

A Revision of the Cardinalfish  
Subgenera *Pristiapogon*  
and *Zoramia* (Genus *Apogon*)  
of the Indo-Pacific Region  
(Teleostei: Apogonidae)

THOMAS H. FRASER  
and  
ERNEST A. LACHNER

## SERIES PUBLICATIONS OF THE SMITHSONIAN INSTITUTION

Emphasis upon publication as a means of "diffusing knowledge" was expressed by the first Secretary of the Smithsonian. In his formal plan for the Institution, Joseph Henry outlined a program that included the following statement: "It is proposed to publish a series of reports, giving an account of the new discoveries in science, and of the changes made from year to year in all branches of knowledge." This theme of basic research has been adhered to through the years by thousands of titles issued in series publications under the Smithsonian imprint, commencing with *Smithsonian Contributions to Knowledge* in 1848 and continuing with the following active series:

*Smithsonian Contributions to Anthropology*  
*Smithsonian Contributions to Astrophysics*  
*Smithsonian Contributions to Botany*  
*Smithsonian Contributions to the Earth Sciences*  
*Smithsonian Contributions to the Marine Sciences*  
*Smithsonian Contributions to Paleobiology*  
*Smithsonian Contributions to Zoology*  
*Smithsonian Folklife Studies*  
*Smithsonian Studies in Air and Space*  
*Smithsonian Studies in History and Technology*

In these series, the Institution publishes small papers and full-scale monographs that report the research and collections of its various museums and bureaux or of professional colleagues in the world of science and scholarship. The publications are distributed by mailing lists to libraries, universities, and similar institutions throughout the world.

Papers or monographs submitted for series publication are received by the Smithsonian Institution Press, subject to its own review for format and style, only through departments of the various Smithsonian museums or bureaux, where the manuscripts are given substantive review. Press requirements for manuscript and art preparation are outlined on the inside back cover.

Robert McC. Adams  
Secretary  
Smithsonian Institution

SMITHSONIAN CONTRIBUTIONS TO ZOOLOGY • NUMBER 412

A Revision of the Cardinalfish  
Subgenera *Pristiapogon* and *Zoramia*  
(Genus *Apogon*)  
of the Indo-Pacific Region  
(Teleostei: Apogonidae)

*Thomas H. Fraser*  
and *Ernest A. Lachner*



SMITHSONIAN INSTITUTION PRESS

City of Washington

1985

## ABSTRACT

Fraser, Thomas H., and Ernest A. Lachner. A Revision of the Cardinalfish Subgenera *Pristiapogon* and *Zoramia* (Genus *Apogon*) of the Indo-Pacific Region (Teleostei: Apogonidae). *Smithsonian Contributions to Zoology*, number 412, 47 pages, 20 figures, 6 tables, 1985.—Characters distinguishing 10 subgenera recognized in the genus *Apogon* of the cardinalfish family Apogonidae by the authors are given in a key. Diagnostic accounts of the two subgenera *Pristiapogon* and *Zoramia* are provided. A key to the six species of the subgenus *Pristiapogon* includes *A. abrogramma*, new species, *A. kallopterus* Bleeker, *A. exostigma* (Jordan and Starks), *A. fraenatus* Valenciennes, *A. mensemus* Jenkins, and *A. taeniopterus* Bennett. The key to the four species of the subgenus *Zoramia* includes *A. leptacanthus* Bleeker, *A. perlitus*, new species, *A. gilberti* (Jordan and Seale), and *A. fragilis* Smith.

Data for important meristic and certain morphological characters are tabulated. All species are illustrated by photographs or drawings. The accounts of the species include primary synonymy, diagnosis, description, geographic distribution, life history data pertaining to oral incubation, discussion of relationships, and material studied.

*Apogon abrogramma* is characterized by having seven first dorsal spines; the preopercular ridge and infraorbital edges serrated; a narrow, dark mid-body stripe from snout to base of caudal fin; no basicaudal spot; and well-developed gillrakers numbering 10–13. *Apogon perlitus* is characterized by having a black alimentary canal; six first dorsal spines; nine soft anal fin rays; a very small basicaudal spot; a dark gular mark; the side of caudal peduncle with a cluster of diffuse melanophores; 4 to 8 short, dark, vertical lines on body just above base of anal fin; and the second dorsal fin is not produced as a filament.

Geographic distributions are plotted on maps for the 10 species comprising the two subgenera. Several species are widespread, extending from the Red Sea or the East African coast to eastern Oceania, whereas other species have more restricted distributions in parts of the Indo-West Pacific region. *Apogon kallopterus* has the most extensive distribution, extending from the Red Sea eastward to the Tuamotu Archipelago, Pitcairn Island, and the Hawaiian islands. *Apogon mensemus* is restricted to the Hawaiian and Johnston islands, whereas *A. perlitus* and *A. gilberti* share similar and limited distributions in the central portion of the study region, in the Philippine Islands, southern Palau Islands and the New Guinea area. Other distributional patterns were observed, such as the occurrence of *A. abrogramma* in the Indian Ocean eastward to the Philippine Islands.

OFFICIAL PUBLICATION DATE is handstamped in a limited number of initial copies and is recorded in the Institution's annual report, *Smithsonian Year*. SERIES COVER DESIGN: The coral *Montastrea cavernosa* (Linnaeus).

---

Library of Congress Cataloging in Publication Data

Fraser, Thomas H.

A revision of the Cardinalfish Subgenera *Pristiapogon* and *Zoramia* (Genus *Apogon*) of the Indo-Pacific Region (Teleostei: Apogonidae).

(Smithsonian contributions to zoology ; no. 412)

Bibliography: p.

Supt. of Docs. no.: SI 1.27:412

I. *Apogon*—Classification. 2. Fishes—Classification. 3. Fishes—Indo-Pacific Region—Classification. I. Lachner, Ernest A. II. Title. III. Series.

QL1.S54 no. 412 [QL638.A7] 591 s [597'.58] 84-600287

# Contents

	<i>Page</i>
Introduction .....	1
Methods and Materials .....	2
Acknowledgments .....	3
<i>Apogon</i> .....	4
Key to the Subgenera of <i>Apogon</i> .....	4
Subgenus <i>Pristiapogon</i> Klunzinger .....	4
Key to the Species of the Subgenus <i>Pristiapogon</i> .....	4
<i>Apogon abrogramma</i> , new species .....	5
<i>Apogon kallopterus</i> Bleeker .....	8
<i>Apogon exostigma</i> (Jordan and Starks) .....	20
<i>Apogon fraenatus</i> Valenciennes .....	24
<i>Apogon menesemus</i> Jenkins .....	28
<i>Apogon taeniopterus</i> Bennett .....	29
Subgenus <i>Zoramia</i> Jordan .....	33
Key to the Species of the Subgenus <i>Zoramia</i> .....	33
<i>Apogon leptacanthus</i> Bleeker .....	34
<i>Apogon perlitus</i> , new species .....	38
<i>Apogon gilberti</i> (Jordan and Seale) .....	40
<i>Apogon fragilis</i> Smith .....	43
Literature Cited .....	47





# A Revision of the Cardinalfish Subgenera *Pristiapogon* and *Zoramia* (Genus *Apogon*) of the Indo-Pacific Region (Teleostei: Apogonidae)

*Thomas H. Fraser*  
and *Ernest A. Lachner*

## Introduction

Revisions of two subgenera in the genus *Apogon* Lacepède are treated in this paper. Both of these groups contain species that are widespread and commonly represented in fish collections. We examined about 17,900 specimens altogether in the 10 species we recognize. The extensive secondary synonymy is to a great degree not to be relied upon by students of *Apogon*, because many species have been confused. We present only the primary synonyms for each species, after reviewing approximately 400 nominal species' descriptions in the family and from examination of nearly all of the extant type material by both of us. Summaries of the species in each subgenus provide the reader with our historical, taxonomic, distributional, and biological notes.

In 1870 Klunzinger recognized three sub-

genera of *Apogon* and named one of them *Pristiapogon*. Since then, authors have treated *Pristiapogon* either as a subgenus of *Apogon* or as a genus; for example, Weber and de Beaufort (1929) and Smith (1961), respectively. Most authors have used the characters mentioned by Klunzinger (1870:715) to distinguish this group of species from other cardinalfishes. An osteological basis for *Pristiapogon* was provided by Fraser (1972), who treated the group as a subgenus of *Apogon*.

We include the following species in *Pristiapogon*: *Apogon fraenatus* Valenciennes, *Apogon exostigma* (Jordan and Starks), *Apogon kallopterus* Bleeker, *Apogon menesemus* Jenkins, *Apogon taeniopterus* Bennett, and *Apogon abrogramma*, new species. All of these species are found only in the Indo-West Pacific region. The difficulty in identifying these species can be summarized by an examination of the synonymy provided by Weber and de Beaufort (1929) for *A. fraenatus* and by J.L.B. Smith's (1961) comments on species he treated. Weber and de Beaufort confused three species as well as listing taxa of doubtful status.

---

*Thomas H. Fraser, Environmental Quality Laboratory, Inc., Industrial Park, 1009 Tamiami Dr., Port Charlotte, FL 33952. Ernest A. Lachner, Department of Vertebrate Zoology, National Museum of Natural History, Smithsonian Institution, Washington, D.C. 20560.*

Smith noted one of the problems that commonly occurs, that of presumed gradation in color patterns.

Once the important aspects of color pattern are understood, all of these species show only minor qualitative changes, even over the vast distance between the Red Sea and the Hawaiian Islands. Such determinations can be made from having abundant material to examine. Most meristic characters are very stable and do not differ among closely related species; for example, *A. menesemus*–*A. taeniopterus* species pair and *A. exostigma*–*A. abrogramma* species pair. These two apparently allopatric pairs differ only in their color patterns (see specific sections on color). Sympatric species may differ not only in color pattern but also in one or more meristic or morphometric characteristics, usually with some overlap in frequency (see tables). These quantitative features are especially valuable when working with faded, preserved material.

The maximum size is variable among the species from about 85 mm SL for *A. fraenatus* to 150 mm SL for *A. taeniopterus*. Several species are known to be oral egg-brooders. This specialized activity has not inhibited the widespread occurrence of *Apogon khallopterus* from the Red Sea to the outer reaches of Oceania (Figure 4). These species treated herein have been collected from various coral reef environments, mostly from tide pools down to about 30 meters depth. We have no evidence that any of these species enters brackish or freshwater as reported by Weber and de Beaufort (1929:297).

In 1917 Jordan proposed a new genus, *Zoramia*, based on *Apogon graeffii* Günther. Only a few authors have used this name other than as a synonym of *Apogon*; for example, Munro (1958:176). The characters provided by Jordan are mostly confined to two species and therefore are not useful at the generic or subgeneric level. Fraser (1972) provided an osteological basis for *Zoramia* and treated the group as a subgenus of *Apogon*.

Although the three species of *Zoramia* that we recognize as valid were clearly described, some disagreement still exists (Hayashi, 1980). We in-

clude the following species in *Zoramia*: *Apogon leptacanthus* Bleeker, *Apogon gilberti* (Jordan and Seale), *Apogon fragilis* Smith, and *Apogon perlitus*, new species. All of these species are found only in the Indo-West Pacific region.

Two species had oral egg masses and a third exhibited buccal enlargement but no eggs. *Apogon leptacanthus*, although widely distributed, does not have so extensive a distribution as *A. khallopterus*. All species of *Zoramia* have been collected from coral reef environments. None of the collection data suggests that these species enter brackish or freshwater.

#### METHODS AND MATERIALS

Our methods of taking and recording meristic data and measurements are given below.

- Standard length. Symphysis of upper jaw to base of hypural plate.
- Body depth. Origin of first dorsal spine to insertion of pelvic spine.
- Head length. Front of symphysis of upper jaw to posterior-most membrane of opercle flap.
- Upper jaw length. Front of symphysis of upper jaw to mid-posterior edge of maxilla.
- Snout length. Front of symphysis of upper jaw to anterior edge of orbit.
- Eye length. Horizontal orbit distance to edge of bony borders.
- Pectoral fin length. From the dorsal anterior base to tip of longest ray.
- Pelvic fin length. From the origin of pelvic fin spine to tip of longest ray.
- Caudal peduncle depth. Least depth in vertical plane.
- Caudal peduncle length. Horizontal distance from end of the base of the anal fin to lower hypural base.
- Spine length. Base of spine to its tip.
- Interorbital width. Least distance between the dorsal bony edges of the eyes.
- Dorsal and anal fin-rays. All elements with the last ray, a double element with a single support, counted as one.
- Pectoral fin-rays. All elements counted with no differentiation between branched and unbranched elements.
- Gillrakers. All elements counted and divided into rudiments and well-developed rakers, the gillraker in the angle included as part of the lower arch count and separate from the upper arch gillrakers. Rudiments are very small, undeveloped structures.
- Lateral-line scales. Pored scales from posttemporal bone to base of hypural plate.



Longitudinal rows of scales above lateral line. Same method as lateral-line count starting with scale in transverse row just above first pored scale.

Transverse scale rows. Rows of scales from origin of first dorsal fin (but not median row) counting downward and backward to but not including lateral line, and rows of scales from anal fin origin counting upward and forward to but not including lateral line.

Pre-dorsal row of scales. Median row of scales on nape from anteriormost one to origin of first dorsal spine, including last scale at spine, which is hardly visible in some specimens.

Circumpeduncular scales. Rows around peduncle at narrow portion divided into those above lateral line, the two lateral line rows and those below the lateral line.

Records and data pertaining to literature reports of species are not included in this study if the specimens were not examined by one of us. Such records have not been plotted on the distribution maps.

**PRESENTATION OF DATA.**—All of the specimens studied are grouped by major geographic areas in the "Material Examined" section for each species. Data referring to type specimens, including those pertaining to synonymies, are identified and treated separately. The data for each lot of type material include the catalog number, total number of specimens (size range in mm standard length, SL), depth of capture, date of collection, and principal collector and field station number. Data referring to non-type specimens have been abbreviated and include the catalog number, total number of specimens (size range), pertinent locality and only the important published station numbers, such as those for the *Albatross-Philippine Expedition*.

Synonymies are based on examination of the original specimens, a diagnostic description, or a published illustration.

All of the localities for each species reported under "Material Examined" are plotted on a map. The symbols on the maps may represent one or more collections taken at different times and one or more specimens.

Oral incubation was checked by examining the mouth cavity of all of the larger specimens. Where we found eggs in the mouth, the size of specimens is listed under the section "Life History."

**ABBREVIATIONS.**—The following acronyms are used to designate institutions and collections cited:

AMNH	American Museum of Natural History, New York
AMS	Australian Museum, Sydney
ANSP	Academy of Natural Sciences, Philadelphia
BMNH	British Museum (Natural History), London
BPBM	Bernice P. Bishop Museum, Honolulu
CAS	California Academy of Sciences, San Francisco; also houses collections formerly at Stanford University (CAS-SU), including the George Vanderbilt Foundation collections (GVF register numbers)
FMNH	Field Museum of Natural History, Chicago.
MCZ	Museum of Comparative Zoology, Harvard University, Cambridge
MNHN	Museum National d'Histoire Naturelle, Paris
NHMW	Naturhistorisches Museum, Wien (Vienna)
QM	Queensland Museum, Brisbane
RMNH	Rijksmuseum van Natuurlijke Historie, Leiden
RUSI	J.L.B. Smith Institute of Ichthyology, Grahamstown, South Africa
SMF	Natur-Museum and Forschungs-Institute Senckenberg, Frankfurt-Am-Main
UG	University of Guam, Mangilao
USNM	collections of the former United States National Museum, deposited in the National Museum of Natural History, Smithsonian Institution, Washington, D.C.
UTAI	Tel Aviv University, Israel
YCM	Yokosuka City Museum, Yokosuka, Kanagawa, Japan
ZMA	Zoologisch Museum, Amsterdam

#### ACKNOWLEDGMENTS

For the loan of material and the use of museum facilities we extend our thanks to many of our colleagues over the past decade. We especially recognize the following individuals: William F. Smith-Vaniz and the late James E. Böhlke (ANSP), Karel F. Liem and M.M. Dick (MCZ), William N. Eschmeyer and Tomio Iwamoto (CAS), Robert K. Johnson (FMNH), John E. Randall (BPBM), M. Boeseman (RMNH), P.J.P. Whitehead (BMNH), M.M. Smith (RUSI), Donn E. Rosen (AMNH), John R. Paxton (AMS), M.L. Bauchot (MNHM), Leslie W. Knapp (SOSC, Smithsonian Institution), Gerald R. Allen (WAM), E. Bertelsen, Marinbiologisk Lab., Den-

mark, W. Klausewitz (SMF), R.J. McKay (QM), Reeve M. Bailey University of Michigan Museum of Zoology, Lev Fishelson (UTAI), Harry T. Kami, Division of Fish and Wildlife, Guam, and Richard C. Wass, U.S. Fish and Wildlife Service, Honolulu. Janet C. Gomon and Susan L. Jewett,

Smithsonian Institution, aided in curatorial processes.

The first author was supported by a Smithsonian post-doctoral fellowship for part of this study. TFH funds were provided by Victor G. Springer for several study trips to the Smithsonian.

### *Apogon*

#### Key to the Subgenera of *Apogon*

1. Pored lateral-line scales incomplete, only pits present past second dorsal fin . . . . . *Brephamia* Jordan, 1922  
Pored lateral-line scales complete to base of caudal fin . . . . . 2
2. Supramaxilla large, easy to detect . . . . . *Yarica* Whitley, 1930  
Supramaxilla absent . . . . . 3
3. Some teeth enlarged as canines . . . . . *Paroncheilus* Smith, 1963  
No canine teeth . . . . . 4
4. Pored lateral-line scales 35–37 . . . . . *Lepidamia* Gill, 1863  
Pored lateral-line scales 22–27 . . . . . 5
5. Scales in rows above lateral-line scales much smaller than lateral-line scales, more than 35; alimentary canal black . . . *Zapogon* Fraser, 1972  
Scales in rows above lateral-line scales about same size as lateral-line scales; if scales smaller, alimentary canal pale . . . . . 6
6. Preopercular ridge and some infraorbital edges serrated . . . . . 7  
Preopercular ridge and infraorbital edges smooth . . . . . 8
7. Seven visible first dorsal spines . . . . . *Pristiapogon* Klunzinger, 1870  
Six visible first dorsal spines . . . . . *Pristicon* Fraser, 1972
8. Alimentary canal pale; six visible first dorsal spines . . . . .  
. . . . . *Apogon* Lacepède, 1802  
Alimentary canal black . . . . . 9
9. Usually eight soft anal rays, if nine then black body stripes or seven visible dorsal spines . . . . . *Nectamia* Jordan, 1917  
Nine soft anal rays; six visible first dorsal spines; no black stripes . . . . . *Zoramia* Jordan, 1917

#### Subgenus *Pristiapogon* Klunzinger

*Pristiapogon* Klunzinger, 1879:715 [type-species: *Apogon fraenatus* Valenciennes, 1832, by monotypy as a subgenus of *Apogon*].

DIAGNOSIS.—Seven spines in the first dorsal fin; paired uroneurals absent; infraorbitals with the upper edge serrated; preopercular ridge serrated; posterior and ventral edges of preopercle serrated; gillrakers 17–23; palatine teeth in one row or absent; pale stomach and intestine.

#### Key to the Species of the Subgenus *Pristiapogon*

1. Well-developed gillrakers 10–13 . . . . . 2  
Well-developed gillrakers 16–19 . . . . . 5

- 2. No spot at base of caudal fin . . . . . *Apogon abrogramma*, new species  
 Large or small spot present on caudal peduncle near base of caudal fin  
 . . . . . 3
- 3. Body depth usually 34%–39% SL; circumpeduncular scales usually 14;  
 stripe same width posteriorly; spot diffuse in adults . . . . .  
 . . . . . *Apogon kallopterus*  
 Body depth usually 29%–34% SL; circumpeduncular scales usually 12;  
 stripe decreases in width posteriorly; spot well defined in adults . . . . 4
- 4. Caudal spot always above midsection of pored lateral-line scales; pectoral  
 rays usually 13 . . . . . *Apogon exostigma*  
 Caudal spot located centrally on pored lateral-line scales; pectoral rays  
 usually 14 . . . . . *Apogon fraenatus*
- 5. Vertical dark bar in caudal fin complete in adults . . . *Apogon mensemus*  
 Vertical dark bar incomplete, absent or interrupted in central part of  
 caudal fin . . . . . *Apogon taeniopterus*

***Apogon abrogramma*, new species**

FIGURES 1, 2

DIAGNOSIS.—A species of the subgenus *Pristiapogon* with a narrow, dark midbody stripe from snout to base of caudal fin, no basicaudal spot, 11–13 well-developed gillrakers.

DESCRIPTION.—Important morphometric and meristic characters are treated in Tables 1–3. For general shape and pigment pattern see Figure 1. Proportions (as percent standard length with holotype in parentheses): body depth (33.8) 30–35; head length (38.3) 38–42; eye length (11.4) 11–14; snout length (11.2) 9–12; bony interorbital width (5.9) 5–7; upper jaw length (15.8) 14–19; caudal peduncle depth (16.4) 14–16; caudal peduncle length (26.7) 22–27; dorsal spine lengths—first (2.5) 2–3, second (8.9) 8–11, third (20.0) 15–20, fourth (19.1) 16–20, spine in second dorsal (14.4) 12–14; anal spine lengths—first (2.0) 2, second (13.6) 11–14; pectoral fin length (23.7) 21–25; pelvic fin length (23.3) 21–23.

Second dorsal fin I,9; 2 anal spines; pectoral fin usually 13 (rarely 14); pelvic fin I,5; well-developed gillrakers 11–13 (2 upper rakers + 9 to 11 lower rakers), including rudiments 17–19 (2 to 3 rudiments + 2 rakers on upper arch; 9 to 11 rakers + 3 to 6 rudiments on lower arch), holotype 2 + 2 – 10 + 4; pored lateral-line scales

23–25; transverse scale rows above the lateral line 2; median predorsal scales 4–5; circumpeduncular scales 12 (5 + 2 + 5).

COLOR OF PRESERVED SPECIMENS.—The characteristic color pattern consists of a dark, horizontal midlateral body stripe extending from tip of snout to mid-base of caudal fin. This strip widest and darkest behind eye, its width about one-half diameter of eye, gradually narrowing to a thin streak on mid-caudal peduncle, usually ending at caudal fin base. Stripe may extend onto middle portion of caudal fin, but weakly developed with some dark chromatophores, or obscure. Stripe on snout less intense than on trunk and about equal in width to stripe on middle of trunk. Stripe in smaller specimens more intense than on larger ones. Opercle and base of pectoral fin variably dusky. Lower portion of head and belly with some dark, scattered chromatophores. Remainder of head and trunk pale to light dusky. Membrane immediately posterior to and attached to first, second, and third dorsal spines black, forming a narrow streak from base of first spine outward to tip. Second dorsal and anal fins with a narrow horizontal dark strip near bases. Upper and lower margins of caudal fin blackish from the procurrent ways to tips of lobes. The streak and stripes sometimes faintly developed or obscure. Remainder of these fins light dusky to pale. Pectoral and pelvic fins pale.

TABLE 1.—Variation in body depth and upper jaw length as a percentage of standard length in species of the subgenus *Pristiapogon*.

Species	Body depth (% SL)														Upper jaw length (% SL)																
	27	28	29	30	31	32	33	34	35	36	37	38	39	40	N	$\bar{X}$	14	15	16	17	18	19	20	21	22	N	$\bar{X}$				
<i>A. abrogramma</i>				1	6	21	27	5	2							62	32.6			22	34	3							59	16.7	
<i>A. exostigma</i>		1	1	5	10	18	12	6	2							55	32.0		5	28	18	3							54	16.4	
<i>A. fraenatus</i>	1	1	2	8	17	13	13	9	1							65	31.8	1		4	31	22	4							62	17.4
<i>A. kallopterus</i>				1	-	1	8	10	24	33	18	9	4	2	110	35.8				28	67	15	2							112	17.9
<i>A. taeniopterus</i>							2	2	7	5	3	4			23	35.7						6	14	3			23	19.9			
<i>A. menesemus</i>				1	2	4	4	3	4	4	-	1	1		20	34.4						4	8	8			20	20.6			

TABLE 2.—Variation of gillrakers and rudiments for species of the subgenus *Pristiapogon*.

Species	Upper arch					Lower arch								Both arches														
	3	4	5	6	N	$\bar{X}$	12	13	14	15	16	17	18	N	$\bar{X}$	16	17	18	19	20	21	22	23	N	$\bar{X}$			
<i>A. abrogramma</i>		55	8		63	4.1		1	53	9				63	14.1		1	45	17							63	18.3	
<i>A. exostigma</i>	1	59	10		70	4.1		11	45	13	1			70	14.1		12	34	22	1	1						70	18.2
<i>A. fraenatus</i>		67	8		75	4.1	12	51	12					75	13.0	6	44	25								75	17.2	
<i>A. kallopterus</i>		110	10		120	4.1	17	97	6					120	13.9	17	89	13	1							120	18.0	
<i>A. taeniopterus</i>		1	15	10	26	5.3					1	8	16	1	26	16.7							7	10	9	26	22.1	
<i>A. menesemus</i>			15	5	20	5.2						4	15	1	20	16.8							4	9	7	20	22.1	

TABLE 3.—Variation of pectoral fin rays, circumpeduncular scales, and median predorsal scales for species of the subgenus *Pristiapogon*.

Species	Pectoral fin rays						Circumpeduncular scales								Predorsal scales								
	12	13	14	15	16	N	$\bar{X}$	12	13	14	15	16	17	18	N	$\bar{X}$	4	5	6	N	$\bar{X}$		
<i>A. abrogramma</i>		76	1			77	13.8	42								42	12.0	1	44			45	5.0
<i>A. exostigma</i>	3	80	2			85	13.0	18								18	12.0		44			44	5.0
<i>A. fraenatus</i>		6	84	2	1	93	14.0	46	1							47	12.0	2	34			36	4.9
<i>A. kallopterus</i>		150	5			155	13.0	2	9	86						97	13.9	5	25	62	92	5.6	
<i>A. taeniopterus</i>		49	1			50	13.0					5	7	6	6	24	16.5	4	2	14	20	5.5	
<i>A. menesemus</i>		1	36			37	14.0						2	4	1	7	16.8		1	14	15	5.9	

**ETYMOLOGY.**—The specific epithet *abrogramma* is a Greek combination and refers to the faint lateral stripe of this species.

**GEOGRAPHIC DISTRIBUTION.**—Known from Indian Ocean localities (Figure 2) and the Philippine Islands.

**REMARKS.**—This species is distinguishable from *A. exostigma* in the absence of the dark, caudal peduncle spot just above the lateral line and in the reduced intensity of the dark, lateral, midbody stripe.

