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Taxonomy of Larval Blennioidei of Belize, Central America

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TAXONOMY OF LARVAL BLENNIOIDEI OF BELIZE, CENTRAL AMERICA

A Thesis
Presented to
The Faculty of the School of Marine Science
The College of William and Mary in Virginia

In Partial Fulfillment
Of the Requirements for the Degree of
Master of Arts

by
Martin Ray Cavalluzzi
1992

This thesis is submitted in partial fulfillment of

the requirements for the degree of

Master of Arts

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DEDICATION

To my parents, Remo and Glenda,
for sending me to science camp at Cold Spring Harbor Fish Hatchery
when I was a kid.

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ABSTRACT

The suborder Blennioidei comprises six families: Blenniidae, Chaenopsidae, Clinidae, Dactyloscopidae, Labrisomidae, and Tripterygiidae. Of the 128 genera and approximately 675 species of blennioids, early life history information is known for only 29 genera and 37 species. A faunal list was constructed for all species of blennioids known to inhabit the tropical and subtropical western Atlantic. Meristic data tables were constructed for 33 genera and 122 species of blennioids known to inhabit these areas. Seventy-three blennioid larvae (3.6-15.3 mm SL) from Ambergris Cay, Belize, were grouped into 20 morphotypes based on pigment characters. Larvae representing 12 morphotypes were cleared and stained and identified to the lowest taxonomic level using meristics. Larvae of the following taxa were identified: *Gillellus jacksoni*, *G. uranidea* (Dactyloscopidae); *Stathmonotus hemphilli*, *Stathmonotus stahli tekla*, *Paraclinus* sp., *Labrisomus* or *Malacoctenus* sp. (Labrisomidae); three *Enneanectes* spp. (Tripterygiidae); and two unidentified species of Chaenopsidae.

Unifying characters among blennioid larvae include ventral midline melanophores associated with the bases of the anal-fin elements, little pigmentation overall, lack of neural spines on one to several vertebrae anteriorly, and the presence of spine-like processes on pterygiophores that support dorsal- and anal-fin spines. The spine-like processes on the pterygiophores project anteriorly through the basal halves of the spines.

Pigment is helpful in the separation and identification of larval blennioids. All larvae possess epidermal melanophores on the ventral midline associated with the bases of the anal-fin rays. Other key pigmentation areas include the basipterygia, cleithral symphysis, abdomen, caudal peduncle, occiput, gut, gasbladder, dorsal midline, otic capsules, and the posterior edges of the hypural plates. Larvae of the suborder Blennioidei can be differentiated from larvae of the majority of non-blennioid families based on these pigment characters. Meristics and general morphology can differentiate the remainder of the families. The above-mentioned osteological characters, used in conjunction with pigmentation characters and meristics, offers great taxonomic utility.

TAXONOMY OF LARVAL BLENNIOIDEI OF BELIZE, CENTRAL AMERICA

INTRODUCTION

The suborder Blennioidei contains six families: Blenniidae, Chaenopsidae, Clinidae, Dactyloscopidae, Labrisomidae, and Tripterygiidae (first proposed by Springer in Springer and Freihofer, 1976; George and Springer, 1980). Adult blennioids are small (most less than 15 cm standard length), benthic, cryptic fishes that primarily inhabit tidepools and coral and rocky reefs. Most species are distributed in tropical and subtropical regions of the Atlantic, Pacific, and Indian oceans (Nelson, 1984); however, representatives of some families can be found in boreal (e.g. Blenniidae and Clinidae) (Matarese et al., 1984), brackish (Dactyloscopidae, Blenniidae: *Chasmodes* and *Hypsoblennius*) (Nelson, 1984, Springer, pers. comm.), and freshwater (Blenniidae) (Springer and Gomon, 1975a) environments.

The monophyly of the Blennioidei has been hypothesized (Springer, in press; Johnson, in press) based on six specialized osteological features involving the: dorsal gill arches, pectoral fin and girdle, pelvic fin and girdle, caudal fin, anal fin, and vertebrae. Although the Blennioidei has not been subjected to a rigorous phylogenetic analysis, George and Springer's (1980) classification is widely cited (e.g. Nelson, 1984; Eschmeyer, 1990), and is used in this study.

The taxonomy of blennioid fishes is based primarily on meristic characters, adult coloration, osteological features (e.g. soft-ray type, scale type), and morphology of sensory structures (cirri, sensory canal pores). Adult blennioids are characterized by a combination of several features: anal fin with zero to two spines and all soft rays simple; pelvic fins with one spine and 2-4 simple soft rays; insertion of pelvic fins anterior to pectoral fins; cirri often present on head (variously on nape, above eye, on nostrils, or on margins of cephalic sensory pores); no autogenous parhypural (parhypural absent or indistinguishably fused to hypurals); and hypurals 3 and 4 fused to each other and to urostylar centrum (Springer, pers. comm., as cited in Nelson, 1984).

Four salient characters define the family Blenniidae: body naked (Springer, 1968); anal fin with two spines (the first is buried beneath genital tissue in females) (Nelson, 1984); teeth comblike, close-set, evenly aligned, and in a single row; coracoid reduced and fused to the cleithrum (Springer, 1968). Chaenopsids are characterized by seven features: body elongate, laterally compressed, and naked (Stephens, 1963; Nelson, 1984); head generally fringed and often with heavy rugosities or spines; anus rimmed with fringelike folds (Stephens, 1963); lateral line absent; maxilla adnate (Nelson, 1984); palatine teeth well developed; generally two circumorbital bones (some with three) (Springer, pers. comm.) (Stephens, 1963).

Clinids can be distinguished from other blennioid fishes by the presence of cycloid scales with radii in all fields (excluding the monotypic *Clinoporus*, which lacks scales) (Springer, pers. comm.), and a specialized cordlike ligament connecting the ceratohyal to the dentary (George and Springer, 1980). Dactyloscopids are characterized by seven features: eyes superior; gape oblique to subvertical; lips with or without fimbriae; opercles with ventral margins overlapping below isthmus and with fimbriae on posteriodorsal margins; cephalic sensory canal system extensive and complex (Dawson, 1982); basipterygia extending anteriorly or dorsoanteriorly beyond the cleithra (Springer, pers. comm.); anterior vertebrae compressed.

Labrisomids have large cycloid scales with radii only on the anterior margin, and cirri often present on the nape, above the nostrils, and above the eyes (Nelson, 1984). Tripterygiids are characterized by four features: dorsal fin divided into three distinct segments, the first two composed of spines and the third with six or more soft rays; scales usually ctenoid, with radii on anterior field only (Nelson, 1984); first ray-bearing dorsal-fin pterygiophore does not support a supernumerary spine (an exception to this is in the two species of *Ruanoho*, where 5% of the specimens examined possessed a ray-bearing dorsal-fin pterygiophore that supported a supernumerary spine (Hardy, 1986)); 0-4 pterygiophores not bearing spines anterior to the pterygiophore supporting the first ray (Springer, pers. comm., as cited in Hollemen, 1982; Springer, in press). The soft dorsal fin of tripterygiids is separate from the second spinous dorsal fin; separated by as much as three myomeres, although some New Zealand species possess dorsal fins connected by broad membranes (Springer, in press). The spinous dorsal fin is continuous with the soft dorsal fin in all families except Tripterygiidae. Some species of these families may possess three dorsal fins (i.e. an isolated dorsal finlet in some dactyloscopids and clinids) or four dorsal fins (*Haptoclinus apectolophus*, Labrisomidae), however, the posteriormost spinous dorsal fin is always continuous with the soft dorsal fin.

Meristic variability within species, overlapping extremes in meristic ranges among species, lack of available meristic data, and the absence of adult characteristics (fully developed cirri, sensory pores, adult coloration, etc.) in many larvae, all combine with an unstable classification to make identification of blennioid larvae difficult; these factors probably account for the relative paucity of published data on the early life history of blennioid fishes. Matarese et al. (1984) recognize 128 genera and 675 species of blennioids; Springer (unpublished data) increases these numbers to 138 and 783, respectively. Of those species recognized by Matarese et al. (1984), early life history information is known for only 29 genera and 37 species (Table 1). The majority of this information is available for blenniid taxa. Larvae are unknown for the families Dactyloscopidae and Chaenopsidae, although Stephens et al. (1966) sketched a 17 mm SL larva of *Acanthemblemaria macrospilus*, a chaenopsid from the eastern Pacific, and

Bohlke (1957a) commented on larvae of *Chaenopsis alepidota*. Within the western central Atlantic, the site of my study, data on early life history are available for only three species of blenniids (*Chasmodes bosquianus, Hypsoblennius hentz*, and *Parablennius marmoreus*), and one species of labrisomid (*Paraclinus marmoratus*). Larvae of other families are unknown (Richards, 1990). Known blennioid larvae are characterized by a coiled gut, a short to moderate preanal length, precocious development of teeth and cirri, and the presence of ventral-midline melanophores at the base of each anal-fin soft ray (Matarese et al., 1984).

There are five tribes of blenniids (Blenniini, Salariini, Omobranchini, Phenablenniini, and Nemophini), of which, larvae have been described for all except Phenablenniini. Early- and late-stage blenniid larvae are more easily differentiated from the other blennioid families than the other families are from one another. Blenniid larvae possess three distinctive features: preopercular spination (the spines may be numerous, elaborate, or large, or completely lacking); gut pigment light to heavy; and pectoral-fin pigment common except in the tribe Nemophini (Leis and Rennis, 1983). Clinid and labrisomid larvae are difficult to differentiate from one another and both are characterized by dorsal and ventral gut pigment, and melanophores on the posterior portion of the dorsal midline in some species (Matarese et al., 1984). Late-stage clinid larvae, however, can be differentiated from larvae of the other blennioid families by the presence of midlateral pigment and pigment on the nape with increasing development (Matarese et al., 1984). Tripterygiid larvae are distinguished from other blennioid larvae by three features: body elongate and slightly laterally compressed; small, simple cirrus over each eye and nostril (after flexion); and pigment present on the hindgut just anterior to the vent and on the dorsal surface of the gasbladder (Leis and Rennis, 1983).

Seventeen genera and 60 species of blennioids are known to occur in Belize (the sampling location of the present study) and the central western Atlantic coast (Greenfield and Johnson, 1981). These authors reported 20 species as new records for Belize, with 13 representing significant range extensions for the species. Consequently, I considered all species of tropical and subtropical western Atlantic species of blennioids in this study, a faunal list that included all families of Blennioidei except the Clinidae (Nelson, 1984; Springer, pers. comm.). No species of blennioid is known to inhabit both the eastern Pacific and the western Atlantic, however, one Indo-west Pacific blenniid (*Omobranchus punctatus*) was introduced into the Caribbean (Springer and Gomon, 1975a).

To date, ontogeny has contributed little to analyses of blennioid relationships (Rosenblatt, 1984). Early life history characters are important in systematic studies (Kendall et al., 1984) and may help to clarify relationships within the Blennioidei (Matarese et al. 1984). It is the goal of this thesis to compile meristic data on all species of blennioids that occur in the tropical and subtropical western Atlantic, and to use these data to identify blennioid larvae captured in Belize. Descriptions and illustrations of blennioid larvae from the Caribbean would make a significant contribution to the overall knowledge of Caribbean ichthyoplankton. It is hoped that information made available in this thesis will be useful in future efforts to describe phylogenetic relationships within and among blennioid families.

The specific objectives of this study were to: 1) compile a species list and construct tables of meristic data for all species of blennioid fishes known to occur in the Caribbean, the Gulf of Mexico, and the east coast of Florida; and 2) use these tables to identify, describe, and illustrate previously unknown blennioid larvae from Belize collections.

Table 1. Number of genera and species of Blennioidei and summary of available early life history information. Data on the family Dactyloscopidae are based on a description of the egg stage only. This table is modified from Matarese et al. (1984). Numbers within parentheses are estimates from Springer (pers. comm.).

			EARLY LIFE HISTORY		
TAXON	NUMBER OF GENERA	APPROX. NUMBER OF SPECIES	NUMBER OF GENERA	NUMBER OF SPECIES	NUMBER OF SPECIES ILLUSTRA -TED
Blenniidae	53 (56)	289-319 (340?)	17	22	27
Chaenopsidae	10 (11)	55 (65)	0	0	0
Clinidae	26 (27)	85	4	5	14
Dactyloscopidae	6 (9)	20 (41)	1	1	0
Labrisomidae	14 (15)	100 (102)	2	3	3
Tripterygiidae	18-19 (20+)	75-95 (150+)	5	6	7

METHODS

Species List and Meristic Data

A list of all blennioid taxa known to inhabit the tropical and subtropical western Atlantic was constructed, aided by a computer search of all pertinent literature. Databases were searched via the DIALOG Information Service and include: BIOSIS Previews, Zoological Record Online, Oceanic Abstracts, Aquatic Sciences and Fisheries Abstracts, and Dissertation Abstracts Online.

Tables of meristic data were constructed for all taxa of blennioids contained in the species list. Meristic data were obtained from literature, cleared and stained adult specimens, and radiographs of adults. Cleared and stained specimens and radiographs were obtained from The National Museum of Natural History (NMNH), Smithsonian Institution, Washington, D.C., and the Chicago Natural History Museum (CNHM), Chicago, IL. These museums are the primary resource collections in the United States for fishes collected in Belize.

All meristic counts were made following the methods of Springer and Gomon (1975a) and George and Springer (1980), with the exception of caudal-fin elements and caudal vertebrae. Caudal-fin elements were reported as a formula: dorsal procurrent rays + dorsal principle rays + ventral principle rays + ventral procurrent rays. Principle rays are defined as those that are supported by the hypural plates and the autogenous hypural 5 (when present). The first caudal vertebra is the anteriormost vertebra bearing a hemal arch. In cases where the posteriormost dorsal- or anal-fin pterygiophores support two rays, the rays were counted as one. The number of rays supported by the posteriormost dorsal- or anal-fin pterygiophores varies within some species (Springer, pers. comm.), however, it was not observed to vary within species in my study, although only cleared and stained specimens were used for comparison. The meristic tables include the number of spines and segmented rays for all fins, and the number of vertebrae. Vertebral nomenclature is that of Rosen (1973). Various nomenclatures have been employed to describe pores of the cephalic sensory canal system: Smith-Vaniz and Palacio (1974), Hastings and Shipp (1980), Stephens (1963, 1970), Springer (1968), and Johnson and Greenfield (1976). Nomenclature used in this study is that of Johnson and Greenfield (1976).

