Bulletin of the Scripps Institution
of Oceanography
Volume 26

Review of the Deep-Sea Fish Family Platytroctidae (Pisces: Salmoniformes)

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UNIVERSITY OF CALIFORNIA PRESS
Berkeley•Los Angeles•London

BULLETIN OF THE SCRIPPS INSTITUTION OF OCEANOGRAPHY OF THE UNIVERSITY OF CALIFORNIA LA JOLLA, CALIFORNIA

Volume 26
Approved for Publication June 6, 1984
UNIVERSITY OF CALIFORNIA PRESS BERKELEY AND LOS ANGELES CALIFORNIA
UNIVERSITY OF CALIFORNIA PRESS, LTD. LONDON, ENGLAND
ISBN: 0-520-09708-4 LIBRARY OF CONGRESS CATALOG CARD NUMBER: 86-25088

Library of Congress Cataloging-in-Publication Data
Matsui, Tetsuo.
Review of the deep-sea fish family Platytroctidae (Pisces: Salmoniformes).
(Bulletin of the Scripps Institution of Oceanography, University of California, San Diego ; v. 26)
Bibliography: p.
1. Platytroctidae—Classification. 2. Platytroctidae.
3. Fishes—Classification. I. Rosenblatt, Richard H. II. Title. III. Series.
QL638.P63M38 1987 597′ .55 86-25088
ISBN 0-520-09708-4 (pbk. : alk. paper)

CONTENTS

ABSTRACT 1
INTRODUCTION 3
  Taxonomic history 3
  Methods 5
  Abbreviations 5
  Acknowledgments 6
MORPHOLOGICAL CHARACTERS 7
  Shoulder organ 7
  Photophores 11
  Dentition 13
  Modified lateral line scales 15
  Subcutaneous canals and pores 16
  Cephalic lateral line canals 18
  Circumorbital bones 19
  Vertebrae and median fin supports 20
RELATIONSHIPS 23
  Outgroup comparison of the opercular series 24
  Phylogenetic hypothesis 25
VERTICAL DISTRIBUTION 29
EVOLUTION AND DISTRIBUTION 31
  General distribution 31
  Eastern Pacific 31
  Indo-West Pacific 34
  Southern Ocean 35
  Atlantic Ocean 36
  Mouth and body size and the evolution and distribution of platytroctids 37
  Summary and discussion 39
KEY TO THE FAMILY 41
TAXONOMY 49
  Persparsia 49
  P. kopua 49
  Paraholtbyrnia 52
  P. cyanocephala 52

Holtbyrnia 54
H. innesi 58
H. macrops 59
H. latifrons 60
H. laticauda 61
H. conocephala 61
H. sp 62
H. anomala 62
H. rostrata 63
H. intermedia 64
Sagamichthys 65
S. schnakenbecki 67
S. abei 68
S. gracilis 69
Searsia 71
S. koefoedi 71
Mirorictus 74
M. taningi 74
Tragularius n. gen 77
T. perforates 79
T. bythios n. sp 81
T. crassus 82
T. mesalirus n. sp 83
Pellisolus 85
P. facilis 86
P. eubranchus n. sp 87
P. longirostris 89
Maulisia 90
(Subgenus) *Maulisia* 90
M. *(M.)mauli* 91
M. *(M.) argipalla* 92
(Subgenus) *Aphanichthys* n 93
M. *(A.) microlepis* 94
M. *(A.) acuticeps* 95
M. *(A.) isaacsi* n. sp 95
Normichthys 97
N. *operosus* 98
N. yahganorum 99

Searsioides	100
S. multispinus	101
S. calvala	102
Platytroctes	102
P. apus	104
P. mirus	106
Barbantus	106
B. curvifrons	108
B. parini	110
B. elongatus	110
B. aequipinnis n. sp	111
LITERATURE CITED	117
FIGURES	129

ABSTRACT

The salmoniform fish family Platytroctidae (= Searsidae) was last revised by Parr (1960) and then included 17 species in 12 genera. Since Parr's revision, 20 nominal species and 2 genera have been introduced. This rapid increase in new taxa, a number of which are poorly diagnosed and described, has left the taxonomy in an unsatisfactory condition.

As a result of our study, 5 species and 2 genera are synonymized. We recognize 37 species (5 new) in 13 genera (1 new). A key to the family is presented and each genus is diagnosed and described, with a synopsis for each species.

Besides the sac beneath the cleithrum that contains luminous fluid (shoulder organ), platytroctids are clearly set apart from other alepocephaloids by a number of synapomorphies including the presence of a subcutaneous canal system, a unique arrangement of the anterior predorsal spines, and the configuration of the caudal skeletal complex.

Intrafamilial relationships were determined by use of a number of characters, including nature of photophores, presence or absence of a cleithral spine, fin position, shape and configuration of supraorbital and infraorbitals, path of cephalic lateral line canals, and dentition and jaw structure. Subfamilies are not recognized, but lines of relationship between the genera may be discerned. The deeper-living genera (bathypelagic) form a natural group and are regarded as the more advanced. They differ from the shallower-living (mesopelagic) genera in having a spinous cleithral symphysis, and are more compressed, with considerable nonmuscular tissue along the dorsal margin of the body.

The platytroctids and alepocephalids are viewed as having had a common ancestor, which perhaps was closest to the Bathyprionidae among living forms. The course of platytroctid evolution is viewed as involving movement from mesopelagic to bathypelagic depths, with many of the morphological changes being reductional. *Persparsia* is regarded as the most primitive and generalized genus.

Most platytroctid distributions are in the form of relatively narrow bands along the highly productive equatorial waters and the western side of continents. More oceanic records are primarily in areas of high-relief bottom, such as ridges and fracture zones, and near oceanic islands.

Records of the generalized genera *Persparsia* and *Paraholtbyrnia* are from areas where temperatures at mesopelagic depths are relatively high—up to 12°C. However, the remaining mesopelagic genera are mostly distributed meridionally in colder waters of the eastern boundaries of the Atlantic and Pacific. They tend to be rare toward the tropics. The more advanced genera predominate at low latitudes.

The generalized eastern boundary forms are typically provincial in distribution. In contrast, four of the more advanced equatorial forms are circumglobal. However, none of them extends south of 24°S, and two, *Platytroctes apus* and *Searsia koefoedi,* have never been taken in the South Atlantic. Both species show geographic variation, with the eastern Pacific and Atlantic populations more similar to each other than to the Indo-Pacific population. From this and other evidence, we suggest that the former Panama seaway may have provided a passage for deep-water as well as shallow-water fishes.

INTRODUCTION

The family now known as the Platytroctidae was separated from the Alepocephalidae by Parr (1951) on the basis of the presence of a sac containing luminous fluid beneath the cleithrum and opening through a black tube supported by a modified scale. Although it has been referred to almost exclusively as the family Searsidae (or Searsiidae) since then, the family name Platytroctidae Roule 1916 has priority (Sazonov 1980). The family has been the subject of a series of papers by Parr, culminating in his 1960 revision that included 17 species in 12 genera. In subsequent works, 1 species, *Per sparsia taningi*, was synonymized, and 2 genera, *Paraholtbyrnia* Krefft 1967 and *Searsioides* Sazonov 1977, and 20 nominal species have been introduced (Krefft 1967b, 1970, 1980; Lavenberg 1965a, 1965b; Sazonov 1976a, 1977, 1978; Sazonov and Golovan 1976; Sazonov and Trunov 1978; and Matsui and Rosenblatt 1979).

The rapid increase in taxa, some only poorly diagnosed, has left the taxonomy of platytroctids in an unsatisfactory state. As a result of our study, 13 genera (1 new) and 37 species (5 new) are recognized. *Mentodus* is placed in the synonymy of *Holtbyrnia*, and *Platytroctegen* is included in *Platytroctes*. Some of the taxa previously placed in *Mentodus* are placed in a new genus, *Tragularius*. *Maulisia* is further split into subgenera, one of which, *Aphanichthys*, is new. We include *Holtbyrnia problematica* in the synonymy of *H. macrops, H. kulikovi* in the synonymy of *H. innesi, H. ophiocephala* in the synonymy of *Sagamichthys schnakenbecki*, and *Normichthys campbelli* in the synonymy of *Mirorictus taningi*. We consider the holotype of *Bathytroctes melanocephalus* not to be a platytroctid, and agree with Krefft (1980) that the name should no longer be used in *Holtbyrnia*.

Each genus is diagnosed and discussed, and in addition to detailed description of the new forms a synopsis of each species of the Platytroctidae is given. All the genera and most of the species are figured, a key to the species is given, and the relationships within the family and the distributions are discussed.

Taxonomic History

Roule (1916; Sazonov 1980 incorrectly cites Roule 1919) considered the presence of the shoulder organ and the openings in the caudal peduncle of *Platytroctes apus* sufficiently significant to warrant the placement of *P. apus* in a monotypic family, the Platytroctidae. But, except for Koefoed (1927), the new family was not recognized by others until Parr (1951) included it as one of 3 subfamilies in a new family, the Searsidae. The family Searsidae (or its variant Searsiidae) was used by subsequent authors until Sazonov (1980) pointed out that Platytroctidae was the oldest name for the taxon.

The first two platytroctids were collected by the Challenger Expedition and described by Günther (1878) as *Platytroctes apus* and *Bathytroctes rostratus*. The supposed diagnostic characters of *B. rostratus*—i.e., maxilla reaching behind the orbit and the presence of projections on the premaxilla—could apply to a large number of platytroctids and, although for the following 50 years most platytroctids were referred to *B. rostratus*, Parr (1951, 1960) concluded that *Mentodus rostratus* (= *Holtbyrnia rostrata*) has been collected just once, in spite of its lengthy synonymy. The name, however, appears in the synonymy of *Searsia koefoediy Persparsia kopua*, and *Sagamichthys abei*. Other records of *B. rostratus* (e.g., Koehler 1896; Holt and Byrne 1908; Zugmayer 1911; Murray and Hjort 1912) are in our opinion not accompanied by sufficient descriptions to allow their allocation to any species.

Bathytroctes melanocephalus Vaillant 1888, which was placed in *Holtbyrnia* by Parr (1951), also has a complicated history. But it is probably not a platytroctid. *Platytroctegen mirus* Lloyd 1909 (= *Platytroctes mirus*) is relatively rare, with the second record published only recently (Kotthaus 1967). Over 20 years after the introduction of *P. mirus, Bathytroctes curvifrons* Roule and Angel 1931 (=*Barbantus curvifrons*) and *Bathytroctes innesi* Fowler 1934 (= *Holtbyrnia innesi*) were described.

Parr (1937) introduced *Holtbyrnia* and *Searsia* (and a new species, *S. koefoedi*) and ended the placement of elongate platytroctids in the alepocephalid genus *Bathytroctes.* He added another genus and species, *Mirorictus taningi* (Parr 1947). He then removed the platytroctids from the Alepocephalidae and placed them in a new family, Searsidae (Parr 1951), including *Normichthys, Pellisolus, Mentodus* (as a subgenus of *Holtbyrnia), Persparsia*, and *Barbantus*, and 2 new species, *N. operosus* and *P.facilis.* A new genus and species, *Sagamichthys abei* (Parr 1953), was described in the same year that Krefft described *schnakenbecki* as a *Searsia.* In Parr's monographic review of the family, *Maulisia* was added as a new genus. Although 9 of the 17 species were known from single specimens, and the others from few individuals, Parr emphasized body proportions in his diagnoses, and the subgeneric and subspecific categories appeared oversplit. But the review was much needed and a valuable contribution. Lavenberg (1965a, 1965b) described 2 new *Normichthys, N. campbelli* and *N. yahganorum*, but *N. campbelli* is a synonym of *Mirorictus taningi*. Krefft (1967a) added a new genus and species, *Paraholtbyrnia cyanocephala*, and another new species, *Barbantus elongatus*, in 1970.

In 1976 Sazonov introduced 7 new species (*Barbantus parini, Sagamichthys inter-medius, Holtbyrnia laticauda, H. conocephala, H. kulikovi, H. latifrons*, and *Maulisia acuticeps*) and, collaborating with Golovan, 3 others (*M. microlepis, Pellisolus longirostris*, and *Holtbyrnia ophiocephala).* He also placed *Paraholtbyrnia* in the synonymy of *Holtbyrnia.* Unfortunately, the species were poorly diagnosed and in some cases by characters that show ontogenetic and intraspecific variation. Although Sazonov (1976b) summarized the family and gave a key to the genera and a description of each genus, the classification remained unsatisfactory. New taxa continued to be added at a rapid rate since then and include: *Searsioides multispinus* Sazonov 1977, *Sagamichthys gracilis* Sazonov 1978, *Mentodus perforatus* Sazonov and Trunov 1978, *Maulisia argipalla* Matsui and Rosenblatt 1979, *Searsia calvala* Matsui and Rosenblatt 1979, and *Holtbyrnia anomala* Krefft 1980.

Methods

Scale counts in midlateral series were taken near the midline, from the shoulder girdle to the approximate posterior margin of the caudal skeleton, utilizing scalepockets where scales were missing. Medial gillraker counts include rudiments. Counts and measurements are defined in Hubbs and Lagler (1958) or are self-explanatory. An exception is the interorbital width, which was taken at mideye and does not necessarily represent the narrowest interorbital dimension. Length measurements were made with needlepoint dividers or with an ocular micrometer. Length measurements are in standard length (SL); HL .= head length. Terminology for body musculature follows Winterbottom (1974). The term "maxillo-mandibular ligament" applies to the ligament which originates on the medial face of either supramaxilla (usually the posterior) and inserts on the lateral face of the lower jaw. A number of characters are discussed in detail in the following section; the terminology for photophores follows Parr (1960) with a few modifications, and that for cephalic lateral line canals follows Reno (1969). In platytroctids, the infraorbital canal does not intersect the supraorbital canal; the portion between the supratemporal and the ventral flexure that marks the beginning of the infraorbital canal is the postocular commissure. Bases of the gill filaments are often united by membrane; in the text this condition is usually abbreviated as—bases united.

Abbreviations

Specimens utilized in this study are from the Fish Collection of the Scripps Institution of Oceanography (SIO) and sources below. Abbreviations are those given by Leviton et al (1985).

AMNH	American Museum of Natural History
BMNH	British Museum (Natural History)
IMARPE	Instituto del Mar del Peru
IOAN	Institute of Oceanology, USSR Academy of Sciences
ISH	Institute für Seefischerei, Universität, Hamburg
LACM	Natural History Museum of Los Angeles County
MMF	Museu Municipal do Funchal
MMSU	Zoological Museum, Moscow State University
SAM	South African Museum, Capetown
T	Institut Scientifique et Technique des Pêches Maritime
TC	University of Hawaii Department of Oceanography
USNM	National Museum of Natural History
VIMS	Virginia Institute of Marine Science
ZMUC	Københavns Universitet, Zoologisk Museum

Other institutions mentioned in the text are abbreviated as: Bingham Oceanographic Collection, Yale University, Peabody Museum (YPM); Academy of Sciences, Zoological Institute, Leningrad (ZIL); Humboldt Universität Museum für Naturkunde, Berlin (ZMB).

Acknowledgments

We are grateful for the loan of valuable specimens by the institutions listed above, and to the following individuals responsible for the loan material: E. Bertelsen (ZMUC), N. Chirichigno (IMARPE), T. Clarke (TC), D. M. Cohen (USNM), M. N. Feinberg (AMNH), S. X. Kannemeyer (SAM), S. J. Jewett (USNM), R. J. Lavenberg (LACM), D. F. Markle (VIMS), G. E. Maul (MMF), J.-C. Quéro (T), and Y. I. Sazonov (MMSU and IOAN). We especially thank Dr. Gerhard Krefft of the Institut für Seefischerei, Hamburg. Our gratitude goes to B. H. Robison for making the large collection from the *Alpha Helix* cruises available. We also thank Joseph Copp, Janet Berhorst, William Murphy, Julie Haugsness, Darcy L. Gibson, and H. J. Walker for curatorial assistance at SIO.

We are grateful to E. Bertelsen for information on the holotype of *Mentodus crassus*, Jørgen Nielsen (ZMUC) for information on the holotype of *Pellisolus facilis*, and Allwyn Wheeler (BMNH) for a radiograph and information on the holotype of *Bathytroctes rostratus*, Robert K. Johnson, Field Museum of Natural History, for reading the manuscript critically, and to Abraham Fleminger for reading the section on "Evolution and Distribution." We thank John Butler, Barbara Sumida McCall, and H. Geoffrey Moser for arranging use of the x-ray facility at the U.S. National Marine Fisheries Center, La Jolla, and Ruth Ebey, Marine Life Research Group, SIO, who typed the manuscript. Figures were prepared by the Marine Life Research Group Illustration Department and photographs by the SIO Photo Laboratory.

The senior author gratefully acknowledges the support of the Marine Life Research Program, the Scripps Institution of Oceanography's component of the California Cooperative Oceanic Fisheries Investigations.

Kittie Kuhns, technical publications editor, critically read the manuscript for style and consistency, and kept the authors on track at all stages of preparation.

MORPHOLOGICAL CHARACTERS

Descriptions of platytroctid morphological characters are presented here and summarized in Table 1.

There are 2 main groups in the family, distinguished by certain morphological features. Platytroctids collected at shallower depths (ca. 300-800 m) belong primarily to 5 genera (*Persparsia, Paraholtbyrnia, Holtbyrnia, Sagamichthys*, and *Searsia*) that are apparently closely related, as indicated by the sharing of a number of morphological features (Table 1). For brevity, we will henceforth refer to them as the *mesopelagic genera.* But individuals belonging to these genera may not restrict themselves to this zone. For example, *Searsia koefoedi* apparently extends to bathypelagic depths, and some of the species in the group, *e.g., Holtbyrnia rostrata* and *H. anomala*, are clearly bathypelagic. The remaining platytroctids are usually taken at depths below 900 m, and we will refer to them as the *bathypelagic genera.* Members of some of these genera may be taken at deeper mesopelagic depths (ca. 700-1000 m) in certain areas. Among the bathypelagic genera, *Miroricitus taningi* appears more closely related to the mesopelagic forms.

Shoulder Organ

The shoulder organ is a round black sac located inside the shoulder girdle and recognized by a black tubule supported by a modified scale behind the shoulder girdle, just below the lateral line. Internally the sac extends from the base of the pectoral fin to the dorsal tip of the cleithrum, except in *Platytroctes apus*, in which it is somewhat reduced. The sac contains a blue-green luminous fluid that can be expressed into the water (Nicol 1958, Herring 1972, and personal observation on *Miroricitus taningi).* The caudal organs of P. *apus* are similar in appearance and possibly in function to the shoulder organ. As in the shoulder organ, there is a modified scale at each opening. The sacs of the caudal organs are slanted beneath the skin and do not penetrate the body musculature.

The tubular opening of the shoulder organ is more conspicuous in the mesopelagic genera than in the bathypelagic genera. The tubule is especially small in the species of *Barbantus*. The exposed tubule is usually positioned below the midline and the ventral tip of the supracleithrum in the mesopelagic genera, but placed higher in the others, especially *Platytroctes apus*. Female ceratiids (*Ceratias* and *Cryptopsaras*) also discharge a luminous secretion (Nicol 1969), but from 2-3 sacs on the back. Nicol thought the discharge of luminous secretion to be a temporary distractant facilitating escape from predators.

The shoulder organ has been referred to by several other names: e.g., supraclavicular process (Norman 1930, Beebe 1933, Parr 1937); postclavicular organ (Parr 1937, Nicol 1958); postcleithral organ (Nicol 1958, Markle 1976); and shoulder luminescent organ (Nicol 1958). It has been described and illustrated by Beebe (1933), Parr (1951), and Nicol (1958). Norman (1930) stated that there was a shoulder organ in the alepocephalid *Talismania homoptera*, but that observation was based on a misidentification; the specimen was later shown to be a platytroctid, *Normichthys operosus* (Parr 1951).

TABLE 1

Summary of Some Platytroctid Characters

	Mesopelagic genera					Bathypelagic genera								
									Maulisia					
	Persparsia	*Paraholtbyrnia*	*Holtbyrnia*	*Sagamichthys*	*Searsia*	*Mirorictus*	*Tragularius*	*Pellisolus*	*Aphanichthys*	*Maulisia*	*Normichthys*	*Searsioides*	*Platytroctes*	*Barbantus*
Lateral line canal and modified lateral line scales	Present				Absent		Present *mesalirus;* absent others	Absent	Present *microlepis;* absent others	Absent				
Canals in post-temporal bone	Present			Absent	Present	Absent								
Canal in supracleithrum	Present			Present *schnakenbecki*	Present	Absent								
Cephalic lateral line canal (except supratemporal)	Complete and branched							Incomplete and unbranched	Complete and branched				Incomplete and unbranched	
Cleithral symphysis	Normal						Produced in a spine	*	Produced in a spine					Normal
Dorsal margin (body)	Rounded								Sharp					Rounded

* In a spine in *longirostris;* normal in others

Table 1 (cont'd.)

Dentitions:	Mesopelagic genera					Bathypelagic genera								
									Maulisia					
	Persparsia	*Paraholtbyrnia*	*Holtbyrnia*	*Sagamichthys*	*Searsia*	*Mirorictus*	*Tragularius*	*Pellisolus*	*Aphanichthys*	*Maulisia*	*Normichthys*	*Searsioides*	*Platytroctes*	*Barbantus*
basihyal	Medial row; absent *H. anomala*			Circular row		Medial row			Medial row *A. microlepis*, absent others		Medial row	Circular row		
vomerine	Pair	More than 2			Pair								2-4	
palatine	Single	More than 1			Absent		Single, absent in some *Aphanichthys*				Absent	Single	Absent	1 or 2
basibranchial	Present					Absent	Present	Usually absent				Present		
mesopterygoid	Present					Usually absent	Present	Present *longirostris*	Present					Absent
ectopterygoid	Absent		Present		Absent									
upper pharyngeals of 2nd arch	Present					Absent	Present	Present *longirostris*	Present				Absent	Present *curvifrons*
mid-dentary	Present only in young		Present		Present only in young	Absent	Present	Present only in young	Present	Present only in young		Present	Present only in young of *apus*	Absent only in *curvifrons*
premaxillary tusks	Present, 2nd tusk parallel to 1st			Absent or rudimentary	Present, 2nd parallel to 1st	Absent	Present, 2nd points in different direction from 1st					Present, single	Absent	
premaxillary teeth	3-6	10-18	15-20	ca. 20	7-9	1-6	13-14	6-8	7-15	4-8	ca. 13	10-13	5-14	over 20

Table 1 (cont'd.)

	Mesopelagic genera					Bathypelagic genera								
									Maulisia					
	Persparsia	*Paraholtbyrnia*	*Holtbyrnia*	*Sagamichthys*	*Searsia*	*Mirorictus*	*Tragularius*	*Pellisolus*	*Aphanichthys*	*Maulisia*	*Normichthys*	*Searsioides*	*Platytroctes*	*Barbantus*
Supraorbital	**		***		Absent	From mideye forward; adjacent to frontals							Absent	
Infraorbitals	3rd largest		Lacrimal largest	2nd largest	3rd largest	Lacrimal largest								
Upper jaw partly overlapped by infraorbital no.:	1st-3rd	1st-2nd				Lacrimal		Lacrimal *longirostris*; no overlap in others	Lacrimal				No overlap	
Vertebral count	45-46	49-51	46-50	48-52	46-47	43-46	42-43	41-44	43-47	43-47	43-47	45-47	43-47	40-48
Ventral ray count	9	8-10 (usually 9)	9	9-10	6-8 (7)	7-9 (8)	8-9	6-9	7-8	7-9	6-8	8-9	6-7 (0 in *apus*)	7-8
Largest record	145	221	296	250	150	124	245	****	255	250	164	118	176	178

** From mideye forward; part of inner margin below frontals

*** Cupped over most of or entire eye; inner margin adjacent to frontal

**** 194 *longirostris*; 130 in others

Photophores

Photophores are defined here as luminous tissue with definite form and distributed at set locations. In preserved specimens they appear as orange or yellow bodies surrounded by white tissue that is covered by transparent tissue, and with a dark border. Luminous tissue that is always covered by an opaque layer of nonluminous pale tissue in the shape of a photophore at particular sites, or transparent areas without white or yellow material under them are considered to be rudimentary photophores. Rudimentary photophores are usually weakly developed and variably present. They tend to appear later than normal photophores at a particular site and if present in the young persist for a shorter period. Generally, photophores at a given location are better developed in species in which they appear early (i.e., at a smaller length). We are unable to determine whether the white tissue on the infraorbital bones and on the outer margins of the orbit of some platytroctids has photogenic function. Similarly, we are uncertain whether the transparent medial strip on the ventral margin o *Barbantus* and the narrow ventral welt of *Normichthys*, *Holtbyrnia anomala*, and *Platytroctes mirus* are light organs.

We follow the nomenclature of Parr (1960), as shown in Figure 1. Quéro (1970) and Matsui and Rosenblatt (1971) recognized the difference between the horizontally directed larval and early juvenile organs and the ventrally directed ones of the older juvenile. They also separated Parr's GO into an anterior (GO^1) and e posterior (GO_2) organ and added the subopercular organ (SBO). Sazonov (1976b) included an anterior IOO and a preopercular organ (POPO), which are included here although they are weakly developed and could b considered rudimentary. There is another area of luminous tissue at the 3rd infraorbital bone of *Persparsia kopua*, but the tissue appears to be always covered by nontransparent tissue, and we consider it rudimentary.

Persparsia has the best developed and most complete set of photophores. All its photophores are round or broadly elliptical. Those of other platytroctids are more elongated, usually being developed as a narrow ellipse. The transverse series of 3 round THO and 2 round MVO are further specialized into transverse bars. The JO also becomes specialized, either as a short transverse bar (*Sagamichthys*) or one or more longitudinal bars.

The photophores and rudimentary photophores are tabulated in Table 2. The IVO and IPO of *P. kopua* are listed twice in the table, as there are 2 at that position that are independent of each other and face in different directions. Parr (1960) only mentioned the posterior-facing IPO in *Persparsia* and reported it to be present in *Holtbyrnia problematica* as well. Claims of an IPO, but without any orientation indicated, have been made by Quéro (1970) for *H. problematica* and by Sazonov and Golovan (1976) and Sazonov (1976a, 1976b) for several *Holtbyrnia* species. However, we have not found an IPO in any material of *Holtbyrnia* that we examined, including the holotype of *H. problematica*.

In young of *Persparsia kopua, 5* photophores face posteriorly (Table 2). Also in *Persparsia*, several photophores listed as ventrally directed in the table (which is based on adults) are directed subhorizontally or horizontally in the young. In the smallest *P. kopua* examined (23 mm SL), the BRO, THO, SVO, SAO, and PAO are already present and, with the probable exception of the BRO, face laterally. Only the two lateral organs of the THO complex are developed, with the middle one barely discernible. By 33-35 mm SL the organs are better developed and most are directed ventrad. The more medioventral organs—i.e., GO_1, PVO. MVO, ICO, PO, and VO—begin appearing at about this length. In other platytroctids, the photophores listed as ventrally directed in the table appear after 30 mm SL and are already ventrally directed when they appear The anterior IOO and the SBO, listed in the table as horizontally directed, change directions to the vertical in older individuals.

TABLE 2
Distribution of Photophores in Platytroctids

	Young Horizontal Directed										Adult Vertically Directed																	
	Poster. Facing					Anter. Facing																						
	IOO (poster.)	SPO	IPO (anter.)	IVO (poster.)	CO	OO (ventral)	OO (dorsal)	SBO	GO_2	IVO (anter.)	IOO (anter.)	GO_1	POO	POPO	OPO	BRO	PJO	IPO (poster.)	JO	PO	THO	PVO	MVO	SVO	VO	AO	PAO	ICO
Persparsia	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Paraholtbyrnia	R	−	−	−	−	−	R	+	+	+	R	+	+	+	+	+	−	−	L	+	T	−	T	+	+	+	+	+
Holtbyrnia[1]	R	−	−	−	−	−	R	R	+	+	R	+	+	R	+	+	−	−	L	+	T	−	T	+	+	−	+	+
H. anomala	−	−	−	−	−	−	−	R	R	R	−	R	−	−	−	−	−	−	−	+	R	−	R	R	−	−	R	R
Sagamichthys	−	−	−	−	−	−	+	+	+	+	−	+	+	−	+	+	−	−	T	+	T	−	T	+	+	±	+	+
Searsia	R	−	−	−	−	−	−	+	R	+	−	−	R	−	+	+	−	−	−	+	T	−	V	+	−	−	+	+
Maulisia	−	−	−	−	−	−	−	−	R	+	−	+	R	−	−	+	−	−	−	+	V	−	V	+	−	−	+	+
Searsioides	−	−	−	−	−	−	−	−	R	+	−	+	−	−	−	+	−	−	−[2]	+	T	−	T	+	−	−	+	+
Normichthys	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	R	R	−	−	R	R
Platytroctes mirus	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	R?	−	−	R?	−

+, photophore present (round or oval in shape)
−, absent
±, present or absent
R, rudimentary
T, transverse bar
V, either a transverse bar or a round organ
L, longitudinal bar
[1], except *H. anomala* and *H. rostrata*
[2], rudimentary longitudinal bar in holotype of *calvala*, otherwise absent

The horizontally directed photophores of the young are recessed into the narrow end of a cone-shaped pocket. The pockets of the OO, GO_2, SBO, and some of the IVO are lined by a silvery reflecting surface. Although they are functional when the fish is small, these photophores probably serve to illuminate prey. However, the role of some of the posterior-facing photophores of *Persparsia*, e.g., the caudal organ (CO), may be to distract predators.

Most or all horizontally facing organs appear during or shortly after the yolk-sac stage. They begin to turn ventrally or weaken after the ventrally facing organs appear (30-80 mm SL), and are mostly gone by about 150 mm SL. Among the ventrally facing organs, the OPO, VO, POO, and AO appear latest (except in *Persparsia*, in which all organs are present by 45 mm SL), with the AO appearing last and present by 100 mm in *Paraholtbyrnia* and 140-150 mm in some *Sagamichthys*. These late-appearing photophores tend to be the ones absent in genera with fewer photophores. Photophores are better developed in genera with more photophores, and the ventrolateral photophores tend to occur more dorsally as well.

Platytroctids with better-developed photophores occur at shallower depths. Demonstrating the large reductional changes in photophores that occur in species invading greater depths, the two bathypelagic species of *Holtbyrnia* have either completely lost them (*H. rostrata*) or retain mostly rudimentary ones (*H. anomala).* However, photophores or their rudiments are scattered throughout the family. They are entirely absent in the deeper-dwelling *Mirorictus, Pellisolus, Tragularius*, and *Barbantus*, the subgenus *Aphanichthys*, and *Platytroctes opus* and *Holtbyrnia rostrata*.

Viewed ventrally, the platytroctid photophore pattern appears to be a transverse banding, but there are also two longitudinal series. The impression of banding is strongest in *Persparsia*, in which there are, e.g., about 10 photophores across the jugular region. In other platytroctids the MVO, THO, and JO are bars. But in most platytroctids the pattern appears essentially to be two longitudinal series. Often the photophores on the flattened venter are covered by dark tissue so that only the lateral ends of the transverse bar are exposed, with the middle blacked out (Fig. 2). In *Searsia koefoedi* the ICO is separated into two organs in this manner. Even some of the circular photophores of *Persparsia* are partly or entirely covered by dark tissue. Although counterillumination has been suggested as a possible function of ventrally directed photophores, those of platytroctids probably have other roles. The flattened venter, which is about as wide as the greatest body width in the mesopelagic genera, and the barred photophore pattern probably serve to make the fish conspicuous, possibly for species recognition.

Dentition

The teeth of the medial surfaces of the upper and lower jaws are uniserial in all platytroctids except *Barbantus aequipinnis*, which has an additional short outer row on the premaxilla. In the young of most species there is a short row of teeth on a ridge on the anterolateral surface of the lower jaw, outside the mouth. These are termed the mid-dentary teeth. Mid-dentary teeth are often lost with growth, but in some forms persist in the adult. All platytroctids have teeth on the vomer, 4th epibranchial, 5th ceratobranchial, and upper pharyngeal of the 3rd and 4th arches. Teeth on mesopterygoids, basihyal, basibranchials, palatines, and the upper pharyngeal of the 2nd arch are absent in some species (Table 1), and ectopterygoid teeth are variably present in larger individuals of *Holtbyrnia* and *Sagamichthys*. Teeth tend to be lost in larger individuals—and this, combined with the susceptibility to loss by injury during capture and during examination, can lead to apparent wide intraspecific variation.

All platytroctids have a basihyal toothplate. The recurved, fanglike, basihyal teeth are often scattered over the entire toothplate in the young, but with increasing size the number is reduced or the teeth are lost. In larger individuals the teeth are single, or in a single or paired medial row on a narrow toothplate, or in a circle around the margin of a wider plate.

The basibranchials are partly or mostly cartilaginous. A single basibranchial toothplate extends from over the 1st to about the middle of the 3rd basibranchial in all platytroctids. The 4th basibranchial is cartilaginous and without a toothplate. Part of a toothplate in the mesopelagic genera is raised into a very narrow ridge that is barely wider than a tooth. There is often a single row of small, even-sized teeth on the narrow ridge. This high ridge is generally shorter in the bathypelagic genera, and the single or double row of teeth in *Platytroctes* and *Barbantus* is on a flat or slightly raised toothplate.

Most platytroctids have one or two longitudinal rows of teeth on part of, or the entire length of, the mesopterygoid. Mesopterygoid teeth have not been seen in *Barbantus* and are usually absent in *Mirorictus.* There is considerable individual variation in this character. In *Platytroctes apus* there is usually one row of teeth, but in one individual the mesopterygoid was covered by a patch of teeth. The dentition in *Searsioides multispinus* also varies from one row to a dense patch.

Maxillary and dentary teeth, and the premaxillary teeth of *Platytroctes* and *Barbantus*, increase in number with increasing size of fish, but teeth in other areas often decrease in number with growth, and in some forms teeth are absent in adults (pharyngeals not examined). The number of premaxillary teeth of platytroctids other than *Platytroctes* and *Barbantus* remains about the same after the juvenile stage, and the vomerine teeth are usually unchanged (usually 1 on each side) from the larval stages on, except in *Sagamichthys* and *Holtbyrnia* (and some *Paraholtbyrnia)*, in which the number increases to about 4-5 on each side. The palatine teeth also show a similar increase in these two genera. Mid-dentary teeth tend to be retained into the adult stage in species with more than 10 premaxillary teeth, and lost in those with fewer. Exceptions among those with more than 10 premaxillary teeth are *Paraholtbyrnia*, which lacks mid-dentary teeth in adults, and *Platytroctes mirus* and *B. curvifrons*, which lack them at all stages. In most platytroctids the mid-dentary teeth apparently oppose the premaxillary teeth; however, those of two *Barbantus* species are directed anteriorly.

The anterior premaxillary teeth are enlarged into tusks and horizontally directed in platytroctids except for *Barbantus, Platytroctes, Sagamichthys*, and *Mirorictus*, in which they are secondarily normal (the anterior teeth of *Sagamichthys* are often small rudimentary tusks). There are two different arrangements of premaxillary tusks and teeth in the family (Fig. 5). These illustrate a difference in character state between the mesopelagic genera and the bathypelagic genera that does not represent a reductional difference. When present, the 2nd tusk is juxtaposed to, and parallel with, the 1st in the mesopelagic genera. In *Per sparsia*, as many as 3 of the anterior teeth on the premaxilla are enlarged into tusks, with the 2nd smaller than the 1st, and the 3rd and smallest more laterally and subhorizontally directed. Most individuals have 2 tusks on at least one of the premaxillae, but the 3rd is less frequently present. Behind the tusks is the main row of 3-6 downward-directed teeth.

Paraholtbyrnia, Holtbyrnia, and *Searsia* normally have 2 tusks, but a 3rd was found on one side of a single juvenile of *Paraholtbyrnia*. The 2nd tusk is usually present in *Paraholtbyrnia*, less frequently in *Holtbyrnia* and *Searsia*. It is most clearly seen in juveniles, as it is fused to the 1st in larger individuals (including *Persparsia).* Also, in large individuals of these genera the premaxilla is thickened anterolaterally and eventually fuses with the tusks into a single broad-based projection. The smaller teeth behind are downward directed, with the anteriormost tooth often directly under the base of the tusks (Fig. 5A). Thus there is an abrupt change in direction from the horizontal tusks to downward-directed teeth. However, on the premaxilla of a juvenile *Paraholtbyrnia cyanocephala* in which a 3rd tusk is present the small teeth are in series with the tusk and without the abrupt change noted in those lacking the 3rd tusk. The main row of premaxillary teeth in the mainly bathypelagic genera is subhorizontal anteriorly and in series with the tusks (Fig. 5B). In *Maulisia, Tragularius*, and *Pellisolus longirostris* the anteriormost tusk is curved inward and the tusk following is subhorizontal and more laterally directed. There may be as many as 4 tusks in a radiating pattern. The row of small teeth behind the tusks is directed subhorizontally and follows the tusks in series. Premaxillary teeth are subhorizontally directed and in series with the single tusk in *Normichthys* and *Searsioides.*

Except in *Barbantus* and *Platytroctes*, the premaxilla is more firmly attached anteriorly to the ethmoid than posteriorly to the maxilla. In addition, a spur-shaped process projects posterodorsally as a continuation of the thickening of the premaxilla behind the tusks. This process crosses over the maxilla and ligamentously connects to the palatine. Ligaments from the ethmoid and maxilla are also inserted on the process or near its base. The premaxillary process extends beyond the maxilla and articulates with the palatine in the mesopelagic genera (except *Sagamichthys*) and in *Tragularius;* it is shorter in the others. Related to the change in orientation of the tusks, i.e., to a radiating pattern, the premaxilla of *Tragularius*, and especially of *Maulisia*, is deep and triangular. In *Barbantus* and *Platytroctes* the premaxilla and maxilla are mostly separated, with contact chiefly at the process. Proportionately, the premaxilla increases from about one-fourth to one-third the length of the maxilla in the mesopelagic genera to nearly half as long in the very short-mouthed *Platytroctes* and *Barbantus.*

Modified Lateral Line Scales

These are elongate scales (Fig. 3) about a third larger than the normal body scales, numbering about 45-55 in the lateral line, and not in series with the more numerous regular scale rows. They are present in the mesopelagic genera *Persparsia, Paraholtbyrnia*, *Holtbyrnia*, and *Sagamichthys*, and in *Maulisia microlepis* and *Tragularius mesalirus.* We found no detectable differences in the shape or structure of modified scales among these genera. In *M. microlepis* the modified scales near the caudal fin form at a much larger size. In specimens retaining most of the body scales, the modified scales are almost completely covered by regular scales. In some, only the soft siphon extending upward from the posterior end of the scale protrudes between the body scales.

The modified scales form part of the walls of the lateral line canal. The embedded anterior end is concave and lines the inner side of the canal. At about midlength the scale bends outward, and the convex posterior half is near the surface, lining the outer side of the canal. Thus the lateral line canal runs between the anterior and posterior parts of the scale (Fig. 3B), passing through the large opening at the bend at midlength. A short projection from the posterior part of the scale extends anteriorly on the outer surface a short distance from the bend, ending in a pair of anteromedially directed spurs. The modified scales are not strongly imbricated and are most widely spaced at midbody. The row of modified scales extends over the caudal rays as perforated tubules, but this portion appears late in development. In most species, the tubular scales are on the caudal rays by 90 mm SL, but in *M. microlepis* not until 200-225 mm SL. A few scales in the lateral line of *Platytroctes mirus* are perforated by tubular soft tissue, but the scales are not enlarged and modified.

Subcutaneous Canals and Pores

These canals are found just beneath the skin, and except in *Platytroctes* and perhaps *Barbantus* are connected to scalepockets by pores. The canals are largely intersegmental, and in species with numerous pores sire interconnected to form a network passing under most or all of the scales. In *Paraholtbyrnia* the canals run dorsoventrally, lateral to each myoseptum (except in the anterior dorsal region) and beneath alternate longitudinal scale rows. Short side branches interconnecting the dorsoventral canals run beneath those scale rows that are not over them, and a portion of almost every scalepocket is over a subcutaneous canal. *Holtbyrnia* and *Sagamichthys* are similar to *Paraholtbyrnia* in their canal systems. *Persparsia* has a single, uniformly sized pore in each scalepocket over the anterior part of the body. It may also have a similar canal system, but our specimens are small and were not examined for this character. In most of the other platytroctids (including *Searsia),* the canals along the myosepta are present but the side branches are reduced or absent, and there are no pores in part or all of the scalepockets not over the dorsoventral canals.

Dorsoventral canals, as well as the interconnecting canals, are absent in *Platytroctes*, perhaps in relation to the thick layer of nonmuscular tissues beneath the skin. When present, the dorsoventral canals are intersected by large canals running anteroposteriorly near the dorsal and ventral margins and in the midline. The midline canal runs directly beneath the lateral line in those genera with modified lateral line scales. This canal is present in all platytroctids, and the lateral line nerve runs beneath it, but it is lined with smooth, lightly pigmented epithelium and there is no sign of neuromasts.

Longitudinal canals near the dorsal and ventral margins are absent in *Platytroctes*, but appear to be present in all other platytroctids. The canal near the dorsal margin runs between the supracarinalis and the epaxial muscles; the left and right canals are interconnected by short branches. At the base of the dorsal fin, canals between the lateral surfaces of the inclinatores dorsales run out to the base of each dorsal ray. There are three ventral longitudinal canals: two lateral canals between the hypaxialis and the infracarinalis muscles, and one median between the paired infracarinales. In species with photophores, the three canals are on the flattened ventral part of the body. At the cleithral symphysis the three canals join and, passing medial to the symphysis, continue anteriorly. These canals are relatively large: e.g., in a 125 mm SL *Paraholtbyrnia cyanocephala* the diameter of the dorsoventral canals measures about 0.4 mm, and that of the longitudinal about 0.8 mm.

The largest canals and the largest number of pores are in the occipital and shoulder area. One of the canals runs along the shoulder girdle, and several specializations associated with this canal occur around the posttemporal and supracleithral bones. In *Persparsia, Paraholtbyrnia, Holtbyrnia*, and *Searsia* the canal passes along the deeply grooved posterior border of the posttemporal and then passes through the posttemporal near its ventral end, intersecting the cephalic lateralis canal (part of the temporal canal) opposite a large open pore. Thus in these genera the subcutaneous canals are linked to the cephalic lateral line canals and the body lateral line canal (lacking in *Searsia)*, and are open to the outside through the numerous pored openings in the canals. The posttemporal of these genera is not pierced by the subcutaneous canal in the young before the subcutaneous pores are well developed. A 61 mm SL cleared and stained specimen of *H. latifrons* has only the cephalic lateralis canal passing through the posttemporal. *Sagamichthys, Maulisia microlepis*, and *Tragularius mesalirus* have the lateral line canal, as well as a well-developed subcutaneous canal system with numerous pores in scalepockets, but they lack canals in the posttemporal connecting these two systems.

In several species that are without a canal in the posttemporal bone the subcutaneous pores located behind the supracleithrum are enlarged into external openings. The largest of these is the "shoulder pit" (Parr 1960) of the subgenus *Maulisia.* This slit, which runs dorsoventrally over the large canal along the shoulder girdle, occupies several scale rows along the posterior border of the supracleithrum. A large scale that is inserted like a normal scale covers the opening; this scale is usually lost in museum specimens. The scalepockets on the dorsal and ventral borders of the shoulder pit usually have pores that are nearly as large as a normal-sized scale. However, these differ from the "dermal pits" (Parr 1960) of *Normichthys* in position. Dermal pits are holes, usually the size of scale pockets or smaller (but up to twice the diameter of a scalepocket in *N. operosus)*, located on the anterior 6 scale rows of the first few rows (usually the 2nd row) above the lateral line. The pits are covered by scales. In some specimens there is a thin transparent membrane on the floor of the scalepockets, and this probably represents the process of transforming into dermal pits. In the remaining platytroctids no obvious outside opening is evident. In a nearly undamaged *Mirorictus taningi* the scales are tightly covered by a layer of pigmented epithelial tissue, and when the scales are depressed with a pointer the tissue over them becomes inflated with displaced fluid, showing no leakage.

There is an ossification bordering the subcutaneous canal over the shoulder organ ("accessory bone" in Figure 4). It appears to be an embedded enlarged scale that is folded back, with one of the halves bordering the canal. It is not fully formed in some species, and nearly half is absent in *Sagamichthys.* The subcutaneous canal passes between the cleithrum (which is tubular at that point) and the embedded scale before broadening over the cleithrum, or under it. The function of the embedded scale is uncertain, but it may be related to directing water flow into the cleithrum or, judging from its position over the shoulder organ, aiding in its discharge. Its size is reduced in *Pellisolus eubranchus* and *Platytroctes apus*, in which the subcutaneous canals are poorly developed.

Subcutaneous canals have been reported in trachipterids (Walters 1963, Rosenblatt and Butler 1977), stromateoids (Horn 1970, Bone and Brook 1973, McDowall 1981), and the gempylid *Ruvettus pretiosus* (Bone 1972). As in platytroctids, these canals lack sensory neuromasts. A number of pores open externally, and Walters (1963) hypothesized that the canal system of trachipterids serves a hydrodynamic function and maintains laminar flow during swimming; similar conjectures have been made by others. A hydrodynamic function is a possibility in the platytroctids that have the posttemporal pierced by the subcutaneous canal. However, it is puzzling that *Sagamichthys* and the two other species (*Tragularius mesalirus* and *Maulisia microlepis*) with a lateral line canal and a well-developed subcutaneous canal system should have lost the linkage between the subcutaneous canal and the cephalic and body lateral line system. For these platytroctids and others without the post-temporal connection, the lack of an adequate number of external openings appears to exclude a hydrodynamic function for the subcutaneous canal system.

In *Schedophilus medusophagus*, Bone and Brook (1973) report that in adults the epithelial layer that covers the scales in juveniles is lost, and the subdermal canal is connected to the outside. However, this does not appear to be the case in platytroctids, as demonstrated by the specimen of *Mirorictus taningi* mentioned above. Enclosed subcutaneous compartments are described by Best and Bone (1976) in the alepocephalids *Xenodermichthys* and *Photostylus.* From their finding that the fluids in the compartments are more dilute than sea water, they considered that the compartments may function as a buoyancy device. The compartments of the alepocephalids run longitudinally and appear markedly different from the canal system of platytroctids, which is generally in the superficial layer between muscles and, in most, opens into scalepockets. *Xenodermichthys* and *Photostylus*, in addition, are scaleless. *Rouleina*, reported by Markle (1978) to have similar compartments, is also scaleless.

Cephalic Lateral Line Canals

With the exception of *Platytroctes, Barbantus*, and *Pellisolus*, the cephalic lateral line canals are uninterrupted, with side branches which in most are further branched. The supratemporal canal (following the terminology of Reno 1969) is usually without ossicles dorsally except in *Sagamichthys*, but specimens in good condition in most species have this canal continued in a membranous tube and complete. It is incomplete in *Platytroctes* and 3 of the 4 species of *Barbantus*, and entirely absent in *Pellisolus* and *B. aequipinnis.* The intersection of the supratemporal and supraorbital canals is usually in soft tissue and is often difficult to determine; these canals do not intersect in *Platytroctes, B. curvifrons*, and *B. elongatus.* In *Normichthys* and *Persparsia* it appears that the supraorbital canal ends near the supratemporal canal without intersecting it. The supraorbital canal does not intersect the infraorbital canal in platytroctids. It extends from the supratemporal canal or near it, ending anteriorly in the tubular nasal bone which is generally found dorsal to the nares. However, the supraorbital canal is reduced and nearly entirely over the eye in *Pellisolus facilis* and *P. eubranchus.*

The preoperculomandibular canal extends along the ventral margin of the mandible and through the tubular canal in the preopercle, ending at the postocular commissure. Side branches from the preopercular segment of the canal extend out over the opercular region. In *P. eubranchus* and *P. facilis* the preoperculomandibular canal is absent. The canal is interrupted dorsally before reaching the postocular commissure in *P. longirostris, Barbantus*, and *Platytroctes.*

The postocular commissure lies between the infraorbital and supratemporal canals. It is longest in the mesopelagic genera, very short in *Barbantus* and *Pellisolus*, and absent or reduced to an ossicle in *Platytroctes.*

The cephalic lateralis canal extends from the junction of the supratemporal canal and postocular commissure to the body lateralis. In *Persparsia, Paraholtbyrnia, Holtbyrnia*, and *Searsia*, the canal passes through the ventral part of the posttemporal bone and into the supracleithrum before joining the body lateralis (Fig. 4). Part of the canal passes along the supracleithrum in *Sagamichthys schnakenbecki* and *Maulisia microlepis*, but in *S. abei, S. gracilis*, and *Tragularius mesalirus*, the canal continues across the supracleithrum to the lateral line canal. Other platytroctids lack a lateral line canal, and the cephalic lateralis canal ends at about the supracleithrum. The cephalic lateralis canal is interrupted in *Barbantus* (except *elongatus*) and absent in *Platytroctes* and *Pellisolus.* Except for these genera the canal has side branches, which are especially numerous in *Paraholtbyrnia, Maulisia* and *Tragularius.*

The infraorbital canal extends from its intersection with the postocular commissure and ends at the lacrimal. It is not connected to the supraorbital canal. The canal is incomplete and without side branches from the main canal in *Platytroctes, B. aequipinnis, Pellisolus facilis*, and *P. eubranchus*, and complete with side branches in the others (weakly branched or unbranched in *Mirorictus taningi).*

Circumorbital Bones

The orbit is nearly encircled by the 7-bone infraorbital series and a supraorbital bone in the majority of platytroctids. In the mesopelagic genera (except *Searsia*) and in *Maulisia, Tragularius*, and *Pellisolus longirostris*, the bones overlap or articulate in a continuous series with only a short gap between the dermosphenotic and the posterior margin of the supraorbital. This gap is especially small in *Holtbyrnia* and *Sagamichthys*, in which the supraorbital extends to about the posterior margin of the eye. In these genera, and in *Maulisia* and *Tragularius*, the expanded supraorbitals apparently serve to protect the upper margin of the eye. However, in the latter two genera the supraorbital extends only from about mideye to the antorbital (as it does in other platytroctids). But the frontal is expanded laterally over the eye, especially in *Maulisia*, protecting the posterior half of the eye. Similar expansion of the frontal over the eye is carried even further in *Searsia*, in which the supraorbital is entirely replaced by the frontal and is absent, or present only as a small rudiment. In other platytroctids (*Barbantus, Platytroctes, Pellisolus facilis*, and *P. eubranchus)*, the loss of supraorbitals, or reduction to thin, membranous ones, appears related to the acquisition of large eyes that bulge above the head outline.

Judging from the different manner in which the eye is protected, the primitive role of the supraorbital was apparently secondarily attained in platytroctids. In *Persparsia* the supraorbital is shaped like a half-open tubule with the open part lateral, and thus could not protect the eye. It is located just beneath the frontal and, following the outer outline of the frontal, extends anteriorly, articulating with the antorbital. The supraorbital of *Paraholtbyrnia* is much wider posteriorly and furrowed on the dorsal side. Only a small part of the posterior inner margin is below the frontals, and the entire supraorbital is buried in strong fibrous tissue. The supraorbital of the bathypelagic genera is generally shaped like that of *Paraholtbyrnia*, but is not buried in tissue. In *Maulisia* and *Tragularius* it is much larger, with a deeper longitudinal groove. There appears to be a short tubular canal on the anterior ventral end of the supraorbital in the mesopelagic genera and *Maulisia* and *Tragularius*. The antorbital at its junction with the supraorbital is also tubular.

The infraorbitals are best developed in the mesopelagic genera, where they have well-developed laminar bases that, except in *Holtbyrnia*, extend to the preopercle. The laminar bases of the anterior infraorbitals probably give support to the upper jaw. In *Persparsia* the maxilla and parts of the supramaxillae slip under the 1st (lacrimal), 2nd, and 3rd infraorbitals. There are fewer infraorbitals overlapping the upper jaw in other platytroctids, with only the 1st and 2nd overlapping the maxilla in the remaining mesopelagic genera. At most, part of the maxilla slips under the lacrimal in the bathypelagic genera.

Probably related to this, the position of the largest laminar projection advances anteriorly from the 2nd and 3rd infraorbital in the mesopelagic genera (except for *Holtbyrnia*) to the lacrimal in the bathypelagic genera. The 3rd infraorbital is slightly larger than the 2nd or the lacrimal in *Persparsia, Paraholtbyrnia*, and *Searsia*. The 2nd infraorbital is greatly enlarged in *Sagamichthys*, and most of the upper jaw slips under it. In the remaining genera in which the upper jaw is overlapped the lacrimal is enlarged, extending nearly to mideye in *Holtbyrnia, Normichthys, Searsioides*, and the subgenus *Maulisia*, to mideye to the posterior margin of the pupil in *Pellisolus*, and to mideye to the posterior margin of the eye in *Tragularius*. In the remaining genera, the laminar bases are further reduced and the lacrimal is the largest infraorbital.

Vertebrae and Median Fin Supports

The first neural arch is not supported by a vertebral centrum and is above an unossified space, which in the more generalized forms is as long as a centrum (Fig. 6B). The first neural arch is lost in *Platytroctes apus* (Fig. 6C). Gosline (1969) stated that in *Alepocephalus rostratus* the anteriormost centrum is unossified. However, in our material the first centrum is ossified in all stained specimens of platytroctids and alepocephalids, including a species of *Alepocephalus y A. tenebrosus.* The elements of the neural arches of either side are separate, and the epineural intermuscular bones are fused to the neural arches, as indicated by Gosline (1969) for *A. rostratus.* Near the end of the dorsal fin the two sides of the neural arch join to form a normal teleostean neural spine. The extent of the paired neural arches may be related to dorsal fin supports in platytroctids and perhaps alepocephalids. In the mesopelagic genera the proximal radials of dorsal fin pterygiophores are inserted deep between the paired neural spines.

The anal fin pterygiophores of platytroctids are inserted several vertebrae anterior to the 1st haemal arch (usually 5-7 vertebrae) except in *Platytroctes apus*, in which the 1 st pterygi-ophore is opposite the 1st haemal spine.

There are 2 anal and dorsal rays associated with the 1st anal and dorsal pterygiophores, and these articulate directly with the proximal radial. Usually a distal radial appears at the level of the 3rd dorsal ray and 4th anal ray, respectively, but the last pterygiophore lacks a distal radial. The medial and distal ends of the proximal pterygiophores tend to be cartilaginous, with the cartilaginous area more extensive in the bathypelagic genera. The distal radial is mostly to entirely cartilaginous.

The platytroctid caudal skeleton has been figured and compared with that of other alepocephaloids by Greenwood and Rosen (1971) and Markle (1976). It is generally similar to that of *Alepocephalus rostratus* as described by Gosline (1969), but with more laminar bone in the uroneural and neural arches of the ural and first few preural centra. There are 6 hypurals (2 below and 4 above), 2 epurals, and 2-3 uroneurals. Two cartilaginous radials border the posteromedial margin of the 2nd and 3rd hypurals. There are also one or more cartilaginous radials at the ventral margin of the parhypural and the 1st hypural, respectively. The caudal skeleton supports 19 principal rays (9 below and 10 above). In the 9 cleared and stained specimens used in this study, the number of procurrent and principal rays was 12-15+10 + 9+11-13. The bases of the first two hypurals are usually united between the U_1 and PU_1 centra, with the 2nd about opposite the U_1 centrum. But this varies between individuals, and in some which lack the U_1 centrum the 2nd hypural is opposite the U_2 centrum. The bases of hypurals 1 and 2, the parhypural, and the PU_2 haemal spine are cartilaginous where they articulate with the centra. Hypurals 1 and 2 and the parhypural are basally united.

Consolidation of the caudal region by fusion of several elements appears minimal in platytroctids, but there are several features that apparently strengthen the caudal skeleton. Platytroctids maintain the generalized teleostean feature of an elongate 1st uroneural braced on the first two or three preural centra, and have evolved a unique feature in which the U_2 centrum is overlapped by the bases of the 3rd and 4th hypurals. Also unique in the suborder is the shortening of the PU_1 to PU_3 centra to about half the length of the PU_5 and more anterior centra (Fig. 7). This shortens the distance between the last full neural spine and the dorsalmost (6th) hypural. The last full neural spine is usually on the PU_3 centrum in platytroctids, although a shortened or partial neural spine is usually present on the PU_2 centrum.

Filling the gap between the 6th hypural and the last full neural spine apparently helps stiffen the upper caudal lobe. That gap is occupied by laminar flanges of the rudimentary arches of preural and ural centra, the 2 uroneurals, and the 2 epurals. We have examined only a few cleared and stained platytroctids, but it appears that there is individual variation in the manner in which that space is filled. For example, in one of the *Sagamichthys abei* the rudimentary neural arches of the PU_1 and U_1 are greatly reduced and nearly absent, and the space usually occupied by them is instead taken over by the laminar flanges of the 1st uroneural, which interlock anteriorly with the PU_2 neural arch. In a second, smaller, *S. abei* the rudimentary neural arches of the U_1 and PU_1 centra are developed as in *Paraholtbyrnia cyanocephala* (Fig. 7) and inserted between the laminar extensions of the uroneural plates. The anterior epural often fits medially between the laminar extensions of the 1st uroneural. The 2nd epural is much shorter than the 1st, or integrated with the 1st, in platytroctids.

Laminar flanges on the haemal and neural arches of the preural centra are present in most platytroctids as far forward as the PU_5. They are absent, however, in *Platytroctes apus*.