**MATERIAL EXAMINED.**—257 specimens, the largest 114 mm SL.

**Holotype:** USNM 213094 (98.8), Seychelles, W of NW tip of Anonyme I., 11 Feb 1964, IIOE-ANSP sta F-44.

**Paratypes:** COMORO ISLANDS: USNM 211584, 16 (68–92); Grande Comore I.; 27 Nov 1964; IIOE Cr. 9, sta HA-14. USNM 211585, 23 (45–80), about 3.5 mi SW of S Pt. of Pamanzi I., 24 Nov 1964, IIOE Cr. 9, sta HA-9. USNM 211586, 7(41–83), N coast Anjouan I., 21 Aug

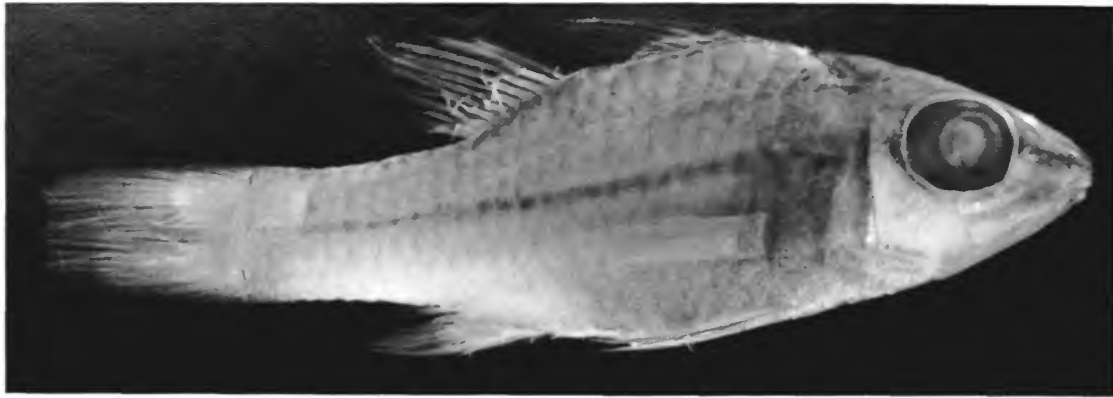


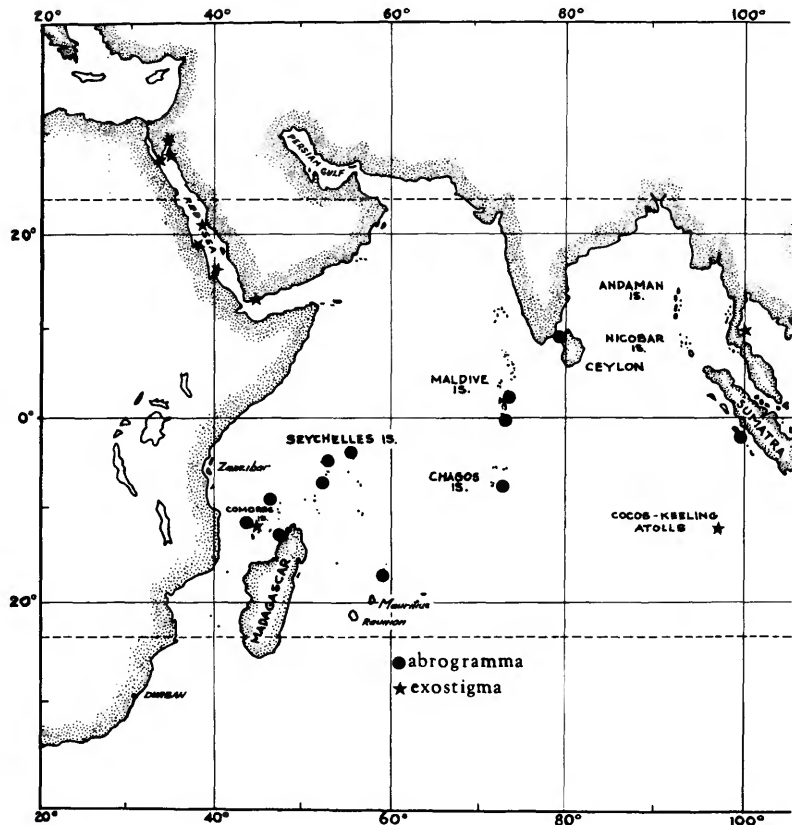
FIGURE 1.—*Apogon abrogramma*, new species: *upper*, USNM 211585, an adult, 75.2 mm SL from the Comoro Is.; *lower*, USNM 211596, a juvenile, 32.0 mm SL from Mentawai Islands, Indonesia.

1964; TE Vega Exp. sta 179, Bolin et al coll. ALDABRA ISLANDS: USNM 211587, 4 (43–78), W side of La Passe Hourareau, 10 Sep 1967, H.A. Fehlmann 67-74. USNM 211588, 2 (48, 54), SE portion of Ile Picard, 3 Dec 1964, IIOE Cr. 9, HA-16. ALPHONSE ISLAND: RUSI 3309 (87), 2 Nov 1954. AMIRANTE ISLES: USNM 211589, 12 (52–81), St. Joseph Is., Ressource I., 8 Dec 1964, IIOE Cr. 9, HA-19, USNM 211590, 9 (14–75), D'Arros I., 5 Mar 1964, IIOE-ANSP sta F-87. SEYCHELLES: ANSP 127821, 12 (69–89), Praslin I., E of St. Ann's Bay, 22 Feb 1964, IIOE-ANSP sta F-59. RUSI 3308, 2 (111, 114), Mahé, 29 Sep 1954. USNM 211591, 7 (69–100), taken

with holotype. CHAGOS ARCHIPELAGO: USNM 211592, 5 (45–76), Diego Garcia Atoll, 20 Jul 1967, H.A. Fehlmann sta 67-49. USNM 211593, 5 (57–75), Diego Garcia Atoll, 26 Jun 1967, H.A. Fehlmann sta 67-18. USNM 211594, 2 (43, 44), Diego Garcia Atoll, H.A. Fehlmann sta 67-17. USNM 211595, 2 (79, 84), Diego Garcia Atoll, 18 Jun 1967, H.A. Fehlmann sta 67-11. WEST OF SUMATRA: USNM 211596, 26 (32–82), off Pulo Siburu, Mentawai Is., 30 Nov 1963, Te Vega sta 104. USNM 211597, 5 (34–62), Pulo Siburu, Mentawai Is., 1 Dec 1963, Te Vega sta 103. MADAGASCAR: USNM IIOE-J. Rudloe sta 72, 5 (77–88), Nossi Bé, 14 Feb 1964. USNM IIOE-



FIGURE 2.—Distribution of *Apogon abrogramma*, new species, and *A. exostigma*.



J. Rudloe sta 76, 2 (21, 35), Nossi Bé, 18 Feb 1964. ST. BRANDON SHOALS: USNM 225693, 15 (17-99), S of Raphael I., 8 Apr 1976, VGS 76-12. USNM 225694, 7 (81-102), 2.5 mi E of Raphael I., 4 Apr 1976, VGS 76-8. RUSI 1894, 5 (24-86), 1 mi W of Tortue I., 15 Mar 1971, T.H. Fraser SA-35. MALDIVE ISLANDS: FMNH 75797, 35 (23-78), Addu Atoll, Wilingili I., 30 Apr 1964, L.P. Woods-38. FMNH 75795, 32 (15-72), S Nilandu Atoll, 24 Apr 1964, L.P. Woods-37. FMNH 75794 (70), locality as above. FMNH 75796, 3 (25-43), Ari Atoll, 22 Apr 1964, L.P. Woods-35. FMNH 75703, 3 (21-35), Addu Atoll, 30 Apr 1964, L.P. Woods-38. FMNH 75692 (27), S Nilandu Atoll, 24 Apr 1964, L.P. Woods-37. USNM 205216, 4 (32-81), Addu Atoll, Bushy I., 10 May 1964, L.W.-40. INDIA: FMNH 75848 (45), Mandapam Camp, 31 Jan 1964, L.P. Woods-15.

Non-type Material: COMORO ISLANDS: USNM 211598 (20), Grande Comore I. PHILIPPINES: USNM 261616, 2 (17.4, 75.5), Mactan I.

### *Apogon khallopterus* Bleeker

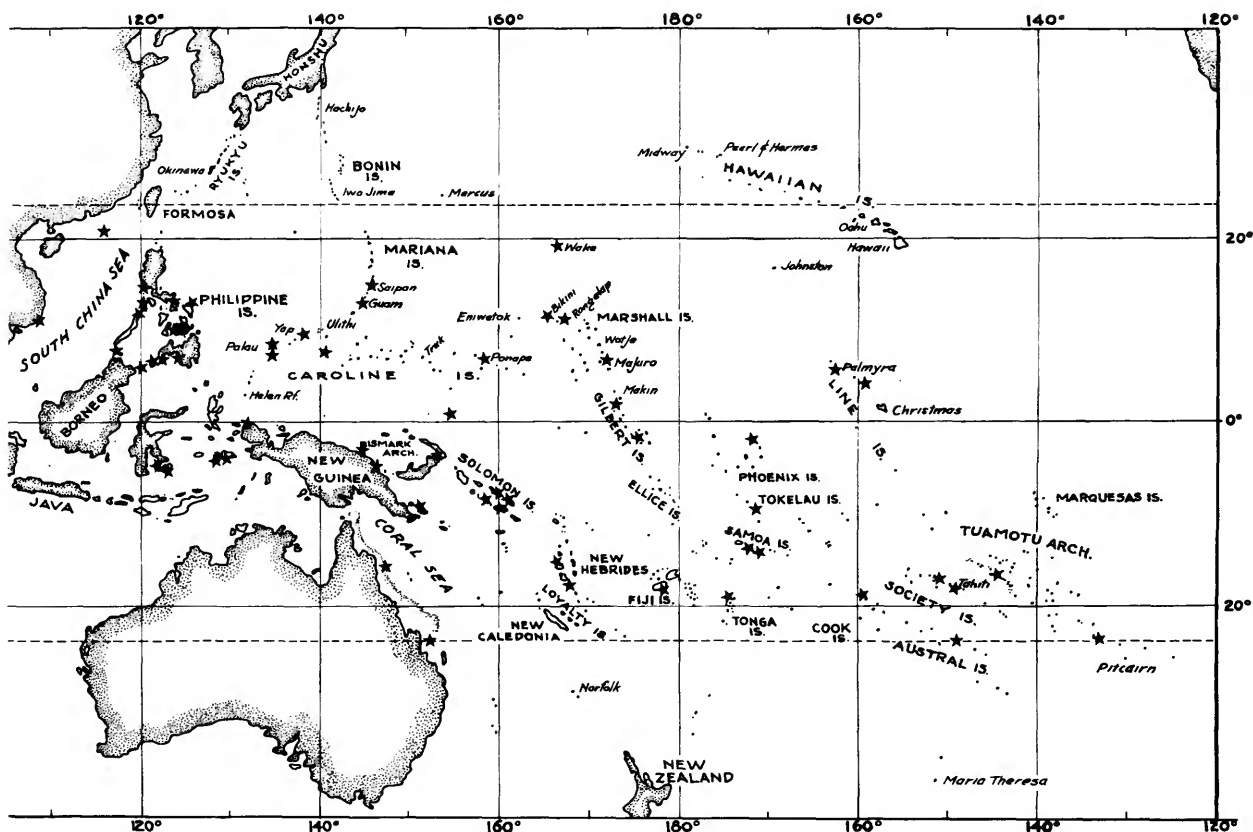
FIGURES 3-5

*Apogon khallopterus* Bleeker, 1856b:33-34 [type-locality: Celebes Manado].

*Apogon snyderi* Jordan and Evermann, 1903:180-181 [type-localities: Hawaii, Honolulu, and Hilo].

*Apogon frenatus yaeyamaensis* Aoyagi, 1943:79-80, fig. 19 [type-locality: Ryukyu Islands, Ishigaki Island].

DIAGNOSIS.—A single dark stripe from snout through eye on middle of body not tapering in width to a round basicaudal spot above lateral line; pectoral rays usually 13; gillrakers on lower arch usually 14; circumpeduncular scales usually 14.



**DESCRIPTION.**—Important morphometric and meristic characters are treated in Tables 1–3. For general shape and pigment pattern see Figures 3 and 4. Proportions (as percent standard length): body depth 30–40; head length 39–42; eye length 11–14; snout length 9–13; bony interorbital width 7–8; upper jaw length 17–20; caudal peduncle depth 13–17; caudal peduncle length 23–28; dorsal spine lengths—first 3–5, second 11–13, third 17–21, fourth 16–21, spine in second dorsal 13–15; anal spine lengths—first 2–3, second 13–14; pectoral fin length 23–26; pelvic fin length 21–26.

Second dorsal fin 1,9; 2 anal spines; pectoral fin usually 13 (rarely 14); pelvic fin 1,5; well-developed gillrakers, 10–14 (2 upper rakers + 8 to 12 lower rakers); including rudiments 17–20 (2 to 3 rudiments + 2 rakers on upper arch; 8 to 12 rakers + 2 to 6 rudiments on lower arch);

pored lateral-line scales 23–25; transverse scale rows above the lateral line 2; median predorsal scales 4–6; circumpeduncular scales 12–14 (5 + 2 + 5 to 7).

**COLOR OF PRESERVED SPECIMENS.**—The salient color pattern consists of a dark horizontal stripe on the midbody from snout to base of caudal fin where it just touches the lower portion of a round, dark, basicaudal spot. Head and trunk light dusky to tan, some specimens darker; lateral stripe usually dark brown, its width about one-half diameter of eye and extends from tip on snout on side of head to behind middle of eye and posteriorly along middle of trunk to midbase of caudal fin; stripe well developed in young and juveniles, but sometimes obscure in adults; spot at base of caudal fin usually conspicuous, circular to oval, and located above but touching lateral line in young to adults; a diffuse, faint dark

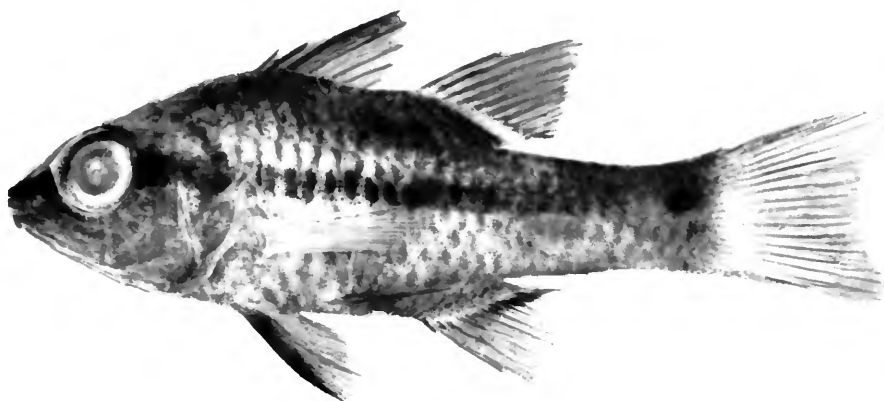


FIGURE 3.—*Apogon kallopterus*, USNM 211652, 62.5 mm SL, an adult from the Comoro Islands.

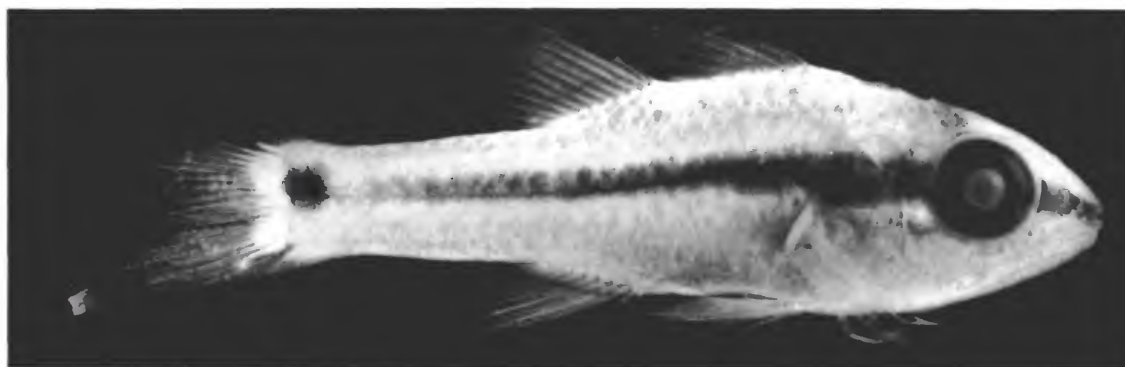


FIGURE 4.—*Apogon kallopterus*, USNM 211744, 24.7 mm SL, a young specimen from Tongareva Atoll.

brown band encircles base of caudal fin, passing through spot; a diffuse dark brown blotch at base of soft dorsal fin sometimes present; membrane between first and second spine of first dorsal fin, upper half of membrane between second and third spines, and upper third between third and fourth spines brownish black, remainder of fin dusky to pale; second dorsal fin with a row of brown spots on membranes just above and parallel to base forming a narrow stripe; another group of dark spots on membranes near center of second dorsal fin, in an irregular row, and sometimes merging with basal stripe; remainder of second dorsal fin transparent to dusky; outer

two rays of caudal fin with a brownish streak, remainder of fin dusky to pale; anal fin with a brownish black stripe near base and parallel with it, remainder of fin pale; pectoral fins transparent; membranes of outer two rays of pelvic fins brownish, the remainder pale. Brownish band encircling base of caudal fin darker and more intensely developed in specimens from the Red Sea and the Line Islands.

**COLOR IN LIFE.**—Burgess and Axelrod (1975, figs. 82–84) show living coloration in color photographs.

**LIFE HISTORY.**—One specimen (82 mm SL) from Apia, Samoa, CAS 19846, and 2 specimens

(80, 81) from Makyan Island, Celebes (Nov 1909) USNM 171966 and 171870, have egg masses in their mouth. *Apogon kallopterus* occurs in a wide array of habitats from tide pools to deep reef environments at depths to about 60 m.

**GEOGRAPHIC DISTRIBUTION.**—The extensive distribution of *A. kallopterus* is shown in Figure 5. This map is based on specimens that we examined. Literature records show even more extensive distributions than our map. No specimens have been reported from the Eastern Pacific coast of North and South America.

**REMARKS.**—This species is closely related to *A. fraenatus* and *A. exostigma* and they have been frequently confused by many authors. All three were captured together at the same locality in the Society Islands and the Celebes (Sulawesi): *A. kallopterus*, AMNH 42989, USNM 213081; *A. exostigma*, AMNH 42964, USNM 213088, *A. fraenatus*, AMNH 42959, USNM 213086.

The smaller specimens of *A. kallopterus* have a discrete black caudal spot, and when the lateral stripe is obscure such specimens are most frequently confused with juvenile *A. exostigma*. These species are distinguished by the following characters: *A. kallopterus* has a lateral strip of uniform width from head to caudal peduncle, whereas *A. exostigma* has a tapering lateral stripe, its width on middle of trunk only one-half width of stripe on head; the dark caudal spot in *A. kallopterus* is larger, less intense and its lower portion just touches lateral line, whereas the caudal spot is smaller, more intensely developed, more circular in shape and is located higher above the lateral line, not touching the lateral line in adults. Meristic and body proportional differences, such as the scales around the caudal peduncle and body depth, are shown in Tables 1–3.

**MATERIAL EXAMINED.**—About 4000 specimens, the largest 122 mm SL.

**Holotype:** RMNH 5592 (76.5 mm SL) (102 mm TL), Manado, Celebes; Bleeker collection.

**Type Specimens of *Apogon snyderi*:** Holotype: USNM 50640, 101.3, Honolulu, Hawaii, U.S. Fish Comm.

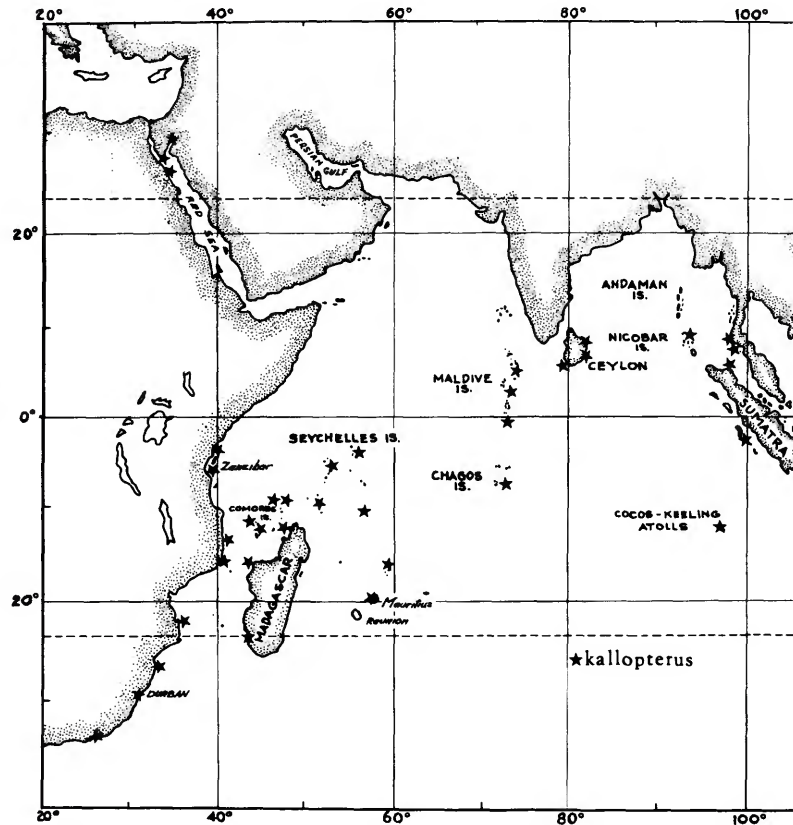
Paratypes (all from the Hawaiian Islands): USNM 50641, 76.6, U.S. Fish Comm. USNM 126510, 7 (56.0–94.5), field nos. 03079, 03215, 5, 6, 10, 12, 14, U.S. Fish Comm. USNM 211793, 3 (67–87), Honolulu, field nos. 3, 7, and 11; formerly Univ. Iowa Mus. Nat. Hist. 19184–86, 1901, Jordan and Evermann. FMNH 3957 (89), Hilo, field no. 05147, 1901, Hawaiian Exp. FMNH 3956 (95), Hilo, field no. 05146, 1901, Hawaiian Exp. CAS-SU 7154, 3 (71–105), Honolulu (tin tag nos. 430, 431, 673). CAS-SU 7459, 3 (81–93), Honolulu, U.S. Fish Comm. (tin tag nos. 02941, 03067; I paper tag no. 4). CAS-SU 3333, 7 (85–102), Honolulu, 1889, O.P. Jenkins coll.

**Other Material:** RED SEA (Gulf of Aqaba): USNM 211632, 10 (23–98), Marsa Muqabila. USNM 211633, 13 (23–95), bay between Marsa Mokrakh and El Himeira. USNM 211634, 19 (23–110), just N of Ras Burqa. USNM 211635, 24 (26–108), between Marset Mahash el Ala and Marset Abu Samra. USNM 211636, 11 (88–102), Marsa Muqabila. USNM 211637, 8 (53–96), bay at El Himeira. USNM 211638, 2 (20, 22), bay at El Himeira. UTAI-NS 2461 (97), Sinai Peninsula, Shurat El Mankata. UTAI-NS 3668, 2 (47, 54), Sinai Peninsula, Dahab. UTAI-NS 1766, 2 (32, 35), Sinai Peninsula, Dahab.

**RED SEA (other localities):** USNM 211639, 15 (35–95), Strait of Jubal. USNM 211640 (108), Koseir, Egypt. BMNH 1960.3.15.540 (90).

**AFRICAN COAST:** USNM 211641 (24), Bamburi, N of Mombasa Cliff, Kenya. SMF 9089, 5 (27–47), same locality as above. RUSI 3361, 2 (66, 81), Malindi, Kenya. RUSI 3360 (69), Malindi. RUSI 3367 (90), Shimoni, Kenya. USNM 211642, 4 (66–92), S of entrance to Port Kilindini, Mombasa Harbor, off Ras Mwa Kisenge. RUSI 3366 (86), Zanzibar. RUSI 3365 (83), Zanzibar. RUSI 1788, 4 (77–85), Inhaca, Mozambique. CAS-SU 31281, 3 (97–101), Natal, Durban. CAS-SU 31280, 2 (48, 87), Natal, Durban. CAS-SU 31282, 3 (59–100), Natal, Durban. RUSI 3341 (65), Natal, Durban. RUSI 3362 (96), Inhaca I.; RUSI 1732, 4 (65–83), Inhaca I.; RUSI 1836, 5 (80–104), Inhaca I.; RUSI

FIGURE 5.—Distribution of *Apogon kallopterus*.



3351, 2 (54, 65), Mefu Reef; RUSI 3337, 2 (32, 42), Pinda Reef; RUSI 3364, 2 (75, 86), Mozambique I.; RUSI 3339 (55), Ibo I.; RUSI 3343, (28), Mozambique I.; RUSI 3346 (64), Pinda Reef; RUSI 3356 (52), Bazaruto I.; RUSI 3347 (45), Pinda Reef; RUSI 3259 (29), Matemo I.; RUSI 3338, 2 (30, 32), Mofamede I.; RUSI 3340 (55), Mozambique I.; RUSI 3357 (77), Pinda Reef; RUSI 3349 (69), Inhaca I.; RUSI 3350, 2 (41, 45), Isla das Rolas; RUSI 3358 (39), Pinda Reef, all Mozambique. RUSI 3348 (57), Durban Bay, Natal. RUSI 1471 (28), Algoa Bay, Cape. BMNH 1916.9.23.19 (100), Durban.

**KENYA:** RUSI 3355 (39), Shimoni. RUSI 3354 (49), Shimoni. RUSI 3345 (48), Mombasa.

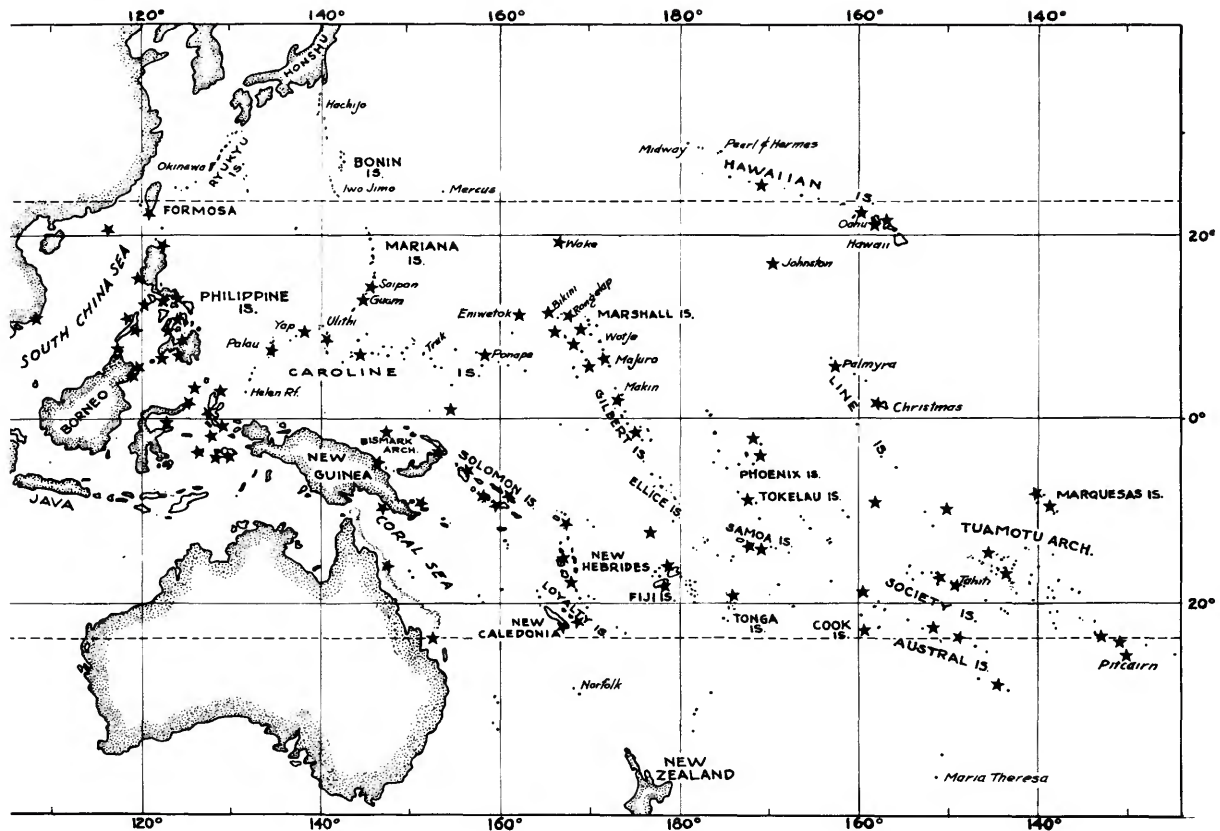
**MADAGASCAR:** MNHN 1963-160 (73), Tulear. USNM 211643 (50), Tulear Harbor. USNM 211644 (30), Tulear. USNM 211645 (61), Cra-

ter Point, Nossi Bé. USNM 211646 (98), Pt. Fievre, Nossi Bé. USNM 211647 (31), Banc du Leven. USNM 211648, 12 (40-85), Chesterfield I.

