin 1.5 or 1.6, upper lobe 1.3, all in length of head; interorbital in eye 1.0 or 1.1; angle of snout profile with axis of body 44 to 47 degrees.

First two dorsal spines short and strong; third spine greatly elongated and filamentous; supraocular horns evident in specimens of 64 mm. but not prominent in specimens under about 100 mm.; teeth long, fairly strong, and curved near tips, in inner row of 4 or 5 imbedded teeth with only points projecting.

Color in alcohol.—Ground color light grayish yellow; top of snout and chin black; a black bordered dark saddle over the top of snout, sometimes with a white line along posterior edge; a broad black band below eye, bordered anteriorly by white, extending from origin of dorsal, including eye, broadening below to include pectoral base, sides of breast and pelvic fins; a thin white line (sometimes interrupted) passing from origin of dorsal along posterior edge of operculum, then continuing on breast to origin of pelvics; a second line anterior to this passing just behind eye on operculum to its lower margin; a third white line from upper rim of eye to midline of profile where it meets its fellow, and a fourth from anterior margin of eye passing just behind supraocular horn; another thin white line starts near insertion of pectoral and continues downward to anal opening; a second broad black vertical band begins on dorsal fin from second to about sixteenth soft ray, crosses body just anterior to caudal peduncle and extends onto elongated first 17 or 18 soft anal rays; a thin white line crosses body about its width in front of posterior edge of black band; caudal peduncle pale; spinous dorsal fin rays dusky at base, white distally, soft dorsal rays with narrow distal margin black from the seventh to thirtieth; anal fin rays tipped with white, black basally to the seventeenth or eighteenth, the rest white basally, rays tipped with black except last 2 or 3; anterior basal portion of anal gray; caudal fin with a broad black crescent from tip of upper ray to tip of lowest branched ray; distal margin pale; a white line borders black lunate band of caudal anteriorly, extending diagonally to lower edge of fin and along outer unbranched ray; pectoral fin pale with a black line along upper marginal ray, black basally.

Ecology.—The coral head area in the deeper water is the usual habitat of this fish in the lagoon. On the ocean reef it occurs in the surge channels and in deep pools along the outer edge at low tide.

ZANCLUS CANESCENS (Linnaeus)

PLATE 60

Chaetodon canescens LINNEAUS, Systema naturae, ed. 10, p. 272, 1758 (type locality, Indies).

SPECIMEN STUDIED

Bikini Atoll: Boro Channel, surface light at night, April 6–7, 1946, S–46–53, Schultz and Brock, 1 specimen, 63 mm.

Description.—Dorsal rays VII,40; anal III,32; pectoral I,i,17; pelvic I,5; branched caudal 7+7; teeth about 19 in upper jaw and 15 in lower (outer rows).

Depth 1.0, head 2.4, both in standard length; snout 1.7, eye 3.2, least depth of caudal peduncle 2.85, length of pectoral fin 1.1; postorbital part of head 6.1, lower lobe of caudal 1.2, upper lobe 1.15, all in length of head; interorbital in eye 1.0; angle of snout profile with axis of body 53 degrees.

Third dorsal spine exceedingly long and filamentous, slightly over twice in standard length; supraocular spines completely lacking; small recurved spine present on anterior edge of preorbital bone above corner of mouth, an additional small part of anterior edge of preorbital elevated just anterior to spine and bearing 4 small protuberances.

Color in alcohol.—Ground color yellowish; tip of snout black; chin dusky; faint dark band about as wide as eye, extending from origin of dorsal through eye onto breast; a silvery band just behind dark band extending across operculum broadening below pectoral; a second dark band extending from first dorsal rays downward, broadening below to include bases of 7th to 22nd anal rays and nearly to tips of first eight rays; broad black crescent covering basal three-fourths to two-thirds of caudal fin, distal portion of caudal pale; tips of posterior dorsal and anal rays white; pectoral dark at base, pale distally, pelvics dusky, with pale margins; no white lines on head.

Ecology.—The only specimen taken was in the ocean at the entrance of Boro Channel, apparently pelagic, the unpigmented areas nearly translucent when alive.

Remarks.—The two species *Zanclus cornutus* and *Z. canescens* have often been confused, with *canescens* reported as the young of *cornutus*. We have separated the two species on the basis of fin ray counts as given in table 54. Specimens of *cornutus* are reported to range in size from 47 to 200 mm., while *canescens* grows only to a length of 80 mm., according to Weber and de Beaufort (Fishes of the Indo-Australian Archipelago, vol. 7, p. 175, 1936.)

TABLE 54.—*Ray counts of* Zanclus cornutus *and* Z. canescens

Species	Dorsal rays				Anal rays			
	40	41	42	43	32	33	34	35
cornutus	7	8	2	2		11	9	5
canescens	2				2			

Specimens of *cornutus* in the U.S. National Museum range from 53 to 138 mm., whereas the only two specimens of *canescens* are 51 and 63 mm. The chief differences lie in the coloration and in certain anatomical characters noted in the key. The facts on which these two species are separated are not conclusive, however, because too few specimens of *canescens* are available for comparison. Serious doubt is cast on the importance or value of the presence or absence of the preorbital spine above the corner of the mouth, as this character is exceedingly variable in the closely related subfamily Pomacanthinae. Nor is color pattern sufficient ground for absolute separation, because the colors of the specimens of *cornutus* examined vary slightly and the difference in *canescens* may be owing to age, sexual dimorphism, or habitat. A study of *canescens* in an aquarium might reveal whether it loses its preorbital spine and thus transforms into *cornutus*.

Family ACANTHURIDAE: Surgeonfishes

By Leonard P. Schultz and Loren P. Woods

Several series of pelagic acanthurids were captured by the use of electric light at night. These were translucent and variously pigmented, but all had the caudal peduncular spine discernible and the skin in the form of vertical striae. Günther gave these postlarval surgeonfishes the generic name of *Acronurus*. We are calling the pelagic larvae of surgeonfishes before metamorphoses the acronurus stage. A study of our material indicates that this stage for each species ends at certain lengths, such as at 38 to 41 mm. for *A. elongatus* and at 21 to 24 mm. for *A. triostegus*. During the metamorphosis the convex contour of the snout may change to concave, scales form, the body and head become less deep, and the adult color pattern begins to form. No attempt was made to include the acronurus stages in in the key that follows because we did not capture the postlarvae for all of the species.

KEY TO THE ACANTHURIDAE OF THE NORTHERN MARSHALL ISLANDS AND ADJOINING AREAS

1*a*. Side of caudal peduncle armed with a single sharp, antrorse, erectile spine, fitting into a groove; this spine sometimes very small in specimens 30 mm. long and smaller.

2*a*. Teeth long, movable on pedicels, tips expanded and cuplike, denticulate on outer side, numbering about 11 to 26 in one side of both jaws, usually 15 to 26 in adults; dorsal rays usually VIII (rarely IX),26 to 30; anal III,25 to 27; pectoral I,i,13 to 15; pelvic I,5; ground color uniform dark brown to black; median fins blackish, pelvics blackish; pectorals pale, upper unbranched soft ray black; sides of body with numerous wavy darkish lines, blue when alive.

Ctenochaetus striatus (Quoy and Gaimard) (p. 620)

2*b*. Teeth immovable, not on long pedicels, but with broad bases, both inner and outer margins of expanded tips denticulate, teeth on one side of both jaws fewer than 15; pelvic rays I,5.

3*a*. Dorsal spines usually VIII or IX.

4*a*. Sides of body (head and trunk) with 5 or 6 vertical narrow blackish lines or bars on a pale or light grayish background, this pale background often tinged with dusky purplish; first blackish vertical bar from occiput or nape through eye, ending on lower edge of cheek, second from first dorsal spine through pectoral base, sometimes continuing a short distance below, third from sixth or seventh dorsal spine to above anus, fourth from fourth or fifth soft dorsal ray to front of anal fin, fifth from thirteenth or fourteenth soft dorsal ray to middle third of anal, and last on caudal peduncle,

sometimes represented as a pair of dots; dorsal rays IX,22 to 25; anal III,19 to 22; pectoral I,i,13 or 14; teeth on one side of upper jaw 6 or 7, of lower jaw 7 to 9.

Acanthurus triostegus triostegus (Linnaeus) (p. 624)

4*b*. Sides of body without 5 or 6 vertical narrow black lines as in 4*a*.

5*a*. A pale U-shaped bar or narrow ring ventrally at rear of mouth extending on sides of mouth dorsally but not on snout; general ground color dark brown or black; profile of snout concave.

6*a*. Posterior fleshy margin of gill cover black, this color extending ventrally to meet its fellow on breast just behind chin; pelvic fins black; caudal fin forked, tips of rays pale; distal margin of soft rays of dorsal and anal fins without white line; nostrils pale; caudal spine black; a black spot at upper edge of gill opening; pectoral fins with basal third black, distal two-thirds pale; dorsal rays VIII (occasionally IX),26 to 29; anal III,25 or 26; pectoral I,i,14; teeth on one side of upper jaw 6 to 8, of lower jaw 9 or 10_____ Acanthurus leucosternon Bennett (p. 626)

6*b*. Posterior fleshy margin of gill cover white or not darker than rest of operculum; outer margin of pelvic fins white; distal margin of soft rays of dorsal and anal fins with a white line; pectorals dusky basally; the rays blackish and membranes unpigmented; anus pale.

7*a*. A pale blotch below eye, more or less distinct; upper posterior margin of opercle with a narrow pale band, not sharply contrasting with black opercle; bases of soft dorsal and anal fins with a white line or streak anteriorly broadening into a broad pale band posteriorly, including two-thirds to three-fourths of basal portion of fins; dorsal rays IX,28 to 31; anal III,27 or 28, pectoral I,i,14 or 15; teeth on one side of upper jaw 4 to 6, of lower jaw 5 or 6.

8*a*. Caudal fin whitish, abruptly paler than caudal peduncle, distal margin pale or whitish, then a dusky band (yellowish when alive) of equal width submarginally; pale blotch below eye distinct; caudal spine pale, area around it brownish or black_____ Acanthurus aliala Lesson (p. 627)

8*b*. Caudal fin pale dusky, this color grading into the blackish basal part of caudal fin, caudal fin with pale band posteriorly, becoming narrower on upper and lower lobes, then a diffuse brownish band, with a black line that follows basal contour of this band, no pale band basally; pale blotch below eye scarcely visible; caudal spine and small area around it pale_____ Acanthurus rackliffei Schultz

7*b*. No pale blotch below eye; fleshy margin of opercle with a distinct white area sharply contrasting with black opercle; a narrow white streak at bases of soft rays of dorsal and anal fins; in adults an oval light area, red in life, around and in front of caudal spine, this color marking not appearing until a length of about 65 mm. is attained; margin of caudal fin pale, then a submarginal black line or narrow band that follows outline of edges of entire caudal fin, enclosing a central pale area, absent on specimens 70 mm. and shorter. Dorsal rays IX,30 to 34; anal III,26 to 30; pectoral I,i,14 or 15; teeth in one side of upper jaw 4 to 6, of lower jaw 4 or 5.

Acanthurus achilles Shaw (p. 629)

5*b*. No pale U-shaped ring around mouth.

9*a*. Lower portion of head and trunk abruptly pale below a lengthwise line through lower edge of pectoral base sharply contrasting with blackish pelvic and anal fins and upper sides and back; upper sides and back with about 11 sets of nearly longitudinal narrow bands, each set consisting of a blue line, bordered above and below by a narrow black band, these sets separated by a pale band (orange in life); dorsal rays IX,27 to 29; anal III,26 to 27; pectoral I,i,14 or 15; teeth on one side of upper jaw 4 to 6, of lower jaw 6 or 7.

Acanthurus lineatus (Linnaeus) (p. 630)

9*b*. Color pattern not as in 9*a*.

10*a*. Ground color sepia brown with posterior half of body and median fins spotted with white; four vertical pale bands (obscure in young) across body, first from nape through opercle to isthmus, next from base of fifth dorsal spine to anal origin, third from base of fifth soft ray of dorsal to third soft anal ray, fourth from rear of soft dorsal to rear of soft anal fins, the posterior bands sometimes scarcely discernible; caudal fin abruptly pale basally, distal half dark, dorsal rays IX,26 to 28; anal III,23 to 26; pectoral I,i,14; teeth on one side of upper jaw 4 to 6, of lower jaw 4 to 7.

Acanthurus guttatus Bloch (p. 631)

10*b*. Color pattern not as in *A. guttatus;* ground color brown or blackish without vertical pale bands.

11*a*. A broad pale band behind eye, bordered with narrow black band extending to opposite tips of pectoral fins except in young this area may be dusky; basal three-fourths of pectoral fin blackish, the distal one-fourth pale but with tips of rays somewhat pigmented; pelvics black; ground color of head, trunk, and median fins dark brown or black; caudal fin with a central pale area distally in posterior third of middle rays, with a submarginal black line, then margin pale; dorsal rays IX,23 or 25; anal III,22 or 24, pectoral I,i,14 or 16; teeth on one side of upper jaw 7 to 10, of lower jaw 8 to 10; profile of snout convex.

Acanthurus olivaceus Bloch and Schneider (p. 632)

11*b*. No pale band just behind eye.

12*a*. Black band extends from behind eye posteriorly, ending opposite the middle of the length of pectoral fin on adults; black bar extends forward from caudal spine, tapering to a point, and ending from one-half to nine-tenths length of pectoral fin behind tip of that fin on adults; dorsal and anal fins dark brown, margined with a black line; distal margin of brown caudal fin margined with a narrow pale band; basal three-fourths of pectoral fin blackish, and distal one-fourth whitish, sharply contrasting with dark portion; pelvics black; profile of head convex; dorsal rays VIII or IX,25 to 27; anal III,24 or 25; pectoral I,i,14 to 16; teeth on one side of upper jaw 8 or 9, of lower jaw 8 to 10.

Acanthurus nigricans (Linnaeus) (p. 633)

12*b*. No black bar behind eye or in front of caudal spine.

13*a*. Profile of snout concave or straight in young; ground color brownish to purplish dark gray, often with numer-

ous dark bluish or purplish lengthwise lines, more obvious on pale specimens; dorsal and anal fins darker than body, each with a conspicuous black spot at base of last soft ray; caudal spine blackish; caudal peduncle sometimes abruptly paler than body or caudal fin; caudal fin with a pale marginal line posteriorly, wider in the young and more conspicuous; pectoral dusky but paler than body; dorsal rays IX,24 or 25; anal III,22 to 24; pectoral I,i,14; teeth on one side of upper jaw 4 to 7, of lower jaw 5 to 8.

Acanthurus elongatus (Lacepède) (p. 634)

13*b*. Profile of snout and of head convex; no conspicuous black spots at base of last soft rays of dorsal and of anal fins; head with conspicuous to faint alternating wavy dark and pale streaks or lines, these scarcely discernible on trunk; dorsal rays VIII or IX,25 to 27 (rarely VIII); anal III,23 to 25; pectoral I,i,13 to 16; teeth on one side of upper jaw 6 to 11, of lower jaw 6 to 13.

14*a*. A line from center of caudal spine to rear corner of maxillary passes one-half to two-thirds diameter of orbit above dorsal edge of pectoral fin base; angle between two lines radiating from center of eye, one to rear edge of maxillary, other to dorsal front edge of pectoral fin base, is 75 to 81 degrees; pectoral fin blackish; teeth on one side of lower jaw 11 to 13.

15*a*. Caudal fin blackish; about 10 dark wavy lines on cheeks, 8 or 9 more on breast below pectoral fin base, and 10 to 12 above orbit to dorsal fin origin; least depth of caudal peduncle about 3 in head.

Acanthurus bleekeri Günther (p. 636)

15*b*. Caudal fin notably paler than dark brownish head, trunk, and fins; no wavy lines on head or trunk; least depth of caudal peduncle 2.7 in head.

Acanthurus philippinus Herre (p. 637)

14*b*. A line from center of caudal spine to rear corner of maxillary passes over dorsal edge of pectoral fin base; angle between two lines radiating from center of eye, one to rear edge of maxillary, other to dorsal front edge of pectoral fin base, is 53 to 62 degrees; usually more than a dozen dark wavy lines across cheek and operculum.

16*a*. Posterior one-third of pectoral fin pale, the basal two-thirds brownish; upper or dorsal edge of gill opening not blackish but same color as body; base of caudal fin may or may not be abruptly paler than caudal peduncle; dorsal and anal fins usually with several lengthwise dark streaks but these absent in adults.

Acanthurus fuliginosus Lesson (p. 637)

16*b*. Pectoral fin plain blackish or dark brownish; dorsal edge of gill opening blackish and sometimes as a

roundish black blotch; caudal, dorsal, anal fins plain blackish.

Acanthurus mata Cuvier and Valenciennes (p. 639)

3*b*. Dorsal spines IV or V.

17*a*. Ground color blackish or dark brown with five or six pale vertical bands and parallel faint blackish lines, first band from just in front of dorsal fin through rear of orbit to base of pelvics, second from base of spinous dorsal fin to just behind pectoral base thence to anal origin; third, fourth, and fifth from dorsal to anal; sixth from dorsal to just in front of caudal spine to anal base; dorsal and anal fins with transverse pale lines posteriorly; head anteriorly plain pale or with numerous small pale spots; dorsal rays IV,30 to 32; anal III,24 or 25; pectoral I,i,14; teeth on one side of upper jaw about 7, of lower jaw 8 to 10.

Zebrasoma veliferum (Bloch) (p. 640)

17*b*. Ground color blackish or yellowish without transverse bands; when ground color is blackish, caudal spine is whitish, trunk with obscure wavy longitudinal bluish or grayish lines; pectoral plain pale, median fins blackish, sometimes a blue streak on side above pectoral fin; dorsal rays V,24 (rarely IV); anal III,19 or 20; pectoral I,i,13; teeth in one side of upper jaw 7 or 8, of lower jaw 8 to 11.

Zebrasoma flavescens (Bennett) (p. 641)

1*b*. Side of caudal peduncle armed with two immovable, keeled, bony bucklers or rigid spines, these often obscure in small specimens; dorsal spines V to VII.

18*a*. Caudal peduncle with two white areas (orange or yellow in life) around spines meeting their fellows below, but absent on specimens of 55 to 60 mm.; ground color blackish; lips pale (yellow in life); vertical pale bar at rear of mouth, curving to front of eye; margin of soft dorsal with white line, then a black submarginal line followed below by a white band, basal half of fin black; anal fin blackish with a marginal white line; rear margin of caudal fin white, rest of fin blackish; pectoral blackish except tips are paler; pelvics blackish; color of 55- to 60-mm. specimens about same as those over 100 mm. in length, except yellow mark from mouth to eye absent; no brown spots on sides of body as in young of *Naso unicornis;* dorsal rays VI or VII,27 to 30; anal II,29 or 30; pelvic I,2 or 3; pectoral I,i,14 or 15; teeth on one side of upper jaw 12 to 14, of lower jaw 8 to 14--- Naso lituratus Bloch and Schneider (p. 642)

18*b*. Caudal peduncle with only one or no white areas around spines; no pale streak from mouth to eye.

19*a*. Forehead convex but without horn or hump at any age.

20*a*. Forehead evenly rounded to origin of dorsal fin; interorbital convex; ground color of head and body uniform grayish brown, back darker than lower sides and belly; upper lip black; dorsal, caudal, and anal fins dark brown in adults, young with 2 or 3 lengthwise lighter streaks on soft dorsal and anal membranes; pectoral dusky brown with paler margin; pelvics dark brown distally, pale at base; dorsal VI,28 or 29; anal II,29 or 30; pectoral I,i,14; teeth on one side both jaws 20---------- Naso hexacanthus (Bleeker) (p. 644)

19*b*. Forehead with a hump or bony protuberance (in all except smallest specimens).

21*a*. Caudal spines and bucklers no darker than general ground color.

22*a*. Ground color plain grayish brown; lips pale, soft dorsal and anal fins with pure white margin and a black submarginal line, basal

parts of fins lighter; caudal fin with a broad white posterior margin, broader on outer rays, a black indefinite submarginal area, and basal part of fin grayish brown; a single light ring around caudal peduncle may or may not be evident, when present located between caudal spines; dorsal rays V,28 or 29; anal II,27 to 29; pectoral I,i,15 or 16; teeth on one side of upper jaw 16 to 20, of lower jaw 14 to 17.

Naso annulatus (Quoy and Gaimard) (p. 644)

22*b*. Ground color uniform brownish on back with very indistinct darker vertical lines posteriorly on sides, breast and belly lighter brown, gill flap white or cream colored, dorsal and anal fins dusky brown; base of caudal fin darker than general body color, with distal half to one-third of fin lighter; pectoral fin with pale margin; dorsal rays VI,27 to 29; anal II,28 to 30; pectoral I,i,13 or 14; teeth on one side of upper jaw 16 to 20, of lower jaw 16 to 20.

Naso brevirostris [22] (Valenciennes) (p. 645)

21*b*. Caudal spines, bucklers, and narrow surrounding area black or at least darker than general ground color.

23*a*. Ground color plain pale gray to dark brownish gray, dorsal with a white marginal line, then a dark blue or blackish submarginal line, rest of fin light brown; anal similar to dorsal, sometimes with 2 alternating light and dark lines; pectoral translucent, caudal fin dusky at base, distal half pale; lips pale; caudal spines, basal plates, and narrow surrounding area black; young specimens in acronurus stage grayish brown with 4 vertical rows of dark spots (about size of pupil) 3 or 4 spots per row; dorsal fin sometimes with black blotches, usually with only membranes of spinous dorsal dusky; rest of fins colorless; dorsal rays VI,28 to 30; anal II,27 to 30; pectoral I,i,15 or 16; teeth on one side of upper jaw 11 to 15, of lower jaw 7 to 14.

Naso unicornis (Forskål) (p. 646)

23*b*. Ground color rich light brown; head with dark line below eye extending and broadening to a bar the width of eye anterior to eye, and continuing forward along side of bony protuberance; cheeks with evenly spaced dark brown spots (blue in life); lips black; opercular flap and space just behind gill opening black; a black blotch before and behind pectoral fin; back with small scattered spots, those on sides lengthening into vertical lines; breast and belly with fine dark punctations smaller than those of back or cheeks; caudal spines and bucklers darker than general ground color (black in adults) but surrounding area not black; dorsal and anal fins dark brown; caudal fin very dark brown (vertical yellow submarginal bar in life); pectoral and pelvic fins dusky brown to black; bar before eye and blotch behind pectoral lacking in young; lines along sides not complete, although many spots elongate; dorsal fin with oblique darker streaks on membranes; anal fin with broken lengthwise lines; caudal fin spotted at base; dorsal rays V to VII,26 or 27; anal II,27 to 29; pectoral I,i,14 or 15; teeth on one side of upper jaw 14 to 32, of lower jaw 15 to 27.

Naso vlamingi (Valenciennes) (p. 647)

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[22] The young specimen described by Schultz (U. S. Nat. Mus. Bull. 180, pp. 160–161, 1943) in his key as *Naso brevirostris* we now identify as *Naso vlamingi*.

Genus CTENOCHAETUS Gill

Ctenochaetus GILL, Proc. U. S. Nat. Mus., vol. 7, p. 279, 1884. (Genotype, *Acanthurus strigosus* Bennett.)

CTENOCHAETUS STRIATUS (Quoy and Gaimard)

PLATES 61, A; 62, A, B

Acanthurus striatus QUOY and GAIMARD, Voyage autour du monde . . . executé sur les corvettes de S. M. L'*Uranie* et La *Physicienne* . . ., Zool., vol. 2, p. 373, pl. 63, fig. 3, 1824 (type locality, Guam).

SPECIMENS STUDIED

Bikini Atoll: 25 stations, 184 specimens, 32 to 177 mm. standard length.
Eniwetok Atoll: 4 stations, 8 specimens, 36 to 154 mm.
Rongelap Atoll: 7 stations, 78 specimens, 52 to 163 mm.
Rongerik Atoll: 3 stations, 24 specimens, 31 to 145 mm.
Kwajalein Atoll: 4 specimens, 128 to 150 mm.
Guam: 4 lots, 208 specimens, 38 to 101 mm.
Rota: 1 lot, 1 specimen, 137 mm.

Description.—Dorsal rays usually VIII,26 to 30; anal III,25 to 27; pectoral I,i,13 to 15; pelvic always I,5; branched caudal 7+7; number of teeth in jaws increases with size (see table 55).

TABLE 55.—*Number of teeth on each side of upper and lower jaws of specimens of* Ctenochaetus striatus *of various standard lengths*

Standard length in millimeters	Number of teeth on each side													
	Upper jaw							Lower jaw						
	11–12	13–14	15–16	17–18	19–20	21–22	23–24	13–14	15–16	17–18	19–20	21–22	23–24	25–26
41–50	1	1						1	1					
51–60	1	1							2					
61–70	1		3						3	1				
71–80			1	1						1	1			
81–90			2	3						2	3			
91–100		1	1	3	1					1	5			
101–110			2		1									
111–120				2		1					1	1	1	
121–130					1	1						1	1	
131–140				2							1		1	
141–150						2	1						2	1
151–160					1								1	
161–170					1								1	
171–180						2							1	1

Depth 1.9 to 2.2, head 2.6 to 3.4, both in standard length; snout 1.3 to 1.8, eye 3.1 to 5.2, least depth of caudal peduncle 2.3 to 3.0, length of pectoral 0.9 to 1.05, postorbital part of head (hind margin of eye to upper edge of gill opening) 4.5 to 6.0, lower lobe of caudal fin 0.7, upper lobe 0.7 to 0.8, all in length of head (tip of snout to upper edge

of gill opening); interorbital in eye 0.7 to 1.0; length of caudal spine in snout 2.0 to 3.0; length of caudal peduncle in its depth 0.8 to 0.95; angle of snout profile with axis of body 68 to 75 degrees (in 9 specimens).

Body deep, compressed, with sides nearly straight; profile of snout evenly convex in large specimens, a little concave in those 46 to 50 mm.; soft dorsal and anal fins pointed posteriorly, the angles between the margins of these fins 60 to 90 degrees when fully distended; caudal fin lunate, with tips of upper and lower rays considerably elongated in large individuals; pelvics extending beyond the tip of the depressed second anal spine; bases of dorsal and anal fins scaled with the scales extending along the membranes between the soft rays; lower jaw shaped like a broad V, with teeth of lower jaw fitting behind those of upper; teeth long, slender, movable, expanded at tips with outer side crenulate and inner side smooth.

Color in alcohol.—Head and body uniform dark brown to black in most specimens; some lighter brown with darker brown wavy lengthwise lines and with small lighter spots on forehead, nape, below eye, and behind opercular opening; dorsal, anal, caudal, and pelvic fins blackish; pectorals pale, with dusky rays and with upper unbranched ray black; lips black; area inside gums of lower jaw and lower velum black; caudal spine pale; fleshy sheath of caudal spine black edged but paler in groove; chin and breast of many specimens yellowish with narrow black V-shaped streak at the groove separating chin and isthmus; about 12 specimens listed herein had the soft rays of dorsal and anal fins black at base, then a lighter gray area distally with black margins; caudal base black then a gray band distally following outline of fin, tips of caudal rays black.

Color when alive.—Ground color black, with narrow bluish wavy lines on sides and with traces of orange in black ground color between the wavy blue lines; several bright orange specks below eye; fins all blackish except pectoral, which is tinged with translucent yellow, with outer ray black; axil of pectoral yellowish with blue specks.

Ecology.—This is a common species in the shallow waters over the reefs both along the ocean side and in the lagoon, occurring down to depths of 40 feet or more.

Remarks.—Herre (Philadelphia Journ. Sci., vol. 34, pp. 437–41, pl. 13, fig. 2, pl. 15, figs. 2, 3, 1927) distinguishes two species, *C. striatus* and *C. strigosus* (Bennett). We have before us 7 specimens of the striped color pattern, 29 to 43 mm. in standard length, taken in various tropical Pacific localities that have the depth in length from 1.5 to 2.3. We have a specimen from Guam, 42 mm. long, that is changing from the striped phase to the nonstriped adult color pattern and its depth in length is 2.2; another specimen, 44 mm., has a faint trace of the striped

TABLE 56.—*Counts recorded for certain species of* Acanthurus

Species	Dorsal rays													Anal rays										
	VIII	IX	22	23	24	25	26	27	28	29	30	31	32	III	19	20	21	22	23	24	25	26	27	28	29
achilles		8									3	2	3	8								1	1	2	4
triostegus triostegus		21	7	13		1								21	2	17	1	1							
olivaceus		12		1	9	2								12				4	5	3					
nigricans	1	8				1	7	2						9						5	5				
aliala		7								2	5			7								6	1		
leucosternon	4	1					1	1	2	1				5							2	3			
elongatus		23			10	10								21				4	15	2					
lineatus		6						2	3	1				6								2	4		
guttatus		6					1	3	2					6					2	2	1	1			
rackliffei		3							1	1		1		3								1	2		
fuliginosus	1	11				1	8	2						11						7	4				
philippinus		1					1							1						1					
bleekeri		2				1	1							2					1	1					
mata		2				1	1							2						2					

color phase, its depth is 1.8 in the standard length and further, this specimen has completed its metamorphosis from the acronurus stage, the snout having the concave profile, as does the 42 mm. specimen. Because of these "connecting links" between *striatus* and the *strigosus* of Herre (not of Bennett), we conclude that the latter is a synonym of *striatus*.

John E. Randall of the University of Hawaii has determined that *C. strigosus* (Bennett) is a distinct and valid species and that the figure by Hiyama (Report on the Poisonous Fishes of the South Seas, pl. 19, fig. 53, 1943) is an unnamed species of *Ctenochaetus* which Randall proposes to publish in the near future. It may be recognized when alive by the numerous small blue specks on the head and body.

Genus ACANTHURUS Forskål

Acanthurus FORSKÅL, Descriptiones Animalium . . ., p. 59, 1775. (Genotoype *Teuthis hepatus* Linnaeus.)

Certain counts have been made on various species of *Acanthurus* and these are recorded in table 56.

ACANTHURUS TRIOSTEGUS TRIOSTEGUS (Linnaeus)

FIGURE 90, *b, d, e;* PLATES 63 A, B, C; 64 A, B, C

Chaetodon triostegus LINNAEUS, Systema naturae, ed. 10, p. 274, 1758 (type locality, Indies).

Teuthis troughtoni WHITLEY, Rec. Australian Mus., vol. 16, No. 4, p. 233, pl. 16, fig. 1, 1928 [figure 1 is coloration of breeding adult males] (type locality, Peu and Naunaha Island, Vanikoro; off North Queensland; New Guinea); Linnean Soc. New South Wales, vol. 63, pts. 3–4, p. 294, fig. 3, 1938 (bibliography on Acronurus stage; Nauru, Gilbert Islands).

SPECIMENS STUDIED

Bikini Atoll: 29 stations, 307 specimens, 22 to 147 mm. in standard length.
Rongelap Atoll: 6 stations, 34 specimens, 31 to 156 mm.
Eniwetok Atoll: 6 stations, 55 specimens, 22 to 152 mm.
Rongerik Atoll: 3 stations, 13 specimens, 23 to 118 mm.
Kwajalein Atoll: 26 specimens, 23 to 130 mm.
Jaluit Atoll: 1 lot, 1 specimen, 45 mm., *Albatross*.
Guam: 11 lots, 253 specimens, 21 to 140 mm.
Rota: 5 lots, 169 specimens, 21 to 109 mm.
Saipan: 1 lot, 2 specimens, 32 to 37 mm.

Description.—Dorsal rays usually IX,22 to 24; anal III,19 to 21; pectoral I,i,13, or 14; pelvic always I,5; branched caudal 7+7; teeth on one side of upper jaw 7, of lower jaw 9 (based on 4 specimens).

Depth 1.8 to 2.2, head 3.1 to 3.4, both in standard length; eye 3.2 to 4.2, least depth of caudal peduncle 2.9 to 3.0, length of pectoral 1.1 to 1.2, postorbital part of head (hind margin of eye to upper edge of gill opening) 4.8 to 5, lower lobe of caudal fin 1.1 to 1.3, upper lobe

1.0 to 1.2, all in length of head (tip of snout to upper edge of gill opening); interorbital in eye 0.7 to 0.9; length of caudal spine 5.0 to 6.5, eye 2.0 to 3.0, both in snout; length of caudal peduncle in its depth 0.7 to 1.0; angle of snout profile with axis of body 60 to 65 degrees; profile of snout nearly straight in young, a little concave in adult.

Color in alcohol.—Head and body grayish to light brownish, paler below, with 5 or 6 narrow transverse blackish streaks, the first from nape through eye, across cheek to isthmus; second from dorsal origin to base of pectoral; third from sixth or seventh dorsal spine nearly

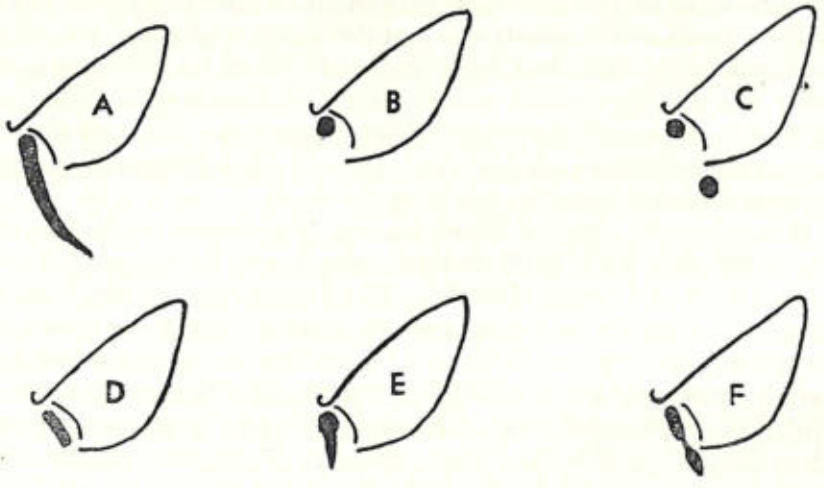


FIGURE 90.—Color patterns on and below pectoral fin base of *Acanthurus triostegus triostegus* (Linnaeus) and *A. sandvicensis* Streets: *a*, Black streak on *A. sandvicensis*; *b*, black spot on *A. triostegus triostegus*; *c*, two black spots on *A. triostegus marquesensis* Schultz and Woods; *d*, *e*, variation of color pattern in the form of short bar or elongate spot in some specimens of *A. triostegus triostegus* from the Phoenix Islands; *f*, elongate streak occurring on juvenile specimens of *A. triostegus marquesensis*. (After Schultz and Woods.)

to anus; fourth and fifth from soft dorsal fin nearly to base of soft anal; and last on caudal peduncle, usually incomplete, represented by a spot on dorsal and ventral sides, or a saddle, sometimes absent except for a small spot on dorsal surface only, never completely across side of caudal peduncle; median fins dusky, the anal with a narrow white margin.

The 24-mm. specimen from Eniwetok Atoll, caught with a light at night, was still in its pelagic stage and lacked the dark vertical bars. The area over orbits is blackish and is continuous with a wide silvery band through eye, across cheek and gill cover to breast, as far back as anal fin origin; a vertical bar of black pigment occurs at base of caudal fin, tips of caudal fin rays slightly pigmented, otherwise the specimen is unpigmented. Other specimens herein recorded at

lengths as short as 21 mm. had traces of the characteristic vertical dark bars.

Color when alive.—Ground color olive tinged with grayish to light brownish; vertical stripes on body dark purple to blackish, in breeding males vertical stripes as wide as pupil, in females dark stripes narrower; margin of anal fin white; margins of pelvics white; median fins dusky; general coloration of breeding males much darker than females, sometimes almost blackish dorsally.

Ecology.—This species is one of the more common surgeon fishes on the reefs; at low tide they congregate in great numbers in the shallow pools on the nearly drained flat reefs, grazing on the algae, and swimming with their backs exposed. They do not take alarm until they are approached within a few feet, at which moment they all break away, and the whole school appears to swim and turn in unison as the individuals dart from place to place attempting to hide in crevices and hollows far too small for them.

Remarks.—Schultz and Woods (Journ. Washington Acad. Sci., vol. 38, pp. 248–251, fig. 1, 1948) worked out certain subspecies and species related to *Acanthurus triostegus.* They concluded, on the basis of meristic characters and color pattern, that *A. triostegus triostegus* occurred in the tropical Pacific and Indian Oceans (specimens studied were from Mauritius; Seychelles; Sumatra; New Guinea; Solomons; Philippines; Okinawa; Japan; Marianas; Marshalls; Samoan group; Phoenix group; Niuafu Island; Tahiti; Tuamotus; Mangareva; Takaroa; and eastern Pacific from Clarion, Clipperton, and Cocos Islands), whereas *A. triostegus marquesensis* Schultz and Woods occupied the Marquesas Islands. *A. sandvicensis* Streets is a distinct species and has been found in the Hawaiian Islands and at Johnston Island. Table 57 and figure 90, *a*, *c*, and *f*, illustrate the chief differences that distinguish these species and subspecies.

ACANTHURUS LEUCOSTERNON Bennett

PLATE 61, B

Acanthurus leucosternon BENNETT, Proc. Comm. Zool. Soc. London, pt. 2, p. 183, 1832 (type locality, Ceylon).

SPECIMENS STUDIED

Bikini Atoll: Arji Island, 100 yards off shore, lagoon coral heads to depth of 40 feet, August 7, 1946, S–46–308, Brock and Herald, 5 specimens, 111 to 127 mm.

Description.—Dorsal rays VIII or IX, 26 to 29; anal III,25 or 26; pectoral I,i,14; pelvic I,5; branched caudal 7+7; teeth on one side of upper jaw 6 to 8, of lower jaw 7 to 10 (based on 5 specimens).

Depth 1.8 to 2.0, head 2.2 to 2.4, both in standard length; snout 1.4 to 1.5, eye 3.6 to 3.8, least depth of caudal peduncle 2.6 to 2.8, length of pectoral fin 0.9 to 1.0, postorbital part of head (hind margin of eye to upper edge of gill opening) 5.1 to 5.3, lower lobe of caudal fin 0.6 to 0.7, upper lobe 0.6 to 0.7, all in length of head (tip of snout to upper edge of gill opening); interorbital space in eye 0.8; length of caudal spine 2.3 to 2.8, eye 2.1 to 2.5, both in snout; length of caudal peduncle in its depth 1.0 to 1.1; angle of snout profile with lengthwise axis of body 68 to 71 degrees; profile of snout concave.

Color in alcohol.—Body chocolate brown, with median fins black except that tips of rays of forked caudal fin are pale, forming a crescent-shaped marginal band, abruptly contrasting with black on rest of fin; pelvics black; pectorals with basal third blackish, distal two-thirds pale; pale ring or band around sides and lower parts of mouth, leaving lips and dorsal surface of snout black; nostrils pale; caudal spine black; base of pectoral black, especially axil; black spot at upper edge of gill opening continuous with black margin of gill cover and opercle, extending as wide band ventrally along gill membranes to meet its fellow on isthmus and breast just behind pale ring around mouth; probably a pale area on body behind head above pectoral fin base.

Color when alive.—Recorded on a Kodachrome photograph, margin of caudal fin yellowish orange; pale area behind head just above pectoral fin is red; general color of head, body and fins bluish black; ring around mouth white.

Ecology.—This species was taken only in deep water in the lagoon. It was not seen in the shallow reef waters.

ACANTHURUS ALIALA Lesson

PLATE 65, A

Acanthurus aliala LESSON, Voyage autour du monde . . . sur la corvette . . . La *Coquille*, Zool., vol. 2, pt. 1, p. 150, 1830 (type locality, Oualan, Caroline Islands).

SPECIMENS STUDIED

Bikini Atoll: 9 stations, 19 specimens, 77 to 147 mm. standard length.
Eniwetok Atoll: 1 specimen, 134 mm.
Kwajalein Atoll: 3 specimens, 56 to 147 mm.

Description.—Dorsal rays usually IX,29 or 30; anal III,27 or 28; pectoral I,i,14; pelvic always I,5; branched caudal usually 7+7; teeth on one side of upper jaw 4 to 6, of lower jaw 5 or 6.

Depth 1.6 to 1.7, head 3.0, both in standard length; snout 1.4, eye 3.3 to 3.6, least depth of caudal peduncle 2.9 to 3.1, length of pectoral

0.9 to 1.1, postorbital part of head (hind margin of eye to upper edge of gill opening) 5.0 to 5.6; lower lobe of caudal fin 1.2, upper lobe 0.9 to 1.1, all in length of head (tip of snout to upper edge of gill opening); interorbital in eye 0.8; length of caudal spine 2.6 to 3.0, eye 2.4 to 2.8, both in snout; length of caudal peduncle in its depth 0.9 to 1.0; angle of snout profile with axis of body 78 to 80 degrees.

Color in alcohol.—Head and body uniform black to dark brown; caudal spine pale; narrow pale U-shaped ring around mouth except across upper surface of snout; pale oblong area under orbit, extending about half diameter of eye in front of lower part of eye; fleshy margin of operculum pale as far ventrally as opposite pectoral fin base; bases of both dorsal and anal fins with a narrow pale streak or white line anteriorly, this broadening to include about two-thirds of fin posteriorly; remainder of fins blackish anteriorly, fading posteriorly; distal margin of soft rays with a narrow whitish edge, then a very narrow black submarginal band; outer margin of pelvic fins pale; pectoral fins translucent distally, dusky basally; caudal fin abruptly pale at base of its rays, distal margin of fin pale or whitish, a dusky band (yellowish when alive) of equal width submarginally; rest of fin basally pale.

A 90-mm. specimen, when held in certain angles, shows about 6 or 7 vertically alternating light and dark bars on sides that are almost obscure, but their presence is very important because we have a single specimen in the Kwajalein collection that shows similar but distinct vertical bars. This specimen is 56 mm. in standard length and is still in the postlarval or acronurus stage; these vertical bars appear to have slightly paler centers than their margins; pale area below eye and around mouth lacking; otherwise coloration similar to the 90 mm. specimen.

Color when alive.—Body blackish, caudal spine yellow; iris pale yellow; spot below eye white; opercular margin pale yellow; U-shaped mouth band white; basal part of dorsal and anal fins yellow, and distal margins of soft rays of these fins bright blue; caudal fin whitish except orange submarginal transverse band; pectoral colorless; pelvics black with outer margins blue.

