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Systematics and Biology of the Tilefishes (Perciformes: Branchiostegidae and Malacanthidae), With Descriptions of Two New Specie

James K. Dooley

April 1978

U.S. DEPARTMENT OF COMMERCE
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Systematics and Biology of the Tilefishes (Perciformes: Branchiostegidae and Malacanthidae), With Descriptions of Two New Species

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Systematics and Biology of the Tilefishes (Perciformes: Branchiostegidae and Malacanthidae), With Descriptions of Two New Species

JAMES K. DOOLEY[1]

ABSTRACT

Tilefishes have been examined on a world basis with the following conclusions: 1) Tilefishes belong to two distinct phyletic lines here designated as the family Branchiostegidae and the resurrected family Malacanthidae. 2) The Branchiostegidae include 3 genera and 21 species. 3) The Malacanthidae include 2 genera, 2 subgenera, and 8 species. 4) A new species, *Caulolatilus hubbsi*, is described from off southern California, the Gulf of California, the Galapagos Islands, and from Callao, Peru; it is generally found sympatrically with the other two eastern Pacific species of *Caulolatilus*. 5) A second new species, *Branchiostegus albus*, is described from off central Honshu, Japan; Pusan, Korea; along the coast of the East China Sea including Shanghai and Taiwan; and the coasts of the South China Sea including Hong Kong and Macao. *Branchiostegus albus* was formerly confused with *B. argentatus* Cuvier 1830. 6) Branchiostegids are generally relatively deep dwelling (20-600 m; usually deeper than 50 m) fishes found along the edges of continental margins, near the upper slope of islands, or at the heads of deep-sea canyons. These fishes are deep bodied and have prominent skull crests. 7) Malacanthids are relatively shallow water (10-150 m; usually shallower than 50 m), burrow-dwelling or mound-building fishes with elongate bodies, rounded or flat skulls with no prominent crests. 8) Tilefishes appear to have basal percoid affinities, having a number of larval and osteological characters found among beryciform fishes (considered antecedent to perciforms) and characters considered primitive among perciform fishes.

INTRODUCTION

Tilefishes represent two phyletic lines (branchiostegid and malacanthid) and are found worldwide in tropical and temperate marine waters. The Branchiostegidae include 3 genera and 21 nominal species, are usually found in deeper water (20-600 m, usually deeper than 50 m), are bottom-associated, and may occasionally inhabit caves or crevices, but they are not known to construct mounds or burrows as are the malacanthids. The Malacanthidae are comprised of two genera, two subgenera, and eight nominal species; are found in shallower water (10-150 m, usually shallower than 50 m); and live in self-constructed mounds or burrows. The dichotomous depth distributions between the two families can be seen arranged according to genus (broken lines, Fig. 1) and species, and were compiled from reliable museum records, literature citations, and personal collections. The small depth range evident for several species is a consequence of limited reliable records.

Although some tilefishes have been known for almost two centuries, they have remained a mystery. Their life histories are practically unknown and their taxonomy is confused. The paucity of knowledge concerning tilefishes is in part a result of the inaccessibility of their habitats. Consequently, few specimens have been deposited in museums. Nevertheless, the genera *Caulolatilus*, *Lopholatilus*, and *Branchiostegus* particularly are playing an increasing role in commercial and sport fish catches as fishing pressures have increased in the deeper waters of the continental slopes and canyon heads.

This study was undertaken in order to define the families, genera, and species of tilefishes and where possible to provide a review of their biology. The comparative osteology of the two families is beyond the scope of this paper and will be treated in a subsequent paper.

The early life histories (larvae-prejuveniles) of the tilefishes show interesting parallels in the patterns and forms of the head spination and serrations. An attempt has been made to draw together available information on cephalic morphology in order to: 1) demonstrate the similarities of the early forms of tilefishes, 2) determine possible phyletic affinities with certain beryciforms and basal percoids, and 3) illustrate young forms where possible so that ontogenetic series can be eventually completed for the tilefishes.

The closely related families Branchiostegidae and Malacanthidae have been recognized variously as one or as two families. The uncertain taxonomic position of the tilefishes is reflected in their inclusion in at least nine major taxa. Cuvier (1829) placed the genus *Malacanthus* in Labroidei; Swainson (1839) put the tilefishes in the family Chaetodontidae under two subfamilies,

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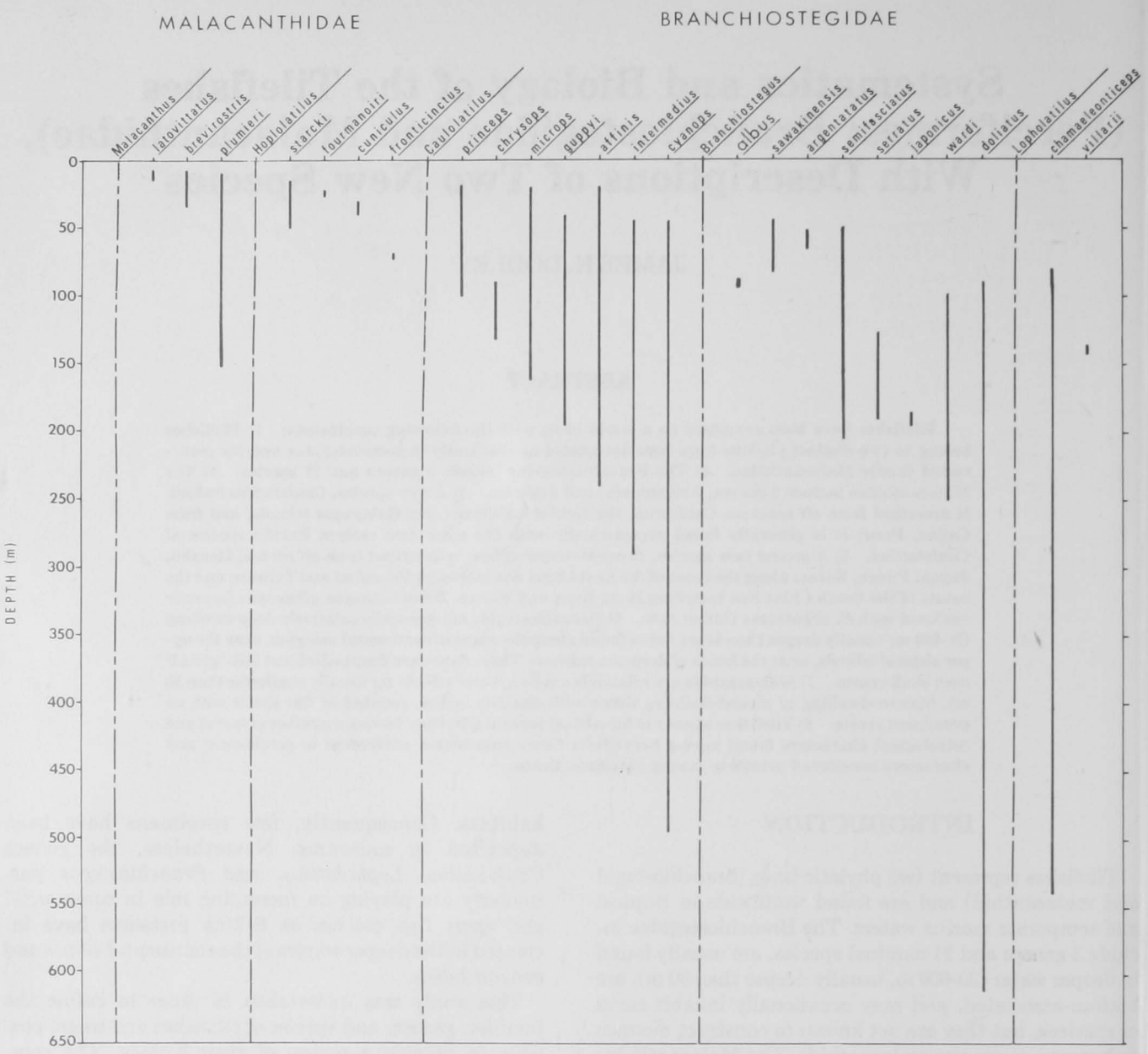


Figure 1.—Depth distribution of the tilefishes. Broken vertical lines separate the genera, solid lines reflect known depth range (not necessarily a continuum). Small ranges usually reflect limited records.

Sciaeninae and Scarinae; Castelnau (1855) included tilefishes in the genus *Labroides*; Bleeker (1859) placed *Malacanthus* in Percoidei; Günther (1860) included *Latilus* (= *Branchiostegus*) in the family Trachinidae and *Malacanthus* in the family Malacanthidae; Gill (1862) included a subfamily Latiloidae under the family Notothenioidae; Poey's (1865) Malacanthidi included the genera *Malacanthus* and *Caulolatilus*; Gill (1872) listed the tilefishes under the family Latilidae and later (1893) he split the family Malacanthidae into three subfamilies (Malacanthinae, Caulolatilinae, and Latilinae); Jordan and Evermann (1898) considered the three genera (*Malacanthus*, *Caulolatilus*, and *Lopholatilus*) of tilefishes in the family Malacanthidae; Bridge and Boulenger (1904) and later Goodrich (1909) relegated tilefishes to the Pseudochromidae; Regan (1913) listed Latilidae as the only family of tilefishes; Jordan (1923:202) separated these fishes into the families Branchiostegidae and Malacanthidae; Berg (1940) retained Jordan's (1923) scheme; Norman (1966) consolidated the tilefishes into a single family (Branchiostegidae); Greenwood et al. (1966), Bailey et al. (1970), and Gosline (1971) retained Norman's classification.

Tilefishes are herein considered as comprising two families (Branchiostegidae and Malacanthidae) as proposed by Jordan (1923). The justification for this decision will be subsequently discussed.

METHODS

Specimens examined are noted in the descriptions of species only by the institutional abbreviations (listed below) or as uncataloged specimens with field numbers (JKD, Anton Bruun Cr., etc.) with the number of specimens in each lot in parentheses followed by the standard length (or range of standard length (SL)) in millimeters.

AMNH (AM)	American Museum of Natural History, New York
AMS	Australian Museum, Sidney
ANSP	Academy of Natural Sciences of Philadelphia
BMNH	British Museum (Natural History), London
BPBM	Bernice P. Bishop Museum, Honolulu, Hawaii
CAS	California Academy of Sciences, San Francisco
CSIRO	Commonwealth Scientific and Industrial Research Organization, Marine Biological Laboratory, Cronulla, N.S.W., Australia
FAKU	Kyoto University, Maizuru, Japan
FMNH	Field Museum of Natural History, Chicago, Ill.
FSBC	Department of Natural Resources, St. Petersburg, Fla.
GCRL	Gulf Coast Research Laboratory Museum, Ocean Springs, Miss.
GMBL	Grice Marine Biological Laboratory, Charleston, S.C.
INIBP	Instituto Nacional Investigaciones Biológico-Pesqueras, Cuauhtemoc, Mexico
LACM	Los Angeles County Museum of Natural History, Los Angeles, Calif.
MBM	see MEPA
MCZ	Museum of Comparative Zoology, Harvard University, Cambridge, Mass.
MEPA (MBM, CBAT)	Centro de Biologia Aquática Tropical, Lisbon, Portugal
MISZ	Museo Instituto di Zoologia Sistematica della Universitá di Torino, Italy
MNHN	Muséum National d'Histoire Naturelle, Paris
MNRJ	Museum Nacional de Rio de Janeiro
MZUSP	Museu de Zoologia da Universidade de São Paulo, Brazil
OSU	Oregon State University, Corvallis
QM	Queensland Museum, Brisbane
RGMC (MRAC)	Museum Royal de Afrique Centrale, Belgium
RMNH	Rijksmuseum van Natuurlijke Historie, Leiden, Netherlands
ROM	Royal Ontario Museum, Toronto
RUSI (IIRU)	J. L. B. Smith Institute of Ichthyology, Rhodes University, Grahamstown
SAM	South African Museum, Cape Town
SOSC	Smithsonian Oceanographic Sorting Center, Washington, D.C.
TABL	Tropical Atlantic Biological Laboratory, Miami, Fla. (collection now at Florida State Museum, Gainesville, Fla.)
UA	University of Arizona, Tucson
UBC	Institute of Fisheries, University of British Columbia, Vancouver, Canada
UCR	Museo de Zoologia, University of Costa Rica, Cuidad Universitaria
UG	University of Guam, Agana, Guam
UMML	Rosenstiel School of Marine and Atmospheric Sciences, University of Miami, Miami, Fla.
UMMZ	Museum of Zoology, University of Michigan, Ann Arbor
UNC	University of North Carolina, Morehead City
UPR	University of Puerto Rico, Mayaguez
USNM	National Museum of Natural History, Smithsonian Institute, Washington, D.C.
UTMSI (IMSUT)	University of Texas Marine Science Institute, Port Aransas
ZMA	Zoölogisch Museum, Universteit van Amsterdam, Netherlands
ZMB	Zoologisches Museum an der Humboldt Universität zu Berlin, D.D.R.
ZMK (UZMK)	Universitetes Zoologiske Museum, Copenhagen

The vernacular names were selected largely from the literature based upon popular usage. Exceptions in selecting vernacular names were: 1) in undescribed species, 2) when no published vernacular name could be found, and 3) when the vernacular name had been apparently misassigned, or was misleading. In these cases a vernacular name was created.

Measurements were made with dial calipers or dividers and read to the nearest 0.5 mm. All measurements and count conform to those as defined by Hubbs and Lagler (1958) except for the following: head length was taken from the premaxillary symphysis of upper jaw to tip of opercular spine; cheek depth was measured as shortest vertical distance from lower rim of orbit to horizontal ventral edge of preoperculum; opercular length was taken as horizontal distance from point where preoperculum overlaps operculum to tip of opercular spine; suborbital depth was measured from lower rim of orbit to dorsal edge of upper jaw; pectoral fin length was measured from dorsal axil near base of uppermost ray to tip of fin; dorsal fin height was greatest height of extended soft dorsal fin, excluding elongate ultimate or penultimate soft dorsal rays if present.

The last dorsal and anal rays were counted as one unless the ray base was clearly bifurcated. Opercular scales were counted along a horizontal line to the opercular spine. Only lateral-line scales with pores or tubes were counted; irregular rows of scales caused slight inconsistancies so several counts were necessary.

Vertebral counts were taken from radiographs and disarticulated skeletons and include the terminal urostylar vertebra. The first caudal vertebra was considered as the one on which the parapophyses were fused at their tips forming a haemal arch (clearly visible in radiographs). Skeletons from 15 of the 29 species of tilefishes have been dissected and examined. In addition, nearly 300 radiographs (most on file at the Institute of Marine Science, University of North Carolina) from representatives of all but two of the species (*Branchiostegus ilocanus* and *B. vittatus*) have been examined.

The dorsal fin support to neural spine ratio refers to the number of dorsal fin pterygiophores divided by the number of neural spines. The anal fin support to haemal spine ratio is the number of anal fin pterygiophores divided by the number of haemal spines.

The predorsal fin support formula as used by Smith and Bailey (1961) refers to the following: 0-0-2- = two predorsal pterygiophores, followed by a third pterygiophore supporting two dorsal fin spines; 2- = no predorsal pterygiophore, with the first supporting two dorsal fin spines; 0-1- = one predorsal, followed by the first pterygiophore supporting a single dorsal fin spine.

Larvae were cleared and stained using Taylor's (1967) digestion method. Drawings were made using a camera

lucida. The terminology of the young stages follows that of Hubbs (1943).

EARLY LIFE HISTORY

The early development of tilefishes, as is true of other biological aspects, has received little study. Tilefish ontogeny is rather unusual; so much so that some larvae have been described by several authors as fishes new to science (Smith 1956; Berry 1958). Hubbs (1958) recognized *Dikellorhynchus incredibilis* and *D. tropidolepis* as prejuveniles of *Malacanthus hoedtii* (= *brevirostris*) and *M. plumieri* respectively. Numerous pelagic larvae of *M. hoedtii* (= *brevirostris*) and *Hoplolatilus* sp. have been collected from the southeastern Pacific from tuna stomachs and in midwater trawls by Fourmanoir (1969, 1970, 1971a, 1971b).

All tilefishes probably have pelagic larvae. This conclusion is based on the following: 1) larvae from four of the five tilefish genera (larvae of *Lopholatilus* remain undescribed) have been taken only pelagically, or apparently washed ashore (Smith 1956); 2) all known larvae have similar elaborate head and scale spination, an apparent adaptation for flotation and/or protection in the pelagia; 3) the spinous stage is transitory, occurring from shortly after the yolk has been absorbed (about 3 mm in *Branchiostegus japonicus*) until the prejuvenile metamorphosis to a juvenile and takes up a benthic habitat; 4) the relatively sedentary life of the adults would not seem to account for their worldwide distribution. At least, in the case of *M. brevirostris*, pelagic larvae have enabled the species to establish a foothold in the eastern Pacific, along Central America, more than 7,000 km east of the probable gene source in the central Pacific islands and across the eastern Pacific barrier (Briggs 1961).

The only detailed study of tilefish's early development has been *B. japonicus* from Japan by Okiyama (1964). His study pieced together, through larval collections, a complete ontogenetic series for the species. Okiyama found that: 1) head and scale spination occurred only between the sizes of 3.5 and 13.2 mm TL (total length), and by 28 mm, the adult form had been acquired; 2) head length, snout to anus distance, body depth, and eye diameter showed allometric growth; 3) postlarvae (3 mm TL) fed chiefly on copepod nauplii and mollusk larvae, later copepods and polychaetes played a major role, and ultimately a third change in diet occurred when a benthic habitat was taken up at about 28 mm or larger.

Examination of larval and prejuvenile specimens of *Caulolatilus princeps* revealed a marked similarity to the

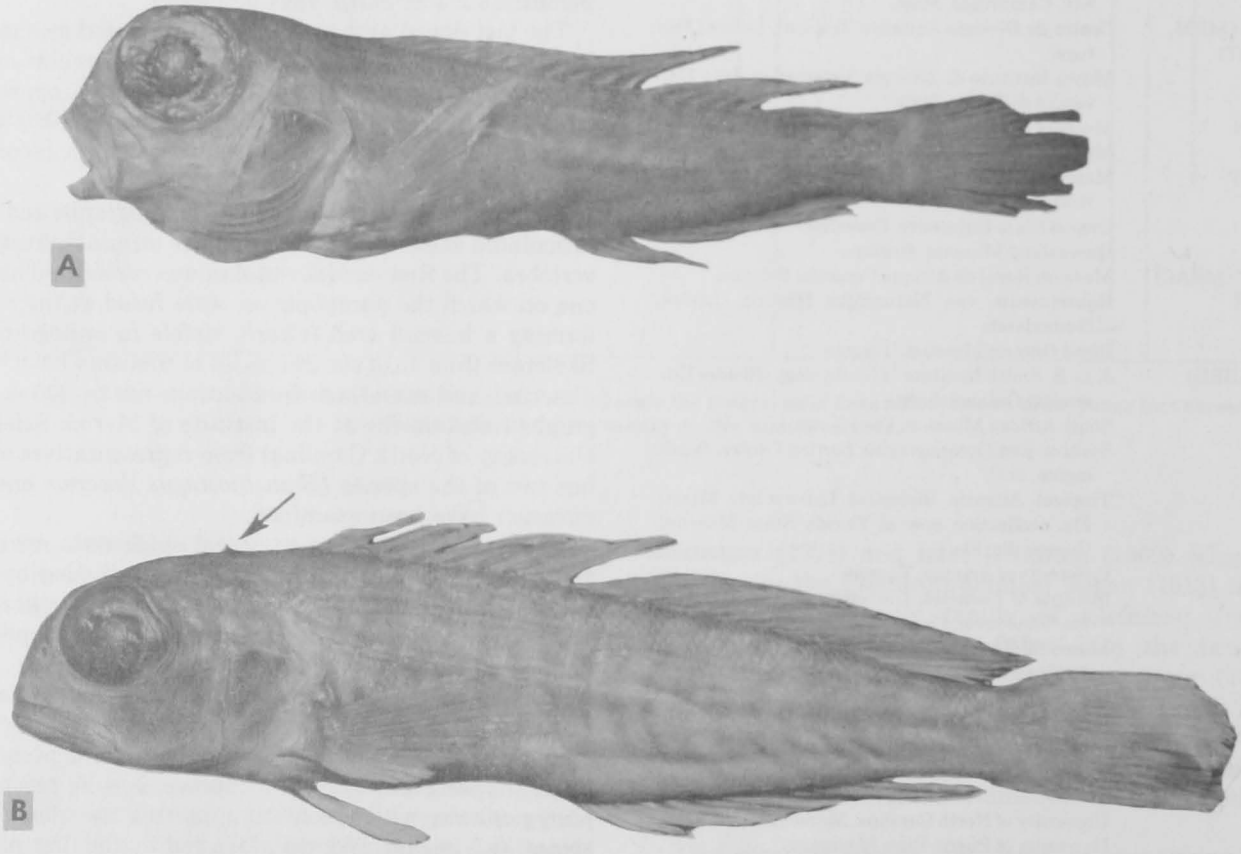


Figure 2.—A. 51-mm juvenile specimen (MCZ 34564) of *Lopholatilus chamaeleonticeps*. B. 82-mm specimen (MCZ 34562) of *L. chamaeleonticeps*. Arrow denotes precursor of predorsal flap.

illustrations of the young stages of *B. japonicus* in the work by Okiyama (1964). Despite this, the number of dorsal and anal elements and vertebrae would easily distinguish these two species. Both species have bands of serrae on the dorsum of the head crown and along the snout, also on the border of the upper and lower orbit, dentary, and above and behind the operculum. Elongate spines occur on both species along the posterior margin of preoperculum, with the largest spine at the angle of preoperculum.

As previously mentioned, the very early stages of *Lopholatilus* remain undescribed. However, a 51-mm specimen (MCZ 34564), the smallest known of *L. chamaeleonticeps*, has no spination, a very large eye, and no predorsal flap characteristic of larger specimens. In place of the flap only a dark predorsal ridge is evident (Fig. 2A). An 82-mm specimen (MCZ 34562) had a more characteristic adult form, with a tiny tab of skin on the predorsal ridge, apparently a precursor of the adult flap (Fig. 2B). Both of the formerly discussed specimens had taken up benthic living (100-200 m depth).

Malacanthid larvae show a strong resemblance to branchiostegid larvae (Berry 1958). The predorsal head serrae are in bands more or less parallel to body axis in *Malacanthus*, but they are perpendicular to the body axis in branchiostegids and radiate fanlike on either side of the head in *Hoplolatilus*. *Malacanthus* and *Hoplolatilus* usually have an enlarged rostral spine with either lateral projections (*Malacanthus*) or a very elongate four-edged serrated bill (*Hoplolatilus*); branchiostegids have no rostral spine. Larval *Hoplolatilus* may have very elongate spines, nearly equal to the head length, at the angle of the preoperculum and above the operculum (Figs. 3, 4); whereas branchiostegids and *Malacanthus* are not known to have these structures. More detailed descriptions of malacanthid larvae can be found in the species descriptions.

The unknown larva (CSIRO A.509) illustrated by Whitley (1970) appears to be a species of *Hoplolatilus*. The larvae listed by Fourmanoir (1971b) as *Caulolatilus* all appear to be *Hoplolatilus*. Fourmanoir (1970:figs. 7, 10) figured other larval specimens as *Hoplolatilus* sp.; they appear to be *H. fronticinctus* and a new Pacific record based on specimens sent by Fourmanoir. Fourmanoir's (1970) figure 8 appears to be *H. starcki*, and his figure 9 appears to be an undescribed species of *Hop-*

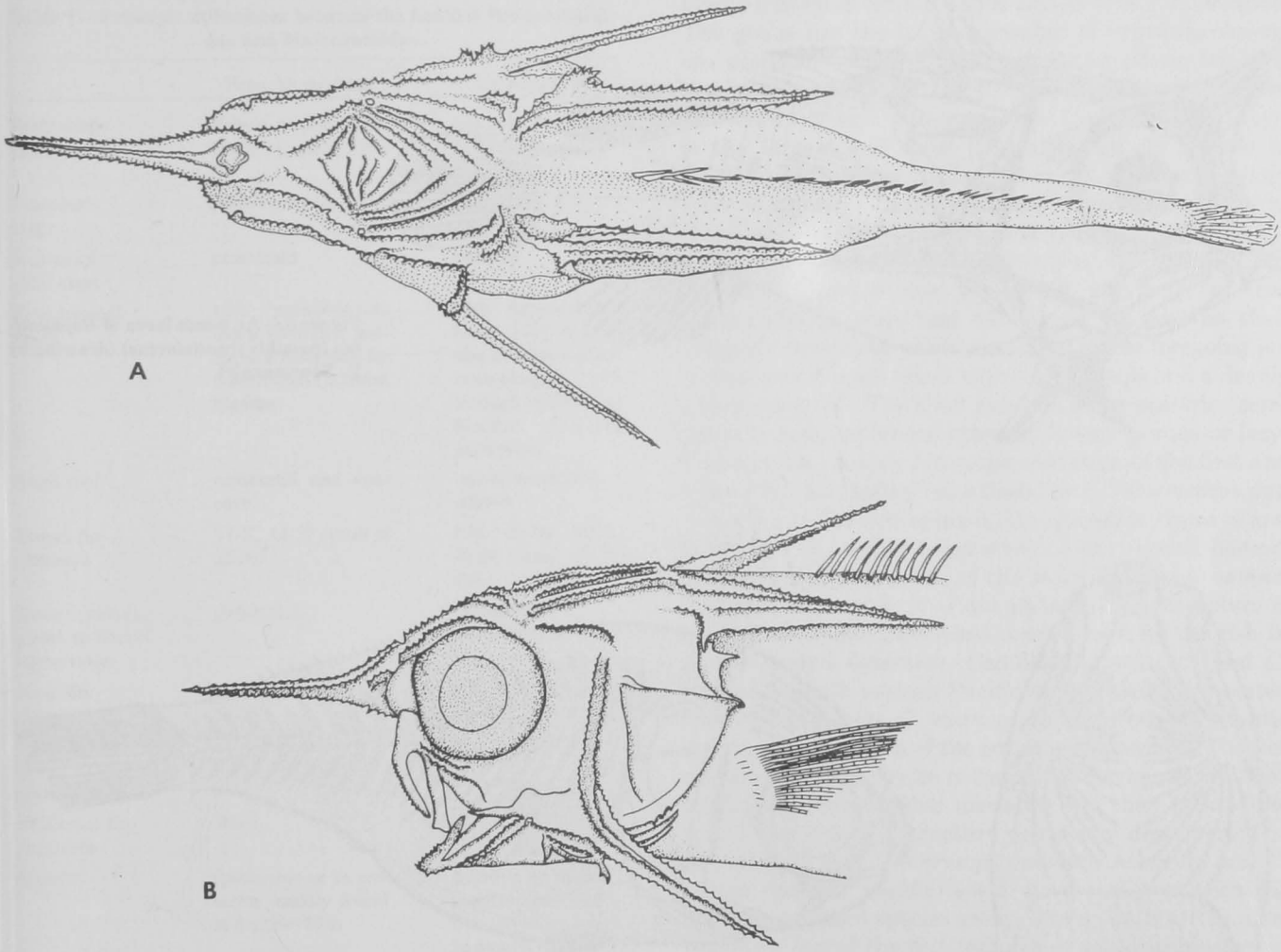


Figure 3.—A. Dorsal view of a 15-mm postlarval *Hoplolatilus fronticinctus*. B. Lateral head view of same specimen.

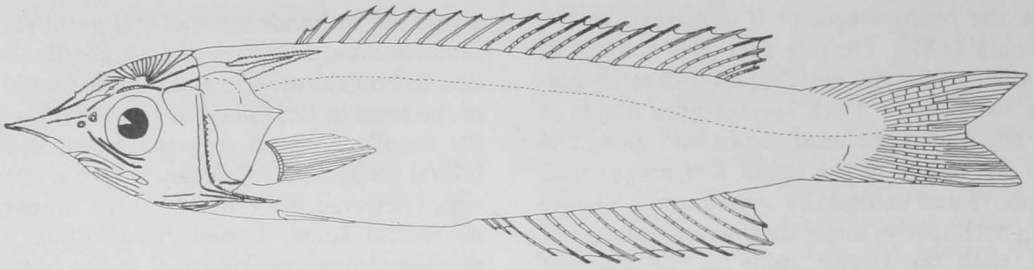


Figure 4.—A 42-mm prejuvenile *Hoplolatilus fronticinctus* (drawing by P. Fourmanoir).

lolatilus. Fourmanoir's (1971a) figure 1 listed as *Hoplolatilus* sp. is *H. fronticinctus*; other presumptive larval *Hoplolatilus* appear in Figures 5 and 6.

Larvae with similar rostra and head spination to those of tilefish have been illustrated among holocentrids, lutjanids, serranids, and istiophorids (McKenney 1959; Heemstra 1974; Smith 1971; and Voss 1953, respectively). The similarity between the larvae of these relatively diverse families could be considered as convergence or perhaps a relict characteristic carried over from a common beryciform ancestor. The latter hypothesis seems reasonable when considering that Perciformes are generally thought to have evolved from an ancestral beryciform stock (Patterson 1964). Fishes that show similar spinous larvae belong either to the order Beryciformes or are considered among the basal Perciformes. A remarkable resemblance can be seen in the serrated larvae of *Holocentrus vexillarius*, order Beryciformes (McKenney 1959) and *Hoplolatilus fronticinctus*, order Perciformes (Fig. 3).

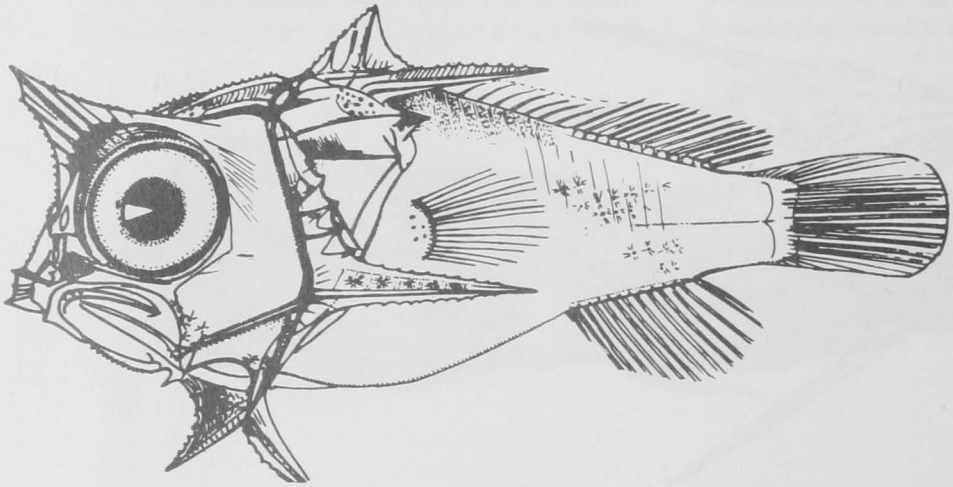


Figure 5.—An 8-mm larva of *Hoplolatilus* (possibly *fronticinctus*) (drawing by P. Fourmanoir).

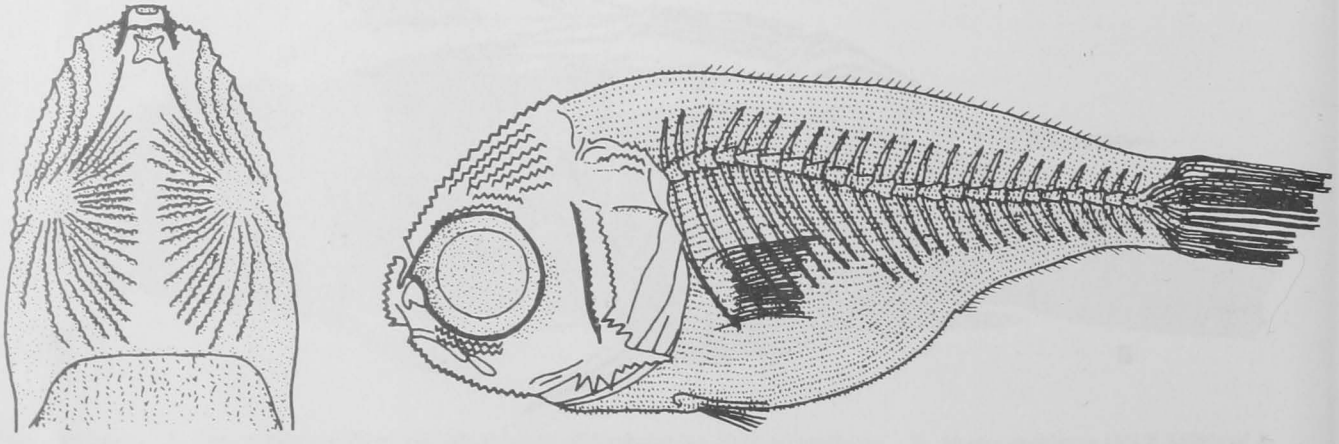


Figure 6.—A 13-mm larval specimen of *Hoplolatilus* sp.

EVOLUTION OF THE TILEFISHES

Tilefishes belong to two distinct phyletic lines based upon comparative morphological and behavioral characters. Heretofore, little or no justification has been given in the literature for systematic or phylogenetic considerations of the tilefishes. Tilefishes are herein considered as two distinct families as first considered by Jordan (1923: 202), and retained in Berg's (1940) classification of fishes. Subsequently, Norman (1966), Greenwood et al. (1966), McAllister (1968), Bailey et al. (1970), and Gosline (1971) listed the tilefishes as a single family without giving reasons. Aside from percoid characters, the branchiostegids and malacanthids have few characters in common that might be used to justify their consolidation into a single family. Indeed, branchiostegids and malacanthids could as easily be aligned with several other percoid families as with each other. This statement is based upon examination of external and internal characters. Detailed examination of myological and osteological characteristics of the branchiostegids and malacanthids should refute or support this conclusion. Table 1 contains the salient differences between the branchiostegids and the malacanthids. The first six characters appear to be relatively conservative and useful in differentiation at the family level. The only common characters found between the two tilefish families are: 1) dorsal and anal fins relatively long and continuous (a character found in more than 25 percoid families), 2) a single opercular spine (not an uncommon character), and 3) grossly similar larval stages (also similar to those of lutjanids, serranids, istiophorids, and holocentrids).

Table 1.—Principle differences between the families Branchiostegidae and Malacanthidae.

	Branchiostegidae	Malacanthidae
Body shape	Robust or quadriform	Elongate or fusiform
Body depth	21-36% (usually 27%) SL	12-26% (usually 18%) SL
Predorsal ridge	always present	absent
Supraoccipital crest	prominent	reduced
First haemal spine	with parapophyses fused medially, acting as a receptacle for posterior end of swim bladder	with parapophyses fused only at their tips forming a wishbone-shaped arch through which swim bladder protrudes posteriorly
Skull roof	contoured and concave	uncontoured, flat or convex
Dorsal fin elements	VI-X, 14-27 (total of 22-36)	I-V, 43-60; III-X, 13-34 (total of 22-64)
Dorsal pterygiophore to neural spine ratio	(0.9-1.3):1	(1.0-2.5):1
Anal fin elements	I-II, 11-26 (total of 14-28)	I-II, 12-55 (total of 14-56)
Anal pterygiophore to naemal spine ratio	(0.9-1.7):1	(0.9-3.9):1
Predorsal fin supports	0-0-2-	0-0-2-, 0-1-, or 2-
Habitat	epibenthic or in crevices; usually found in depths >50 m	burrows or mounds constructed of rubble; usually found in depths <50 m
Dorsal plus anal fin base length	80-109% (usually 90%) SL	80-135% (usually over 90%) SL

Some of the differences between the genera of tilefishes are summarized in Table 2. The major phyletic changes within the tilefishes are illustrated in Figure 7. A hypothetical phylogenetic tree based on characters in Figure 7 and other characters, to a lesser extent, can be seen in Figure 8.

Branchiostegidae (Infrafamilial Relationships)

Caulolatilus.—*Caulolatilus* appears to be the most generalized and primitive of the tilefish genera. The skull is highly contoured and has an elevated supraoccipital crest extending as a ridge to the median ethmoid. The preoperculum is serrate and is armed with a stout spine. The genus has the highest number of vertebrae among the tilefishes (11 + 16) and high for perciform fishes in general. The line that led to *C. microps* seems to have evolved early and independently. *Caulolatilus microps* is the largest and most generalized of all species of *Caulolatilus* and has the longest snout, greatest development of the lateral ethmoid, least bifurcate median ethmoid, and the least ossified first haemal spine.

The species group of *Caulolatilus hubbsi - C. princeps - C. cyanops* was assembled primarily on the similarities in body and tail shape, as well as their similarly developed skull crests. All of the foregoing are somewhat elongate fishes with a small gape and a deeply emarginate tail. The skull exhibits some posterior compression and the lateral ethmoid is very porous or lacy. *Caulolatilus cyanops* has a specialization of the first and second haemal spines (also found in *C. intermedius* and *C. guppyi*). The first spine is cup-shaped or concave and fitted into a similar congruence of the second haemal spine. The posterior end of the swim bladder is capped by these structures. It is not known if this structure is capable of sound transmission or is used by the fish in greater sound detection. *Caulolatilus princeps* and *C. hubbsi* are both eastern Pacific species perhaps isolated from the geminate *C. cyanops* in the western Atlantic during an emergence of the isthmus of Panama. The former two species may be more primitive than *C. cyanops* based upon their higher meristics and their lack of the specialized haemal structure previously described. The geminate species *C. chrysops* (western Atlantic) and *C. affinis* (eastern Pacific) seem closely aligned with the above-mentioned species group. Their skulls are similar, but show few of the fine features or sculpturing seen in the *princeps* group. *Caulolatilus chrysops* and *C. affinis* both have deep rounded bodies, lunate tails, and similar

Table 2.—Principle differences between the genera of tilefishes. The number in parentheses expresses the usual figures (average) within a genus. Proportional measurements are given as percent standard length.

	Caulolatilus	*Branchiostegus*	*Lopholatilus*	*Malacanthus*	*Hoplolatilus*
Body depth	21-34 (28)	22-36 (27)	21-31 (27)	11-20 (16)	15-26 (20)
Body width	10-20 (13)	10-15 (13)	11-18 (14)	8-15 (11)	9-16 (11)
Predorsal length	28-39 (32)	27-37 (32)	30-39 (33)	19-34 (26)	25-34 (29)
Base of dorsal fin	54-68 (62)	50-66 (59)	52-62 (56)	62-78 (70)	53-64 (60)
Base of anal fin	31-44 (39)	27-37 (31)	27-33 (28)	53-63 (55)	27-36 (31)
Length of dorsal + anal fin bases	96-109 (101)	80-97 (89)	81-95 (85)	112-135 (125)	80-100 (90)
Predorsal ridge	present	present	prominent	absent	absent
Margin of preoperculum	serrate	serrate	serrate	smooth	serrate
Vertebrae	11 + 16	10 + 14	10 + 14	10 + 14	(10-11) + 14
Dorsal fin elements	VI-X, 22-27 (total $\bar{x}$ = 32)	VI-VIII, 14-16 (total $\bar{x}$ = 22)	VII-VIII, 14-15 (total $\bar{x}$ = 22)	I-V, 43-60 (total $\bar{x}$ = 56)	III-X, 13-34 (total $\bar{x}$ = 31)
Anal fin elements	I-II, 20-26 (total $\bar{x}$ = 25)	I-II, 11-13 (total $\bar{x}$ = 14)	I, 14 (rarely 13) (total $\bar{x}$ = 15)	I, 37-55 (total $\bar{x}$ = 48)	I-II, 12-20 (total $\bar{x}$ = 19)
Gill rakers (first arch)	17-27	18-24	22-26	6-20	16-28
Pored lateral-line scales	73-115	47-72	66-75	116-181	89-140
Predorsal fin supports	0-0-2-	0-0-2-	0-0-2-	0-0-1-, 0-1-, or 2-	0-0-2-
Position of 1st haemal spine	over 5th-7th anal ray	over 2nd anal ray	over 2nd anal ray	over 12th-18th anal ray	over 1st-2nd anal ray
Dorsal fin supports to neural spine ratio	(1.15-1.33):1	0.92:1	0.92:1	(2.04-2.5):1	(0.96-1.46):1
Anal fin supports to haemal spine ratio	(1.47-1.67):1	0.86:1	0.93:1	(2.79-3.86):1	(0.86-1.36):1
Caudal fin	emarginate, truncate, or rounded	truncate, rounded, or scalloped	truncate	forked or truncate	forked or truncate
Habitat	epibenthic, generally> 50 m	epibenthic, generally >50 m	epibenthic, generally >50 m	mounds, generally <50 m	burrows, generally <50 m

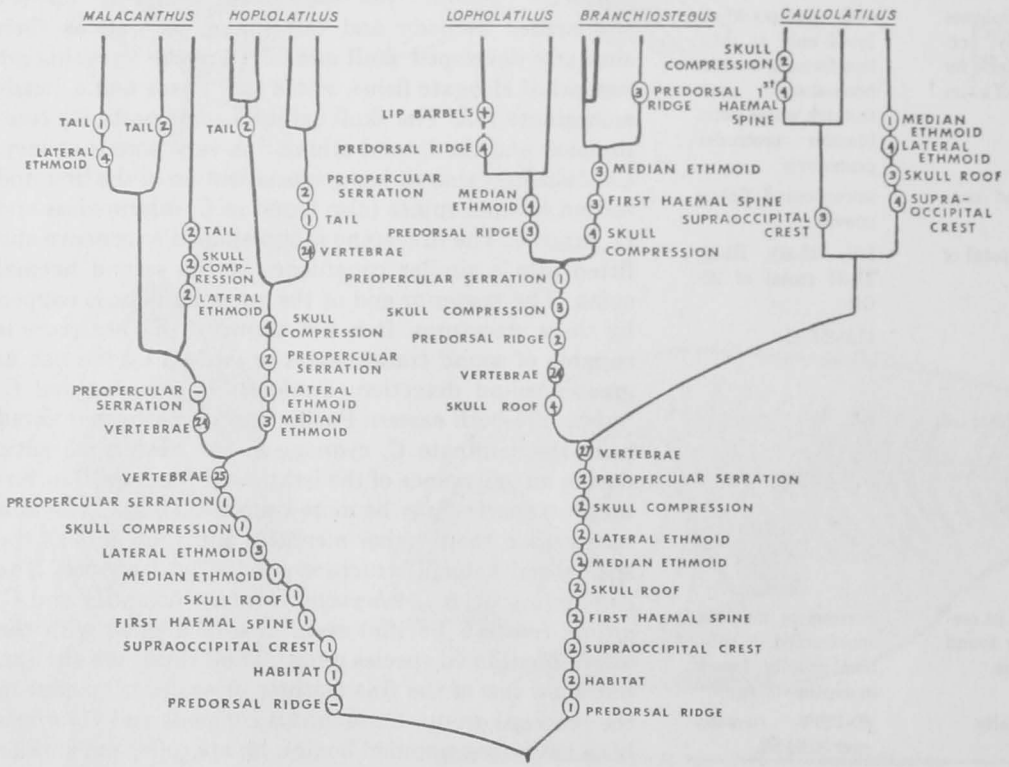


Figure 7.—Major phyletic changes within the tilefishes. The following codes were used: tail (1) = forked, tail (2) = truncate; plus (+) = added or new, minus (−) = lost or absent; habitat (1) = shallow water, burrow dwelling, habitat (2) = deep water, nonburrow dwelling; the number following vertebrae = the total number of vertebrae; all other numbers (1-4) denote the relative degree of development with one least, and four greatest; the order of characters does not imply a sequence of gain or loss.

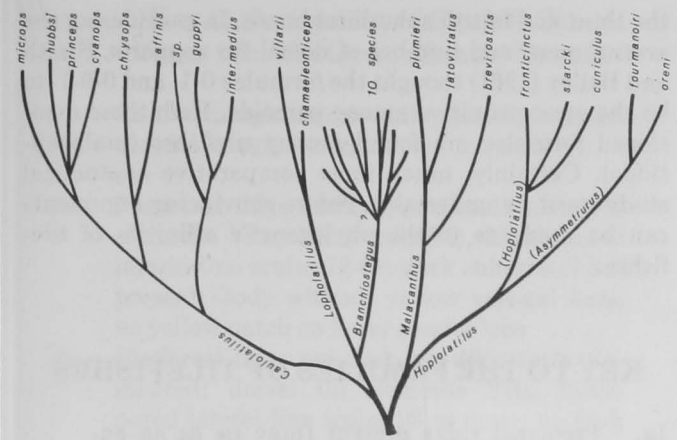


Figure 8.—A phylogenetic tree of the tilefishes.

body markings, but are otherwise distinguishable.

The species group containing *C. guppyi* and *C. intermedius* apparently has a restricted distribution. *Caulolatilus guppyi* is restricted to the northern coast of South America—Lesser Antilles area, and *C. intermedius* is found only in the Gulf of Mexico. These species have markedly shortened skulls, heads with rounded profiles, and rounded tails. Also as mentioned, both have the specialized haemal structure seen in *C. cyanops*. Several specimens of *C. intermedius* have shown an exaggeration of the haemal concavity into the third and fourth haemal spines. The general body shapes of *C. intermedius* and *C. guppyi* are similar to those of the genus *Branchiostegus*, but can be easily distinguished from species of that genus by their greater development of the supraoccipital crest and their higher number of vertebrae (27 vs. 24).

Branchiostegus.—The relationships within the genus *Branchiostegus* are not clear. To avoid speculation, conclusions should await detailed anatomical and perhaps biochemical examination.

Lopholatilus.—This genus includes the largest species of tilefishes. *Lopholatilus chamaeleonticeps* (western North Atlantic) and *L. villarii* (western South Atlantic) have rounded heads and square tails. Their skulls have long, low supraoccipital crests similar to the species of *Branchiostegus*. The predorsal flap present in *L. chamaeleonticeps* appears to be a specialization of the elevated predorsal ridge seen in *L. villarii* and other branchiostegids (particularly *Branchiostegus semifasciatus*). *Lopholatilus villarii* may have more dorsal spines (VII-VIII vs. always VII) and does not have the specialized dorsal flap or lip barbels found on *L. chamaeleonticeps*. With respect to specialized structures, *L. villarii* appears the more primitive of the two species. The predorsal ridge of *L. villarii* is well elevated with no flap, a dition common to juvenile (below 50-60 mm SL) *L. chamaeleonticeps*. A predorsal ridge similarly elevated is only found in *B. semifasciatus* among the tilefishes. *Branchiostegus semifasciatus* is the only representative of the genus in the Atlantic and is found along the west coast of Africa adjacent to the distribution of *L. villarii*. Perhaps the prominent predorsal ridge is a relect character of a predecessor of these two genera and retained to a lesser extent in all branchiostegids.

Malacanthidae (Infrafamilial Relationships)

Malacanthids apparently split away from the branchiostegids quite early during the percoid radiation. This assumption is based upon the few characters held in common and the absence of clear-cut pleisiomorphic characters. Possibly the malacanthids are a branch of the labrid-scarid lineage, while the branchiostegids show closer affinities to the serranid-percid line of perciform evolution. This hypothesis is based primarily upon body form, cranial osteology, and skull musculature.

Malacanthus.—*M. plumeri* (western Atlantic) and *M. latovittatus* (Red Sea, Indian and Pacific Oceans) are allopatric species, the former with a relatively restricted distribution and the latter with a very wide range. *Malacanthus brevirostris* has a shortened skull and seems most closely related to the line that led to the genus *Hoplolatilus*.

Hoplolatilus.—*Hoplolatilus* appears to have evolved from an early *Malacanthus*-like ancestor that lived in burrows in tropical shallow water. Unlike *Malacanthus*, *Hoplolatilus* has a very short skull, a well-armed or serrate preoperculum, and no foramen above the dermosphenotic. *Hoplolatilus* has been divided into two subgenera: *H.* (*Hoplolatilus*) having a forked tail, 10 + 14 vertebrae, and a shallow maxillary, and *H.* (*Asymmetrurus*) with a square tail, slightly exserted upper caudal rays, 11 + 14 vertebrae, and a deeper maxillary (Randall and Dooley 1974).

Evolution

The fossil record of the tilefishes is essentially nonexistant. The only fossil attributed to a tilefish was cited by Romer (1966) as the description of *Latilus* (= *Branchiostegus*) *mesogeus* from the Mediterranean Miocene (Oran, Algeria) by Arambourg (1927). The fossil was in poor condition and the illustration is very unclear. C. Patterson and P. Greenwood kindly examined Arambourg's description and were unwilling, due to the unclear nature of the illustration and description, to express an opinion as to the validity of the identification and description.

The Acanthopterygii, an enormous group of spiny-finned fishes including some 200 families, have fossil members going back to the Cretaceous (Nelson 1969). Within the Acanthopterygii, the order Perciformes (including the superfamily Percoidea to which the tilefishes and some 50 other families belong) has served as a catch-all group (Gosline 1966a, 1966b). It is generally believed that the perciforms have arisen from a bery-

ciform stock (Patterson 1964). According to Patterson and Greenwood et al. (1966) perciforms had three to five lines of derivation from the beryciforms. With the proximity of basal percoids to beryciforms, it would be of interest to compare characters found in tilefishes and some beryciforms. Primitive perciform characters found in tilefishes might give perspective as to their relative position in perciform phylogeny. The argument that characters held in common might only represent convergence and are not therefore useful in phylogenetic inferences is less probable in light of the following quote from Patterson (1964:471): "... the resemblances between the various beryciform and perciform groups indicates real relationship, for if the resemblances were due to convergence, one would expect there to be as many characters in which beryciform genera are more specialized than the percoid groups as there are characters in which the percoid groups are more specialized than the Beryciformes."