The U_1 centrum is absent (or fused to the PU_1) much more commonly in platytroctids than is indicated in the literature. It is absent in *Tragularius, Pellisolus, Barbantus*, the subgenus *Aphanichthys*, and most individuals of *Platytroctes mirus*. We have not found it missing in *Persparsia kopua* (2 individuals examined), *Paraholtbyrnia cyanocephala* (12), *Searsia koefoedi* (12), *Searsioides multispinus* (2), or *Platytroctes apus* (11). Except for *P. apus*, these forms all have well-developed photophores. Of 24 specimens of *Holtbyrnia* examined for this character, the U_1 was absent only in *H. rostrata*. In *Sagamichthys* the U_1 is partly (9 individuals) or entirely (7) unossified. One of 6 individuals of *Maulisia mauli* examined was without the U_1 centrum, and in *Normichthys* and *Mirorictus* the ratio was about 1 of 5.

RELATIONSHIPS

The families Platytroctidae (=Searsiidae), Alepocephalidae (including *Bathylaco* and *Leptochilichthys)*, and Bathyprionidae were recognized by Greenwood and Rosen (1971) as constituting the superfamily Alepocephaloidea of the salmoniform suborder Argentinoidei. Inclusion of these families in the Argentinoidei was largely based on the presence of a distinctive epipharyngeal structure, the crumenal organ, and an accessory cartilage at the posterior end of the 5th epibranchial.

However, there are trenchant differences between argentinoids and alepocephaloids. The argentinoid dentition and jaw mechanism differ widely from those of the alepocephaloids. The dentition of argentinoids is greatly reduced, and the functions of the maxilla and pre-maxilla tend to be taken over by the palatine and vomerine teeth (Cohen 1964). Argentinoids also lack a supramaxilla, which is present in alepocephaloids, and the premaxilla may be lost. Other specialized features of argentinoids, in addition to those noted by Greenwood and Rosen (1971), illustrate the wide differences between the two groups. Alepocephaloids lack an uncinate process on the 4th epibranchial (Markle 1976; this study), that is present in argentinoids. Greenwood and Rosen (1971) illustrated such a process (their Fig. 1A) for *Searsia koefoedi*, but we have not found this feature in our material.

The similarities between alepocephaloids generally involve the retention of primitive characters (Gosline 1969; Markle 1976). But as Gosline has pointed out, such features at best only suggest the path that evolution of the group has not followed. In the phylogenetic systematics of Hennig (1966) and others, relationships can only be determined by homologous, derived characters (apomorphies) that are shared by more than one species (synapomorphies). The dorsally reduced opercle is the only synapomorphy (Greenwood and Rosen 1971) that characterizes alepocephaloids.

Within the Alepocephaloidea, the Platytroctidae is clearly defined by five specialized characters. The unique shoulder organ distinguishes the platytroctids from other alepocephaloids. Also unique is the extensive subcutaneous canal system. Unlike other alepocephaloids (and argentinoids), which have a predorsal bone (supraneural) over each of the more anterior vertebrae, in platytroctids there is one for every 2nd to 3rd vertebra. The PU_1 to PU_3 centra are shortened to half the length of more anterior centra, e.g., the PU_5 centrum, and the U_2 centrum are overlapped in platytroctids by the bases of the 3rd and 4th hypurals (as pointed out by Markle 1976). Only *Photostylus* in the suborder has been reported with similar overlapping of the U_2 centrum (Markle 1976). But this is probably convergence, as the caudal skeleton of *Photostylus* is more consolidated than those of most alepocephaloids, with the U_1 and the 6th hypural absent and several hypurals fused (Markle 1976). Presence of these specializations in all platytroctids is a strong indication of monophyly. Also, the anterior epural is much longer than the 2nd in platytroctids. In other alepocephaloids (and argentinoids), the 2nd epural, when present, is almost as long as the 1st. There are also photophores arranged in unique set patterns, with a separate and differently oriented set for the young. However, in a number of platytroctids, photophores are rudimentary or absent. Most members also have the premaxillary dentition enlarged into forward-directed tusks.

Besides these specialized characters, platytroctids retain the primitive basipterygoid process (Gosline 1969, and our observation), which otherwise only occurs in osteoglossoids in living teleosts. Platytroctid dentitions are the most generalized in the Argentinoidei, and include teeth on the mesopterygoid that are usually in a single longitudinal row (absent in *Barbantus* and in *Pellisolus facilis* and *P. eubranchus)*, ectopterygoid (present in *Holtbyrnia* and *Sagamichthys)*, basibranchial, and basihyal (present in most platytroctids). Only the alepocephalid *Rinoctes nasutus* (Markle and Merrett 1980) has basibranchial teeth, and *Bajacalifornia calcarata* (Markle and Merrett 1980) and the argentinids (Rosen 1974) have basihyal teeth. An antorbital, 2 supramaxillae, and 1-2 suprapharyngobranchials represent other generalized teleostean characters of platytroctids.

In the previous section we suggested the division of the family into two major groups, mesopelagic and bathypelagic. The mesopelagic genera are slender forms that are mostly large-mouthed, usually with well-developed photophores and a lateral line canal that is lined by modified scales (see Table 1 and preceding section describing morphological characters). *Searsia* is an exception in having a small mouth and in lacking a lateral line canal and modified scales. But as in other mesopelagic genera (except *Sagamichthys)*, its premaxillary tusks are parallel and its posttemporal bone is pierced by the cephalic lateralis and subcutaneous canals.

With two exceptions, the lateral line canal is absent in the bathypelagic genera, and about half are without photophores. The bathypelagic genera also lack canals in the posttemporal bone and, when present, the multiple tusks point in different directions (Fig. 5B). About half are moderately to highly compressed and deeper bodied than the mesopelagic group. The mouth is large in the larger species only. Probably as adaptations to greater depths, a number of characters are more reduced than in the mesopelagic genera. For example, the infraorbitals extend no more than halfway to the preopercle instead of to it, and the cephalic lateral line canals are unbranched and interrupted in some. There are also fewer vertebrae and ventral rays.

Platytroctes and *Barbantus* differ in a number of features from the mesopelagic genera, and their reduced condition indicates that they may be among the most advanced platytroctids. However, in a number of features *Platytroctes* and *Barbantus* resemble the Alepocephalidae, which is generally thought of as the group closest to the platytroctids. This may be because the alepocephalids are also reduced with respect to most platytroctids. For example, the sharp ridge on the basibranchial toothplate (considered by Rosen 1974 to be a synapomorphy of the entire Argentinoidei) is best developed among platytroctids in the mesopelagic genera and (apparently secondarily) absent in *Platytroctes.* Markle (1976) reported the ridge as only slightly developed or absent in most alepocephalids. Another notable reduction in *Platytroctes* is the absence of an accessory neural arch before the 1st centrum. An accessory neural arch is often found in primitive taxa (e.g., *Diplophos;* Fink and Weitzman 1982) and nearly all platytroctids, but there is an unossified noncartilaginous space in *P. apus* (Fig. 6C), and one of four cleared and stained alepocephalid species we examined for this character was also without the accessory neural arch. Absence of these features in *Platytroctes* and some of the alepocephalids represents an independent loss.

Outgroup Comparison of the Opercular Series

The characters of reduction in the bathypelagic genera could be interpreted as derived. But for a better hypothesis of the polarity of these characters, we include an outgroup comparison based on the opercular series, following procedures discussed by Eldredge and Cracraft (1980). The outgroup chosen was the Argentinoidea, and characters shared with that group were considered to be plesiomorphic within the Alepocephaloidea.

The opercle of *Argentina* (and *Bathyprion*) is squarish, that of the alepocephalids triangular. That of the platytroctids (except for *Platytroctes*, in which it is reduced) is intermediate (Figs. 8E-H). The differences in opercular shape mostly involve the lower margin. The characters in the opercular series are compared in the cladogram (Fig. 9) as A, B, and C. Camera lucida drawings of the opercular series of the salmoniforms, including the species used in the cladogram, are shown in Figure 8.

Among platytroctids, the ventral margin of the opercle of *Persparsia kopua* (Fig. 8E) is subhorizontal and flat as in *Bathyprion danae* (Fig. 8D). In the remaining mesopelagic platytroctids (e.g., *Paraholtbyrnia cyanocephala*, (Fig. 8F) and in *Mirorictus*, the ventral margin is flat and subhorizontal over only the posterior half, but runs dorsad anteriorly so that the opercle becomes narrower. The flat, subhorizontal portion is shorter in the bathypelagic genera, and in *Searsioides, Barbantus*, and *Normichthys* (Fig. 8G) the entire ventral margin slopes upward, resulting in a triangular opercle like that of the alepocephalids. The opercle of *Platytroctes* (Fig. 8H) is much deeper than broad, with a considerable space between it and the preopercle and interopercle. This highly reduced opercle is unique in the family. The apparent transformation series of the opercle in the Platytroctidae has, at its extremes, an opercle like that of *Persparsia* and those of *Normichthys, Barbantus*, and *Searsioides.* Thus, for the cladogram, we chose *Persparsia* as representative of the mesopelagic group and *Normichthys* for the bathypelagic.

In the cladogram, a three-taxon statement comprised of the two platytroctids and *Bathytroctes* for characters B and C gives a result different from a comparison of *Bathyprion* and the two platytroctids. Inclusion *of Argentina* in a wider outgroup indicates that the squarish opercle and large overlap of the interopercle by the preopercle of *Persparsia* and *Bathyprion* are primitive, and the character of *Normichthys* and *Bathytroctes* derived. But only *Bathytroctes* does not share character A with *Argentina.*

Further evidence of the plesiomorphic nature of characters A and B in *Argentina* is their widespread occurrence. They are also found in the Salmonidae and Osmeridae (Fig. 8A-B). Even the opercular series of the primitive stomiiforms *Diplophos* and *Maurolicus* show resemblances. The plesiomorphic state of character C is an apparent apomorphy of the Argentinoidei. However, the interopercle is predominantly overlapped by the horizontal arm of the preopercle in the Argentinoidea, but by the enlarged posterior portion in *Bathyprion* and the mesopelagic platytroctids. The posterior part of the preopercle is reduced in the bathypelagic platytroctids and in the alepocephalids, as indicated by the presence of the posterior unprotected area representing the derived state (Fig. 8).

Because considerable evidence (e.g., characters 1-3 in Fig. 9) indicates the monophyly of the platytroctids (as mentioned above), the advanced state of characters B and C shared by the bathypelagic platytroctids and the alepocephalids must have been independently derived. Other derived features (e.g., reductional advances) shared exclusively by them would also have to be considered parallelisms.

Phylogenetic Hypothesis

From the results of the outgroup comparison, indicating that the character states of mesopelagic platytroctids are primitive for the family, some of the ancestral character states of platytroctids are hypothesized as: (1) PU_1, U_1, and U_2 centra present and unfused; (2) supraorbital over anterior half of eye, articulating and attached by ligaments to antorbital anteriorly; (3) laminar flanges of infraorbitals extending to preopercle, with the 2nd-3rd infraorbitals largest; (4) opercular opening wide, dorsal margin level with top of eye; (5) 9-10 ventral rays; (6) a lateral line canal and modified scales; (7) cephalic lateral line canals well developed, complete and branched; (8) posterior half of ventral margin of opercle nearly horizontal; and (9) 4 flattened branchiostegal rays laterad on epihyal with the dorsal 3 overlapping and with 4-5 acinaciform rays on ventral to ventro-medial border of ceratohyal. In addition, the following character states are also considered ancestral: (1) photophores in set pattern; (2) well-developed subcutaneous canal system with pores in most scalepockets and a canal passing through the posttemporal; (3) upper jaw slipping under 1st to 3rd or 1st to 2nd infraorbitals; (4) several anteriormost premaxillary teeth enlarged into tusks; and (5) cephalic lateralis canal passing through the posttemporal and supracleithral bones before entering the body lateralis canal.

Our hypothesis for the phylogeny of the family is shown in Figure 10. The broadly elliptical photophores of *Persparsia* appear to represent the ancestral condition, as some photophores, including the posterior-directed sets of the juveniles (Table 2) found only in *Persparsia*, are displayed as rudimentary photophores in the others (character 1). The broadly elliptical photophores are also closer to the shape of other fish photophores. The barred THO, MVO, and JO or the absence of photophores (character 2) of the remainder of the family are regarded as derived characters. The upper jaw is partially overlapped by the 1st to 3rd infraorbitals in *Persparsia*, but by the 1st and 2nd in the remaining mesopelagic genera (character 4) and at most by the lacrimal in the bathypelagic genera (character 9).

The presence of a ventrally directed tooth at the base of the premaxillary tusk (character 3) is a synapomorphy shared by *Paraholtbyrnia, Holtbyrnia*, and *Searsia*. The 2nd tusk of *Holtbyrnia* and *Searsia* is reduced in size and much smaller than the 1st (character 5) and represents a reductional advance over the condition found in *Paraholtbyrnia* (and *Persparsia). Sagamichthys* lacks premaxillary tusks (or has only rudimentary ones), but its upper jaw is overlapped by the 1 st and 2nd infraorbitals as in the above three genera (character 4). The 2nd infraorbital of *Sagamichthys* is distinctive in that it extends to the preopercle, and most of the upper jaw slips under it when the mouth is closed. *Sagamichthys* is also without canals in the posttemporal bone, and only in *S. schnakenbecki* does the cephalic lateralis pass through the supracleithrum.

In spite of its specializations, *Sagamichthys* is the apparent sister group of *Holtbyrnia*. The large supraorbital (extending over most of the eye; character 6) shared by them is not found elsewhere in the family. Reverse imbrication of the nape scales could be considered another shared derived feature, but it may be homoplastic instead, because only one of 9 *Holtbyrnia* species (*H. intermedia*) has this character, and reverse imbricated scales also occur in the distantly related *Barbantus parini*, but not the other species of that genus. The double ICO of *Searsia* is a distinctive feature that does not occur in any other platytroctid. *Searsia* is more reduced than the other mesopelagic genera in a number of characters, e.g., absence of a supraorbital, lateral line canal and modified scales and a VO photophore.

The mesopelagic genera are best characterized by a number of specialized features that are apparently primitive in the family, i.e., well-developed photophores and infraorbitals, canals in the posttemporal bone, and a 2nd premaxillary tusk that is parallel to the 1st. Reduction or absence of these features is characteristic of the bathypelagic genera. Canals in the posttemporal bone are apparently lost (character 10), and the only circumorbital bone overlapping part of the upper jaw is the lacrimal (character 9). But the bathypelagic genera have also acquired novelties that separate them from the mesopelagic group. As many as 4 premaxillary tusks are present in some of the large-sized species, and none of the tusks are parallel (character 8), as they are in the mesopelagic group. The premaxilla is not laterally thickened at the base of the tusks as in the mesopelagic group, and the row of teeth immediately behind the tusks is subhorizontal and follows in series with them.

A spinelike cleithral symphysis (character 7) is the synapomorphous feature that unites the bathypelagic species, although it has apparently been secondarily lost in the most reduced species (*Barbantus* spp., *Pellisolus facilis*, and *P. eubranchus).* Another specialized feature of the bathypelagic genera is the compressed body (character 12), with the ventral and dorsal margins extended by nonmuscular tissue. This character is most strongly expressed in *Normichthys* and *Platytroctes*. *Tragularius, Pellisolus*, and *Barbantus* are exceptions. *Tragularius* is the most generalized bathypelagic genus and probably never acquired that feature. *Pellisolus* appears to be derived from the same lineage, since *P. longirostris* resembles species of *Tragularius* in the possession of multiple tusks arranged in a radiating pattern, relatively wide frontals, large supraorbitals, large lacrimal, and relatively large body and mouth size. But *Maulisia* has a similar arrangement of tusks, possesses large supraorbitals and mouth size, and attains a relatively large body size among bathypelagic platytroctids. The large lacrimal that extends as far back as the posterior margin of the eye (character 11) is the synapomorphy shared by *Tragularius* and *Pellisolus*. *P. longirostris* is related to *P. facilis* and *P. eubranchus* on the basis of its enlarged, high eyes with an increased binocular field, lack of a cephalic lateralis, and near absence of subcutaneous pores. The last two are regarded as characters of reduction from a *Tragularius-like* state. *Platytroctes* and *Barbantus* resemble *Pellisolus* in the three characters, but the similarities are apparent homoplasies. *Pellisolus*, like *Tragularius*, apparently never acquired a compressed body and nonmuscular tissue. *Barbantus* also has little nonmuscular tissue. *Barbantus*, however, is the most derived and must have lost nonmuscular tissue, as it shares other unique specializations with *Platytroctes*. These are: (1) a ligament crossing over the top of the dentary, either ending the tooth row or causing a diastema (character 18); and (2) all or most of the premaxillary teeth transverse, with none lateral (character 19). The shallow muscular portion of the body of *Platytroctes* is no deeper than that of *Barbantus*, and some nonmuscular tissue is indeed present along the dorsal margin of *Barbantus* species.

In the bathypelagic group, *Tragularius* and the subgenus *Aphanichthys* of *Maulisia* represent lineages closest to the mesopelagic genera, as indicated by the absence of some of the specialized features of the other bathypelagic genera and the retention of a number of primitive characters, i.e., large mouth and body; well-developed, branched, cephalic lateral line canals; presence of lateral line canal and modified scales (in *T. mesalirus* and *M. microlepis);* retention of a large lacrimal; and multiple premaxillary tusks. The top of the skull of the species of *Maulisia* is diamond shaped when viewed from above, with the widest point just behind mideye (character 13). The subgenus *Maulisia* is separated from *Aphanichthys* by possession of a shoulder pit, the reductional characters of the smaller lacrimal, and absence of the lateral line canal and modified scales. However, the species of *Maulisia* have photophores, and their absence in *Aphanichthys* is considered an independent loss. *Normichthys* and *Searsioides* are reduced with respect to mouth and body sizes, and the supraorbitals are much smaller (character 16) than those of *Tragularius* and *Maulisia*. The body is compressed, with a relatively narrow snout and a narrow edentulous space between the single tusks on either side, and the anal and dorsal fins are subequal and nearly opposed (character 14). Subequal and opposed fins are retained in *Platytroctes* and in *Barbantus aequipinnis*, the most generalized species of that genus, and tusks and supraorbitals are absent in the species of both genera. The cleithral symphysis of *Searsioides*, like that of *Platytroctes*, is sharply pointed (character 17), an apparent refinement of the stout cleithral termination of the other bathypelagic genera.

The position of *Mirorictus* is less clear. Its dentition is greatly reduced and it retains none of the character states identified with the mesopelagic genera. However, it is less reduced and apparently more primitive than some of the other small-mouthed bathypelagic platytroctids. For example, it retains an uninterrupted cephalic lateral line canal, a well-developed subcutaneous canal system, and medial gillrakers on the 1st arch. Also its eyes are relatively small, directed laterally instead of anterodorsally, and located below the dorsal margin of the head.

We can find no compelling reason for recognizing subfamilies. The Mirorictinae of Parr 1960 was based on a specimen with an injured jaw, and the deep body shape of his Platytroctinae is the greater development of a feature that is found in other platytroctids, most notably in *Normichthys*. Furthermore, *Barbantus*, which was included in the Searsinae by Parr (1960), together with *Platytroctes* forms a sister group to other platytroctids.

VERTICAL DISTRIBUTION

Most platytroctids have been collected in open nets. Such samples give fairly reliable estimates on the shallowest distribution depth of a species (when enough tows with reliable sampling depths are available). There is less confidence in the estimation of maximum depth. The possibility of contamination is related to the amount of water strained above the sampling depth, and it follows that the chance of contamination increases with greater net size (including bottom trawls) and with increase in sampling depths. It is probable that records of platytroctids below 2000 m are based on individuals collected at shallower depths.

Platytroctids are only rarely taken at depths shallower than 200 m. Attesting to this, in the approximately 30,000 sorted 1-m plankton-net samples from the CalCOFI sampling program that had sampled depths of 0-140 m and 0-200 m off the west coast of North America, not a single platytroctid has been found (Elizabeth Stevens, Southwest Fisheries Center, National Marine Fisheries Service, pers. comm.). Pearcy (1964) also did not catch platytroctids in 57 trawls hauled between 0-200 m, but in 7 trawls out of 23 attempted between 0-500 m, and 6 of 24 between 0-1000 m, he did. In their fish survey, Berry and Perkins (1966) report on 69 midwater trawls made at depths shallower than 200 m. Their single positive tow, supposedly from 37 m sampling depth over water 137 m deep, may be an error. Their next shallowest tows catching platytroctids were at 298 m. Krefft's (1973) records of *Holtbyrnia macrops* from 100 m and another from 120 m in the North Atlantic appear to be the only other records of platytroctids taken shallower than 200 m.

The general impression from open-net Isaacs-Kidd Midwater Trawl (IKMT) and opening-closing 1-m net tows (eastern Pacific samples) is that platytroctids of different sizes occur together. The samples we examined are too few and randomly taken to give a clear picture of diel migration. Occasional migration with the scattering layer seems indicated by the capture of *Barbantus curvifrons* (SIO76-61) at 425-525 m in an Isaacs-Brown opening-closing midwater trawl sampling from the deep scattering layer. This species generally occurs below 1000 m (Krefft 1976). However, reports of diel migration are poorly documented. Badcock's (1970) 900 m daytime depth distribution of *Searsia koefoedi*, which he considered a partial migrator, was based on a sample from 750-900 m, and his upper night depth of 500 m was based on 5 individuals, the shallowest of which was taken at 510-565 m and the deepest at 800-900 m.

Fitch and Lavenberg (1968) gave no corroborating evidence for their claim that the young of *Sagamichthys abei* (which is perhaps the shallowest living platytroctid) migrated to within 200 m of the surface at night, and their claim is not supported by other studies. For example, Ebeling et al. (1970) in their extensive sampling did not find significant diel variation for *S. abei*. Taylor (1967a), in a series of tows sampling the deep scattering layer with the large 1200-mesh Engel net, caught 5. *abei* in day hauls when the scattering layers were at 275-285 m and 575-593 m, but not in night hauls when the scattering layer was shallower. The low caloric value of *S. abei* reported by Childress and Nygaard (1973) also agrees with that of nonmigrators among the more common and better-known midwater species in their study.

Avoidance of sampling gear rather than diel or ontogenetic vertical migration is most likely the cause of differences between day-night and shallow-deep catches. The data from the Berry and Perkins (1966) fish survey show that the IKMT sampling shallower than 400 m only caught platytroctids smaller than 100 mm, and at night and not during the day. However, the more efficient Cobb Trawl, also used in that survey, caught individuals smaller than 100 mm as well as larger ones in both day and night tows at the shallow (366 m) depths. Deeper tows, both by day and by night, caught more platytroctids than shallower tows. According to Pearcy and Laurs (1966), the best indicator of vertical migration is the daytime increase at middepth over that of night. But in Berry and Perkins' data, both shallow and deep night tows caught more and larger platytroctids than did day tows at comparable depths.

Platytroctids with the best-developed photophores occur at shallower depths. They are the species of *Persparsia, Paraholtbyrnia, Sagamichthys*, and *Holtbyrnia*, and judging from sampling depth data, we estimate occurrence at depths of about 250 900 m. Several species of *Holtbyrnia (H. anomala, rostrata, conocephala*, and *H*. sp.) and *Sagamichthys gracilis* occur deeper. *Searsia koefoedi* occurs as shallow as 500 m but may extend below 1000 m. In our text we refer to these genera as the mesopelagic genera.

The remaining genera we designate as the bathypelagic genera, as they are usually collected below 900 m. But platytroctids are without a gas bladder, and the bathypelagic species probably enter shallower depths on occasion.

EVOLUTION AND DISTRIBUTION

General Distribution

The distribution of platytroctids shown in Figures 12-20 includes material examined by us in addition to most published records (some questionable data have been excluded). As can be seen, the distributions fall into relatively narrow bands: (1) a meridional pattern along the western side of the continents; (2) zonal patterns along the equatorial waters; and (3) corresponding to the general area of the subtropical convergence, areas influenced by the eastern boundary and equatorial currents, and part of the subarctic and subantarctic gyres, where zooplankton volumes are high (Reid et al. 1978). The distribution charts thus indicate that platytroctids are nearly absent from the central regions of the oceans, which are generally considered to be areas of low productivity. The absence of members of the family in the Mediterranean Sea may also be related to low productivity, and probably also to high temperature. In contrast to the areas of the eastern boundary currents, records of platytroctids are few in the deeper and stronger western boundary currents.

Except for parts of the eastern equatorial Pacific, platytroctids have generally been taken near continental slopes or, if in oceanic areas, near high-relief bottoms such as oceanic ridges and fracture zones, or near islands. Sazonov (1976b) noted the occurrence of platytroctids in or near areas of underwater elevation. Krefft (1976) also pointed out the close association of *Barbantus elongatus* to the slopes of St. Helena and Ascension islands and the Mid-Atlantic Ridge, and of *Pellisolus facilis* to the Mid-Atlantic Ridge. Similar associations with land masses or islands have been reported in other midwater fishes as well, e.g., melamphaids (Ebeling 1962); the sternoptychid genus *Polyipnus* (Baird 1971); *Stomias nebulosus* (Gibbs 1969), *Astronesthes macropogon* (Goodyear and Gibbs 1969); and *Scopelarchoides danae* (Johnson 1982). Elevated productivity and sea life are generally associated with land masses (see Hubbs 1959).

Eastern Pacific

In the eastern equatorial Pacific, platytroctids are generally taken near the coast, but records of *Searsia koefoedi, Mirorictus taningi, Platytroctes apus, Pellisolus facilis,* and *Holtbyrnia* sp. extend westward near the equator to about 125°-165°W. Platytroctids are virtually absent between 165°W and about 145°E. Discussing a similar decline in zooplankton species, Van der Spoel and Pierrot-Bults (1979) note hydrographic changes west of 140°-160°W consisting of higher temperature, salinity, and oxygen and decreased productivity, and considered this the western boundary of the eastern equatorial Pacific. Beyond the disjunct area, the above species (except *H.* sp. which appears endemic to the eastern equatorial Pacific) also occur in the Indo-West Pacific and, except for *H.* sp. and M. *taningi,* in the Atlantic Ocean as well. Near the coast in the eastern Pacific, all these platytroctids, and in addition *Barbantus curvifrons* (which also occurs in the Indo-West Pacific and the Atlantic) extend southward into the area of intensely low-oxygen water as far as 24°S.

The apparent southern limit at 24°S is a well-noted faunal break separating equatorial midwater species from the transition water species farther south (Antezana 1978, 1981), including midwater fishes (Bussing 1965, Wisner 1976). The break for these wide-ranging species is suprisingly sharp, as illustrated by the following southernmost records: *Platytroctes apus* and *Barbantus curvifrons*—23°14.8′S, 71°22′W (SIO72-166); *Searsia koefoedi*—23°2l′S, 71°42′W (Parin et al. 1973); *Pellisolus facilis*—*23*°30′S, 71°19′W (Parin et al. 1973); and the eastern Pacific species *Holtbyrnia latifrons* and *H*. sp.— 23°24.5′S, 72°20.1′W(SIO72-171).

Brinton (1979), treating euphausiid crustacea, and Johnson (1974, 1982), the midwater fish families Scopelarchidae and Evermannellidae, provide extensive discussions comparing the distributions of these animals to the extensive hypoxic waters of the eastern equatorial Pacific, where the layer of water with less than 0.1 ml/L of dissolved oxygen content is more than 800 m thick off Peru arid over 1200 m thick off Mexico. Johnson (1982) believed the low-oxygen water to be the single most important factor controlling the pattern of distribution of evermannellids and scopelarchids in the eastern equatorial Pacific. In both the euphausiids and the midwater fishes, there are avoiders of the oxygen-deficient waters and those that remain in that layer, at least for part of the day. Euphausiid species endemic to the eastern equatorial Pacific fall in the latter group, and the scopelarchid *Scopelarchoides nicholsi* is generally associated with the most intensely oxygen-deficient waters. The endemic evermannellid *Evermannella ahlstromi* and the scopelarchid *Rosenblattichthys volucris*, also endemic, appear to be avoiders.

Most platytroctids found in the eastern equatorial Pacific are probably avoiders, as they have poorly developed gill filaments. Like the nonmigrating euphausiids of the genus *Stylocheiron* (Brinton 1979), they apparently remain in relatively well-oxygenated water. But instead of occupying the mixed layer above the low-oxygen water, *Platytroctes apus* and *Pellisolus facilis* are found below the extremely low-oxygen layer off Peru; *P. apus* also occurs in the low-oxygen waters of the Bay of Bengal and the Arabian Sea. Both species have poorly developed gill filaments.

Seemingly like *Rosenblattichthys volucris* and *Evermannella ahlstromi, Searsia koefoedi* and *Holtbyrnia* sp. appear to be avoiding the area of very low oxygen. The records of *H*. sp. (Fig. 13) between 20°S and the equator are to the west of the low oxygen area off Peru (Johnson 1982, Figs. 59-61); there are no records of *S. koefoedi* in that interval. All of the apparent avoiders—i.e., *Platytroctes apus, Pellisolus facilis, Holtbyrnia* sp., and *Searsia koefoedi*—are absent from the northern low-oxygen area off Mexico. The deeper-living *P. facilis* occurs farthest north, 6°48′N, 80°33′W (Parr 1960). *Platytroctes apus*, which is also usually taken below 1000 m, has been recorded at 6°40′N, 80°47′W (Parr 1960). The northernmost coastal records of the shallower-living *H*. sp., 1°1.5′N, 91°45.7′W(SIO52-409), andS. *koefoedi*, l°08′N, 95°10′W(ZMUC uncat. step 1, sta. 83), are not as far north, and farther to the west. These species extend westward in a narrow band along the oxygenated area of the equatorial countercurrent (Brinton 1979, Johnson 1982) between the northern and southern low-oxygen areas. The narrow eastward extension of platytroctids is centered about the equator, and it seems that they are associated with the South Equatorial Current System.

The gill filaments of *Barbantus curvifrons* from the eastern Pacific are relatively well developed, and the species probably can survive in the low-oxygen water. An individual was collected in a net sampling between 400 and 525 m off Peru at 17°S, 73°W by the Krill Expedition (SIO76-61). There is also one record of *B. curvifrons* from the Gulf of California (Brewer 1973). However, most platytroctids are apparently absent from the deeper anoxic layer in the northern half of the eastern equatorial Pacific, which lies approximately between 10-21°N. Only three platytroctids, *Mirorictus taningi, Holtbyrnia latifrons*, and *Pellisolus eubranchus*, are recorded from that area. Their gill filaments are relatively long for platytroctids (Fig. 11). *H. latifrons* occurs at shallow depths for a platytroctid (ca. 300-800 m), and *M. taningi* appears to be among the shallower-living species of the bathypelagic group of platytroctids. Two individuals of *M. taningi* collected by the Krill Expedition at 13°34′N, 98°36′W were taken in an opening-closing midwater trawl that sampled between 420-900 m (SIO76-41); oxygen levels at those depths ranged from 0.05-0.15 ml/L. Both *M. taningi* and *Holtbyrnia latifrons* are only sparsely represented in the area, and are more abundant elsewhere. *M. taningi* occurs from 35°N to 11°S in the eastern Pacific. It also extends westward in the more highly oxygenated equatorial waters and occurs in the Indo-West Pacific as well. *H. latifrons* is an eastern Pacific form ranging from British Columbia to Chile. *Pellisolus eubranchus*, the deepest living of the three, is a North Pacific form, with its southern limit at about 17°N off Mexico.

Maulisia (Aphanichthys) acuticeps, M. (A.) *isaacsi, Tragularius crassus Holtbyrnia intermedia*, and *Barbantus parini*, are represented by single or a few records in the eastern equatorial Pacific. These species probably live below the oxygen-poor waters off Peru. *B. parini* also occurs in the Indo-West Pacific, with one record in the oxygen-poor waters of the Bay of Bengal, and *M. acuticeps* has been taken at an unspecified location in the North Pacific (Sazonov 1976b).

Although *Sagamichthys abei* has about the longest gill filaments in the family (Fig. 11), there is only one record (16°S off Peru) from the low-oxygen areas. Equatorial captures are to the west of the low-oxygen area at 3°S, 145°W. S. *abei* is the shallowest living of the eastern Pacific platytroctids. Temperature and oxygen values of waters at the estimated maximum depth of capture have been usually in the 6-8°C range, with 0.4-0.9 ml/L of dissolved oxygen (hydrographic data from Scripps Institution of Oceanography 1960, 1963, 1965a, and 1965b; the relatively few samples from deeper tows are assumed to be contaminants collected above designated sampling depths, and are not included). The horizontal distribution of *S. abei* is typical of a transition water species in the North Pacific: that is, along the coast from about 26° to 55°N. Where the distribution extends westward, there is only a single record over the relatively flat-bottomed, eastern half (and that near the Mendo-cino Fracture Zone), but records are more numerous over the heavily ridged western half of the area. *S. abei* occurs from 16° to 39°S along the coast of Peru and Chile and does not extend westward. The horizontal distribution of *Normichthys yahganorum* weakly resembles that of a transition water species, but there is only a single record between Chile and New Zealand. Off Peru and Chile, records extend from 20° to 45°S.

Maulisia (Maulisia) argipalla and *Holtbyrnia innesi* are other forms found at higher latitudes of the Pacific but absent from the tropics. Both species are also found in the Atlantic. *M. argipalla* has been recorded off Valparaiso, but we are uncertain whether the *Maulisia* reported from the Indian Ocean is *argipalla. H. innesi* has been found at 58°N, which is the northernmost record of a platytroctid in the Pacific. In addition, several small individuals of *Pellisolus* and *Tragularius* have been taken in the north central Pacific. These two genera seem adapted to low-productivity waters.

Indo-West Pacific

Six species occurring in the eastern equatorial Pacific (*Searsia koefoedi, Mirorictus taningi, Pellisolusfacilis, Platytroctes apus, Barbantus curvifrons*, and *Barbantus parini*) are also found in the tropical region of the Indo-West Pacific. Records of platytroctids in the western Pacific are mostly from the semiclosed seas of the Indo-Malay Archipelago. These fertile seas surrounded by islands and steeply sloping bottoms appear to be suitable areas for platytroctids. Records of *S. koefoedi* are the most numerous and widespread, with westernmost records in the area of the Eauripik Ridge in the Caroline Basins and the Halmahera and Ceram seas. Other records extend from the South China Sea, in the north, southward into the Sulu, Celebes, Molucca, Banda, Flores, and Timor seas. The other platytroctids are found in one or more of these interocean seas. *Searsioides multispinus* also occurs in the area of the Eauripik Ridge and in the Halmahera, Banda, and Sulu seas; during the intensive collecting operations on *Alpha Helix* by B. Robison in the area, only *Searsia koefoedi* (22 stations) was more commonly taken than *Searsioides multispinus* (14 stations) in the Banda Sea. Its only congener, *S. calvala*, is known from one collection in the Halmahera Sea. *Searsioides* is limited to the Indo-West Pacific.

Mirorictus taningi and *Barbantus curvifrons* are the only other platytroctids recorded from the area of the Caroline Basins. Both are relatively rare in the interocean seas. There is one record of *M. taningi* in the Banda Sea and two of *B. curvifrons* in the South China Sea. Records of *Barbantus* are generally from the northern sector of the interocean seas, with *B. aequipinnis* taken in the Sulu Sea and *B. parini* in the Sulu and Celebes seas.

The Sulu Sea is warm, with lower oxygen levels than the other interocean seas. The differences are related to the shallow sill of about 400 m, over which water from the South China Sea enters the Sulu Sea (Wyrtki 1961). Below 400 m, the temperature changes little, ranging from about 10.1°C to 11.4°C, and increases slightly below 1200 m (Table 86 in Sverdrup, Johnson, and Fleming 1942). The oxygen levels of about 1.5-1.7 ml/L below 300 m (Wyrtki 1961) are less than in the other basins by nearly one ml/L. The temperature in the other basins ranges from 4°-5°C at 1000 m and a few degrees lower than that at 2000 m.

Paraholtbyrnia cyanocephala, which was collected at two *Alpha Helix* Stations in the Banda Sea, was taken at 11 stations in the Sulu Sea. Although there were fewer *Searsia koefoedi* than in the Banda Sea, it occurred at one more station than *P. cyanocephala*. The two species, especially *P. cyanocephala*, are taken in the shallowest tows. *P. cyanocephala* could have been in waters of 12°C in the shallower tows, which is the highest known for a platytroctid. In the eastern Atlantic, *P. cyanocephala* also seems to occur at temperatures as high as 12°C. Except for *S. koefoedi* and *Platytroctes apus*, which occur everywhere, the other Sulu Sea species are generally found in the southern sector of the Sulu Sea. Although temperature and oxygen values change relatively little below 400 m in the Sulu Sea, the four occurrences of *P. apus* were in the deeper tows. *P. apus* has also been taken in the South China, Celebes, and Banda seas and, although their temperatures are about 5°C less, it appears to have occurred at similar depths as in the Sulu Sea. *Holtbyrnia conocephala*, an Indo-West Pacific form, is recorded from the South China, Celebes, and Flores seas.

Except for *Barbantus aequipinnis* and *Searsioides calvala*, which are endemic to the interocean area between the Indian and Pacific oceans, the other platytroctids found there also occur in the Indian Ocean. Nearly all records are from north of 10°S (but there is one record of *B. curvifrons* at 11°24′S, 50°05′E). According to Wyrtki (1973), a pronounced front distinguished by a "tongue of low-salinity water" that extends from Sumatra to the African coast at about 10°S separates the oxygen-poor, nutrient-rich “monsoon gyre” of the Indian Ocean from the oxygen-rich, nutrient-poor “southern subtropical gyre.” Brinton and Gopalakrishnan (1973) reported a sharp decline of equatorial species of euphausiids south of 10°S.

A pronounced layer of oxygen-deficient water lies below the mixed layer in the northern part of the “monsoon gyre.” Wyrtki shows (1973; his Fig. 3b) dissolved oxygen values of 0.5 ml/L extending from about 200 m to about 800 m. The region north of 10°N, which includes the Arabian Sea and the Bay of Bengal, has notably fewer species of euphausiids (Brinton and Gopalakrishnan 1973) and midwater fishes (Goodyear and Gibbs 1969, Johnson 1982) than do areas to the south. *Platytroctes mirus* is endemic to the northern region. Its distribution is generally to the north of 10°N, but with a few records extending to about 5°N. There are also four records of *P. apus* in the Bay of Bengal and Arabian Sea, but seven others of *P. apus* are between 5°N and 5°S. The only other record of a platytroctid north of 10°N is of *Barbantus parini*, which has also been taken south of the equator. In other midwater fish families, *Chauliodus pammelas* (Gibbs and Hurwitz 1967) and *Astronesthes lamellosus* (Goodyear and Gibbs 1969) are also endemic to the northern part of the monsoon gyre, with distributions extending to about as far south as 5°N. As in *P. mirus*, the gill filaments of these endemic forms are better developed than those of their congeners, which have the greater part of their distributions south of 10°N in the Indian Ocean.

Brinton and Gopalakrishnan also recognized a boundary at the equator, which they placed as the southern edge of the North Equatorial Current. Distribution of some of the platytroctids also seems to indicate the presence of a boundary in that area. Most records of *Searsia koefoedi* and all of those of *Mirorictus taningi* are between 10°N and the equator, while the records of *Pellisolus facilis, Holtbyrnia conocephala*, and *Sagamichthys gracilis* (two records) are south of the equator.

The only records of platytroctids between 10°S and 30°S in the Indian Ocean are those of *Barbantus curvifrons* at 11°S and the few *Persparsia kopua* near the southern tip of Africa. Gibbs and Hurwitz considered the low-productivity region between 10°S and about 23°S to be a barrier separating the equatorial population of *Chauliodus sloani* from the richer area near the Subtropical Convergence. Brinton and Gopalakrishnan (1973) also indicated that *Euphausia similis*, which is primarily found at 0°-10°S and 28°-50°S, is nearly absent between 10°S and 28°S. Johnson (1982), however, has called attention to the poor sampling efforts in this region and the uncertainties of the distributional patterns. In the Platytroctidae, *Tragularius* is represented by two records at 30°-35°S and another at about 5°S. Although this area of the Indian Ocean may be poorly sampled, there appears to be a general absence of platytroctids between 10°-30°S, probably related to low productivity.

No platytroctid appears to be associated with the Agulhas Current system, although the occurrence of *Persparsia kopua* around the southern end of Africa may reflect its influence. Johnson (1982) indicated several tropical midwater fishes of the Indian Ocean as extending southward along the Agulhas into the eastern South Atlantic, and Krefft (1974) mistakenly included *Persparsia kopua* as a tropical form that belongs to the “Agulhas pattern.”

Southern Ocean

Persparsia kopua, Holtbyrnia laticauda, and *Normichthys yahganorum* are the only platytroctids occurring south of 40°S. In the Atlantic and Indian oceans, the latitudinal range of *P. kopua* extends from 25° to 50°S but with most captures between 30° to 40°S, and that of *H. laticauda* extends from 31° to 45°S and *N. yahganorum* from 30° to 59°S, but mainly 37° to 47°S. *P. kopua* appears to be a shallow-living form (Krefft 1976). Samples of *P. kopua* at 35°S, 60°E (USNM200502) and 38°S, 60°E (USNM200483) were from open nets that had fished as deep as 680 m and 637 m, respectively. Temperature was 10°-ll°C at the maximum sampling depth (International Indian Ocean Expedition 1965a, 1965b). Judging by our estimated depth of occurrence of 300-800 m, the vertical distribution of *P. kopua* may be centered near the oxygen maximum layer, which occurs throughout the subtropical gyre in the Indian Ocean at 400-500 m depth and a temperature range of 10°-12°C (Wyrtki 1973). An oxygen maximum layer is reported in the Tasman Sea (Wyrtki 1962), which is the easternmost boundary of the distribution of *P. kopua* (and of *Holtbyrnia laticauda*, which is probably also shallow-living). South of the Subtropic Convergence, *P. kopua* is probably in temperatures near 10°C, but certainly above 6°C, based on our assumption of a shallow depth range for the species. Although the horizontal distribution of *N. yahganorum* is similar to that *of P. kopua* and *H. laticauda*, that species occurs deeper and thus is probably in much colder water. *N. yahganorum* is circumglobal. Its distribution extends across the Atlantic, and it is the only mid-to-high-latitude platytroctid in the western half of the South Atlantic. *P. kopua* and *H. laticauda* do occur on both sides of South Africa, but extend only a short distance westward in the eastern Atlantic.

Atlantic Ocean

Except for the three species in the area of the Subtropic Convergence, distribution patterns in the Atlantic generally run north-south along the continents and the Mid-Atlantic Ridge. This differs from the predominantly east-west pattern in the Indo-West Pacific where, except for the short distances along the Indonesian and Philippine archipelagos, the meridional pattern is absent. Except for *Pellisolus facilis*, which is found between 27°N and 21°S, the panoceanic species extend farther to the north in the Atlantic. Warm, saline water extends into high northern latitudes in the eastern half of the Atlantic (Krefft 1976), and *Searsia koefoedi* and *Platyroctes apus*, species that are equatorial in the Indian Ocean, extend to about 66°N in the eastern Atlantic. The colder, less saline water does not extend as far north in the western Atlantic, and, as Krefft pointed out, the species of warm-water midwater fishes do not penetrate as far north as in the eastern Atlantic, with the northernmost record of *S. koefoedi* at 32°N. Both *S. koefoedi* and *P. apus* are absent from the South Atlantic. *Barbantus curvifrons* occurs from 15°S to 57°N in the eastern Atlantic and is absent from the western Atlantic. *Paraholtbyrnia cyanocephala* is generally equatorial, with records from 8°S to 26°N in the eastern Atlantic and one western Atlantic record at 32°N. It apparently occurs at relatively shallow depths and seems to live in relatively warm water (possibly as high as 12°C). *Holtbyrnia innesi* and *Maulisia argipalla* are the other Atlantic forms found in other oceans. Both occur in the Pacific.

The northernmost record of an Atlantic platytroctid, at 72°N, is that of *Holtbyrnia macrops*, which is limited to the North Atlantic. *Normichthys operosus* and *Sagamichthys schnakenbecki* occur to about 66°N, and *Maulisia (Aphanichthys) microlepis* and *H. anomala* to about 60°N. The majority of platytroctids in the Atlantic (16 of 21) are found in both the North and South Atlantic, and tend to have the greater part of their ranges in the North Atlantic. *Tragularius perforatus, T. mesalirus, Pellisolus longirostris*, and *Barbantus elongatus* are exceptions in that they have the greater part of their distributions in the South Atlantic. The only Atlantic species absent from the North Atlantic are the three in the area of the Subtropical Convergence and *Holtbyrnia rostrata.*

Mouth and Body Size and the Evolution and Distribution of Platytroctids

Changes in mouth and body size seem to have been important in the evolution of the family. Although these features do not indicate relationships, they are good indicators of primitive and advanced taxa. The more primitive, large-mouthed (maxilla extending behind eye), larger (maximum size 180-300 mm, but largest *Persparsia* 145 mm SL) species are generally more provincial than the small-mouthed (maxilla ending about at the posterior margin of eye to anterior to it), smaller (about 120-180 mm) species. Four of the five mesopelagic genera—*Persparsia, Paraholtbyrnia, Holtbyrnia*, and *Sagamichthys*—are large-mouthed, as are two of the most primitive bathypelagic genera, *Tragularius* and *Maulisia.* Smaller mouth and body size are characteristic of the more advanced taxa, and this seems to be associated with greater oceanic capabilities, judging from their occurrences away from land masses. But these changes appear to have developed in parallel, and small-mouthed species are found in advanced genera of several lineages: *Searsia*—the most advanced mesopelagic genus; *Mirorictus*—relationships uncertain, but perhaps nearest to *Searsia;* and *Normichthys, Searsioides, Barbantus*, and *Platytroctes*—the most advanced of the bathypelagic genera. *Pellisolus*, which appears closely related to *Tragularius*, although reduced in several features, contains both large- and small-mouthed species. *P. longirostris*, the most primitive form, has a relatively large mouth and is large in size; the others are small with a small mouth.

The large-mouthed platytroctids are relatively provincial. None are circumglobal, and only five of the 24 species are found in more than one ocean. Most widely distributed are *Persparsia kopua* and *Holtbyrnia laticauda*, with distributions extending from the eastern South Atlantic to New Zealand. The other species found in more than one ocean have disjunct distributions. *Paraholtbyrnia cyanocephala* is disjunct between the Atlantic and the Indo-West Pacific, but its tropical distribution is unusual for a generalized large-mouthed platytroctid. It appears to occur at the upper temperature range for platytroctids, judging by the capture of relatively high numbers in the Sulu Sea. The shallow depths, where it occurs in the tropical Atlantic, are equally warm, with the upper limit at about 12°C. Considering its relatively shallow depth of occurrence, it may have been possible for *P. cyanocephala* to have extended farther south around South Africa during periods of ocean warming. However, the other species with disjunct distributions, *Holtbyrnia innesi* and *Maulisia argipalla*, are in the Atlantic and the Pacific.

Paraholtbyrnia cyanocephala, Persparsia kopua, and *Holtbyrnia laticauda* are the only platytroctids occurring in both the Atlantic and the Indian Ocean-western Pacific regions but absent from the eastern Pacific. As discussed above, *P. kopua* and *H. laticauda* occur in the area of the Subtropic Convergence in relatively warm water. The three species are among the most primitive in the family. Although *H. laticauda* does not appear to be the most generalized in that genus, it has small body scales like those of *intermedia*, which does appear to be the most primitive form.

In addition to *Persparsia* and *Paraholtbyrnia*, all the other large-mouthed genera are represented in the Atlantic and the Indian Ocean-western Pacific region. This might suggest a possible Southern Hemisphere-wide distribution of ancestral platytroctids. However, the most primitive species assemblage is that of the Atlantic. Except for *Holtbyrnia*, the most generalized forms of the remaining large-mouthed genera—i.e., *Sagamichthys, Maulisia, Tragularius*, and *Pellisolus*—are found in the Atlantic. But these genera are poorly represented in the Indian Ocean, and usually by the most advanced species. Only *Tragularius* has Indian Ocean species that are closely related to the generalized Atlantic species. The observed pattern may be related to environmental differences. *Sagamichthys* and *Maulisia* and the majority of *Holtbyrnia* spp. are meridionally distributed along the western borders of the continents in the eastern Pacific and the Atlantic. These areas are characterized by a sharp thermocline and high productivity. Below 300-400 m the temperature is 4°-8°C over a wide depth range, one which includes most of the estimated depth ranges of platytroctids in the region. We would not speculate that these genera are adapted to these cooler temperatures, but none have been taken in the warm Sulu Sea. Moreover, reported captures decline in the tropical latitudes of the Atlantic and eastern Pacific, and congeners taken in the tropical latitudes of the Indian Ocean are apparently deeper living.

Normichthys, which appears to be among the most primitive of the small-mouthed genera, is usually taken below 1000 m and probably occurs at the lower range of temperatures for the family. Krefft (1976) estimated the depth range of *N. yahganorum* as 785-2000 m and associated it with the bottom of the Antarctic Intermediate Water. Its congener *N. operosus* is meridionally distributed along the eastern Atlantic from about 9°S to 57°N at depths of about 1000 m (Krefft 1976). However, *Searsioides, Platytroctes*, and *Barbantus*, which may have been derived from a *Normichthys*-like ancestor, appear to tolerate relatively warm water. Four of the six species in the Sulu Sea belong to these three genera. Of the remaining species of these genera not found in the Sulu Sea, *P. mirus* is endemic to the Arabian Sea and the Bay of Bengal, *S. calvala* is endemic to the Halmahera Sea, and *B. elongatus* is found only in the Atlantic. *B. curvifrons* is the only wide-ranging species of these genera that has not been recorded from the Sulu Sea.

One could also hypothesize an Atlantic center of origin of these primitive genera. In a few cases, radiation of predominantly South Atlantic forms (*Tragularius*) seems to have been to the east, and those that are predominantly North Atlantic (*Sagamichthys* and *Aphanichthys*) may have spread to the west. *Tragularius*, which appears to be the most primitive of the bathypelagic genera, is represented in the Atlantic by two generalized species, *T. mesalirus* and *T. perforatus*. The two records of *T. mesalirus* are in tropical latitudes. Those of *T. perforatus* extend from the tropical area to near the southern end of Africa. *T. bythios* of the Indian Ocean has more reduced cephalic lateral line canals and subcutaneous pores, a small lacrimal, and fewer lamellae in the nasal rosette. Like *T. perforatus*, it is without a lateral line canal. The cephalic lateral line canal and subcutaneous pores of *T. crassus* of the eastern Pacific are still more reduced. The species of *Tragularius* are thus progressively more advanced to the east, with the eastern Pacific form least like the Atlantic forms.

Sagamichthys is represented in the Atlantic by *S. schnakenbecki*, which is similar to *Holtbyrnia*, the apparent primitive sister group of *Sagamichthys*, in the scaleless opercle and head, with reverse imbricated scales limited to the nape, and an opercular opening extending to a level with the top of the eye. The head and opercle of the Pacific *S. abei* are scaled, with reverse imbrication extending to the shoulder region on the dorsal half of the body, and the opercular opening is more restricted, extending only to mideye. *S. gracilis* of the Indian Ocean is the most advanced species, with reverse imbrication extending back to the pelvics on both the dorsal and the ventral halves of the body, and the opercular opening restricted to the level of the ventral margin of the eye. The species of *Sagamichthys* are thus progressively more advanced from the Atlantic westward.

Maulisia (Aphanichthys) microlepis, the apparent primitive species of that genus, has been taken mostly from the eastern side of the Atlantic from 31°S to 62°N, with one western North Atlantic record. Two species of *Aphanichthys, acuticeps* and *isaacsi*, are found in the eastern Pacific, but none have been taken in the West Pacific or Indian Ocean. (We are uncertain of the species allocation of some of the published records of the subgenus *Maulisia* in the Atlantic and eastern Pacific and of the records from the Indo-West Pacific.)

Pellisolus longirostris—a large-mouthed form, but congeneric with small-mouthed forms—and *Normichthys operosus* occur only in the Atlantic, and they are more primitive than any bathypelagic small-mouthed forms in the tropical latitudes of the Indo-West Pacific. The small-mouthed forms are best represented in the tropical regions of the Indian Ocean and western Pacific, and the primitive forms of the three most advanced genera are endemic to these regions. *Searsioides*, which has morphological features indicating close relationship to *Normichthys*, occurs only in these regions, and the generalized species of *Platytroctes, P. mirus*, and of *Barbantus, B. aequipinnis*, are also endemic to those areas. The remaining small-mouthed species of the Indo-West Pacific (*Searsia koefoedi, Mirorictus taningi, Pellisolus facilis, Platytroctes apus,*$_y$ *Barbantus curvifrons*, and *B. parini*) have wide distributions and, except for the absence of *M. taningi* in the Atlantic, essentially the same species assemblage occurs in the eastern Pacific and the Atlantic. These wide-ranging species comprise the entire small-mouthed contingent in the eastern equatorial Pacific. A single small-mouthed species, *Pellisolus eubranchus*, is endemic to the North Pacific. The Atlantic fauna differs from that of other regions in the absence of *Mirorictus taningi* and the replacement of *Barbantus parini* by the Atlantic form *B. elongatus.*

In the Pacific and Indian oceans the panoceanic species are equatorially distributed, and nearly all the records at tropical latitudes in the western Atlantic pertain to *Searsia koefoedi*, *Platytroctes apus*, and *Pellisolus facilis.* Although these species extend as far north as 66°N in the eastern Atlantic, the southernmost record is 24°S, and *S. koefoedi* and *P. apus* have not been taken in the South Atlantic. *Normichthys yahganorum*, which is circumglobal in the area of the Subtropical Convergence, is the only small-mouthed species found south of 24°S in the southern oceans, and it seems that other panoceanic species in the Atlantic are isolated from populations elsewhere.

Summary and Discussion

Most platytroctid distributions are in the form of relatively narrow bands along the enriched waters of the west coast of the continents and the equatorial and Subtropical Convergence regions; platytroctids are absent from most of the other regions of the oceans. High productivity appears to be the most important factor determining their presence. Platytroctid distributions, when extending across the central ocean areas, appear to be restricted to areas near high-relief bottoms such as oceanic ridges and fracture zones, or near islands. Platytroctids produce a small number of large eggs that apparently remain at about the same depths occupied by the adults, and the species are without a specialized larval stage, taking on the adult shape after the yolk is exhausted (Beebe 1933). Dispersal thus appears to be limited. To illustrate the general provincialism in the family in the area from 180° to 15°W (that is, from approximately the meridian of New Zealand eastward to about the Mid-Atlantic Ridge), there is only one species of platytroctid (*Normichthys yahganorum*) in waters south of 24°S, excluding the waters just west of Chile. Yet in the eastern portion of the South Atlantic and from 24°S to the equator on the western side, there are 18 species of platytroctids—half the recognized species in the family.

Only three species of the family have distributions extending south of 40°S, and these are the only species found on either side of South Africa, with apparent gene flow around South Africa. The large-mouthed species are usually restricted either to (1) the Atlantic Ocean, (2) the Indian Ocean and the western Pacific region, or (3) the eastern Pacific Ocean, sharing in this respect the provincialism noted by Fleminger and Hulsemann (1973) for low-latitude calanoid copepods. However, two large-mouthed species that have disjunct distributions occur in the Atlantic and the Pacific, respectively, and another is limited to the Atlantic and the Indo-West Pacific. These distributions are notable as indicated by Johnson's (1982) comment that "There appear to be very few warm-water oceanic species limited to two ocean basins in which one member of the pair is in the Atlantic . . ." Similarly discordant are the five panoceanic small-mouthed species, with only *N. yahganorum* extending south of 40°S. In fact, no other small-mouthed species extends farther south than 24°S, and two panoceanic species are not known from the South Atlantic at all. Furthermore, the large-mouthed forms are generally meridionally distributed, and in the South Atlantic the majority extend farther south than the panoceanic forms, although most occur only in the Atlantic. It is also peculiar that in the large-mouthed genera *Sagamichthys, Maulisia*, and *Holtbyrnia*, the Atlantic forms are most closely related to eastern Pacific forms.

These features of platytroctid distributions suggest to us that for much of the family there was a direct interocean movement between the Atlantic and the eastern Pacific. Such a connection also seems indicated in the bathypelagic fish genus *Ataxolepis* (Goodyear 1970), represented by two species, an eastern Pacific form, *A. henactis;* and the closely related *A. apus* in the Atlantic. The history of *Chauliodus* also indicates possible radiation across the Bolivar Trough (Crane 1966). The distribution of the species of *Rondeletia* is also suggestive. *R. bicolor* was described from the western North Atlantic and had been thought to be restricted to that area (Paxton 1974). The rest of the world's oceans, including the South Atlantic, are inhabited by its congener *R. loricata*. However, *R. bicolor* does occur in the eastern Pacific. The SIO collection contains a single individual of *R. bicolor* from off Peru (25°58′S, 108°51′W, SIO69-345). This individual has been compared with material from the North Atlantic, from which it is morphologically indistinguishable except for having relatively longer gill filaments.

The distributions of *Searsia koefoedi, Pellisolus facilis*, and *Platytroctes apus* illustrated in Figures 15, 16, and 19 form a pattern that best fits a past connection through the Panama Seaway between the eastern Pacific and the Atlantic oceans. It is significant in this regard that in *P. apus* and *S. koefoedi* the eastern Pacific populations are more similar morphologically to those of the Atlantic than to those of the western Pacific. The only western Atlantic records of platytroctids in the Caribbean area are of the three circumtropical species. A passage across Central America seems possible, as a recent study indicates deep-water circulation existed through the Panama Seaway until about the Miocene-Pliocene boundary about 4.5 million years ago, over a sill depth of about 500 m (Casey, McMillen, and Bauer 1975). Indication that significant morphological changes may not have occurred in that time period is found in several studies of fossil remains of midwater fishes suggesting that some Miocene species were practically identical to extant species (*Argyropelecus*—Baird 1971, *Chauliodus*—Crane 1966, David 1943). Although passage of the equatorial forms around South Africa cannot be completely ruled out, it seems that the Panama Seaway, long recognized as a passageway for shallower-water marine biota, may have provided a passage for midwater organisms as well.