Measurements were made and defined following Leis and Trnski (1989). The following abbreviations are used throughout the text and tables: BL- body length; FL- flexion length; SL- standard length; HL- head length; ED- eye diameter; PAL- pre-anal length; PDL- pre-dorsal fin length; SnL: snout length; PL- pectoral fin length; BD- body depth. Box plots (Mendenhall, 1987) were constructed to elucidate similarities and differences in morphometry between larvae.

Pterygiophore interdigitation patterns, the position of dorsal- and anal-fin pterygiophores in relation to vertebrae, (Olney et al., 1983; Potthoff and Kelley, 1982) were obtained from radiographs and cleared and stained adult specimens, and were used only to corroborate identifications of larvae. It was beyond the scope of this study to analyze interdigitation variation within and among species of blennioids. The first interneural space is defined as the space anterior to the anterior-most dorsal-fin pterygiophore. The first interhaemal space is defined as the space located anterior to the anterior-most caudal vertebra.

No attempt was made to account for intraspecific variation that may occur within the Caribbean, however, specimens from varied geographic locations were examined when possible. Any geographic variation is reflected in the ranges in meristic data.

Identification of Larvae

Blennioid larvae were obtained during a 13-month ichthyoplankton survey conducted at four stations near Ambergris Cay (18° N, 88° W), Belize, Central America (Fig. 1), from February, 1985 through February, 1986. Specimens were collected with a bridled one-meter ring fitted with a 333 micron mesh NITEX plankton net. The net was towed at the surface immediately after dusk for 10 minutes by a small boat at a speed of approximately one knot. Specimens were fixed in a seawater buffered formalin (5%) solution and preserved in 70% ethyl alcohol. The 152 blennioid specimens collected from Belize are housed at VIMS.

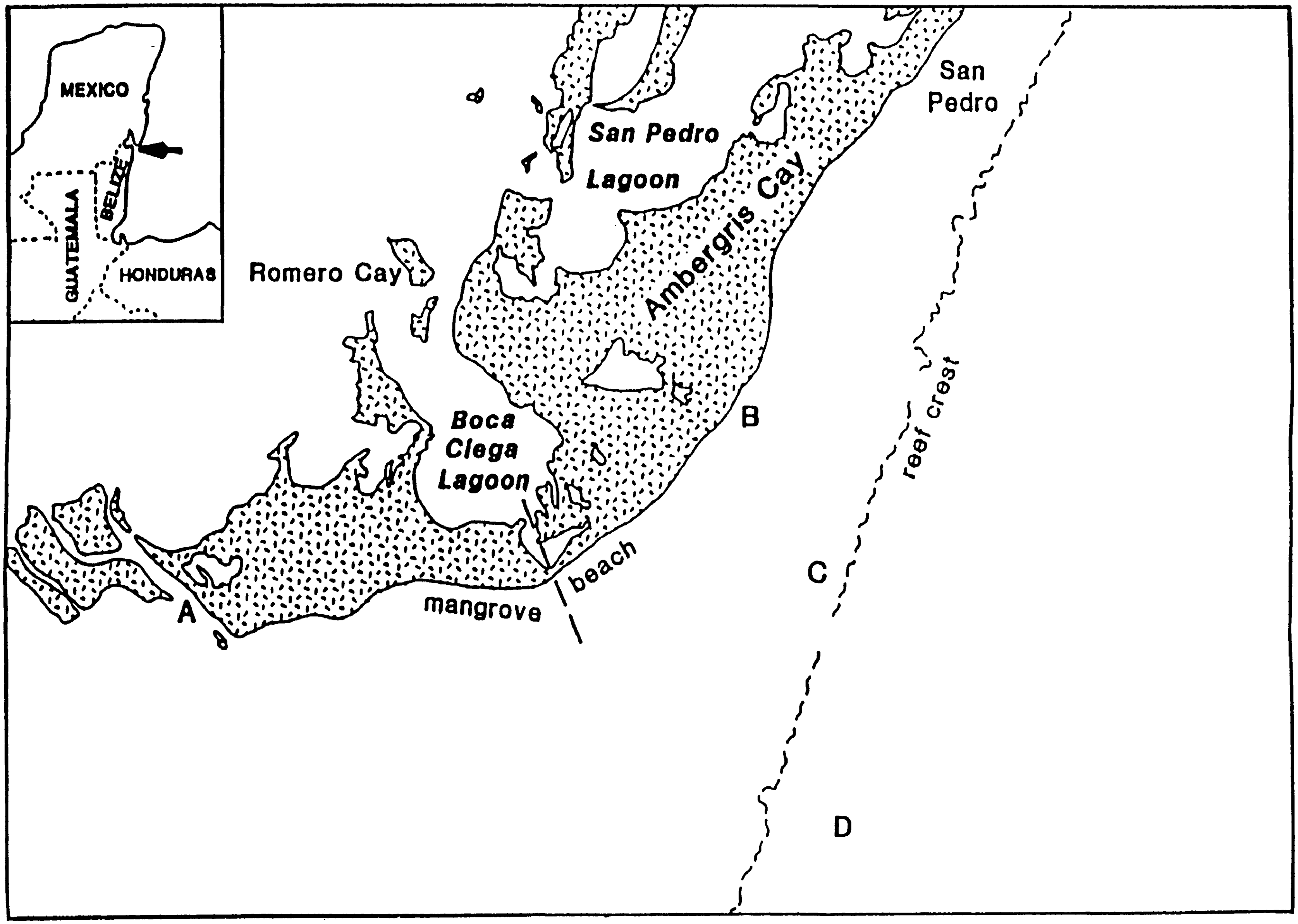
The four stations (designated A-D) occupied at Ambergris Cay (Fig. 1) were: mangrove-bordered channel (station A), lagoon (station B), back reef (station C), and fore reef (station D). Bottom types at these localities were: fine silt and sand often covered with seagrasses with interspersed algae (station A); seagrasses, sea fans, and corals, in patches over a substrate of coarse to fine sands (station B); coarse sand and gravel, as well as, coral rubble covered with living coral at depths of 1.0-1.75 m (station C); and corals and sponges growing on rocky substrate in depths of 5-14 m (station D). Depths range from 1.5 m on the edge of the channel to 3.0 m in the channel. Analyses of gobiid larvae and a summary of the general composition of the ichthyoplankton collected during this survey are presented by Maddox (1992).

Larvae in the VIMS collections were initially sorted as blennioids based on the presence of one or more of the characters mentioned previously (pages 2-5). Larvae were separated into morphotypes based on pigment characters, arranged in developmental series, and representatives of each morphotype were cleared and stained to facilitate meristic counts following procedures outlined in Potthoff (1984). Some counts were made on whole specimens.

The sequence of ossification was described when specimens were adequately stained. The interpretation of cartilaginous and ossified structures and the sequence of ossification was based on the presence or absence of alcian blue and alizarin red stains, in the structures. Errors in the interpretation of stained structures can occur and need to be considered. The staining process should result in bony structures having been stained with alizarin red and cartilaginous structures stained with alcian blue (Potthoff, 1984). A positive alcian blue reaction may result in both cartilaginous- and developing bone tissue, whereas a positive alizarin red reaction may result in true bone or calcified cartilage (Govoni, 1984). This may lead to misinterpretation of dermal and non-dermal bone. In addition, cartilaginous structures within the same specimen may differentially stain, ranging from a dark blue stain (usually the developed cartilaginous structures) to pale blue or no stain at all (usually the developing cartilaginous structures) (Potthoff, 1984). Histological preparations may be used to elucidate possible errors resulting from interpreting stained structures (Govoni, 1984).

Larvae with fully developed fin elements were initially identified using adult meristic data. The meristic data available in the literature is not complete; vertebral- and caudal-fin ray counts are not available for many species. In addition, there is a general lack of correspondence between principle caudal ray counts in larvae versus adults, with the larvae usually possessing fewer principle rays than adults. Osteological and morphological features, and interdigitation patterns (when available), were used to further substantiate identifications by making comparisons between larvae and adults. Previously unknown larvae were described and illustrated. Illustrations were made with the aid of a camera lucida attached to a WILD M5 stereoscope. In illustrations of osteological structures, features that are cartilaginous are stippled.

Figure 1. Location of four ichthyoplankton collection sites near Ambergris Cay, Belize, Central America.


MEXICO
BELIZE
GUATEMALA
HONDURAS
San Pedro
San Pedro Lagoon
Romero Cay
Ambergris Cay
Boca Clega Lagoon
reef crest
beach
mangrove
A
B
C
D

RESULTS

A survey of 50 taxonomic, systematic, and biogeographic studies (Appendix I) revealed 33 genera and 122 species of blennioids reported to inhabit the tropical and subtropical western Atlantic (Table 2). Meristic data compiled for these taxa from the literature, cleared and stained specimens, and from radiographs are presented in Appendices II-XII.

Seventy-nine of 152 specimens contained within the VIMS collection were small (approximately 2.5 mm total length) and did not have fully developed fin elements. These larvae were not included in the study. The remaining specimens (3.6-15.2 mm BL) were sorted into 20 morphotypes (designated A-V) based on similarity in both number and position of melanophores (Table 3). Thus far, 12 morphotypes have been identified to the lowest taxonomic level possible using the meristic data tables. These identifications are: *Gillellus jacksoni*, *G. uranidea* (Dactyloscopidae); *Stathmonotus hemphilli*, *Stathmonotus stahli tekla*, *Paraclinus* sp., *Labrisomus* or *Malacoctenus* sp. (Labrisomidae); three *Enneanectes* spp. (Tripterygiidae); and two species of Chaenopsidae.

Table 2. Nominal species of blennioid fishes of the Caribbean Sea and the tropical western Atlantic Ocean (33 genera, 122 species). Faunal list compiled from literature cited in Appendix I.

Blenniidae: (9 genera, 18 species)
- *Chasmodes* Valenciennes (2 species, 1 sub-species)
- *C. bosquianus* Lacepede (1 sub-species)
- *C. bosquianus longimaxilla* Williams
- *C. saburrae* Jordan & Gilbert
- *Entomacrodus* Gill (2 species)
- *E. nigricans* Gill
- *E. vomerinus* (Valenciennes)
- *Hypleurochilus* Gill (4 species)
- *H. aequipinnis* (Günther)
- *H. bermudensis* Beebe & Tee-Van
- *H. geminatus* (Wood)
- *H. springeri* Randall
- *Hypsoblennius* Gill (4 species)
- *H. exstochilus* Böhlke
- *H. hentz* (LeSueur)
- *H. invemar* Smith-Vaniz & Acero
- *H. ionthas* (Jordan & Gilbert)
- *Lupinoblennius* Herre (2 species)
- *L. dispar* Herre
- *L. nicholsi* (Tavolga)
- *Omobranchus* Ehrenberg in Cuvier & Valenciennes, (1 species)
- *O. punctatus* (Valenciennes in Cuvier & Valenciennes)
- *Ophioblennius* Gill (1 species, 2 sub-species)
- *O. atlanticus* (Valenciennes in Cuvier & Valenciennes) (2 sub-species)
- *O. atlanticus atlanticus* (Valenciennes in Cuvier & Valenciennes)
- *O. atlanticus macclurei* Silvester
- *Parablennius* Ribeiro (1 species)
- *P. marmoreus* (Poey)
- *Scartella* Jordan (1 species)
- *S. cristata* (Linnaeus)

Chaenopsidae: (9 genera, 37 species)
- *Acanthemblemaria* Metzelaar (9 species)
- *A. aspera* (Longley)
- *A. betinensis* Smith-Vaniz & Palacio
- *A. chaplini* Böhlke
- *A. greenfieldi* Smith-Vaniz & Palacio
- *A. maria* Böhlke
- *A. medusa* Smith-Vaniz & Palacio
- *A. paula* Johnson & Brothers
- *A. rivasi* Stephens
- *A. spinosa* Metzelaar
- *Chaenopsis* Poey (5 species)
- *C. limbaughi* Robins & Randall
- *C. ocellata* Poey
- *C. resh* Robins & Randall
- *C. roseolla* Hastings & Shipp

Table 2 (cont.)

Chaenopsis (cont.)
C. stephensi Robins & Randall
Coralliozetus Evermann & Marsh (2 species)
C. cardonae Evermann & Marsh
C. tayrona Acero
Ekemblemaria Stephens (1 species)
E. nigra (Meek & Hildebrand)
Emblemaria Jordan & Gilbert (9 species)
E. atlantica Jordan & Evermann
E. biocellata Stephens
E. caldwelli Stephens
E. caycedoi Acero
E. culmenis Stephens
E. diphyodontis Stephens & Cervigón in Stephens
E. hyltoni Johnson & Greenfield
E. pandionis Evermann & Marsh
E. piratula Ginsburg & Reid
Emblemariopsis Longley (8 species)
E. bahamensis Stephens
E. bottomei Stephens
E. diaphana Longley
E. leptocirris Stephens
E. occidentalis Stephens
E. pricei Greenfield
E. randalli Cervigón
E. signifera (Ginsburg)
Hemiemblemaria Longley & Hildebrand (monotypic)
H. simulus Longley & Hildebrand
Lucayablennius Böhlke (monotypic)
L. zingaro (Böhlke)
Protemblemaria Stephens (1 species)
P. punctata Cervigón
Clinidae: Not known from the tropical western Atlantic
Dactyloscopidae (7 genera, 17 species)
Dactylagnus Gill (1 species)
D. peratikos Böhlke & Caldwell
Dactyloscopus Gill (7 species)
D. boehlkei Dawson
D. comptus Dawson
D. crossotus Starks
D. foraminosus Dawson
D. moorei Fowler
D. poeyi Gill
D. tridigitatus Gill
Gillellus Gilbert (4 species)
G. greyae Kanazawa
G. healae Dawson
G. jacksoni Dawson
G. uranidea Böhlke

Table 2 (cont.)