The caudal structure and skull were examined from representative tilefishes by Monod (1968) and Lucas (1905), respectively, and both considered these to have basal percoid affinities. Gosline (1961) stated that *Kuhlia sandvicensis* had the most primitive perciform caudal skeleton of those he examined. The caudal skeleton contained: 15 branched caudal rays, 3 epurals, 2 independent uroneurals, a urostyle with a single ossification, and 6 autogenous hypurals. This caudal configuration is nearly identical to those found among tilefishes, and in the Beryciformes. The major differences between the perciform and beryciform caudal skeletons are the reduction of branched caudal rays from 17 to 15 and an increase of urostylar ossifications from 1 to 2 in primitive perciforms. Gosline (1968) subsequently placed the branchiostegids near the basal percoids in his system of classification. Tilefishes all possess a well-formed beryciform foramen in the ceratohyal, a beryciform character found only in several other perciform families including: Serranidae, Centrarchidae, and Bathyclupeidae (McAllister 1968). Tilefishes have a spinous pelagic larva very similar to those found in beryciform fishes and among the perciform families Serranidae, Lutjanidae, and Istiophoridae (perhaps a convergence?). The tilefishes, like the beryciforms, may exceed (24-27) the usual percoid number of vertebrae (24). The subocular shelf first appears in the beryciform fishes and appears to be found only in the orders Perciformes and Beryciformes (Smith and Bailey 1962). The subocular shelf in *Myripristis microphthalmus* (a berycoid), according to Smith and Bailey (1962), is made up of segments derived from bones two through five of the suborbital series, and they considered this arrangement the primitive condition. In the tilefishes, the second suborbital appears to have been fused to the first or is very reduced. In *Lopholatilus*, the shelf is formed mainly from the third suborbital, though the fourth and fifth suborbitals contribute. In *Branchiostegus*, the shelf is formed mainly by the fusion of the third and fourth suborbitals, with the fifth contributing slightly. In the genus *Caulolatilus*, the subocular shelf is formed essentially from the fusion of the third and fourth suborbital bones. In considering the arrangement and number of dorsal fin supports, Smith and Bailey (1961) thought the formulae 0-1- and 0-0-1- to be the most primitive among percoids. Both these mentioned formulae are found among tilefishes (malacanthids). Certainly, much more comparative anatomical study must be undertaken before convincing arguments can be made as to the phylogenetic affinities of tilefishes.

KEY TO THE FAMILIES OF TILEFISHES

1a. Predorsal ridge present (may be as an enlarged flap); body depth 21-36% (usually 27%) SL; dorsal fin elements 22-36; anal fin elements 14-28; dorsal plus anal fin base length 80-109% (usually around 90%) SL; body shape robust or quadriform . . . . . Branchiostegidae

1b. No predorsal ridge; body depth 12-26% (usually 18%) SL; dorsal fin elements 22-64; anal fin elements 14-56; dorsal plus anal fin base length 80-135% (usually over 90%) SL; body shape elongate or fusiform . . . . . Malacanthidae

KEY TO THE GENERA OF THE FAMILY BRANCHIOSTEGIDAE

1a. Operculum with strong, pointed spine; dorsal fin VI-X, 22-27 (mean total number of elements = 32); anal fin I or II, 20-26 (mean total number of elements = 25); pored lateral-line scales 73-115; vertebrae 11 + 16; length of dorsal plus anal fin bases 96-109 ($\bar{x}$ = 101)% SL . . . . . *Caulolatilus*

1b. Operculum without strong spine, instead reduced to soft blunt tab; dorsal fin VI-X, 14-16 (mean total number = 22); anal fin I or II, 11-14 (mean total number = 14 or 15); pored lateral-line scales 47-75; vertebrae 10 + 14; length of dorsal plus anal fin bases 80-97% SL 2

2a. Predorsal ridge reduced (prominent only in *Branchiostegus semifasciatus* from west Africa), and never modified into a predorsal flap; upper lip without barbel; anal fin I or II, 11-13 (mean total elements = 14); total first arch gill rakers 18-24; pored lateral-line scales 47-72 (47-51 in all species but *B. serratus* from eastern Australia, where they number 67-72) . . . . . *Branchiostegus*

2b. Predorsal ridge prominent and elevated (may be modified into a flap); upper lip may have thin barbel at posterior margin; anal fin I, 14 (rarely 13); total first arch gill rakers 22-26; pored lateral-line scales 66-75 *Lopholatilus*

Key to the Species of *Caulolatilus* from the Western Atlantic Ocean

1a. Caudal margin double emarginate or rounded . . 2
1b. Caudal margin emarginate or truncate 4

2a. Predorsal ridge darkly pigmented; dorsal fin elements VI or VII (rarely VI), 23-26; pored lateral-line scales 73-81; dark suborbital bar present; body without yellow vertical bars; no yellow patch on lower caudal lobe 3
2b. Predorsal ridge not dark nor differently pigmented; dorsal fin elements VIII, 22-23; pored lateral-line scales 96 or more; no dark suborbital bar; body with 17-20 light yellow vertical bars; caudal with large yellow patch on lower lobe . . . . . *williamsi*
(Cay Sal Bank, British West Indies; Virgin Islands)

3a. Upper body with numerous dark mottlings; mouth relatively large, extending to well under eye; dark predorsal ridge without anterior dark semicircle . . . . . *guppyi*
(Lesser Antilles, South America)
3b. Upper body more or less uniformly light gray-brown without dark markings; mouth relatively small, extending to just under orbit; dark predorsal ridge with dark anterior semicircle, forming a continuous dark mask outline when viewed head on . . . . . *intermedius*
(Gulf of Mexico)

4a. Dorsal fin elements VIII, 23-25; caudal emarginate; body without distinct markings (though very faint irregular bars may be present); dorsal fin membrane with yellow and gray pattern; anal fin II, 22-24; broad golden patch under eye to nostril; caudal with small yellow spots . . . . . *chrysops*
(North Carolina to Caribbean; also Brazil)
4b. Dorsal fin elements VII (rarely VIII), 23-27; caudal emarginate or truncate; body with or without upper markings; dorsal fin may have pattern; anal fin I or II, 20-24; no broad yellow area under eye (though a thin yellow diagonal line may run from orbit to upper lip); caudal with large yellow areas on each lobe or with small yellow spots 5

5a. Jaws extend to below anterior margin of orbit; caudal deeply emarginate with broad yellow areas on each lobe; spinous dorsal membrane brilliant orange-yellow; upper body with dark markings and a dark line below dorsal fin base; large dark area above pectoral fin axil; large orbit (23-41%, modally 31% HL); bright yellow predorsal ridge . . *cyanops*
(North Carolina to South America)
5b. Jaws to not extend nearly to orbit; caudal truncate or slightly emarginate, with small yellow spots but no large yellow areas; spinous dorsal dusky, soft portion unpatterned; upper body uniformly pigmented, no dark subdorsal line; no large dark area above pectoral fin axil; small orbit (15-29%, modally 19% HL); dark predorsal ridge . . . . . *microps*
(Virginia to Gulf of Mexico)

Key to the Species of *Caulolatilus* from the Pacific Ocean

1a. Dorsal fin VII-IX (usually VIII), 22-25; anal fin I or II, 21-24; pored lateral-line scales 80-91; large dark area above pectoral fin axil; broad bright yellow marking passing from under eye to end of snout . . . . . *affinis*
(Gulf of California to Cape San Lucas; from Costa Rica to Pisco, Peru; including the Galápagos Islands)
1b. Dorsal fin VII-X (usually IX), 23-27; anal fin II, 20-26; pored lateral-line scales 99-115; no dark area above pectoral fin axil; no broad bright yellow marking under eye 2

2a. Body depth 23-28% (modally 25%) SL; mouth relatively small and reaching only to anterior rim of orbit . . . . . *princeps*
(from Vancouver Island, British Columbia to Pisco, Peru, including eastern Pacific islands)
2b. Body depth 22-31% (modally 27%) SL; mouth relatively large and reaching posteriorly to under middle of pupil . . . . . *hubbsi* n.sp.
(more or less sympatric with *C. affinis*)

Key to the Species of *Branchiostegus*

1a. Pored lateral-line scales 67-72 (modally 70); no dark pigment on operculum, predorsal ridge, nor above pectoral axil . . . . . *serratus*
(eastern Australia)
1b. Pored lateral-line scales 47-51; dark pigment may be present on operculum, predorsal ridge, or above pertoral axil 2

2a. Dorsal fin VI, 16 (rarely 15); body with a series of dark bars tapering ventrally 3
2b. Dorsal fin VII, 15 (rarely VIII, 14); body without dark tapering bars 4

3a. Body bars number 19 or 20; prominently elevated dark predorsal ridge; large dark spot above axil of pectoral fin . . . . . *semifasciatus*
(West Africa)
3b. Body bars number 16-18; reduced light colored predorsal ridge; no large dark spot above axil of pectoral fin . . . . . *doliatus*
(Mauritius and Reunion Islands; Mozambique to South Africa)

4a. Body with 6 or 7 rows of black spots on scales between lateral line and pectoral base; dark areas along base of dorsal fin membrane between rays; 4 mandibular lateral-line pores unilaterally . . . . . *sawakinensis*
(Sudan, Red Sea; South Africa to Durban)

4b. Body without rows of black spots on side; no dark areas along base of dorsal fin membrane between each ray; 5 mandibular lateral-line pores 5

5a. Jaws do not reach to under orbit 6

5b. Jaws reach posteriorly beyond anterior rim of orbit 7

6a. Predorsal ridge light colored; caudal with numerous white spots, and no dark triangle of pigment on ventral lobe of caudal; often with a broad silver suborbital area . . . *albus* n.sp.
(Tokyo Bay, Japan; Pusan, South Korea; Shanghai, China; Taiwan; to South Vietnam)

6b. Predorsal ridge darkly pigmented; caudal without white spots; ventral lobe of caudal with dark triangle of pigment; no broad silver suborbital area . . . . . .(this species not positively seen) . . . . . *ilocanus*
(Philippines)

7a. Head with 2 thin silver bars extending from suborbit to upper lip; dorsal fin membrane with a median series of elongate dark spots . . . . . *argentatus*
(Hong Kong, China; Nhatrang, Vietnam)

7b. Head without suborbital bars; dorsal fin membrane without a median series of dark spots 8

8a. Caudal with 2 horizontal central yellow bands, lower lobe with large triangle of pigment; body dark dorsally, silver below . . . . *wardi*
(eastern Australia)

8b. Caudal with 4-6 yellow bands on upper lobe; body pink or yellowish 9

9a. Snout bright pink with pearl-colored band crossing in front of eyes; a silver band running from posterior orbit across cheek to throat; large dark brown spot above lateral line . . . . . . (this species not positively seen) . . . *vittatus*
(Philippines)

9b. Snout red or yellow, no pearl-colored band in front of eyes; no silver band across cheek to throat; no large brown spot above lateral line . . . . . *japonicus*
(Japan, Honshu; East China Sea; South Korea; China; Ryuku Islands; Taiwan; South China Sea to South Vietnam)

Key to the Species of *Lopholatilus*

1a. Predorsal ridge developed into a flap (on specimens greater than 80 mm SL) near origin of dorsal fin; cutaneous barbel extending from ventral margin of lower lip near jaw angle . . . . . *chamaeleonticeps*
(western North Atlantic)

1b. Predorsal ridge prominent, but not developed into a flap on nape; no cutaneous barbel on lower lip . . . . . *villarii*
(western South Atlantic)

KEY TO THE GENERA OF THE FAMILY MALACANTHIDAE

1a. Preoperculum edge smooth; dorsal fin elements 47-64 (modally 56); anal fin elements 38-56 (modally 48); total first arch gill rakers 6-20; pored lateral-line scales 116-181; length of dorsal plus anal fin bases 112-135% (modally 125%) SL . . . . . *Malacanthus*

1b. Preoperculum edge serrate, and may have enlarged spine at angle; dorsal fin elements 22-38 (modally 31); anal fin elements 14-21 (modally 19); total first arch gill rakers 16-28; pored lateral-line scales 89-140; length of dorsal plus anal fin bases 80-100% (modally 90%) SL . . . . . *Hoplolatilus*

Key to the Species of *Malacanthus*

1a. Dorsal fin elements 46-51 (modally 49); total first arch gill rakers 6-14 (modally 9); broad dark stripe from operculum to dorsal tip of caudal fin . . . . . *latovittatus*
(Red Sea, Indian and Pacific Oceans)

1b. Dorsal fin elements 54-64; total first arch gill rakers 8-18; no broad stripe from operculum to caudal fin 2

2a. Caudal rounded with 2 dark parallel stripes; jaws extend posteriorly to under anterior half of orbit . . . . . *brevirostris*
(sympatric with *latovittatus* except also found in eastern Pacific)

2b. Caudal forked (large specimens with elongate filaments) with no dark parallel stripes; jaws extend posteriorly well anterior of orbit . . *plumieri*
(western North Atlantic; Gulf of Mexico, Caribbean; central and western South Atlantic)

Key to the Subgenera and Species of *Hoplolatilus* (after Randall and Dooley 1974)

1a. Caudal fin forked; vertebrae 10 + 14; total

gill rakers in first arch 21-28; opercular spine smaller than pupil; maxillary width less than diameter of pupil (subgenus *Hoplolatilus*) 2

1b. Caudal fin truncate, the upper lobe somewhat produced; vertebrae 11 + 14; total gill rakers in first arch 16-19; opercular spine larger than pupil; maxillary width about equal to or greater than pupil diameter (subgenus *Asymmetrurus*) 4

2a. Dorsal fin X, 13; anal fin II, 12; pored lateral-line scales 89-92; penultimate dorsal and anal fin rays produced; elongate palp of white skin near pectoral base along inner edge of clavicle under operculum; a narrow black band running from eye to eye across front of snout; dorsal fin with a broad median black band except last few rays . . . . . *fronticinctus*
(Mauritius Island; Bay of Bengal; Palau Islands)

2b. Dorsal fin III-VIII, 21-34; anal fin I or II, 15-20; pored lateral-line scales 100-140; penultimate dorsal and anal fin rays not produced; no elongate palp of white skin near pectoral base along inner edge of clavicle under operculum (though flattened pads may be present); no narrow black band on snout; dorsal fin without a median dark band 3

3a. Dorsal fin VIII, 21-23; anal fin II, 15-16; pored lateral-line scales 100-113; depth of body 22-29% SL . . . . . *starcki*
(Guam, Mariana Islands; Palau Islands; Ilithi, Caroline Islands; Eniwetok, Marshall Islands; Rangiroa, Tuamotu)

3b. Dorsal fin III-V, 29-34; anal fin I, 19-20; pored lateral-line scales 116-140; depth of body 16-19% SL . . . . . *cuniculus*
(Tahiti)

4a. A prominent spine at preopercular angle, half or greater than length of opercular spine; anal fin II, 18-19; lateral-line scales 98-101; maxillary reaching a vertical at posterior rim of orbit; large irregular light areas separated by dark on either side of postorbital head region and anterodorsal portion of body; a large teardrop-shaped dark spot on caudal fin . . . . . *fourmanoiri*
(Vietnam)

4b. A short broad-based spine at preopercular angle; anal fin II, 20 (based on one specimen); pored lateral-line scales 92; maxillary reaching beyond a vertical at posterior rim of orbit; an irregular dark stripe slightly above midside of body, ending in middle of caudal fin; an irregular row of dark spots on body above stripe . . . . . *oreni*
(Red Sea)

SUMMARY OF SYNONYMS

Caulolatilus Gill 1863
- *Caulolatilus chrysops* (Valenciennes) 1833
  - *Latilus chrysops* Valenciennes 1833
- *Caulolatilus microps* Goode and Bean 1878
- *Caulolatilus cyanops* Poey 1866
- *Caulolatilus intermedius* Howell-Rivero 1936
- *Caulolatilus guppyi* Beebe and Tee-Van 1937
- *Caulolatilus williamsi* Dooley and Berry 1977
- *Caulolatilus affinis* Gill 1865
  - *C. cabezon* Evermann and Radcliffe 1917
- *Caulolatilus princeps* (Jenyns) 1842
  - *Latilus princeps* Jenyns 1842
  - *Dekaya anomala* Cooper 1863
  - *C. anomalus* Gill 1865
  - *C. affinis* Hildebrand 1946 (junior homonym of *C. affinis* Gill 1865)
- *Caulolatilus hubbsi* n.sp.

Branchiostegus Rafinesque 1815
- *Branchiostegus serratus* Dooley and Paxton 1975
- *Branchiostegus japonicus* (Houttuyn 1782)
  - *Coryphaena japonica* Houttuyn 1782 (junior homonym of *Coryphaena* Linnaeus 1758)
- ?*Coryphaena branchiostega* Gmelin 1788
- ?*Coryphaenoides hottuynii* Lacépède 1802 (junior homonym of *Coryphaenoides* Gunner 1765)
- *Latilus japonicus*. Jordan and Snyder 1901a
  - *L. ruber* Kishinouye 1907
- *Branchiostegus wardi* Whitley 1932
- *Branchiostegus sawakinensis* Amirthalingam 1969
- *Branchiostegus albus* n.sp.
- *Branchiostegus semifasciatus* (Norman) 1931
  - *Latilus semifasciatus* Norman 1931
- *Branchiostegus doliatus* (Cuvier) 1830
  - *Latilus doliatus* Cuvier 1830
  - *L. doleatus*. Swainson 1839 (misspelled)
- *Branchiostegus argentatus* (Cuvier) 1830
  - ?*Coryphaena sinensis* Lacépède 1802
  - *Latilus argentatus* Cuvier 1830
  - *L. sinensis*. Jordan and Snyder 1901
  - *L. auratus* Kishinouye 1907
  - *L. tollardi* Chabanaud 1924
  - *Branchiostegus sericus* Herre 1935
  - *B. sericeus*. Fowler 1949 (misspelled)
  - *B. tollarai*. Kuronuma 1961 (misspelled)
- ?*Branchiostegus ilocanus* Herre 1928
- ?*Branchiostegus vittatus* Herre 1926

Lopholatilus Goode and Bean 1880a
- *Lopholatilus chamaeleonticeps* Goode and Bean 1880a
- *L. villarii* Maranda-Ribeiro 1915
  - *L. abbreviatus* Lahille 1930

Malacanthus Cuvier 1829
- *Malacanthus plumieri* (Bloch) 1787a
  - *Coryphaena plumieri* Bloch 1787a
  - *Malacanthus plumieri*. Cuvier 1829
  - *M. trachinus*. Cuvier 1829
  - *Dikellorhynchus tropidolepis* Berry 1958
- *Malacanthus brevirostris* Guichenot 1848
  - *Malacanthe'a caudale tricolore* Lienard 1842 (origi-

nal description; trinomial designation only)
Malacanthus hoedtii Bleeker 1859
M. hoedti. Playfair and Günther 1866
M. parvipinnis Vaillant and Sauvage 1875
Dikellorhynchus incredibilis Smith 1956
Malacanthus latovittatus (Lacépède) 1802
Labrus latovittatus Lacépède 1802
Taenianotus latovittatus Lacépède 1803
Malacanthus latovittatus: Quoy and Gaimard 1833
M. taeniatus Valenciennes 1839
M. urichthys Fowler 1904
Oceanops latovittata Jordan and Seale 1906
O. latovittatus. Snyder 1912
Hoplolatilus Günther 1887
Hoplolatilus fronticinctus Günther 1887
Latilus fronticinctus Günther 1887 (type-species by monotypy)
Hoplolatilus starcki Randall and Dooley 1974
H. cuniculus Randall and Dooley 1974
H. fourmanoiri Smith 1963
H. oreni (Clark and Ben-Tuvia) 1973
Asymmetrurus oreni Clark and Ben-Tuvia 1973

FAMILY BRANCHIOSTEGIDAE

Diagnosis.—Found worldwide in tropical, warm- and cold-temperate waters along the edges of continental shelves and the upper slopes of continental margins; occasionally found around continental or oceanic islands (Fig. 1); unlike malacanthids, as far as known, branchiostegids do not inhabit or construct mounds or burrows; body shape ranges from robust and round-headed to quadriform and square-headed; body depth 21-36% (usually 27%) SL vs. 12-26% (usually 18%) SL in malacanthids; predorsal ridge always present (not found in malacanthids); supraoccipital crest well elevated and elongate (very reduced in malacanthids); first haemal spine with parapophyses fused medially, acting as a receptacle for posterior end of swim bladder (parapophyses fused only at tips in malacanthids, forming an arch through which swim bladder protrudes); dorsal and anal fins long and continuous (sum of dorsal and anal fin bases = 80-109%, usually 90% SL), in malacanthids this proportion = 80-135%, usually over 90% SL; dorsal fin VI-X, 14-27 (total of 22-36 elements); anal fin I or II, 11-26 (total of 14-28 elements); pectoral fin 16-20 (usually 17-18) rays; pelvic I, 5; caudal fin with 17 principal rays (15 branched), emarginate, truncate, or rounded margin (the latter two types may have produced rays); gill membranes free from isthmus and may nearly cover pectoral fin bases; 6 branchiostegal rays; 4 gill arches and well-developed pseudobranch; nostrils paired, posterior naris enclosed in thin cutaneous tube with a flap; upper and lower jaws with canine teeth and patches of villaform teeth near both symphyses; no teeth on palatines, pterygoids, vomer, or tongue; well-developed pharyngeal teeth present; preoperculum serrate on upper limb to angle or just beyond, lower limb with few or no serrae; no enlarged spines at angle of preoperculum; operculum with either an exposed single stout spine, or with a soft blunt projection; vertebrae 10 + 14 or 11 + 16; subocular shelf always present; scales ctenoid over most of the body, nearly all cycloid in head region.

CAULOLATILUS GILL 1862a

Caulolatilus Gill 1863:240 (*Latilus chrysops* Valenciennes 1833 was subsequently designated as the type-species *Caulolatilus chrysops* by Gill 1863).
Dekaya Cooper 1863:70 (type-species: *Dekaya anomala* by original description); subsequently designated as a junior synonym of *Caulolatilus* by Gill (1865); Gill (1882) restated *Dekaya* as a synonym of *Caulolatilus*.

Diagnosis.—Base of dorsal fin 54-68% (modally 62%) SL; base of anal fin 31-44% (modally 39%) SL; length of dorsal plus anal fin bases 96-109% (modally 101%) SL; predorsal ridge present, not enlarged into a flap; vertebrae 11 + 16, a unique character among tilefishes; dorsal fin elements VI-X, 22-27 (mean total elements = 32) (Table 3); anal fin elements I or II, 20-26 (mean total = 25) (Table 4); total gill rakers on first arch 17-27 (Table 5); pored lateral-line scales 73-115 (Table 6); first haemal spine positioned over fifth to seventh anal ray; dorsal fin supports to neural spine ratio (1.15-1.33):1; anal fin supports to haemal spine ratio (1.47-1.67):1; caudal fin emarginate, truncate, or rounded.

Description.—The most generalized of the tilefish genera. First caudal vertebrae with broad haemal spine

Table 3.—Frequency distribution of the number of dorsal fin elements of the species of *Caulolatilus*.

												Soft elements		
Species	VI	VII	VIII	IX	X	22	23	24	25	26	27	$\bar{x}$	*N*	SD
chrysops			17				2	12	3			24.1	17	0.558
microps		80	1					7	37	41	1	25.5	81	0.573
cyanops		38	1				11	28				23.7	39	0.456
intermedius		59						28	30	1		24.5	59	0.536
guppyi	2	33					2	31	2			24.0	35	0.343
williamsi			2			1	1					22.5	2	—
affinis		4	143	4		1	34	94	22			23.9	151	0.625
princeps		1	4	103	2			6	48	48	8	25.5	110	0.713
hubbsi			2	22	1		1	1	12	10	1	25.4	25	0.810

Table 4.—Frequency distribution of the number of anal fin elements of the species of *Caulolatilus*.

Species	I	II	20	21	22	23	24	25	26	Soft elements $\bar{x}$	*N*	SD
chrysops		17			3	10	4			23.1	17	0.659
microps		73			17	55	1			22.8	73	0.430
cyanops	20	19	1	8	27	2				21.8	39	0.577
intermedius	29	30			11	48				22.8	59	0.393
guppyi	12	23	1	4	26	4				21.9	35	0.591
williamsi						1	1		24.5	2	—	
affinis	8	128		2	26	91	17			22.9	136	0.607
princeps		112	1	—	2	8	38	52	11	24.5	112	0.939
hubbsi		25				1	13	8	3	24.5	25	0.770

Table 5.—Frequency distribution of the number of first arch gill rakers of the species of *Caulolatilus*.

Species	17	18	19	20	21	22	23	24	25	26	27	$\bar{x}$	*N*	*SD*
cyrysops	1	2	5	7	1							19.3	16	1.01
microps					1	2	15	32	13	4	1	24.0	67	0.961
cyanops	2	19	12	5	1							18.6	39	0.880
intermedius		1	11	20	22	5						20.3	59	0.937
guppyi			3	8	16	7	1					20.9	35	0.944
williamsi					1							21.0	1	—
affinis				1	3	4	21	55	51	12	2	24.3	149	1.12
princeps				1	6	31	47	18	4	1		22.8	108	0.99
hubbsi					3	9	9	1	1	1		22.6	24	1.17

Table 6.—Frequency distribution of the number of pored lateral-line scales in the species of *Caulolatilus*.

Species	73-5	76-8	79-81	82-4	85-7	88-91	95-7	98-100	101-3	104-6	107-9	110-12	113-15	$\bar{x}$	*N*	SD
chrysops			1	6	5	3								84.8	15	2.68
microps			7	8	14	4								84.8	33	2.80
cyanops	1	15	18	3										78.9	37	1.78
intermedius	9	39	9											77.2	57	1.60
guppyi	1	28	6											77.8	35	1.26
williamsi							1							96.0	1	0
affinis			12	67	58	13								84.4	150	2.23
princeps								6	22	41	27	4	3	105.4	103	3.05
hubbsi								2	3	7	7	2		105.5	21	2.96

or with a posteriorly curved haemal process that receives the end of the swim bladder; pectoral fin rays 16-20 (rarely 20); cheek scales 8-18; opercular scales 5-20; scales above lateral line 9-21; below lateral line 28-50.

Body depth 21-34% (modally 28%) SL; body width 10-20% (modally 13%) SL; caudal peduncle length 8-13% SL; caudal peduncle depth 7-12% SL; head length (HL) 23-34% SL (Table 7); predorsal length 28-39% SL; head depth 72-100% HL; snout length 27-51% HL; length of upper jaw 28-42% HL; length of lower jaw 36-48% HL;

Table 7.—Range of proportional measurements of the species of *Caulolatilus* expressed as percent standard length and percent head length. Number in parentheses is the mean percent.

	Percent standard length					Percent head length		
Species	Body depth	Body width	Caudal peduncle depth	Head length	Predorsal length	Snout length	Orbit diameter	Sub-orbital depth
chrysops	27-30 (29)	14-15 (14)	7-9 (8)	26-30 (27)	29-34 (32)	28-46 (42)	19-33 (23)	21 (21)
microps	24-31 (29)	11-16 (13)	8-9 (9)	28-32 (31)	30-39 (34)	37-51 (48)	15-29 (19)	17-24 (20)
cyanops	25-31 (26)	11-17 (13)	7-9 (8)	27-32 (30)	30-35 (33)	27-41 (34)	23-41 (31)	7-18 (13)
intermedius	26-32 (29)	10-14 (12)	8-12 (10)	27-31 (29)	30-36 (33)	29-40 (35)	26-40 (32)	15-19 (17)
guppyi	28-34 (30)	11-14 (12)	9-11 (10)	27-30 (29)	30-34 (32)	32-39 (36)	24-34 (29)	14-19 (16)
williamsi	21-23	14	10	25	29	43	19	20
affinis	23-32 (29)	10-16 (13)	8-10 (9)	25-34 (31)	31-36 (33)	33-44 (39)	16-31 (22)	8-20 (18)
princeps	23-28 (25)	12-17 (14)	7-10 (7)	23-30 (27)	28-33 (30)	32-41 (36)	18-26 (22)	11-17 (14)
hubbsi	24-31 (27)	13-20 (15)	7- 9 (8)	26-30 (27)	29-36 (32)	32-39 (35)	20-24 (23)	12-16 (14)

cheek depth 18-42% HL (allometric); opercular length 22-33% HL; snout to dorsal margin of preoperculum 68-79% HL; orbit diameter 15-41% HL (allometric); suborbital depth 7-24% HL (allometric).

Jaws reach posteriorly from between posterior naris and anterior rim of orbit to under middle of eye; canine teeth in outer row along margins of upper and lower jaws number about 17-33 on each side, with 1 or 2 enlarged anteriorly curved teeth at the posterior end of upper and lower jaws; 4-6 rows of villiform teeth in patches at symphysis of jaws; villiform teeth may extend posteriorly as a single row medial to canines.

Preoperculum finely serrated on upper limb and to just below angle, lower limb with few or no serrae; preopercle angle 90-120°; operculum with a well-developed flat spine (usually toothed); predorsal ridge present, though not prominent; ridge may be dark, light, or not differentially pigmented; cephalic lateral-line pores numerous (usually more than 100); mandibular series with 4-6 on each side.

Scales extend on top of head from anterior third of eye to anterior rim of orbit; caudal fin with fine scales; a small patch of scales on pectoral fin base; other fins unscaled; body with a very high percentage (around 90) of regenerated scales.

Dorsal fin height 7-10% SL; fin height fairly uniform, except spinous portion slightly lower than soft portion; antepenultimate soft dorsal ray may be elongate; fin base 54-68% (modally 62%) SL; first dorsal spine always joined with second to a common pterygiophore; two predorsal interneural bones present (formula 0-0-2-); dorsal fin origin over or slightly posterior to pectoral fin base.

Anal fin slightly lower than dorsal fin; fin base 31-44% (modally 39%) SL; first spine, when present, may be minute and subcutaneous and enter into the length of second spine 3-6 times; first soft ray segmented, though may be undivided; antepenultimate ray may be elongate.

Pectoral fins long and pointed, reaching to anus or beyond to base of third or fourth anal soft ray; length from axil to tip 20-31% SL.

Pelvic fin origin below or somewhat posterior to ventral base of pectoral fin; extends posterior to anterior of anus or past anus to first or second anal ray; length 14-20% SL.

Caudal fin emarginate, truncate, or slightly rounded with exserted tips; dorsal portion may be somewhat larger than ventral portion of fin; 11-13 dorsal and 9-12 ventral procurrent caudal rays.

Caulolatilus chrysops (Valenciennes 1833)

Atlantic Gold-Eyed Tilefish

Figure 9

Latilus chrysops Valenciennes 1833:496 (*in* Cuvier and Valenciennes 1833, original description; Brazil) (MNHN 8157). Poey 1865:311 (compared to *C. cyanops*). Günther 1860:253 (British Museum specimens).

Caulolatilus chrysops. Gill 1863:240 (generic designation); 1865:66 (synopsis of genus). Goode and Bean 1878:42 (compared to *C. mycrops*). Gill 1882:162 (synopsis). Goode and Bean 1885:45 (specimen listed in table as *C. chrysops* is most probably *C. cyanops*, BMNH 1866·6·7·18). Miranda-Ribeiro 1915:6 (Brazil). Fowler 1915:49 (Santo Domingo). Miranda-Ribeiro 1918:145 (Brazil). Metzelaar 1919:70 (Aruba, West Indies). Beebe and Tee-Van 1928:278 (Port au Prince, Haiti). Howell y Rivero 1936:62 (Havana, Cuba).

Diagnosis.—A species of *Caulolatilus* that is distinguished from other Atlantic species in having: dorsal fin elements VIII, 23-25; a broad (three-fourths diameter of pupil) brilliant yellow streak from suborbital to over naris (present as light area on preserved specimens); also yellow pigment on medial side of pectoral fin base. Differs from *C. microps* in having dark spot above pectoral axil and having a patterned dorsal fin (Fig. 9). The dark spot above the pectoral axil, the broad yellow suborbital streak, and the VIII dorsal spines are characters also shared with the Pacific species *C. affinis*, but these species differ in coloration of body and fins, and the

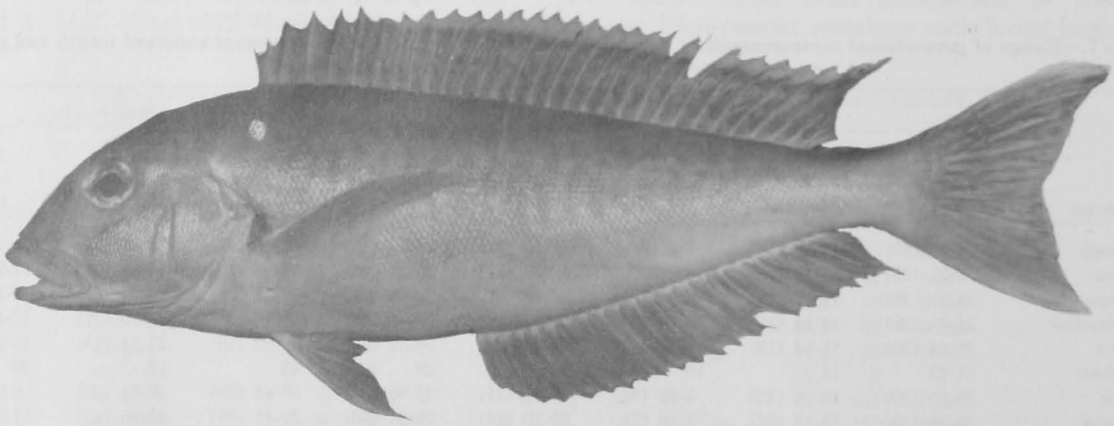


Figure 9.—*Caulolatilus chrysops*, 348 mm SL (UPR 2493), Venezuela (photograph by J. E. Randall).

number of first arch gill rakers (17-21, $\bar{x}$ = 19 for *C. chrysops*; 20-27, $\bar{x}$ = 24 in *C. affinis*).

Description.—Anal fin II, 22-24; pectoral fin rays 18 or 19 (rarely 19); pored lateral-line scales 79-89 (modally 85) plus 2-5 more on tail; cheek scales 10-15; opercular scales 8-12; scales above lateral line 13-16; scales below lateral line 40-45.

Body depth 27-30% (modally 29%) SL; body width 14-15% (modally 14%) SL; caudal peduncle length 11-13% SL; caudal peduncle depth 7-9% (modally 8%) SL; head length (HL) 26-30% (modally 27%) SL; predorsal length 29-34% (modally 32%) SL; head depth 79-97% HL; snout length 28-46% (modally 42%, allometric) HL; length of upper jaw 33-42% HL; length of lower jaw 41-46% HL; cheek depth 25-36% HL (allometric); opercular length 24-28% HL; snout to dorsal margin of preoperculum 71-78% HL; orbit diameter 19-33% (modally 23%, allometric) HL; suborbital depth about 21% (modally 21%) HL (allometric).

Jaws extend posteriorly to nearly beneath anterior rim of orbit; teeth moderately large canines; upper and lower jaws with 28-32 teeth on each, and each with 1 or 2 enlarged antrorsely curved teeth at posterior margins; both jaws with about 8 rows of villiform teeth in patches at their symphysis, patches narrow to a single row posteriorly.

Preoperculum with well-developed serrae on upper limb only; angle of preoperculum 90-95°; operculum with a prominent tapered flat spine; opercular spine length equal to, or less than, half the pupil diameter; predorsal ridge dark, not prominent.

Lateral-line pores in a low curve; cephalic pores numerous and diffuse, mandibular series with five pores on each side, including pore at preopercular margin.

Scales nearly all regenerated, extend on top of head to near anterior rim of pupil. Pectoral fins with a small patch of scales near their bases; caudal covered with fine scales, remaining fins scaleless.

Dorsal fin greatest height about 8% SL; spinous portion (except for anterior three spines) about same height as soft portion; dorsal base 59-65% SL; first spine 1.2-1.6 into length of second spine; dorsal fin origin over pectoral base; rays all branched, with antepenultimate ray elongate and reaching past hypural base.

Anal fin slightly lower than dorsal, height about 7% SL; anal fin base 37-42% SL; origin below between dorsal soft rays 6-7; anal with two spines, the first is reduced (about 5.5 times in length of second) and concealed; rays all branched; antepenultimate ray elongate, reaching to hypurals.

Pectoral fins long and pointed, reaching nearly to anal fin; fin length 23-27% SL; all rays except stout uppermost ray branched; stout pectoral ray about 3.5 times in length of longest ray.

Pelvic fins broad and pointed, not reaching anus; fin length 15-19% SL; origin slightly posterior to below origin of pectorals; spine about 2 times in length of fin.

Caudal fin emarginate, upper lobe somewhat longer than ventral lobe; 17 principal rays, 15 branched; 12 dorsal and 10 ventral procurrent caudal rays.

Color.—Fresh coloration (12 Cape Lookout, N.C. specimens) as follows: body violaceous with a light yellow cast on upper body; body with a silvery underlying sheen fading to a pearly white underbelly; head with an undifferentially pigmented predorsal ridge; a broad brilliant yellow marking from suborbit to over naris with a bright (less distinct) blue underlying marking; yellow pigment also on branchiostegal membrane just under opercular spine, covering underside of pectoral fin base, and a small spot on lateral side of pectoral fin base; iris golden; dorsal fin membrane with a basal zone of pearly white, above which there is a broad area of gray and yellow mottling (spinous portion mostly gray); finally the dorsal margin of the fin is whitish; anal fin with a faint central band of dusky gray on the otherwise pearly white membrane; pectoral fins with yellow markings as mentioned, and dorsalmost eight rays gray with remaining rays white; pelvic fins white with an overlying light gray cast; caudal fin with small light yellow patches, mostly on lobes.

Biology.—Fishes found associated with *C. chrysops* (off North Carolina): *Lutjanus campechanus, Rhomboplites aurorubens, Pagrus pagrus*; often also found with *Centropristis philadelphica, Epinephelus niveatus, E. morio, E. nigritus, Mycteroperca interstitialis, Seriola rivoliana, S. dumerili*, and *Caulolatilus microps*. Sport fish catches off North Carolina show *C. microps* to outnumber *C. chrysops* about 30 to 1 in the same area (75-125 m, on coral-shell rubble bottom). *Caulolatilus chrysops* generally ranges somewhat deeper than *C. microps*, though not as deep as *C. cyanops*. The stomach contents (usually lost as fish is landed) from a single specimen taken off North Carolina (UNC 6237) contained: bivalves, urchin parts, worm tubes, and crab parts. Specimens examined were collected only in May, July, and September. Running ripe females were found in September. *Caulolatilus chrysops* is intermediate in maximum size reached between *C. microps* (653 mm SL) and *C. cyanops* (325 mm SL). The largest specimen of *C. chrysops* examined was 445 mm SL, 540 mm TL, and had a fresh weight of 1.84 kg.

Distribution.—Now known from off Cape Lookout, N.C. (the first verification of this species north of southern Florida); also known from Tortugas, Fla.; Havana, Cuba; (?) Aruba, West Indies; (?) Port au Prince, Haiti; (?) Santo Domingo, Dominican Republic and from Rio de Janeiro and São Paulo, Brazil. The disjunct distribution may be due to lack of sampling, unsuitable bottom, or perhaps from the hyposaline and attendant turbidity barrier caused by the Amazon and Orinoco Rivers (C. Gilbert and J. Staiger, pers. commun.) although this barrier does not seem to be effective for reef fishes (Collette and Rützler in press). The depth distribution is from 90 to 131 m, generally on a rubble bottom.

Material examined.—A total of 18 specimens (87-445 mm SL) were examined. (JKD) specimens deposited at UNC. NORTH CAROLINA: UNC 6237 (JKD field # 16), 383 mm; UNC 6231 (JKD field # 17), 418 mm; UNC 6235 (JKD field # 19), (3) 430-445 mm; UNC 6236 (JKD field # 21), (2) 333-422 mm; UNC 7933 (JKD field # 22), 376 mm; UNC uncat., 400 mm; UNC uncat., (2) 410-430 mm; (JKD field # 73-1), 360 mm. FLORIDA: USNM 157719, 420 mm. VENEZUELA: UPR 2493, 340 mm. BRAZIL: MZUSP 8982, 183 mm; MZUSP 8984, 138 mm; MZUSP 8983, 87 mm; MNHN 8157 (holotype), 265 mm.

Holotype.—MNHN 8157; 265 mm SL, 327 mm TL; Brazil; very flacid and depigmented, although the dark spot above the pectoral axil is still evident; D. VIII, 24; anal fin elements II (the first spine was small and subcutaneous, only evident through radiograph), 23 (Valenciennes counted II, 22); P_1 18; B. 6; first arch gill rakers 8 + 13; pored lateral-line scales 89 + 3 on tail; scales above lateral line 15; below lateral line 45; cheek scales 12; opercular scales 10; body depth 28% SL; body width 15% SL; head length 27% SL; orbit 25% HL; photographed; vertebrae 11 + 16.

Caulolatilus microps Goode and Bean 1878
Gray Tilefish

Figure 10

Caulolatilus microps Goode and Bean 1878:42 (original description; Pensacola, Fla.) (USNM 20971); 1880b: 131 (Pensacola, Fla.); 1885:44 (Florida). Jordan 1884:33 (Pensacola, Fla.). Jordan and Evermann 1896:462 (checklist); 1898:2277 (synopsis). Evermann and Kendall 1900:91 (Pensacola, Fla.). Firth 1937:189 (Cape Henry, Va.). Briggs 1958:276 (Florida). Nelson and Carpenter 1968:51 (Campeche, Mexico).

Caulolatilus cyanops. (not of Poey, 1866) Pearson 1932:1 (probably misidentified; Currituck, N.C.)

Diagnosis.—This species differs from all other Atlantic species of *Caulolatilus* in lacking a large dark spot above the axil of its pectoral fin and lacking any pattern on the dorsal fin membranes. *Caulolatilus microps* shares a high number of pored lateral-line scales (80-91) only with *C. chrysops* and *C. affinis* (a Pacific species) but can be separated from these species by its lower number of dorsal spines (VII vs. usually VIII or higher in *C. chrysops* and *C. affinis*). *Caulolatilus microps* has the highest number of first arch gill rakers (21-26) among Atlantic species of *Caulolatilus* and can be separated from the Pacific species that overlap in gill raker counts by its usually lower dorsal fin count of VII (rarely VIII), 24-27. *Caulolatilus microps* also has the proportionately smallest eye (15-29%, usually 19% HL) among all species of *Caulolatilus*, although this is an allometric character. The jaws of *C. microps* extend posteriorly only to a vertical half way between naris and rim of orbit on specimens larger than about 400 mm SL, or just below anterior orbital rim on smaller specimens, a unique character within the genus. All other congeners have jaws extending to below orbit or beyond.

Description.—Anal fin II, 22-24; pectoral fin 17 or 18 (usually 18); cheek scales 10-17; opercular scales 10-15; scales above lateral line 12-16; scales below lateral line 33-46.

Body depth 24-31% (modally 29%) SL; body width 11-16% (modally 13%) SL; caudal peduncle length 10-12%; caudal peduncle depth 8-9% (modally 9%) SL; head length (HL) 28-32% (modally 31%) SL; predorsal length 30-39% (modally 34%) SL; head depth 77-96% HL; snout length 37-51% (modally 48%) HL; lengths of upper jaw 35-42% HL; length of lower jaw 38-46% HL; cheek depth 28-42% HL; opercular length 24-28% HL; snout to dorsal margin of preoperculum 72-78% HL; suborbital depth 17-24% (modally 20%) HL (allometric).

Jaws extend posteriorly to a vertical about half way between posterior naris and anterior rim of orbit, well in front of eye; teeth moderately large canines numbering 20-32 in outer row of both upper and lower jaws; upper jaw with a single enlarged tooth at posterior end of jaw; lower jaw with 1 or 2 enlarged teeth posteriorly; both up-

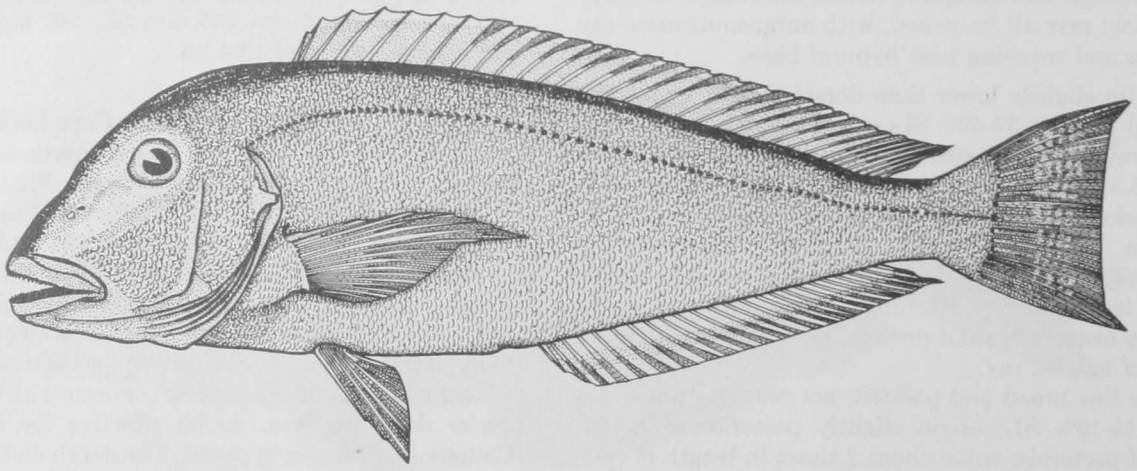


Figure 10.—*Caulolatilus microps*, 550 mm SL (specimen later dissected), Cape Lookout, N.C.

per and lower jaws with 4 or 5 rows of villiform teeth medial to canines in patches at symphysis, narrowing to a single row half way back on jaw.

Preoperculum well serrate only on upper limb; angle of preoperculum 90-105°; operculum with strong flat spine with several small teeth along posterior edge; spine length three-fourths diameter of pupil; gill rakers well developed, although not elongate; predorsal ridge darkly pigmented and fairly prominent.

Lateral-line pores in a nearly flat sigmoid curve; cephalic pores numerous, mandibular series with five pores on each side.

Scales nearly all (95%) regenerated; extend on top of head to anterior rim of orbit; pectoral fin with fine scales near base; caudal also with scales, remaining fins naked.

Dorsal fin greatest height about 7% SL; spinous portion slightly lower than soft portion; dorsal fin base 56-66% SL; first two dorsal spines were supported by a common pterygiophore; first spine about 1.5 times into length of second; dorsal fin origin over posterior margin of pectoral base; dorsal rays all branched, antepenultimate ray slightly elongate and just reaching hypurals.

Anal fin slightly lower than dorsal fin, about 6% SL; anal fin base 33-40% SL; origin below between dorsal soft rays 7 and 8; anal with two spines, the first hidden and about 3-4 times into length of second spine; all rays branched; antepenultimate ray slightly elongate, reaching to hypurals.

Pectoral fins long an pointed, reaching to anus; fin length 20-27% SL; all rays branched except stout uppermost ray whose length goes about 3-4 times into length of pectoral fin.

Pelvic fins broad, not reaching anus; length 14-18% SL; origin posterior to origin of pectorals; spine about 1.5 times into length of fin; all five rays branched.

Caudal fin slightly emarginate; with tips exserted; all but upper and lowermost rays branched (17 principal, 15 branched); 13 dorsal and 12 ventral procurrent caudal rays.

Color.—Live coloration based on about 20 North Carolina specimens: body dark brown dorsally fading to light beige-white ventrally; body darkens to a brown-gray after death; a hint of yellow overlies the brown body color; head with a black predorsal ridge; snout turquoise blue with a narrow gold stripe under the eye (not nearly as broad as in *C. chrysops*) extending to upper lip; a broader brilliant blue band (greenish near orbit) underlines the gold stripe and extends diagonally from orbit to upper lip; eye with gold iris, metallic green under pupil; preoperculum bright yellow; operculum pale brown with overlying bright yellow; spine bright blue; dorsal fin membrane light gray with an overlying bluish-white hue; membrane has no distinct markings except some light yellow areas which fade after death; dorsal fin upper margin with a light yellow band (widest over soft portion), but not nearly as evident as the brilliant yellow-orange areas found on *C. cyanops*; anal fin membrane pearly white and translucent with a central bright yellow band and a bluish-white ventral margin; pectorals pale bluish-white and gray near margins; pelvic rays clear, membrane milky white; caudal ray bases solid yellow, posteriorly forming a twin series of parallel spots for each ray; caudal with gray-blue dorsal and ventral margins.

Biology.—Food consists mainly of: urchin parts, caridean and penaeid shrimps, polychaetes, brittle stars, crabs, mollusks (*Semele purpurascens, Pitar fulminata*, and *Microcardium tinctum*, identified by H. Porter), ascideans, bryozoans, amphipods, eels and other fishes, and coral conglomerate. *Caulolatilus microps* appears to be an epibenthic browser and has well-developed pharyngeal teeth for grinding. Little is known about the reproduction of the species. Running ripe females were taken during the course of the study in January and from May through September. Beside ripe ovaries, the dominant organ within the viscera is a very large liver comprising from 0.9 to 1.6% of the body weight (measured from 20 specimens). Associated fish species are the same as those listed for *C. chrysops*.

Distribution.—(?) Cape Henry, Va.; Cape Lookout, N.C. to Florida; Florida-Gulf of Pensacola, Fla. (probably throughout Gulf); Campeche, Mexico; apparently a continental species with pelagic larvae; depths 30-162 m (abundant off North Carolina in 75-125 m on a rubble bottom).