**COMORO ISLANDS:** USNM 211649, 20 (23-76), about 3.5 mi SW of S Pt. of Pamanzi I. USNM 211650, 26 (29-89), Grande Comore I. USNM 211651 (27), Grande Comore I. USNM 171049 (87), Anjouan I. USNM 211652, 18 (16-95), N coast Anjouan I. USNM 211653, 2 (25, 25). USNM 211654, 89 (31-91), N coast Anjouan I.

**ALDABRA ISLANDS:** USNM 211655, 6 (45-74), W side of La Passe Houareau. USNM 211656, 6 (58-68), West I. USNM 211657, 27 (45-68), West I. USNM 211658, 7 (49-85), E side of La Passe Houareau. USNM 211659, 6 (30-54), channel S of La Passe Du Bois. USNM 211660 (65), S of La Passe Femme, SW of West I. USNM





211661 (47), channel S of La Passe Du Bois. USNM 211662 (37), La Passe Femme, just S of West I.

FARQUHAR ISLANDS: USNM 211663, 11 (26-79). USNM 211664, 16 (27-71), lagoon W of North I. RUSI 3352 (72), Providence I.

COSMOLEDO GROUP: RUSI 3342 (53), Cosmoledo I. RUSI 3353 (78), Astove I.

AGALEGA IS.: USNM 225681, 12 (25-61), North I.

MASCARENE ISLANDS, MAURITIUS: RUSI 2157, 4 (28-95), near Jacotet Bay. USNM 211665 (77), outside Port Louis. USNM 211666, 4 (75-88), outside Port Louis. USNM 211667, 10 (60-110), N of Port Louis Harbor. USNM 211668, 7 (77-93), off Port Louis Harbor. RUSI 1975 (44), La Preneuse. BMNH 1934.2.22.12 (104). FMNH 75713, 3 (79-89), Black Rock Point. RUSI 2310,

10 (32-54), Palamar. RUSI 2235, 4 (46-62), Riambel. RUSI 2118, 5 (26-65), Le Morne, Brabant. RUSI 1870 (34), Round I. RUSI 1872 (39), La Preneuse. RUSI 2084, 7 (27-99), Jacotet Bay.

ST. BRANDON SHOALS: RUSI 2209 (79), Raphael I.

CHAGOS ARCHIPELAGO, DIEGO GARCIA ATOLL: USNM 211669, 17 (36-79). USNM 211670, 21 (42-65), 1 mi NW of Cust Pt. USNM 211671, 16 (41-86). USNM 211672, 7 (51-80), off SW East I. USNM 211673, 3 (59-75), off E shore of lagoon. USNM 211674, 4 (47-73), E of West I. USNM 211675, 3 (35-61), N of east point. USNM 211676, 23 (38-63), SE of east point. USNM 211677, 2 (61, 71). USNM 211678, 2 (52, 77), N of east point.

COCOS-KEELING ATOLL: BMNH 1949.11.-

29.148 (79). ANSP 130820, 34 (28–85), Direction I. ANSP 130798, 9 (28–93), West I. ANSP 130791, 4 (28–85), Horsburgh I. ANSP 130790 (29), Direction I. ANSP 130797, 2 (39, 72), lagoon off West I. pier. ANSP 130789, 4 (31–72), Direction I. ANSP 130795, 10 (27–82), North Keeling I. ANSP 130794, 3 (32–71), Turk Reef. ANSP 130788 (59), Direction I. ANSP 130793, 8 (29–43), Prison I. ANSP 130796, 2 (31, 31), Turk Reef. ANSP 130792 (45), West I.

AMIRANTES ISLES: ANSP 127841, 10 (29–81), vic. St. Joseph I., SW Ressource I. USNM 211679, 16 (24–44), locality as above. USNM 211680, 17 (25–83), African Is., SW of North I. ANSP 127834, 8 (23–82), African Is., SE of South I. ANSP 127825 (25), African Is., off N end North I. ANSP 127832, 5 (28–66), D'Arros I. off E side. ANSP 127839, 40 (28–80), off-shore, D'Arros I.

SEYCHELLES: ANSP 127835, 3 (101–108), Mahé I. off N. tip. USNM 211681, 11 (55–107), Mahé I., W side. ANSP 127838, 8 (85–98), Mahé I., E side. USNM 211682, 3 (27–39), Mahé I., inshore of Souris I. ANSP 127828, 3 (49–92), Mahé I., Beau Vallon Bay. ANSP 127827, 2 (66, 89), Mahé I., Beau Vallon Bay. ANSP 127829, 2 (83, 83), between Anonyme and Mahé Is. USNM 211683, 7 (83–103), Mahé I. vicinity, just N of Anonyme I. ANSP 127831 (96), locality as above. ANSP 127833 (40), Anonyme I., E end. USNM 211684 (85), Praslin I., just E St. Ann's Bay. ANSP 127840, 5 (38–51), Praslin I. vicinity, just S of Round I. ANSP 127837, 16 (24–99), Curieuse I. ANSP 127826 (82), Faon I., S shore. ANSP 127842, 6 (80–88), locality as above. ANSP 127830 (100), Beacon I., off Port Victoria. USNM 211685, 2 (90, 94), Beacon I., off S shore.

MALDIVIVE ISLANDS: FMNH 75704, 15 (28–73), Addu Atoll. FMNH 75709 (78), Addu Atoll. FMNH 75694, 11 (27–75), S. Nilandu Atoll. FMNH 75673 (79), Tiladummati Atoll. FMNH 75653, 3 (47–87), S. Male Atoll. FMNH 75669, 5 (53–78), Miladumadulu Atoll. SMF 4724–4734, 11 (57–83), Ari Atoll.

CEYLON (Sri Lanka): USNM 211630, 7 (31–87), Galle. USNM 211686, 3 (42–84), Hikkaduwa. USNM 211687 (31), Hikkaduwa. USNM 211688, 2 (34, 54), Weligama. USNM 211689 (97), Trincomalee. USNM 211690, 4 (24–45), Trincomalee. USNM 211691 (31), Trincomalee harbor. USNM 211692, 3 (38–59), N of Trincomalee. USNM 211693, 2 (40, 41), Trincomalee. USNM 211694, 5 (66–93), Galle harbor. USNM 211695, 3 (55–77), eastern Batticaloa District, just S of Palamunai. USNM 211696, 2 (51, 74), Trincomalee. FMNH 75643 (69), Galle. FMNH 75648, 6 (25–86), Galle. MCZ 46921, 3 (23–31), Trincomalee.

NICOBAR ISLANDS: SMF 7720 (77), Tillachong I., Castle Bay.

THAILAND: USNM 211697, 6 (35–79), Goh Huyong, Similan I. USNM 211698, 2 (37, 83), Phuket.

SUMATRA (Sumatera): USNM 211690 (63), Pulo Mega, Mentawai Is. USNM 211700, 2 (71, 72), Pulo Siburu, Mentawai Is. USNM 211701 (77), Pulo Perak, Molacca Strait.

MOLUCCAS: USNM 209872 (25), Nusa Laut, N shore at Tandjung Tala. USNM 210961, 8 (65–73), locality as above. USNM 210035, 9 (68–79), Ceram, just offshore and just W of Tandjung Namatatuni. USNM 210360, 10 (63–78), Saparua, off Kulur. USNM 210314 (92), NE Ambon I., about 2 km E Sawa Telu. USNM 209791 (35), Ambon I., off Tandjung Suli. USNM 209584, 10 (23–46), Haruku I., E of Tandjung Naira. USNM 205717 (67), Gilolo, Morotai I. USNM 171959 (A. 18258) [A. = *Albatross* number] (66); USNM 171926 (A. 23318) (28); USNM 171888 (A. 23317) (76); USNM 171834 (A. 23107) (63); USNM 171795, 31 (26–56); USNM 171949 (A. 14488) (73); USNM 171970 (A. 24077) (28); USNM 171825 (A. 14486) (73); USNM 171842 (A. 14487) (74); all Tomahu, Bouro I. USNM 171836 (A. 23486) (67), Kayoa I. USNM 171893 (A. 23485) (73) Kayoa I. USNM 171886 (A. 23312) (66), Gomomo I., S of Obi. USNM 171826 (A. 23469) (63), Maitara I. SMF 4735–7, 3 (19–21), Batjan I. USNM 213085, 78 (34–89), Banda I. USNM 213083, 11 (36–83), Banda

1. USNM 213084, 5 (47–53), Banda I. USNM 213082, 3 (31–78), Saparua I. USNM 213195, 13 (23–60), Great Band I. USNM 213196, 6 (21–50), Ambon I. USNM 213197, 18 (48–81), Ambon I. USNM 171973 (A. 23576) (68, eggs); USNM 171924 (A. 23614) (58); USNM 171880 (A. 23583) (67); USNM 171879 (A. 23615) (43); USNM 171817 (A. 23579) (82); USNM 171823 (A. 14136) (84); USNM 171808 (A. 23580) (78); USNM 171806 (A. 23582) (72); USNM 171810 (A. 23581) (82); all Tifu Bay, Bouro I.

**NORTH BORNEO:** USNM 211753, 5 (71–78), Pulan Bohidulong, Darvel Bay. USNM 211754, 4 (88–91), Pulau Gaya, Darvel Bay. USNM 171931 (A. 23744) (60); USNM 171816 (A. 23384) (67); both at Danawan and Si Amil Is. USNM 171964 (A. 15866) (67); USNM 171898 (A. 23958) (59); both same data as USNM 171931.

**CELEBES (Sulawesi):** USNM 171862 (A. 23118) (63); USNM 171984 (A. 23116) (47); USNM 171980 (A. 23117) (66); all from Labuandata Bay, Gulf of Boni. USNM 171981 (A. 23500) (75); USNM 171983 (A. 23501) (35); USNM 171988 (A. 23499) (71); all from Binang Unang I. USNM 171982 (A. 23306) (72); USNM 171881 (A. 23414) (79); both Gillolo I. USNM 171946 (A. 12891) (75); USNM 171985 (A. 23395) (64); USNM 171867 (A. 12786) (57); all from Gulf of Tomeni. USNM 171986 (A. 23971) (43); USNM 171989 (A. 23457) (63); USNM 171987 (A. 23973) (63); USNM 171860 (A. 23458) (66); USNM 171866 (A. 20040) (74); all Limbe Strait. USNM 171861 (A. 14862) (67), Gulf of Tomini. USNM 171864 (A. 23550) (66); USNM 171865 (A. 23940) (63); both Talisse I., N of Celebes. USNM 171871 (A. 23288) (82); USNM 171977 (A. 23287) (81); USNM 171952 (A. 13836) (71); USNM 171978 (A. 23114) (70); USNM 171909 (A. 23113) (74); USNM 171814 (A. 24007) (77); USNM 171971 (A. 23633) (73); USNM 171809 (A. 23631) (78); USNM 171961 (A. 12478) (90); all Powati anchorage, Makyan I. USNM 171869 (A. 23350) (57); USNM 171966 (A. 23151) (80, eggs); USNM 171870 (A. 23152) (81, eggs); USNM 171990 (A. 23289)

(83); USNM 171991 (A. 24006) (75); USNM 171798 (A. 23632) (78); all Makyan I. USNM 171930 (A. 23523) (89); USNM 171935 (A. 23526) (73); USNM 171975 (A. 23881) (66); USNM 171941 (A. 23879) (52); USNM 171883 (A. 23882) (74); USNM 171899 (A. 23524) (81); USNM 171894 (A. 23880) (60); USNM 171804 (A. 23522) (83); USNM 171821 (A. 12943) (80); USNM 171831 (A. 23525) (77); all Tidore I., S of Ternate. CAS-SU 67370, 4 (29–42), Lembeh Strait (out of SU 28851). USNM 213081, 39 (30–82), Kabaena I., Tallabassi Bay. USNM 213248, 3 (61–65), Buton I.

**INDONESIA:** CAS-SU 30018, 16 (26–80), Sangi I.

**PHILIPPINES:** USNM 171863 (A. 23299) (54), Maribojoc Bay, Maribojoc, Bohol I. USNM 171933 (A. 20030) (84); USNM 171929 (A. 20032) (72); USNM 171921 (A. 6198) (78); USNM 171890 (A. 20029) (78); USNM 171820 (A. 20031) (71); USNM 171851 (A. 26) (72); all Malapascua I., N of Cebu. USNM 171932 (A. 23159) (88); USNM 171895 (A. 23158) (88); USNM 171802 (A. 23160) (60); USNM 171832 (A. 23157) (82); all Puerta Princesa, E Palawan. USNM 171950 (A. 15089) (73); USNM 171824 (A. 15080) (80); both Capulaan Bay, Pagbilao, Chico I. USNM 171957 (A. 15901) (77), Mansalay, Mindoro. USNM 171928 (A. 23680) (68); USNM 171942 (A. 23473) (63); USNM 171976 (A. 23681) (52); USNM 171877 (A. 23679) (64); USNM 171805 (A. 23474) (67); USNM 171833 (A. 23472) (64); all Tapiantana I., S of Zamboanga. USNM 171968 (A. 18781) (73); USNM 171906 (A. 18782) (58); both Tictauan I., E of Zamboanga. USNM 171945 (A. 14367) (100), Port Caltom, Busuanga I. USNM 171948 (A. 14597) (77); USNM 171908 (A. 23270) (88, eggs); USNM 171891 (A. 23260) (77); USNM 171902 (A. 15338) (77); USNM 171884 (A. 23261) (76); USNM 171904 (A. 14600) (79); USNM 171848 (A. 14599) (83); USNM 171839 (A. 23271) (79); all Port Palapag, E Luzon. USNM 171962 (A. 11908) (76); USNM 171943 (A. 12244) (73); both Lampinigan I., S of Zamboanga. USNM 171958 (A. 8767) (79); USNM

- 171911 (A. 10362) (45); both Port Jamelo, Manila Bay, Luzon. USNM 171965 (A. 10639) (72); USNM 171944 (A. 10640) (63); USNM 171901 (A. 10642) (72); USNM 171797 (28); all Polloc, Mindinao. USNM 171954 (A. 15541) (79); Rita I., Ulugan Bay, Palawan I. USNM 171960 (A. 15206) (82); USNM 171912 (A. 15665) (77); USNM 171905 (A. 19818) (80); all Mactan I. between Cebu and Bohol. USNM 171979 (A. 23828) (74); USNM 171936 (A. 23829) (76); USNM 171887 (A. 23826) (81); USNM 171829 (A. 23819) (28); USNM 171815 (A. 23818) (37); USNM 171837 (A. 23830) (66); USNM 171840 (A. 23825) (75); USNM 171827 (A. 23827) (65); all Pandanon I., between Cebu and Bohol. USNM 171868 (A. 19434) (77); USNM 171947 (A. 16985) (75); USNM 171855 (A. 4572) (77); USNM 171918 (A. 4573) (73); all Mompog I., Anabayas Is. USNM 171951 (A. 16145) (85); USNM 171913 (A. 16146) (91); both Mahinog, Camiguin I. USNM 171925 (A. 23180) (76); USNM 171927 (A. 23179) (59); USNM 171882 (A. 23181) (75); all Port Banalacan, Marindique. USNM 171923 (A. 13365) (79); USNM 171903 (A. 15397) (74); USNM 171843 (A. 13362) (76); USNM 171847 (A. 15398) (69); USNM 171850 (A. 13363) (68); all Sablayan Bay, Mindoro. USNM 171953 (A. 15013) (79); USNM 171846 (A. 15015) (84); both Makesi I., E. Palawan. USNM 171955 (A. 6433) (72), W coast Palau I., off N Luzon. USNM 171956 (A. 18907) (74), Tulnalutan I., E of Zamboanga. USNM 171938 (A. 23925) (72); USNM 171885 (A. 23926) (74); USNM 171907 (A. 23927) (62); USNM 171811 (A. 23929) (70); USNM 171838 (A. 23928) (73); USNM 171828 (A. 23914) (78); all Limbones Cove, Manila Bay, Luzon. USNM 171937 (A. 24059) (53); USNM 171919 (A. 6149) (62); USNM 171796 (57); all Tonquil I. S of Zamboanga. USNM 171972 (A. 23406) (58); USNM 171969 (A. 19556) (52); USNM 171967 (A. 19555) (82); USNM 171875 (A. 23405) (91); all Singaan I. between Jolo and Tawi Tawi. USNM 171974 (A. 23360) (48), Uki I., Bouro I. USNM 171799 (A. 23331) (81); USNM 171940 (A. 23327) (56); USNM 171819 (A. 23328) (63); USNM 171835 (A. 23329) (74); USNM 171892 (A. 23330) (68); all Simaluc I. N of Tawi Tawi. USNM 171934 (A. 23570) (45), Romblon reefs. USNM 171939 (A. 23253) (56); USNM 171876 (A. 23252) (79); USNM 171896 (A. 23251) (85); all Mantacao I., W coast of Bohol. USNM 171878 (A. 19050) (73), Varadero Bay. USNM 171915 (A. 17683) (90), Murcielagos Bay, Mindanao. USNM 171920 (A. 5938) (89), Sabtan I. USNM 171910 (A. 12696) (78), Gandra I. between Jolo and Tawi Tawi. USNM 171858 (A. 8888) (48); USNM 171922 (A. 8890) (74); both Mabul I. E of Zamboanga. USNM 171897 (A. 23353) (67), Pangasinan I., Jolo. USNM 171914 (A. 16289) (72); USNM 171900 (A. 16290) (69); both Alibijaban I., Ragay Gulf, Luzon. USNM 171853 (A. 1534) (51), Little Santa Cruz I., Zamboanga. USNM 171844 (A. 16000) (49); USNM 171845 (A. 16001) (72); both Mactan I. off E Cebu. USNM 171874 (A. 23239) (74), Tataan I., Similuc I., Tawi Tawi group. USNM 171917 (A. 8032) (73); USNM 171857 (A. 8030) (79); USNM 171854 (A. 8031) (75); USNM 171856 (A. 8028) (65); all Tumindao I., W of Sibutu I. USNM 171916 (A. 8074) (60); USNM 171852 (A. 8076) (71); both Sacol I., E of Zamboanga. USNM 171889 (A. 23906) (61), Tataan I. USNM 171849 (A. 10411) (89), Varadero Bay, Verde I., vicinity southern Luzon. USNM 171837 (A. 23277) (85), Tutu Bay, Jolo I. USNM 171801 (A. 22249) (88); USNM 171800 (A. 23141) (86); both Port Matalvi, western Luzon. USNM 171818 (A. 23377) (37), Alimango, Burias I. USNM 171830 (A. 22741) (84), Port Maricaban, southern Luzon. USNM 171807 (A. 23490) (76), Balakias Bay, Lubang I. USNM 171822 (A. 10378) (70), Tilig I., Lubang I., S. Luzon. USNM 171859 (A. 4684) (74, eggs), Galvaney I., Ragay Gulf, Luzon. USNM 171803 (A. 23368) (53), Santa Cruz I., Marinduque. USNM 171813 (A. 22084) (74), Pagapas Bay, Luzon. USNM 171812 (A. 23232) (67), Port Ciego, Balabac. USNM 171841 (A. 17977) (67), Simaluc I. USNM 171972, 26 (55–90), Opol, N. Mindanao I., *Albatross-Philippines* Exp. 1907–09. USNM 171092 (A. 16030) (56), Saluda I.,



vicinity of Jolo I. USNM 171794, 2 (81, 83), Maagnas, Lagonoy Gulf, *Albatross-Philippine Exp.* 1907–09. USNM 171793, 6 (44–77), Tutu Bay, Jolo I., *Albatross-Philippine Exp.* 1907–09. CAS-SU 27366, 3 (81–89), Jolo, Sulu Prov. CAS-SU 33475 (57), Dumaguette. CAS-SU 27377 (38), Dumaguette. CAS-SU 33463 (66), Sulu I., Sitankai. CAS-SU 27364 (77), Luzon I., Nasugbu. GVF 2671, 2 (25, 27), Negros I.

VIETNAM: GVF 2116, 6 (75–109), Bay of Nha-trang. GVF 2113, 2 (97, 98), Ilot du Sud.

SOUTH CHINA SEA: GVF 1750, 2 (76, 92), Pratas Reef.

TAIWAN: USNM 211755, 3 (42–61), southern portion. USNM 211756, 6 (31–47); USNM 211757, 5 (45–99); USNM 211758, 4 (31–98); all SW shore. USNM 171872 (A. 11160) (92), Nau Wau Bay.

AUSTRALIA: USNM 211759 (78), One Tree I., Queensland. AMNH 43011 (76), Endeavour Reef, NW edge. AMNH 43010 (93), Endeavour Reef. AMNH 43012, 2 (30, 31), Escape Reef, northern part. MCZ 36732, 2 (83, 93), Cairns.

NEW GUINEA: USNM 211702, 10 (40–75), Madang, Send Belian I. USNM 211703, 19 (25–91), Madang. AMS 1.17080-008, (28), locality as above. USNM 211704, 2 (43, 47), inlet on harbor side Krankett I., Madang. USNM 211705, 2 (53, 71), inside S tip Paeowai I. USNM 211706, 15 (28–55), locality as above. USNM 211707, 2 (42, 71), Madang harbor, off S edge Massas I. USNM 211708 (48), Madang harbor. USNM 211709, 6 (60–68), Madang harbor, off S edge Massas I. USNM 211710, 41 (33–81), NW Trobriand I. AMS 1.17096-025, 3 (66–76), locality as above. USNM 210711 (65), Trobriand I. AMS 1.16671-035, 11 (31–81), Madang. BPBM 5949, 2 (75, 80), Port Moresby.

BISMARCK ARCHIPELAGO: USNM 144821, 6 (31–60), Manus I., Admiralty Is. USNM 114820 (58), Manus I., Admiralty Is. USNM 211712, 6 (27–71), Rabaul, New Britain. USNM 211713, 2 (77, 79), Rabaul, New Britain. USNM 211714, 11 (26–64), Keraward I., Duke of Kirk group.

SOLOMON ISLANDS: USNM 211631, 2 (69, 73), New Georgia. USNM 211715, 5 (31–69), Munda

lagoon, New Georgia. USNM 211716 (72), New Georgia. USNM 211717, 2 (33, 58), Wana-Wana I., New Georgia. USNM 211718 (57), Wana-Wana I. and Blackett Straits, New Georgia. USNM 211719, 2 (62, 66), Gizo I., New Georgia. USNM 211720 (64), New Georgia. USNM 211721, 2 (36, 45), Bougainville, Kieta. CAS-SU 67369, 3 (69–84), Isabel I., Tenibuli (out of SU 25361). CAS-SU 67371 (79), locality as above (out of SU 25362). CAS-SU 25170 (80), Malaita I. GVF 1813, 2 (76, 81), Guadalcanal. USNM 211722, 9 (25–76), Bougainville, Tautsina I. E of Kieta Peninsula. AMS 1.17491-001 (76), Savo I. AMS 1. 15767-015 (74), Inia Atoll. FMNH 22054 (84), Tenibuli, Isabel I. FMNH 22055 (84), locality as above. FMNH 22059–61; 22063–64, 5 (61–85), Isabel I.

SANTA CRUZ ISLANDS: USNM 211723, 2 (51, 74); USNM 211724, 5 (27–75); both Vanikoro I.

NEW HEBRIDES (Vanuatu): USNM 211725, 8 (30–71); USNM 211726, 5 (56–79, the largest with eggs); USNM 211727, 30 (37–82); USNM 211728, 11 (34–77); all Espiritu Santos Harbor. AMS 1.17142-012 (80); AMS 1A.6234, 2 (64, 78); both Espiritu Santo. AMS 1.17473-002 (82); AMS 1.17472-003, 6 (69–86); CAS-SU 25002 (68); BPBM 5798, 8 (46–96); all Efate I. CAS-SU 25115, 2 (76, 80), Malo I. GVF 1828, 4 (20–27), Espiritu Santo I.

NEW CALEDONIA: USNM 211729, 19 (26–80), Noumea. USNM 211730 (91); USNM 211731 (52); both Noumea, Ducos Peninsula.

LOYALTY ISLANDS: BMNH 1877.7.24.6–8, 3 (92–102).

MARIANA ISLANDS: USNM 112324, 2 (46–58); BPBM 8441 (27); UG 1427 (45); UG 1429 (35); UG 4304, 5 (34–38); UG 4303, 3 (31–90); all Guam. CAS-SU 29163, 2 (39, 39); GVF 789, 9 (29–55); GVF 832, 21 (35–55); GVF 790, 10 (26–90); all Saipan. CAS-SU 29162, 4 (30–41), Tinian I. GVF 1845 (82), Guam, reef between Cocos I. and Babe I. GVF 1839, 7 (37–88), Guam, off Babe I. GVF 1855, 5 (26–84), Guam, reef flat between Cocos I. and Babe I. GVF 1859 (37), Guam. GVF 1831 (54), Guam. GVF 1838,



8 (52-70), Guam, N of Cocos I. ANSP 128528 (81); ANSP 117253 (36); both Saipan.

PAULAU ISLANDS (Belau): USNM 177853, 2 (63, 66), Ngaremedin I. GVF 511, 2; GVF 802, 2; GVF 811, 1; GVF 1870, 1; all Urukthapel I. GVF 576, 13; GVF 798, 5; GVF 877, 1; GVF 1414, 1; all Auluptagel I. (Aurapushekaru I.). GVF 529, 3, between Kaibakku I. and Auluptagel I. GVF 864, 1; GVF 867, 28; GVF 868, 1; GVF 914, 2; GVF 942, 8; GVF 946, 1; all Kayangel Atoll. GVF 834, 1; GVF 847, 1; both Babelthaupt I. GVF 1425, 6, Angaur I. GVF 560, 6, Ngemelis I. GVF 488, 10, Aurapushekaru I. GVF 1958, 4, Ngethil I. GVF 1976, 1; GVF 1991, 2; both Aulong I. GVF 1950, 4; GVF 536, 3; both Peleliu I. GVF 1385, 2; GVF 1869, 2; both Ngadarak Reef. GVF 1450, 2, Ngerdiluches Reef. GVF 1852, 2, Aulebesiechel I. GVF 1849, 1, Ngaremediu Reef. GVF 926, 4, Ngaruangl Reef. GVF 526, 3, Butottoribo I. CAS-SU 29164, 5, Palau I.