Leurochilus Böhlke (monotypic)
L. acon Böhlke
Myxodagnus Gill (1 species)
M. belone Böhlke
Platygillellus Dawson (2 species)
P. rubrocinctus Longley
P. smithi Dawson
Storrsia Dawson (monotypic)
S. olsoni Dawson
Labrisomidae (7 genera, 45 species)
Haptoclinus Böhlke & Robins (monotypic)
H. apectolophus Böhlke & Robins
Labrisomus Swainson (9 species)
L. albigenys Beebe & Tee Van
L. bucciferus (Poey)
L. filamentosus Springer
L. gobio (Valenciennes in Cuvier & Valenciennes)
L. guppyi (Norman)
L. haitiensis Beebe & Tee-Van
L. kalisherae (Jordan)
L. nigricinctus Rivero
L. nuchipinnis (Quoy & Gaimard)
Malacoctenus (Gill) (8 species)
M. aurolineatus Smith
M. boehlkei Springer
M. delalandei (Valenciennes in Cuvier & Valenciennes)
M. erdmani Smith
M. gilli (Steindachner)
M. macropus (Poey)
M. triangulatus Springer
M. versicolor (Poey)
Nemaclinus Böhlke & Springer (monotypic)
N. atelestos Böhlke & Springer
Paraclinus Macquard (8 species)
P. barbatus Springer
P. cingulatus (Evermann & Marsh)
P. fasciatus (Steindachner)
P. grandicomis (Rosen)
P. infrons Böhlke
P. marmoratus (Steindachner)
P. naeorhegmis Böhlke
P. nigripinnis (Steindachner)
Starksia Jordan & Evermann (15 species)
S. atlantica Longley
S. brasiliensis Gilbert
S. culebrae Evermann & Marsh
S. elongata Gilbert
S. fasciata (Longley)
S. guttata (Fowler)

Table 2 (cont.)

Starksia (cont.)
S. hassi Klausewitz
S. lepicoelia Böhlke & Springer
S. nanodes Böhlke & Springer
S. occidentalis Greenfield
S. ocellata (Steindachner)
S. sluiteri (Metzelaar)
S. starcki Gilbert
S. variabilis Greenfield
S. y-lineata Gilbert
Stathmonotus Bean (3 species, 2 sub-species)
S. gymnodermis Springer
S. hemphilli Bean
S. stahli (Evermann & Marsh) (2 sub-species)
S. stahli stahli (Evermann & Marsh)
S. stahli tekla Nichols
Tripterygiidae (1 genus, 5 species)
Enneanectes Jordan & Evermann (5 species)
E. altivelis Rosenblatt
E. atrorus Rosenblatt
E. boehlkei Rosenblatt
E. jordani (Evermann & Marsh)
E. pectoralis (Fowler)

Table 3. Pigment characters used to define 20 morphotypes of larval blennioids collected in Belize, Central America, 12 of which are treated in this thesis. X indicates presence of at least one melanophore in whole specimen.

Morphotype	A	B	C	D	E	F	H	I	J	K
Number of specimens	11	13	1	11	4	2	1	14	1	1
Ventral midline	X	X	X	X	X	X	X	X	X	X
Cleithral symphysis	X	X	X		X	X	X	X		X
Basipterygia		X	X						X	
Abdomen	X	X							X	
Abdomen (subdermal)							X			
Ventral midline of caudal peduncle		X	X	X	X	X	X			
Caudal fin					X					X
Posterior edge of hypural plates					X					
Perimeter of foramen in caudal fin		X								
Dorsal midline					X		X			
Dorsolateral wall								X		
Occiput				X	X		X	X		X
Cranium	X			X	X	X		X		X
Otic capsules					X	X		X		X
Preopercle				X			X			
Premaxilla							X			
Dentary and ventral to eye										X
Gut	X	X			X	X		X		X
Gasbladder								X	X	X
Interhaemal melanophores										X
Interneural melanophores										X

Table 3 (cont.)

Morphotype	L	M	N	O	P	Q	R	S	U	V
Number of specimens	1	1	1	1	1	1	4	2	1	1
Ventral midline	X	X	X	X	X	X	X	X	X	X
Cleithral symphysis	X	X	X	X	X	X	X		X	X
Basipterygia		X				X	X			
Abdomen	X	X		X						
Abdomen (subdermal)			X							
Ventral midline of caudal peduncle			X		X		X		X	
Caudal fin	X									
Posterior edge of hypural plates			X		X				X	
Perimeter of foramen in caudal fin				X						
Dorsal midline		X	X						X	
Dorsolateral wall										
Occiput	X	X	X		X	X	X		X	
Cranium	X		X		X				X	
Otic capsules	X		X						X	
Preopercle							X			X
Premaxilla Dentary and ventral to eye										
Gut	X	X	X	X	X		X		X	X
Gasbladder	X									
Interhaemal melanophores	X									
Interneural melanophores	X									

DACTYLOSCOPIDAE

Gillellus jacksoni

Morphotype A

Material examined. Larvae: VIMS 524, 4, 6.7-7.6 mm SL, station D, 13 August, 1985; VIMS 524, 2, 7.9 and 8.4 mm SL, cleared and stained, station D, 13 August, 1985; VIMS 600, 1, 7.7 mm SL, cleared and stained, station D, 13 August, 1985; VIMS 607, 1, 8.2 mm SL, cleared and stained, station D, 13 August, 1985; VIMS 896, 3, 6.8-7.6 mm SL, station D, 13 August, 1985.

Adults: ANSP 144081, 1, 24.9 mm SL, radiograph; ANSP 105438, 4, 20.1-24.1 mm SL, radiograph; ANSP 116536, 1, 14.8 mm SL, radiograph; ANSP 116535, 1, 16.9 mm SL, radiograph.

Identification. A comparison of dorsal- and anal-fin ray counts of cleared and stained larvae (Table 4) with those of adult blennioids excludes all blennioid families except Chaenopsidae and Dactyloscopidae (Appendix II). Within the Chaenopsidae (Appendix IV), these data exclude all genera except *Acanthemblemaria.* No species of *Acanthemblemaria* (Appendix IX) possesses the unique combination of dorsal- and anal-fin counts of the cleared and stained larvae. Furthermore, caudal-fin, pectoral-fin, and vertebral counts (Table 4) of the cleared and stained larvae exclude the Chaenopsidae.

A comparison of the number of dorsal- and anal-fin elements of the cleared and stained larvae with those of the family Dactyloscopidae (Appendix V), excludes all genera except *Gillellus*. Within *Gillellus* (Appendix X), all species are excluded except *G.*

jacksoni. The identification is further substantiated by several morphological features. Both *G. jacksoni* adults and larvae (Fig. 2) possess a distinct three-spined dorsal finlet, an anterior dorsal-fin pterygiophore interdigitation pattern of 1+1//1//1/, overlapping opercles below the isthmus (Fig. 3) (Dawson, 1982), and an extensive and complex cephalic sensory canal system. Meristic data from the larvae were also compared with those from all species of *Gillellus* from the eastern Pacific; all eastern Pacific species are excluded.

Gross morphology. The material includes 11 specimens ranging from 6.7-8.4 mm SL. The larvae (Figs. 2 & 3) are naked, elongate (smallest specimen less so), slightly laterally compressed, and have a short gut. The head lacks spination and rugosity, and is moderately large with a short snout. The maxilla terminates below a vertical from the midpoint of the pupil. The opercles have slightly scalloped edges (Fig. 2), extend ventrally beyond the body and overlap below the isthmus (a character of the family Dactyloscopidae, Dawson, 1982). The eyes are round and are lateral (as opposed to dorsal in adults). The lower jaw projects beyond the upper jaw. There is no gas bladder. The spinous dorsal fin is continuous with the soft dorsal fin. The majority of larvae possess the anlage of a genital papilla that has its origin on the posterior rim of the anus. Sensory pores evident on whole specimens include those of the infraorbital series and the preoperculomandibular series.

Pigment. In the size range represented, larvae of *Gillellus jacksoni* are lightly pigmented (Figs. 2 & 3). External pigment is confined to the ventral midline, the abdomen, and the cleithral symphysis. There are 24-28 epidermal, y-shaped melanophores on the ventral midline, associated with the bases of the anal-fin soft rays. Their number and position is variable, ranging from one melanophore immediately posterior to the base of each soft ray to melanophores being absent from the first (typical case) or second anterior-most soft rays and up to three additional soft rays. One 6.9 mm specimen has an additional ventral midline subdermal melanophore on the caudal peduncle.

There are 2-4 epidermal stellate melanophores on the abdomen and one melanophore on the cleithral symphysis (Fig. 3). Internal pigment evident in cleared and stained specimens consists of three pigment patches located on the gut: ventroanteriorly, dorsoanteriorly, and dorsoposteriorly; the dorsoposterior pigment patch is apparent in whole specimens. Other internal pigment consists of one stellate melanophore on the dorsal surface of the posterior portion of the parasphenoid.

Meristics and morphometrics. Data are summarized in Tables 4-9. The pterygiophore interdigitation pattern for the anterior section of the dorsal fin is the same for larvae and adults (Table 7). Pterygiophore interdigitation patterns of the posterior section of the dorsal fin are variable, with only two of seven specimens exhibiting the same pattern (Table 8). Pterygiophore interdigitation patterns for the anterior section of the anal fin are variable (Table 9).

The first two spines of the three-spined dorsal finlet are approximately equal in length and the third spine is shorter than the other two. The pelvic-fin spine is difficult to see in whole specimens and is less than half as long as the first pelvic-fin ray. All segmented pelvic-fin rays are approximately equal in length. There are small relative decreases in both the pectoral-fin length and body depth from 6.7-6.8 mm SL. No other trends with growth are apparent.

Osteology. The full complement of fin rays is present by 6.7 mm, the smallest size represented in the material. The following description is based on a single cleared and stained larva (7.9 mm SL). Ossification of the spines of the dorsal finlet and the second spinous dorsal fin appears to proceed from anterior to posterior. Ossification of the soft dorsal-fin rays appears to proceed from posterior to anterior. None of the dorsal-fin elements is fully ossified. Ossification of the anal-fin elements appears to proceed from anterior to posterior. None of the dorsal- or anal-fin pterygiophores are ossified. Each pterygiophore that supports a dorsal- or anal-fin spine (excluding the third dorsal-fin pterygiophore, which is not adequately stained) possesses a spine-like process (possibly the fused distal radials of the preceeding pterygiophore) (Springer, pers. comm.) that projects anteriorly through the basal halves of the supernumerary spine. The middle rays of the pectoral fin appear to ossify first. The pectoral-fin radials are partially ossified. The ventroposterior process of the coracoid is spike-like, although this process connects to a wing-like structure that extends between the process and the ventral portion of the coracoid. A foramen is present at the base of the spike-like process. All elements of the pelvic fin are ossified. All caudal elements are ossified except the two anteriormost dorsal procurrent rays and the anteriormost ventral procurrent ray. The dorsal- and ventral hypural plates are partially ossified and fused to each other only proximally. The three ventral procurrent caudal-fin rays are supported by procurrent tissue (cartilage?). There are two foramina in the ventral hypural plate, the anterior one is the larger of the two.

All vertebral centra are ossified. The nine anteriormost vertebral centra are compressed; all are obviously narrower than the remaining. Ossification of the neural arches proceeds from anterior to posterior. All neural spines are cartilaginous. Neural spines are absent from the four anteriormost vertebrae, and the fifth anteriormost vertebra possesses a nubbin-like neural spine. Ossification of hemal spines appears to proceed from the anterior and posterior extremes towards the middle. Canals of the sensory canal system that are present and surrounded by bone include: the circumorbital series; the supraorbital canals in the frontals; the preoperculomandibular series; post-temporal, and supratemporal canal extending over the posterior section of the head. Dentition consists of 4-8 conical teeth on each dentary, 5-6 teeth on each premaxilla, and upper and lower pharyngobranchial tooth patches.

Comments. *Gillellus jacksoni* larvae differ from the adults in lacking lower lip fimbriae, barred coloration, and dermal flaps associated with the distal extremity of the eye. Dawson's (1982) description of *G. jacksoni* was based on 11 specimens, which were collected near Anguilla Island, St. Barthelemy, Union Island, and Aruba at depths ranging to 16.8 m. The collection of *G. jacksoni* in Belize represents a significant range extension (~1900 km) for the species. Species of *Gillellus* are typically collected on or near rock or coral habitats and individual collections range from 1-5 specimens (Dawson, 1982). All larvae were collected over rocky substrate containing corals and sponges. Spawning appears to be restricted since all larvae were captured only in August. See description of *G. uranidea* for a comparison between the larvae of the two species.

Figure 2. Larva of *Gillellus jacksoni* (Dactyloscopidae) (morphotype A); VIMS 524 (1 of 4), 7.6 mm SL. Note the maxilla terminates below a vertical from the midpoint of the pupil, but due the bend in the body of the larva, the maxilla appears to extend beyond the pupil. Scale = 1 mm.