Ecology.—This uncommon species was found in the more abundant growths of corals where wave action was moderate to severe.

Remarks.—This species, often reported upon as *A. aliala* Lesson, from the eastern Pacific and from the Galápagos Islands does not appear to differ from specimens in the central Pacific. The name *glaucopareius* Cuvier and Valenciennes (1835) (no such name in Bloch and Schneider) is a synonym of *aliala*.

ACANTHURUS ACHILLES Shaw

PLATE 65, B

Acanthurus achilles SHAW, General zoology, vol. 4, pt. 2, p. 383, 1803 (no locality given).

SPECIMENS STUDIED

Bikini Atoll: 13 stations, 38 specimens, 66 to 155 mm. standard length.
Eniwetok Atoll: 5 stations, 21 specimens, 56 to 150 mm.
Rongerik Atoll: 3 specimens, 65 to 114 mm.
Rongelap Atoll: 3 stations, 3 specimens, 114 to 140 mm.

Description.—Dorsal rays IX,30 to 32; anal III,26 to 29; pectoral I,i,14 or 15; pelvic I,5; branched caudal 7+7; teeth on one side of upper jaw 4 to 6, of lower jaw 4 or 5, rarely 4.

Depth 1.7 or 1.8, head 2.9 to 3.2, both in standard length; snout 1.4 to 1.5, eye 3.2 to 4.3, least depth of caudal peduncle 2.8 to 3.2, length of pectoral fin 1.1 to 1.2, postorbital part of head (hind margin of eye to upper edge of gill opening) 6.2 to 6.6, lower lobe of caudal fin 0.9 to 1.0, upper lobe 0.7 to 0.9, all in length of head (tip of snout to upper edge of gill opening); interorbital in eye 0.8 to 1.0; length of caudal spine 2.8 to 2.9, eye 2.2 to 2.8, both in snout; length of caudal peduncle in its depth 1.0 to 1.2; angle of snout profile with lengthwise axis of body 73 to 79 degrees; snout profile concave.

Color in alcohol.—Body and head black or dark brownish black with a large pale heart-shaped area posteriorly in front of and including the caudal spine; posterior margin of operculum just above pectoral fin base white, but not extending to upper edge of gill opening; a narrow pale streak along bases of soft rays of dorsal and of anal fins and outer edge of soft rays of these fins with very narrow pale margin, remainder of fins black; rays of pectorals black, membranes colorless; pelvics black, outer margins pale; caudal blackish basally, abruptly pale distally, but with a submarginal narrow black band all the way around caudal fin set off by the wide pale band distally; anus whitish; a 56-mm. specimen has the opercular flap white, and posterior margin of caudal slightly pale but no other pale areas are present.

Color when alive.—Large caudal spot bright red; band at base of soft dorsal and anal fin rays red, margin of these fins with blue line; margin of caudal fin red and central area enclosed by black line red; color in fins not appearing until 60 to 65 mm. is reached; red caudal spot lacking on specimens 70 mm. and shorter.

Ecology.—This species appears to prefer those reefs where the surf breaks and can be seen in fair abundance in the surge channel along the outer edge of the reef at low tide.

ACANTHURUS LINEATUS (Linnaeus)

Chaetodon lineatus LINNAEUS, Systema naturae, ed. 10, p. 274, 1758 (type locality, Indies).

SPECIMENS STUDIED

Bikini Atoll: Univ. Washington, 1 specimen, 101 mm.
Eniwetok Atoll: 1 station, 1 specimen, 128 mm. standard length.
Guam: 3 lots, 6 specimens, 35 to 119 mm.
Rota: 5 lots, 31 specimens, 30 to 183 mm.

Description.—Dorsal rays IX,27 to 29; anal III,26 or 27; pectoral I,i,14 or 15; pelvic always I,5; branched caudal 7+7; teeth on one side of upper jaw 4 to 6, of lower jaw 6 or 7 (in 6 specimens).

Depth 2.1 to 2.2, head 3.5 to 3.7, both in standard length; snout 1.3 to 1.7, eye 3.0 to 4.6, least depth of caudal peduncle 2.2 to 3.0, length of pectoral 0.95 to 1.0, postorbital part of head (hind margin of eye to upper edge of gill opening) 4.0 to 5.1, lower lobe of caudal fin 0.5 to 1.1, upper lobe 0.5 to 1.1, all in length of head (tip of snout to upper edge of gill opening); interorbital in eye 0.7 to 1.2; length of caudal spine 1.5 to 2.0, eye 1.5 to 3.9, both in snout; length of caudal peduncle in its depth 0.8 or 0.9; angle of snout profile with lengthwise axis of body 65 to 72 degrees.

Color in alcohol.—Body of adults with 11 sets of narrow light and dark longitudinal bands, those of young 32 mm. long with 8, these narrowing anteriorly and extending onto head; each set consists of a narrow pale (blue when alive) band bordered on each side by a wider dark brown band; pale space between these sets of dark bands nearly equal to combined width of dark bands; 3 lower sets and 2 upper sets continuous to snout, where they bend and follow profile; ground color of cheeks and snout coppery red, breast and belly dirty yellowish white; at base of caudal fin a separate transverse blue band with dark borders, then posteriorly a vertical yellow area; rest of caudal fin dark brown with a prominent (in adults) to nearly obscure (in young) lighter crescent area midway between its base and margin distally; elongate outer caudal rays black and posterior margin with a black line; dorsal fin dark brown, bordered with a black line. Three of the sets of bands extend onto base of soft dorsal; anal fin basally light with a narrow black submarginal line and margin a white line; pectoral dark at base with one set of body bands extending out the rays about a third their length, rays blackish with membranes translucent white; pelvics pale with outer margin black.

Ecology.—This species is not common in the northern Marshalls; only one specimen was taken, on a reef in surf.

Remarks.—There is an antrorse procumbent spine present just before the dorsal fin that is quite evident in small specimens (35 to 67

mm.) but dissection is required to expose it in larger specimens (156 to 183 mm.).

The postlarval form of this fish changes to the adult color pattern at 30 to 31 mm. in standard length. With the change of colors the profile becomes straighter and snout longer. The profile change is probably brought about by descent of the two large upper median teeth. These teeth are formed in a specimen of 30 mm. but do not project beyond the gum line; in the 31-mm. specimen these teeth have descended, the lateral teeth are much larger, and the snout is longer with teeth projecting.

ACANTHURUS GUTTATUS Bloch and Schneider

PLATE 66, A

Acanthurus guttatus BLOCH and SCHNEIDER, Systema ichthyologiae, p. 215, 1801 (type locality, Tahiti).

SPECIMENS STUDIED

Bikini Atoll: 10 stations, 19 specimens, 63 to 154 mm. standard length.
Eniwetok Atoll: 4 stations, 11 specimens, 90 to 170 mm.
Rongerik Atoll: 1 station, 4 specimens, 65 to 144 mm.
Guam: 1 lot, 1 specimen, 33 mm.
Saipan: 1 lot, 1 specimen, 43 mm.
Rota: 2 lots, 2 specimens, 112 and 127 mm.

Description.—Dorsal rays IX,26 to 28; anal III,23 to 26; pectoral I,i,14; pelvic I,5; branched caudal 7+7; teeth on one side of upper jaw, 4 to 6 (usually 5), of lower jaw, 4 to 7 (usually 6).

Depth 1.5 to 1.8, head 2.7 to 3.0, both in standard length; snout 1.3 to 1.8, eye 3.2 to 4.3, least depth of caudal peduncle 2.4 to 3.0, length of pectoral 0.9 to 1.1, postorbital part of head (hind margin of eye to upper edge of gill opening) 4.9 to 6.2, lower lobe of caudal fin 0.9 to 1.1, upper lobe 0.95 to 1.2, all in length of head (tip of snout to upper edge of gill opening); interorbital in eye 0.8 to 1.0; length of caudal spine 5.1 to 11.0, eye 1.7 to 3.2, both in snout; angle of snout profile with lengthwise axis of body 64 (in 33-mm. specimen) to 73 degrees.

Color in alcohol.—Head and body light grayish to sepia brown; 4 vertical pale bands, obscure in young; the first from nape, across opercular bone (not on flap) widening to include all of isthmus and breast anteriorly to pelvics, the second begins below base of fifth dorsal spine, passes under middle of pectoral fin, widening ventrally to include anus and first anal spine, the third from base of fifth dorsal soft ray to base of third anal soft ray, the fourth from nineteenth dorsal ray to base of fourteenth and fifteenth anal rays. Body with numerous white round or oval spots over posterior half, the spotting extending onto the dorsal and anal fins; spots arranged in wavy longitudinal rows; largest spots smaller than pupil, many spots with a dark

border; spots are less numerous on small specimens 33 to 43 mm., and scarcely visible on the 33-mm. specimen. A chocolate brown stripe runs just back of opercular flap from level of eye to axis of pectoral; iris pale; dorsal and anal fins much darker at bases than body and distal third of soft rays black; caudal fin pale at base, distal half black; pectoral fin colorless except for dusky first ray; pelvics silvery-dusky with a black margin.

Color when alive.—Recorded from a Kodachrome photograph: light rusty brown on head and body, yellowish tints on opercular flap, pectoral, and pelvic fins; spiny dorsal and base of anal yellow; a white stripe on posterior part of caudal peduncle; base of caudal fin yellow; no dark margins around spots. A painting from a living Philippine specimen has iris red and spots blue.

Ecology.—This species was found to occur in areas on the reefs where the waves were active and the water surged in and out of channels.

ACANTHURUS OLIVACEUS Bloch and Schneider

PLATE 67

Acanthurus nigricans var. *olivaceus* BLOCH and SCHNEIDER, Systema ichthyologiae, pp. xxxviii, 214, 1801 (type locality, Tahiti).

SPECIMENS STUDIED

Bikini Atoll: 3 stations, 7 specimens, 90 to 193 mm. standard length.
Eniwetok Atoll: 3 stations, 3 specimens, 29 to 210 mm.
Rongerik Atoll: 1 station, 1 specimen, 140 mm. (coughed up partly digested by *Gymnosarda nuda*).

Description.—Dorsal rays IX,23 to 25; anal III,22 to 24; pectoral I,i,14 to 16; pelvic I,5; branched caudal 7+7; teeth on one side of upper jaw 7 to 10, of lower jaw 8 to 10.

Depth 2.1 to 2.3, head 3.3 to 3.5, both in standard length; snout 1.3 to 1.4, eye 4.0 to 4.8, least depth of caudal peduncle 2.7 to 2.9, length of pectoral fin 0.9 to 1.0, postorbital part of head (hind margin of eye to upper edge of gill opening) 5.0 to 5.2, lower lobe of caudal fin 0.7 to 1.0, upper lobe 0.7 to 0.9, all in length of head (tip of snout to upper edge of gill opening); interorbital in eye 0.6 to 0.8; length of caudal spine 2.3 to 2.7, eye 2.9 to 3.8, both in snout; length of caudal peduncle in its depth 0.7 to 0.8; angle of snout profile with lengthwise axis of body 70 to 72 degrees; profile of head and snout convex.

Color in alcohol.—Body and head brown to dark brown or blackish; median fins brown to blackish, sometimes a little paler basally; the caudal fin with a central pale area distally in posterior one-third of middle rays with a submarginal black line near tips of rays, then margin pale; when dorsal and anal fins are somewhat pale their margins have 2 or 3 black lines; a broad pale band behind eye, bordered with

narrow black band, extending to opposite tips of pectoral fins; caudal spine black; basal three-fourths of pectoral fin blackish, distal one-fourth pale but with tips of rays somewhat pigmented; pelvics black.

Specimens 44 to 78 mm. pale with only a trace of pale-centered dusky streak behind eye; edges of median fins and of pelvics black-lined; pectoral pale; peduncular spine a little dusky.

Color when alive.—Pale band behind eye olive to orange, bordered by narrow purplish band; iris yellowish-orange; a narrow orange line or streak at base of soft rays of both dorsal and anal fins, sometimes head and body ground color pale, dirty yellow.

Ecology.—This surgeon fish appears to prefer those sections of the reef where the wave action is severe and the water rather deep. It was not taken over the shallow parts of the reef.

Remarks.—The single specimen in the acronurus stage (29 mm.) from Eniwetok Atoll has been identified with this species primarily on the basis of fin ray counts, pigmentation, and size as compared with other postlarval stages of the Acanthuridae. This specimen, translucent when alive, in alcohol is opaque and whitish, but with very fine black pigment cells all over its body and head giving it a slightly grayish appearance; all fins are pale, except that the distal margins of the dorsal and anal fins have a black line. We count dorsal rays IX,24; anal III,23; pectoral I,i,14 (on each side); branched caudal 7+7; teeth on both sides of upper jaw 7 and 8, of lower jaw 8 and 8.

ACANTHURUS NIGRICANS (Linnaeus)

PLATE 68

Chaetodon nigricans LINNAEUS, Systema naturae, ed. 10, p. 274, 1758 (type locality, Red Sea).

SPECIMENS STUDIED

Bikini Atoll: 2 stations, 2 specimens, 177 to 201 mm. standard length.
Eniwetok Atoll: 2 stations, 2 specimens, 194 and 202 mm.
Rongelap Atoll: 1 station, 1 specimen, 136 mm.
Rongerik Atoll: 2 specimens, 180 and 194 mm.
Guam: 2 lots, 2 specimens, 75 and 93 mm.

Description.—Dorsal rays VIII or IX,25 to 27, rarely VIII; anal III,24 or 25; pectoral I,i,14 to 16; pelvic I,5; branched caudal 7+7; teeth on one side of upper jaw 7 to 9, of lower jaw 7 to 11.

Depth 2.0 to 2.2, head 3.4 to 3.5, all in standard length; snout 1.4 to 1.5, eye 3.9 to 4.8, least depth of caudal peduncle 2.6 to 2.8, length of pectoral fin 1.0 to 1.2, postorbital part of head (hind margin of eye to upper edge of gill opening) 5.0 to 5.2, lower lobe of caudal fin 0.5 to 0.6, upper lobe 0.6 to 0.7, all in length of head (tip of snout to upper edge of gill opening); interorbital in eye 0.6 to 0.7; length of caudal spine 2.3 to 3.3, eye 2.5 to 3.0, both in snout; length of caudal

peduncle in its depth 0.8; angle of snout profile with lengthwise axis of body 69 to 71 degrees; profile of head convex.

Color in alcohol.—Body and head dark brown; a black bar extends from behind eye posteriorly, ending opposite midpoint of length of pectoral fin, width of this bar about two-thirds diameter of orbit; lengthwise black bar extends forward from caudal spine, tapering to a point and ending from one-half to nine-tenths length of pectoral fin behind tip of depressed pectoral fin; median fins dark brown, the dorsal and anal margined with a black line; posterior margin of lunate-shaped caudal fin margined with a narrow pale or white band; basal three-fourths of pectoral fin blackish, the distal quarter whitish, sharply contrasting with the black; pelvics black; sometimes base of caudal fin abruptly a little paler than caudal peduncle. On a specimen 77 mm. in standard length the black bar behind the eye is scarcely visible, and the one in front of caudal spine is lacking, but spine black.

Color when alive.—Body, head, and fins dark brown, bars on sides black.

Ecology.—This uncommon species appears to occur in deeper water of the lagoon and is seldom found in the shallow waters over the reefs or where the wave action is severe.

ACANTHURUS ELONGATUS (Lacepède)

PLATES 62, C, D; 63, D; 64, D, E

Chaetodon elongatus LACEPÈDE, Histoire naturelle des poissons, vol. 4, pp. 454–473, fig., 1803 (type locality, The Great Ocean [Pacific?]).

Acanthurus lincolatus VALENCIENNES, *in* Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 10, p. 207, 1835 (type locality, Mer des Indies).

SPECIMENS STUDIED

Bikini Atoll: 32 stations, 756 specimens, 26 to 136 mm. standard length.
Eniwetok Atoll: 10 stations, 189 specimens, 36 to 144 mm.
Rongelap Atoll: 11 stations, 504 specimens, 38 to 110 mm.
Rongerik Atoll: 5 stations, 106 specimens, 44 to 107 mm.
Kwajalein Atoll: 1 station, 54 specimens, 36 to 137 mm.
Guam: 1 lot, 1 specimen, 62 mm.

Description.—Dorsal rays IX,24 or 25; anal III,22 to 24; pectoral I,i,14; pelvic always I,5; branched caudal 7+7; upper teeth on one side of upper jaw 4 to 7, of lower jaw 5 to 8.

Depth 1.8 to 2.3, head 3.1 to 3.4, both in standard length; snout 1.3 to 1.7, eye 3.0 to 4.1, least depth of caudal peduncle 0.8 to 3.0, length of pectoral 0.9 to 1.9, postorbital part of head (hind margin of eye to upper edge of gill opening) 4.3 to 6.0, lower lobe of caudal fin 1.0 to 1.1, upper lobe 0.8 to 0.95, all in length of head (tip of snout to upper edge of gill opening); interorbital in eye 0.8 to 1.0; length of caudal spine 2.0 to 3.0, eye 1.5 to 3.0, both in snout; length of caudal peduncle

in its depth 0.8 to 1.0; angle of snout profile with axis of body 65 to 75 degrees; the profile of snout concave or straight in young.

Upper caudal lobe usually longer than lower in small specimens; in those of over 100 mm. tips of both lobes blunter, caudal not so deeply lunate.

Color in alcohol.—There is great variation in both color and pattern ranging from uniform black to very pale on head, body, and vertical fins; in pale specimens dark pigmentation occurs only around the edge of vertical fins, mouth, caudal spine, and the spots at posterior base of dorsal and anal. Usually head and breast lighter than body; body uniform chocolate brown; lips, caudal spine-sheath darker. Dorsal and anal fins black, often with 3 to 5 lengthwise stripes, light alternating with dark, then more pronounced on posterior part of fin. Black spots at posterior bases of dorsal and anal fins variable in size; dorsal spot usually larger, anal spot sometimes almost obsolete, spots often bordered with light area. Caudal fin blackish, distal margin white, often with 3 thin vertical stripes; pectoral translucent, upper ray dusky; pelvics with spine, first soft ray, and tips black or with whole fin darker distally.

Some specimens with very pale head, light brown body and darker fine wavy lengthwise lines; posterior half of caudal peduncle abruptly lighter; white or red spots smaller than pupil occur over cheeks and breast; fin streaks of darker color from eye to mouth, and on body lengthwise lines more or less continuous or broken into rows of dots. Specimens that have just completed the acronurus stage still retain the 12 stripes with 2 or 3 dark bars on the fins.

Color when alive.—Body ground color grayish with a tinge of yellow and numerous close-set blue specks; about 6 narrow faint yellow wavy streaks extend from eye toward snout; head gray without yellow tinge; posterior margin of caudal white edged; spots at posterior bases of dorsal and anal fins purple, bordered with pastel orange color.

Ecology.—This is apparently the most abundant species of surgeonfish on the reefs and occurs in almost every type of habitat investigated.

Remarks.—Fishes in the acronurus stage of *A. elongatus* between 26 and 41 mm. in standard length are translucent when alive but pale white with a pinkish tinge in alcohol. Preserved specimens have a wide silvery band from occiput through eye, across cheek and gill cover ventrally widening to include base of pectoral, posterior half of breast to anal fin origin; this band above eye is bluish-black; tips of caudal rays blackish, remainder of fin pale; base of caudal peduncle with vertical black bar including its dorsal surface; caudal spine with a little black pigment around it; dorsal and anal fins pale, with black

pigment cells at base of each ray; back along base of dorsal fin with some black pigment cells; tip of snout blackish. We identify these postlarval stages with *elongatus* mostly on the basis of fin ray counts, teeth, and through the elimination of other species which already have the adult color pattern at smaller sizes or at larger sizes.

ACANTHURUS BLEEKERI Günther

Acanthurus bleekeri GÜNTHER, Catalogue of the fishes in the British Museum, vol. 3, p. 335, 1861 (type locality, East Indian Archipelago).

Harpurus gnophodes FOWLER, Journ. Acad. Nat. Sci. Philadelphia, vol. 12, pp. 544–545, pl. 22, upper figure, 1904 (type locality, Padang, Sumatra).

SPECIMENS STUDIED

U.S.N.M. No. 139993, Rongelap Atoll, Rongelap Island, ½ mile north of western end at Able Buoy, top of coral head, depth 15 feet, July 26, 1946, S–46–295, Brock, 1 specimen, 273 mm.

Description partially based on two other specimens, U.S.N.M. Nos. 57998 from the Philippines and 66053 from the Taumotu Islands.

Description.—Dorsal rays IX,25 or 26; anal III,23 or 24; pectoral I,i,13 to 15; pelvic I,5; branched caudal 7+7; teeth on one side of upper jaw 10 or 11, of lower jaw 11 to 13.

Depth 2.4, head 4.0, both in standard length; snout 1.8, eye 4.7, least depth of caudal peduncle 3.0, length of pectoral fin 1.1, postorbital part of head (hind margin of eye to upper edge of gill opening) 4.0, lower lobe of caudal fin 0.8 and upper lobe 0.8, all in length of head (tip of snout to upper edge of gill opening); angle of snout profile with lengthwise axis of body 55 degrees; profile of snout convex. A line from center of caudal spine to rear corner of maxillary passes one-half to two-thirds diameter of orbit above pectoral fin base. Angle between two lines radiating from center of eye, one to rear edge of maxillary, the other to dorsal edge of front of base of pectoral fin, 79 to 81 degrees.

Color in alcohol.—Brownish black with median fins plain blackish; pelvics black; pectoral rays blackish, but the interradial membranes unpigmented; the area a little behind, below, and in front of eye pale brownish or a little lighter than remainder of head; head and body with wavy dark lines, most distinct on the head but fading out posteriorly on body; 10 dark lines (probably blue when fish are alive) from eye to lower edge of preopercle; 8 or 9 more dark lines from in front of pectoral fin base to breast, 2 or 3 in front of eye, 10 to 12 from dorsal edge of eye to dorsal fin origin; those dark lines behind head too indistinct to count; fleshy opercular margin black; none of the fins with pale edges.

Remarks.—This species is characterized by the slender caudal peduncle, elongate body, depth about 2.2 in standard length, and by the

ventral position of the pelvic fin in reference to a line from mouth to caudal spine.

ACANTHURUS PHILIPPINUS Herre

Acanthurus philippinus HERRE, Philippine Journ. Sci., vol. 34, No. 4, p. 434, pl. 5, fig. 1, 1927 (type locality, Calapan, Mindoro, Philippines).

SPECIMEN STUDIED

U.S.N.M. No. 140054, Rongelap Atoll, Rongelap Island, southwest end, passageway, coral head at depths of 10 to 60 feet, speared, July 23, 1946, S-46-282, Brock, Herald, and Kohler, 1 specimen, 113 mm.

Description.—Dorsal rays IX,26; anal III,24; pectoral I,i,14–I,i,14; pelvic I,5; caudal 7+7; teeth on both sides of upper jaw 8 and 8, of lower jaw 12 and 11.

Depth 2.2, head 4.0, both in standard length; snout 2.0, eye 3.6, least depth of caudal peduncle 2.7, length of pectoral fin 0.9, postorbital part of head (hind margin of eye to upper edge of gill opening) 3.7, lower lobe of caudal fin 0.7, upper lobe 0.6, all in length of head (tip of snout to upper edge of gill opening); interorbital in eye 0.8; length of caudal spine 1.8, eye 1.7, both in snout; length of caudal peduncle in its depth 0.8; angle of snout profile with lengthwise axis of body 73 degrees; profile of snout convex. A line from center of caudal spine to rear corner of maxillary passes about one-third to one-half diameter of orbit above pectoral fin base; angle between two lines radiating from center of eye, one to rear edge of maxillary, the other to dorsal edge of pectoral base, 75 degrees.

Color in alcohol.—Head, trunk, pectorals, pelvics, dorsal, and anal fins plain dark brown; caudal fin notably paler than dark brown body, but tinged with light dusky; a trace of a blackish marginal line on edge of dorsal and anal fins; fleshy margin of gill cover black.

Ecology.—A great school of this species was observed swimming about the coral heads at depths of more than 10 feet, but only a single specimen could be speared.

ACANTHURUS FULIGINOSUS Lesson

Acanthurus fuliginosus LESSON, Voyage autour du monde . . . sur la corvette *La Coquille*, Zool., vol. 2, pt. 1, p. 149, pl. 27, fig. 2, 1830 (type locality, Oualan, Caroline Islands).

SPECIMENS STUDIED

Guam: 5 lots, 12 specimens, 26 to 341 mm. standard length.

Description partially based on U.S.N.M. Nos. 52735, from Hawaii, and 115161, from the Phoenix Islands.

Description.—Dorsal rays VIII or IX,25 to 27 (rarely VIII); anal III,24 or 25; pectoral I,i,15 or 16; pelvic I,5; branched caudal 7+7; upper teeth on one side of jaw 6 to 8, on lower jaw 6 to 8.

Depth 2.0 to 2.2, head 3.3 to 3.5, both in standard length; eye 4.2 to 5.3, least depth of caudal peduncle 2.4 to 2.7, length of pectoral fin 1.1 to 1.2; postorbital part of head (hind margin of eye to upper edge of gill opening) 4.9 to 5.4, lower lobe of caudal fin 0.8 to 0.9, upper lobe 0.6 to 0.8, all in length of head (tip of snout to upper edge of gill opening); interorbital in eye 0.6 to 0.8; length of caudal spine 3.8, eye 3.0 to 4.0, both in snout; angle of snout profile with lengthwise axis of body 60 to 70 degrees. A line from center of caudal spine to rear corner of maxillary passes over dorsal edge of pectoral fin base. Angle between two lines radiating from center of eye, one to rear edge of maxillary, the other to dorsal edge of base of pectoral fin, 53 to 62 degrees.

Color in alcohol.—Specimens 26 mm. and longer plain brownish with alternating pale and brownish narrow bands numbering 2 or 3 anteriorly, 5 posteriorly in both soft dorsal and soft anal fins; basal two-thirds to three-fourths of pectoral fins brownish, the distal one-third to one-quarter translucent; pectoral fin in specimens 26 to 40 mm. pale throughout and caudal fin in these specimens light brownish gray, abruptly paler than body; also in specimens 26 mm. there are only 3 lengthwise dark bands in dorsal and anal fins. In adults caudal fin abruptly paler than body, grading into dark brown distally; a pale streak (blue in life) at bases of dorsal and of anal fins. The basal part of pectoral fin is somewhat blackish at 50 mm. standard length.

Remarks.—We have experienced genuine difficulty in distinguishing species of surgeonfishes closely related to *A. fuliginosus*. There have appeared during the past two centuries numerous figures and descriptions of species related to *fuliginosus*. The color patterns of these as described vary considerably. We think the chief causes of the confusion in recognizing these species are the result of (1) poorly preserved and faded specimens, (2) use of dried skins, and (3) the use of too few specimens for comparison. Among the specimens referable to this complex relationship of species we are able to recognize two distinct kinds, both reaching a size of 400 to 500 mm. in standard length. The differences that distinguish between *fuliginosus* and *mata* are as follows:

Character	*fuliginosus*	*mata*
Pectoral fin	Posterior one-third pale, basal two-thirds dark.	Plain blackish or dark brownish.
Dorsal edge gill opening	Not blackish	Blackish and sometimes as a roundish black blotch.
Caudal fin	May or may not (in adults) have pale base.	Plain blackish.

These two forms, as alcoholic specimens, have in common a brown to blackish coloration without traces of blackish or pale margins to the median fins; area adjoining caudal spine blackish; a pale area in front and behind orbit; cheek, operculum, and below pectoral fin base to breast and above eye to dorsal origin, with numerous alternating pale and dark lines or streaks, these scarcely discernible on large adults, more obvious on half grown and young. The fleshy margin of operculum is blackish on *mata* but blackish only dorsally on *fuliginosus;* in *fuliginosus* there are 3 to 5 or 6 dark streaks in dorsal and anal fins, and the caudal may be spotted with dark pigment but both of these characters definitely fade out in some large adults, whereas in *mata* these fins are plain blackish or dark brown.

The changes in the convexity and prominence of the snout in large fishes of the genus *Acanthurus* appear to be comparable with similar changes that occur in the growth of the horny to bony protuberance of the front part of the head in the genera *Naso* and *Prionurus* Lacepède. Thus, in certain species of *Acanthurus*, we conclude that considerable doubt must be cast on the use of the convexity or concavity of the head and snout profile in separating the larger specimens.

ACANTHURUS MATA Cuvier and Valenciennes

Acanthurus mata Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 10, p. 202, 1835 (based on pl. 82, *Chaetodon nigrofuscus* Forskål? [not *C. nigrofuscus* Forskål] of Patric Russell, Descriptions and figures of two hundred fishes, collected at Vizagapatam on the coast of Coromandel, vol. 1, p. 64, 1803).—Day, Fishes of India, vol. 1, p. 205, pl. 48, fig. 1, 1876 (Madras; additional synonymy given).

Acanthurus gahm (not *gahhm* of Forskål) Day, Fauna of British India, vol. 2, p. 141, 1889 (India).

Hepatus mata Fowler and Bean, U. S. Nat. Mus. Bull. 100, vol. 8, p. 213, 1929 (Philippines).

SPECIMENS STUDIED

U.S.N.M. No. 140043, Rongerik Atoll, Bock Island, ocean reef, April 24, 1946, S–46–113, Brock and Marr, 1 specimen, 280 mm.

U.S.N.M. No. 140044, Eniwetok Atoll, lagoon off Eniwetok Island, *Bowditch* anchorage, hook and line, May 20 to June 6, 1946, S–46–154, Welsh and Schaefer, 1 specimen, 310 mm.

Description.—Dorsal rays IX,25 or 26; anal III,24; pectoral I,i,15 or 16; pelvic I,5; branched caudal 7+7; teeth on both sides of upper jaw 9 or 10, of lower jaw 9 or 10.

Depth 1.9 to 2.1, head 3.5 to 3.7, both in standard length; eye 4.7 to 5.8, least depth of caudal peduncle 2.5 to 2.6, length of pectoral 1.1, postorbital part of head (hind margin of eye to upper edge of gill opening) 4.5 to 5.0, lower lobe of caudal fin 0.8, upper lobe 0.7 to 0.8, all in length of head (tip of snout to uper edges of gill opening); in-

terorbital in eye 0.5 to 0.6; length of caudal spine 2.3 to 3.0; eye 3.7 to 4.2, both in snout; length of caudal peduncle in its depth 0.6 to 0.8; angle of snout profile (profile nearly straight to a little convex) with axis of body 64 degrees; a line from center of caudal spine to rear corner of maxillary passes over dorsal edge of pectoral fin base. Angle between two lines radiating from center of eye, one to rear edge of maxillary, the other to dorsal edge of base of pectoral fin, 58 to 61 degrees.

Color in alcohol.—Head and trunk blackish brown, all fins blackish; cheek and operculum from eye to isthmus with or without about 16 or 17 alternating pale and dark streaks, others may occur on breast and above eye; alternating pale and darkish streaks usually occur on side of body; area just behind eye with a light brownish rectangular blotch a little smaller than eye; elongate area in front of eye slightly pale; fleshy margin of operculum blackish from upper edge of gill opening to isthmus.

Remarks.—In identifying our two specimens as *A. mata* we do so with some doubt, but conclude that this procedure is better than adding a new name to an already complex and ill-defined group of species. One thing clear to us is that these two specimens differ from the other species described herein and we can find no other named species that are figured that appear to be so close to our two specimens as *mata*. Because there never has been a revision of the Acanthuridae it seems best now to restrict *A. mata* Cuvier and Valenciennes to Day's figure and description, which is accurate enough to make identification possible. That figure agrees fairly well with our two specimens. We make this restriction in spite of the fact that Day later (1889) changed his mind and referred *A. mata* to the synonomy of *A. gahhm* Forskål, now considered as *nigricans* Linnaeus. Both these descriptions by Day are the same. We make our identifications of *mata* on the basis of color, fin ray counts, teeth, and the similarity of the shape of the body with that originally figured by Day. Russell's plate 82 of *A. mata is* too diagrammatic to be of much value, yet his remarks that the head and parts of the body have blue lines, caudal spine in black sheath, and general color shining black are diagnostic.

Genus ZEBRASOMA Swainson

Zebrasoma SWAINSON, The natural history and classification of fishes, amphibians, and reptiles, or monocardian animals, vol. 2, p. 256, 1839. (Genotype, *Acanthurus velifer* Bloch.)

ZEBRASOMA VELIFERUM (Bloch)

Acanthurus velifer BLOCH, Naturgeschichte der ausländischen Fische, pt. 9, p. 106, pl. 427, fig. 1, 1795 (type locality, Seas of the East Indies). (Reference copied).

SPECIMENS STUDIED

Bikini Atoll: 2 stations 2 specimens, 245 to 275 mm. standard length.
Eniwetok Atoll: 2 stations, 3 specimens, 126 to 238 mm.
Rongelap Atoll: 2 stations, 3 specimens, 158 to 238 mm.

Description.—Dorsal rays IV,30 to 32; anal rays III,24 or 25; pectoral I,i,14; pelvics I,5; branched caudal rays 7+7; teeth on one side of upper jaw 7, of lower jaw 8 to 10.

Depth 1.9 to 2.0, head 3.3 to 3.8, both in standard length; snout 1.5 to 1.6, eye 3.7 to 5, least depth of caudal peduncle 3.0 to 3.4, length of pectoral fin 0.9 to 1.1, postorbital part of head (hind margin of eye to upper edge of gill opening) 5.0 to 5.9, lower lobe of caudal fin 1.2, upper lobe 1.2, all in length of head (tip of snout to upper edge of gill opening); interorbital in eye 0.6 to 0.8; length of caudal spine in snout 3.1 to 3.2; length of caudal peduncle in its depth 1.4; angle of snout profile with axis of body about 70 degrees; profile strongly concave.

Color in alcohol.—Head, trunk, and all fins blackish or dark brown with 5 or 6 transverse pale bands and dark parallel lines; first band from just in front of dorsal fin through rear of orbit past front of pectoral fin base to base of pelvics; second from below spinous dorsal fin, past rear of pectoral fin base to origin of anal fin; third, fourth, and fifth from dorsal fin to anal fin; sixth from dorsal, passing just in front of caudal spine to anal base; dorsal and anal fins posteriorly with transverse pale streaks, sometimes indistinct; head in front of orbits and breast pale or with numerous small pale spots.

Color when alive.—The pale bands are yellowish.

Remarks.—The present collections do not indicate the actual abundance of *Zebrasoma veliferum* on the reefs or in the lagoon. A large school of this species was observed on the reef on an incoming tide in water about one to two feet deep. They were swimming at times with their dorsal fins out of the water like a sail. The moment they were approached, the entire school hastily retreated into the surge channels in the surf and disappeared.

ZEBRASOMA FLAVESCENS (Bennett)

PLATE 66, B

Acanthurus flavescens BENNETT, Zool. Journ., vol. 4, p. 40, 1828 (type locality, Sandwich Islands).

Zebrasoma agana Seale, Occ. Pap. Bishop Mus., vol. 1, p. 110, 1901 (type locality, Guam).

SPECIMENS STUDIED

Bikini Atoll: 6 stations, 14 specimens, 28 to 103 mm. standard length.
Rongelap Atoll: 1 station, 1 specimen, 64 mm.

Description.—Dorsal rays V (rarely IV), 24; anal III,19 or 20; pectoral I,i,13; pelvic I,5; branched caudal 7+7; upper teeth on one side of upper jaw 7 or 8, of lower jaw 8 to 11.

Depth 1.6 to 1.7, head 2.6 to 2.9, both in standard length; snout 1.3 to 1.4, eye 2.9 to 4.0, least depth of caudal peduncle 3.5 to 3.8, length of pectoral fin 1.2, postorbital part of head (hind margin of eye to upper edge of gill opening) 7.2 to 7.5, lower lobe of caudal fin 1.5 to 1.6 and upper lobe 1.5 to 1.6, all in length of head (tip of snout to upper edge of gill opening); interorbital in eye 0.9 to 1.2; length of caudal spine in snout 3.3 to 4.5; length of caudal peduncle in its depth 0.8 to 1.0; angle of snout profile with lengthwise axis of body about 53 or 54 degrees, profile greatly concave (from front of orbit to tip of snout).

Color in alcohol.—Ground color of head and trunk dark brown to blackish, fins plain blackish to dark brown, except that pectoral is translucent or pale with its upper edge black lined; caudal spine white; trunk with wavy lengthwise pale or grayish lines; soft rays of median fins narrowly margined with a white line. A short pale streak just above pectoral and extending behind it occurred in some extralimital specimens, but was entirely lacking in those from Bikini and Rongelap Atolls.

YOUNG (28 mm.): Head and upper anterior part of body pale; lips blackish, body with about 9 transverse bars, consisting of 2 parallel narrow dark lines separated by a light line, bars extending from base of dorsal to base of anal, faint anteriorly, caudal peduncle dark brown, spine white, median fins dark brown, their posterior margins pale; pectoral fin pale; pelvics dusky.

YELLOW PHASE: Head and body uniform pale yellow, median fins pale yellowish, the caudal with narrow black line on outer edge of upper and lower unbranched rays; upper edge of unbranched pectoral ray with narrow black line, rest of fin pale; pelvics pale. Only one example of the yellow phase was collected in the Marshall Islands.

Color when alive.—Head and trunk chocolate brown or plain yellowish in yellow color phase; wavy lengthwise lines on trunk bluish and streak on side above pectoral blue; iris golden or yellowish.

Remarks.—This species occurs in both the lagoon and over the ocean reefs where coral and algal growths are abundant. It is found in or close to deep water, and does not appear to venture into very shallow water.

Genus NASO Lacepède

Naso LACEPÈDE, Histoire naturelle des poissons, vol. 3, p. 165, 1802. (Genotype, *Chaetodon fronticornis* Linnaeus.)

NASO LITURATUS (Bloch and Schneider)

PLATE 69

Acanthurus lituratus BLOCH and SCHNEIDER, Systema ichthyologiae, p. 216, 1801 (type locality, not given).

Monoceros garreti Seale, Occ. Pap. Bishop Mus., vol. 1, p. 112, 1901 (type locality, Guam).

SPECIMENS STUDIED

Bikini Atoll: 22 stations, 50 specimens, 68 to 255 mm. standard length.
Eniwetok Atoll: 6 stations, 22 specimens, 66 to 238 mm.
Rongelap Atoll: 7 stations, 18 specimens, 65 to 250 mm.
Rongerik Atoll: 2 stations, 2 specimens, 140 to 165 mm.
Northern Marshall Island: 1 lot, 9 specimens, 64 to 176 mm.
Guam: 3 lots, 5 specimens, 70 and 114 mm.

Description.—Dorsal rays VI,28 to 30; anal II,29 or 30; pectoral rays I,i,14 or 15 (usually 15); pelvic I,2 or 3; branched caudal 7+7; upper teeth on one side of jaws 12 to 14, lower 8 to 14 (in 7 counts).

Depth 1.9 to 2.4, head 3.1 to 3.7, both in standard length; snout 1.3 to 1.6, eye 3.1 to 4.0, least depth of caudal peduncle 5.05 to 5.8, length of pectoral 1.4 to 1.6, postorbital part of head (hind margin of eye to upper edge of gill opening) 5.1 to 5.9, lower lobe of caudal fin 1.2 to 1.5, upper lobe 1.2 to 1.4, all in length of head (tip of snout to upper edge of gill opening); interorbital in eye 0.9 to 1.0; eye in snout 2.05 to 3.0; length of caudal peduncle in its depth 0.3 to 0.5; angle of snout profile with lengthwise axis of body 45 to 57 degrees; teeth bluntly rounded and close set; outer rays of caudal fin greatly elongated and threadlike in largest specimens.

Color in alcohol.—Body and head uniform grayish brown to black; lips pale; vertical pale bar behind mouth extending along anterior cheek to ventral rim of orbit; nasal membranes white; preopercular margin pale; dorsal fin black at base then a broad white band, soft rays with a black submarginal line, distal tips of soft rays white and anal fin similar except that pale area is not so distinct; pectoral fins blackish with lighter posterior margin; pelvic fins dusky with black tips; caudal fin black basally with pale band along posterior margin; caudal penduncular spines white with bucklers and area surrounding spines pale.

YOUNG (63 to 77 mm.): Bar behind mouth and stripe curving toward eye lacking or barely evident; preopercular margin same color as rest of head; light area around caudal spines very small, may be scarcely lighter than rest of body; pectoral fin entirely colorless, otherwise color as in adults.

Color when alive.—Body ground color rich dark brown to dark purplish; lips orange; caudal spines, bucklers, and area surrounding them light orange to yellow, bar behind mouth and stripe running to eye orange to pale yellow; iris white; a greenish coppery blotch on interorbital; dorsal fin with pale blue or purple stripe at base; membranes of spiny dorsal black basally, diagonal white spots just below margin, margin light brown; soft dorsal with basal half black, then a broad white band distally; a thin, brown, submarginal line, tips of rays white. Anal fin brownish orange basally, then a thin submarginal black line and an equally wide white marginal line;

caudal fin colored as body at base, then a pale yellow mesial crescent and a marginal white band; pelvic fins light brown; pectoral fins same color as body at bases with margins white.

Ecology.—Usually taken where the reef conditions were rugged and the wave action strong.

NASO HEXACANTHUS (Bleeker)

Priodon hexacanthus BLEEKER, Nat. Tijdschr. Nederl.-Indië, vol. 8, p. 421, 1855 (type locality, Amboina).

Callicanthus metoposophron JENKINS, Bull. U. S. Fish Comm., vol. 22, p. 481, fig. 31, 1902 (holotype, U.S.N.M. No. 50706, Honolulu).

SPECIMENS STUDIED

U.S.N.M. No. 140088, Bikini Atoll, Bikini lagoon, deep coral head at 30 to 45 feet, diving and spearing, July 13, 1946, S–46–252, Brock, Emory, and Kohler, 1 specimen, 359 mm.

Description.—Dorsal rays VI,28 or 29; anal II,29 or 30; pectoral I,i,14; pelvic I,3; branched caudal 7+7; teeth on one side of both upper and lower jaw about 20 (many are broken so it is not possible to count exactly).