KEY TO THE FAMILY

la.	Body deep (2.5-3 in SL), strongly compressed, with about half of dorsal and ventral profiles developed as nonmuscular keels; dorsal margin anterior to dorsal fin sharp, only one scale wide	(*Platytroctes* Günther 1878). . .2
lb.	Body shallow to deep (3.5-6.5 in SL), compressed to nearly round in cross section; dorsal and ventral margins of body of either muscular or nonmuscular tissue, which may be as thick as one-fourth of body depth but usually much less; dorsal margin more than one scale wide (except *Normichthys)*, usually rounded	3
2a.	Pelvic fins absent; cleithral symphysis produced as a pointed spine; most scales with a median ridge; luminous sacs between scales along dorsal and ventral margins of caudal peduncle; mid-dentary teeth present in young; dentary tooth row interrupted by a diastema	*P. apus* nther 1878
2b.	Pelvic fins present; cleithral spine barbed; scales without a median ridge, caudal peduncle normal; mid-dentary teeth absent; tooth row of dentary short, ending at maxillo-mandibular ligament	*P. mirus* (Lloyd 1909)
3a.	Maxillo-mandibular ligament crossing dentary, causing a diastema in dentary teeth; vomerine teeth well separated, on either side of vomer; palatine teeth lateral to vomerine teeth; scales large, about 45-55 in mid-lateral series	(*Barbantus* Parr 1951). . .4
3b.	No ligament across dentary; vomerine teeth closely spaced, and palatine teeth, when present, posterior to vomerine teeth; scales usually more than 55 in mid-lateral series (*Mirorictus* and *Pelliosolus* with as few as45-50)	7
4a.	Entire dorsal fin before anal fin; dorsal base twice as long as anal base; greatest body depth about 5.5-6.5 in SL; least depth at caudal peduncle about 1.4-1.6 in greatest depth	5
4b.	Dorsal origin ahead of anal origin by at most half its basal length; base of dorsal fin less than 30% longer than that of anal; greatest body depth 4.5-5.4 in SL; least depth at caudal peduncle 1.6-2.2 in greatest depth.	6

5a.	Gill opening restricted, ending at pectoral base; body squamation extending uninterrupted to posterior margin of eye across opercles; about 17 anterior rows of scales reverse-imbricated	*B. parini* Sazonov 1976
5b.	Gill opening normal, reaching about level of middle of eye; opercles without scales; scales normally imbricated	*B. elongatus* Krefft 1970
6a.	Anal origin about opposite middle of dorsal fin; basal length of dorsal fin 20-30% longer than that of anal; no external dentary (mid-dentary) teeth, a pair of laterally projecting mandibular spines or a ridge across symphysis; anteriormost scale row on occiput over posterior fourth of eye; D 16-18	*B. curvifrons* (Roule and Angel 1931)
6b.	Dorsal and anal origins nearly opposed, with the dorsal origin slightly ahead; bases of dorsal and anal fins subequal; a row of about 13 mid-dentary teeth on a poorly developed mid-dentary ridge; anteriormost scale row on occiput clearly behind eye; D 13	*B. aequipinnis* n. sp.
7a.	Dorsal part of upper jaw overlapped by lacrimal and all or part of laminar extension of 2nd infraorbital bone (also by that of 3rd in *Persparsia);* when present, 2nd premaxillary tusk parallel to 1st; regular row of premaxillary teeth directed downward in normal way; cephalic lateralis canal passing through posttemporal (except *Sagamichthys*) and supracleithral bones (except *S. abei* and *S. gracilis);* about 50 modified scales in lateral line (except *Searsia);* pelvic rays usually 9 (8-10; except 6-8 in *Searsia);* cleithral symphysis normal, not in a spine	8
7b.	Dorsal part of upper jaw either overlapped by lacrimal only or not overlapped at all (except some individuals of subgenus *Maulisia* with slight overlapping by the 2nd infraorbital); when present, 2nd premaxillary tusk directed more laterally than 1st and not parallel to it, premaxillary teeth behind tusks subhorizontal and in series with tusks; posttemporal and supracleithral bones not pierced by cephalic lateralis canal; lateral line without modified scales (except in *Maulisia microlepis* and *Tragularius mesalirus);* pelvic rays 6-8 (uncommonly 9); cleithral symphysis produced as a spine (except *Mirorictus, Pellisolus facilis,* and *P. eubranchus).*	22

8a.	Maxilla ending between mideye and posterior margin of eye; supraorbital absent or rudimentary; lateral line marked by papillae (often abraded and lost or represented by neuromasts only), without a canal and modified scales; ICO photophore double; pelvic rays 6-8; one-fourth or less of dorsal fin before anal origin	*Searsia koefoedi* Parr 1937
8b.	Maxilla ending behind eye; supraorbital present; approximately 50 modified scales lining lateral line canal; when photophores present, ICO single; pelvic rays 8-10 (usually 9); one-third or more of dorsal fin before anal origin	9
9a.	Photophores all circular, THO position marked by 3 round organs, JO single and round, and PVO present; young with CO and dorsal and ventral 00; branchistegal rays 7; gillrakers about 38-40 on 1st arch	*Persparsia kopua* (Phillipps 1942)
9b.	Photophores may be present, rudimentary, or absent; when present, THO and JO as a bar, PVO absent; in young, CO and ventral 00 absent, dorsal 00 present or absent; branchiostegal rays 8; gillrakers 20-32 on 1st arch	10
10a.	Premaxillary tusks absent or rudimentary; 2nd infraorbital much the largest, reaching preopercle; posttemporal bone without canal for cephalic lateralis; JO a transverse bar; dorsal 00 present in young .... (*Sagamichthys* Parr 1953)	11
10b.	Premaxillary tusks present; 2nd infraorbital usually not the largest, reaching only to posterior border of mouth; posttemporal bone with canal for cephalic lateralis; JO a longitudinal bar (absent in *Holtbyrnia anomala* and *H. rostrata);* dorsal 00 rudimentary or absent in young	13
11a.	Head and opercles scaleless; reverse-imbricated scales anterior to opercular opening on nape only; dorsal margin of opercular opening level with top of eye; cephalic lateralis canal with a short section through supracleithrum	*S. schnakenbecki*(Krefft 1953)
11b.	Head and opercles with reverse-imbricated scales; reverse imbrication extending at least to shoulder organ on dorsal half of body; dorsal margin of opercular opening level with lower margin of eye to mideye; cephalic lateralis canal passing over, not through, supracleithrum	12

12a.	Opercular opening level with lower margin of eye; lateral line canal without dorsal jog before joining cephalic lateralis canal; scales reverse imbricated anteriorly, from about THO photophores, both dorsal and ventral to lateral line; gillrakers on 1st arch 27-29; greatest body depth less than length of caudal peduncle	*S. gracilis* Sazonov 1978
12b.	Opercular opening level with mideye; lateral line canal with a short dorsal jog before joining cephalic lateralis canal; reverse-imbricated scales anterior to exposed tube of shoulder organ and only dorsal to lateral line on the body, ventral half of body normally imbricated; gillrakers 24-26; greatest body depth usually greater than length of caudal peduncle, occasionally about equal to it	*S. abei* Parr 1953
13a.	Dorsal rays 20-23; AO present (at least by 100 mm SL); no white tissue on infraorbitals; palatine and middentary teeth, if present, weak, ectopterygoid teeth absent; infraorbitals reaching preopercle; 3rd infraorbital the largest; supraorbital elongate and over anterior half of eye	*Paraholtbyrnia cyanocephala* Krefft 1967
13b.	Dorsal rays 16-20 (22 in *Holtbyrnia intermedia)*; AO absent; white tissue on 2nd-3rd infraorbital bones and, following a gap, another patch on 4th-6th infraorbitals (except *H. rostrata*; not known for *H. intermedia*); palatine teeth often in a cluster, mid-dentary teeth well developed, ectopterygoid teeth present in most large individuals; infraorbitals not reaching preopercle; 1st infraorbital (lacrimal) the largest (not known for *H. in- termedia)*; supraorbital cupped over most of eye, its medial margin in contact with frontals for most of its length (not known for *H. intermedia*)	(*Holtbyrnia* Parr 1937). . . 14
14a.	Anterior 7-8 rows of scales on nape reverse imbricated	*H. intermedia* (Sazonov 1976)
14b.	Scales normally imbricated	15
15a.	Photophores absent in young, rudimentary (with a weak PO photophore) or absent in large individuals	16
15b.	Photophores well developed, IVO and GO_2 present in young	17
16a.	Rudimentary photophores present; white tissue on 2nd-3rd infraorbitals, and above a gap another patch on 4th-6th	*H. anomala* Krefft 1980
16b.	Photophores absent; no white tissue on infraorbitals bones	*H. rostrata* (Günther 1878)

17a.	GO_1 at symphysis; gill filaments long, about 3-6% SL at junction of ceratobranchial and epibranchial, bases of filaments not united	*H. latifrons* Sazonov 1976
17b.	GO_1 at least 1.5 organ-diameters behind symphysis; gill filaments short, 0.6-0.8% SL at junction of ceratobranchial and epibranchial, bases of filaments united	18
18a.	Gillrakers 19-23, with 6-7 on upper limb; scales 94-107 in midlateral series	19
18b.	Gillrakers 24-29, with 6-9 on upper limb; scales 100-145 in midlateral series	21
19a.	Gill filaments relatively well developed, anterior row clearly present at angle of 1st arch and free part longer than united base	*H. innesi*(Fowler 1934)
19b.	Gill filaments poorly developed, anterior row absent at angle of 1st arch, and united basal part much wider than free length of exposed filaments	20
20a.	Pelvic rays 9	H. sp.
20b.	Pelvic rays 8	*H. conocephala* Sazonov 1976
21a.	Gillrakers 24-27; scales 125-145 along midline	*H. laticauda* Sazonov 1976
21b.	Gillrakers 27-29; scales 100-110 along midline	*H. macrops* Maul 1957
22a.	Premaxillary tusks and mid-dentary teeth absent; maxilla ending before mideye; pelvic fins usually inserted before body midlength	*Mirorictus taningi* Parr 1947
22b.	Forward-directed premaxillary tusks present, mid dentary teeth present in some young; maxilla ending behind mideye; pelvic fins inserted behind body midlength	23
23a.	Widest part of frontals over eye, abruptly narrower anteriorly and posteriorly; supraorbital large, canted subhorizontally with lateral margin below medial margin	(*Maulisia* Parr 1960). . . 24
23b.	Frontals widest at posterior end of eye to behind eye, narrowing to about half as wide over eye, with sides nearly straight; supraorbital small to large, either extending horizontally or with lateral margin only slightly below medial margin	28

24a.	Photophores present; body deep (3.5-4 in SL); snout relatively short, 3.8-4.8 in HL; a large opening several scale rows wide behind supracleithrum (shoulder pit); premaxilla with 4-8 teeth behind tusks	(*Maulisia* subgen.). . .25
24b.	Photophores absent; body shallow to moderately deep (4.3-5.2 in SL); snout long, 3.2-3.8 in HL; no pits behind supracleithrum; premaxilla with 7-15 teeth behind tusks	(*Aphanichthys* n. subgen.). . . 26
25a.	THO a transverse bar; top of head widest at frontals; 43-45 vertebrae	*Maulisia (M.) mauli* Parr 1960
25b.	THO round; top of head widest at supraorbitals, which extend laterally behind the widest part of frontals; 46-47 vertebrae	*M. (M.) argipalla* Matsui and Rosenblatt 1979
26a.	Approximately 50 modified scales in lateral line and approximately 112-125 body scales in midline	*M. (A.) microlepis* Sazonov and Golovan 1976
26b.	Lateral line marked by papillae (which may be abraded and lost), or only by neuromasts, modified scales absent; 80-100 scales in midline	27
27a.	Top of gill opening level with mideye; scales about 80 in midline; pyloric caeca with 6 primary branches and 21 terminal diverticula	M. (A.) isaacsi n. sp.
27b.	Top of gill opening nearly level with top of eye; scales about 100 in midline; pyloric caeca with 6 primary branches and 10 terminal diverticula	*M. (A.) acuticeps* Sazonov 1976
28a.	Body compressed, dorsal margin relatively sharp, nonmuscular tissue about 1-2 scale rows in width along dorsal margin; anal and dorsal fin nearly opposed; dorsal origin ahead of anal by one-fourth or less of its base; photophores present, rudimentary, or absent	29
28b.	Body moderately compressed, dorsal margin rounded, with little or no nonmuscular tissue along dorsal margin; dorsal fin origin ahead of anal by about one-fourth to one-third of its base; photophores absent	32

29a.	Photophores rudimentary or absent, maxilla ending below posterior fourth of eye; nasal sac close to maxillary bone; several large subcutaneous pores behind supracleithrum, largest equal to 2 scalepockets (dermal pits); tendon of adductor mandibulae inserting on maxilla	(*Normichthys* Parr 1951). . . 30
29b.	Photophores present, IVO and GO_2 present in young; maxilla extending to about posterior margin of eye; nasal sac located at about middle of snout; no pits behind supracleithrum; tendon of adductor mandibulae inserting on anterior supramaxilla	(*Searsioides* Sazonov 1977). . . 31
30a.	Body depth 3.4-4 in SL; gillrakers 24-28; scales 100-125 along midline; largest dermal pit about the size of a scalepocket	*Normichthys yahganorum* Lavenberg 1965
30b.	Body depth 4-5 in SL; gillrakers 28-30; scales 80-100 along midline; largest dermal pit often equal in size to 2 scalepockets	*N. operosus* Parr 1951
31a.	Gillrakers on 1st arch 40-45; 77-90 scales along midline; dorsal and anal fin origins nearly opposite (dorsal about 4 dorsal rays ahead)	*Searsioides multispinus* Sazonov 1977
31b.	Gillrakers on 1st arch 29-34; about 120 scales along midline; dorsal ahead of anal fin by one-fourth its basal length	*S. calvala* (Matsui and Rosenblatt 1979)
32a.	Scales large, 47-75 on midline; cephalic lateral line canals without any side branches; cephalic lateralis and supratemporal canals and all or part of postocular and preoperculomandibular canals absent; eyes anterolaterally directed, with dorsal margin included or nearly included in outline of head	(*Pellisolus* Parr 1951). . .33
32b.	Scales small, 75-100 on midline; cephalic lateral line canals complete, most with side branches; eyes directed laterally, dorsal margin below head outline.	(*Tragularius* n. gen.). . . 35
33a.	Gillrakers 26-30 on 1st arch; premaxillary tusks large; snout long (9.5-10% SL); scales approximately 70 in midline count; mesopterygoid teeth present	*Pellisolus longirostris* Sazonov and Golovan 1976
33b.	Gillrakers 21-24 on 1st arch; premaxillary tusks small, barely larger than other teeth; snout short (6-9% SL); scales large, 40-60 along midline; mesopterygoid teeth absent	34

34a.	Gill filaments well developed, outer row at angle of 1st arch 0.5-1.2% SL; scales 56-62 in midline; lateral bulge of eyes about in line with widest part of skull at sphenotic or extending only slightly beyond outline of skull; eye about 11% SL at about 100 mm SL	*P. eubranchus* n. sp.
34b.	Gill filaments poorly developed, outer row lacking at angle of 1st arch; scales 47-58 in midline; lateral bulge of eye extending beyond widest part of skull at sphenotic; eyes 12-13% SL at 100 mm	*P. facilis* Parr 1951
35a.	Approximately 50 modified scales in lateral line	*Tragularius mesalirus* n. sp.
35b.	Lateral line without modified scales, marked by papillae (which may be abraded and lost) or neuromasts	36
36a.	Lacrimal extending to posterior margin of eye; 1-15 subcutaneous pores (0.2-0.5 mm diameter) in most scalepockets; 2-4 teeth on basihyal and basibranchials; cephalic lateral line canals well branched	*T. perforatus* (Sazonov and Trunov 1978)
36b.	Lacrimal extending as far back as mideye to posterior one-fourth of eye; 1-4 subcutaneous pores (0.1-0.15 mm diameter) in some scalepockets; a single tooth on basihyal and basibranchials in large individuals; cephalic lateral line canals branched to nearly unbranched	37
37a.	Cephalic lateral line canals unbranched or little branched; most scalepockets without subcutaneous pores, a few with 1-2; dorsal origin ahead of that of anal by about one-third its length	*T. crassus* (Parr 1960)
37b.	Cephalic lateral line canals branched; most scalepockets with 1-4 subcutaneous pores; dorsal origin slightly ahead of that of anal	*T. bythios* n. sp.

TAXONOMY

Persparsia Parr 1951

Persparsia Parr 1951:17; type species: *Persparsia taningi* Parr 1951 (= *Bathytroctes kopua* Phillips 1942), by original designation.

Generic diagnosis. Body elongate, shallow, and moderately compressed, with rounded dorsal margin. Nonmuscular tissue insignificant or absent along dorsal margin. Cleithral symphysis normal, not produced as a spine. Photophores all circular; AO, PJO, and PVO present. In young, photophores consist of dorsal and ventral OO, IOO, SPO, IPO, anterior-and posterior-facing IVO, and a pair of CO, as well as the GO_2. Narrow band of white tissue around eye, extending over infraorbitals. Lateral line with a canal lined by about 50 modified scales that continue onto caudal rays. Posttemporal bone receiving cephalic lateralis and subcutaneous canals; cephalic lateralis canal passing through the supracleithrum; cephalic lateral line canals complete and branched. Dorsal part of upper jaw overlapped by lacrimal and 2nd and 3rd infraorbitals. Posterior border of maxilla behind eye. Innermost premaxillary tooth enlarged as a horizontal incurved tusk; a 2nd tusk juxtaposed to 1st and similarly directed in most individuals; a 3rd subhorizontal and more laterally directed tusk less frequently present. In larger individuals, individual tusks may be fused together. Main tooth row of premaxilla vertical, no teeth directly beneath the base of tusks. Mid-dentary teeth present in young, absent in adults. Ectopterygoid teeth absent. Posteriormost branchiostegal ray as wide as subopercle. Dorsal origin ahead of that of anal by half or more of its basal length. Slender supraorbital partially embedded in tissue and located below the level of frontal. P_2 9, vertebrae 45-46, U_1 present.

Generic description. That of the single species *P. kopua*.

Persparsia kopua (Phillips 1942)
(Fig.22A)

Bathytroctes (Bathytroctes) rostratus (not of Günther 1878) Norman 1930: 268, Fig. 1 (descr. and ill., spec, from 33°25′S, 6°31′E and 33°50′S, 16°04′E).

Bathytroctes rostratus (not of Günther 1878) Beebe 1933: Figs. 8c-d (fig. of juv.; cat. number in error, see Parr 1960: 45).

Searsia n. sp. Parr 1937: 16 (in key).

Bathytroctes kopua Phillips 1942:49-50, Fig. 1 (orig. descr.; holotype: Dominion Mus. no. 826, stomach of grouper caught in 100 fms, middle bank, Cook Strait, New Zealand).

Persparsia tåning Parr 1951: 18-19 (orig. descr.; holotype: ZMUC P17288, 35°42′S, 18°37′E, 2500 m wire out); 1960: 50-53, Figs. 35-36 (descr.; 1 spec, from same sta. as, but shallower depth than, holotype, and 8 others from 34°23.5′S, 178°42.5′W).

?Persparsia taaning Tucker 1954: 208-211, Figs. 18-19 (23 mm spec, lacking photophores, insufficient descr. to assign to any species; see Parr 1960: 53).

Persparsia kopua Parr 1960: 48-50, Figs. 33-34 (descr. and ill. of holotype); Matsui and Rosenblatt 1971: 447-448 (syn. *P. taningi* as young of *P. kopua;* ontogenetic changes in photophores); Hulley 1972a: 203, Fig. 2, Table 1 (counts, meas., and list of photophores in table; ill.; spec, from 37°17′S, 54°36′E and 36°38′S, 16°28′E); 1972b: 237 (counts and list of photophores of a spec, from 31°38′S, 8°21.5′E); Krefft 1974: Fig. 13 (distr.; spec. from 4 loc. S Atlantic, 30°-36°S, 4°-17°E); Sazonov 1976b: 68, Figs. 8, 9 (compiled distr.; new records off W coast Australia and between Australia and New Zealand); Sazonov and Trunov 1978: 87 (descr.; spec, from 30°12′S, 3°14′E).

Diagnosis. That of the genus.

Description. Body elongate, moderately compressed (width at cleithrum 1.8 in greatest depth) and shallow (greatest depth about 5 in SL). Body profile without much taper, least depth at caudal peduncle about 2.5 in greatest depth. Nonmuscular tissue lacking on dorsal margin. Ventral body wall thick. Dorsal ahead of anal by one-half to three-fourths its basal length and ending before last anal ray. Pelvic origin behind midlength by about twice its basal length. Anus about opposite the middle of dorsal fin.

Head large, about 3.3 in SL at 145 mm SL. Frontals forming an isosceles triangle before eye, becoming abruptly wider at margin of eye, then narrowing in a gentle curve in interorbital area, then widening again behind eye so that top of head behind anterior margin of orbit is roughly hourglass-shaped. Supraorbital slender and concave, its posterior third lying beneath the frontal. As it emerges from the margin of the eye it curves medially, then anteriorly, reaching the nasal sac where it is loosely joined to the elongated antorbital by a ligament. Eye large, 3.5 in HL. Snout long, slightly shorter than eye length. Nasal sac closer to orbit than to maxilla, rosette with about 17 lamellae. Mouth large, maxilla extending behind eye. Supramaxillae mostly exposed, slightly overlapped anteriorly by lacrimal, which ends below anterior one-fourth of eye. The 2nd infraorbital bone mostly a tubule with only a small laminar portion, as are the other infraorbitals except the 3rd and 4th; laminar portion of 3rd extending to preopercle; lacrimal and laminar portion of 2nd and 3rd infraorbitals overlapping dorsal part of upper jaw when mouth is closed. Anterior supramaxilla longer than posterior supramaxilla by about a third of its length. Tendon from adductor mandibulae inserted on anterior supramaxilla.

As many as 3 anterior teeth on each premaxilla enlarged, the anteriormost the largest, with the anteriormost 2 incurved and horizontally directed. Premaxillae not meeting anteriorly, with a wide edentulous space between tusks. The 2nd tusk somewhat smaller than 1st and juxtaposed to it; a 3rd tusk, less frequently present, subhorizontally and more laterally directed. Tusks may be fused together in larger individuals. The main row of 3-6 teeth vertical, beginning behind the tusk; no teeth with base beneath the tusk. Maxilla and dentary with small, close-set teeth. Short row of (about 5) mid-dentary teeth present in smaller individuals but absent in larger ones. Vomer with 2 teeth, each palatine with a tooth, and basihyal either with a single median tooth or toothless. One or more rows of teeth on basibranchial, and single row on mesopterygoid. Teeth present on upper pharyngeals of 2nd-4th arches and on 4th epibranchial and 5th ceratobranchial. Medial gillrakers lacking on ceratobranchial of 1st and 2nd arches; epibranchial and hypobranchial with 8-13 short ones. Row of medial rakers complete on 3rd and 4th arches (as they are in all platytroctids). Gill filaments variably developed, present or absent on outer row at angle of 1st arch. Basal part of filaments united by membrane, with the united part equal to the exposed end on the ceratobranchial, much narrower at angle of 1st arch. Dorsal margin of gill opening at a level with the upper margin of eye.

Lower margin of opercle running horizontally for nearly its entire length. Opercle widest at posterior margin, which is twice as wide as subopercle and 1st branchiostegal ray. Subopercle with a ventral diagonal ridge running anterodorsally for about a third the distance from its anterior margin. In young stages, the subopercle is not developed anterior to this ridge, so that the ridge is an arch with the SBO photophore under it (similar to that of *Sagamichthys abei*, Fig. 21). The SBO is occluded as the anterior part of subopercle forms. Subopercle and interopercle in line, with their long axes nearly parallel to posteriormost branchiostegal ray. Four flattened rays laterally on epiphyal, with the last 3 bunched and overlapping, 3 acinaciform rays ventrally on ceratohyal. Exposed tube of shoulder organ long, about half an eye length, opposite to slightly below ventral tip of supracleithrum and nearly an eye diameter below the tip of gill opening. Cleithrum expanded as an oval plate and partly over sac of shoulder organ. Cleithral symphysis normal, not produced into a spine.

Photophores all round or oval, with a dark inner ring. In addition to the photophores listed in Table 2, there are numerous small, downward-directed photophores on the sides ventral to the lateral line, around the shoulder organ, anterior to the base of the pectoral fin, and along the flattened ventral surface from the cleithral symphysis to middle of the anal base. THO, SVO, and PAO are directed laterally until about 30 mm SL; in larger specimens they are directed ventrally. White tissue on the 2nd and 4th infraorbitals and, at a larger size (98 mm SL), surrounding the orbit.

Scales small, about 107 in midlateral series. About 50 modified scales lining lateral line canal and extending onto caudal rays; those on caudal rays tubular. Minute subcutaneous pores (0.12-0.16 mm) in most scalepockets of 145 mm individual; no enlarged pits behind supracleithrum.

Except for the supratemporal canal, other canals of the cephalic lateral line system are complete, with some branches off the main canals. About half of the supratemporal canal is partly ossified and present, but we could not determine whether it continues in soft tissue. It is not intersected by the supraorbital canal. The cephalic lateralis canal passes through the ventral part of the posttemporal bone, then turns ventrally into the supracleithrum for about a third of its length before joining the body lateralis. About one-third of the canal in the supracleithrum is ossified with 1 pored opening, the remainder being of soft tissue with 2 pored openings. A subcutaneous canal also passes dorsoventrally through the posttemporal and intersects with and apparently ends at the cephalic lateralis canal.

D20-22, A 13, P_1 19-21, $P_2$9, Br 7, GR 10-12 + 26-30(38-40), vertebrae 25-26 + 19-21 (45-46). Largest record: 145 mm.

Distribution (Fig. 12). Southern Hemisphere, most records between 30°S to 40°S, with record nearest equator 25°25′S, 38°11′E (SIO69-27); southernmost record 49°26′S, 132°18′E (SIO61-41); westernmost record from the South Atlantic at 30°12′S, 3°14′E (Sazonov and Trunov 1978), easternmost record from the South Pacific at 34°24′S, 178°42′W (Parr 1960).

Material examined. SAM23160 (1), SAM26145 (1), SAM27505 (2), SAM27851 (2), SAM28396 (1), SAM28415 (2), SAM28753 (1), SAM28754 (1). SIO61-37 (7); SIO61-38 (3); SIO61-41 (1); SIO69-27 (1).

Relationships. Persparsia probably does not attain a large size and is reduced in several characters, especially the subcutaneous canal system. The reduction of the branchiostegal rays to 3 on the ceratohyal is related to a shortening of the jaw, as the number of ceratohyal rays is correlated with the length of the jaw in alepocepahaloids (Marshall 1966). However, *Persparsia* appears closest to the base of the family in the generalized condition of photophores, premaxillary tusks, and the overlapping of the upper jaw by the 3 anterior infraorbitals.

Paraholtbyrnia Krefft 1967

Paraholtbyrnia Krefft 1967b: 1-2; type species: *Paraholtbyrnia cyanocephala* Krefft 1967, by original designation.

Generic diagnosis. Body spindle shaped, shallow, and moderately compressed, with rounded dorsal margin. Small amount of nonmuscular tissue along dorsal margin. Cleithral symphysis normal, not produced in a spine. AO present; JO a longitudinal bar; THO a transverse bar; in young, SBO, GO_2, and IVO present. Ventral margin flattened and nearly equal to body width. White tissue surrounding eye, with some light tissue outside orbit. Lateral line with a canal lined by about 50 modified scales that continue onto caudal rays. Posttemporal bone receiving cephalic lateralis and subcutaneous canals, cephalic lateralis passing through supracleithrum. Cephalic lateral line canals complete and well-branched. The 2nd infraorbital bone extends nearly to posterior end of the upper jaw, which is partially overlapped by lacrimal and 2nd infraorbital when mouth is closed; 3rd infraorbital extends to preopercle. Innermost premaxillary tooth enlarged and anteriorly directed, often a 2nd, somewhat smaller tooth juxtaposed to 1st; rarely, a 3rd subhorizontally and more laterally directed tusk present; in larger individuals, tusks generally fused together. Teeth in main row of premaxilla directed downward, the 1st often beneath the base of tusk. Mid-dentary teeth present in young, absent in adults. Ectopterygoid teeth absent. Frontals widest behind eye, nearly straight over eye. Supraorbital elongated, located over anterior half of eye, its posterior half flattened. P_2 8-10 (usually 9), vertebrae 49-51, U_1 present.

Generic description. That of the single species, *P. cyanocephala.*

Paraholtbyrnia cyanocephala Krefft 1967
(Fig. 22B)

Paraholtbyrnia cyanocephala Krefft 1967b: 2-11, Figs. 1-11 (orig. descr.; holotype: ISH 194/66, 23°50′N, 20°08′W, 500-220 m; 10 paratypes from 19°11′N, 21°58′W, 10°46′N, 23°54′W, 6°25′N, 24°34′W, and 2°44′N, 25°12′W; all ISH material); 1974: Fig. 10 (distr., spec, from 16 loc. in Atlantic 26°N-8°S, 15°-25°W); Quéro 1974: 443-447, Figs. 1-3 (descr., 3 juv., 1 adult spec, from 2 loc. S of Canary Is.); Golovan 1976: 300 (descr., spec, from 9°55′N, off W Africa, same rec. as *H. cyanocephala* Sazonov 1976b); Quéro 1978: 19-20, Fig. 11a (same rec. as Quéro 1974).

Holtbyrnia cyanocephala Sazonov 1976b: 68-69, Figs. 14d, 15, Table 1 (compiled distr., counts, and meas. in table); 1978: 103 (descr., spec, from 0°57′N, 56°32′E and 8°43′S, 60°23′E); Golovan 1978: 209 (listed).

Diagnosis. That of the genus.

Description. Body elongate, shallow (about 5.7-7.1 in SL), with little taper (least depth 2-2.4 in greatest body depth) and moderately compressed (greatest body width about 1.6 into greatest body depth). (Indian Ocean samples of Sazonov 1978 and our cleared 125 mm individual from the Banda Sea appear deeper-bodied than Atlantic material.) Venter flattened, about 10 scale rows wide. Pelvics at or slightly behind body midlength. Dorsal origin behind body midlength by half to twice eye length and ahead of that of anal by one-third basal length of dorsal. Dorsal base longer than that of anal by 5-30%. Anus about opposite the 5th-6th dorsal ray.

Frontals widening gradually from behind ethmoid to mideye with lateral margins nearly parallel over remainder of eye, then widening behind eye. Front profile with a slight dorsal convexity in front of eye. General shape of bony parts of head obscured by soft tissue. Similarly, the elongate supraorbital is surrounded by soft tissue and not readily seen; it is flat and narrow and grooved anteriorly, with only a short length of the posterodorsal margin level with the frontals; the remainder lies below. The supraorbital extends anteriorly from about mideye and attaches ligamentously to the antorbital. Antorbital well separated from lacrimal. Nasal sac approximately midway between premaxilla and orbit; about 17 lamellae in rosette. Snout 4-5 in HL and longer than eye. Mouth large, maxilla extending behind eye. Anterior supramaxilla longer than posterior supramaxilla by about one-third the length of former. Tendon from A_1 of adductor mandibulae inserted at about middle of anterior supramaxilla. Lacrimal extending to below mideye. Dorsal part of upper jaw overlapped by lacrimal and 2nd infraorbital (and by part of 3rd in some individuals) when mouth is closed. All infraorbitals with laminar portions, the 3rd the largest, with laminar part of the 3rd and 4th reaching preopercle.

Innermost tooth on each premaxilla enlarged as a horizontally directed, slightly incurved tusk; a 2nd somewhat smaller tusk, similarly directed and juxtaposed to 1st, often present; a 3rd, rarely present, subhorizontally and more laterally directed. Tusks generally fused together in larger individuals. Premaxillae not meeting anteriorly, and the space between innermost tusks edentulous. Teeth in main row on premaxilla (about 10-18) downward-directed, the anteriormost usually directly below the base of tusks. Smaller teeth on maxilla and dentary, those on dentary the smallest. Short row of mid-dentary teeth present in smaller individuals, absent in larger ones. Vomerine teeth varying from 2 close-set teeth to several in a cluster. Palatines with 1 or more teeth and 1-2 medially on basihyal. A single short row of teeth on narrow part of tooth plate at about the 2nd and 3rd basibranchial. A few small teeth on mesopterygoid (sometimes absent). Teeth present on 4th epibranchial and 5th ceratobranchial and upper pharyngeals of 2nd-4th arches. No teeth on ectopterygoid.

Posterior half of the ventral margin of opercle nearly horizontal. Subopercle about a third as wide as opercle and slightly wider than posteriormost branchiostegal. Subopercle with a diagonal ridge across it. In the young, the ventral part anterior to the ridge is not ossified and the ridge is an arch with the SBO photophore under it. Preopercle large, widely bordering opercle. Subopercle and interopercle aligned parallel to branchiostegals and similar in appearance to them; 4 flattened branchiostegal rays laterally on epihyal, the 3 posteriormost close together and overlapping; 4 acinaciform rays ventrally on ceratohyal. Complete row of medial gillrakers on 1 st-4th arches. Gill filaments well developed for a platytroctid (1-2% SL at angle of 1st arch). Bases of filaments free at angle, united area on ceratobranchial about one-half as long as filaments. Dorsal margin of gill opening level with upper margin of eye. Exposed tube of shoulder organ relatively long, nearly equal to one-half of eye length and located about midline or slightly below.

JO a single or fragmented longitudinal bar; THO and MVO transverse bars; AO well developed; POO and posterior IOO relatively weak. Photophores of young stage consist of an IVO, weak SBO, and rudimentary OO; other photophores listed in Table 2. White tissue around orbit, absent on infraorbitals.

Scales small, about 100 in midlateral series. About 50 modified scales lining lateral line canal on body and 1-2 tubular scales extending onto caudal rays; 1-20 (rarely more than 15, usually 3-5) small subcutaneous pores (0.1-0.3 mm) under scales. Pores somewhat fewer near midline and toward caudal fin. No enlarged pits behind supracleithrum.

Cephalic lateral line canals complete and with numerous arborescent branches. Supratemporal canal mostly in soft tissue and intersected by the supraorbital canal. Cephalic lateralis canal passing through canals at the ventral end of the posttemporal and the dorsal half of supracleithrum before joining body lateralis. Canal in supracleithrum only partly ossified. A subcutaneous canal also passing through posttemporal bone (dorsoventrally) and intersecting the cephalic lateralis canal.

D 21-23, A 17-18, P_1 19-23, P_2 8-10 (usually 9), Br 8, GR 9-10 + 19-21 (28-31), vertebrae 27-29 + 21-24 (49-51). Largest record: 221 mm.

Distribution (Fig. 12). Eastern Atlantic from 8°30′S, 15°W (Krefft 1974, Fig. 10) to 26°05′N, 15°53′W (Quéro 1974). One record from the western North Atlantic, 32°02′N, 78°59′W (uncat. USNM material from *Oregon* sta. 5362). Sazonov (1978) reported samples from two locations in the Indian Ocean, 0°57′N, 56°32′E and 8°43′S, 60°23′E. SIO samples from the Banda Sea and Halmahera Sea collected by B. Robison.

Material examined. ISH294/66a-c (3 paratypes), USNM206945 (6), USNM uncat. material from *Oregon* sta. 5362 (1), AMNH41550 (3), SIO77-44 (1), SIO77-52 (2), SIO77-53 (6), SIO77-55 (1), SIO77-62 (9), SIO77-64 (6), SIO77-65 (3), SIO77-66 (1), SIO77-67 (3). SIO material mostly small individuals.

Holtbyrnia Parr 1937

Holtbyrnia Parr 1937: 6; type species: *Bathytroctes innesi* Fowler 1934, by original designation.

Mentodus Parr 1951: 16, 18 (as a subgenus of *Holtbyrnia);*, type species: *Bathytroctes rostratus* Günther 1878, by original designation.

Generic diagnosis. Body elongate, moderately deep, and moderately compressed. Dorsal margin rounded, without nonmuscular tissue. Cleithral symphysis normal, not produced in a spine. Photophores present in most species (rudimentary except for the presence of the PO in *anomala*, absent in *rostrata).* When present, JO a longitudinal bar, THO a transverse bar; in young, GO_2, and IVO present. A patch of white tissue in front of eye at about midorbit, and 2 patches that cover most of the posterior border of eye on the infraorbitals (absent *rostrata)*, one patch at about the 2nd to 3rd infraorbitals and another, slightly larger, at about the 5th to 6th, with a short space between them. Scales over nape normal or reverse imbricated (*intermedia).* Lateral line with a canal lined by about 50 modified scales that continue onto caudal rays. Posttemporal bone receiving the cephalic lateralis and the subcutaneous canals. Cephalic lateralis canal passing through the supracleithrum. Cephalic lateral line canals complete and branched. Dorsal part of upper jaw overlapped by lacrimal and 2nd infraorbital (only lacrimal in *anomala* and *rostrata).* Maxilla extending behind eye by about one-half eye length. A single large uncurved tusk on each premaxilla, occasionally a 2nd much smaller tusk juxtaposed to 1st. Anterior teeth of main tooth row directed downward, with the anteriormost often inserted directly below the base of tusk. Mid-dentary teeth well developed, persistent in the adult. Ectopterygoid teeth often present in larger individuals. A large supraorbital running along lateral margin of frontals and cupped over most of the eye (three-fourths of eye in *rostrata* and *anomala).* P_2 7-10 (usually 9-10), vertebrae 44-50 (usually 46-48), U_1 present (except in holotype of *rostrata*, in which it is either absent or fused to PU_1).

Remarks. Holtbyrnia was erected by Parr (1937) as a monotypic genus for *Bathytroctes innesi* Fowler 1934. Additions and changes in later works by Parr (1951, 1960) left the taxonomy of its species in a confused state. In 1951 Parr considered *innesi*, the generic type, to be a synonym of *Holtbyrnia melanocephala* (Vaillant 1888), and divided the genus into two subgenera, *Mentodus* and *Holtbyrnia*. Subsequently the two species referred to *Mentodus* were placed in different genera (Parr 1960). *H. (M.) polycaeca* (of Parr 1951, not *Searsia polycaeca* Parr 1937) became *Maulisia mauli*, and *Mentodus* was retained as a genus for *Bathytroctes rostratus* Günther and a new species, *M. crassus*.

Parr also erected another subgenus, *Krefftia*, within *Holtbyrnia* for *Searsia schnakenbecki* Krefft 1953, *H. macrops* Maul 1957, and *H. problematica* Parr 1960, with the first designated as the type species. Subsequently, *Searsia schnakenbecki* (but not the other two species included by Parr in *Krefftia*) was placed in *Sagamichthys* (Matsui and Rosenblatt 1971).

Parr (1960, p. 63) cited the lack of the JO to differentiate *H. (H.) melanocephala* (including *innesi*) from *H. (K.) macrops* and *H. (K.) problematica*. However, he stated (p. 65), "The condition of the type of *melanocephala* cannot reveal the presence of luminous organs" and "the state of the type of *innesi* only permits one to establish the presence of some of the luminous organs." (This was the only material available to Parr.) However, as discussed below, *Bathytroctes melanocephalus* Vaillant 1888 is not congeneric with *H. innesi*. Also, although Quéro (1970) was able to detect an IPO on some of his Atlantic specimens and referred them to *H. problematica*, we were unable to detect an IPO on either the specimen he sent us or the holotype *of problematica*. We thus consider *H. problematica* to be a synonym of *H. macrops*. We also can find no significant difference between *macrops* and *innesi* that would warrant placement in separate subgenera.

The only major characters separating *Mentodus rostratus* (the only record we recognize is the holotype) from those now placed in *Holtbyrnia* are the absence of photophores and the white tissue behind the eye. Although Parr (1960) considered the presence or absence of photophores of generic significance, we include *rostrata* in *Holtbyrnia*. Krefft (1980) has already included his new species *anomala*, which has only the PO photophores and several rudimentary ones in *Holtbyrnia*.

Bathytroctes melanocephalus Vaillant 1888, which was placed in *Holtbyrnia* by Parr (1951), has a complicated history. Bertin (1940, p. 274) reported that only two of the four specimens from off Morocco and Sudan utilized by Vaillant remained in the Paris Museum. Although the one supposedly designated as the holotype of *B. melanocephalus* (no. 85-167) was one of the two, it measured 225 mm in length, while Vaillant's description was of a 108 mm individual; Bertin therefore believed that it could not be the holotype. Parr (1951, p. 12), after examining the two remaining specimens, considered the text of the description of *B. melanocephalus* to be based on the (present) no. 85-167 and therefore considered it to be the holotype. He believed the second specimen (no. 86-3) to be the one illustrated in Vaillant's (1888) Plate 11, Figure 3, as the type of *B. melanocephalus*, but considered it to belong to an undescribed genus and species; it became the holotype of *Bellocia vaillanti* Parr 1951 of the family Alepocephalidae. Later, Parr (1960, pp. 66-67) reversed himself, stating that it was Vaillant's figure rather than the text to which (present) no. 85-167 pertained, and that the text was based on no. 86-3, the type of *Bellocia vaillanti*.

However, (present) no. 85-167, as illustrated in Parr's (1960) Figure 44, cannot be the same specimen shown in Vaillant' s Plate 11, Figure 3. These are entirely different fishes, as indicated by relative fin position and fin-ray counts. Since (present) no. 85-167 does not fit the description of the holotype either, it appears that Bertin was probably correct in his assumption that Vaillant had placed the number on another specimen and that the type of *B. melanocephalus* is lost. The illustrations of premaxillary tusks and the mid-dentary teeth show that Parr's (1960) Figure 44 (of the present 85-167) is that of a platytroctid, although the shoulder organ was not indicated. Krefft (1980) found modified scales and the posttemporal bone pierced by a canal in (present) 85-167.

The proper allocation of *B. melanocephalus* is still uncertain. The lateral line scale illustrated by Vaillant's Plate 11, Figure 3a, does resemble that of a platytroctid. However, if the specimen before Vaillant was a platytroctid, it is unlike any presently known in dorsal and anal counts and fin positions. In any case, judging from Vaillant's illustrations, *B. melanocephalus* Vaillant 1888 is not a *Holtbyrnia* and probably not a platytroctid. We agree with Krefft (1980) that the name *melanocephala* not be used in *Holtbyrnia.*

Sazonov (1976b) included 10 species in *Holtbyrnia.* Besides the aforementioned nominal species—i.e., *melanocephala, innesi, macrops,* and *problematica*—the list includes the recently described species *H. ophiocephala* Sazonov and Golovan 1976, *H. conocephala* Sazonov 1976, *H. laticauda* Sazonov 1976, *H. kulikovi* Sazonov 1976, *H. latifrons* Sazonov 1976, and *Paraholtbyrnia cyanocephala* Krefft 1967, which he considered to be a *Holtbyrnia.* Judging from the lack of the premaxillary tusks, *ophiocephala* is widely separated from other *Holtbyrnia* species. From its measurements and counts and from the figure of the holotype, we strongly suspect that it is a large *Sagamichthys schnakenbecki.* Sazonov's (1976b) species separation of the four new species he introduced is vague and based on characters we consider highly variable. For example, *latifrons* was separated from the others by the lack of ectopterygoid teeth and the presence of an IPO photophore. We have found ectopterygoid teeth in larger individuals of *latifrons* (as well as in *macrops* and *innesi,* two other species considered to lack them), and we have not found the IPO in *latifrons* (or any *Holtbyrnia* species). Also utilized in his diagnosis are the POPO photophore, which is rudimentary in *Holtbyrnia,* and minor differences in the shape of the JO and ICO, which are all highly variable. Allegations of differences in the cephalic lateral line canals, the number of pyloric caeca, and body proportions were also made but not clearly discussed.

We recognize three of Sazonov's species. But we are unable to separate *kulikovi* from *innesi*, and thus place it in the synonymy of *innesi*. From his description of the gill filaments and the number of gillrakers of *latifrons*, we recognize it as one of two *Holtbyrnia* species found in the SIO collections from the southeastern Pacific (the type locality of *latifrons).* It is the only *Holtbyrnia* with the bases of the gill filaments not united. The second species from that area has fewer than 25 gillrakers, and we refer to it here as *H.* sp. Additional records of *laticauda* (Sazonov 1978; Sazonov and Trunov 1978) have extended its distribution from the Tasman Sea, where it was previously known, to the Indian Ocean and the Atlantic to just west of Africa, between the latitudes of 31°S and 43°S. Its distribution pattern resembles that of *Persparsia kopua.* Also, their data substantiate a much higher (125-145) scale count than found in other *Holtbyrnia* species, with the exception of *intermedia.*

Sagamichthys intermedius Sazonov and Golovan 1976, placed in that genus because of the reversely imbricated scales on its nape, should have been placed in *Holtbyrnia.* According to their description, *S. intermedius* has: a longitudinal JO, premaxillary tusks, a snout that is longer than eye length, and laminar process of infraorbital bones not reaching the preopercle. These character states are found in *Holtbyrnia* but not in *Sagamichthys.*

Based on our findings, we recognize *innesi, macrops, latifrons, laticauda, anomala, rostrata, intermedia,* and *conocephala* in *Holtbyrnia.* We also recognize *Paraholtbyrnia* as distinct from *Holtbyrnia.*

Generic description. Body elongate, with greatest body depth about 5-7 in SL, and moderately compressed. Dorsal margin rounded, without nonmuscular tissue. Pelvics just behind midlength. Dorsal origin behind midlength by one-half to three-fourths its basal length. One-third to slightly over one-half of dorsal base in advance of anal origin and ending ahead of the end of anal by about 5 rays. Dorsal base about one-fifth to more than one-third its length longer than that of anal; about a third of dorsal base in advance of anus.

Interorbital space wide, its margin extended by oblong supraorbitals attached to the sides of frontals. Supraorbital curved dorsally, following contour of eye from near its posterior margin to a short distance before eye (somewhat reduced in *anomala, rostrata*, and *intermedia*). Anterior tip of supraorbital tubular medially, joined to antorbital, which is also tubular where it articulates with supraorbital (almost no information on supraorbital, antorbital, and lacrimal of *intermedia*). Top of skull between supraorbitals with a slight convexity. Antorbital flat in young, expanding medially and becoming more robust in large individuals. The antorbital borders the posterior naris and extends ventrally to the lacrimal. Nasal rosette relatively large, usually situated closer to orbit than to snout tip, with 10-14 lamellae. Snout somewhat shorter to longer than eye length. Mouth large, extending well behind eye. Anterior supramaxilla longer than posterior, with the tendon from A_1 of the adductor mandibulae inserted on it. Lacrimal the largest, infraorbital bones with laminar portions (absent on 2nd in *anomala* and *rostrata;* mostly unknown in *intermedia*), with the lacrimal and 2nd infraorbital (only lacrimal in *anomala* and *rostrata*) partly overlapping the supramaxillae. Laminar bases of 3rd and 4th infraorbitals extending less than half the distance to preopercle.

Innermost tooth of each premaxilla enlarged into a horizontally directed tusk; on some individuals a 2nd much smaller tusk juxtaposed to 1st. Other premaxillary teeth (as many as 15-20) all directed downward, with the anteriormost usually beneath the base of tusk. A narrow edentulous space between the innermost tusks. There are 2 or more teeth on vomer and 1 or more on each palatine. A single row of teeth on mesopterygoid and on narrow and high part of toothplate that is over the 2nd basibranchial and, farther back, 2-3 uneven rows on flat part of the same toothplate (basibranchial teeth absent in *anomala;* not known for *intermedia*). A sparse row of teeth on ectopterygoid of some of the larger individuals; presence or absence of ectopterygoid teeth showing intraspecific variation in all species. A single tooth to a medial row of teeth on basihyal, except in *anomala*, where they are usually absent (not known for *intermedia*). Mid-dentary teeth well developed, numbering as many as 13 and persistent, but fewer, in larger individuals. Small teeth on the 4th epibranchial and the 5th ceratobranchial, and on the upper pharyngeal of 2nd-4th arches.

Lower margin of opercle curving downward from anterior end to about its middle, then nearly horizontal over the posterior half, resulting in an opercle that is only slightly deeper at posterior margin than at middle. Subopercle about a third as deep as opercle and about equal to twice as deep as posteriormost branchiostegal ray. In the young, subopercle with diagonal arch across it, accommodating the SBO photophore with the anteroventral part unossified. Entire subopercle eventually ossified, but with a slight ridge running diagonally across it, and in some individuals there is a small incision along the top. There are 4 flattened branchiostegal rays laterally on epihyal, with the last 3 wide, close-set, and overlapping; 4 acinaciform rays ventrally on ceratohyal. Medial gillrakers lacking on ceratobranchial of 1st arch, occasionally 1-2 present on 2nd ceratobranchial. Epibranchial and hypobranchial of 1st and 2nd arches with about 3-8 medial gillrakers. Exposed tube of shoulder organ relatively short, located at about midline, at a level with ventral tip of supracleithrum and slightly less than an eye length below gill opening. Dorsal margin of gill opening about level with top of eye. Cleithral symphysis normal, not produced in a spine.

Photophores rudimentary in *anomala*, absent in *rostrata*, present in others. In species having photophores, GO_2 and IVO appear at yolk-sac stage but are covered over in adults. Small SBO appears in juveniles. Adult photophores listed in Table 2 begin to appear in individuals larger than 30 mm SL. Unlike regular photophores, the rudimentary photophores listed in Table 2 for *anomala* vary between individuals. In all species except *rostrata* (not known for *intermedia*), a patch of white tissue in front of eye at midorbit and 2 others on infraorbitals behind eye, one on 2nd-3rd infraorbital and the other at the 5th-6th, with a short space between them. Tissue on posterior border of eye, on orbit, silvery on some individuals.

Scales small, 94-145 in midlateral series. Scales on nape normally imbricated or reverse imbricated (*intermedia);* one to 20 (usually 1-10) subcutaneous pores (0.04-0.15 mm) in most scalepockets (not seen in holotype of *rostrata* , probably because of its poor condition; not known for *intermedia*), being somewhat fewer and smaller toward the midline and posteriorly. The pores are much smaller and fewer than in other *Holtbyrnia* species in the northern material of *anomala*. Lateral line with a canal lined by about 50 modified scales that continue onto caudal rays. Cephalic lateralis canal passing through the ventral end of posttemporal bone, then turning ventrally into supracleithrum. Canal through supracleithrum overlain by soft tissue and with 2 open pores. Cephalic lateral line canals complete and with the canals relatively well branched. Subcutaneous canal passing dorsoventrally through posttemporal bone. Pelvic rays usually 9 (8-9 in *anomala*).

Holtbyrnia innesi (Fowler 1934)
(Fig.23B)

Bathytroctes (Bathytroctes) innesi Fowler 1934: 252, Fig. 14 (orig. descr.; holotype: USNM93174, 38°29.5′N, 70°54.5′W).

Bathytroctes innesi Parr 1937: 6 (in key; designated as genotype *of Holtbyrnia*).

Searsia polycaeca Parr 1937: 15-16, 19, Fig. 5 (orig. descr.; holotype: YPM3719, 32°24.2′N, 64°29′W, 10,000 ft. wire out).

Holtbyrnia innesi Parr 1951: 16 (in key as synonym (?) of *H. melanocephala)′* , Sazonov 1976b: 69, Fig. 15, Table 1 (compiled distr.; 2 new rec. off Peru; counts and meas. in table); Sazonov and Trunov 1978:90-91, Fig. 2 (descr. and ill.; 2 spec, from 30°38′S, 14°15′E and 23°18′S, 12°42′E); Parin, Sazonov, and Mikhailin 1978: 174 (rec. 8°29′S, 12°45′E).

Holtbyrnia (Holtbyrnia) melanocephala innesi Parr 1960: 68-70, Fig. 45 (descr. and ill.; counts and meas. of holotypes of *innesi* and *polycaeca* and the alleged holotype of *melanocephala* in compar. table).

Holtbyrnia kulikovi Fedorov 1973: 48 (nomen nudum, listed from Bering Sea, no descr.); Sazonov 1976a: 19-20 (orig. descr.; holotype: ZIL37843, 58°15′N, 175°20′W, 570-0 m); 1976b: 68, Table 1, Figs. 14c, 15 (taxonomy, distr.); Novikov, Kodolov, and Gavrilov 1980: 32 (listed; rec. N Pacific).

Diagnosis. Photophores present. GO_1 more than its diameter behind mandibular symphysis (about 3.5% SL). P_1 16-20, P_2 9. Gillrakers 22-23,7 on upper arch. Gill filaments medium, length of those of outer row at angle of 1st arch about 0.5% SL, their bases narrowly united. Scales 94-104 in midlateral series. Supraorbitals of large individuals not fused to frontals. Two patches of white tissue behind eye separated by more than the length of ventral body. D 18-19, A 17, P_1 16-20, P_2 9, Br 8, GR 7 + 15-16, vetebrae 26-30 + 18-20 (46-48). Largest record: 213 mm.

Distribution. (Fig. 13). The 3 North Atlantic records are from the western side (USNM uncat. from 32°02′N, 78°59′W, and the holotypes of *Bathytroctes innesi* and *Searsia polycaeca*). We examined material from the tropical Atlantic at 4°43′S, 26°39′W (ISH927/68) and 5°58′S, 26°52′W (ISH978/68) and the specimen recorded by Parin, Sazonov, and Mikhailin (1978). Sazonov and Trunov (1978) reported 2 records from the southeastern Atlantic, and Sazonov (1976b) indicated 2 records off Peru in the eastern South Pacific. The holotype of *kulikovi* is from the Bering Sea, and a second specimen, which we have examined, is from the central North Pacific (10AN uncat. from the *Raduga* collection).

Material examined. ISH927/68 (1), ISH978/68 (1), USNM uncat. *Oregon* sta. 5362 (1), MMSU P14144 (1), IOAN uncat. from R/S *Raduga* (1).

Holtbyrnia macrops Maul 1957
(Fig. 23C)

Searsia schnakenbecki (not of Krefft 1953) Krefft 1953:259-266 (in part, ISH50/llc only).

Holtbyrnia macrops Maul 1957: 8-9, 11-14, Figs, 1c, 2-3 (orig. descr.; holotype: MMF6313, stomach of *Aphanopus carbo*, Madeira); Kotthaus 1972: 6, Fig. 4 (counts, 2 juv.; photo of otolith; spec, from 29°34′N, 24°13′W and 34°02′N, 15°18′W); Krefft 1973: 96 (synon., distr.); Sazonov 1976b: 69, Fig. 15, Table 1 (compiled distr., with 2 new rec. from Atlantic; counts and meas. in table); Quéro 1978: 18-19 (new rec. 26°05′N, 15°53/W).

Holtbyrnia (Krefftia) macrops Parr 1960: 78-79, Fig. 53 (descr. of holotype; fig. from Maul 1957); Quéro 1970: 271, Fig. 10 (descr. and ill. of a juv. from 28°11′N, 16°05′W).

Holtbyrnia (Krefftia) problematica Parr 1960: 78-81, Figs. 52c-d, 54-55 (orig. descr.; holotype: ISH 50/11c, Rosengarten area SE of Iceland, 460 m); Quéro 1969: (sampling data only); 1970: 269-271, Fig. 9 (descr. and ill.; ontogenetic changes in photophores; 29 spec. 15-76 mm from 12 loc. in Bay of Biscay).

?Holtbrynia (Krefftia)problematica Krefft 1966: 176 (spec, poor cond., rec. from stomach of fish from Anton Dohrn Bank).

?Holtbyrnia (Holtbyrnia) macrops Geistdoerfer, Hureau, and Rannou 1971a: 1178 (listed rec. 44°33.7′N, 3°47.6′W).

?Holtbyrnia (Holtbyrnia) melanocephala (not of Vaillant 1888) Geistdoerfer, Hureau, and Rannou 1971b: 364 (same spec, as *H. (H.) macrops* reported in Geistdoerfer, Hureau, and Rannou 1971a).

Holtbyrnia problematica Krefft 1973: 96 (synon. and distr.); Sazonov 1976b: 69, Fig. 15, Table 4 (compiled distr.; 1 new rec. S of Iceland; counts and meas. in table); Golovan 1978 (distr.); Quéro 1978: 19, Fig. 10b (new rec. 26°05′N, 15°53′W); Gushchin and Kukuev 1980: 37 (new rec. 49°41′N, 29°05′W).

Diagnosis. Photophores present. GO_1 more than its diameter from mandibular symphysis (1.7-2.8% SL). P_1 17-20, P_2 9. Gillrakers 27-29, 8-9 on upper arch. Gill filaments short, those at outer row at angle of 1st arch, about 0.1-0.2% SL, their bases united. Scales 100-111 in midlateral series. Supraorbital of large individuals not fused to frontals. Two patches of white tissue behind eye separated by less than the length of ventral body.

D 18-20, A 15-16, P_1 17-20, P_2 9, Br 8, GR 8-9 + 19-21 (27-29), vertebrae 26 + 20 (1 specimen). Largest record: 200 mm.

Distribution (Fig. 13). Eastern half of North Atlantic from 32°N to 64°N.

Material examined. ISH50/11c (holotype of *H. problematica)*, ISH59/61 (1), MMF15336 (1), SIO 85-63(1).

Holtbyrnia latifrons Sazonov 1976

(Fig.23D)

Holtbyrnia macrops (not of Maul 1957) Lavenberg 1964: 62-63 (distr.); Berry and Perkins 1966:637, Fig. 6d (2 rec. off California); Childress and Nygaard 1973: Tables 1-6 (chemical composition of fish as function of minimum depth of occurrence); Brewer 1973:17, Table 2 (3 spec, in Gulf of California); Peden 1974:49, Table 1 (rec. 48°13.5′N, 126°26′W, diagn.).

?Holtbyrnia macrops (not of Maul 1957) Bussing 1965: 192 (descr.; 3 juv. from off Chile, 33°S, only THO photophores present); Parin et al. 1973: 76-77, Fig. 3 (listed, 14 rec. SE Pacific).