Material examined.—The largest specimen examined measured 653 mm SL, 765 mm TL, and had an estimated weight of 6 kg (reported to reach about 7 kg). A total of 87 specimens (133-653 mm SL) were examined. (JKD) specimens were deposited at UNC. NORTH CAROLINA: UNC 6077 (JKD field # 1), (3) 458-460 mm; UNC 6078, 510 mm; UNC 6079, (2) 350-435 mm; UNC 6080, (21) 317-530 mm; UNC 6081, 345 mm; UNC 6082, 507 mm; UNC 4665, 550 mm; UNC 4222, (3) 520-620 mm; UNC 3783, 470 mm; UNC 4650, (2) 277-515 mm; UNC 6235, (8) 410-525 mm; UNC 6457, 445 mm; UNC 4139, 165 mm; UNC uncat. (JKD field # 13-1), (10) 320-522 mm; UNC uncat. (JKD field # 15-1), (12) 365-653 mm; FMNH 67434, (3) 133-147 mm; (formerly TABL, *Silver Bay* 2930, uncat.), 230 mm. SOUTH CAROLINA: (formerly TABL, *Silver Bay* 5398, uncat.), 365 mm; GMBL 70-72, 406 mm; GMBL 70-37, 438 mm; USNM 204954, 520 mm; USNM 204956, 415 mm; USNM 204955, 550 mm; USNM 204957, 355 mm. FLORIDA-ATLANTIC: UMML 9610, 265 mm; UMML 13652, 267 mm; UMML 16275, 178 mm. FLORIDA-GULF: USNM 20971 (holotype), 570 mm; USNM 32636, 475 mm.

Holotype.—USNM 20971, 570 mm SL, 675 mm TL (tips of tail broken); Pensacola, Fla.; specimen in fairly good condition, although color lost from years in alcohol; D. VII, 25; A. I, 23; P_1 17; B. 6; total first arch gill rakers 9 + 15; pored lateral-line scales 84 + 4 on tail; scales above lateral line 13; below lateral line 38; body depth 31% SL; body width 13% SL; head length 31% SL; orbit 17% HL.

Caulolatilus cyanops Poey 1866
Blackline Tilefish

Figure 11

Caulolatilus cyanops Poey 1866:312 (original description; Cuba); 1868:330 (list); 1876:137 (Cuba). Goode and

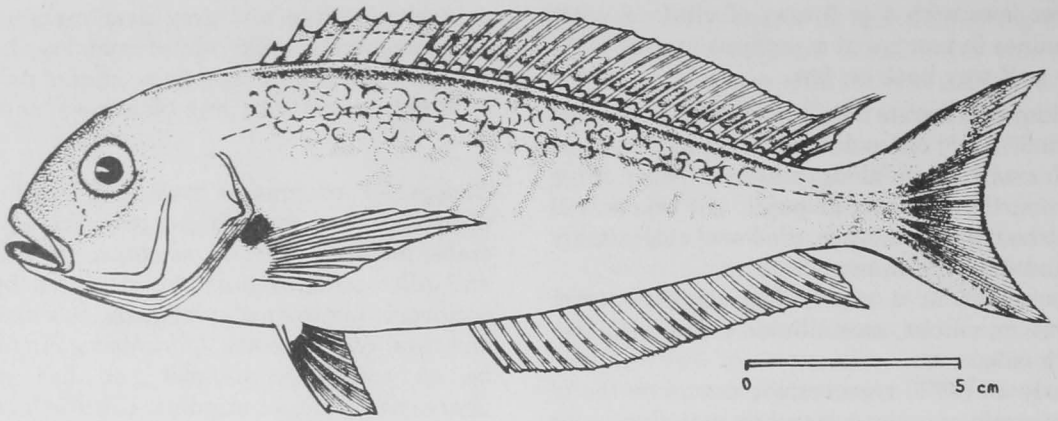


Figure 11.—Line drawing of *Caulolatilus cyanops*.

Bean 1885:45 (compared to *microps*, *C. chrysops* listed in table appears to be *C. cyanops* BMNH 1866•6•7•18 from Barbados). Jordan and Evermann 1896:462 (checklist); 1898:2278 (synopsis). Evermann and Marsh 1902:303 (Puerto Rico). Nichols 1930:371 (Puerto Rico). Jordan et al. 1930:357 (checklist). Longley and Hildebrand 1941:145 (Tortugas, Fla.). Briggs 1958:276 (Florida). Cervigón 1966:351 (Venezuela). Mago Leccia 1970:96 (Venezuela). Ewald et al. 1971:pl. 58 (Venezuela).

(?) *Caulolatilus* sp. Bullis and Struhsaker 1970:73 (west Caribbean).

Diagnosis.—Caulolatilus cyanops can be distinguished from all other species of the genus by: having the shortest suborbital depth (7-18%, modally 13% HL); the greatest orbit diameter (23-41%, modally 31% HL), a character shared only with *C. intermedius* (26-40%, modally 32% HL), and *C. cyanops* can be distinguished from *C. intermedius* by its deeply emarginate tail and lack of a dark diagonal bar under the eye; *C. cyanops* is distinct in having a dark stripe running the length of its body just below the dorsal fin and a brilliant orange-yellow spinous dorsal fin membrane; *C. cyanops* can be distinguished from *C. microps* in having a large dark spot above the axil of the pectoral fin (*C. microps* lacks a pectoral axil spot).

Description.—Dorsal fin elements VII, 23-24 (modally 24); anal fin elements I or II (equally often, although first spine often inconspicuous), 20-23 (modally 22); pectoral fin 16 (rarely 17 or 18); total first arch gill rakers 17-21 (modally 19); pored lateral-line scales 75-82 (modally 79); cheek scales 8-13; opercular scales 5-11; scales above lateral line 9-13; scales below lateral line 29-38.

Body depth 25-31% (modally 26%) SL; body width 11-17% (modally 13%) SL; caudal peduncle length 10-12% SL; caudal peduncle depth 7-9% (modally 8%) SL; head length (HL) 27-32% (modally 30%) SL; predorsal length 30-35% (modally 33%) SL; head depth 72-90% HL; snout length 27-41% (modally 34%) HL; length of upper jaw 33-41% HL; length of lower jaw 37-48% HL; cheek depth 18-31% HL; opercular length 22-28% HL; snout to dorsal margin of preoperculum 72-78% HL.

Jaws reach posteriorly to anterior rim of pupil; moderately large canine teeth along outer margin of upper jaw, numbering 17 or 18 plus an enlarged antrorsely curved canine at posterior end of jaw; lower jaw with 15 moderately large canines plus an enlarged antrorse tooth as in upper jaw; both jaws with about 7 rows of villiform teeth in patches at their symphysis.

Preoperculum finely serrate on upper limb with coarser more widely spaced serrae along lower limb; angle of preoperculum 100-105°; operculum with well-developed spine about one-half the diameter of the pupil; gill rakers well developed; predorsal ridge not prominent nor darkly pigmented.

Lateral-line pores in a low curve flattening out posteriorly at tip of pectorals; cephalic lateral-line pores numerous with 6 pores in mandibular series on each side; a total of about 100 cephalic pores per side.

Scales extend on top of head to over anterior margin of pupil; pectoral fin with fine scales near base; caudal fin nearly entirely covered with scales, remaining fins naked.

Dorsal fin greatest height about 10% SL; spinous portion slightly lower than soft portion (about three-fourths the height of soft ray portion); dorsal fin base 54-63% SL; first and second spines united at their bases to a common pterygiophore, first spine about 1.5 in length of second; origin of dorsal fin slightly posterior to pectoral base; rays all branched; antepenultimate ray elongate, reaching past hypurals.

Anal fin slightly lower than dorsal fin (about 9% SL); anal fin base 33-41% SL; origin below dorsal soft rays 6 and 7; one or two spines, first close to second and inconspicuous; first spine about 3-4 times in length of second spine; first ray may be unbranched, remaining rays all branched; antepenultimate ray slightly elongate, reaching hypurals.

Pectoral fins long and pointed, reaching to first or second anal soft ray; fin length 23-29% SL; all but uppermost rays branched; stout uppermost ray about one-fourth the length of pectoral fin.

Pelvic fins broad and pointed, reaching nearly to anus; length of pelvics 14-19% SL, origin slightly posterior to origin of pectoral fin; spine about three-fourths the length of longest ray; all five rays branched.

Caudal deeply emarginate; 17 principal rays (15 branched); tips of fin slightly exserted; 10 or 13 dorsal and 9 or 11 ventral procurrent caudal rays.

Color.—Fresh coloration based on three North Carolina specimens donated by J. Stabley (UNC uncat.) as follows: body blue to violaceous dorsally overlying a light yellow and silver hue; body changing to a milky white ventrally; upper body with an electric-blue chainlike pattern with a solid stripe running longitudinally on either side of the dorsal fin base; head gray dorsally; snout electric-blue, silver-white below the cheek; cheeks silver; iris silver and gold, pupil black; a broad diagonal bar of metallic greenish blue from suborbital to upper lip; upper half of spinous dorsal membrane a characteristic brilliant orange-yellow, lighter yellow below; some hint of gray around bases of dorsal spines; a scalloped band of bright yellow along upper margin of dorsal (soft ray portion) and a narrower band ventrally; both yellow bands along dorsal fin centrally bordered by a dusky area and a clear area; pelvics milky white with a hint of overlying gray; anal fin membrane clear; caudal fin with two distinctive large yellow areas covering most of dorsal and ventral lobes; dorsal yellow patch extending to posterior dorsal fin base along peduncle; between the two yellow patches is a dusky area; the outer margins of the caudal fin margin translucent.

Distribution.—Cape Lookout, N.C. (a range extension and most northern authenticated record); Bermuda; Florida; Havana, Cuba; Yucatan, Mexico; Puerto Rico; Lesser Antilles; Nicaragua; Colombia (Caribbean); Venezuela. Recorded at depths from 45 to 495 m (more commonly between 150 and 250 m). A rare species in North Carolina (only four specimens known taken by sport fishing boats from 1971 to 1973); rarity perhaps because depths usually fished (45-125 m) by commercial boats are generally too shallow for this species. A 342-mm specimen was recently taken from 200 fathoms (360 m) off Bermuda, and it represents the only known record of *Caulolatilus* from Bermuda. This specimen was kindly loaned by W. Smith-Vaniz of the Academy of Natural Sciences of Philadelphia.

Material examined.—Total of 40 specimens, 51-342 mm SL; the largest specimen examined measured 325 mm SL, 385 mm TL, and weighed 445 g (preserved). Cervigón (1966) cited a 370 mm SL, 460 mm TL specimen. NORTH CAROLINA: UNC (uncat., field # JKD 72-4), (2) 265-300 mm; UNC (uncat., field # JKD 73-3) 286 mm. FLORIDA: UMML 5076, (2) 180-190 mm; UMML 8414, (3) 202-255 mm; USNM 116834, 98 mm; (formerly TABL, *Silver Bay* 2471) 103 mm; (formerly TABL, *Silver Bay* 2467) 51 mm; FMNH 46560, 66 mm. COLOMBIA: (formerly TABL, *Oregon* 4393) 122 mm; UMML 15403, 155 mm. NICARAGUA: UMML 13168, (4) 69-76 mm; FMNH 67431, (3) 115-211 mm; FMNH 67433, 127 mm; USNM uncat., *Oregon* 3578, 73 mm. CUBA: MCZ 12826 (cotype), 210 mm; USNM 33609, 293 mm; USNM 4750, 325 mm; MCZ 41327, 280 mm; ZMB 5772, 300 mm; ANSP 91896, 208 mm. PUERTO RICO: UPR 2602, 230 mm; Dep. Agric., Puerto Rico, 285 mm. TOBAGO I.: (formerly TABL, *Oregon* 5030), (2) 177-206 mm. YUCATAN, MEXICO: FMNH 59821, 167 mm. BARBADOS: BMNH 1866·6·7·18, 295 mm; (formerly TABL uncat.) 160 mm. MARTINIQUE: (formerly TABL, *Fregata* 68-9) 315 mm. (?) LOCATION: (formerly TABL, *Fregata* 80) 220 mm. BERMUDA: ANSP .1-137600, 342 mm.

Lectotype.—MCZ 12826 labelled "cotype." The whereabouts or existance of any other syntypes is unknown. Specimen MCZ 12826 is herein designated as the lectotype (collection locality, Cuba). No other data appears on the museum label. The specimen was in fair condition but nearly depigmented. The dark spot above the pectoral axil was still quite evident, as was the dark longitudinal stripe under the dorsal fin base. There were only traces of the upper body reticulations left. The following counts and measurements were made: 210 mm SL, 265 mm TL; preserved weight 170 g; D. VII, 24; A. I, 22; C. 17 (15 branched); P_1 17; B. 6; total first arch gill rakers 7 + 12; pored lateral-line scales 79 + 3 on tail; scales above lateral line 10; scales below lateral line 31; cheek scales 10, opercular scales 9; body depth 27% SL; body width 13% SL; head length 30% SL; orbit diameter 29% HL (with silvery area beneath orbit); photographed; vertebrae 11 + 16, with first haemal with a concavity that fits into a similar concavity of second, and to a slight extent third haemal spine; two predorsal pterygiophores.

Caulolatilus intermedius Howell-Rivero 1936
Gulf Bar-Eyed Tilefish

Figure 12

Caulolatilus intermedius Howell y Rivero 1936:61 (original description; Havana, Cuba). Beebe and Tee-Van 1937:93, fig. 1 (compared with *C. guppyi*). Hoese 1958:332 (Texas).

Caulolatilus cyanops. (not of Poey 1866) Hildebrand 1954:313 (Gulf of Mexico). Hoese 1958:332 (Texas). Briggs 1958:276 (Florida). Parker 1972:97 (Texas).

Diagnosis.—Differs from all species of *Caulolatilus* except *C. guppyi* and *Caulolatilus williamsi* in having a rounded caudal fin with tips slightly extended, all others have an emarginate or square caudal fin. *Caulolatilus intermedius* differs from *C. guppyi* in having a relatively small mouth that extends posteriorly to just beneath anterior rim of orbit (extends to under center of orbit in *C. guppyi*) and has no body markings on upper body (*C. guppyi* has numerous dark reticulations). *Caulolatilus intermedius* has (along with *C. cyanops* and *C. guppyi*) the lowest number of pored lateral-line scales, 73-81 (modally 72), found in the genus, and can be separated from *C. cyanops* by the lack of upper body markings and rounded tail found in *C. intermedius.*

Description.—Dorsal fin elements VII, 24-26 (rarely 26); anal fin I or II, 22 or 23; pectoral fin 16 or 17 (rarely 16); total first arch gill rakers 18-22 (modally 20); cheek scales 8-12; opercular scales 7-9; scales above lateral line 9-11; scales below lateral line 28-35.

Body depth 26-32% (modally 29%) SL; body width 10-14% (modally 12%) SL; caudal peduncle length 10-12%

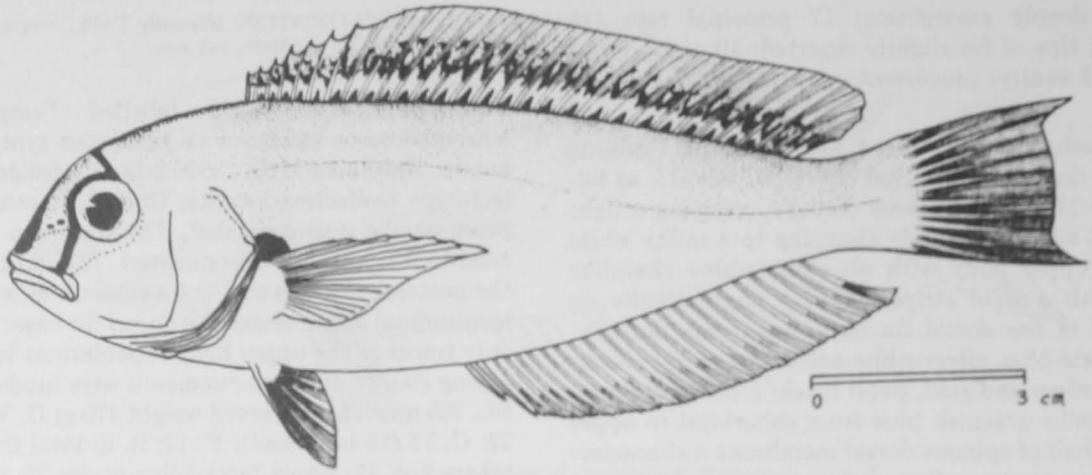


Figure 12.—Line drawing of *Caulolatilus intermedius*.

SL; caudal peduncle depth 8-12% (modally 10%) SL; head length (HL) 27-31% (modally 29%) SL; predorsal length 30-36% (modally 33%) SL; head depth 80-99% HL; snout length 29-40% (modally 35%) HL; length of upper jaw 31-37% HL; length of lower jaw 41-48% HL; cheek depth 22-36% HL; opercular length 24-31% HL; snout to dorsal margin of preoperculum 71-79% HL; orbit diameter 26-40% (modally 32%, although allometric) HL; suborbital depth 15-19% (modally 17%, although allometric) HL.

Jaws reach to just under anterior rim of orbit; teeth are fine canines, numbering about 35 in each upper and lower jaw; an enlarged antrorsely curved tooth at the rear of upper and lower jaws; patches of villiform teeth (about 6 rows) at the symphysis of both jaws.

Preoperculum finely serrate on upper limb only; angle of preoperculum 90-95°; operculum with a broad tapered flat spine, length about half the diameter of pupil; gill rakers well developed; predorsal ridge darkly pigmented, fairly prominent, and extending to anterior rim of orbit.

Lateral-line pores in low curve; cephalic pores numerous as in other species of *Caulolatilus*; mandibular series with five pores on each side.

Scales extend to top of head to near anterior rim of orbit; pectoral fin with a small patch of tiny scales near the base of its rays; caudal fin nearly covered with fine scales, remaining fins naked.

Dorsal fin height about 10% SL; spinous portion lower than soft portion; dorsal fin base 57-65% SL; first spine close to second and united at their bases to a common pterygiophore; first spine about 1.6 times in length of second; origin of dorsal fin over middle of pectoral base; rays all branched; antepenultimate ray elongate, reaching to base of caudal rays.

Anal fin height about 9% SL; anal fin base 31-44% SL; origin below sixth dorsal soft ray; first spine reduced to a minute subcutaneous chip or is absent; one thin spine usually present; first ray segmented and often not divided.

Pectoral fin long, reaching to a vertical with base of third or fourth anal soft rays; fin length 22-31% SL; all rays branched except stout dorsalmost ray which is about one-fifth the length of fin.

Pelvic fins pointed, tips just reaching anus; length of fin 16-20% SL; origin slightly posterior to base of pectoral fins; all five rays branched; spine about 1.7 in length of fin.

Caudal fin rounded with upper and lowermost rays exserted; 17 principal (15 branched) rays; 11 dorsal and 9 ventral procurrent rays.

Color.—Live coloration not seen; freshly preserved coloration in alcohol as follows: body uniformly light—violaceous—brown dorsally; underbelly white with some overlying dusky pigment; iris golden; head dorsally with a characteristically arrow-shaped dark marking (the dark predorsal ridge plus an anterior marking); the interorbital region anterior to dark marking is light colored; snout dark; area below naris silver-white; a wide diagonal bar from anterior rim of orbit to and including the maxillary; remainder of head brown; dorsal fin with upper half of spinous membrane dusky, followed by a band of irregularly shaped dark patches on an opaline area; basally, a single row of tapered patches between each fin ray running the entire length of the fin; upper portion of soft membrane with overlying yellow; anal fin membrane basally opaline, remainder transparent and somewhat dusky; pectoral with yellow along upper rays and along base of rays; caudal with light yellow along upper and lowermost rays, central portion dusky, with darker area around bases of central rays. Yellow fades rapidly upon preservation.

Distribution.—Found throughout the Gulf of Mexico from Florida to Yucatan, Mexico; also from Havana, Cuba (type-locality). Depth distribution includes 45-290 m, usually over muddy bottom.

Material examined.—The largest specimen examined measured 253 mm SL, 312 mm TL, and weighed 285 g (preserved). A total of 59 specimens (45-253 mm) were examined. FLORIDA-GULF: USNM 116835, 185 mm; FMNH

59823, 172 mm; USNM 83977, 45 mm; USNM uncat., *Oregon* 4945, 188 mm. ALABAMA: GCRL 1950, (2) 226-253 mm. LOUISIANA: USNM uncat., *Oregon* 2700, 109 mm; FMNH 46559, 163 mm; FMNH 67432, 205 mm; GCRL 2788, 157 mm; GCRL 774, 143 mm; GCRL 777, 197 mm; GCRL 2291, (2) 174-183 mm; GCRL 2074, 114 mm; USNM Uncat., *Oregon* 1060, 45 mm. TEXAS: GCRL 1464, (5) 107-227 mm; USNM 185384, (3) 113-210 mm; USNM 156978, 100 mm; FMNH 67564, 112 mm; USNM 155402, 180 mm; USNM 159671, 199 mm; USNM 155403, 195 mm; USNM 152564, (2) 149-155 mm; USNM 152563, (2) 103-113 mm; USNM 187112, 83 mm; UMML 24272, 185 mm; UMML 2010, 167 mm; UMML 13324, 140 mm; UTMSI 2129, (5) 103-165 mm; UTMSI (IMS-1), 110 mm; UTMSI (IMS 1077), (2) 71-86 mm; (formerly TABL uncat., *Silver Bay* 2471) 104 mm. MEXICO: GCRL 4601, (2) 203-206 mm; INIBP (photo 87), (2) 176-190 mm; UTMSI (IMS 2), (5) 71-120 mm. CUBA: MCZ 34784, 210 mm; MCZ 34146 (holotype), 250 mm. GULF OF MEXICO: USNM 196776, 158 mm.

Holotype.—MCZ 34146; Havana, Cuba; specimen very stiff with brittle and broken fin rays; pelvics apparently lost before being collected; the dark spot above the pectoral axil is still evident, as is the dark head ridge; the upper limb of the preoperculum serrate, lower limb nearly smooth; 250 mm SL, 300 mm TL; D. VII, 25 (listed as VII, 24 by Howell y Rivero 1936); A. I, 23; C. 17 (15 branched); P_1 17; B. 6; total first arch gill rakers 8 + 13; pored lateral-line scales 76 + 2 on tail; scales above lateral line 10; scales below lateral line 34; cheek scales 12; opercular scales 8; body depth 31% SL; body width 12% SL; head length (HL) 29% SL; orbit 27% HL; photographed; vertebrae 11 + 16.

Caulolatilus guppyi Beebe and Tee-Van 1937
Reticulated Tilefish

Figure 13

Caulolatilus guppyi Beebe and Tee-Van 1937:93, fig. 1 (original description; type-locality; Trinidad). Lowe 1962:669 (British Guiana). Cervigón 1966:353 (Venezuela).

Diagnosis.—Differs from all other species of *Caulolatilus* in having a body with numerous dark reticulations on upper portion and a rounded caudal with exserted tips; unlike the chainlike pattern and deeply emarginate tail found in *C. cyanops*. Like *C. intermedius* (and unlike any other species of the genus), *C. guppyi* has a diagonal dark bar from under the eye to the upper jaw, a dark spot above pectoral, a rounded-caudal and a rounded-head profile. Unlike *C. intermedius*, *C. guppyi* has reticulated body markings and a larger mouth that extends posteriorly to under middle of the eye. The following characters showed a highly significant difference between *C. intermedius* and *C. guppyi* (n = 68): predorsal length (t = 3.2), snout length (t = 3.6), body depth (t = 4.5), upper jaw length (t = 4.0), pored lateral-line scales (t = 3.6), scales above lateral line (t = 3.5), snout to dorsal margin of preoperculum (t = 4.1), peduncle depth (t = 3.9), gill rakers (t = 3.1), opercular length (t = 5.2), body width (t = 4.7).

Description.—Dorsal fin elements VI or VII (six spines in 2 of 35 specimens), 23-25 (usually 24); anal fin elements I or II, 20-23 (modally 22); pectoral fin rays 16 or 17 (rarely 16); total first arch gill rakers 19-23 (modally 21); pored lateral-line scales 75-81 (modally 78); cheek scales 9-12; opercular scales 7-9; scales above lateral line 9-12; scales below lateral line 28-34.

Body depth 28-34% (modally 30%) SL; body width 11-14% (modally 12%) SL; caudal peduncle length 9-12% SL; caudal peduncle depth 9-11% (modally 10%) SL; head length (HL) 27-30% (modally 29%) SL; predorsal length 30-34% (modally 32%) SL; head depth 91-100% HL; snout length 32-39% (modally 36%) HL; length of upper jaw 33-39% HL; length of lower jaw 39-47% HL; cheek depth 26-38% HL; opercular length 26-30% HL; snout to dorsal margin of preoperculum 70-76% HL; orbit diameter (allometric) 24-34% (modally 29%) HL; suborbital depth (allometric) 14-19% (modally 16%) HL.

Dorsal origin over pectoral base; dorsal fin base 54-68% SL; anal fin base 37-43% SL; pectorals long and pointed, length 25-29% SL; pelvics long, 16-19% (modally 18%) SL; base of pelvics slightly posterior to pectoral base, pelvics extend to anus; preopercular angle 90° and finely

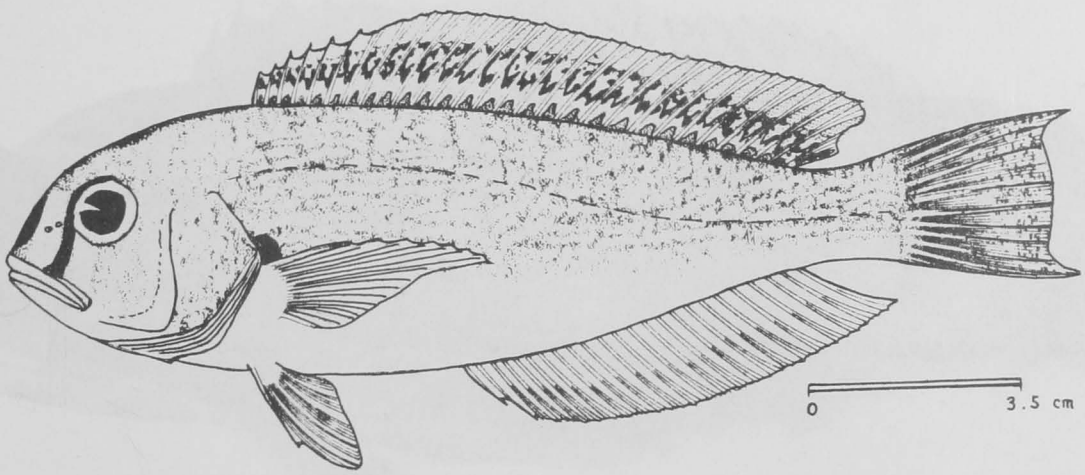


Figure 13.—Line drawing of *Caulolatilus guppyi*.

serrate on upper limb only; opercular spine blunt and flat; scales as in other species of *Caulolatilus*.

Color.—Preserved coloration rather uniformly silver-brown; upper body covered with numerous dark reticulations; dark spot above pectoral axil; predorsal ridge dark (though not with dark arrowhead as in *C. intermedius*); dark bar extending from eye to upper lip; dorsal fin pigment similar to *C. intermedius*, other fins transparent.

Distribution.—Found off the coast of eastern Venezuela, Trinidad, Guyana, and Surinam; recorded at depths from 41 to 171 m (more commonly 60-110 m) on shell-sand bottom. Geographic isolation appears complete, and analyses of various meristic and morphometric characters showed highly significant differences between *C. intermedius* and *C. guppyi* not attributable to a cline of a continuous population (no cline evidenced in any other species of *Caulolatilus*).

Material examined.—The largest specimen known appears to be the holotype measuring 295 mm SL, 350 mm TL, and weighing 570 g (preserved). A total of 35 specimens (93-295 mm SL) were examined. VENEZUELA: (formerly TABL uncat., *Oregon* 4402), (2) 180-192 mm; (formerly TABL uncat., *Oregon* 4403), (4) 105-245 mm; UMML 15700, 173 mm; UMML 17069, 117 mm; UMML 16284, 113 mm; FMNH 6317, (2) 232-238 mm. GUYANA: FMNH 67437, 139 mm; FMNH 67439, (6) 134-160 mm; (formerly TABL uncat., *Oregon* 2229) 124 mm; (formerly TABL uncat., *Oregon* 2230) 190 mm; (formerly TABL uncat., *Oregon* 2259) 124 mm; BMNH 1961.9.1.1-2, 182 mm; BMNH 1961.1.9.1, 195 mm. SURINAM: USNM 185311, 93 mm; (formerly TABL uncat., *Oregon* 2288), (3) 175-178 mm; UMML 12304, (2) 150-155 mm. MARGARITA I. (Venezuela): (formerly TABL uncat., *Calamar* 69-7) 205 mm. TRINIDAD: (formerly TABL uncat., *Calamar* 67-13) 228 mm; (formerly TABL uncat., *Calamar* 68-7) 230 mm.

Holotype.—USNM 170565; 295 mm SL, 350 mm TL; Port of Spain, Trinidad; body with reticulations, although faded; dark spot above pectoral axil; head with light and dark diagonal bars under eye; caudal with ray tips broken; head with dark predorsal ridge; D. VII, 24; A. I, 22; P_1 17; B. 6; gill rakers on first arch 8 + 12; pored lateral-line scales 78 + 3 on tail; scales above lateral line 11; scales below lateral line 30; cheek scales 10; opercular scales 8; body depth 31% SL; body width 13% SL; head length (HL) 29% SL; orbit 24% HL; photographed; vertebrae 11 + 16.

Caulolatilus williamsi Dooley and Berry 1977

Figure 14

Holotype: USNM 216073, 385 mm SL, 450 mm TL; 1075 g round weight; Cay Sal Bank, British West Indies; caught with baited hook by Frank Williams in 219 m, October 1975.

Diagnosis.—Can be distinguished from all species of *Caulolatilus* (except *C. intermedius* and *C. guppyi*) by its double emarginate tail; uniquely *Caulolatilus williamsi* has a broad yellow patch on the lower portion of the caudal and 17-20 light yellow body bars; 96 or more pored lateral-line scales (73-91, Atlantic species; 80-91 or 99-115 in Pacific species); shares the proportionally smallest eye 19% HL with *C. microps* (15-29%, modally 19% HL); *C. williamsi* has the shallowest body depth among all species of the genus 21-23% SL; dorsal fin elements VIII, 22 or 23; anal fin elements I, 24 or 25.

Description.—For detailed description see Dooley and Berry 1977.

Color.—Based on holotype (after being kept on ice) and notes from a second lost specimen collected by J. A. Yntema (frozen): most of subtle yellows of the holotype faded upon preservation in Formalin; only the dusky snout, spinous dorsal, and above pectoral axil remained obvious; only a hint of the yellow vertical body markings remained, as did the yellow along the tail; frozen color as follows: upper body violaceous gray with 17-20 light yellow vertical bars blending ventrally into solid pale yel-

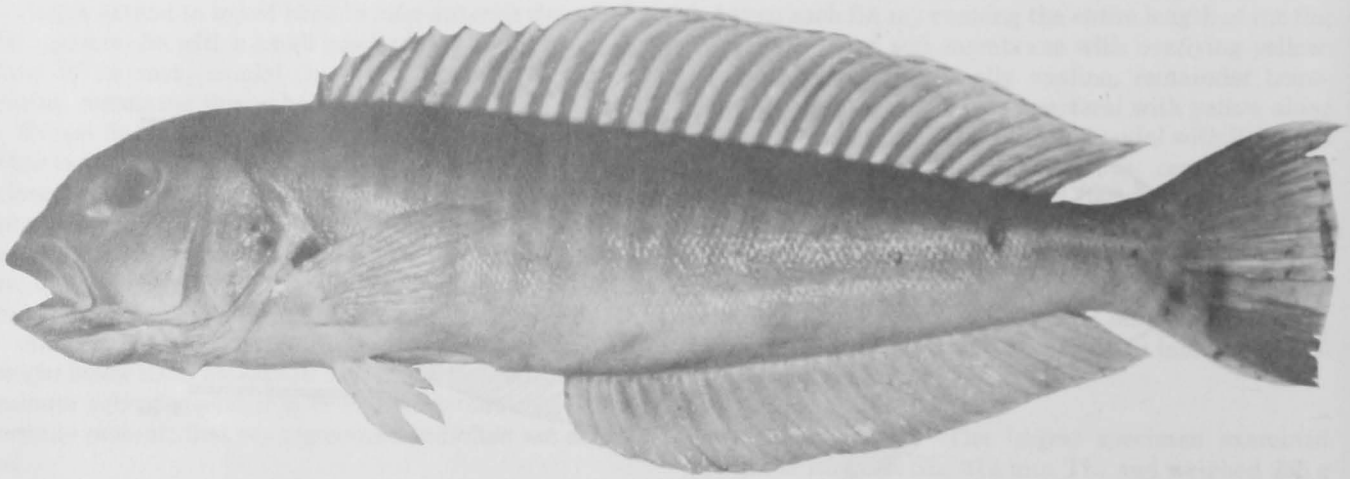


Figure 14.—Holotype of *Caulolatilus williamsi* (USNM 216073), 385 mm SL, Cay Sal Bank, Bahamas.

low and finally white on belly; anterior portion of head, snout and upper lip dusky; lower lip lighter; chin white; small patch of white under anterior suborbit; dark area above pectoral fin axil; predorsal ridge not differently pigmented than surrounding area (dark predorsal ridge in the only other species with rounded tail; *C. intermedius* and *C. guppyi*); spinous dorsal with dusky upper margin, yellow along anterior portion of both spines and rays; soft dorsal with a golden-yellow margin, membrane translucent with a thin dusky vertical line between each ray; pectoral fin with upper rays slightly opaque, lower membrane clear; pelvics milky white; anal fin membrane clear with golden-yellow edge; caudal fin with characteristic large yellow area on ventral portion, a thin short (about 20 mm on 385 mm SL specimen) yellow line above followed by a broader yellow horizontal stripe extending from about below the 18th dorsal ray medially along peduncle nearly to posterior caudal margin; remainder of caudal gray.

Remarks.—Presently known only from the holotype and two other photographed specimens from St. Croix, Virgin Islands; a broader Caribbean distribution probably exists; two photographs of specimens taken in 1972 were received by C. Richard Robins and forwarded to me; specific information from one of these specimens was kindly gathered by J. A. Yntema, Department of Conservation, St. Croix, as follows: caught by handline 6 April 1972, probably between 70 and 100 fathoms by T. Skov; 348 mm SL; body depth 21% SL; dorsal fin VIII, 22; anal fin I, 24; ventral fin II (I, 5?, author's note), 4; lateral-line scales about 120 (pored?); dentition and color conform to original description (Dooley and Berry 1977).

Caulolatilus affinis Gill 1865
Pacific Golden-Eyed Tilefish

Figure 15

Caulolatilus affinis Gill 1865:68 (original description; Cape San Lucas, Baja California) (not of Hildebrand 1946).

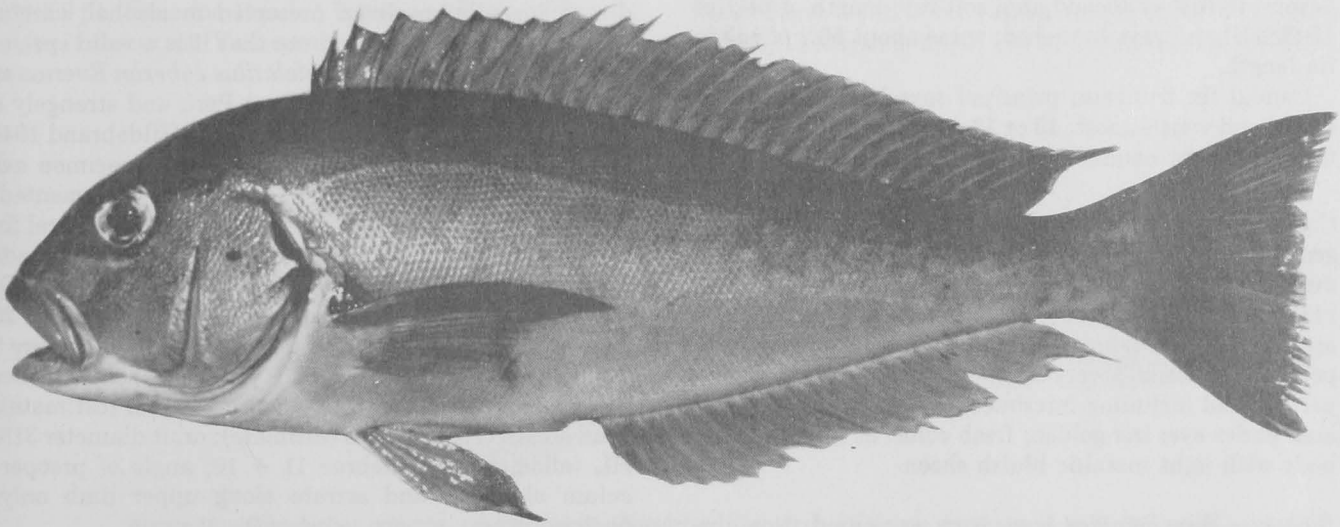
Caulolatilus cabezon Evermann and Radcliffe 1917:111, pl. 10, fig. 3 (original description; Chimbote, Peru). Chirichigno 1969:51 (Ecuador and Peru).

Diagnosis.—This species differs from all other Pacific representatives of *Caulolatilus* in having a dark spot above the pectoral fin axil, and usually eight dorsal spines (usually nine in *C. princeps* and *C. hubbsi*). The only other species within the genus with eight (usually) dorsal spines is *C. chrysops* from the Atlantic. *Caulolatilus affinis* can be separated from *C. chrysops* by the number of first arch gill rakers (20-27, modally 24 vs. 17-21, modally 19, respectively). *Caulolatilus affinis* can additionally be distinguished from all other Pacific species of the genus by its greater body depth of 23-32% (modally 29%) SL and lower number of pored lateral-line scales (80-91, modally 84 vs. 99-115 found in *C. princeps* and *C. hubbsi*). Only *C. affinis* and *C. chrysops* (from the Atlantic) have a broad yellow bar from under the eye to the end of the snout.

Description.—Dorsal fin elements VIII (rarely VII or IX), 22-25 (modally 24); anal fin elements I or II (rarely I), 21-24 (modally 23); pectoral fin 18 or 19; cheek scales 11-18; opercular scales 10-15; scales above lateral line 14-19; scales below lateral line 36-46.

Body width 10-16% (modally 13%) SL; caudal peduncle length 11-13% SL; caudal peduncle depth 8-10% (modally 9%) SL; head length (HL) 25-34% (modally 31%) SL; predorsal length 31-36% (modally 33%) SL; head depth 76-98% (modally 86%) HL; snout length 33-44% (modally 39%) HL; length of upper jaw 35-41% (modally 38%) HL; length of lower jaw 40-48% (modally

Figure 15.—*Caulolatilus affinis*, ca. 320 mm SL, Pacific Costa Rica (photograph by F. H. Berry).



42%) HL; cheek depth 26-37% (allometric); opercular length 27-33% (modally 30%) HL; snout to dorsal margin of preoperculum 68-79% (modally 72%) HL; orbit diameter 16-31% (modally 22%, allometric) HL; suborbital depth 8-20% (modally 18%, allometric) HL.

Jaws extend posteriorly to anterior third of pupil; teeth moderately small along outer row of jaws with single enlarged forward curved canine tooth at the rear of both jaws; upper jaw with 28-33 teeth; lower jaw with 23-31 teeth; upper and lower jaws with patches of villiform teeth at their symphyses.

Preoperculum with moderately large serrae, on upper limb only numbering about 20-50; angle of preoperculum 90-100°; well-developed flat toothed spine on operculum, length about three-fourths pupil diameter; gill rakers somewhat elongate; predorsal ridge moderately developed and not differenly pigmented than surrounding skin. Cephalic lateral-line pores numerous; mandibular series with four pores on each side.

Scales on head extend to near anterior rim of orbit; pectoral fin with small patch of scales at base; caudal entirely covered with scales.

Dorsal fin height about 7% SL; spinous portion about same height as soft portion, except anterior two spines somewhat lower; dorsal fin base 57-66% SL; first and second spines united at their bases to a common pterygiophore, first spine 1.5 in length of second; origin of dorsal fin over dorsal portion of pectoral fin base; rays all branched; antepenultimate ray elongate, reaching just past hypural base.

Anal fin slightly lower than dorsal fin (about 6.6% SL); anal fin base 36-40% SL; origin below fifth dorsal soft ray; two spines, first spine hidden under skin and small (about one-sixth length of second); rays generally all branched; antepenultimate ray slightly elongate, not quite reaching hypural base.

Pectoral fins broad and pointed, reaching to fourth or fifth anal soft ray; fin length 23-29% SL; all rays branched except stout dorsalmost ray which is about one-fourth the length of pectoral fin.

Pelvic fins narrow and pointed; origin somewhat posterior to ventral base of pectorals, reaching to anus or beyond to first or second anal soft ray; length of pelvics 17-20% SL; all rays branched; spine about 56% of pelvic fin length.

Caudal fin truncate; principal rays branched except dorsal and ventralmost; 13 or 12 dorsal and 12 or 11 ventral procurrent caudal rays.

Color.—In alcohol: body either light or dark brown, but generally uniform; dorsal, caudal, anal, and pelvics dusky; first five pectoral rays dusky, remaining fin clear; branchiostegal membrane with dusky area sometimes apparent in cusp above opercular spine; dark spot above pectoral axil usually very apparent; dark pigment on upper jaw and including interbuccal flaps; light diagnonal area under eye; iris golden; fresh color: as above except body with light metallic bluish sheen.

Biology.—Ripe females have been examined from the Gulf of California taken in April and November, and in September from Colombia, Ecuador, and the Galapagos Islands; ripe females from Peru were found in May and February and ripe and ripening individuals in June.

Distribution.—Found from the Gulf of California to Cape San Lucas, Baja California; no specimens recorded from the Pacific coast of Mexico south to Costa Rica, perhaps due to a lack of sampling; distribution continues from Costa Rica to Panama, Colombia, Ecuador, the Galapagos Islands, and to Pisco, Peru (ca. lat. 13°45'S) the most southern record. Recorded at depths from 20 to 239 m (common 80-185 m).

Material examined.—The largest specimen examined, from Peru; measured 403 mm SL, 495 mm TL, and weighed 1.5 kg (preserved). A total of 198 specimens (65-403 mm SL) were examined. GULF OF CALIFORNIA: UA 67-59-5, (3) 162-175 mm; UA 71-91-15, 205 mm; UA 70-29-6, 145 mm; LACM 30625-1, 310 mm; LACM 8836-3, (3) 330-360 mm; INIBP DU63, 170 mm. COSTA RICA: UCR 139-12, 150 mm; UCR 323-14, (2) 135-165 mm. COLOMBIA: SOSC (LK 69-28), (4) 326-395 mm; SOSC (LK 69-32), (2) 366-378 mm; SOSC (Ant. Br. 18B-784) 340 mm. ECUADOR: SOSC (Ant. Br. 18B-769), (22) 177-327 mm; SOSC (Ant. Br. 18B-771), (2) 315-335 mm; SOSC (Ant. Br. 18B-775), (7) 115-140 mm; ANSP 102837, 340 mm; SOSC (Ant. Br. 18B-776), (20) 100-216 mm. GALAPAGOS IS.: SOSC (Ant. Br. 18B-791A), (2) 262-338 mm; SOSC (Ant. Br. 18B-789), (2) 370-395 mm. PERU: USNM 77732, 268 mm; USNM 77654 (holotype of *C. cabezon*), 230 mm; USNM 200014, 135 mm; SOSC (Ant. Br. 16-623C), 332 mm; SOSC (Ant. Br. 16-624E), (13) 170-403 mm; SOSC (Ant. Br. 18B-761), (10) 205-315 mm; SOSC (Ant. Br. 18B-760), (4) 115-197 mm; SOSC (Ant. Br. 16B-625A), (7) 207-286 mm; SOSC (Ant. Br. 18B-757), 194 mm; SOSC (Ant. Br. 16B-642B), (5) 147-165 mm; SOSC (Ant. Br. 18B-764), (7) 190-220 mm; SOSC (Ant. Br. 16-627A), (3) 185-197 mm; SOSC (Ant. Br. 16-636B), (19) 97-123 mm; SOSC (Ant. Br. 18B-759), (3) 180-206 mm; SOSC (Ant. Br. 16-639A), (2) 183-188 mm; SOSC (Ant. Br. 16-637A), 103 mm; SOSC (Ant. Br. 16-633A), 120 mm; SOSC (Ant. Br. 16-631A), 193 mm; SOSC (Ant. Br. 18B-763), (11) 177-210 mm; SOSC (Ant. Br. 16-630A), (2) 180-305 mm; SOSC (Ant. Br. 18B-761), (26) 215-300 mm; UBC 56-236, 395 mm.

Holotype of C. affinis.—USNM 5789, 65 mm SL, 74 mm TL; collected from Cape San Lucas, Baja California and described tenuously by Gill (1865) as a new species of *Caulolatilus*; the specimen is a very badly dehydrated juvenile specimen preserved in alcohol; careful examination has convinced me that it is a valid species and a senior synonym of *Caulolatilus cabezon* Evermann and Radcliff 1917 described from Peru and strangely a senior homonym of *Caulolatilus affinis* Hildebrand 1946 (a junior synonym of *C. princeps*); Gill's specimen has broken fins and is nearly completely depigmented; however, a faint dark area appears above the pectoral fin axil; the following counts and measurements were made from the specimen and radiographs of the specimen: D. IX, 24 (total of 33 elements); A. II (?), 23 (total of 25 elements); C. 17; P_1 18; B. 6; total first arch gill rakers 8 + 15; pored lateral-line scales 83 (estimate); cheek scales 16; opercular scales 13; body depth 24% SL (estimate); head length (HL) 31% SL (estimate); orbit diameter 31% HL (allometric); vertebrae 11 + 16; angle of preoperculum about 90°and serrate along upper limb only; photographed.

Holotype of C. cabezon.—USNM 77654, 230 mm SL; dark spot above pectoral axil; preoperculum serrate on upper limb only, angle 90°; caudal truncate; D. VIII, 23; A. II, 22; C. 17; P_1 18; B. 6; total first arch gill rakers 10 + 16; pored lateral-line scales 82 + 5 on tail; cheek scales 18; opercular scales 13; body depth 31% SL; head length (HL) 32% SL; orbit diameter 23% HL (allometric); vertebrae 11 + 16.

Caulolatilus princeps (Jenyns 1842)

Ocean Whitefish

Figure 16

Latilus princeps Jenyns 1842:52 (original description; Chatham I., Galapagos Is.) Günther 1861:68 (list).

Dekaya anomala Cooper 1863:70, fig. 17 (original description; Catalina I., Calif.). Gill 1865:68 (synonymized with *Caulolatilus anomalus*); 1882:162 (synonymized *Dekaya* with *Caulolatilus*).

Caulolatilus princeps. Gill 1865:68 (synopsis). Lockington 1881:14 (synopsis). Jordan and Gilbert 1883:368 (Cape San Lucas). Jordan and Bollman 1890:182 (Charles and Albemarle Is., Galapagos Is.). Jordan and Evermann 1896:462 (checklist); 1898:2276 (synopsis). Snodgrass and Heller 1905:417 (Charles and Albemarle Is., Galapagos Is.). Starks 1906:761 (Callao, Peru). Borodin 1928:22 (Galapagos Is.). Jordan et al. 1930:357 (checklist). Barnhart 1936:196 (southern California). Herre 1936:217 (Galapagos Is.). Fowler 1944:57 (Chatham and Albemarle I., Galapagos Is.). Nichols and Murphy 1944:254 (La Plata I., Ecuador). Fowler 1945a:235 (synopsis). Hildebrand 1946:199 (Peru). Clothier 1950:59 (axial skeleton). Le Monte 1952:149, pl. 62 (color). Mann F. 1954 (Arica to Antofagasta, Chile). Fitch 1958:57 (California). Orces 1959:81 (Ecuador). Smith and Bailey 1961:358 (dorsal fin supports); 1962:7 (subocular shelf). Jow 1963:212 (Redding Rock, Humbolt Co., Calif.). Robinson 1965:52 (Willapa Bay, Wash.). Lavenberg and Fitch 1966:106 (larvae; Gulf of California). Smith and Goldstein 1967:533 (eye lens protein). Chirichigno 1969:51 (Ecuador, Peru). Pattie and Baker 1969:1371 (west coast of Vancouver I., Canada). Fitch and Lavenberg 1971:46 (California.) Miller and Lea 1972: 143 (California). Hart 1973:283 (drawing, Canada).

Caulolatilus anomalus. Gill 1865:68 (list; Catalina I., Calif.). Streets 1877:48 (list; California). Lockington 1881:13 (synonymized *C. anomalus* with *C. princeps*).

Caulolatilus affinis Hildebrand 1946 (non Gill 1865):201, fig. 44 (a junior homonym of Gill 1865), (original description; Peru). Chirichigno 1969:51 (Peru).

Caulolatilus princeps princeps. Roedel 1953:101 (Galapagos Is.).

Caulolatilus princeps anomalus. Roedel 1953:101 (California). Hubbs and Rechnitzer 1958:277 (Guadalupe I., Baja California).

Diagnosis.—This species differs from all other Pacific species of *Caulolatilus* in having a slender body depth (23-28%, modally 25% SL). It can be distinguished from *C. affinis* by its lack of a dark area above its pectoral fin axil, lack of bright yellow diagonal mark under its eye, and a higher number of dorsal spines (IX vs. VIII) and pored lateral-line scales (99-115 vs. 80-91 in *C. affinis*). *Caulolatilus princeps* can be separated from *C. hubbsi* by the fact that the jaws reach posteriorly only to near the anterior orbital rim, while the jaws reach to under the middle of the eye in *C. hubbsi*. *Caulolatilus princeps* can be distinguished from all species of Atlantic tilefishes by its number of dorsal spines (usually nine) and pored lateral-line scales.