Depth 2.6 to 2.8, head 4.1 to 4.3, both in standard length; snout 1.7 or 1.8, eye 3.4 to 4.4, least depth of caudal peduncle 5.5 or 5.6, length of pectoral 1.4, postorbital part of head (hind margin of eye to upper edge of gill opening) 4.1, lower lobe of caudal 1.1, upper lobe 1.05, all in length of head (tip of snout to upper edge of gill opening); interorbital in eye 0.7 to 0.95; eye in snout 1.9 to 2.6; length of caudal peduncle in its depth 0.3; angle of snout profile with axis of body 51 or 52 degrees; teeth small, slightly flattened, with minute serrations near tips; skin smooth and velvety to touch; interorbital convex.

Color in alcohol.—Ground color of head and body uniform gray-brown, back darker than lower sides and belly; upper lip black; no markings on head or around opercle; dorsal, caudal, and anal fins dark brown, dorsal and anal with obscure darker markings on membranes; pectoral fin brown with pale margin; pelvic fins dark brown distally, pale at base.

NASO ANNULATUS (Quoy and Gaimard)

Priodon annulatus QUOY and GAIMARD, Voyage autour du monde . . . executé sur les corvettes de S. M. *L'Uranie* et La *Physicienne* . . ., Zool., p. 337, 1824 (type locality, Timor).

SPECIMENS STUDIED

Bikini Atoll: Namu Island, ocean reef, April 4, 1946, S–46–51, Schultz, 4 specimens, 153 to 201 mm.

Eniwetok Atoll: Rujoru Island, lagoon reef, June 2, 1946, S–46–195, Schultz, 1 specimen, 184 mm.

Guam: Nov. 26, 1945, Frey, 1 specimen, 61 mm.

Description.—Dorsal rays V,28 or 29; anal II,27 to 29; pectoral rays I,i,15 or 16; pelvics I,3; branched caudal rays 7+7; teeth on one side

of upper jaw 16 to 20 (usually 16 or 17), of lower jaw 14 to 17 (usually 16), (in 10 counts).

Depth 2.3 to 2.5, head 3.6 to 3.7, both in standard length; snout 1.6 to 1.7, eye 2.95 to 3.3, least depth of caudal peduncle 5.7 to 6.0, length of pectoral 1.4 to 1.6, postorbital part of head (hind margin of eye to upper edge of gill opening) 5.1 to 6.5, lower lobe of caudal fin 1.2 to 1.3, upper lobe 1.1 to 1.2, all in length of head (tip of snout to upper edge of gill opening); interorbital in eye 1.0 to 1.1; eye in snout 1.9 to 2.0; length of caudal peduncle in its depth 0.3 to 0.4; angle of snout profile with lengthwise axis of body 58 to 60 degrees; teeth sharply pointed with edges finely serrate.

Color in alcohol.—Body and head light grayish brown to dark grayish brown, upper part of body darker; lips pale, spiny dorsal fin with distal third of membranes black, basal two-thirds lighter; soft dorsal fin pale basally with a submarginal black line and tips of rays white; anal fin colored as dorsal; caudal fin pale with submarginal black line and broad marginal white band about as wide as half diameter of pupil; pectoral fin dusky basally with a white margin almost as wide as that of the caudal; pelvic fin pale at base, rays white tipped, mesial area dusky; caudal peduncular spines and bucklers no darker than general ground work; 3 of 5 specimens with a white ring around caudal peduncle between caudal spines.

NASO BREVIROSTRIS (Valenciennes)

PLATE 70

Naseus brevirostris VALENCIENNES, *in* Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 10, p. 277, 1835 (type locality, Moluccas; Île de France; New Guinea).

SPECIMENS STUDIED

U.S.N.M. No. 140087, Bikini Atoll, Bikini lagoon, deep coral head at 30 to 45 feet, diving and spearing, July 13, 1946, S–46–252, Brock, Emory, and Kohler, 1 specimen, 169 mm.

Description based in part on specimens U.S.N.M. Nos. 52668, from Hawaii, (196 mm.) and 71558, from Okinawa (157 mm.).

Description.—Dorsal rays VI,27 to 29; anal II,28 to 30; pectoral I,i,13 or 14; pelvic I,3; branched caudal 7+7; teeth on one side of upper jaw 16 to 20, of lower jaw 16 to 20.

Depth 2.4 to 2.7, head 4.0, both in standard length; snout 1.6 to 1.8, eye 3.1 to 3.4, least depth of caudal peduncle 5.1 to 6.2, length of pectoral fin 1.3 to 1.4, postorbital part of head (hind margin of eye to upper edge of gill opening) 5.0 or 5.1, lower lobe of caudal fin 1.1 to 1.3, upper lobe 1.1 or 1.2, all in length of head (tip of snout to upper edge of gill opening); interorbital in eye 0.9 or 1.0; eye in snout 1.8 to 2.1; length of caudal peduncle in its depth 0.3; angle of snout profile with

axis of body 93 to 105 degrees. Teeth small, sharp pointed, finely serrated near tip; anterior margin of snout above lips almost vertical and straight to base of bony protuberance.

Color in alcohol.—Ground color uniform dark brown on back, lighter below on breast and belly; gill flap white; dorsal and anal fins uniform dark brown; base of caudal fin darker than general body color with distal half to one-third of fin lighter; pectoral fin brown along rays, membranes white, margin of fin pale; pelvic fins light brown.

NASO UNICORNIS (Forskål)

PLATE 71

Chaetodon unicornis FORSKÅL, Descriptiones animalium . . ., pp. xiii, 63, 1775 (type locality, Djedda, Red Sea).

SPECIMENS STUDIED

Bikini Atoll: 9 stations, 18 specimens, 58 to 192 mm. standard length.
Eniwetok Atoll: 5 stations, 15 specimens, 57 to 218 mm.
Rongelap Atoll: 4 stations, 6 specimens, 57 to 143 mm.
Rongerik Atoll: 1 station, 1 specimen, 139 mm.
Kwajalein Atoll: 1 station, 8 specimens, 56 to 107 mm.
Guam: 3 lots, 3 specimens 55 to 400 mm.

Description.—Dorsal rays VI,28 to 30; anal II,27 to 30; pectoral I,i,15 or 16 (usually 16); pelvic I,3; branched caudal 7+7; teeth on one side of upper jaw 11 to 15, of lower jaw 7 to 14.

Depth 1.8 to 2.3, head 3.1 to 3.5, both in standard length; snout 1.3 to 1.9, eye 2.9 to 4.6, least depth of caudal peduncle 4.8 to 6.5, length of pectoral fin 1.5 to 1.6, postorbital part of head (hind margin of eye to upper edge of gill opening) 6.5 to 7.0, lower lobe of caudal fin 1.2 to 1.3, upper lobe 1.05 to 1.2, all in length of head (tip of snout to upper edge of gill opening); interorbital in eye 0.8 to 1.1; eye in snout 1.9 to 3.5; angle of snout profile with lengthwise axis of body 49 to 60 degrees; teeth sharply pointed with edges finely serrate; caudal spines smoothly rounded.

Color in alcohol.—Head and body pale gray to dark brownish gray; head darker than body; lower sides and belly paler than upper parts of body; dorsal and anal fins pale, sometimes with alternating light and dark streaks, usually tips of rays white; pectoral translucent; pelvic fins with dusty tips, caudal fin dusky at base, pale distally; lips pale; plates of caudal spine and area surrounding plates black.

Specimens 57 to 87 mm. in acronurus stage are grayish brown with 4 vertical rows of dark spots (about size of pupil) 3 or 4 spots per row; in larger of these specimens spots above midline indistinct, leaving only the ones along a line from eye to caudal bucklers; fins all colorless, except that membranes of spinous dorsal are dusky.

Color when alive.—Head and body uniform pale olive green, lips pale; soft dorsal and anal fins sometimes with alternating lines of light and dark, otherwise plain tan, with tips of rays white, then a submarginal black streak; pectoral membranes dusky at base; pelvic fins dusky at tips, caudal fin dark basally with distal margin white, caudal spine black or blue.

NASO VLAMINGI (Valenciennes)

PLATE 72

Naseus vlamingi VALENCIENNES, *in* Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 10, p. 293, 1835 (type locality, Moluccas).

Naso coume (not of Lesson) FOWLER, U. S. Nat. Mus. Bull. 100, vol. 8, p. 275, fig. 20, 1929 (Philippines).

Naso brevirostris (not of Valenciennes) SCHULTZ, U. S. Nat. Mus. Bull. 180, pp. 160–161, 1943 (key).

SPECIMENS STUDIED

Bikini Atoll: 2 stations, 2 specimens, 131 and 404 mm. standard length.
Rongelap Atoll: 2 stations, 2 specimens, 120 and 369 mm.
Rongerik Atoll: 1 station, 1 specimen, 339 mm.

Description.—Dorsal rays V to VII (one specimen),26 or 27; anal II,27 to 29; pectoral I,i,14 or 15, pelvics I,3; branched caudal rays 7+7; upper teeth on one side of jaw 14 to 32, lower 15 to 27 (in 6 counts).

Depth 2.1 to 2.8, head 3.7 to 4.5, both in standard length; snout 1.5 to 1.8, eye 3.0 to 4.4, least depth of caudal peduncle 4.8 to 6.0, length of pectoral 1.2 to 1.5, postorbital part of head (hind margin of eye to upper edge of gill opening) 4.7 to 5.8, lower lobe of caudal 1.0 to 1.2, upper lobe 0.35 to 1.0, all in length of head (tip of snout to upper edge of gill opening); interorbital in eye 0.8 to 1.0; eye in snout 1.9 to 2.9; length of caudal peduncle in its depth 0.3; angle of snout profile with lengthwise axis of body 55 to 95 degrees; teeth very small, pointed, finely serrate, serrations usually stronger on one side than on the other; in adults, upper and lower rays of caudal fin very long and threadlike, dorsal and anal fin rays much longer than in young.

Color in alcohol.—Head and body ground color light brown; head with dark brown line below eye broadening to a bar the width of eye just anterior to eye, continuing along side and anterior tip of bony protuberance on snout; cheeks with evenly spaced small round dark spots; lips black; opercular flap and space just behind opercular opening black; a black blotch before and behind pectoral fin; dorsal part of body with small scattered spots, the spots on sides lengthening into vertical, narrow, vermiculate lines; breast and belly with fine dark dots, smaller than those of back or cheeks; caudal spines and bucklers darker than general body color; dorsal and anal fins dark brown,

membranes lighter than rays; caudal fin very dark brown, almost black; pectoral fins black; pelvic fins light brown.

Young specimens with same ground color, no bar before eye or blotch posterior to pectoral; lines along sides not complete, although most spots are elongate; dorsal fin with oblique darker streaks on membranes; anal fin with more or less broken lengthwise lines; caudal fin spotted at base, distal one-third paler, although rays are all dusky; pectoral and ventral fins dusky.

Color when alive.—Ground color dark grayish brown; top of head and back darker than sides and belly; iris yellow; a dark blue line below eye extending forward along the bony protuberance of snout; cheeks and back with small evenly spaced blue spots (about half the size of pupil); lips pale; opercular flap darker brown than rest of head; dorsal and anal with membranes brown distally, bluish gray basally, rays dark brown; caudal fin dark brown at base, a broad vertical yellow submarginal bar about as wide as one-third of length of fin; pectoral brown, paler distally though not a distinct pale band; pelvics with light greenish brown membranes and dark brown rays. (Description from two colored drawings based on Philippine specimens.)

Family SIGANIDAE

By Loren P. Woods

The fishes of this family are unique in having two pelvic spines, an outer and an inner. These spines are grooved and serve as conductors of a very painful venom. The seven anal spines are also shallowly grooved as are the dorsal spines along the line of attachment of the fin membranes. Drs. W. M. Chapman and L. P. Schultz, both of whom have handled large numbers of siganids, report that the dorsal, anal, and pelvic spines carry a painful poison.

The genus *Lo* Seale differs from *Siganus* only in the produced snout and constricted thorax. *S. puellus* (Schlegel) has an elongate body and slightly produced snout in large individuals, and hence helps to bridge the difference in shape between *Lo* and *Siganus*.

Genus SIGANUS Forskål

Siganus Forskål, Descriptiones animalium . . ., pp. x, 25, 1775. (Genotype *Scarus rivulatus* Forskål=*Scarus siganus* Forskål.)

KEY TO SPECIES OF SIGANUS OF THE NORTHERN MARSHALL ISLANDS

1*a*. Snout produced into a short tube; cheeks entirely scaly; interorbital flat; caudal fin slightly forked; top of head, top and sides of snout and chin black; cheeks and opercles light brown with small dark brown spots; throat brown with white spots; breast black from opercular opening and isthmus across base of pectoral to insertion of pelvics; upper pectoral spine and ray and outer pelvic spines black; body plain brown; pectoral I,i,14---------- Siganus vulpinus (Schlegel and Müller)

1*b*. Snout not produced into a short tube.

2*a*. Area between pubic bones naked.

3*a*. Cheeks without scales; depth of body 3.8 to 4.0 in standard length; top of head and back light brownish with tiny dark brown spots; cheeks, opercles, and sides of body silvery; spiny dorsal fin membranes each with large oval dusky spot mesially and small dusky spot distally; caudal with short, vertical, brown line at its base; caudal fin forked; pectoral I,i,16---------- Siganus argenteus (Quoy and Gaimard)

3*b*. Cheeks with at least one or with numerous scales, sometimes more or less embedded and difficult to observe (drying usually causes the scales to become easily visible under magnification).

4*a*. Interorbital flat or slightly concave; caudal slightly forked, its lower lobe rounded; middle caudal ray in upper ray 1.2 to 1.5; body with wavy, narrow whitish (bluish when alive) lines about equal in width to brown interspaces, forming a reticulated pattern along back and running lengthwise on sides; caudal peduncle with 2 vertical thin white lines; base of caudal fin with a white vertical line and brown line distally, head plain grey or brownish; cheeks silvery; caudal fin slightly forked, its outer rays with 3 or 4 faint brown bars; pectoral I,i,15 or 16---------- Siganus spinus (Linnaeus)

4*b*. Interorbital convex.

5*a*. Caudal shallowly forked, its lobes angular, middle caudal rays in upper rays 1.55 to 1.97; body light brownish or grayish brown; a dark spot about size of eye present behind upper edge of gill opening (may be faint and indistinct in large specimens); scattered dark brown spots on back and sides, some specimens with small indistinct pale spots on dorsal half of sides; spiny dorsal and anal membranes pale with brownish spots, soft rays barred; dorsal and ventral edges of caudal fin barred, posterior margin of caudal blackish; pectoral I,i,13_____ Siganus fuscescens (Houttuyn)

5*b*. Caudal deeply forked, tips of lobes pointed, middle caudal rays in upper rays 2.44 to 3.2; light bluish gray to dark brown network over head and body, spaces filled with small pale spots or dots; spots or dots larger than interspaces; membranes of spiny dorsal and anal fins clouded or sometimes with dusky blotches; outer caudal rays dark or faintly barred; pectoral I,i,16.

Siganus rostratus (Valenciennes)

2*b*. Area between pubic bones densely scaled.

6*a*. Head and body completely covered with small pale spots; spots larger than interspaces; spaces between spots dark purplish brown; fins darkish or dusky brown, pale spots on bases of median fins, sometimes reaching margin; a large black spot (about size of eye) usually present behind upper edge of gill opening; cheeks entirely scaled without any naked area on fleshy part between posterior tip of maxillary, eye, and preopercle; caudal deeply forked, its lobes rounded, middle caudal rays in upper rays 1.79 to 2.28; pectoral I,i,12 to 15.

Siganus punctatus (Bloch and Schneider)

6*b*. Top of head and snout with 9 or 10 transverse dark brown lines, cheeks sometimes with network of pale lines; dorsal half of body with 18 to 20 narrow dark vertical lines; sometimes centers of these lines pale and sometimes they are broken up anteriorly and ventrally into wavy lines; ventral half of body pale; median fins plain; cheeks with scales on lower posterior fleshy part only, upper anterior part naked, anterior border of scaly portion forming a diagonal line across cheek from about diameter of pupil behind maxillary to behind middle of eye; caudal fin slightly emarginate, tips of lobes angular, middle caudal rays into upper caudal rays 1.32 to 1.79; pectoral I,i,14 or 15.

Siganus doliatus (Valenciennes)

SIGANUS VULPINUS (Schlegel and Müller)

Amphacanthus vulpinus SCHLEGEL and MÜLLER, Verh. Natuur. Gesch. Leiden, vol. 2, p. 12, 1839–44 (type locality, Molukka; Celebes). (Reference copied.)

SPECIMEN STUDIED

U.S.N.M. No. 140314, Bikini Atoll, Bikini lagoon, submerged coral head, 4 miles southwest of Bikini Island, spearing, by breaking up coral heads, July 11, 1946, S–46–247, Brock, Herald, and Kohler, 1 specimen, 153 mm., a female with nearly mature eggs.

Description.—Dorsal rays XIII,10; anal VII,9; pectoral I,i,14; pelvic I,3,I; branched caudal 8+7; teeth on one side of upper jaw 14, of lower jaw 14; gill rakers on first arch 6+16; pyloric caeca 4.

Depth 2.3, head 3.2, both in standard length; snout 2.0, eye 4.1, least depth of caudal peduncle 5.0, length of pectoral 1.3, postorbital part of head 4.1, lower lobe of caudal fin 1.4, upper lobe 1.3, all in length of head; interorbital in eye 0.95; depth of cheek in its length 2.5; depth of caudal peduncle in its length 1.3; middle caudal rays in upper caudal rays 1.5; angle of snout profile with lengthwise axis of body 40 degrees, profile outline concave anterior to interorbital; interorbital flat; cheeks scaly; anterior nostril with short tube; gill rakers short, wedge-shaped; caudal fin slightly emarginate, lobes rounded; snout produced into a short tube.

Color in alcohol.—Body uniform light brown; top of head, top and sides of snout black, the black area extending to origin of dorsal fin thence onto shoulder and downward to upper edge of gill opening and lower margin of eye; cheeks and opercle light brown sometimes with small dark brown spots on cheek; chin black; throat brown, spotted with white, a large dark brown patch extending from back of opercular opening, anterior to isthmus, across base of pectoral fin to insertion of pelvics; dorsal, anal and caudal fins light brown, outer margins lighter; pectoral rays dusky, membranes pale; upper spine and first ray intense black; pelvics with outer spine and first ray black; membranes dusky.

SIGANUS ARGENTEUS (Quoy and Gaimard)

Amphacanthus argenteus Quoy and Gaimard, Voyage autour du monde . . . executé sur les corvettes de S. M. *L'Uranie* et La *Physicienne* . . ., Zool., p. 368, pl. 2, fig. 3, 1824 (type locality, Guam).

SPECIMENS STUDIED

Bikini Atoll: Bikini lagoon, east end at *Bowditch* anchorage, surface light at night, April 24, 1946, S–46–112, Schultz, 2 specimens, 40 and 41 mm. standard length; Orukuen Pass, surface light at night, May 24, 1946, Marr and Brock, 1 specimen, 42 mm.

Eniwetok Atoll: Southwest passage, leeward side of reef, 2 miles south of Rigili Island, surface light at night, May 24, 1946, S–46–183, Schultz, 7 specimens, 47 to 50 mm.; south of Rigili Island, May 25, 1946, S–46–184, Schultz and Cali, 4 specimens, 45 to 50 mm.

Description.—Dorsal rays XIII,10; anal VII,9; pectoral I,i,16; pelvic I,3,I; branched caudal 8+7; teeth on one side of upper jaw 7 or 8, of lower jaw 7 or 8; gill rakers 4+17; pyloric caeca 6 (buds).

Depth 3.8 to 4.0, head 3.7 or 3.8, both in standard length; snout 2.9 or 3.0, eye 4.0; least depth of caudal peduncle 6.0 to 6.3; length of pectoral 1.7 or 1.8, postorbital part of head 3.0 to 3.3, upper lobe of caudal peduncle 1.5, lower lobe 1.5, all in length of head; depth of cheek in its length 2.0; depth of caudal peduncle in its length 2.1; middle caudal rays in upper rays 2.0 or 2.1; angle of snout profile with lengthwise axis of body 30 degrees, profile outline straight to

slightly convex; interorbital slightly convex; anterior nostril usually lacking flap, when present flap is rudimentary; cheeks naked; gill rakers short, simple; caudal fin deeply forked, tips of lobes rounded.

Color in alcohol.—Top of head and back light brownish with tiny dark brown dots; cheeks, opercles, and sides of body silvery; spiny dorsal fin membranes with oval dusky spot mesially and smaller similar spot distally on each membrane; soft dorsal pale; caudal pale or with faint bars on outer rays, a short vertical dark line present at base of caudal; anal pale, sometimes faint bars on spiny part, pectorals pale, translucent; pelvics pale or with one or two faint bars.

Ecology.—These specimens were pelagic and came to a light at night; those dissected had the body cavity filled with a greatly enlarged fatty liver which crowded the other organs dorsally and to one side; this fatty liver may be of some use as a mechanism to assist in floating.

Remarks.—The appearance, habits, small number of teeth, and rudimentary condition of pyloric caeca indicate that *Siganus argenteus* may be the young of some other species. It most nearly resembles *Siganus rostratus* but a careful comparison with a 51-mm. specimen of that species shows differences in coloration, and in the size of the eye.

SIGANUS SPINUS (Linnaeus)

PLATE 73

Sparus spinus LINNAEUS, Systema naturae, ed. 10, vol. 1, p. 281, 1758 (type locality, Indies).

Siganus spinus SCHULTZ, U. S. Nat. Mus. Bull. 180, p. 137, 1943 (in part, U.S.N.M. No. 115212, incorrectly published as 115121, 20 specimens).

Amphacanthus nebulosus QUOY and GAIMARD, Voyage autour du monde . . . executé sur les corvettes de S. M. *L'Uranie* et La *Physicienne* . . ., Zool., p. 369, 1825.

Teuthis striolata HERRE and MONTALBAN, Philippine Journ. Sci., vol. 35, p. 177, pl. 5, fig. 2, 1928.

SPECIMENS STUDIED

Guam: 24 lots, 418 specimens, 31 to 176 mm. standard length.
Saipan: 3 lots, 8 specimens, 34 to 66 mm.
Rota: 1 lot, 1 specimen, 122 mm.

Description.—Dorsal rays XIII,10; anal VII,9; pectoral I,i,15 or 16; pelvics I,3,I; branched caudal 8+7; teeth on one side of upper jaw 13 or 14, of lower jaw 14 or 15; gill rakers on first gill arch 5+13 to 17; pyloric caeca 4 or 5.

Depth 2.4 to 2.7, head 3.8 to 4.0, both in standard length; snout 2.7 to 2.9, eye 2.6 to 3.1, least depth of caudal peduncle 4.1 to 4.9, length of pectoral fin 1.2 to 1.4, postorbital part of head 2.9 to 3.9, upper lobe of caudal 1.1, lower lobe 1.2 or 1.3, all in length of head; interorbital in eye 1.1 to 1.2; depth of cheek in its length 1.2; depth of

caudal peduncle in its length 1.8 to 2.0; middle caudal rays in upper ray 1.2 to 1.5; angle of snout profile 32 to 35 degrees; interorbital area flat or slightly concave; anterior nostril with a flap; cheeks with a row of scales slightly wider than maxillary from maxillary almost to posterior rim of cheek, space above and below this oblong row naked; gill rakers short, wedge-shaped; caudal fin slightly forked in young, almost straight in adults.

Color in alcohol.—Head plain gray or brownish with cheeks silvery; interorbital space sometimes crossed by 2 or 3 thin, wavy light lines; lower part of head and breast usually silvery white in adults; body with irregular, wavy, narrow, whitish (bluish when alive) lines forming a reticulated pattern along back, more continuous along upper sides and running more or less lengthwise on lower sides; pale lines usually narrower than the brown spaces between, but on lower sides blue and brown lines are about equal in width (width of blue lines varies considerably on different parts of body and in different specimens); caudal peduncle with two thin, vertical white lines; membranes of spinous dorsal and anal fins clouded with brownish or blackish, becoming more intense near outer region; soft dorsal and anal fins usually with 2 or 3 faint brown bars; caudal fin crossed vertically by 3 or 4 alternating light and dark brown curved lines, center part of these dark lines often obscure in adults but still evident on outer rays; a white vertical line usually evident at base of caudal fin with a brown vertical line of equal width just distal to it; pectoral fin pale; membrane of pelvics dusky.

Remarks.—Siganus nebulosus (Quoy and Gaimard) is believed to be a color phase of this species, as specimens agreeing with the color descriptions of *nebulosus* have the flat interorbital space, short rounded snout, same scale pattern on cheek, same number and shape of pyloric caeca, as well as the same type of caudal fin as described above for *S. spinus*. The proportions also are in agreement. Many of the young specimens listed above (up to 66 mm.) have a color pattern similar to that of *nebulosus*, with traces of thin wavy light lines appearing on back and lower sides.

SIGANUS FUSCESCENS (Houttuyn)

Centrogaster fuscescens HOUTTUYN, Verh. Holl. Maatsch. Wet. Haarlem, vol. 20, p. 333, 1782 (type locality, Japan).

SPECIMENS STUDIED

Guam: 1945, Frey, 7 specimens, 104 to 205 mm.

Description.—Dorsal rays XIII,10; anal VII,9; pectoral I,i,13; pelvic I,3,I; branched caudal 8+7; gill rakers on first gill arch 4 to 6+1+19 to 21=26 to 28.

Depth 2.56 to 2.9, head 3.95 to 4.15, both in standard length; snout 2.48 to 2.53, eye 2.8 to 3.28, least depth of caudal peduncle 4.2 to 4.29; length of pectoral fin 1.25 to 1.34, postorbital part of head 3.8 to 4.12, lower lobe of caudal fin 0.99 to 1.0, upper lobe 0.92, all in length of head; interorbital in eye 1.0 to 1.28; eye in snout 1.1 to 1.32; depth of caudal peduncle in its length 1.88 to 2.14; middle caudal rays in upper rays 1.55 to 1.97; angle of snout profile with lengthwise axis of body 47 to 50 degrees, snout profile convex; interorbital convex, cheeks with scales sparsely scattered over entire lower posterior half; caudal fin shallowly forked, tips of lobes angular.

Color in alcohol.—Head and body light brown, dorsal portion darker than lower sides; body with indistinct, small white spots, smaller than interspaces, dark brown irregular spots scattered over rest of body; a darkish spot almost as large as eye present behind upper edge of gill opening; spiny dorsal fin membranes with brownish spots, soft rays of dorsal and of anal fins barred; upper and lower margins of caudal fin barred, posterior margin narrowly black; pectorals pale; pelvic membrane dusky between outer spine and first ray, rest of fin pale.

Remarks.—This species is rather difficult to distinguish and define, and until the family Siganidae is adequately revised considerable doubt may be cast upon the identity of several species separated on the basis of color alone. It is possible to distinguish *S. fuscescens* (Houttuyn) and *S. albopunctatus* (Schlegel) by the presence of the small distinct white spots in the latter, but the number of gill rakers is the same (see table 58). Specimens of *fuscescens* from Guam have a slightly higher number of gill rakers than specimens from Japan and the China coast and examples from the Philippine Islands a still higher number. Perhaps those from the Philippines and Guam should be recognized as a distinct subspecies but sufficient specimens are not available from other parts of the range, such as *S. oramin* (Bloch and Schneider) described from Tranquebar, or *S. margaritiferus* (Valenciennes), or *S. canaliculatus* Mungo Park, from the East Indies, to warrant this recognition.

SIGANUS ROSTRATUS (Valenciennes)

PLATE 74

Amphacanthus rostratus VALENCIENNES, *in* Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 10, p. 158, 1835 (type locality, Massuah, Red Sea).

Siganus spinus SCHULTZ (in part), U. S. Nat. Mus. Bull. 180, p. 137, 1943 (Tutuila Island).

Siganus oramin FOWLER and BEAN (in part), U. S. Nat. Mus. Bull. 100, vol. 8, pp. 307–310, 1929.

TABLE 58.—*Gill raker counts of* Siganus fuscescens *and* S. albopunctatus

Species	Upper arch				Atangle	Lower arch										Total number of gill rakers										
	4	5	6	7	1	16	17	18	19	20	21	22	23	24	25	22	23	24	25	26	27	28	29	30	31	32	33
fuscescens:																											
Japan		3	2		5	2	1	1	1							2	1		2								
Hainan			2		2	1	1										1	1									
Ningpo		1			1		1										1										
Guam	1		5		6				2		4									3		3					
Philippine Islands			5		5					1	2	2									2		3				
albopunctatus:																											
Japan	1	1	2		4	2		1	1							1	1	1	1								
Hongkong		1	1		2	1	1										2										
Borneo			1		1			1											1								

SPECIMENS STUDIED

Bikini Atoll: 20 stations, 75 specimens, 137 to 307 mm. standard length.
Eniwetok Atoll: 4 stations, 16 specimens, 143 to 329 mm.
Rongelap Atoll: 3 stations, 8 specimens, 74 to 153 mm.
Rongerik Atoll: 4 specimens, 136 to 154 mm.
Guam: 2 lots, 3 specimens, 99 to 142 mm.

Description.—Dorsal rays XIII,10; anal VII,9; pectoral I,i,16; pelvic I,3,I; branched caudal 8+7; teeth on one side of upper jaw 11 to 17, of lower jaw 12 to 19 (in 7 counts); gill rakers 6+17 or 18; pyloric caeca 5 to 7.

Depth 2.3 to 2.8, head 4.1 to 5.0, both in standard length; snout 2.4 to 2.6, eye 3.0 to 4.5, least depth of caudal peduncle 4.3 to 5.2, length of pectoral 1.2 or 1.3, postorbital part of head 3.1 to 3.7, lower lobe of caudal fin 0.8 to 0.9, upper lobe 0.7 to 0.9, all in length of head; interorbital in eye 0.8 to 1.1; depth of cheek into length 1.5 to 2.1; depth of caudal peduncle in its length 2.5 to 2.8; middle caudal rays in upper rays 2.4 to 3.2, in lower 2.9 to 3.3; angle of snout profile with lengthwise axis of body 29 to 36 degrees; profile straight or with slight concavity just behind interorbital; interorbital convex; anterior nostril with a flap in small specimens, flap disappearing in large; cheeks naked except for a small patch of scales just behind maxillary; gill rakers short, branched, with center prong largest; caudal fin deeply forked, tips of lobes pointed.

Color in alcohol.—Ground color on head, back, and sides bluish gray to dark brown, with small, faint, lighter spots or dots; belly silvery in light-colored specimens, dark brown with elongated small white spots in dark-colored specimens; a small black spot on upper margin of eye; membranes of spinous dorsal and anal clouded or with dusky blotches, color most intense at outer edge of membrane just behind spine; anterior margins of spines dusky; soft dorsal and anal fins usually clear and pale, rarely barred; outer caudal rays dark, on smaller specimens caudal faintly barred, sometimes with tips of outer caudal rays dusky, rest of fin pale; dark-colored specimens with caudal dark brown except posterior clear margin; pectoral colorless; pelvics crossed by 2 or 3 indistinct bars, sometimes colorless except for faintly clouded membranes.

Color in life.—Light bluish or grayish reticulations over head, back, and sides, interspaces filled with golden spots broader than bluish interspaces, spots elongated on lower sides; spiny dorsal and anal fin membranes cloudy at base and edges, darkest near tips of spines; soft dorsal and anal fins hyaline or faintly yellowish; caudal fin blue at base and on outer rays, margin clear or yellowish; pectoral fin yellow or clear; pelvic fin with 2 or 3 faint brown bars.

Ecology.—This species seems to prefer open shallow or shore waters, although it was observed in deeper waters (7 fathoms). It is

found where there are some coral growths but usually not where the growths are heavy. The fish habitually come in over the reefs, day or night, when the reefs are covered with only a foot or so of water, hence large numbers of them may frequently be trapped there in pools.

Remarks.—Some females taken between May 20 and June 6 had ovaries, full of tiny eggs, filling about one-third of body cavity. Three of the specimens of U.S.N.M. No. 115212 (misprinted 115121) described by Schultz are of this species. Part of the specimens described under *S. oramin* (Bloch and Schneider) by Fowler and Bean are *S. rostratus.*

SIGANUS PUNCTATUS (Bloch and Schneider)

Amphacanthus punctatus BLOCH and SCHNEIDER, Systema ichthyologiae, p. 210, 1801 (type locality, Pacific Ocean).

SPECIMENS STUDIED

Bikini Atoll: 3 stations, 6 specimens, 166 to 293 mm. standard length.
Guam: 3 lots, 4 specimens, 96 to 151 mm.

Description.—Dorsal rays XIII,10; anal VII,9; pectoral I,i,12 to 15; pelvic I,3,I; branched caudal 8+7; teeth on one side of upper jaw 12 to 15, of lower jaw 12 to 15; gill rakers 6+13 to 18; pyloric caeca 5.

Depth 2.0 to 2.3, head 3.5 to 4.2, both in standard length; snout 2.0 to 2.1, eye 3.2 to 4.0, least depth of caudal peduncle 3.1 to 4.0; length of pectoral fin 1.2 or 1.3, postorbital part of head 3.6 to 4.0, lower lobe of caudal 0.8 to 1.0, upper lobe 0.7 to 0.95, all in length of head; interorbital in eye 0.8 to 1.0; depth of cheek in its length 1.0 to 1.2; depth of caudal peduncle in its length 1.1 to 1.7; middle caudal rays in upper rays 1.79 to 2.28; angle of snout profile with lengthwise axis of body 45 to 52 degrees, profile convex; interorbital convex; anterior nostril with a short flap in all but two largest specimens (210 and 247 mm.); cheeks entirely scaled; gill rakers hooked, wedge-shaped in smallest specimens, branched in largest; caudal fin deeply lunate, tips of lobes rounded.

Color in alcohol.—Head and body completely covered with dark purplish-brown reticulations extending onto soft dorsal and caudal fins but not onto anal fin; small, nearly round, pale dots filling all spaces between dark brown network; pale dots varying in size though always larger than interspaces; dots on caudal fin sometimes with a small dark brown center, those on breast sometimes golden; a nearly black shoulder spot, as large as eye, often indistinct, this spot not dark enough to obscure network pattern under it; dorsal and anal fins darker than body; spiny dorsal membranes clouded with brown; soft dorsal with reticulated pattern though not so distinct as on body; membranes of spiny part of anal darkish, nearly black; soft anal

plain dark brown; pectoral fin pale distally, crossed by a thin, crescent-shaped, dark-brown line near its base; pelvics dark sooty brown; thin edge of caudal fin paler than rest of fin but no distinct line of demarkation.

SIGANUS DOLIATUS (Valenciennes)

Amphacanthus doliatus VALENCIENNES, Histoire naturelle des poissons, vol. 10, p. 132, 1835 (type locality, Buru and Vanicolo).

SPECIMENS STUDIED

U.S.N.M. No. 143466, Guam, 1945, Frey, 2 specimens, 70.8 and 79 mm.

Description.—Dorsal rays XIII,10; anal VII,9; pectoral I,i,14 or 15; pelvic I,3,I; branched caudal 8+7; teeth on one side of upper jaw 12, of lower jaw 11; gill rakers on first arch 4+1+18=23.

Depth 2.08, head 3.23 to 3.36, both in standard length; snout 2.35 to 2.46, eye 2.73 to 2.81, least depth of caudal peduncle 4.12 to 4.38, length of pectoral fin 1.32 to 1.34, postorbital part of head 4.21 to 4.52, lower lobe of caudal fin 1.07 to 1.08, upper lobe 1.04 to 1.12, all in length of head; interorbital in eye 1.28 to 1.39; eye in snout 1.14 to 1.16; depth of caudal peduncle in its length 1.23 to 1.34; middle caudal rays in upper rays 1.3 to 1.4; angle of snout profile with lengthwise axis of body 53 degrees; snout profile convex; interorbital convex; caudal fin slightly forked, tips of lobes angular; cheeks densely scaled on posterior two thirds.

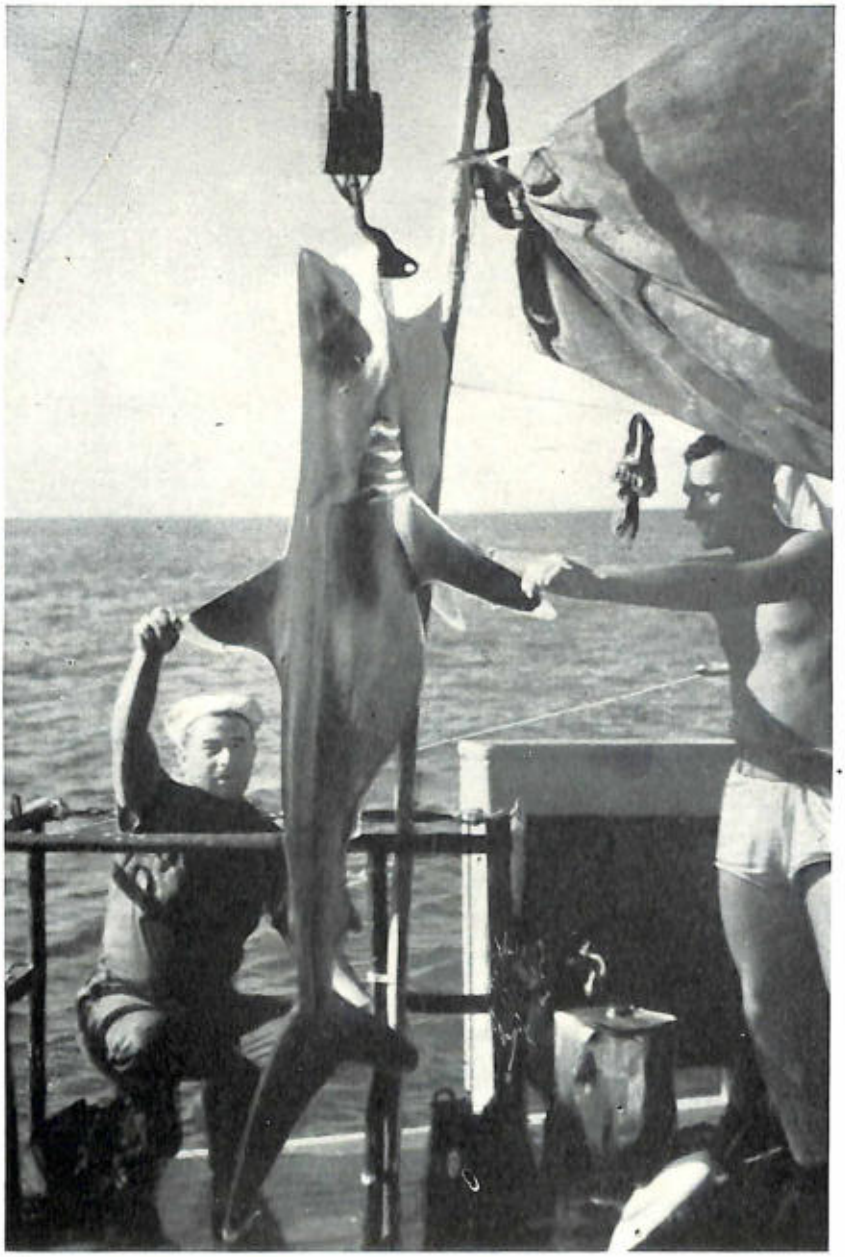
Color in alcohol.—Head and body light grayish brown, top of head and snout barred with 9 or 10 transverse dark brown lines; body with 18 to 20 narrow, black transverse bars on dorsal half, fading on ventral half; median fins pale; pectorals pale; tips of pelvic rays dusky.

NEW GENERA, SUBGENERA, SPECIES, AND SUBSPECIES

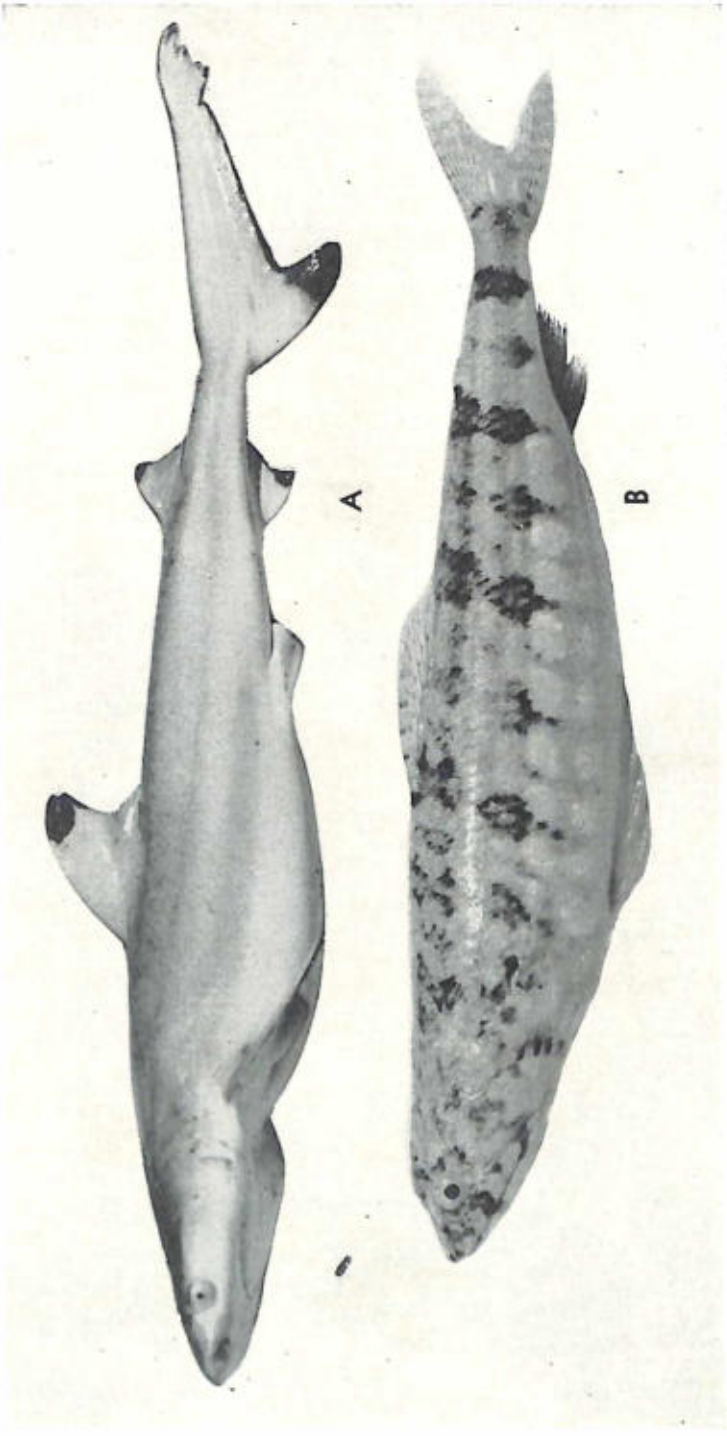
Hemigaleops fosteri, new genus, new species.
Taeniura brocki, new species.
Synodus binotatus, new species.
Synodus ulae, new species.
Synodus englemani, new species.
Cirricaecula johnsoni, new genus, new species.
Kaupichthys atronasus, new species.
Kaupichthys brachychirus, new species.
Leptenchelys pinnaceps, new species.
Moringua latebrosa, new species.
Moringua penni, new species.
Echidna unicolor, new species.
Gymnothorax bikiniensis, new species.
Gymnothorax melatremus, new species.
Gymnothorax bayeri, new species.
Rabula fuscomaculata, new species.
Rabula marshallensis, new species.
Uropterygius dentatus, new species.
Uropterygius fuscoguttatus, new species.
Rhaphiobelone robusta, new species.
Cypselurus antoncichi, new species.
Myripristis bowditchae, new species.
Bulbonaricus, new subgenus.
Ichthyocampus davaoensis, new species.
Ichthyocampus bikiniensis, new species.
Doryrhamphus melanopleura cooki, new subspecies.
Dunckerocampus caulleryi chapmani, new subspecies.
Siokunichthys herrei, new genus, new species.
Microgнathus brachyrhinus, new species.
Microgнathus brocki, new species.
Corythoichthys ocellatus, new species.
Corythoichthys schultzi, new species.
Corythoichthys nigripectus, new species.
Atherion elymus freyi, new subspecies.
Atherion elymus asper, new subspecies.
Atherion elymus aphrozoicus, new subspecies.
Allanetta crenolepis, new species.
Hypoatherina barnesi, new species.
Pranesus insularum whitei, new subspecies.
Plicomugil, new genus.
Epinephelus kohleri, new species.
Epinephelus emoryi, new species.
Epinephelus elongatus, new species.
Epinephelus melanostigma, new species.
Epinephelus spilotus, new species.
Epinephelus spilotoceps, new species.