CAROLINE ISLANDS: GVF 794, 3; 894, 1; 1904, 1; 1905, 10; 1906, 1; 1907, 6; 1910, 13; 1912, 13; 1915, 6, 1917, 10; 1918, 1; 1923, 3; 1924, 6; 1936, 4; 1938, 1; 1940, 10; 1946, 2; all Yap Is. GVF 987, 5; 989, 4; 993, 11; 1004, 1; all Sorol Atoll. GVF 122, 12; 123, 4; 129, 27; 133, 47; 136, 9; 137, 8; 166, 2; 185, 60; 212, 1; 216, 11; 221, 1; 230, 35; 232, 1; 251, 10; 261, 1; 262, 19; 267, 23; 268, 1; 271, 1; all Ifaluk Atoll. GVF 493, 6; 496, 11; 497, 6; 499, 5; all Ponape. GVF 309, 9; 315, 6; 317, 19; 323, 1; 338, 10; 341, 11; 344, 1; 345, 34; 350, 2; 363, 1; 364, 2; 367, 9; 374, 10; 377, 1; 380, 3; 410, 6; 429, 2; 436, 18; 440, 11; 446, 43; 450, 8; 462, 4; 468, 6; 470, 24; 479, 6; all Kapingamarangi Atoll.

MARSHALL ISLANDS: USNM 112342, 114 (26-87); USNM 112343, 48 (27-93); both Bikini Atoll. USNM 112345, 39 (53-87); USNM 112344, 7 (53-96); BPBM 8126, 2 (71, 72); BPBM 16708 (46); all Eniwetak Atoll. USNM 112341, 32 (38-82), Rongelap Atoll. USNM 112338, 2 (27, 36); USNM 211733 (25); both Kwajalein Atoll. USNM 112339 (89); USNM 112340, 18 (29-97); both Rongerik Atoll. USNM 211732 (82), Bikar I. USNM 179400, 9

(46-77), Majuro Atoll. USNM 166601, 5 (38-48), Arno Atoll. USNM 211734 (61), Taka I. USNM 152972, 4 (54-73), Likiep Atoll. USNM 211735 (64), Lijeron I., Jaluit Atoll.

WAKE ISLAND: CAS-SU 50054, 2 (57, 59); CAS-SU 50049, 5 (51-65); CAS-SU 50053, 8 (47-65); all Wilkes I. CAS-SU 67366 (53), between Wilkes and Peale Is. (out of SU 51221). CAS-SU 50055, 2 (65, 78). CAS-SU 50064, (38), near Suwa Maru. GVF 2868, 3 (57-75). GVF 2869, 2 (53, 64).

GILBERT ISLANDS: MCZ 9724, 3 (40-62), Abaiang. USNM 167320, 26 (41-88), Onotoa. USNM 214162, 10 (52-84), Abaiang Atoll.

ELLICE ISLANDS (Tuvalu): BMNH 1897.-8.23.10 (65), Rotuma I.

FIJI ISLANDS: USNM 211736, 10 (50-84); USNM 211737, 4 (43-72); both reef N of Vuro I. USNM 211738, 4 (82-90), Wailangilala I. USNM 211739, 20 (37-69), SW shore Mbulia I. GVF 2008, 2 (94, 100), Cakau Moya. CAS 12072 (84). GVF 2009 (86), Vomo I.

TONGA ISLANDS: USNM 211740, 6 (60-90), Neiafu.

SAMOAN ISLANDS: USNM 56987, 2 (86, 89), Apia, Samoa. USNM 152299, 2 (69, 87), Tutuila I., Tafuna. USNM 152298, 6 (41-75), Pago Harbor. USNM 211741 (Univ. Iowa 19612), 2 (68, 81); CAS-SU 8891, 11 (72-91); CAS 19846, 2 (78, 82); MCZ 30229, 2 (76, 84); all Apia. USNM 114969 (39); USNM 211742 (72); both Tutuila I. USNM 52399, 9 (82-98); CAS 54629, 3 (56-89); both Pago Pago. CAS 54627, 3 (29-33); CAS 54628 (23); both Swain's I.

TOKELAU ISLANDS: USNM 211743 (64), Nokunono Atoll. USNM 211744, 14 (25-56), Tongareva Atoll.

PHOENIX ISLANDS: USNM 211745 (85), Canton I. BPBM 15233 (Univ. Hawaii 1110), 3 (28-60), Hull I.

SOCIETY ISLANDS: USNM 211746 (30), Bora Bora I. USNM 164556, 2 (74, 78), Tahiti Lagoon. USNM 211747 (70), Tahiti, Motu Uta I. USNM 211748 (80), Moorea. USNM 211749 (37), near Fare, Huahine I. USNM 65737 (A. 05828) (76), Tahiti, Papeete. AMNH 42998, 6

(48–79), Tahiti, S of Tapueraha Pass. AMNH 42993, 2 (24, 26); AMNH 42992, 5 (28–59); both Tahiti, off Papeari. AMNH 42996, 10 (26–86), locality as above. AMNH 42995, 2 (24, 25), Tahiti, S of Tapueraha Reef. AMNH 42990, 13 (43–89), Tahiti, between Papeari and reef front. AMNH 42997, 24 (26–60), Tahiti, S of Tapueraha Pass. AMNH 42991, 2 (25, 27), Tahiti, off Papeari. AMNH 43000, 15 (25–42), Moorea, W point of mouth of Cook's Bay. AMNH 43002, 27 (23–29), Moorea, pass into Cook's Bay. AMNH 43005 (27), Moorea, near E side Cook's Bay. AMNH 43003, 2 (26, 28), Moorea, E side of pass into Cook's Bay. AMNH 43004, 4 (26–57), Moorea, off Maharepa. AMNH 43014, 7 (51–77), Huahini Nui I. AMNH 42988, 14 (25–47), Raiatea I., N of Uturoa. AMNH 42989, 16 (41–81), Tahiti, off Papeari. AMNH 43001, 11 (21–55), Moorea, W side of pass into Cook's Bay. AMNH 43009, 15 (26–43), Bora-Bora, SW Topua I. AMNH 42994, 2 (26, 28), Tahiti I., off Papeari. AMNH 43008, 6 (25–35), Bora-Bora, SW Topua I. AMNH 43007, 2 (31, 37), Bora-Bora, S of Topua I. AMNH 42999 (26), Tahiti, off Papeari. FMNH 22046–22051, 6 (52–79), Tahiti. FMNH 22057 (90), Maraa, Tahiti. FMNH 75720, 4 (87–92), Tahiti. ANSP 85895 (46), Raiatea. BPBM 11101, 4 (61–75), Moorea I. MCZ 9719, 15 (58–112), Society Is. ZMA 8145a–c, 3 (70–86), Tahiti. SU 24608, 1; SU 24573, 10; GVF 1083, 44; GVF 1152, 1; GVF 1153, 2; GVF 1340, 2; GVF 1342, 14; GVF 1344, 1; GVF 1346, 20; GVF 1347, 33; GVF 1349, 8; GVF 1350, 8; all from Tahiti. GVF 1357, 1; GVF 1358, 17; both from Huahine Iti. GVF 1371, 1; 1364, 5; both Bora-Bora. GVF 1354, 15, Maiao. GVF 1361, 22, Tupia (Motu Titi). GVF 1359, 1, Raiatea. SU 67372, 1 (out of SU 24736), Moorea. GVF 1100, 1; 1110, 17; 1111, 2; 1138, 9; 1143, 28; 1145, 1; 1160, 1; 1184, 35; 1189, 23; 1289, 3; 1308, 18; all Moorea.

TUAMOTU ARCHIPELAGO: USNM 211750, 7 (36–74), Tikahau, off Matiti I. USNM 66090 (122), Makemo I., Paumotu Is. GVF 119 (78); GVF 96 (30); both from Raroia Atoll. BPBM

14295, 3 (94–98), Mangareva Atoll, Tenoko I. BPBM 16490, 2 (45, 67), Oeno Atoll. BPBM 16652 (102), Pitcairn I.

LINE ISLANDS: GVF sta 51GV-42, 6 (57–94), Palmyra I., NW Sand Islet. GVF sta 51GV-46, 7 (59–98), Palmyra I., Sand Islet. GVF sta 51GV-52, 9 (31–35), Christmas I. GVF sta 48, 5 (49–90), Palmyra I. USNM 211751, 17 (25–63), Caroline I., N of South I.

JOHNSTON ISLAND: USNM 112337, 11 (41–98). USNM 112336 (68).

AUSTRAL ISLANDS: ANSP 85895 (51), Tubuai I. BPBM 13703 (46), Rurutu I. BPBM 12838 (108), Rapa I.

COOK ISLANDS: BPBM 16706 (42), Aitutaki I. FMNH 16236–37, 2 (83, 95), Aitutaki I. GVF 1670, 4 (59–60), Mangaia. GVF 1655, 2 (55, 60), Mangaia.

MARQUESAS ISLANDS: CAS-SU 24487 (81), Hiva Oa I., freshwater Atuona. ANSP 85899 (80), Nukuhiva. BPBM 10997, 2 (31, 32). Motu Takati.

HAWAIIAN ISLANDS: USNM 55134, 3 (58–107), Honolulu, *Albatross*. USNM 55131, 5 (76–97), Laysan I., *Albatross*. USNM 55147, 2 (86, 91), Hanalei Bay, Kauai, *Albatross*. USNM 55490, 2 (81, 86), Hawaii. USNM 78069 (92); USNM 149454 (77); USNM 152465, 2 (87, 94); FMNH 55690 (69); all Honolulu. USNM 55160, 2 (90, 95), S coast Molokai I., *Albatross* sta 3834. USNM 149453, 7 (74–96), Hawaii Molokai, S coast, *Albatross*. USNM 162694 (92); USNM 109321 (42); both Oahu I. USNM 55198, 6 (32–39), Honolulu, *Albatross*. USNM, 211752, 3 (81–95), Lahaina, Maui. USNM 108472 (33), Oahu, off Mokuleia Waialua. MNHN 8061 (95), Ballieu. FMNH 73705 (92), Hawaii. FMNH 63564, 10 (31–100), Hawaii, Oahu, Kahuku. CAS 54630 (69); GVF 54, 12 (46–95); GVF 55 (48); SU 53367 (64); CAS 24989, 51 (34–94); all Oahu. SU 3252, 2 (69, 71), Honolulu. CAS nos. 394, 395, and 463, 3 (84–88), Hawaii. CAS 19847, 2 (64, 93), Hawaiian Is. (tin tag 05145, paper tag 16). GVF 26 (50), Laysan I. MCZ 28896–7, 2 (82, 89). ZMA 1–2, 2 (90, 94), Honolulu.

*Apogon exostigma* (Jordan and Starks)

FIGURES 2, 6

*Amia exostigma* Jordan and Starks in Jordan and Seale, 1906:238–239, fig. 31 [type-locality: Samoa].

**DIAGNOSIS.**—A single dark stripe from snout through eye on middle of body tapering in width and ending below the small round basicaudal spot; basal caudal spot above pored lateral-line scales; pectoral rays usually 13; gillrakers on lower arch usually 14; circumpeduncular scales usually 12.

**DESCRIPTION.**—Important morphometric and meristic characters are treated in Tables 1–3. For general shape and pigment pattern see Figure 6. Proportions (as percent standard length): body depth 28–35; head length 38–42; eye length 12–13; snout length 10–13; bony interorbital width 6–7; upper jaw length 15–18; caudal peduncle depth 13–17; caudal peduncle length 24–27; dorsal spine lengths—first 2–3, second 8–11, third 17–21, fourth 16–18, spine in second dorsal 12–15; anal spine lengths—first 2–3, second 12–14; pectoral fin length 21–25; pelvic fin length 20–24.

Second dorsal fin 1,9; 2 anal spines; pectoral fin usually 13 (rarely 12 or 14); pelvic fin 1,5; well-developed gillrakers 10–13 (2 + 8 to 11), including rudiments 17–21 (1 to 3 + 2; 8 to 11 + 3 to 6); pored lateral-line scales 23–25; transverse scale rows above the lateral line 2; median predorsal scales 5; circumpeduncular scales 12 (5 + 2 + 5).

**COLOR OF PRESERVED SPECIMENS.**—The essential color pattern of this species consists of a dark, horizontal lateral stripe that tapers from head to caudal peduncle, where it may be nearly obscure, and a dark basicaudal spot located above lateral line. Head and trunk light tan; chin and belly slightly dusky; dark lateral stripe extends from tip of snout, through middle of eye, to base of caudal fin, narrowing in width posteriorly to a streak on caudal peduncle where its width is less than one-half its width on the opercle; a round, discrete dark spot at base of caudal fin above lateral line, variable in intensity in some

localities. Caudal spot not touching lateral line in adults, but lower portion of spot touching lateral line in some juvenile specimens; upper portion of membranes of first 3 spines of first dorsal fin blackish; a narrow dark stripe above and parallel to base of second dorsal fin, remainder of fin transparent to dusky; pectoral fins transparent; pelvic fins dusky to pale, with outermost membrane dusky; a narrow dark stripe below and parallel to base of anal fin, the remainder of fin pale to dusky; caudal fin transparent to light dusky, usually with the two outermost rays dusky brown.

Numerous specimens from the Caroline Islands have variably developed caudal spots, some with intense spots, some with weakly developed spots, and some with the spots obscure. Some specimens from Tahiti have large prominent dark caudal spots.

**COLOR IN LIFE.**—From a Kodachrome transparency: trunk and fins colored as above but with area below body midline more silvery; lateral stripe black, widest on side of head, tapering toward caudal peduncle; narrow stripe above base of second dorsal fin and below anal fin base black and conspicuous. Axelrod and Emmens (1969:214) illustrate this species in life colors from a color film transparency.

**LIFE HISTORY.**—One specimen, 52 mm SL, from Palau, contained eggs in the mouth.

**GEOGRAPHIC DISTRIBUTION.**—Known from the Red Sea and Comoro Islands and Cocos-Keeling Atolls, Indian Ocean, and widespread in the central and western Pacific Ocean (Figure 2). Based on material that we have examined, *A. exostigma* is absent in the central Indian Ocean.

**REMARKS.**—This species is closely related to *A. abrogramma*, which occurs in the central Indian Ocean. Also, see “Remarks” under *A. kallopterus*. Specimens of *A. exostigma* have been identified commonly with *A. kallopterus* and *A. fraenatus*.

**MATERIAL EXAMINED.**—1990 specimens, the largest 94 mm SL.

Holotype: USNM 51732, 55.5, Apia, Samoa (specimen bears catalogue label and “drawn” label).

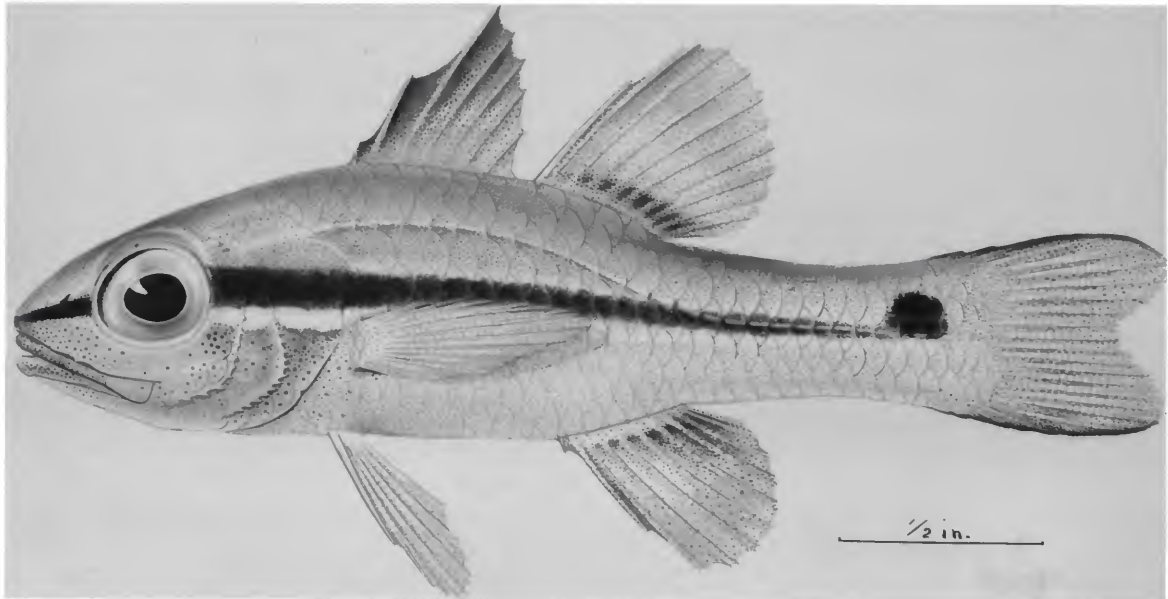


FIGURE 6.—*Apogon exostigma*, USNM 51732, holotype, 55.5 mm SL, from Apia, Samoa.

Paratypes: USNM 211511, originally catalogued with USNM 51732, 4 (27–29). SU 8688, 2 (53, 58), Apia and Pago Pago, Samoa, D.S. Jordan coll. (58 mm specimen bears tin tag 04609) (1 specimen, *Apogon kallopterus*, 28 mm, removed).

Other Material: RED SEA (Gulf of Aqaba): USNM 211465, 11 (15–74), NW coast. USNM 211466, 18 (33–75); USNM 211472, 14 (15–64); USNM 211473, 4 (50–61); all from bay at El Himeira. USNM 211467, 3 (41–58), near road at Marsa Muqabila, NW coast. USNM 211468, 3 (18–56), about 1 mi N of Ras Burqa, NW coast. USNM 211469, 5 (47–77), just N of Ras Burqa. USNM 211470, 12 (50–87), near road at Marsa Muqabila. USNM 211471, 14 (18–83), between Maset Mahash el Ala and Maset Abu Samra. UTAI-NS 1791 (41); UTAI-NS 5398 (31); both Sinai Peninsula, Dahab.

RED SEA (other localities): USNM 211474 (58), Straits of Jubal. USNM 211475, 3 (37–68), Ras Muhammad, Straits of Jubal. USNM 211476, 7 (26–34), 1/2 mi off SW shore of Sciumma I., Ethiopia. USNM 211477, 9 (29–77), Massawa, Ethiopia. USNM 211478, 13 (26–42), Sheikh el

Abu, just W of south end Harat I., Ethiopia. BMNH 1960.3.15.423–33, 11 (31–66), Aqiq, Sudan. USNM 211479 (71), 27°17'23"N, 33°48'52"E, Egypt. SMF 4688 (61), Al Ghar-daqa, Egypt. USNM 227914, 2 (42, 66), reef on N side of Jeddah Harbor.

GULF OF ADEN: USNM 211480 (80), Gold Mohur Bay.

COMORO ISLANDS: USNM 211481, 3 (53–94), W side Grande Comore I.

COCOS-KEELING ISLANDS: BMNH 1949.11.29.149 (72). ANSP 131106, 4 (19–56), lagoon off West I. pier. ANSP 131107 (35), West I. ANSP 131108 (59), Direction I.

SOUTH CHINA SEA: GVF 750, 2 (47, 82), Pratas Reef. GVF 535 (85), Goh Tao I., Gulf of Siam. GVF 2116, 2 (70, 93), Bay of Nha Trang.

NEW GUINEA: USNM 211482, 10 (21–56), Madang Harbor, inside S tip Paeowai I. USNM 211483, 2 (41, 43); USNM, 211485 (70); both inlet on harbor side Krankett I., Madang. USNM 211484, 3 (39–57), S end Belian I., Madang. USNM 211486, 2 (49, 65), bay in Krankett I., Madang Harbor. USNM 211487, 2 (21, 46); AMS I.17096-023 (61); both NW Trobriand I.



USNM 225683, 5 (20–30), Muschu I.

**MOLUCCAS:** USNM 210048 (26), just offshore and just W of Tandjung Namatatuni, Ceram. USNM 209642, 13 (57–78), Tandjung Liang, E shore Piru Bay, Ceram (Seram). USNM 210533, 2 (83, 87); USNM 210438 (80); both Poka, Ambon. USNM 211625 (57), Nusa Laut, N shore at Tandjung Tala. USNM 213090, 2 (25, 47), Banda Is. USNM 213202 (54), Latuhalat, Ambon I. USNM 213203, 3 (58–89), Ambon Bay, Ambon I.

**CELEBES (Sulawesi):** USNM 149747 (A. 23119) (60), Labuandata Bay, Gulf of Boni. USNM 149755 (A. 23889–90), 2 (48, 56), Pendek I., Buton Strait. USNM 213088, 19 (28–72); USNM 213089, 11 (30–65); both Kabaena I., Tallabassi Bay.

**INDONESIA (Irian Jaya):** USNM 225691, 9 (30–80), Batanta I.

**PHILIPPINES:** USNM 149382 (A. 12697) (65), Tara I., Mindoro Strait. USNM 149384 (A. 24013) (57), Tara I. USNM 149386 (A. 14250) (48); USNM 149741 (A. 14253–4), 2 (59, 70); both Candaraman I., Balabac. USNM 149391 (A. 23508) (43), Dalaganem I., vicinity eastern Palawan. USNM 175752 (A. 8303) (60), Tabaco Bay, San Miguel I., Luzon. USNM 149742 (A. 14598) (83); USNM 149751 (A. 23274) (65); both Port Palapag, Samar I. USNM 149743 (A. 15507) (72); USNM 149753 (A. 23642) (73); both Caracaran, Batan I. USNM 149744 (A. 15778–9), 2 (45, 56), Sacol I. E of Zamboanga. USNM 149745 (A. 16854, 23987), 2 (74, 77), Cataingan Bay, Masbate I. USNM 149746 (A. 18783) (51), Tictauan I., E of Zamboanga. USNM 149748 (A. 23173–4), 2 (55, 69), Tutu Bay, Jolo I. USNM 149749 (A. 23188) (62), Romblon. USNM 149750 (A. 23207–10), 4 (62–74), S lagoon, Tumindao I. USNM 149752 (A. 23342–3), 2 (57, 69), Romblon Harbor. USNM 149754 (A. 23816–7), 23831–2), 4 (53–61), Pandanon I. between Cebu and Bohol. USNM 149757 (A. 23930) (72), Limbones Cove, Luzon. USNM 171963 (A. 10641) (69), Polloc, Mindanao.

**AUSTRALIA:** USNM 211488, 4 (83–84); USNM 211489 (88); USNM, 211490, 10 (76–

93); AMSI.15681-018, 2 (45, 80); AMS I.19111-017 (83); AMS I.20210-049, 2 (70, 78); AMS I.20208-025 (43); AMS I.15679-016 (88); AMS I.15634-015, 2 (64, 87); all One Tree I., Queensland. ANSP 123376, 4 (83–85); ANSP 123317, 3 (62–83); ANSP 123408, 8 (15–25); ANSP 123349, 2 (16, 19); ANSP 123350, 3 (15–17); all Endeavour Reef, Queensland. ANSP 123308 (78); ANSP 123378, 2 (55, 79); ANSP 128524, 6 (16–26) out of ANSP 123333; all Big Hope I., Queensland. AMNH 42975 (71); AMNH 42972, 4 (17–83); AMNH 42973, 9 (15–21); ANSP 123322, 22 (16–28); all Little Hope I., Queensland. ANSP 123326, 15 (17–44), Northern Escape Reef, Queensland. AMNH 42976 (67), Endeavour Reef, E section. AMNH 42984, 3 (21–29), Escape Reef, Queensland. AMNH 42974, 2 (16, 27), Endeavour Reef, ~1/3 mi N Cook's wreck site. AMNH 42983, 4 (16–27), Endeavour Reef, ~1/4 mi N Cook grounding site. ANSP 123437, 7 (16–25), near Cook wreck site, Queensland. MCZ 36726 (43), Cairns. QM 24723, 3 (57–93), Lizard I., Queensland.

**FIJI ISLANDS:** USNM 211491, 8 (36–78), SW shore, Mbulia I. USNM 211492, 21 (33–80), reef N of Vuro I., Great Astrolabe Reef. USNM 211493, 4 (20–71), locality data as above. USNM 211494, 10 (42–84), Wailangilala I. USNM 176645 (65), Suva. BMNH 1856.9.4.18 (49). SU 24870 (24), Ovalau I.

**SOLOMON ISLANDS:** FMNH 22062 (61); SU 25362, 2 (50, 76); SU 67368 (56); all Isabel I. SU 25335, 2 (54, 73), Malaita I. USNM 211495, 3 (46–66); USNM 211496, 5 (50–72); USNM 211497 (49); USNM 211627, 2 (42, 53); all Munda Lagoon, New Georgia. BPBM 15693 (33), Guadalcanal. FMNH 22052 (63), Auki I. FMNH 22053 (66), locality as above. FMNH 22056 (68), Tenibuli, Isabel I.

**NEW HEBRIDES (Vanuatu):** AMS I.17517-001 (46), Espiritu Santo. AMS I.17475-002, 4 (33–77). AMS I.17472-002, 3 (45–59), Efate I. GVF 1829, 3 (57–82), Efate I. USNM 211498, 5 (43–78), Espiritu Santos Harbor.

**NEW BRITAIN:** USNM 211499, 33 (28–77), Rabaul. USNM 211508, 9 (24–56), Keraward I., Duke of Kirk group, in St. George's Channel



between New Britain and New Ireland.

GILBERT ISLANDS: USNM 167311, 4 (36–61), Onotoa. USNM 167307 (36), locality as above. USNM 211629, 13 (42–76), Apaiang Atoll.

PHOENIX ISLANDS: USNM 175463, 14 (48–69), Canton I.

TOKELAU ISLANDS: USNM 211500, 2 (18, 33), Atafu I. USNM 211501 (33), Nukunono Atoll. USNM 211502 (64), Fakaofu Atoll.

TONGA ISLANDS: USNM 211503, 2 (67, 72), Neiafu, Vava'u Tonga.

SAMOA ISLANDS: USNM 152300 (78), Tafuna, Tutuila.

CAROLINE ISLANDS: GVF 1905, 5; 1907, 5; 1910, 15; 1912, 23; 1915, 2; 1917, 19; 1918, 30; 1920, 5; 1921, 2; 1923, 8; 1924, 6; 1927, 7; 1930, 18; 1935, 8; 1937, 8; 1938, 2; 1940, 12; 1946, 1; 894, 3; all Yap I. GVF 492, 4; 496, 20; 497, 8; all Ponape Is. GVF 993, 1; 1001, 1; both Sorol Atoll. GVF 122, 4; 129, 15; 133, 5; 137, 8; 162, 13; 166, 28; 185, 13; 215, 9; 216, 23; 221, 25; 248, 6; 262, 1; all Ifaluk Atoll. GVF 309, 3; 315, 5; 317, 32; 323, 3; 338, 18; 341, 5; 345, 36; 350, 1; 364, 1; 367, 1; 374, 1; 377, 3; 380, 4; 401, 3; 410, 15; 420, 1; 424, 2; 429, 7; 436, 3; 437, 1; 446, 22; 452, 10; 462, 1; 470, 65 (29–72); 475, 15; 479, 3; all Kapingamarangi Atoll.

PALAU ISLANDS (Belau): FMNH 47099, 2 (47, 51); SU 29160, 3 (39–72); GVF 866, 11 (58–73); GVF 867, 72 (26–62); GVF 868, 3 (65–74); GVF 941, 13 (31–67); GVF 946, 9 (48–62); all Kayangel I. GVF 653 (45), Rattakadokoru I. GVF 1380, 3 (60–80); 1409 (74); 503, 13 (39–83); all Koror I. GVF 1994, 2 (81, 81); 911, 3 (36–44); 843 (82); all Babelthuap I. GVF 1451, 3 (80–86), Auluptagel I. GVF 526, 6 (62–90); 1933, (67); 1979, 2 (68, 73); 811, (34); all Urukthapel I. GVF 450, 7 (34–71), Ngerdiluches Reef. GVF 1387, 5 (61–85), Gnadarak Reef. GVF 1439 (84), Sanryo I. GVF 925, 6 (25–68), Ngaruangel Reef. GVF 926, 36 (60–85). GVF 650, 2 (68, 76), Malakal I.