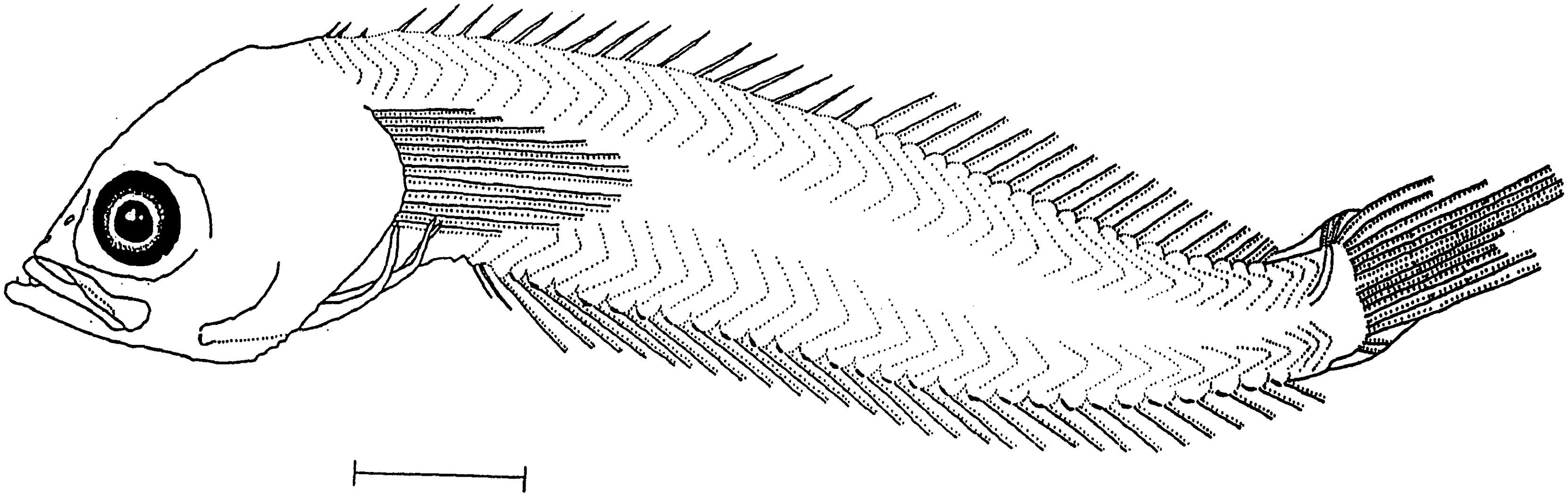


Figure 3. Ventral view of the head and pelvic region of *Gillellus jacksoni* (Dactyloscopidae) (morphotype A); VIMS 524 (1 of 4), 7.6 mm SL. Pigment at the cleithral symphysis is located below overlapping opercles. Scale = 0.5 mm.

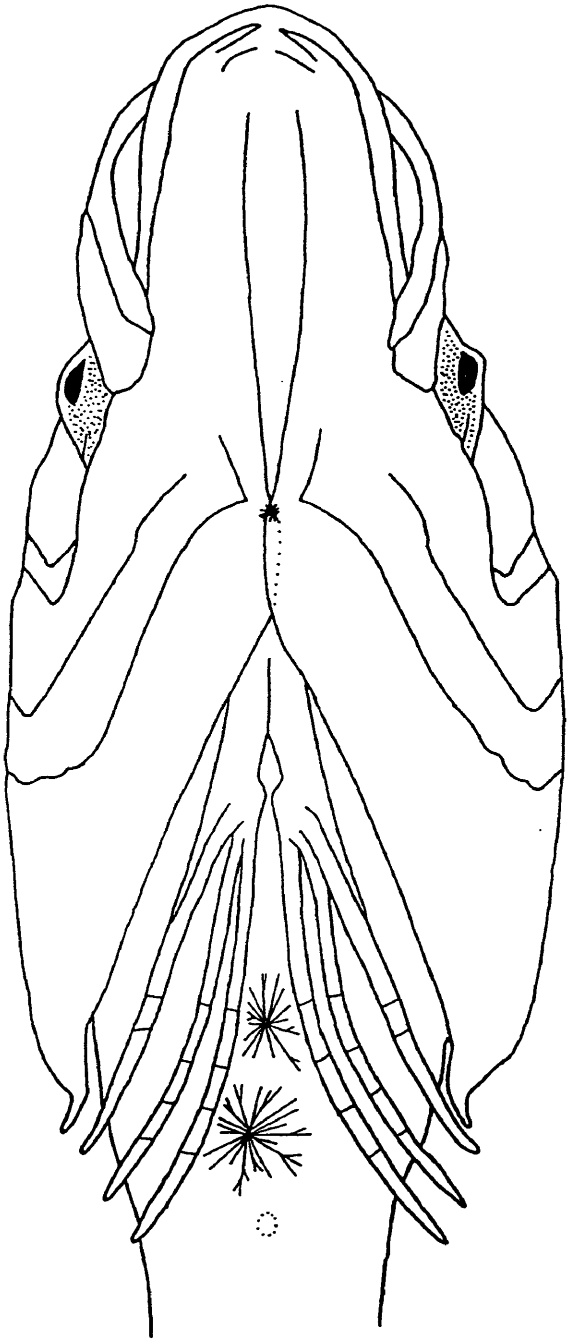


Table 4. Sizes (mm SL) and meristic data of blennioid larvae from Belize, Central America. ND is no data.

Taxon	Body length	Dorsal fin	Anal fin	Pectoral fin	Pelvic fin	Caudal fin Principle	Caudal fin Procurrent	Vertebrae or Myomeres (m)
Gillellus jacksoni	7.7	III+XIV,20	II,28	12	I,3	5+5	4+3	10+30
Dactyloscopidae	7.9	III+XVI,19	II,29	12	I,3	5+5	3+3	11+31
(Morphotype A)	8.2	III+XV,18	II,28	12	I,3	5+5	5+3	10+31
	8.4	III+XVI,18	II,28	12	I,3	5+5	4+3	11+30
Gillellus uranidea	6.7	III+X,16	II,22	13	I,3	6+6	2+1	10+24
Dactyloscopidae	7.3	XV,15[1]	II,22	13	I,3	5+5	2+2	10+25
(Morphotype B)	7.9	III+XI,16	II,21	13	I,3	6+5	3+2	10+24
	8.3	III+XII,15	II,22	13	I,3	5+5	3+2	10+24
	8.4	III+XI,16	II,22	13	I,3	5+6	3+2	10+25
Chaenopsidae sp. (Morphotype C)	13.2	XXI,16	II,23	13	I,3	6+5	4+4	13+30
Chaenopsidae sp. (Morphotype J)	8.7	XIX,14	II,22	14	I,3	6+6	4+3	12+27[2]
Paraclinus sp.	5.3	XXVII,0	II,14	12	I,2	7+6	3+3	10+22[3]
Labrisomidae	6.0	XXVII,0	II,16	12	I,2	7+6	3+2	10+22
(Morphotype F)								

1. The 4 anterior-most dorsal-fin spines are variously separated from one another and the rest of the fin, but there is no distinct three-spined dorsal finlet.
2. Poor quality specimen: actual count is either 12+27 or 11+28; first obvious hemal spine is on 13, it is possible that there is also a haemal spine on centrum 12.
3. The penultimate and antepenultimate vertebral centra are fused (2 hemal spines, 2 neural spines): the actual number of vertebrae could be interpreted as 10+23.

Table 4 (cont.)

Taxon	Body length	Dorsal fin	Anal fin	Pectoral fin	Pelvic fin	Caudal fin		Vertebrae or Myomeres (m)
						Principle	Procurrent	
Labrisomus or	15.3	XX,11	II,20	13	I,3	8+6	7+7	10+26
Malacoctenus sp.						14 segmented		
Labrisomidae								
(Morphotype H)								
Stathmonotus	7.8 (K)	L,0	II,26	5	I,2	5+5	1+1	24+32
hemphilli	6.2 (L)	48[4]	26[4]	O	O	6+6	1+1	23+31[5]
Labrisomidae								
(Morphotypes K&L)								
Stathmonotus	7.5	XLI,0	II,23	8	I,2	6+5	2+1	17+28
stahli ssp.	7.5	XL,0	II,23	ND	I,2	6+6	2+1	17+28
Labrisomidae	7.6	XLI,0	II,24	ND	I,2	6+6	2+2	17+28
(Morphotype I)	8.4	XLI,0	II,23	9	I,2	6+6	2+2	17+28
Enneanectes sp. 1	8.8	III+XII+8	II,16	15	I,2	7+6	8+6	33 (m)
Tripterygiidae	9.1	III+XII+8	II,16	15	I,3	8+6	6+7	9+24
(Morphotype E)	9.3	III+XII+8	II,16	15	I,2	7+6	7+7	33 (m)
	10.2	III+XII+8	II,16	15	I,3	8+6	6+6	10+23
Enneanectes sp. 2								
Tripterygiidae	7.1	III+XII+7	II,15	15	I,3	8+6	5+6	9+23
(Morphotype N)								
Enneanectes sp. 3								
Tripterygiidae	8.7	III+XII+7	II,15	15	I,3	8+6	5+5	10+21
(Morphotype U)								

4. The total number of pterygiophores presumably supporting spines in dorsal fin and spines and segmented rays in anal fin.
5. The penultimate and antepenultimate vertebral centra are fused (2 neural spines, 2 hemal spines): the actual number of vertebrae could be interpreted as 23+32.

Table 5. Summary of morphometric data for blennioid larvae. For each taxon, rows are: range, mean, and standard deviation, in descending order. Body length is in millimeters. All other values except eye diameter are ratios to body length. Eye diameter is expressed as a ratio to head length. Numeral in parentheses is the number of larvae measured.

TAXON	BL	HL	ED	PAL	PDL	SnL	PL	BD
Gillellus jacksoni	6.7-8.4	0.27-0.31	0.23-0.25[1]	0.33-0.37	0.21-0.26	0.05-0.08[1]	0.14-0.19	0.17-0.23
Dactyloscopidae	7.48	0.29	0.24	0.35	0.24	0.06	0.16	0.19
Morphotype A	0.56	0.01	0.01	0.01	0.02	0.01	0.01	0.01
(11)								
Gillellus uranidea	3.6-8.4	0.27-0.34	0.19-0.35	0.37-0.43	0.24-0.36	0.07-0.10	0.08-0.20	0.19-0.24
Dactyloscopidae	7.08	0.31	0.23	0.40	0.27	0.09	0.16	0.21
Morphotype B	1.18	0.02	0.04	0.02	0.03	0.01	0.03	0.02
(13)								
Chaenopsidae sp.	13.2	0.27	0.22	0.45	0.19	0.06	0.11	0.14
Morphotype C								
(1)								
Chaenopsidae sp.	8.7	0.28	0.22	0.43	0.23	0.08	0.18	0.13
Morphotype J								
(1)								
Stathmonotus hemphilli	6.2-7.8	0.20-0.23	0.22-0.27	0.53-0.57	0.23-0.28	0.05-0.06	0.06	0.12-0.13
Labrisomidae	7.0	0.21	0.24	0.55	0.25	0.05	0.06	0.12
Morphotypes K & L								
(2)								
Stathmonotus stahli tekla	6.5-8.4	0.20-0.25	0.22-0.28	0.47-0.54	0.20-0.26	0.04-0.06	0.06-0.09	0.13-0.17
Labrisomidae	7.5	0.22	0.25	0.51	0.24	0.05	0.08	0.14
Morphotype I	0.51	0.01	0.02	0.02	0.02	0.00	0.01	0.01
(14)								

1. Ten specimens were used for these measurements.

Table 5 (cont.)

TAXON	BL	HL	ED	PAL	PDL	SnL	PL	BD
Paraclinus sp.	5.3-6.0	0.35-0.36	0.23-0.26	0.52-0.57	0.28-0.32	0.09-0.11	0.18-0.20	0.25-0.26
Labrisomidae	5.6	0.35	0.24	0.54	0.30	0.10	0.19	0.25
Morphotype F								
(2)								
Labrisomus or	15.3	0.30	0.23	0.46	0.24	0.07	0.20	0.20
Malacoctenus sp.								
Labrisomidae								
Morphotype H								
(1)								
Enneanectes sp.	8.8-10.2	0.26-0.28	0.26-0.29	0.42-0.45	0.22-0.24	0.06-0.07	0.22-0.25	0.17
Tripterygiidae	9.35	0.27	0.28	0.43	0.23	0.07	0.24	0.17
Morphotype E	0.60	0.01	0.01	0.01	0.01	0.01	0.01	0.0
(4)								
Enneanectes sp.	7.1	0.32	0.25	0.49	0.29	0.08	0.13	0.17
Tripterygiidae								
Morphotype N								
(1)								
Enneanectes sp.	8.7	0.28	0.24	0.44	0.21	0.06	0.27	0.17
Tripterygiidae								
Morphotype U								
(1)								

Table 6. Morphometric data for 11 larvae of *Gillellus jacksoni* (Dactyloscopidae) (morphotype A). Body length is in millimeters. All other values except eye diameter are ratios to body length. Eye diameter is expressed as a ratio to head length. ND is no data.

BL	HL	ED	PDL	SnL	PAL	PL	BD
6.7	0.31	0.25	0.21	0.06	0.34	0.19	0.23
6.8	0.28	0.24	0.26	0.07	0.35	0.15	0.19
6.9	0.31	0.25	0.24	0.06	0.36	0.16	0.19
7.1	0.31	0.23	0.25	0.07	0.37	0.17	0.18
7.4	0.30	0.23	0.26	0.08	0.37	0.17	0.19
7.6	0.29	0.23	0.26	0.08	0.37	0.16	0.17
7.6	0.29	0.23	0.21	0.06	0.33	0.17	0.18
7.7	0.29	0.25	0.23	0.05	0.36	0.14	0.19
7.9	0.27	0.25	0.23	0.06	0.35	0.15	0.19
8.2	0.28	0.24	0.24	0.06	0.35	0.15	0.20
8.4	0.28	ND	0.22	ND	0.35	0.15	0.18

Table 7. Numbers of pterygiophores in interneural spaces 1-6 in four larvae and two adults of *Gillellus jacksoni* (Dactyloscopidae). Numerals in parentheses indicate number of specimens examined.