Description.—Dorsal fin elements VII-X (usually IX), 24-27; anal fin elements II, 20-26 (usually 24 or 25); pectoral fins 18-20 (usually 19); total first arch gill rakers 20-26 (modally 23); pored lateral-line scales 99-115 (modally 105, plus 2-6 more on tail); cheek scales 9-16 (modally 13); opercular scales 11-20 (modally 14); scales above lateral line 15-21 (modally 17); scales below lateral line 35-50 (modally 44).

Body width 12-17% (modally 14%) SL; caudal peduncle length 8-13% SL; caudal peduncle depth 7-10% (modally 7%) SL; head length (HL) 23-30% (modally 27%) SL; predorsal length 28-33% (modally 30%) SL; head depth 78-92% HL; snout length 32-41% (modally 36%) HL; length of upper jaw 31-38% (modally 35%) HL;

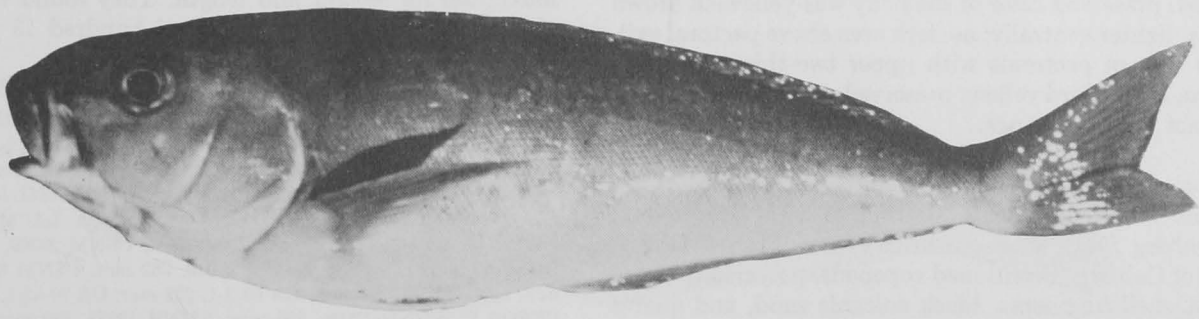


Figure 16.—*Caulolatilus princeps*, ca. 330 mm SL, Magdelena Bay, Baja California (photograph by F. H. Berry).

length of lower jaw 36-44% (modally 41%) HL; cheek depth 23-31% (modally 26%) HL; opercular length 25-30% HL; snout to dorsal margin of preoperculum 70-76% HL; orbit diameter 18-26% HL (modally 22%, allometric); suborbital depth 11-17% HL (modally 14%, allometric).

Four mandibular pores on each side; small teeth, upper and lower jaws with 22-32 canine teeth; both jaws with a single antrorsely curved tooth at the rear, and patches of villiform teeth at their symphyses.

Preoperculum finely serrate on upper limb only, smooth on lower limb; preoperculum rounded with an angle of about 95-115° (usually 105-110°), not as angulate as other species of *Caulolatilus*; gill rakers blunt; predorsal ridge neither prominent nor differently pigmented; scales extend on top of head to about the anterior third of pupil; pectoral fin with scales at base; caudal covered with fine scales; remaining fins naked.

Dorsal fin height about 7% SL, spinous portion slightly lower than soft portion; dorsal fin base 59-68% SL; first spine about twice in second; first and second spine united at bases; dorsal origin over pectoral fin base; all rays branched; antepenultimate ray elongate, just reaching hypural base.

Anal fin slightly lower than dorsal fin (about 6% SL); anal fin base 37-43% SL; origin below the base of sixth dorsal soft ray; anal fin with two spines, the first short, stout and well hidden; the second spine is thin and flexible; the first ray may be segmented and unbranched, all other rays branched; antepenultimate ray slightly elongate, but not reaching hypural base.

Pectoral fins long and pointed, reaching to a vertical with first or second anal soft ray; fin length 21-27% (modally 24%) SL; all rays branched except uppermost stout ray which goes about 3.5 in length of fin.

Pelvic fins narrow and pointed, reaching, or just short of reaching anus; length 14-17% SL; spine about 58% the length of fin.

Caudal fin deeply emarginate, all principal rays branched, except dorsal and ventralmost; 12 or 13 dorsal and 11 or 12 ventral procurrent rays.

Color.—Fresh coloration according to Miller and Lea 1972; Fitch and Lavenberg 1971; and Roedel 1953: a central light blue band running the length of the dorsal and anal fins; pectoral fins bluish with a yellowish streak near the center; caudal fin yellowish, and a yellow edging on fins; preserved color of the body was yellowish brown above, lighter ventrally; no dark area above pectoral axil, inner side of pectorals with upper two-thirds purplish brown, lower third yellow; preserved specimens reveal no distinct body markings.

Biology.—Stomachs examined contained shrimp, crabs, hermit crabs, anchovies, and lanternfish (Fitch and Lavenberg 1971); a specimen from San Marcos Island, Gulf of California contained copepods, polychaete worm tubes, shell fragments, black volcanic sand, and quartz sand.

Ripe females were examined from California; Guadalupe Island and Guaymas, Mexico; the Galapagos; and Ecuador and were recorded for all months except August. Fitch and Lavenberg (1971) reported spawning from October to April off California.

Larvae of *C. princeps* are similar to the larvae of other tilefishes, having numerous cephalic spines and serrated ridges. Lavenberg and Fitch (1966) captured postlarvae (24 mm SL) in April in the Gulf of California at a depth of 0-15 m in water 200 m deep. They reported taking other larvae in the stomach of albacore about 50 km off the coast of California. Ahlstrom (pers. commun.) has collected and drawn numerous *C. princeps* larvae. A series of these larvae were kindly loaned by Ahlstrom. Larvae of *C. princeps* somewhat resemble those of *Epinephelus* sp. drawn by Smith (1971) except for the prolonged dorsal and pelvic spines, and the 3 anal spines and 24 vertebrae found in *Epinephelus*.

Distribution.—Found from the west coast of Vancouver Island (lat. 48°41'-49°07'N), British Columbia (Pattie and Baker 1969) and Willapa Bay, Wash. (Robinson 1965); however, considered rare north of Point Conception, Calif. Common along the coast of southern California and the channel islands; found along Baja California, including Guadalupe, Cerros, and the Revilla Gigedo Islands; found throughout most of the Gulf of California; a gap in distribution exists along western Mexico and Central America (although listed in the collection of UCR; F. H. Berry, pers. commun.) to Ecuador, and this gap could be due to a lack of sampling or a real gap due to temperature or bottom type; found along the coast of Ecuador and the Galapagos Islands; apparently rare south of Pisco, Peru; according to Mann F. (1954) *C. princeps* occurs to Arica and Antofagasta, Chile (lat. 23°30'S), although this has not been verified by other Chilean ichthyologists.

A depth range of 18-68 m has been recorded for *C. princeps*. Fitch and Lavenberg (1971) reported a range of 10-150 m on a rocky bottom. L. P. Woods reported catching *C. princeps* at less than 10 m from the Galapagos (pers. commun.); *C. princeps* is apparently the shallowest dwelling branchiostegid.

Material examined.—The largest specimen measured 470 mm SL, 570 mm TL. According to Fitch and Lavenberg (1971), individuals that exceed 4.5 kg are rarely seen, with 5.4 kg and about 1 m probably being about the maximum for weight and length. They found that the oldest fish, examined from several hundred 13 yr olds, weighed 3.4 kg and was 648 mm long.

A total of 115 specimens, 20(larvae)-470 mm SL, were examined. CALIFORNIA: USNM 27069, 470 mm; USNM 52971, 355 mm; LACM 2001, 290 mm; LACM 2349, (2) 203-275 mm; LACM 473, 260 mm; MCZ 32717, (2) 254-275 mm; ANSP 12223, 265 mm; USNM 46911, 355 mm; USNM 24973, (3) 277-280 mm; USNM 26863, (3) 272-400 mm; USNM 20004, 400 mm. BAJA CALIFORNIA: LACM 472, 325 mm; ZMK uncat., *Gathathea* 706, 245 mm; USNM 29369, 373 mm. GULF OF CALIFORNIA: USNM 39048, 382 mm; USNM 83906, 440 mm; LACM 3644, 370 mm; UA 63-3-1, 222 mm; UA 70-52-1, 235 mm. CEROS I.: AMNH 12026, 285 mm; AMNH 12023, 320 mm; AMNH 12025, 244 mm; USNM 47007, 315 mm. REVILLA GIGEDO I.: USNM 131420, 270 mm. GUADALUPE I.: LACM 3207, (5) 240-393 mm; ANSP

89072, 390 mm. GALAPAGOS IS.: SOSC (Ant. Br. 18B-792B), (2) 320-330 mm; SOSC (Ant. Br. 18B-797D), (5) 313-395 mm; SOSC (Ant. Br. 18B-792A), 375 mm; SOSC (Ant. Br. 18B-789), (8) 330-385 mm; SOSC (Ant. Br. 16-HA115), (29) 242-303 mm; USNM 41439, 226 mm; USNM 49782, 370 mm; FMNH 22971, 285 mm; TABL (Ant. Br., at Florida State Museum), 450 mm; MCZ 12856, (5) 265-330 mm; MCZ 12855, 378 mm; MCZ 12554, (2) 365-383 mm; USNM 41343, 290 mm; USNM 41342, 243 mm; ANSP 89056, (3) 255-335 mm; ANSP 82004, 345 mm. ECUADOR: SOSC (Ant. Br. 18B-771), (2) 425-450 mm; SOSC (Ant. Br. 16-623C), 450 mm. PERU: USNM 128050, 258 mm; USNM 128049, 135 mm; USNM 53476, 175 mm; USNM 128051 (holotype of *C. affinis*, Hildebrand 1946), 237 mm; USNM 77736, 263 mm; AMNH 7945, 196 mm; AMNH 7402, 308 mm; AMNH 7486, (2) 193-204 mm.

Holotype.—Kindly examined by J. E. Randall while at the British Museum: BMNH 1917.7.7.25.8, 428 mm SL specimen as a dried, varnished, half skin, glued to a board with the label "C. Darwin, Beagle Voyage"; 497 mm TL; body depth about 103 mm; head length (HL) 106 mm; head depth about 101 mm; orbit 21.9 mm; lateral-line scales about 115 (part of lateral line missing anteriorly); Jenyns 1842 described the species from Chatham Island, Galapagos Archipelago as: D. VIII, 26; A. II, 26; B. 5(?); P_1 18 or 19; P_2 I, 5; C. 15; "Colour.—Above, and the fins, obscure greenish; sides obscure coppery, passing on the belly into salmon-colour. Pectorals edged with dull blue. Iris yellowish brown: pupil black-blue."

Caulolatilus hubbsi n.sp.

Hubbs' Tilefish

Figure 17

Holotype.—USNM 41421, 360 mm SL, Charles I., Galapagos Is., March 1888.

Paratypes.—USNM 50091, 350 mm SL, Albemarle I., Galapagos Is., ripe female; USNM 53476, 190 mm SL, Callao, Peru; LACM 8836-3, (8) 222-325 mm SL, Santa Inez Bay, Gulf of California, Mexico, April 1964; RV *Alaska* stn. 64A2-35.

Diagnosis.—The new species is distinguished by the following combination of characters: mouth large with thick fleshy lips, jaws extending posteriorly to under middle of pupil (gape small and jaws extending only to under anterior orbital rim in *C. princeps* and extending only to under anterior part of pupil in *C. affinis*, the other Pacific species of *Caulolatilus*); can be distinguished from all Atlantic congeners by having usually nine dorsal spines and 100-110 pored lateral-line scales; easily distinguished from *C. affinis* by the higher number of pored lateral-line scales (100-110 vs. 80-89) in *C. hubbsi*, and the lack of a dark area above the pectoral axil and lack of yellow under the eye in *C. hubbsi*; *C. hubbsi* can also be distinguished from *C. princeps* by the more rounded profile and slightly deeper body in *C. hubbsi* and the nearly truncate tail versus emarginate tail in *C. princeps*.

Description.—The following counts and measurements are of the holotype with the paratypes and other specimens examined given in parentheses: dorsal fin elements VIII (with gap where fourth spine is usually found; pterygiophore present) [VIII(1), IX(22), X(1)] and 26 rays (23-27); anal fin II, 25 (23-26); pectoral 19 (18 rarely); branchiostegals 6; total first arch gill rakers 22 (21-26); pored lateral-line scales 107 (100-110); cheek scales 13 (11-15); opercular scales 14 (10-15); scales above lateral line 16 (15-18); scales below lateral line 42 (36-46); vertebrae 11 + 16.

Body depth 31% (24-29%) SL; body width 16% (13-20%) SL; caudal peduncle length 10% (9-12%) SL; caudal peduncle depth 8% (7-9%) SL; head length (HL) 29% (26-30%) SL; predorsal length 36% (29-35%) SL; head depth 83% (72-90%) HL; snout length 38% (32-39%) HL; length of upper jaw 39% (31-36%) HL; length of lower jaw 44% (39-44%) HL; cheek depth 31% (23-29%) HL; opercular length 27% (26-29%) HL; snout to dorsal margin of preoperculum 73% (72-74%) HL; orbit diameter 21% (20-24%) HL (allometric); suborbital depth 16% (12-16%) HL (allometric).

Jaws extend to under middle of pupil; four mandibular pores per side (as in both *C. affinis* and *C. princeps*); teeth 27 + 23 canines along outer margin of lower jaw; 32 + 31 canines along outer margin of upper jaw; both jaws with antrorsely curved canine at rear and patches of villiform teeth at their symphysis; preoperculum margin rounded with fine serrae (26-50) along edge to just below angle; angle of preoperculum about 120° (95-110°); operculum with flat sharp spine; total gill rakers on first arch 22 (21-26), as in *C. princeps*; predorsal ridge not prominent, nor differently pigmented; ridge extends on head to above posterior margin of pupil, while the scales extend on head to over anterior orbital rim (op-

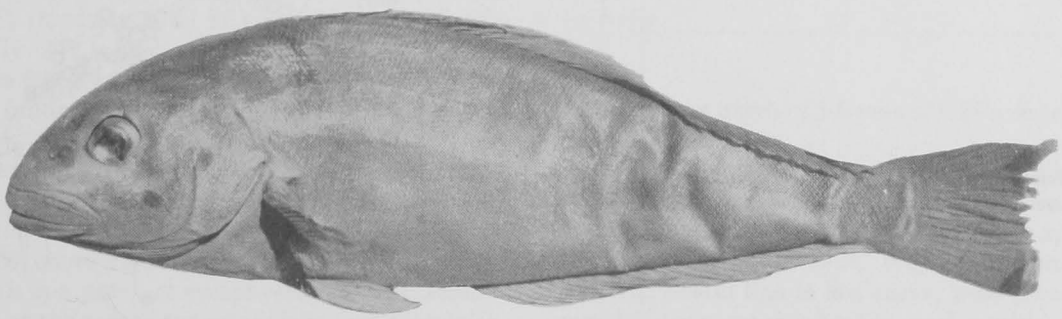


Figure 17.—Holotype of *Caulolatilus hubbsi* (USNM 41421), 360 mm SL, Charles Island, Galapagos.

posed to over anterior third of pupil in *C. princeps*).

Dorsal fin height about 7% SL; base 68% (66-68%) SL; spinous portion about same height as soft portion; first and second spines united at their bases, first spine 1.1 (to 1.6) in second spine; origin of dorsal over pectoral fin base; rays all branched, antepenultimate ray elongate, not reaching hypurals as in *C. affinis*.

Anal fin about same height as dorsal fin; fin base 40% (39-42%) SL; origin below fifth or sixth dorsal soft ray; two spines, first reduced.

Pectoral fins broad and pointed; 19 rays (rarely 18), the dorsalmost ray stout and unbranched; fin length 24% (23-28%) SL and reach to near anus.

Pelvic origin slightly anterior to that of *C. princeps*, and about the same to those of *C. affinis*, or slightly posterior of under ventral origin of pectoral fin base; fin length 16% (15-17%) SL.

Caudal fin truncate or slightly emarginate; rays all branched except dorsal and ventralmost; most of fin covered with small scales.

Color.—Preserved color not distinguishable from *C. princeps*; some dark pigment is evident above pectoral fin axil, though not a large dark area as in *C. affinis*; underside of pectoral fin darkly pigmented as in *C. princeps*.

Remarks.—This species, although distinguishable from the other two Pacific species of *Caulolatilus*, appears to possess characters from each and does not have the clear-cut differences usually seen within the genus.

Distribution.—Found from California and the Gulf of California southward to the Galapagos Islands and Callao, Peru; found generally sympatrically with *C. princeps* and *C. affinis* (Fig. 18); recorded from 18 to 41 m depths.

Material examined.—Nontype material. The following specimens were examined along with the type-specimens previously designated. CALIFORNIA: MCZ 26798, 243 mm SL. GULF OF CALIFORNIA: LACM 3644, (2) 305-390 mm SL. GUADALUPE I.: LACM 3207, 280 mm; SOSC (Ant. Br. 18B 792B; now at USNM), (2) 300-335 mm; TABL (Ant. Br. 18B 792B; now at Florida State Museum), 355 mm; SOSC (Ant. Br. 18B 791A; now at USNM), 317 mm; MIZS (CN 2816), 292 mm; MCZ 25752, 325 mm; SOSC (Ant. Br. 18B 797D; now at USNM), (2) 313-325 mm. PERU: USNM 77616, 222 mm. SANTA CATALINA I., CALIF.: USNM 24973, 208 mm. LOCALITY (?): USNM 26798, 283 mm.

The specimens listed above were not designated as paratypes either because the specimens were not in good condition or the data or locality was doubtful.

Etymology.—This species is named in honor of Carl L. Hubbs whose early and contemporary work on tilefishes has added greatly to our knowledge of these fishes.

BRANCHIOSTEGUS RAFINESQUE 1815

Coryphaena. (non Linnaeus 1758) Houttuyn 1782:315 (type-species: *Coryphaena japonica* Houttuyn 1782 by original designation); Houttuyn's description based on the general similarity to Linnaeus' *Coryphaena*; the description is brief, general, and without mention of type-specimen disposition; a junior homonym of *Coryphaena* Linnaeus 1758. Lacépède 1802:209.

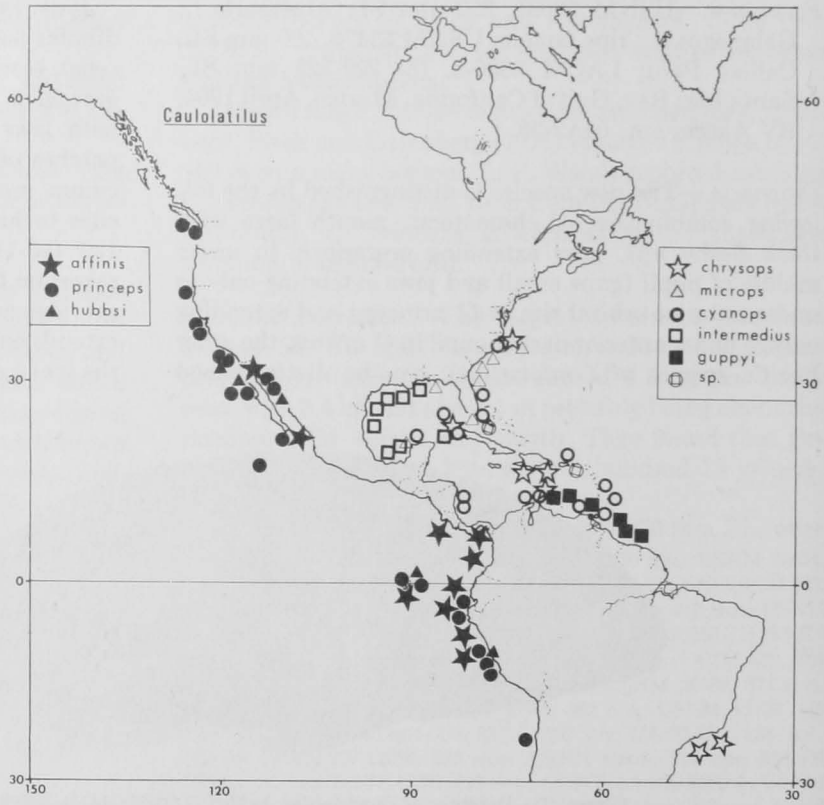


Figure 18.—Distribution of the genus *Caulolatilus* based upon museum specimens and reliable records.

Coryphaenoides. (non Gunner 1765) Lacépède 1802:219 (type-species: *Coryphaenoides hottuynii* Lacépède 1802 by original description; a junior synonym of *Coryphaena japonica* Houttuyn 1782 and *Coryphaena branchiostega* Gmelin 1788); the description is brief and general; type-specimen disposition was not mentioned; a junior homonym of *Coryphaenoides* Gunner 1765, a genus of macrourid. Lacépède 1832:299.

Branchiostegus Rafinesque 1815:86; type-species: *Branchiostegus hottuynii* (Lacépède 1802).

Latilus Cuvier 1830:368 (*in* Cuvier and Valenciennes 1830); type-species: *Latilus argentatus* Cuvier 1830 by original description and a substitution for *Coryphaena sinensis* Lacépède 1802; a *nomen dubium*; type was described by Cuvier (*in* Cuvier and Valenciennes 1830) and the type-specimen was deposited at MNHN.

Diagnosis.—Length of dorsal plus anal fin bases 80-97% (modally 89%) SL; predorsal ridge prominent in only one species (*B. semifasciatus*) and never modified into a flap; vertebrae 10 + 14 (like *Lopholatilus*, but unlike *Caulolatilus* (11 + 16)); dorsal fin elements VI-VIII (usually VII), 14-16 (modal total = 22) (Table 8); dorsal fin elements similar to *Lopholatilus*, but lower than those of *Caulolatilus* (VI-X, 22-27; total mode = 32); anal fin elements I or II (usually II except in *B. semifasciatus*), 11-13 (modally = 14) (Table 9); anal elements similar to *Lopholatilus*, but fewer rays than *Caulolatilus* (I or II, 20-26); pored lateral-line scales 47-72 (Table 10) (47-51 except in *B. serratus*; unique among tilefish genera); first haemal spine over second anal ray (like *Lopholatilus*; differing from *Caulolatilus*, over fifth to seven anal ray); anal fin supports to haemal spine ratio unique at 0.86:1; caudal fin truncate, rounded or scalloped, never emarginate.

Description.—Body quadriform, head blunt; body depth 22-36% (modally 27%) SL; body width 10-15% (modally 13%); first arch gill rakers 18-24 (modally 21) (Table 11); cheek scales 7-14; opercular scales 5-9; scales above lateral line 6-11; scales below lateral line 16-31; caudal peduncle length 13-18% (modally 15%) SL; caudal peduncle depth 8-14% (modally 11%) SL; (Table 12); head length (HL) 24-33% (modally 28%) SL; predorsal length 27-37% (modally 32%) SL; head depth 82-108% (modally 95%) HL; snout length 30-55% (modally 42%) HL; length of upper jaw 34-47% (modally 42%) HL; length of lower jaw 41-52% (modally 47%) HL; cheek depth 27-49% (modally 40%) HL; opercular length 23-32% (modally 26%) HL; snout to dorsal margin of preoperculum 69-82% (modally 77%) HL; orbit diameter 20-37% HL (allometric); suborbital depth 10-35% HL (allometric).

Jaws somewhat oblique and extend posteriorly from midway under rear nostril and anterior rim of orbit to below posterior rim of pupil; teeth of upper jaw in 1-3 rows of 13-30 short canines widening to 4-6 rows of villiform teeth in a patch at symphysis, 1 or 2 anteriorly curved teeth at the rear of the upper jaw; lower jaw with 1-3 antrorsely curved teeth, 1 or 2 rows of 13-25 canines

Table 8.—Frequency distribution of the number of dorsal fin elements in the species of *Branchiostegus*.

							Soft elements	
Species	VI	VII	VIII	14	15	16	$\bar{x}$	*N*
serratus	2	18			20		15	20
japonicus		71	2	2	71		15	73
wardi		19			19		15	19
sawakinensis		8			8		15	8
albus		22			22		15	22
semifasciatus	54				1	53	16	54
doliatus	9					9	16	9
argentatus		33			33		15	33

Table 9.—Frequency distribution of the number of anal fin elements in the species of *Branchiostegus*.

						Soft elements	
Species	I	II	11	12	13	$\bar{x}$	*N*
serratus		20		19	1	12	20
japonicus		73		72	1	12	73
wardi		19		19		12	19
sawakinensis		8	1	7		12	8
albus		22		22		12	22
semifasciatus	52	2		2	52	13	54
doliatus		9		9		12	9
argentatus		33	1	31	1	12	33

Table 10.—Frequency distribution of the number of pored lateral-line scales in the species of *Branchiostegus*.

Species	47	48	49	50	51	67	68	69	70	71	72	$\bar{x}$	SD
serratus						2	4	3	5	2	4	69.7	1.66
japonicus	8	20	11	8								48.4	0.97
wardi		2	11	4	1							49.2	0.73
sawakinensis	1	2	3	2								48.8	1.04
albus		5	6	9	1							49.3	1.03
semifasciatus	2	21	19	1								48.4	0.63
doliatus			4	4	1							49.7	0.71
argentatus	5	17	4	4								48.2	0.90

Table 11.—Frequency distribution of the number of first arch gill rakers in the species of *Branchiostegus*.

Species	18	19	20	21	22	23	24	$\bar{x}$	SD
serratus	10	9	1					18.6	0.61
japonicus		2	4	11	23	8	1	21.7	1.04
wardi		8	7	3	—	1		19.9	1.05
sawakinensis	1	—	4	2				20.0	1.00
albus			1	12	3	1		21.4	0.96
semifasciatus	2	7	8	17	11	1		20.7	1.19
doliatus		6	2	1				19.4	0.73
argentatus		1	12	16	1			20.6	0.63

widening to a patch of 3-6 rows of villiform teeth as in upper jaw.

Preoperculum finely serrate on upper limb, lower limb with few or no serrae below angle; preopercular angle 85-115°; operculum with a broad soft tablike spine; predorsal ridge always present, may be differentially pigmented; lateral line in low curve; head pores numerous, mandibular pores number four or five (rarely 4) per side.

Scales large, embedded in pockets and ctenoid except

Table 12.—Range of proportional measurements of the species of *Branchiostegus* as percent standard length and percent head length. Number in parenthesis is the mean percent.

Species	Precent standard length					Percent head length		
	Body depth	Body width	Caudal peduncle depth	Head length	Predorsal length	Snout length	Orbit diameter	Sub-orbital depth
serratus	25-28 (27)	12-14 (13)	10-12 (11)	24-26 (26)	27-32 (31)	36-45 (41)	25-33 (27)	19-25 (22)
japonicus	24-30 (28)	11-15 (13)	10-12 (11)	26-30 (28)	31-37 (33)	36-55 (43)	20-37 (28)	17-35 (26)
wardi	23-26 (25)	12-14 (13)	10-14 (11)	25-28 (27)	29-36 (31)	34-41 (37)	21-29 (26)	16-22 (19)
sawakinensis	25-29 (27)	11-14 (13)	11-12 (11)	26-31 (28)	29-34 (32)	39-46 (43)	22-26 (23)	21-29 (25)
albus	24-28 (26)	10-14 (12)	10-13 (12)	26-29 (28)	29-35 (32)	39-47 (44)	21-29 (24)	21-30 (25)
semifasciatus	27-36 (29)	11-15 (13)	10-13 (11)	29-33 (31)	30-37 (34)	34-47 (40)	22-35 (28)	16-22 (19)
doliatus	25-28 (26)	10-14 (12)	8-10 (9)	24-27 (27)	30-32 (31)	31-38 (36)	27-36 (33)	10-16 (14)
argentatus	22-25 (24)	10-12 (11)	11-12 (11)	24-26 (25)	28-31 (30)	30-41 (36)	25-36 (30)	14-24 (19)

in head region where they are mostly cycloid; scales in a patch on pectoral base; caudal covered with fine scales, remaining fins naked; body scales nearly all regenerated.

Dorsal fin continuous, height 6-10% SL, base 50-66% SL; antepenultimate ray elongate; dorsal spines thin, usually flexible; first and second spines joined at their bases; two predorsal interneural bones present.

Anal fin continuous, slightly lower or nearly the same height as dorsal fin; base 27-37% SL; one or two spines (usually two), first spine 1.5-3.0 in length of second; penultimate ray elongate.

Pectoral fins pointed, reaching to anus or beyond; length 22-34% SL; uppermost ray stout, remaining rays branched.

Pelvic fins long and usually pointed, inserted below posterior margin of pectoral origin; length 11-19% SL.

Caudal with 17 principal rays, 15 branched; margin truncate rounded or scalloped, usually with slightly extended tips; caudal with 10-11 (usually 10) dorsal and 9-10 (usually 9) ventral procurrent rays.

Branchiostegus serratus Dooley and Paxton 1975

Figure 19

Branchiostegus serratus Dooley and Paxton 1975:151 (original description; Newcastle, N.S.W., Australia).

Diagnosis.—This species differs from all congeners by the following: a series of 18 or 19 dark tapered vertical bars on the dorsal portion of the body, 67-72 pored lateral-line scales; differs from *B. doliatus* (East Africa) by the fewer lateral-line scales (49-51), pigmented operculum and predorsal ridge and fewer dorsal spines (6) found in *B. doliatus*; differs from *B. semifasciatus* (West Africa) by the dark pigment above the pectoral fin axillae and fewer dorsal spines (6) found in *semifasciatus*.

Description.—Dorsal fin elements VI(rarely)-VII, 15; anal fin II, 12-13 (rarely); pectoral fin 17 (rarely 18; principal caudal rays 17; cheek scales 10-13; opercular scales 5-7; scales above lateral line 7-10; scales below lateral line 20-25; pored lateral-line scales to hypural base 67-72 (plus 2 on tail); total first arch gill rakers 18-20; branchiostegal rays 6; vertebrae 10 + 14.

Body depth 25-28% (modally 27%) SL; body width 12-14% (modally 13%) SL; caudal peduncle depth 10-12% (modally 11%) SL; caudal peduncle length 16-18% (modally 17%) SL; head length (HL) 24-26% (modally 26%) SL; predorsal length 27-32% (modally 31%) SL; head depth 98-108% (modally 101%) HL; snout length 36-45% (modally 41%) HL; length of upper jaw 37-43% (modally 42%) HL; length of lower jaw 45-51% (modally 48%) HL; cheek depth 39-47% (modally 44%) HL; opercular length 24-29% (modally 26%) HL; snout to upper margin of preoperculum 74-79% (modally 78%) HL; or-

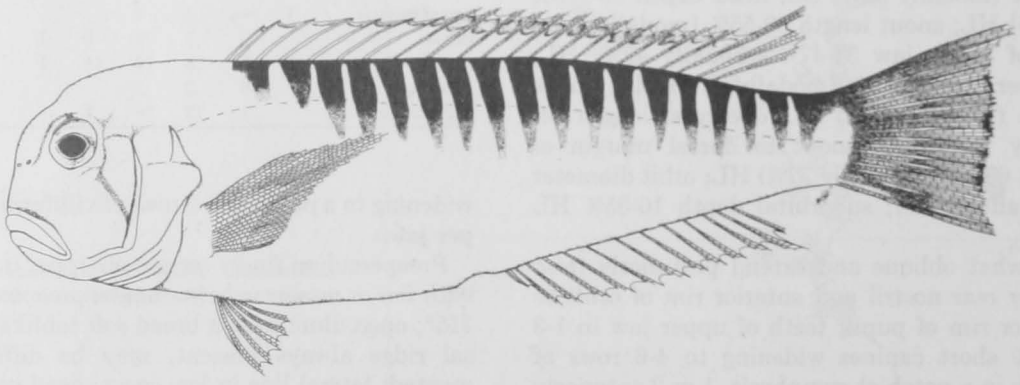


Figure 19.—Drawing of the holotype of *Branchiostegus serratus* (AMS I.16207-400), 285 mm SL, New South Wales, Australia.

bit diameter 25-33% (modally 27%, allometric) HL; suborbital depth 19-25% (modally 22%, allometric) HL.

For a more detailed description see Dooley and Paxton (1975).

Color.—Silvery white body with some overlying yellow-orange and 18 or 19 dark blue-violet tapered vertical bars, bars shorter anteriorly and posteriorly; iris golden; black area on dorsal margin of orbit; cheeks silver-white with an oblique dark band from preoperculum nearly to orbit; snout yellow-orange with black area on medial portion of upper lip; dorsal head colored as snout with overlying gray hue; predorsal ridge yellow; dorsal fin membrane dusky, spinous portion dusky with narrow yellow margin; some diffuse yellow in front of first ray and elliptical yellow spots along dorsal margin between each ray, decreasing between rays 8 and 9, disappearing between rays 12 and 13, last ray dusky; anal membrane translucent; pectoral fin opaque with black edging on first and second rays; pelvic fin translucent; caudal fin base orange, central portion yellow with medial black area; medial posterior edge of caudal, dorsal, and anal lobes black; color based on fresh specimens.

Biology.—Stomach contents of seven specimens were examined and revealed remains of fish (*Apogonops anomalous*), mollusks (bivalves and gastropods), crustaceans (crabs, amphipods, and stomatopods), and polychaetes; it appears to be a benthic carnivore (Dooley and Paxton 1975). Selected market specimens were dissected to determine the sex and reproductive state. A deviation from the expected 50/50 sex ratio was found for *B. serratus*. Under 380 mm the 29 specimens exhibited an almost even ratio between sexes. However, larger sizes were only identified as males. Perhaps either males reach a larger size, there is schooling according to sex, or there is protogynous sex reversal. The only ovaries of *B. serratus* examined were collected in June and were filled with ova from 0.2 to 0.9 mm in diameter (Dooley and Paxton 1975). The larvae, although unknown, probably resemble those of *B. japonicus* (Okiyama 1964). Larvae of four of the five tilefish genera have a similar arrangement of head serrations and spinules.

Distribution.—*Branchiostegus serratus* is known only from Cape Moreton, Queensland and the coast of New South Wales, where it is trawled from Coff's Harbour (lat. 30°20'S) to Lake Illawarra (lat. 34°30'S). The only depth record, well documented, is 110-150 m, from a State Fisheries trawl off Newcastle (lat. 33°S). *Branchiostegus serratus* has been recorded from 126 to 162 m and is often caught in the same trawl with *B. wardi*; the only other species of *Branchiostegus* known from Australia. Neither the *Thetis* Expedition of 1898 which trawled off Port Stephens-Newcastle in 60-100 m (Waite 1899) nor the *Endeavour* Collections of 1909-1910 which trawled from 30 to 110 m in the same area (McCulloch 1911) took any specimens of *Branchiostegus*. *Branchiostegus wardi* was not known until its collection in 1928 and its subsequent description in 1932 (Whitley 1932). Both species of *Branchiostegus* are now common in the fish markets of Sydney (Dooley and Paxton 1975). It may be that both species are more abundant now than 60-70 yr ago. Fluctuations in the abundance of the North Atlantic *Lopholatilus chamaeleonticeps* have been well documented (Collins 1884).

Material examined.—A total of 20 specimens (213-405 mm SL) in the type-series were examined (all that were designated; Dooley and Paxton 1975). AUSTRALIA: AMS I.16207-004, 285 mm (holotype). Paratypes: AMS I.16207-002, 285 mm; USNM 209532, 290 mm; USNM 209533, 245 mm; AMS I.15916-003-006, (4) 263-275 mm; AMS IB.5074, 240 mm; AMS I.15885-006, 228 mm; AMS IB.2908, 405 mm; AMS uncat., (4) 237-302 mm; BMNH 1973.7.17.3, 232 mm; MNHN 1973-36, 235 mm; CAS 28355, 229 mm; QM I-8707, 268 mm; QM I-8968, 213 mm.

Holotype.—AMS I.16207-004, 285 mm SL, 355 mm TL; 500 g (preserved); specimen in good condition with dark banding clearly visible, however yellow pigmentation fading; Newcastle, N.S.W.; collected 8 May 1971 by trawl, purchased in Sydney fish market by J. Paxton; D. VII, 15; A. II, 12; P_i 17; B. 6; C. 17; vertebrae 10 + 14; gill rakers on first gill arch 7 + 11; pored lateral-line scales 70 + 2; scales above lateral line 8; scales below lateral line 22; cheek scales 10; opercular scales 7; body depth 26% SL; body width 13% SL; head length (HL) 25% SL; head depth 98% HL; orbit 27% HL; suborbital depth 23% HL.

***Branchiostegus japonicus* (Houttuyn 1782)**

Aka-Amadai; Red Horsehead

Figure 20

Coryphaena japonica (not of Linnaeus 1758) Houttuyn 1782:315 (original description; southern Japan; description brief and general; refers to a common name "Japanese orange-fish," as a dolphin from its blunt head; color bright yellow; body covered with fine scales; D. 24; P. 14; v. 6; C. 17; no type designated. Gmelin 1788:1194 (listed from the Sea of Japan). Lacépède 1802:220 (synonymized with *Coryphaenoides hottuynii*, a junior synonym). Jordan and Snyder 1901a:745 (senior synonym of *Latilus sinensis* = *Latilus argentatus*); 1902:489 (synonymy). Snyder 1912a:417 (synonymy).

?*Coryphaena branchiostega* Gmelin 1788:1194 (uncertain synonymy; "Asiatic Ocean").

?*Coryphaenoides hottuynii* (not of Gunner 1765; a genus of macrourid) Lacépède 1802:219 (original description; very brief).

Branchiostegus hottuynii. (Lacépède 1802) Rafinesque 1815:86 (substitute for *Coryphenoides* Lacépède 1802, preoccupied by a genus of macrourid, Gunner 1765); possibly misspelled by Rafinesque, although spelled two ways by Lacépède 1802.

Latilus japonicus. Jordan and Snyder 1901a:745 (substitute for *Coryphaena japonica* Houttuyn 1782); 1902:489 (synonymy and description; Japan). Jordan et al. 1913:187 (synonymy). Jordan and Thompson 1914:260 (Japan).

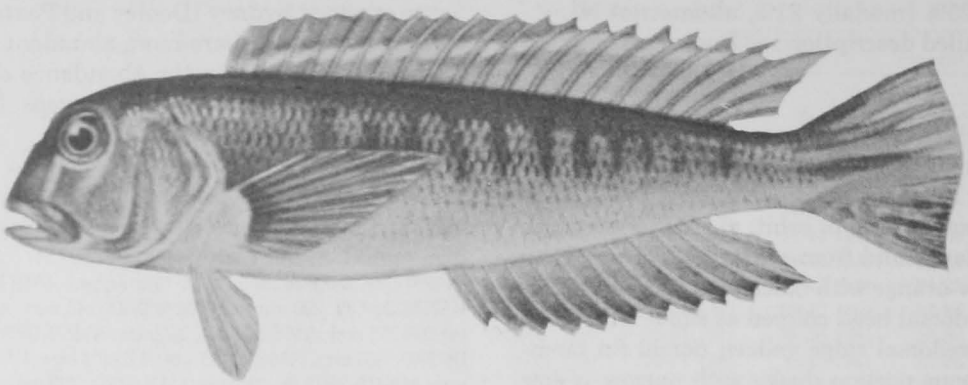


Figure 20.—*Branchiostegus japonicus* (after Abe 1965; listed as *B. japonicus auratus*).

Latilus ruber Kishinouye 1907:59 (original description; Japan). Snyder 1912a:417 (list; Japan). Jordan et al. 1913:187 (junior synonym of *Latilus japonicus*).

Branchiostegus japonicus. Jordan and Hubbs 1925:248 (*Branchiostegus* a senior synonym of *Latilus*. Chu 1931:137 (list). Tanaka 1931:89 (color pl. I C; "aka," red form). Fowler 1949:56 (list). Yasuda and Kosaka 1950:855 (growth). Kamohara 1952:51 (Tosa, Japan). Mori 1952:95 (Pusan, Korea). Herre 1953: 481 (Philippines). Irie 1953:14 (diagnosis). Okada 1955:261 (description). Chyung 1961:372 (Korea). Liang et al. 1962:49 (description; Taiwan). Okada 1966:270 (Japan).

Branchiostegus japonicus japonicus. Ochiai 1953:306 (originally recognized; Japan). Tomiyama and Abe 1958:158, pl. 468 (color). Matsubara 1963:596 (drawing and description). Okiyama 1964:1 (larvae). Abe 1965:146 pl. 436 (color). Kamohara 1967:78, pl. 39 (color). Kitahara 1968:300 (fishery). Lindberg and Krasyukova 1971:154, pl. 154 (key and description). Shiino 1972:86 (common name).

Branchiostegus argentatus. (not of Cuvier 1830) Burgess and Axelrod 1973:533, pl. 495 (color).

Diagnosis.—Can be distinguished from all other species of the genus by the following combination of external characters: head without silver bar from under eye to upper lip, may have silver triangular area behind orbit, dark predorsal ridge, body primarily reddish, may have yellowish tint, preoperculum angle 90-95° without notch above angle, jaws reach posteriorly to under pupil, large eye (usually 28% HL), caudal rounded with five radiating yellow stripes (ventral two are not nearly parallel as in *B. argentatus*), dark triangle on lower lobe of caudal as in *B. argentatus*; can be distinguished from *B. albus* by the dark predorsal ridge, more posterior position of the jaws, lack of notched preoperculum, larger eye, red color, tail stripes, and dark triangle found in *B. japonicus*; can be distinguished from *B. argentatus*, the other common sympatric species, by: the one or usually two silver bars under the orbit, the series of dark spots ascending along the dorsal fin membrane, the orange-golden body color, usual two longitudinal orange body stripes, and the two central parallel yellow tail stripes found in *B. argentatus*.

Description.—Dorsal fin elements VII (very rarely VIII), 15 (rarely 14); anal fin elements II, 12 (very rarely 13); pectoral fin 17-19 (usually 18); total first arch gill rakers 19-24 (modally 22); pored lateral-line scales 47-50 (modally 48, plus 2-4 on tail); cheek scales 7-10 (modally 8); opercular scales 5-8 (modally 6); scales above lateral line 7-9 (modally 8); scales below lateral line 17-25 (modally 22).

Body depth 24-30% (modally 28%) SL; body width 11-15% (modally 13%) SL; caudal peduncle length 15-16% SL; caudal peduncle depth 10-12% (modally 11%) SL; head length (HL) 26-30% (modally 28%) SL; predorsal length 31-37% (modally 33%) SL; head depth 82-100% (modally 95%) HL; snout length 36-55% (modally 43%) HL; length of upper jaw 38-43% (modally 40%) HL; length of lower jaw 41-47% (modally 44%) HL; cheek depth 34-47% (modally 37%) HL; opercular length 23-32% (modally 25%) HL; snout to dorsal margin of preoperculum 74-79% (modally 76%) HL; orbit diameter 20-37% (modally 28%, although allometric) HL; suborbital depth 17-35% (modally 26%, allometric) HL.

Jaws slightly oblique and terminal, mouth small with jaws extending posteriorly to under anterior third of pupil; teeth on outer margin of upper and lower jaws fine and number about 20, an enlarged tooth at the rear of the upper and lower jaws; both jaws with villiform tooth patches at their symphyses as other species of *Branchiostegus*.

Preoperculum finely serrate on upper limb, lower limb with few serrae; margin above angle not indented as in *B. albus*; operculum with broad single soft tablike spine; gill rakers well developed (longest about half pupil diameter); predorsal ridge extending from origin of dorsal fin to over middle of pupil; lateral line in low curve; head pores numerous, mandibular series with five pores on each side; scales small and ctenoid over most of body, cycloid around head region; scales on head extend to over

middle of pupil; pectoral fin with small patch of scales at base; caudal fin with fine scales; other fins naked.

Dorsal fin height about 10% SL; fin base 50-61% (modally 58%) SL; first and second spines thin and close together, united at their bases; first spine about 1.6 in length of second; dorsal margin over ventral margin of pectoral base; first dorsal ray may be unbranched, the remainder branched; antepenultimate ray elongate, reaching well past hypural base.

Anal fin about same height as dorsal; fine base 28-33% (modally 31%) SL; origin below about fifth dorsal ray; two spines, first 2-3 times in length of second; first ray may be unbranched, remaining branched; penultimate ray elongate, reaching to hypural base; last ray divided.

Pectoral fin elongate, reaching anus; fin length 22-30% (modally 25%) SL; dorsalmost ray stout and unbranched, second ray may be undivided; stout ray 3-4 times in length of fin.

Pelvic fin origin below middle of pectoral fin base; not broad; reach posteriorly to about halfway between pelvic base and anal fin. Caudal fin rounded with tips slightly extended; 10 or 11 dorsal and 9 or 10 ventral procurrent caudal rays.

Color.—Preserved color as follows: body pink or reddish with slight yellow hue, may have faint underlying red bars corresponding to myosepta; head may have silver postorbital or suborbital areas, but no silver suborbital bars; dorsal fin translucent or pinkish with some dusky areas, but no series of dark areas as in *B. argentatus*; pectorals dusky; pelvics opaque, with some overlying dusky pigmentation; anal fin translucent along base, the remainder dusky; caudal with usually five radiating thin yellow bands, lower lobe covered by a dark triangle; dark predorsal ridge.

Remarks.—There are at least three sympatric species of *Branchiostegus* in the waters of Japan and China. *Branchiostegus japonicus* (Houttuyn 1782) was first described from southern Japan. Houttuyn (1782) did not mention a type-specimen and a search for his type has been unsuccessful. In order to clear up a complex nomenclatural problem, a neotype is here designated as a 267-mm specimen from Nanao, Japan collected by the *Albatross* cruise and deposited in the National Museum of Natural History (USNM 150133). Valenciennes (*in* Cuvier and Valenciennes 1833:495) mentioned that Langsdorff collected and deposited a specimen in the Berlin Museum that Langsdorff thought was a rediscovery of Houttuyn's (1782) *Coryphaena japonica*. Valenciennes (*in* Cuvier and Valenciennes 1833) mistakenly assumed that the specimen was actually another specimen of their previously described (1830) *Latilus* (= *Branchiostegus*) *argentatus* (Cuvier, *in* Cuvier and Valenciennes 1830). With the kind cooperation of C. Karrer (ZMB), the specimen referred to by Valenciennes (*in* Cuvier and Valenciennes 1833) (ZMB 8791) was photographed and examined. The specimen is stuffed and in poor condition, but is undoubtedly that of *B. japonicus*, as Langsdorff first assumed. The position and shape of the jaws, the lack of indention of the preopercle, and large eye distinguish it from both *B. argentatus* and *B. albus*. Houttuyn's (1782) original description, although rather brief and general, gave meristics (nondistinctive) —mentioned its blunt head, fine scales, and orange-yellow coloration. Although *B. japonicus* is generally reddish overall, specimens appear orange-yellowish upon preservation. It is possible that Houttuyn's description referred to *B. argentatus* (Cuvier, *in* Cuvier and Valenciennes 1830), due to the orange-yellow bands often seen, but the predominantly silvery color, dark upper body, and pinkish-white belly of *B. argentatus* seem to vary from Houttuyn's color description.

Considerable confusion exists with regard to the remaining two species of Chinese-Japanese *Branchiostegus*. Apparently shortly after Cuvier's (1830) description of *Latilus* (= *Branchiostegus*) *argentatus*, Temminck and Schlegel (1846) misassigned *Latilus* (= *Branchiostegus*) *argentatus* to an undescribed species. Examination of Cuvier's (*in* Cuvier and Valenciennes 1830) type (MNHN 8153) has confirmed its identity. Temminck and Schlegel's (1846) error has been perpetuated by other authors until now. This species has been considered as at least five different species and presently is usually incorrectly considered as a subspecies *Branchiostegus japonicus auratus*.

The undescribed species incorrectly considered by Temminck and Schlegel (1846) and subsequent authors as *B. argentatus* will be herein described as *Branchiostegus albus* n.sp.

Distribution.—Found from the southern island of Japan (Honshu) as far north as Akita (lat. 39°43′N, long. 140°07′E) on the Sea of Japan and to Tokyo Bay on the Pacific coast; along both coasts of Honshu and throughout the East China Sea including South Korea; throughout the Ryukyu Islands to Okinawa; from Taiwan and the Philippines; and along the China coast and South China Sea to off South Vietnam (lat. 15°40′N, long. 109°25′E). Not confirmed from the Indian Ocean. Previous records from South Africa (Smith 1949) are attributable to *B. sawakinensis*. Known depth ranges from 200 m in the South China Sea to 80 m off Taiwan.