Ypsigramma lineatus, new genus, new species.
Ypsigramma brocki, new species.
Anthias heraldi, new species.
Grammistops ocellatus, new genus, new species.
Pseudochromis aurea marshallensis, new subspecies.
Pseudoplesiops revellei, new species.
Pseudoplesiops sargenti, new species.
Acanthoplesiops hiatti, new species.
Siphamia elongata, new species.
Siphamia argentea, new species.
Siphamia cuprea, new species.
Siphamia fuscolineata, new species.
Siphamia ovalis, new species.
Apogon menesemops, new species.
Apogon nigrofasciatus, new species.
Gymnapogon urospilotus, new species.
Gymnapogon gracilicauda, new species.
Pterocaesio marri, new species.
Pterocaesio kohleri, new species.
Centropyge heraldi, new species.
Centropyge flammeus, new species.
Centrogype nigriocellus, new species.

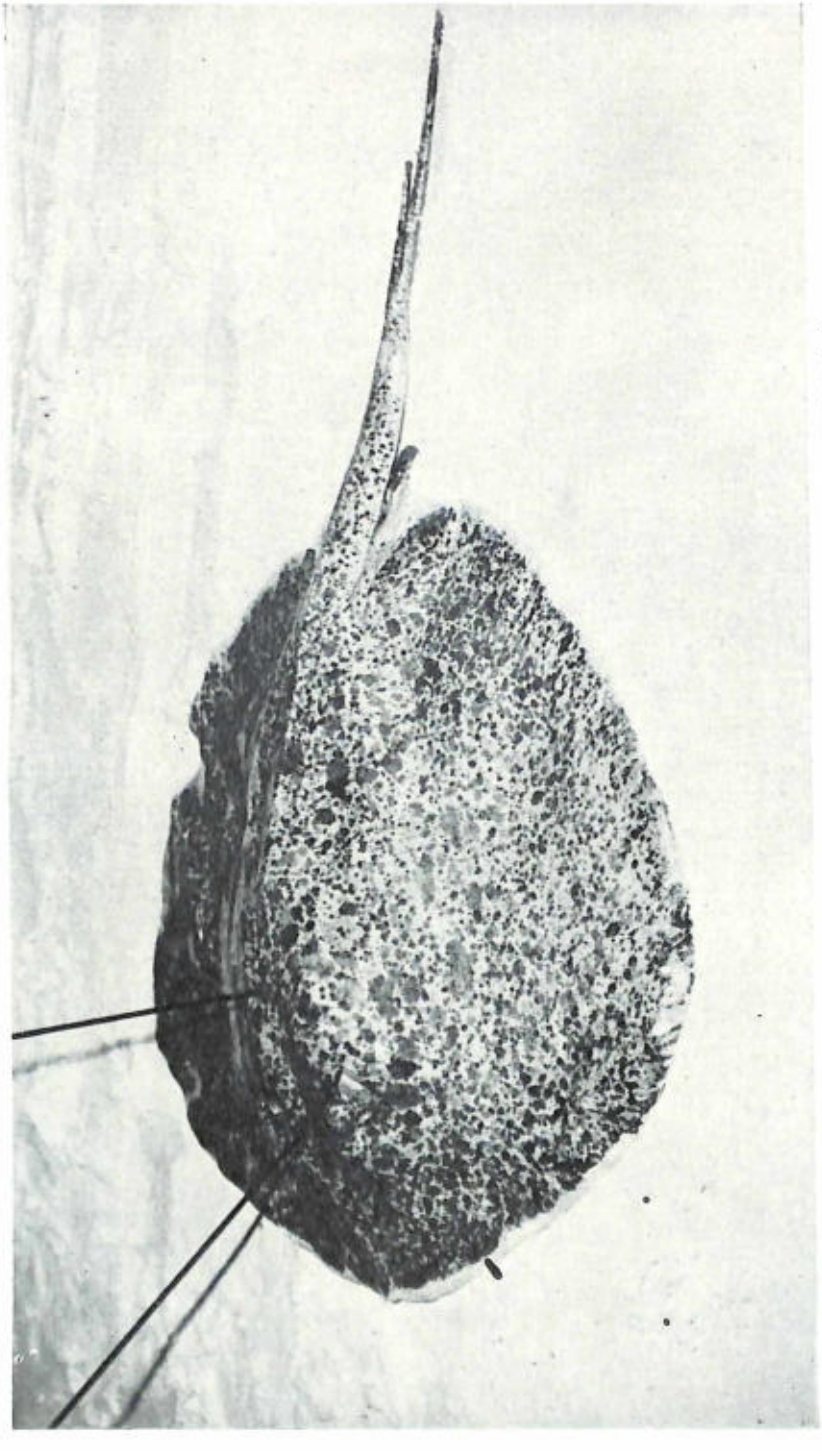
Holotype of *Hemigaleops fosteri*, new genus, new species, U.S.N.M. No. 152917, from Bikini Atoll.



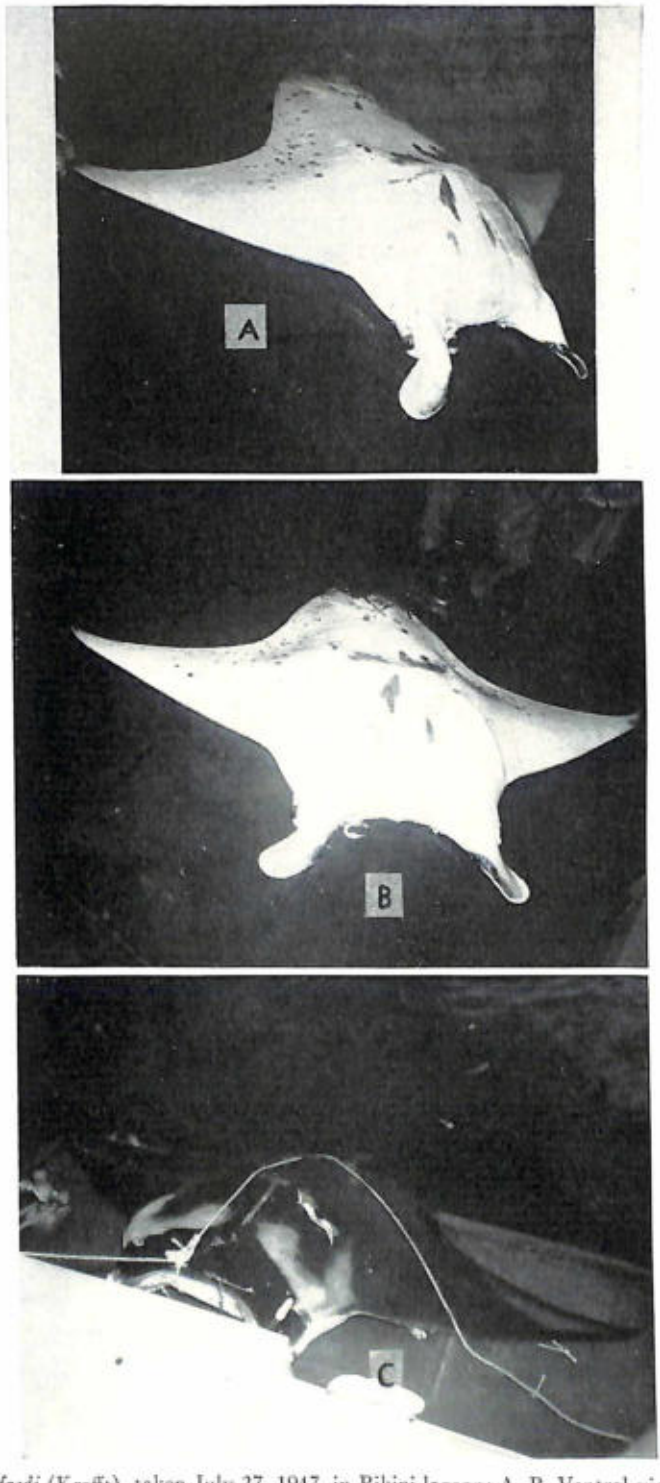
Carcharhinus albimarginatus (Rüppell), taken April 6, 1946, in Boro Channel, Bikini Atoll.



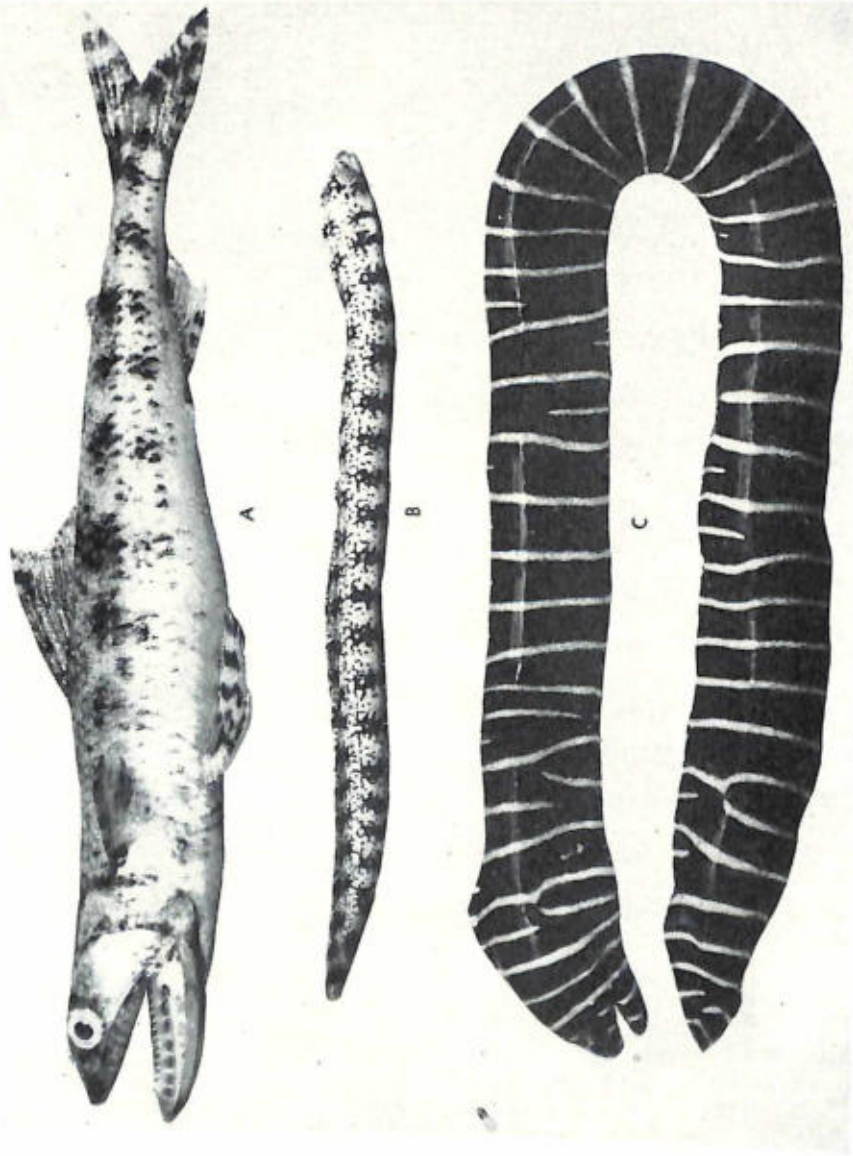
A, *Carcharhinus melanopterus* (Quoy and Gaimard); B, *Synodus variegatus* (Lacepède); both from Bikini Atoll.



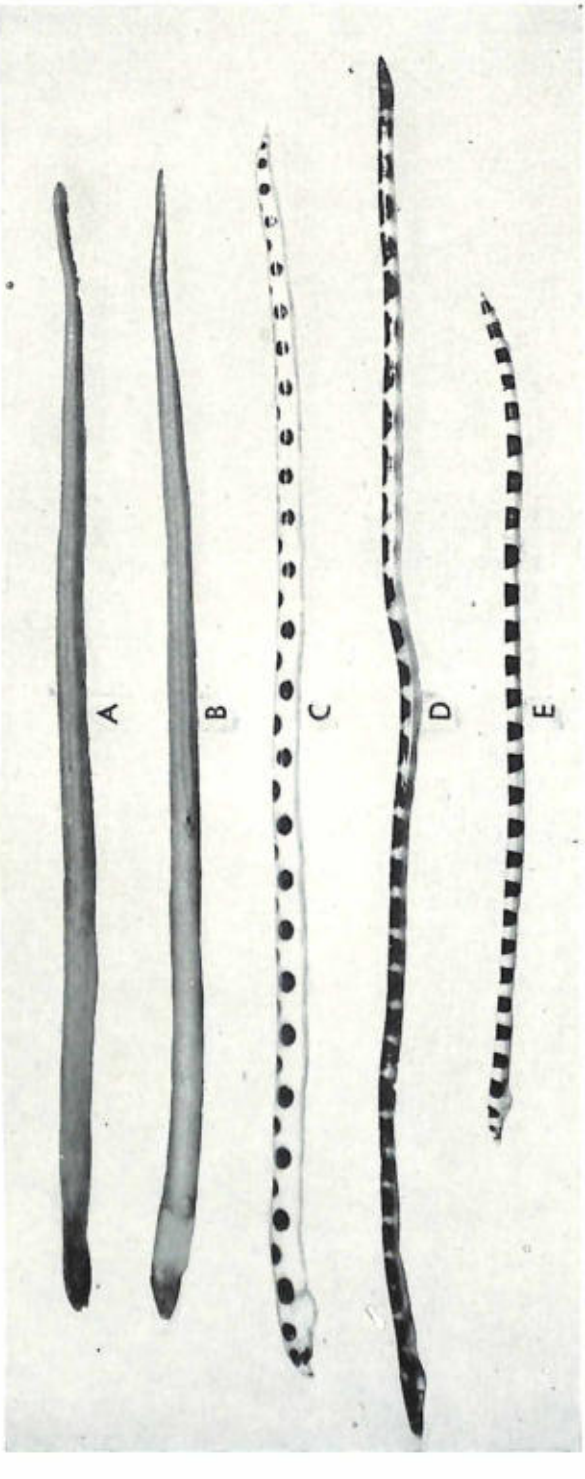
Holotype of *Taeniura brocki*, new species, U.S.N.M. No. 140978, from Bikini Atoll.



Manta alfredi (Krefft), taken July 27, 1947, in Bikini lagoon: A, B, Ventral views showing color pattern; C, dorsal view.

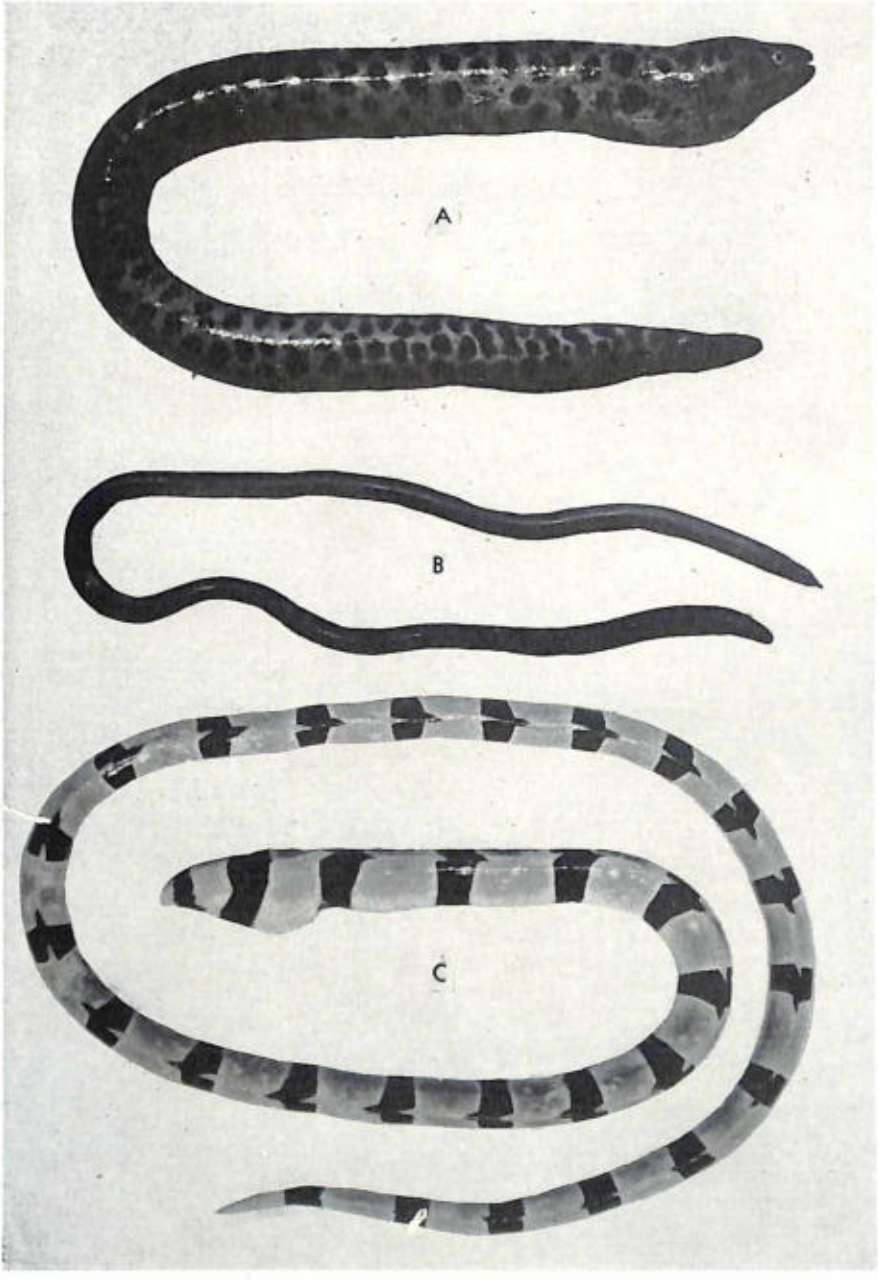


A, *Saurida gracilis* (Quoy and Gaimard); B, *Echidna nebulosa* (Ahl); C, *Echidna zebra* (Shaw); all from Bikini Atoll.



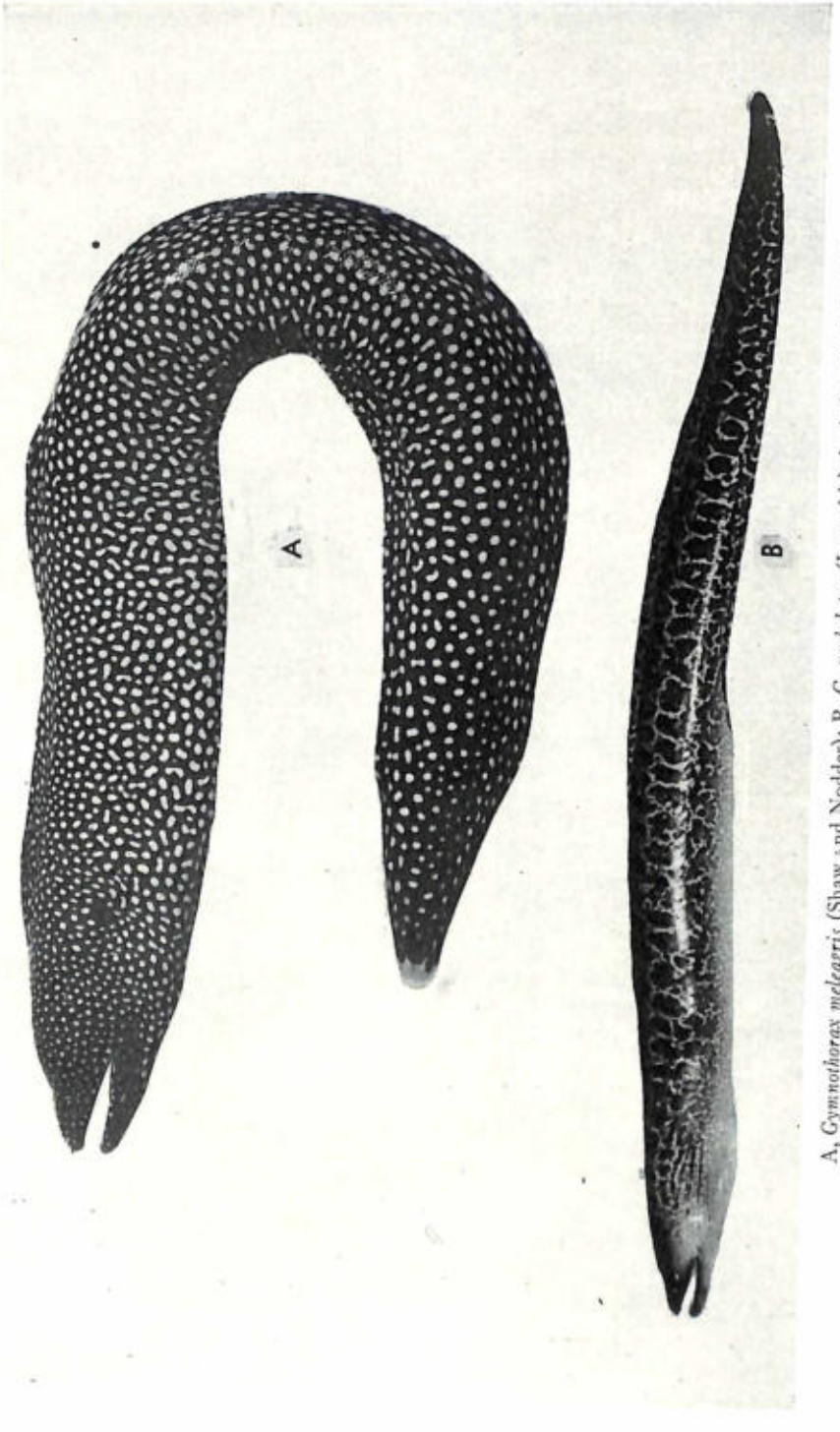
A, *Muraenichthys laticaudata* (Ogilby), dorsal view; B, same species, ventral view; C, *Myrichthys maculosus* (Cuvier); D, *Leiuranus semicinctus* (Lay and Bennett), large adult; E, same species, small adult; all from Bikini Atoll.

Muraenichthys gymnotus Bleeker (= *M. fowleri* Schultz, holotype, U.S.N.M. No. 115972, from Tau Island, Samoan group).



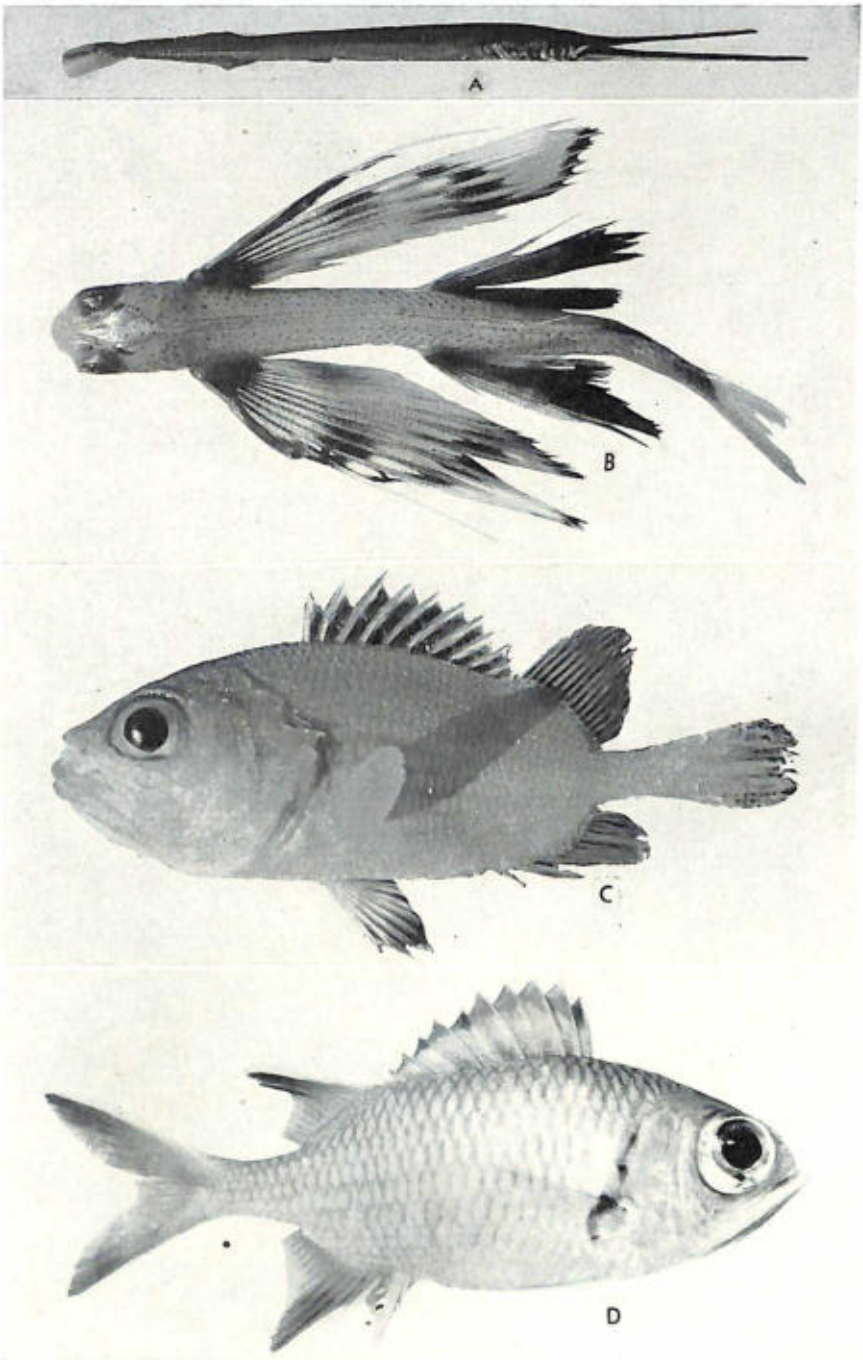
A, *Gymnothorax javanicus* (Bleeker); B, *Moringua abbreviata* (Bleeker); C. *Myrichthys colubrinus* (Boddaert); all from Bikini Atoll.

Holotype of *Echidna leucolaenia* Schultz, U.S.N.M. No. 115949, from Enderbury Island, Phoenix group.

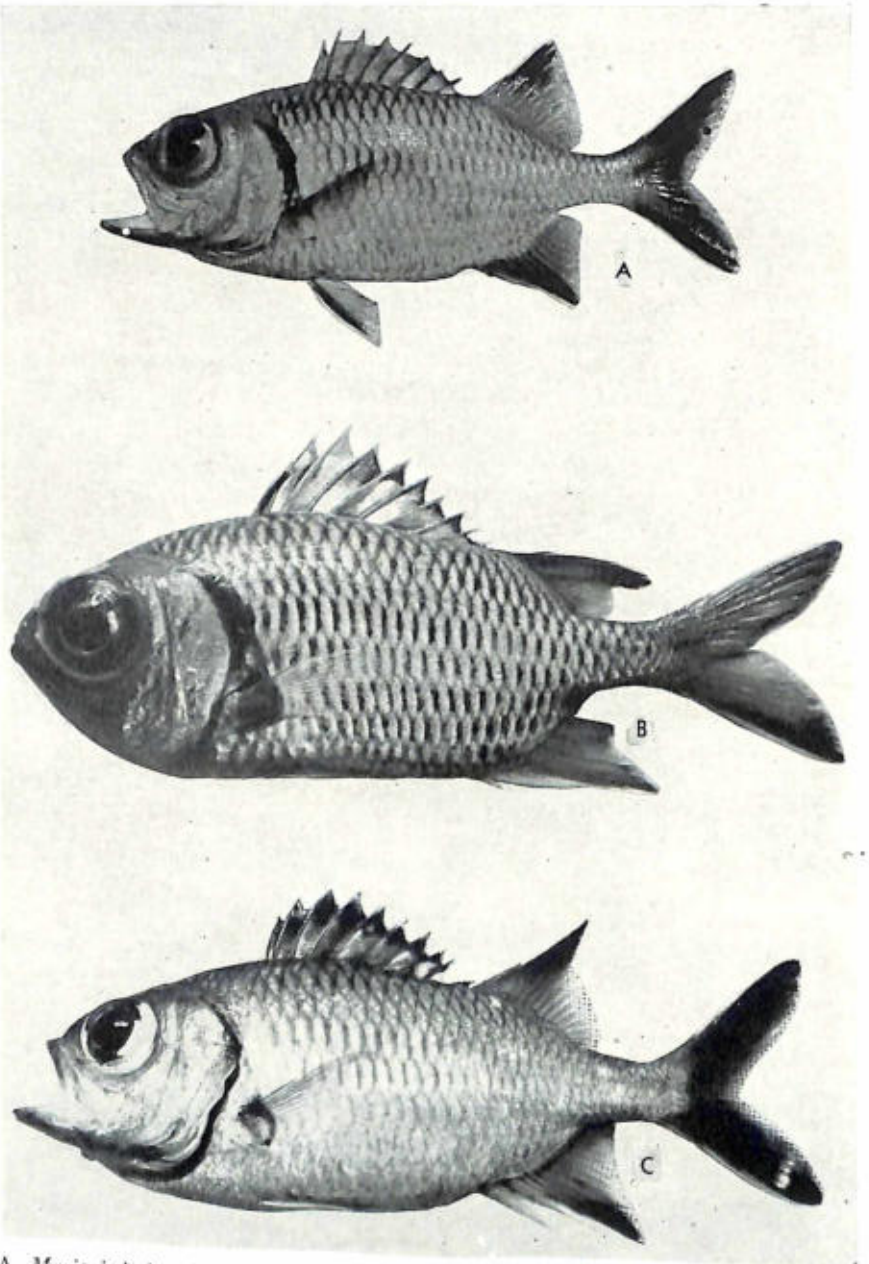


A, *Gymnothorax meleagris* (Shaw and Nodder); B, *G. undulatus* (Lacepède); both from Bikini Atoll.

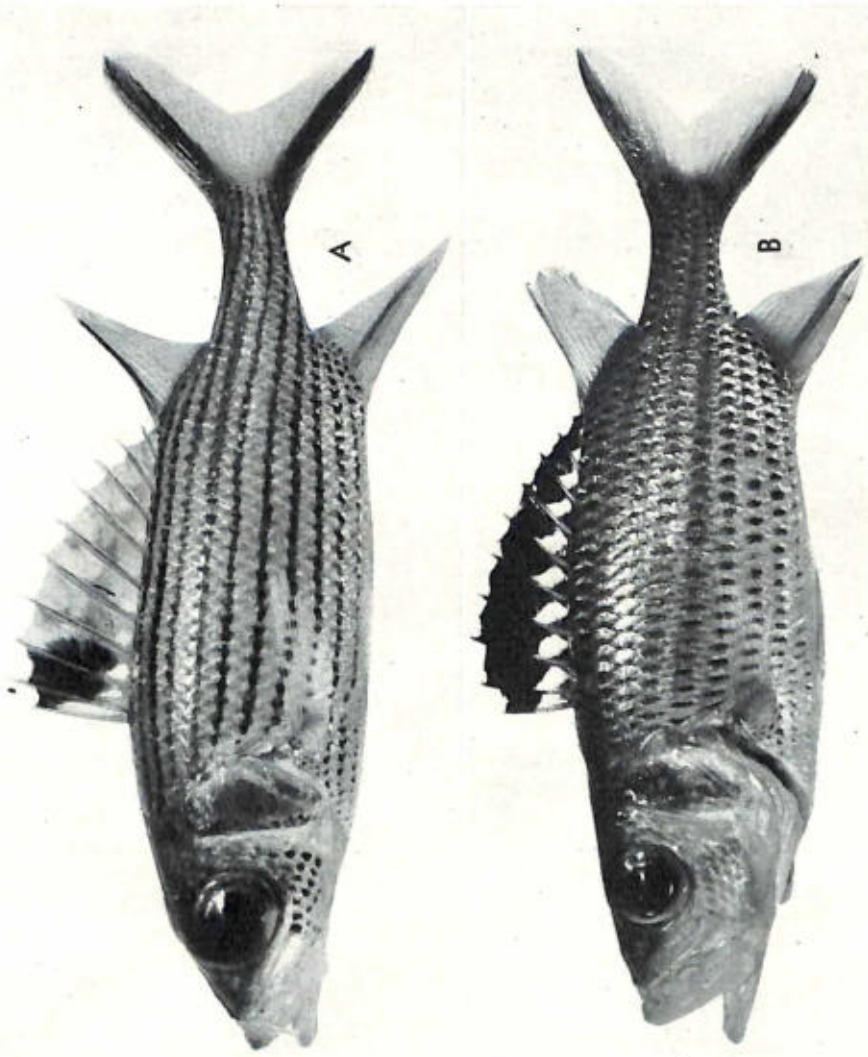
Holotype of *Uropterygius reidi* Schultz, U.S.N.M. No. 116077, from Tau Island, Samoan group.



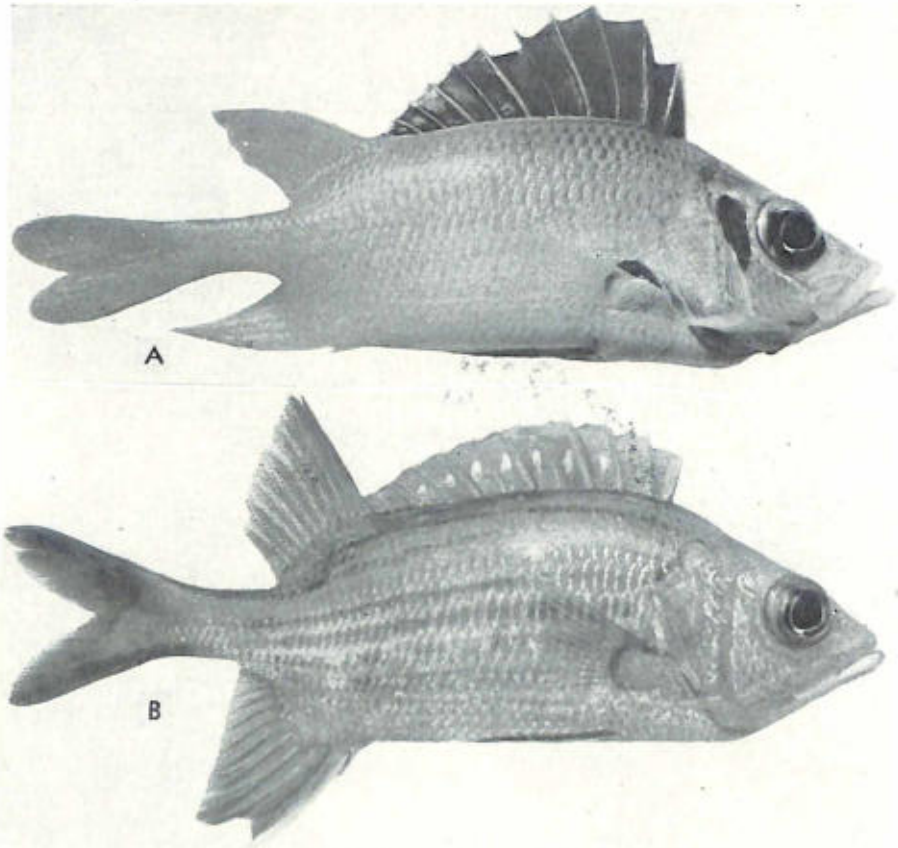
A. Paratype of *Rhaphiobelone robusta*, new species, U.S.N.M No. 141750, from Bikini Atoll; B, *Prognichthys* sp. ?, 46 mm. in standard length, from Eniwetok Atoll; C, *Holotrachys lima* (Valenciennes), from Bikini Atoll (dark area behind pectoral fin is a shadow); D, *Myripristis murdjan* (Forskål), from Bikini Atoll.



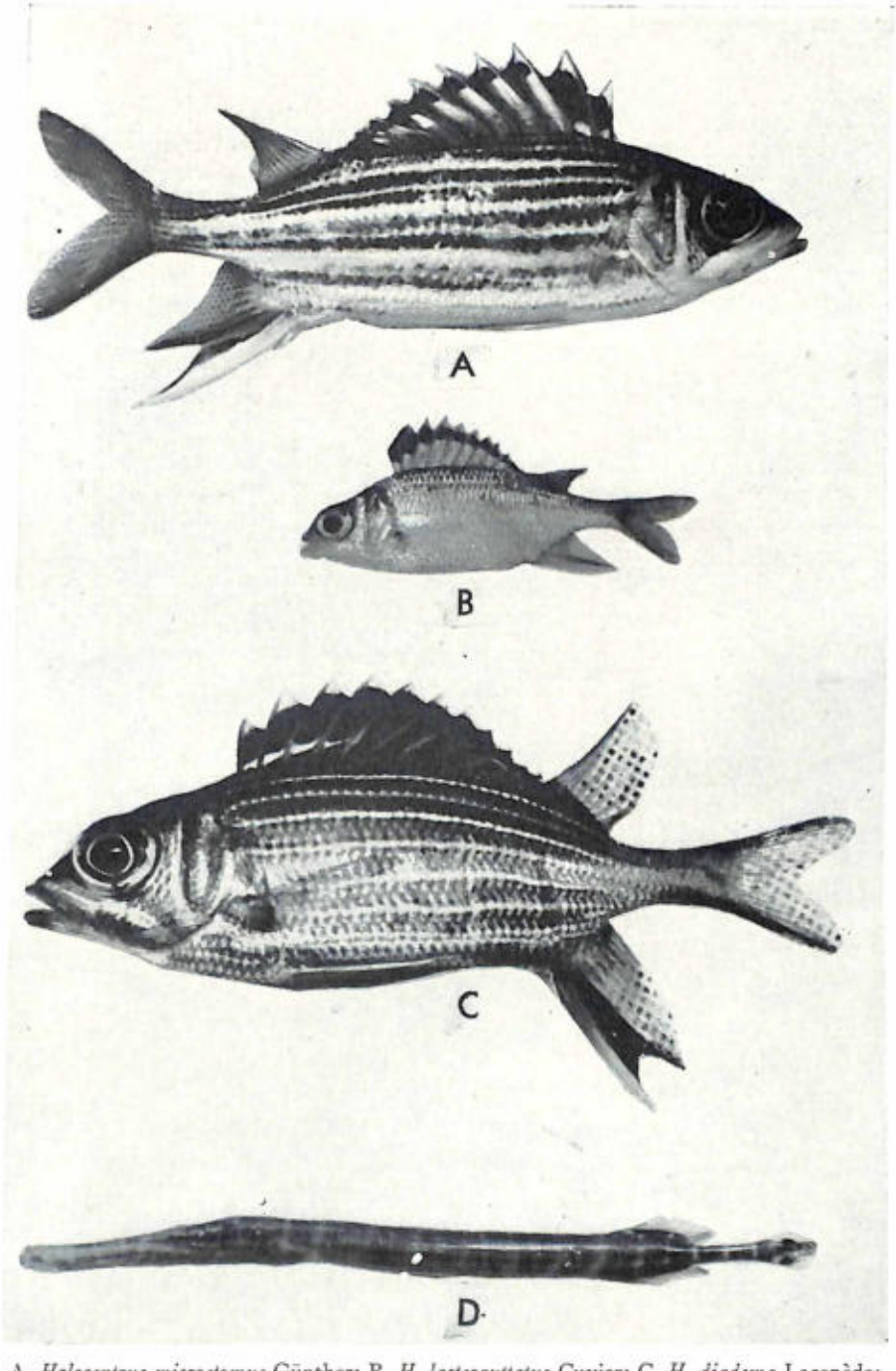
A, *Myripristis berndti* Jordan and Evermann; B, *M. bowditchae*, new species, paratype; C, *M. argyromus* Jordan and Evermann; all from Bikini Atoll. These specimens were photographed on a net, which shows through their fins.