Interneural space						
1	2	3	4	5	6	Material examined
2	0	1	0	1	1	VIMS 524 (2), VIMS 600 (1), VIMS 607 (1) ANSP 144081 (1), ANSP 105438 (1)

Table 8. Numbers of pterygiophores in interneural spaces 31-38 in four larvae and three adults of *Gillellus jacksoni* (Dactyloscopidae). Numerals in parentheses indicate number of specimens.

Interneural space								
31	32	33	34	35	36	37	38	Material examined
1	0	1	1	1	1	0	0	VIMS 524 (1)
1	1	1	1	1	0	1	1	VIMS 524 (1), ANSP 105438 (1)
1	1	1	1	0	1	1	0	ANSP 105438 (1)
1	1	1	1	0	1	1	1	VIMS 600 (1)
1	1	1	1	0	2	0	0	VIMS 607 (1)
1	1	1	1	1	1	0	2	ANSP 144081 (1)

Table 9. Numbers of pterygiophores in interhaemal spaces 11-14 in four larvae and five adults of *Gillellus jacksoni* (Dactyloscopidae) (Morphotype A). The first interhaemal space with pterygiophores corresponds with the first caudal vertebra (e.g. in the first line of data in this table the first caudal vertebra is 11 and interhaemal space 11 is the space anterior to it). Numerals in parentheses indicate number of specimens.

Interhaemal space				
11	12	13	14	Material examined
3	1	1	1	VIMS 607 (1), VIMS 600 (1) ANSP 105438 (1)
	4	1	1	VIMS 524 (1), ANSP 144081 (1) ANSP 105438 (3)
	3	1	1	VIMS 524 (1)

DACTYLOSCOPIDAE

Gillellus uranidea

Morphotype B

Material examined. Larvae: VIMS 548, 1, 3.6 mm NL, station D, 13 August, 1985; VIMS 562, 4, 7.4-8.4 mm SL (2 specimens, 8.3 and 8.4 mm SL, cleared and stained), station D, 13 August, 1985; VIMS 926, 5, 6.7-7.3 mm SL (1 specimen, 7.3 mm SL, cleared and stained), station D, 13 August, 1985; VIMS 1064, 2, 6.7 and 7.9 mm SL, cleared and stained, station D, 13 August, 1985.

Adults: USNM 276136, 1, 18.5 mm SL, cleared and stained, Carrie Bow Cay, Belize; USNM 270071, 1, 25.6 mm SL, radiograph, Belize; USNM 276136, 1, 21.0 mm SL, radiograph, Carrie Bow Cay, Belize; USNM 261340, 2, 22.9 and 24.0 mm SL, radiograph, Looe Key, Florida.

Identification. A comparison of dorsal- and anal-fin counts of cleared and stained larvae (Table 4) with those of adult blennioids excludes all families except Blenniidae and Dactyloscopidae (Appendix II). No blenniid genus (Appendix III) possesses the combination of dorsal- and anal-fin counts of the larvae. In addition, the larvae do not possess pigmented pectoral fins, a character diagnostic of non-nemophinine blenniid larvae. Within Dactyloscopidae (Appendix V), number of dorsal- and anal-fin elements excludes all genera except *Gillellus*. Within *Gillellus* (Appendix X), the unique combination of counts are only within the ranges of *G. uranidea*.

Gross morphology. The material includes one specimen (3.6 mm NL) in notochord flexion (Fig. 4) and twelve specimens ranging from 6.7- 8.4 mm SL. The larvae (Figs. 4-6) are naked, moderate to elongate in length, slightly laterally compressed, and have a short gut. The head lacks spination and rugosity, and is moderately large with a short snout. The maxilla terminates below a vertical from anterior to the anterior margin of the eye. The eyes are round, although somewhat irregularly shaped in the flexion larva, and are located laterally (as opposed to the dorsal position in the adults). There is no head spination or rugosity. The spinous dorsal fin is continuous with the soft dorsal fin. Pelvic fins are not present on the flexion larva. There is no gas bladder. The majority of postflexion larvae possess the anlage of a genital papilla located posterior to the vent (Figs. 5 & 6). Sensory pores evident on whole specimens include those of the infraorbital series (Fig. 5) and the preoperculomandibular series (Figs. 5 & 6).

Pigment. In the size range represented, larvae of *Gillellus uranidea* are lightly pigmented (Figs. 4-6). External pigment is confined to the ventral midline, cleithral symphysis, and the area overlying the basipterygia. There is no other lateral pigment. There are 18-22 epidermal melanophores on the ventral midline associated with the bases of the anal-fin rays. These melanophores are small and round during flexion but become elongate or Y-shaped after flexion. Their number and position is variable, ranging from one melanophore immediately posterior to the base of each soft ray to melanophores being absent from the first and/or second anterior- and posterior-most rays.

There is one round epidermal melanophore located on the caudal peduncle. In some specimens, an additional melanophore is present, either on the caudal peduncle or the caudal-fin procurrent membrane. There are one to three dendritic epidermal melanophores on the abdomen, and one epidermal melanophore located on the cleithral symphysis (Fig. 6). There is one dendritic epidermal melanophore overlying the basipterygia, with pigment distributed primarily over the suture (Fig. 6).

Internal pigment is present in three areas; the ventral hypural plate, the gut, and the cranium. There is one internal melanophore, which is evident in whole specimens (Figs. 4 & 5), present on the perimeter of the anteriormost foramen of the ventral hypural plate. Gut pigment consists of one large, elongate, dorsal patch, only the posterior portion of which is apparent in whole specimens (Fig. 5). This patch is heavily pigmented at the extremes. There is an internal stellate pigment patch located on the dorsal surface of the posterior portion of the parasphenoid.

Meristics and morphometrics. Data are summarized in Tables 4, 5, and 10-13. Pterygiophore interdigitation patterns for the anterior section of the dorsal fin of *G. uranidea* are variable for larvae and adults, however, the pattern is the same for the first three interneural spaces (Table 11). Pterygiophore interdigitation patterns for the posterior section of the dorsal fin are variable, with five patterns exhibited in seven specimens (Table 12). Anal-fin pterygiophore interdigitation patterns are invariable in larvae and adults (Table 13). Pectoral-fin length increases and eye diameter decreases in relative size from flexion to postflexion (Table 5). All other morphometric values are similar for flexion and post-flexion larvae, and growth appears to be isometric within larvae of 3.6-8.4 mm BL.

As in adults, the first spine of the distinct three-spined dorsal finlet is the longest and the third the shortest. The pelvic-fin spine is thin, not easily seen in whole specimens, and is approximately one-third the length of the first soft ray. The third pelvic-fin ray is the longest and the first ray the shortest. The caudal fin is damaged in all specimens; the longest ray is 1.7 mm (21.5 % SL) in one 7.9 mm SL specimen.

Osteology. Examination of cleared and stained material and radiographs of adults and larvae reveals that some specimens possess a fourth anteriormost dorsal-fin pterygiophore without an associated spine, a condition not mentioned in Dawson's (1982) description of *G. uranidea*. The occasional development of a pterygiophore without an associated spine is typical of many fishes (usually eel-like fishes), and in particular, blennioids (Springer, pers. comm.). Among blennioids, spineless pteryiophores located anteriorly in the dorsal fin are found in some dactyloscopids, some species of *Stathmonotus* (Labrisomidae), and several clinids (Springer, pers. comm.). Development of the soft rays of the dorsal and anal fins begins posteriorly (Fig. 4). There are no dorsal- or anal-fin spines visible in the 3.6 mm NL specimen. The full complement of all fin rays is present by 6.7 mm.

Five larvae were cleared and stained, of which only one (7.9 mm SL) retained enough stain to describe progression of ossification. All dorsal- and anal-fin spines are partially ossified. None of the dorsal-fin soft rays is ossified. Progression of ossification of the anal-fin rays proceeds from anterior to posterior; all rays except the three posteriormost rays are at some stage of ossification. None of the pterygiophores of the dorsal or anal fins is ossified. Each pterygiophore that supports a dorsal- or anal-fin spine possesses a spine-like process (possibly the fused distal radials of the preceeding pterygiophore) (Mooi, 1989) that projects anteriorly through the basal halves of the supernumerary spine. All of the principle caudal-fin rays are partially ossified; the dorsal- and ventral-most rays are less ossified than the others. The posteriormost dorsal and ventral procurrent caudal-fin rays are partially ossified. The hypural plates are partially ossified and fused only proximally. The ventral procurrent caudal-fin rays are supported by procurrent tissue (cartilage?). There are two foramina located in the ventral hypural plate. The anterior foramen is the larger of the two. The pelvic-fin rays are ossified along most of their lengths. Ossification of the pectoral-fin rays appears to proceed from the middle rays to the dorsal and ventral extremes and all rays except the dorsalmost ray are partially ossified. The ventroposterior process of the coracoid is spike-like, and is connected to the ventral portion of the coracoid by a thin, flange-like structure. A foramen is present at the base of the spike-like process. All vertebral centra are ossified. Progression of ossification of neural and hemal arches proceeds from anterior to posterior. Only the two anteriormost vertebrae are fully ossified. The six anteriormost vertebrae are compressed. Of four specimens, neural spines are absent from the four anteriormost vertebrae in two, and the five anteriormost vertebrae in two.

Canals of the sensory system that are present and surrounded by bone include the infraorbital series, the supraorbital series in the frontals, the preoperculomandibular series, and a small section of the lateral series, immediately posterior to the dorsal section of the preoperculomandibular series. Dentition consists of 2-6 conical teeth on each dentary, 1-3 conical teeth on each premaxilla, and upper and lower pharyngobranchial tooth patches.

Comments. Larvae of *Gillellus uranidea* lack the following adult features (Dawson, 1982): overlapping opercles below the isthmus, a character diagnostic of adult dactyloscopids (present in *G. jacksoni* larvae); fimbriae on the lower lip or the posteriodorsal margins of the opercles; dermal flaps or protrusions around the eye; scales; anterior nares that are raised and tubiform (although some larvae possess anterior nares with slightly raised margins); and adult coloration. The size at which these features are attained is unknown. Dawson (1982) examined larval specimens of *G. uranidea* (UMML 6335, 9.9 mm SL, Bahama Island; FSM 30014, 9.5 mm SL, Antigua; ANSP 102974, 7.2 mm SL, Cayman Island) but did not illustrate or describe the material, nor does he state how he confirmed the identification. These specimens were not examined in my study.

In addition to meristic variability (Table 4), larvae of *G. uranidea* differ from *G. jacksoni* in having pigmented basipterygia, melanophores on the ventral midline of the caudal peduncle, pigment on the perimeter of the foramen of the ventral hypural plate, and gut pigment consisting of one elongate, dorsal patch (in contrast to gut pigment of *G. jacksoni* larvae which consists of three distinct melanophores located dorsoanteriorly, dorsoposteriorly, and ventroanteriorly). *Gillellus uranidea* and *G. jacksoni* larvae commonly possess a single epidermal melanophore on the cleithral symphysis, epidermal abdominal pigment, and an internal stellate melanophore on the parasphenoid. Unlike *G. jacksoni*, *G. uranidea* adults are known to inhabit Belize (Dawson, 1982) and are distributed throughout the western Atlantic. Adults inhabit sandy areas around rocks and patch reefs, at depths of 1.5-12.2 m (Bohlke, 1968) and are never collected in large numbers (usually one or two are collected at a time). All larvae were collected over rocky substrate containing corals and sponges. Spawning appears to be restricted since all larvae were captured only in August.

Larvae of some chaenopsid genera (see Identification of Morphotype J) may possess counts that fall within the meristic ranges of *Gillellus*. Larval chaenopsids differ from those of *Gillellus* in that they do not possess an internal stellate melanophore on the parasphenoid.

Figure 4. Larva of *Gillellus uranidea* (Dactyloscopidae) (morphotype B); VIMS 548, 3.6 mm NL. The right side of the specimen was illustrated and photographically reversed. Scale = 0.5 mm.

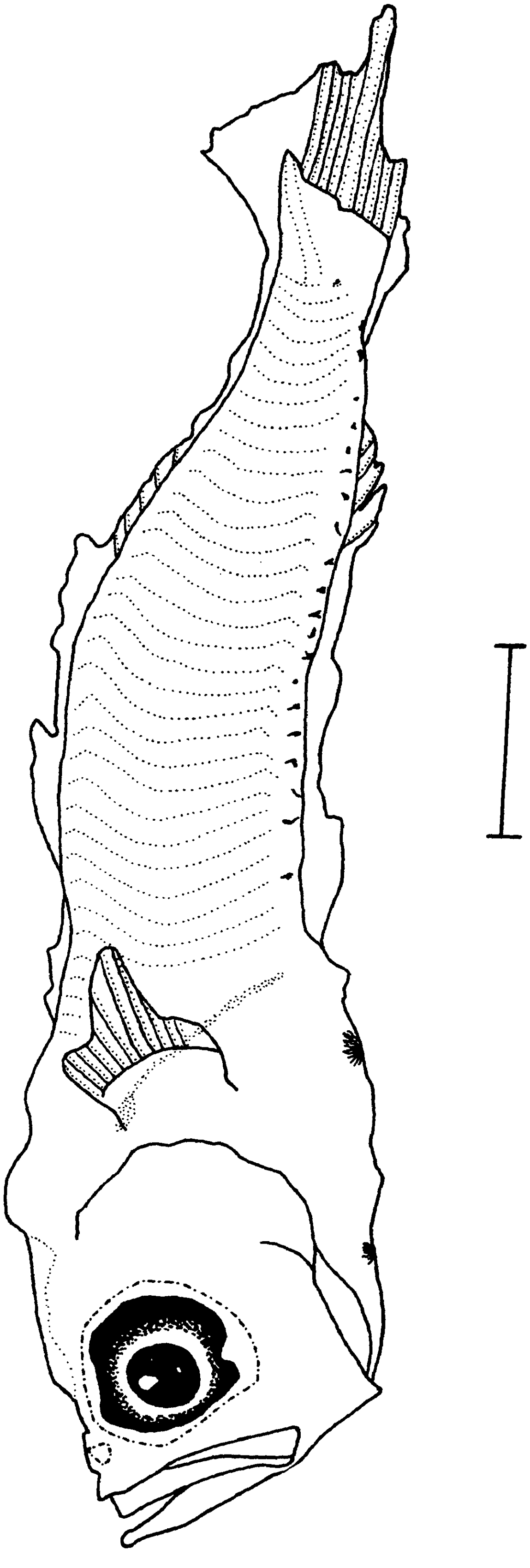


Figure 5. Composite illustration of larva of *Gillellus uranidea* (Dactyloscopidae) (morphotype B); VIMS 562(4 of 4), 7.4 mm SL. Dorsal and anal fins drawn from a 7.1 mm SL larva; VIMS 926(2 of 3). Scale = 1 mm.