Material examined.—Total of 76 specimens, 61-303 mm SL. JAPAN: UMMZ (uncat. series coll. by C. L. Hubbs, 1929), unnumbered spec., 61 mm SL; (H29-31), 280 mm; (H29-247), 150 mm; (H29-231-235), 176 mm; (302), 71 mm; (526), 110 mm; (H29-249), (3) 63-120 mm; (H29-185), 148 mm; (H29-128), (5) 93-195 mm; (123), 207 mm; (unnumbered), 187 mm; (unnumbered), (2) 170-187 mm; (H29-236), 260 mm; (H29-183), 216 mm; (H29-185-63), 201 mm; (H29-255), 160 mm; (H29-222), (2) 92-135 mm; (H29-259), 150 mm; (unnumbered), 149 mm; (unnumbered), 106 mm; (H29-240), 76 mm; (H29-209), (6) 82-140 mm; (H29-248), 76 mm; (uncat. Tokaiku Fish. Lab.), (2) 175-188 mm; USNM 28585, 247 mm; USNM 150133, 267 mm (neotype); USNM 44924, 303 mm; USNM 50252, 203 mm; USNM 71138, 208 mm; USNM 71377, (4) 132-141 mm; USNM 71284, 125 mm; USNM 151655, 136 mm; USNM 57489, 161 mm; USNM 59671, 180 mm; ZMK uncat., 136 mm; FMNH 57210, (2) 100-144 mm; FMNH 58765, 105 mm; MIZS (CN-2714), 199 mm; FAKU 17927, 213 mm; FMNH 58766, 131 mm; FAKU 17934, 202 mm; FAKU 17947, 185 mm; AMNH 3706, 190 mm; AMNH 12993, (2) 225-236 mm. OKINAWA: USNM 71814, 218 mm; USNM 71815, 245 mm. TAIWAN: Taiwan Univ. uncat., (3) 182-215 mm. PHILIP-

PINES: USNM 5255; USNM 14951, 205 mm. CHINA: USNM 86437, 266 mm; CAS uncat., GUF reg. 1771, 163 mm; CAS uncat., GUF reg. 2077, (4) 85-130 mm; UMMZ uncat., H29-151, 286 mm. LOCALITY UNKNOWN: MNHN 999, (2) 290-395 mm.

Neotype.—USNM 150133, 267 mm SL, 325 mm TL; 323 g (preserved); specimen in fair condition; faded with silver area at posterior orbit; upper body dark, lower body silver; dark predorsal ridge; Nanao, Japan (*Albatross* expedition); D. VII, 15; A. II, 12; P_1 17 (left) 18 (right); B. 6; C. 17; gill rakers on first gill arch 7 + 1 + 14; pored lateral-line scales 49 + 3 on tail; scales above lateral line 8; scales below lateral line 21; cheek scales 9; opercular scales 6; body depth 29% SL; body width 12% SL; head length (HL) 29% SL; orbit 24% HL; suborbital depth 31% HL; vertebrae 10 + 14.

Branchiostegus wardi Whitley 1932

Figure 21

Branchiostegus wardi Whitley 1932:335 (original description; Port Stephens, N.S.W., Australia); 1962:154 (Australia). Marshall 1964:164 (Queensland, Australia).

Branchiostegus sp. Marshall 1928:189 (Queensland).

Diagnosis.—Can be easily distinguished from *B. serratus*, the other Australia branchiostegid, by its lack of dark vertical body bars, tail with two yellow parallel bands, dorsal lobe of caudal yellowish with some gray, ventral lobe with black triangle; and 48-51 pored lateral-line scales (vs. 67-72 in *B. serratus*). *Branchiostegus wardi* has the least body depth (23-26%, modally 25% SL) of all species of *Branchiostegus*; only *B. argentatus* has a lesser body depth (22-25%, modally 24% SL); *B. wardi* can be distinguished from *B. argentatus* by the larger orbit diameter (25-36%, modally 30% HL found in *B. argentatus* vs. 21-29%, modally 26% HL in *B. wardi*), the series of dark medial marks along the dorsal fin membrane, and the position of the jaws under the posterior orbital rim in *B. artentatus*; *B. wardi* shares the shortest suborbital depth with *B. argentatus* and *B. semifasciatus* (found only from West Africa, and with six dorsal spines).

Description.—Dorsal fin elements VII, 15 (as in all species of *Branchiostegus* except *B. semifasciatus* and *B. doliatus*, both with VI, 16); anal fin II, 12; pectoral fin 17-19 (rarely 17 or 19); total first arch gill rakers 19-23 (modally 20); pored lateral-line scales 48-51 (modally 49, plus 2 on tail); cheek scales 8-11 (usually 10 or 11); opercular scales 5-8 (usually 7); scales above lateral line 7-10 (usually 8); scales below lateral line 21-27 (usually 22).

Body depth 23-26% (modally 25%) SL; body width 12-14% (modally 13%) SL; caudal peduncle length 14-17% (modally 16%) SL; caudal peduncle depth 10-14% (modally 11%) SL; head length (HL) 25-28% (modally 27%) SL; predorsal length 29-36% (modally 31%) SL; head depth 81-95% (modally 90%) HL; snout length 34-41% (modally 37%) HL; length of upper jaw 40-45% (modally 42%) HL; length of lower jaw 44-50% (modally 45%) HL; cheek depth 35-42% (modally 38%) HL; opercular length 26-30% (modally 28%) HL; snout to dorsal margin of preoperculum 69-75% (modally 74%) HL; orbit diameter 21-29% (modally 26%, although allometric) HL; suborbital depth 16-22% (modally 19%, although allometric) HL.

Jaws extend posteriorly to under middle of pupil; teeth on outer margin of jaw well developed, about 20 in each jaw, including a single enlarged anteriorly curved tooth at the rear of both jaws.

Preoperculum finely serrate only on upper limb, lower limb smooth; preopercular angle 100-110°; operculum with broad single soft tablike spine (as all congeners); gill rakers elongate (longest equal to half diameter of pupil); predorsal ridge relatively prominent and dark, extending from dorsal fin to near margin of head scalation over anterior orbit; lateral-line pores in shallow curve; head pores numerous, mandibular series with five pores per side; scales ctenoid over most of body, cycloid in head region; scales on head extend to anterior orbit; pectoral fins with patch of scales at their base; caudal fin finely scaled; remaining fins naked.

Dorsal fin height about 9% SL; nearly uniform in height except for most anterior and posterior portions; fin base 56-62% (modally 59%) SL; first and second spines close together and united at their base; first spine about twice in length of second spine; dorsal origin slightly behind pectoral base; all rays branched; antepenultimate ray somewhat elongate, almost reaching hypural base.

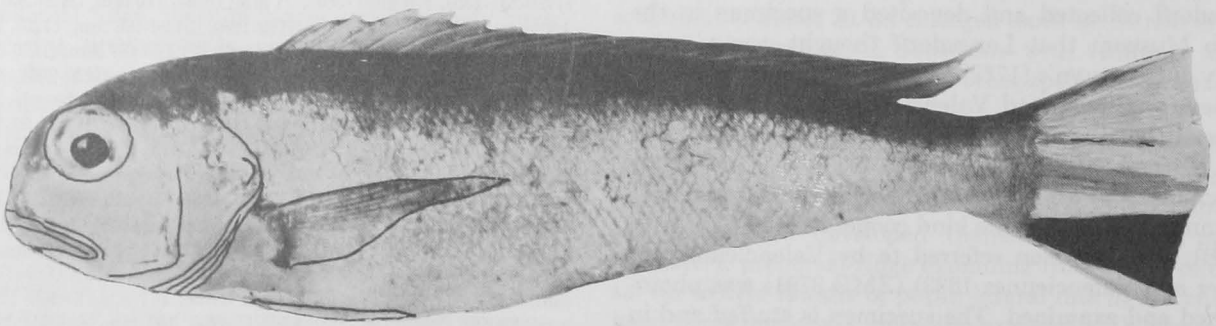


Figure 21.—*Branchiostegus wardi*, 250 mm SL, New South Wales, Australia (retouched photograph by J. R. Paxton).

Anal fin about same height as dorsal fin; fin base 27-32% (modally 30%) SL; origin below between fifth and sixth dorsal soft rays; two spines, first about twice in length of second; first ray may be unbranched, all other rays branched; penultimate ray elongate, slightly longer than elongate ray, reaching to hypural base.

Pectoral fins broad, reaching to below between third and fourth dorsal soft rays, not reaching anus; fin length 23-25% (modally 24%) SL; all rays branched except stout uppermost ray; stout ray nearly 4 times in length of fin.

Pelvic fins origin below ventral margin of pectoral base; reach to slightly less than half way between origin of pelvics and anal fin; length 13-15% (modally 14%) SL; spine about 1.7 in length of fin; caudal fin with 17 rays, fin truncate and scalloped to give a sigmoid margin.

Color.—Fresh coloration: body without vertical bars, dark brown above, lighter below; silver-white belly; snout purple; top of head dark; dark predorsal ridge; cheeks silver; dorsal fin membrane dusky dorsally; spinous and ventral portions lighter with some yellow; anal fins and pelvics dusky; pectoral with dark dorsal margin, upper half of fin dusky, lower half transparent; tail with dark triangle on lower lobe (as in *B. argentatus* and *B. japonicus*) with dorsal and ventral margins yellow; two parallel medial bands with gray intermediate; dorsal caudal lobe yellowish with some gray.

Remarks.—Often caught along with *B. serratus* off eastern Australia; stomach analysis of *B. wardi* revealed it to be a benthic carnivore, feeding on fish (*Apogonops anomalous*), mollusks (bivalves and gastropods), crustaceans (crabs, amphipods, and stomatopods), and polychaetes (Dooley and Paxton 1975). Selected specimens of *B. wardi* were dissected to determine sex and reproductive state; a deviation from a 50/50 sex ratio was found; specimens under 300 mm were predominantly females; above 300 mm, only males were identified; either males reach a larger size, or protogynous sex reversal exists. Ovaries were collected from specimens taken in June, July, September, and January; the ovaries measured 35-50 mm in length and 10-20 mm in diameter; ova ranged from 0.2 to 0.8 mm in diameter. No seasonal changes in gonads were observed, perhaps indicating multiple spawnings during the year (Dooley and Paxton 1975). The larvae are unknown, but probably resemble those of *B. japonicus* (Okiyama 1964). The largest specimen known is a 401 mm SL specimen captured off New Caledonia (P. Fourmanoir, pers. commun.).

Distribution.—Known from southern Queensland (Noosa Heads) to Sydney, N.S.W., Australia; also a new record for New Caledonia was caught near the edge of the barrier reef at 250 m off Nouméa (P. Fourmanoir, pers. commun.); depth distribution is between 100-250 m.

Material examined.—Total of 19 specimens, 215-336 mm SL. AUSTRALIA: USNM 176980, (2) 215-245 mm SL; SOSC 560 (at USNM), (8) 215-283 mm; UNC uncat., (8) 246-336; AMS IA.5130 (holotype), 327 mm.

Holotype.—Counts and measurements made by J. R. Paxton, AMS IA.5130, 327 mm SL, 396 mm TL; D. VII, 15; A. II, 12; P_1 18; B. 6; C. 17; total first arch gill rakers 8 + 13; pored lateral-line scales 49; scales above lateral line 6.5; scales below lateral line 27; body depth 26% SL; body width 14% SL.

Branchiostegus sawakinensis Amirthalingam 1969

Shawra; Theena; Freckled Tilefish

Figure 22

Branchiostegus japonicus (not of Houttuyn 1782). Barnard 1927:500 (Natal and Zululand, South Africa). Fowler 1934:474 (Durban, South Africa). Smith 1949: 188, pl. 16 (South Africa).

Branchiostegus sawakinensis Amirthalingam 1969:129, pl. 1 (color), (original description; Sawakin, Sudan, Red Sea).

Diagnosis.—The only species of *Branchiostegus* with about six or seven rows of black spots on the sides of the body posterior to the pectoral fins; has a dark spot above the pectoral axil (a character shared only with *B. semifasciatus* from West Africa); *B. sawakinensis* can be easily distinguished from *B. semifasciatus* by the 19 or 20 dark body bars found in *B. semifasciatus*; *B. sawakinensis* has a caudal fin similar in coloration (e.g., dark ventral lobe with two parallel yellow bands above) to *B. japonicus*, *B. argentatus*, and *B. wardi*. *Branchiostegus*

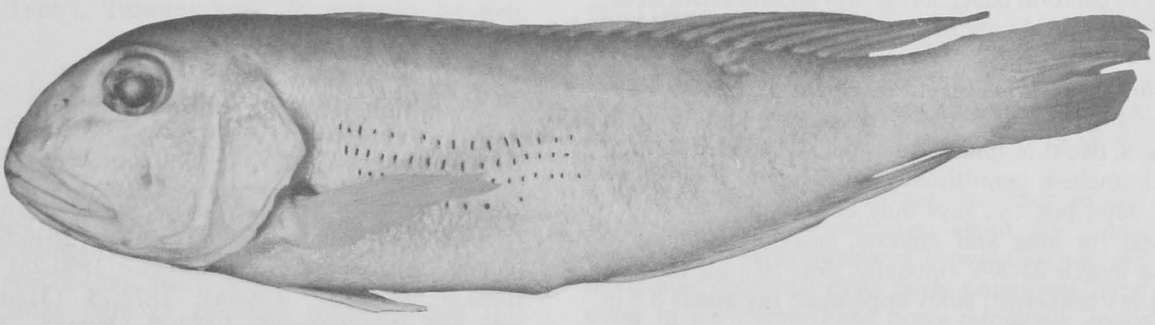


Figure 22.—*Branchiostegus sawakinensis*, 283 mm SL (specimen later dissected), Sudan, Red Sea.

sawakinensis can be distinguished from the former three species by the previously mentioned color characters plus a series of dark areas between the dorsal fin elements bases.

Description.—Dorsal fin elements VII, 15; anal fin II, 12 (rarely 11); pectoral fin 18 or 19; total first arch gill rakers 18-21 (modally 20); pored lateral-line scales 47-50 (modally 49); cheek scales 8-11 (modally 10); opercular scales 6-8; scales above lateral line 8-9; scales below lateral line 19-21.

Body depth 25-29% (modally 27%) SL; body width 11-14% (modally 13%) SL; caudal peduncle length 15-17% (modally 16%) SL; caudal peduncle depth 11-12% (modally 11%) SL; head length (HL) 26-31% (modally 28%) SL; predorsal length 29-34% (modally 32%) SL; head depth 85-95% (modally 91%) HL; snout length 39-46% (modally 43%) HL; length of upper jaw 40-47% (modally 43%) HL; length of lower jaw 47-51% (modally 48%) HL; cheek depth 37-49% (modally 43%) HL; opercular length 25-27% HL; snout to dorsal margin or preoperculum 73-77% (modally 76%) HL; orbit diameter 22-26% (modally 23%) HL; suborbital depth 21-29% (modally 25%) HL.

Jaws extend posteriorly to under middle of pupil; teeth, well-developed canines in both jaws; each jaw with about 25 teeth including a single enlarged forward curved tooth at the rear of both jaws; upper and lower jaws with a patch of villiform teeth at their symphyses.

Preoperculum finely serrate only to just below angle, lower limb smooth; preopercular angle 95-100°; operculum with broad soft tablike spine as other species of *Branchiostegus*; well-developed gill rakers (longest slightly greater than half pupil diameter); predorsal ridge not prominent, but darkly pigmented; lateral line in shallow curve; head pores numerous and difficult to discern; mandibular series with four pores on each side (unique among congeners).

Scales mostly ctenoid, cycloid in head region; extend on top of head to near anterior rim of pupil; pectoral fins with small patch of scales at their base; caudal fin with fine scales, remaining fins naked.

Dorsal fin height about 7% SL; except for most anterior and posterior portions; dorsal fin almost uniform in height; fin base 55-58% (modally 57%) SL; first and second spines close together and united at their base; first spine about 1.2 in length of second; dorsal origin slightly posterior to pectoral base; dorsal rays all branched; antepenultimate ray elongate, reaching well past hypural base.

Anal fin about same height as dorsal fin; fin base 29-32% (modally 29%) SL; origin below fourth and fifth soft dorsal rays; two thin spines, first about 3 times in second; all rays branched; penultimate ray elongate, reaching to hypural base; last two rays may be united.

Pectoral fin long and pointed, usually reaching to anus; fin length 23-26% (modally 25%) SL; all but uppermost ray branched; stout uppermost ray about 3.5 in length of pectoral fin.

Pelvic fins triangular, reaching about half the distance between anal fin and origin of pelvics; length 13-17% (modally 14%) SL; single spine about 1.5 in length of fin.

Caudal fin truncate or slightly rounded with margin forming a sigmoid shape; Figure 22 of a specimen with broken rays; 10 dorsal and 9 ventral procurrent rays.

Color.—Fresh coloration according to Amirthalingam (1969:131): "Rose violet round the eye and silvery yellow below; deep gold blotch above the operculum; black rectangular markings at base and yellow above on the membrane of the dorsal fin; reddish brown above the lateral line and yellow below; rows of black spots on scales between lateral line and pectoral base; a dark blotch in pectoral axil; gold triangle above and olive brown one below with vivid yellow and orange bands between them on caudal fin." Preserved coloration generally retains the following: dark blotches between dorsal ray bases, rows of dark spots on side, dark predorsal ridge, dark pigment in interorbital region where squamation ends, and ventral lobe of caudal darker than dorsal lobe.

Distribution.—Known from Sudan, Red Sea, and South Africa to Durban; the only depth record is 45 m from South Africa; in the Red Sea, it apparently inhabits a muddy bottom and has been reported to occasionally be poisonous (Amirthalingam 1969).

A recently received color transparency from Norbert Rau (University of San Carlos, Philippines) opens the possibility of a remarkable range extension to the Philippines. The markings and counts of the specimen very closely resemble those of *B. sawakinensis*. Conformation awaits receipt of the specimen.

Material examined.—Total of eight specimens, 208-390 mm SL. The largest known specimen measured 390 mm SL, 460 mm TL, and had a preserved weight of 1 kg. RED SEA: (specimen donated by Amirthalingam), 283 mm SL. SOUTH AFRICA: ANSP 101051, 240 mm; ANSP 93152, 363 mm; BMNH 1969.3.12.1 (holotype), 250 mm; BMNH 1927.12.6.32, 390 mm; BMNH 1927.12.6.33, 390 mm; RUSI 2230, 232 mm; RUSI 2229, 208 mm.

Holotype.—Kindly examined by J. E. Randall: BMNH 1969.3.12.1, 264 mm SL, 318 mm TL; D. VII, 15; A. II, 12; P_1 17; total first arch gill rakers 8 + 13; pored lateral-line scales about 53; body depth 29% SL; body width 14% SL; head length 31% SL; orbit diameter 27% HL.

Branchiostegus albus n.sp.

Shiro-Amadai; White Horsehead

Figure 23

Latilus argentatus. (not of Cuvier, *in* Cuvier and Valenviennes 1830) Temminck and Schlegel 1846:63, pl. 28 (color) (description). Günther 1960:251 (list). Bleeker 1873:139 (China); 1875:78 (Mauritius)?; 1897a:12 (Mauritius)?; 1897b:7 (Japan). Nystrom 1887:29 (Nagasaki, Japan). Ishikawa and Matsubara

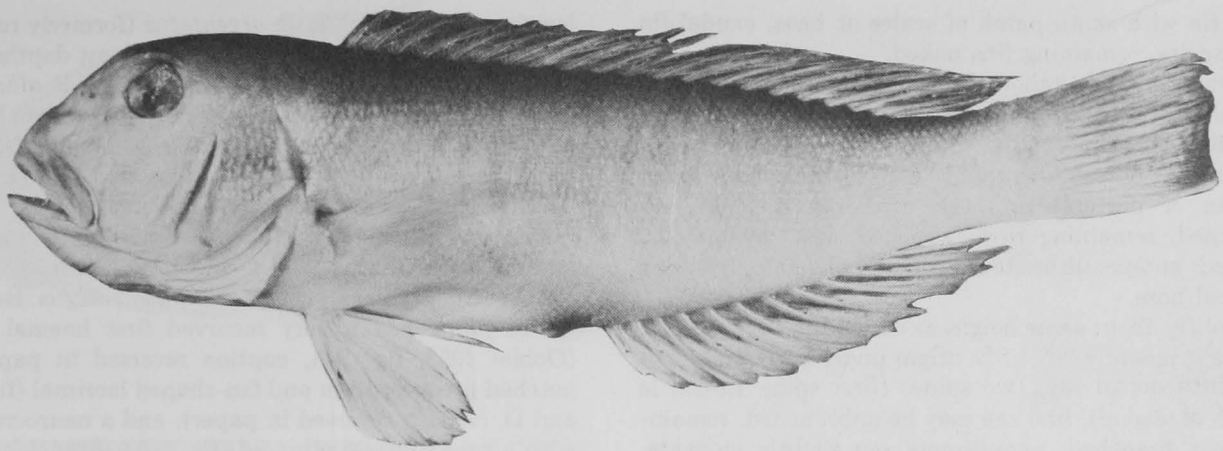


Figure 23.—*Branchiostegus albus*, 217 mm SL (later dissected), Hong Kong.

1897:45 (Tagato and Nagato, Japan). Jordan and Snyder 1902:489 (synonymy). Kishinouye 1907:58 (description; Japan). Snyder 1912a:417 (synonymy). Jordan et al. 1913:187 (synonymy). Boeseman 1947: 69 (list).

Branchiostegus japonicus. (not of Houttuyn 1782) Tanaka 1931:89 (color pl. I A; "shirakawa," white form). Okada 1966:270, pl. 247 (color).

Branchiostegus argentatus. (not of Cuvier, *in* Cuvier and Valenciennes 1830) Mori 1952:95 (Pusan, Korea). Ochiai 1953:306 (compared with *B. japonicus japonicus* and *B. japonicus auratus*). Kamohara 1957:31 (Japan). Tomiyama and Abe 1958:158, pl. 466 (color). Chyung 1961:373, p. 30 (color; Korea). Kuronuma 1961 (list; Vietnam). Abe 1965:146, pl. 437 (color). Lindberg and Krasyukova 1971:153, pl. 153, 154 (key and description). Shiino 1972:86 (common name).

Branchiostegus japonicus japonicus. (not of Houttuyn 1782) Burgess and Axelrod 1973:532, pl. 493 (color).

Holotype.—USNM 71063, 225 mm SL; Kagoshima, Japan; 1906 *Albatross* cruise.

Paratypes.—USNM 191187, (4) 216-230 mm SL; T'ouch'eng, Taiwan (ca. long. 121°35'E, lat. 24°50'N). MNHN 4910; 236 mm; Macao, China. BMNH 1939.1.17.39; 315 mm; no locality (Herklots). National Taiwan University, Department of Zoology (no catalog number); Tach'i, Taiwan; hook, 50 fathoms, 24 Feb. 1972.

Diagnosis.—This species can be distinguished from all other species of *Branchiostegus* by the following combination of characters: margin of preoperculum slightly indented above angle; jaws not quite reaching vertical with anterior rim of orbit; body without dark vertical bars, upper body silvery white with overlying pinkish hue (in fresh specimens), belly white, snout yellow-pink; predorsal ridge light or colorless (distinguishes this species from *B. japonicus, B. argentatus, B. sawakinensis*, and *B. wardi*, the other species without dark body bars); caudal also distinctive in being rounded and scalloped with yellow mottling or spots, no dark ventral lobe as in the above-mentioned species; eye proportionately small (20-24%, modally 24% HL) and placed high on head.

Description.—The following counts and measurements are of the holotype, with the paratypes and other specimens examined given in parentheses: dorsal fin VII, 15; anal fin elements II, 12; pectoral fin 18 (usually 19, rarely 18); principal caudal rays 17, 15 branched as in all tilefishes; branchiostegals 6; total first arch gill rakers 9 + 12 (20-23); pored lateral-line scales 50 + 2 on tail (48-51, modally 49 + 2-4 on tail); cheek scales 9 (7-9, modally 8); opercular scales 6 (6-9, modally 7); scales above lateral line 8 (6-10, modally 8); scales below lateral line 19 (20-26, modally 24).

Body depth 26% (24-28%, modally 26%) SL; body width 14% (10-14%, modally 12% SL); caudal peduncle depth 10% (11-13%, modally 12% SL); peduncle length 17% (15-18%, modally 15% SL); head length (HL) 27% (26-29%, modally 28%) SL; predorsal length 32% (29-35%, modally 32%) SL; head depth 100% (85-98%, modally 88%) HL; snout length 43% (39-47%, modally 44%) HL; length of upper jaw 41% (39-45%, modally 41%) HL; length of lower jaw 48% (43-48%, modally 45%) HL; cheek depth 44% (36-45%, modally 40%) HL; opercular length 26% (25-30%, modally 27%) HL; snout to dorsal margin of preoperculum 78% (74-78%, modally 76%) HL; orbit diameter 29% (21-29%, modally 24%, allometric) HL; suborbital depth (21-30%, modally 25%, HL, allometric).

Jaws extend to nearly under anterior orbital rim; teeth canine and fine, similar to other species of *Branchiostegus*.

Preoperculum finely serrate, and only to just below angle; angle of preoperculum about 105°; operculum with spine as other species of *Branchiostegus*; gill rakers moderate; predorsal ridge fairly prominent; lateral-line pores in low curve; head pores numerous, mandibular series with five pores on each side.

Scales extend on head to anterior rim of pupil; pec-

toral fin with small patch of scales at base, caudal fin with scales, remaining fins naked.

Dorsal fin height (about 8% SL); fin base 55% (52-61%, modally 57%) SL; first and second spines close together, united at their base; (first spine about 2 times in length of second); dorsal fin origin slightly anterior to dorsal margin of pectoral fin base; first ray may be unbranched, remaining rays branched; last ray may be divided; antepenultimate ray slightly elongate, reaching hypural base.

Anal fin about same height as dorsal fin; fin base 31% (28-31%, modally 30%) SL; origin under between fourth and fifth dorsal ray; two spines (first spine 1.8-2.9 in length of second), first ray may be unbranched, remaining rays branched; penultimate ray slightly elongate, just reaching hypural base, last ray may be divided.

Pectoral fin rounded, not elongate, not reaching to anus; fin length 27% (20-27%, modally 22%) SL; rays branched except two dorsalmost; first ray stout, about 3 times in length of fin.

Pelvic fins rounded and comparatively very broad to other species of *Branchiostegus*; not nearly reaching anus; fin length 17% (16-19%, modally 18%) SL; spine about 2 times in length of fin.

Caudal fin partially broken, but usually with a scalloped or rounded margin, 17 rays, 15 branched; 6 autogenous hypurals; 10 or 11 dorsal and 9 ventral procurrent rays.

Color.—Type-specimens mostly faded; color from a freshly frozen specimen received from L. Trott from Hong Kong: body dark along dorsal third, silver with a pinkish hue medially, white over the belly; a hint of yellow-pink on snout, a broad silver area from suborbital to lower edge of lacrimal; predorsal ridge light; chin and branchiostegal membrane white; pectoral fins clear; pelvics milky white, dusky along outer margin and overlying the white (particularly on underside of fin); anal fin clear along base, remainder of fin milky white with overlying dusky tint; dorsal fin translucent with some areas of white or pink, a dusky band runs along the top edge of spinous dorsal to second or third soft ray; numerous white or faded yellow spots cover caudal fin forming an appearance of vertical bands near margin, base of rays yellow, dorsal and ventralmost edge white, most of remaining caudal dusky, particularly near posterior margin.

Remarks.—Refer to remarks under *B. japonicus*. Since Temminck and Schlegel (1846), this species has been incorrectly considered as *B. argentatus*. Examination of Cuvier's (*in* Cuvier and Valenciennes 1830) type (MNHN 8153) has confirmed its identity, *Latilus* (= *Branchiostegus*) *argentatus*, as a senior synonym of *Latilus* (= *Branchiostegus*) *tollardi* Chabanaud 1924. The three oriental sympatric species have often been referred to as subspecies or color forms of *B. japonicus*. The "forms" are said to be separable by color and depth distribution. The red form, aka-amadai, is actually *B. japonicus* and found at intermediate depths. The yellow form, ki-amadai, is *B. argentatus* (formerly referred to as *B. tollardi*) and found at the greatest depths. The white form, shiro-amadai, is the new species *B. albus* and found at the shallowest depths. These species can be distinguished by characters other than color, as discussed under each species. The three species can also be easily distinguished osteologically. Kishinouye (1907), Ochiai (1953), and others have noted differences in the preoperculum, neurocranium, first caudal vertebra, and lacrimal of the Japanese species of *Branchiostegus*. Basically, *B. albus* has a very recurved first haemal spine (Ochiai 1953, fig. 2-A, caption reversed in paper), a notched preoperculum and fan-shaped lacrimal (fig. 3-A and D, caption reversed in paper), and a neurocranium with a broad lateral ethmoid (fig. 1-A). *Branchiostegus japonicus* has an intermediately curved first haemal spine (Ochiai 1953, fig. 2-B), an unnotched preoperculum and broad lacrimal (fig. 3-C and F), and a neurocranium with intermediately wide lateral ethmoid (fig. 1-C). *Branchiostegus argentatus* can be distinguished by its moderately curved first haemal with a broad tip (Ochiai 1953, fig. 2-C), a preoperculum with distinctive sensory funnels and a square lacrimal (fig. 3-B and E), and a neurocranium with a very narrow lateral ethmoid (fig. 1-B).

Distribution.—Found from the central part of Honshu, Japan; near the entrance of Tokyo Bay, Yokohama, Nagasaki, and Kagoshima, Japan to Pusan, Korea; along the coasts of the East China Sea including Shanghai and Taiwan; along the coasts of the South China Sea including Hong Kong and Macao; also listed from Vietnam (?) by Kuronuma (1961). A record from Mauritius (Bleeker 1879a) is most likely *B. doliatus*. The only depth record verified is 90 m from Taiwan.

Material examined.—Total of 23 specimens (including types), 100-363 mm SL. Lengths of 600 mm have been reported by Abe (1965). Non-type specimens: JAPAN: USNM 608, 170 mm SL; ZMK uncat., (3) 132-270 mm; T. Abe (uncat.), 217 mm; FAKU 19491, 170 mm; FMNH 57371, 215 mm; UMMZ uncat., (3) 100-115 mm. CHINA: USNM 5699, 300 mm; USNM 148417, 178 mm; ZMB 11022, 363 mm. TAIWAN: USNM 177410, 318 mm. These specimens were excluded from the paratype series either because of their poor condition or unreliable collection location or data.

Branchiostegus semifasciatus (Norman 1931)

Figures 24, 25

Latilus semifasciatus Norman 1931:352, fig. 3 (original description; Accra, Ghana); 1935:13 (Elephant Bay, Angola). Poll 1969:500, fig. 20 (swim bladder).

Branchiostegus semifasciatus. Fowler 1936:1305, fig. 553 (West Africa). Cadenat 1950:306 (Senegal). Furnestin et al. 1958:438 (Casablanca, Morocco). Monod 1968:341, fig. 615 (caudal skeleton). Troadec et al. 1969:table 9, pls. 47, 57 (catch vs. temperature, salinity, depth, season). Blache et al. 1970:299 (West Africa).

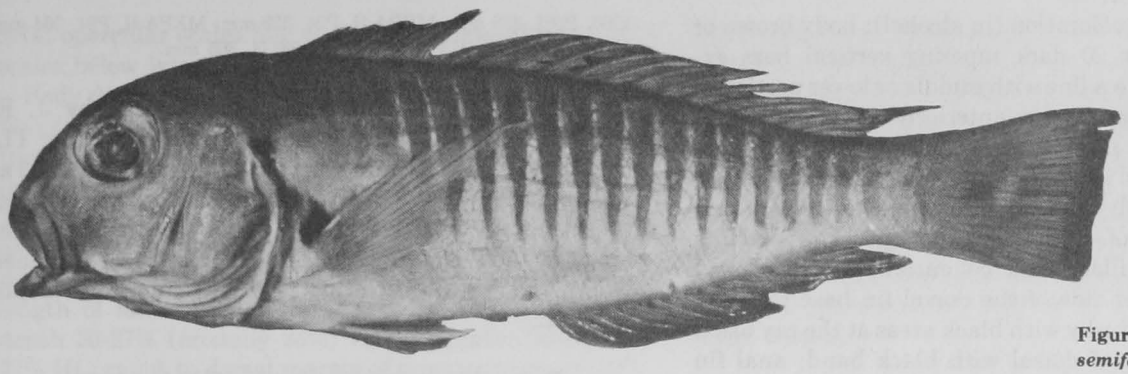


Figure 24.—*Branchiostegus semifasciatus*, 165 mm SL (OSU 3200), Angola, West Africa.

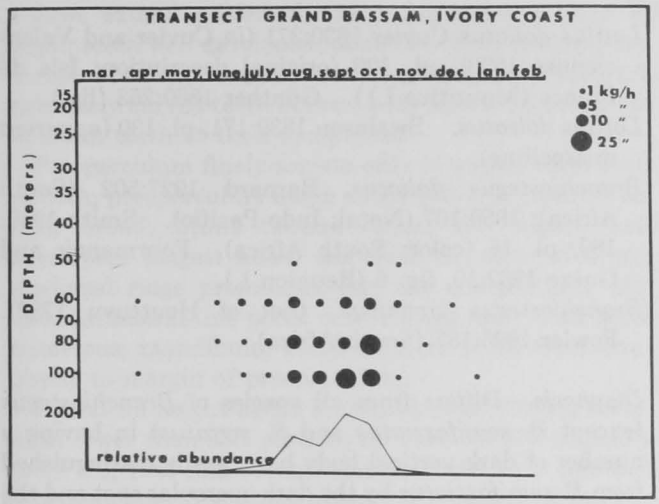


Figure 25.—Depth and seasonal distribution of *Branchiostegus semifasciatus* (redrawn from Troadec et al. 1969).

Diagnosis.—This species can be distinguished from all other species of the genus by the following combination of characters: body with 19 or 20 dark body bars (as in *B. doliatus, B. serratus*); distinguished from both these species by the elevated dark predorsal ridge and the large dark area above the pectoral fin axil; uniquely, *B. semifasciatus* has only 1 anal spine (rarely 2) and 13 anal soft rays.

Description.—Dorsal fin elements VI, 16 (rarely 15, only 1 of 54 specimens); pectoral fin 17-19 (rarely 17 or 19); total first arch gill rakers 18-23 (modally 21); pored lateral-line scales 47-50 (plus 1-3 on tail); cheek scales 7-11 (modally 9); opercular scales 6-8 (modally 7); scales above lateral line 8-11 (modally 9); scales below lateral line 23-31 (modally 28).

Body depth 27-36% (modally 29%) SL; body width 11-15% (modally 13%) SL; caudal peduncle length 13-16% (modally 14%) SL; caudal peduncle depth 10-13% (modally 11%) SL; head length (HL), the longest in the genus, 29-33% (modally 31%) SL; predorsal length 30-37% (modally 34%) SL; head depth 88-100% (modally 95%) HL; snout length 34-47% (modally 40%) HL; length of upper jaw 34-41% (modally 36%) HL; length of lower jaw 41-48% (modally 45%) HL; cheek depth 27-37% (modally 35%) HL; opercular length 23-28% (modally 26%) HL; snout to dorsal margin of preoperculum 73-79% (modally 76%) HL; orbit diameter 22-35% (modally 28%, allometric) HL; suborbital depth 16-22% (modally 19%, allometric) HL.

Jaws extend posteriorly only to anterior rim of pupil; teeth about 18, plus single enlarged tooth posteriorly in both jaws; teeth otherwise as in other species of *Branchiostegus*.

Preoperculum finely serrate only on upper limb; angle of preoperculum 105-115°; single blunt opercular spine as in other species of *Branchiostegus*; gill rakers moderately well developed; predorsal ridge most prominent of all congeners, comparatively as well developed as in *Lopholatilus villarii*; predorsal ridge elevated and dark; lateral-line scales in low curve; cephalic lateral-line pores numerous, mandibular series number five on each side.

Scales extend on top of head to over middle of pupil; pectoral fin with small patch of scales at base, caudal fin with fine scales, other fins naked.

Dorsal fin height about 6% SL; fin base 52-60% (modally 56%) SL; first two spines close together and united at their base; first spine about 1.3 in length of second; dorsal fin origin about over opercular opening, well anterior to pectoral fin base (unlike other species of the genus where origin is over pectoral fin base); first dorsal ray may be unbranched, remaining rays branched; antepenultimate ray elongate, reaching well past hypural base.

Anal fin slightly lower than dorsal fin (5.5% SL); fin base 27-32% (modally 30%) SL; origin under fifth or sixth dorsal soft ray; single spine about 3 times in length of first soft ray (usually unbranched); last ray usually divided; penultimate ray elongate, reaching past hypural base.

Pectoral fin elongate and pointed, reaching to origin of anal fin; fin length 22-29% (modally 26%) SL; two dorsalmost rays and ventralmost ray unbranched, remaining rays branched; stout dorsalmost ray about 4 times in length of pectoral fin.

Pelvic fins rounded, not nearly reaching anus; fin length 14-18% (modally 16%) SL; single spine about 1.5 in length of fin.

Caudal fin truncate with tips slightly extended, dorsal portion of caudal slightly longer than ventral portion; 10 dorsal and 9 ventral procurrent rays.

Color.—Preserved coloration (in alcohol): body brown or silvery with 19 or 20 dark tapering vertical bars extending ventrally to a line with middle or lower portion of pectoral base; bars extend anteriorly from over opercular opening to posteriorly to base of caudal; bars become fainter and shorter at extreme ends of the series; chin and underbelly white; dark areas over pectoral axillae, along edge of operculum and opercular opening above pectoral axillae; dark coloration from predorsal ridge and on either side of the dorsal fin base to tip of caudal; dorsal fin dusky with black areas at the ray bases and upper margin of dorsal with black band; anal fin membrane lighter near base, dusky over remainder; pectorals and pelvics opaque with some dusky areas.

Distribution.—Found from Casablanca, Morocco (ca. lat. 34°N) and along the coast of West Africa as far south as Baia dos Tigres, Angola (about lat. 16°S) near where the cold Benguela Current swings westward. *Branchiostegus semifasciatus* is apparently rare north of Dakar, Senegal; the distribution is more or less continuous from this point south; the species has a marked seasonal availability and depth distribution according to Troadec et al. (1969); the species is most abundant between June and October in depths from 50 to 100 m; (Fig. 24). Depth ranges found in this study included 61-155 m; Blache et al. (1970) reported a range of 70-200 m. Ripe females were found in September and January.

Material examined.—Total of 51 specimens, 42-413 mm SL. Blache et al. (1970) reported lengths to 600 mm. SENEGAL: ZMUC (uncat., Atlantide Exped. 1945-46), (2) 232-275 mm. PORTUGUESE GUINEA: USNM 216687, 278 mm. SIERRA LEONE: USNM 216685, (3) 124-215 mm. LIBERIA: USNM 216686, (2) 145-166 mm; USNM 216689, (4) 177-228 mm; USNM 216688, (8) 135-263 mm; USNM 216691, (2) 245-255 mm; USNM 216690, (2) 191-206 mm; USNM 193976, 257 mm. GULF OF GUINEA: ORSTOM, Point Noire, (2) 143-155 mm. IVORY COAST: UMML 16979, 221 mm; ZMUC (uncat., Atlantide Exped. 1945-46), 278 mm. GHANA: UMML 16800, (3) 184-205 mm; BMNH 1930.8.26.44 (holotype), 250 mm. NIGERIA: UMML 15793, (2) 180-221 mm. GABON: TABL (*Geronimo* 2, Stn. 202; Florida State Museum) 123 mm; TABL (*Geronimo* 2, Stn. 226; Fla. St. Mus.), (2) 42-43 mm. CONGO: RGMC 94469, 285 mm; RGMC 97476, 308 mm; RGMC 97468, 204 mm; TABL (*Geronimo* 2, Stn. 244; Fla. St. Mus.) 268 mm; TABL (*Geronimo* 2, Stn. 235; Fla. St. Mus.) 143 mm. ANGOLA: OSU 3200, (2) 164-168 mm; MEPA I, P11, 215 mm; MEPA 1960, P307, 228 mm; MEPA II, P24, 329 mm; MEPA II, P81, 364 mm; MBM 1957, P50, 413 mm; RGMC 128174, 305 mm.

Holotype.—Most counts and measurements by J. E. Randall; BMNH 1930.8.26.44, 250 mm SL, 307 mm TL; D. VI, 16; A. II, 12 (from Norman 1931; probably I, 13 as was found in all specimens examined except two); total first arch gill rakers 9 + 12; pored lateral-line scales about 50; body depth 29% SL; body width 14% SL; head length (HL) 32% SL; orbit 27% HL; suborbital depth 22% HL.

Branchiostegus doliatus (Cuvier 1830)

Figure 26

Latilus doliatus Cuvier 1830:371 (*in* Cuvier and Valenciennes 1830), pl. 130 (original description; Isle de France (Mauritius I.)). Günther 1860:253 (list).

Latilus doleatus. Swainson 1839:171, pl. 130 (apparent misspelling).

Branchiostegus doliatus. Barnard 1927:502 (South Africa); 1950:107 (Natal; Indo-Pacific). Smith 1949: 189, pl. 16 (color; South Africa). Fourmanoir and Guèze 1962:10, fig. 8 (Reunion I.).

Branchiostegus japonicus. (not of Houttuyn 1782). Fowler 1925:187 (South Africa).

Diagnosis.—Differs from all species of *Branchiostegus* (except *B. semifasciatus* and *B. serratus*) in having a number of dark vertical body bars; easily distinguished from *B. semifasciatus* by the dark opercular spot and the number of anal fin elements found in *B. doliatus* (II, 12 vs. I, 13 in *B. semifasciatus*); separated from *B. serratus* by the lower number of dorsal spines (VI, 16 vs. VII, 15 in *B. serratus*) and fewer pored lateral-line scales (49-51 vs. 67-72 in *B. serratus*); finally, *B. doliatus* has an undifferentially pigmented predorsal ridge, *B. semifasciatus* has a well-elevated dark predorsal ridge, *B. serratus* has a yellow predorsal ridge.

Description.—Dorsal fin elements VI, 16; anal fin II, 12; pectoral fin 18; total first arch gill rakers 19-21; pored lateral-line scales 49-51 (plus 1 or 2 on tail); cheek scales

Figure 26.—Holotype of *Branchiostegus doliatus* (MNHN 8154), 355 mm SL, Isle de France (now Mauritius).

9-14; opercular scales 5-9; scales above lateral line 7-10; scales below lateral line 20-30.

Body depth 25-28% (modally 26%) SL; body width 10-14% (modally 12%) SL; caudal peduncle length 13-16% (modally 15%) SL; caudal peduncle depth 8-10% (modally 9%) SL; head length (HL) 24-27% (modally 27%) SL; predorsal length 30-32% (modally 31%) SL; head depth 89-102% HL; snout length 31-38% (modally 36%) HL; length of upper jaw 35-41% (modally 38%) HL; length of lower jaw 43-48% (modally 45%) HL; cheek depth 30-37% (modally 33%) HL; opercular length 24-27% HL; snout to dorsal margin of preoperculum 75-82% (modally 77%) HL; orbit diameter 27-36% (modally 33%) HL; suborbital depth 10-16% (modally 14%) HL.

Jaws extend posteriorly to under anterior third of pupil; teeth well developed; about 13-18 teeth along outer row of both upper and lower jaws; both jaws with 1 or 2 antrorsely curved teeth at rear; both jaws with a patch of villiform teeth at their symphyses.

Preoperculum finely serrate only to angle, lower limb smooth; preoperculum angle about 100-110°; operculum with broad, blunt tablike spine; gill rakers well developed, longest about one-third diameter of pupil; predorsal ridge prominent, but not differentially pigmented; lateral-line pores in a straight line; head pores numerous; mandibular series with six pores from symphysis to margin of preoperculum.

Dorsal fin height about 9% SL; spinous portion somewhat lower than soft portion; fin base 54-60% (modally 57%) SL; first and second spines united to a common pterygiophore; first spine about 1.5 in length of second; dorsal origin somewhat posterior to pectoral base; dorsal rays all branched; antepenultimate ray very elongate, reaching to base of caudal rays, well past hypural base.

Anal fin lower than dorsal height, about 7% SL; fin base 31-37% (modally 33%) SL; origin in a vertical below sixth dorsal soft ray; two thin spines, first about 1.8 in length of second; all rays branched; penultimate ray elongate, reaching hypural base.

Pectoral fin elongate, reaching a vertical to anus; fin length 23-27% (modally 26%) SL; all but stout uppermost ray branched; upper ray about 3.3 in length of fin.

Pelvic fin triangular and short; length 12-15% SL; single spine about 1.4 in length of fin.

Caudal fin truncate with exserted tips; 17 principal rays, 15 branched (upper and lowermost rays unbranched); 10 dorsal and 9 ventral procurrent caudal rays.

Color.—Preserved coloration: body with 16-18 violaceous vertical bars from above operculum to near caudal peduncle, longest bars at midbody; according to Cuvier (*in* Cuvier and Valenciennes 1830) and from Smith's (1949) color pl. 16, fig. 416, the body is rosy pink (color lost upon preservation); all fins except caudal transparent, dorsal fin without markings; operculum with characteristic dark spot (not apparent in Fig. 26); supraorbital region darkly pigmented.

Remarks.—Associated fish species from Mozambique (according to F. J. Schwartz, pers. commun.): *Zenopsis conchifer, Zeus faber, Uranoscopus archionema, Polymixia nobilis, Chloropthalmus agassizi, Saurida undosquamis, Lepidotrigla aratolepis, Epinnula orientalis, Thyrsitoides marleyi,* and *Bembrops caudimacula.*

Distribution.—Known from Inhaca Island and Mozambique to Durban and South Africa; also found from Mauritius and Reunion Islands; a relatively deep-dwelling species found from 90 to 612 m, usually over mud bottom.

Material examined.—Total of nine specimens, 180-355 mm SL. MAURITIUS I.: MNHN 8154 (holotype), 355 mm SL. SOUTH AFRICA: BMNH 1922.1.13.36, 275 mm; USNM 211423, 185 mm; SOSC (UNC uncat.), 240 mm; RUSI 228, (5) 180-248 mm.

Holotype.—MNHN 8154, 355 mm SL, 430 mm TL; specimen faded except for body bars; specimen also gutted and partially split medially; D. VI, 16; A. II, 12; P_1 18; B. 6; first arch gill rakers 19; pored lateral-line scales 51 + 1 on tail; cheek scales 14; opercular scales 9; body depth 26% SL; head length (HL) 24% SL; orbit diameter 27% HL; vertebrae 10 + 14.

***Branchiostegus argentatus* (Cuvier 1830)**

Ki-Amadai: Yellow Horsehead

Figure 27

?*Coryphaena sinensis* Lacépède 1802:176, 209 (original description; from a Chinese painting supposedly located in MNHN, efforts to locate the painting have failed; description general and unclear; nomen dubium; China). Cuvier 1830:369 (*in* Cuvier and Valenciennes 1830) (synonymy).

Latilus argentatus Cuvier 1830:368 (*in* Cuvier and Valenciennes, 1830); (original description; Indian Ocean). Valanciennes 1833:495 (a supplement to the 1830 description refers incorrectly to the same species as being collected by Langsdorff and deposited in the Berlin Museum, ZMB 8791; actually the stuffed specimen = *Branchiostegus japonicus*). Bleeker 1979a:12 (list); 1879b?:7 (list)

Latilus sinensis. Jordan and Snyder 1901b:369 (list; Tokyo). Schmidt 1904:368 (list).

Latilus auratus Kishinouye 1907:59 (original description; Japan).

Latilus tollardi Chabanaud 1924:357 (original description; Annam, Vietnam).

Branchiostegus japonicus. (not of Houttuyn 1782) Jordan and Hubbs 1925:248 (*Branchiostegus* = a senior synonym of *Latilus*; description). Tanaka 1931:89 pl. I B (color) ("kiama," a yellow form). Fowler 1949:56 (list). Yasuda and Kosaka 1950:885 (growth). Kamohara 1952:51 (Japan). Mori 1952:95 (Korea). Herre 1953:481 (Philippines). Okada 1955:261 (description). Chyung 1961:372 (Korea; color plate). Liang et al. 1962:49 (Taiwan; description). Okada 1966:270 (Japan; description).

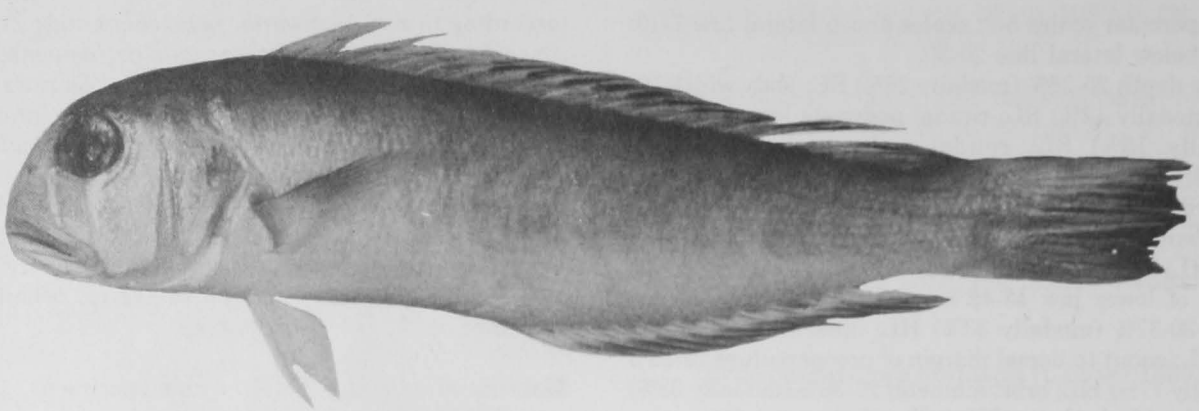


Figure 27.—*Branchiostegus argentatus*, 245 mm SL (later dissected), Hong Kong.

Branchiostegus auratus. Schmidt and Lindberg 1930: 1141 (Tsuruga, Japan; color description). Yasuda and Kosaka 1950:855 (growth). Mori 1952:95 (Tongyong, Korea). Chyung 1961:374 (Korea).

Branchiostegus sericus Herre 1935:285 (original description; Hong Kong).

Branchiostegus sericeus. Fowler 1949:53 (China; list, probable misspelling of *B. sericus*). Fourmanoir 1965:49 (fig. 28; Nhatrang, Vietnam; misspelling).