SOCIETY ISLANDS: USNM 164555, 2 (63, 71), Papeete, Tahiti. USNM 211504, 8 (41–85), Tikahau, Tahiti. USNM 211505, 2 (38, 43), off Matiti I., Tahiti. BPBM 6198, 4 (61–74), Moo-

rea, Papetoai Bay. BPBM 15231, 24 (46–70), Punaauia, Tahiti. AMNH 42971, 10 (20–40), Tahiti, S of Tapueraha Pass. AMNH 42964, 34 (19–68), Tahiti, off Papeari. AMNH 42986, 7 (18–23), Moorea, pass into Cook's Bay. AMNH 42980 (47), Bora-Bora, S of Topua I. AMNH 42977 (20), Bora-Bora, 2 mi SW Topua I. AMNH 42966 (19), Tahaa I., just N Tiamahana Pass. AMNH 42967, 4 (21–29), Tahiti, off Papeari. AMNH 42963, 104 (19–68), Tahiti I., S of Tapueraha Pass. AMNH 42978 (20); AMNH 42981, 7 (17–20); both Bora-Bora, SW Topua I. AMNH 42985, 9 (18–39), Huahini Nui I. AMNH 42979, 3 (20–54), Bora-Bora, S of Topua I. AMNH 42965, 2 (63, 67); AMNH 42968, 5 (18–25); AMNH 42969 (66); AMNH 42970 (22); all Tahiti, off Papeari. AMNH 42987 (25), Raiatea, N of Uturoa. GVF 1358, 2, Huahini I. GVF 1369, 1; 1366, 6; 1371, 2; all Bora-Bora I. GVF 1354, 1, Maiao I. GVF 1184, 1; 1289, 1; 1308, 1; all Moorea I. GVF 1340, 14; 1342, 4; 1344, 2; 1347, 18; 1350, 2; 1320, 2; 1189, 6; all Tahiti I.

TUAMOTU ARCHIPELAGO: GVF 63, 5; 67, 1; 77, 4; 82, 1; 96, 1; 102, 3; all Raroia Atoll. RUSI 3325, 23 (35–55), Rangiroa Atoll. USNM 65424, 2 (91, 94), Mangareva, *Albatross*. MCZ 29432 (63), Mangareva.

MARSHALL ISLANDS: USNM 112355, 2 (70, 72); USNM 112356, 7 (16–76); both Bikini Atoll. USNM 112354, 88 (30–69), Arji I., Bikini Atoll. USNM 112357, 8 (21–33), Rongerik Atoll, Bock I. USNM 166591 (68), Eoneb-je I., Arno Atoll. USNM 211506, 9 (36–71), Bikar I. USNM, 211507, 2 (71, 77), Taka I., Taka Atoll. USNM, 112358, 43 (38–67), Kieshiechi I., Rongelap Atoll. USNM 112359, 43 (20–62), Tufa I., Rongelap Atoll. USNM 166601 (21), Majuro Atoll. BPBM 8253 (62), Eniwetok Atoll. ANSP 121345 (58), Bikini Atoll, Bikini I. FMNH 60017, 4 (37–46), Bikini Atoll, Enyu I.

WAKE ISLAND: USNM 166592 (46), near Peale I. SU 50052 (58). SU 51221, 5 (56–75), between Wilkes and Peale Is.

MARIANA ISLANDS: UG 1428 (49); UG 1416, 8 (24–80); UG 1430 (69); GVF 1847 (24); GVF 788, 2 (75, 76); all Guam. GVF 790, 2 (19, 34);

ANSP 128527, 3 (38–40); both Saipan. SU 29159, 3 (24–51), Tinian I. SU 19281 (20), Guam I.

LINE ISLANDS: BPBM 7625, 5 (20–61), Fanning I. GVF 42, 4 (44–51), Palmyra I.

COOK ISLANDS: BPBM 5616, 9 (18–43); FMNH 16235 (34); both from Aitutaki I.

AUSTRAL ISLANDS: ANSP 85896 (86); ANSP 85898 (95); both from Tubuai I.

### *Apogon fraenatus* Valenciennes

FIGURES 7, 8

*Apogon fraenatus* Valenciennes, 1832:57–58, pl. 4: fig. 4 [type-localities: New Guinea and Guam].

**DIAGNOSIS.**—A dark stripe from snout through eye on middle of body, tapering in width to round, centrally located basicaudal spot; pectoral rays usually 14; gillrakers on lower arch usually 13; circumpeduncular scales usually 12.

**DESCRIPTION.**—Important morphometric and meristic characters are treated in Tables 1–3. For general shape and pigment pattern see Figure 7. Proportions (as percent standard length): body depth 27–35; head length 38–42; eye length 11–14; snout length 9–12; bony interorbital width 5–7; upper jaw length 14–19; caudal peduncle depth 14–16; caudal peduncle length 22–27; dorsal spine lengths—first 2–3, second 8–11, third 15–19, fourth 16–20, spine in second dorsal 12–14; anal spine lengths—first 2, second 11–13; pectoral fin length 21–25; pelvic fin length 21–23.

Second dorsal fin 1,9; 2 anal spines; pectoral fin usually 14 (rarely 13, 15, or 16); pelvic fin 1,5; well-developed gillrakers 9–13 (2 + 3 to 7 + 11), including rudiments 17–21 (2 to 3 + 2; 7 to 11 + 2 to 7); pored lateral-line scales 23–25; transverse scale rows above the lateral line 2; median predorsal scales 4–5; circumpeduncular scales 12 (5 + 2 + 5).

**COLOR OF PRESERVED SPECIMENS.**—The salient color pattern consists of a horizontal dark brown stripe on midbody extending from the tip of snout on upper jaw through middle of eye, on opercle, and laterally on body to base of caudal

fin, where its width narrows considerably, and ends in a conspicuous, round, dark-brown spot at midbase of caudal fin; lateral stripe widest and more intensely developed on head behind eye, its width more than one-half diameter of pupil, narrowing posteriorly on caudal peduncle, where it may become faint or obscure; dark basicaudal spot almost equal to diameter of pupil; head and trunk otherwise pale to light dusky; outer tips of membranes of first three spines of first dorsal fin blackish; outer rays of lobes of caudal fin dark brownish; a dark, narrow stripe parallel to and just above base of second dorsal fin and below base of anal fin, often faint or obscure; remainder of fins pale.

**COLOR IN LIFE.**—Axelrod and Emmens (1969:216) illustrate this species in color from a color transparency.

**GEOGRAPHIC DISTRIBUTION.**—A wide-ranging species, occurring from the Gulf of Agaba, Red Sea, eastward to the Tuamotu Archipelago (Figure 8); absent in the Hawaiian Islands.

**REMARKS.**—*Apogon vittiger* Bennett (1833:32) was described from Mauritius. No types are known to us, the descriptive data are incomplete and not diagnostic; therefore, we only tentatively allocate this species to the synonymy of *A. fraenatus*. Syntypes (RMNH 5591) of *Apogon melanorhynchus* Bleeker (1852:255–256) were examined by both authors. Bleeker's original account included three syntypes, but the jaw now contains 12 specimens. Bleeker (1873–1876: 90, pl. 343: fig. 1) emended the spelling to *A. melanorhynchus* and illustrated the species. We find that the 12 syntypes represent at least six species of *Apogon*. His illustration represents *A. fraenatus* Valenciennes, characterized by the dark lateral stripe, the dark caudal spot, and the serrations on both margins of the preopercle and the upper margin of the infraorbitals. None of the 12 syntypes represents *A. fraenatus* or any other species in *Pristiapogon*. Bleeker's original three specimens ranged in length from 47 to 65 mm; possibly five to seven specimens in the series of 12 syntypes occur in this range, depending on whether one uses the SL or TL as a measure of length.

Four syntypes of *A. fraenatus* are extant in the

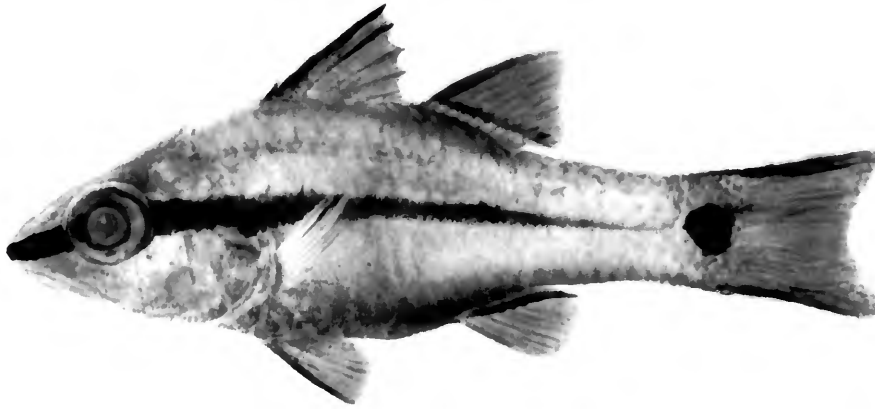


FIGURE 7.—*Apogon fraenatus*, USNM 211426, 57.0 mm SL, from the Red Sea.

Paris Museum. We selected MNHN 8709 containing one specimen from New Guinea as a lectotype because diagnostic color marks still prevail. The other three specimens do not represent *A. fraenatus*: MNHN 8710, two specimens, Guam, may be *A. hallopterus*, based on the caudal spot located just above the lateral line, and MNHN 8711, one specimen, Guam, is a member of the subgenus *Pristiapogon* but it is not identifiable to a species.

**MATERIAL EXAMINED.**—956 specimens, the largest 85 mm SL.

**Lectotype:** MNHN 8709, 70.2, New Guinea, collected by Quoy and Gaimard.

**Other Material:** RED SEA: USNM 211426, 3 (56–72), Ras Burqa, NW Gulf of Agaba, Egypt. UTAI-NS 5918 (90), Sinai Peninsula, Taba.

**GULF OF ADEN:** USNM 211427, 4 (56–63), Gold Mohur Bay, 3 mi E Steamer Point, Aden.

**EAST AFRICA:** RUSI 3331 (76), Kenya, Malindi. RUSI 3330 (33), Mozambique, Palma. RUSI 3332 (38), Mozambique, Kifufi I. RUSI 3329 (34), Mozambique, Pinda Reef. RUSI 3333, 2 (47, 77), Pinda Reef. RUSI 1735, 2 (72, 77), Mozambique, Inhaca I. RUSI 1834 (85), Inhaca I.

**COMORO ISLANDS:** USNM 211428, 21 (23–59), N coast Anjouan I. USNM 211429 (23), Grande Comoro I. USNM 211430 (49), 12°46'S, 47°45'E. USNM 211627 (54), N coast Anjouan I.

**ALDABRA ISLANDS:** USNM 211432, 29 (60–83), SE portion of Ile Picard.

**AMIRANTES ISLES:** USNM 211433, 26 (20–68), vicinity St. Joseph I., SW of Ressource I. ANSP 127823, 8 (23–37), St. Joseph I., SW of Ressource I.

**SEYCHELLES:** ANSP 127824, 5 (56–85), Mahé I., Beau Vallon Bay. USNM 211434, 49 (43–83), locality as above. ANSP 127822, 3 (29–52), Curieuse I., SE of Rouge Pt.

**ST. BRANDON'S SHOALS:** USNM 225685 (37), S of Raphael I.

**MADAGASCAR:** USNM 211431 (23), Nossi Bé.

**MOZAMBIQUE:** RUSI 3334 (40), Wamizi I. RUSI 3335 (24), Mofamede I.

**AGALEGA ISLANDS:** USNM 225682, 3 (24–26), North I.

**CEYLON:** USNM 211435, 8 (56–74); USNM 211436 (36); USNM 211437 (75); USNM 211438, 3 (32–38); USNM 211439, 2 (38, 40); MCZ 46924, 13 (26–73); all Trincomalee. USNM 211440 (35), Hikkaduwa, off Akralla.

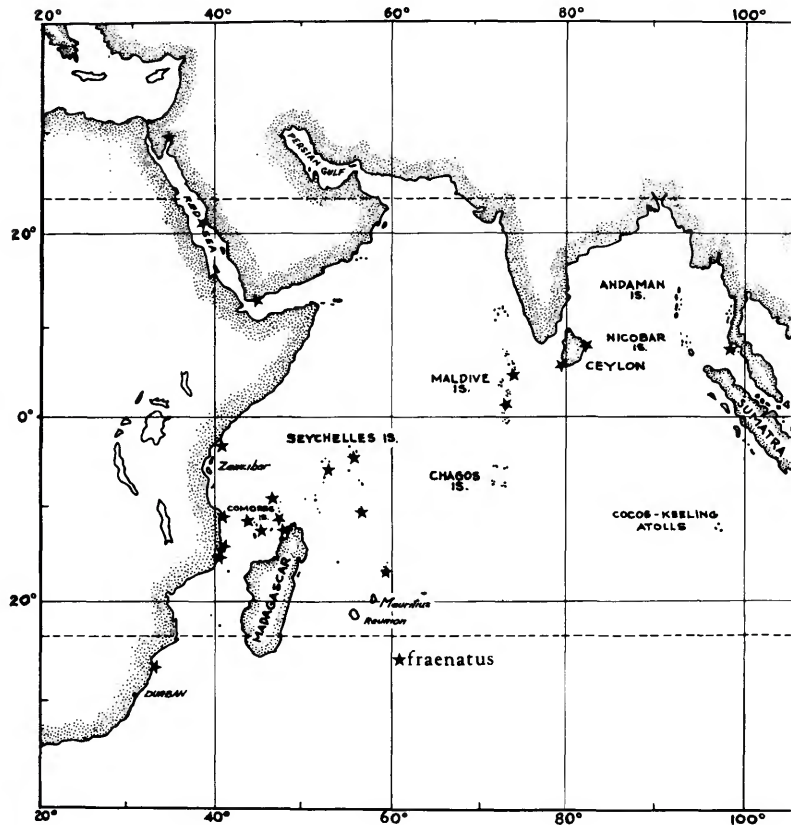
**MALDIVE ISLANDS:** FMNH 75689, 6 (24–47), Ari Atoll. FMNH 75596, 2 (43, 44), Fadiofolu Atoll.

**THAILAND:** USNM 211441, 6 (25–36), Phuket, Patong Bay.

**BORNEO:** USNM 149380 (A. 8889) (48), Mabul I., vicinity Sibuko Bay.

**MOLUCCAS:** USNM 209926 (61), Saparu I. USNM 211442 (76), Poka, Ambon. USNM

FIGURE 8.—Distribution of *Apogon fraenatus*.



211624, 2 (24, 24), Ambon I., off Tandjung Suli.

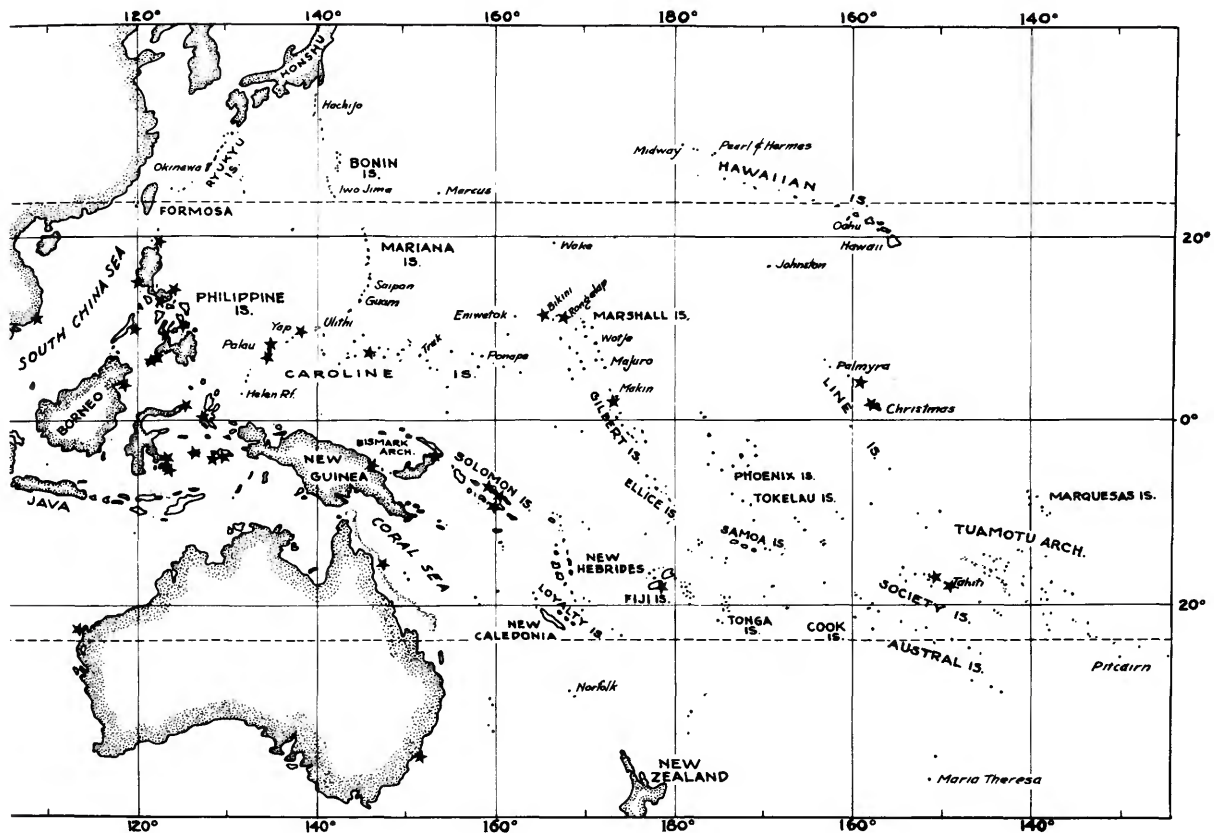
SOUTH CHINA SEA: GVF 2116 (60), Bay of Nhatrang.

CELEBES (Sulawesi): USNM 149378, 2 (22, 28), Makassar I., *Albatross-Philippine* Exp. USNM 149383 (A. 13672, 20041, 23459, 23460, 23461, 23462, 23969, 23970, 23972), 9 (46-68), Limbe Strait. USNM 149384 (A. 13834-5, 23111-2, 23291, 23634, 24008), 7 (60-74), Potwari Harbor, Makyan I., Molucca Passage. USNM 149389 (A. 23108) (48), Tomahu I., vicinity Bouro I. USNM 149392 (A. 23714) (45), Labuan Blanda I., Buton Strait. USNM 149373, 2 (49, 61), Tomahu I. SU 28851, 2 (22, 38), Lembah Strait. USNM 213086, 47 (25-64), Kabana I., Tallabassi Bay.

JAVA: USNM 213087, 9 (22-76), Pulau Seribae. USNM 213189, 47 (50-74), Buton Bay, Buton I.

PHILIPPINES: USNM 149379 (A. 8301) (46), San Miguel I., Tobacco Bay, E coast Luzon. USNM 149381 (A. 12661) (56), Port San Pio Quinto, Camiguin I., China Sea, vicinity Batanes. USNM 149385 (A. 14012) (59), W coast Palau I., off northern Luzon. USNM 149387 (A. 17347, 17348, 17350), 3 (69-79), Basilan I., S of Zamboanga. USNM 149388 (A. 18570, 24040, 24043, 24044, 24046), 5 (44-68), Malanipa I., S of Zamboanga. USNM 149390 (A. 23376) (45), Alimango Bay, Burias I. USNM 56192 (76), Bacon, Sorsogon, Luzon I. USNM 149377, 4 (56-65), Port Jamelo, Luzon, *Albatross-Philippine* Exp. USNM 149374 (61), Limbones Cove, Luzon. USNM 149375, 10 (18-22), Zamboanga Light, Mindanao, *Albatross-Philippine* Exp. USNM 149376 (22), Port Dupon, Leyte I., *Albatross-Philippine* Exp. CAS-SU 27365, 2 (54, 76), Negros I. USNM 225690 (75), Palawan, Puerto Princessa Bay.





NEW GUINEA: USNM 211443, 128 (22-63), Madang Harbor, inside S tip Paeowai I. USNM, 211444, 2 (22, 24), Madang, S end Belian I. USNM 211445 (26), Madang Harbor, inside S tip Paeowai I. AMS I.17087-011, 10 (38-57), same locality as USNM 211445. SU 28242 (39), Madang.

NEW BRITAIN: USNM 211446, 64 (23-61), Simpson Harbor.

FIJI ISLANDS: USNM 205773, 3 (58-60), Viti Levu, S of Suva. USNM 211447, 6 (18-35), Wailangilala I.

MARSHALL ISLANDS: USNM 142464, 2 (66, 67), Bikini Atoll. USNM 142465, 3 (34-40), Rongelap Atoll, Rongelap I.

PALAU ISLANDS (Belau): GVF 534 (33), Peleliu I. GVF 867, 76 (40-64), Kayangel Atoll. GVF 1450 (50), Ngerdiluches Reef. GVF 1991, 7 (46-54), WSW of Aulong I.

CAROLINE ISLANDS: GVF 216, 6 (47-61); GVF

215, 4 (47-60); GVF 185, (40); all Ifaluk Atoll. GVF 1920, 8 (45-68), Yap I.

SOLOMON ISLANDS: BPBM 15650, 4 (40-55), Florida I., N side Tanavula Pt. AMS I.17491-002, 4 (38-49), Savo I. AMS I.17481-002. (33); GVF 1812 (77); both Guadalcanal. SU 25361, 2 (50, 58), Isabel I.

SOCIETY ISLANDS: BPBM 11267, 3 (46-63), Tahiti I., Papara, Teavaraa Pass. BPBM 8622, 5 (23-27), Papetoo, Moorea I. AMNH 42952 (53) AMNH 42958 (24), Bora Bora, SW Topua I. AMNH 42948, 40 (21-24); FMNH 22277 (64); CAS-SU 24736 (72); GVF 1111 (63); GVF 1289, 3 (31-56); all Moorea. AMNH 42959, 31 (38-59); AMNH 42953 (36); AMNH 42949, 3 (20-31); AMNH 42957, 3 (20-28); all Tahiti I., off Papeari. AMNH 42951, 100 (20-65), Tahiti I., S of Tapueraha Pass. AMNH 42954, 2 (55, 61), Moorea, W side of pass into Cook's Bay. AMNH 42950, 15 (22-31), Huahini Nui I. FMNH



75724 (39); FMNH 75725 (27); both Tahiti. GVF 1369, 3 (45–58); GVF 1366, 5 (40–61); both Bora-Bora. GVF 1339, 4; 1340, 15; 1342, 1; 1347, 6; 1350, 4; 1344, 15; 1355, 19; all Tahiti.

LINE ISLANDS: BPBM 14073 (39); BPBM 16707, 12 (45–55); both Fanning I. ANSP 82243, 10 (16–23); ANSP 82242, 38 (16–24); both Christmas I.

AUSTRALIA: AMS I.17168-001 (41), Clovelly, New South Wales. AMNH 42955 (30), West Australia, just S of Mandu-Mandu Cr. AMNH 42956, 50, Escape Reef, Queensland. ANSP 123333, 5 (18–31); ANSP 123309, 2 (68, 77); ANSP 123379, 2 (61, 69); all Big Hope I., Queensland.

NEW HEBRIDES (Vanuatu): AMS I.17475-003, 7 (23–68).

GILBERT ISLANDS (Kiribati Republic): USNM 211628, 5 (49–70), Abaiang Atoll.

### *Apogon menesemus* Jenkins

FIGURES 9, 10

*Apogon menesemus* Jenkins, 1903:448, fig. 19 [type-locality: Honolulu].

DIAGNOSIS.—A complete, dark vertical bar near base of caudal fin joining the dark streaks on the upper and lower caudal fin lobes.

DESCRIPTION.—Morphometric and meristic characters are treated in Tables 1–3. For general shape and pigment pattern see Figure 9. Proportions (as percent standard length): body depth 32.7–39.4; head length 39.3–42.7; eye length 11.7–14.5; snout length 9.5–11.6; bony interorbital width 7.8–9.9; upper jaw length 19.0–21.9; caudal peduncle depth 13.1–18.1; caudal peduncle length 23.5–28.1; dorsal spine lengths—first 1.7–4.5, second 9.0–11.8, third 17.6–20.3, fourth 14.4–21.4, spine in second dorsal 11.6–16.3; anal spine lengths—first 1.8–2.9, second 10.6–14.3; pectoral fin length 20.0–25.8; pelvic fin length 21.4–25.9.

Second dorsal fin 1,9; 2 anal spines; pectoral fin usually 13 rarely 12; pelvic fin 1,5; well-

developed gillrakers 16–17 (3 upper arch + 13 to 14 lower arch); including rudiments 21–23 (2 to 3 rudiments + 3 rakers upper arch; 13 to 14 rakers + 3 to 4 rudiments lower arch); pored lateral-line scales 25; transverse scale rows above the lateral line 2; median predorsal scales 5–6; circumpeduncular scales 16–18 (6 to 7 + 2 + 8 to 9).

COLOR OF PRESERVED SPECIMENS.—See Figures 9, 11, and 12 for a comparison of the color pattern between *A. menesemus* and *A. taeniopterus*. The prominent color pattern of this species is very similar to that of *A. taeniopterus*. The head and trunk pigmentation, the dark portions of the first dorsal and pelvic fins, and the dark horizontal stripe on the second dorsal and anal fins are similar. The only difference is the complete development of the dark caudal bar in larger specimens of *A. menesemus*, whereas this bar is clearly interrupted by a central pale area in most specimens of *A. taeniopterus*. In a few specimens of *A. taeniopterus*, the pale interrupted portion of the dark bar is nearly filled in with black or blackish streaks, or the pale area is greatly reduced, the black arcs from each lobe nearly joining in the central portion of the fin. Further collecting and studies may justify recognizing one very wide ranging species with two subspecific populations.

GEOGRAPHIC DISTRIBUTION.—Widely distributed in the Hawaiian Islands and Johnston Island (Figure 10).

REMARKS.—This species is closely related to, if not conspecific with, *A. taeniopterus*, sharing many similarities in meristic, morphometric, and color characters, apparently differing only in the complete development of the dark bar near the base of the caudal fin and in having one more pectoral fin ray (Table 3). The bar is incompletely developed or interrupted in the central portion of the fin in varying degrees in *A. taeniopterus*. For further discussion see "Remarks" section under *A. taeniopterus*.

This species was captured by hook and line several times at depths of up to about 30 m.

MATERIAL EXAMINED.—75 specimens, the largest one 134 mm SL.

Holotype: USNM 50700 (97.2), Honolulu,

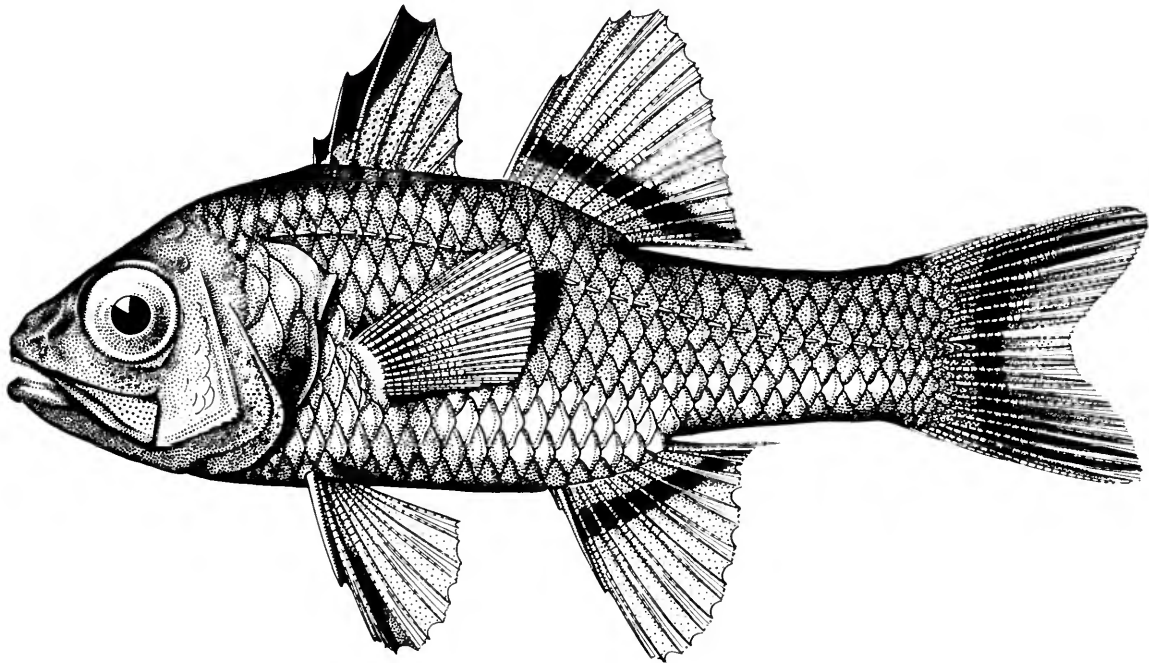


FIGURE 9.—*Apogon menesemus*, USNM 50700, holotype, 97.2 mm SL, from Honolulu, Hawaii.