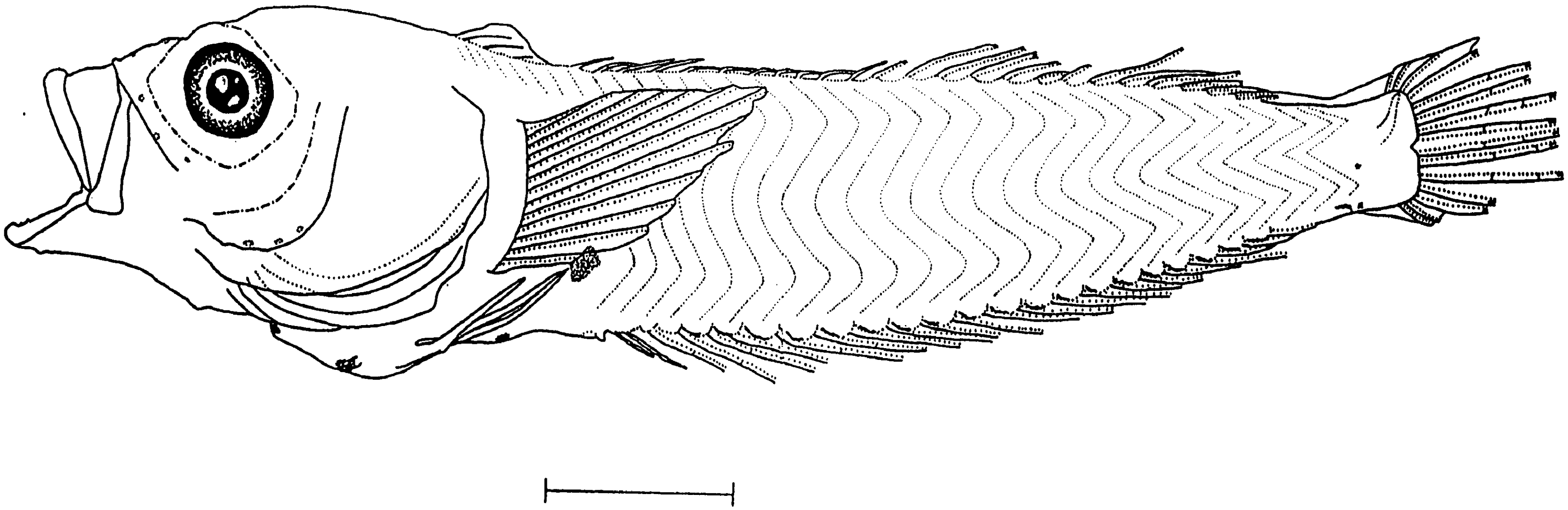


Figure 6. Ventral view of the head and pelvic region of *Gillellus uranidea* (Dactyloscopidae) (morphotype B); VIMS 562 (1 of 4), 7.6 mm SL. Scale = 0.5 mm.

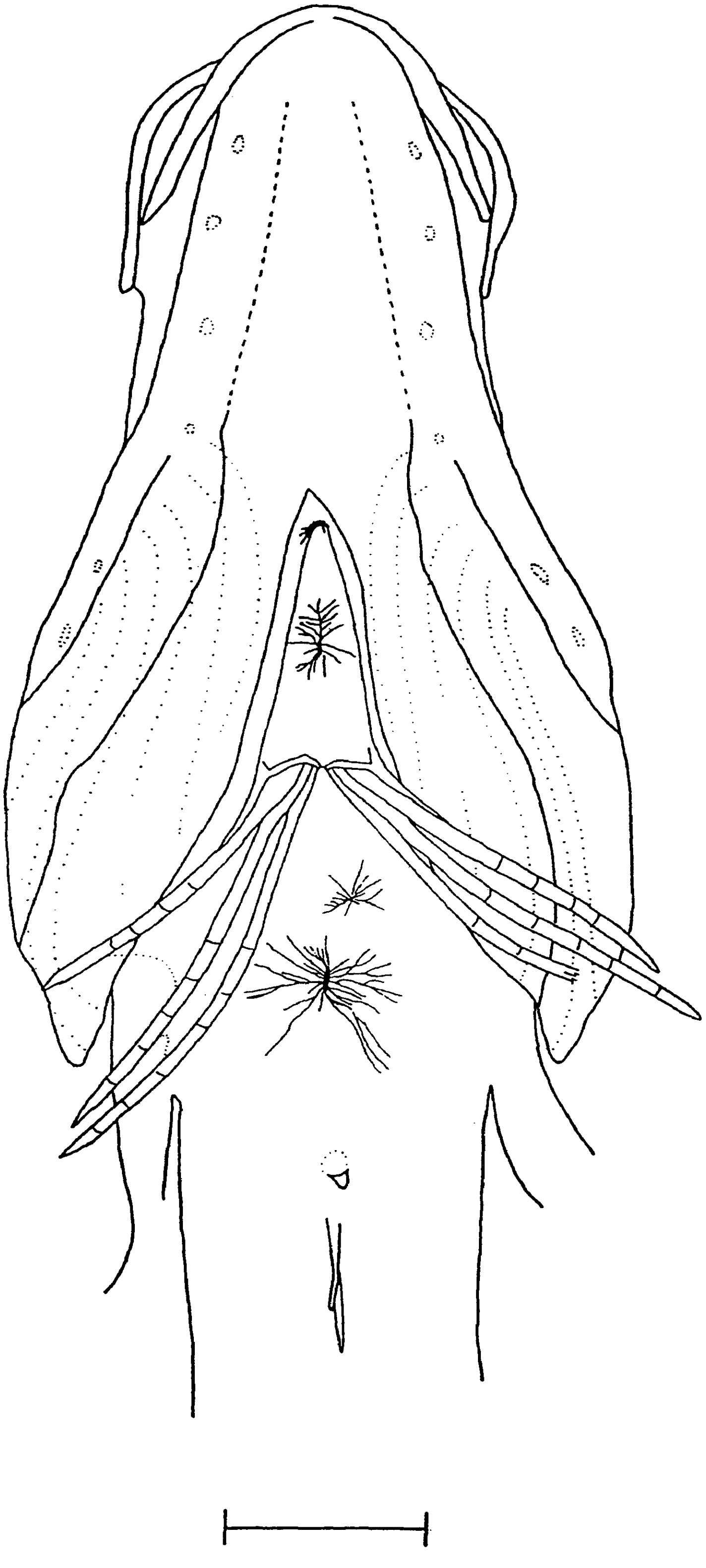


Table 10. Morphometric data for 13 larvae of *Gillellus uranidea* (Dactyloscopidae) (morphotype B). Body length is in millimeters. All values except eye diameter are ratios to body length. Eye diameter is expressed as a ratio to head length. The dashed line separates flexion from postflexion larvae. ND is no data.

BL	HL	ED	PDL	SnL	PAL	PL	BD
3.6	0.29	0.35	ND	0.09	0.43	0.08	0.23
6.7	0.32	0.23	0.25	0.09	0.39	0.20	0.23
6.7	0.33	0.23	0.26	0.09	0.37	0.19	0.21
6.9	0.32	0.21	0.28	0.09	0.41	0.17	0.22
7.0	0.32	0.23	0.24	0.08	0.37	0.18	0.21
7.1	0.30	0.24	0.26	0.08	0.40	0.17	0.20
7.1	0.31	0.21	0.26	0.09	0.40	0.17	0.21
7.3	0.30	0.25	0.27	0.07	0.39	0.16	0.24
7.4	0.33	0.19	0.29	0.10	0.43	0.18	0.19
7.6	0.34	0.20	0.29	0.10	0.40	0.19	0.19
7.9	0.33	0.25	0.26	0.08	0.41	0.15	0.21
8.3	0.27	0.22	0.27	0.09	0.40	0.16	0.19
8.4	0.30	0.22	0.27	0.09	0.42	0.14	0.21

Table 11. Numbers of pterygiophores in interneural spaces 1-6 in five larvae and two adults of *Gillellus uranidea* (Dactyloscopidae) (morphotype B). Numerals in parentheses indicate number of specimens.

Interneural space						
1	2	3	4	5	6	Material examined
2	0	1	0	1	1	VIMS 562 (2), VIMS 1064 (1) USNM 276136 (1), USNM 270071 (1)
2	0	1	1	0	1	VIMS 1064 (1), VIMS 926 (1)

Table 12. Numbers of pterygiophores in interneural spaces 25-32 in five larvae and two adults of *Gillellus uranidea* (Dactyloscopidae) (morphotype B). Numerals in parentheses indicate number of specimens.

Interneural space								
25	26	27	28	29	30	31	32	Material examined
1	1	1	1	1	0	1	0	VIMS 926 (1)
1	0	1	1	1	1	1	0	VIMS 562 (1)
1	1	1	1	0	1	1	0	VIMS 562 (1), VIMS 1064 (1) USNM 270071 (1)
1	1	0	2	1	0	1	0	VIMS 1064 (1)
1	1	0	1	1	1	0	0	USNM 276136 (1)

Table 13. Numbers of pterygiophores in interhaemal spaces 11-13 in five larvae and two adults of *Gillellus uranidea* (Dactyloscopidae) (morphotype B). Numerals in parentheses indicate number of specimens. Interhaemal space 11 corresponds with the first caudal vertebra (11).

Interhaemal space			
11	12	13	Material examined
3	1	1	VIMS 562 (2), VIMS 926 (1), VIMS 1064 (2) USNM 270071, USNM 276136

CHAENOPSIDAE

Acanthemblemaria, Ekemblemaria, Emblemaria, or *Protemblemaria* sp.

Morphotype C

Material examined. Larva: VIMS 184, 1, 13.2 mm SL, cleared and stained, station D, 26 February, 1985.

Adults: *Acanthemblemaria aspera*: USNM 276069, 1, 21.4 mm SL, cleared and stained; USNM 276196, 2, 23.1 and 24.2 mm SL, radiograph, Belize, Carrie Bow Cay; USNM 167669, 1, ~19.5 mm SL (specimen is bent), radiograph, Gulf of Mexico, Florida, patch reef between Margot Fish Shoal and Long Reef. *Emblemaria diphyodontis*, USNM 203820, 1, 59 mm SL, holotype, radiograph, Caba Cera de Cubagoa, Venezuela. *Ekemblemaria nigra*, USNM 299813, 1, 15.0 mm SL, radiograph, Santa Marta, Caribbean Colombia. *Emblemaria hyltoni*, USNM 214839, 1, 21.8 mm SL, radiograph, Isla Roatan, Honduras.

Identification. The number of dorsal-fin elements of the larva (Table 4) excludes the blennioid families Blenniidae, Dactyloscopidae, Labrisomidae, and Tripterygiidae (Appendix II). Within the Chaenopsidae (Appendix IV), the number of dorsal-fin elements excludes the genera *Chaenopsis, Coralliozetus, Emblemariopsis, Hemiemblemaria,* and *Lucayablennius*. Within *Acanthemblemaria* (Appendix IX), all counts from the larva are only within the ranges of *A. aspera*. All counts except the total number of vertebrae are within the ranges of *A. paula* (43 vertebrae total in the larva as opposed to 42 total in *A. paula*). In addition, only one of the 115 specimens of *A. paula* examined by Johnson and Brothers (1989) possessed 21 dorsal-fin spines.

Within *Ekemblemaria*, all counts from the larva corresponded with those of *E. nigra* except those of the caudal-fin rays (12-14 unbranched principle rays as opposed to 11 segmented in the larva). Within *Emblemaria*, all counts from the larva are within the ranges of *E. diphyodontis* except those of the caudal-fin rays (13 segmented as opposed to 11 segmented in the larva). All counts are within the ranges of *E. hyltoni* except the total number of vertebrae (43 total in the larva as opposed to 42 total in *E. hyltoni*). Within *Protemblemaria*, all counts from the larva are within the ranges of *P. punctata* except those of the caudal-fin rays (13-14 unbranched principle rays as opposed to 11 segmented rays in the larva).

Although all counts from the larva are only within the ranges of *A. aspera*, more information is necessary before the other species (*Ekemblemaria nigra*, *Emblemaria diphyodontis*, *E. hyltoni*, *Protemblemaria punctata*) can be excluded. Unfortunately, the caudal-fin rays of the larva were lost due to excessive handling and future comparison with other specimens is not possible.

Gross morphology. The larva (Figs. 7-9) is naked, elongate, and slightly laterally compressed. The gut is moderate in length. The head lacks spination and rugosity, and is moderately large with a short snout. The eyes are round and small. The maxilla terminates below a vertical from the middle of the eye and is visible externally, a character not found in adult chaenopsids (Nelson, 1984). There is a simple supraorbital cirrus. A gas bladder is present but was not evident in the uncleared specimen. The spinous dorsal fin is continuous with the soft dorsal fin. Dorsal- and anal-fin membranes are not continuous with the caudal-fin membrane. Pores of the sensory canal system evident in the whole specimen include those of the infraorbital series and the preoperculomandibular series (Figs. 7 & 8).