Branchiostegus japonicus auratus. Ochiai 1953:306 (original description; Japan). Tomiyama and Abe 1958:158, pl. 466 (color; Japan). Matsubara 1963:596 (drawing). Abe 1965:146, pl. 438 (color). Kamohara 1967:78 (description). Lindberg and Krasyukova 1971:155 (key and description). Shiino 1972:86 (common name).

Branchiostegus tollarai. Kuronuma 1961 (Vietnam; misspelling of *Branchiostegus tollardi*). Irie 1953:14 (diagnosis).

Diagnosis.—Jaws extend nearly to vertical under posterior rim of orbit; uniquely with two thin silvery bars extending from suborbital to upper lip; characteristically with a medial series of large dark elongate areas along dorsal membrane; least body depth of the genus 22-25% (modally 24%) SL; narrowest body width of the genus 10-12% (modally 11%) SL; shortest predorsal length among congeners 28-31% (modally 30%) SL; can be distinguished from *B. japonicus* by the suborbital silver bars and more posterior position of the jaws of *B. argentatus*. Distinguished from *B. albus* by the position of the jaws anterior to orbit, the light predorsal ridge, the small eye 20-30% (modally 24%) HL, and the preoperculum indented above angle in *B. albus*; distinguished from *B. doliatus*, *B. semifasciatus*, and *B. serratus* by the lack of dark body bars; distinct from *B. wardi* because of the smaller orbit 21-29% (modally 26%) HL, lack of medial dorsal dark markings, and more anterior position of the jaws (under middle of pupil) in *B. wardi*.

Description.—Dorsal fin elements VII, 15; anal fin elements II, 12 (rarely 11 or 13); pectoral fin 17-19 (usually 18); total first arch gill rakers 19-22 (modally 21); pored lateral-line scales 47-50 (modally 48, plus 1-3 on caudal); cheek scales 8-11 (modally 9); opercular scales 5-8 (modally 6); scales above lateral line 6-8; scales below lateral line 16-20 (modally 18).

Body depth 22-25% (modally 24%) SL; body width 10-12% (modally 11%) SL; caudal peduncle length 14-17% (modally 15%) SL; caudal peduncle depth 11-12% (modally 11%) SL; head length (HL) 24-26% (modally 25%) SL; predorsal length 28-31% (modally 30%) SL; head depth 84-98% (modally 94%) HL; snout length 30-41% (modally 36%) HL; length of upper jaw 41-46% (modally 45%) HL; length of lower jaw 48-52% (modally 49%) HL; cheek depth 39-45% (modally 43%) HL; opercular length 23-28% (modally 27%) HL; snout to dorsal margin of preoperculum 74-77% (modally 76%) HL; orbit diameter 25-36% (modally 30%, allometric) HL; suborbital depth 14-24% (modally 19%, allometric) HL.

Jaws extend posteriorly to vertical under posterior rim of orbit; teeth canine and larger posteriorly in lower jaw, larger anteriorly in upper jaw; teeth number about 30 in each jaw including an enlarged anteriorly curved tooth at the rear of both jaws; villiform teeth in patches at the symphyses.

Preoperculum very finely serrate, only to angle, lower limb smooth; preopercular angle 85-95°; operculum with broad flat tablike spine as other species of *Branchiostegus*; gill rakers well developed, longest about equal to length of opercular spine; predorsal ridge fairly prominent and dark; lateral-line pores nearly in straight line; head pores numerous, mandibular series with five pores on each side.

Scales extend on top of head to anterior rim of pupil; pectoral with a patch of small scales at base, caudal covered with fine scales, remaining fins naked.

Dorsal height about 8% SL; almost uniform in height except for anterior and posterior portions; fin base 59-66% (modally 62%) SL; first and second spines thin and close together, united at their base; first spine about 1.2 in length of second; dorsal origin slightly anterior to dorsal margin of pectoral base; first ray may be unbranched, remaining rays branched; antepenultimate ray elongate, extending well past hypural base.

Anal fin slightly lower than dorsal (about 7% SL); fin base 31-35% (modally 32%) SL; origin below fourth dorsal soft ray; two thin spines, first about 1.5-2.0 in length

of second; first ray may be undivided, remaining rays branched; penultimate ray slightly prolonged, just reaching hypural base; last ray may be divided.

Pectoral fin elongate, reaching to anus; fin length 22-27% (modally 24%) SL; all but stout uppermost ray branched; stout ray 3 times in length of fin.

Pelvic fins triangular, reaching to slightly more than half the distance between pelvic origin and origin of anal fin; fin length 13-17% (modally 15%) SL; single spine about 1.7 in length of fin.

Caudal fin margin rounded and slightly indented to give a somewhat sigmoid margin; 10 dorsal and 9 ventral procurrent caudal rays.

Color.—Coloration taken from a freshly frozen specimen kindly sent from Hong Kong by L. Trott: body dusky above lateral line, silvery below with a hint of light yellow-orange bands; belly white with a flush of pink; cheek and operculum silver, two characteristic pearly silver bands extending from suborbit to upper lip; area between silver bands light yellow; snout pink; iris gold; black predorsal ridge; dorsal fin membrane pink with large dark elongate areas medially along soft portion and disappearing before antepenultimate ray, these areas become smaller and progressively lower anteriorly along spinous dorsal; upper margin of pectoral black, dorsal third dusky, remainder of fin translucent; leading edge of pelvics white, remainder clear; anal fin basally translucent with elliptical white spots which disappear posteriorly; ventral half of anal dusky; caudal with dark leading upper edge, pink underneath, followed by six bright yellow longitudinal stripes, membrane dusky between stripes; two broader parallel stripes medially; nearly all of ventral lobe of caudal dusky; preserved coloration: numerous thin orange longitudinal body stripes (not apparent on fresh specimen); dark predorsal ridge; dark dorsal fin areas; silver suborbital markings usually retained; most other coloration generally lost.

Distribution.—Found from Tsuruga and central Honshu, Japan; the southern coast of Korea; the South China Sea, Taiwan, and Hong Kong southward to Nhatrang, Vietnam. Depth records range from 51 to 65 m.

Material examined.—Total of 33 specimens, 110-248 mm SL. JAPAN: USNM 149784, 161 mm SL. FORMOSA (Taiwan): ZMB 16161, 233 mm. HONG KONG: FMNH 46992, 240 mm; BMNH 1939.3.23.52, 218 mm; USNM 46801, 170 mm; CAS, GVF reg. 1777, (5) 173-197 mm; CAS, GVF reg. 1765, 248 mm; CAS SU 30982, holotype of *B. sericus* Herre 1935, 245 mm; CAS, GVF reg. 2794, (5) 130-195 mm; specimen (dissected) from L. Trott, 225 mm; MNHN 8455, 170 mm; USNM 5699, (2) 230 mm. VIETNAM: MNHN 24-160, holotype of *B. tollardi* Chabanaud 1924, 220 mm; ZMUC 10.12.1959, (13) 110-245 mm. INDIAN OCEAN?: MNHN 8153, holotype of *Latilus argentatus* Cuvier 1830 (*in* Cuvier and Valenciennes 1830) 168 mm.

Holotype.—Of *L. argentatus*: MNHN 8153, 168 mm SL; in very poor condition, dorsal and anal fin membranes completely gone, caudal rays lost and broken; body faded except for dark predorsal ridge, silvery head, and two suborbital silver bars and white belly; D. VII, 15; A. II, 12; body depth 23% SL; orbit diameter 36% HL; suborbital depth 16% HL; vertebrae 10 + 14.

Of *B. sericus*: CAS SU 30982; A. W. Herre; Hong Kong, 28 Feb. 1934; 245 mm SL, 295 mm TL; specimen in faded but fair condition; head with dark predorsal ridge, lower snout and anterior upper lip dark; two distinct silver bars from lower orbital rim to upper lip; upper body with three dark longitudinal stripes; spinous dorsal fin membranes with a medial series of dark spots to antepenultimate spine; caudal with a gray lower lobe, two light (faded yellow?) parallel medial stripes and with two lighter diverging stripes above; caudal margin rounded; jaws extending to posterior rim of orbit; D. VII, 15; A. II, 12; P_1 18; B. 6; total first arch gill rakers 21; pored lateral-line scales 50; body depth 25% SL; head length (HL) 26% SL; orbit diameter 27% HL; vertebrae 10 + 14.

Of *B. tollardi*: MNHN 1924-160; Chabanaud; Annam, Vietnam; 220 mm SL, 270 mm TL; specimen faded, split open and in poor condition; dorsal fin membranes torn; dark predorsal ridge evident; jaws extending to posterior rim of orbit; D. VII, 15; A. II, 12; P_1 18; B. 6; total first arch gill rakers 19; pored lateral-line scales 50 + 4 on tail; body depth 24% SL; head length (HL) 24% SL; orbit diameter 26% HL; vertebrae 10 + 14.

Remarks.—Lacépède (1802) described a new species "coryphène chinoise" (*Coryphaena sinensis*) based upon a Chinese painting supposedly located at the Paris Museum (MNHN). The description was vague and very general: ". . . Sa couleur est d'un verd plus ou moins clair, suivant les parties du corp sur lesquelles il paroît; mais ces nuances agréables et douces sont melees avec des reflets ecalatans et argentins.

"Le beau coryphéne chinois montre une trés-longue nageoire dorsale; mais celle de l'anus est assez court. La nageoire caudale est arrondie. De grandes ecailles courient le corps, la queue et les opercules. La manchoire inférieure est relevée et plus avancée que eu supérieure; ce que ajoule aux rapports du chinois avec le coryphéne camus."

Efforts to locate the Chinese painting in MNHN by both M. L. Bauchot and Y. Laissus of the Bibliothèque Centrale have been unsuccessful.

Cuvier (*in* Cuvier and Valenciennes 1830) described *Latilus argentatus* (MNHN 8153) from the "Mer des Indes" (he probably included the China Seas). According to Cuvier (1830): "Nois avoins d'abord établi ce genre d'apris un poisson qui n'était par M. de Lacépéde que sur une peinture chinoise, mais que nous est arrivé il y a quelques années de l'mer des Indes. Cette mer nous en a fourni récemment une espèce beaucoup plus belle qui a confirmé les charactères génériques indiquers par la premiere."

The unclear nature of Lacépède's (1802) description and the unavailability of the Chinese painting from which his description was based makes it impossible to identify *Coryphaena sinensis*; *C. sinensis* should be considered a nomen dubium.

Branchiostegus ilocanus Herre 1928

Figure 28

?*Branchiostegus ilocanus* Herre 1928:31, pl. 3 (original description; Ilocos, Luzon, Philippines); 1953:481 (list).

Diagnosis.—Ventral lobe of caudal with dark triangle is unique among species of *Branchiostegus* except *B. wardi*, *B. japonicus*, and *B. argentatus* (*B. sawakinensis* has a darker ventral lobe, but not a dark triangular area); *B wardi* can be distinguished from *B. ilocanus* by the two parallel yellow bands on the caudal of *B. wardi*; *B. japonicus* has a silvery triangle behind orbit and five radiating yellow stripes on the caudal; the posterior extension of the maxillary to under posterior rim of orbit easily separates *B. argentatus* from *B. ilocanus* where the maxillary extends only to under between posterior nostril and anterior rim of orbit.

Description.—The validity of this species has not been positively established. Location of the type-specimen was not given by Herre (1928) and all efforts to locate the type have been unsuccessful. Probably the type was destroyed in the Philippines during World War II. Herre's (1928) description and figure of *B. ilocanus* do not conclusively differentiate this species from other Indo-Pacific branchiostegids. The possibility that *B. ilocanus* is a senior synonym of *B. wardi* has not been completely dismissed, though very doubtful. Herre's (1928) description is reproduced as follows: "Dorsal VII-14, first and second spines united; anal II-11; lateral line about 60; scales in transverse series 25.

"The head and the tapering body flattened laterally, much thicker anteriorly, depth 3.6 in length; the large head thicker than trunk, 2.96 in total; head almost flat above, profile rounded as it descends over eye, snout very steep; dorsal profile straight and slightly descending from above head to caudal peduncle; anterior half of ventral line nearly straight, then curving upward to caudal peduncle; the very large lateral eye high up, the distance from its front margin to tip of snout approximately equal to distance from its rear margin to posterior extremity of opercle, 4.55 in head and 1.95 in the large prominent snout, which is 2.33 in head; interorbital very slightly exceeds eye in breadth, 4.33 in head, a longitudinal groove along its middle; cheek very broad, its depth approximately equal to snout; the oblique mouth rather large, lower jaw included, posterior extremity of maxillary reaching a vertical midway between posterior nostril and anterior margin of eye; teeth of upper jaw in two rows except anteriorly, where they are in four rows; teeth of outer row much larger and stronger than the others, the last two teeth on each side hooked canines; teeth of lower jaw in one row except at symphysis, where they are in three rows: no reduced teeth in lower jaw, but those along middle of each side enlarged; 8 rows of scales on cheek, the three middle rows of enlarged scales; posterior margin of preopercle denticulate; scales extending forward on head to anterior portion of interorbital; body scaled everywhere, and fine scales extend on pectoral and more than half the length of caudal; no scales on suborbital, snout, jaws, and underside of head.

"Origin of dorsal above pectoral base, first spine three-fourths of an eye diameter, second spine 1.5 times eye, the remaining spines and rays very gradually increasing until the next to the last, which is 2.65 times eye or a trifle more than 1.7 in head; anal resembles dorsal, the last few rays about equal, 1.75 times eye or 2.6 in head; depth of caudal peduncle 3 in head; caudal subtruncate, the uppermost rays longest, 1.44 in head or 4.28 in length; pectoral pointed, the central rays elongate, 1.33 times in head or 3.97 in length; the ray next below the longest, or seventh ray, not abruptly shortened as described by Snyder for *B. japonicus*; the narrow pointed ventrals fall far short of anus, 2 + times in head, 6 in length.

"Color in alcohol dusky olive brown on top of head and along back, the sides and belly silvery; a black seam extends forward from base of dorsal to anterior extremity of interorbital space; suborbital and snout bright yellow, with a triangular orange spot on lower median portion of snout; a yellow band on base of dorsal, now almost entirely disappeared; a fine blackish marginal line on dorsal and upper margin of pectoral; anal, pectoral, and ventral colorless; an olive brown triangle covers lower third of caudal, its apex at lower side of caudal peduncle; a central longitudinal band of the same color, and a marginal line of olive brown above; remainder of fin yellowish.

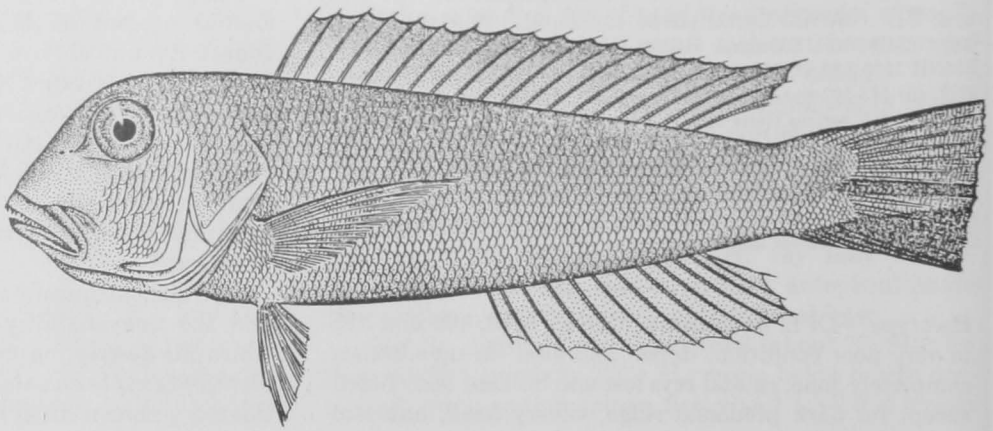


Figure 28.—Drawing of *Branchiostegus ilocanus*, 270 mm SL (after Herre 1928).

"Here described from a specimen, 270 millimeters long, purchased in the market at Narvacan, Ilocos Sur Province, Luzon.

"*Ilocanus*, from Ilocos."

Material examined.—Two specimens (USNM 149051, 205 mm SL; USNM 5255) in poor condition and not identifiable to species were examined from the Philippines; these specimens are the only known specimens from the Phillipines; N. Rau (pers. commun., University of San Carlos) revealed that branchiostegids are known to occur there.

Branchiostegus vittatus Herre 1926a

(see Here's 1926a:pl. 2)

?*Branchiostegus vittatus* Herre 1926a:535, pl. 2 (original description; Manila, Philippines); 1953:481 (list).

Diagnosis.—As with *B. ilocanus*, this species is of doubtful validity; the only apparent differential characters listed by Herre (1926a) are in the color pattern: the presence of a pearl-colored band across the snout, and a large brown spot above the lateral line distinguish *B. vittatus* from *B. argentatus*.

Description.—Herre's (1926a) description is reproduced in its entirety: "Dorsal VII-15; anal II-11; lateral line 68 to 72; scales in transverse series opposite origin of anal, about 22.

"The head and body strongly compressed laterally, the body elongate, tapering, its depth 3.75 to 4 times in the length; the large, deep, boldly convex head 3.48 to 3.63 times in the length, its depth almost equal to that of the body; the snout very steeply inclined, 2.64 to 2.76 times in the head; the large eyes 3.5 to 3.65 times in the head; the interorbital a little less than an eye diameter; the nape produced into a low keel; the mouth large, oblique, very low, the jaws subequal, the posterior angle of the maxillary beneath the pupil of the eye; the upper jaw has an outer row of strong sharp teeth and two inner rows of very small sharp teeth, with four short inner rows at the symphysis; the last tooth of the outer row is a small, hooked, forward-pointed canine; the lower jaw has an outer row of strong teeth as in the upper jaw, and five inner rows of much smaller teeth anteriorly, reduced to one inner row posteriorly; the body everywhere covered with medium-sized scales, apparently cycloid but really very finely ctenoid, the nape scaled forward halfway between the eyes with smaller scales than on the sides, the opercles and cheeks scaled as far as a perpendicular line from the eye to the angle of the mouth, ten rows of scales on the preopercle; the posterior margin of the preopercle finely toothed; the spinous portion of the dorsal low, the seventh spine longest and approximately one-third the depth, the rays higher, the antepenultimate longest, extending on the caudal when depressed, 1.1 to 1.2 times in the depth; the anal shorter and lower, 1.55 to 1.77 times in the depth; the depth of the caudal peduncle 1.12 to 1.32 times in its own length, 2.64 to 2.76 times in the head; the caudal subtruncate or with undulate margin, 4.4 to 4.7 times in the length; the long, narrow, pointed pectorals nearly equal to the depth, 1.1 to 1.2 times in the head, the lower rays abruptly shorter than the middle ones; the origin of the ventrals a little before that of the pectorals, the fins narrow, pointed, about 1.75 times in the head."

Color.—"The color of fresh specimens was silvery, with a roseate flush along the upper half of the body, the snout bright deep pink; a pearl-colored band crossed the snout in front of the eyes; from the lower front margin of the eye a wide pearl band, rapidly narrowing, descended to the upper lip; from opposite the posterior margin of the pupil a silver band crossed the cheek nearly vertically to the throat; a large, dark brown spot above the origin of the lateral line; a black longitudinal line on the middle of the ridge crowning the nape; the dorsal spines with a black margin; the upper part of the entire dorsal was yellow, with a basal pearly band along its whole length; about six yellow bands on the upper two-thirds of the caudal, running back and a little diagonally upward, the lowest one separated from the rest; each scale above the lateral line with a small dark spot, these spots forming longitudinal rows; below the lateral line a pearly spot on each scale, these spots also forming faint lines; the pupil very large, black.

"In alcohol the roseate flush and pink have disappeared and the fin markings are all gone; otherwise the color and markings are the same as when fresh."

Distribution.—"Here described from three specimens, 240 millimeters long, collected by me [Herre] in the Manila market."

Remarks.—Again, as with *B. ilocanus* no mention of the type deposition was given by Herre (1926a). It seems highly probable that if the type was deposited in the Philippine Museum, it was destroyed during World War II. *Branchiostegus vittatus* appears to be remarkably similar to the descriptions of *B. argentatus* or *B. sawakinensis*. *B. vittatus* will probably prove to be a synonym of one of these species when the branchiostegid fauna of the Philippines is better defined. *Branchiostegus argentatus* is known from the South China Sea, Taiwan, and Hong Kong southward, but is as yet unknown from the Philippines (Fig. 29). A color transparency recently received from N. Rau (University of San Carlos) appears identical with *B. sawakinensis*.

LOPHOLATILUS GOODE AND BEAN 1880a

Lopholatilus Goode and Bean 1880a:205 (type-species: *Lopholatilus chamaeleonticeps* Goode and Bean 1880a by original designation).

Diagnosis.—Predorsal ridge well elevated, often forming an enlarged flap (separating this genus from all other

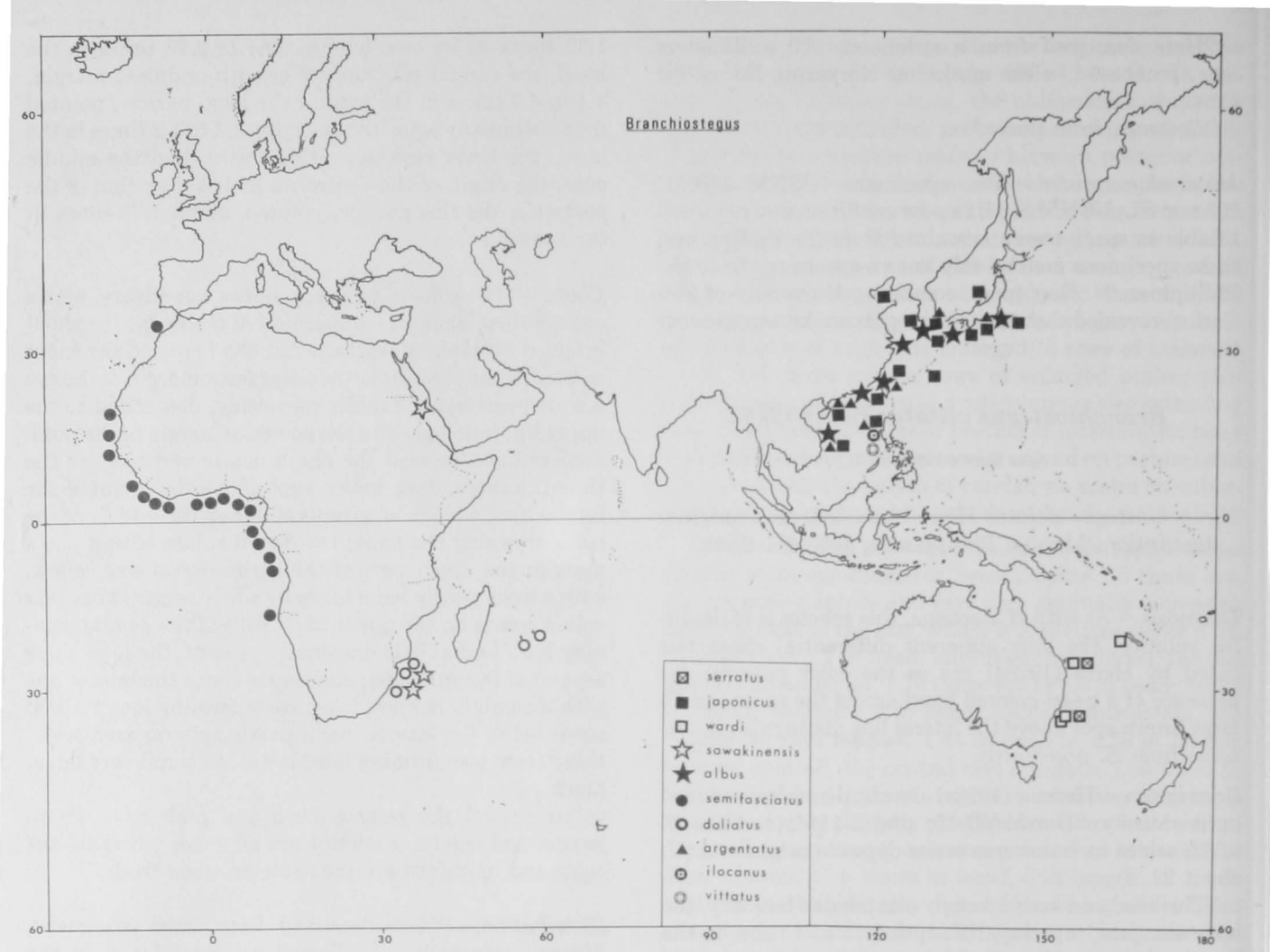


Figure 29.—Distribution of the genus *Branchiostegus* based upon museum specimens and reliable records.

branchiostegids); vertebrae 10 + 14; opercular spine blunt and tablike (separating *Lopholatilus* from *Caulolatilus*).

Description.—Body quadriform, head rounded; first caudal vertebra with heavy bladelike haemal process, not a specialized concave structure that encloses the end of the swim bladder as found in *Caulolatilus* and *Branchiostegus*; dorsal fin elements VII-VIII, 14-15 (modally, VII, 15) (Table 13); anal fin I, 14 (rarely 13) (Table 14); pectoral fin 16-18 (modally 17); total first arch gill rakers 22-26 (modally 23) (Table 15); pored lateral-line scales 66-75 (modally 70 (Table 16); scales above lateral line 7-11 (modally 8); scales below lateral line 23-34 (modally 28); cheek scales 6-10 (Table 17).

Body depth 21-31% (modally 27%) SL; body width 11-18% (modally 14%) SL; caudal peduncle length 13-16% (modally 15%) SL; caudal peduncle depth 8-10% (modally 9%) SL; head length (HL) 28-35% (modally 30%) SL; predorsal length 30-39% (modally 33%) SL; head depth 72-100% (modally 85%) HL; snout length 27-51% (modally 40%) HL; length of upper jaw 37-53% (modally 44%) HL; length of lower jaw 43-56% (modally

Table 13.—Frequency distribution of the number of dorsal fin elements in the species of *Lopholatilus*.

					Soft elements	
Species	VII	VIII	14	15	$\bar{x}$	*N*
chamaeleonticeps	63			63	15	63
villarii	1	2	2	1	14.3	3

Table 14.—Frequency distribution of the number of anal fin elements in the species of *Lopholatilus*.

			Soft elements		
Species	I	13	14	$\bar{x}$	*N*
chamaeleonticeps	63	2	61	14	63
villarii	2		2	14	2

Table 15.—Frequency distribution of the number of gill rakers (first arch) in the species of *Lopholatilus*.

Species	22	23	24	25	26	$\bar{x}$	SD
chamaeleonticeps	7	23	21	8	1	23.6	0.93
villarii	2					22.0	0

Table 16.—Frequency distribution of the number of pored lateral-line scales in the species of *Lopholatilus*.

Species	66	67	68	69	70	71	72	73	74	75	$\bar{x}$	SD
chamaeleonticeps	1	-	2	3	18	14	10	6	1	2	71	1.6
villarii		1	-	1							68	1.4

Table 17.—Frequency distribution of the number of cheek scales in the species of *Lopholatilus*.

Species	6	7	8	9	10	$\bar{x}$	SD
chamaeleonticeps	6	14	19	13	2	7.8	1.04
villarii	2					6.0	0

46%) HL; cheek depth 20-47% (modally 41%) HL; opercular length 24-32% (modally 27%) HL; snout to dorsal margin of preoperculum 74-80% (modally 76%) HL; orbit diameter (allometric) 16-44% (modally 26%) HL; suborbital depth (allometric) 14-28% (modally 20%) HL (Table 18).

Upper jaws protusile (as other tilefishes), somewhat oblique and undershot, reaching posteriorly to a vertical under anterior orbital rim; teeth strong and conical; lower jaw with about 15-17 enlarged canines in a single outer row; upper jaw with 13-18 enlarged canines in a single outer row; both jaws with inner patches of villiform teeth at their symphysis; posterior margin of lower lip may have thin cutaneous barbel.

Preoperculum finely serrate on upper limb, slight indention just above angle; lower limb smooth; preopercular angle 105-110°; operculum with single soft blunt spine; lateral line in low curve; head pores numerous, mandibular pores six to nine on each side from symphysis to preopercular margin.

Scales ctenoid, large and embedded in pockets; scales in head region mostly cycloid; most of body scales are replacement scales, nonreplacement scales are found mainly around pectoral fin base; scales in a patch on pectoral fin, caudal fin covered with fine scales, remaining fins naked.

Dorsal fin continuous, height about 7% SL; base of fin 52-62% (modally 56%) SL; origin over pectoral fin base; spines long and slender or stout, about same length as rays; first spine about 1.3-1.9 in length of second; both spines joined to a common pterygiophore; two predorsal interneural bones present; rays all divided, generally of about equal length, with the exception of an antepenultimate elongate ray nearly reaching the hypural base.

Anal fin continuous and about same height as dorsal fin; origin between a vertical below fourth and fifth dorsal rays; one thin spine, 2.2-2.3 in length of first ray; base 27-33% (modally 28%) SL; first ray usually segmented but not divided, remaining rays divided; first two or three rays slightly shorter than remaining rays; penultimate ray elongate, reaching posteriorly nearly as far as elongate dorsal ray.

Pectoral fin long, 21-29% (modally 26%) SL, and pointed, reaching nearly to anus; origin below a vertical between second and third dorsal spines; first ray stout, segmented and undivided, about 3.5 in length of fin; except for ventralmost ray, all remaining rays are divided.

Pelvic fins long and pointed, inserted below origin of pectorals; length 13-25% (modally 18%) SL; single stout spine about 1.5 in length of fin.

Caudal fin with 17 principal rays, 15 branched; margin always truncate with dorsal and ventral tips extended; caudal with 11-12 dorsal procurrent rays and 10-11 ventral procurrent rays.

Lopholatilus chamaeleonticeps Goode and Bean 1880a

Great Northern Tilefish

Figure 30

Lopholatilus chamaeleonticeps Goode and Bean 1880a: 205 (original description; Massachusetts). Goode 1881a:337 (associated fishes); 1881b:482 (synopsis). Gill 1882:164 (systematics). Collins 1883:301, pl. 2 (massive kill); 1884:237 (history). Lucas 1891:647 (listed extinct). Jordan and Evermann 1896:462 (checklist). Goode and Bean 1895:284, fig. 265 (synopsis). Jordan and Evermann 1898:2278 (synopsis). Bumpus 1898:576 (reappearance); 1899:321 (reappearance). Evermann 1900:302 (key). Linton 1901:471 (food, parasites). Eigenmann 1902:37 (eggs). Lucas 1905:81 (cranial osteology). Silvester 1905:87 (circulatory system). Smith 1905:75 (Canada). Goodrich 1909:431 (systematics). Tracy 1909:171 (Rhode Island). Miranda-Ribeiro 1915:8 (synopsis). Sherwood 1916:433 (tilefishing). Bigelow and Welsh 1925:352, pl. 353 (synopsis). Jordan et al. 1930:357 (checklist). Hildebrand and Schroeder 1928:305 (synopsis). Woodward 1942:911 (phylogeny). Bigelow and Schroeder 1947:62 (Yucatan). Breder 1948:262 (synopsis). Bigelow and Schroeder 1953:426, pl. 221 (synopsis). de Sylva 1955:4 (popular account). Gordon 1955:273 (popular account). Hoese 1958:332 (Gulf of Mexico). Briggs 1958:276 (Flor-

Table 18.—Range of proportional measurements of the species of *Lopholatilus* as percent standard length and percent head length. The number in parentheses is the mean percent.

	Percent standard length					Percent head length		
Species	Body depth	Body width	Caudal peduncle depth	Head length	Predorsal length	Snout length	Orbit diameter	Sub-orbital depth
chamaeleonticeps	21-31 (25)	11-18 (13)	8-10 (9)	28-35 (30)	30-39 (32)	27-51 (40)	16-44 (26)	14-28 (20)
villarii	28-30	14-17	8	32-33	34	43-46	18-22	27-28

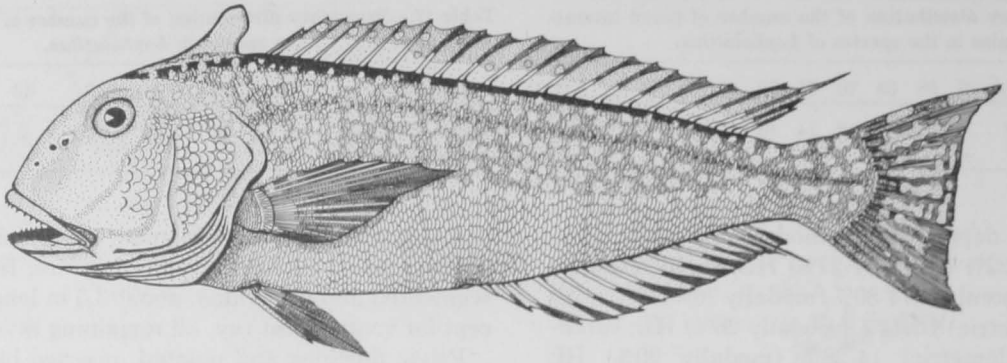


Figure 30.—Drawing of *Lopholatilus chamaeleonticeps*, 580 mm SL (later dissected), Miami, Fla.

ida). Leim and Day 1959:510 (Le Have and Emerald Banks, Canada). Gordon 1960:66 (Rhode Island). Leim 1960:732 (Emerald Bank, Canada). Grosvenor (ed.) 1965:203 (popular account; color pl.). Norman 1966:257 (key). Leim and Scott 1966:243 (Canada). Monod 1968:341, fig. 615 (caudal skeleton). Nelson and Carpenter 1968:57 (Gulf of Mexico). Struhsaker 1969:261 (Gulf of Mexico). Sands 1971:22 (popular account). Wickers 1972:180 (popular account). Parker 1972:95 (Texas; key).

Diagnosis.—Differs from all other branchiostegids by the following: predorsal ridge well elevated, forming a flap just anterior to dorsal origin; although relative size and shape are somewhat variable, the flap is nearly always found (absent on only 1 or 2 specimens of more than 60 examined) on specimens over about 80 mm SL; characteristic thin cutaneous barbel found on the posterior margin of lower lip.

Description.—The generic description was based mostly on *L. chamaeleonticeps* (included only two specimens of *L. villarii*), therefore only these characters that differ markedly from *L. villarii* will be listed: dorsal fin VII, 15; anal fin I, 13-14 (rarely 13, only 2 of 63 specimens), Goode and Bean (1880a) erroneously gave the anal count as III, 13; cheek scales 6-10 (modally 8 or 9), 6 in *L. villarii*; opercular scales 6-10 (modally 8), 7 in *L. villarii*; scales above lateral line 7-11 (modally 8), 7 or 8 in *L. villarii*; proportional measurements of *Lopholatilus* reflect those of *L. chamaeleonticeps*.

Color.—Based on two fresh specimens collected off Miami: upper body steel blue-gray fading to milky white below midbody, some overlying golden hue; upper body, head and tail covered with characteristic golden-yellow spots, spots slightly irregular, though nearly round and small; spots extend over caudal where they fuse into eight or nine vertical bands; ventral portion of caudal with wide dusky area extending to margin; caudal dusky between yellow markings; small yellow spots on head to interorbital, cheek to snout and operculum; chin and branchiostegal membrane milky white, upper head light blue with a rose flush, a silver streak from under posterior nostril fading to operculum; dorsal fin upper margin light, remainder of membrane dark except along base; spines and rays golden-yellow, some light yellow markings between rays (from second spine to about sixth ray); adiposelike flap yellow with dark leading edge; anal fin membrane opaline, basal portion clear; pectoral axil yellow, dorsalmost rays yellow medially near base, remainder of pectoral membrane dusky, ventral and base portions white; pelvic membrane white, spine orange-yellow.

Biology.—A relatively deep-dwelling branchiostegid found at depths between 81 and 540 m, but generally along a relatively narrow zone along the continental slope and upper reaches of canyons. The habitat is generally restricted to sand or mud bottom between 8° and 17°C isotherms, but is apparently more abundant closer to the 15°C isotherm between the depths of 120 and 200 m. *Lopholatilus chamaeleonticeps* seems to be relatively stenothermal as reflected by its fairly restricted habitat, and evidenced by its historic kill apparently caused by a sudden drop of about 6°C. The drop in water temperature was apparently caused by the incursion of the cold Labrador Current over the tilefish grounds usually warmed by the Gulf Stream. Nelson and Carpenter (1968) found *L. chamaeleonticeps* extremely abundant in the Gulf of Mexico over rough bottom or on moderate to steep slopes. Their highest catches occurred off Texas (0.23 kg/hook) at 360 m depth and 13°-14°C. *Lopholatilus chamaeleonticeps* was caught only once in depths greater than 360 m and only twice in less than 225 m. Catches ranged from: specimen weights of 0.4-12 kg, water temperatures of 10°-17°C, and depths between 162 and 450 m. Longline catches (*Calamar* cruise report 47-C, I and II) off Guyana resulted in five specimens of *Lopholatilus* sp. (presumably *L. chamaeleonticeps* judging from photos received from W. F. Rathjen). Sizeable sport and commercial catches have been reported from the Hudson Canyon (Sands 1971; Wickers 1972) and off Florida where 13-18 kg (30-40 pounds) specimens are taken.

The northern tilefish is omnivorous, but relies heavily on decapod crustaceans as food. According to Linton (1901) stomachs contained mainly crabs, but also squid, spiny dogfish (*Squalus acanthias*), eels, fish bones, salps

(*Salpa zonaria*, bivalve mollusks (*Yoldia*), annelids, worm tubes, holothurians (*Thyone* sp.), actinians, an anomuran (*Munidia caribaea*), eupagurids, brachyurans, and spider crabs. The stomach of a 320-mm specimen taken off Savannah, Ga. (GMBL 72-29) in 180 m contained five myctophids (W. D. Anderson, pers. commun.). Associated fauna based upon shipboard identifications from *Oregon II* station 11719 off Savannah consisted of: shrimp (*Solenocera atlantidis*, *Panaeopsis megalops*, *Parapenaeus longirostris*), spider crabs (*Anasimus latus*), butterfish (*Peprilus triacanthus*), and spotted hake (*Urophycis regius*) (W. D. Anderson, pers. commun.).

Lopholatilus chamaeleonticeps appears to spawn in July and August according to Bigelow and Schroeder (1953). I have observed ripe females collected in February, March, June, and July. Eggs preserved in Formalin measured 1.25 mm and contained an oil droplet of 0.2 mm (Eigenmann 1902). The larval form is presently unknown, but probably resembles the spinous larvae of *Branchiostegus*. The smallest specimens examined were collected in the following months: April (51 mm), May (71 mm), and July (79 mm). The age and growth relationship is unknown, but preliminary examination indicated that tilefish may live more than 20 yr. Bigelow and Schroeder (1953) collected 60- to 90-mm tilefish along the outer continental slope (off New England) in April and others from 100 to 105 mm in July. As in all other branchiostegids known, *Lopholatilus* probably has a pelagic larva metamorphosing into a bottom dwelling juvenile form. Also, as in other branchiostegids, there is a suggestion of protogynous sex reversal through a disproportionate ratio of females over males in smaller specimens. H. C. Mears (pers. commun.) observed that 20 specimens of *L. chamaeleonticeps* (635-900 m) were all females, while 16 larger specimens (900-1,090 mm) were all males. Dooley and Paxton (1975) observed a similar disparity in sex ratio among *Branchiostegus wardi* and *B. serratus* from Australia. Either males reach a larger size, or there is protogynous sex reversal. More work on the reproduction of branchiostegids is needed before conclusions can be made.

History.—It is of interest to recapitulate briefly the unusual history of the tilefish fishery off the northeastern United States (Fig. 31). Many detailed accounts have appeared in the literature (Collins 1884; Bumpus 1899; Bigelow and Welsh 1925; Bigelow and Schroeder 1953; de Sylva 1955).

Perhaps *L. chamaeleonticeps* has become established only relatively recently in the northern waters off New England. Prior to 1879, fishermen fishing for cod and hake off New England failed to catch any of these large (up to 23 kg) and unusual looking fish. In May 1879, a Captain Kirby caught nearly a ton of these fish while fishing for cod and hake in 38 m of water south of Nantucket Shoals Lightship. Subsequently, other cod fishermen and the RV *Fish Hawk* landed sizeable catches. Coincidently, Verrill (1880) dredged an enormous number of new and exotic fishes and invertebrates from the outer shelf off New England. Additional dredging in 1882 revealed a scarcity or absence of many of the species taken in the previous 2 yr in the same area. In March of the same year, vast numbers of tilefish (estimated at over 1.5 billion fish) as well as many other fishes were seen dead and dying over an area of some 2,700 km^2 (Collins 1884). This is reported to be the largest single kill of vertebrates ever recorded. Thorough searches of the area formerly occupied by *Lopholatilus* in the following years 1882-1891 failed to locate a single specimen. As a result, *L. chamaeleonticeps* was considered to have become extinct (Lucas 1891). In 1892, eight specimens of tilefish were taken off Marthas Vineyard by the RV *Grampus*. Finally, by 1898, the species had become plentiful again (363 specimens were taken by the *Grampus* on three short cruises). In subsequent years, the landings grew steadily, especially when in 1915 the Bureau of Fisheries attempted to popularize the species for the market. From 1916 to 1917, 5,300 metric tons of tilefish were landed. Fluctuations in landings in the years to follow probably were more a reflection of decreased demand than of availability. The potential of the fishery has still not apparently been reached (Fig. 31). Various hypotheses for the kill have been suggested from submarine volcanoes to disease and thermal shock (Libbey 1891). Unfortunately, temperature measurements were not taken at the time of the kill, but measurements taken in August 1891 showed a reestablishment of the 10°C isotherm along the upper slope just prior to the rediscovery of *Lopholatilus* (Libbey 1895). Thus, cold water seems the most likely cause of the kill. It is known that *Lopholatilus* inhabits a rather narrow band of relatively warm Gulf Streem water, with cooler water above the shelf for most of the year (particularly winter) and cold water below this zone. Cyclic meandering of the Gulf Stream has been photographed with infrared film from satellite (Rao et al. 1971) and shown for areas of the North Carolina shelf and slope (Blanton 1971; Stefansson et al. 1971). Perhaps a meander of the Gulf Stream in March 1882 allowed a sudden influx of cold shelf water or Labrador Current waters, thus killing most of the warm-water inhabitants.

Distribution.—Found from Banquereau Bank (about lat. 44°26′N, long. 57°13′W), including La Have, Emerald, and Roseway Banks off Nova Scotia to Key West, Fla.; throughout the Gulf of Mexico (particularly off the mouth of the Mississippi in Desoto Canyon, and Texas and the Campeche Banks; found disjunctly (possibly due to a lack of adequate sampling) off Venezuela to Guyana and Surinam. Found at depths between 81 and 540 m (usually 100-200 m).

Material examined.—Specimens up to 25 kg (55 lb) and about 1 m in total length have been seen. A total of 63 spcimens (51-867 mm SL) were examined. NANTUCKET I.: (holotype) USNM 22899, 675 mm SL. MAINE: ROM 22157, 720 mm. NEW JERSEY: USNM 25976, 593 mm; USNM 25977, 560 mm; USNM 28859, (15) 353-400 mm; USNM 61259, 295 mm (no definite

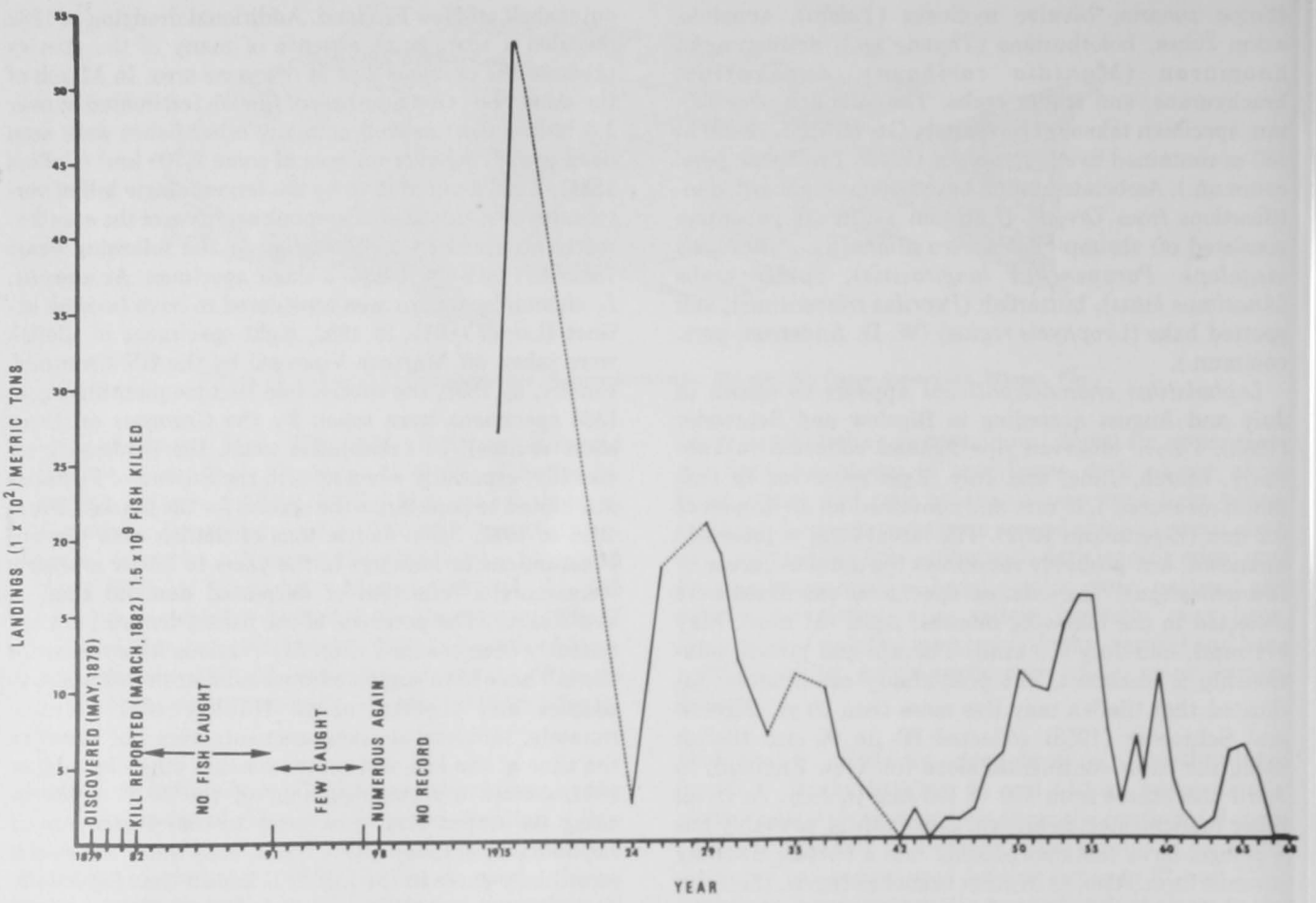


Figure 31.—History of the tilefish fishery (*Lopholatilus chamaeleonticeps*), 1879-1968; dashed line denotes no data.

locality); USNM 61253, (2) 284-285 mm (no definite locality); MCZ 34564, 51 mm; MCZ 34566, (2) 66-90 mm; MCZ 34562, (2) 82-90 mm; MCZ 34766, 350 mm; MCZ 27686, 405 mm (no definite locality); MCZ 28804, 520 mm. NORTH CAROLINA: ROM 23957, 680 mm; UNC 4679, 650 mm. SOUTH CAROLINA: GMBL (not accessioned) 876 mm; 16 kg, 18 Sept. 1971; hook and line; Loran 3H6-3409, 3H7-4790; 146 m depth. GEORGIA: GMBL 72-29, 320 mm; *Oregon II* (stn. 11719); 21 Jan. 1972; 183 m depth, bottom temperature 7.8°C, smooth sand (lat. 31°47'N, long. 79°21'W). FLORIDA: USNM (*Silver Bay* 2732), 158 mm; USNM (*Silver Bay* 4236), 245 mm; TABL (*Oregon* 4543; at UMML), 205 mm; TABL (*Oregon* 4151; at UMML), 198 mm; TABL (*Oregon* 4531), 184 mm; TABL (*Oregon* 4544), 193 mm; TABL (*Silver Bay* 2731), 130 mm; TABL (*Silver Bay* 2732), (4) 123-140 mm; MCZ 34565, 79 mm; UMML 8232, 220 mm; JKD-4 (disarticulated) 580 mm; UNC 6363, 420 mm. FLORIDA STRAITS: TABL (*Oregon* 4537), 352 mm. FLORIDA-GULF: GCRL 1473, 125 mm; USNM 152562, 187 mm; USNM 152561, 141 mm; USNM (*Oregon* 4082), (2) 150-153 mm; USNM 158622, 365 mm; FMNH 46558, 160 mm. ALABAMA: GCRL (*Oregon* 1467), 275 mm. TEXAS: TABL (*Oregon* 4606), 228 mm; USNM 157724, 520 mm; GCRL 1493, 120 mm. LOCALITY UNKNOWN: ANSP 72094, 240 mm. VENEZUELA: UPR 2504, 375 mm.

Holotype.—USNM 22899, 675 mm SL, 5.4 kg (preserved); specimen in fair condition, color very faded; 815 mm TL; D. VII, 15; A. I, 13 (not III, 13 as described); P_1 17 (not II, 15); B. 6; C. 17 (not 18); gill rakers removed; pored lateral-line scales 68 + 3 on tail (not 93); cheek scales 9; opercular scales 8; head length (HL) 33% SL; orbit 16% HL; body depth 31% SL; body width 15% SL.