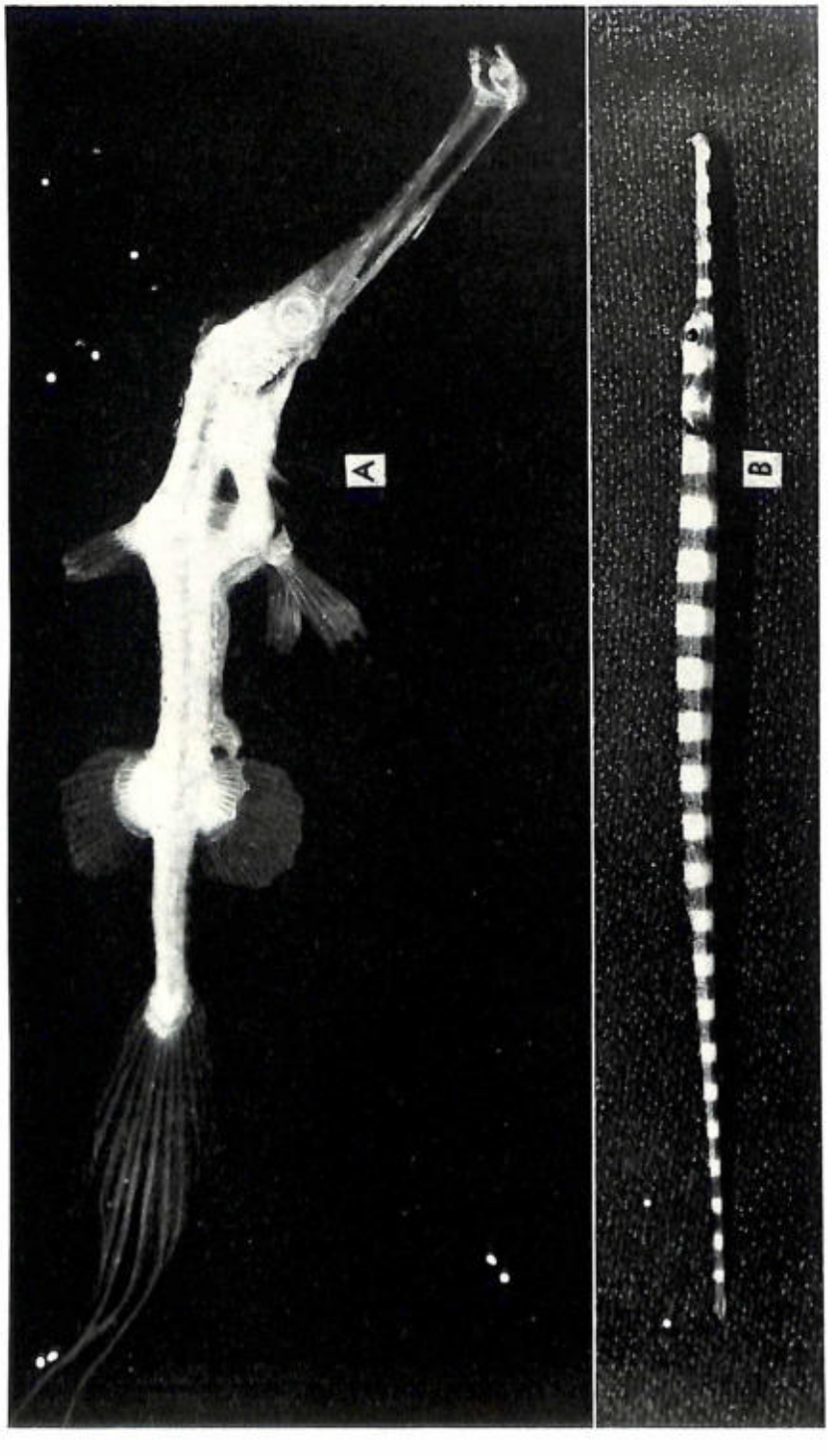
A, *Holocentrus sammara* (Forskål); B, *H. opercularis* Valenciennes; both from Bikini Atoll.



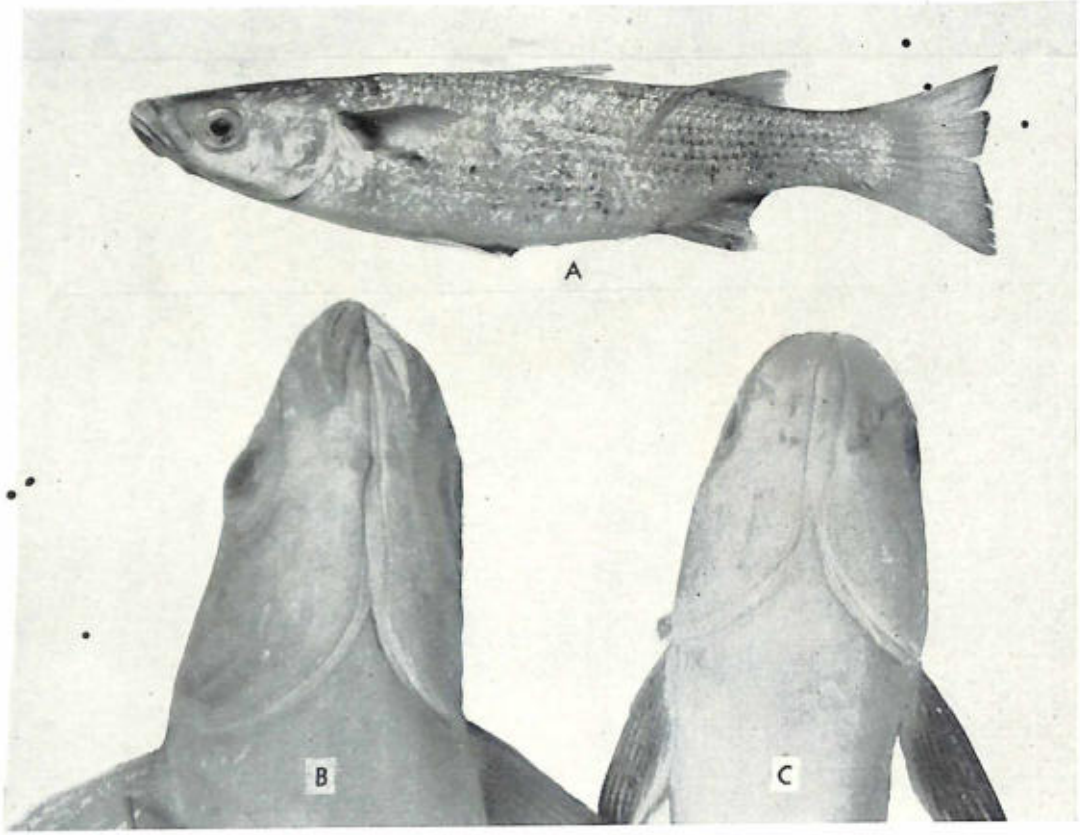
A, *Holocentrus spinifer* Forskål; B, *H. tiere* Cuvier and Valenciennes; both from Bikini Atoll.



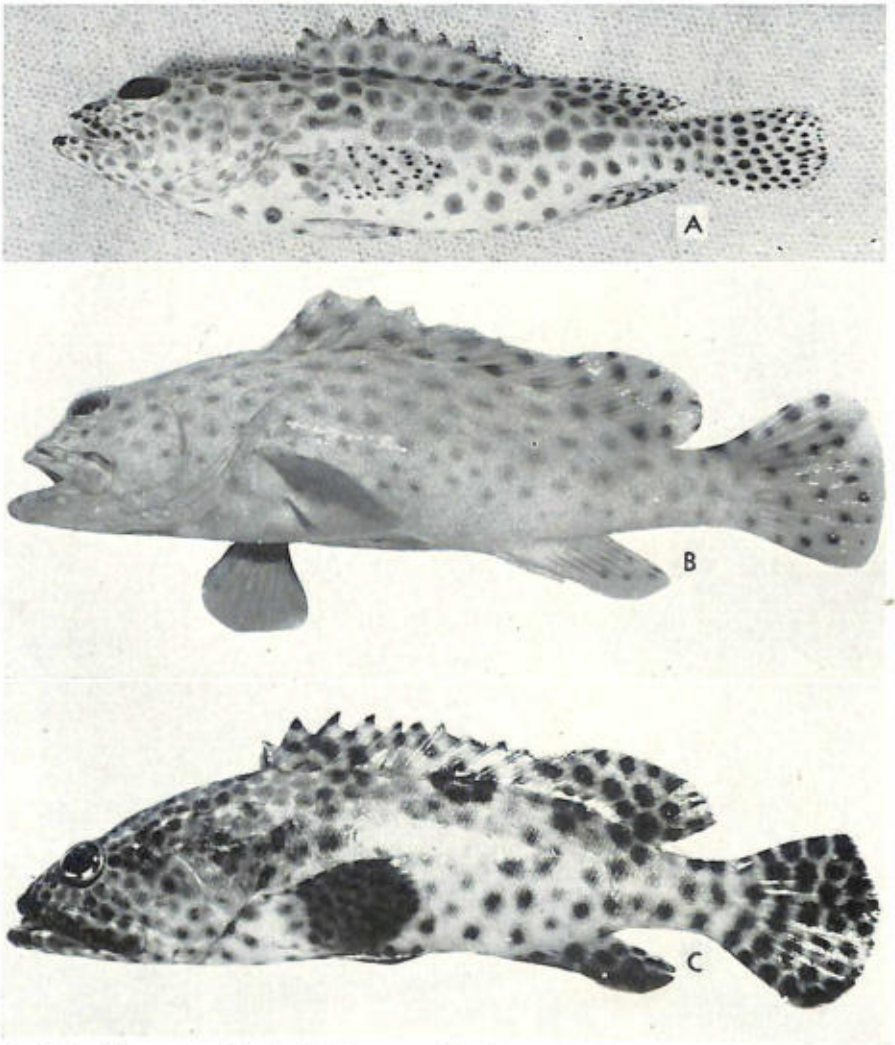
A, *Holocentrus microstomus* Günther; B, *H. lacteoguttatus* Cuvier; C, *H. diadema* Lacepède; D, *Aulostomus chinensis* (Linnaeus); all from Bikini Atoll. These specimens were photographed on a net, which shows through their fins.



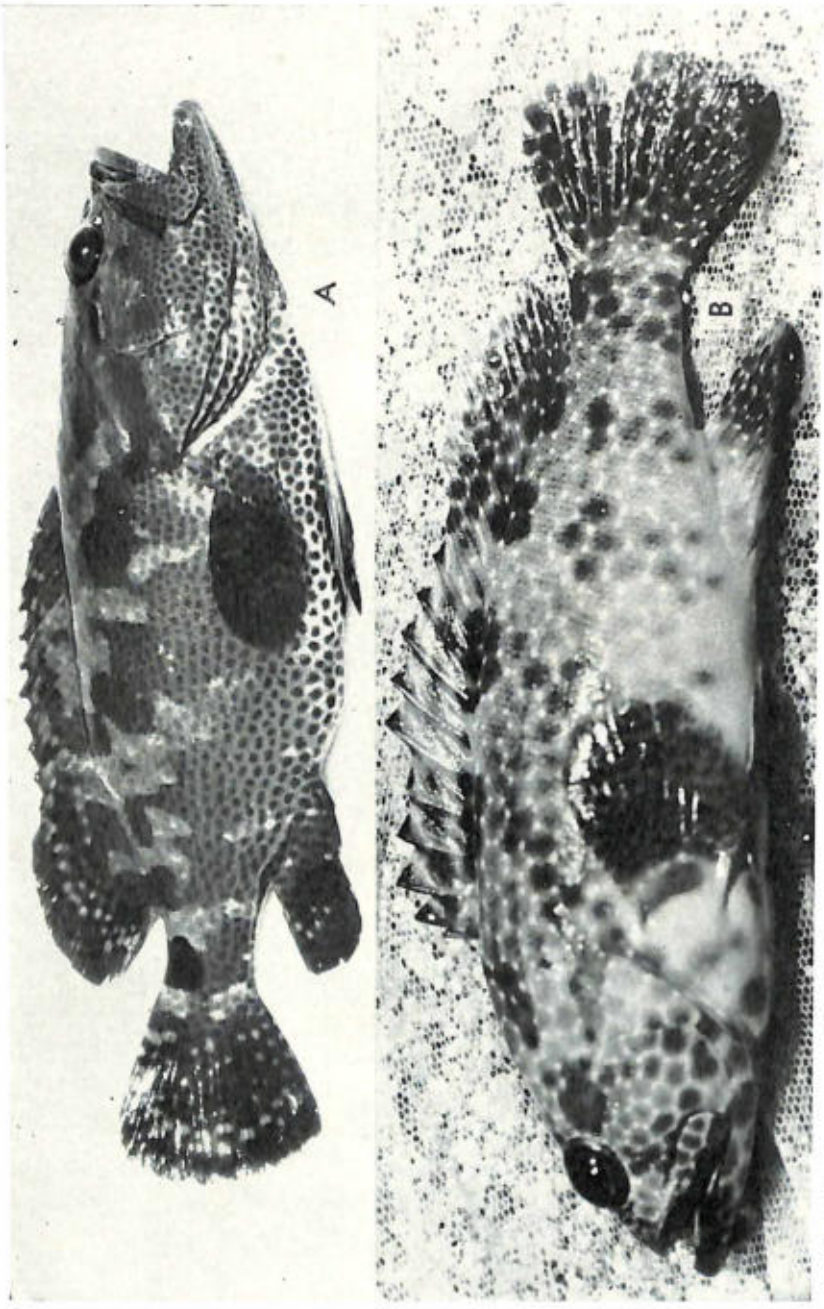
A, *Solenostomus armatus* Weber, taken off Bikini Atoll; B, *Dunckerocampus dactyliophorus* (Bleeker), from Bikini Atoll.



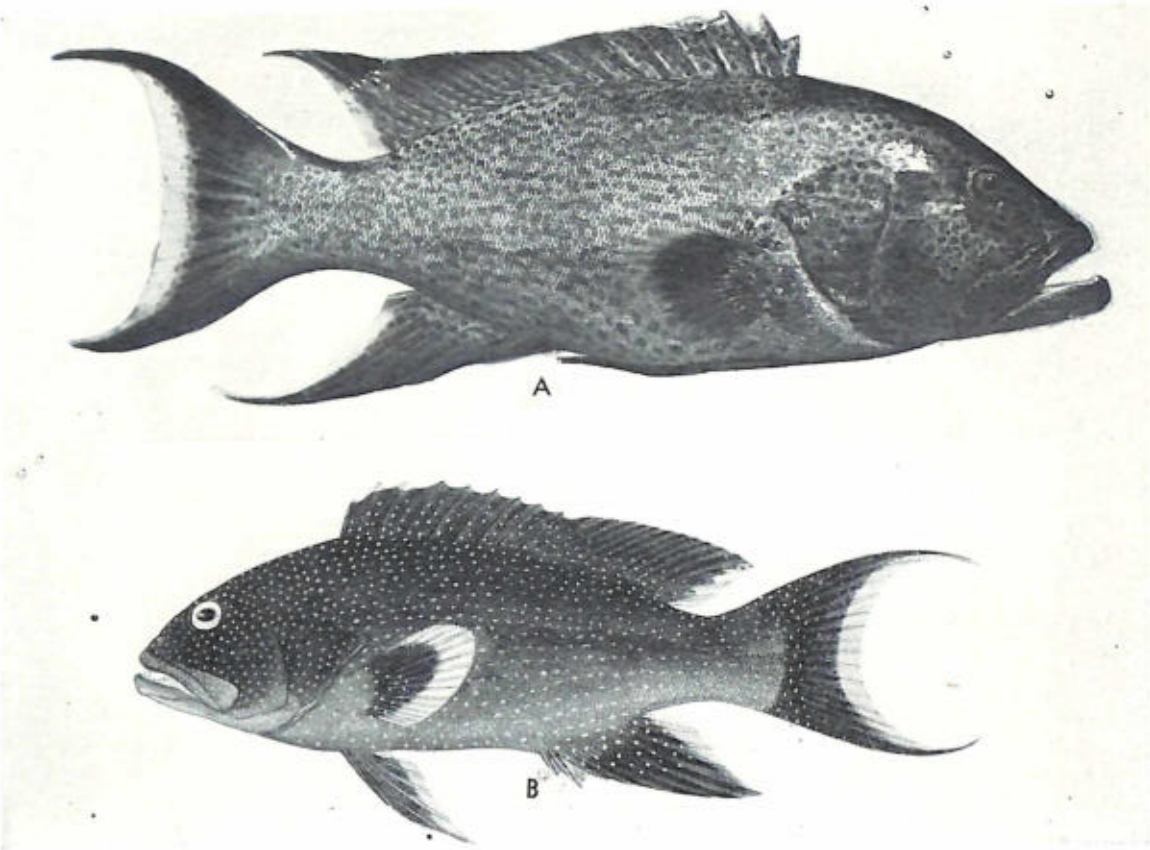
A, *Neomyxus chaptalii* (Eydoux and Souleyet); B, ventral side of head of *N. chaptalii*; C, ventral side of head of *Chelon vaigiensis* (Quoy and Gaimard); both from Bikini Atoll.



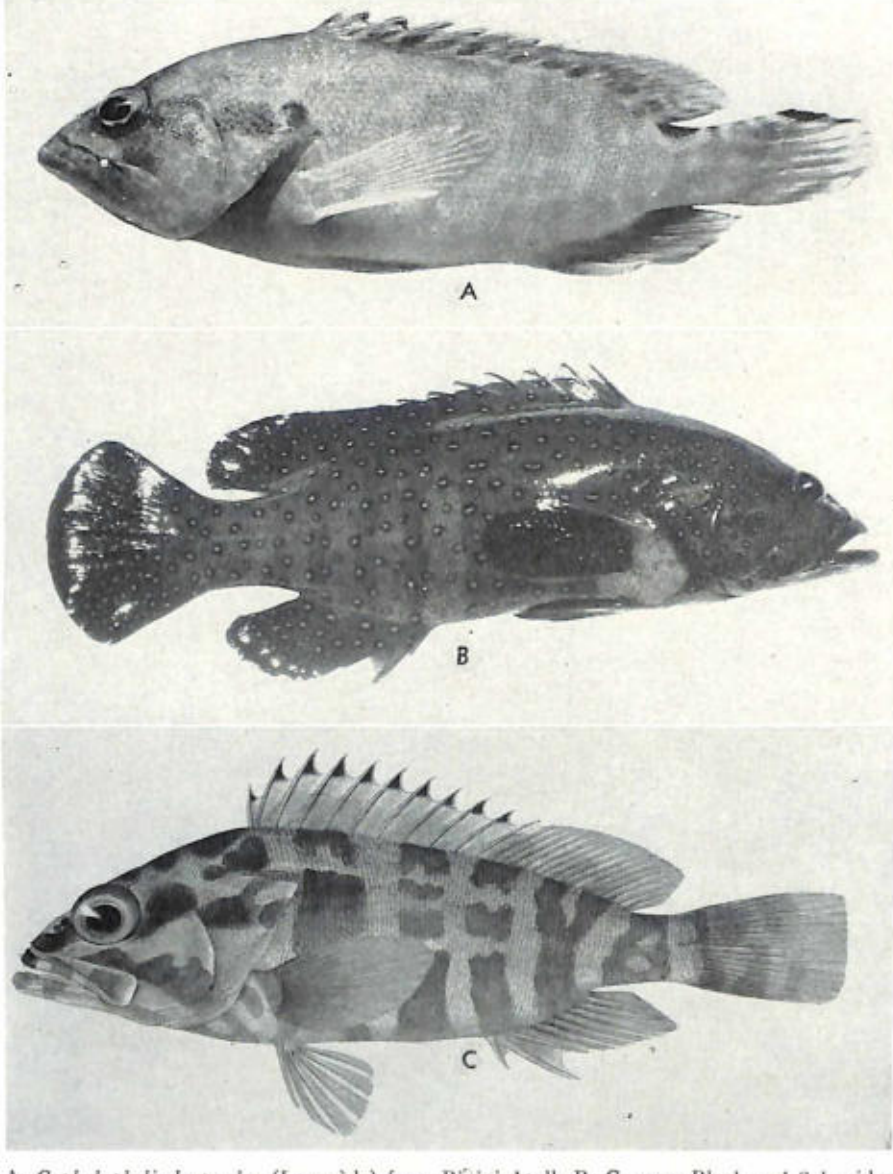
A, *Epinephelus merra* Bloch; B, *E. macrospilos* (Bleeker) (upper part of tail with dark shadow); C, *E. elongatus*, new species.



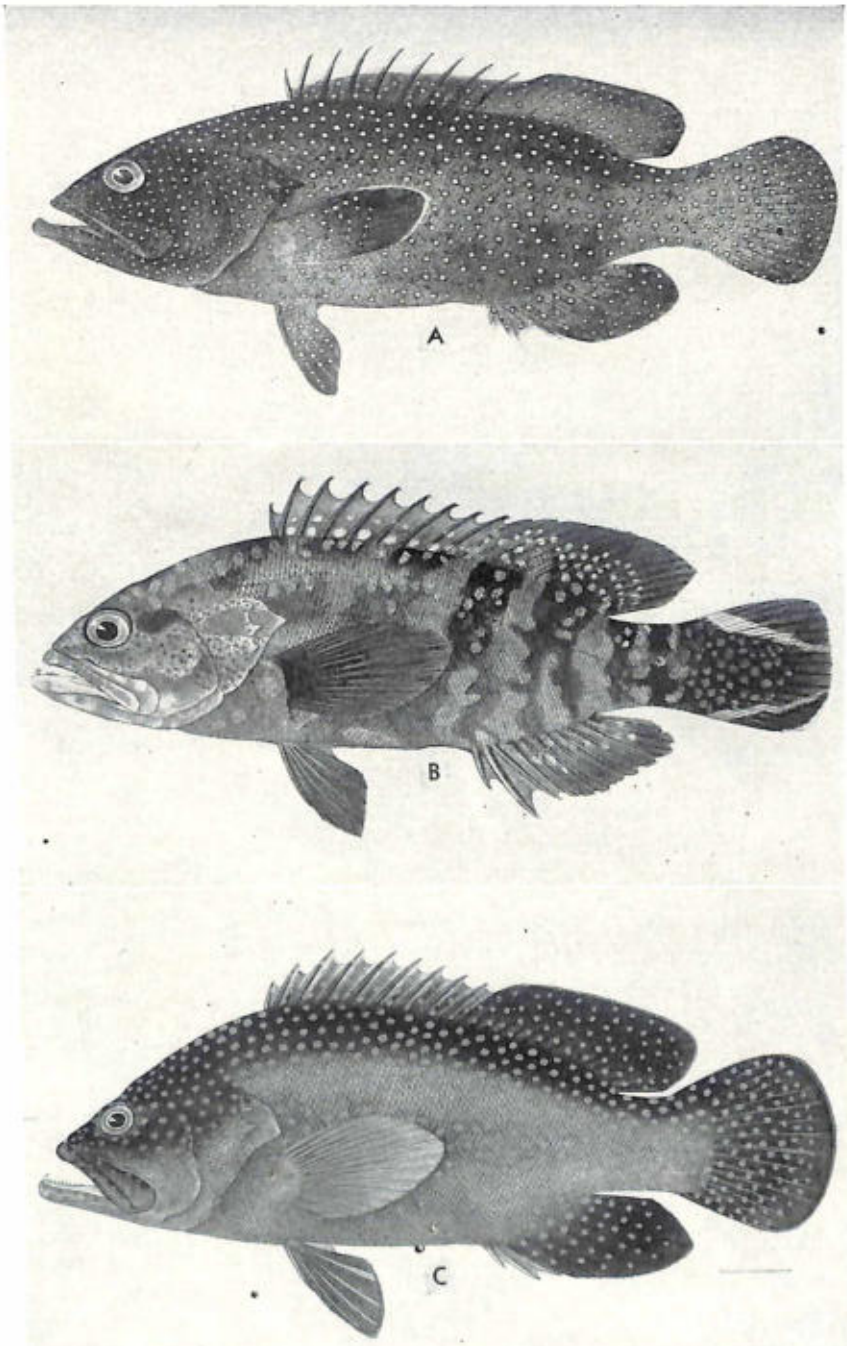
A, *Epinephelus fuscoguttatus* (Forskål); B, *E. hexagonatus* (Bloch and Schneider); both from Bikini Atoll. *E. hexagonatus* was photographed on a net.



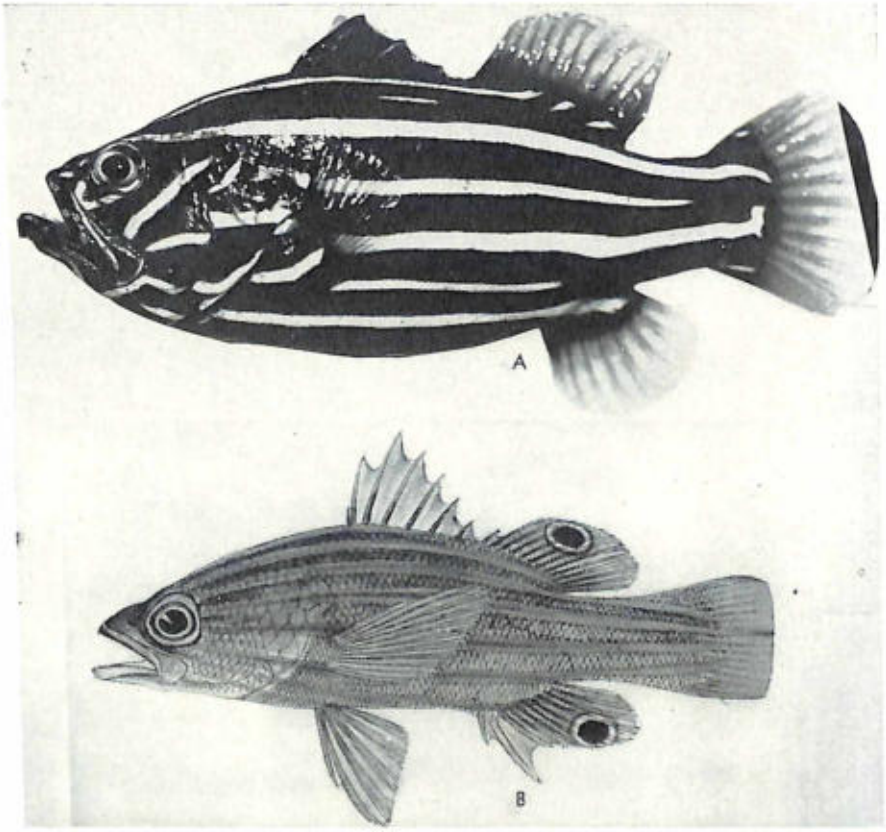
Variability of spots in *Variola louti* (Forskål): A, Specimen from Bikini Atoll; B, photograph of drawing from the *Albatross* Philippine collection.



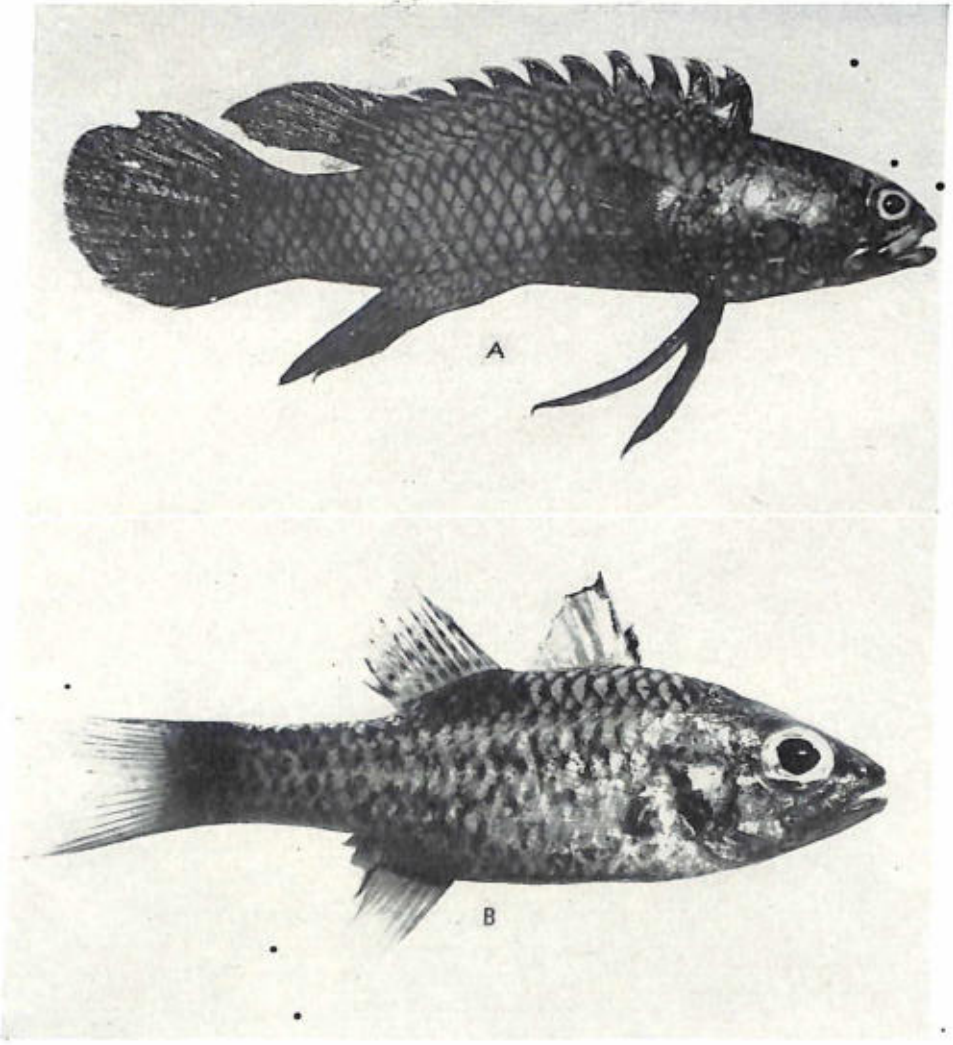
A, *Cephalopholis leopardus* (Lacepède) from Bĭkĭni Atoll; B, *C. argus* Bloch and Schneider from Bikini Atoll; C, *Epinephelus fasciatus* (Forskål), photograph of drawing from the *Albatross* Philippine collection.



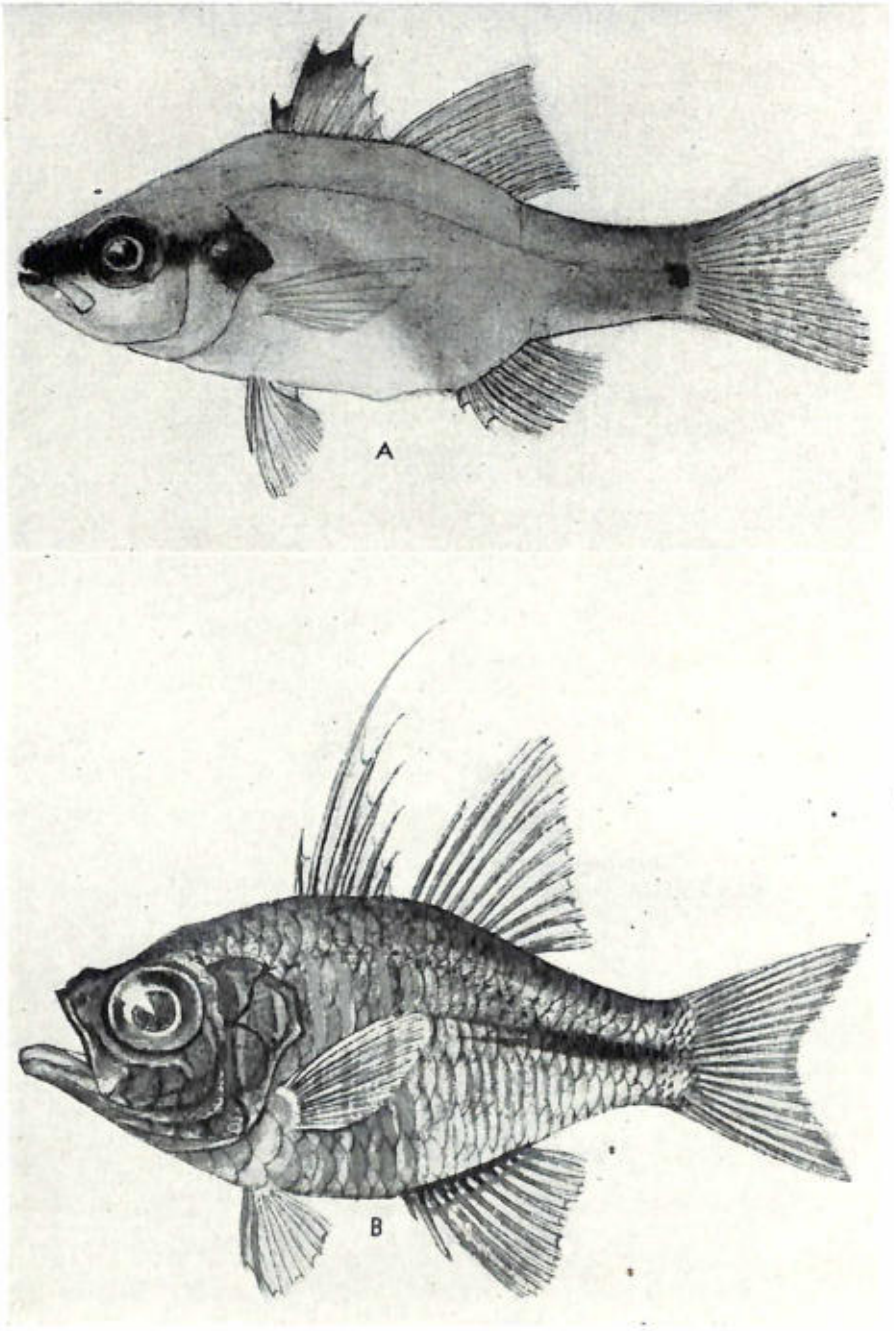
A, *Cephalopholis argus* Bloch and Schneider; B, *C. urodelus* (Bloch and Schneider); C, *C miniatus* (Forskål); photographs of drawings from the *Albatross* Philippine collection.



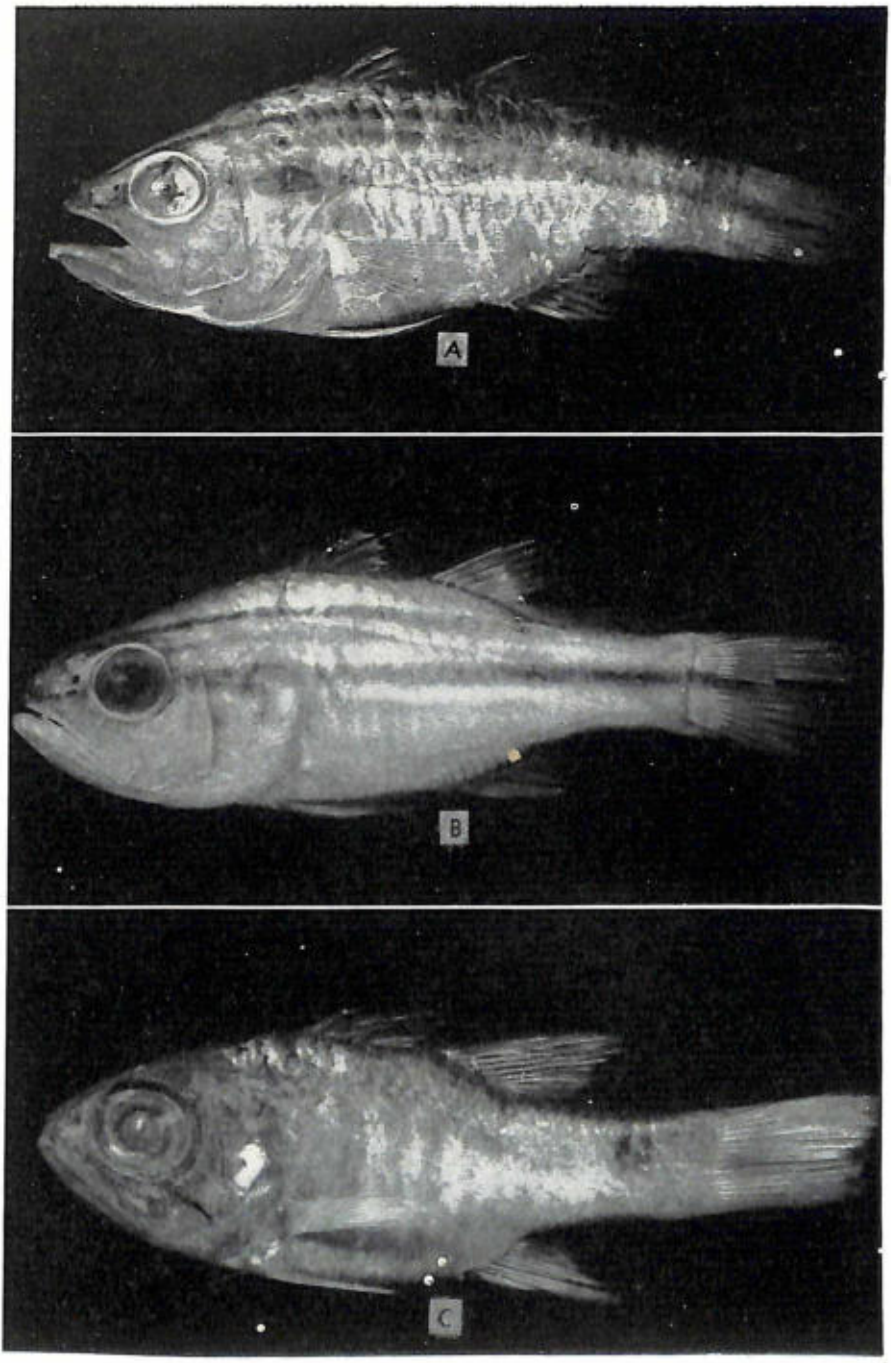
A, *Grammistes sexlineatus* (Thünberg), from Bikini Atoll (dark edge of caudal fin is a shadow); B, *Chorististium swalesi* Fowler and Bean, photograph of drawing from the *Albatross* Philippine collection.



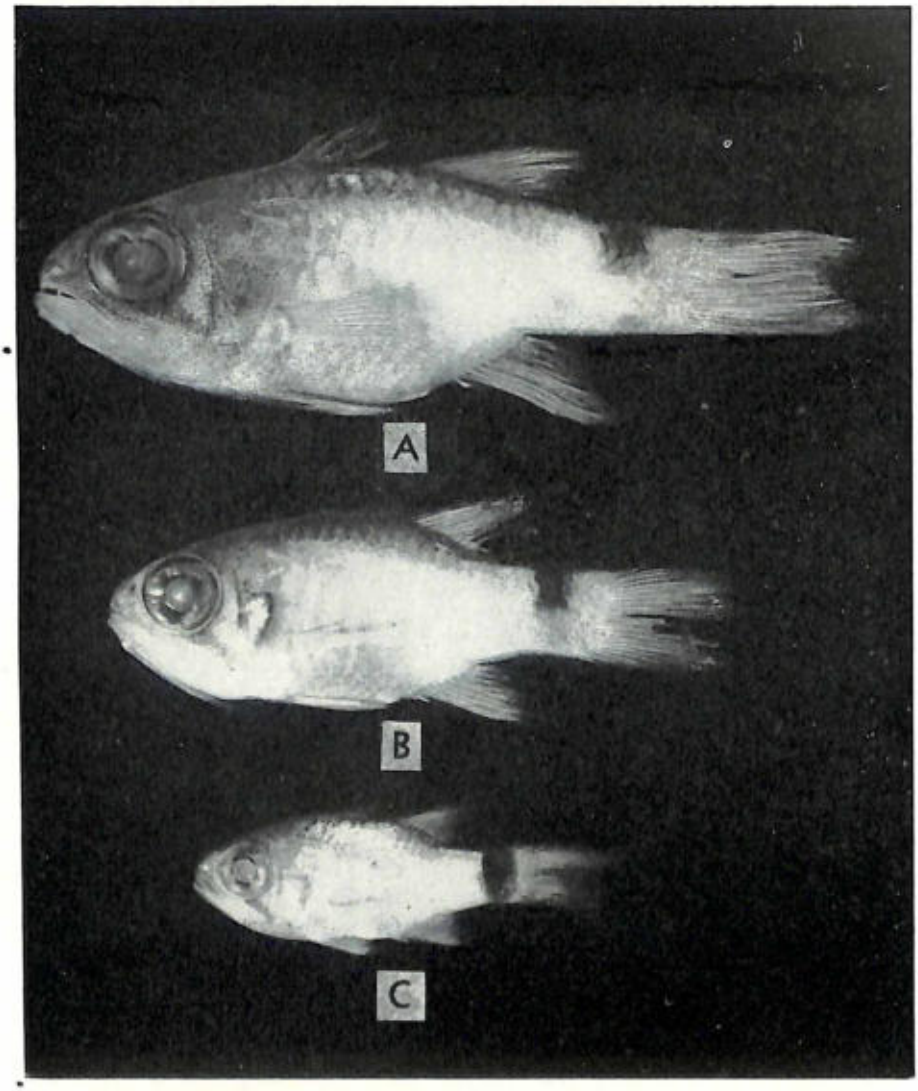
A, *Plesiops nigricans* (Rüppell); B, *Apogon snyderi* Jordan and Evermann; both from Bikini atoll.