Holtbyrnia melanocephala (not of Vaillant 1888) Lavenberg 1964: 63 (distr.); Bussing 1965: 192 (descr.; 8 spec, from off Peru); Chirichigno 1969: 25 (listed; Fig. 53 is not this species); Robison 1972: Table 1 (listed); Brewer 1973: 17, Table 2 (1 spec. Gulf of California).

Holtbyrnia sp. Berry and Perkins 1966: 638, Fig. 6d (13 spec, from 4 loc. eastern N Pacific); Matsui and Rosenblatt 1971: 44-45 (ontogenetic changes of photophores).

Holtbyrnia latifrons Sazonov 1976a: 20-23, Fig. 3 (orig. descr.; holotype ZIL42628, 5°59′S, 84°59′W, 800-900 m); Sazonov 1976b: 68, Figs. 14d, 15, Table 1 (distr.; counts, meas. in table); Hubbs, Follett, and Dempster 1979: 9 (checklist, eastern N Pacific).

Diagnosis. Photophores present. GO^1 less than its diameter from mandibular symphysis (0.4-1.5% SL). P_1 16-20, P_2 8-9 (usually 9). Gillrakers 25-30, 7-9 on upper arch. Gill filaments well developed for a platytroctid, those of outer row at angle of 1st arch 1-3% SL (in specimens larger than 50 mm SL), their bases free, not united. Scales 95-105 in midlateral series. Supraorbitals of large individuals not fused to frontals. Two patches of white tissue behind eye separated by less than the length of ventral body.

D 17-20, A 14-16, P_1 16-20, P_2 8-9 (usually 9), Br 8-9 (usually 8), GR 7-9 + 18-21 (25-30), vertebrae 26-29 + 20-21 (46-50). Largest record: 200 mm.

Distribution (Fig. 13). Eastern Pacific, generally near the coast. Northernmost record 48°13.5′N, 126°26′W (Peden 1974); only sparsely present in the low-oxygen region between 5°-22°N; southernmost record at 23°24.5′S, 72°20.1′W (SIO72-171). Although the records of *H. macrops* by Bussing (1965) may refer to *H. latifrons*, in the absence of more positive identification we are reluctant to recognize them, since they would extend the distribution of *latifrons* to 33°S. Most records are from nets sampling from below 300 m to less than 1000 m.

Material examined. SIO50-261 (1), SIO50-262 (2), SIO50-270 (1), SIO50-271 (1), SIO50-277 (1), SIO50-286 (1), SIO51-70 (1), SIO51-80 (1), SIO51-82 (1), SIO51-190 (1), SIO51-392 (2), SIO51-399 (1), SIO52-32 (1), SIO52-376 (1), SIO54-122 (1), SIO56-66 (1), SIO56-67 (2), SIO56-72 (1), SIO56-114 (1), SIO57-96 (2), SIO57-191 (1), SIO57-212 (2), SIO62-192A (2), SIO62-473 (1), SIO63-165 (10), SIO63-189 (1), SIO63-447 (9), SIO63-871 (1), SIO64-1 (1), SIO64-28 (1), SIO64-34 (1), SIO64-36 (1), SIO64-444 (7), SIO64-978 (2), SIO64-979 (1), SIO64-980 (3), SIO65-188 (1), SIO65-193 (1), SIO65-213 (5), SIO65-220 (2), SIO65-236 (1), SIO65-439 (3), SIO65-440 (4), SIO65-443 (3), SIO65-554 (2), SIO65-603 (3), SIO65-608 (1), SIO65-611 (7), SIO65-620 (1), SIO66-5 (10), SIO66-16 (3), SIO66-42 (1), SIO66-355 (1), SIO66-398 (1), SIO66-406 (2), SIO66-421 (1), SIO66-432 (1), SIO66-536 (6), SIO66-546 (3), SIO66-549 (4), SIO67-49 (1), SIO67-52 (3), SIO67-59 (4), SIO67-61 (1), SIO67-62 (5), SIO67-67 (1), SIO67-101 (1), SIO67-104 (1), SIO67-112 (1), SIO67-113 (1), SIO67-116 (1), SIO67-117 (1), SIO68-536 (1), SIO69-497 (1), SIO72-171 (1), SIO72-180 (3), SIO72-182 (6), SIO72-195 (5).

Holtbyrnia laticauda Sazonov 1976
(Fig. 23A)

Holtbyrnia laticauda Sazonov 1976a: 17-18 (orig. descr.; holotype: ZIL42629, 34°58′S, 168°33′E, 1300-0 m); 1976b: 68, Figs. 14a, 15, Table 1 (counts and meas. of holotype in table); 1978: 103, Table 1 (descr. and ill., 6 spec, from 6 loc. Indian Ocean); Sazonov and Trunov 1978: 88-90, Fig. 1 (descr. and ill., 2 spec, from 2 loc. 32°48′S, 1°48′E and 36°50′S, 20°30′E).

Diagnosis. Photophores present. GO_1 more than its diameter from mandibular symphsis (2.5% SL). P_1 18-20, P_2 9-10. Gillrakers 24-27, 6-8 on upper arch. Gill filaments short, outer row at angle of 1st arch lacking, bases of filaments united. Scales 120-145 rows from middle rays of caudal fin to top of gill opening. Supraorbitals of large individuals fused to frontals. Two patches of white tissue behind eye, separated by less than the length of ventral body.

D 19-21, A 15-17, P_1 16-20, P_2 9-10, Br 8, GR 6-8 + 17-19 (24-27), vertebrae 27-28 + 20. Largest record: 296 mm.

Remarks. Data for the diagnosis are from Sazonov (1976a, 1978), Sazonov and Trunov (1978), 2 specimens collected by the *Svedza Kryma* and 1 collected by the *Eltanin*. The caudal peduncle of *laticauda* is short and deep. However, when reduced to percentages of body ratios, there is overlap with those of other *Holtbyrnia* species. The few *macrops* we examined were least like *laticauda* in this respect.

Distribution (Fig. 13). Southern Hemisphere, from off Africa (32°48′S, 1°48′E) to the Tasman Sea (holotype). Northernmost catch at 30°43′S, 93°24′E, southernmost, the *Eltanin* specimen at 45°53′S, 132°33′E.

Material examined. Smithsonian Oceanographic Sorting Center, *Eltanin* Cruise 35, sta. 2250(1);IOANuncat. *Svezda Kryma* sta. 187(1);IOAN uncat. *Svezda Kryma* sta. 134(1).

Holtbyrnia conocephala Sazonov 1976
(Fig. 23E)

Holtbyrnia conocephala Sazonov 1976a: 18-19 (orig. descr.; holotype: ZIL42627, 7°49′S, 120°10′E, 1500-0 m); 1976b: 68, Figs. 14b, 15 (taxonomy, distr.); Parin et al. 1977: 106 (rec.5°29′N, 123°56′E and 7°49′S, 120°10′E).

Diagnosis. Photophores present. GO_1 more than its diameter from mandibular symphysis (2% SL). P_1 16-18, P_2 8, gillrakers 21-22, 6-7 on upper arch. Gill filaments short, outer row at angle of 1st arch lacking, bases of filaments united by a membrane twice as wide as longest length of filaments on 1st arch. Specimens on hand too small for scale counts and comparison of fusion of supraorbitals. Also white tissue behind eye small and not yet clearly formed. Holotype reported with 107 transverse rows of scales from base of middle rays of the caudal fin to apex of the gill aperture.

Counts of holotype in parentheses: D 18-19 (20), A 14-16 (16), P_1 16-18 (16), P_2 8 (8), Br 8-9, GR 6-7 + 14-15 (21-22) (6 + 15), vertebrae 27 + 21 (1 specimen). Largest record: 193 mm.

Distribution (Fig. 13). Tropical Indo-West Pacific. Holotype from the Flores Sea; other records from the Celebes Sea (*tVitiaz* sta. 7234, 5°29′N, 123°56′E), the Indian Ocean (MMSU P14654, 8°45′S, 60°07′E), and 2 SIO samples from the S China Sea, the northernmost at 18°06′N, 119°08′E(SIO70-343).

Material examined. IOAN uncat., *Vitiaz* Cr. 57, sta. 7234 (1); MMSU P14654 (1); SIO70-343(1);SIO70-346(1).

Holtbyrnia sp.

Diagnosis. Scales not yet formed in the available specimens, because of their small size. Photophores present. GO_1 more than its diameter from mandibular symphysis (2.9-3.5% SL). P_1 16-18, P_2 8-10 (mostly 9), gillrakers 19-23, 5-7 on upper arch. Gill filaments short, outer row at angle of 1st arch lacking, with bases of filaments united by membrane whose width is 2.5-4 times greater than length of longest filaments on 1st arch.

D 18-19, A 16, P_1 16-18, P_2 8-10(usually 9), Br 7-9(usually 8), GR 5-7 + 14-16 (19-23). Largest specimen: 49 mm.

Remarks. The preceding diagnosis is based on 4 juveniles (43-49 mm SL) and supplemented with 3 smaller individuals (18-34 mm SL). The maxilla extends behind the eye in specimens as small as 35 mm SL, comparable in this respect to *H. latifrons* of about 75 mm SL, and the body depth is somewhat shallower than in other *Holtbyrnia* species. Teeth on vomer and palatines are larger than in *latifrons.* Except for the absence of the BRO and POO (which probably form at about 80 mm SL in *Holtbyrnia)*, a 49 mm specimen (SIO68-534) from the tropical central Pacific has the same photophores, including the longitudinal JO, as those of other *Holtbyrnia* larger than 50 mm SL that we have examined.

Distribution (Fig. 13). Eastern equatorial Pacific. Southernmost record near the coast at 23°24.5′S, 72°20.1′W (SIO72-171) off Chile. Apparently avoiding the low-oxygen areas to the north discussed in Brinton (1979), with other records near the coast near the equator and the northernmost record at 4°06′N, 97°10′W (SIO52-355). Westward distribution equatorial to 165°42.5′W (SIO68-534). These records indicate a more oceanic habitat than for any large-mouthed platytroctid.

Material examined. SIO52-355 (1), SIO52-409 (1), SIO60-234 (1), SIO65-622 (1), SIO68-534 (2), SIO69-338 (1), SIO72-171 (1), SIO72-180 (1).

Holtbyrnia anomala Krefft 1980
(Fig. 24A)

Mentodus rostratus (not of Günther 1878) Krefft 1966: 176 (3 spec, 57-70 mm SL, from stomach of fish, 65°25′N, 30°30′W); 1973: 97 (in part, in ref. to Krefft 1966).

Holtbyrnia melanocephala (not of Vaillant 1888) Golovan 1976: 299 (descr.; single spec, 22°50′N, off W coast of Africa); Sazonov 1976b: 69, Fig. 15, Table 1 (spec from Golovan 1976 only; counts and meas. in table); Sazonov and Trunov 1978: 91, Fig. 3 (descr.; single spec from 18°23′S, 11°17′E); Golovan 1978: 209 (distr.).

Holtbyrnia anomala Krefft 1980: 55-60, Figs. 1 and 2, Table 1 (orig. descr.; holotype: ISH379/73a, 61°21′N, 32°20′W, 700-1000 m; paratypes: ISH379/73 (2) collected with the holotype: ISH1005/73 (1), 56°28′N, 26°44′W, ISH 572/73 (4), 53°28′N, 23°17′W; ISH612/73 (3), 52°35′N, 22°20′W; ISH691/73 (2), 50°08′N, 19°46′W; ISH297/75 (4), 57°09′N, 9°47′W; ISH1983/79 (1), 31°51′N, 42°55′W).

Diagnosis. Photophores rudimentary (except PO). P_1 13-17, P_2 7-9 (usually 8-9). Gillrakers 27-28, 8-9 on upper arch. Gill filaments short, outer row either lacking or short at angle of 1st arch, their bases united. Scales 103-113 in midlateral series. Supraorbitals of large individuals not fused to frontals. Two patches of white tissue behind eye separated by less than the length of ventral body which extends mostly along posterior border of eye.

D 19-20, A 16-17, P_1 13-17, P_2 7-9, Br 8, GR 8-9 + 19-20 (27-28), vertebrae 24-27 + 18-22 (44-47). Largest record: 230 mm.

Remarks. In our material of *H. anomala*, we find two morphologically different forms that we believe will eventually be recognized as separate species. Because the differences are small and some partly overlap, we are reluctant to separate them on the basis of our limited material.

The two individuals collected at 14°11′N, 18°28′W (ISH202/74) have 9 ventral rays and 15-17 pectoral rays. *H. melanocephala* of Sazonov and Trunov (1978), recorded from 18°23′S, 11°17′E, also seems to belong to this form of *anomala*. The other form—represented by three specimens from 61°21′N, 32°20′W (ISH379/73), a single specimen from 59°49′N, 13°32′W (ISH34/74), and a single specimen from 36°37.5′N, 74°33.6′W (VIMS03472)–has mostly 8 ventral rays (one individual with 9/9 and another with 8/9) and 13-15 pectoral rays (the only *Holtbyrnia* with such low pectoral counts). *H. melanocephala* of Golovan (1976), collected at 22°50′N off the west coast of Africa, appears to belong to this form also. In the southern material from ISH202/74, there are more pores (as many as 12) in scalepockets, with some as large as 0.16-0.24 mm diameter. This compares with the maximum number of 8 and a maximum size of 0.08 mm of the more northern individuals. The northern form has a slightly thicker body With deeper caudal peduncle and smaller eyes. The gill filaments are smaller and the outer row is absent at the junction of the ceratobranchial and epibranchial. The outer is complete (although the filaments are short) in ISH202/74. In the northern form, the supraorbitals are larger, covering most of the eye (as in other *Holtbyrnia* species), and the interorbit is relatively wide. It is On the northern form that Krefft′s description of the species was based, as indicated by the low pectoral ray count in his diagnosis.

Distribution (Fig. 13). Tropical Atlantic to the Denmark Strait. As discussed above, there appear to be two forms: (1) a tropical Atlantic form from 18°S (Sazonov and Trunov 1978) to 14°N (ISH202/74), and (2) a northern form from 22°N (Golovan 1976) to 62°N (ISH379/73) in the North Atlantic. Taken in open trawls 700-2700 m deep, mesopelagic to bathypelagic.

Material examined. ISH379/73, 3(140-179 mm); ISH34/74, 1(105 mm); ISH202/74, 2(161-171 mm); VIMS03472, 1(96 mm).

Holtbyrnia rostrata (Günther 1878)

Bathytroctes rostratus Günther 1878: 250 (orig. descr.; holotype: BMNH1887-12-7-234, 8°33′S, 34°30′W, 675 fms); 1887: 227-228, pi. 58, Fig. B (redescr. of holotype); Goode and Bean 1896: 41-42 (descr. from Günther 1887); Fowler 1936: 187-188, Fig. 76 (descr. and fig. from Günther 1887); Lozano y Rey 1947: 71-73, Fig. 10 (descr. and fig. from Günther 1887); Albuquerque 1954-56: Fig. 126 (descr. and fig. from Günther 1887); Postel 1959: 144 (listed).

?Bathytroctes rostratus (The following are inadequately described and cannot be assigned to *rostratus* or any species: Koehler 1896; Zugmayer 1911; Murray and Hjort 1912; Barnard 1925; Roule and Angel 1933.)

Holtbyrnia (Mentodus) rostratus Parr 1951: 16 (in key).

Searsia rostratus Tucker 1954: Table 2 (holotype of *B. rostratus* reexamined, compared in table).

Mentodus rostratus Parr 1960: 87-89, Fig. 61 (descr. and ill. of holotype of *B. rostratus);* Krefft 1973: 97 (synon. and distr. of holotype of *B. rostratus* only); Golovan 1978: 209 (listed).

?Mentodus rostratus Golovan 1976: 301 (counts and meas. of spec, from 10°36′N off W coast of Africa); Sazonov 1976b: Figs. 16a, 17 (rec. from Golovan 1976 included; except for holotype from Günther 1878, no information given on others); 1978: 104 (counts and meas. of spec, from 30°04′S, 45°57′E); Sazonov and Trunov 1978: 92-93 (counts and meas. of a juv. platytroctid from 32°02′S, 2°11′E).

Diagnosis. Photophores absent. P_1 16 (17-18) (data from Günther 1887; data in parentheses from Parr 1960). P_2 9 (9). Gillrakers 27 (28), 7 on upper arch. Gill filaments very short, their bases united (from our observations). Scales 100 (110). Supraorbital not fused to frontals. No white tissue behind eye.

D 20 (20), A 17 (18), P_1 16 (17-18), P_2 9 (9), GR 7 + 20 (7 + 21—Parr 1960; 8 + 21 and 10 + 22—Tucker 1954; 8 + 21 and 7 + 20—our counts); vertebrae (49—Tucker; in our count 25 + 22, U_1 centrum unossified and not counted). Largest record: 146 mm.

Remarks. The only unquestioned record of *rostrata* remains that of the holotype, and the synonymy listed above refers to that specimen. Questionable records of Golovan (1976), Sazonov (1976b, 1978), and Sazonov and Trunov (1978) do not address themselves to establishing the authenticity of their records. Scale counts are high in material reported by Sazonov (130) and Sazonov and Trunov (110-130).

Distribution. Holotype from off Brazil, 8°33′S, 34°30′W.

Material examined. Holotype of B. *rostratus* (BMNH1887-12-7-234).

Holtbyrnia intermedia (Sazonov 1976)

Sagamichtys intermedius Sazonov 1976a: 15-17, Fig. 2 (orig. descr.; holotype MMSU P13716, 17°46′S, 71°45′W, 0-720 m); 1976b: 68, Fig. 12b (taxonomy).

Diagnosis. Scales on nape reverse imbricated. Photophores present; GO_1 position not known; P_1 19; P_2 8; GR 29, 8 on upper arch. Gill filament length not known; bases united. Scales 130 in midlateral series. We have no information as to whether the supraorbital is fused to the frontal, or regarding the presence or absence of white tissue behind the eye.

D 22, A 17, P_1 19, P_2 8, Br 8, GR 8 + 21. Largest recorded: 184 mm.

Remarks. All data are from the description of holotype (Sazonov 1976a). Besides the reverse-imbricated scales, *H. intermedia* differs by its higher gillraker counts from *H.* sp., and in the broadly united bases of the gill filaments from *H. latifrons*. It differs from *laticauda* the only other *Holtbyrnia* with similarly small scales, by having a snout that is longer than eye length. There are no records of *laticauda* from the eastern Pacific.

Distribution. Holotype and only known specimen from off Chile, 17°46′S, 71°45′W.

Sagamichthys Parr 1953

Sagamichthys Parr 1953: 1-6, type species: *Sagamichthys abei* Parr 1953, by original designation.

Generic diagnosis. Body elongate, moderately shallow and moderately compressed. Dorsal margin rounded, without nonmuscular tissue. Cleithral symphysis normal, not produced in a spine. JO and THO as transverse bars; in young a dorsal OO and a well-developed SBO that is partially enclosed in the subopercle, as well as a well-developed IVO and GO_2. White tissue around eye, but none on infraorbitals. Scales over nape and, if present, on head, reverse imbricated. Lateral line with a canal lined by modified scales that continue onto caudal rays. Posttemporal and supracleithrum not pierced by canals (except in *S. schnakenbecki* there is a short canal in supracleithrum). Cephalic lateral line canal complete with some branching. Second infraorbital bone large, covering a significant part of cheek; 2nd-4th infraorbitals well developed, extending back to the preopercle and covering entire cheek. Most of upper jaw slipping beneath lacrimal and 2nd infraorbital. Premaxillary teeth not enlarged into tusks. Ectopterygoid teeth present or absent. Mid-dentary teeth well developed and persistent in adult. A large supraorbital running along lateral margins of frontals and cupped over most of eye. P_2 9-10, vertebrae 48-52, U_1 centrum present, but often partly or entirely unossified.

Generic description. Body elongate, moderately shallow (4.8-6.6 in SL) and moderately compressed (width at sphenotic 1.3-1.9 in greatest depth). Venter flattened, about 10 scale rows across. Dorsal margin rounded, without nonmuscular tissue. Pelvics a short distance behind body midlength. Dorsal origin behind body midlength by about its basal length and ahead of anal origin by one-fourth to over half the basal length of dorsal. End of dorsal slightly ahead of the end of anal and its basal length 10-35% longer than that of anal. Anus about opposite the 4th-9th dorsal ray.

Snout short, much shorter than eye. Nasal sac just before orbit, rosette with 8-15 lamellae. Lacrimal and antorbital bordering the posterior margin of posterior nares. In the young, antorbital is flat and crescent-shaped, in larger individuals it expands medially into a more robust structure that broadly borders the lacrimal and attaches to it by ligaments. Frontals narrow anteriorly, gradually widening to posterior part of eye, then widening more rapidly to nearly twice as wide behind eye as over eye. A thin, oblong supraorbital attached along its side and extending the outline outward. Supraorbital curved dorsally, following contour of eye from near the posterior margin of eye to posterior margin of nasal sac and nearly bordering the antorbital, to which it does not appear connected. Supraorbital narrowing into a trough anteriorly and separate from the frontals; buried in soft tissue in older specimens. Mouth large, maxilla extending well behind eye in large individuals. Supramaxilla slipping under lacrimal, which extends to mideye and the large 2nd infraorbital. Laminar portion of infraorbitals well developed, with the 2nd-4th covering entire cheek and all reaching the preopercle, the 2nd the largest. Anterior supramaxilla longer than posterior supramaxilla by a fourth or more of the former. Tendon from the A_1 of the adductor man-dibulae inserted on anterior supramaxilla.

Premaxillary teeth ranging from slightly enlarged anteriorly to even in size, none enlarged into tusks, directed downward to somewhat inward in adult, with the tooth rows nearly meeting anteriorly; as many as 20 teeth on each premaxilla. Teeth on anterior part of maxilla similar in size to those of posterior part of premaxilla. Dentary teeth slightly smaller. Mid-dentary teeth as many as 8-12 on each side, large recurved, and opposing the single row of premaxillary teeth; the number tends to be fewer in larger individuals, especially in *schnakenbecki*. As many as 6 recurved teeth over entire vomer, about the same number on each palatine, and a single row on mesopterygoid. Number of vomerine, palatine, mesopterygoid, and ectopterygoid teeth higher in larger individuals. In most platytroctids only the number of maxillary, premaxillary, and dentary teeth increases with size. As many as 12 ectopterygoid teeth on a side present in individuals larger than 130 mm SL in *abei* and, although not seen in material of *gracilis* and *schnakenbecki* we examined, they may be present in these species as well. Except for the ectopterygoid teeth, which are smaller, teeth in roof of mouth similar in size. Basihyal tooth plate oblong, with teeth in a circular pattern around the periphery in young, decreasing to an anterior pair in large individuals. Basibranchial teeth in a single row on high, very narrow part of tooth plate anteriorly, with multiple rows on flatter posterior part of tooth plate. Small teeth on the 4th epibranchial, 5th ceratobranchial, and upper pharygeal of 2nd-4th arches.

Ventral margin of opercle nearly horizontal over its posterior half, with the posterior margin nearly as deep as at middle. Deepest part of subopercle about half to nearly equal to depth of opercle near posterior margin of opercle, and from twice to about equal in width to posteriormost branchiostegal ray. Anteroventral part of subopercle not formed in young. (Fig. 21 A). Behind this area the subopercle is arched to accommodate the anteriorly directed SBO photophore. With increase in size, the subopercle becomes fully formed, blocking out the SBO and leaving a diagonal ridge (Fig. 21B). In some individuals the parts are not fully fused, leaving an incision across the top of the ridge. There are 4 flattened branchiostegal rays laterally on epihyal, with the 3 posterior branchiostegal rays close-set, widened, and overlapping, and 4 acinaciform rays ventrally on ceratohyal. Medial gillrakers lacking on ceratobranchial of 1st and 2nd arches, about 5-8 on the epibranchial and the hypobranchial. Dorsal margin of gill opening ranging from about level of ventral margin to dorsal margin of eye. Exposed tube of shoulder organ about a third of eye diameter in length and located at about midline, opposite the ventral tip of supracleithrum. Cleithral symphysis normal, not produced into a spine.

GO_2, IVO, SBO, and dorsal OO present from yolk-sac stage on, but becoming inconspicuous or covered over in adult. Photophores appearing in juvenile stage and persisting in adult are: GO_1, BRO, OPO, PO, SVO, SAO, PAO, ICO, a weak AO in some large individuals, and JO, THO, and MVO as transverse bars. White tissue around orbit not extending onto infraorbitals.

Scales over nape and, if present, on head, reverse imbricated. Reverse imbrication of body scales variable interspecifically, ranging from anterior third of body to none. Lateral line extending onto caudal, in a canal lined by about 50 modified scales, the last scale a perforated tubule. Scales small, 90-130 in midlateral series. About 10-20 small pores (0.02-0.25 mm) in most scalepockets, fewer near midline and toward caudal fin. No enlarged pits behind supracleithrum. Cephalic lateralis passing ventral to posttemporal bone and either through a short, partly ossified tubule in supracleithrum that lacks pores in *schnakenbecki*, or over the supracleithrum. Ventral half of posttemporal without a canal. Supratemporal canal a partly ossified tubule, the ossified part fused to skull. Other canals of cephalic lateral line system complete, with some branches. P_2 9-10.

Remarks. We have a 36-mm specimen of *Sagamichthys* (SIO77-51) from the Halmahera Sea that is unlike any presently known species in its possession of poorly developed gill filaments with bases that are united. The bases of the gill filaments are free in the 3 known species. Because of the small size of our specimen, morphometric comparisons are difficult. The body scales are also undeveloped. The gillraker count of 25 is higher than expected in *abei* (the only *Sagamichthys* we have data on for comparably sized fish), in which they are fewer than 20 at this length. The SBO photophore is also relatively weakly developed compared to that of *abei*. A decision on whether to consider this as a new form must await more specimens.

Sagamichthys schnakenbecki(Krefft 1953)
(Fig. 22C)

Searsia schnakenbecki Krefft 1953: 259-266, Fig. 1 (orig. descr.; holotype: ISH50/lld, Iceland-Faroe Ridge, 460 m, 3 paratypes (ISH50/11a,e,f) collected with holotype and 2 others collected in same area, 2 additional paratypes in AMNH); Brandes, Kotthaus, and Krefft 1953: 48 (rec. from stomach of fish, near Iceland); 1954: 45 (rec. from stomach of fish, near Iceland); 1957: 55 (rec. from stomach of fish, 64°51′N, 35°04′W and 65°42′N, 29°36′W); Kotthaus and Krefft 1957: 171, 185 (descr. of 2 spec, from E of Greenland); Nicol 1958: 729-732, Fig. 11 (descr. light organs; spec, from 46°55′N, 5°57′W); Krefft 1959: 42 (rec. from stomach of fish, Anton Dohrn Bank); 1960: 72 (rec. from stomach of fish, 64°30′N, 35°10′W and 65°27′N, 30°05′W).

Holtbyrnia (Krefftia) schnakenbecki Parr 1960: 75-78, Figs. 50-52b (descr. and ill. of type material); Kotthaus 1963: 102 (rec, 2 spec, from 60°N, 23°W); Krefft 1967a: 185 (rec, 1 spec from 62°39′N, 12°47′W); Quéro 1970: 267-269, Figs. 4-8 (descr., ill., ontogenetic changes in photophores, 6 rec from 43°45′-47°20′N, 2°20′-6°50′W); Badcock and Merrett 1976: Table 9 (depth range of capture of day and night samples from 30°N, 23°W).

Holtbyrnia (Krefftia) shankenbecki (misspelling) Geistdoerfer, Hureau, and Rannou 1971a: 1178 (listed); 1971b: 34 (same rec as 1971a).

Sagamichthys schnakenbecki Matsui and Rosenblatt 1971: 445-447, Fig. 5b, Table 1 (compar. with *S. abei*); Krefft 1973: 97-98 (syn.); Karrer 1975: 67 (rec. 18°45′S, 11°25′E); Sazonov 1976b; 68, Fig. 13 (taxonomy, compiled distr.); Golovan 1978:210 (distr.); Quéro 1979: 99-100, Figs. 1-2 (photophores, rec 56°43′N, 16°16′W); Gushchin and Kukuev 1980: 37 (rec: 49°50′N, 29°33′W and 52°18′N, 30°58′W).

?Holtbyrnia ophiocephala Sazonov and Golovan 1976: 8-9, Fig. 1 (orig. descr.; holotype: ZIL42291,9°04′N, 17°36′W); Golovan 1976: 300 (listed); Sazonov 1976b: 68, Figs. 14, 15 (taxonomy, distr.); Golovan 1978: 209 (listed).

?Sagamichthys schnakenbecki Sazonov and Trunov 1978: 87-88 (descr., low gillraker counts).

Diagnosis. Head naked. Scales reverse imbricated anterior to opercular opening on nape only; none on body reverse imbricated. Dorsal margin of opercular opening level with top of eye. Supracleithrum with a short trough for cephalic lateralis canal. Lateral line with a noticeable dorsal jog before joining cephalic lateralis canal. About 95-112 scales in midlateral series. Gillrakers 8-10 + 19-22 (27-32). P_2 9-10 (rarely 9).

D 16-18, A 15-17, P_1 15-19, P_2 9-10 (rarely 9), Br 8, vertebrae 28-30 + 18-21 (48-49), U_1 of 4 of 5 individuals examined not ossified, and not counted. Largest record: 250 mm.

Remarks. We have some reservations concerning the identity of the specimen reported by Sazonov and Trunov (1978) from the Southern Hemisphere. It has only 22 (on the right side) and 25 (on the left side) gillrakers. The 70 mm SL specimen is large enough to have developed all of its gillrakers. Sazonov and Trunov found reverse-imbricated scales on the nape but failed to mention other salient features. There was no description of the other South Atlantic record of *schnakenbecki* (Karrer 1975), but the identification was verified by Dr. G. Krefft.

We suspect that *Holtbyrnia ophiocephala* Sazonov and Golovan 1976, which is known from a specimen found in the stomach of a fish, is actually *S. schnakenbecki*. Unlike other *Holtbyrnia* species, *H. ophiocephala* was said to lack tusks on the premaxillae, and the teeth on the premaxilla are equal in size and ventrally directed. The JO was described as droplike in form. The specimen does resemble *schnakenbecki* in head and body form, has gill filaments with bases free (only found in *latifrons* among *Holtbyrnia* we recognize), and has similar meristic counts and morphometric ratios.

Distribution (Fig. 14). Except for the records from the South Atlantic mentioned above, all records are from the NE Atlantic, from the Denmark Strait, e.g., 65°N, 30°W (Krefft 1960), to 9°32′N, 16°20′W (USNM specimen from the Guinea Trawling Survey).

Material examined. ISH50/11 a,e,f, (3 paratypes), ISH50/13a (1 paratype), ISH51/13a (1 paratype), ISH724/73 (3), USNM Guinea Trawing Survey, trawl no. 18 (1).

Sagamichthys abei Parr 1953
(Fig. 22D)

Bathytroctes rostratus (not of Günther 1878) Tanaka 1910: 251-252, Fig. 1 (not seen).

Sagamichthys abei Parr 1953:6-7 (orig. descr.; holotype: cat. no. 47820, Zool. Inst., Univ. Tokyo, Sagami Bay); 1960: 42-45, Figs. 29-31 (descr. and ill. of holotype); Abe 1963: 31 (rec. off Cape Manazuru, Japan); Huzita and Nishino 1964: 7-9, Figs. 1-2 (descr., ill. of spec, from off Miyako, Japan); Pearcy 1964: Table 1 (listed); Lavenberg 1964: 64 (distr.); Bussing 1965: 193 (descr. of spec, off Chile, 33°S); Berry and Perkins 1966: 635-637, Fig. 6c (126 spec, from 22 locations in eastern N Pacific); Taylor 1967a: 2102-2103 (descr.; spec. from52°18′N, 133°11 ′Wand another from 52°18′N, 133°13′W); 1967b: 13, 28 (rec. same as Taylor 1967a); Fitch and Lavenberg 1968: 19-20, Fig. 2 (descr. and ill.); Matsui and Rosenblatt 1971: 445-447, Figs. 2-4, 5a (ontogenetic changes of photophores); Childress and Nygaard 1973: 1094-1095 (chemical composition of fish as function of minimum depth of occurrence); Hart 1973: 173-174, 1 fig. (descr. and ill.); Peden 1974: 50, Table 1 (10 spec, 98-223 mm SL from 3 sta. at 48°N, 126°W; descr. photophores, counts and meas.); Sazonov 1976b: 68, Figs. 12-13 (taxonomy; compiled distr. and 10 new rec. in Pacific); Parinteal. 1977:107 (rec, 1 spec. from29°20′N, 142°41′E); Hubbs, Follett, and Dempster 1979: 9 (checklist, NE Pacific); Novikov, Kodolov, and Gavrilov 1980: 32 (2 rec. N. Pacific); Parin et al. 1980: 8 (rec. 20°54′S, 80°44′W).

Diagnosis. Scales on opercle, and on head to posterior margin of nasal sac, present and reverse imbricated. Above the lateral line, scales reverse imbricated from shoulder organ anteriorly, body scales normally imbricated below lateral line. Dorsal margin of opercular opening level with mideye. Supracleithrum not pierced by cephalic lateralis canal. Lateral line canal with a slight dorsal jog before joining cephalic lateralis canal. About 110-125 scales in midlateral series. Gillrakers 7-8 + 16-18 (24-26). P_2 9-10 (usually 9).

D 16-18, A 14-16, P_1 14-18, P_2 9-10 (usually 9), Br 8, vertebrae 30-31 + 19-21 (50-52). U_1 not ossified (and not counted) in 2 of 8 individuals examined. Largest record: 252 mm.

Distribution (Fig. 14). Eastern Pacific from 39°23.5′S, 74°33.1′W (SIO75-451) to 16°15′S, 75°31′W (SIO72-186) in the Southern Hemisphere, and from 26°31′N, 117°47′W (Berry and Perkins 1966) to 52°18′N, 133°11 ′W (Taylor 1967a); west to Japan in the north (holotype; Sazonov 1976b); to 145°W near the equator (TC-47-52). Mesopelagic, mostly from nets with estimated towing depths of about 300-900 m. Records of 4 juveniles at an estimated depth of 37 m over water 130 m deep (Berry and Perkins 1966) is much shallower than reported for any other platytroctid. It should be noted that over 30,000 open 1 -m plankton net tows by the CalCOFI sampling program to depths of 150-200 m have not taken a platytroctid.

Material examined. TC-47-52 (1), TC-47-76 (2). SIO49-106 (1), SIO50-265 (1), SIO50-269 (1), SIO51-149 (4), SIO51-160 (1), SIO51-165 (5), SIO51-188 (1), SIO51-190 (4), SIO51-278 (2), SIO51-358 (1), SIO52-49 (1), SIO54-83A (2), SIO54-84 (2), SIO54-121 (4), SIO54-122 (1), SIO55-3 (2), SIO56-114 (1), SIO57-41 (7), SIO57-88 (2), SIO57-96 (1), SIO57-208 (1), SIO59-256 (3), SIO60-155 (1), SIO60-156 (1), SIO60-239 (1), SIO60-288 (2), SIO60-387 (1), SIO60-459 (1), SIO63-165 (3), SIO63-189 (1), SIO63-870 (1), SIO64-36 (1), SIO64-39 (1), SIO64-444 (3), SIO64-554 (1), SIO64-973 (3), SIO64-1027 (1), SIO65-188 (3), SIO65-193 (4), SIO65-439 (4), SIO65-554 (4), SIO65-665 (1), SIO65-667 (1), SIO66-5 (3), SIO66-6 (4), SIO66-16 (1), SIO66-20 (1), SIO66-31 (1), SIO66-188 (2), SIO66-371 (1), SIO66-382 (2), SIO66-390 (2), SIO66-398 (1), SIO66-422 (1), SIO66-431 (1), SIO66-439 (1), SIO66-488 (7), SIO66-536 (8), SIO66-541 (9), SIO66-549 (5), SIO66-553 (2), SIO67-49 (4), SIO67-59 (3), SIO67-61 (1), SIO67-62 (3), SIO67-104 (1), SIO67-113 (4), SIO67-116 (1), SIO67-117 (1), SIO68-570 (2), SIO68-571 (2), SIO68-572 (3), SIO69-433 (1), SIO70-8 (5), SIO70-20 (1), SIO70-236 (1), SIO70-240 (1), SIO71-311 (1), SIO72-186 (1), SIO73-7 (1), SIO75-451 (1), SIO75-463 (3), SIO75-470 (1), SIO75-472 (1), SIO77-383 (1).

Sagamichthys gracilis Sazonov 1978
(Fig. 22E)

Sagamichthys gracilis Sazonov 1978: 101-102, Fig. 1 (orig. descr.; holotype: MMSU P14184, 8°29′S, 59°35′E, 950-1200 m; 2 paratypes (MMSU P14185) collected with holotype).

Diagnosis. Scales on opercle and on head to before eye present and on cheek, reverse imbricated. Reverse-imbricated scales anteriorly from about the THO photophore near midlength, both above and below lateral line. Dorsal margin of opercular opening level with lower margin of eye. Supracleithrum not pierced by cephalic lateralis canal; lateral line canal without a dorsal jog before joining cephalic lateralis canal. About 125-130 transverse rows of scales from apex of gill opening to middle rays of the caudal fin. Gillrakers 8 + 20. $P_2$9.

D 18, A 16, P_1 15, P_2 9, Br 8, Gr 8 + 20, vertebrae 28 + 20. Largest record: 203 mm.

Remarks. S. gracilis is shallower bodied than *S. abei* and *S. schnakenbecki*, with a shorter head, upper jaw, and snout. Due to negative allometry, the ratios tend to overlap and have not been included in the diagnosis. The upper jaw shows the clearest difference in the 150-250 mm SL interval; it is about 10-11.5% SL for *gracilis* and about 13-15% for *abei* and *schnakenbecki*. These morphometric differences were noted by Sazonov (1978) *for gracilis* and *abei*. However, his description of the posteriormost location of reverse-imbricated scale as being at the opercular opening fits *schnakenbecki* and differs considerably from that of the specimen *of gracilis* he sent us on a loan.

Distribution (Fig. 14). Known only from the Indian Ocean: the holotype and paratype from 8°29′S, 59°35′E, captured at depths of 950-1200 m; and material we received on a loan from 8°07′S, 59°18′E at depths of 1240-1300 m.

Material examined. MMSU P14662 (1).

Relationships. *Sagamichthys* species are compared in Table 3. The high opercular opening and the short canal in the supracleithrum of *S. schnakenbecki* are the generalized condition found in other mesopelagic genera. The species is like *Holtbyrnia intermedia* in its scaleless head and opercle and in having reverse-imbricated scales restricted to the nape. *S. abei* and *S. gracilis* are more advanced, with reverse-imbricated scales on the head and opercle. In abei, reverse-imbricated scales are over the dorsal half of body to the shoulder region and the opercular opening, extending as high as mideye. *S. gracilis* is the most advanced, with reverse-imbricated scales extending over the dorsal and ventral halves of the body to about the pelvic fins and the opercular opening more restricted, extending only as high as the ventral margin of the eye.

TABLE 3 Comparison of Differentiating Characters in *Sagamichthys* Species

	schnakenbecki (Atlantic)	*abei* (E Pacific)	gracilis (Indian Ocean)
Scales on head and opercle	absent	present	present
Tusks	rudimentary	absent	absent
Reverse imbrication of body scales	nape only	dorsal half, to shoulder tube	both dorsal and ventral halves, about to pelvics
Dorsal margin of opercular opening level with:	top of eye	mideye	ventral border of eye

Searsia Parr 1937

Searsia Parr 1937: 8, 12-15 (in part); type species: *Searsia koefoedi* Parr 1937, by original designation.

Searsea Maul 1948: 12 (invalid subsequent spelling).

Generic diagnosis. Body elongate, moderately deep, and moderately compressed. Dorsal margin rounded. Cleithral symphysis normal, not ending in a spine. ICO double; GO_1, JO, and VO absent. Thin layer of white tissue bordering posterior dorsal half of eye. Lateral line without a canal and modified scales. Posttemporal bone receiving cephalic lateralis and subcutaneous canals. Cephalic lateralis canal passing through supracleithrum. Cephalic lateral line canals complete with side branches. Upper jaw partly overlapped by lacrimal and 2nd infraorbital; 3rd and 4th infraorbitals with laminar extensions, the 3rd reaching preopercle. Mouth small, maxilla ending variably between mideye to posterior margin of eye. Each premaxilla with a single incurved, horizontally directed tusk, occasionally a much smaller one juxtaposed to 1st. The 1st tooth on main row of premaxilla directed downward and usually directly below the base of tusk. Mid-dentary teeth present in young only. Eye below head outline; supraorbital rudimentary or absent. All or most scalepockets with subcutaneous pores. P2 6-8 (usually 7), vertebrae 46-47, U_1 present.

Generic description. That of the single species, 5. *koefoedi.*

Searsia koefoedi Parr 1937
(Fig.25A)

Bathytroctes rostratus (not of Günther 1878) Brauer 1906: 17-18, pl. 14, Figs. 2-3 (ill.; descr., in part) Koefoed 1927: 51-53 (in part, descr., compar. with other coll.).

?Bathytroctes rostratus (not of Günther 1878) Holt and Byrne 1908:45-47, pl. 4, Figs. 3-5 (inadequate diagn. based on 10-32 mm spec); Misra 1953: 390, Fig. 9d (in key).

Searsia koefoedi Parr 1937: 15-19, Fig. 4 (orig. descr.; holotype: YPM3720, 23°39′N, 76°41′W, 7000 ft. wire out); 1951: 17 (in key); Grey 1955: 269, Fig. 45 (rec. 2 spec, from 32°00′N, 64°51.7′W and 32°11.5′N 64°36′W, photo of spec); Nicol 1958: 726, Fig. 4 (descr. of photophores of freshly caught spec from 46°42′N, 6°22′W); Parr 1960: 53-60, Figs. 37-43 (descr. and ill., rec. 16 Dana sta.); Kotthaus 1963: 102 (rec, 60°N, 23°W); Krefft 1963: 83 (spec, from stomach of fish, 64°40′N, 35°08′W); 1966: 176 (spec, from stomach of fish, 65°25′N, 30°30′W); Badcock 1970: 1035, 1041 (rec of 9 spec, from about 28°N, 14°W); Blache, Cadenat, and Stauch 1970:148, Fig. 391 (in key); Quéro 1970: 264-266, Figs. 2-3 (ontogenetic changes in photophores; 41 spec from 14 loc, Bay of Biscay); Kotthaus 1972: 6, Fig. 3 (counts, photo of otolith of a spec from 33°46′N, 15°33′W); Krefft 1973: 95 (syn. and distr., NE Atlantic); Golovan 1976: 299 (rec from 22°30′N and 22°40′N off the W coast of Africa); Parin et al. 1973: 76 (rec. 23°21′S, 71°42′W and 22°14′S, 70°33′W); Sazonov 1976b: 68, Figs. 10-11 (compiled distr., 15 new rec. in distr. chart, including one from 20°S off Chile); Badcock and Merrett 1976: 48 (rec 30°N, 23°W); Parin et al. 1977: 106 (rec. 11 spec, 4 loc., Indonesian waters); Quéro 1978: 18, Fig. 10a (rec. 24°30′N, 17°02′W and 26°05′N, 15°53′W); Parin, Sazonov, and Mikhailin 1978: 174 (rec 3°08′N, 8°54′E); Golovan 1978: 209 (listed); Gushchin and Kukuev 1980: 37 (rec, 49°41′N, 29°05′W).

Searsea koefoedi Maul 1948: 12-14, Fig. 3 (descr., ill., spec from stomach of fish, Madeira); Albuquerque 1954-56: 230, Fig. 127 (gen. descr., fig. from Parr 1937).

?Searsia koefoedi Tucker 1954: 206, Fig. 15 (descr. of 15 mm spec).

Searsia koefoedi koefoedi Parr 1960: 60-61, Fig. 43 (descr. and ill.); Geistdoerfer, Hureau, and Rannou 1971a: 1178 (listed); 1971b: 364 (same as 1971a).

Searsia koefoedi primicrops Parr 1960: 61-62, Fig. 43 (orig. descr.; holotype: YPM3723, 23°49′N, 76°58′W, 7000 ft. wire out).

Diagnosis. That of the genus.

Description. Body elongate, moderately deep, depth about 4-5 in SL and moderately compressed, with the greatest depth about twice greatest width. Venter flattened, 4-5 scale rows across. Ventral body wall thick. Pelvic fins inserted about at body midlength. Dorsal origin slightly less than its basal length behind body midlength. Dorsal and anal fins subequal and nearly opposed, dorsal origin ahead of that of anal by about a fourth or less of its basal length (4-6 rays). Anus opposite dorsal origin. Pectorals low on body.

Head relatively short, about 4 in SL. Frontals flaring outward posteriorly and converging anteriorly over eye. Interorbital wide, about equal to eye length. Supraorbital rudimentary or absent (a small supraorbital found on one side of the stained and cleared specimen). A thin crescent-shaped antorbital loosely held by surrounding tissue along the posterior edge of nasal sac. Eye about 6.5-8% SL and below head outline. Frontals cupped dorsad over eye. Snout short, about 4-5 in HL. Oblong nasal sac extending anteriorly and nearly reaching anterior end of maxilla. About 6-10 lamellae in rosette. Mouth small, posterior margin of maxilla extending variably from mideye to posterior margin of eye. Supramaxillae as deep as or deeper than maxilla and dorsally overlapped by lacrimal to about mideye and by laminar extension of the 2nd infraorbital over the remaining length when mouth is closed. Anterior supramaxilla longer than posterior. Tendon from A_1 of the adductor mandibulae inserted on the anterior supramaxilla; 3rd and 4th infraorbitals with laminar processes, the 3rd reaching preopercle.

Premaxillary tusks incurved and separated by nearly the width of mouth. A broad edentulous space between the tusks. When present, 2nd tusk much smaller than 1st and juxtaposed to 1st. Premaxillary teeth lateral and directed downward, the anteriormost often inserted below the base of tusk, about 7-9 teeth on each side. Row of close-set, smaller teeth on maxilla and dentary, teeth of dentary the smaller. A short row of 4-5 mid-dentary teeth on a side present in young, but usually lacking in larger individuals. There are 2 closely spaced vomerine teeth. Palatines edentulous. A single row of basibranchial teeth on a sharp toothplate, and a single tooth row along mesopterygoid. Teeth along the border of narrow basihyal in a circle, generally fewer with increasing size. Teeth present on 4th epibranchial and 5th ceratobranchial and on upper pharyngeals of 2nd-4th arches:

Lower margin of opercle nearly horizontal over posterior half. Subopercle about a fourth to a third as deep as opercle and slightly deeper than posteriormost branchiostegal ray. There are 4 flattened branchiostegal rays laterally on epihyal, the 3 posteriormost close set and slightly overlapping; 4 acinaciform rays ventrally on ceratohyal. Small area on the ventral side of the anterior third of subopercle not formed in young stages because of the SBO photophore, resulting in a slight ridge across the subopercle in older individuals. Exposed tube of shoulder organ less than an eye diameter from top of gill opening, which is about level with mideye. Cleithral symphysis normal, not produced in a spine.

Only photophore visible in small individuals is a small IVO, which disappears without a trace by 100 mm SL. A rudimentary GO_2 appears relatively late in the young and is marked by a transparent membrane. The following photophores are found in juveniles and adults: BRO, small PO, OPO, SVO, SAO, PAO, a transverse THO, a transverse or round MVO, and a double ICO. Transparent spots are found at the positions of the POO and posterior IOO. The SBO increases in size in larger individuals, but appears to be covered by pigmented skin. GO_1 absent. Thin layer of white tissue bordering posterior dorsal half of eye.

Cephalic lateral line canals complete, with a number of branches from the main canals. Supraorbital canal intersecting the supratemporal canal. The cephalic lateralis canal passing posteriorly through the ventral part of the posttemporal bone, then ventrally for a short distance grooved into the posterior margin of the supracleithrum. In addition, the subcutaneous canal passes dorsoventrally through the posttemporal bone. Lateral line marked by black papillae anteriorly and neuromasts posteriorly. Most scales over anterior half of body with subcutaneous pores in scalepockets. Pores measuring about 0.05-0.3 mm diameter and somewhat fewer in number medially and posteriorly. Scales small, 77-88 in midlateral series.

D 18-20, A 16-18, P_1 20-24, P_2 6-8 (usually 7), Br 8 (one with 6/7), GR7-9 + 20-22 (27-30), vertebrae 22-25 + 22-24 (46-47). Preural flanges on last 5 haemal spines and on opposing neural spines. Largest record: 150 mm.

Remarks. The width of the frontals differs between *S. koefoedi* of the 3 ocean regions. The frontals are much wider in individuals from the Indo-West Pacific than from the Atlantic; and although the width is intermediate in those from the eastern Pacific, it is only slightly greater than in individuals from the Atlantic.

Distribution. (Fig. 15). Most captures have been near the equator in the Pacific and Indian oceans. Parin et al. (1973) record a specimen at 23°21′S in the eastern Pacific; near Indonesia and the Philippine Islands recorded from 8°50′S, 129°57′E (SIO77-13), with northernmost sample at 14°49′N, 119°32′E (SIO70-346). Also in the equatorial Indian Ocean. In the Atlantic, recorded from the North Atlantic from 3°08′N, 8°54′E (Parin, Sazonov, and Mikhailin 1978) to 65°45′N, 29°15′W (ZMUC uncat.) on the E side and as far N as 32°11.5′N, 64°36′W (Grey 1955) on the W side. Appears to have a wide depth range, being taken in nets sampling from 500 m to below 1000 m in estimated depth, but a number of those below 1000 m may have been collected at shallower depths.

Material examined. USNM206896 (5), USNM206873 (5), USNM150795 (1), ZMUC uncat. Step 1 sta. 83 (1), ZMUC uncat. *Galathea* sta. 268 (1), ZMUC uncat. (1), AMNH 41551 (3), SIO52-338 (1), SIO70-346 (1), SIO71-182 (1), SIO77-13 (1), SIO77-15 (1), SIO77-20 (6), SIO77-21 (2), SIO77-22 (16), SIO77-24 (4), SIO77-25 (1), SIO77-26 (1), SIO77-28 (1), SIO77-29 (1), SIO77-30 (5), SIO77-31 (1), SIO77-35 (2), SIO77-36 (8), SIO77-37 (7), SIO77-38 (3), SIO77-39 (3), SIO77-41 (1), SIO77-42 (2), SIO77-43 (1), SIO77-45 (1), SIO77-48 (1), SIO77-49 (1), SIO77-52 (7), SIO77-53 (9), SIO77-54 (2), SIO77-56 (8), SIO77-57 (9), SIO77-59 (7), SIO77-60 (1), SIO77-61 (4), SIO77-63 (5), SIO77-65 (1), SIO77-66 (6), SIO77-69 (4), SIO77-70 (3), SIO77-71 (5).

Mirorictus Parr 1947

Mirorictus Parr 1957: 59-60, type species: *Mirorictus tåningi* Parr 1947, by original designation.

Generic diagnosis. Body elongate, moderately deep, and moderately compressed. Dorsal margins somewhat sharp, with a layer of nonmuscular tissue. Cleithral symphysis normal, not ending in a spine. Photophores absent. Traces of white tissue bordering dorsal half of eye. Lateral line without a canal and modified scales. Posttemporal and supracleithrum not pierced by a canal. Cephalic lateral line canal complete, with few side branches. Upper jaw not overlapped by lacrimal or infraorbitals. The 2nd infraorbital tubular; laminar extension of 3rd and 4th infraorbitals extending about half the distance to preopercle. Mouth small, maxilla ending below mideye. No tusks on premaxilla, only small, loosely attached teeth in jaw. Mid-dentary teeth absent. No maxillo-mandibular ligament across dentary. Eye below head outline. Frontals narrow, with lateral margins nearly parallel over eyes. Supraorbital small, loosely attached to lateral margin of frontals over anterior third of eye. All or most scalepockets with subcutaneous pores. P_2 7-9 (usually 8), vertebrae 43-46, U_1 mostly present.

Mirorictus taningi Parr 1947
(Fig. 25B)

Mirorictus tåningi Parr 1947: 59-61, pi. 1 (orig. descr.; holotype: ZMUC P1749, 7°15′N, 78°54′W, ca. 1750 m); 1960: 30-31, Figs. 18-20 (descr. and ill. of holotype).

Mirorictus taningi Grey 1956: 116 (listed); Hubbs, Follett, and Dempster 1979: 9 (checklist).

Mirorictus taaningi Berry and Perkins 1966: 637, Fig. 6d (rec. off California); Parin et al. 1976: 208 (descr., spec, from eastern S Pacific); Sazonov 1976b: 68, Figs. 3, 6 (taxonomy, compiled distr., 6 new rec. in Pacific and 2 in Indian Ocean); Parin et al. 1977: 106 (rec., 1 spec., 5°07′N, 142°52′E).

Normichthys campbelli Lavenberg 1965a: 22-26, Fig. 1 [(orig. descr.; holotype: LACM-7068, 33°18′N, 118°39′W, 900 m; paratypes: SIO56-79 (1), SIO57-46 (2), SIO57-76 (1)]; Brewer 1973: 17 (3 spec. Gulf of California).

Diagnosis. That of the genus.

Description. Body elongate, moderately compressed and shallow (body depth 4-5 in SL) with a relatively long caudal peduncle (about 5 in SL). Nonmuscular tissue about 3 scale rows deep along dorsal and ventral margins from head to vertical fins. Pelvic fins usually inserted slightly before body midlength. Dorsal fin origin about half its basal length behind body midlength and ahead of anal by about 4 rays. Dorsal base slightly longer than that of anal. Anus opposite dorsal origin.

Head small, about 3-4 in SL. Eye below head profile. Frontals narrow, lateral margins nearly parallel over eye. A thin supraorbital along frontal margin above anterior third of eye. Antorbital separated from supraorbital and lacrimal and lying free in skin. Snout short, about 5 in head length. Nasal sac nearly round and small, about 6 in snout length, located at about the middle of snout. About 2-5 small lamellae in nasal rosette. Mouth small, maxilla ending below mideye. Premaxillae meeting anteriorly. Anterior and posterior supramaxillae about equal in length. Small tendon from A_1 of the adductor mandibulae inserted on anterior supramaxilla and from there onto the maxilla. Dentary shallow anteriorly, deep posteriorly, with a coronoid process on posterior half.

Teeth small and loosely attached. Our material exhibits great variability in dentition; probably most of this is associated with net damage. All specimens have teeth on the dentary, ranging from a complete row to a few scattered teeth. Only 5 of 21 specimens examined have any maxillary teeth, and the maximum number is 3 on one side; the maxillary teeth are so weak and deciduous that they may be removed without any apparent damage. Only one specimen apparently lacked premaxillary teeth, although the numbers for one premaxilla varied continuously from 1-6 in the total sample. Most of the specimens have 2 small, closely spaced vomerine teeth; four appeared to lack them, and in two only 1 vomerine tooth could be found. Probably unrelated to net damage, the mesopterygoid teeth are usually absent. Basihyal with a single tooth at about its middle. No teeth on palatines, ectopterygoids, and basibranchials; no mid-dentary teeth. Teeth on 4th epibranchial and 5th ceratobranchial and on the upper pharyngeals of the 3rd and 4th arches.

Lower margin of opercle curved downward from anterior end, then running horizontally for the posterior half. Subopercle about a third the depth of posterior part of opercle and twice that of posteriormost branchiostegal ray. There are 3-4 branchiostegal rays laterally on epihyal, with the last 2 wide and partly overlapping. Usually 3 (occasionally 4) acinaciform rays ventrally on ceratohyal. Medial gillrakers lacking on ceratobranchial of 1st and 2nd arches and ranging from 0-3 on hypobranchial and epibranchial of 1st and 2nd arches. Gill filaments well developed for a platytroctid in samples from the eastern Pacific, but much shorter in the western Pacific specimen (SIO77-31). Outer row of filaments at angle of epibranchial and ceratobranchial barely present in SIO77-31. Base of filaments not united. Dorsal margin of gill opening level with mideye. Exposed tube of shoulder organ about 5 in eye, and located at midline just above the ventral tip of supracleithrum and slightly less than an eye length below top of gill slit. Cleithral symphysis normal, not produced into a spine.

Scales large, 55-66 on midline. Lateral line marked by black papillae, without a canal or modified scales. Most scalepockets with 1-8 (usually 2-4) pores of 0.1-0.4 mm diameter. There is some decrease in number and size of pores posteriorly and toward midline. No enlarged pits behind supracleithrum. Upper jaw not overlapped by lacrimal or other infraorbitals. The 2nd infraorbital a long osseous tubule without a laminar portion, 3rd and 4th with laminar processes that extend nearly half the distance to preopercle; 3rd infraorbital slightly longer than lacrimal. Supratemporal canal complete and nearly entirely of soft tissue. Supraorbital canal intersecting supratemporal canal. Cephalic lateralis canal ending at shoulder girdle in a tubular ossicle without passing through the posttemporal and supra-cleithral bones. Subcutaneous canal not passing through posttemporal bone. There are few side branches from the main canals of the cephalic lateral line system. Photophores absent.

D 15-20, A 14-17, P_1 16-20, P_2 7-9 (usually 8), Br 6-7 (usually 7), GR 4-6 + 12-15 (18-21), vertebrae 22-26 + 19-22(43-46). Largest record: 124 mm.

Remarks. *Mirorictus taningi* was described by Parr (1947) on the basis of a single specimen from the Gulf of Panama. Because of the supposed unique nature of the jaws, the genus was subsequently (Parr 1951, 1960) considered to represent a monotypic subfamily. Our collection contains a number of specimens of an eastern Pacific platytroctid that agree with the holotype of *M. taningi* except for the peculiarities of mouth and dentition described by Parr.