Hawaii, collected in 1889 by O.P. Jenkins.

Paratypes: CAS-SU 7831, 5 (93–119), Honolulu, 1900, D.S. Jordan and J.O. Snyder (tin tag numbers 019, 397, 404, 434, 792). CAS-SU 23299, 6 (97–107), Honolulu, 1889, O. P. Jenkins (tin tag numbers, all six 3299).

Other Material: HAWAIIAN ISLANDS: FMNH 73703, 2 (99, 108), Hawaii. FMNH 4077 (121). FMNH 4078 (110). FMNH 55663 (116). Honolulu. FMNH 63563, 12 (34–109), Hawaii, Oahu, Kahuku. CAS-SU 7632, 3 (107–130), Hilo (tin tags 03470, 05158, 05159). GVF 54 (124), Oahu I. CAS 30115 (113), W. Hawaii. CAS 30078 (109), (captured at night on bottom, ~30 m, with hook and line, by T. Iwamoto, sta 73-16). CAS 30071, 3 (117–134); CAS 30120, 8 (103–133); both W. Hawaii, and both taken at night, on bottom, “ca. 14–15 fathoms” by T. Iwamoto, 1973). CAS 28517 (80), Hawaii, Pokai Bay. CAS 19850, 2 (111, 118) (tin tags 03096, 05154; Indiana Univ. nos. 10340, 10341). CAS (Acc. 278), 4 (81–110), Honolulu. GVF 26 (48), Laysan I. ANSP 105323 (117), French Frigate

Shoals. ZMA 1–3, 3 (87–105), Honolulu. BPBM 6352, 6 (56–122).

JOHNSTON ISLAND: RUSI, 11 (48–112), Aug 1963.

### *Apogon taeniopterus* Bennett

FIGURES 10–12

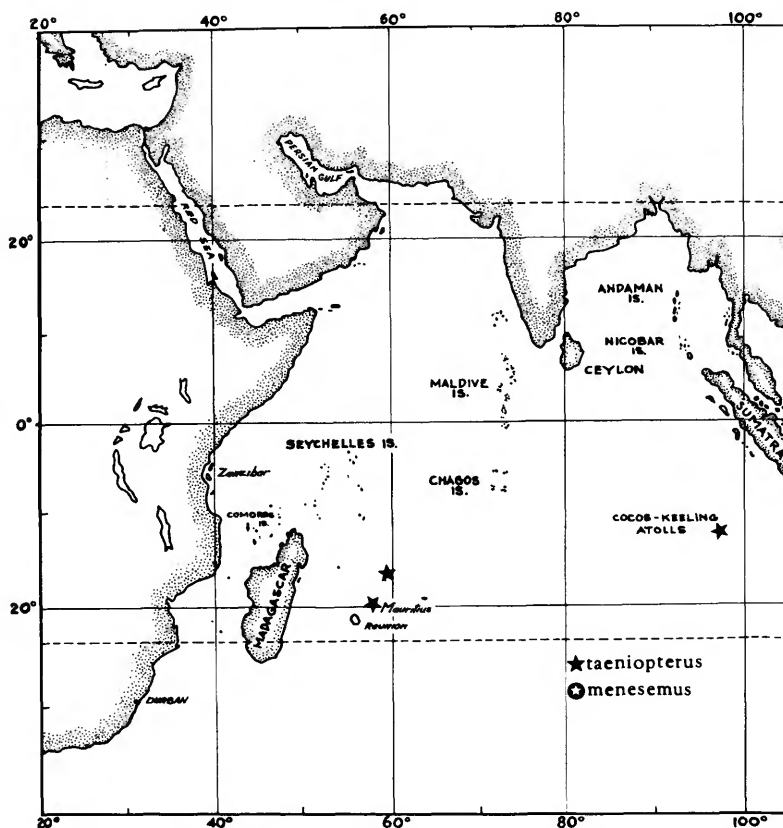
*Apogon taeniopterus* Bennett, 1835:206 [type-locality: Mauritius].

*Apogon menesemops* Lachner, 1953:455, fig. 78 [type-locality: Bikini Atoll].

**DIAGNOSIS.**—Dark vertical bar near base of caudal fin incompletely developed or interrupted at the central portion of the fin.

**DESCRIPTION.**—Certain morphometric and meristic characters are treated in Tables 1–3. For general shape and pigment pattern see Figure 11. Proportions (as percent standard length): body depth 31.5–38.9; head length 37.2–41.2; eye length 10.8–15.0; snout length 9.1–11.5;

FIGURE 10.—Distribution of *Apogon menesemus* and *A. taeniopterus*.

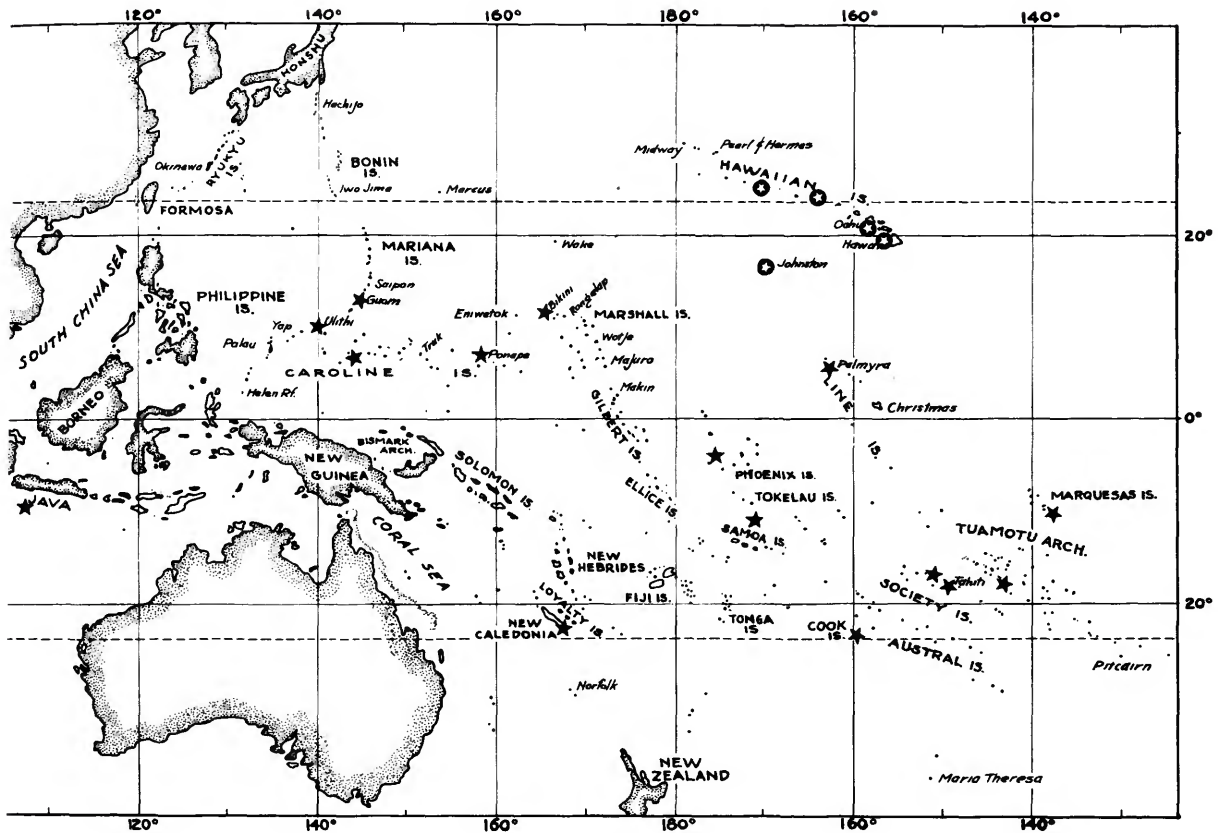


bony interorbital width 7.9–8.7; upper jaw length 17.9–21.5; caudal peduncle depth 14.7–17.2; caudal peduncle length 22.6–28.5; dorsal spine lengths—first 2.6–4.1, second 9.6–11.6, third 17.4–22.0, fourth 14.0–19.1, spine in second dorsal 13.2–15.5; anal spine lengths—first 1.7–3.3, second 11.5–14.7; pectoral fin length 21.8–24.8; pelvic fin length 21.3–26.8.

Second dorsal fin 1,9; 2 anal spines; pectoral fin 13–13; pelvic fin 1,5; well-developed gillrakers 15–17 (2 to 4 upper arch + 12 to 14 lower arch; including 1 to 3 rudiments + 2 to 4 rakers upper arch; 12 to 14 rakers + 2 to 5 rudiments lower arch); pored lateral-line scales 25; transverse scales rows above the lateral line 2; median predorsal scales 4–6; circumpeduncular scales 15–18 (5 to 7 + 2 + 7 to 9).

**COLOR OF PRESERVED SPECIMENS.**—The important color pattern consists of dark stripes or

markings on all fins except the pectoral fin, but mainly observed on the dorsal, anal, and caudal fins. Trunk light brown above midline, somewhat more silvery to tan on belly; head mostly dusky tan; a broad dark diffuse stripe from tip of snout to eye, usually faint or obscure; anterior portion of first dorsal fin dark, the membrane between the first and second spines black, upper two-thirds of membrane between second and third spines black and upper one-half of membrane between third and fourth spines black, remainder of fin mostly pale with a little dusky at tips of membranes; second dorsal and anal fins with a prominent dark stripe near basal portion of fin and parallel to base, its width slightly greater than one-half diameter of pupil; remainder of these fins pale with some dusky on anterior membranes and the outer margin; lobes of the caudal fin from tips of the outer three rays to



scaly basal portion of fin black, with heavy black pigmentation on third to fifth rays about midway between fork of caudal fin and last scales of fin; this black pattern does not form a complete vertical bar on caudal fin; caudal peduncle at base of caudal fin with a diffuse, brown band, bordered posteriorly by a light tan or pale bar just beyond last scale row; pectoral fins pale; pelvic fins pale to light dusky, the membrane between the two outer rays and the outer margin blackish.

A few specimens have various caudal color patterns with the black interrupted bar nearly complete, approaching the bar present in *A. mensesemus*. These specimens are documented in the following "Remarks" section.

**COLOR IN LIFE.**—From a Kodachrome transparency: trunk dark brown above midbody; belly silvery to dusky tan; free edges of many scales

above lateral line light colored; head dorsally, snout and chin dark brown; posterior to eye and on opercular, silvery to brown; iris with some yellow, pupil black; snout bar blackish; pectoral fins light pink; black bar of anal fin bordered above and below with milky white; black markings of second dorsal fin bordered behind by white; portion of fin between bar and base of spinous dorsal fin whitish; caudal peduncle encircled with a black band; outer developed rays of caudal fin whitish; tips of rays and membranes of caudal fin blackish, remainder of caudal fin colored as described above.

Axelrod and Emmens (1969:224) illustrate this species in color from a color transparency.

**GEOGRAPHIC DISTRIBUTION.**—This species is known to us from the southern Indian Ocean eastward to the Marquesas Islands (Figure 10). Over this wide range it is associated with small,



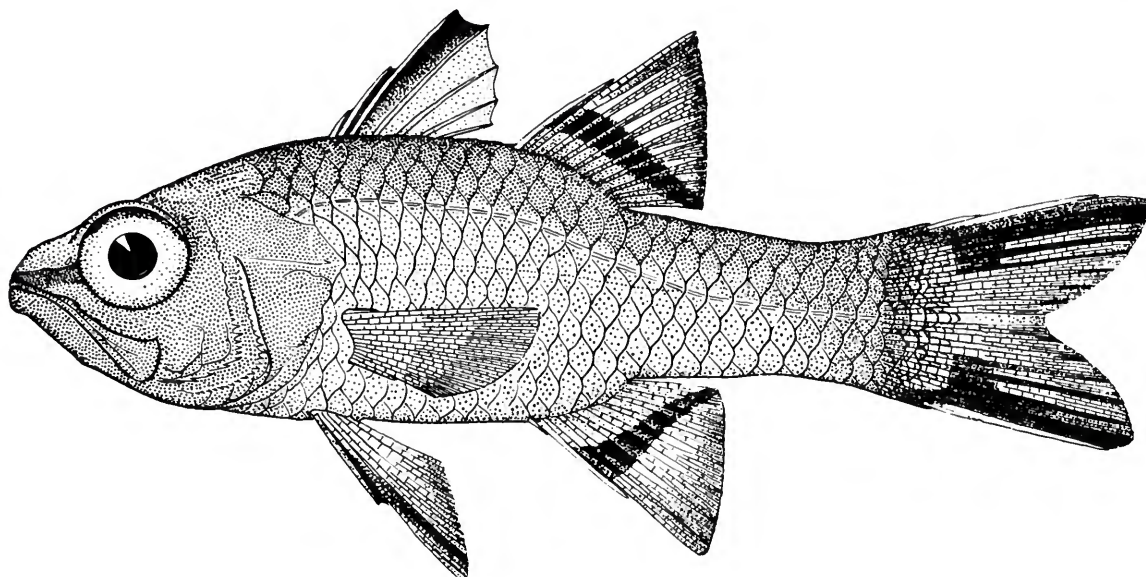


FIGURE 11.—*Apogon taeniopterus*, USNM 142232, 103 mm SL, an adult from Enyu Island, Bikini Atoll.



FIGURE 12.—*Apogon taeniopterus*, USNM 224273, 60.8 mm SL, a juvenile from Ponape, Caroline Islands.

high and low islands; it has not been reported from the African, Asian, and Australian shelves nor the larger islands such as Madagascar, Sri Lanka, Java, Sumatra, Borneo, Luzon, New Guinea, and others.

REMARKS.—The coloration of the caudal fin is uniformly developed for most of our speci-

mens. Atypical development of coloration was noted in three collections as follows: Guam, UG 4190 (most of the central portion of the bar is complete, with some dark pigmentation, rather than having the bar sharply interrupted by a pale area); Moorea, Society Islands, GVF 1314 (the pale, interrupted portion is reduced); Marquesas,



BPBM 11692 (the pale interrupted portion is interspersed with dark streaks).

We have examined only one small specimen (27 mm SL) of *A. taeniopterus*, and the caudal fin had weak dark streaks on both lobes, but the remainder of the fin was pale with no indication of any development of the dark arcs near the base of the fin; young specimens of *A. menesemus* (~34 mm SL) also have weak dark streaks on both lobes of the caudal fin and they also show no development of the dark bar. Although the young of these two species appear to be similar, the extant material is insufficient in size ranges and quality of preservation to ascertain the differences in the development of the caudal coloration with increase in body size. Perhaps these populations represent a single, wide-ranging species with a subspecies represented in the Indo-Pacific region and another in the Hawaiian and Johnston islands. Carefully appraised living coloration between these two populations may reveal further differences, but we cannot come to any conclusions based on two or three colored transparencies or field sketches.

**MATERIAL EXAMINED.**—43 specimens, the largest 150 mm SL.

**Holotype:** BMNH 1855.12.26.478, 138.9 mm SL, Mauritius.

**Paratypes:** USNM 142283, 2 (101, 113), same data as USNM 142232. USNM 142284, 2 (108, 115), same locality as USNM 142232, 16 Mar 1946, L.P. Schultz sta 46-8.

**Type Specimens of *Apogon menesemops*:** Holotype: USNM 142232, 100.3 mm SL, Marshall Islands, Bikini Atoll, 1 Aug 1947, L.P. Schultz sta 46-83.

**Other Material:** COCOS-KEELING ISLANDS: ANSP 128361 (27), N. Keeling I. (taken at a depth of 21-24 m). CHRISTMAS ISLAND: BMNH

1911.1.31.5 (90). MAURITIUS: MCZ 5716, 4 (146-150) (bone tags 254-256). ST. BRANDON'S SHOALS: USNM 260487, 4 (133-142); USNM 260488 (122); both from Isle Raphael. SOCIETY ISLANDS: BPBM 8364 (119), Popote Bay, Tahiti. BPBM 8114, 4 (63-105); CAS 1350 (104); both Papara, Tahiti. FMNH 77289 (110); CAS 17595 (114); CAS 17594 (99); GVF 1184, 2 (50, 54); all Tahiti. GVF 1314 (116); GVF 1110 (64); both Moorea. GVF 1364 (114), Bora-Bora. MCZ 9720 (110). NEW CALEDONIA: RUSI 3324 (104), Noumea. MICRONESIA: BMNH 1865.3.2.62 (105). TUAMOTU ARCHIPELAGO: BPBM 10272 (90), Makemo. GVF 81 (93), Raroia Atoll. GVF 63 (76), Raroia Atoll. LINE ISLANDS: GVF 47 (72), Palmyra I. COOK ISLANDS: GVF 1675 (61), Mangaia. SAMOAN ISLANDS: CAS 30639, 2 (35, 38), Swain's I. CAROLINE ISLANDS: BPBM 9324 (122), Ulithi Atoll, S side Falalop I. GVF 257 (132), Ifaluk. USNM 224273 (63), Ponape I. PHOENIX ISLANDS: USNM 225684 (47), McKean I. MARQUESAS ISLANDS: BPBM 11692, 2 (72, 80), Fatu Hiva. MARIANA ISLANDS: UG 4190 (121), Guam.

**Subgenus *Zoramia* Jordan**

*Zoramia* Jordan, 1917:46 [type-species: *Apogon graeffi* Günther, 1873 (= *Apogon leptacanthus* Bleeker, 1856a) by original designation and monotypy, as a genus].

**DIAGNOSIS.**—Six spines in the first dorsal fin; nine soft anal rays; infraorbital shelf absent on third bone; supraoccipital crest high; frontals with crests; gillrakers 24-32; two or three rows of villiform teeth toward the symphysis of the premaxilla, one or two rows on the dentary becoming one row posteriorly; one row of villiform teeth on palatine; black stomach and intestine; second and third dorsal spines variably elongate or filamentous.

**Key to the Species of the Subgenus *Zoramia***

- 1. Dark line on dorsum from origin of first dorsal fin onto caudal peduncle; ventral margin of caudal peduncle with dark line . . . . . *Apogon leptacanthus*
- No such dark line on dorsum or on dorsal and ventral surfaces of the caudal peduncle . . . . . 2

- 2. Gular area dark; vertical short, dark lines just above insertion of some anal rays . . . . . *Apogon perlitus*, new species  
 Gular area pale; no vertical lines above anal rays . . . . . 3
- 3. Opercular flap with prominent to diffuse dark spot; caudal spot small with many diffuse melanophores on caudal peduncle . . . . . *Apogon gilberti*  
 No spot on opercular flap; caudal spot small, without diffuse melanophores on caudal peduncle . . . . . *Apogon fragilis*

***Apogon leptacanthus* Bleeker**

FIGURES 13, 14

*Apogon leptacanthus* Bleeker, 1856a:204 [type-locality: Ternate, Moluccas].  
*Apogon graeffi* Günther, 1873:22, pl. 20: fig. E [type-locality: Boston Island, Marshall Islands].  
*Amia nematacantha* Ogilby, 1913:85, pl. 22: fig. 1 [type-locality: Darnley Island, northern Queensland, Australia].

DIAGNOSIS.—A narrow dark line along dorsum at base of dorsal fins extending to upper procurrent rays of caudal fin; a similar, but fainter, line along ventral portion of caudal pedun-

cle; no basicaudal spot or dusky areas on side of caudal peduncle; second dorsal fin filamentous, usually longer than 30% of standard length.

DESCRIPTION.—Important morphometric and meristic data are treated in Tables 4–6. For general shape and pigment pattern see Figure 13. Proportions (as percent standard length): body depth 35–52; head length 36–40; eye length 12–15; snout length 7–9; bony interorbital width 9–10; upper jaw length 16–18; caudal peduncle depth 15–17; caudal peduncle length 17–24; dorsal spine lengths—first 7–13, second 24–66, third 22–31, fourth 17–25, spine in sec-

TABLE 4.—Variation of gillraker counts for species of the subgenus *Zoramia*.

Species	Upper arch						Lower arch						Total													
	5	6	7	8	9	N	X̄	19	20	21	22	23	24	N	X̄	24	25	26	27	28	29	30	31	32	N	X̄
<i>A. perlitus</i>	12	42				54	6.78	14	29	11				54	20.94			3	18	26	7				54	27.69
<i>A. fragilis</i>	2	31	21			54	6.35	7	19	14	13	1		54	20.67	1	6	15	12	11	8	1			54	27.00
<i>A. gilberti</i>	4	44	17			65	7.20			7	38	17	3	65	22.25					10	27	19	7	2	65	29.45
<i>A. leptacanthus</i>	5	35	23	1	64	7.31			2	24	26	12	64	22.75					5	19	18	11	11	64	30.06	

TABLE 5.—Variation of the length of the second dorsal spine for species of the subgenus *Zoramia* as a percentage of standard length.

Species	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	N	X̄	
<i>A. perlitus</i>	2	13	19	9																									43	17.63
<i>A. fragilis</i>	3	13	17	9	2																								44	17.73
<i>A. gilberti</i>				1	6	6	10	10	5	1	1																		40	26.30
<i>A. leptacanthus</i>						2	-	-	3	1	3	3	4	3	4	1	3	5	6	4	3	3	4	2	2			2	58	46.34

TABLE 6.—Variation in body depth for species of *Zoramia* as a percentage of standard length.

Species	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	N	X̄	
<i>A. perlitus</i>	1	-	2	2	1	4	7	9	15	10	5	1														57	36.19
<i>A. fragilis</i>		1	-	1	-	4	1	4	3	8	8	8	16	6	1											61	38.93
<i>A. gilberti</i>												2	2	16	18	20	8	4	2							72	43.42
<i>A. leptacanthus</i>							1	1	-	3	4	4	4	5	6	7	10	11	13	9	6	1	-	1	86	44.60	



FIGURE 13.—*Apogon leptacanthus*, USNM 211830, 32.8 mm SL, an adult from Madang Harbor, New Guinea.

ond dorsal 16–21; anal spine lengths—first 2–5, second 13–17; pectoral fin length 25–30; pelvic fin length 20–23.

Second dorsal fin 1,9; 2 anal spines; pectoral fin 13–14; pelvic fin 1,5; well-developed gillrakers 27–31 (5 to 7 + 21 to 24), including rudiments 28–32 (0 to 2 + 5 to 7; 21 to 24 + 0 to 1); pored lateral-line scales 24, transverse scale rows above the lateral line 2; median predorsal scales 6, circumpeduncular scales 12 (5 + 2 + 5).

**COLOR OF PRESERVED SPECIMENS.**—Head and trunk pale to light dusky; fins transparent; a narrow dark line at base of dorsal fins and extending posteriorly to the procurrent rays of the caudal fin; a similar dark line, but no so prominent, on ventral portion of caudal peduncle.

**COLOR IN LIFE.**—This species is illustrated in color by Burgess and Axelrod (1976, fig. 37) from a color transparency.

**LIFE HISTORY.**—Three specimens of unknown sex were observed to have eggs in their mouths: USNM 183739, 29 mm SL, Palawan I., collected in December; USNM 183742, 38 mm SL, Tonquil I., Philippines, collected in September; USNM 211833, 31 mm SL, Solomon Is.,

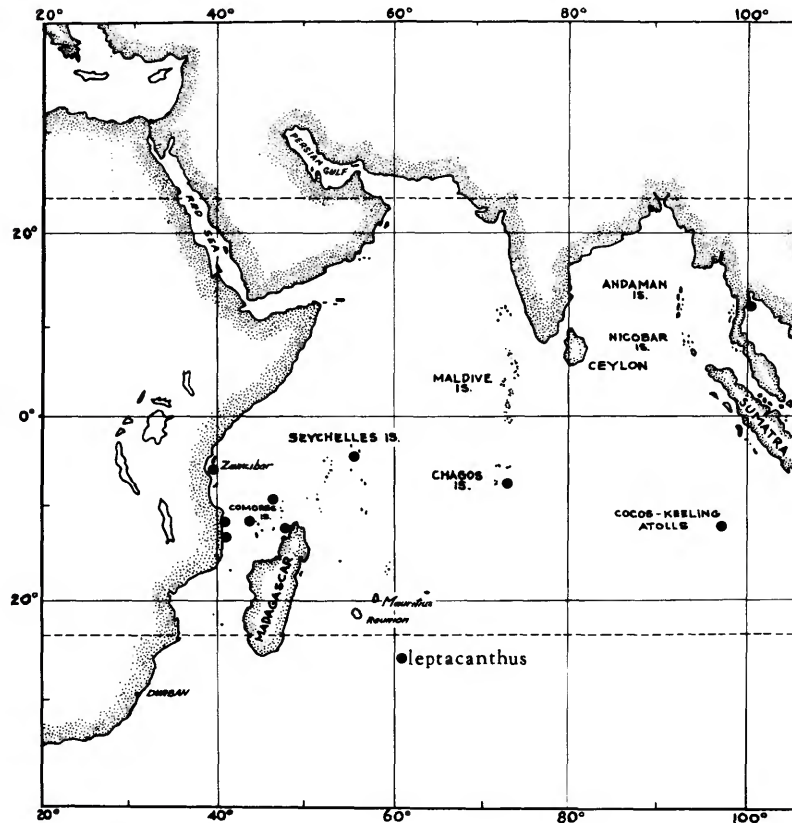
collected in June. The following specimen had no eggs in the mouth but had the characteristic buccal enlargement: GVF 483, 33 mm SL, Urukthapel I., Palau Is., collected in September.

**GEOGRAPHIC DISTRIBUTION.**—This species has a wide range, extending from the African coast eastward to the Samoan and Tonga islands (Figure 14). We have seen no material from the Red Sea and the northern Indian Ocean and from such other comparatively well-collected areas from the Line Islands southeastward to the Society Islands. Randall (1983:62) illustrated from a color slide a specimen captured in the Red Sea.

**REMARKS.**—The extant type material consists of one syntype, RMNH 5570, but Bleeker (1856a) reported on two specimens in the original description. One specimen is apparently lost. The existing specimen is in a poor state of preservation. Our use of Bleeker's name is based on the original description, Bleeker's illustration in volume 7 of his *Atlas* (1873–1876:97, pl. 71: fig. 3), and the existing syntype.

A large collection of *A. leptacanthus* (GVF 1853) consisting of about 200 specimens from the Palau Islands included 77 specimens of *A.*

FIGURE 14.—Distribution of *Apogon leptacanthus*.



*gilberti* and four specimens of *A. fragilis*. Several other collections of *A. gilberti* were taken with *A. leptacanthus*.