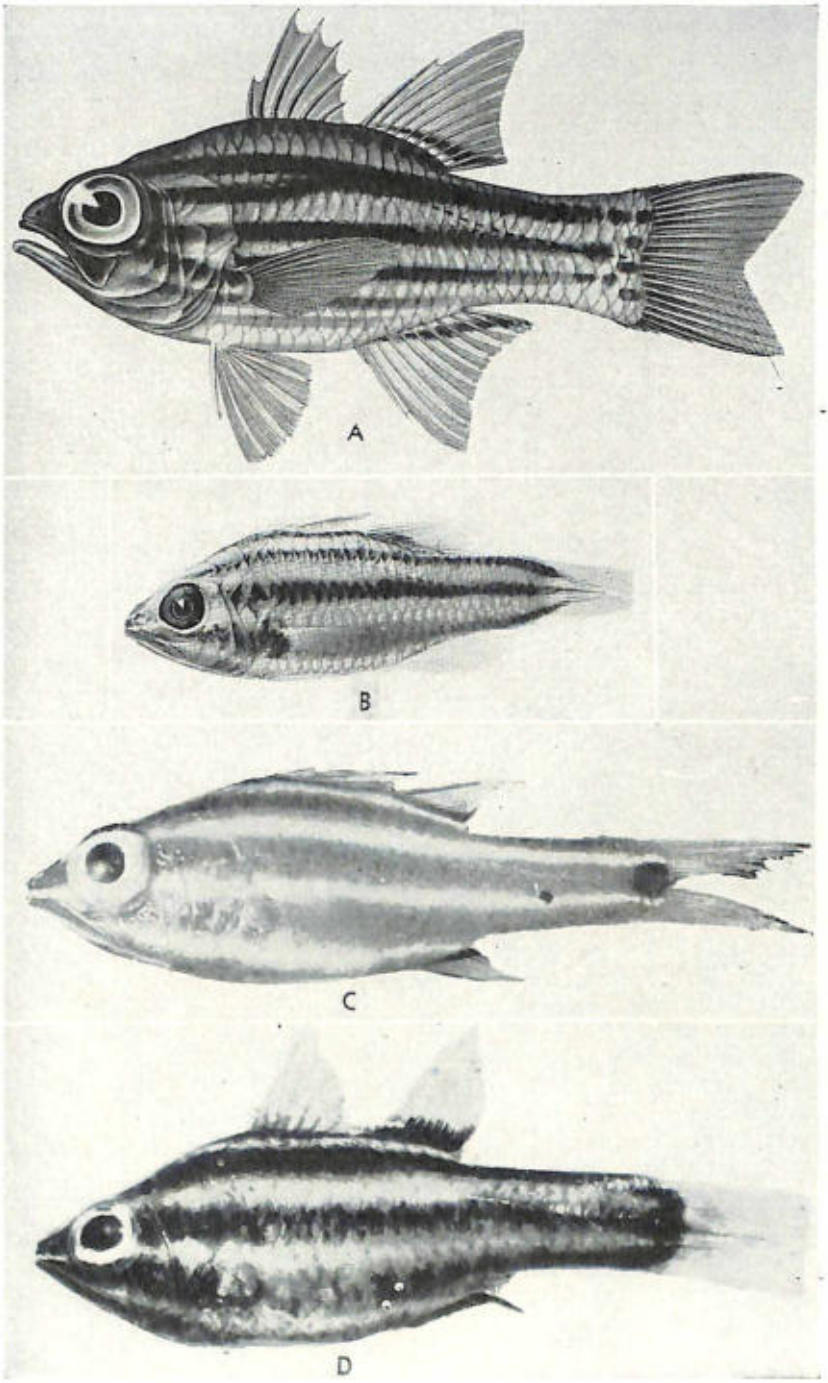
A, *Apogon lateralis* Valenciennes; B, *A. leptacanthus* Bleeker; photographs of color drawings from the *Albatross* Philippine collection.



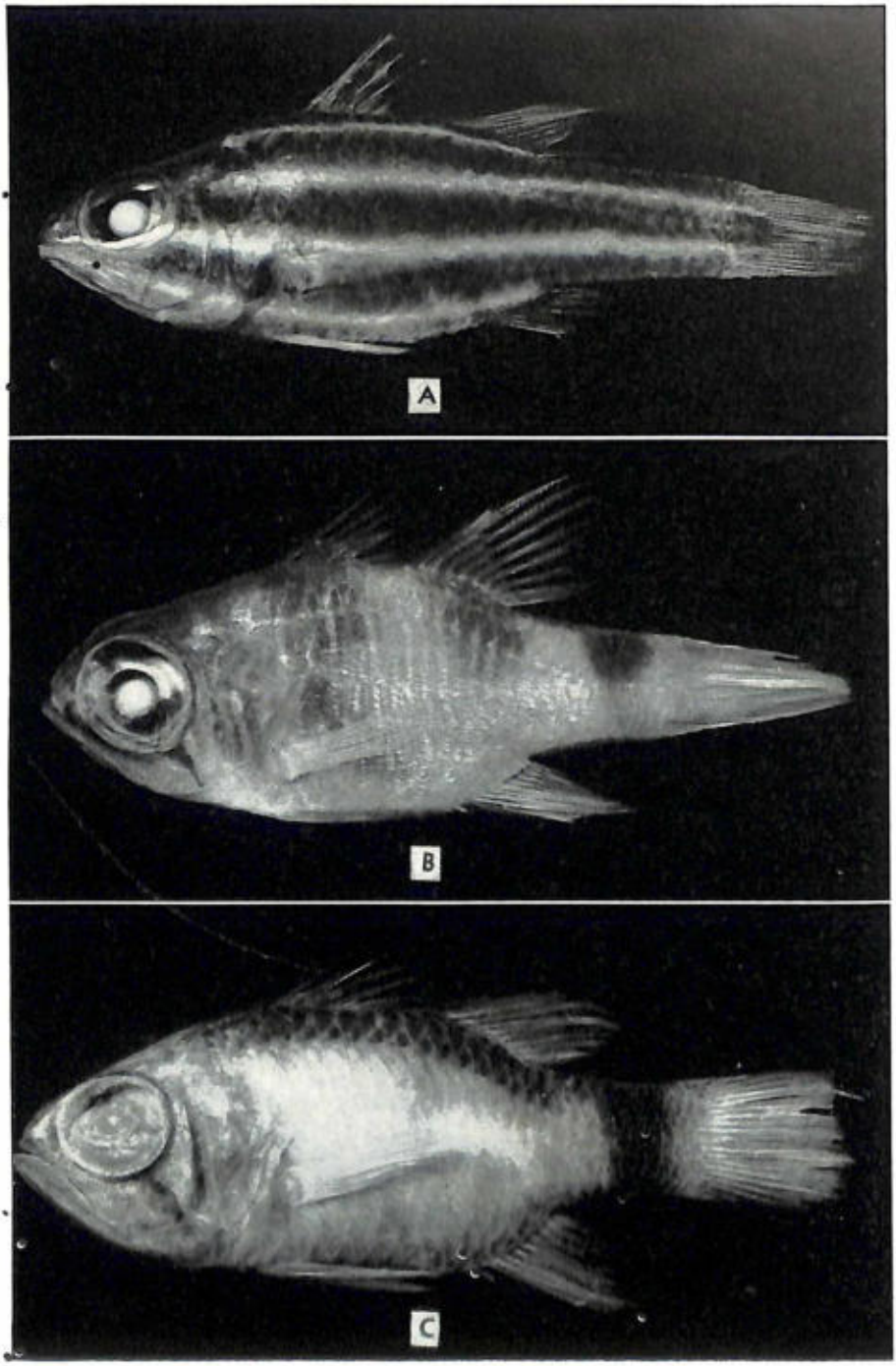
A, *Apogon fasciatus* (White), neotype, U.S.N.M. No. 59972, from New South Wales; B, *A. fasciatus*, U.S.N.M. No. 148623, from New South Wales, showing color pattern in detail; C, *A. nubilus* Garman, from Bikini Atoll.



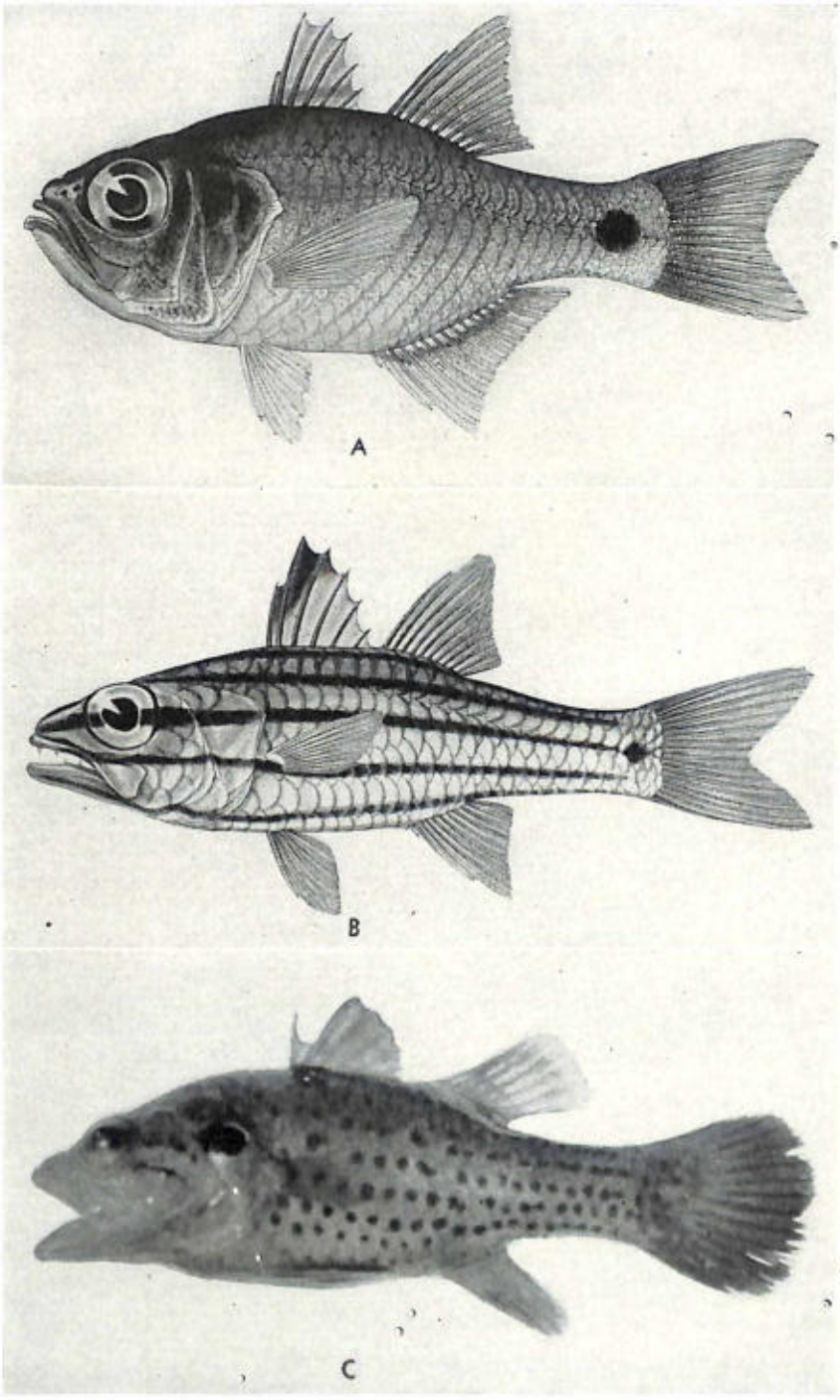
Apogon savayensis Günther, from Bikini Atoll, showing transition of color marking on caudal peduncle in young to adult: A, Adult, 71 mm. in standard length; B, juvenile, 51, mm.; C, young, 34 mm.



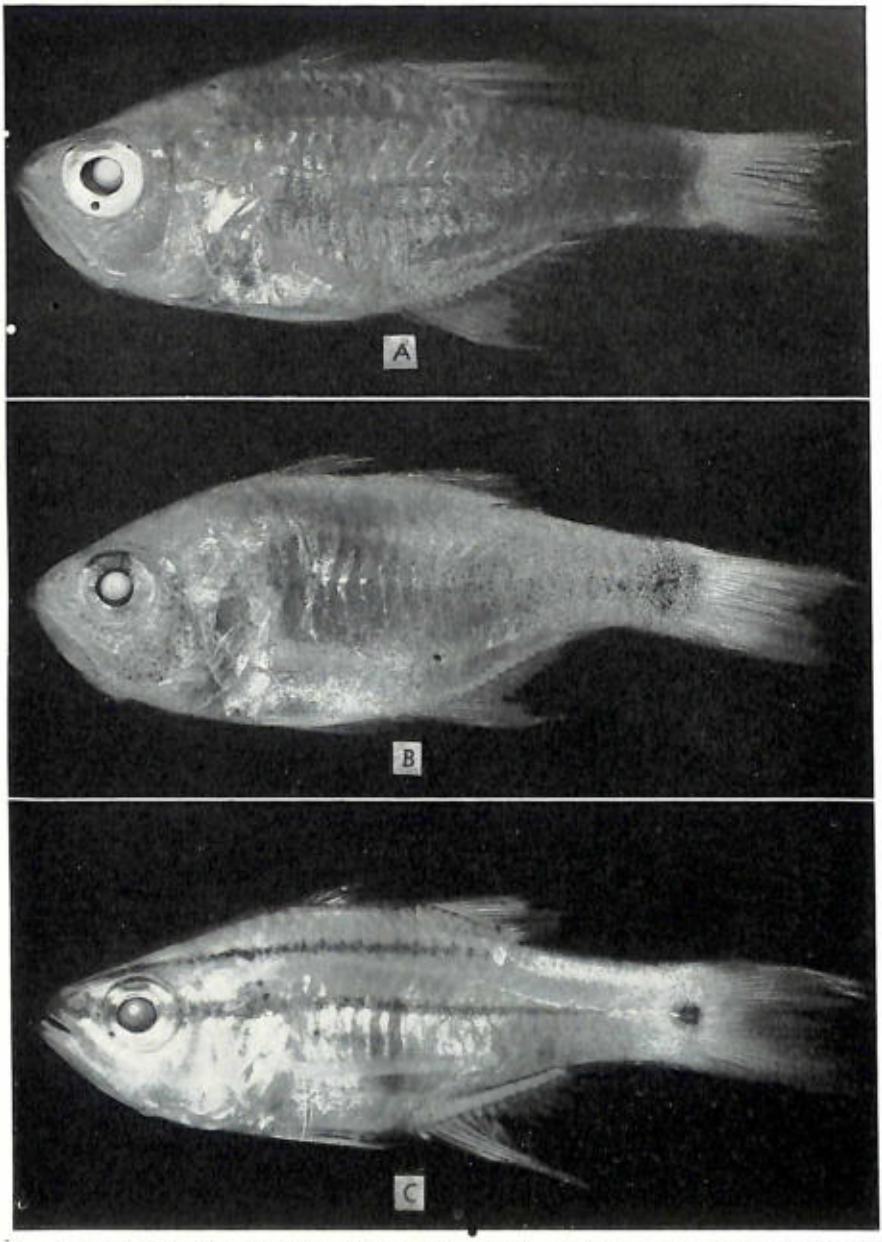
A, *Apogon compressus* (Smith and Radcliffe) photograph of color drawing of paratype from the *Albatross* Philippine collection; B, *A. novemfasciatus* Cuvier and Valenciennes, photograph of drawing from the *Albatross* Philippine collection; C, *A. nigrofasciatus*, new species, female, paratype, from Bikini Atoll; D, same species, male, paratype, from Bikini Atoll.



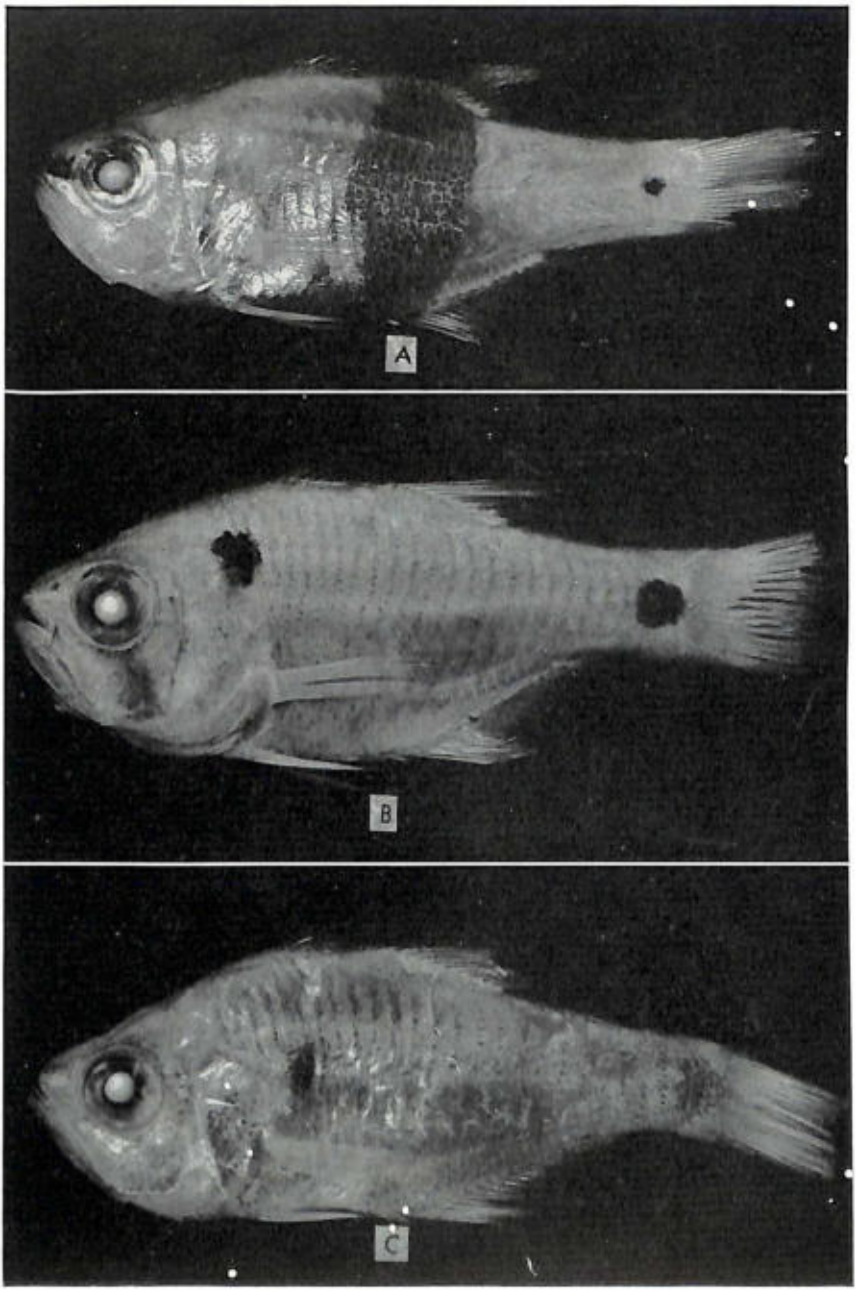
A, *Apogon aroubiensis* Hombron and Jacquinot, *Albatross* linen tag No. 23976, *Albatross* Philippine collection; B, *A. bandanensis* Bleeker, *Albatross* linen tag No. 23776, *Albatross* Philippine collection; C, *A. erdmani* Lachner, holotype, U.S.N.M. No. 147518, from the Red Sea.



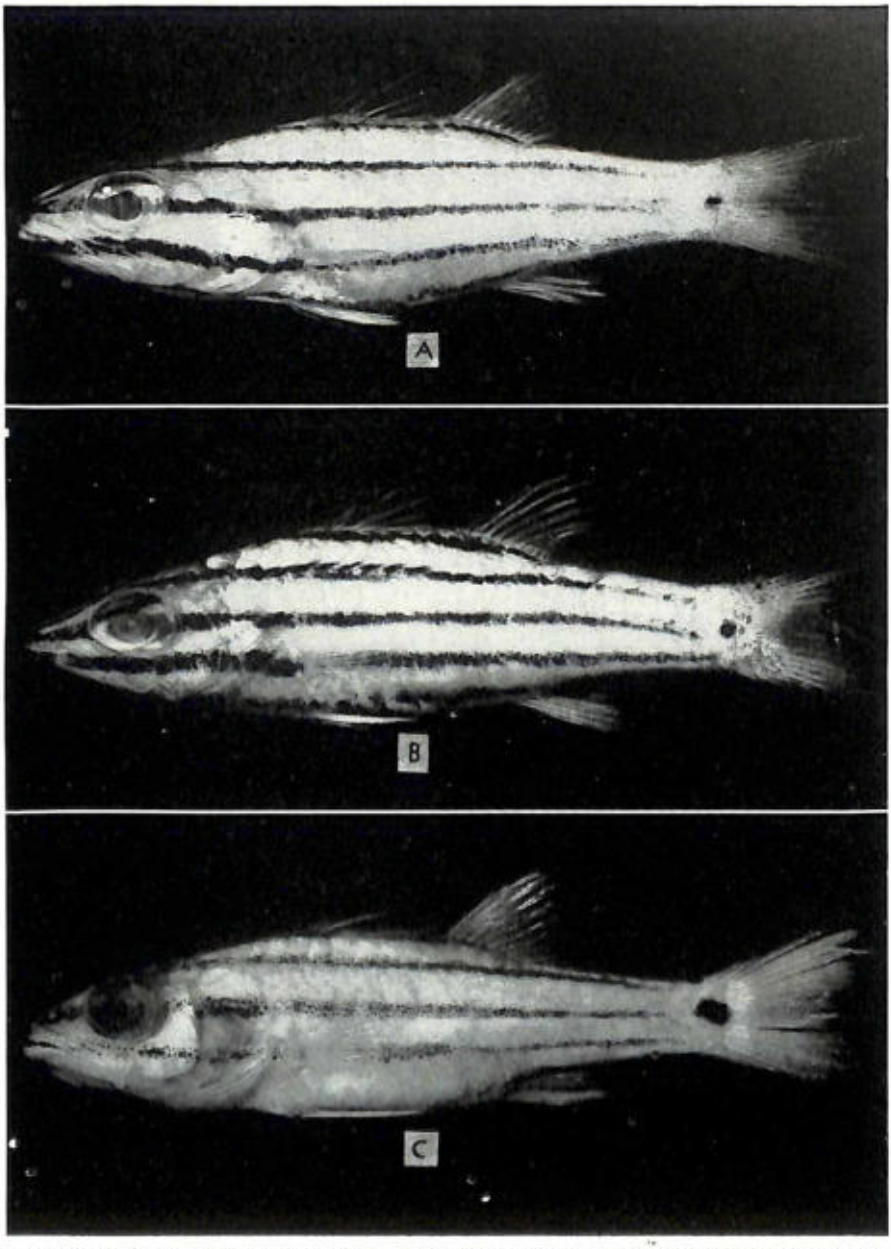
A, *Archamia lineolata* (Cuvier and Valenciennes), photograph of color drawing from the *Albatross* Philippine collection; B, *Paramia quinquelineata* (Cuvier and Valenciennes) photograph of color drawing from the *Albatross* Philippine collection; C, *Apogon isostigma* (Jordan and Seale), from Bikini Atoll.



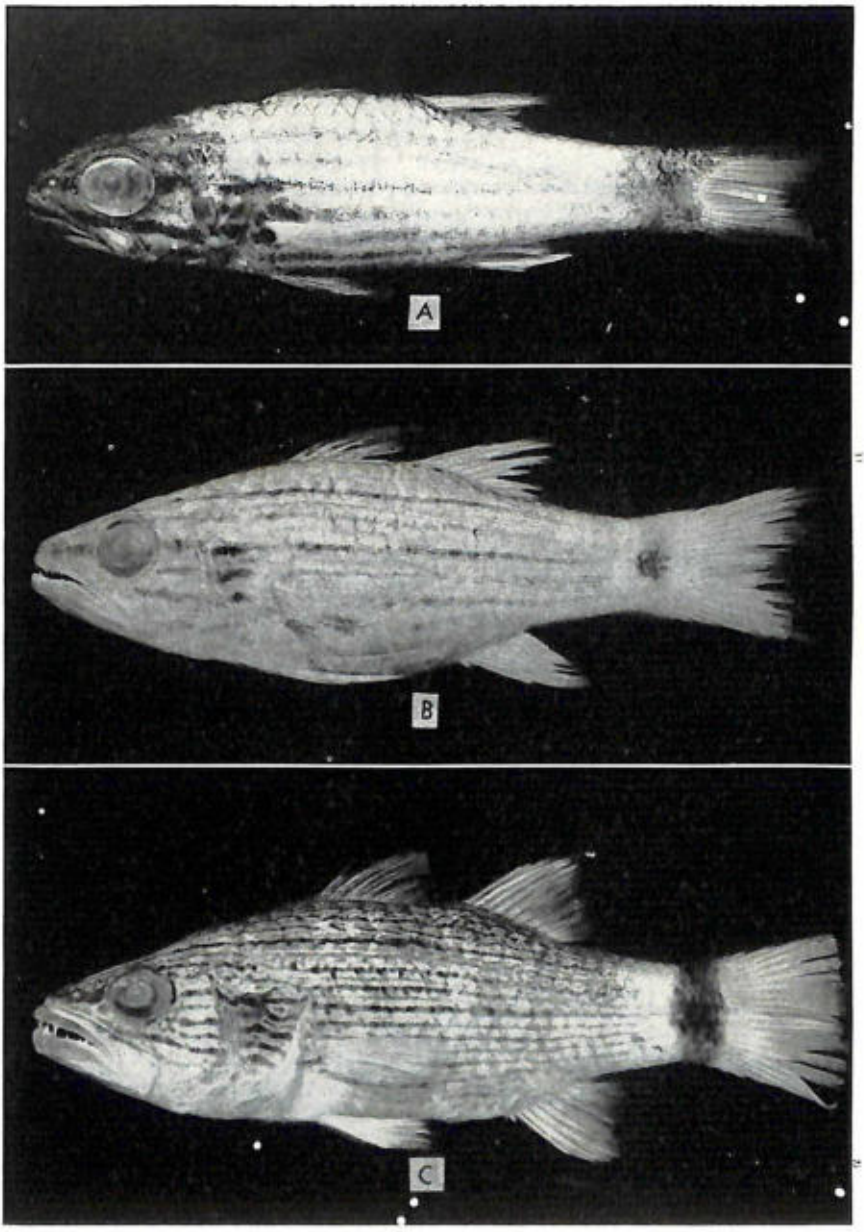
A, *Archamia lineolata* (Cuvier and Valenciennes), from Makyan Island, East Indies; B, *A. fucata* (Cantor), from Bikini Atoll; C, *A. buruensis* (Bleeker), from Mindanao, P. I.



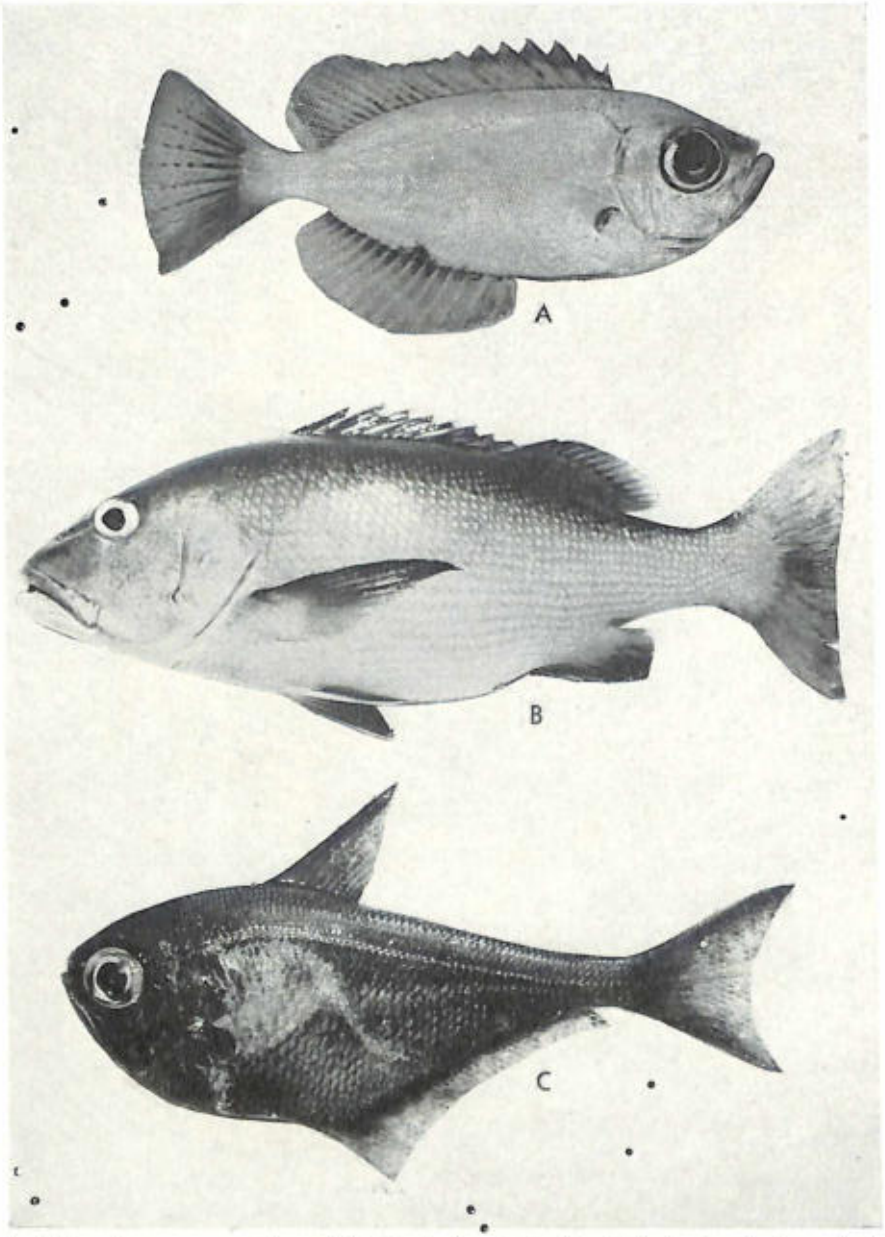
A, *Archamia zosterophera* (Bleeker), specimen from the *Albatross* Philippine collection; B, *A. biguttata* Lachner, U.S.N.M. No. 56156, from Luzon, P. I.; C, *A. dispilus* Lachner, holotype, U.S.N.M. No. 112041, from Soo Wan Bay, Formosa.



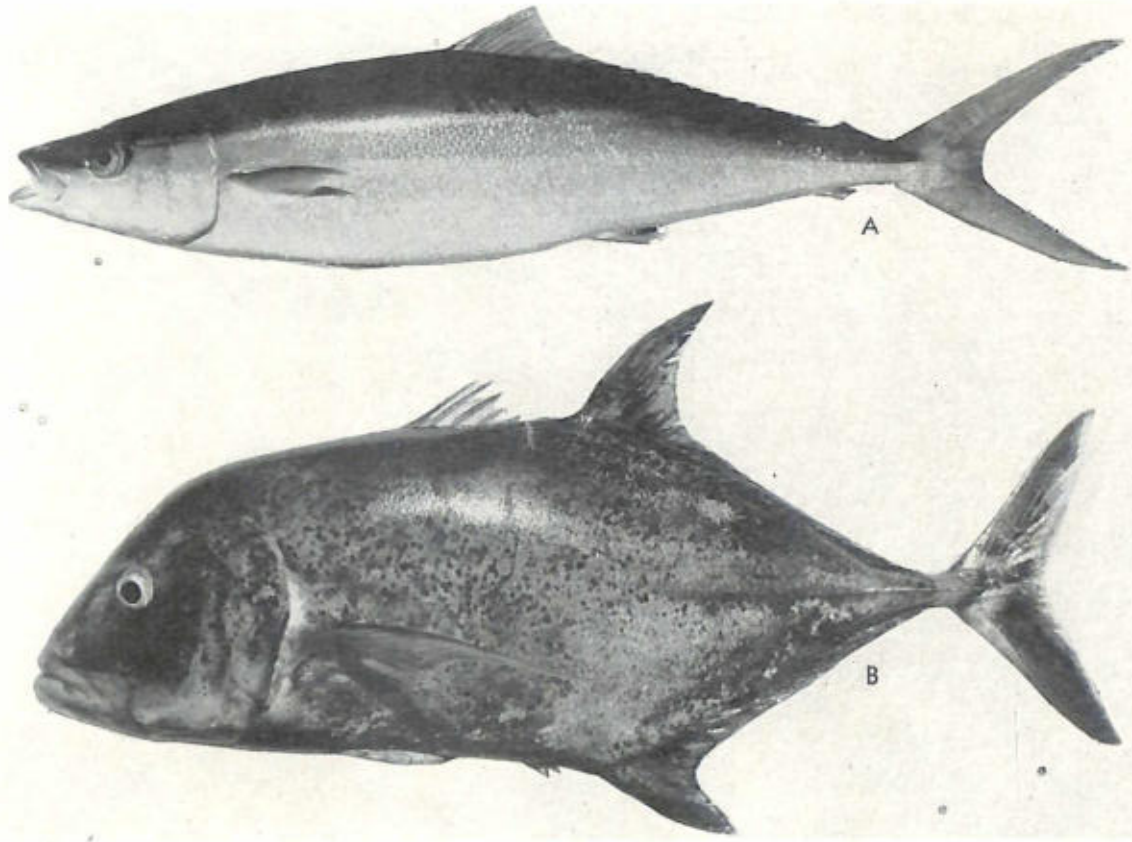
A, *Cheilodipterops isostigma* Schultz; B, *Paramia quinquelineata* (Cuvier and Valenciennes), from Bikini Atoll; C, *P. bipunctata* Lachner, holotype, U.S.N.M. No. 147944, from the Persian Gulf.



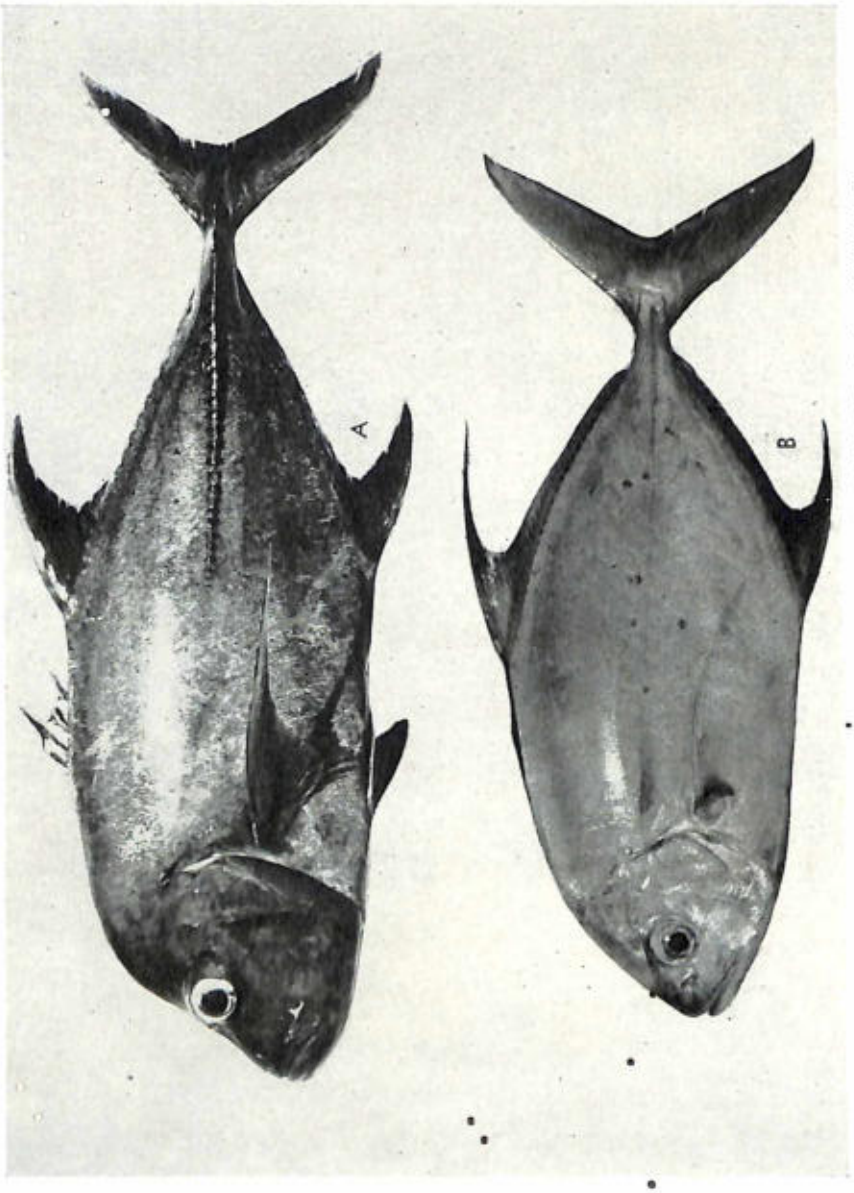
A, *Cheilodipterus macrodon* (Lacepède), from Bikini Atoll; B, *C. arabicus* (Gmelin), from the Persian Gulf; C, *C. lineatus* (Linnaeus), from the Red Sea.



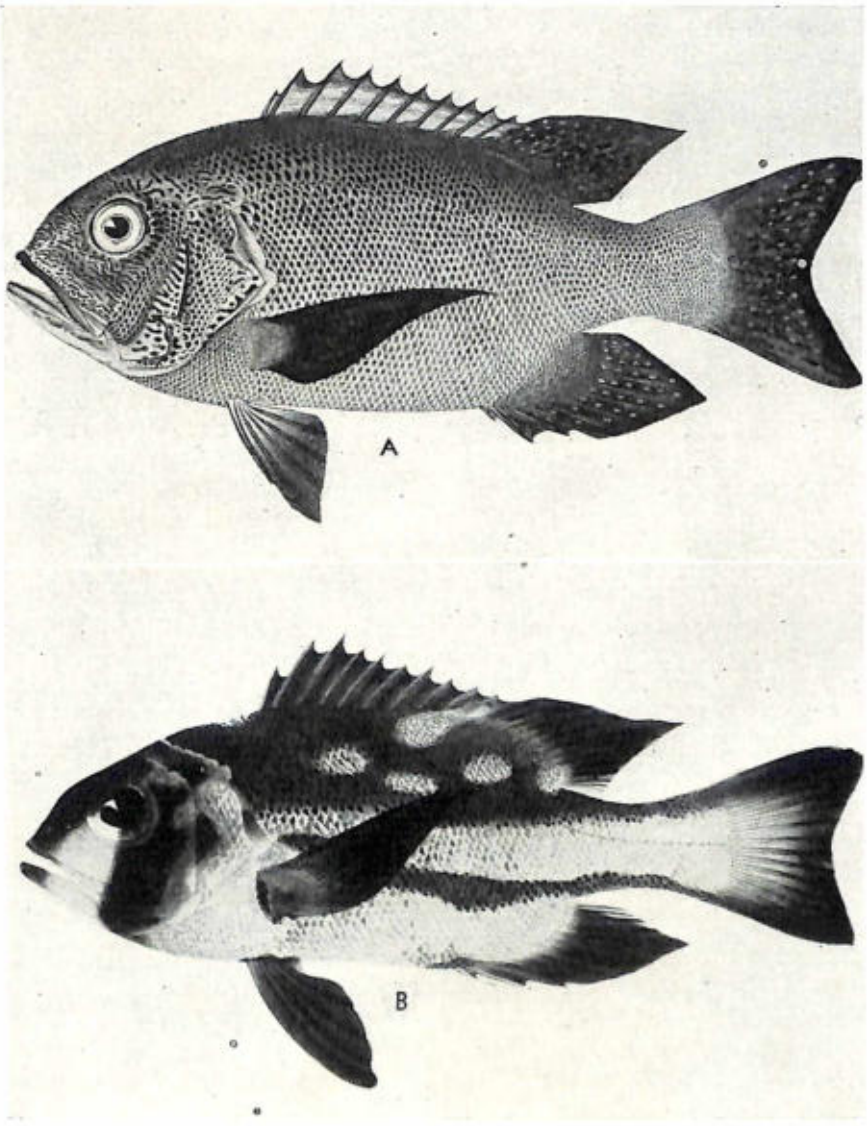
A, *Priacanthus cruentatus* (Lacepède); B, *Lutjanus bohar* (Forskål); C, *Pempheris oualensis* Cuvier and Valenciennes; all from Bikini Atoll. These specimens were photographed on a net, which shows through their fins.



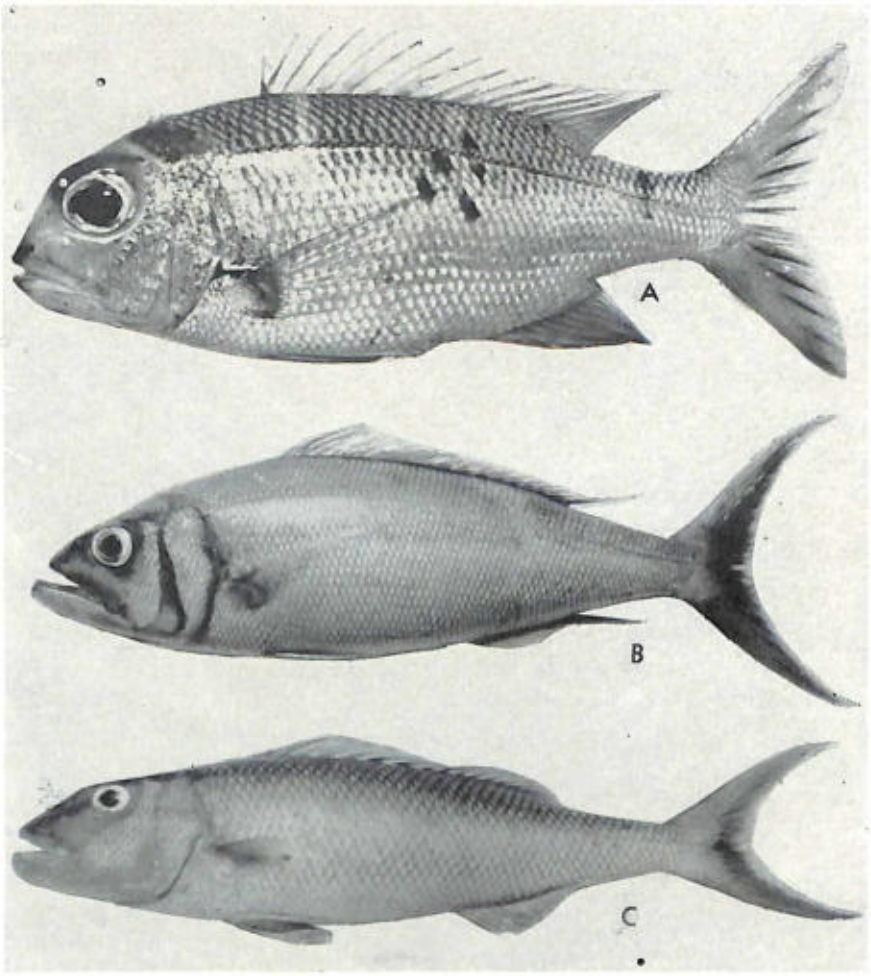
A, *Elagatis bipinnulatus* (Quoy and Gaimard); B, *Caranx melampygus* Cuvier, adult coloration; both from Bikini Atoll.