Lopholatilus villarii Miranda-Ribeiro 1915
Great Southern Tilefish; Batata

Figure 32

Lopholatilus villarii Miranda-Ribeiro 1915:8 (original description; Brazil); 1918:227 (Brazil). Devincenzi 1924:252, pl. 19 (Uruguay). Devincenzi and Legrand 1940:1, pl. 38 (Uruguay). Fowler 1941:169 (Rio de Janeiro). Ringuelet and Arámburu 1960:65 (Argentina).

Lopholatilus abbreviatus Lahille 1930:35 (original description; Argentina). Ringuelet and Arámburu 1960: 65 (Argentina).

Diagnosis.—Most body proportions fall within the range of *L. chamaeleonticeps*; easily separated from *L. chamaeleonticeps* by the absence of the elevated predorsal flap, only a prominent predorsal ridge is present in *L. villarii*. *Lopholatilus villarii* lacks a cutaneous barbel on the posterior ventral margin of the lower lip; dorsal fin elements VII or VIII, 14 or 15 compared with VII, 15 in *L. chamaeleonticeps*; first dorsal spine 1.9 times in second vs. 1.2-1.5 times in *L. chamaeleonticeps*; dorsal fin base 54% SL vs. 52-62% (modally 56%) SL in *L. chamaeleonticeps*; anal fin base 27-28% SL vs. 27-33% (usually always greater than 28%) SL in *L. chamaeleonticeps*;

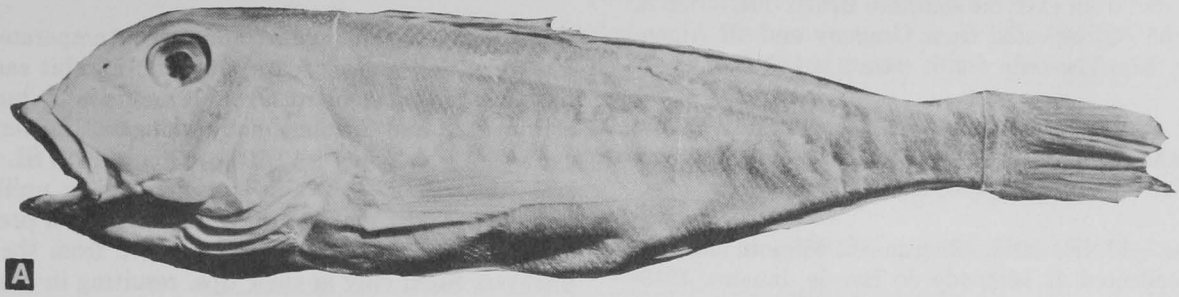


Figure 32.—A. Lateral view of *Lopholatilus villarii* (lectotype, MNRJ 3049, 490 mm SL, Rio de Janeiro. B. Dorsal view of head and predorsal ridge of *L. villarii*.

modal differences in the number of lateral-line scales, cheek scales, and gill rakers appear to exist between *L. villarii* and *L. chamaeleonticeps*, but these need to be verified by the examination of additional specimens of *L. villarii*. *Lopholatilus villarii* can be distinguished from species of *Caulolatilus* by dorsal, anal, and vertebral counts, and from both *Caulolatilus* and *Branchiostegus* by the elevated predorsal ridge (only *B. semifasciatus* has a prominent ridge, but can be differentiated by the body bars and higher number of dorsal elements in *B. semifasciatus*, VI, 16).

Description.—Body quadriform, head rounded; anal fin I, 14 (15 in original description); pectoral fin 17; total first arch gill rakers 22; pored lateral-line scales 67 or 69 (plus 4 on tail) (94 lateral-line scales given by Miranda-Ribeiro 1915); scales above lateral line 7 or 8; scales below lateral line 29 or 30 (Miranda-Ribeiro 1915 listed 41 scales in transverse series).

Body depth 28-30% SL; body width 14-17% SL; caudal peduncle length 14% SL; caudal peduncle depth 8% SL; head length (HL) 32-33% SL; predorsal length 34% SL; head depth 82% HL; snout length 43-46% HL; length of upper jaw 43-45% HL; length of lower jaw 45% HL; cheek depth 34% HL; opercular length 25% HL; snout to dorsal margin of preoperculum 76% HL; orbit diameter 18-22% HL; suborbital depth 27-28% HL.

Caudal fin with 17 principal rays, 15 branched; margin truncate with dorsal and ventral tips extended; caudal with 11 dorsal procurrent rays (usually 12 in *L. chamaeleonticeps*) and 11 ventral procurrent rays (usually 10 in *L. chamaeleonticeps*).

Color.—Coloration according to Miranda-Ribeiro (1915): body olive dorsally, whitish ventrally; sides with sulfur-yellow spots; a dark predorsal ridge; dorsal fin dusky with a broad transparent band more or less distinct to the posterior margin; caudal dusky with yellow rays not including the dorsal border, remaining caudal with yellow bands.

Distribution.—Type-locality off Rio de Janeiro, Brazil; also recorded from extreme southern Brazil (lat. 33°35'S, long. 50°55'W), reported from Uruguay and off Argentina (Fig. 33). The only depth record is 142 m.

Material examined.—Two specimens, 490 and 677 mm SL. BRAZIL: (lectotype) MNRJ 3049, 490 mm; ZMB 21776, 677 mm, near Uruguay, 142 m depth, 20 Nov. 1966.

Lectotype.—MNRJ 3049, 490 mm SL, 595 mm TL; ripe female, collected at Mercado do Rio de Janeiro, 1915; specimen in good condition, although color faded; 1.7 kg (preserved weight without viscera); D. VIII, 14; A. I, 14; P_1 17; B. 6; total first arch gill rakers 7 + 15; pored lateral-line scales 69; cheek scales 6; opercular scales 7; body depth 28% SL; body width 14% SL; head length (HL) 32% SL; orbit diameter 22% HL. The designator of the lectotype is unclear, possibly Miranda-Ribeiro: "Lectotype" appeared only on the label with no literature designation known; should be considered as such since no holotype is known to exist at MNRJ or elsewhere. No information concerning other syntypes or their deposition has been obtained.

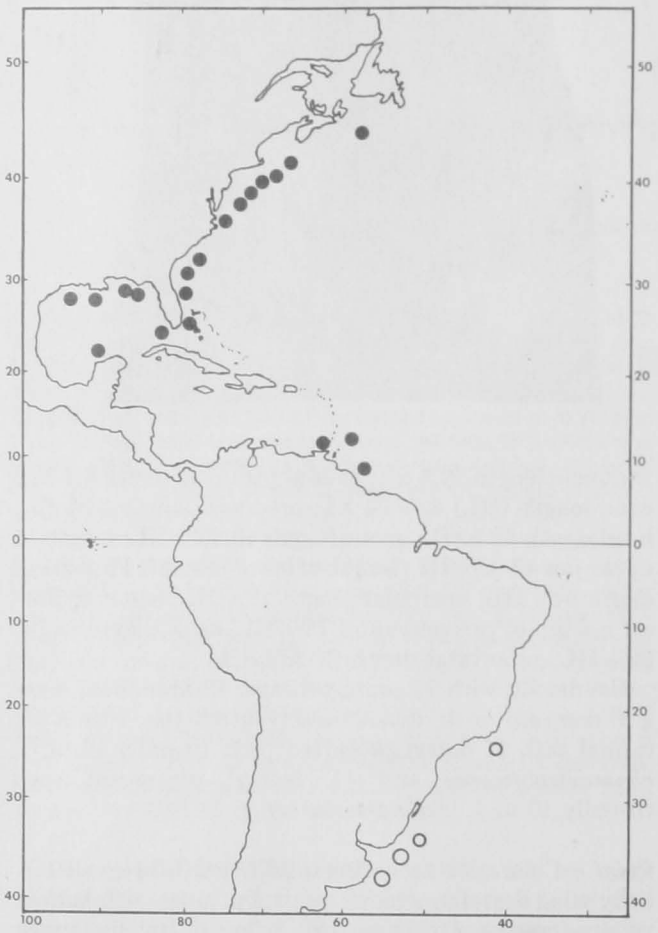


Figure 33.—Distribution of the genus *Lopholatilus* based upon museum specimens and reliable records. Dots represent *L. chamaeleonticeps*, open circles *L. villarii*.

FAMILY MALACANTHIDAE

Diagnosis.—Circumtropical and warm-temperate shallow-water fishes often found in pairs; inhabit sandy or rubble bottoms, construct rubble mounds or burrows; continental and insular; body elongate, fusiform, or cylindrical; body depth 12-20% (modally 16%) SL vs. 21-36% (modally 27%) SL in branchiostegids; unlike the branchiostegids, malacanthids do not have a predorsal ridge; the first haemal spine is formed from the parapophyses fused only at their tips, resulting in a haemal arch that is broad and elliptical; branchiostegids have a first haemal spine formed from the medial fusion of their parapophyses, forming a broad receptacle for the posterior end of the swim bladder; dorsal and anal fins long and continuous, sum of dorsal and anal fin bases 80-135% (usually more than 90%) SL vs. 80-109% (usually 90%) SL found in branchiostegids; dorsal fin I-V, 43-60 (*Malacanthus*); III-X, 13-34 (*Hoplolatilus*) (total elements 22-64); branchiostegids have VI-X, 14-27 dorsal elements (total 22-36); malacanthids with anal fin with I-II, 12-55 (total of 14-56 elements); branchiostegids have I-II, 11-26 anal elements (total of 14-28); malacanthids with pectoral fin 15-19 (usually 16-18); pelvic I, 5; caudal fin falcate or truncate with 17 principal rays, 15 branched; gill membranes free from isthmus; 6 branchiostegal rays; 4 gill arches and pseudobranch; nostrils paired, posterior naris enclosed in thin cutaneous tube with flap; upper and lower jaws with canine teeth and patches of villiform teeth near symphysis; no teeth on palatines, pterygoids, vomer, or tongue; well-developed pharyngeal teeth; preoperculum smooth or serrate; always serrate in branchiostegids; may have enlarged spine at angle of preoperculum; branchiostegids never have enlarged spine at angle; operculum with single sharp spine; vertebrae 10-11 + 14; subocular shelf present; scales ctenoid (one species with few ctenii on scales) over most of body, mostly cycloid in head region.

MALACANTHUS CUVIER 1829

Malacanthus Cuvier 1829:90, fig. 3 (type-species, *Malacanthus trachinus*, by monotypy).
Oceanops Jordan and Seale 1906:277, pl. 39 (color) (type-species, *Oceanops latovittata*, by monotypy).
Dikellorhynchus Smith 1956:54 (type-species, *Dikellorhynchus incredibilis*, by monotypy).

Dignosis.—Length of dorsal plus anal fin bases 112-135% (modally 125%) SL, *Hoplolatilus* dorsal plus anal fin bases equals 80-100% (modally 90%) SL; margin of preoperculum always smooth, *Hoplolatilus* with serrate preoperculum; dorsal fin elements I-V, 43-60 (total elements modally 56) (Table 19); *Hoplolatilus* with III-X, 13-34 dorsal elements (total modally 31); anal fin elements I, 37-55 (total modally 48) (Table 20); *Hoplolatilus* with I-II, 12-20 anal fin elements (total modally 19); first haemal spine positioned over anal rays 12-18; *Hoplolatilus* with first haemal spine over anal rays 1 or 2.

Table 19.—Frequency distribution of the number of dorsal fin elements of the species of *Malacanthus*.

Species	I	II	III	IV	V	Soft elements 43	44	45	46	47	52	53	54	55	56	57	58	59	60	*N*	$\bar{x}$	SD
plumieri				15	59								7	11	19	23	9	2	1	74	56.4	1.31
brevirostris	4	52	1	1							1	2	5	8	9	12	12	5	4	58	56.7	1.90
latovittatus			2	36		7	11	10	7	3										38	44.7	1.20

Table 20.—Frequency distribution of the number of anal fin rays of the species of *Malacanthus*.

Species	37	38	39	40	46	47	48	49	50	51	52	53	54	55	Soft elements *N*	$\bar{x}$	SD
plumieri							1	2	5	19	27	12	4	3	73	51.9	1.33
brevirostris					2	1	1	11	10	15	10	5	1	1	57	50.6	1.77
latovittatus	2	10	14	12											38	38.9	0.90

Description.—Pectoral fin rays 15-17; total first arch gill rakers 6-20 (Table 21); pored lateral-line scales 116-181; cheek scales 6-12; opercular scales 5-10; scales above lateral line 7-17; scales below lateral line 31-53; vertebrae 10 + 14.

Body elongate, body depth 12-20% (modally 16%) SL; body width 8-15% (modally 11%) SL; caudal peduncle length 5-8% SL; caudal peduncle depth 5-8% SL; head length (HL) 19-32% SL; predorsal length 19-34% SL; head depth 49-64% HL; snout length 29-52% HL (allometric); length of upper jaw 30-42% HL; length of lower jaw 36-48% HL; cheek depth 17-28% HL; opercular length 23-34% HL; snout to dorsal margin of preoperculum 67-78% HL; orbit diameter 11-29% HL (allometric); suborbital depth 5-20% HL, allometric (Table 22).

Mouth terminal, fleshy lips; jaws either end well anterior to eye or under eye; teeth fine to moderate canines, upper jaw with outer row of 19-32 teeth, lower jaw with 14-30 teeth; both upper and lower jaws with patches (4-5 rows) of villiform teeth at their symphysis, 1 or 2 anteriorly curved teeth at the rear of both jaws.

Gill rakers short and rudimentary; skull roof almost flat with supraoccipital crest reduced to a small pointed process; lateral line in low curve; cephalic pores number 50-60 on each side, 4 or 7 mandibular pores per side; scales on base of pectoral; caudal fin with fine scales, remaining fins naked; body scales nearly all regenerated.

Pectoral fins reach a line with origin of anal fin or fall to a vertical with anus; length 11-17% SL.

Pelvic fins pointed, origin slightly posterior to lower origin of pectoral; length of fin 7-10% SL.

Caudal fin falcate or truncate, dorsal tips slightly exserted or with elongate filaments; 10-12 dorsal and 10-12 ventral procurrent rays.

Malacanthus plumieri (Cloch 1787a)

Sand Tilefish; Blanquillo

Figure 34

Coryphaena plumieri Bloch 1787a:146 (original description; taken from a drawing by Plumier; Martinique); 1787b:73, pl. 175 (color). Bonnaterre 1788:60, pl. 34, fig. 131 (Antilles). Gmelin 1788:1191 (Antilles). Lacépède 1802:201 (synopsis); 1803:pl.8 (synopsis). Shaw 1803:215 ("American Seas").

Table 21.—Frequency distribution of the number of gill rakers (first arch) in the species of *Malacanthus*.

Species	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	$\bar{x}$	SD
plumieri			2	8	40	10	4	4								10.3	1.05
brevirostris				1	1	2	4	9	9	7	18	4	3	-	1	14.8	1.97
latovittatus	1	2	13	10	9	-	1	-	1							8.9	1.42

Table 22.—Range of proportional measurements of the species of *Malacanthus* as percent standard length and percent head length. Number in parentheses is the mean percent.

Species	Percent standard length: Body depth	Body width	Caudal peduncle depth	Head length	Predorsal length	Percent head length: Snout length	Orbit diameter	Suborbital depth
plumieri	13-19 (16)	8-14 (10)	6-8 (7)	23-28 (26)	23-27 (25)	39-52 (49)	11-25 (13)	9-20 (16)
brevirostris	12-16 (14)	8-11 (9)	5-6 (5)	19-24 (22)	19-24 (22)	29-37 (32)	19-29 (22)	5-11 (8)
latovittatus	15-20 (17)	10-15 (14)	6-7 (6)	25-32 (29)	26-34 (30)	37-47 (44)	13-24 (16)	8-20 (17)

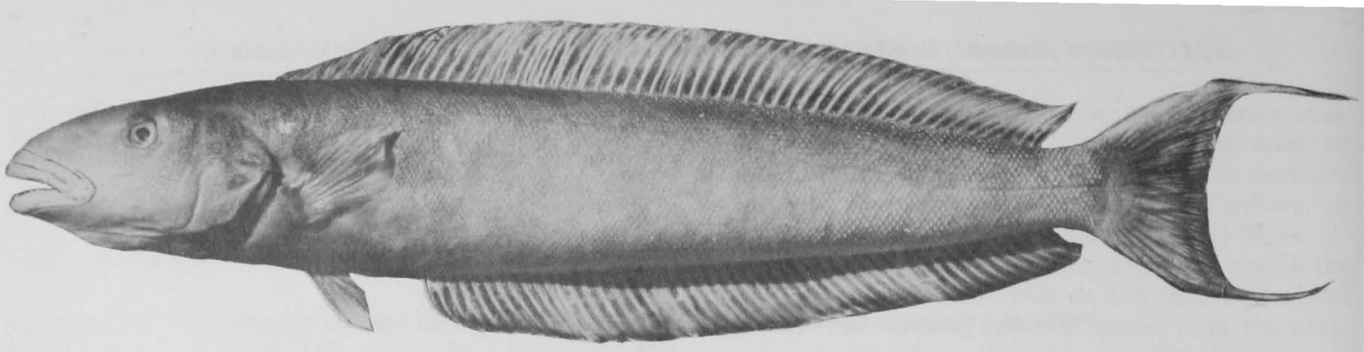


Figure 34.—*Malacanthus plumieri*, 440 mm SL (later dissected), Cape Lookout, N.C.

Malacanthus trachinus Cuvier 1829:90, fig. 3 (original description). Valenciennes 1837:205, Atlas, pl. 90, fig. 3.

Malacanthus plumieri. Cuvier 1829:264 (synopsis). Swainson 1839:225 (systematics). Cuvier and Valenciennes 1839:319, pl. 380 (color). Castelnau 1855:29 (Bahia, Brazil). Günther 1861:359 (synopsis). Poey 1868:330 (Brazil, Martinique, Haiti, Jamaica); 1876:95 (checklist). Jordan and Evermann 1896:462 (checklist); 1898:2275 (synopsis). Gilbert 1900:178 (Brazil). Evermann 1900:302 (Puerto Rico). Blosser 1909:300 (St. Croix, Virgin Is.). Bean 1906:83 (Bermuda). Miranda-Ribeiro 1915:5 (Brazil); 1918:146 (Brazil). Metzelaar 1919:70 (Curaçao, Bonaire, Aruba). Fowler 1920:128 (Jamaica, Grand Cayman, New Providence, Bahamas). Jordan 1923:130, 202 (checklist). Beebe and Tee-Van 1928:177 (Haiti). Borodin 1928:22 (new variety?). Jordan et al. 1930:356 (checklist). Nichols 1930:371, fig. 273 (West Indies). Parr 1930:67 (Cat Is., Bahamas). Beebe and Tee-Van 1933:172 (Bermuda). Borodin 1934:117 (Haiti). Norman 1935:56 (Ascension I.). Fowler 1936:1359 (synopsis); 1938:313 (Haiti); 1939:15 (Jamaica); 1942:169 (Brazil). Longley and Hildebrand 1941:145 (Tortugas, Fla.). Fowler 1944:447, 469 (Caribbean); 1945b:213, 312 (Charleston, S.C.). Baughman 1947:280 (Texas). Breder 1948:262 (synopsis). Baughman 1950:251 (Texas). Fowler 1952:99 (Hispaniola). Springer and Bullis 1956:88 (Gulf of Mexico). Hoese 1958:332 (Texas). Briggs 1958:276 (Florida). Smith and Bailey 1962:7 (subocular shelf). Cervigón 1964:1 (*Malacanthus* misspelled "*Melacanthus*," Venezuela); 1966:354 (Isla de los Hermanos, Venezuela). Caldwell 1966:46 (Jamaica). Randall 1967:742 (food study); 1968:97 (St. Johns, Virgin Is.). Böhlke and Chaplin 1968:314, pl. 11 (color) (Bahamas). Mago Leccia 1970:96 (Venezuela). Brownell and Rainey 1971:table 1-C (depth; Virgin Is.). Dahl 1971:308 (Colombia). Parker 1972:97 (Texas). Clifton and Hunter 1972:87 (burrow building). Colin 1973:89 (burrow building). Deboer et al. 1973:42 (Antilles).

Dikellorhynchus tropidolepis Berry 1958:116, figs. 1-6 (original description; Cape Lookout, N.C.). Hubbs 1958:282 (synonymy with *Malacanthus*).

Note.—Parra (1778) described a species "Matejuelo blanco" only by the vernacular name. The figure and description obviously refer to *M. plumieri*.

Diagnosis.—Tail forked with elongate filaments (on specimens larger than 300 mm SL); body elongate, depth 13-19% (modally 16%) SL; the only malacanthid represented in the Atlantic; distinguished from branchiostegids by family characters previously listed including a lack of a predorsal ridge; distinguished from the Pacific species of *Malacanthus* as follows: lacks dark tail bands, jaws extend well anterior of orbit (distinguishes *M. plumieri* from *M. brevirostris*); dorsal fin elements IV-V (modally V), 54-60 (modally 57) distinguishes *M. plumieri* from all other tilefishes including *M. latovittatus* III-IV (modally IV), 43-47 (modally 45).

Description.—Anal fin I, 48-55 (soft rays modally 52); pectoral fin rays 16 or 17; total first arch gill rakers 8-13 (modally 10); pored lateral-line scales 135-152 (modally 143); cheek scales 7-12 (modally 10); opercular scales 6-10 (modally 8); scales above lateral line 11-17 (modally 16); scales below lateral line 40-53 (modally 50).

Body width 8-14% (modally 10%) SL; caudal peduncle length 6-7% SL; caudal peduncle depth 6-8% (modally 7%) SL; head length (HL) 23-28% (modally 26%) SL; head depth 49-60% (modally 56%) HL; snout length 39-52% (modally 49%, allometric) HL; length of upper jaw 35-42% (modally 38%) HL; length of lower jaw 39-48% (modally 44%) HL; cheek depth 19-28% (modally 23%) HL; opercular length 23-26% HL; snout to dorsal margin of preoperculum 72-78% (modally 76%) HL; orbit diameter 11-25% (modally 13%, allometric) HL; suborbital depth 9-20% (modally 16, allometric) HL.

Teeth along outer jaw margins well-developed rearward curved canines; lower jaw with approximately 4-5 anterior curved canines followed by 4 enlarged recurved canines, 6-9 smaller teeth, and a single enlarged anteriorly curved canine at the rear for a total of 14-18 teeth; upper jaw with 3-4 small anterior canines followed by 15-17 larger teeth and a single enlarged anteriorly curved tooth for a total of 19-22 teeth; upper and lower jaws with patches of fine villiform teeth at their symphysis; upper lip fleshy, overhanging upper jaw.

Preoperculum edge smooth, angle about 110-115°; operculum with a well-developed sharp spine about

three-fourths the diameter of eye; gill rakers blunt and rudimentary.

Lateral-line pores in low curve; pores of cephalic lateral line more discernible on smaller specimens; head pores: per side, 7 mandibular, 12 preopercular, 14 infraorbital, 10 in postocular-cephalic lateralis series, 5 supratemporal, 11 supraorbital, and 1 central (pineal) pore for a total of 60 pores.

Scales cetnoid over most of body, mostly cycloid in head and thoracic regions; scales in pockets and nearly all replacement type; scales on cheek, operculum, and extending on top of head to a vertical over middle of orbit; caudal with scales, scales on base of pectoral, all other fins naked; scales of larvae have an unusual medial keel (Berry 1958, fig. 4-6).

Dorsal fin continuous and almost uniform in height; fin base 67-73% (modally 70% SL; spines short and feeble, first spine about three-fourths length of second and united to a common pterygiophore; anterior two or three rays unbranched, remaining rays branched; origin of dorsal over pectoral base; differences in the number of dorsal elements were found regionally: Atlantic coast of the United States, Bermuda, and Bahamas ($\bar{x}$ = 61.2), Gulf of Mexico ($\bar{x}$ = 60.0), Caribbean ($\bar{x}$ = 61.1), Brazil ($\bar{x}$ = 62.2), and Ascension Island ($\bar{x}$ = 62.0).

Anal fin slightly greater than dorsal height, base 53-63% (modally 56%) SL; origin below a vertical between eighth or ninth dorsal ray; single spine about half the length of first ray; first ray unbranched, remaining rays branched; the number of anal fin elements indicated a slight cline: Atlantic coast of the United States, Bermuda, and Bahamas ($\bar{x}$ = 52.6), Gulf of Mexico ($\bar{x}$ = 52.4), Caribbean ($\bar{x}$ = 52.8), Brazil ($\bar{x}$ = 53.8), and Ascension Island ($\bar{x}$ = 54.5).

Pectoral fin broad and pointed; extends to origin of anal fin; length 11-14% SL; all but stout dorsalmost ray branched; upper ray 3 times in length of fin.

Pelvic fins slightly pointed; length 7-10% (modally 9%) SL; origin slightly posterior to pectoral origin; spine about 2 times in length of fin.

Caudal falcate with elongate filaments on larger specimens; 12 dorsal and 11 ventral procurrent rays.

Color.—Fresh coloration: body light metallic bluish-green, darker dorsally, bluish-white belly, may be light yellow bars on sides; head with a series of yellow and blue stripes under and around eyes; dorsal fin with brilliant thin yellow upper margin, a narrow clear band underneath and another yellow band, remainder of dorsal with three to four rows of light yellow spots; anal fin as dorsal except yellow spots are lighter and most of fin membrane milky white; caudal with areas of orange-yellow on bases of dorsal and ventral lobes, area between lobes black, remainder of caudal milky white with some gray, posterior margin clear; pectorals clear, pelvics milky white; a color plate appeared in Böhlke and Chaplin (1968).

Biology.—Prejuveniles of *Malacanthus plumieri* are pelagic and are characterized by an anchor-shaped rostral spine not projecting beyond the snout. Behind this spine there is another pair of larger lateral spines and a pair of short serrate ridges, a gap and another pair of serrate ridges extending to the posterior orbital rim. Medial to the serrate ridges are two patches of serrate ridges in about 12 rows over the posttemporal region. There are two infraorbital serrate ridges, a single supraorbital ridge, two more serrate ridges extending from under the mandible to the preopercular margin, and finally another ridge along the subopercular margin. The unusual head spination and keeled scales prompted Berry (1958) to describe the prejuveniles as a new species of *Dikellorhynchus*. *Dikellorhynchus* Smith 1956 was subsequently recognized by Hubbs (1958) to represent larval *Malacanthus*. Metamorphosis into a prejuvenile appears to occur at about 60 mm SL, whereupon it takes up a benthic habitat.

According to Randall (1967), food of *M. plumieri* from the West Indies consisted (based on eight specimens) of: ophiuroids (21%), crabs (18.5%), stomatopods (15%), fishes (12.4%), polychaetes (7.2%), sipunculids (7.2%), unidentified worms (6.4%), chitons (5.7%), echinoids (2.7%), amphipods (1.6%), and shrimps (1.4%).

The sand tilefish like other species of malacanthids, builds a burrow in the bottom. The mounds are constructed of coral and shell rubble (primarily broken branches of *Acropora cervicornis*) and have an opening at one end (Colin 1973). They enter their mound when frightened or disturbed. As a result of their mound building activities, *M. plumieri* redistribute coarse shell and coral fragments (Clifton and Hunter 1972). Sand tilefish burrows are characteristic of open sandy areas near reefs and grass beds, and often are found associated with the following species of fishes: *Serranus tortugarum, Pomacentrus partitus, Apogon quadrisquamatus*, and *Centropyge argi* (Colin 1973).

According to Harry Pederson (pers. commun.), *Malacanthus plumieri* appears to be a shy fish mingling only with its own kind. He has observed what appeared to be nest building activities consisting of the fish making a shallow depression in the sand, at a depth of 10 m in a rubble covered bottom, by pushing its snout against one wall and rapidly oscillating its body. When a chunk of coral fell into the trough, the fish would carry it in his mouth to one side. After 15 or 20 min the fish abandoned its activity and swam away. Underwater observations by Collette and Talbot (1972) revealed *M. plumieri* to be a diurnal species, hovering over open sand near its burrow entrance from 0645 to 1730 h.

Distribution.—*Malacanthus plumieri* ranges from Cape Lookout, N.C. (a range extension found during this study), south including South Carolina, Florida, Bermuda, Bahamas, throughout the Gulf of Mexico, Central America, throughout the Caribbean, and the coasts of Colombia (Atlantic) and Venezuela; a gap in distribution exists from the Orinoco River region to south of the Amazon River delta, probably because of the soft muddy bottom unsuitable for *Malacanthus* mound building. *Malacanthus plumieri* is found again below the

Amazon delta south to São Paulo, Brazil; *M. plumieri* is said to be tolerant of hyposaline waters, so the specimen (USNM 15173) listed from Paraguay may be correct, or perhaps only collected from a fish market and caught elsewhere; the southern limit of *M. plumieri* is probably near the Río de la Plata, Uruguay; the only extension of its range east of the western Atlantic includes two specimens examined from Ascension Island.

As an adult, the sand tilefish is primarily a shallow water benthic fish, found most abundantly between the depths of 10 and 50 m on sand and rubble bottom. The greatest confirmed depth record is 153 m off Charleston, S.C. (GMBL 72-325); an incorrect record of 396 m (Bullis and Thompson 1965) has been corrected by a 1967 *Oregon* station amended list to 76 m.

Material examined.—Total of 75 specimens, 54-513 mm SL. Reported to reach 600 mm SL. NORTH CAROLINA: UNC 6126, 430 mm SL; UNC 6127, 465 mm; UNC 6128, 478 mm; UNC 6129, 446 mm; UNC 6130, 485 mm; UNC 4525, (2) 427-450 mm; UNC 5925, 470 mm; UNC 6456, 495 mm; USNM 158376, 57 mm; USNM 158377, 60 mm; TABL (*Gill* cr. 2) 55 mm. BERMUDA: MCZ 31030, 308 mm. SOUTH CAROLINA: GMBL 72-325, 450 mm, 153 m depth, 7 Aug. 1972, lat. 32°43.2'N, long. 78°18.0'W. FLORIDA: FSBC 2420, 513 mm; FSBC 1579, 485 mm; FSBC 1888, 332 mm; TABL (uncat., now Florida State Museum) 395 mm; USNM 116836, 543 mm. BAHAMAS: USNM 53214, 255 mm; MCZ 12830, (2) 270-293 mm; RMNH 16227, 257 mm; ANSP 110106, 350 mm; TABL 67-31, 303 mm. YUCATAN: TABL (*Silver Bay* 431-435) 309 mm; TABL (*Oregon* 4987) 408 mm. CUBA: USNM 123657, 194 mm; MCZ 12829, 265 mm; MCZ 12833, (2) 265-403 mm; MCZ 12828, 158 mm; MCZ 12827, (2) 220-240 mm; USNM 9819, 173 mm; USNM 4749, 270 mm; USNM 12551, 205 mm; ANSP 103468, (2) 250-265 mm. JAMAICA: LACM 5710, 310 mm; USNM 32072, 393 mm. PUERTO RICO: UPR 2794, (3) 273-343 mm; UPR 693, 338 mm. COSTA RICA: UCR 442-37, 52 mm. VENEZUELA: Nucleo Esparta (uncat.) 470 mm. CURAÇAO: UNC 5098, 183 mm; UPR 1193, 210 mm; RMNH 9458, 208 mm; RMNH 9457, 378 mm. BONAIRE: RMNH 9440, (2) 210-320 mm. ARUBA: RMNH 9459, 407 mm. ST. ANDREWS (ANTILLES): ANSP 89028, 395 mm. GRENADINES: TABL 105617, (2) 56-60 mm. SABA BANK: TABL (*Oregon* 2631) 220 mm. HAITI: USNM 133717, (2) 300-333 mm. BRAZIL: Ceará, MCZ 4671, 273 mm; MCZ 12831, 278 mm; Recife, USNM 104325, 317 mm; São Paulo, MZUSP 8986, 343 mm; MZUSP 8985, 210 mm. PARAGUAY: USNM 15173, 365 mm (locality questionable). ASCENSION ISLAND: BMNH 1908.7.24.20, 385 mm; BMNH 1932.2.19.25, 475 mm.

Types.—Holotype of *Dikellorhynchus tropidolepis*: USNM 158376, 55.9 mm SL, 62.5 mm TL, north San Salvador, B.W.I., stomach of *Coryphaena*; lat. 24°28.5'N, long. 73°38.5'W; 12 May 1953. Paratypes of *D. tropidolepis*: USNM 158377, 58.4 mm SL, 66.2 mm TL, cleared and stained; TABL (*Gill* cruise 2, reg. 80), 55 mm SL, location and data same as holotype. All specimens spinous as previously discussed.

Malacanthus brevirostris Guichenot 1848
Quakerfish

Figure 35

Malacanthe à caudale tricolore Lienard 1842:80 (original description; Mauritius; not binomial, thus not available).

Malacanthus brevirostris Guichenot 1848:14 (original description; Madagascar and Bourbon I. (now Reunion I.)) Playfair and Günther 1866:10 (East Africa). Pollen and Van Dam 1875:80 (Madagascar). Bleeker 1875:80 (Madagascar). Sauvage 1891:336 (Madagascar).

Malacanthus hoedtii Bleeker 1859:18 (original description; Doreh, New Guinea). Günther 1861:361 (synopsis); 1876:160, pl. 98 (Mauritius, New Guinea, Louisiades, Yap, Sandwich Islands; color pl.). Bleeker 1875:80 (Reunion I.); 1878:53 (New Guinea); 1879a:17 (Mauritius). Sauvage 1891:336 (Madagascar). Fowler 1922:84 (Hawaii). Herre 1926b:221 (Philippines). Fowler 1928:236 ("Oceania"); 1944:57 (Hawaii, Tahiti, Nuku Hiva); 1949:53 (Ryukyu Islands, Formosa, Mauritius I., Bourbon I., Ceylon, East Indies, Micronesia, and Polynesia). Marshall 1952:221 (Gulf of Aqaba, Red Sea). Smith 1955a:3 (Mozambique). Berry 1958:120 (key, synopsis). Hubbs 1958:282 (*Dikellorhynchus incredibilus* = *Malacanthus hoedtii*). Gosline and Brock 1960:165 (Hawaii). Kuronuma 1961 (Vietnam). Helfman and Randall 1973:145 (Palau Is.). Randall 1973:188 (Tahiti). Clark and Ben-Tuvia 1973:1, figs. 1-4 (underwater photos of burrow, Red Sea).

Malacanthus hoedti. Playfair and Günther 1866:10 (East Africa). Pollen and Van Dam 1875:80 (list). Weber and de Beaufort 1936:549 (Indo-Australian region). Fourmanoir 1963:92, pl. 5 (Madagascar). Munro 1967:348 (New Guinea). Fourmanoir 1971b: 112 (tuna stomach). Shiino 1972:86 (common, local name).

Malacanthus parvipinnis Vaillant and Sauvage 1875:283 (original description; Hawaii). Jenkins 1904:499 (Hawaii). Snyder 1904:536 (Hawaii). Jordan and

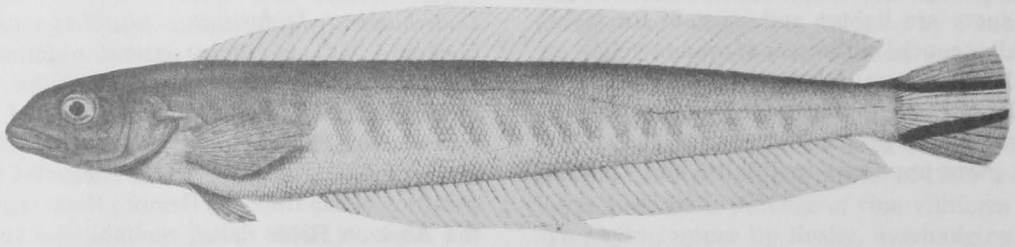


Figure 35.—*Malacanthus brevirostris* (after Günther 1876).

Evermann 1905:275, fig. 118 (color; Hawaii). Jordan and Seale 1906:277 (Hawaii). Snyder 1912b:416 (Okinawa). Jordan and Jordan 1922:53 (Hawaii). Gregory 1933:356 (misspelled *M. parvispinnis*; cranial osteology).

Dikellorhynchus incredibilis Smith 1956:54 (original description; South Africa). Berry 1958:121 (synopsis). Hubbs 1958:282 (synonymy with *M. hoedtii*).

Diagnosis.—Short snout, 29-37% (modally 32%) HL, other species of *Malacanthus* have snout greater than 37% HL; the number of dorsal fin spines (I-IV, mostly II) separates *M. brevirostris* from both *M. plumieri* (IV-V, mostly V) and *M. latovittatus* (III-IV, mostly IV); *M. brevirostris* has two distinct dark parallel bands on the tail.

Description.—Dorsal fin elements I-IV, 52-60 (modally II, 57); anal fin elements I, 46-55 (modally I, 51); pectoral fin rays 15-17 (nearly always 16); first arch gill rakers 9-20 (modally 15); pored lateral-line scales 146-181 (mean 169); cheek scales 7-9; opercular scales 5-9 (modally 7); scales above lateral line 7-10 (modally 9); scales below lateral line 31-36 (modally 34).

Body depth 12-16% (modally 14%) SL; body width 8-11% (modally 9%) SL; caudal peduncle length 5-8% (modally 6%) SL; caudal peduncle depth 5-6% (modally 5%) SL; head length (HL) 19-24% (modally 22%) SL; length of upper jaw 33-39% (modally 35%) HL; length of lower jaw 38-46% (modally 42%) HL; cheek depth 17-22% (modally 20%) HL; opercular length 26-34% (modally 30%) HL; snout to dorsal margin of preoperculum 67-72% (modally 70%) HL; orbit diameter 19-29% (modally 22%, allometric) HL; suborbital depth 5-11% (modally 8%, allometric) HL.

Jaws extend posteriorly to half way between anterior rim of orbit and pupil (unlike other species of *Malacanthus*); teeth along jaw margins stout conical canines; lower jaw with approximately 16-21 teeth plus a single anteriorly curved canine at rear of jaw; upper jaw with about 21-32 teeth plus a single anteriorly curved tooth; upper and lower jaws with patches of villiform teeth at their symphysis; upper lip overhanging upper jaw; preoperculum smooth, angle 105°; operculum with single sharp spine nearly equal to diameter of pupil; rudimentary gill rakers.

Lateral-line pores slightly sigmoid in profile; mandibular pores 4 per side; head pores: preopercular series 9-12, infraorbital series 12 or 13, 7 in postocular-cephalic series, 5-7 supratemporal pores, 5 supraorbital pores, and 1 central (pineal) pore, 50 total pores on each side.

Scales ctenoid over most of body, mostly cycloid in head region; nearly all replacement scales; cheek and operculum scaled, scales extend on head to over posterior orbital rim; caudal with scales, a few scales on pectoral fin base, other fins naked; scales on prejuveniles have medial keel with two serrae (Smith 1956).

Dorsal fin low and continuous, height slightly less than anal; fin base 72-76% (modally 74%) SL; spines short and fairly stout; first spine twice in length of second; anterior two or three rays segmented but unbranched, remaining rays branched; origin of dorsal fin over upper portion of pectoral base; specimens from the eastern Pacific and Red Sea have fewer dorsal elements ($\bar{x}$ = 56.5 and $\bar{x}$ = 57.7, respectively) than the Indian Ocean ($\bar{x}$ = 59.7) and elsewhere in the Pacific ($\bar{x}$ = 58.7).

Anal fin slightly greater in height than dorsal; fin base 56-61% (modally 59%) SL; origin below a vertical between dorsal ray 11 or 12; single spine, length twice in length of first ray; first ray unbranched, remaining rays branched; again as was seen with dorsal elements, specimens from the eastern Pacific ($\bar{x}$ = 49.9) and Red Sea ($\bar{x}$ = 49.7) had fewer anal elements than those from the Indian Ocean ($\bar{x}$ = 51.7) and elsewhere in the Pacific ($\bar{x}$ = 51.6). Collette and Parin (1970) reported a similar pattern with needlefishes, particularly *Platybelone argulus*.

Pectoral fins pointed, extend to vertical with anal fin origin; length 12-16% (modally 14%) SL; all but dorsalmost ray branched; stout upper ray 3 times in length of fin.

Pelvic fins pointed, origin directly under pectorals; do not reach anus; single spine more than twice in length of fin; fin length 7-10% (modally 8%) SL.

Caudal truncate, dorsal tip slightly produced; 11 or 12 dorsal and 10 or 11 ventral procurrent rays.

Color.—After preservation: dorsal portion of body light brown, lower body white; caudal with two dark medial parallel bands, separated by a whitish region; pelvic fins milky white; remaining fins translucent; no other distinct color.

Remarks.—Prejuveniles of *M. brevirostris* are similar to *M. plumieri*, both are pelagic, have keeled scales, lateral rearward curved paired spines on the rostrum, paired patches of serrae on the posttemporal and an elongate body. However, prejuveniles of *M. brevirostris* have an anchor-shaped rostral spine that extends well ahead of the snout, whereas *M. plumieri* has a spine that is enclosed within the dorsal surface of the snout or projects only slightly. *Malacanthus brevirostris* has a single pair of serrate ridges parallel near the rostrum then diverging near the lateral posttemporal region, with a small gap in the ridges near the orbits. In *M. brevirostris* there are 6 pairs of concentric serrate ridges over the posttemporal region, 12 pairs in *M. plumieri*. The remaining head spines as well as the scales are similar in both *M. brevirostris* and *M. plumieri*. Prejuvenile characters have been seen on specimens up to 70 mm SL.

Malacanthus brevirostris is a shallow-water form found over coral rubble or sand bottom adjacent to reefs in 5-33 m depths. According to J. Randall (pers. commun.) as well as Rosenblatt et al. (1972), *M. brevirostris* inhabits burrows in pairs (it is not known if a pair includes both male and female). These burrows are often found beneath ledges of large rocks (Clark and Ben-Tuvia 1973). When this fish is frightened, it dives into the burrow head first, as do *M. plumieri* and *M. latovittatus*.

Distribution.—Found from the Gulf of Aqaba, Red Sea; along east Africa to Cape Province, South Africa; throughout the Indian Ocean (including: Madagascar, Mauritius, Reunion Island, Mascarene Islands, Sumatra, and most of Indonesia); from the Philippines north to Okinawa; also throughout most of the western Pacific islands; south to Queensland, Australia and Lord Howe Island; also in the south Pacific islands (including the Société Islands) and Marquesas; and at the central Pacific islands of Hawaii and Fanning. Reported from Pacific Costa Rica (W. A. Bussing, pers. commun.), Gulf of Panama, and Pacific Colombia (Rosenblatt et al. 1972).

Material examined.—Total of 59 specimens, 68-270 mm SL. Reported to reach 300 mm (Jordan and Evermann 1905). RED SEA: BMNH 1935.9.1.3, 213 mm SL. MOZAMBIQUE: RUSI 2227, 65 mm. SOUTH AFRICA: RUSI 169 (holotype, *Dikellorhynchus incredibilis*) 58 mm SL. MAURITIUS: RMNH 6351 (holotype, *Malacanthus hoedtii*) 190 mm SL; MCZ 6095, 183 mm SL. INDONESIA: ZMA 111.186, 176 mm; ZMA 111.185, 182 mm; RMNH 184 mm; AMS IA.7011, 211 mm; AMS IB.129, 217 mm. OKINAWA: USNM 151601, (3) 20-22 mm. AUSTRALIA: ANSP 113893, 69 mm; AMS I.15625-006, 190 mm. LORD HOWE I.: AMS I.14347, 254 mm; AMS IB.129, 217 mm; AMS I.4341, 241 mm; AMS I.5373, 270 mm; QM I.32456, 253 mm. GUAM: UG 5679, (2) 155-160 mm; BPBM 8461, 78 mm. CAROLINE I.: CAS GVF reg. 1878, 164 mm; CAS 24824, 165 mm. NAURU I.: AMS IA.7011, 211 mm. FANNING I.: BPBM 7646, 226 mm. HAWAIIAN IS.: MCZ 12832, 235 mm; MCZ 28949, 193 mm; ANSP 113893, 69 mm; ANSP 97824, (2) 190-215 mm; ANSP 97815, 242 mm; ANSP 28167, 195 mm; ANSP 83533, 200 mm; ANSP 95276, 245 mm; ANSP 29730, (2) 195-250 mm; ANSP 87045, 233 mm; ANSP 87729, 185 mm; ANSP 28025-6, (2) 163-203 mm; USNM 51034, 230 mm; USNM 55087, 217 mm; USNM 52677, 210 mm; USNM 52728, 197 mm; USNM 151601, (3) 203-248 mm; USNM 88260, (2) 180-190 mm; LACM 477, (2) 218-225 mm. MARQUESAS IS.: BPBM 11801, (3) 180-210 mm. SOCIÉTY IS.: BMNH 1873.8.1.14, 203 mm; BPBM 11870, 168 mm; CAS GVF reg. 1094, 222 mm.

Types.—Malacanthus brevirostris Guichenot 1848 has priority over the junior synonyms *M. hoedtii* Bleeker 1859, *M. parvipinnis* Vaillant and Sauvage 1875, and *Dikellorhynchus incredibilis* Smith 1956. All but the type of *M. parvipinnis* were examined; *M. parvipinnis* was described thoroughly and a colored figure was included by Vaillant and Sauvage (1875), and is clearly a synonym of *M. brevirostris*. Guichenot's (1848) description was based upon two specimens, one from Madagascar and the other from Bourbon; these two specimens (syntypes) were located in the Paris Museum (MNHN A.3661 and MNHN A.3662, respectively). MNHN A.3661 from Madagascar is designated as the lectotype and MNHN A.3662 as the paralectotype. Both specimens were kindly examined by M. L. Bauchot of the Paris Museum (MNHN). Both specimens are dried and lacquered with glass eyes; therefore, proportional measurements were either impossible or somewhat erroneous, and counts were difficult. Although both specimens were in poor condition, MNHN A.3661 was in slightly better condition and was selected as the lectotype. The following are the measurements and counts as taken by M. L. Bauchot: MNHN A.3661, 198 mm SL, 218 mm TL (Guichenot's original description indicated a length of 24 cm, apparently an error since shrinkage could not have been that great); D. 57 elements, A. 43; P_1 16; pored lateral-line scales about 160; body depth about 12% SL; head length (HL) 19% SL; orbit diameter about 18% HL; and MNHN A.3662, 191 mm SL, 209 mm TL; D. 56 elements; A. 45; P_1 15 or 16; pored lateral-line scales about 175; body depth about 14% SL; head length about 18% SL; orbit diameter about 26% HL. Color: brownish-yellow body, both specimens with the characteristic two dark bars on the caudal. The descriptions, proportional measurements, counts, and distinctive tail color conform to the species range.

Dikellorhynchus incredibilis, Smith 1956, holotype, RUSI 160, 58.4 mm SL, 67.8 mm TL (not including rostrum); Cape Province, South Africa; 24 Jan. 1955, by J. Rennie; body depth 13% SL; body width 8% SL; head length (HL) 19% SL; orbit diameter 26% HL; D. II, 55; A. I, 50; first arch gill rakers 16; keeled scales, head spines as previously described.

Malacanthus hoedtii Bleeker, 1959a, holotype(?), RMNH 6351, 190 mm SL, 213 mm TL; collected by P. Bleeker in 1879 (?) (either this date is erroneous or this specimen labeled as a holotype is not; Bleeker's description occurred 20 yr prior to 1879); body depth 12% SL; body width 8% SL; jaws well under eye; head length (HL) 21% SL; orbit diameter 24% HL; D. III, 57; A. I, 50; P 16; pored lateral-line scales 146; first arch gill rakers 9; specimen soft and faded.

Malacanthus latovittatus (Lacépède 1802)
Blue Blanquillo

Figure 36

Labrus latovittatus Lacépède (non Rüppell) 1802:455, 517, 526, pl. 28 (original description; "Great Equitorial Ocean"). Shaw 1803:496 (Indian Ocean). Quoy and Gaimard 1833:701, pl. 20, fig. 3 (color plate; synonymy).

Taenianotus latovittatus Lacépède 1803:304, pl. 3, fig. 2 (list), later synonymized by Cuvier and Valenciennes 1839.