Examination of the holotype of *M. taningi* shows the maxilla on the left side to be enclosed within the ramus of the lower jaw as described by Parr. However, the right side is now in a normal condition. Parr (1947) considered but rejected the hypothesis that the condition of his specimen might be attributable either to teratology or trauma. The present normal condition of the right maxilla of the holotype, as well as the existence of material that otherwise fits the description of the holotype, indicate to us that the peculiarities of the jaw in the holotype were caused by injury in the net and do not represent a profound structural modification. The bones of the jaws of *M. taningi* are thin, flexible, and weakly connected, and may be manipulated easily. It is possible to bend the upper jaw and pass it inside the corner of the mouth without apparent damage. The ease of this modification is borne out by a specimen (SIO60-282) in which (as in the holotype) the jaws are in the *"Mirorictus"* condition on one side but not the other. We believe that this represents injury during capture. Most early juveniles of *Holtbyrnia latifrons* and *Sagamichthys abei*, as well as a few of those of the alepocephalid *Alepocephalus tenebrosus* that we have examined, have the jaws inverted in this way.

The condition of the jaws of the holotype is probably also responsible for Parr's report of a single supramaxilla (unique in the family). When the upper jaw is twisted, the anterior supramaxilla is directed horizontally, and not readily apparent. The reported lack of dentary and vomerine teeth (also unique in the family) can also be attributed to injury or variability. The edge of the right jaw of the holotype is broken, and there is a single tooth not reported by Parr remaining on the left dentary. The dentition of the type was described as "almost rudimentary, with only a few minute teeth," and our material of *M. taningi* demonstrates that all of the teeth are fragile and easily lost (see description above).

Our material identified as *M. taningi* agrees with the holotype in several important respects. These include the short mouth with transverse premaxillae and feeble dentition, body proportions and fin positions, the relatively large scales, unmodified lateral line scales, the presence of pores beneath the body scales, and the absence of photophores. Meristic characters also agree. The low gillraker number is especially significant. *M. taningi* is the only one of the few platytroctids with as few as 14 gillrakers on the lower limb of the 1st arch. Parr gave the branchiostegal count as 4, but the holotype in fact has 7. *Normichthys campbelli* Lavenberg 1965 was described from the eastern North Pacific. The nominal species is, however, a junior synonym of *Mirorictus taningi*. *N. campbelli* was placed in *Normichthys* by the describer on the basis of the absence of photophores (a character shared with 6 genera) and the presence of "3 open dermal pits over the top of the shoulder girdle." However, the so-called pits above the opercle of *Normichthys campbelli* are actually pores associated with the cephalic lateralis canal. Such conspicuous pores are also found in other platytroctids. Parr (1960, p. 13) called attention to those of *Searsia*, which he stated should not be confused with "dermal pits." The dermal pits of *Normichthys* are enlarged pores in the scalepockets, some twice as large as the scales overlying them, located behind the shoulder girdle, and are part of the subcutaneous system. The subcutaneous pores in the scalepockets of specimens of 'W. *campbelli* are much smaller. Once it is recognized that the jaws of the holotype of *M. taningi* are distorted, it is apparent that the holotype of *N. campbelli* is conspecific with it. Our material, which includes the paratypes of *N. campbelli*, certainly agrees with M. *taningi* as discussed above. *Distribution (Fig.* 15). Along the eastern Pacific from 35° 15.5′N, 122°16.5′W(SIO67-101) to 11°54′S, 80°40′W (SIO65-606), with 1 record in the Gulf of California (Brewer 1973) and several records in the oxygen-poor water off Mexico. Equatorial waters of the eastern Pacific, western Pacific (SIO77-31), and Indian Ocean (Sazonov 1976b).

Material examined. SIO52-41 (1), SIO52-338 (1), SIO56-66 (1), SIO56-79 (1), SIO60-287 (1), SIO62-192A (1), SIO63-444 (1), SIO64-11 (1), SIO65-556 (1), SIO65-606 (1), SIO66-20 (1), SIO66-42 (2), SIO67-52 (1), SIO67-56 (1), SIO67-59 (1), SIO67-101 (2), SIO70-95 (1), SIO72-392 (1), SIO75-463 (1), SIO76-41 (2), SIO77-31 (1). Paratypes of *Normichthys campbelli:* SIO56-76 (1), SIO56-79 (1), SIO57-46 (2).

Tragularius n. gen.

Generic diagnosis. Body elongate, moderately shallow, and relatively wide anteriorly. Dorsal margin rounded with little or no nonmuscular tissue. Cleithral symphysis ending in a blunt spine. Photophores absent. White tissue surrounding eye (not apparent in holotype of *crassus).* Lateral line either with a canal lined by modified scales or marked by papillae and without a canal and modified scales. Posttemporal and supracleithrum not pierced by a canal. Cephalic lateral line canals complete and branched. Upper jaw partly overlapped by lacrimal. Posterior margin of upper jaw about one eye length behind eye. Innermost tooth of premaxilla an anteriorly directed tusk; as many as 3 other tusks pointed more ventrolaterally in a radial pattern, none parallel. Teeth nearest tusks subhorizontal and in series with tusks, 13-15 teeth in main row of premaxilla. Mid-dentary teeth present. Frontals widest behind eye, tapering anteriorly, with margins nearly straight over eye. Supraorbital lateral to frontals anterior to mideye. Eye below head outline. At least some scalepockets with 1-20 pores. P_2 7-8, vertebrae 42-43. U^1 centrum absent (or fused).

Comparative diagnosis. The spinous cleithral symphysis and the radiating pattern of pre-maxillary tusks with none of the tusks parallel are synapomorphies setting the species of *Tragularius* apart from the mesopelagic platytroctids and indicating inclusion in the bathypelagic group. However, they resemble the mesopelagic group in a number of features, most notably in the retention of a large mouth and a rounded dorsal body margin and attainment of a large size. The conspicuous white tissue surrounding the entire eye of a *Tragularius* also appears to be the retention of a plesiomorphy, as that feature is present in *Persparsia, Paraholtbyrnia*, and *Sagamichthys*.

An enlarged lacrimal extending back to below mideye or to the posterior margin of the eye is an apparent derived feature of *Tragularius* shared with *Pellisolus* that sets the two apart from the other bathypelagic platytroctids. However, *Pellisolus* shows several reductional advances, e.g., loss of subcutaneous pores and interruption in the cephalic lateral line canals, not found in *Tragularius.* The eyes *of Pellisolus* are also specialized and positioned to face more anterodorsally. *Maulisia*, the other large bathypelagic genus, has a characteristically shaped head and a more compressed body. The remaining bathypelagic genera have small mouths, usually compressed bodies and are reduced in a number of features.

Generic description. Body elongate, moderately deep, about 4.5 in SL, tapering to 10-11 in SL at caudal peduncle. Dorsal margin narrow, generally lacking nonmuscular tissue. Ventral fin origin just behind midlength. Dorsal origin half to entire basal length of dorsal behind midlength, and from opposite to ahead of that of anus by about 4 dorsal rays. Anal fin origin about opposite 4th-12th dorsal ray. Pectoral low on body, with rays directed backward. Cleithral symphysis ending in a blunt spine (except in holotype of *crassus*).

Head large, 2.4-3.1 in SL. Eyes 3.3-6.8 in HL. Snout relatively long, 2.8-4.0 in HL. About 5-11 lamellae in nasal rosette. Frontals widest behind eye, narrowing abruptly by about one-fourth the width at posterior margin of eye, then gradually tapering to snout. Supraorbital lateral to frontals from mideye forward. Anterior half of supraorbital separated from frontals, with anterior tip articulating with antorbital and joined by ligament. Antorbital bordering posterior margin of posterior naris.

Mouth large, maxilla ending well behind eye (just behind eye in holotype of *crassus).* Upper jaw slipping partly under lacrimal. The 2nd infraorbital with well-ossified lamellar portion but not overlapping upper jaw. Laminar extension of 3rd and 4th infraorbital extending less than half the distance to preopercle; lacrimal the largest, extending back from below mideye to behind eye. Anterior supramaxilla longer than posterior supramaxilla. Tendon from A_1 of adductor mandibulae inserted on anterior supramaxilla (then continuing a thin band anterior to maxilla). Premaxilla short, 3.0-3.4 in maxilla, and relatively deep, with a posterodorsally directed process that does not entirely cross maxilla. Innermost tooth on premaxilla enlarged as an anteriorly directed tusk. Narrow edentulous space between tusks. As many as 3 other teeth nearest inner tusk similarly enlarged and more laterally and subvertically directed, with none parallel to each other. Anterior regular row of teeth subhorizontal and in series with tusks, about 13-14 teeth in premaxilla. About 2-6 mid-dentary teeth in adults. Vomer with 2 teeth, single tooth on each palatine. Medial row of 1-4 teeth in basihyal and a row of small teeth in basibranchial. Mesopterygoid with a single row of teeth. Small teeth on 4th epibranchial, 5th ceratobranchial, and 2nd-4th upper pharyngeals.

Opercle at posterior margin about as deep as, to a third deeper than middle; subopercle half as deep as opercle. There are 4 flattened branchiostegal rays laterally on epihyal and 4 acinaciform rays ventrally on ceratohyal; 2-3 dorsalmost branchiostegal rays overlapping, the dorsalmost about one-third to half as wide as subopercle. Dorsal margin of gill opening level with top of eye. Exposed tube of shoulder organ level with ventral tip of supracleithrum and about 10 scale rows below top of gill opening. Bases of gill filaments united. Medial gillrakers lacking on ceratobranchial of 1st and 2nd arches, relatively few (2-5) stubby medial rakers on epibranchial and hypobranchial.

Lateral line marked by a canal and modified scales or by papillae or neuromasts. About 80-95 scales in midline. At least some scalepockets with 1-20 pores (not found in holotype of *crassus*, probably because of its small size). Posttemporal and supracleithrum not pierced by a canal. Cephalic lateral line canals complete. Photophores absent. White tissue around orbit (not apparent in holotype of *crassus).*

Derivation of name: From the Latin *tragularius*, javelin thrower, in allusion to the forward-directed tusks, gender masculine.

Type species: Mentodus perforatus Sazonov and Trunov 1978.

Remarks. In his revisionary work, Parr (1960) placed 2 specimens with large mouths but without photophores in the genus *Mentodus.* Since then, species with large mouths and without photophores, or only weakly developed photophores, have usually been placed in *Mentodus.* (The two species that were placed in *Maulisia, M. microlepis* and *M. acuticeps*, are distinguished by the shape of the top of skull.) However, *Bathytroctes rostratus*, the genotype, is a *Holtbyrnia*, and we have placed *Mentodus* as a junior synonym of that genus. Other species presently included by authors in *Mentodus* are widely different from *B. rostratus* and most are referable to *Tragularius.*

Tragularius retains a number of generalized features that are most commonly seen in the mesopelagic genera, but has also acquired some of the specializations of the bathypelagic genera. As in the mesopelagic genera, individuals of *Tragularius* attain a large size for platytroctids and have a large mouth and an elongate body that is rounded dorsally. The head is relatively wide, with a large supraorbital that extends forward from mideye and attaches to the antorbital anteriorly. White tissue surrounds the eyes, which are directed laterally. The cephalic lateral line canals are complete and branched, and the most generalized species, *T. mesalirus*, retains a lateral line canal and modified scales.

However, *Tragularius* shares a number of significant features with the bathypelagic genera. Among them are a spinous cleithral symphysis and premaxillary tusks arranged in a radial pattern, with none parallel. In addition, the following reductional features are present: no photophores, U_1 centrum, canals in posttemporal and supracleithrum, and a low number of ventral rays and vertebrae.

Pellisolus seems closest to *Tragularius*, as indicated by the presence of the features just mentioned for *Tragularius* in *P. longirostris*, which is also large-mouthed, large in size and has a spinous cleithral symphysis. *Pellisolus* is rounded dorsally and the body is not compressed as in most of the other bathypelagic genera. It seems that *Tragularius* and *Pellisolus* may have branched from the remainder of the bathypelagic group before that character was derived. But *Pellisolus* is more reduced than *Tragularius* in the loss of subcutaneous pores, and reduction or loss of part of the cephalic lateral line canals. Its eyes are enlarged, extend above the outline of the head, and appear specialized in being directed anterodorsally. The lacrimal is enlarged in both genera and extends from below mideye to posterior margin of eye. Although *Pellisolus* and *Tragularius* do not share other outstanding derived features that are not shared with some other platytroctids, the similarities just mentioned suggest that *Tragularius* may be the primitive sister group of *Pellisolus.*

Maulisia is another large-sized, large-mouthed platytroctid with a spinous cleithral symphysis. But *Maulisia* is more specialized, in having the deep and compressed body characteristic of more advanced bathypelagic genera, and the head is characteristically shaped.

With the exception of the few specialized features, such as the spinous cleithral symphysis, common to most of the bathypelagic genera, *Tragularius* is unspecialized and is the most generalized of the bathypelagic genera.

Tragularius perforatus (Sazonov and Trunov 1978)
(Fig. 24C)

Mentodus perforatus Sazonov and Trunov 1978: 93-95, Fig. 4, Table 1 (orig. descr.; holotype: ZIL42957, 31°08′S, 15°17′E, 1200-1520 m; 2 paratypes: 31°02′S, 2°56′E and 30°12′S, 3°14′E); Parin, Sazonov, and Mikhailin 1978: 174 (rec. 8°33′S, 12°35′E).

?Mentodus crassus Pakhorukov 1980: 23 (rec. 26°07′S, 5°51′E, with counts and meas.).

Diagnosis. Lateral line marked by neuromasts or papillae. Most scalepockets with 1-15 subcutaneous pores of 0.2-0.5 mm diameter. Cephalic lateral line canals well branched; lacrimal large, extending to posterior margin of eye. Head length 2.7-3.0 in SL; greatest body depth 4.3-4.6 in SL.

D 18-20, A 15-18, P1, 13-15, P_2 8-9, Br 8, GR7-8 + 19-21 (27-28), vertebrae 23-24 + 19 (42-43). U_1 centrum absent (or fused to PU_1. Largest record: 228 mm.

Distribution (Fig. 16). Published records are from the eastern half of the South Atlantic (8°-31°S). These samples were collected at depths 1060-1450 m. The MMSU material we examined is from 26°07′S, 5°51′E. The ISH material is from 14°11′N, 18°28′W and represents the only Northern Hemisphere record; it was collected at 2000 m.

Material examined. ISH202/74 (3); MMSU uncatalogued, *Kazdaz* sta. 23 (1).

TABLE 4 Comparison of Certain *Tragularius* Species

	perforates	*bythios* (holotype)	*crassus* (MMSU uncat.)	*crassus* (holotype)
Locality	Atlantic	Indian Ocean	E Pacific	E Pacific
Subcutaneous pores	1-15 (0.2-0.5 mm)	1-4 (0.1-0.15 mm)	1-2 (0.1-0.15 mm)	none?
Basihyal teeth	2-4	single	single	6 (medial row)
Basibranchial teeth	3-4	single	single	?
Lacrimal extends to:	posterior margin of eye	mideye	posterior 4th of eye	posterior 3rd of eye
Anal fin origin opposite dorsal ray	3rd-9th	about 5th	11th-12th	5th-6th
Cephalic lateral line canals	well branched	branched	nearly unbranched	unbranched?
Nasal rosette	6-10	5-6	5	damaged
SL (mm)	186-205	181	206	92
Distance between origins of ventral and anal fins in % SL	15	14	17	11
HL(%SL)	33	35	32	42
Body depth (% SL)	22-33	20	21	26
Snout	longer than eye	longer than eye	longer than eye	shorter than eye

Tragularius bythios n. sp.
(Fig. 24E)

Mentodus perforatus Sazonov 1978: 104, Fig. 2, Table 2 (counts and meas., spec. no. 5 only).

Diagnosis. Lateral line marked by neuromasts or papillae. Scalepockets with 0-4 subcutaneous pores of 0.1-0.15 mm diameter. Cephalic lateral line canals branched. Lacrimal extending back to mideye. Head length 2.8 in SL; greatest body depth 4.9 in SL.

D 19, A 17, P_1 15, P_2 8, Br 8, GR 8 + 19, vertebrae 24 + 19. U_1 centrum absent (or fused to PU_1).

Description. Counts and measurements of holotype are in Table 7. Body elongate, moderately deep (4.9 in SL), about 2.5 times least depth. Body width 2.2 in depth; however, specimen appears dehydrated. Dorsal margin not sharp, with little nonmuscular tissue. Caudal peduncle relatively long, its length twice its least depth. Pelvics inserted slightly behind midlength. Pectorals low on body, with rays directed backward. Dorsal origin behind midlength by about two-thirds of its basal length, opposite anus, and ahead of anal fin origin by about 5 rays. Dorsal base longer than that of anal. Cleithral symphysis ending in a blunt spine. Head large, 2.8 in SL. Eyes relatively small, 4.6 in HL, and below outline of frontals. Top of skull widest just behind eye, narrowing abruptly anteriorly to about a third of its width, then nearly straight over eye, but tapering gradually anteriorly. Posterior half of supraorbital nearly flat, medially grooved anteriorly. Supraorbital strongly attached, lateral to frontal, and slanted subhorizontally over anterior half of eye. Supraorbital attached ligamentously to elongate antorbital. Nasal sac appears to have been abraded and lost. Ant-orbital medially ribbed over posterior half. About 5-6 poorly preserved lamellae in nasal rosette. Snout long, 3.4 in HL.

Mouth large, maxilla extending half an eye length behind orbit. Part of upper jaw slipping under lacrimal, which extends to below mideye. Laminar extension of 2nd infraorbital not overlapping upper jaw; those of 3rd and 4th extending about half the distance to preopercle. Lacrimal the largest. Anterior supramaxilla longer than posterior supramaxilla by a third its length. Tendon from A_1, adductor mandibulae inserted on anterior supramaxilla. Premaxilla short, equal to about a third of maxilla and relatively deep and triangular. Spur-shaped process projecting posterodorsad but not completed across maxilla. Most premaxillary teeth and all tusks broken. Bases of 4 tusks on right and 3 on left remain, followed in series by 14 teeth on right and 13 on the left. Teeth in jaws uniserial; those on premaxilla largest and dentary smallest. Mid-dentary teeth present, 5 on right and 4 (one with base only) on left. Vomer with 2 teeth, tooth on each palatine and a row of strong teeth on mesopterygoid (15 on right and 13 on left). A single medial tooth on narrow toothplate of basihyal, and a single tooth on basibranchial. Small teeth on 4th epibranchial and 5th ceratobranchial and upper pharyngeals of 2nd-4th arches.

Lower margin of opercle curved downward from anterior margin to posterior border, resulting in a opercle one-third wider at posterior border than at middle; posterior border twice depth of subopercle. Upper 3 branchiostegal rays close set, with the dorsalmost about half as deep as subopercle. There are 4 flattened branchiostegal rays on epihyal and 4 acinaciform rays of ceratohyal. Dorsal margin of gill opening level with top of eye. Exposed tube of shoulder organ about 10 scale rows below top of gill opening.

Gill filaments poorly developed, with bases united. Outer row at angle of 1st arch absent. Medial gillrakers lacking on ceratobranchial of 1st and 2nd arches, with 3 small rakers on hypobranchial of 1st and 2nd arches, 2 on epibranchial of 1st arch, and 5 on 2nd; 3rd and 4th arches with complete row of medial gillrakers (as in all platytroctids).

Scales abraded and lost on right side, only a few remaining on left side. Scale counts based on scalepockets, 82 along midline. Lateral line without a canal or modified scales and appears to be marked by papillae and neuromasts, as indicated by a few seen on midline. Most scalepockets with 4 or fewer small pores (0.1-0.15 mm diameter). No canals in posttemporal bone or supracleithrum. Cephalic lateral line canals well developed and branched. Condition of the specimen cannot reveal whether the supratemporal canal is complete and whether it intersects the supraorbital canal.

Photophores absent. White tissue around orbit.

Remarks. The 5 individuals reported from the Indo-West Pacific by Sazonov (1978) as *perforatus* belong to undescribed forms. In Table 2 of that publication, specimen no. 5 appears to be the individual we examined and designate here as the holotype of *T. bythios.* It shows small but clear differences (see our Table 4) from *perforatus.* Sazonov reported a lateral line canal in specimen nos. 1,4,6, and 7, and they may be *T. mesalirus.*

Derivation of name. From the Greek *bythios*, of the deep, in reference to the habitat of platytroctids.

Distribution (Fig. 16). Holotype from the Indian Ocean. We have examined 3 juveniles (51-70 mm SL) that are apparently of this species from the Indian Ocean (SIO61-31, 11°57′S, 115°22′E) and the western Pacific (SIO61-46, 34°01′S, 161°49′W; SIO70-336, 18°49′N, 124°22′W).

Material examined. Holotype IOAN uncat., 181 mm SL, *Zvezda Kryma*, 6th cruise, sta. 137, 31°33.2′S, 95°40′E, in a bottom trawl sampling at 1420 m depth on September 19, 1976. Other material probably of this species: SIO61-31, 1 (51 mm); SIO61-46, 1 (70 mm); SIO70-336, 1(52 mm).

Tragularius crassus (Parr 1960)
(Fig. 24D)

Mentodus crassus Parr 1960: 89-90, Fig. 62 (orig. descr.; holotype: ZMUC P1748,6°40′N, 80°47′W, ca. 2250 m); Parin et al. 1973: 78 (counts and meas. of spec, from 12°20′S, 81°43′W); Sazonov 1976b: 69, Fig. 16b, 17 (taxonomy, 2 new rec. off Peru); Sazonov and Trunov 1978: Table 1 (counts and meas. of 2 spec, from Sazonov 1976b in compar. table).

Diagnosis. Dorsal ahead of anal by one-third of its length. Lateral line marked by neuromasts or papillae. Few scalepockets may have 1-2 subcutaneous pores of about 0.15 mm diameter (but not found in holotype). Cephalic lateral line canals unbranched or little branched. Lacrimal extending to below posterior fourth or third of eye. Head length 3.0 (2.4 in holotype) in SL; greatest body depth 4.7 (3.8 in holotype) in SL.

D 19 (17), A 15 (15), P_1 16 (16), P_2 8 (8), Br 8 (8), GR 8 + 20 (27), vertebrae 24 + 18. U_1 centrum absent (or fused). Counts of holotype in parentheses. Largest record: 245 mm.

Remarks. It cannot be stated with certainty that any material referred to this species subsequent to the original description is conspecific with the holotype. Proportions of head length, snout length, and body depth of holotype differ from those of individuals assigned to *crassus* by Parin et al. (1973) and by Sazonov and Trunov (1978). This is probably because of the much smaller size of the holotype. The absence of subcutaneous pores and white tissue around the eye, and the relatively small mouth and supraorbital of the holotype, are probably also related to its smaller size. However, it also has the pelvic and anal fins closer together, and the dorsal fin origin does not lead that of the anal as much as in the specimen of Sazonov and Trunov (1978) we examined (Fig. 24D and Table 4). Clearly the solution of this problem awaits the availability of more material with a wider size range.

Distribution (Fig. 16). Holotype from the eastern tropical Pacific, off Colombia. Samples of Parin et al. (1973) and of Sazonov and Trunov (1978) were collected off Peru.

Material examined. ZMUC P1748 (holotype; counts shown above are from Parr (1960); ZMSU uncat., *Professor Mesiatsev,* 1st cruise, sta. 344, (1).

Tragularius mesalirus n. sp.

(Fig. 24B)

?Pellisolus perforatus Sazonov 1978: Table 2 (compar., counts and meas., spec. nos. 1,4, 6, 7 only).

Diagnosis. Lateral line with a canal and modified scales. Scalepockets with as many as 20 subcutaneous pores; maximum size of pores 0.25 mm. Cephalic lateral line canals well branched. Lacrimal extending back to mideye. Head length 2.6-3.0 in SL. Snout (2.8-3.8 in HL) longer than eye length. Top of gill opening level with top of eye. Greatest body depth 4.6-5.0 in SL.

D 18-20, A 16-19, P_1 15-19, P_2 7-8, Br 8, GR 7-8 + 19-22 (27-28), vertebrae 22-24 + 18-20 (42-43). U_1 centrum absent (or fused).

Description. Counts and measurements of holotype and paratypes are in Table 7. The description is of the holotype, and the paratypes agree unless noted. Body elongate, moderately deep (4.6 in SL), about 2.5 times least depth at caudal peduncle and twice greatest body width at shoulder. Dorsal margin not sharp, with little nonmuscular tissue. Pectorals low on body, with rays directed backward. Cleithral symphysis ending in a blunt spine. Pelvies inserted just behind midlength. Dorsal origin behind midlength by about half basal length of dorsal. Anal and dorsal fins subequal, with dorsal slightly ahead (4 rays). Anus opposite dorsal origin.

Head large, 3 in SL (2.6-2.8 paratypes). Eyes small, 6.8 in HL (4.8-5.6 paratypes), and below outline of frontals. Frontals expanded behind, narrowing rapidly anterior to the posterior margin of eye, then narrowing more gradually over eye, with width at anterior margin of eye three-fourths that at the posterior margin. Interorbital width about twice eye length at posterior margin of eye and about one and one-half times as long at anterior margin. Supraorbital lateral to frontals and slanted subhorizontally over anterior half of eye. Medially grooved, it is nearly tubular at anterior end. About half of its length before eye is separate from frontal, extending anteriorly to dorsal tip of antorbital, which is also tubular and joined to it by ligaments. Antorbital along posterior border of posterior naris and bordering lacrimal, to which it is loosely attached by tissue. Snout 3.8 (3.4-3.8 paratypes) in HL and longer than eye length, with nasal sac about at its midlength. Nasal rosette with 11 lamellae on left side and 9 on right.

Mouth large, maxilla ending about an eye length behind orbit. Part of upper jaw slipping under lacrimal, which extends posteriorly to below mideye. The 2nd infraorbital with well-ossified laminar extension, but not overlapping upper jaw. Laminar extension of 3rd and 4th infraorbitals extending less than half the distance to preopercle. Anterior supramaxilla longer than posterior supramaxilla and divided into 2 parts. Tendon from A_1 of adductor mandibulae inserted on anterior supramaxilla, then continues onto maxilla. Only right premaxilla remains. Premaxilla short, about one-fourth length of maxilla, and relatively deep and triangular in shape. A spur-shaped process projecting posterodorsally but not completely across maxilla. Only bases of premaxillary tusks and teeth remain on right side of holotype. Bases of 13 teeth in regular row in series with that of tusks. In 222 mm paratype, innermost tooth an anteriorly directed tusk, followed by 2 other similar-sized tusks that are progressively more laterally and subvertically directed. In that specimen, teeth in jaw uniserial, those of premaxilla the largest and dentary smallest. Mid-dentary teeth broken on holotype, but bases of 6 on left and 6 on right remain. Vomer with 2 teeth, 1 tooth on right palatine (1 on left in paratype), and a single row of teeth on mesopterygoid. Basihyal and basibranchial edentulous in holotype, but paratype, ISH 3244/71, with 2 teeth in a medial row on narrow basihyal tooth plate, and ISH 3246/71 with several basibranchial teeth. Small cluster of short dentition on 4th epibranchial, 5th ceratobranchial, and upper pharyngeals of 2nd-4th arches.

Lower margin of opercles curving downward from anterior end to posterior border, resulting in a opercle one-third wider at posterior border than at middle; posterior border of opercle twice width of subopercle. Upper 3 branchiostegal rays close set, with the dorsal-most about a third as wide as subopercle. There are 4 flattened branchiostegal rays laterally on epihyal and 4 acinaciform rays ventrally on ceratohyal. Dorsal margin of gill opening level with top of eye. Exposed tube of shoulder organ slightly above midline and about 10 scale rows below top of gill opening. Gill filaments poorly developed, with bases united. Outer row at angle of 1st arch absent. Medial gillrakers absent on ceratobranchial of 1st and 2nd arches, with 7-8 on epibranchial and 5 on hypobranchial.

Lateral line with 47 modified scales (right side) plus 1 tubular scale on caudal rays. Body scales small, 85 in longitudinal count (97 in one paratype). Scalepockets with pores, those on anterior part of body and near ventral and dorsal margins with highest number of pores, as many as 20 over the nape. No subcutaneous canal through posttemporal bone. Cephalic lateral line canals complete, with numerous small branches. Cephalic lateralis canal mostly of semiclosed ossicles and crossing supracleithrum in soft tissue before joining body lateralis. No cephalic lateralis canal through posttemporal and supracleithrum. Supraorbital canal extending from nasal bone above the anterior naris to supratemporal canal but, due to abraded condition, it cannot be determined whether they intersect.

Photophores absent. White tissue around orbit.

Remarks. A 70 mm SL specimen (SIO68-486) from the central N Pacific (27°57′N, 177°53′W) agrees with *T. mesalirus* in having modified lateral line scales and the premaxillary teeth in series with the tusks, and in lacking photophores. The lateral margins of the frontals are straight over the eyes. Sazonov (1978) reported 4 specimens of *"Mentodus perforatus"* that differ from other *M. perforatus* in having a lateral line canal (no mention was made of modified scales). It seems possible that these may be *T. mesalirus.* These samples were collected at 33°08′S, 34°58′E; 8°43′S, 60°23′E; and 5°09′S, 146°06′E.

Derivation of name: From the Latin *mesa*, middle, and *lira*, ridge, in allusion to the ridging of the lateral line by modified scales.

Distribution (Fig. 16). In the Atlantic from 7°N, 20°W (holotype) to 27°S, 3°E. Bathypelagic. Possibly also in Indian and Pacific oceans (see Remarks).

Material examined. Holotype: ISH2488/71, 205 mm SL, *Walter Herwig* sta. 486/71 at 7°32′N, 20°54′W, in a 1600 Engel trawl at 1300 m depth on April 4, 1971. Paratypes: ISH3244/71, 147 mm SL, *Walter Herwig* sta. 435/71 at 27°14′S, 2°56′E, 2660-0 m; ISH3246/71, 222 mm SL, *Walter Herwig* sta. 443/71 at 21°35′S, 2°00′W, 2000-2100 m.

Pellisolus Parr 1951

Pellisolus Parr 1951: 18, 19, type species: *Pellisolus facilis* Parr 1951, by original designation.

Generic diagnosis. Body elongate, shallow to moderately shallow, and relatively wide anteriorly. Dorsal margin rounded, with little or no nonmuscular tissue along dorsal margin. Cleithral symphysis either ending in a spine (*longirostris*) or not (*eubranchus and facilis*). Photophores absent. White tissue weakly developed on dorsal border of orbit. Lateral line marked by papillae and without a canal and modified scales. Posttemporal and supracleithrum not pierced by a canal. Cephalic lateral line canals interrupted and without side branches. Cephalic lateralis and supratemporal canals absent. Upper jaw either free for its entire length or partly overlapped by lacrimal. Posterior margin of upper jaw from below posterior margin of pupil to behind eye. Innermost tooth of premaxilla an anteriorly directed tusk; as many as 3 other tusks directed more ventrolaterally in a radial pattern (*longirostris*), none parallel. Teeth nearest tusks subhorizontal and in series with tusks; 6-8 teeth in main row of premaxilla. Mid-dentary teeth present in small individuals, absent in large individuals. No maxillo-mandibular ligament across dentary. Frontals widest behind eye, tapering anteriorly, nearly straight over eye. Supraorbital lateral to frontals from mideye anteriorly (membranous in *facilis* and *eubranchus*). Subcutaneous pores missing from most scalepockets. P_2 6-9, vertebrae 41-44. U_1 centrum (fused or) absent.

Generic description. Body elongate, moderately compressed and shallow (greatest depth 4.4-5.6 in SL), with little taper. A shallow band of nonmuscular tissue along dorsal margin. Ventral fin origin at body midlength or slightly behind midlength. Dorsal origin behind body midlength by about its basal length and ahead of anal origin by about one-fourth the basal length of dorsal. Anus opposite dorsal origin to opposite 6th dorsal ray. Dorsal base equal to or longer than that of anal. Cleithral symphysis normal or ending in a spine. Gill opening about level with mideye to near top of eye. Exposed tube of shoulder organ short, and located above the ventral tip of supracleithrum.

Frontals narrow, sides nearly parallel from posterior margin of eye anteriorly, and widening behind eye. Eye large (9-14% SL), included in head outline and anterodorsally directed. Supraorbital over anterior half to third of eye (membranous in *eubranchus and facilis*). Antorbital nearly articulating with supraorbital and joined by ligaments in *longirostris*, reduced and nearly free in others. Nasal sac with 1-8 lamellae in rosette.

Maxilla ending from posterior margin of pupil to behind posterior margin of eye. Anterior supramaxilla longer than posterior supramaxilla. Tendon of the A_1 of adductor mandibulae inserted on the anterior supramaxilla (in *facilis* and *eubranchus* the tendon then continues onto the maxilla). Innermost tooth on each premaxilla enlarged and forward-directed. A 2nd, more laterally directed tusk that is not parallel to 1st may also be present; in *longirostris*, as many as 4 in a radial pattern. Main row of premaxillary teeth in series with tusks, about 6-8 well-spaced teeth. A single row of teeth on premaxilla, maxilla, and dentary; those on premaxilla the largest, and on dentary the smallest. Vomer with 2 teeth.

Palatines usually edentulous, toothed in some smaller individuals, occasionally in larger ones. Similarly, mid-dentary teeth tend to be present in smaller individuals only. Basibranchial and basihyal teeth usually absent; when present, basihyal with a single medial tooth. Single row of mesopterygoid teeth present in *longirostris*, absent in others. Small teeth on 4th epibranchial, 5th ceratobranchial, and 3rd and 4th (also on 2nd in *longirostris*) upper pharyngeals.

Lower margin of opercle curving downward over anterior half but nearly horizontal posteriorly, resulting in an opercle that is only about a fourth wider at its posterior margin than at middle. Subopercle about a third as deep as opercle, and the dorsalmost branchiostegal ray about half as deep as subopercle. Usually 4 partly flattened branchiostegal rays laterally on epihyal; 4 acinaciform rays ventrally on ceratohyal. Last 3 branchiostegals on epihyal relatively close set.

Lateral line marked by black papillae, without a canal and modified scales. Scales large, 47-75 in midlateral series. Only a few anterior scalepockets with pores, and these are single and minute. Cephalic lateral line canals without any side branches. Supratemporal and cephalic lateralis canals absent. All or part of preoperculomandibular canals absent. Infraorbital bones either with or without small laminar flanges, lacrimal largest and extending as far back as mideye or posterior margin of pupil. Posttemporal and supracleithrum not pierced by a canal.

Photophores absent. Trace of white tissue around dorsal half of eye. No pits behind supracleithrum. P_2 6-9.

Pellisolus facilis Parr 1951
(Fig. 25D)

Pellisolus facilis Parr 1951:18, 19 (orig. descr.; holotype: ZMUC P1764, 6°48′N, 80°33′W, ca. 1800 m); Grey 1956:118 (listed); Parr 1960: 96-97, Figs. 67-68 (descr., ill. of holotype); Bussing 1965: 193 (descr. 2 spec, from 7°45′S, 81°23′W); Chirichigno 1969: 25 (listed); Parin et al. 1973: 78 (5 rec. eastern S Pacific between 5°-23°S, 71°-90°′W); Becker, Shcherbachev, and Tchuvasov 1975:291-292, Table 1 (counts and meas. of 2 spec, from 14°12′N, 66°45′W and 23°50′N, 91°36′W; 74 mm spec, compared in table with holotype and with spec, of Bussing 1965); Sazonov 1976b: 69, Figs. 17, 18a (taxonomy; new rec. in distr. chart from eastern Pacific, Indian Ocean, W Indies, and Gulf of Mexico); Krefft 1976: Fig. 12 (in distr. chart, new rec. from 11 sta. in Atlantic from approx. 21°S-27°N, 3°-32°W).

Diagnosis. No preoperculomandibular or postocular canals. Infraorbital canal restricted to lacrimal and the ventral margin of eye. Supraorbital canal extending from just in front of eye to just behind eye. Snout short, about half to three-fourths eye length. Nasal sac nearly bordering maxilla. Premaxillary tusks usually 2 and only slightly larger than other teeth. No teeth on mesopterygoid and on upper pharyngeals of 2nd arch. Gill filaments poorly developed, outer row at angle of 1st arch lacking. Bases of filaments united by membrane whose width at angle of 1st arch equals twice the length of filaments. Scales 47-58 in midlateral series. Dorsal margin of gill opening ranging from opposite opening of shoulder organ to a scale row above it (about level with mideye). Eyes large, 12-13% SL, bulging beyond lateral margin of the widest part of skull at sphenotic. Cleithral symphysis normal, not ending in a spine.

D 16-19, A 14-18, P_1 18-20, P_2 7-8, Br 6-8, Gr 5-6 + 16-18 (21-24), vertebrae 22-23 + 19-21 (41-44). Largest record: 130 mm.

Distribution(Fig. 16). Circumtropical, generally equatorial. Single records from the South China Sea (SIO69-20) and the Banda Sea (SIO77-40), and 2 recorded from the Indian Ocean between 4-5°S (Sazonov 1976b). In the eastern Pacific from 6°48′N, 80°33′W (holotype) to 23°30′S, 71°19′W (Parin et al. 1973) near the continent, extending westward at the equator to 140°W (SIO60-236). In the western side of the Atlantic Becker et al. (1975) reported 1 specimen from the West Indies and another from the Gulf of Mexico. In the eastern half of the Atlantic, Krefft's (1976) distribution chart indicates their presence from about 21°S to 27°N.

Material examined. SIO52-328 (1), SIO60-225 (1), SIO60-235 (1), SIO60-236 (1), SIO63-560 (1), SIO69-20 (1), SIO72-193 (1), SIO77-40 (1). The largest specimen examined measured 100 mm SL, and 6 are larger than 50 mm SL.

Pellisolus eubranchus n. sp.
(Fig. 25E)

Pellisolus facilis (not of Parr 1951) Lavenberg 1964:63-64 (distr.); Berry and Perkins 1966: 637, Fig. 6d (rec, 1 spec, 30°28.8′N, 124°06.6′W); Brewer 1973: 17 (rec. from 7 sta. in Gulf of California and W coast of Mexico); Hubbs, Follett, and Dempster 1979: 9 (checklist).

Diagnosis. No preoperculomandibular or postocular canals. Infraorbital canal restricted to lacrimal and ventral margin of eye. Supraorbital canal extending from just in front of eye to just behind eye. Snout short, about half to three-fourths eye length. Nasal sac nearly bordering maxilla. Premaxillary tusk single and slightly larger than other teeth. No teeth on mesopterygoid and on upper pharyngeals of 2nd arch. Gill filaments relatively well developed for a platytroctid, outer row at angle of 1st arch 0.5-1.2% SL. Bases of filaments united by membrane, which at angle of 1 st arch is one-third to one-fourth the length of inner filaments. Scales 56-62 in midlateral series. Dorsal margin of gill opening 1-3 (usually 2) scale rows above the opening of shoulder organ (about level with mideye). Eye large, 11% SL at about 100 mm SL, its lateral bulge usually about in line with the widest part of skull at sphenotic or barely beyond it. Cleithral symphysis normal, not ending in a spine.

D 17-19, A 15-16, P_1 18-21, P_2 6-8, Br 6-8, GR 5-6 + 17-18 (22-24), vertebrae 20-23 + 20-22 (42-44).

Description. Counts and measurements of holotype and paratypes are in Table 7. The description is of the holotype, and paratypes agree except as noted. Proportional differences due to negative allometry of head and anterior body parts can be expected in smaller paratypes. Body shallow (4.8 in SL), nearly round anteriorly with a short snout that is slightly greater than half an eye length. Body deepest and widest at shoulder, gradually tapering posteriorly and becoming more compressed. Least depth at caudal peduncle slightly less than half of greatest depth. Nonmuscular tissue about 2 scale rows deep along dorsal profile from nape to dorsal origin. Pelvic insertion about at midlength. Dorsal origin behind midlength by about its basal length and ahead of that of anal fin by about 4-5 rays. Anus slightly ahead of dorsal origin. Posterior margin of dorsal and anal fins opposite, dorsal base slightly longer than anal. Pectorals small and low on body, directed upward.

Head small, 3.4 in SL (2.8 in paratypes). Snout much shorter than eye length. Mouth small, with maxilla extending to the posterior margin of pupil. Premaxilla, maxilla, and anterior part of dentary shallow, half as deep as supramaxillae. Maxillo-mandibular ligament weakly developed, extending anteriorly nearly to the middle of dentary tooth row. Anterior supramaxilla longer than posterior. Tendon from adductor mandibulae inserting on anterior supramaxilla and running from there onto maxilla.

Dentition weak. Innermost tooth of premaxilla slightly enlarged and horizontally directed. Anterior teeth of main tooth row subhorizontal, with tusk in series with tooth row. About 6 teeth on left premaxilla (teeth missing on right side). Maxillary teeth smaller than those on premaxilla and those of dentary the smallest, all uniserial. Most maxillary and dentary teeth lost. Vomer with 2 relatively closely spaced teeth. A single mid-dentary tooth on left side. Teeth absent on mesopterygoid, ectopterygoid, basibranchial, and basihyal.

Ventral margin of opercle nearly horizontal over posterior half. Opercle about 2.5 times deeper than subopercle and 8.5 times deeper than dorsalmost branchiostegal ray. There are 4 partly flattened branchiostegal rays laterally on epihyal, with the upper 3 rays relatively close-set but not overlapping; 4 acinaciform rays ventrally on ceratohyal. Dorsal margin of gill opening level with mideye and even with a line 2 scale rows above the exposed tube of shoulder organ, which is just dorsal to the ventral tip of supracleithrum. Gill filaments relatively well developed, outer row present (shortest filament 0.52% SL) at angle of 1st arch. Bases of filaments united for about a fourth the length of exposed filaments. Medial gillrakers absent on ceratobranchial of 1st and 2nd arches. Hypobranchial and epibranchial of 1st arch with single stubs, and those of 2nd with 3 stubs.

Scales large, with considerable overlapping (about 60%) and deciduous; about 62 in midlateral series. Scalepockets deep and without pores, except for a few anterior ones with single minute pores. Lateral line marked by papillae, without a canal and modified scales. Anteriormost row of scales on nape in line with preopercle. Head and opercles scaleless.

Cephalic lateral line canals poorly developed, none complete. Supraorbital canal extending from just anterior to eye to just behind eye. Supratemporal, postocular commissure, preoperculomandibular, and cephalic lateralis canals absent. Infraorbital canal extending from lacrimal to 3rd infraorbital bone, which extends to the posterior margin of eye. The 2nd and 3rd infraorbital bones of tubular ossicles only, no laminar portion. Anterior part of upper jaw partly overlapped (when mouth is closed) by lacrimal, which extends posteriorly to slightly behind mideye. Nasal sac nearly bordering maxilla, only a single lamella in rosette.

U_1 centrum absent (or fused to PU_1). Photophores absent. No white tissue surrounding orbit.

Remarks. We have examined 2 *eubranchus*-like specimens that are sufficiently different that we choose not to refer them to the species. They probably represent 2 different species. SIO78-196 (105 mm SL) was collected at 30°45′N, 120°40′W in an area where *eubranchus* has been taken. Its eyes are smaller (10% SL) and, in distinction to any known *Pellisolus*, are below the head outline. The gill filaments are about half the size (outer row present at angle of 1st arch) of those of *eubranchus*, and the scales are much smaller, although the scale count is only slightly higher (65). This apparent discrepancy is probably accounted for by the reduced imbrication of the scales in SIO78-196 (about 40%) compared to *eubranchus* (about 60%). There are also 5-6 small mid-dentary teeth on each side, which would be high for a specimen of *P. eubranchus* of this size.

An 83-mm SL specimen taken at *Galathea* sta. 235 (4°47′S, 46°19′E) is similar to SIO78-196 in the development of the gill filaments. The scales are lost, but scalepocket counts indicate about 60 in midlateral series. Unfortunately the eyes have been removed. In both specimens the gill opening appears to be much higher than in *P. eubranchusy*, but there are only 2 scale rows from the top of gill opening to the exposed tube of shoulder organ. The *Galathea* specimen was collected in equatorial waters where *facilis*, occurs, but in the greater development of gill filaments, higher scale counts, and higher position of gill opening, it differs from *facilis* and is more like *eubranchus*, of which we only have material from the central and eastern North Pacific.

Derivation of name. From the Greek *eu*, good, and *branchos*, gill, in reference to the relatively long gill filaments.

Distribution (Fig. 16). In the eastern Pacific, the northernmost record is from off central California at 35°15.5′N, 122°16.5′W (SIO67-101), southward and into the Gulf of California, with the southernmost record in the low-oxygen water off the W coast of Mexico at 17°01′N, 102°07′W (Brewer 1973). One record from the central North Pacific taken over a seamount at 28°43′N, 177°52.5′W (SIO68-492) in an IKMT. All were taken in nets at depths extending below 1000 m.

Material examined. Holotype: SIO64-39, 28°25.0′N, 118°11.5′W, 111 mm SL, taken in a 3-m IKMT with 5500 m wire out on February 11, 1964. Paratypes: SIO59-200, 25°15′N, 109°50.5′W, 48 mm SL; SIO67-101, 35°29.5′N, 122°37.6′W, 62 mm SL. Other material examined: SIO60-287,1 (114 mm SL) stained; SIO66-422,1 (20 mm SL); SIO67-49,1 (44 mm SL) damaged; SIO68-492, 1(58 mm SL).

Pellisolus longirostris Sazonov and Golovan 1976

(Fig. 25C)

Pellisolus longirostris Sazonov and Golovan 1976: 9-10, Fig. 2 (orig. descr.; holotype: ZIL42296,12°00′N, 17°32′W, in a bottom trawl, 1300-1400 m); Golovan 1976:301 (counts of holotype); Sazonov 1976b: 69, Figs. 17, 18b (taxonomy); Golovan 1978: 210 (distr.).

Diagnosis. Preoperculomandibular canal present, interrupted at dorsal end and not intersecting the postocular commissure. Infraorbital canal complete and intersecting postocular commissure. Supraorbital canal extending forward to about nasal sac. Snout relatively long, equal to or slightly shorter than eye. Nasal sac at about midlength of snout. Innermost premaxillary tusk forward-directed, much larger than other teeth and followed by 2-3 tusks that are more laterally directed in a radial pattern. Single row of teeth in mesopterygoid. Small teeth on upper pharyngeal of 2nd arch. Gill filament poorly developed, anterior row at angle of 1st arch barely present. Base of filaments united by membrane, whose width at angle of 1st arch is twice that of gill filament length. Scales about 73-75 in midlateral series. Dorsal margin of gill opening nearly on a level with top of eye and about 5 scale rows above the opening of shoulder organ. Eye about 9% SL at 191-194 mm SL, its lateral bulge not extending beyond widest part of skull at sphenotic. Cleithral symphysis ending in a blunt spine.

In the following data, numbers in parentheses are those of the holotype (from Sazonov and Golovan 1976). D18 (17), A15-16 (15), $P_1$16 (15-16), $P_2$8-9 (8), Br8, GR 7-8 + 21 = 26-28 (8 + 21), vertebrae 24-25 + 19-20 = 44.

Remarks. We have an 81-mm individual collected at 31°01′N, 155°04.4′W in the central North Pacific that may be referable to this species, but because of its small size and damaged condition we have not included it in our diagnosis. It has the following meristics: D 20, A 17, P_1 20, P_2 7, Br 9/8, GR 8 + 19, vertebrae 25 + 21. Largest record: 194 mm.

Distribution (Fig. 16). Eastern tropical Atlantic. ISH1517/71 was collected at 15°45′S, 6°06′W, holotype from 12°00′N, 17°32′W.

Material examined. ISH1517/71, 2 (191-194 mm).

Maulisia Parr 1960

Maulisia Parr 1960:81-82, type species: *Maulisia mauli* Parr 1960, by original designation.

Generic diagnosis. Body deep and compressed. Dorsal margin relatively narrow, with some nonmuscular tissue along it. Cleithral symphysis ending in a blunt spine. Photophores present or absent; when present, THO either round or a transverse bar, only IVO present in young. A thick patch of white tissue around border of orbit from 2nd to 6th infraorbitals, with lesser amount around remainder of eye except the anteroventral quadrant at front of eye, where it is absent or nearly absent. Lateral line either in a canal lined by about 50 modified scales or without a canal and marked by papillae or neuromasts. Posttemporal and supracleithrum not pierced by a canal (except in *microlepis*, in which the cephalic lateralis canal passes through the supracleithrum). Cephalic lateral line canals complete and moderate to well branched. A portion of upper jaw overlapped by lacrimal (slight overlap also by 2nd infraorbital in *argipalla* and some individuals of *mauli*). Laminar flange of infraorbitals extending less than half the distance to preopercle; lacrimal the largest. Mouth large, maxilla extending well behind eye (just behind eye in small holotype of *isaacsi*). Inner tooth of premaxilla enlarged as an anteriorly directed tusk, followed by a 2nd more laterally and subhorizontally directed tusk; another tooth may also be enlarged into a tusk. Innermost tusks widely spaced with wide edentulous space, so that teeth in main row are lateral, those nearest tusks somewhat enlarged and subhorizontal and in series with tusks. Mid-dentary teeth present in young, usually absent in larger individuals. Frontals expanded laterally, top of head diamond-shaped, widest over eye, narrowing anteriorly and posteriorly. A large supraorbital slanting subhorizontally anterior to widest point of head.

Subgenus Maulisia Parr 1960

Maulisia Parr 1960: 81-82, type species *Maulisia mauli* Parr 1960.

Subgeneric diagnosis. Photophores present. A large cavity several scale rows wide behind supracleithrum (shoulder pit). Lateral line marked by papillae or neuromasts and without a canal and modified scales. About 4-8 teeth in premaxilla behind tusks. Body moderately compressed and deep (3.5-4 in SL) with relatively short snout (3.8-4.8 in HL). Gillrakers 23-26, P_2 7-8. U_1 usually present, occasionally absent.

Subgeneric description. Body deep (3.5-4 in SL) and compressed, width about 2.5 in greatest depth. Dorsal margin narrow, with a thin layer of nonmuscular tissue. Ventral body wall considerably thickened. Ventral surface of body narrowly flattened. Pelvies slightly behind midlength. Dorsal origin behind midlength by about its basal length to slightly more, and ahead of that of anal by one-fourth to one-third basal length; dorsal base slightly longer than that of anal.

Head large, about 3 in SL. Frontals narrow anteriorly, then expanding, so that the widest point of the head is just behind mideye, then narrowing again; the widest point is a sharp angle, so that the skull is diamond-shaped when viewed from above. Supraorbital is large, extending anteriorly from widest point of frontals, angling down and out over eye and joined anteriorly to a rod-shaped antorbital. Antorbital also bordering lacrimal and connected to both it and supraorbital by ligaments. Nasal rosette with 8-11 lamellae. Snout 3.8-4.8 in HL and longer than eye. Mouth large, extending some distance behind eye. Anterior supra-maxilla longer than posterior supramaxilla. Lacrimal overlapping part of upper jaw and extending posteriorly to anterior fourth to third of eye. Second infraorbital of *argipalla* and some *mauli* also overlapping part of the upper jaw. Laminar flange of 3rd and 4th infraorbitals extending less than half the distance to preopercle.

Innermost tooth of premaxilla enlarged into a forward-directed tusk. Usually 1 or more (as many as 3) tusks present lateral to 1st, but none parallel to each other. Teeth nearest tusks slightly enlarged and subhorizontal and in series with tusks. Premaxilla triangular, with 4-8 widely spaced teeth. The inner tusk of one side widely separated from that of the other, so that there is a broad edentulous space. Smaller teeth of upper jaw only along lateral border. A short outer tooth row on mid-dentary present in young, usually absent in larger individuals. Vomer with 2 closely spaced teeth. Palatine either with a single tooth or none. Basibranchials and basihyal with or without teeth. Mesopterygoid with a single row of teeth. Small teeth on the 4th epibranchial, the 5th ceratobranchial, and the upper pharyngeal of 2nd-4th arches.

Lower margin of opercle curving downward from anterior end, then running horizontally for a short distance, resulting in a opercle that is usually much deeper posteriorly than at middle. Subopercle about a third as deep as opercle and somewhat wider than posteriormost branchiostegal ray. There are 4 flattened branchiostegal rays laterally on epihyal; last 3 branchiostegal rays close-set, wide, and overlapping; 4 acinaciform rays ventrally on ceratohyal. Dorsal margin of gill opening level with top of eye. Exposed tube of shoulder organ short, less than a fifth of eye, and located level with the ventral tip of supracleithrum and over an eye length below top of gill opening. Cleithral symphysis produced as a blunt spine.

Photophores weakly developed and generally ventral. A small IVO in young, disappearing by 100 mm SL. GO_1 and BRO weakly developed. Other photophores present are: round or transverse THO, round MVO, PO, SVO, PAO, SAO, and ICO. White tissue around posterior border of eye on 2nd or 3rd-5th infraorbitals.

Scales small, 80-95 along midline. Lateral line marked by papillae anteriorly, or neuromasts posteriorly, or unmarked; without lateral line canal or modified scales. There are 1 to several subcutaneous pores (0.1-0.8 mm) in most scalepockets. Cephalic lateral line canals complete and well branched. Supratemporal canal complete, intersected in some individuals by supraorbital canal. Cephalic lateralis canal in an ossified tubule to the supracleithrum, without passing through posttemporal and supracleithral bones. Subcutaneous canal not passing through posttemporal bone. P_2 7-8.

Maulisia (Maulisia) mauli Parr 1960
(Fig.26A)

?Holtbyrnia (Mentodus) polycaeca (not of Parr 1937) Parr 1951: 16 (in key).

?Searsia polycaeca (not of Parr 1937) Tucker 1954: 204-206, Table 2 (descr., *Discovery* sta. 2074 only, in compar. table); Grey 1956: 118 (distr., eastern Atlantic rec. only).

Maulisia mauli Parr 1960: 82-86, Figs. 56-60 (in part: orig. descr., MMF9594, from stomach of *Aphanopus carbo*, Madeira; 2 rec. from Dana coll.); Krefft 1973: 96-97 (syn., in part); Matsui and Rosenblatt 1979: 63-65, Figs. 1, 2a, 3a-b (descr., distr., syn.).

?Maulisia mauli de Groot and Nijssen 1971: 6 (listed, rec. 27°48′N, 15°12′W); Jonsson 1973; 219 (rec. from 62°56′N, 22°02′W); Golovan 1976: 300 (descr., spec, from 22°30′N off the W coast of Africa); Sazonov 1976b: 69, Fig. 19a, 20 (taxonomy, compiled distr.); 1978: 106 (rec. 4 spec, from 2 loc. in Indian Ocean); Quéro 1978: 20 (descr. 4 spec, from 26°05′N, 15°53′W); Sazonov and Trunov 1978: 95 (descr. 3 spec, from 3 loc. off SW Africa); Parin, Sazonov, and Mikhailin 1978:. 174 (rec. 10°46′S, 13°13′E); Golovan 1978: 209 (distr.); Gushchin and Kukuev 1980: 37 (rec. 49°50′N, 29°33′W).

Diagnosis. Top of head widest at frontals, lateral margins usually notched just anterior to widest point of head. Posterior border of maxilla a short distance behind eye, half an eye length or more before preopercular margin. Infraorbital canal running along lacrimal about a canal diameter or more dorsad to its ventral margin. Medial row of gillrakers on ceratobranchial of 2nd arch complete or with a few absent. Pelvic base and anus separated by approximately 14-16 scale rows. Anus opposite 4th-8th dorsal ray. THO photophore a transverse bar. White tissue on infraorbitals around the posterior border of the orbit, then extending anteriorly around the ventral margin along the posterior third of eye.

D 17-21, A 15-18, P_1 17-19, $P_2$7-8, Br8, GR7-8 + 15-18 (23-26), vertebrae 24 + 19-21 (43-45), scales 79-95. Largest record: 250 mm.

Distribution (Fig. 17). The holotype is from Madeira. We have examined specimens from 12°07′N, 23°08′W (ISH591/68) and 32°47′N, 16°24′W (ISH3003/71). Other records from the eastern North Atlantic range from 8°26′N, 15°11′W (Parr 1960) to 62°56′N, 22°02′W (Jonsson 1973); however, it is uncertain whether some of these are actually *M. mauli*. Sazonov and Trunov (1978) reported 3 records from the South Atlantic (23°18′S, 12°42′E; 25°39′S, 6°05′E; and 17°33′S, 11°18′E) and Sazonov (1978) reported on 2 samples from the Indian Ocean (0°57′N, 56°32′E, and 8°43′S, 60°23′E), but the identity of these is also uncertain.

Material examined. ISH591/68 (4), ISH3003/71 (2).

Maulisia (Maulisia) argipalla Matsui and Rosenblatt 1979
(Fig. 26B)

Holtbyrnia (Mentodus) polycaeca (not of Parr 1937) Maul 1954: 41-47, Figs. 14-16, Tables 5-6 (descr., ill., spec, from Madeira only).

Maulisia mauli Bussing 1965: 19 (descr. 1 spec, off Chile, 33°S); Quéro 1970: 271-272, Fig. 11 (in part, 186 mm spec, in fig. from 46°46′N, 5°39′W); Hubbs, Follett, and Dempster 1979: 9 (checklist).

?Maulisia mauli Fedorov 1973: 48 (listed, Bering Sea); Parin et al. 1973: 78 (rec. 30°42′S, 76°05′W); Peden 1974: 49-50, Fig. 2 (descr. 1 spec. from 48°09′N, 126°43′W); Sazonov 1976b, Fig. 20 (distr., including Fedorov's rec.); Novikov, Kodolov, and Gavrilov 1980:32 (1 rec. N Pacific).

Maulisia argipalla Matsui and Rosenblatt 1979: 65-68, Figs. 2b, 3c-d, 4, Table 1 (orig. descr.; holotype: SIO72-392, 32°14.5′N, 117°57.7′W, ca. 1000 m; 4 paratypes from: 35°03.2′N, 122°52.6′W; 31°35′N, 118°16′W; 32°19.6′N, 118°37.8′W; 12°07′N, 23°08′W).

Diagnosis. Supraorbital extending laterally beyond the widest part of frontals. Margin of frontals adjacent to supraorbital straight and without a notch. Posterior border of maxilla much less than half an eye length from preopercle. Infraorbital canal running near ventral margin of lacrimal. Ceratobranchial of 2nd arch usually lacking all medial gillrakers, rarely with a few present. Pelvic base and anus separated by about 12 scale rows. Anus about opposite dorsal origin. THO photophore round. White tissue on infraorbital around the posterior border of orbit, then extending forward around the ventral margin to about mideye.