**MATERIAL EXAMINED.**—About 4059 specimens, the largest 45 mm SL.

**Syntype:** RMNH 5570, 31 mm SL, Ternate, Moluccas, Bleeker collection.

**Type Specimens of *Apogon graeffi*:** BMNH 1873.4.3.32, 2 syntypes (27.9, 30.4), Boston I., Marshall Is. NHMW 34966–34967, 2 syntypes (23, 38), Boston I., Marshall Is.

**Type Specimens of *Amia nematacantha*:** QM I.1273, holotype, 32.8 SL, Darnley I., Torres Strait, between Cape York and New Guinea. QM I.1270–1272, 1275, 4 paratypes (29.0–32.4 SL), Darnley I.

**Other Material:** AFRICAN COAST: RUSI 3070, 3 (39–42), Zanzibar. RUSI 3067, 2 (42, 43),

Kifuki I., Mozambique. RUSI 3069, 3 (27–32), Takamji I., Mozambique. RUSI 3071, 8 (30–45), Pinda Reef, Mozambique. RUSI 3064, 4 (30–34); RUSI 3068, 4 (30–40); both Wamizi I., Mozambique.

MADAGASCAR: USNM 211822, 59 (21–29); USNM 211823 (27); both Nossi Bé.

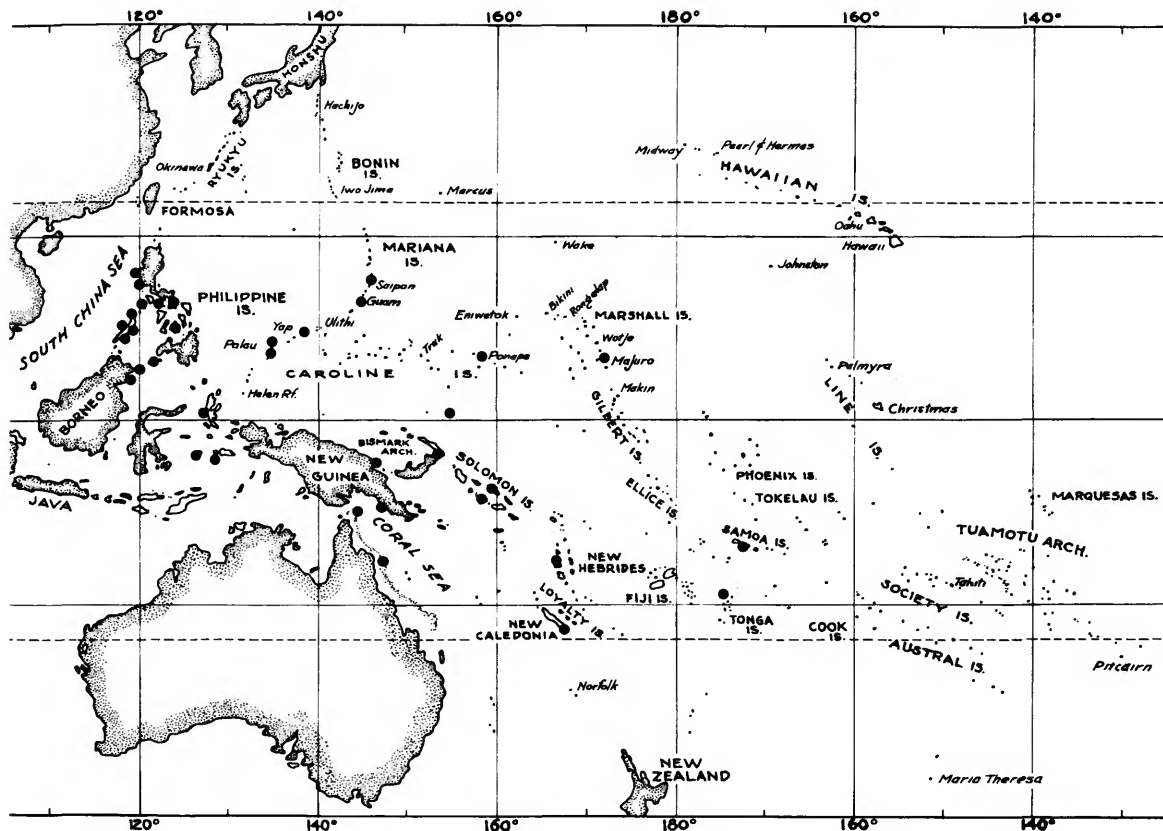
COMORO ISLANDS: USNM 213051 (38), Grande Comore I.

ALDABRA: RUSI 3065, 2 (28, 31).

SEYCHELLES: RUSI 3063 (39); RUSI 3066, 5 (29–38); both from Mahé I. USNM 211824, 8 (18–28), Mahé vicinity, W of NW tip of Anonyme I.

COCOS-KEELING ISLANDS: ANSP I30727 (41), Pulo Pandang.

CHAGOS ARCHIPELAGO: USNM 211825, 7 (32–35), Diego Garcia Atoll.



**BORNEO:** USNM 211826 (34), Palau Gaya, Darvel Bay. USNM 211827, 11 (18–23), Palau Gaya, Darvel Bay.

**GULF OF SIAM:** GVF 1462 (28), Goh Sak I.

**MOLUCCAS:** USNM 210429, 4 (18–41), Ambon I., Poka. USNM 210461 (17), Ambon I.

**PHILIPPINES:** USNM 183740, 3 (28–30), Rasa I., Mautaquin Bay, Palawan I. USNM 179690, 134 (21–34), Luzon, near Palag Bay. USNM 183739, over 80 (20–35), Balalo Bay, Palawan I. USNM 183741, 21 (25–39), Pt. Uson, Pinas I. USNM 168420 (30), Tonquil I. USNM 183782, 72 (24–44), Tifu Bay, Bouro I. USNM 183743, 4 (34–36), Makes I., Palawan I. USNM 183772, 3 (32–33), Mantacao I., W coast Bohol. USNM 183778, 2 (25, 30), Romblon. USNM 183757 (A. 23300) (38), Makes I., Palawan I. USNM 183761 (A. 23905) (35), Tataan Tawi Tawi

group. USNM 183759 (A. 23649) (38), Caracaran, Batan I. USNM 183756 (A. 23262) (38), Port Palapag, E coast Luzon. USNM 183769 (A. 480–482), 3 (24–32); USNM 183771, 2 (34, 35); both Romblon. USNM 183747 (A. 23171, 23172, 23425), 3 (38–40); USNM 179691, 8 (37–40); both Tutu Bay, Jolo I. USNM 183751 (A. 16103–16106), 4 (32–33); USNM 183762, 10 (30–38); both Cataingan Bay, Masbate I. USNM 183767, 6 (32–36), Biri Channel, E coast Luzon. USNM 183758 (A. 23589–91), 3 (38–41), Tifu Bay, Bouro I. USNM 183752 (A. 16539) (32), Port Matalvi, Luzon. USNM 152109, 10 (32–38), Rapu Rapu. USNM 183742, 87 (24–38), Tonquil I. USNM 183746 (A. 23773) (32); USNM 183764, 2 (24, 24); both Ulugan Bay, Palawan I. USNM 183744 (A. 8304–8313), 10 (24–36), San Miguel I., Tobacco



Bay, E coast Luzon. USNM 211828, 2 (22, 30), Port Matalvi, Luzon I. SU 20960, 2 (26, 31), Culion I.

CELEBES (Sulawesi): USNM 183774 (33), Tomahu I.

NEW GUINEA: USNM 211829 (29); USNM 211830, 3 (19–33); USNM 211831, 28 (19–36); AMS 1.17089;027, 7 (19–33); all Madang Harbor, Krankett I. BPBM 15759, 2 (31, 32), Madang, Sinaub I. AMS 1.17262-022, 2 (33, 34), Port Moresby, bay on Manubada I.

AUSTRALIA: ANSP 123419, 13 (36–41); AMNH 42961, 4 (37–41); AMNH 42960, 11 (35–40); AMNH 42962, ~200 (19–41); all Little Hope I., Queensland.

BISMARCK ARCHIPELAGO: USNM 211832, 46 (21–35), Keraward I., Duke of Kirk group.

NEW CALEDONIA: USNM 197682, 2 (34, 42), Magenta Bay and Ansevata Bay.

SOLOMON ISLANDS: USNM 211833, 12 (30–34); USNM 211834, 15 (26–31); USNM 211835, 10 (23–31); all Wana-Wana I. and Blakett Straits, New Georgia. USNM 211836 (31), N shore Wana-Wana I. USNM 207033 (17), Mundi region, New Georgia I. USNM 211837, ~300 (19–36), Munda lagoon, New Georgia. FMNH 22121–22, 2 (30, 32), Tenibuli, Isabel I. SU 25360, 2 (29, 33), Isabel I.

PALAU ISLANDS (Belau): USNM 154239 (23). USNM 154240, 123 (22–37), W Koror. GVF 558, ~100 (23–45); GVF 1873, ~100 (22–36); GVF 1412 (40); GVF 1957, 3; GVF 1959, 1; GVF 532, 12; all Koror I. GVF 866, 4; GVF 941, 11; both from Kayangel I. GVF 1829, 26; 2004, 1; 1439, 2; 827, 43; 1992, ~100; all from Babelthaup I. GVF 529, 6; 546, 39; 1414, ~150; 1415, 37; all Auluptagel I. GVF 483, 18; 526, 9; 1870, 12; 1979, 1; all from Urukthapel I. GVF 1972, 1, Ngadarak Reef. GVF 1853, ~200; BPBM 6958, 18; both from Arakabesan I. GVF 754, 6; GVF 639, 60; both from Iwayama Bay.

MARIANA ISLANDS: USNM 154241, 2 (21, 22), Saipan. USNM 124165 (30), Guam, Merizo.

TONGA ISLANDS: USNM 211838, 1475 (22–42), Neiafu, Vava'u Tonga.

SAMOAN ISLANDS: USNM 52407, 4 (33–39) (tin

tag 06581); USNM 111965, 2 (27, 32); both Apia. USNM 15110 (35). USNM 20512, 1 specimen. SU 8897, 5 (26–45), Apia (tin tags 02575, 02345 loose in jar). BPBM 6143, 24 (28–33), Apia, Upolu.

MARSHALL ISLANDS: USNM 166595, 12 (27–37), Uliga I., Majuro Atoll.

NEW HEBRIDES (Vanuatu): GVF 1826, 23 (24–32), Espiritu Santo I.

CAROLINE ISLANDS: GVF 496 (29); GVF 492, 2; BPBM 11854, 48 (23–33); all Ponape I. GVF 377 (31), Kapingamarangi Atoll. GVF 470, 9; Kapingamarangi. GVF, sta 196, 38 (13–24), Japutik I. GVF 1903, 47; 1904, 3; 1907, ~200; 1910, ~1000 (20–40); 1912, 2; 1915, 1; 1935, ~200; 1937, 36; 1941, 9; 1942, 13; 1946, 17; all from Yap I.

### *Apogon perlitus*, new species

FIGURES 15, 16

DIAGNOSIS.—A tiny basicaudal spot; dark mark on gular area; many diffuse melanophores on side of caudal peduncle; 4 to 8 short, dark, vertical lines on body just above base of anal fin; second dorsal spine not produced as a filament, less than 21% of standard length.

DESCRIPTION.—Important morphometric and meristic data are treated in Tables 4–6. For general shape and pigment pattern see Figure 15. Proportions (as percent standard length, holotype in parentheses): body depth (39.7) 29–40; head length (40.4) 39–44; eye length (13.5) 13–15; snout length (8.7) 7–10; bony interorbital width (8.7) 8–10; upper jaw length (18.7) 17–19; caudal peduncle depth (16.1) 13–17; caudal peduncle length (22.5) 22–26; dorsal spine lengths—first (9.0) 7–11, second (18.4) 15–21, third 16–20, fourth 13–17, spine in second dorsal (15.6) 15–18; anal spine lengths—first 2–4, second (13.0) 13–16; pectoral fin length (26.7) 25–28; pelvic fin length (20.8) 19–21.

Second dorsal fin 1,9; 2 anal spines; pectoral fin 14 (rarely 15); pelvic fin 1,5; well-developed gillrakers 25–27 (5–6 + 19–21), including rudiments 26–29 (0–2 + 5–6; 19–21 + 0–1), holo-

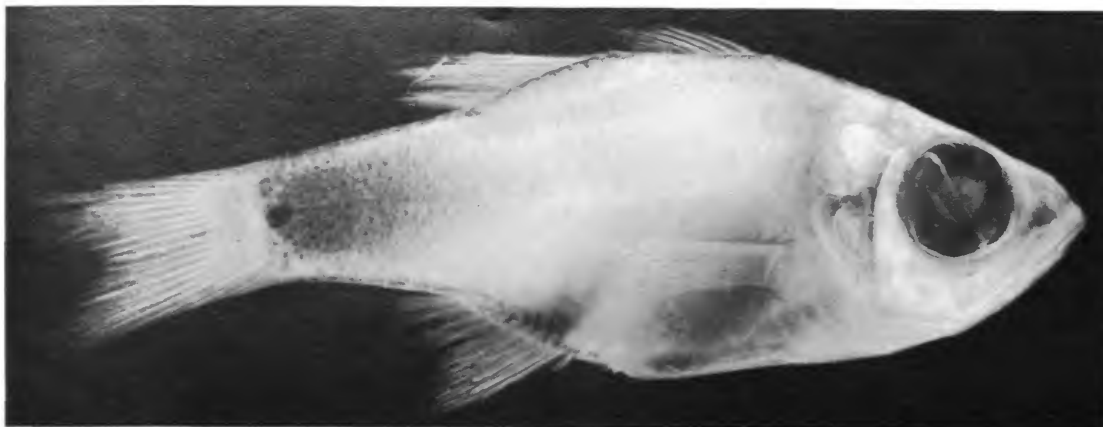


FIGURE 15.—*Apogon perlitus*, new species, USNM 177850, 38.4 mm SL, an adult from the Palau Islands.

type 2 + 5 – 21 + 0; pored lateral-line scales 24; transverse scale rows above lateral line 2; median predorsal scales 6; circumpeduncular scales 12 (5 + 2 + 5).

**COLOR OF PRESERVED SPECIMENS.**—The only conspicuous color mark is a small, dark, round to slightly oval, discrete basicaudal spot, its diameter almost one-half that of pupil; a diffuse, broad patch of melanophores scattered over caudal peduncle anterior to basicaudal spot; four to eight dark, short, moderately intense vertical lines on body just above anal fin base; a dark to dusky gular spot; a dark mark between tip of snout and eye; a dark spot between angle of jaw and eye; outer membranes black between second and third, and third and fourth dorsal spines; some scattered melanophores dorsally on head and nape, on dorsal midline of trunk and laterally on trunk above the midline; remainder of body mostly pale and the fins transparent.

**ETYMOLOGY.**—The specific name *perlitus* is a Latin word meaning smeared or bedaubed, in reference to the large, dark, diffuse cluster of chromatophores on the caudal peduncle.

**GEOGRAPHIC DISTRIBUTION.**—Known from the Philippines and Palau, southeastward to the Bismark Archipelago (Figure 16).

**REMARKS.**—A large collection of *Zoramia* was captured at Ambon Island, consisting of 7 speci-

mens of *A. perlitus* (USNM 210439), 4 specimens of *A. leptacanthus* (USNM 210429), and about 400 specimens of *A. fragilis* (USNM 210419).

**MATERIAL EXAMINED.**—The type material consists of 417 specimens ranging in size from 16–42 mm SL.

**Holotype:** BPBM 15476, 42.3 mm SL, Palau I., Kayangel Lagoon; 5 Dec 1956; P.T. Wilson coll.

**Paratypes:** PALAU ISLANDS (Belau): BPBM 15477, 13 (23–40); RUSI 3393, 5 (36–39); AMS 1.17267-001, 5 (26–38); USNM 177850, 320 (21–39), one stained and cleared; BPBM 10545, 22 (23–40); RMNH 27056, 2 (36, 40); BMNH 1974.6.24.5–6, 2 (33, 40); all taken with holotype. GVF 1974, paratypes, 5 (24–27), bay in SW portion of Urukthapel I., over sand and coral heads, 16 Aug 1959, sta 713. GVF 1414, paratype, 31 mm SL, Palau I., at northern tip of Auluptagel I., 7 Oct 1957, sta 57-36. USNM 213450, 1 specimen cleared and stained, out of USNM 177850. MOLUCCAS: USNM 210439, 7 (16–33), Ambon I., Poka, 24 Jan 1973, Rumphius Exp. 1, sta AB-3, V.G. Springer 73-20. PHILIPPINES: USNM 211850 (20), Tonquil I., E of Gumila Reef, 14 Sep 1909, *Albatross*. USNM 211851, 14 (22–35), Palawan I., Makesi I., 5 Apr 1909, *Albatross*. USNM 183748 (A. 6754) (25), Palawan I., Endeavour Strait, near Chase Head,

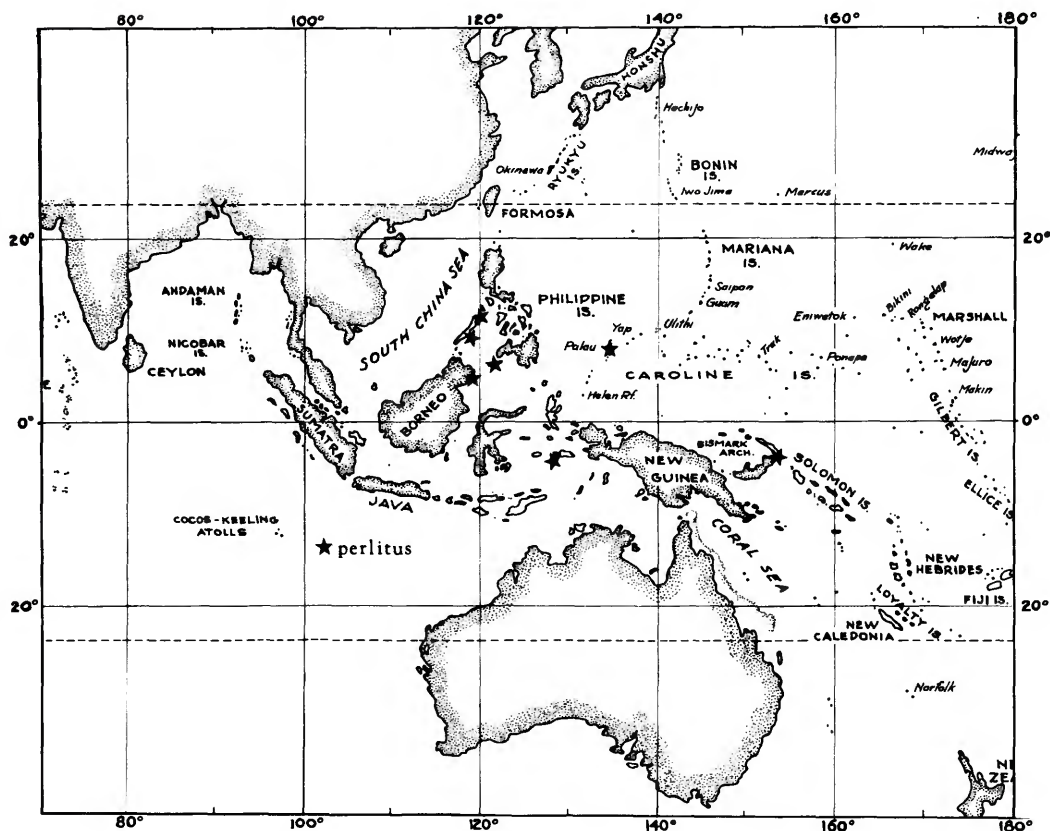


FIGURE 16.—Distribution of *Apogon perlitus*, new species.

22 Dec 1908. BISMARK ARCHIPELAGO: USNM 213052, 18 (28–31), Keraward I., 25 Feb 1965, Te Vega Cr. 6, sta 234.

Non-type Material: PAPUA, NEW GUINEA: USNM 262223, 2 (30, 33), Ninigo Is.

***Apogon gilberti* (Jordan and Seale)**

FIGURES 17, 18

*Amia gilberti* Jordan and Seale, 1905:777–778, fig. 3 [type-locality: Negros Island, Philippines].

DIAGNOSIS.—A broad diffuse area of melanophores on side of caudal peduncle; usually a well-developed but small dark basicaudal spot; a small, dark, opercular spot, variable, prominent to faint; second dorsal spine elongate or slightly

filamentous, usually greater than 22% of standard length.

DESCRIPTION.—Important morphometric and meristic data are treated in Tables 4–6. For general shape and pigment pattern see Figure 17. Proportions (as percent standard length): body depth 40–47; head length 36–43; eye length 13–16; snout length 8–10; bony interorbital width 8–9; upper jaw length 16–19; caudal peduncle depth 14–18; caudal peduncle length 20–24; dorsal spine lengths—first 9–13, second 20–35; third 22–24, fourth 16–20, spine in second dorsal 15–18; anal spine lengths—first 3–4, second 13–15, pectoral fin length 23–29; pelvic fin length 19–25.

Second dorsal fin 1,9; 2 anal spines; pectoral fin 14 (rarely 13); pelvic fin 1,5; well-developed

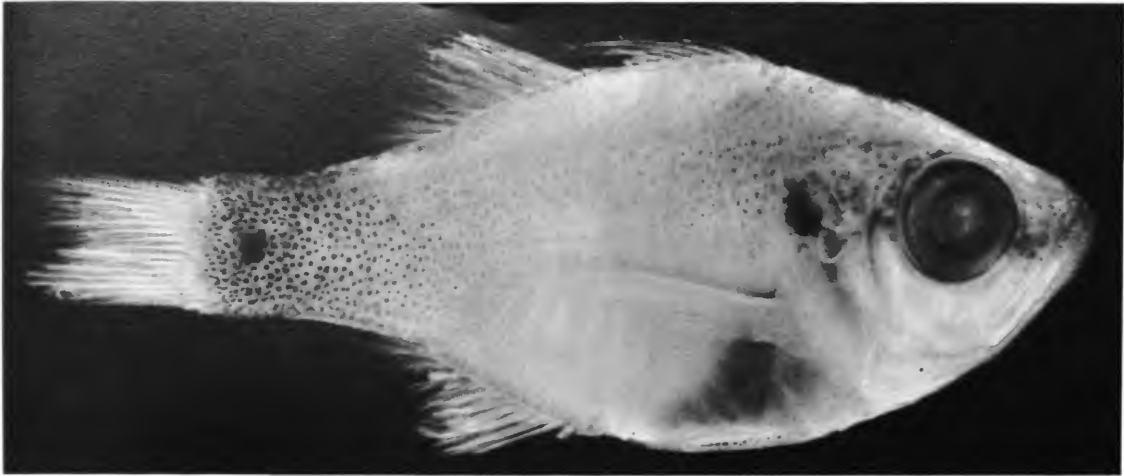


FIGURE 17.—*Apogon gilberti*, USNM 225697, 42.6 mm SL, an adult from Darvel Bay, Borneo.

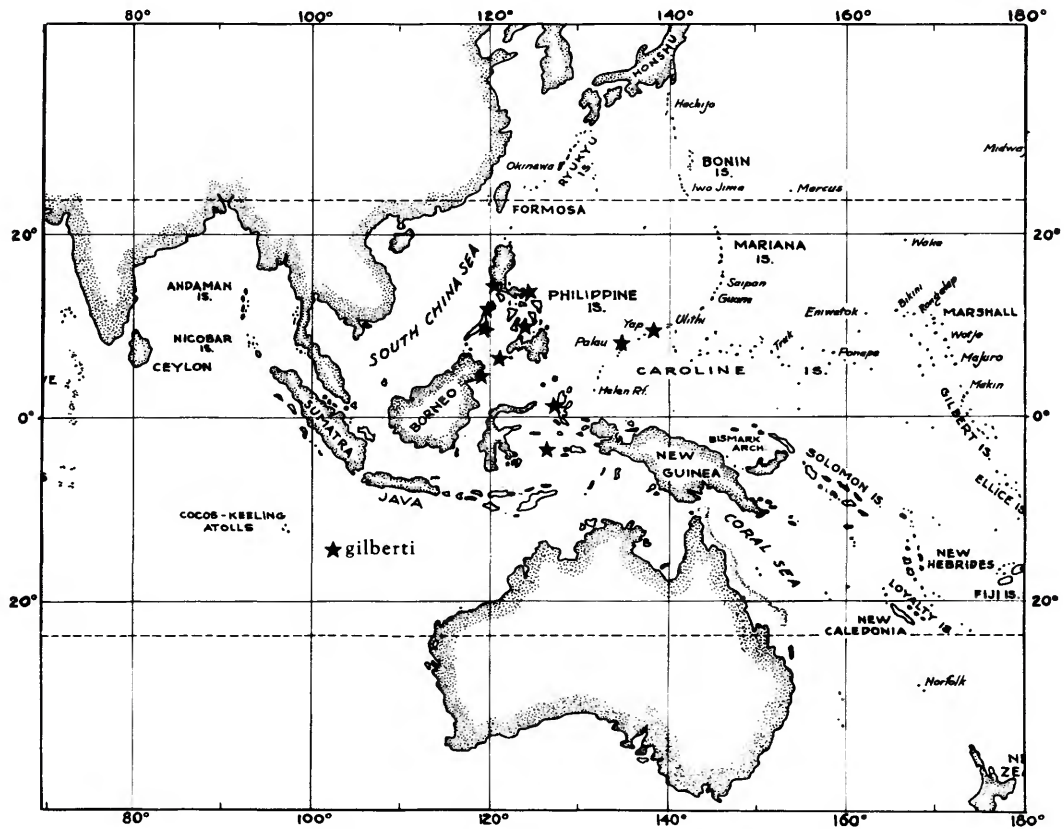


FIGURE 18.—Distribution of *Apogon gilberti*.



gillrakers 26–30 (5–7 + 21–23), including rudiments 28–32 (0–2 + 5–7; 21–23 + 0–1); pored lateral-line scales 24; transverse scale rows above lateral line 2; median predorsal scales 6; circum-peduncular scales 12 (5 + 2 + 5).

**COLOR OF PRESERVED SPECIMENS.**—The conspicuous color mark in this species is the small, dark, circular, discrete basicaudal spot, as is present in *A. perlitus* but slightly larger, its diameter one-half that of pupil; a dark spot on posterior portion of opercle in a horizontal line with eye, its maximum depth about equal to diameter of pupil, variable in intensity from prominent to faintly developed, sometimes obscure; sides of caudal peduncle with a diffuse area of melanophores, more widely scattered than in *A. perlitus*, extending over the depth of the peduncle and anterior and posterior to the basicaudal spot; a faint, broad, pale stripe on midside of trunk interspersed with melanophores; sometimes another pale stripe dorsolaterally on trunk; these stripes often obscure; snout, interorbital and anterior portion of upper and lower jaws dusky; body at bases of dorsal fins and dorsal midline of caudal peduncle with a narrow dusky streak; body at base of anal fin and lower midline of caudal peduncle dusky; a narrow dusky stripe on anal fin just at its base; head and trunk otherwise with scattered melanophores; dorsal, anal, caudal, and pelvic fins with variously scattered melanophores; pectoral fins mostly pale.

**LIFE HISTORY.**—Several specimens had prominent buccal enlargements: GVF 1909, 27–33 mm SL, collected in December from Yap I., and USNM 225697, 33–40 mm SL, taken in February from Borneo. No specimens examined contained eggs in the mouth.

**GEOGRAPHIC DISTRIBUTION.**—This species has a fairly restricted distribution, limited to the Philippines and some eastern Indonesian islands and to Belau and Yap islands (Figure 18).