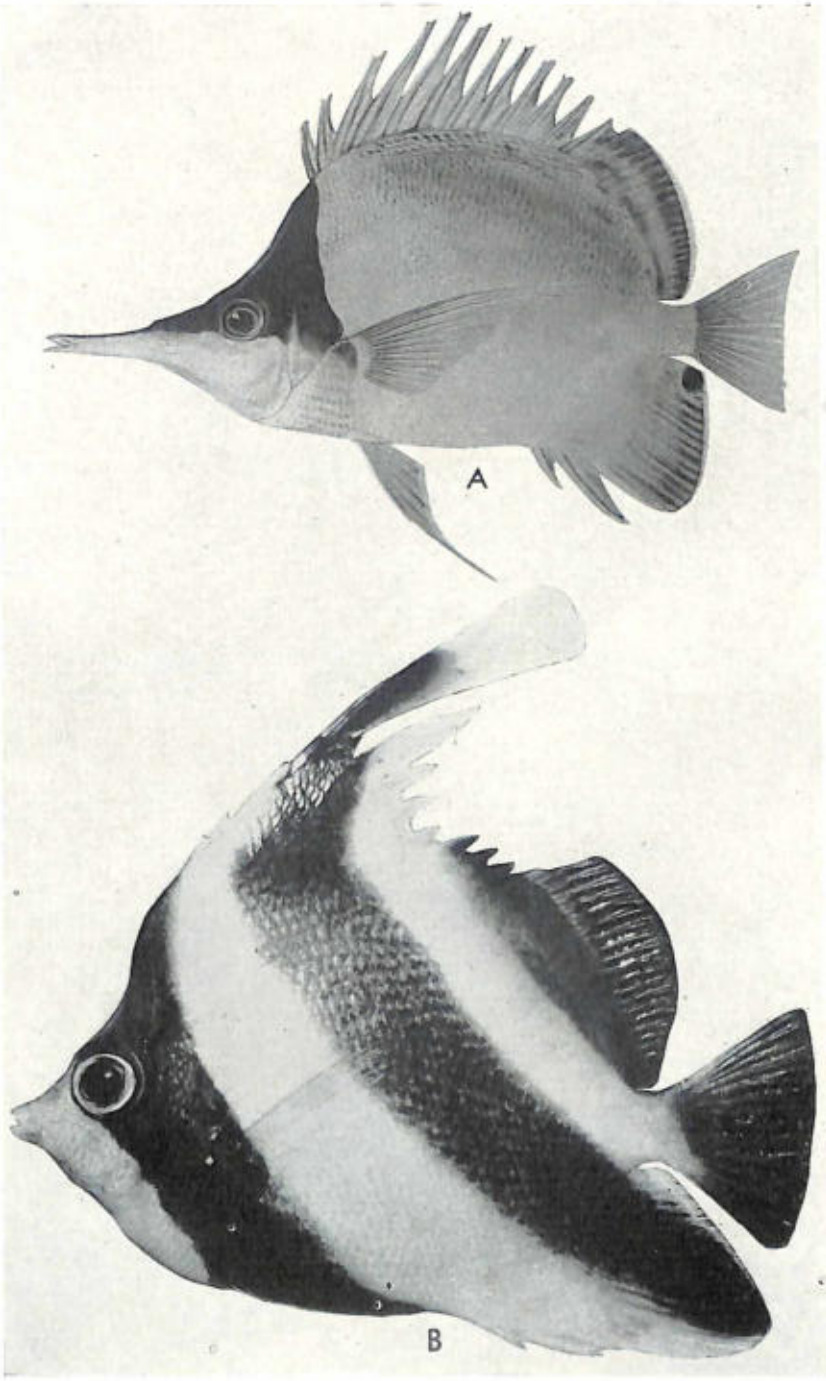
A, *Caranx lugubris* Poey; B, *Carangoides ferdau jordani* Nichols; both from Bikini Atoll.



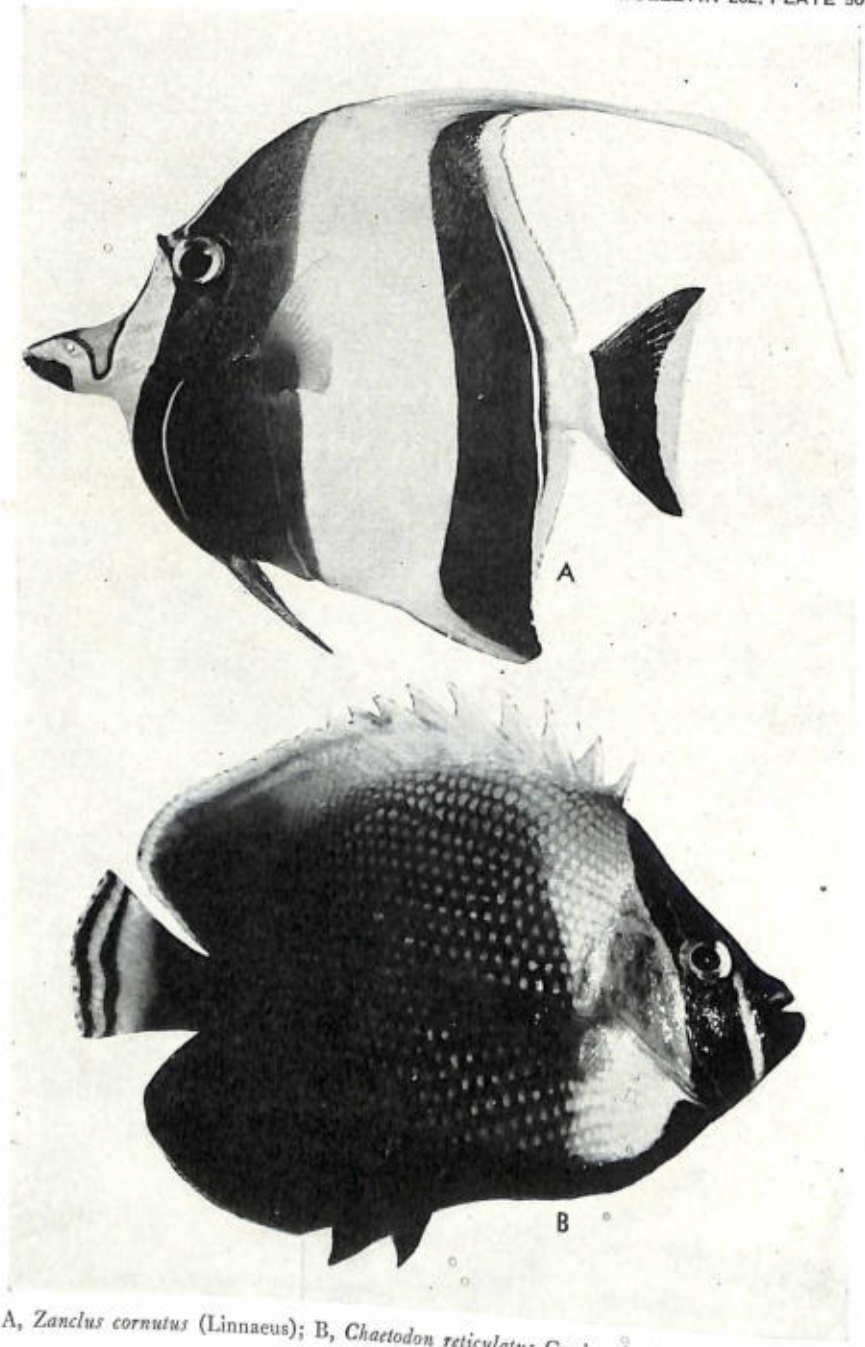
Macolor niger (Forskål), photographs of color drawings from the *Albatross* Philippine collection: A, Adult coloration; B, immature coloration.



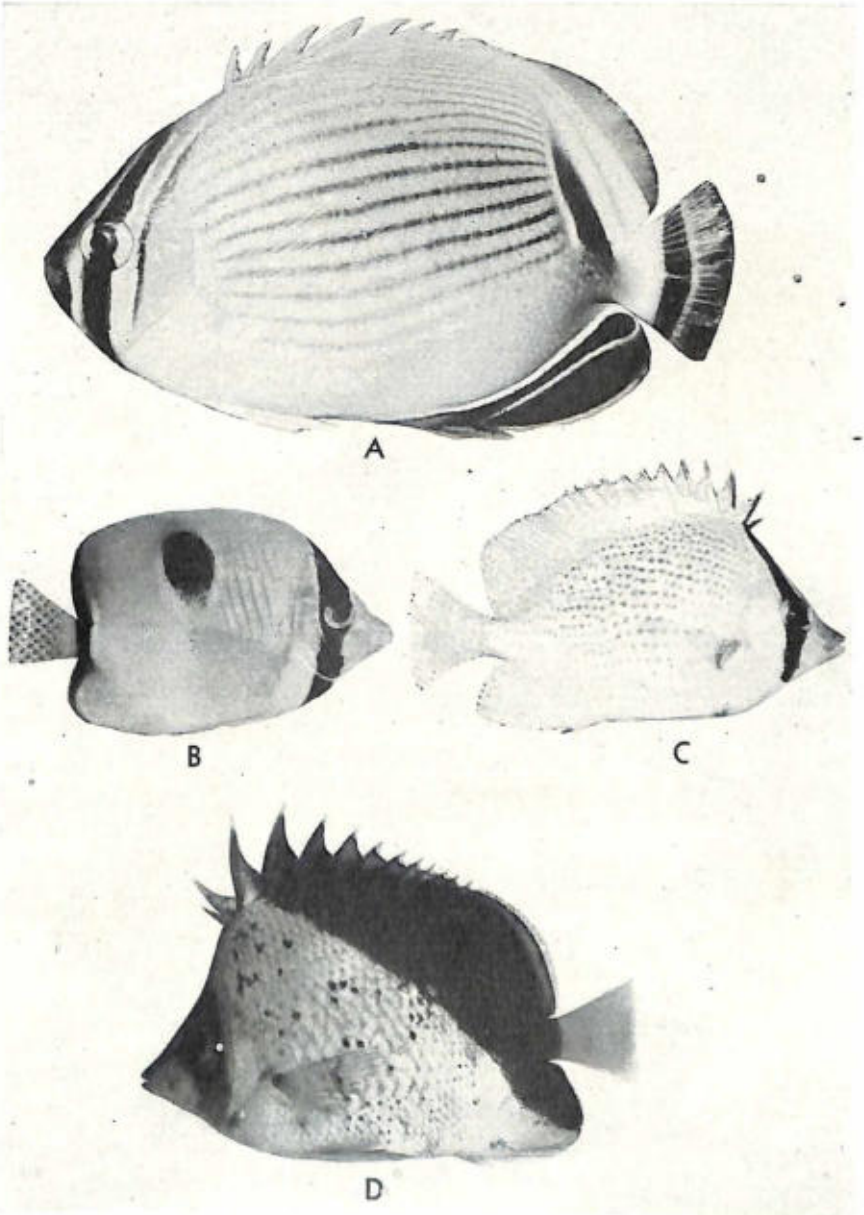
A, *Monotaxis grandoculis* (Forskål); B, *Aphareus furcatus* (Lacepède); C, *Aprion virescens* Cuvier and Valenciennes; all from Bikini Atoll.



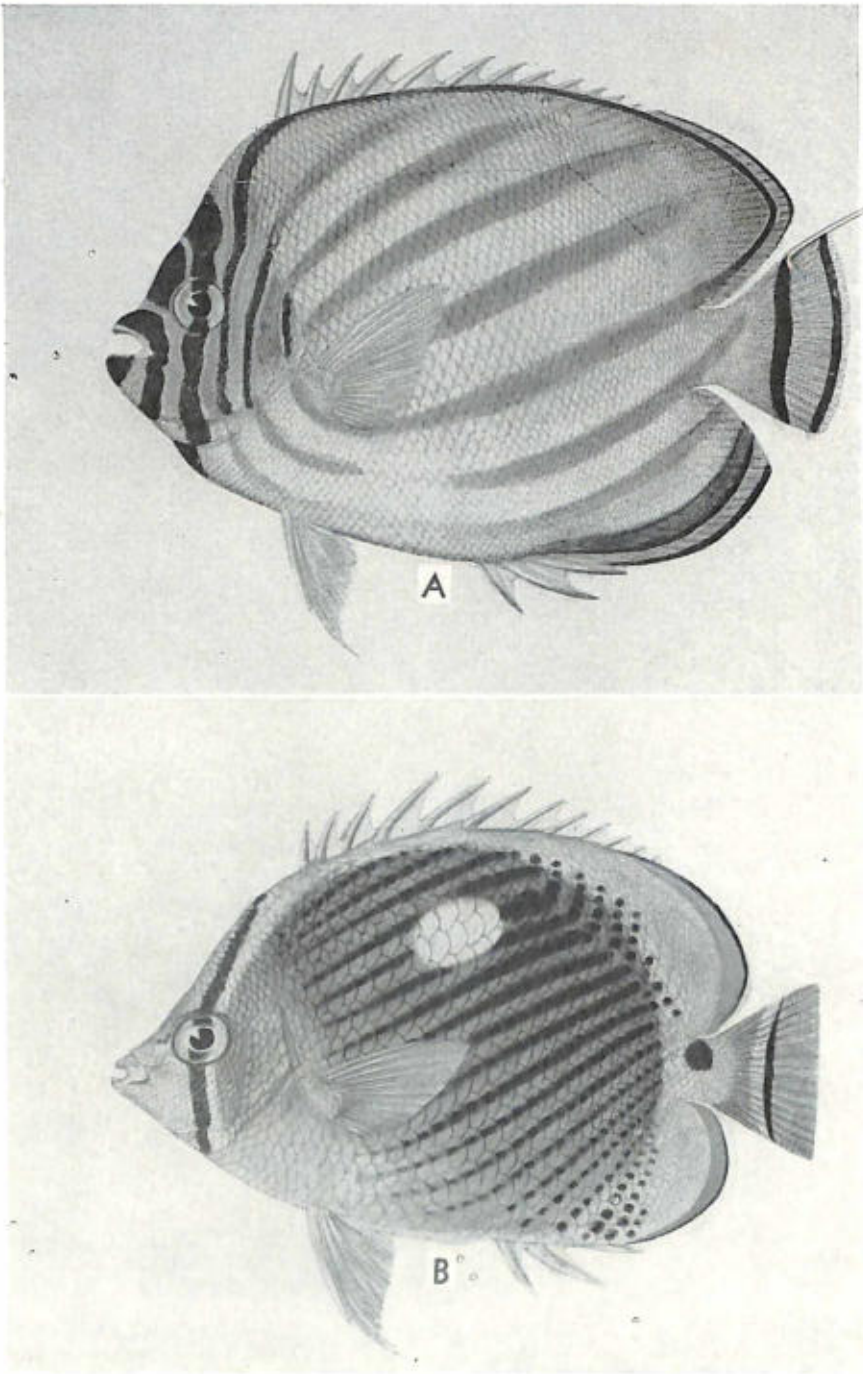
A, *Forcipiger longirostris* (Broussonet), photograph of color drawing from the *Albatross* Philippine collection; B, *Heniochus permutatus* Cuvier, from Bikini Atoll.



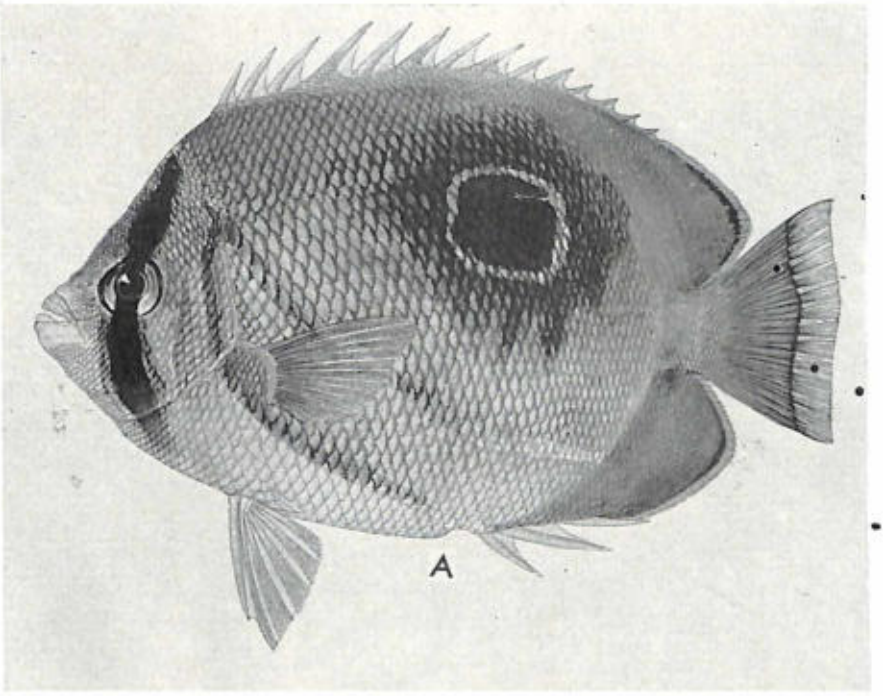
A, *Zanclus cornutus* (Linnaeus); B, *Chaetodon reticulatus* Cuvier; both from Bikini Atoll.

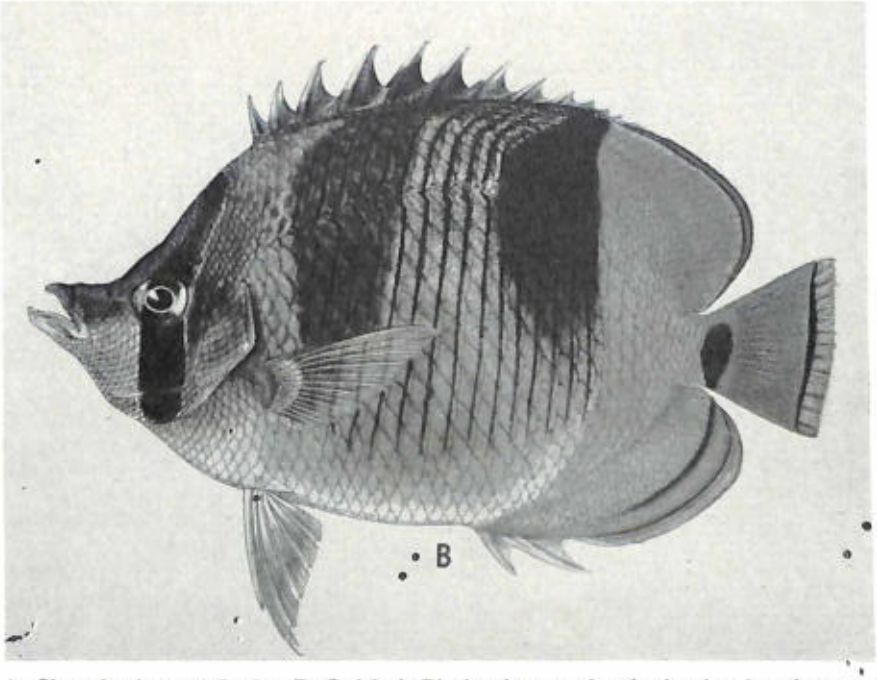


A, *Chaetodon trifasciatus* Mungo Park, from Bikini Atoll; B, *C. unimaculatus* Bloch, from Bikini Atoll; C, *C. citrinellus* Cuvier, from Bikini Atoll; D, *C. tinkeri* Schultz, from Oahu Island; photograph by Spencer Tinker, Waikiki Aquarium.

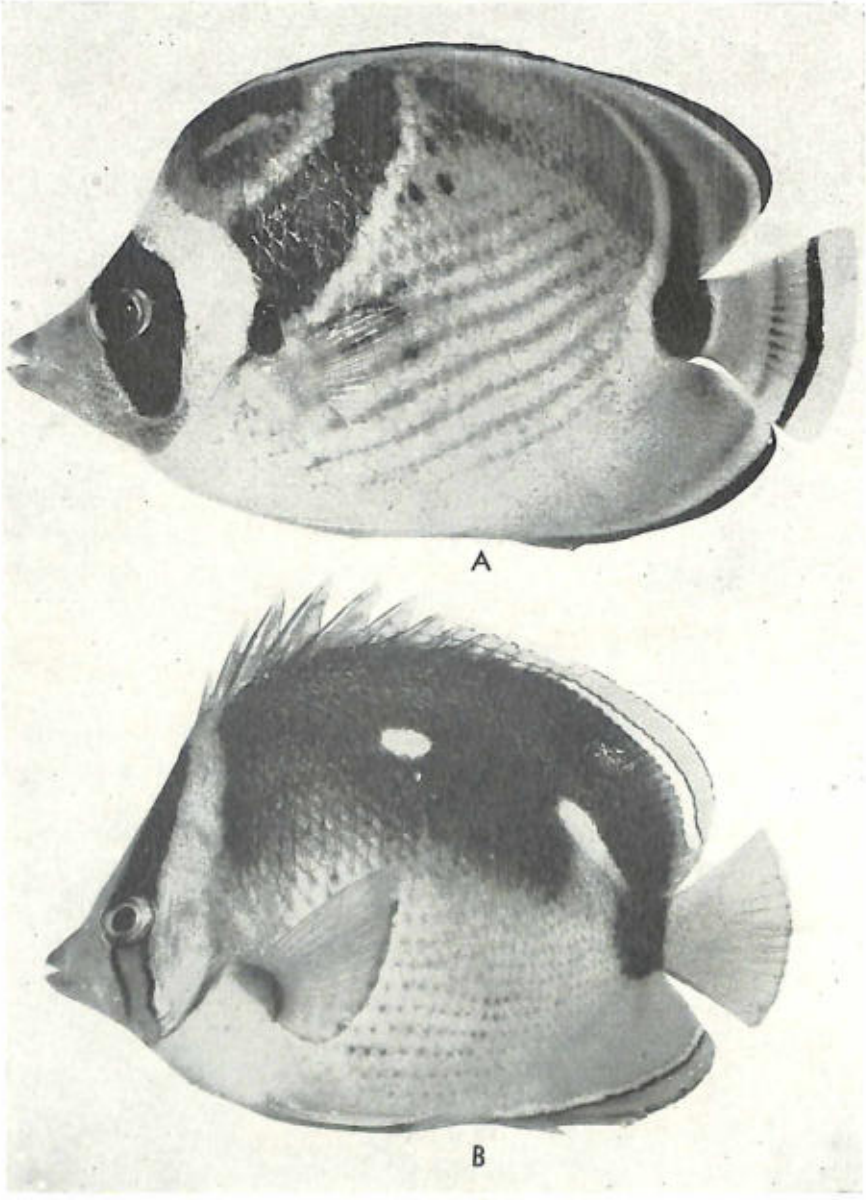


A, *Chaetodon ornatissimus* Cuvier and Valenciennes; B, *C. melannotus* Bloch and Schneider; photographs of color drawings from the *Albatross* Philippine collection.

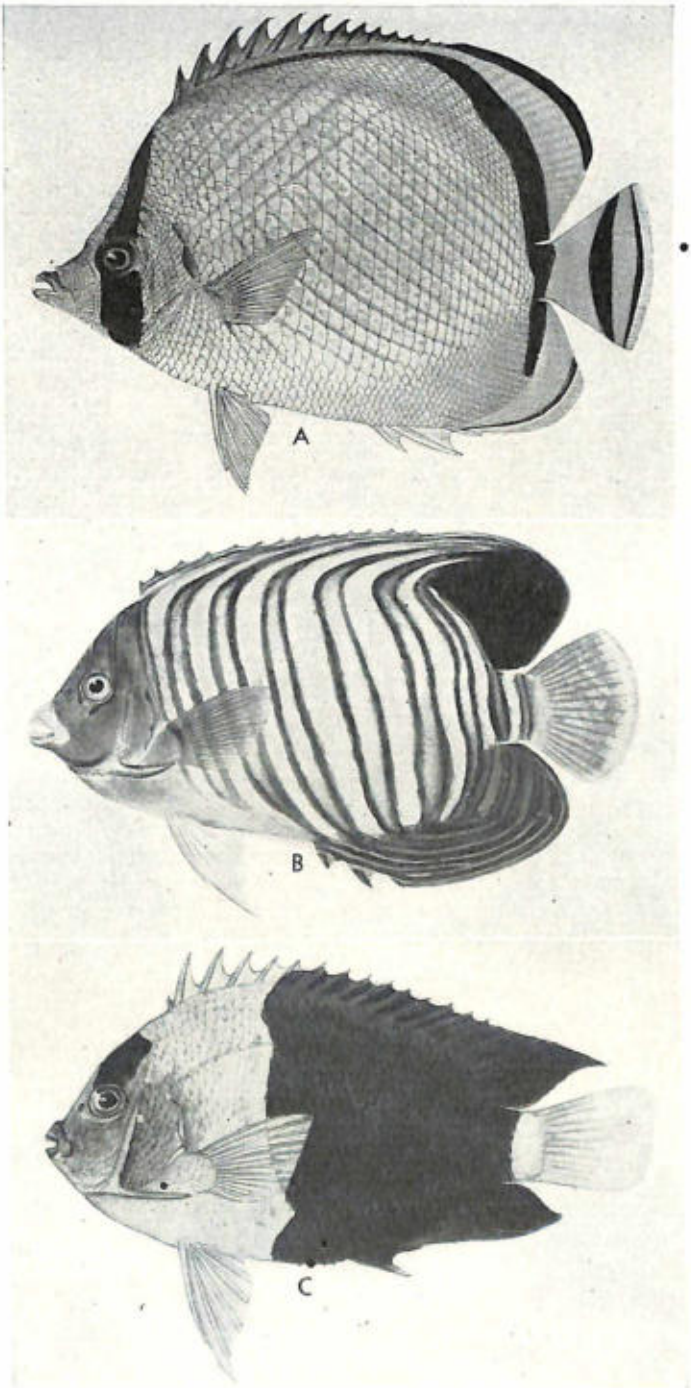




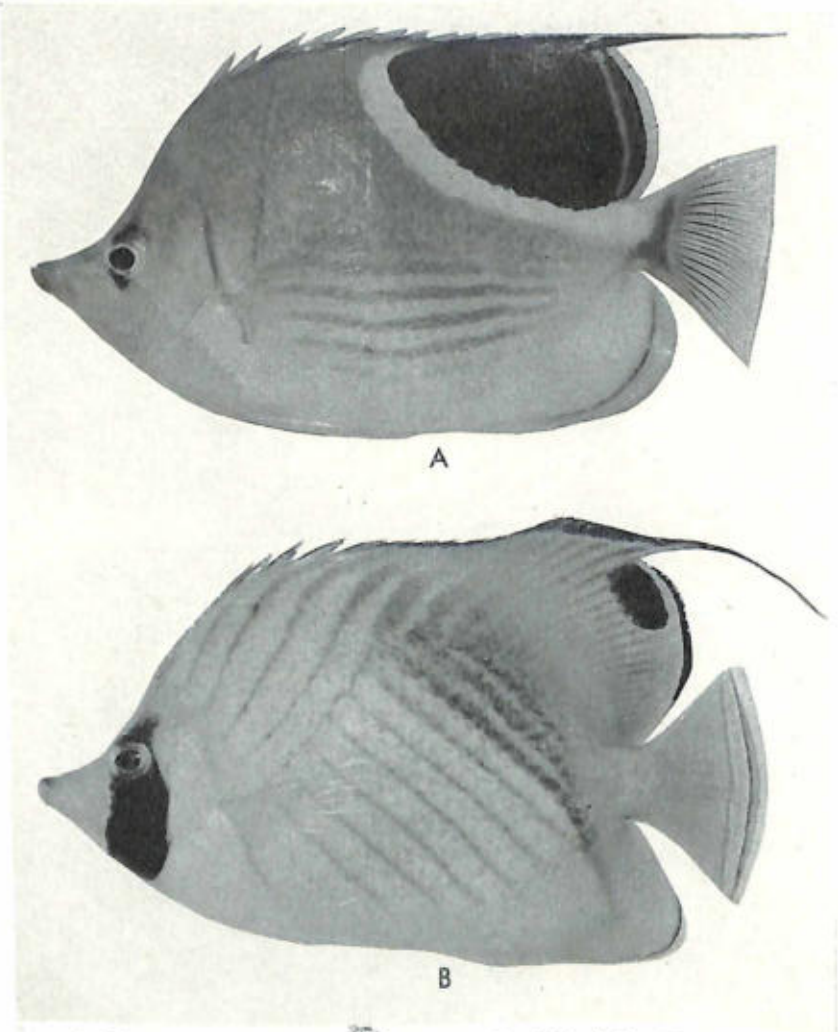
A, *Chaetodon bennetti* Cuvier; B, *C. falcula* Bloch; photographs of color drawings from the *Albatross* Philippine collection.



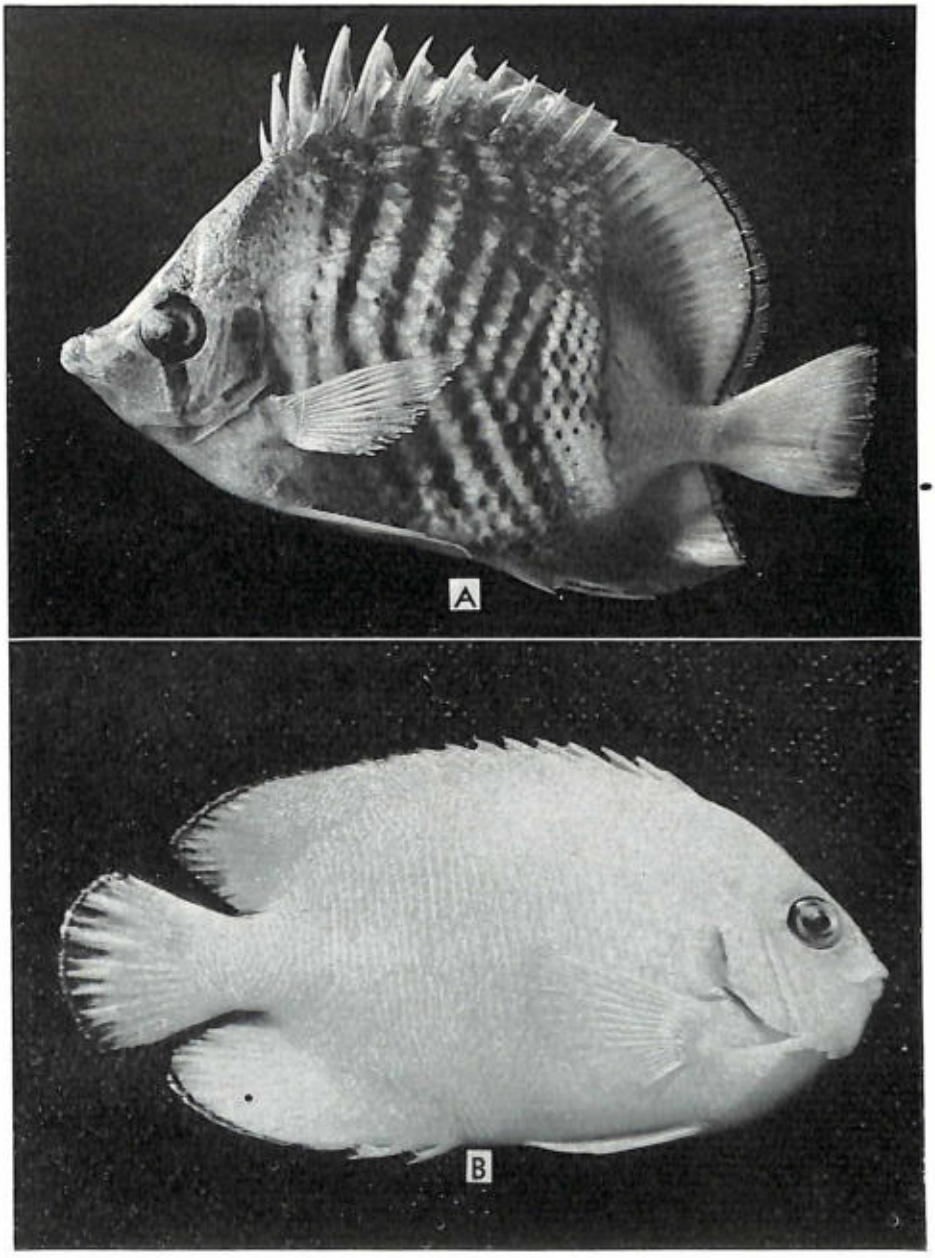
A, *Chaetodon lunula* (Lacepède); B, *C. quadrimaculatus* Gray; both from Bikini Atoll.



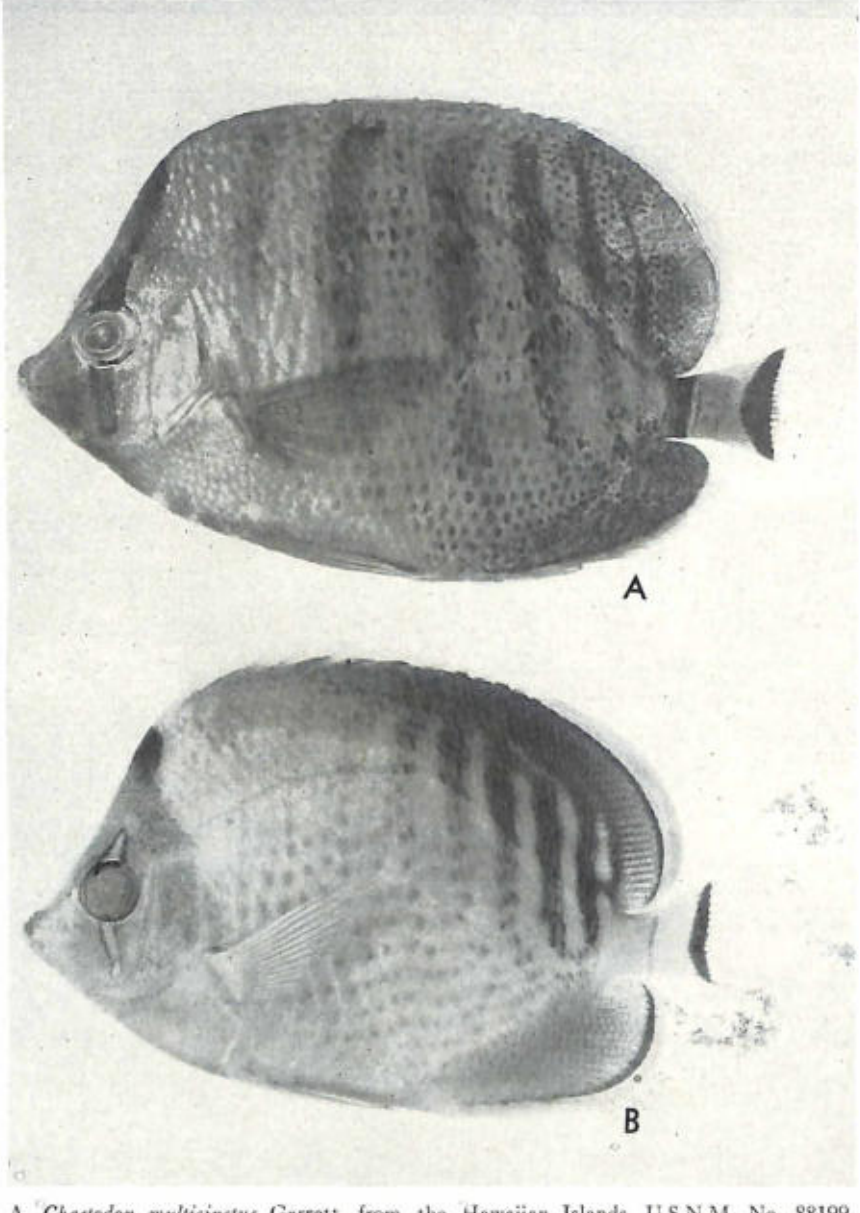
A, *Chaetodon vagabundus* Linnaeus; B, *Pygoplites diacanthus* (Boddaert); C, *Centropyge bicolor* (Bloch); photographs of color drawings from the *Albatross* Philippine collection.



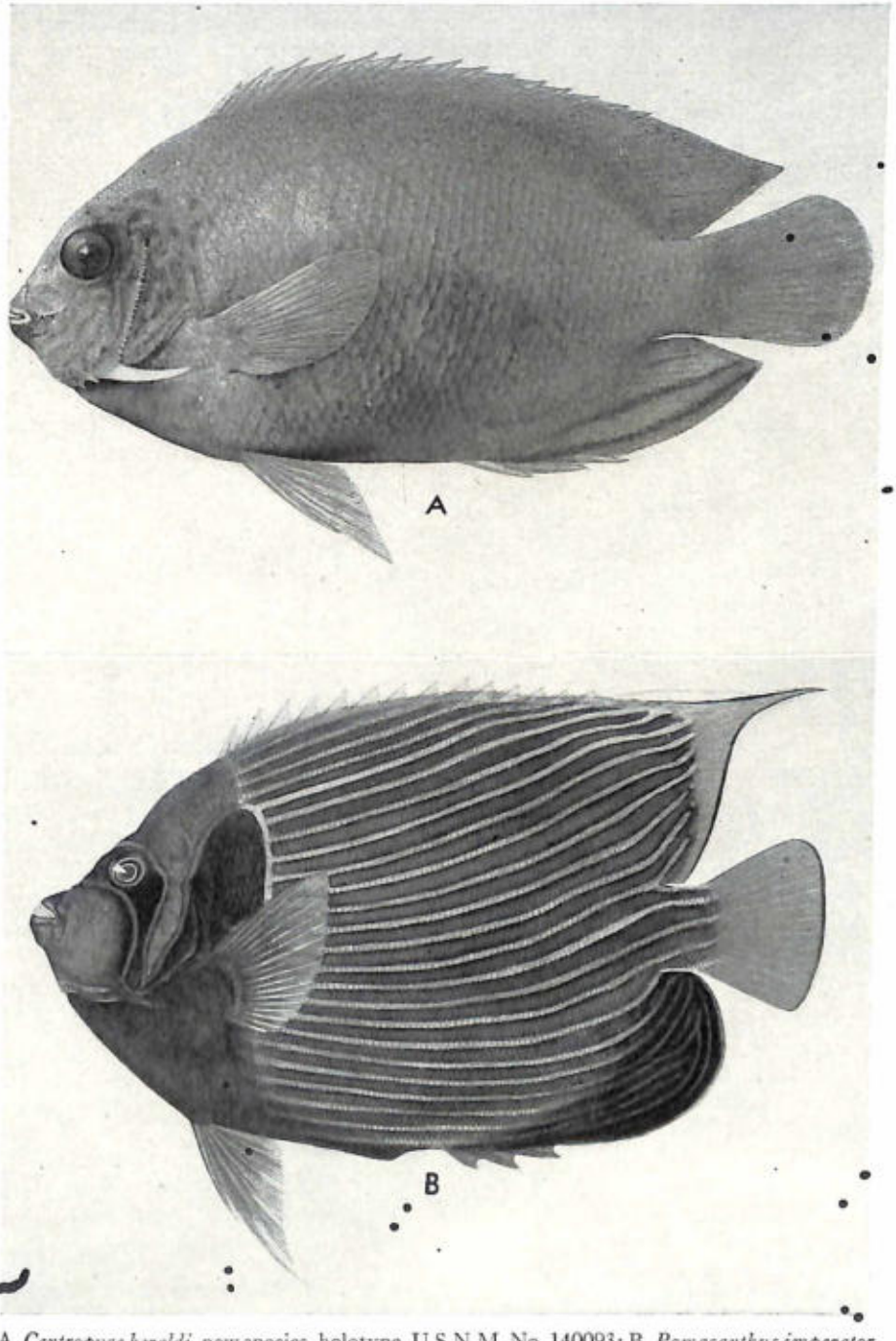
A, *Chaetodon ephippium* Cuvier; B, *C. auriga* Forskål; both from Bikini Atoll.