Malacanthus latovittatus. Quoy and Gaimard 1833:701 (New Guinea). Bleeker 1859:5 (New Guinea). Günther 1861:360 (list; Mauritius, New Guinea). Bleeker 1863a:252 (Flores I.); 1863b:236 (Ternate I.); 1865:292 (Ambon I.). Pollen and Van Dam 1875:80 (list). Bleeker 1875:80 (Madagascar); 1878:53 (New Guinea). Günther 1876:160 (list). Bleeker 1879a:17 (Mauritius). Macleay 1882:360 (New Guinea); 1883:266 (Goldie R., New Guinea). Day 1888:787 (Ceylon). Sauvage 1891:518 (Madagascar). Herre 1926a:220 (Philippines); 1934:58 (Phillipines). Fowler 1928:236 (Indo-Pacific). Weber and de Beaufort 1936:551 (synopsis). Smith 1939:215 (Mozambique). Fowler 1949:53 (synopsis). Smith 1949:179, pl. 13 (color; Delagoa Bay, Mozambique). Herre 1953:480 (Philippines). Mendis 1954:175 (Ceylon). Smith 1955b:304 (Aldabra). Munro 1955:122 (Ceylon). Fourmanoir 1957:190 (Mozambique). Kamohara 1959:3 (Okinoshima, Japan). Matsubara 1963:598 (synop-

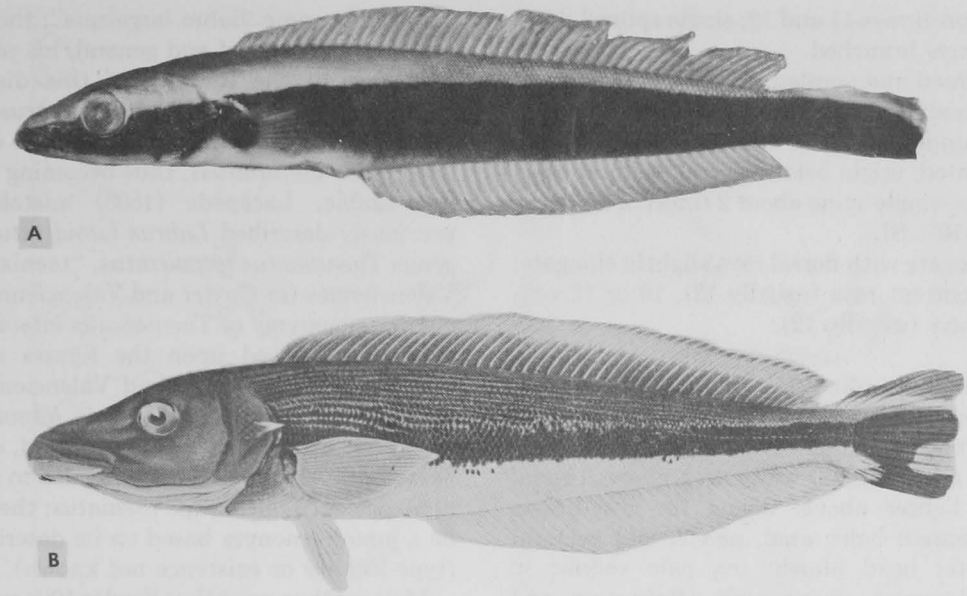


Figure 36.—A. *Malacanthus latovittatus*, juvenile coloration, 67 mm SL (BPBM 7283). B. *M. latovittatus*, adult coloration (after Jordan and Seale 1906).

sis). Smith and Smith 1963:13, pl. 8 (Seychelles). Araga 1969:405, fig. 1 (juvenile specimen; Japan). Yasuda and Hiyama 1971:135, pls. 226, 227 (color, underwater). Shiino 1972:86 (common name). Helfman and Randall 1973:145 (Palau). Clark and Ben-Tuvia 1973:6, fig. 5 (Red Sea). Burgess and Axelrod 1973:531, pl. 492 (color; synopsis).

Malacanthus taeniatus Valenciennes 1839: 239, 327, pl. 381 (*in* Cuvier and Valenciennes 1839) (original description; Port Dorey, New Guinea). Bleeker 1849:7 (Java); 1851:218 (Celebes); 1860:43 (Celebes).

Malacanthus urichthys Fowler 1904:549, pl. 22 (original description; Padang, Sumatra).

Oceanops latovittata Jordan and Seale 1906:277, pl. 39 (color; original description of new genus). Jordan and Thompson 1914:260 (Japan).

Oceanops latovittatus. Snyder 1912b:487 (Okinawa). Fowler 1949:54 (Indo-Pacific).

Diagnosis.—Easily distinguished from the remaining species of *Malacanthus* by the broad (about the width of the pectoral base) dark longitudinal body stripe running from the operculum to the tip of the caudal fin. The low number of anal fin rays (37-40, modally 39) distinguishes *M. latovittatus* from the other species of *Malacanthus* (46-55 anal rays), see Table 20.

Description.—Dorsal fin elements III-IV (rarely III), 43-47 (modally 45); anal with single spine; pectoral fins 16 or 17 (modally 17); total first arch gill rakers 6-14 (modally 9); pored lateral-line scales 116-132 (mean 124); cheek scales 6-10 (modally 7); opercular scales 6-9 (modally 7); scales above lateral line 10-15 (modally 12); scales below lateral line 32-40 (modally 37).

Head elongate, pointed snout; body depth 15-20% (modally 17%) SL (Table 22); body width 10-15% (modally 14%) SL; caudal peduncle length 6-8% (modally 7%) SL; caudal peduncle depth 6-7% (modally 6%) SL; head length (HL) 25-32% (modally 29%) SL; predorsal length 26-34% (modally 30%) SL; head depth 48-56% (modally 50%) HL; snout length 37-47% (modally 44%) HL; length of upper jaw 29-32% (modally 31%) HL; length of lower jaw 36-42% (modally 40%) HL; cheek depth 17-21% (modally 20%) HL; opercular length 22-27% (modally 25%) HL; snout to dorsal margin of preoperculum 74-77% (modally 76%) HL; orbit diameter (allometric) 13-24% (modally 16%) HL; suborbital depth 8-20% (allometric) (modally 18%) HL.

Jaws reach posteriorly to below anterior nostril, well anterior to orbit; teeth relatively small; upper jaw with 28-31 canine teeth along outer row, 5 posterior teeth being slightly larger than others; lower jaw with approximately 30 canine teeth, posterior 15 teeth slightly larger; upper and lower jaws with patches of villiform teeth at symphysis; lips very fleshy, upper lip nearly covering lower jaw.

Preoperculum edge smooth, angle about 110-120°; operculum with sharp spine, about equal to diameter of pupil; gill rakers reduced.

Lateral-line pores in a low profile; head pores: 4 mandibular, 14 preopercular series, 12-14 infraorbital series, 12 postocular-cephalic lateralis series, supratemperal branch with 7, 6-7 supraorbital, 1 or 2 medial (pineal) pores, total about 60 cephalic pores on each side.

Dorsal fin with low spinous portion, soft portion nearly uniform in height, slightly less than anal; fin base 62-69% (modally 65%) SL; spines short and flexible, first spine about three-fourths length of second; anterior one or two rays unbranched, remaining rays branched; dorsal origin over anterior margin of pectoral base.

Anal fin base length 46-52% (modally 50%) SL; origin

below between dorsal rays 11 and 12; single spine 2 times in first ray; all rays branched.

Pectoral fins broad and pointed reaching to over anus; length 14-17% (modally 16%) SL; all but dorsalmost ray branched; stout upper ray about 3 times in length of fin.

Pelvic fins pointed, origin below ventral pectoral base; do not reach anus; single spine about 2 times in length of fin; fin length 9-10% SL.

Caudal fin truncate with dorsal rays slightly elongate; 10-12 dorsal procurrent rays (usually 12), 10 or 12 ventral procurrent rays (usually 12).

Color.—Live coloration: olive gray to violet-blue above, whitish blue ventrally; body with broad dark longitudinal stripe from operculum to tail; caudal fin ventrally dark with a rectangular white area above, caudal medially dark, lighter above; dorsal fin gray-brown basally, upper margin light; anal, pelvic, and pectoral fins bluish white; head bluish; iris pale yellow; in alcohol: body brownish above with alternating and numerous thin light-colored stripes forming convoluted patterns; dark longitudinal band evident; ventral body whitish; head brown; all fins translucent, pectoral fin base milky white; juvenile color pattern quite unlike adult, more resembling that of the cleaner wrasse, *Labroides dimidiatus* (Fig. 36); mimicry of *L. dimidiatus* seems likely (Araga 1969).

Distribution.—Like other species of malacanthids, *M. latovittatus* has been observed inhabiting burrows (J. Randall, pers. commun.; Araga 1969). Range includes the Red Sea (Clark and Ben-Tuvia 1973), Kenya, Mozambique, Aldabra Is., Madagascar, Mauritius, Ceylon, Indonesia, Micronesia, Philippines, Okinawa, Tanabe Bay (Honshu, Japan; most northern record, Araga 1969), Melanesia, New Guinea (also reported from hyposaline waters of the Goldie R., Macleay 1883), New Caledonia (P. Fourmanoir, pers. commun.); apparently not found off New Zealand as reported by Weber and de Beaufort (1936) according to R. McDowall and J. Garrick Pers. commun.); Palau Is., Samoa, Fanning I., and Hawaiian Is. (Fig. 37): recorded from 6-10 m depths.

Material examined.—Total of 38 specimens, 64-380 mm SL. KENYA: RUSI 2224, 340 mm SL; RUSI 2225, 288 mm. MADAGASCAR: RMNH 4390, 305 mm. MAURITIUS: MCZ 5791, 335 mm; USNM 19973, 249 mm. INDONESIA: ZMA 111.184, 285 mm; RMNH 16012, (3) 235-360 mm; USNM 216683, 274 mm; USNM 216684, 315 mm; USNM uncat., 64 mm; RMNH 6350, (2) 200-318 mm. PHILIPPINES: USNM 116794, 270 mm; USNM 6541, 300 mm; USNM 216682, (2) 332-345 mm; OSU 706, 158 mm. OKINAWA: USNM 71898, 365 mm. GUAM: UG 4139, 305 mm; UG 1163, 330 mm. NEW GUINEA: ZMA 111.183, 183 mm; BPBM 7283, 67 mm; AMS I.9075, 335 mm. NEW BRITAIN: AMS B.3737, 275 mm. PALAU IS.: CAS 14809, (2) 172-180 mm; BPBM 10196, 215 mm; RMNH 11504, 320 mm. IFALIK ATOLL: CAS 14807, 260 mm; CAS 14808, 270 mm. FANNING I.: BPBM 7800, 102 mm. SAMOA: USNM 52482, 347 mm. LOCALITY (?): USNM 19973, (2) 249-360 mm.

Remarks.—The location or existence of Lacépède's (1802) type is unknown; Lacépède (1802) designated *Labrus latovittatus* = *Malacanthus latovittatus* with the vernacular name "labre large-raie"; though his description was rather brief and general, his plate 28 leaves no doubt as to the identity of this distinctive species because of the broad body stripe. *Labrus latovittatus* was subsequently used by Rüppell 1835, to describe a labrid (*Labroides dimidiatus*), thus becoming a homonym and unavailable; Lacépède (1803) mistakenly listed his previously described *Labrus latovittatus* under another genus *Taenianotus latovittatus*, "taenianote large-raie"; Valenciennes (*in* Cuvier and Valenciennes 1839) pointed out the synonymy of *Taenianotus latovittatus* = *Labrus latovittatus* based upon the figures of both species; Valenciennes (*in* Cuvier and Valenciennes 1839) recognized Lacépède's (1802) *Labrus latovittatus* not as a labrid but as a species of malacanthid, closely related to *Malacanthus plumieri*; he proceeded to redescribe it as a new species *Malacanthus taeniatus*; the latter proved to be a junior synonym based on its description and figure (type-locality or existence not known).

Malacanthus urichthys Fowler 1904 was described and then subsequently synonymized by him (Fowler 1928); my examination of the holotype (ANSP 27783) confirms its synonymy: 300 mm SL, 346 mm TL; Padang, Sumatra; D. IV, 44; A. I, 38 (plus an unattached ray); P_1 16 (not 15 as Fowler described); B. 6; C. 17; total first arch gill rakers 10; pored lateral-line scales 120 plus 2 on tail (not 128); cheek scales 8; opercular scales 9; head length (HL) 32% SL; orbit 15% HL; body depth 17% SL; specimen in good condition.

HOPLOLATILUS (GÜNTHER 1887)

Hoplolatilus Günther 1887:550 (type-species, *Latilus fronticinctus* Günther, by monotypy).

Asymmetrurus Clark and Ben-Tuvia 1973:1 (type-species, *Asymmetrurus oreni*, original description).

Diagnosis.—Length of dorsal plus anal fin bases 80-100% (modally 90%) SL; *Malacanthus* dorsal plus anal fin bases equals 112-135% (modally 125%) SL; preopercular margin serrate (never serrate in *Malacanthus*), enlarged spine may be present at preopercular angle; dorsal fin elements III-X, 13-34 (modally 31); *Malacanthus* with I-V, 43-60 (modally 56); *Hoplolatilus* with I-II, 12-20 (modally 19) anal fin elements, *Malacanthus* always with a single anal spine and 37-55 (modally 48) rays; first haemal spine positioned over first or second anal ray; first haemal spine of *Malacanthus* positioned over anal rays 12-18; predorsal fin supports 0-0-2-; among species of *Malacanthus*: 0-0-1-, 0-1-, or 2- (Table 2).

Description.—Pectoral fin rays 16-19; total first arch gill rakers 16-28 (Table 23); pored lateral-line scales 89-140 (Table 24); cheek scales 6-14; opercular scales 7-11; scales above lateral line 10-20; scales below lateral line 34-49; vertebrae 10 or 11 + 14 (Table 25).

Body elongate, depth 15-26% SL (depth greater on specimens under 50 mm SL); body width 9-16% SL (width greater on specimens under 50 mm SL); caudal peduncle length 12-18% SL; caudal peduncle depth 9-

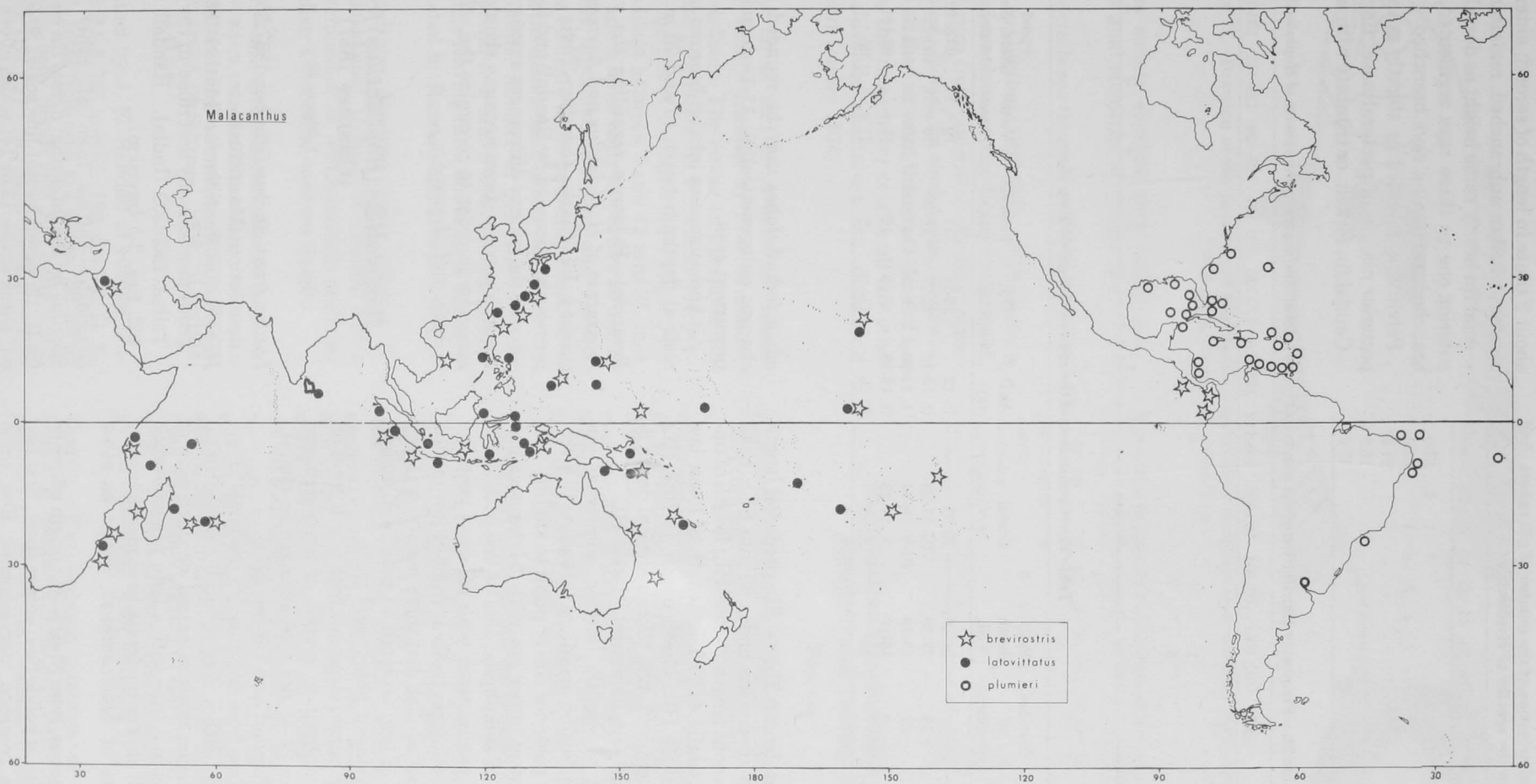


Figure 37.—Distribution of the genus *Malacanthus* based upon museum specimens and reliable records.

Table 23.—Frequency distribution of the number of gill rakers (first arch) in the species of *Hoplolatilus*.

Species	16	17	18	19	21	22	23	24	25	26	27	28	$\bar{x}$
fronticinctus										1	1	2	27.0
starcki						1	7	4	3	-	1		23.8
cuniculus					4	7	1						21.8
fourmanoiri	4	3	1	1									16.8
oreni		1											17.0

about 2 times in length of second; anterior first or second rays branched or unbranched, remaining rays branched.

Anal fin nearly same height as dorsal, base 26-36% SL; anterior one to three rays segmented, branched or unbranched, remaining rays branched.

Pelvic fins rounded or slightly pointed; origin below posterior margin of pectoral base; fin length 9-17% SL.

Caudal fin forked, or truncate with upper rays produc-

Table 24.—Frequency distribution of the number of pored lateral-line scales in the species of *Hoplolatilus*.

Species	89-92	97-100	101-104	105-108	109-112	113-116	117-120	121-124	125-128	129-132	133-140	$\bar{x}$
fronticinctus	4											91.3
starcki		1	5	5	4	1						106.0
fourmanoiri		6	2									99.4
oreni	1											92.0
cuniculus						1	3	1	2	3	2	125.8

Table 25.—Comparison of the species of *Hoplolatilus*.

Species	Number of specimens	Body depth % SL	Dorsal rays	Anal rays	Gill rakers	Pectoral rays	Vertebrae	Pored lateral-line scales	Preopercular serrae $\bar{x}$
fronticinctus	4	24-26	X, 13	II, 12	26-28	17	10 + 14	89 or 92	18
starcki	16	22-29	VIII, 21-23	II, 15-16	22-27	18-19	10 + 14	100-113	43
cuniculus	12	16-19	III-V, 29-34	I, 19-20	21-23	17 (18)	10 + 14	116-140	41
fourmanoiri	9	16-19	X, 21-23	II, 18-19	16-19	16	11 + 14	98-101	37
oreni	1	15	X, 22	II, 20	17	16	11 + 14	92	56

13% SL; head blunt, length 21-28% SL; predorsal length 20-34% SL (less on specimens under 50 mm SL); head depth 57-86% HL; snout length 20-29% HL; length of upper jaw 37-48% (modally 44%) HL; length of lower jaw 38-51% (modally 46%) HL; cheek depth 19-30% HL; fleshy interorbital width 27-42% HL; suborbital depth 3-7% HL; orbit diameter (allometric) 22-31% HL.

Mouth terminal to slightly inferior, somewhat oblique; upper jaw protrusile; maxillary extending to a vertical from between posterior rim of pupil to slightly posterior of orbit; front of upper jaw with 1-3 large canine teeth on each side of symphysis; side of jaw with single outer row of small canine teeth with enlarged posterior canine; 3-5 rows of villiform teeth at front of jaw medial to canines; lower jaw similar, but there may be enlarged canines along side of jaw; no teeth on palatines, vomer, or tongue; well-developed pharyngeal teeth.

Lateral line a low curve; lower jaw with 5 or 6 pores on each side from symphysis to margin of preoperculum; total cephalic pores 34-45 per side arranged in characteristic patterns (Randall and Dooley 1974).

Gill membrane free from isthmus; no predorsal ridge; skull rather smooth with a very reduced supraoccipital crest; orbit very large; nostrils paired on each side of head, anterior naris in a tube with a flap; pseudobranch well developed; gill rakers moderate to elongate (unlike the reduced rakers of *Malacanthus*); scales as other malacanthids.

Dorsal fin continuous, base 53-64% SL; origin above or just posterior to base of pelvic fins; spines short, first two spines united to a common pterygiophore; first spine ed; if forked, lobes may be rounded or pointed (shape changes ontogenetically); 11-13 dorsal and 9-13 ventral procurrent rays.

All known species inhabit burrows in the bottom near reefs at depths between 15 and 70 m.

Remarks.—Evidence regarding the validity of generic separation of *Hoplolatilus* and *Asymmetrurus* as distinguished by Clark and Ben-Tuvia (1973) has been previously discussed by Randall and Dooley (1974). Considering the generic differences among malacanthids and branchiostegids, *Asymmetrurus* should be regarded as a subgenus in order to recognize the affinities of *H. fourmanoiri* and *H. oreni*.

Hoplolatilus (*Hoplolatilus*) *fronticinctus* (Günther 1887)

Figure 38

Latilus fronticinctus Günther 1887:550, pl. 48 (original description; Mauritius).

Hoplolatilus fronticinctus Günther 1887:550, pl. 48 (new genus provisionally described in the same publication). Talbot 1969:309 (India). Randall and Dooley 1974: 462, figs. 2-5 (revision).

Diagnosis.—Differs from all other species of *Hoplolatilus* by the following: dorsal fin elements X, 13; anal fin II, 12; pored lateral-line scales 89-92; caudal fin forked; cheek scales 13 or 14; scales above lateral line 17-20;

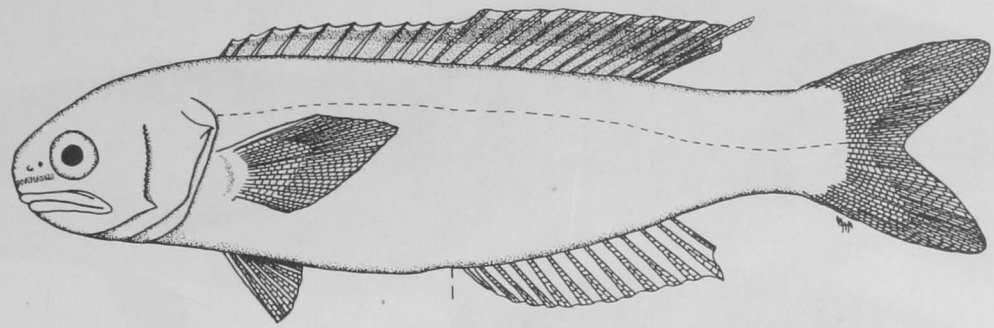


Figure 38.—Drawing of the holotype of *Hoplolatilus fronticinctus* (redrawn from Günther 1887), BMNH 1886.2.5.8, 169 mm SL, Mauritius.

dusky band across snout; elongate palp under operculum; dorsal plus anal elements 37 (Table 26).

Description.—For details see Randall and Dooley (1974).

Color.—According to Günther (1887:551): "The body is of a uniform light olive colour, rather darker on the back. A dark violet band runs from one eye to the other across the front of the snout. Dorsal fin dark violet, yellowish along the base and on the last rays; the upper third of the pectoral fin bluish, the remainder, as also all the other fins, yellowish." Juvenile specimens are differently colored (Randall and Dooley 1974).

Larvae.—Numerous larval and prejuvenile specimens and drawings were kindly donated by P. Fourmanoir, ORSTOM, New Caledonia. The larvae and prejuveniles have elongate serrate projections on the snout, preoperculum, and dorsal margin of the operculum (figs. 3-5). The spination is evident between 8 and 42 mm SL (not including rostrum) and is apparently lost before 50 mm is attained. A juvenile specimen (Randall and Dooley, 1974; fig. 3) had the elongate white palp characteristic of the adult as well as the dusky band across the snout; the dorsal and anal counts, number of gill rakers, cheek scales and pored lateral-line scales conform completely with the species range leaving little doubt to its identity (not doubtful as stated by Randall and Dooley (1974)).

Distribution.—Mauritius; Madras, India; Palau Is. (juvenile); New Caledonia; Gilbert Is.; South Africa (possible larval specimens of *H. fronticinctus*); probably throughout the Indian Ocean and western Pacific.

Material examined.—MAURITIUS: BMNH 1886.2.5.8 (holotype), 157 mm SL; BMNH 1891.3.11.2, 169 mm. INDIA: AMS 15599-001, 105 mm. PALAU IS.: BPBM 12454, 51 mm (juvenile). SOUTH AFRICA: SAM 26657, 37 mm; SAM 26658, (2) 24-26 mm. NEW CALEDONIA: numerous larvae (JKD) 22-42 mm.

Holotype.—Examined by J. E. Randall at British Museum: BMNH 1886.2.5.8, 157 mm SL, 198 mm TL; D. X, 13; A. II, 12; P_1 17; total first arch gill rakers 29; pored lateral-line scales 92; body depth 26% SL; body width 13% SL; head length (HL) 27% SL; head depth 87% HL; orbit 24% HL; suborbital depth 4% HL.

Table 26.—Frequency distribution of the total number of dorsal plus anal fin elements in the species of *Hoplolatilus*.

Species	37	46	47	48	49	52	53	54	56	57	58	59	$\bar{x}$
fronticinctus	4												37.0
starcki		5	1	8	2								47.6
cuniculus									4	5	2	1	57.0
fourmanoiri						4	3	2					52.8
oreni								1					54.0

Hoplolatilus (Hoplolatilus) starcki Randall and Dooley 1974

Figure 39

Hoplolatilus starcki Randall and Dooley 1974:464, figs. 6-8 (original description; Guam).

Diagnosis.—Caudal fin forked with bright yellow lobes, *H. fourmanoiri* and *H. oreni* both have truncate tails; dorsal fin with VIII spines, *H. fronticinctus, H. fourmanoiri*, and *H. oreni* with X, and *H. cuniculus* with III-V spines; anal fin II, 15-16; the number of pored lateral-line scales 100-113 are characteristic of *H. starcki.*

Description.—For details see Randall and Dooley (1974).

Color.—According to Randall and Dooley (1974): in life, tan with a well-defined large bright blue area beneath the pectoral fin, over all of thorax and postorbital portion of head (except dorsally); caudal fin bright yellow except for a centro-posterior area, the upper margin and, to a lesser extent, the lower margin abruptly whitish; dorsal and anal fins yellowish, dorsal with a bluish cast; paired fins pale; color in alcohol: body light tan except for bright blue head turned a dark brown or metallic silver; fins all transparent, caudal with light yellow lobes; a 41-mm juvenile was entirely light blue on body, most of head and scaled portion of caudal fin; caudal lobes dull yellow, central portion transparent; intermediate color phases have been photographed (Fig. 39).

Biology.—The stomach contents of six adults from Eniwetok, Guam, Ulithi, and Palau consisted of copepods (31.4% by volume), pelagic tunicates (31.0%, larvaceans, including *Oikopleura*), fish eggs (28.6%),

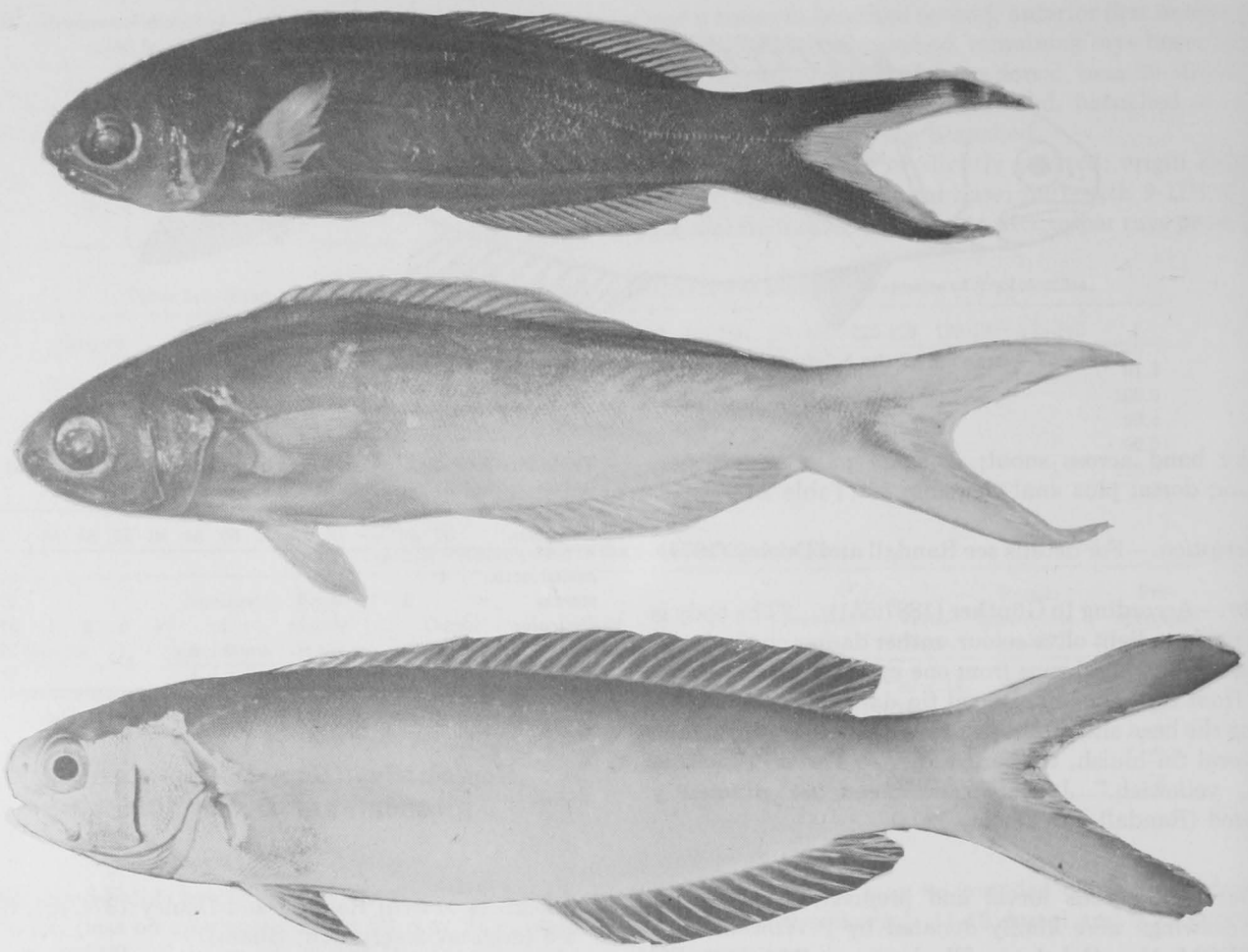


Figure 39.—A. *Hoplolatilus starcki*, juvenile coloration, 66 mm SL (paratype, BPBM 12571), Palau Islands. B. *H. starcki*, intermediate coloration, 90 mm SL (paratype, BPBM 9441), Palau Islands. C. *H. starcki*, adult coloration, 102 mm SL (holotype, BPBM 7298), Guam (C. photographed by J. E. Randall).

siphonophores (5.5%), larval shrimps (1.2%), fish (0.8%), amphipods (0.7%), unidentified decapod larvae (0.5%), and heteropods (0.3%) (Randall and Dooley 1974).

Hoplolatilus starcki prefers relatively deep water of outer reef areas; often seen (Randall and Dooley 1974) as much as 4-5 m above the bottom where it feeds on zooplankton. When frightened, *H. starcki* retreats to the vicinity of its burrow, hovering with its head angling slightly downward over its opening. If an observer comes within about a meter of the fish, it will dart head-first into its burrow. Two fish will often occupy the same burrow and will hold an alert position, side by side, above their burrow. Further harassment causes both fish to enter the hole, one a split second after the other (Randall and Dooley 1974).

According to W. A. Starck II (pers. commun.), blue juveniles sometimes join schools of *Mirolabrichthys* sp. which they resemble in color.

Distribution.—Known from Guam, Palau, and Mariana Islands; Ulithi, Caroline Islands, Eniwetok, Marshall Islands; and Rangiroa, Tuamotu Archipelago. Also observed but not captured by J. Randall off Temoe, Gambier Group, Tuamotu Archipelago.

Material examined.—Total of 16 specimens, 41-116 mm SL. GUAM: BPBM 7298, (holotype) 102 mm SL; paratypes: BPBM 7297, 99 mm. ULITHI: BPBM 9202, (2) 113 and 116 mm. PALAU IS.: BPBM 9441, 90 mm; BPBM 9535, 41 mm; AMS I.17154-001, 91 mm; BMNH 1973.7.17.1, 98 mm; CAS 28353, 103 mm; MNHN 1973.34, 106 mm; BPBM 12456, 60 mm; BPBM 12455, 55 mm; BPBM 12457, 57 mm. ENIWETOK: BPBM 11662, 109 mm; USNM 209535, 108 mm. RANGIROA: BPBM 14005, 70 mm.

Hoplolatilus (*Hoplolatilus*) *cuniculus* Randall and Dooley 1974

Figure 40

Hoplolatilus cuniculus Randall and Dooley 1974:466, fig. 9 (original description; Tahiti).

Diagnosis.—Can be distinguished from other species of *Hoplolatilus* by the low number of dorsal spines (III-V) and high number of dorsal rays (29-34); *H. cuniculus* is the only species with a single anal spine (I, 19 or 20), the remaining species of *Hoplolatilus* have two anal spines; characteristically with a high number of pored lateral-line scales 116-140 (Table 24); the forked tail and 10 + 14 vertebral count separate *H. cuniculus* from *H. fourmanoiri* and *H. oreni* (both with truncate tail, 11 + 14

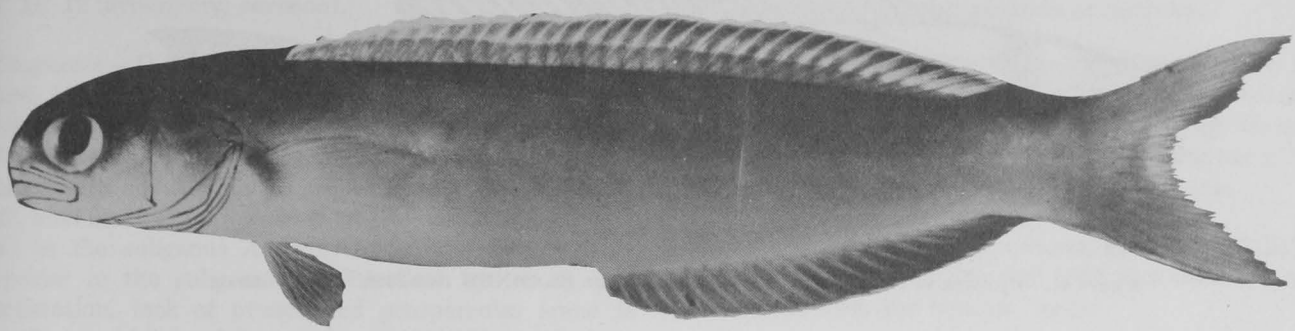


Figure 40.—Holotype of *Hoplolatilus cuniculus*, 79 mm SL (BPBM 11996), Tahiti (photograph by J. E. Randall).

vertebrae); dorsal plus anal fin elements 56-59, other species of *Hoplolatilus* 54 or less.

Description.—See Randall and Dooley (1974) for details.

Color.—Life colors: light olive brown on back shading to pale yellow ventrally; blue area over dorsal and postorbital head regions (fades soon after death); posterior caudal peduncle and caudal fin deep yellow, except for centro-posterior portion of fin; upper and lower caudal margins whitish, white margins separated from yellow caudal lobes by a dark line; dorsal fin with pink margin, a broad median bluish band, and basally colored like body; anal fin light yellowish with a pale pink margin; paired fins pale.

Color in alcohol: body dark brown above, light ventrally; base of caudal yellow-orange; dorsal and ventral caudal lobes dusky, distal margin clear; pectoral fin milky above, remainder clear; remaining fins clear except the dusky ventral portion of dorsal fin.

Biology.—This species was observed a meter above the bottom. With the approach of a diver, it retreated to a burrow which it rapidly entered head first. As with *H. starcki*, two fish were seen entering the same burrow (Randall and Dooley 1974).

Stomachs of six adult specimens (91-104 mm SL) were opened for food analysis. Two stomachs were empty, the others contained: calanoid copepods (58% by volume), larvaceans (20%), siphonophores (20%), and fish eggs (2%); all organisms were pelagic forms (Randall and Dooley 1974).

Distribution.—Known only from a deep channel leading to Popote Bay, District of Papara, Tahiti; possible postlarval specimens collected by P. Fourmanoir might indicate a widespread South Pacific distribution (Randall and Dooley 1974).

Material examined.—Total of 12 specimens, 55-88 mm SL (all previously designated as types, Randall and Dooley, 1974). TAHITI: BPBM 11996 (holotype), 79 mm SL; paratypes: BPBM 9281, (2) 72-88 mm; BPBM 11997, (4) 55-82 mm; AMS I.17155-001, 78 mm; BMNH 1973.7.17.2, 82 mm; CAS 28354, 72 mm; MNHN 1973-35, 81 mm; USNM 209534, 79 mm.

Holotype.—For counts and measurements see Randall and Dooley (1974).

Hoplolatilus (*Asymmetrurus*) *fourmanoiri* Smith 1963

Figures 41, 42

Hoplolatilus fourmanoiri Smith 1963:745, pl. 23 (original description; Vietnam). Fourmanoir 1965:48, fig. 27 (Nhatrang, Vietnam). Randall and Dooley 1974:469, fig. 10 (revision).

Asymmetrurus fourmanoiri. Clark and Ben-Tuvia 1973: 6 (placed in new genus).

Diagnosis.—Distinguished from all other species of *Hoplolatilus* by the large dark area on the tail, also dark irregular pigment on head and nape; large, usually upcurved sharp spine at angle of preoperculum; a similarly shaped spine on operculum; broad maxillary (equal to pupil diameter); can be separated from *H. fronticinctus*, *H. starcki*, and *H. cuniculus* by: vertebrae 11 + 14, number of dorsal plus anal elements (52-54), total first arch gill rakers 16-19, and number of pectoral rays (16); distinguished from *H. oreni* by: coloration, preopercular spine, and number of pored lateral-line scales (98-101 vs. 92 in *H. oreni*) (Table 24).

Description.—See Randall and Dooley (1974) for details.

Color.—Fresh color according to Fourmanoir (1965): dorsal surface of head and supraorbital with violet-black pattern; area between pattern yellow-orange; back dark; tail with triangular black area covering medial portion.

Color in alcohol: dark back, remaining body yellowish-brown, pale areas on lips, snout, either side of nape and beneath anterior dorsal fin, dorsal pattern variable; other dark areas on head and tail as on fresh specimens.

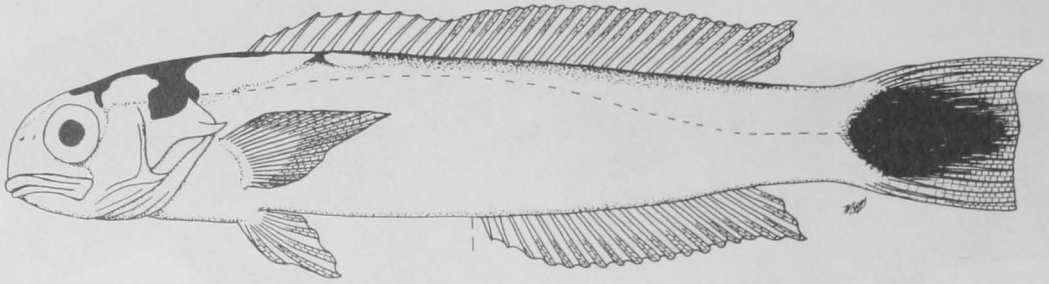


Figure 41.—Drawing of *Hoplolatilus fourmanoiri*, 110 mm SL (MNHN 1964-248), South Vietnam.

Figure 42.—Dorsal view of *Hoplolatilus fourmanoiri* depicting various patterns of pigmentation (MNHN 1964-248).

Distribution.—Known only from South Vietnam at 18-36 m depths.

Material examined.—VIETNAM: RUSI 608 (paratype), 109 mm SL; RUSI 609 (paratype), 112 mm; BMNH 1965-580 (paratype), 110 mm; MNHN 1964-248, (6) 110-112 mm.

Paratype.—Holotype was not examined, deposited at RUSI. Smith's (1963) type-description was based on the holotype and three paratypes (examined in this study); two RUSI paratypes were examined by the author, the paratype deposited at BMNH was kindly examined by J. Randall. The following counts and measurements were taken from a paratype (RUSI 608): 109 mm SL, 132 mm TL; D. X, 22; A. II, 18; P_1 16; first arch gill rakers 17 pored lateral-line scales 98; cheek scales 10; opercula scales 8; body depth 18% SL; body width 12% SL; hea length 27% SL; orbit diameter 25% HL.

Hoplolatilus (*Asymmetrurus*) *oreni* (Clark and Ben-Tuvia 1973)

Figure 43

Asymmetrurus oreni Clark and Ben-Tuvia 1973:8, figs 6-8 (original description; Red Sea).

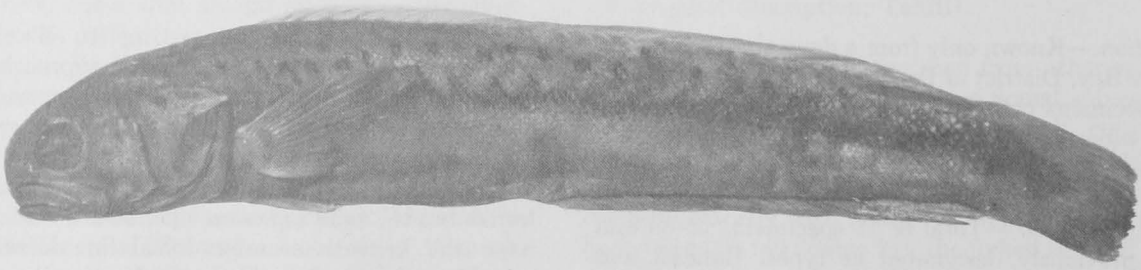


Figure 43.—Holotype of *Hoplolatilus oreni*, 141 mm SL (USNM 208593), Massawa, Ethiopia.

Hoplolatilus oreni. Randall and Dooley 1974:470, figs. 11, 12 (synonymy; revision).

Diagnosis.—Differs from *H. fronticinctus*, *H. starcki*, and *H. cuniculus* by: tail truncate in *H. oreni*, vertebrae 11 + 14, 17 first arch gill rakers (21 or more in former species), opercular spine larger than pupil, maxillary width about equal to pupil diameter, dorsal fin X, 22, anal fin II, 20; differs from *H. fourmanoiri* (both placed in the subgenus *Asymmetrurus*; the former three species in the subgenus *Hoplolatilus*) by: body pigmentation, lack of pronounced preopercular spine at angle, pored lateral-line scales 92 (98-101 in *H. fourmanoiri*), and upper jaw extending beyond posterior orbital rim in *H. oreni*.

Description.—For details see Clark and Ben-Tuvia (1973) and Randall and Dooley (1974).

Color.—In alcohol: body with a series of dark tapered bands following the lateral line from pectoral base to caudal base; a series of small (about half pupil diameter) dark spots above the tapered dorsal tips of dark bands.

Distribution and materials examined.—Known only from the holotype (USNM 208593, 141 mm SL) from near Massawa, Ethiopia, in the Red Sea (Fig. 44).

SUMMARY

1. The tilefishes (branchiostegids) and blanquillos (malacanthids) were examined for the first time on a worldwide basis. The study included a majority of the available specimens from more than 50 museums and institutions. Limited field study and the examination of fresh material supplemented the study of museum collections. Distributions were derived from museum data, reliable literature records, and personal communications. Osteological characters were examined, but a detailed discussion is beyond the scope of this paper.

2. The tilefishes and blanquillos have been taxonomically separated and united numerous times in the literature, most recently united into a single family Branchiostegidae. Little or no justification was given for these transitions. Examination of numerous characteristics discussed in this study suggest that the tilefishes and malacanthids belong to two distinct phyletic lines distinguishable at the family level. Differences equal or exceed differences between many other percoid families.

3. Branchiostegidae includes 3 genera and 21 nominal species; these are deep-bodied, robust fishes that inhabit relatively deep water (20-600 m, usually greater than 50 m depths) at the heads of oceanic canyons, or over mud or rubble bottoms; they may occasionally inhabit caves or crevices (as do some serranids), but unlike malacanthids are not known to construct or inhabit mounds or burrows.

4. The genus *Caulolatilus* consists of six western Atlantic species and three (including a new species) eastern Pacific species. These sympatric species have been isolated at least since the last emergence of the Panamanian Isthmus in the Late Pliocene.

5. *Caulolatilus cabezon* Evermann and Radcliff 1917 is a synonym of *C. affinis* Gill 1865; *C. hubbsi* is a new species from the eastern Pacific.

6. The genus *Branchiostegus* consists of 10 nominal species: 9 from the Red Sea and Indo-west Pacific and 1 species restricted to west Africa.

7. *Branchiostegus albus* is a previously undescribed species from the western Pacific often confused with *B. argentatus*.

8. *Lopholatilus* contains two species: *L. chamaeleonticeps* from the western North Atlantic and *L. villarii* a little known species from the western South Atlantic.

9. Malacanthidae consists of two genera and eight species; these fishes are generally found in shallow water (10-150 m, usually less than 50 m) over sand or rubble bottoms close to reefs. They are mainly tropical or subtropical fishes and apparently all inhabit self-constructed mounds or burrows.

10. The genus *Malacanthus* is comprised of three species: *M. latovittatus* found in the Red Sea and the Indian and western and central Pacific Oceans; *M. brevirostris*, sympatric with *M. latovittatus* except it extends to the eastern Pacific; *M. plumieri* is essentially restricted to the western Atlantic (plus Ascension I.).

11. *Malacanthus hoedtii* is a junior synonym of *M. brevirostris*.

12. *Hoplolatilus* is composed of five species found along the deeper areas of the reef and restricted to the Indian and western and central Pacific Oceans.

13. Early life history aspects were summarized as far as known from the literature. Ontogenetic series were assembled when possible from museum specimens. Tilefishes and blanquillos have an unusual spinous pelagic larva similar to that found among holocentrids, lutjanids, serranids, and istiophorids. A spinous pelagic larva undoubtedly enhances both the dispersal and survivorship of these benthic fishes.

14. Preliminary evolutionary relationships were derived from external and internal morphological characters based on the examination of specimens, radiograms

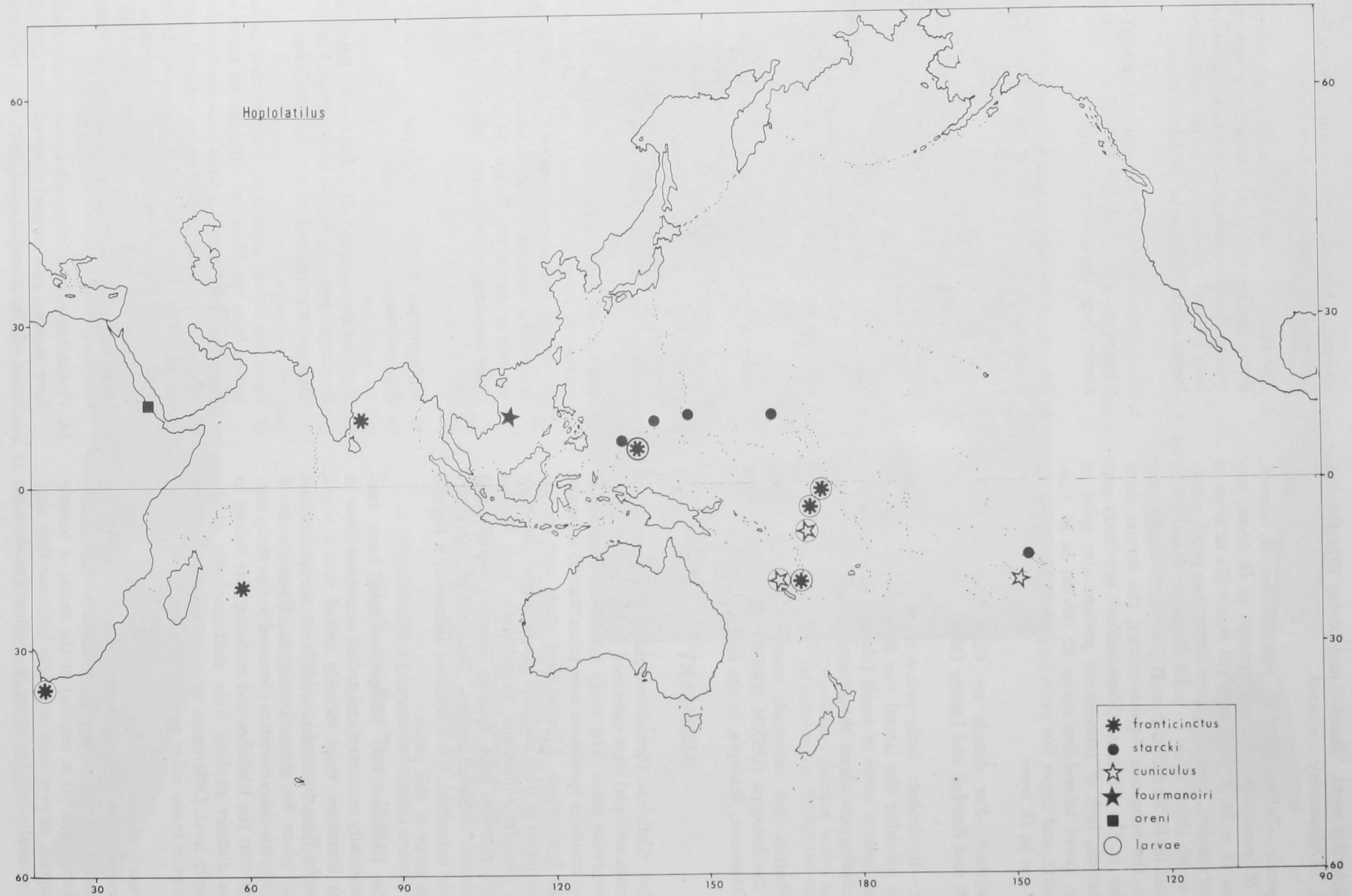


Figure 44.—Distribution of the genus *Hoplolatilus* based upon museum specimens and reliable records.

(from all but 2 species), and disarticulated skeletons (from 15 of 29 species).

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