D 17-20, A 15-17, P_1 18-19, P_2 7-8 (usually 7), Br 8-9 (usually 8), GR 7-8 + 16-18 (23-25), vertebrae 25-27 + 19-22 (46-47), scales 77-90. Largest record: 170 mm.

Distribution (Fig. 17). Eastern N Atlantic, and the eastern Pacific off California and Baja California in the north and off Chile in the south. Samples from the eastern Pacific taken in nets with estimated maximum sampling depths of about 475-530 m (Peden 1974) to about 1000m(SIO). Sazonov (1976b) reported an *M. mauli* captured at 53°25′N, 179°59′W(rec. of Fedorov 1973) in the Aleutian Islands, which may be *M. argipalla*. We have not found a specimen of *M. mauli* in our limited material from the Pacific. Sazonov (1976b; Fig. 20) indicates another record of *mauli* between the Hawaiian Islands and Japan in his distribution chart.

Material examined. SIO72-392 [holotype, and the following paratypes: SIO67-104 (1), SIO70-8 (1), SIO65-444 (1), ISH2199/68 (1)].

Subgenus Aphanichthys n.

Subgeneric diagnosis. Photophores absent. No pit behind supracleithrum. Lateral line either with a canal lined by modified scales or lacking a canal, marked by papillae or neuromasts and without modified scales. Premaxilla with 7-15 teeth behind tusks. Body compressed to moderately compressed and moderately deep (4.3-5.2 in SL) with a relatively long snout (3.2-3.8 in HL). Gillrakers 26-31. P_2 7-8 (usually 8). U_1 absent (or fused to PU_1).

Comparative diagnosis. *Aphanichthys* lacks the shoulder pit that characterizes the subgenus *Maulisia*. It has lost all photophores and the U_1 centrum is absent. Photophores are present in *Maulisia* and the U_1 is also usually present. *Aphanichthys* has more gillrakers and premaxillary teeth and usually 8 ventral rays (usually 7 in *Maulisia*). It also has a shallower body and a slightly longer snout.

Subgeneric description. Body elongate, shallow to moderately deep, about 4.3-5.2 in SL and compressed (body width 2.2-2.7 into depth). Dorsal margin sharp, with a shallow layer of nonmuscular tissue. Pelvies just behind midlength. Dorsal origin ahead of that of anal fin by 4-9 rays. Dorsal base slightly longer than that of anal.

Head large, about 3 in SL. Frontals widest over eye and narrower anterior and posterior from that point. Large supraorbital running anteriorly from widest part of frontal and slanting subhorizontally over eye. Supraorbital medially grooved over its entire length. Antorbital large, running along posterior margin of posterior naris and attached to supraorbital and lacrimal by ligaments. Snout long, about 3.2-3.8 in HL, longer than eye. Mouth large, maxilla ending behind eye (behind pupil in small holotype of *isaacsi*). Anterior supramaxilla longer than posterior supramaxilla. A_1 of adductor mandibulae inserting on anterior supramaxilla. Anterior part of upper jaw partly overlapped by the large lacrimal, which extends posteriorly to nearly mideye. The 3rd and 4th infraorbitals with small laminar flanges, extending less than half the distance to preopercle.

Innermost tooth on each premaxilla enlarged as an anteromedially directed tusk; 1 -2 more laterally directed tusks usually present. Premaxilla triangular, with 7-15 teeth. The inner tusk of one side widely spaced from that of the other, with a broad edentulous space between them, and teeth on the upper jaw are along the lateral border. Teeth behind tusks subhorizontal and in series with tusks. Mid-dentary teeth well developed in small individuals but appear to be fewer in larger. There are 2 teeth on vomer. Palatines with or without teeth, basihyal (except *microlepis*), and basibranchials edentulous. Single row of teeth in mesopterygoid. Small teeth on 4th ceratobranchial, 5th epibranchial, and 2nd to 4th upper pharyngeals.

Opercles slightly wider to a third wider posteriorly than at middle. Subopercle about a third to half as deep as opercle and two or three times deeper than dorsalmost branchiostegal ray. Three dorsalmost branchiostegal rays flattened and relatively close-set. Another also flattened and laterally on epihyal; the anterior 4 ventrally on ceratohyal, acinaciform.

Medial gillrakers absent in ceratobranchial of 1st arch and present or absent on 2nd. Gill filaments poorly developed, with basal part united.

Photophores absent. No enlarged pit behind supracleithrum. Posttemporal bone not pierced by canals. Cephalic lateralis canal passing through supracleithrum in *microlepis* but not in the others. Lateral line with a canal and modified scales in *microlepis*, and lacking a canal, marked by papillae in the others. In *microlepis* modified tubular scales extend onto caudal rays in individuals over 200 mm SL. Body scales small, 80-125 along midline. Most scalepockets with 1-15 small (0.1-0.25 mm diameter) pores. Gill opening extending dorsally from opposite mideye to top of eye. Exposed tube of shoulder organ about a fourth of body depth above midline. Cleithral symphysis in a blunt spine (except in small holotype of *isaacsi*). P_2 7-8 (usually 8).

Derivation of name. From the Greek *a*, no or none, *phanos*, light, and *ichthys*, fish. *Type species*. *Maulisia microlepis* Sazonov and Golovan 1976.

Maulisia (Aphanichthys) microlepis Sazonov and Golovan 1976
(Fig. 26C)

Maulisia microlepis Sazonov and Golovan 1976: 10-11, Fig. 3 (orig. descr.; holotype: ZIL42292, 27°13′S, 14°00′E, 1150-0 m; 1 paratype: ZIL42293, 27°28′S, 14°10′E); Golovan 1976: 300-301 (listed); Sazonov 1976b: 60, Figs. 19c, 20 (taxonomy); Sazonov and Trunov 1978: 95-96 (descr., 2 spec, from S. Atlantic); Parin, Sazonov, and Mikhailin 1978: 174 (4 rec. Gulf of Guinea); Pakhorukov 1980: 23 (3 rec. S. Atlantic, counts and meas. of spec).

Mentodus rostratus (not of Parr 1960) Markle 1976: Figs. 13b, 21b (ill. pectoral girdle and caudal skeletons).

Diagnosis. Lateral line with a canal and modified scales. Body scales 112-125 along midline. Gill opening level with top of eye. Anal origin about opposite 9th dorsal ray. Pyloric caeca with 4 primary branches and 8-9 terminal diverticula; 13-15 small teeth on premaxilla.

D 17-21, A 15-18, P_1 13-18, P_2 8, Br 7-9 (usually 8), GR 8-9 + 20-22 (29-31), vertebrae 22-24 + 20-21 (43-45). Largest record: 255 mm.

Distribution (Fig. 17). The holotype and the paratype are from the South Atlantic. Two additional specimens from the South Atlantic were reported by Sazonov and Trunov (1978) from 31°08′S, 15°17′E. Material we have examined is from the South Atlantic at 6°29′S, 11°13′E, (MMSU P14116) and 8°33.2′S, 12°35.2′E (MMSU P14139), and from the North Atlantic at 37°8.6′N, 73°57.6′W (USNM215612); 55°43′N, 25°53′W (ISH507/73); 62°39′N, 33°45′W (ISH351/73); and 14°11′N, 18°28′W (ISH202/74). The MMSU material we examined and the holotype and paratype were collected in bottom trawls at depths of 1000-1200 m. The North Atlantic material we examined (USNM and ISH) was collected in open nets with sampling depths of 2000-2600 m.

Material examined. USNM215612 (1 stained specimen), ISH507/73 (2), ISH351/73 (1), ISH202/74 (3), MMSU P14116 (1), MMSU P14139 (1).

Maulisia (Aphanichthys) acuticeps Sazonov 1976
(Fig. 26D)

Maulisia acuticeps Sazonov 1976a: 23-24, Fig. 4 (orig. descr.; holotype: ZIL42294, 5°59′S, 84°59′W; 1 paratype (ZIL42295) from same sta. as holotype); 1976b: 69, Figs. 19b, 20 (taxonomy).

Diagnosis. Lateral line marked by papillae and neuromasts, without a canal and modified scales. Body scales 100 along midline. Gill opening level with upper fourth of eye. Anal origin about opposite 8th dorsal ray. Pyloric caeca with 6 primary branches and 10 terminal diverticula; 7-10 small teeth in premaxilla.

D 18-22, A 16-18, P_1 12-16, P_2 7-8 (mostly 8), GR 8-9 + 20-22 (28-31), vertebrae 23 + 20. Largest record: 255 mm.

Distribution (Fig. 17). Holotype and paratype from off the coast of Peru. A third specimen from approximately off the E coast of Japan not plotted on range map.

Material examined. IOAN uncat., sample coll. by Trawler "9-141" at sta. 299. Data given above also includes data from Sazonov (1976a).

Maulisia (Aphanichthys) isaacsi n. sp.
(Fig. 26E)

Diagnosis. Lateral line marked by papillae or neuromasts, without a canal and modified scales. Body scales 80 in midline. Gill opening level with mideye. Anal origin about opposite 4th dorsal ray. Pyloric caeca with 6 primary branches and about 21 terminal diverticula; 7-8 small teeth in premaxilla.

D 16, A 15, P_1 15, P_2 8, Br 8, GR 7 + 19, vertebrae 24 + 22.

Description. Counts and measurements of holotype are in Table 7. Body shallow, greatest depth 5.3 in SL, and twice least depth at caudal peduncle. About a fifth of the dorsal half of body made up of nonmuscular tissue along the dorsal margin. Body compressed, with greatest width at shoulder girdle, half of greatest depth. Probably because of immaturity of holotype, cleithral symphysis normal, not ending in a spine. Dorsal origin behind body midlength by about its basal length, opposite anus, and ahead of anal fin origin by about 4 rays. Dorsal base slightly longer than that of anal fin. Pelvics inserted slightly behind mid-length. Pectorals small and low on body.

Head large (3 in SL) and snout long (3.2 in HL). Dorsal profile of head nearly on a line with that of body, and the ventral profile tapering from posterior end of lower jaw to a pointed snout. Frontals slightly cupped over eye. Top of head concave. Frontals widest over mideye, with widest point at a sharp angle, being narrower anterior and posterior from that point. Supraorbital elongated, slanting subhorizontally from widest point of frontals anteriorly to the posterior margin of nasal sac. Supraorbital flat and broad posteriorly, narrower and trough-shaped anteriorly. Antorbital weakly joined by ligaments to supraorbital and lacrimal. Snout with forward-directed premaxillary tusks, and a wide edentulous space between tusks. Nasal sac small, located midway between orbit and anterior tip of snout. About 4 small lamellae in rosette. Lacrimal large, extending from premaxilla to below the anterior margin of lens and partially overlapping upper jaw. The 2nd infraorbital a tubular ossicle, lacking a laminar portion. The 3rd and 4th infraorbitals with laminar processes that extend one-third of the distance to preopercle, the 3rd the larger. Mouth large, upper jaw length two in head length, with the maxilla ending below posterior margin of pupil. Maxilla about as deep as anterior supramaxilla and about a third shallower than posterior supramaxilla.

Anterior supramaxilla longer than posterior supramaxilla, with the tendon from the A_1 of the adductor mandibulae inserted on it. Premaxilla triangular, at its widest point twice the depth of maxilla. At symphysis, dentary about a third shallower than maxilla. Eyes small (4.3 in HL), shorter than snout, and below head outline.

Innermost premaxillary tooth enlarged into a horizontally directed tusk. A smaller, horizontally and laterally directed tooth arises from same base as tusk on both the left and right sides. Teeth following tusks somewhat enlarged and subhorizontal; 7-8 widely spaced teeth in series with tusks. Inner tusks on each premaxilla widely spaced. Maxillary teeth mostly broken but smaller than those of premaxilla, about 35 on a side. About 6 larger mid-dentary teeth on a side. A single row of about 8 mesopterygoid teeth on right side (not counted on left). Vomer with 2 closely set teeth, palatines, basihyal, and basibranchials edentulous. Small teeth on 4th epibranchial and 5th ceratobranchial and on the upper pharyngeals of 2nd to 4th arches.

Lateral line partially marked by neuromasts, otherwise unmarked, and without a canal and modified scales. Approximately 80 scales along midline. Entire body scaled. Opercular region and head scaleless. Anteriormost scale row on occiput in line with the preoperculomandibular canal. Most scalepockets with 1-5 (usually 1-3) minute (0.1-0.15 mm) pores.

Cephalic lateral line canals complete, with few short branches. Partially ossified supratemporal canal nearly reaching the supraorbital canal, with the remainder in soft tissue. Cephalic lateralis canal reaching shoulder girdle without passing through the posttemporal and supracleithrum.

Dorsal margin of opercular opening level with mideye. Ventral margin of opercle nearly horizontal over posterior half, with the posterior border only a fourth wider than at middle. Maximum width of opercle about a fourth of body depth and twice that of subopercle, which is itself a third wider than posteriormost branchiostegal ray. There are 4 flattened branchiostegal rays on lateral face of epihyal, with the posterior 3 close set and partly overlapping; 4 acinaciform rays ventrally on ceratohyal. Medial gillrakers lacking on ceratobranchial of 1st and 2nd arches. Epibranchial and hypobranchial of 1st arch with 4 medial rakers, and 4 and 8 on 2nd; medial gillrakers on entire 3rd and 4th arches. Gill filaments poorly developed, outer row barely present at angle of 1st arch, absent at angle of 2nd-4th arches. Basal part of gill filaments united, membrane one to one-and-one-half times as long as the longest exposed part of filament. Exposed tube of shoulder organ about a third of eye length and located above the midline and ventral tip of supracleithrum. Pyloric caeca with 6 major branches, (4 of which divide into 3 branches and the remaining 2 bifid), and about 21 terminal diverticulae. Photophores absent. White tissue from about the posterior margin of 2nd infraorbital to the 6th infraorbital bones.

Derivation of name. In honor of the late John D. Isaacs, oceanographer extraordinary, and good friend.

Distribution. Known only from the holotype, taken near the Galapagos Islands.

Material examined. Holotype: SIO52-404, 95 mm SL, 1°43′S, 89°52′W, in a 3-m IKMT with 2500 m wire out, on August 8-9, 1952.

Normichthys Parr 1951

Normichthys Parr 1951: 17, 19; type species: *Normichthys operosa* Parr 1951, by original designation.

Generic diagnosis. Body moderately deep and compressed, with a sharp dorsal margin. About a fourth or less of dorsal and ventral margins an extension of nonmuscular tissue. Cleithral symphysis ending in a short, stout spine. Photophores rudimentary or absent. White tissue around eye encroaching on 2nd-5th infraorbitals. There are 1 to several subcutaneous pores as large or larger than scalepockets (dermal pits) behind supracleithrum. Lateral line without a canal or modified scales. Posttemporal and supracleithrum not pierced by a canal. Cephalic lateral line canals complete and with side branches. Lacrimal overlapping anterior half of upper jaw, 2nd infraorbital tubular, 3rd and 4th with small laminar extension; lacrimal largest. Posterior margin of upper jaw below posterior fourth of eye. One or two anteriormost premaxillary teeth as forward-directed tusks, teeth in main row behind tusk in series with tusk, about 13 in number. Mid-dentary teeth present in young, absent in larger individuals. Frontal margins somewhat flared and wide over eye, forming a rounded canopy posteriorly. Supraorbital small, lateral to frontals from about anterior third to half of eye. P_2 6-8, vertebrae 43-47. U_1 usually present, occasionally absent (or fused).

Generic description. Body moderately deep, about 3.5-5 in SL and compressed. Ventral surface between cleithral symphysis and anus narrowly flattened (4-5 scale rows across); dorsal margin sharp, about a scale row in width. Ventral and dorsal margins extended by about a fourth of body depth or less by nonmuscular tissue. Pelvies small, inserted slightly behind midlength. Dorsal and anal fins subequal and nearly opposite, dorsal slightly ahead and its base slightly longer.

Frontals narrow anteriorly, widening posteriorly, with margins flared over widest part of head and rounded as they narrow over posterior end of eye. Top of skull flat, with slight concavity medially. Small concave supraorbital lateral to frontals from about anterior third to half of eye. Antorbital and supraorbital not in contact, connected by ligaments. Anterior margin of nasal sac nearly bordering maxilla. About 9-11 lamellae in nasal rosette. Mouth ending below the posterior fourth of eye. Anterior supramaxilla longer than posterior supra-maxilla. A_1 of adductor mandibulae inserting by a tendon on maxilla. Part of anterior half of upper jaw overlapped by lacrimal, which is the largest infraorbital bone; 2nd infraorbital tubular, lacking a laminar projection; thin small laminar extension on 3rd and 4th infraorbitals.

Innermost premaxillary tooth enlarged and anteriorly directed as a tusk, a 2nd enlarged subhorizontal tooth present or absent. Teeth in main row behind tusks lateral to base of tusk (not beneath it) and in series with tusks. A row of about 13 close-set teeth on premaxilla. Maxillary teeth uniserial and close-set, smaller than those of premaxilla and larger than those of dentary. A short row (4-5) of mid-dentary teeth present in individuals of less than 100 mm SL, but absent in most large individuals. There are 2 teeth on vomer, a single row of 4-10 teeth on mesopterygoid, and 1-3 (usually 3) medially on basihyal. Basibranchial, palatines, and ectopterygoids endentulous. Teeth present on 4th epibranchial and 5th ceratobranchial and on upper pharyngeals of 2nd to 4th arches.

Posterior margin of opercle deeper than the middle and about three times as deep as subopercle, which is about twice as deep as posteriormost branchiostegal ray. Subopercle usually with a slight diagonal ridge at about its center (better developed in *operosus*). Dorsal margin of gill opening level with mideye. There are 4 flattened branchiostegal rays laterally on epihyal, with the last 2 or 3 branchiostegal rays wide and overlapping; 4 (occasionally 3) acinaciform rays ventrally on ceratohyal. No medial gillrakers on ceratobranchial of 1st arch, and 0-2 on that of 2nd. Epibranchial and hypobranchial of 1st and 2nd arches with 4-7 medial rakers. Exposed tube of shoulder organ less than a fourth of eye length and located about midline, slightly dorsal to ventral tip of supracleithrum and slightly less than an eye length from top of gill opening. Cleithral symphysis produced into a short, rather blunt spine.

Rudimentary photophores at SVO and SAO, and a lightly pigmented area at ICO in some individuals. Venter narrowly flattened between pelvic and pectoral fins, with a whitish median welt. Whitish tissue, which is somewhat obscured by dark pigment from about the 2nd-5th infraorbital, with the white tissue continuing on around orbit.

Lateral line marked by papillae, without a canal and modified scales. Scales small, 80-125 along midline. Most anterior scalepockets with 1-7 (usually 1-2) subcutaneous pores of about 0.05-0.03 mm; pores fewer and smaller posteriorly. A row of 1-4 scalepockets immediately behind the supracleithrum and 2 scale rows above the lateral line, with only a thin membrane over part of the entire floor. The scales over these pockets are usually missing in museum material, and the thin membrane is ruptured, exposing cavities that may be 1-2 scales wide. These cavities were called dermal pits by Parr (1960).

Cephalic lateral line canals complete, with side branches on main canals. Supratemporal canal appears not to be intersected by the supraorbital canal. Cephalic lateralis canal ending over the supracleithrum not running through the posttemporal and supracleithral bones. Subcutaneous canal not passing through posttemporal bone. P_2 6-8.

Normichthys operosus Parr 1951
(Fig.27A)

Bathytroctes (Talismania) homopterus (not of Vaillant 1888) Norman 1930: 269-270, Fig. 2 (descr., ill., spec, from 15°55′S, 10°35′E and 13°25′N, 18°22′W).

Normichthys operosa Parr 1951: 17, 19 (orig. descr.; holotype: ZMUC P1763, 18°22′N, 18°14′W, ca. 1250 m; 1960: 92-93, Figs. 65-66 (descr.); Quéro 1970: 272-273, Fig. 12 (descr., ill., 3 spec, from Bay of Biscay); Blache, Cadenat, and Stauch 1970: 148, Fig. 39 (in key); Herring 1972: 879-887 (bioluminescence).

Normichthys operosa operosa Parr 1960:93-94, Figs. 64, 65d-f, 66 (descr. and ill.); Geistdoerfer, Hureau, and Rannou 1971a: 1178 (listed); 1971b: 364 (same as 1971a).

Normichthys operosa islandica Parr 1960: 94, Figs. 65a-c, 66 (orig. descr.; holotype: ZMUC P1765, ca. 66°N, 26°-27°W).

Normichthys operosus Krefft 1973: 97 (syn. and distr. NE Atlantic); 1976: Fig. 9 (distr. chart shows rec. from 24 loc. ranging approx. from 11°W to 33°W and 5°S to 66°N); Sazonov 1976b: 69, Figs. 21-22 (taxonomy, compiled distr., including 4 new rec. from eastern N Atlantic); Golovan 1976: 301 (descr., rec. off W coast of Africa that are included in distr. chart of Sazonov 1976b; rec. from 33°36′S apparently an error, as indicated by Sazonov and Trunov 1978); Quéro 1978:20, Fig. 9b (rec. 26°05′N, 15°53′W); Sazonov and Trunov 1978: 96, Fig. 5, Table 2 (counts and meas. in table of 5 spec, from 18°35′S, 11°12′E and 18°23′S, ll°07′E); Golovan 1978: 210 (listed); Parin, Sazonov, and Mikhailin 1978: 174

(3 rec. Gulf of Guinea, approx. 8°-11°S, 12°-13°E); Gushchin and Kukuev 1980: 37 (rec. Mid-Atlantic Ridge).

Diagnosis. Scales 80-99 in midline, gillrakers 28-30, and vertebrae 43-44. Usually one of the dermal pits as wide as 2 scale rows. Body depth about 4-5 in SL (in individuals larger than 50 mm SL). Nonmuscular tissue extending the dorsal and ventral margins by about one-sixth body depth. Supraorbital extending anteriorly from about mideye. Posterior margin of maxilla below the posterior margin of eye. Anterior margin of pelvic base and anus separated by about 12 scale rows. Rudimentary photophores usually absent. Outer and inner row of gill filaments present at angle of epibranchial and ceratobranchial of 1st arch in specimens larger than 100 mm SL; basal part of filaments usually united by membrane. A 2nd enlarged subhorizontal tusk usually present behind forward-directed tusk.

D17-20, A 16-17, P_1 16-17, P_2 6-7, Br 7-8 (usually 8), GR 7-8 + 20-22 (28-30), vertebrae 21-23 + 20-22 (43-45). Largest record: 160 mm.

Distribution (Fig. 18). Eastern half of N Atlantic from 66°N, 26°-27°W (Parr 1960) to 9°N (Golovan 1976), and the eastern S Atlantic from 5°30′S, 16°28′W (ISH206/71) to 18°35′S, 11°12′E (Sazonov and Trunov 1978). Shallowest reported depth of capture 780-785 m (Sazonov and Trunov 1978); other captures with maximum sampling depth below 1000 m.

Material examined. ISH790/64 (5), ISH206/71 (1), ISH613/73 (3), ISH922/73 (1), ZMUC uncat., *Dana* sta. 4007 (1).

Normichthys yahganorum Lavenberg 1965
(Fig.27B)

Normichthys yahganorum Lavenberg 1965b: 3-7, Figs. 1-2 (orig. descr.; holotype: LACM 10264, 45°01′S, 76°33′W, 0-1100 m; 1 paratype: 38°00′S, 74°48;W); Krefft 1976: Fig. 9 (distr. chart shows rec. from 13 loc. ranging from 33°-46°S, 21°E-50°W); Sazonov 1976b: 69, Fig. 22 (taxonomy, compiled distr. and new rec. from 4 loc. approx. from 46°-58°S, 55°-59°W); Sazonov and Trunov 1978: 96-97, Fig. 5, Table 2 (descr., ill., counts and meas., 7 spec, from 6 loc: 30°08′S, 3°16′E; 30°12′S, 3°14′E; 33°36′S, 16°38′E; 36°25′S, 20°13′E;35°35′S, 18°51′E; and31°08′S, 15°17′E).

Diagnosis. Scales 100-125 in midline, gillrakers 24-28, and vertebrae 44-47. Largest dermal pit equal to about a scale in diameter. Body depth about 3.4-4 in SL. Nonmuscular tissue extending dorsal and ventral margins by about a fourth of body depth. Supraorbitals anteriorly over the anterior third of eye. Maxilla extending about one-fourth eye length from posterior margin of eye. Anterior margin of pelvic base about 18 scale rows before anus. Rudimentary photophores usually present at SVO and SAO, with an unpigmented patch at ICO. Outer row of gill filaments at angle of epibranchial and ceratobranchial of 1st arch poorly developed or absent; their bases united. Tusks usually single on each premaxilla.

D 17-20, A 16-19, P_1 14-19, P_2 6-8 (usually 7), Br 7-8 (usually 8), GR 6-8 + 17-21(24-28), vertebrae 21-24 + 22-24 (44-47; mostly 46-47). Largest record: 164 mm.

Distribution(Fig. 18). Circumglobal in the Southern Hemisphere, mostly between 30°-50°S but from 20° (SIO72-180) to 45°S (holotype) off Peru and Chile. Southernmost record at 59°S in the Atlantic. Only platytroctid at midlatitudes in the western half of the S Atlantic.

Material examined. SIO61-37 (1), SIO61-41 (2), SIO61-45 (1), SIO72-180 (1), ISH376/71 (4), ISH606/71 (3), ISH687/71 (1), ISH719/71 (2), ISH824/71 (4), ISH1034/71 (1), ISH1065/71 (1), ISH1155/71 (1), ISH1208/71 (1), USNM206857 (1), USNM208093 (1), SAM 28755(1).

Searsioides Sazonov 1977

Searsioides Sazonov 1977: 55-56; type species: *Searsioides multispinus* Sazonov 1977, by original designation.

Generic diagnosis. Body elongate, shallow to moderately deep, and moderately compressed. Dorsal margin relatively sharp, nonmuscular tissue about one or two scale rows wide along dorsal margin. Cleithral symphysis ending in a sharp spine. Photophores present, THO a transverse bar, MVO circular, GO_1 present, JO rudimentary or absent. In young, IVO disappearing by 100 mm SL, GO_2 rudimentary. Ventral margin narrowly flattened, 4-5 scale rows across. No white tissue around eye. No enlarged subcutaneous pores (dermal pits) behind supracleithrum. No lateral line canal or modified scales. Posttemporal and supracleithrum not pierced by canals. Cephalic lateral line canals complete and with side branches. Lacrimal overlapping anterior half of upper jaw, 2nd infraorbital tubular, 3rd with small laminar plate not reaching preopercle. Posterior margin of upper jaw reaching posterior border of orbit. Only the innermost tooth of premaxilla a forward-directed tusk, teeth in main row behind tusk subhorizontal and in series with tusk; about 11-13 premaxillary teeth behind tusk. Mid-dentary teeth present. Frontals widest behind eye, nearly straight over eye. A narrow supraorbital ranging from mideye and anterior margin of eye to near nasal sac. P_2 8-9, vertebrae 45-47. U_1 present.

Generic description. Body shallow to moderately deep (4.5-6 in SL), without much taper (least depth 1.6 to 2.5 in greatest depth), and moderately compressed. A narrow band of nonmuscular tissue, one or two scales wide, on dorsal margin. Venter narrowly flattened, 4-5 scale rows across. Ventral fm origin at or slightly behind body midlength. Dorsal origin over anus and behind body midlength by less than its basal length. Anal origin opposite anterior one-third to one-fourth of dorsal (4th-10th dorsal ray). Dorsal and anal fins subequal, dorsal usually slightly longer. Pectorals low on body. Pel vies with 8-9 rays.

Head 3-4 in SL. Frontals viewed from above laterally expanded behind eye, almost parallel over eye, then tapering to snout. A narrow supraorbital with deep concavity anteriorly over anterior part of eye. Antorbital elongated, separated from supraorbital and lacrimal, but connected to both by weak ligaments. Snout about 3.5 in HL and shorter than eye length. Nasal sac located about at midlength of snout, with 6-8 lamellae in rosette. Eye below dorsal outline of head. Maxilla ending about at posterior margin of orbit. Anterior supramaxilla longer than posterior supramaxilla. A_1 of adductor mandibulae attaching tendinously on anterior supramaxilla.

Only the innermost tooth on each premaxilla enlarged into an anteriorly directed tusk; teeth nearest tusk slightly subhorizontal, their bases in series with tusk. Edentulous space between tusks about a third width of snout. Teeth relatively numerous and close set in jaws, more numerous in larger individuals. Premaxillary teeth largest, usually about 10-13 excluding tusk; dentary teeth the smallest. A row of as many as 13 mid-dentary teeth on a side, but usually fewer, especially in larger individuals. There are 2 close-set teeth on vomer; palatines with 1 tooth on each side in young, but usually toothless in larger individuals. Basihyal teeth along the outer edge of bone in a circular pattern, with additional teeth medially, fewer teeth in larger individuals. There are 1-2 rows of teeth on mesopterygoid and a single row of basibranchial. Teeth on 4th epibranchial, 5th ceratobranchial, and upper pharyngeals of 2nd-4th arches. Medial gillrakers 3-8 on 1st and 2nd arches, absent on ceratobranchial. Gill filaments short, united by a membrane for about half or more of length, unpaired at angle on first 2 arches. Dorsal margin of opercular opening level with mideye.

Opercle slightly deeper posteriorly than at middle, with ventral margin horizontal along its posterior half. Subopercle about a third as deep as opercle and deeper than posteriormost branchiostegal ray. There are 4 flattened branchiostegal rays laterally on epihyal, with the last 2 branchiostegal rays wide and partially overlapping; 4 acinaciform rays ventrally on ceratohyal. Exposed tube of shoulder organ less than one-fifth eye diameter long, located above the ventral tip of supracleithrum. Cleithral symphysis ending in a sharp spine.

Photophores present are: GO_1, BRO, PO, transverse THO, circular MVO, SVO, SAO, PAO, and a single ICO. The only photophore found in young stages is a small IVO, which disappears by about 100 mm SL. A rudimentary GO_2 marked by a round transparent spot may be present or absent between 30-100 mm SL. No white tissue around eye.

Cephalic lateral line canals branched, complete or nearly complete. We are uncertain whether the supratemporal canal is complete in *calvala*. The supraorbital canal intersects the supratemporal canal; the cephalic lateralis canal does not pass through the posttemporal and supracleithrum, but ends over the pectoral girdle. The 3rd infraorbital mostly tubular, with small laminar extension; 4th similar, but laminar portion rudimentary. Lacrimal largest, extending below the anterior fourth to third of eye, and overlapping upper jaw anteriorly. Lateral line marked by black papillae and neuromasts. Most or few scalepockets with subcutaneous pores. Subcutaneous canal not passing through posttemporal. Scales 75-120 in midlateral series.

Discussion. *Searsioides* was erected by Sazonov (1977) for the reception of *S. multispinus*. However, the diagnostic characters selected were for the most part insignificant or erroneous—and although we found several significant differences separating *multispinus* and *calvala* from *Searsia koefoedi*, we considered them insufficient to warrant generic separation (Matsui and Rosenblatt 1979). Since our earlier decision, however, additional differences as well as a better appreciation of these differences have been noted, and we now recognize that *multispinus* and *calvala* should be in a distinct genus. *Searsia* agrees with the mesopelagic genera in the presence of canals in the posttemporal and supracleithral bones, lacking in *calvala* and *multispinus*. The sharp dorsal margin and the spinous cleithral symphysis of *calvala* and *multispinus*, which *Searsia* lacks, are specialized features of the bathypelagic genera. These characters in particular emphasize the wide differences between *koefoedi* and *calvala* on the one hand and *multispinus* on the other.

Searsioides multispinus Sazonov 1977
(Fig.27C)

Searsioides multispinus Sazonov 1977: 56-58, 1 fig. (orig. descr.; holotype: ZIL42626, 7°55′N, 142°21′E, 1500-0 m; paratypes (no cat. no.): 1 spec, 9°16′S, 91°27′E; 1 spec, 5°07′N, 142°52′E); Parin et al. 1977: 106 (listed, holotype and 1 paratype).

Searsia multispinus Matsui and Rosenblatt 1979: 71-74, Figs. 5b, 7b, 8b, 9, Table 2 (descr., ill., 12 spec, from 9 loc).

Diagnosis. Greatest body depth 4.6-5.9 in SL. Anal origin nearly opposite that of dorsal, at about 4th dorsal ray. Anus opposite dorsal origin. Gillrakers 40-45 on 1st arch. Scales 76-81 in midlateral series; 1-5 subcutaneous pores of about 0.05-0.3 mm in diameter in most scalepockets.

D 16-19, A 15-18, P_1 19-21, P_2 8-9 (usually 8), Br 7-8 (usually 8), GR (specimens larger than 50 mm SL) 10-12 + 30-33 (40-45), vertebrae 22-24 + 21-23 (45-46). U_1 present. Largest record: 118 mm.

Distribution (Fig. 18). SIO material from the Banda Sea, Halmahera Sea, and over the Java Trench. Caught mostly in nets sampling between 600 and 1000 m. The holotype and 1 paratype from the Eauripik Ridge between the Caroline Basins of the western Pacific, and the other paratypes from the Indian Ocean.

Material examined. SIO61-32 (6), SIO77-16 (1), SIO77-21 (1), SIO77-22 (1), SIO77-23 (1), SIO77-30 (1), SIO77-34 (3), SIO77-35 (2), SIO77-45 (1).

Searsioides calvala (Matsui and Rosenblatt 1979)
(Fig. 27D)

Searsia calvala Matsui and Rosenblatt 1979: 74-76, Figs. 5c, 8c, 10, Table 3 (orig. descr.; holotype: SIO77-47, 0°41.7′S, 128°55.7′E, 1000-1400 m; 3 paratypes collected with holotype).

Diagnosis. Greatest body depth 5.8-6.0 in SL. Dorsal origin ahead of that of anal by a third of its basal length (8-10 rays). Anus opposite 6th dorsal ray. Gillrakers 29-34 on 1st arch. Scales 120 in midlateral series; 1-2 minute subcutaneous pores (0.04 mm) in some of the anterior scalepockets.

D 16-18, A 15-16, P_1 19-20, P_2 8-9, Br 8, GR (49 mm SL and larger) 7-9 + 22-25 (29-34), vertebrae 25-26 + 20-21 (45-47). U_1 present. Largest record: 93 mm.

Distribution. Known from one station in the Halmahera Sea.

Material examined. SIO77-47, 4 (93 mm holotype and 49-77 mm paratypes).

Platytroctes Günther 1878

Platytroctes Günther 1878: 249; type species: *Platytroctes apus* Günther 1878, by monotypy.

Platytroctegen Lloyd 1909: 145; type species: *Platytroctegen mirus* Lloyd 1909, by monotypy.

Generic diagnosis. Body ovate and strongly compressed, with sharp dorsal margin only a scale row in width, narrow ventral margin 1-3 scale rows wide. Body depth doubled by non-muscular fleshy keels that extend from behind head to bases of vertical fins. Pelvies small (*mirus*) or absent (*apus*). Cleithral symphysis ending in a pointed or barbed spine. Photophores absent. No white tissue on infraorbitals. Lateral line without a canal or modified scales. Posttemporal and supracleithrum not pierced by a canal. Cephalic lateral line canals unbranched and with portions of most canals, including the dorsal end of the preoperculomandibular canal, absent. Upper jaw not overlapped by lacrimal and other infraorbitals. Mouth small, maxilla ending anterior to mideye. Premaxillary and dentary tooth rows transverse rather than lateral; premaxillary without tusks. Mid-dentary teeth present or absent. Maxillo-mandibular ligament wrapped across dorsal face of dentary, causing a diastema or ending the tooth row. Frontals gradually widening posteriorly and relatively wide over eye. Supraorbital bone absent. Scalepockets without subcutaneous pores. P_2 0-6, vertebrae 43-47. U_1 centrum present or absent.

Generic description. Body deep (30-40% SL), ovate in lateral view, with the deepest part near midlength of body. Body depth greatly increased by dorsal and ventral fleshy (non-muscular) keels that extend from behind the head to bases of ventral fins. Depth at vertical fins relatively shallow, fin bases only slightly separated from the muscular layer of body. Caudal peduncle shallow (about 4.0-6.8 in greatest depth) and relatively long. Body strongly compressed; dorsal margin sharp, about a scale row in width; ventral margin narrow or sharp, one to three scale rows across. Dorsal and anal fins subequal and nearly opposite, dorsal origin slightly ahead of that of anal. Anus opposite dorsal origin. Caudal and pectoral fins small. Pectoral fin base pedunculated, about one-fourth to one-third of body depth from ventral margin. Cleithra long and narrow (for a platytroctid), with symphysis produced in a strong spine.

Head relatively short (23-30% SL) and shallow (15-22% SL). Frontals narrow anteriorly and gradually widening posteriorly, with the widest part just behind orbit. Interorbital wide, about half of greatest width at sphenotics. No supraorbital. Antorbital joined by ligaments to fibrous tissue dorsally and to the anterior face of lacrimal, which it boarders ventrally. Eye large (8.5-11% SL) and below head outline. Snout short and truncated. Oblong nasal sac nearly half snout length and extending anteriorly to about maxilla; 6-11 lamellae in rosette. Mouth small (11-14% SL), maxilla extending from below mideye to anterior fourth of eye. Maxilla strongly convex ventrally. Posterior supramaxilla deeper than maxilla, longer than anterior supramaxilla, and up to twice as wide. A_1 of adductor mandibulae inserting tendinously on maxilla. Premaxillae shallow, less than half as deep as dentary at symphysis, laterally directed across face of snout. Dentary shallow anteriorly, with a deep coronoid process posteriorly.

Short row of premaxillary and dentary teeth across the front of mouth. Premaxillae lacking tusks. Dentary tooth row either interrupted at about its middle or terminated by a tendon from the maxillo-mandibular ligament. Maxilla with a row of small teeth. There are 1 to a few teeth on vomer, and either a medial or a circular row on basihyal. Palatines edentulous. Mesopterygoid variably toothed, from a single row to multiple rows that cover entire bone. There are 1-2 unbroken rows of teeth over part or all of basibranchial toothplate. Mid-dentary teeth either absent (*mirus*) or present only in small individuals (*apus*). Teeth on 4th epibranchial, 5th ceratobranchial, and upper pharyngeals of 3rd and 4th arches.

Opercle subtriangular, deep posteriorly, with the posterior margin about six times the depth of subopercle. Subopercle small, located below the posterior end of opercle with its long axis parallel to ventral margin of opercle. Posteriormost branchiostegal ray half as wide as subopercle; remaining rays on epihyal only slightly flattened. Usually only 2 (*mirus*) or 3 (*apus*) rays on ceratohyal. Medial gillrakers lacking on 1st arch, few stubs on hypobranchial of 2nd. Gill opening level with mideye. Exposed tube of shoulder organ located above the midline and the ventral tip of supracleithrum, and about a fourth to half an eye length below top of gill opening.

Scales small, about 80-100 in midlateral series. Lateral line marked by black papillae, no modified scales or canal. No subcutaneous pores in scalepockets, and no shoulder or dermal pits. Cephalic lateral line canals poorly developed, without any side branches from the main canals. No cephalic lateralis canal. The postocular commissure is either completely lacking or confined to a small ossicle between the infraorbital and preoperculomandibular canals. Only the supraorbital canal uninterrupted. Infraorbitals tubular, lacking laminar extension. Upper jaw not overlapped by infraorbitals. No mandibular canal; dorsal end of preopercular canal absent. No canals passing through the supracleithral and posttemporal bones. Ventral limb of posttemporal bone ossified for only a short distance, with the remaining extension to intercalar a ligament.

Remarks. A conspicuous feature of *P. apus* and *P. mirus* is the deep and strongly compressed body. On this basis, Parr (1951) placed them in a separate subfamily, the Platytroctinae. However, the two differ only in degree in this respect from certain other platytroctids. The increased body depth solely reflects the exaggerated fleshy keels, and fleshy keels are present in other genera (e.g., *Normichthys*). The depth of the muscular portion of the body is about 5.3-6.3 in SL, which is about that of *Barbantus* species, to which they appear closely related on the basis of other characters.

Similarly, the absence of pelvic fins in *apus*, and their presence in *mirus*, is apparently related to the greater development of the fleshy ventral keel. But the pelvics of *mirus* are also greatly reduced. There are other notable differences between these species, but considering their general similarities we feel that their placement in two monotypic genera is unnecessary and include *Platytroctegen mirus* Lloyd 1909 in *Platytroctes*.

Platytroctes apus Günther 1878
(Fig. 28A)

Platytroctes apus Günther 1878: 249 (orig. descr.; holotype: BMNH1887-12-7-235, 1°N, 26°36′W, 1500 fms.); 1887: 229-230, pl. 58, Fig. A (redescr. of holotype); Alcock 1890: 307 (rec. 1 spec, 15°02′N, 72°34′E); Wood-Mason and Alcock 1891: 11 (same rec. as Alcock 1890); Goode and Bean 1896: 46, Fig. 53 (descr. and fig. from Günther 1887); Jordan and Evermann 1896a: 458-459 (descr. from Günther 1887); 1896b: 288 (listed); Alcock 1899: 177 (descr. of spec, from Alcock 1890); Zugmayer 1911: 8-9 (descr. 1 spec, 37°38′N, 10°53/W); Roule 1916:12-13 (descr., 1 spec, 27°41′N, 17°53′W) 1919:14-16, pl. 1, Fig. 4, 4a-b (ill., redescr. of spec, from Roule 1916); Koefoed 1927:58 (descr., 1 spec, 27°27′N, 14°52′W); Jordan, Evermann, and Clark 1930:53 (listed); Fowler 1936:191-192, Fig. 80 (descr. after Brauer 1906 of *P. procerus* and fig. from Günther 1887); Lozano y Rey 1947: 85-87, Figs. 15-16 (descr. and fig. from Roule 1919); Misra 1949:409 (listed); 1953: 391 (gen. descr.); Grey 1956: 116-117 (distr.); Postel 1959: 145 (listed); Parr 1960: 34-37, Figs. 22-25 (descr., ill., distr.; meas. of holotype; rec 13 spec, from 9 sta., *Dana* material); Krefft 1963: 83 (1 spec, from stomach of fish, 65°30′N, 30°30′W); Rohr 1968: 624-625 (rec from 7°55′N, 53°55′W; 23°25′N, 97°00′W; 24°28′N, 96°27′W); Chirichigno 1969: 25 (listed); Blache, Cadenat, and Stauch 1970: 147 (in key); Herring 1972: 879 (bioluminescence); Krefft 1973: 98 (syn. and distr. NE Atlantic); Parin et al. 1973: 75 (rec 3°21′N, 81°02′W); Becker, Shcherbachev, and Thuvasov 1975:291 (counts, and meas. of a spec, from 19°56′N, 76°14′W); Badcock and Merrett 1976: 48 (mentions capture in sampling area, ca. 30°N, 23°W); Golovan 1976: 301-302 (counts, rec. off W coast of Africa); Sazonov 1976b: 68, Figs. 4-5 (taxonomy, compiled distr., 11 new rec., including that of Golovan from Atlantic, and from Pacific and Indian oceans); Parin et al. 1977: 106 (rec., 7°40′N, 121°32′E; 5°34′S, 130°48′E; 5°33′S, 131°10′E); Quéro 1978: 17, Fig. 9a (rec., 24°32′N, 17°02′W); Golovan 1978: 210 (listed).

Platytroctes procerus Brauer 1906: 23-24, Fig. 3 (orig. descr.; holotype: ZMHU17427, 14°39. 1′N, 21°51. 1′W, 2500 m).

Diagnosis. Ventral margin sharp, about 1 scale row in width. Pelvics absent. Dorsal and anal origin behind midlength by 1-1.5 of their basal length. Basal length of dorsal and anal fins relatively short (15-17% SL). Dentary tooth row interrupted at about its middle by a tendon from the maxillo-mandibular ligament, about 10 teeth before and 10 after diastema. There are 1-4 basihyal teeth in a medial row on narrow toothplate. Mid-dentary teeth present in young, absent in larger individuals. Several openings on dorsal and ventral margins of caudal peduncle leading to black-lined chambers. Openings covered by slightly enlarged oblong scales. Most scales with a medial keel that is usually hollow and open posteriorly, and often peaked into a knob; near the dorsal and ventral margin the scales are more strongly keeled. Cleithral symphysis in a sharp spine. Supratemporal canal absent. Only 3 branchiostegal rays on epihyal (3 on ceratohyal).

D 15-19, A 15-20, P_1 19-24, Br usually 6 (occasionally 7), GR 8-10 + 24-31 (33-41), vertebrae 19-21 + 23-26 (44-47). Largest record: 176 mm.

Remarks. Gillraker counts appear to range slightly higher in individuals from the Indo-West Pacific than those of the eastern Pacific and Atlantic (Table 5). The caudal peduncle also shows little taper compared to the other areas. The eastern Pacific samples do not differ in caudal peduncle shape from the Atlantic material.

Distribution (Fig. 19). In the North Atlantic from near the equator (type locality) to 65°30′N, 30°30′W (Krefft 1963). There are no records from the South Atlantic. In the Pacific and Indian oceans mostly equatorial except in the area of the East Indies to 18°06′N, 119°08′E in the South China Sea (SIO70-343) and in the eastern Pacific to 23°14.8′S, 71°22.4′W off Chile (SIO72-166).

Material examined. SIO52-384 (1), SIO52-404 (1), SIO55-244 (4), SIO55-246 (1), SIO60-225 (1), SIO60-235 (3), SIO69-351 (3), SIO70-343 (1), SIO72-166 (1), SIO72-177 (1), SIO72-186 (1), SIO75-452 (1), SIO77-20 (2), SIO77-27 (1), SIO77-42 (2), SIO77-44 (1), SIO77-54 (2), SIO77-58 (2), SIO81-109 (1), USNM206893 (4), USNM206894 (2), USNM201649 (1), USNM206893 (4), USNM200513 (1); IMARPE uncat. (1).

TABLE 5 Gillraker Counts on 1st Arch of Platytroctes apus From 3 Biogeographic Areas

Gillrakers	33	34	35	36	37	38	39	40	41	$\bar{X}$
Indo -W Pacific	1		2		1		1	1	1	37.1
E Pacific	1	1	1	3	1	1				35.6
Atlantic	3	1	4	1	2					34.8

Platytroctes mirus (Lloyd 1909)
(Fig. 27E)

Platytroctegen mirus Lloyd 1909: 145-146, Figs. 1, la (orig. descr.; holotype: Indian Mus. no. F2382/1, Bay of Bengal, *Investigator* sta. 371,500 fms.); Parr 1960:38-39, Figs. 27-28 (descr. and ill. of holotype); Kotthaus 1967: 12-13, Fig. 10-12 (counts and meas. of 7 spec, from 13°33.5′N, 70°50′E and 15°28′N, 69°26′E; photo of otolith); Sazonov 1976b: 67, Figs. 2-3 (taxonomy, distr. chart with new rec. from 1 loc. in Bay of Bengal and 8 from Arabian Sea).

Diagnosis. Ventral margin narrow, 2-3 scale rows across. Small pelvic fins present. Dorsal and anal origin behind midlength by about one-half their basal length. Basal length of dorsal and anal fins relatively long, 23-26% SL. Dentary tooth row ended by a tendon from the maxillo-mandibular ligament that crosses over the top of dentary, so that there are only about 9 teeth on a side. Basihyal teeth in a circular pattern around wide toothplate; mid-dentary teeth absent. Caudal peduncle normal, without dark-lined chambers. Scales normal, not ribbed. Cleithral symphysis ending in a barbed spine. Supratemporal canal with 1 ossicle and probably continues in a soft tissue, but does not appear to be complete. There are 4 branchiostegal rays on epihyal; usually 2, occasionally 3 on ceratohyal.

D 22-25, A 23-25, P_1 23-30, P_2 6 (one 6/7), Br 6 (one with 7), GR 10-13 + 25-30 (35-43), vertebrae 19-20 + 24-26 (43-45). U_1 centrum absent or fused in 7 of 9 individuals examined. Largest record: 120 mm:

Distribution (Fig. 19). The present material is from the Arabian Sea, and the holotype was from the Bay of Bengal. Kotthaus's (1967) specimens were from the Arabian Sea. The long gill filaments, as long as any found among platytroctids, are probably an adaptation to the oxygen-poor waters of this region, and the species is probably endemic to the area. Krefft (1964) reported a badly damaged 104-mm platytroctid from the stomach of a cod in the Denmark Strait, which he referred to *Platytroctegen* sp. No description of the specimen was given, so we are unable to comment further on the supposed record.

Material examined. USNM200511, 5 (84-107), USNM200512, 4 (90-106).

Barbantus Parr 1951

Barbantus Parr 1951: 18; type species: *Bathytroctes curvifrons* Roule and Angel 1931, by original designation.

Generic diagnosis. Body spindle shaped and shallow, with a relatively deep caudal peduncle. Dorsal margin rounded, with a narrow strip of nonmuscular tissue. Cleithral symphysis normal, not produced as a spine. Photophores absent. No white tissue on infraorbitals. Lateral line without a canal or modified scales. Posttemporal and supracleithrum not pierced by a canal. Cephalic lateral line canals without side branches. The cephalic lateralis canal interrupted in most species. Supratemporal canal lacking or incomplete. Dorsal end of preoperculomandibular canal interrupted. Upper jaw not overlapped by lacrimal. The 2nd infraorbital tubular; 3rd and 4th with or without small laminar extension. Mouth small, maxilla ending from anterior margin of lens to posterior margin of eye. Premaxillae without tusks, 13-22 teeth on premaxilla. Vomerine teeth relatively widely separated. Palatine teeth located nearly as far forward as vomerine teeth and nearly in a line across palate. Mid-dentary teeth present or, when absent, ridge on which teeth are based developed into laterally directed spines. Maxillo-mandibular ligament wrapped across dorsal face of dentary, causing a diastema in tooth row. Frontals narrow, with sides nearly straight over eye, skull widening abruptly behind eye. Eyes included in head outline. Supraorbitals absent. Scalepockets without subcutaneous pores. P_2 7-8, vertebrae 41-48. U_1 centrum absent (or fused).

Generic description. Body slender, greatest depth about 4.5-6.5 in SL and about one and a half to two times deeper than least depth of caudal peduncle. Ventral and dorsal margins with narrow strip of nonmuscular tissue. Pelvic fins at about body midlength. Cleithral symphysis normal, not in a spine.

Frontals narrow and only slightly tapered. Supraorbitals lacking. Snout short (3.5-4.5 in HL) and broad. Eyes extending dorsally above frontal margin, with the aphakic space oriented anterodorsally. Antorbital small, attached to lacrimal by ligaments. Anterior nares and anterior opening of supraorbital canal bordering premaxillae. Nasal sac elongate, extending over about half of snout length, with 5-14 lamellae in rosette.

Mouth small, the posterior margin of maxilla ranging from below the anterior margin of lens to about the posterior margin of eye. Lacrimal not overlapping upper jaw; extending to about the anterior margin of eye or anterior third of eye. Posterior supramaxilla ventrally convex, relatively deep, and longer than anterior supramaxilla. Tendon from the A_1 of adductor mandibulae inserted on maxilla. Premaxillae shallow and directed laterally across the face of snout. Dentary shallow anteriorly, deepening posteriorly, with a well-developed coronoid process. Maxillo-mandibular ligament crossing top of dentary, causing a diastema in tooth row. Teeth on premaxillae, maxillae, and dentary small and relatively even-sized, no enlarged tusks on premaxillae. Vomer wide, with 2-4 teeth spaced relatively far apart. Each palatine with 1-2 teeth that are located nearly as far forward as those of vomer. Basihyal teeth in a circular pattern in young, with the numbers decreasing with size, absent in some larger individuals. The large holotype of *B. aequipinnis* has a medial row of basihyal teeth, and this character may be more widely found in the genus. Basibranchial with 1-2 rows of short teeth. Mesopterygoid edentulous. Teeth present on 4th epibranchial and 5th ceratobranchial and on upper pharyngeals or 3rd and 4th arches. Medial rakers lacking on 1st arch, either lacking or with 1 or several short rakers on the epibranchial and hypobranchial of 2nd arch.

Lateral line marked by black papillae, without a canal or modified scales. Scales large, about 46-56 in midline. No pores in scalepockets. No enlarged pits behind supracleithrum. Scales continue anteriorly on top of head, ending from just behind eye to over the posterior fourth of eye. Cephalic lateral line canals without side branches. Supratemporal canal lacking or incomplete. Cephalic lateralis canal not passing through posttemporal and supracleithral bone, in most species interrupted. Dorsal end of preopercular canal interrupted, not intersecting the postocular commissure. Infraorbital canal either complete or interrupted by a short gap, with the infraorbital bones mostly as osseous tubules, but the 3rd and 4th with small laminar bases in some species. Postocular commissure very short. Supraorbital canal uninterrupted, extending from premaxillae to behind eye.

Photophores absent. No white tissue on infraorbitals. In *B. curvifrons*, there is a translucent median strip two scale rows wide extending from the cleithral symphysis to anal fin and from behind anal fin to caudal fin. Parr (1960) suggested that the strip might be luminous. External tube of shoulder organ small, at most one-sixth of an eye diameter long, and located slightly dorsal to the ventral tip of supracleithrum. Lower margin of opercle curving downward from anterior end, then horizontally over its posterior fifth to third. Opercles relatively deep posteriorly, about a third of body depth. Subopercle about a fourth as deep as the posterior margin of opercle and twice as deep as dorsalmost branchiostegal ray. There are 4 partly flattened branchiostegal rays laterally on epihyal in *aequipinnis* and *curvifrons*, 1 fewer in some *parini* and *elongatus*, and 3-4 acinaciform branchiostegal rays ventrally on ceratohyal. P_2 7-8. U_1 centrum absent (or fused).

Remarks, Binocular vision, which is characteristic of the species of *Barbantus*, is also found in *Pellisolus*, the species of which also have large scales (47-75) and a low vertebral number (41-44). Photophores and the U_1 centrum are absent in the two genera and the cephalic lateral line canals are reduced, with some canals absent or incomplete. They are also similar in the near absence of subcutaneous pores. However, the character states just mentioned are distributed randomly among other platytroctids, and the similarities between *Pellisolus* and *Barbantus* are apparently convergences as there are significant differences between them that indicate a wide phylogenetic separation. *Pellisolus* retains a number of generalized features common to the majority of platytroctids but absent in *Barbantus*, such as the presence of supraorbitals, premaxillary tusks, and white tissue around orbit. *Pellisolus* has a larger mouth and the lacrimal overlaps part of the upper jaw, compared to no overlap in *Barbantus*. A relatively large lacrimal that extends back to between mideye and the posterior margin of the lens is apparently a derived feature in *Pellisolus* shared with *Tragularius*, to which it appears most closely related. The lacrimal of *Barbantus* usually extends only to the anterior margin of eye (anterior third of eye in *B. curvifrons*).

The dentition of *Barbantus* is differently specialized, with relatively well developed palatine and vomerine teeth opposing basihyal teeth; palatine and basihyal teeth are usually absent in *Pellisolus*. The premaxillary teeth are mostly lateral in *Pellisolus* (and in most platytroctids) but run across the front of the jaw in *Barbantus*.

A transverse premaxillary tooth row is found in *Platytroctes*. In addition the maxillo-mandibular ligament crosses over the top of the dentary in *Platytroctes* and *Barbantus*, either ending the tooth row or causing a diastema. *Platytroctes* also has binocular vision. Like *Barbantus* it is without supraorbitals, premaxillary tusks, white tissue around its orbit and lacrimals that overlap the upper jaw, and the cephalic lateral line canals are reduced. In addition, the posterior supramaxilla is larger than the anterior supramaxilla in *Platytroctes* and *Barbantus*, with the ligament from the A_1 adductor mandibulae inserted on the maxilla. In most platytroctids the anterior supramaxilla is larger, with A_1 adductor mandibulae inserted on it. Basihyal teeth are also present in *Platytroctes*, and in both genera there are 1 or more rows of basibranchial teeth on a generally flat toothplate.

Barbantus appears most closely related to *Platytroctes*. The genera differ mainly in the absence in *Barbantus* of the nonmuscular layer along the dorsal and ventral margins and the spinous cleithral symphysis. *Platytroctes* appears to be the primitive sister group of *Barbantus*.

Barbantus curvifrons (Roule and Angel 1931)
(Fig. 28C)

Bathytroctes curvifrons Roule and Angel 1931: 6 (orig. descr.; holotype: Mus. Oceanogr., Monaco, 46°N, 10°W, 0-4500 m); 1933: 6-7, p1. 1, Fig. 2 (ill., and redescr. of holotype); Lozano y Rey 1947:74-76, p1. 3, Fig. 3 (descr. and fig. from Roule and Angel 1933); Belloc 1949: 5 listed.

Barabantus curvifrons Parr 1951: 18 (in key, desig. as genotype); Grey 1956: 118-119 (listed); Maul 1957: 18-20, Figs, la, 5 (descr., ill., spec. from stomach of fish, Madeira); Parr 1960: 100-102, Figs. 70-73 (ill. and descr., meas. of 5 spec, including holotype; 6 rec. *Dana* coll.); Blache 1964: 90-92, 2 figs. (ill. and descr. of a spec, from 9°18′S, ll°10′E);

Quéro 1970: 273-274, Fig. 13 (descr. and ill. of 4 spec. from 28°11′N, 16°05′W); Badcock 1970: 1035 (rec. 3 spec. from approx. 28°N, 14°W); Krefft 1970: 25-27, Fig. 5 (ill., counts and meas., compar. with *B. elongatus*); 1973:95-96 (syn. and distr. NE Atlantic); Kotthaus 1972:6, Fig. 6 (counts, photo of otolith, 1 spec. from 29°30′N, 23°39′W); Brewer 1973:17 (counts, 1 spec. from 24°01′N, 108°52′W); Parin et al. 1973: 78 (rec., 0°00′S, 85°W); Krefft 1976: Fig. 11 (distr., with 5 new rec, 43°-33°N, 16°-23°W); Golovan 1976: 299 (counts, 1 spec, from 22°30′N, off W Africa); Sazonov 1976b: 68, Figs. 7b-8 (taxonomy; compiled distr., including 6 new rec. from E and W Pacific, Indian Ocean, and N Atlantic—the last, same rec. as Golovan 1976); Parin et al. 1977:106 (rec., 1 spec. 6°33′N, 140°42′E); Quéro 1978: 20, Fig. 9c (rec., 24°32′N, 17°02′W and 26°05′N, 15°53′W); Parin, Sazonov, and Mikhailin 1978: 174 (rec, 1 spec. 3°08′N, 8°54′E); Golovan 1978: 209 (distr.); Gushchin and Kukuev 1980: 36 (rec. 57°23′N, 33°OO′W).