Pigment. The larva is lightly pigmented (Figs 7 & 8). External pigment is confined to the ventral midline, cleithral symphysis, caudal peduncle, and the area overlying the basipterygia. There are 23 epidermal, slightly elongate, y-shaped, ventral midline melanophores associated with the bases of the anal-fin elements. There is one melanophore located posterior to each anal-fin element except the anteriormost spine and the posteriormost ray. Additional pigment consists of two small, round, epidermal melanophores on the ventral midline of the caudal peduncle, one small epidermal melanophore on the cleithral symphysis, and one small epidermal pigment patch overlying the basipterygia. Internal pigment evident in cleared and stained material consists of two pigment patches in the gasbladder; one located dorsoanteriorly, one dorsoposteriorly.

Meristics and morphometrics. Data are summarized in Tables 4,5, 14-18. Pterygiophore interdigitation patterns of the larva (Tables 14 & 15) do not correspond with those of *A. aspera* (Tables 16-18). Good radiographs of *Ekemblemaria nigra*, *Emblemaria diphyodontis*, and *E. hyltoni*, were impossible to obtain and pterygiophore interdigitation patterns could not be made. The pectoral fin is relatively short and extends to approximately 43% SL. The second pelvic-fin ray is the longest, the third is the shortest and not easily seen in the whole specimen. The pelvic-fin spine is short, thin, and extends to approximately 3/4 the length of the third soft ray. The caudal fin is damaged; the longest ray is 1.8 mm (13.6% SL) in length.

Osteology. All fin elements are ossified. Each pterygiophore that supports a dorsal- or anal-fin spine possesses an ossified, spine-like process (possibly the fused distal radials of the preceeding pterygiophore) (Springer, pers. comm.) that projects anteriorly through the basal halves of the supernumerary spine (Fig. 9). The pterygiophores of the soft dorsal and anal fins are un-ossified. The ventroposterior process of the coracoid is spike-like and projects ventromedially. At the base of the process is a tooth-like process extending medially. A foramen is present anterior to the base of the process. Ossification of hemal and neural spines proceeds from the anterior and posterior ends of the vertebral column and progresses towards the middle (Fig. 9). All vertebral centra are ossified. Only the anteriormost vertebra does not possess a neural spine (Fig. 9). The upper and lower hypural plates are fused to each other only proximally. The upper plate is cartilaginous. The lower plate is cartilaginous, except anteriorly, where it is ossifying. Of two foramina in the lower hypural plate, the anterior foramen is larger. The pectoral-fin radials, scapula, and coracoid are cartilaginous. The basipterygia are cartilaginous. The hyoid and branchial regions and the suspensorium are cartilaginous. The dentary is ossified except for a rod-like cartilaginous projection extending medially along its length (Meckel's cartilage). The posterior section of the neurocranium is cartilaginous.

Canals of the sensory canal system that are present and surrounded by bone include the infraorbital, preopercular, supratemporal canals, and one sensory canal on each frontal extending from the supraorbital canal and terminating dorsal to the nasal bone. Dentition consists of 18 teeth on each dentary (six of which are larger than the others), five vomerine teeth, 10 conical teeth on each premaxilla (three of which are larger than the rest), five teeth on each palatine, and upper and lower pharyngobranchial teeth.

Comments. The presence in the larva of a single, simple supraorbital cirrus and no head spination or rugosity is consistent with the adult condition in *Emblemaria diphyodontis* and *E. hyltoni.* Adult *Acanthemblemaria aspera* and *Ekemblemaria nigra* each possess a single supraorbital cirrus and numerous spines on the cranial bones.

Adult *Protemblemaria punctata* possess a pair of supraorbital cirri above each eye and no head spination or rugosity, but a simple cirrus on each eye might possibly be a larval condition.

Emblemaria diphyodontis is known only from Isla de Cubagua, Venezuela (Acero, 1984a). *Emblemaria hyltoni* is known only from Isla Roatan, Honduras (Acero, 1984a). *Acanthemblemaria aspera* is widely spread throughout the Caribbean including Belize and Honduras. *Protemblemaria punctata* is known only from Venezuela. *Ekemblemaria nigra* is known only from Panama (Colon) to Colombia (Bahia de Nenguange). The larva was collected in February over rocky substrate containing corals and sponges. For a comparison of this larva with the other chaenopsid described, see Comments in the description of morphotype J.

Figure 7. Unidentified chaenopsid larva (morphotype C); VIMS 184, 13.2 mm SL. Scale = 1 mm.

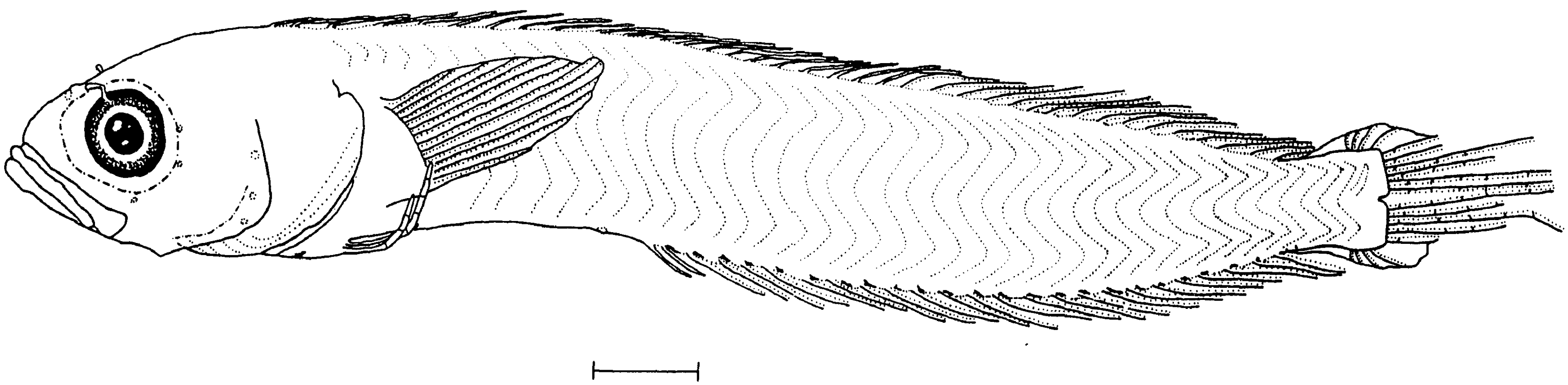


Figure 8. Ventral view of the head and pelvic region of an unidentified chaenopsid larva (morphotype C); VIMS 184, 13.2 mm SL. Scale = 1 mm.

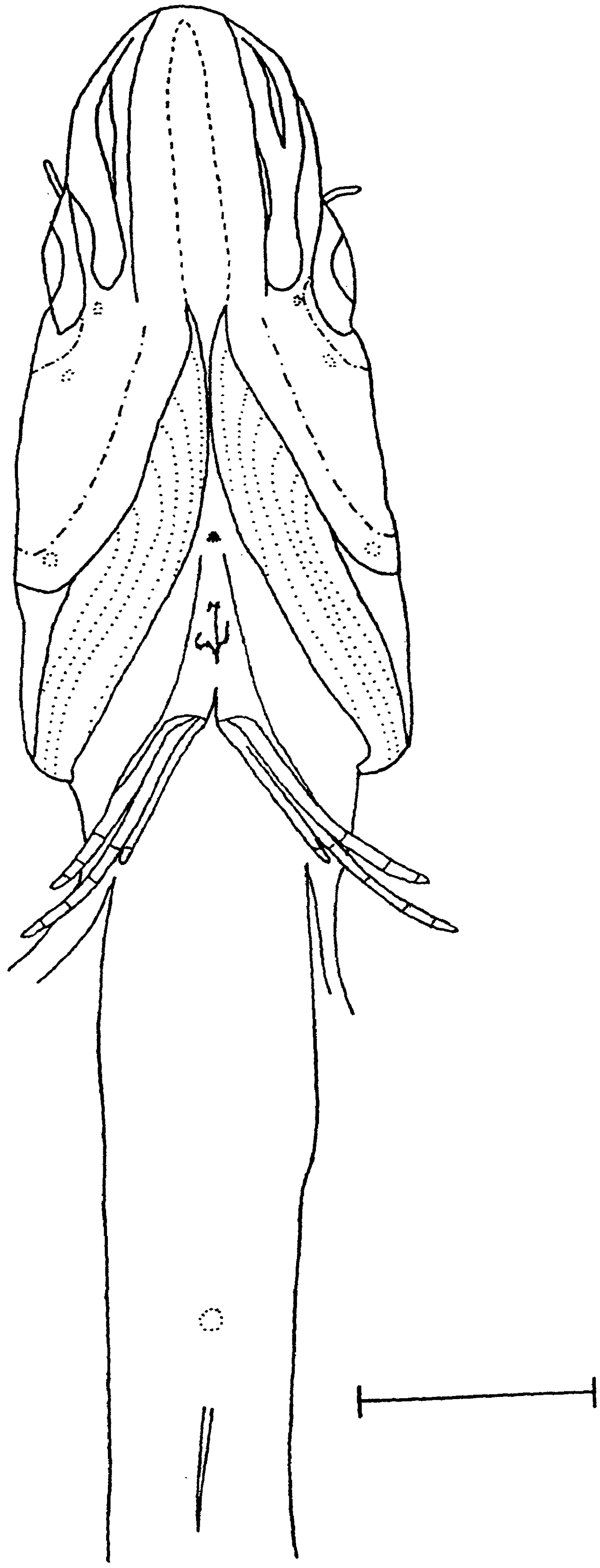


Figure 9. Anterior vertebrae, spines, and supporting elements of an unidentified chaenopsid larva (morphotype C); VIMS 184, 13.2 mm SL. Scale = 1 mm.

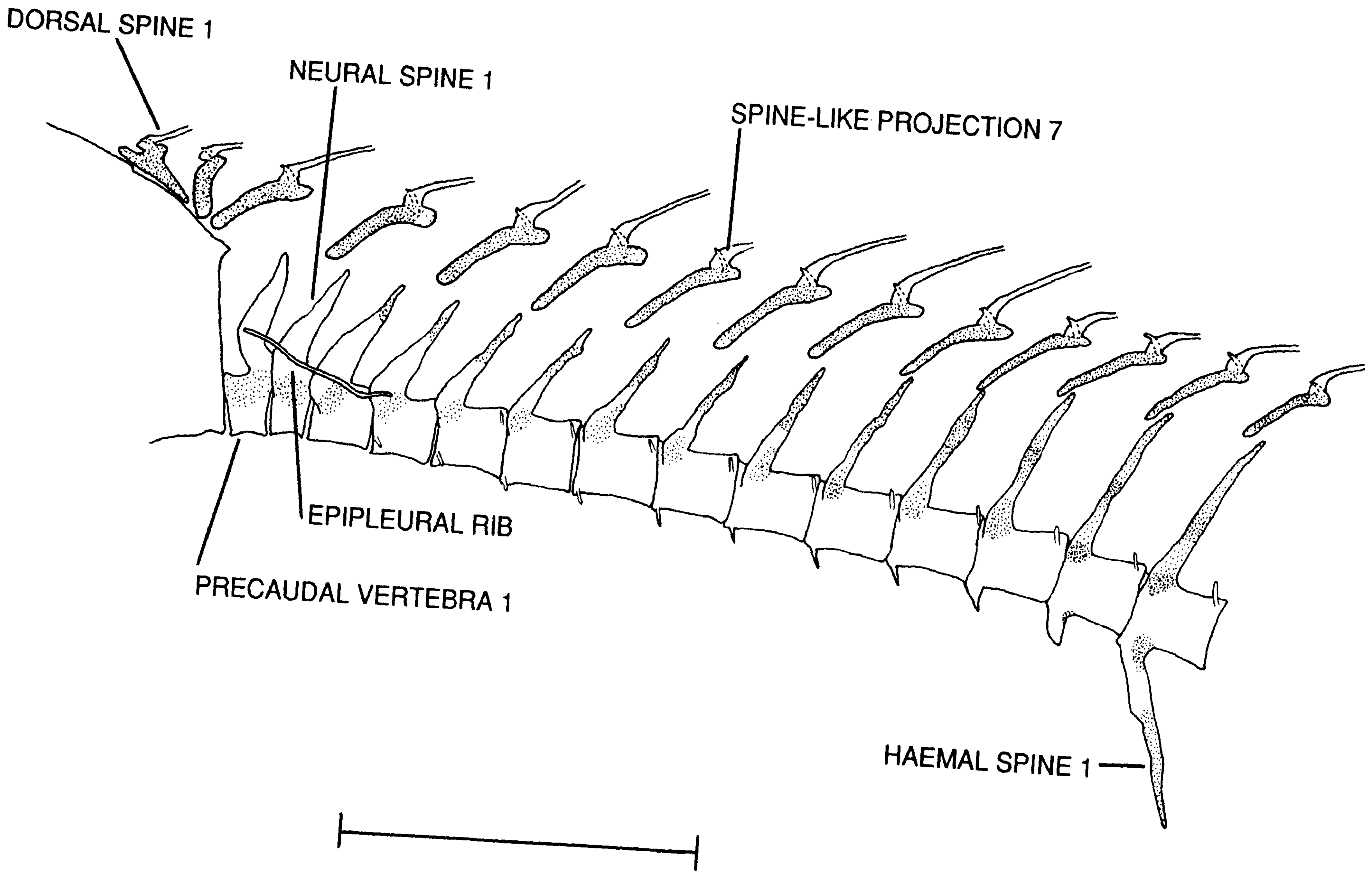

DORSAL SPINE 1
NEURAL SPINE 1
SPINE-LIKE PROJECTION 7
EPIPLEURAL RIB
PRECAUDAL VERTEBRA 1
HAEMAL SPINE 1

Table 14. Numbers of pterygiophores within interneural spaces 1-8 and 31-43 in a single unknown chaenopsid larva (morphotype C); VIMS 184, 13.2 mm SL.