**REMARKS.**—Hayashi (1980:263–266, fig. 3) synonymized *A. fragilis* with *A. gilberti* based on his examination of one type specimen of each form and several other collections. He gave a detailed analysis including meristic and morphometric characters and certain color marks of four

specimens of *A. gilberti* and two specimens of *A. fragilis* in Table 1. Hayashi's decision was undoubtedly influenced by the faded or poorly preserved types and in having only a few specimens available for study, a common problem in revisionary studies. He observed the black spot on the caudal base of the holotype for *A. gilberti* (Table 1) and stated that the black spot on the opercle was absent. On page 264 he states: "a distinctly black spot on upper part of opercle just above and anterior to base of pectorals (not seen in YCM-P4608)." On hundreds of specimens that we have examined of *A. gilberti*, the dark opercular spot is usually present but variable in intensity, ranging from a prominent spot to a faint, diffuse group of melanophores. The holotype of *A. gilberti*, USNM 51941, still shows remnants of a diffuse opercular spot. The caudal peduncle spot on *A. gilberti* is very small, about one-half the diameter of the pupil, the peduncle area is covered with diffuse melanophores and the second spine of the spinous dorsal fin is elongate or slightly filamentous. *Apogon fragilis* lacks the opercular spot, has a larger dark basicaudal spot than *A. gilberti* (more than one-half diameter of pupil), lacks the scattered melanophores in the broad peduncular area anterior to the basicaudal spot, and has no attenuation of the second spine of the spiny dorsal fin. Hayashi's photograph of *A. gilberti* (1980, fig. 3) is clearly *A. fragilis*, which is also shown in color by Burgess and Axelrod (1975:1442, fig. 92; 1976, fig. 36). The large collection of *A. gilberti* (GVF 1910) of about 900 specimens clearly displays the characteristics of this species.

**MATERIAL EXAMINED.**—1719 specimens, ranging in size from 23–42 mm SL.

Holotype: USNM 51941, 32.6 mm SL, Philippines, Negros I., 1901, Bashford Dean coll. (specimen bears label designated "Type").

Paratypes: USNM 211818, 36.4 mm SL, taken with holotype. SU 9135, 34.3 mm SL, Southern Negros, Philippine Is., Bashford Dean coll.

Other Material: INDONESIA: USNM 225695, 7 (34–42), Halmahera I. BORNEO: USNM 225697, 89 (33–42), Darvel Bay. PHILIPPINES:

USNM 183749 (A. 8429) (35), W Luzon, Port Matalvi. USNM 211819, 2 (34, 35), Luzon I., Port Matalvi. USNM 112919 (38), Palawan I., Endeavour Strait. USNM 211820 (A. 16540) (36), W Luzon, Port Matalvi. USNM 225696, 10 (34–40), Palawan I., Makesi I. USNM 183737, 98 (28–34), Luzon I., Palag Bay. USNM 183766 (A. D5143) (32), vicinity Jolo I. USNM 183777 (31), E coast Luzon, Port Palapag. USNM 183773, 8 (32–36), *Albatross-Philippine*. CELEBES (Sulawesi): USNM 211316, 11 (32–36), Bourri I., Tifu Bay. PALAU ISLANDS (Belau): GVF 1397, 33 (27–38), Babelthuap Atoll. GVF 483, 4 (30–37), Urukthapel I. GVF 1853, 77 (29–42), Arakabesan I. CAROLINE ISLANDS: CAS 28781 2 (28, 34); CAS 28780 (39); GVF 1910, ~900 (25–40); GVF 1903, ~200 (23–35); GVF 1942, ~100 (26–38); GVF 1949, 51 (24–37); GVF 1912, 2 (32, 35); GVF 1917 (33); GVF 1929, 14 (27–37); GVF 1909, 44 (27–33); GVF 1908, 26 (24–36); all from Yap I.

*Apogon fragilis* Smith

FIGURES 19, 20

*Apogon fragilis* Smith, 1961:385–386, pl. 46: fig. H [type-locality: Pinda Reef, Mozambique].

DIAGNOSIS.—A small, rounded, basicaudal spot, rest of body and fins pale, only occasionally with some scattered melanophores on caudal pe-

duncle; second dorsal spine not produced as a filament, not more than 22% of standard length.

DESCRIPTION.—Important morphometric and meristic data are treated in Tables 4–6. For general shape and pigment pattern see Figure 19. Proportions (as percent standard length): body depth 30–43; head length 37–41; eye length 13–14; snout length 9–10; bony interorbital width 8–9; upper jaw length 16–19; caudal peduncle depth 15–17; caudal peduncle length 21–25; dorsal spine lengths—first 9–12, second 19–22, third 18–21, fourth 13–17, spine in second dorsal 14–16; anal spine lengths—first 2–4, second 12–15; pectoral fin length 25–29; pelvic fin length 20–23.

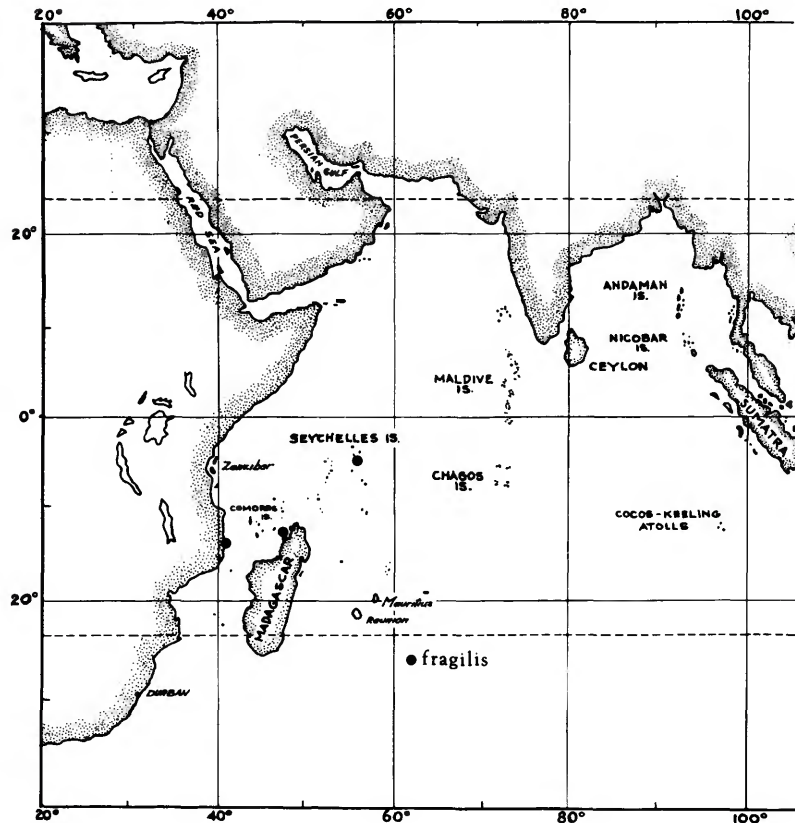
Second dorsal fin 1,9; 2 anal spines; pectoral fin 14; pelvic fin 1,5; well-developed gillrakers 23–28 (4–7 + 19–24) including rudiments 24–30 (1–2 + 4–7; 19–24 + 0–2); pored lateral-line scales 24; transverse scale rows have the lateral line 2; median predorsal scales 6; circumpeduncular scales 12 (5 + 2 + 5).

COLOR OF PRESERVED SPECIMENS.—The dark, circular, discrete basicaudal spot, about the size of that in *A. gilberti*, is the only prominent color mark on this species. A faint dusky mark from snout to eye; some scattered melanophores on trunk, absent on belly; outer portion of membrane between second and third dorsal spines dusky; body otherwise mostly pale and the fins transparent to only slightly dusky.



FIGURE 19.—*Apogon fragilis*, USNM 213073, 49.5 mm SL, an adult from Karimundjawa Islands, Indonesia.

FIGURE 20.—Distribution of *Apogon fragilis*.



**COLOR IN LIFE.**—This species is illustrated in color from a color transparency by Burgess and Axelrod (1975:1442, fig. 92; 1976, fig. 37).

**LIFE HISTORY.**—Twenty-six specimens of unknown sex were observed to have eggs in their mouths: USNM 183781, 31 mm SL, June, from Luzon; USNM 205774, 7 (36–77 mm), April, from Palawan Island; USNM 205845, 12 (34–39 mm), September, from Jolo Island, Philippines; USNM 211315, 6 (30–33 mm), December, from Bouru Island, Philippines. Specimens with buccal development but lacking eggs in the mouth: USNM 211840, 3 (31–34), May from Madang Harbor, New Guinea. A gravid female, GVF 1826, 34.9 mm SL, with typical body coloration had no buccal enlargement.

**GEOGRAPHIC DISTRIBUTION.**—Occurs from the African coast eastward to the Samoan Islands (Figure 20). This species is peculiarly absent in

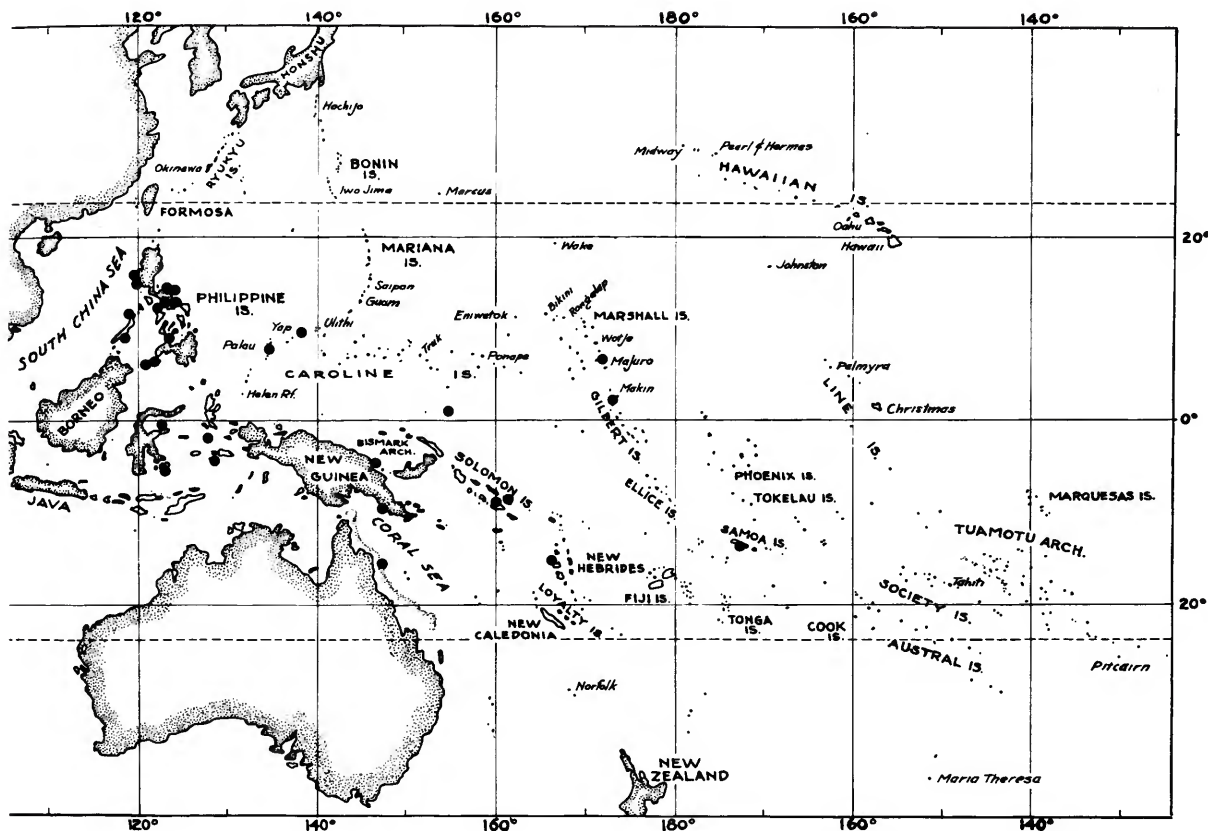
the northern and central insular Indian Ocean.

**REMARKS.**—*Apogon fragilis* can be confused with *A. gilberti* when poorly preserved specimens are being examined. The general body pigmentation of *A. gilberti* differs considerably from *A. fragilis*, although subtly; in addition to the absence of the patch of melanophores encircling the basicaudal spot and the dark opercular spot that is present in *A. gilberti*, the total gillraker count is lower in *A. fragilis* (Table 4), the second dorsal spine shorter (Table 5), and the body is not so deep (Table 6) when compared to *A. gilberti*.

**MATERIAL EXAMINED.**—4333 specimens in 79 collections, ranging from 13–43 mm SL.

Holotype: RUSI 357, 34.1, Mozambique, Pinda Reef, Jul 1950.

Paratypes: RUSI 3078, 2 (37, 39), Mozambique, Pinda Reef, 18 Jul 1950, RUSI 3077 (34),



Seychelles, Mahé I., 9 Sep 1954. RUSI 3079, 7 (37-41), Mozambique, Pinda Reef, Jul 1950. RUSI 3080, 36 (24-42), specific data lost, East Africa to Seychelles.

Other Material: MADAGASCAR: USNM 211839, 9 (26-33), Nossi Bé. MOLUCCAS: USNM 210520, 7 (18-36); USNM 210419, ~400+ (18-40); both from Ambon, Poka. INDONESIA: USNM 213073, 49 (35-41), Karimundjawa Is. BORNEO: USNM 22569, 179 (17-37), Darvel Bay. CELEBES (Sulawesi): USNM 183779, 7 (29-37), Pendek I. USNM 183763, 2 (33, 35), Togian I., Togian Bay. USNM 183750 (A. 13298, 24052-53), 3 (34-35), Gomumu I. USNM 211315, 30 (29-38), Bouru I., Tifu Bay. USNM 211317 (43), Bouru I., Tifu Bay. PHILIPPINES: USNM 183775 (30), San Miguel I., Tabaco Bay. USNM 183780, 5 (35-39), Palawan I., Bolalo Bay. USNM 183781, 4 (31-39); USNM 211849, 3 (24-27);

both Luzon, near Palag Bay. USNM 183776, 11 (26-36): USNM 183745 (A. 122, 123, 129, 24074), 4 (27-34); USNM 183754 (A. 19127) (34); all Endeavour Strait. USNM 211844 (36); USNM 183765 (A. 472-474), 3 (37-38); both Romblon I. USNM 183768 (28), Palawan I., N Endeavour Strait. USNM 183753 (A. 18512) (39), Butauanan I., E coast Luzon. USNM 183755 (A. 21970) (33), Mindanao, Murcielagos Bay. USNM 183760 (A. 23712) (39), Burias I., Busin Harbor. USNM 183770 (38), Batan I., Caracaran Bay. USNM 205844, 38 (25-37), Palawan I., Makesi I. USNM 183738, 100+ (22-37), Luzon, Pt. Jamelo. USNM 183735, 200+ (29-35); USNM 211846 (A. 16538, 16541), 2 (31, 35); both Luzon I., Port Matalvi. USNM 211845 (A. 6646-47), 2 (37, 38): USNM 205845, 37 (29-39); both Jolo I., Tutu Bay. USNM 183736, 33 (24-38), Luzon I., Saboon



l., Ragay Bay. USNM 205774, 51 (29-40), Palawan I., Rasa I. USNM 205846, 35 (29-35), Pt. Uson, Pinas I. USNM 211847 (A. 8281-91, 17780), 12 (28-38), E coast Luzon, San Miguel I., Tobacco Bay. USNM 211848, 24 (25-37), Tonquil I., E of Gumila Reef. NEW GUINEA: USNM 211840, 27 (24-35); AMS I.17089-026, 7 (30-33); both Madang Harbor, bay in Krankett I. USNM 211841, ~700 (28-42), Madang Harbor, inside S tip Paeowai I. USNM 211842, 5 (14-25); AMS I.17087-009, 39 (33-40); both Madang. AMS I.17262-017 (35), Port Morseby, Manubada I. AUSTRALIA: ANSP 123368, 3 (34-40); ANSP sta TSA-5, 5 (18-21); ANSP sta TSA-3, 600+ (20-28); all from Queensland, Endeavour Reef. BISMARCK ARCHIPELAGO: USNM 211843 (29), Nissan Group, Pinipel I. USNM 207068 (20), Nissan I. SOLOMON ISLANDS: BPBM 15627, 11 (30-35), Malaita I. on Alite Reef.

BPBM 15684 (25), Guadalcanal I. at Honiara. NEW HEBRIDES (Vanuatu): GVF 1826, 87 (24-36), Espiritu Santo I. PALAU ISLANDS (Belau): GVF 1390, ~800 (27-34); GVF 602, 8 (20-35); GVF 546, ~100 (25-38); all Auluptagel I. GVF 1853, 4 (32-34), Arakabesan I. GVF 526, 54 (25-40); GVF 610 (31); GVF 1870 (34); GVF 1979, 2 (29, 33); GVF 1993, 77 (24-39); BPBM 8071, 35 (26-37); all Urukthapel I. GVF 1408, 11 (13-26); GVF 754, 3 (26-27); both from lwayama Bay. GVF 1434, 34 (20-33), Malakal I. CAROLINE ISLANDS: GVF 317, ~400 (28-38); GVF 315, 9 (24-31); GVF 470 (23); all Kapin-gamarangi Atoll. GVF 1903, 12 (19-29); GVF 1904, 7 (19-32); GVF 1917 (28); GVF 1918 (30); all Yap. I. MARSHALL ISLANDS: BPBM 9699, 4 (26-30), Majuro Atoll in lagoon. GILBERT ISLANDS (Kiribati Republic): AMS D.F. Hoese sta 73-32 (34), Abaiang Atoll.

## Literature Cited

- Aoyagi, H.  
1943. *Coral Fishes, Part I.* xii + 224 pages. Tokyo: Maruzen Co., Ltd.
- Axelrod, H.R., and C.W. Emmens  
1969. *Exotic Marine Fishes.* 607 pages, numerous color plates. New Jersey: T.F.H. Publications, Inc.
- Bennett, E.T.  
1833. Characters of New Species of Fishes from the Mauritius, Presented by C. Telfair, Esq. *Proceedings of the Zoological Society of London*, 1:32.  
1835. Characters of Several Fishes from Isle de France. *Proceedings of the Zoological Society of London*, 3:206–208.
- Bleeker, P.  
1852. Bijdrage tot de Kennis der ichthyologische Fauna van de Moluksche Eilanden: Visschen van Amboina en Ceram. *Natuurkundig Tijdschrift voor Nederlandsch-Indië*, 3:229–309.  
1856a. Achtste Bijdrage tot de Kennis der ichthyologische Fauna van Ternate (1). *Natuurkundig Tijdschrift voor, Nederlandsch-Indië*, 12:191–210.  
1856b. Beschrijvingen van nieuwe of weingig bekende Vischsoorten van Manado en Makassar grootendeels verzameld op eene reis naar den Molukschen Archipel in het gevolg van den Goovernear-General Dugmaer van Twist. *Acta Societatis Scientiarum Indo-Neerlandicae*, 1:1–80.  
1873–1876. Percoides, I. In *Atlas ichthyologique des Indes Orientales Néerlandaises*, 7:126 pages, plate 71. Amsterdam.
- Burgess, W., and H.R. Axelrod  
1975. Fishes of Melanesia. In *Pacific Marine Fishes*, 6:1387–1654, 479 figures. T.F.H. Publications, Inc.  
1976. Fishes of Melanesia. In *Pacific Marine Fishes*, 7:1658–1925, 412 figures. T.F.H. Publications, Inc.
- Fraser, T.H.  
1972. Comparative Osteology of the Shallow Water Cardinalfishes (Perciformes: Apogonidae) with Reference to the Systematics and Evolution of the Family. *Ichthyological Bulletin, Rhodes University*, 34: i–v + 105 pages, 6 tables, 43 plates.
- Günther, A.C.L.G.  
1873. Die Fische der Südsee (1). *Journal des Museum Godeffroy*, 1:1–128, plate 20.
- Hayashi, M.  
1980. First Records of Three Apogonid Fishes from Japan. *Japanese Journal of Ichthyology*, 27(3):261–267, 3 figures, 1 table.
- Jenkins, O.P.  
1903. Report on Collections of Fishes Made in the Hawaiian Islands, with Descriptions of New Species. *Bulletin of the United States Fish Commission for 1902*, 22:417–511.
- Jordan, D.S.  
1917. Notes on *Glossamia* and Related Genera of Cardinalfishes. *Copeia*, 44:46–47.
- Jordan, D.S., and B.W. Evermann  
1903. Descriptions of New Genera and Species of Fishes from the Hawaiian Islands. *Bulletin of the United States Fish Commission for 1902*, 22:161–208.
- Jordan, D.S., and A. Seale  
1905. List of Fishes Collected by Dr. Bashford Dean on the Island of Negros, Philippines. *Proceedings of the United States National Museum*, 28(1407):769–803, 20 figures.  
1906. The Fishes of Samoa: Descriptions of Species Found in the Archipelago with a Provisional Checklist of the Fishes of Oceania. *Bulletin of the Bureau of Fisheries*, 25:175–488.
- Klunzinger, C.B.  
1870. Synopsis der Fische des Rothen Meeres, I: Percoiden-Mugiloiden. *Verhandlungen der Zoologisch-Botanischen Gesellschaft in Wien*, 20:669–834.
- Lachner, E.A.  
1953. Family Apogonidae: Cardinalfishes. In L.P. Schultz, Fishes of the Marshall and Marianas Islands. *Bulletin of the United States National Museum*, 202(1):412–498.
- Munro, I.S.R.  
1958. The Fishes of the New Guinea Region. *Papua and New Guinea Agricultural Journal*, 10(4):97–369.
- Ogilby, J.D.  
1913. On Six New or Rare Queensland Fishes. *Memoirs of the Queensland Museum*, 2:81–89, plate 22.
- Randall, John E.  
1983. *Red Sea Reef Fishes.* 192 pages, 324 figures. London: IMMEL Publishing.
- Smith, J.L.B.  
1961. Fishes of the Family Apogonidae of the Western Indian Ocean and Red Sea. *Ichthyological Bulletin, Rhodes University*, 22:373–418, plate 46.
- Valenciennes, A.  
1832. Descriptions de plusieurs especes nouvelles de poisson du genre *Apogon*. *Nouvelles Annales Museum Histoire Naturelle* (Paris), 1:51–60, plate 4.
- Weber, M., and L.F. de Beaufort  
1929. *The Fishes of the Indo-Australian Archipelago, V.* xiv–458 pages. Leiden: E.J. Brill.



## REQUIREMENTS FOR SMITHSONIAN SERIES PUBLICATION

**Manuscripts** intended for series publication receive substantive review within their originating Smithsonian museums or offices and are submitted to the Smithsonian Institution Press with Form SI-36, which must show the approval of the appropriate authority designated by the sponsoring organizational unit. Requests for special treatment—use of color, foldouts, case-bound covers, etc.—require, on the same form, the added approval of the sponsoring authority.

**Review** of manuscripts and art by the Press for requirements of series format and style, completeness and clarity of copy, and arrangement of all material, as outlined below, will govern, within the judgment of the Press, acceptance or rejection of manuscripts and art.

**Copy** must be prepared on typewriter or word processor, double-spaced, on one side of standard white bond paper (not erasable), with 1¼" margins, submitted as ribbon copy (not carbon or xerox), in loose sheets (not stapled or bound), and accompanied by original art. Minimum acceptable length is 30 pages.

**Front matter** (preceding the text) should include: **title page** with only title and author and no other information; **abstract** page with author, title, series, etc., following the established format; table of **contents** with indents reflecting the hierarchy of heads in the paper; also, **foreword** and/or **preface**, if appropriate.

**First page of text** should carry the title and author at the top of the page; **second page** should have only the author's name and professional mailing address, to be used as an unnumbered footnote on the first page of printed text.

**Center heads** of whatever level should be typed with initial caps of major words, with extra space above and below the head, but with no other preparation (such as all caps or underline, except for the underline necessary for generic and specific epithets). Run-in paragraph heads should use period/dashes or colons as necessary.

**Tabulations** within text (lists of data, often in parallel columns) can be typed on the text page where they occur, but they should not contain rules or numbered table captions.

**Formal tables** (numbered, with captions, boxheads, stubs, rules) should be submitted as carefully typed, double-spaced copy separate from the text; they will be typeset unless otherwise requested. If camera-copy use is anticipated, do not draw rules on manuscript copy.

**Taxonomic keys** in natural history papers should use the aligned-couplet form for zoology and may use the multi-level indent form for botany. If cross referencing is required between key and text, do not include page references within the key, but number the keyed-out taxa, using the same numbers with their corresponding heads in the text.

**Synonymy** in zoology must use the short form (taxon, author, year:page), with full reference at the end of the paper under "Literature Cited." For botany, the long form (taxon, author, abbreviated journal or book title, volume, page, year, with no reference in "Literature Cited") is optional.

**Text-reference system** (author, year:page used within the text, with full citation in "Literature Cited" at the end of the text) must be used in place of bibliographic footnotes in all Contributions Series and is strongly recommended in the Studies Series: "(Jones, 1910:122)" or "... Jones (1910:122)." If bibliographic footnotes are required, use the short form (author,

brief title, page) with the full citation in the bibliography.

**Footnotes**, when few in number, whether annotative or bibliographic, should be typed on separate sheets and inserted immediately after the text pages on which the references occur. Extensive notes must be gathered together and placed at the end of the text in a notes section.

**Bibliography**, depending upon use, is termed "Literature Cited," "References," or "Bibliography." Spell out titles of books, articles, journals, and monographic series. For book and article titles use sentence-style capitalization according to the rules of the language employed (exception: capitalize all major words in English). For journal and series titles, capitalize the initial word and all subsequent words except articles, conjunctions, and prepositions. Transliterate languages that use a non-Roman alphabet according to the Library of Congress system. Underline (for italics) titles of journals and series and titles of books that are not part of a series. Use the parentheses/colon system for volume(number):pagination: "10(2):5-9." For alignment and arrangement of elements, follow the format of recent publications in the series for which the manuscript is intended. Guidelines for preparing bibliography may be secured from Series Section, SI Press.

**Legends** for illustrations must be submitted at the end of the manuscript, with as many legends typed, double-spaced, to a page as convenient.

**Illustrations** must be submitted as original art (not copies) accompanying, but separate from, the manuscript. Guidelines for preparing art may be secured from Series Section, SI Press. All types of illustrations (photographs, line drawings, maps, etc.) may be intermixed throughout the printed text. They should be termed **Figures** and should be numbered consecutively as they will appear in the monograph. If several illustrations are treated as components of a single composite figure, they should be designated by lowercase italic letters on the illustration; also, in the legend and in text references the italic letters (underlined in copy) should be used: "Figure 9b." Illustrations that are intended to follow the printed text may be termed **Plates**, and any components should be similarly lettered and referenced: "Plate 9b." Keys to any symbols within an illustration should appear on the art rather than in the legend.

**Some points of style:** Do not use periods after such abbreviations as "mm, ft, USNM, NNE." Spell out numbers "one" through "nine" in expository text, but use digits in all other cases if possible. Use of the metric system of measurement is preferable; where use of the English system is unavoidable, supply metric equivalents in parentheses. Use the decimal system for precise measurements and relationships, common fractions for approximations. Use day/month/year sequence for dates: "9 April 1976." For months in tabular listings or data sections, use three-letter abbreviations with no periods: "Jan, Mar, Jun," etc. Omit space between initials of a personal name: "J.B. Jones."

**Arrange and paginate sequentially every sheet of manuscript** in the following order: (1) title page, (2) abstract, (3) contents, (4) foreword and/or preface, (5) text, (6) appendixes, (7) notes section, (8) glossary, (9) bibliography, (10) legends, (11) tables. Index copy may be submitted at page proof stage, but plans for an index should be indicated when manuscript is submitted.