Diagnosis. Greatest body depth 4.4-5.4 in SL; least depth at caudal peduncle 1.6-2.2 in greatest depth. Maxilla extending variably from posterior margin of pupil to posterior margin of eye. Dorsal origin behind midlength by half to three-fourths its basal length. Dorsal ahead of anal fin by a fourth to half of basal length of dorsal, which is longer than that of anal by 20-30% of its length. Anus about opposite the 4th to 5th dorsal ray and in advance of anal fin origin by about a fourth to a third of the distance between anal origin and pelvic fin. Mid-dentary ridge prominent, extending across symphysis and usually developed into a laterally facing spine on one or both sides. Mid-dentary teeth lacking. Opercular opening slightly above mideye. Exposed tube of shoulder organ a scale row below dorsal margin of gill opening. Anterior scale row on dorsal margin over the posterior fourth of eye. Opercular region scaleless. Scales normally imbricated. Pectoral base scaled. Infraorbital canal complete; a short gap in cephalic lateralis canal. Supratemporal canal nearly absent, only a small ossicle at juncture with postocular commissure present. Gill filaments variably developed, outer row present at angle of 1st arch; basal part free or united to as much as half of the exposed part of filaments.

D 16-19, A 12-15, P_1 21-24, P_2 8, Br 7-8, GR 4-5 + 14-16 (17-21), vertebrae 24-25 + 20-21 (43-45). Scales in midlateral series 50-56. Largest record: 130 mm.

Remarks. Although there is considerable morphological variation, comparison of Atlantic, eastern Pacific, and Indo-West Pacific samples was inconclusive. The anteriormost branchiostegal ray is not uncommonly absent, resulting in only 3 rays on the ceratohyal, as in the two individuals from the eastern Pacific. Similarly, gill filaments are long, with bases generally free, in the eastern Pacific specimens, and united in some of the Atlantic and Indo-West Pacific specimens, but free in others.

Distribution (Fig. 20). All Atlantic records are from the eastern side, from 9°18′S, 1 1°10′E (Blache 1964) to 57°N, 33°W (Gushchin and Kukuev 1980). Parr (1960) listed Dana material from the Indian Ocean and the South China Sea, which we have examined, and Sazonov (1976b) lists collections from the Arabian Sea and off Peru and Ecuador. Brewer's (1973) record from the Gulf of California is the northernmost in the eastern Pacific. SIO records are from off Peru and Chile, with the southernmost from 23°14.8′S, 71°22.4′W (SIO72-166).

Estimated depth of capture varies, but usually from below 1000 m (Krefft 1976). Probably the shallowest is that of SIO76-61, which was taken in a 3-m midwater trawl towed at 0-525 m through a deep scattering layer during the SIO Krill Expedition; and perhaps the deepest, at *Galathea* sta. 407 with 5300 m of wire out.

Material examined. SIO72-166 (1), SIO72-186 (4), SIO76-61 (1), LACM 30045-6 (1), MMF19489 (1), MMF22304 (1), ISH2402/71 (1), ISH3002/71 (1), ZMUC P. 1758 (1), ZMUC P. 1759 (1), ZMUC P. 1760 (1), ZMUC P. 17267 (2); MMSU P14130 (1), MMSU P14666 (1), IOAN uncat., *Vitiaz* cruise 57, sta. 7317 (1), IMARPE uncat. (1).

Barbantus parini Sazonov 1976
(Fig. 28E)

Barbantus parini Sazonov 1976a: 14-15, Fig. 1 (orig. descr.; holotype: ZIN42630, 5°29′N, 123°57′E, 1000-0 m); 1976b: 68, Figs. 7a, 8 (taxonomy); Parin et al. 1977: 106 (rec. of holotype); Sazonov 1978: 100-101 (counts and meas. of spec, from 8°53′S, 60°36′E).

Diagnosis. Greatest body depth 5.5 in SL; least depth at caudal peduncle 1.4 in greatest depth. Posterior margin of maxillary below the anterior margin of lens. Dorsal origin behind midlength by half its basal length. Entire dorsal ahead of anal fin. Basal length of dorsal slightly more than twice that of anal. Anus opposite the last to 2nd-from-last dorsal ray and in advance of anal origin by about a fourth of distance between anal origin and pelvic base. Mid-dentary ridge hardly noticeable, located ventrolaterally on the shallow anterior end of dentary, with a short row of 4-5 anteriorly directed mid-dentary teeth on each side. Opercular opening restricted and horizontal, ending at pectoral base. Exposed tube of shoulder organ 4 scale rows dorsad of gill opening. Scale rows on top of head extending to posterior margin of eye. Opercles and the head to posterior margin of orbit scaled; branchiostegal membrane unsealed. Because of the restricted gill opening, body scales continue uninterruptedly across the opercle onto the head, 10 to 11 rows anteriorly from pectoral base to posterior margin of orbit. About midway between pectoral and pelvic fins, a belt of 3-4 scale row with free margins directed ventrally, circles the body. The ventralmost scales in the belt are imbricated normally. Anterior to this belt, all scales (about 17 scale rows) are reverse imbricated. Pectoral base scaled. Infraorbital canal complete. Cephalic lateralis canal mostly lacking. Supratemporal canal intersected by the supraorbital canal, but not complete. Gill filaments relatively well developed, outer row present at angle of 1st arch; basal part united and about a third the length of the exposed part of filament.

D 13, A 10-11, P_1 19, P_2 7-8, Br 6-7, GR 4-5 + 14-17 (18 and 22), vertebrae 27 + 21. Scales in midlateral series (to pectoral fin) 46. Largest record: 163 mm.

Distribution (Fig. 20). The 5 specimens known to us are from the following locations: Gulf of Panama (SIO69-351, 3°10′N, 84°10′W), Celebes Sea (holotype), Sulu Sea (SIO77-53, 7°11′N, 121°26′E), and the Indian Ocean (*Galathea* sta. 316, 12°43′N, 91°12′E, and Sazonov 1978, 8°53′S, 60°36′E). The holotype and SIO69-351 were taken in nets sampling 0-1000-m depths; SIO77-53 at 0-1750 m; *Galathea* specimen with 4500 m of wire out; and Sazonov′s at 1350-1380 m.

Material examined. SIO69-351, 1 (122 mm); SIO77-53, 1 (52 mm); ZMUC uncat. *Galathea* sta. 316, 1 (106 mm).

Barbantus elongates Krefft 1970
(Fig. 28D)

Barbantus elongatus Krefft 1970: 22-27, Figs. 1-4 (orig. descr.; holotype: ISH874/68, 3°00′S, 26°16′W, 2000 m; paratype: ISH126/67,7°45′S, 13°34′W); 1976: Fig. 11 (5 rec. on distr. chart, 15°S-8°N, 6°-33°W); Sazonov 1976b: 68, Fig. 8 (taxonomy).

Diagnosis. Greatest depth 5.6-6.7 in SL; least depth at caudal peduncle 1.4-1.6 in greatest depth. Posterior margin of maxilla below the anterior margin of lens. Dorsal origin behind midlength by half its basal length. Entire dorsal ahead of anal fin. Basal length of dorsal nearly twice that of anal. Anus about opposite the posterior fourth of dorsal fin (10th ray), and in advance of anal origin by about a fourth to third of distance between anal origin and pelvic base. Mid-dentary ridge hardly noticeable, located ventrolaterally on shallow anterior end of dentary, with a short row of 4-5 anteriorly directed mid-dentary teeth on each side. Opercular opening level with mideye. Exposed tube of shoulder organ opposite dorsal margin of gill opening. Anteriormost scale rows on top of head in line with posterior margin of eye. Opercular region scaleless. Scales normally imbricated. Region between pectoral base and cleithrum scaleless. Infraorbital and cephalic lateralis canals complete. Dorsal half of supratemporal canal lacking, and supratemporal canal not intersected by supraorbital canal. Gill filaments relatively well developed, outer row present at angle of 1st arch; filaments basally united, about twice as long as exposed part at angle of 1 st arch and about equal to united part at ceratobranchial.

D 13-15, A 10-11, P_1 18-19, P_2 7-8, Br 6, GR 4 + 17, vertebrae 25 + 19-20 (44-45). About 54 scales in midlateral series. Largest record: 178 mm.

Distribution (Fig. 20). Tropical Atlantic from 15°45′S, 6°06′W (ISH1756/71) to 7°55′N, 32°41′W (ISH594/74). All known samples (5), including holotype and paratype, collected by *Walter Herwig* (ISH) at sampling depths of 1800-2000 m. Only other locality of capture besides those of type material and the two above is 10°57′S, 11°20′W (ISH1916/71).

Material examined. ISH1756/71 (2), ISH594/74 (1).

Barbantus aequipinnis n. sp.

(Fig. 28B)

Diagnosis. Greatest depth 5 in SL; least depth at caudal peduncle 2.2 in greatest depth. Maxilla extending to below the posterior margin of lens. Dorsal origin behind midlength by about its basal length. Dorsal and anal fins equal and nearly opposite, the dorsal ahead by about 4-5 rays. Anus slightly ahead of dorsal and a short distance (less than a fifth of the distance between pelvic and anal fins) before anal origin. Mid-dentary ridge hardly noticeable, with a row of about 13 short mid-dentary teeth on each side. Opercular opening just below mideye. Exposed tube of shoulder organ nearly a scale row below the top of gill opening. Anterior scale row on dorsal side nearly to the posterior margin of eye (a distance about equal to 1-2 scale rows back). Opercular region scaleless. Scales normally imbricated. Area below supracleithrum to slightly below anterior base of pectoral fin unsealed. Infraorbital canal interrupted at about the 3rd infraorbital bone, and the cephalic lateralis canal, by a large gap on the middle. Supratemporal canal absent. Gill filaments poorly developed, no anterior row at the angle of epibranchial and ceratobranchial of lst-4th arches; filaments united basally, united portion equal to exposed part of filaments.

D 13, A 13, P_1 16, P_2 8, Br 8, GR 9 + 25, vertebrae 21 + 19. Scales in midlateral series 52. U_1 centrum absent.

Description. Counts and measurements of holotype are in Table 7. Body elongate, with greatest depth (5 in SL) about twice least depth at caudal peduncle and moderately compressed, the greatest width at cleithrum 1.7 in greatest depth; width at sphenotic slightly greater than at cleithrum. Dorsal and ventral margins between pectoral girdle and the dorsal and anal fins of nonmuscular tissue, comprising about one-fourth body depth. Caudal peduncle long, about twice its least depth. Pelvics inserted just before midlength. Dorsal origin behind midlength by nearly the length of dorsal base. Dorsal and anal fins subequal and nearly opposed, dorsal ahead by 4-5 rays. Anus slightly more anterior than dorsal origin and ahead of that of anal by a short distance. Pectorals low on body, with rays directed backward. Cleithral symphysis normal, not produced as a spine.

Head 3.7 in SL. Eyes large, 2.7 in HL, exposed above outline of frontals and looking partly anteriorly over snout. Aphakic space oriented anterodorsally. Frontals expanded behind eye, narrowing abruptly, and narrow over eye, with little taper anteriorly. Supraorbitals absent. Snout broader (2.9 in HL) than long (4 in HL). Premaxillae shallow and meeting anteriorly. Lower jaw projecting slightly, with a small knob at symphysis. Anterior nares and opening of the supraorbital canal open anteriorly and nearly bordering premaxillae. There are 5 lamellae in rosette near anterior end of elongated nasal sac. The thin antorbital runs along posteroventral margin of nasal sac and is connected to lacrimal by ligaments. Mouth relatively small, with maxilla ending below the posterior margin of lens. Upper jaw not overlapped by lacrimal, which extends to anterior margin of eye. Other infraorbitals without laminar extension. Maxilla convex ventrally, rather deep, about as deep as posterior supramaxilla. Anterior supramaxilla shallower and shorter than posterior supramaxilla. Tendon from A_1 of the adductor mandibulae inserted on anterior part of maxilla. Dentary about half as deep as maxilla at symphysis, deepening posteriorly in a coronoid process. Maxillo-mandibular ligament inserted on dentary lateral to the posteriormost mid-dentary tooth. From a loose lobe of tissue near its anterior end the ligament extends across the top of the dentary and down a very short distance to the medial side. The tendon thus interrupts the dentary tooth row.

Opercles wide posteriorly, narrowing anteriorly, with ventral margin in a relatively steep angle anterodorsally. Posterior margin about 2.5 in body depth, 4 times wider than subopercle, and over 8 times wider than dorsalmost branchiostegal ray. There are 4 partly flattened branchiostegal rays laterally on epihyal, and 4 acinaciform branchiostegal rays on ceratohyal; 3 dorsalmost rays on epihyal relatively close-set. Dorsal margin of gill opening just below mideye. Only tip of the tubular opening of shoulder organ exposed, which is above the ventral tip of supracleithrum and about a scale row below the dorsal margin of gill opening. Gill filaments poorly developed, lacking outer row at angle of epibranchial and ceratobranchial of lst-4th arches. Bases of gill filaments united, the fused portion about equal in length to exposed part. Medial rakers lacking on 1st arch, only a small stub on epibranchial of 2nd arch; 3rd and 4th arches with complete complement.

About 22 small teeth, plus 6 in a short outer row (posteriorly) on the left premaxilla, none enlarged, and 60 on left maxilla in a single row; right side with slight injury. Regular dentary row interrupted by a diastema; on left side 16 anterior to diastema and 8 posterior to it, on the right 12 anterior and 7 posterior. Teeth in premaxillae, maxillae, and dentary short and slightly compressed with a wide base, and ending in a sharp point. Teeth small, of nearly even size, those of premaxillae the smallest. Premaxillary teeth and those before the diastema on dentary are across the front of jaw, none lateral. Similarly, the 10 on left and 11 on right of mid-dentary row are across the front. Mid-dentary teeth short, conical, and pointed dorsad. There are 2 short, widely spaced vomerine teeth aligned with similar-sized teeth on each palatine; 2 uneven rows of small short teeth on a relatively flat tooth plate between 2nd and 3rd basibranchials, and 2 teeth medially on basihyal. Mesopterygoids and ectopterygoids edentulous. Teeth present on 4th epibranchial and on the upper pharyngeal of 4th arch.

Scales relatively large, weakly imbricated, 52 along midline. Area anterior to pectoral base extending dorsally to near the top of opercular opening unscaled. Scalepockets without pores. Lateral line unmarked, without a canal and modified scales.

Cephalic lateral line canals without side branches. Supraorbital canal extending from premaxilla to just behind eye, with 7 pores on left side and 6 on right. The infraorbital and preoperculomandibular canals nearly complete, the infraorbital canal disjunct between the 2nd and 3rd infraorbitals and the preoperculomandibular a short distance at its dorsal end. These canals narrowly separated at dorsal end and the postocular commissure very short. Cephalic lateralis canal interrupted in the middle and not passing through the posttemporal or supracleithral bones. Supratemporal canal absent. Subcutaneous canal without a canal through posttemporal bone.

Photophores absent. U_1 centrum absent. Laminar flanges lacking on haemal and neural spines of preural centra.

Relationships. The equal and nearly opposed dorsal and anal fins of *Barbantus aequipinnis* is a feature found in *Platytroctes*, the apparent primitive sister group of *Barbantus,* and the more advanced dorsal fin position of other *Barbantus* species is apparently derived. The presence of mid-dentary teeth in *B. aequipinnis* also seems generalized with respect to the lateral spine of *curvifrons* or the anteriorly directed teeth of *elongatus* and *parini*.

B. aequipinnis appears to be the most generalized species of *Barbantus*. It is more closely related to *curvifrons* than to *elongatus* and *parini*, as indicated in Table 6.

Derivation of name. From the Latin *aequalis*, uniform, and *pinna*, fin, in reference to the opposed dorsal and anal fins.

Distribution. Known only from the holotype from the Sulu Sea.

Material examined. Holotype: ZMUC P17287, 119 mm SL, 7°54′N, 121°30′E, taken in an otter trawl with 8000 m of wire out on August 17, 1951.

TABLE 6 Characters of *Barbantus* Species

	aequipinnis	$/bar{\rm X}$curvifrons	*elongatus*	*parini*
Basal length of dorsal and anal fin	equal	dorsal 20-30% longer	dorsal twice anal	dorsal twice anal
Position of dorsal and anal origin	nearly opposite	dorsal a fourth to half basal length ahead	entire dorsal ahead of anal	entire dorsal ahead of anal
Posterior margin of maxilla ends	posterior margin of lens	posterior margin of pupil to posterior margin of eye	anterior margin of lens	anterior margin of lens
Greatest depth/least depth	2.1	2.0-2.2	1.4	1.4
Opercular opening	below mideye	above mideye	mideye	pectoral base
D	13	16-19	13-15	13
A	13	12-15	10-11	10-11

TABLE 7 Measurements (in millimeters) and Counts of New Species

	Tragularius mesalirus	T. bythios		
	ISH2488/71 holotype	*ISH3244/71 paratype*	*ISH3246/71 paratype*	*IOAN (uncat.) holotype*
SL	205	147	222	181
Head	68	57	61	64
Upper jaw	45	35	52	40
Eye	10	12	17	14
Interorbital	15	12	17	15
Snout	18	15	23	19
Preanal	135	105	149	121
Prepelvic	105	85	116	97
Predorsal	127	98	145	115
Anal base	38	21	34	29
Dorsal base	42	24	42	34
Length caudal peduncle	35	32	41	31
least depth caudal peduncle	18	11	18	15
Greatest depth	45	29	44	37
Dorsal	20	19	18	19
Anal	19	16	17	17
Pectoral	17/16	19/18	15/15	15/15
Pelvic	8/8	8/8	7/7	8/8
Branchiostegals	8	8	8	8
Gillrakers	8+19	7 + 22	7 + 20	8+19
Vertebrae	24+19	22 + 20	24+18	24+19
Scales along midline	85	97	85	82
Modified scales in lateral line	47	47	45	—
—	—	—	—	—

TABLE 7 Measurements (in millimeters) and Counts of New Species

Pellisolus eubranchus			Maulisia (Aphanichthys) isaacsi	Barbantus aequipinnis
SIO64-39 holotype	SIO59-200 paratype	SIO67-101 paratype	SIO52-404 holotype	ZMUC P17287 holotype
111	48	62	95	119
33	17	22	32	32
17	8.4	10	16	17
12	5.4	7.8	7.5	12
4.7	1.8	2.1	7.9	6
6.8	4.2	4.4	9.9	8
75	30	44	66	81
58	25	34	53	57
73	31	39	63	74
16	8.7	10	14	17
18	9.2	12	16	17
20	9.5	11	19	23
10	3	6.6	9.2	11
23	8.9	13	18	24
17	17	17	16	13
15	15	15	15	13
18/18	ca. 19	20/20	16/16	16/16
8/8	7/7	7/7	8/8	8/8
6	8	7	8	7/7
6+17	5+18	5+17	7+19	9 + 25
20 + 22	—	23 + 21	24 + 22	21 + 19
67	—	57	84	52
—	—	—	—	—

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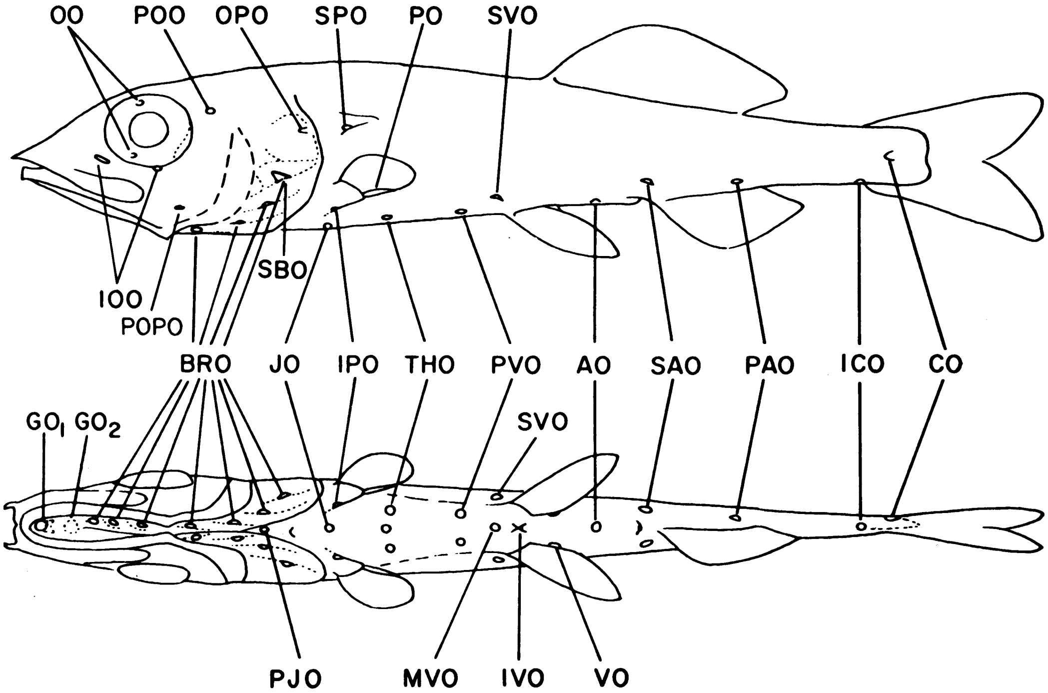


Figure 1. Diagrammatic view of the photophores of platytroctids. AO, anal organ; BRO, branchiostegal organ; CO, caudal organ; GO_1, anterior gular organ; GO_2, posterior gular organ; ICO, infracaudal organ; IOO, infraorbital organ; IPO, infrapectoral organ; IVO, interventral organ; JO, jugular organ; MVO, midventral organ; OPO, opercular organ; OO, orbital organ; PAO, postanal organ; PJO, prejugular organ; PO, pectoral organ; POO, postorbital organ; POPO, preopercular organ; PVO, preventral organ; SAO, supra-anal organ; SBO, subopercular organ; SPO, suprapectoral organ; SVO, supraventral organ; THO, thoracic organ; VO, ventral organ. (Modified from Parr 1960 and Matsui and Rosenblatt 1971.)

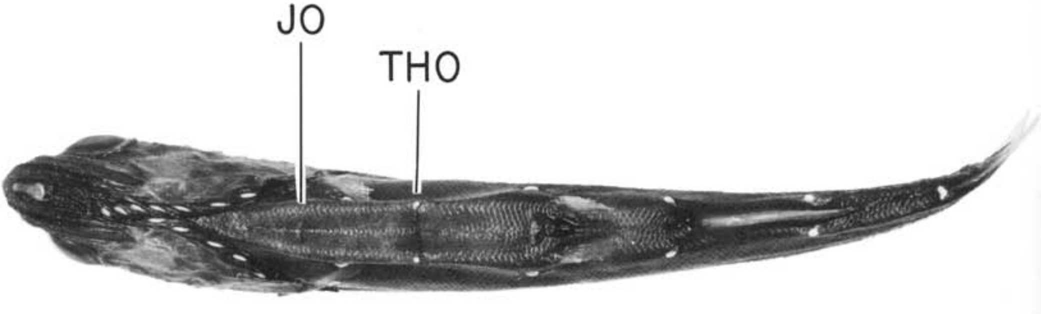


Figure 2. Ventral view of a 117 mm SL *Sagamichthys abei* (SIO75-463), showing two longitudinal rows of photophores laterally along the flattened ventral margin. The transversely barred THO is blacked out at the middle with only the ends exposed, and the transversely barred JO is covered by dark tissue.

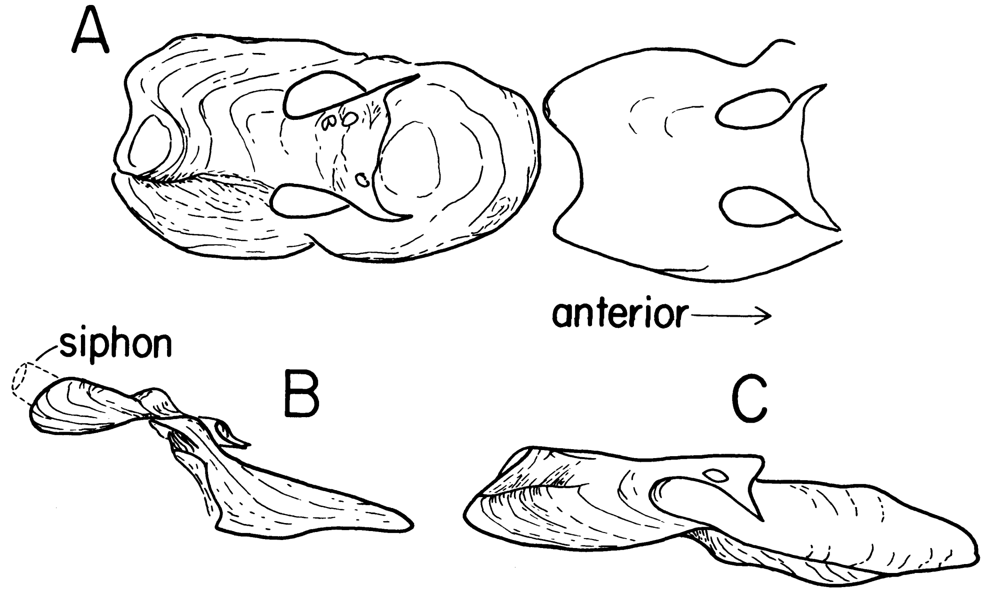


Figure 3. Camera lucida drawings of modified lateral line scales from a 195 mm SL *Sagamichthys abei* (SIO66-488): A. top view; B. side view; C. partially rotated view to show curvature of margins.

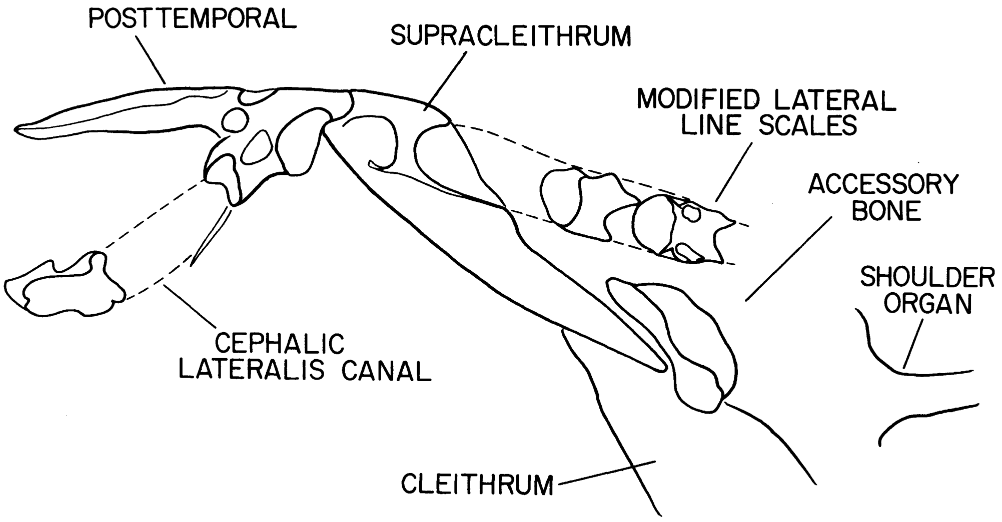


Figure 4. Camera lucida drawing showing the cephalic lateralis canal and part of the shoulder girdle of a (cleared and stained) 125 mm SL *Paraholtbyrnia cyanocephala* (SIO77-53).

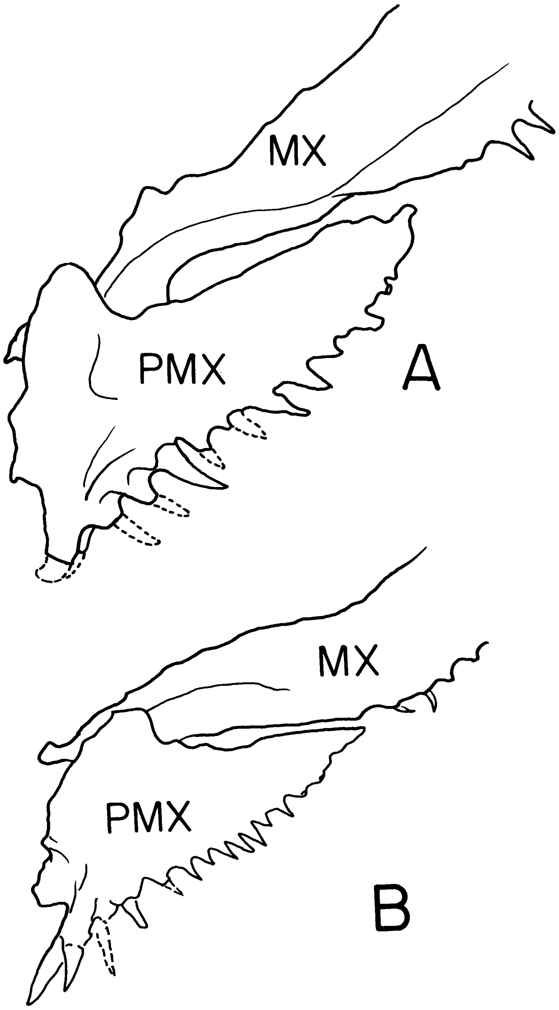
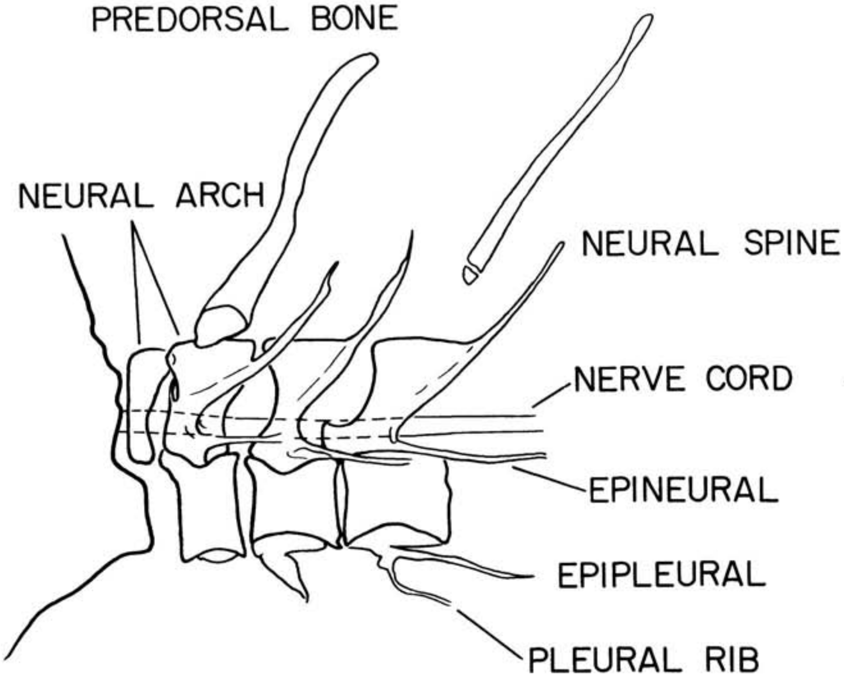


Figure 5. Camera lucida drawing of the premaxilla (PMX) and part of the maxilla (MX) of cleared and stained specimens of: A. the mesopelagic *Paraholtbyrnia cyanocephala* (SIO77-53), and B. the bathypelagic *Maulisia (Aphanichthys) microlepis* USNM215612), showing the difference in the arrangements of premaxillary tusks and teeth.

a


PREDORSAL BONE
NEURAL ARCH
NEURAL SPINE
NERVE CORD
EPINEURAL
EPIPLEURAL
PLEURAL RIB

b

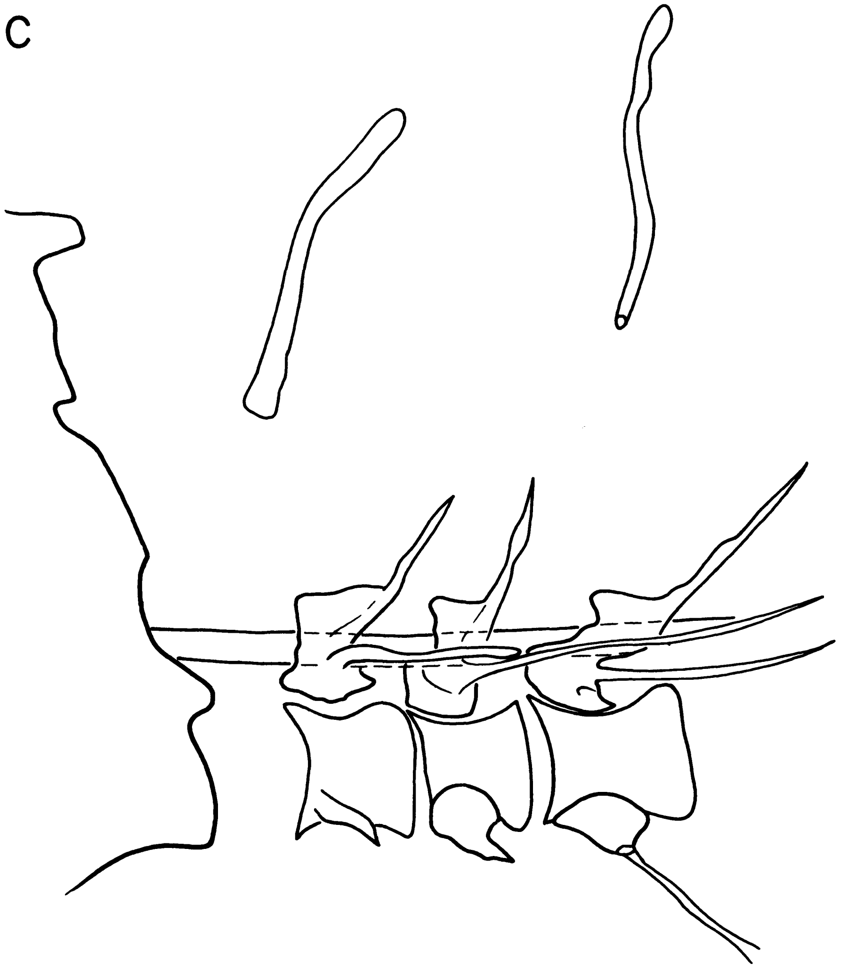


Figure 6. Camera lucida drawings of the anterior vertebrae of certain platytroctids: A. *Mirorictus taningi*, 89 mm SL (SIO66-20); B. *gamichthys abei*, 118 mm SL (SIO66-488); C. *Platytroctes apus*, 100 mm SL (SIO69-351).

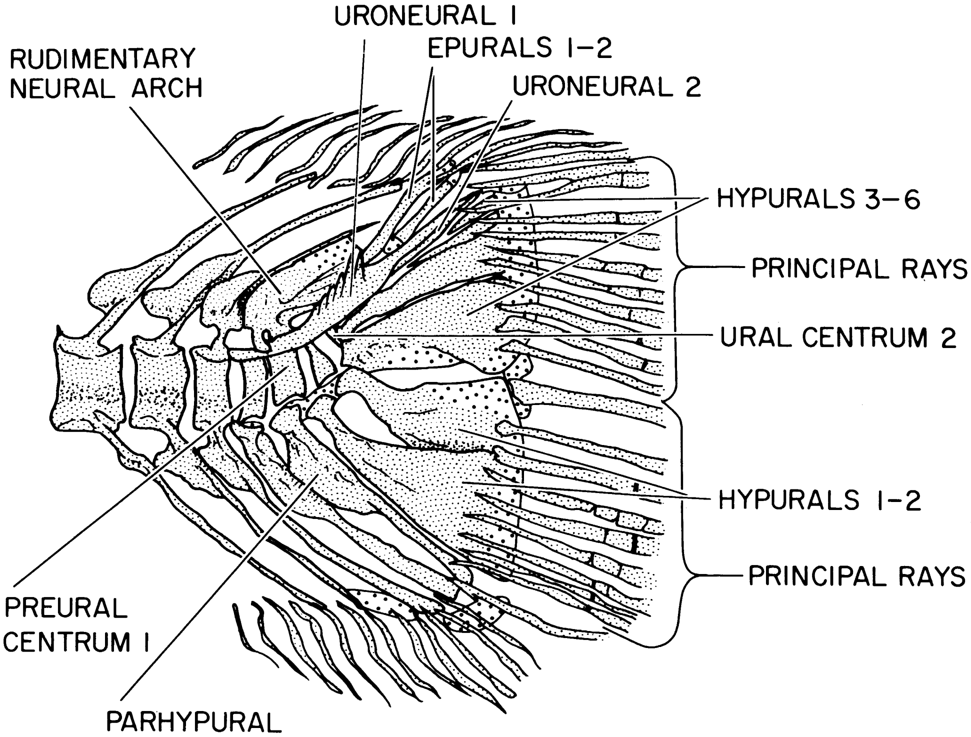


Figure 7. Camera lucida drawing of the caudal region of a 125 mm SL *Paraholtbyrnia cyanocephala* (SIO77-53). Cartilage indicated by coarse stippling.

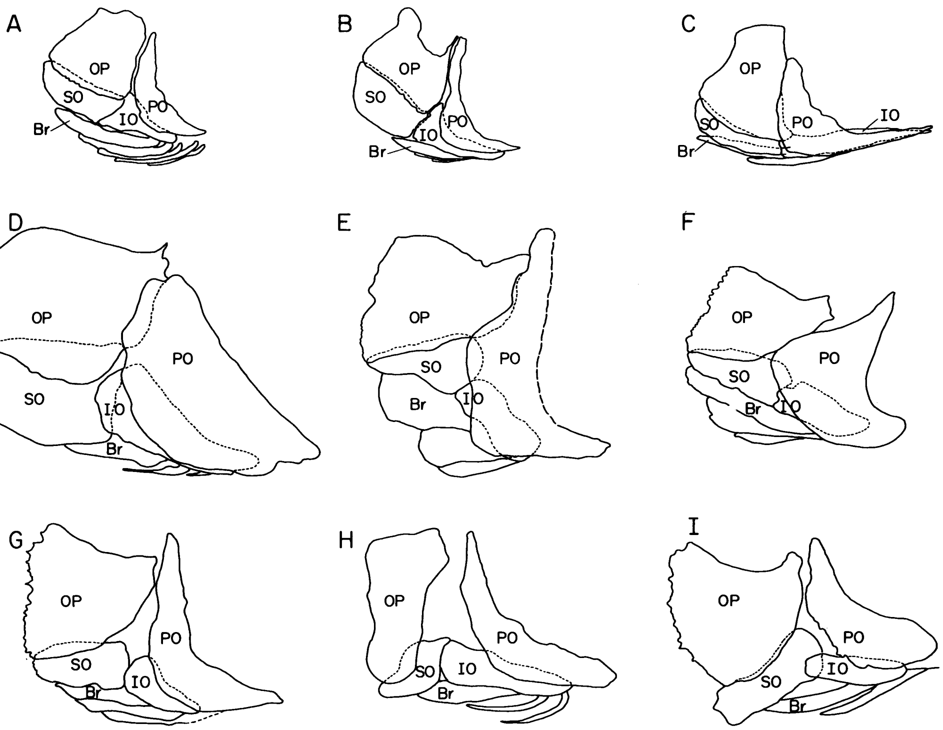


Figure 8. Camera lucida drawings of the opercular series of: A. *Salvelinus malma* (Salmonidae), SIO69-93; B. *Mallotus villosus* (Osmeridae) SIO62-464; C. *Argentina sialis* (Argentinidae), SIO83-52; D. *Bathyprion danae* (Bathyprionidae), SIO68-478; E. *Persparsia kopua*, SAM23160; F. *Paraholtbyrnia cyanocephala*, USNM206945; G. *Normichthys yahganorum*, ISH1034/71; H. *Platytroctes apus*, SIO55-244; I. *Bathytroctes alvifrons*, SIO59-269. Figures A and B are from cleared and stained specimens, the remainder from whole specimens. Br, branchiostegal ray; IO, interopercle; OP, opercle; PO, preopercle; SO, subopercle.

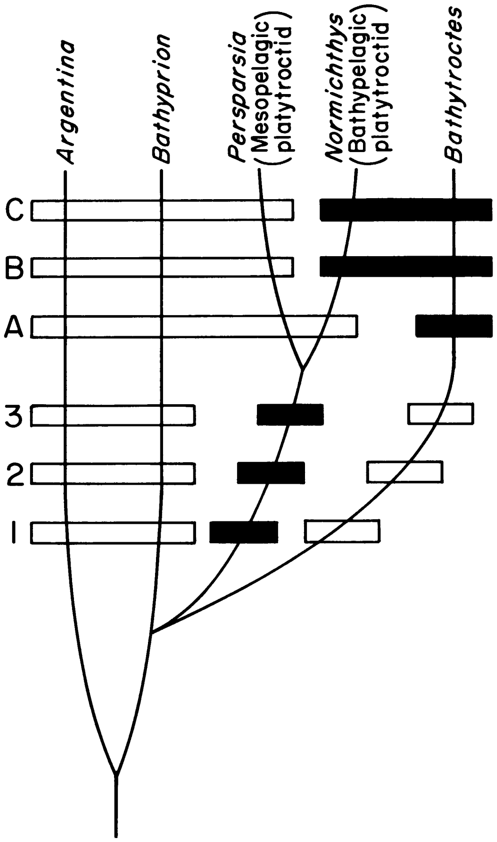


Figure 9. Cladogram comparing the opercular series (characters A, B, C) in aleopcephaloids and including *Argentina* (Argentinidae) as an outgroup. Characters 1,2, and 3 are included as examples showing the monophyly of the Platytroctidae. (Other characters indicating monophyly of platytroctids and discussed in the text are the presence of: the shoulder organ, the subcutaneous canal system, a U_2 centrum that is overlapped by bases of the 3rd and 4th hypurals, an anterior epural that is much longer than the posterior epural, and photophores or their rudiments in a set pattern and at certain locations.) Hypothesized apomorphies are represented by solid bars and symplesiomorphies by open bars. Apomorphic states, with symplesiomorphies in parentheses, are as follows: 1. predorsal spines over every 2nd-3rd anterior vertebra (over every anterior vertebra); 2. PU_1 to PU_3 vertebrae about half as long as PU_5 (PU_1-PU_5 vertebrae about equal in length); 3. premaxillary tusks present (absent); A. subopercle not linearly aligned behind interopercle, but meeting at an angle and not parallel to uppermost branchiostegal ray (subopercle and interopercle linearly aligned and parallel to uppermost branchiostegal ray); B. opercle subtriangular with ventral margin diagonal, posteroventral (opercle squarish, with nearly straight and subhorizontal ventral margin); C. some overlapping of interopercle by preopercle, with partly unprotected area behind preopercle (preopercle widely overlapping interopercle).

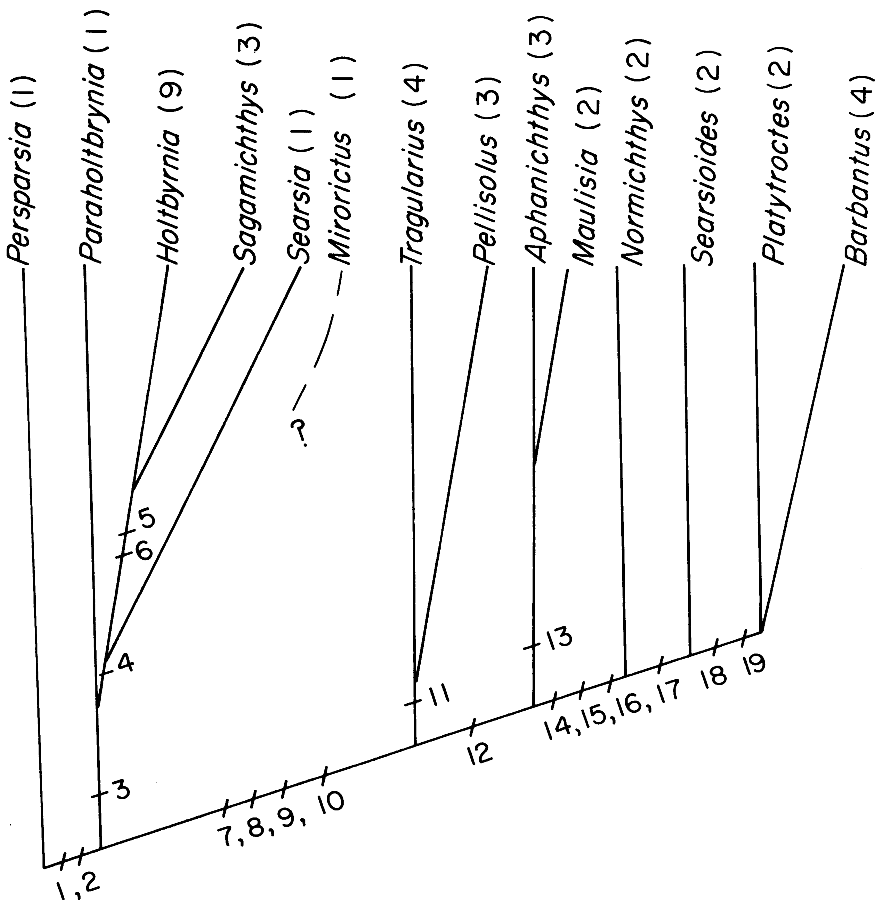


Figure 10. Proposed phylogenetic relationships of the genera of platytroctids. 1. THO, MVO, JO barred; 2. none of the photophores in young posteriorly directed; 3. a vertically directed tooth at base of premaxillary tusk; 4. upper jaw partially overlapped by 1st and 2nd infraorbitals, but not 3rd; 5. 2nd premaxillary tusk parallel to 1st and much smaller; 6. supraorbital cupped over most of eye; 7. cleithral symphysis produced in a spine; 8. as many as 4 premaxillary tusks, none parallel, smaller posterior teeth subhorizontal anteriorly and in series with tusks; 9. lacrimal largest infraorbital, only lacrimal overlapping upper jaw; 10. posttemporal without a canal; 11. lacrimal enlarged, below half to entire border of eye; 12. body compressed, nonmuscular tissue along dorsal margin; 13. top of head diamond shaped, with frontals protecting posterior half of eye and anterior half protected by large supraorbital; 14. anal and dorsal fins subequal and opposed; 15. premaxillary tusks, occasionally 2, usually single or absent; 16. supraorbital reduced or absent; 17. cleithral symphysis sharply pointed; 18. ligament crossing dentary; 19. premaxillary teeth across front of mouth, almost none lateral. (Number of species in the genus in parentheses.)

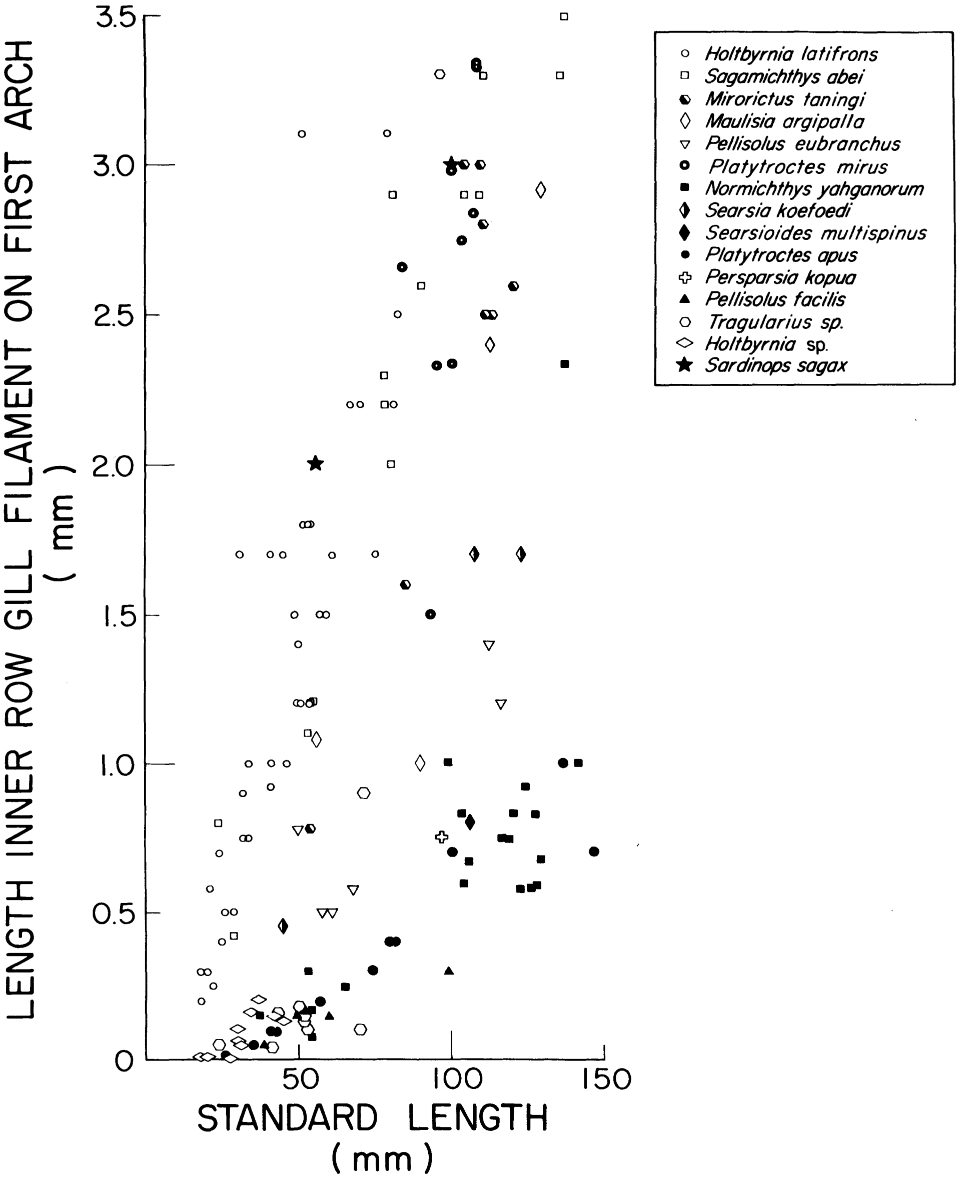


Figure 11. Length of anterior gill filament at junction of the ceratobranchial and epibranchial of the first arch versus standard length in certain platytroctid species. *Sardinops sagax* included for comparison with an active epipelagic fish.

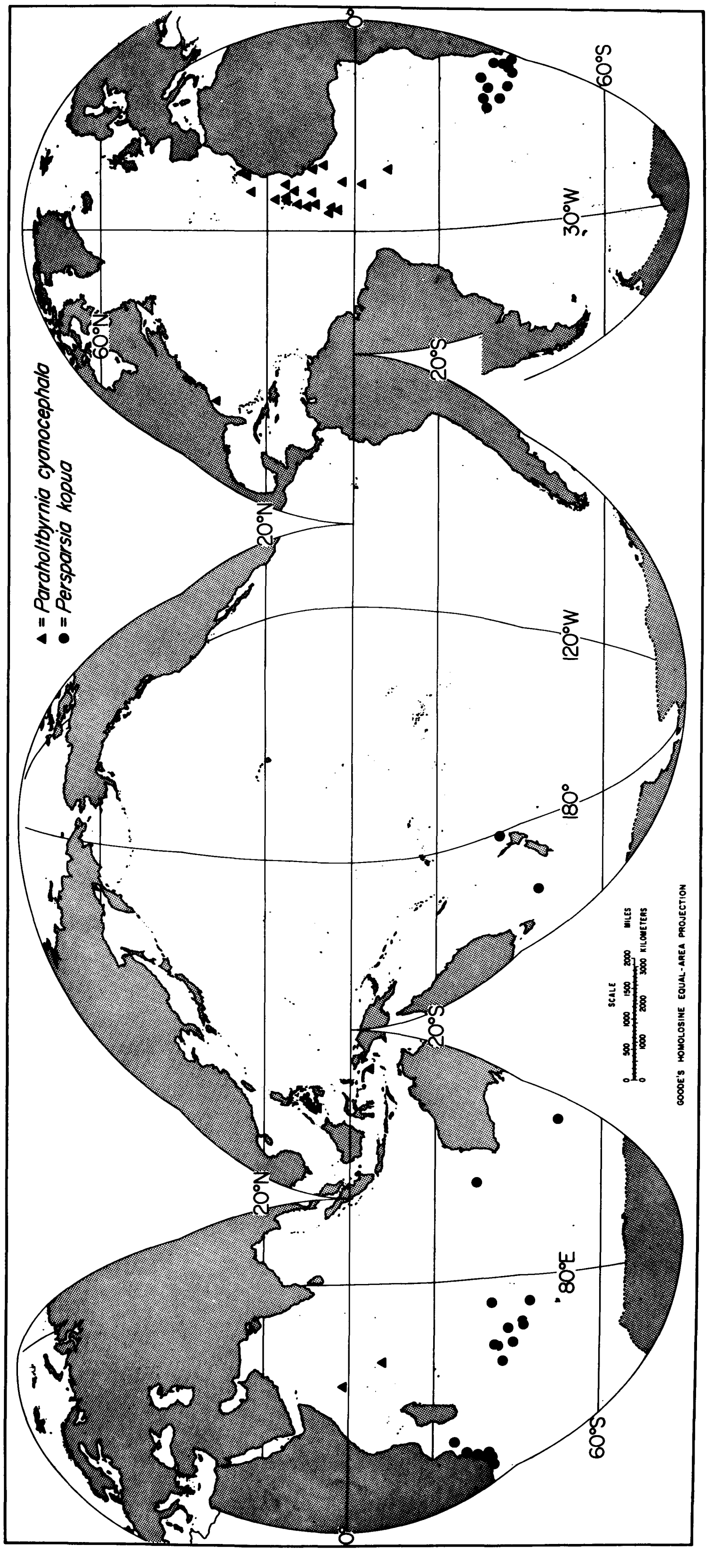


Figure 12. Distribution of *Persparsia kopua* and *Paraholtbyrnia cyanocephala*, based on collections examined and supplemented published records.