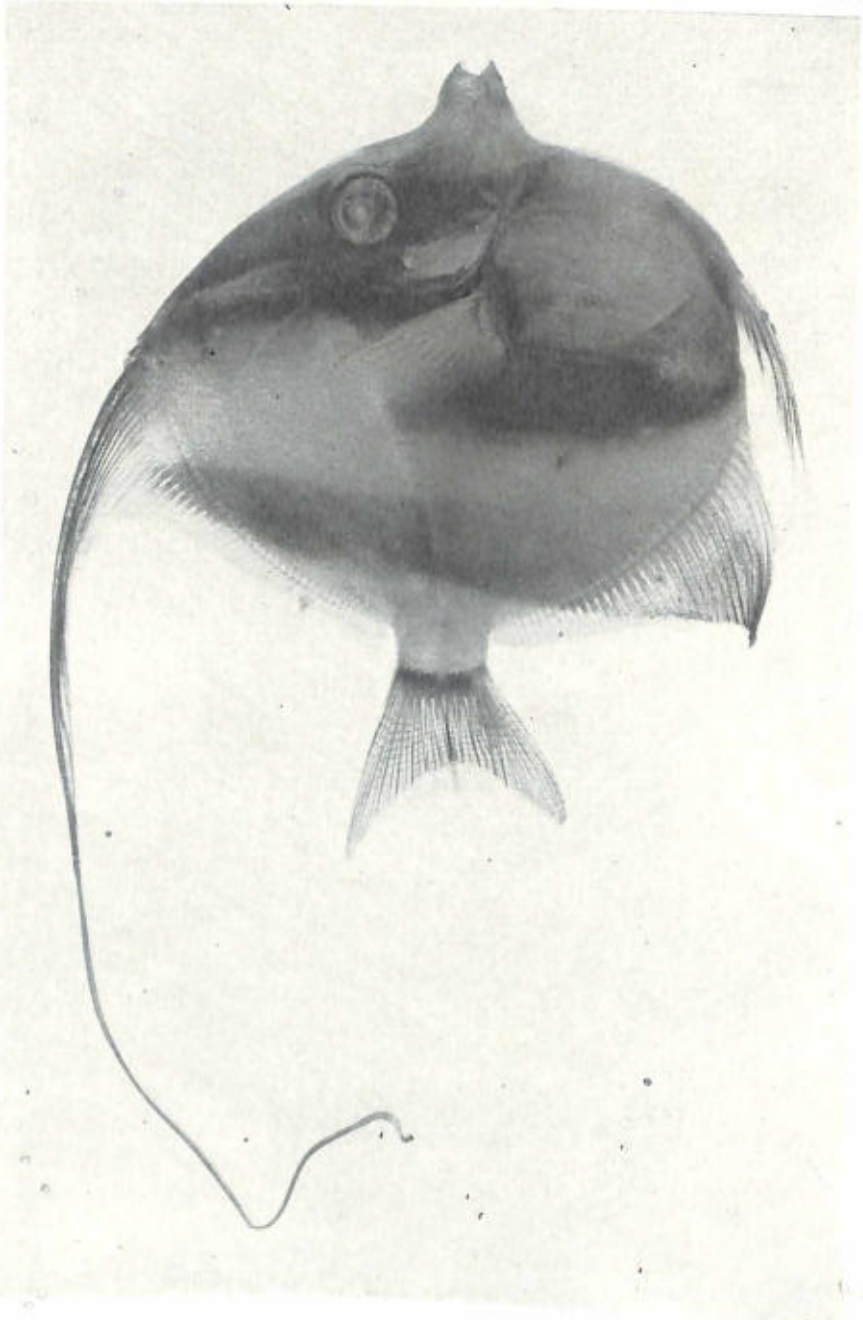
A, *Chaetodon mertensii* Cuvier; B, *Centropyge flavissimus* (Cuvier), U.S.N.M. No. 140105; both from Bikini Atoll.



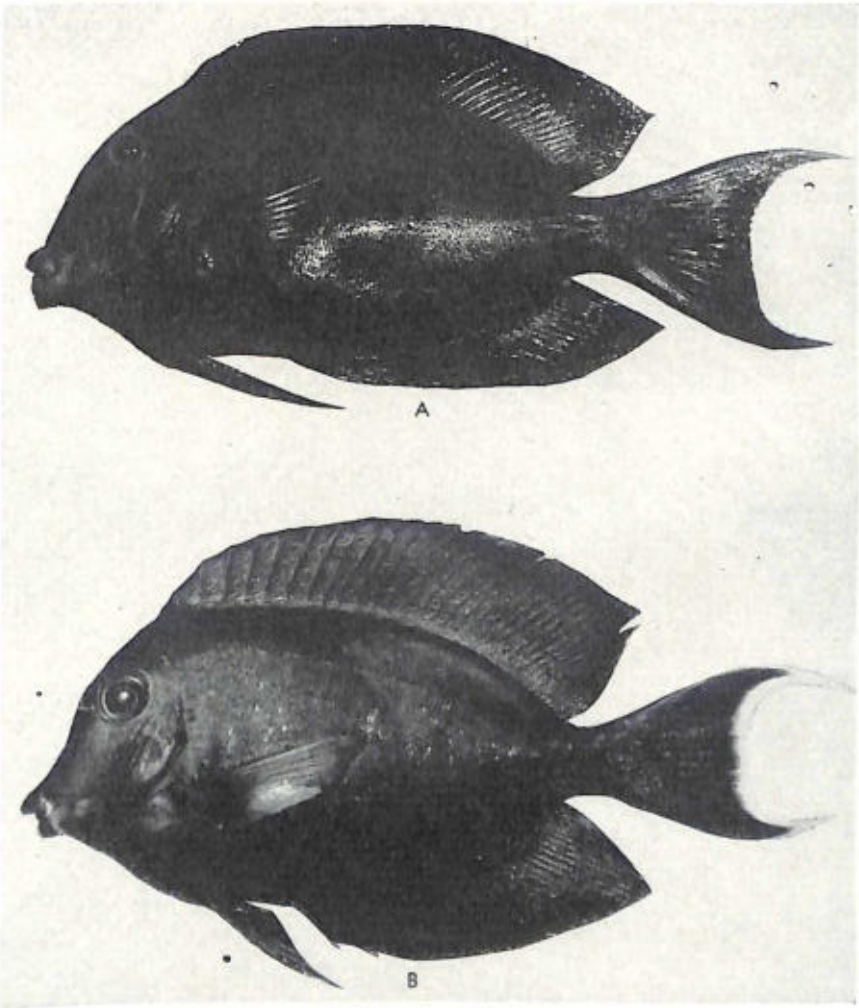
A, *Chaetodon multicinctus* Garrett, from the Hawaiian Islands, U.S.N.M. No. 88199
B, *C. punctato-fasciatus* Cuvier, from Bikini Atoll.



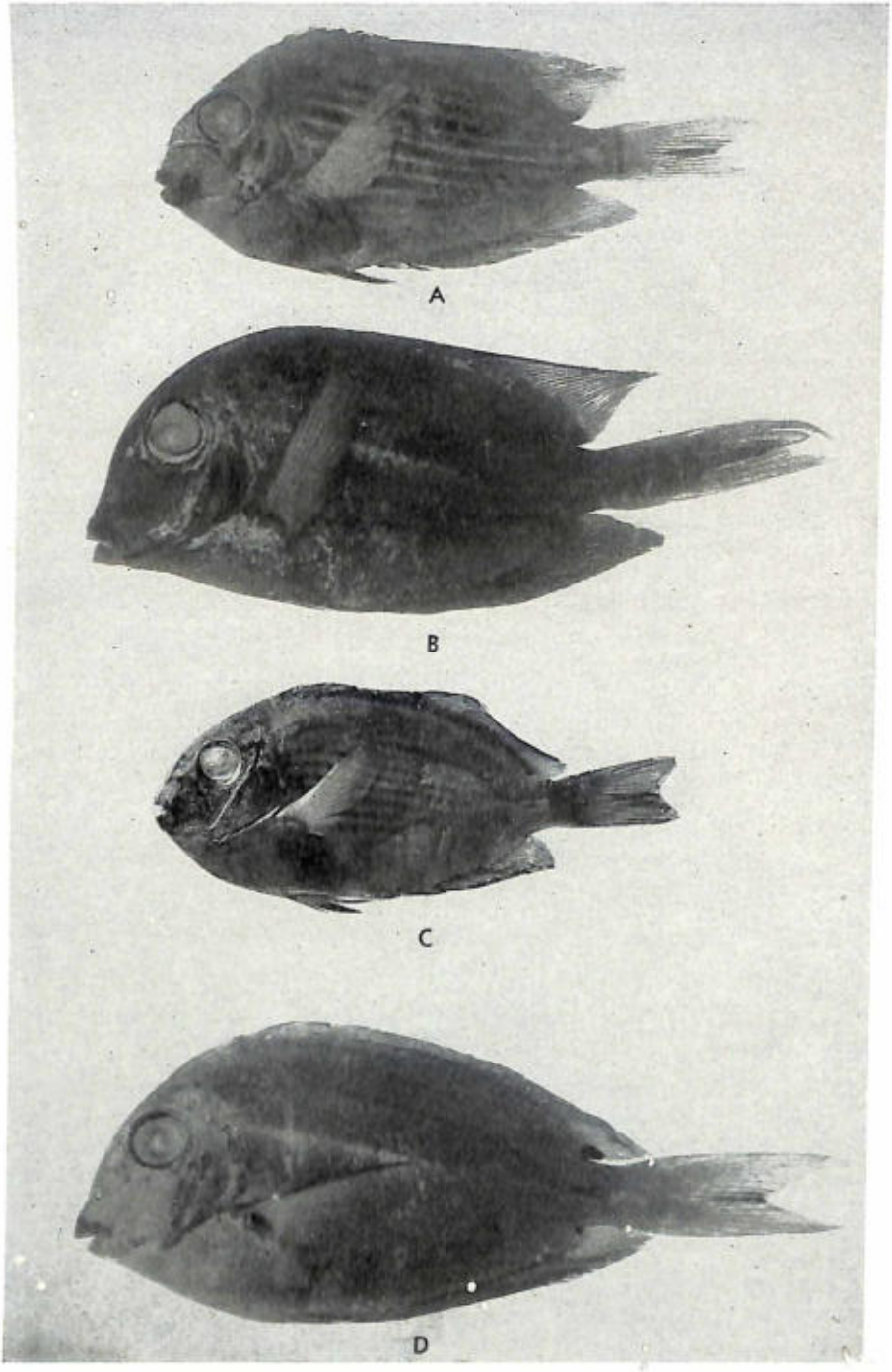
A, *Centropyge heraldi*, new species, holotype, U.S.N.M. No. 140093; B, *Pomacanthus imperator* (Bloch), photograph of color drawing from the *Albatross* Philippine collection.



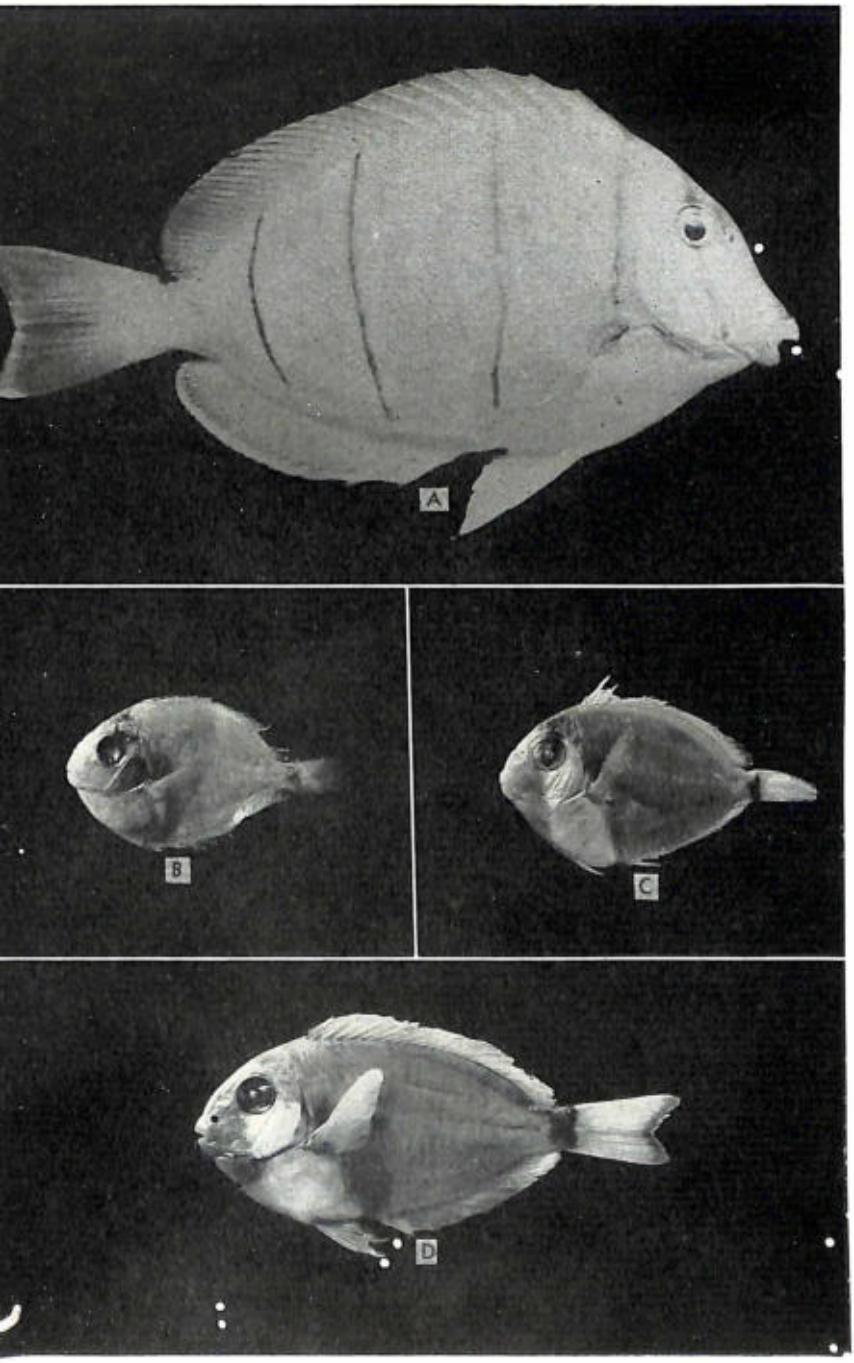
Zanclus canescens (Linnaeus), U.S.N.M. No. 140298 from Bikini Atoll, 63 mm. in standard length.



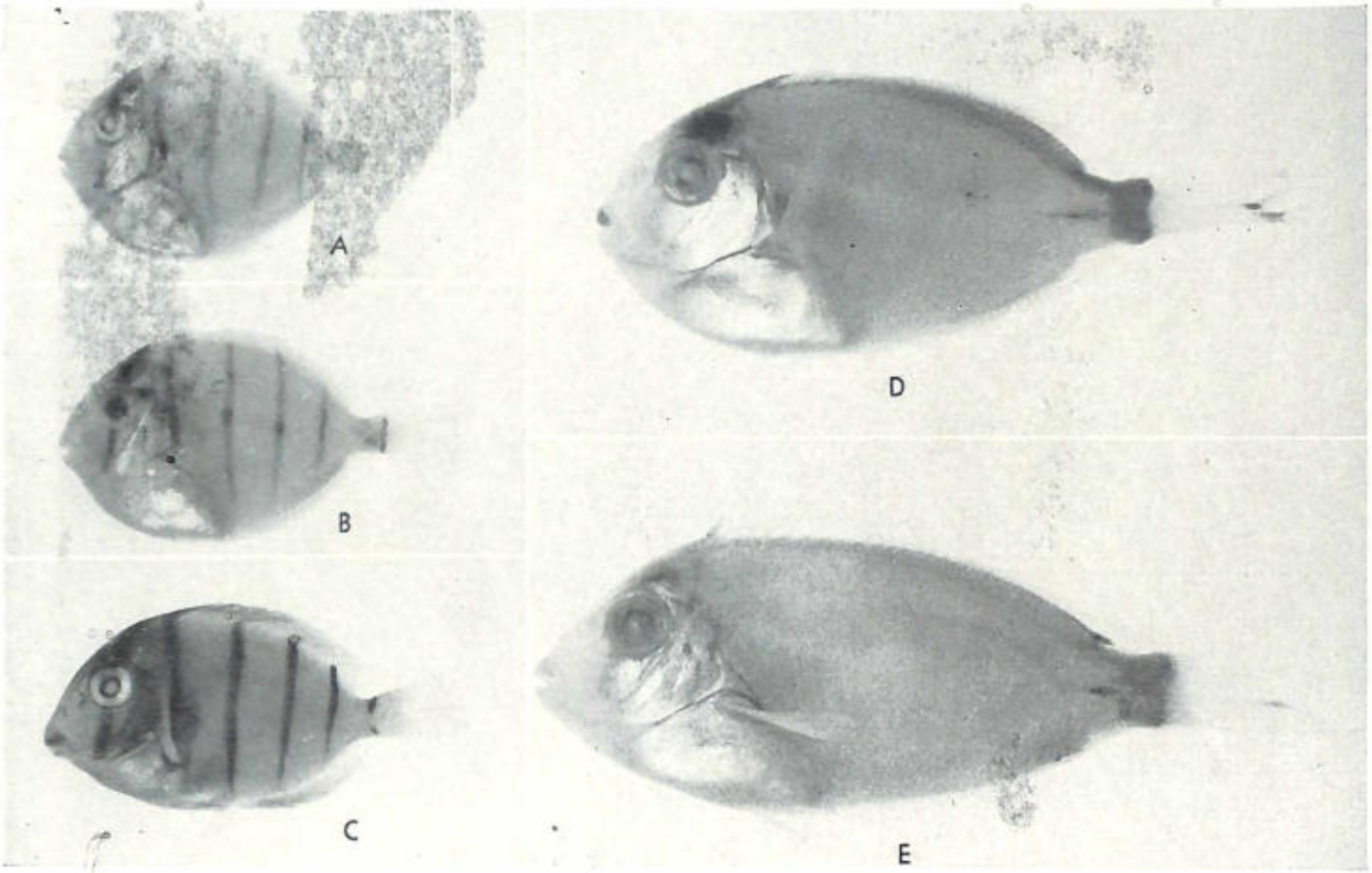
A, *Ctenochaetus striatus* (Quoy and Gaimard), adult; B, *Acanthurus leucosternon* Bennett, adult; both from Bikini Atoll.



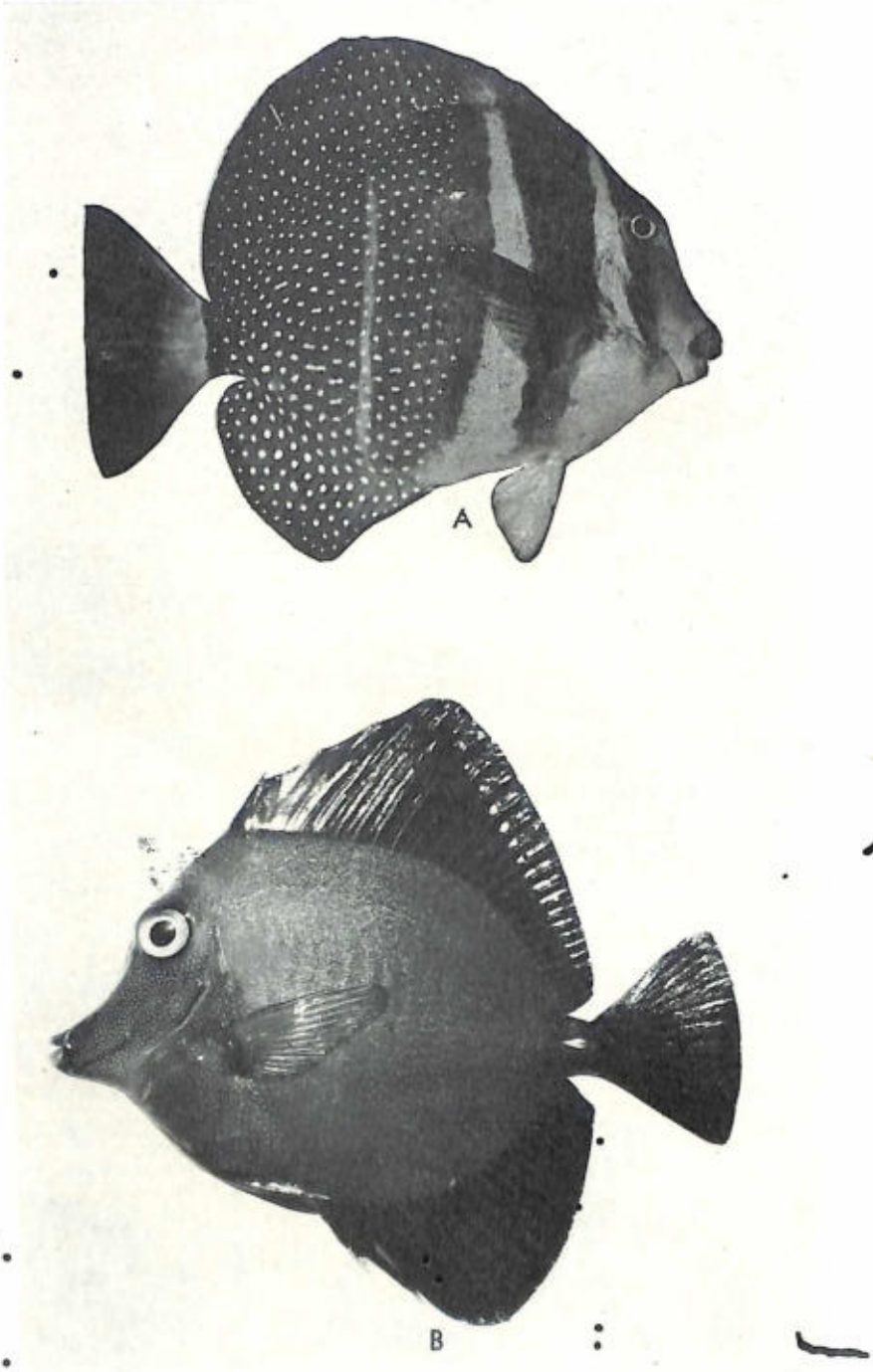
A, 3, Postacronurus stages of *Ctenochaetus striatus* (Quoy and Gaimard), from northern Marshall Islands; C, postacronurus stage of *Acanthurus elongatus* (Lacepède), U.S.N.M. No. 140029, from Eniwetok Atoll; D, immature adult of *A. elongatus* (Lacepède), U.S.N.M. No. 140021, from Bikini Atoll.



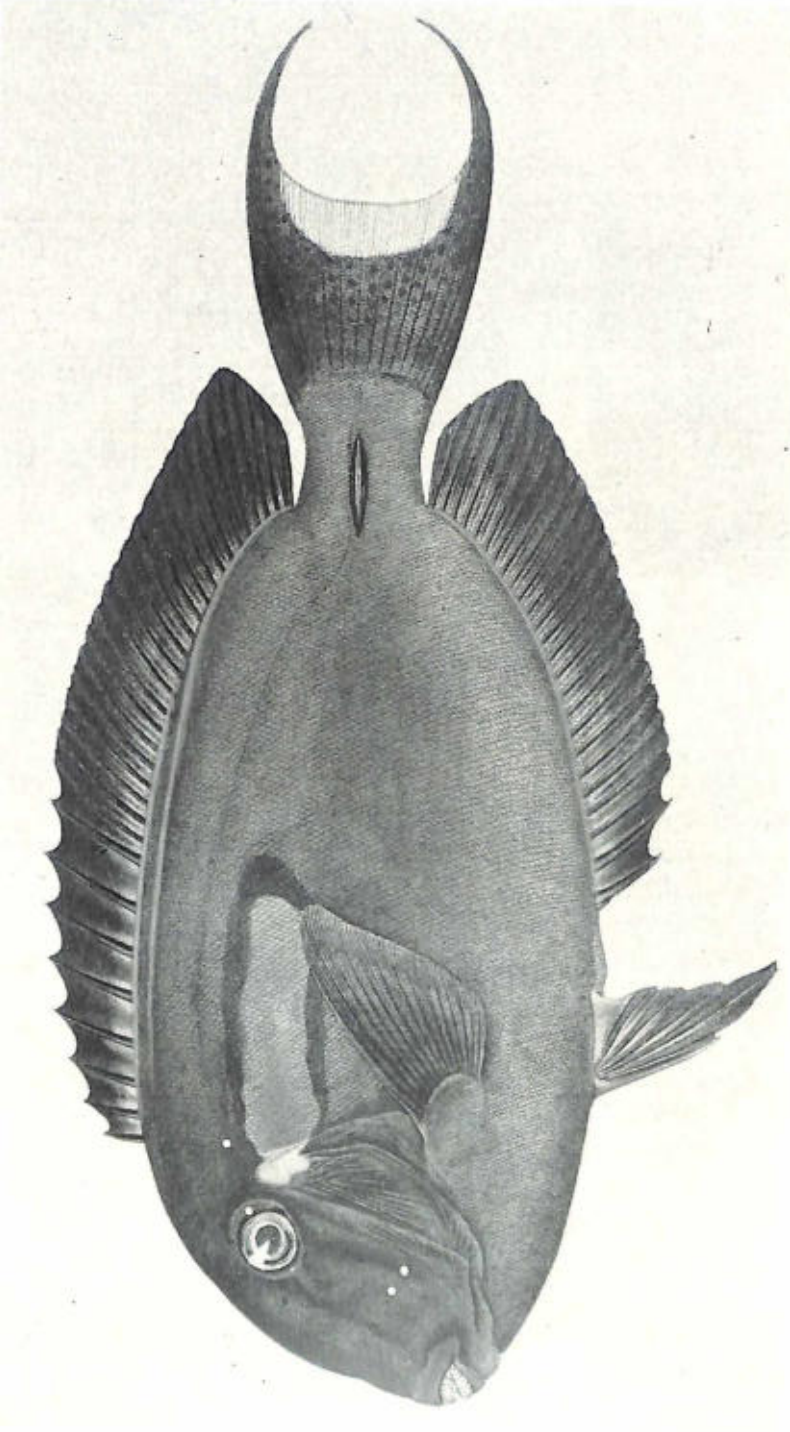
Adult, *Acanthurus triostegus triostegus* (Linnaeus), from Bikini Atoll; B, C, acronurus stages of *A. triostegus triostegus*, U.S.N.M. No. 139760, from Rota Island; D, acronurus stage of *A. elongatus* (Lacepède), from Bikini Atoll.



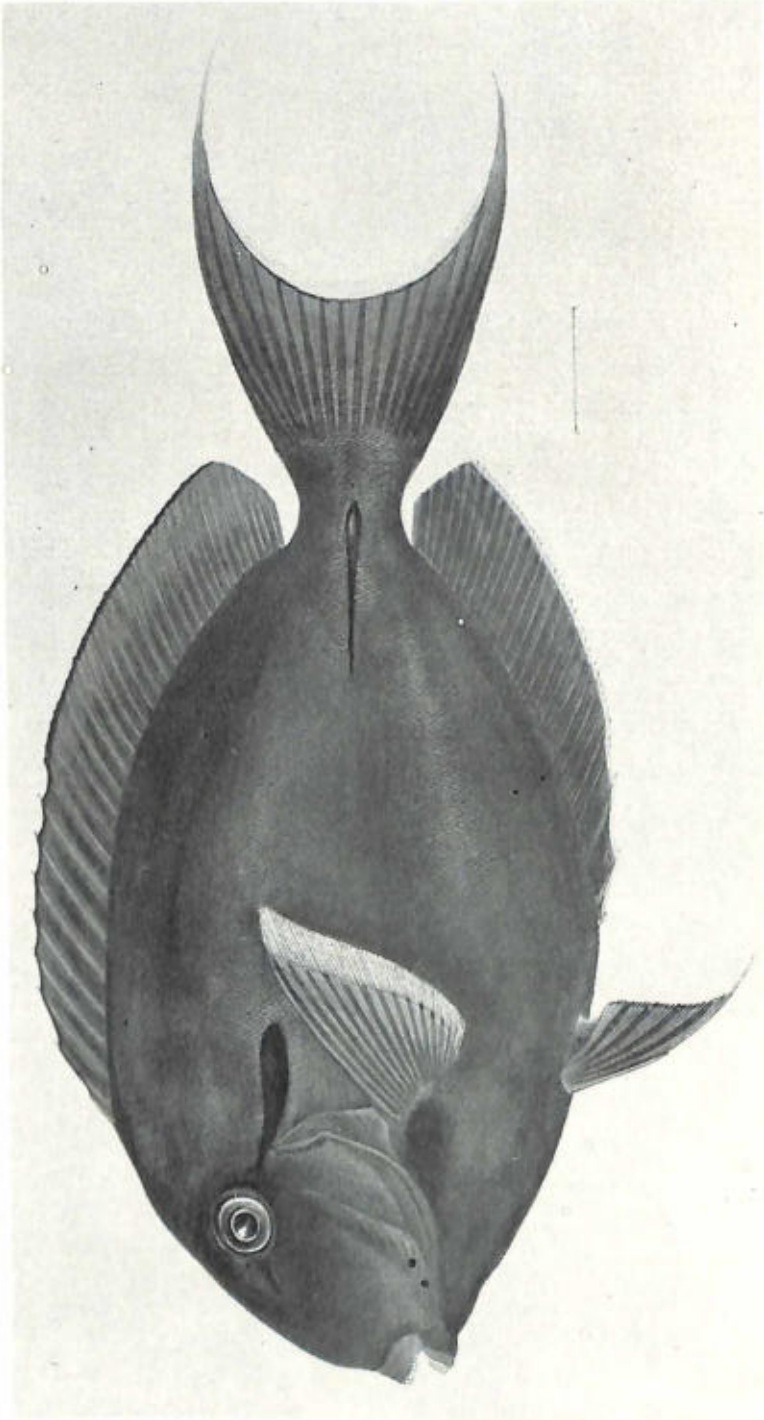
A, B, C, Very young stages of *Acanthurus triostegus triostegus* (Linnaeus), U.S.N.M. No. 139760, from Rota Island; D, E, postacronurus stages of *A. elongatus* (Lacepède), U.S.N.M. No. 140017, from Eniwetok Atoll.



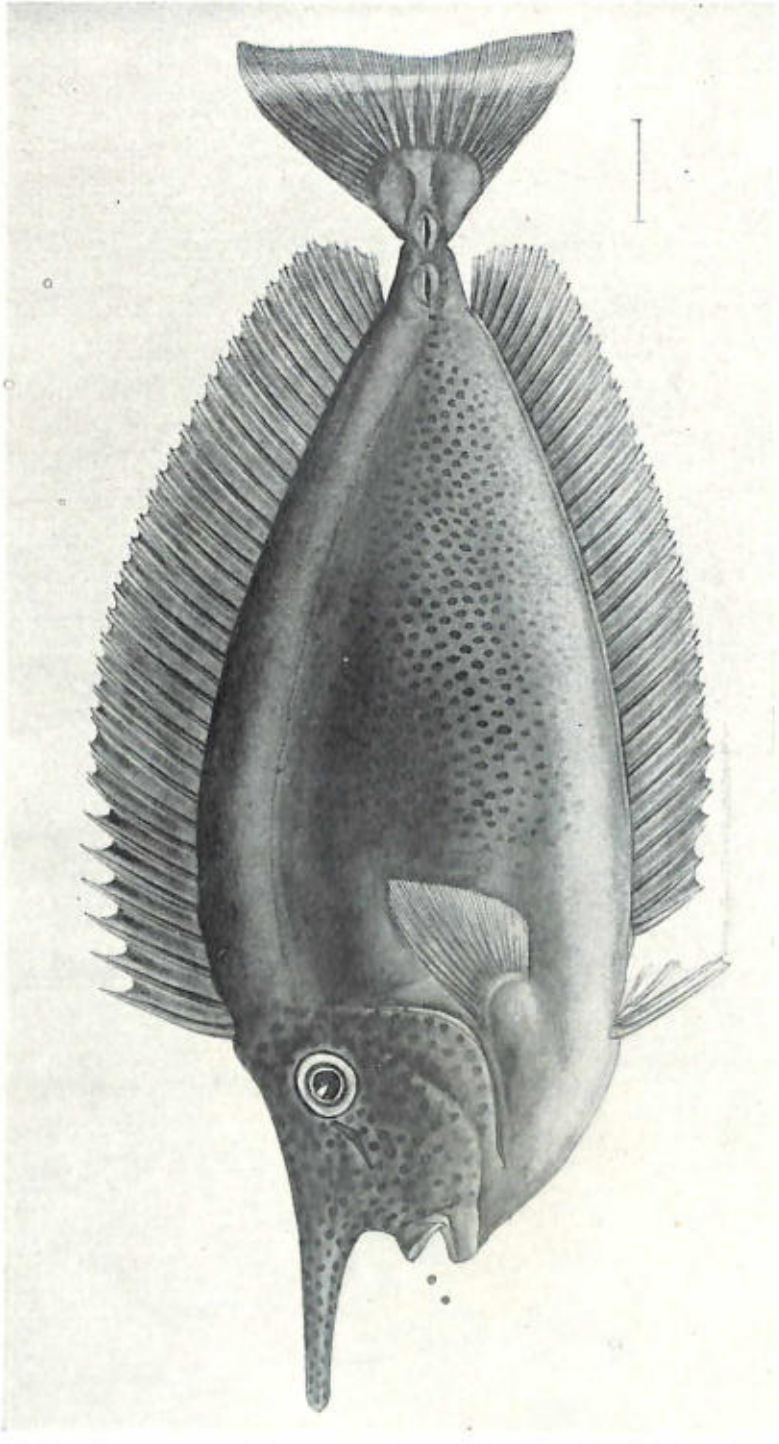
A, *Acanthurus guttatus* Bloch; B, *Zebrasoma flavescens* (Bennett); both from Bikini Atoll.



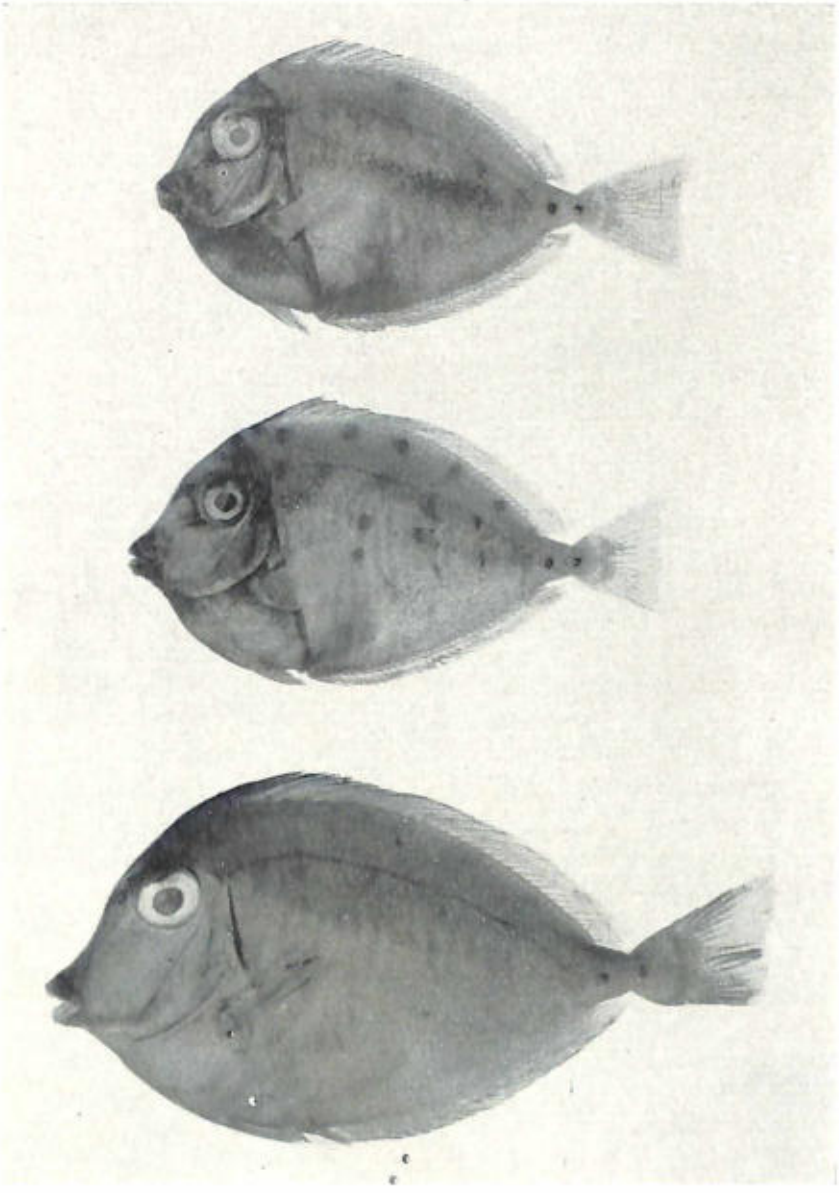
Acanthurus olivaceus Bloch, photograph of a color drawing from the *Albatross* Philippine collection.



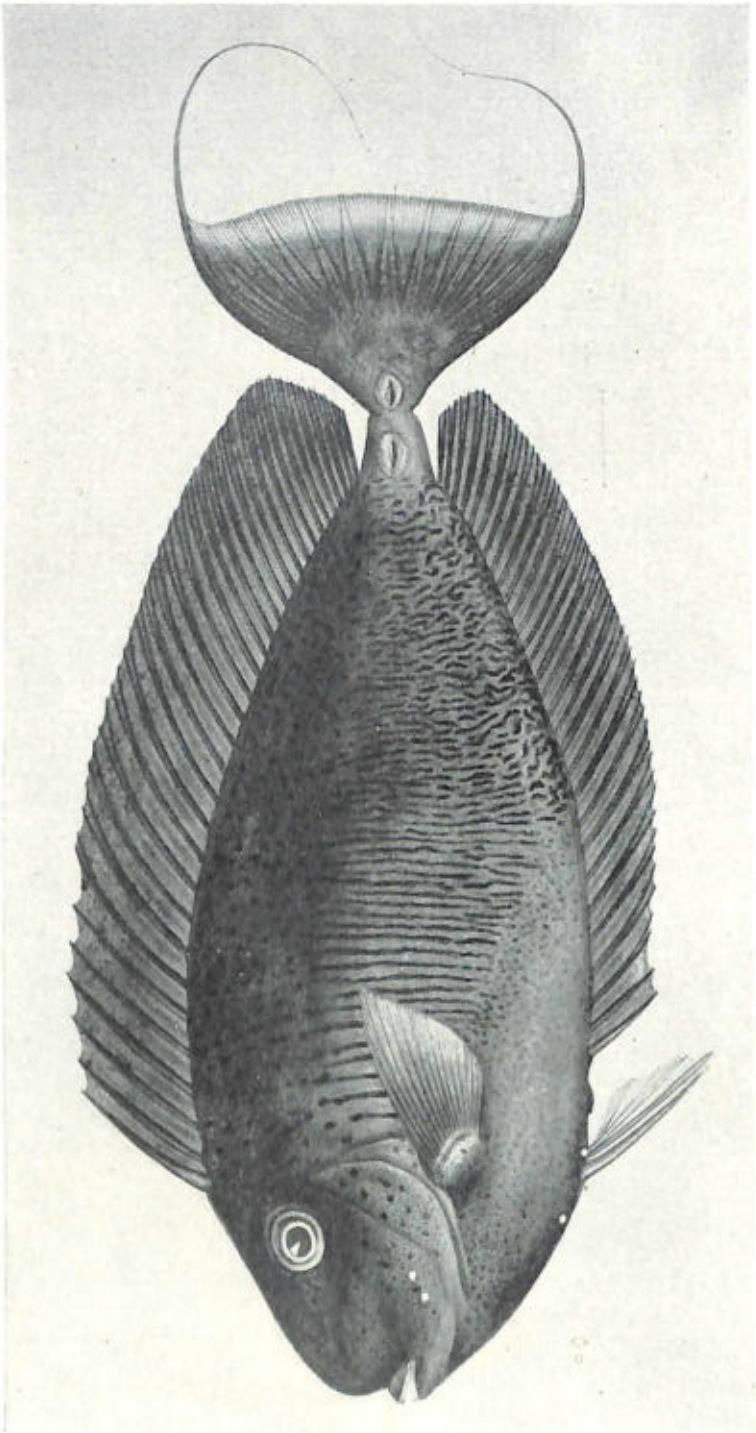
Acanthurus nigricans (Linnaeus), photograph of a color drawing from the *Albatross* Philippine collection.



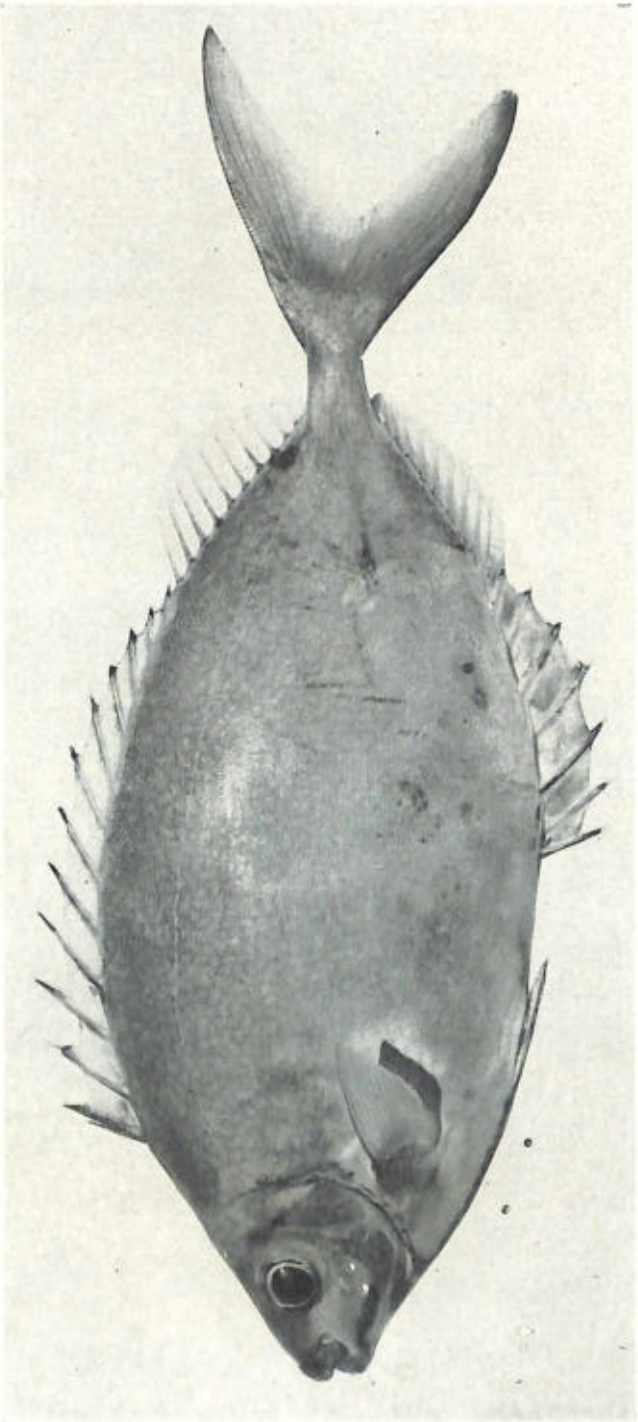
Naso brevirostris (Valenciennes), photograph of a color drawing from the *Albatross* Philippine collection.



Juvenile stages of *Naso unicornis* (Forskål), U.S.N.M. No. 140061, from Kwajalein Atoll.



Naso vlamingi (Valenciennes), photograph of a color drawing from the *Albatross* Philippine collection.



Siganus rostratus (Valenciennes), from Bikini Atoll.

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