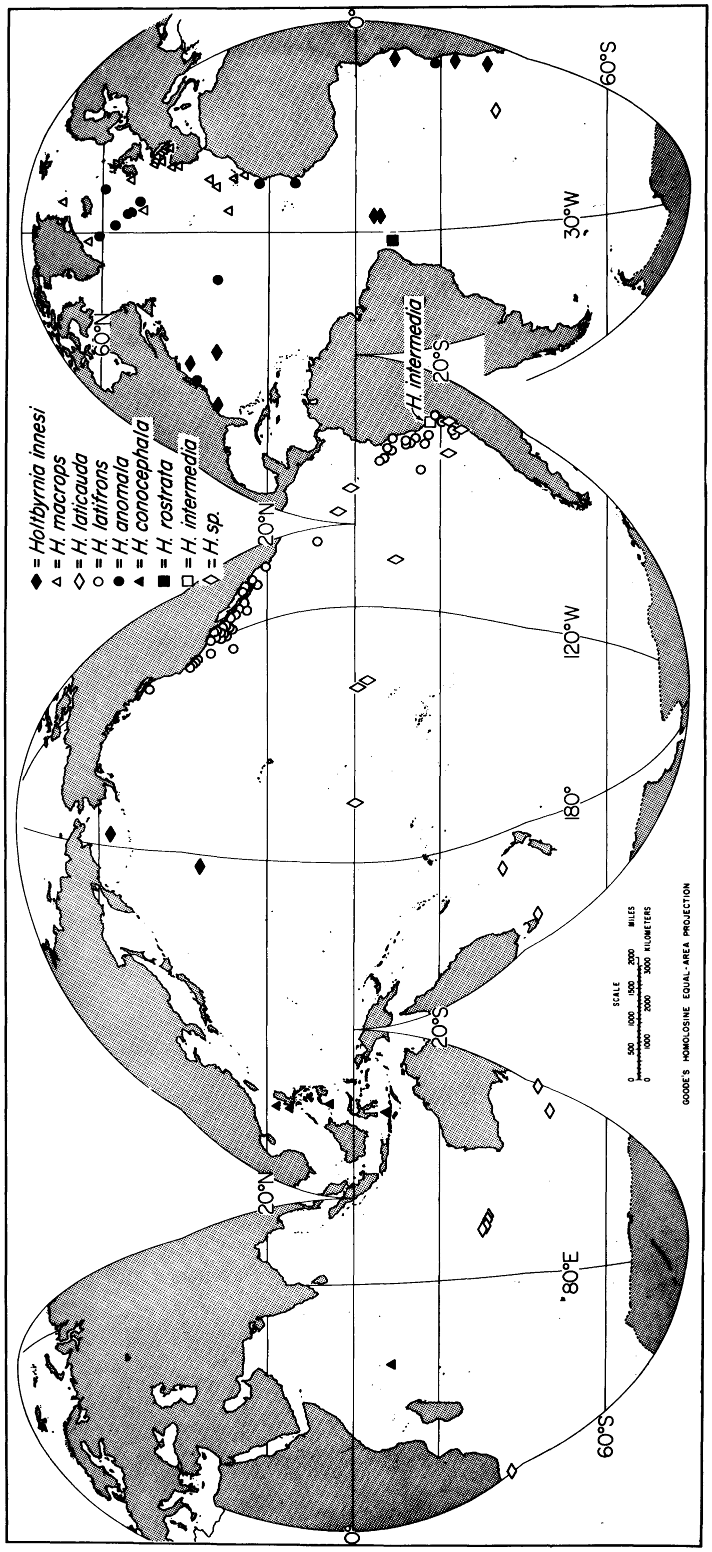


Figure 13. Distribution of *Holtbyrnia* species, based on collections examined and supplemented by published records. In this and other distribution charts, a single mark may represent several closely spaced records (e.g., some of those for *H. latifrons* and *H. macrops).*

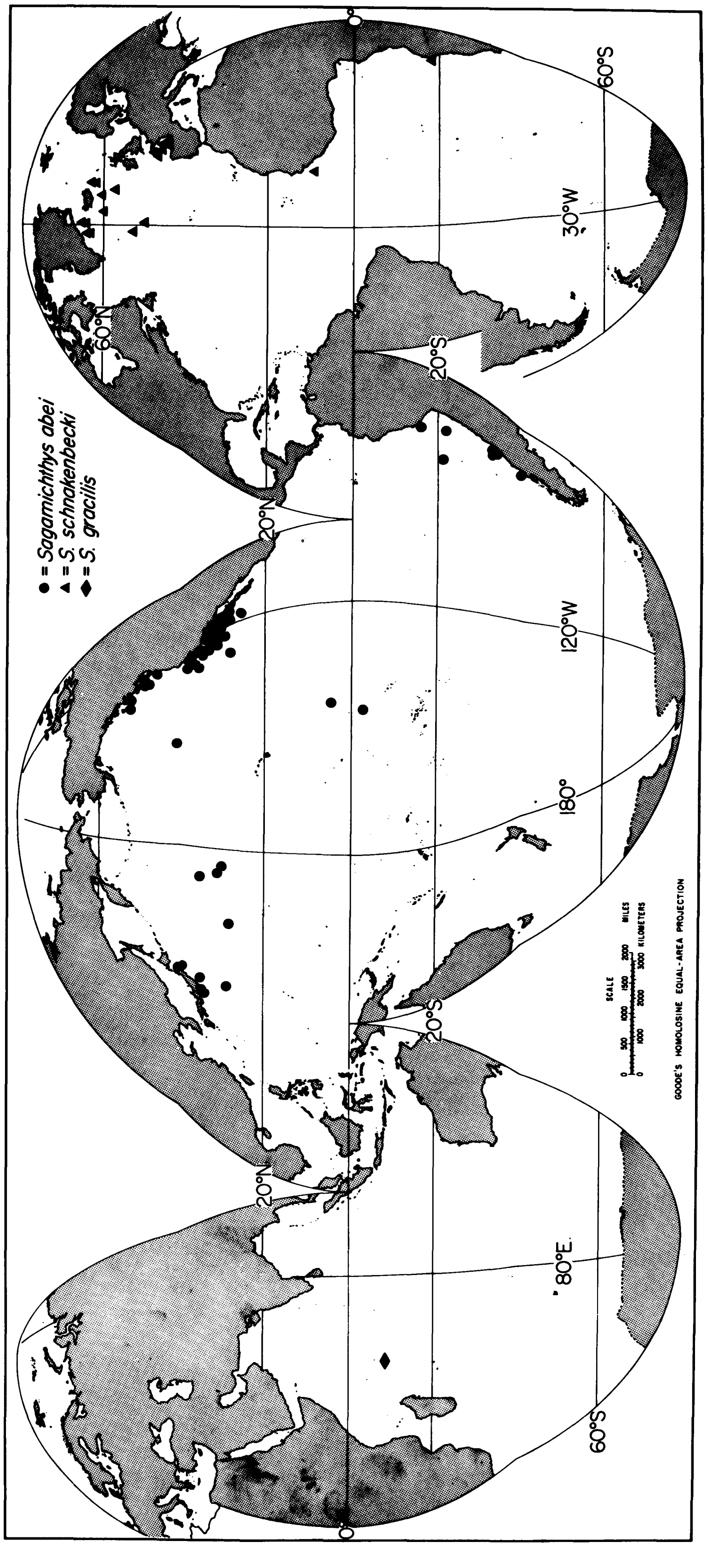


Figure 14. Distribution of *Sagamichthys* species, based on collections examined and supplemented by published records.

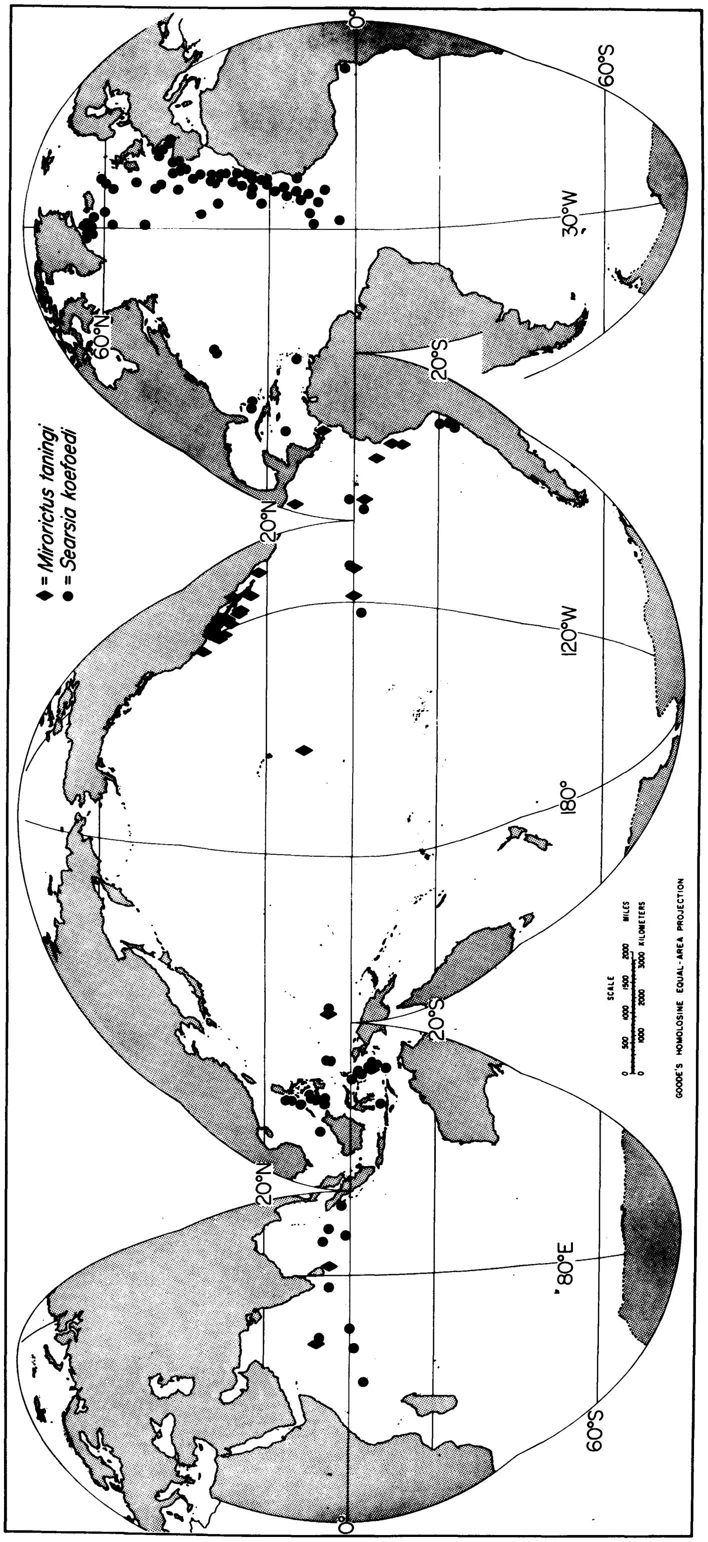


Figure 15. Distribution of *Searsia koefoedi* and *Mirorictus taningi*, based on collections examined and supplemented by published records.

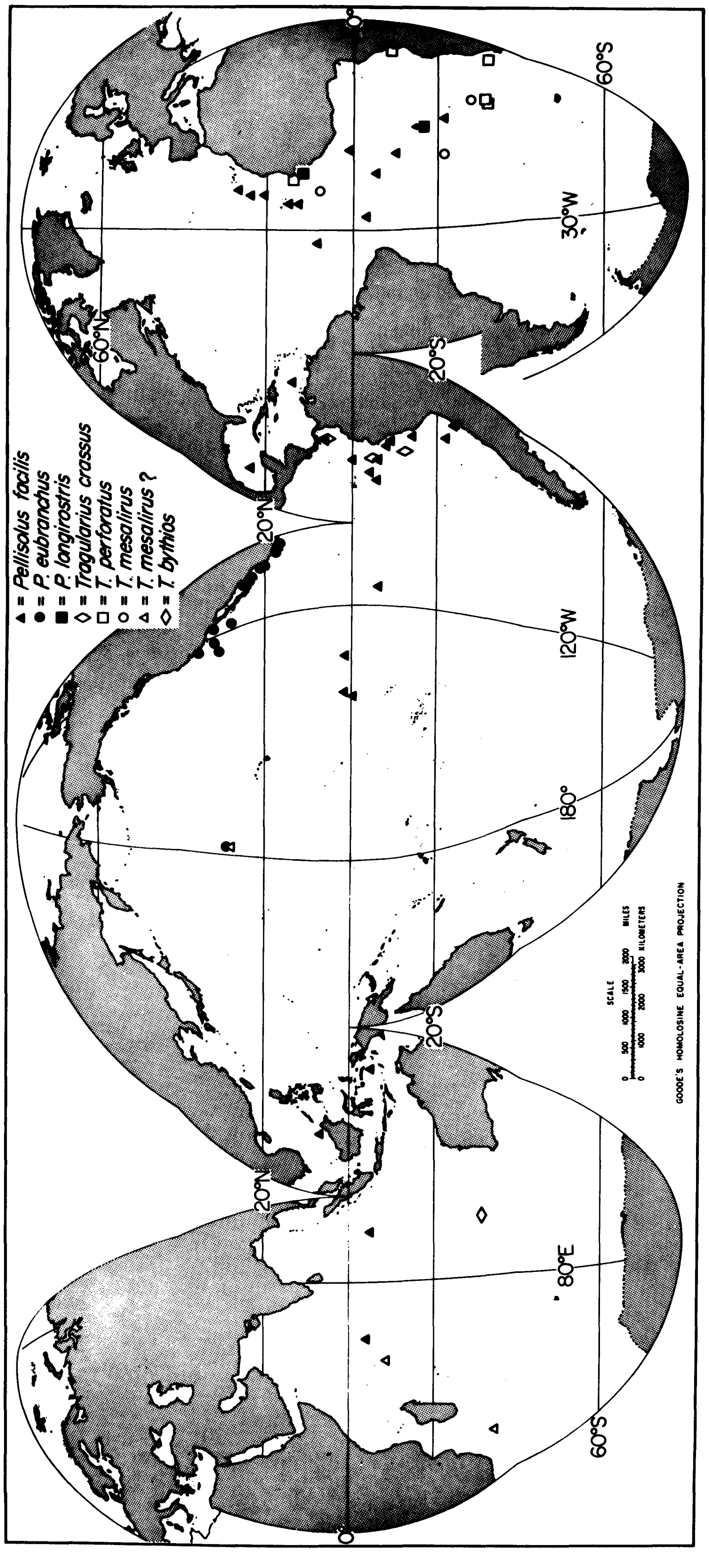


Figure 16. Distribution of *Pellisolus* and *Tragularius*, based on collections examined and supplemented by published records.

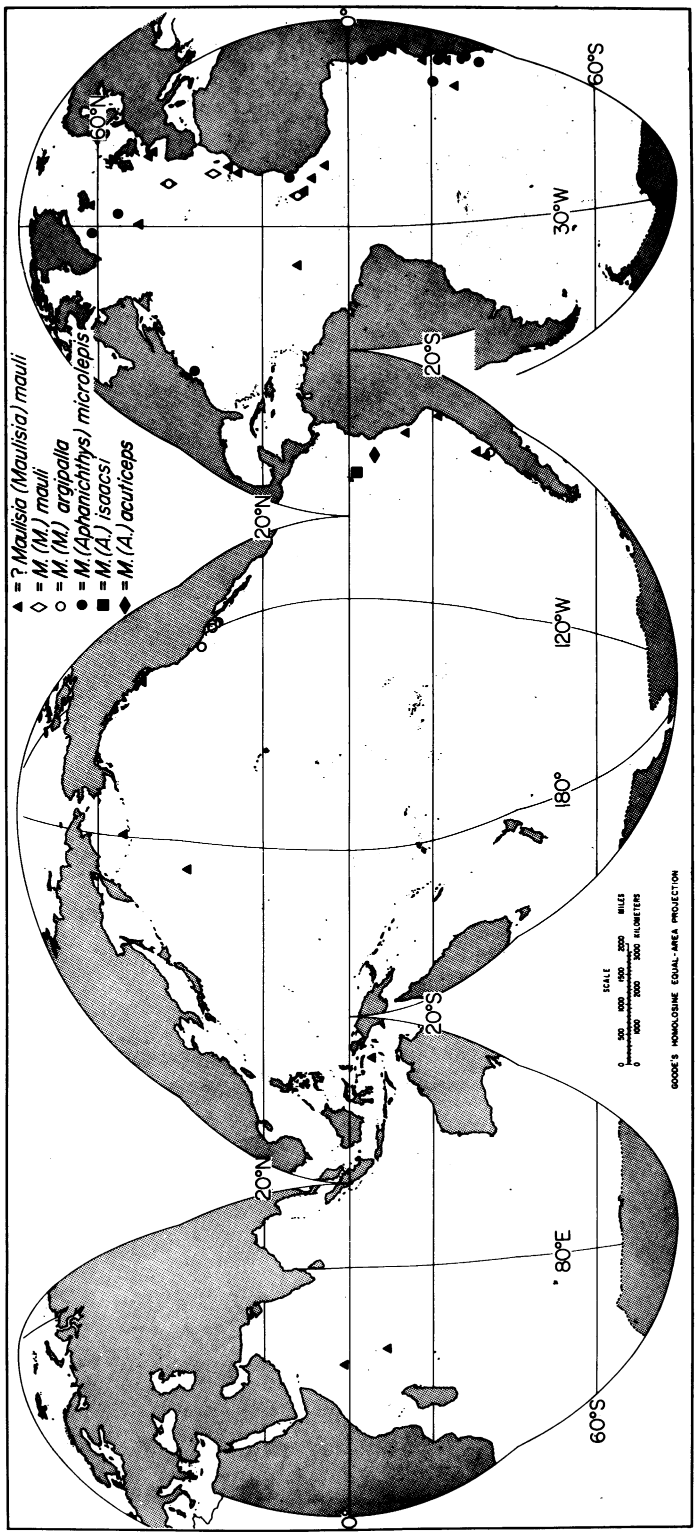


Figure 17. Distribution of *Maulisia*, based on collections examined and supplemented by published records.

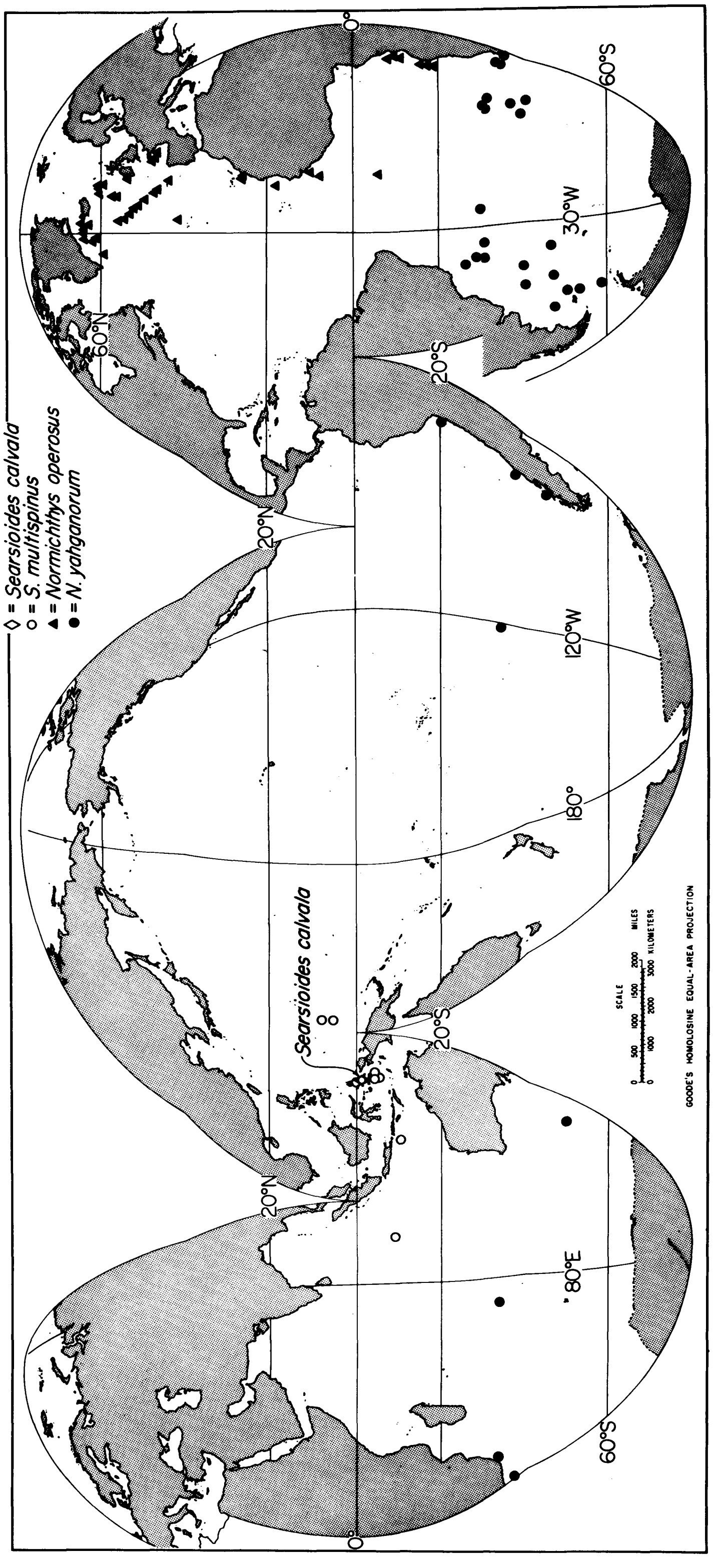


Figure 18. Distribution of *Normichthys* and *Searioides*, based on collections examined and supplemented by published records.

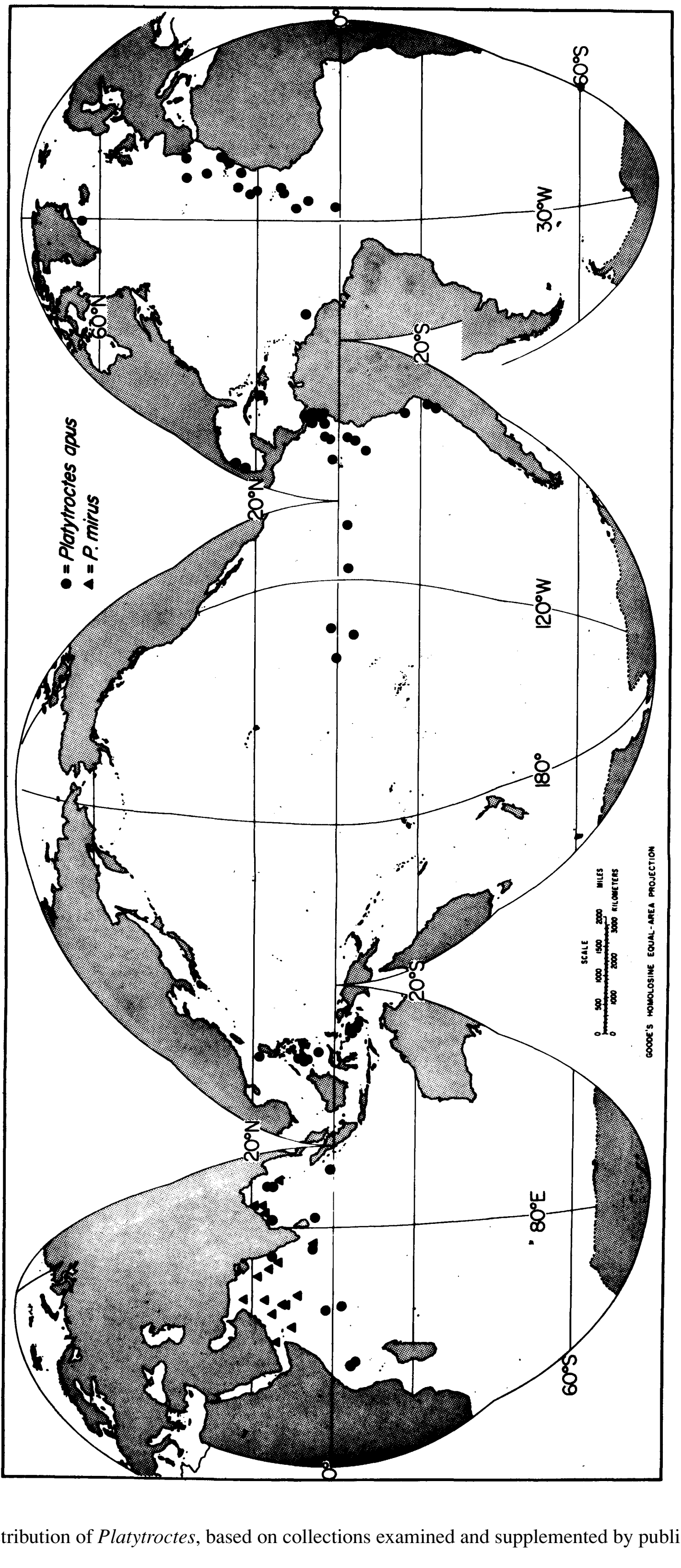


Figure 19. Distribution of *Platytroctes*, based on collections examined and supplemented by published records.

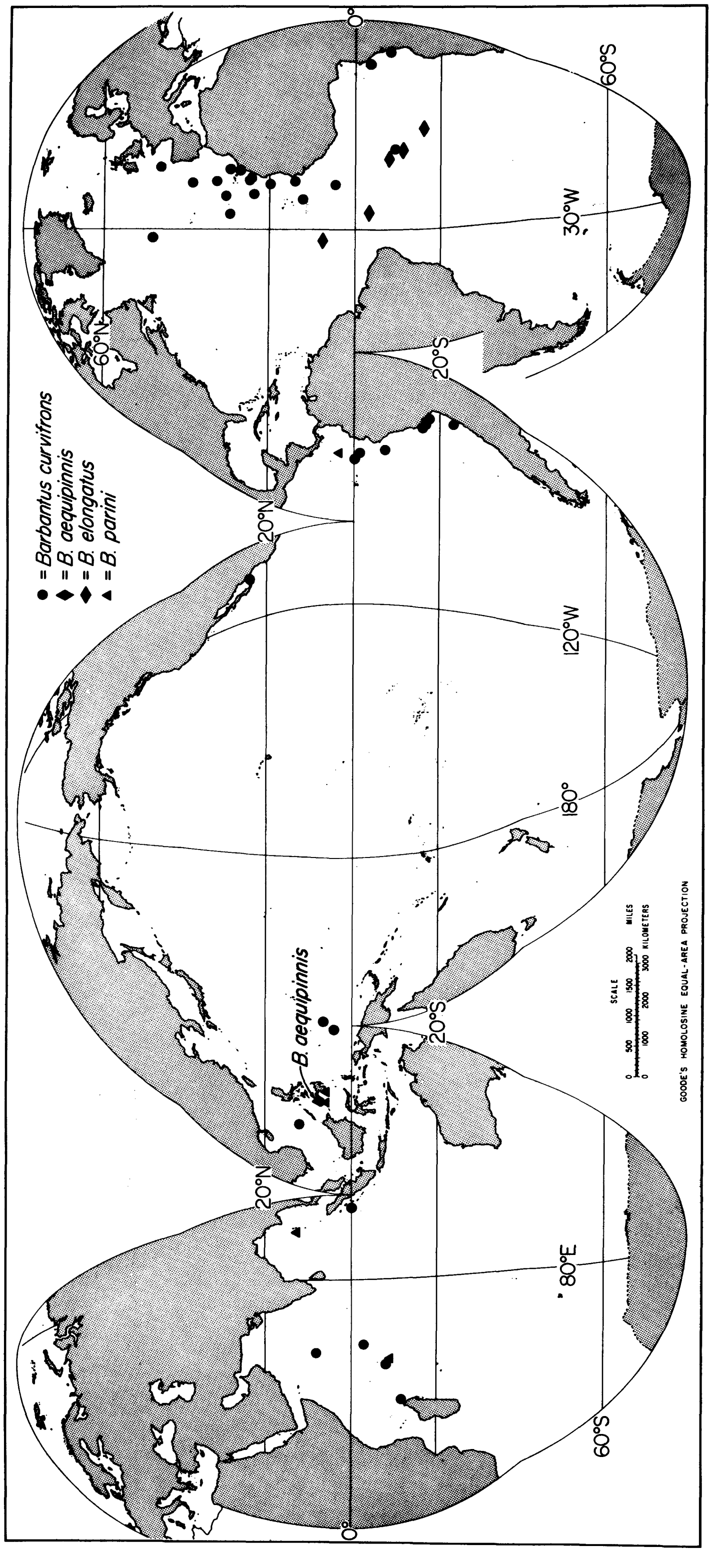


Figure 20. Distribution of *Barbantus*, based on collections examined and supplemented by published records.

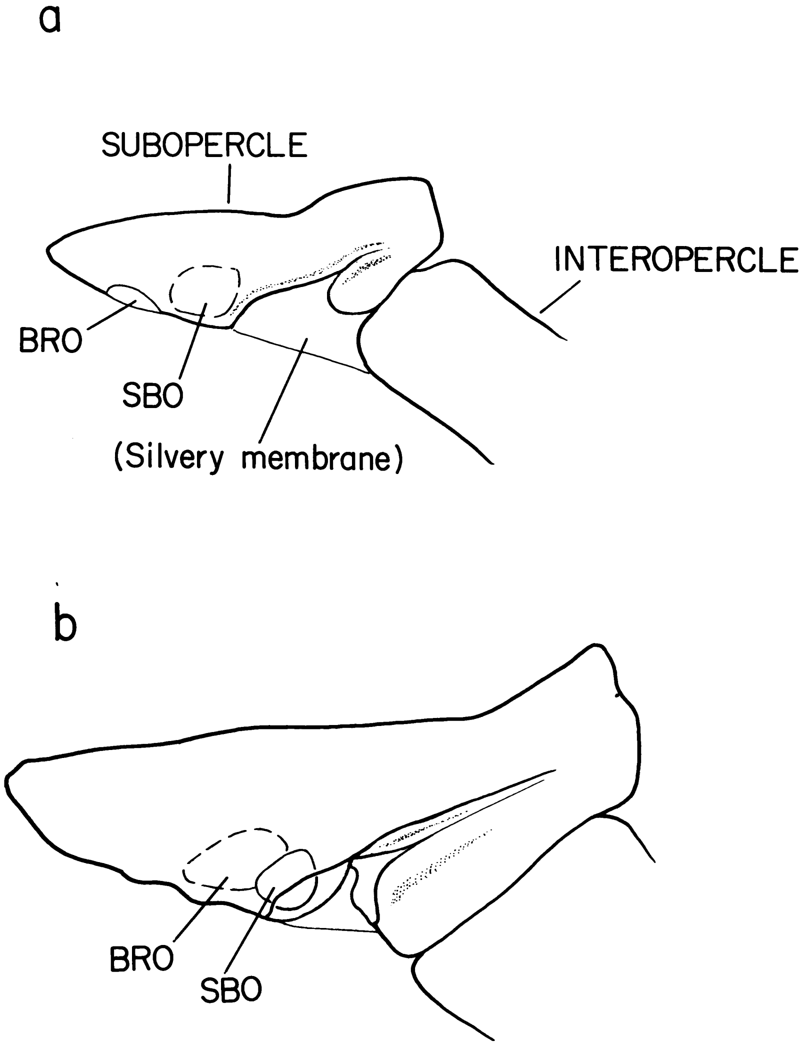


Figure 21. Camera lucida drawings illustrating ontogenetic changes of the subopercle and the position of the BRO and SBO photophores in *Sagamichthys abei* of: A. 82 mm SL (SIO66-541); and B. 133 mm SL (SIO67-49) individuals.

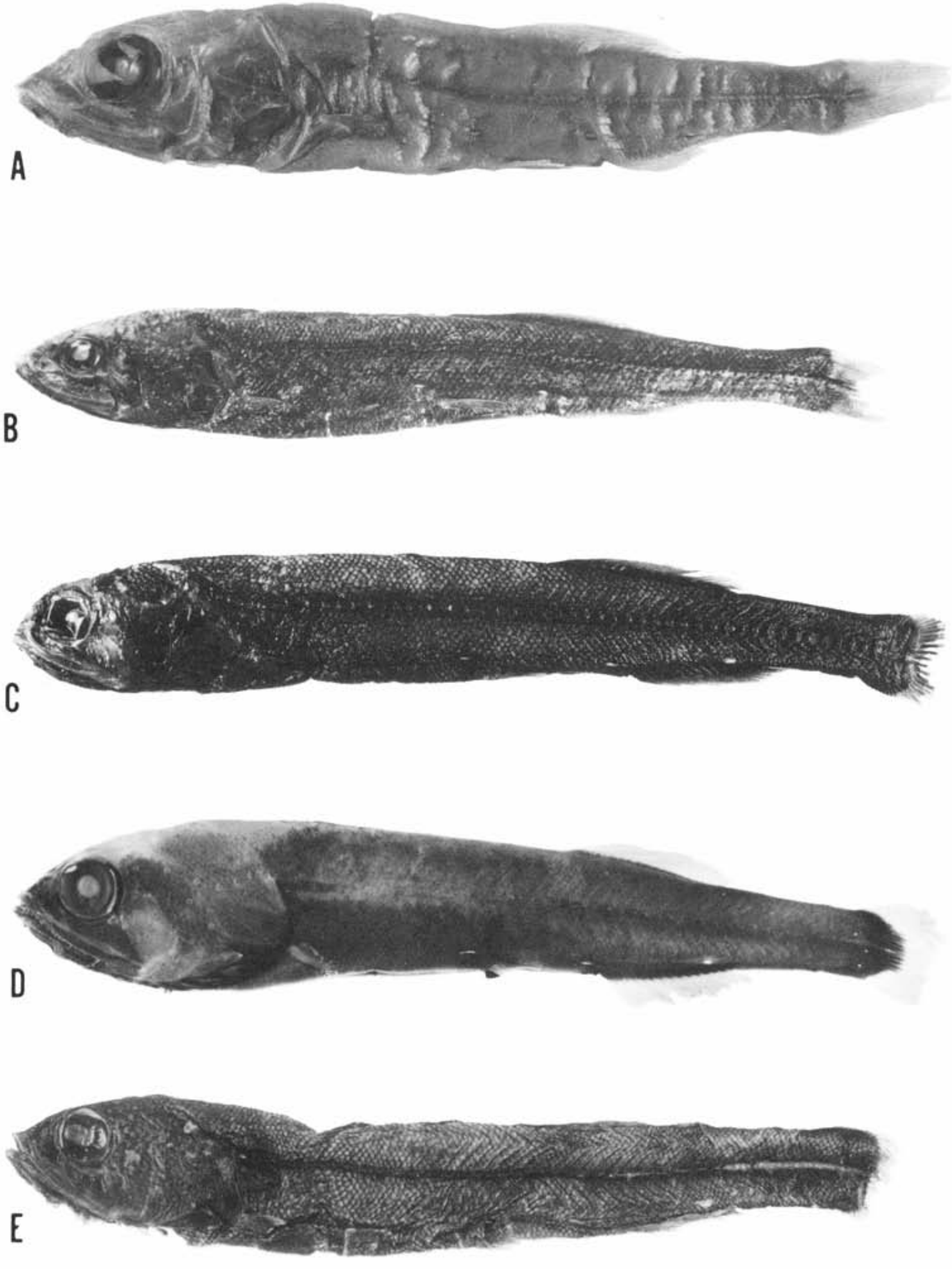


Figure 22. Species of *Persparsia, Paraholtbyrnia,* and *Sagamichthys:* A. *Persparsia kopua* (SIO61-41), 98 mm, 49°26.5′S, 132°18.4′E; B. *Paraholtbyrnia cyanocephala* (USNM206945), 155 mm, 17°22′N, 22°58′W; C. *Sagamichthys schnakenbecki* (ISH724/73), 218 mm, 50°07′N, 19°45′W; D. *S. abei* (SIO75-463), 117 mm, off southern California; E. *S. gracilis* (MMSU14662), 142 mm, 8°07′S, 59°18.6′E.

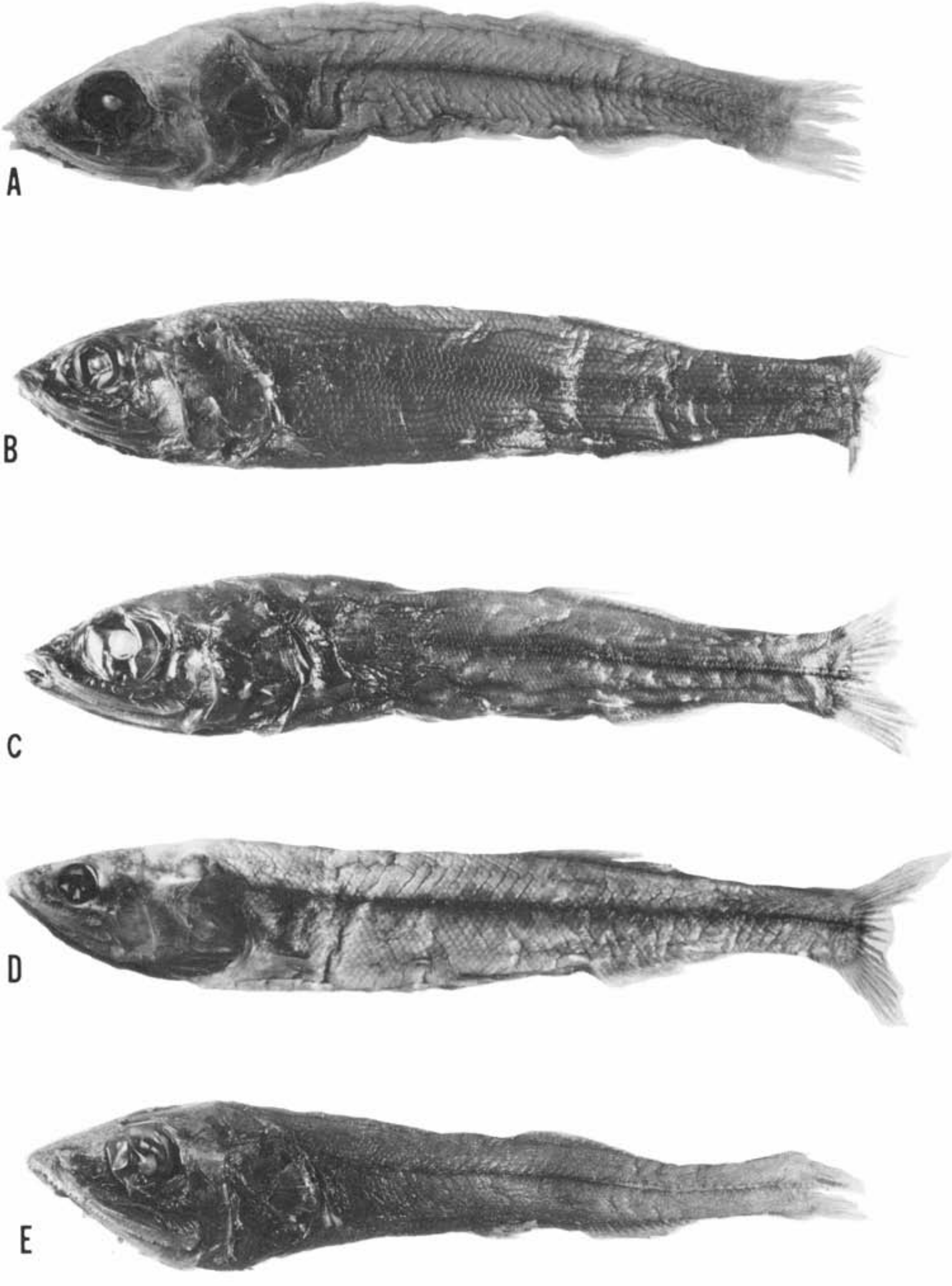


Figure 23. Five species of *Holtbyrnia:* A. *Holtbyrnia laticauda* (USNM *Eltanin,* cruise 35, sta. 2250), 121 mm, 45°53′S, 132°33′E; B. *H. innesi* (USNM uncat. from *Oregon* sta. 5362), 152 mm, 32°02′N, 78°59′W; C. *H. macrops* (SIO85-63), 116 mm, 46°41′N, 10°56′W, Madeira; D. *H. latifrons* (SIO54-122), 200 mm, 32°46′N, 117°39′W; E. *H. conocephala* (MMSU14654), 82 mm, 8°45′S, 60°07′E.

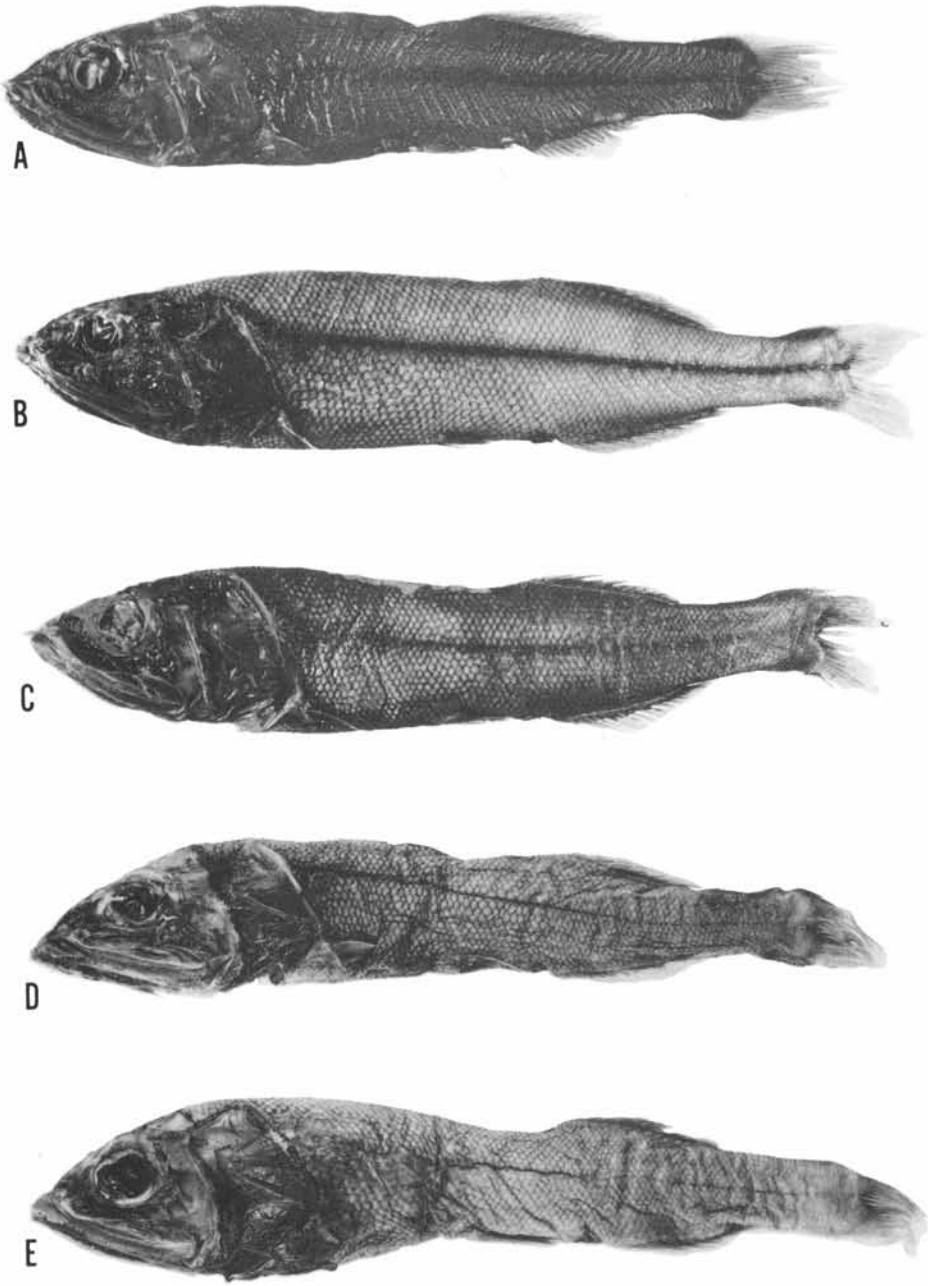


Figure 24. One species of *Holtbyrnia* and four of *Tragularius:* A. *H. anomala* (ISH379/73), 153 mm, 61°21′N, 32°20′W; B. *Tragularius mesalirus* (ISH2488/71), holotype, 205 mm, 7°32′N, 20°54′W; C. *T. perforatus* (ISH202/74), 227 mm, 14°11′N, 18°28′W; D. *T. crassus* (IOAN uncat., *Professor Mesiatsev,* 1st cruise, sta. 344), 206 mm, 5°59′S, 84°59′W; E. *T. bythios* (MMSU uncat., *Zvezde Kryma,* 6th cruise, sta. 137), holotype, 181 mm, 31°33′S, 95°40′E.

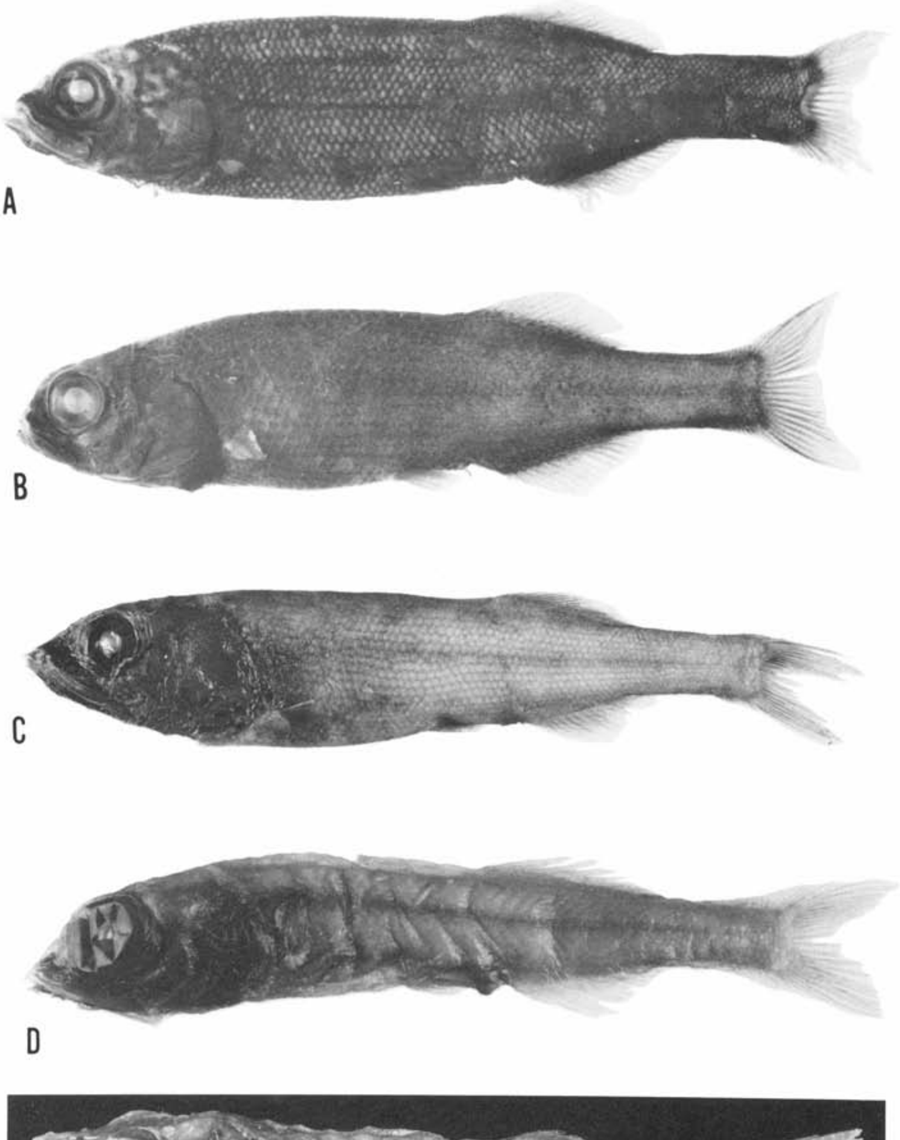


Figure 25. Species of *Searsia, Mirorictus,* and *Pellisolus:* A. *Searsia koefoedi* (USNM206873), 120 mm, 23°47′N, 20°59′W; B. *Mirorictus taningi* (SIO75-463), 108 mm, off southern California; C. *Pellisolus longirostris* (ISH1517/71), 190 mm, 15°45′S, 6°06′W; D. *P. facilis* (SIO63-560), 100 mm, 0°56′N, 11°29′W; E. *P. eubranchus* (SIO64-39), holotype, 111 mm, 28°25′N, 118°11.5′W.

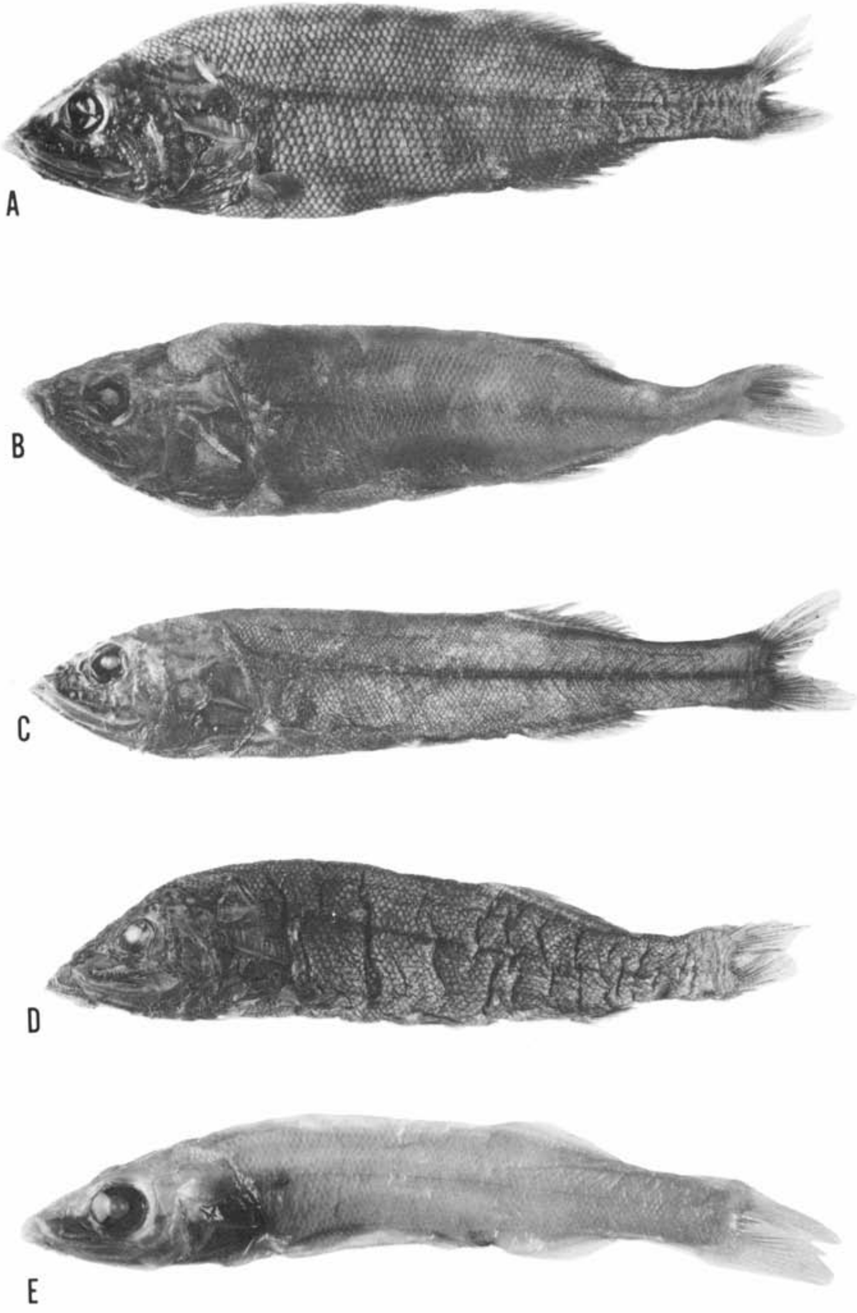


Figure 26. Five species of *Maulisia:* A. *Maulisia (Maulisia) mauli* (ISH591/68), 181 mm, 12°07′N, 23°08′W; B. *M. (M.) argipalla* (SIO72-392), holotype, 129 mm, 32°14.5′N, 117°57.7′W; C. *M. (Aphanichthys) microlepis* (ISH507/73), 225 mm, 55°43′N, 25°53′W; D. *M. (A.) acuticeps* (IOAN uncat., "Trawler 9-141," sta. 299), 173 mm, "Kuroshio region"; E. *M. (A.) isaacsi* (SIO52-404), holotype, 95 mm, 1°43′S, 89°52′W.

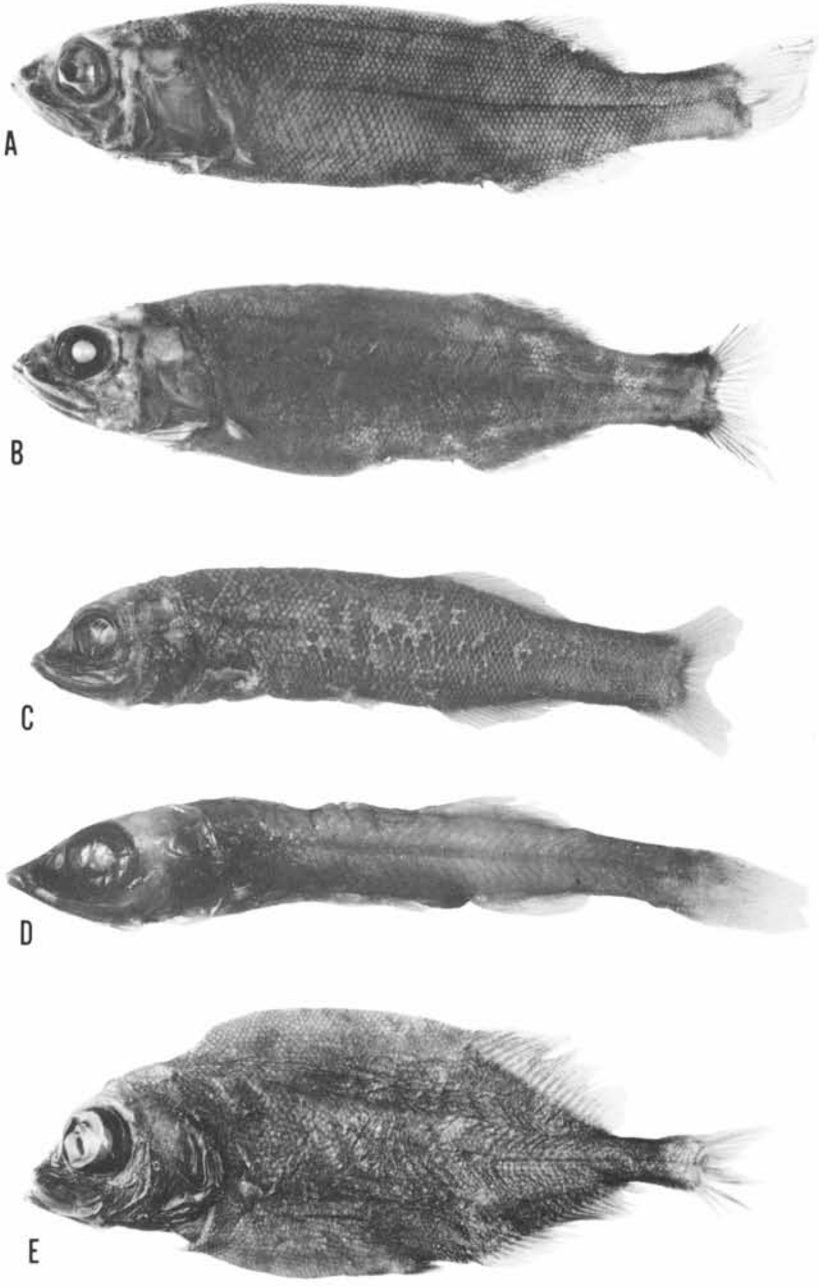


Figure 27. Species of *Normichthys, Searsioides,* and one *Platytroctes:* A. *Normichthys operosus* (ISH922/73), 122 mm, 42°56′N, 13°19′W; B. *N. yahganorum* (ISH1208/71), 137 mm, 34°12′S, 16°35′E; C. *Searsioides multispinus* (SIO77-22), 118 mm, 4°46′S, 129°51′E; D. *S. calvala* (SIO77-47), holotype, 93 mm, 0°41.7′S, 128°55.7′E; E. *Platytroctes mirus* (USNM200512), 103 mm, 11°54′N, 60°46′E.

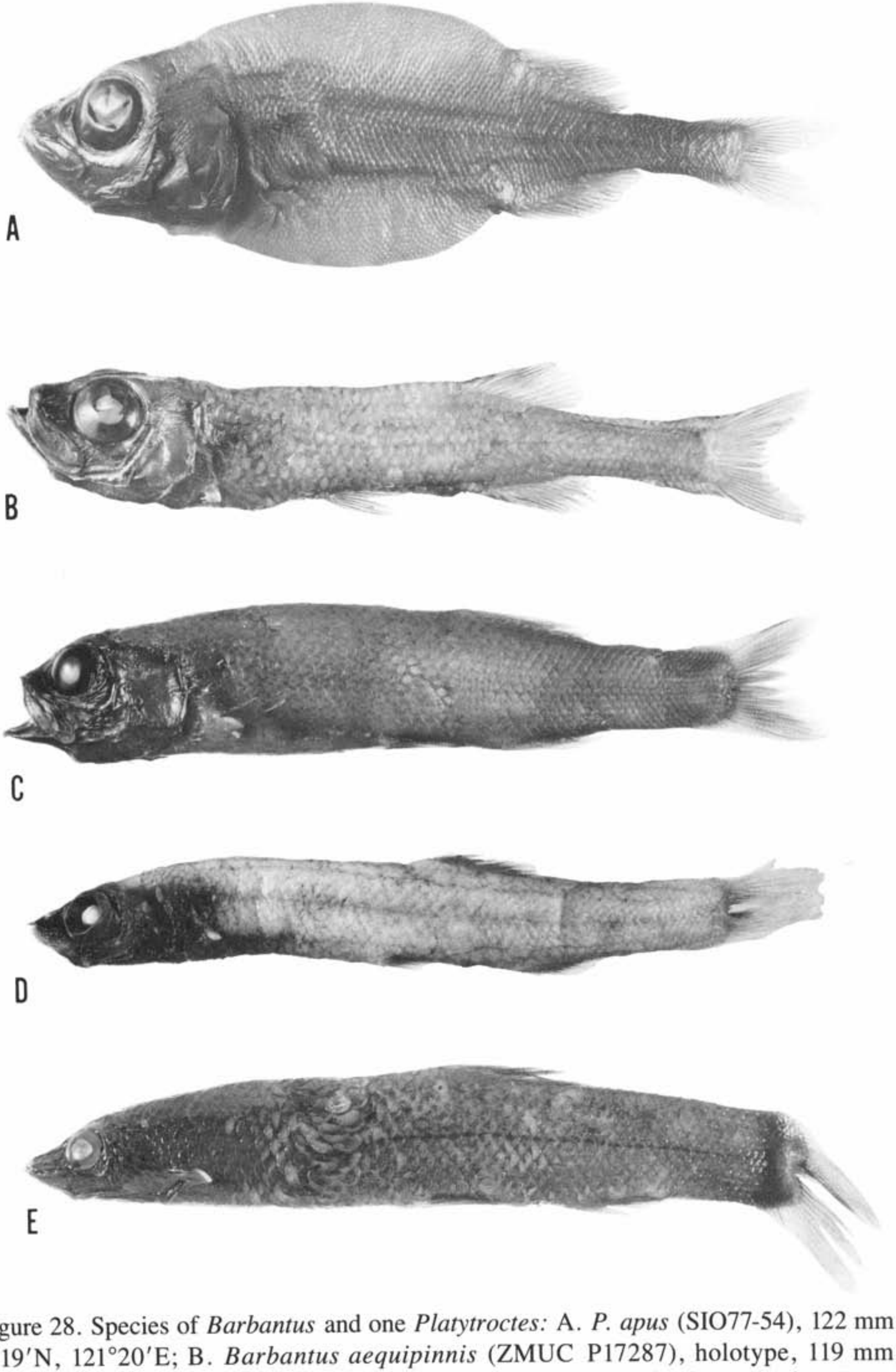


Figure 28. Species of *Barbantus* and one *Platytroctes:* A. *P. apus* (SIO77-54), 122 mm, 7°19′N, 121°20′E; B. *Barbantus aequipinnis* (ZMUC P17287), holotype, 119 mm, 7°54′N, 121°30′E; C. *B. curvifrons* (SIO76-61), 111 mm, 17°20′S, 72°47′W; D. *B. elongatus* (ISH1756/71), 161 mm, 15°45′S, 6°06′W; E. *B. parini* (SIO69-351), 122 mm, 3°10′N, 84°10′W.