Interneural space																				
1	2	3	4	5	6	7	8	31	32	33	34	35	36	37	38	39	40	41	42	43
3	1	0	1	0	1	1	1	1	1	1	1	1	0	1	0	0	0	0	0	0

Table 15. Numbers of pterygiophores within interhaemal spaces 14-20 in a single unknown chaenopsid larva (morphotype C); VIMS 184, 13.2 mm SL. Interhaemal space 14 precedes the first caudal vertebra (14).

Interhaemal space						
14	15	16	17	18	19	20
2	0	1	1	1	1	1

Table 16. Numbers of pterygiophores within interneural spaces 1-8 in *Acanthemblemaria aspera* (adults).

Interneural space								
1	2	3	4	5	6	7	8	Material examined
3	0	1	1	0	1	1	1	USNM 167669, USNM 276196
3	0	1	0	1	1	0	1	USNM 276069

Table 17. Numbers of pterygiophores within interneural spaces 31-38 in *Acanthemblemaria aspera* (adults).

Interneural space								
31	32	33	34	35	36	37	38	Material examined
1	1	0	1	1	0	0	0	USNM 276196
1	1	1	1	0	0	0	0	USNM 276196
1	1	1	1	0	1	0	0	USNM 167669
1	1	1	0	1	0	0	0	USNM 276069

Table 18. Numbers of pterygiophores in interhaemal spaces 13-20 of *Acanthemblemaria aspera* (adults). Interhaemal space 13 precedes the first caudal vertebra (13).

Interhaemal space								
13	14	15	16	17	18	19	20	Material examined
2	1	1	1	1	1	1	1	USNM 276196
1	1	1	1	1	1	1	1	USNM 276196, USNM 276069

Chaenopsidae

Acanthemblemaria aspera or *Emblemaria* sp.

Morphotype J

Material examined. Larva: VIMS 1072, 1, 8.7 mm SL, cleared and stained, station D, 13 August, 1985.

Identification. A comparison of the number of dorsal- and anal-fin elements of the larva (Table 4) with those of adult blennioids (Appendix II) excludes the families Blenniidae and Tripterygiidae. Adults of some *Gillellus* (Dactyloscopidae) (Appendix V) have counts similar to those of the larva, but all other dactyloscopid genera are excluded. The unique combination of counts of the larva does not correspond with any species of the genus *Gillellus* (Appendix X) and the larva does not possess characters that are diagnostic of this genus (see previous sections). Adult *Labrisomus* and *Malacoctenus* (Labrisomidae) (Appendix VI), possess ranges in meristic values that encompass those of the larva, however, no species within these genera (Appendix XI) have the unique combination of counts of the larva. The number of dorsal- and anal-fin elements of the larvae fall within extremes of adults of *Acanthemblemaria*, *Emblemaria*, and *Emblemariopsis* (Chaenopsidae) (Appendix IV). Within *Acanthemblemaria* (Appendix IX), all counts of the larva fit those of *A. aspera* except the vertebral count (12+27 or 11+28 in the larva as opposed to 12-13+28-31 in *A. aspera*); all other species of *Acanthemblemaria* are excluded. Within *Emblemaria* (Appendix IX), all counts fit within the ranges of *E. atlantica* except vertebral counts (12+27 or 11+28 in the larva as opposed to 14+25 in *E. atlantica*). All counts fit those of *E. caycedoi*, but incomplete data prohibit complete comparison with this species. All counts from the larva fit *E. pandionis* except the vertebral count (12+27 or 11+28 in the larva as opposed to 13+26 or 13+28 in *E. pandionis*). Within *Emblemariopsis* (Appendix IX), no species possesses the unique counts of the larva. More information is necessary before a more accurate identification is made. Adults of many species of the genera *Coralliozetus*, *Protemblemaria*, and *Emblemariopsis* have counts that differ from the larva by only one ray. Since geographic variation could account for these small differences, more material is needed.

Gross morphology. The larva (Figs. 10 & 11) is naked, elongate, laterally compressed, and has a long gut. The head is moderate in size, slightly laterally compressed, with a moderate snout. The maxilla terminates below a vertical from the anterior margin of the eye. The eyes are small and round. There are no cephalic cirri, head spination, or rugosity. The anteriormost naris is raised. A gasbladder is present.

Pigment. The larva is lightly pigmented (Figs. 10 & 11). External pigment is confined to the ventral midline, abdomen, and the area overlying the basipterygia. There are 22 epidermal melanophores on the ventral midline, associated with the bases of the anal-fin rays. These melanophores are y-shaped and are associated with each element excluding the anteriormost spine and the posteriormost ray. There is a long, thin pigment patch overlying the basipterygia (Fig. 11). There is one epidermal pigment patch on the abdomen immediately posterior to the pelvic fins (Fig. 11).

Internal pigment consists of a patch of pigment on the dorsal surface of the basipterygia along the suture and a pigment patch (evident in the uncleared specimen) on the dorsomedial section of the gasbladder.

Meristics and morphometrics. Data are summarized in Tables 4, 5, 19, and 20. The dorsal-fin pterygiophore interdigitation pattern of the larva does not correspond with that of adult *Acanthemblemaria aspera* (Tables 16 & 17); however, there is correspondence in anal-fin pterygiophore interdigitation patterns (Table 18). The second pelvic-fin ray is the longest; the first is approximately 4/5 the length of the second. The third ray consists of only the basal halves and is only evident in the cleared and stained specimen. The caudal-fin rays all appear to be damaged and their actual total length is unknown.

Osteology. The larva was inadequately stained so a detailed description of progression of ossification could not be made. The presence of a spine-like process located on each pterygiophore that supports a spine (see Osteology in descriptions of other morphotypes) can not be confirmed in this poor quality (body will not fully clear) specimen. Neural spines are absent from the four anteriormost vertebrae. The ventroposterior process of the coracoid is spike-like, relatively long, and projects ventromedially. At the base of the process is a tooth-like structure extending medially. Of two foramina in the ventral hypural plate, the anterior one is larger. The basipterygia appear to extend dorsoanteriorly beyond the cleithra, a character believed to be possessed solely by the Dactyloscopidae (Springer, pers. comm.); Springer only examined juveniles and adults. Dentition consists of 4 teeth on the vomer, 14 teeth total on the dentaries (6 teeth on one dentary and 8 on the other), and 3 teeth in serial association on each premaxilla. It is not possible to confirm the presence of pharyngobranchial teeth.

Comments. Although the basipterygia appear to extend dorsoanteriorly beyond the cleithra, meristics show that the larva can not be a dactyloscopid. More specimens are needed to elucidate this condition. The larva was collected in August over rocky substrate containing corals and sponges.

In addition to meristic differences (Table 4), the two chaenopsid species can be differentiated based on pigment. The morphotype J larva possesses an epidermal melanophore immediately posterior to the pelvic fins, and does not possess pigment on the cleithral symphysis and ventral midline posterior to the anal fin, as in morphotype C. Pigmented areas held in common by the two chaenopsids (morphotypes C and J) are the ventral midline and basipterygia.

Figure 10. Unidentified chaenopsid larva (morphotype J); VIMS 1072, 8.7 mm SL. Scale = 1 mm.

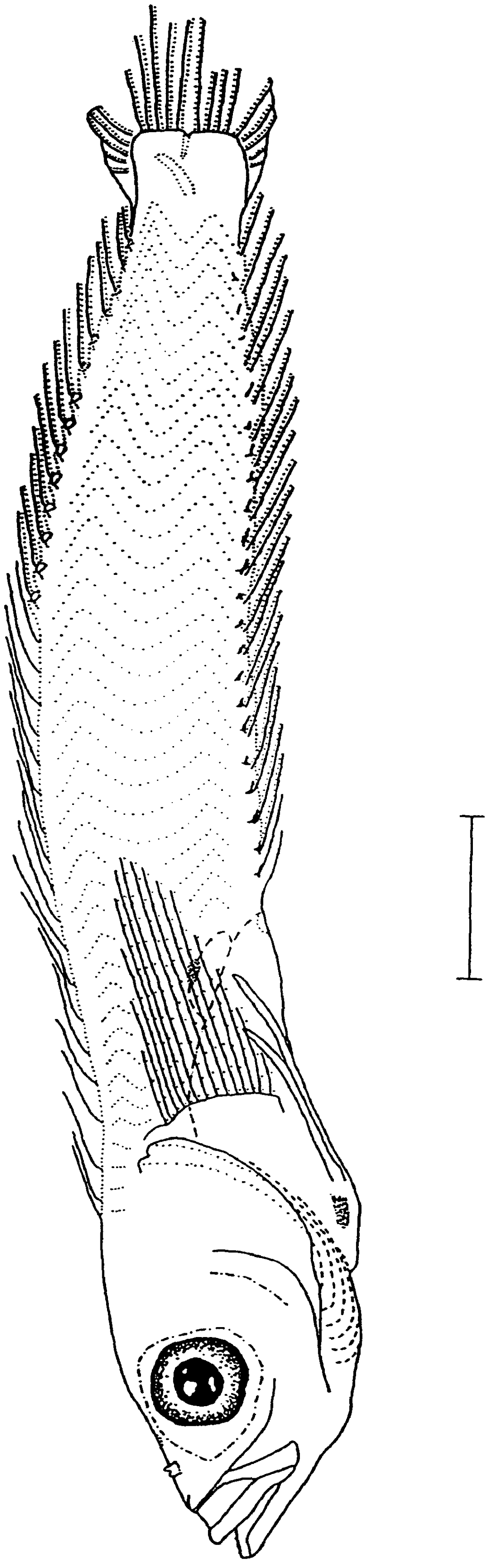


Figure 11. Ventral view of the head and pelvic region of an unidentified chaenopsid larva (morphotype J); VIMS 1072, 8.7 mm SL. Scale = 1 mm.

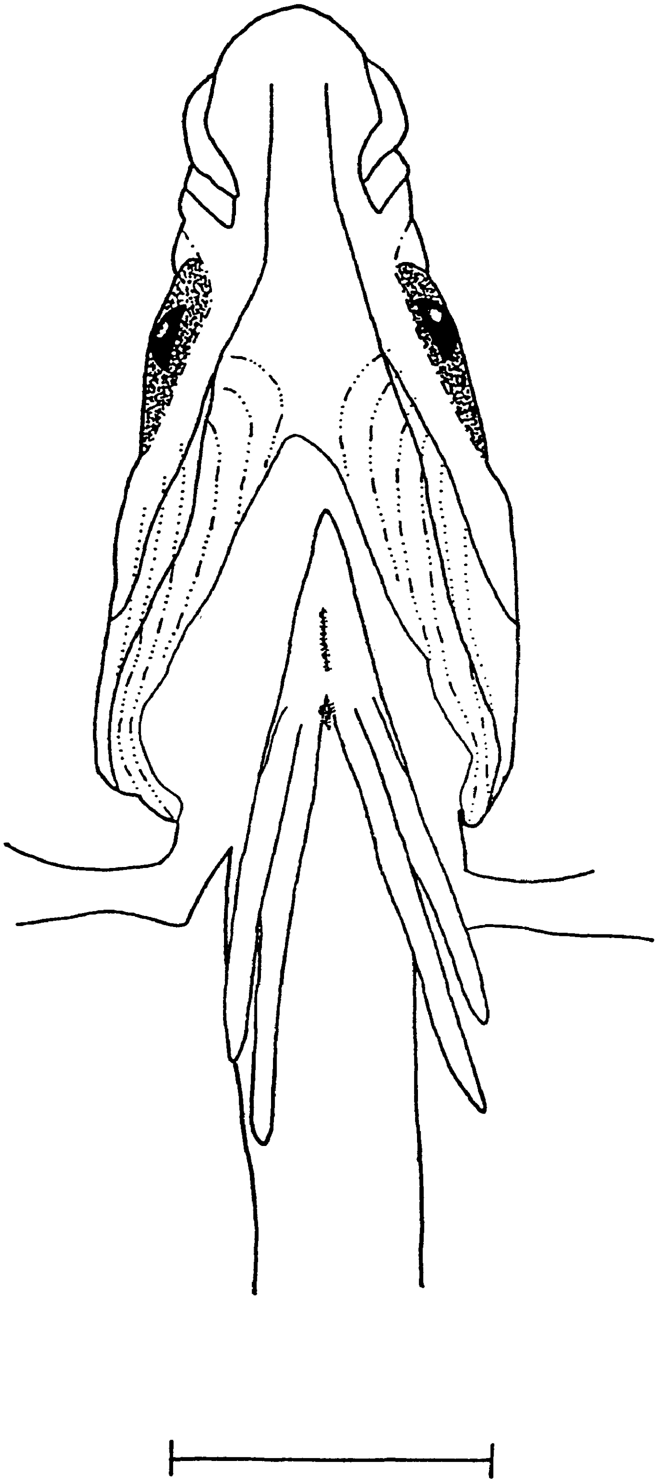


Table 19. Numbers of dorsal-fin pterygiophores within interneural spaces 1-8 in one chaenopsid larva (morphotype J); VIMS 1072.

Interneural space							
1	2	3	4	5	6	7	8
3	1	0	1	0	1	1	1

Table 20. Pattern of anal-fin pterygiophore interdigitation for interhaemal spaces 13-18 of one unknown chaenopsid larva (morphotype J): VIMS 1072. Interhaemal space 13 corresponds to the space anterior to the anteriormost caudal vertebra.

Interhaemal space					
13	14	15	16	17	18
2	1	1	1	1	1

LABRISOMIDAE

Labrisomus or *Malacoctenus* sp.

MORPHOTYPE H

Material examined. Larva: VIMS 790, 1, 15.3 mm SL, cleared and stained, station C, 30 November, 1985.

Adults: *Labrisomus gobio*, USNM 193446, 1, (length unknown), radiograph. *Labrisomus haitiensis*: USNM 129877, 1, (length unknown), radiograph; USNM 088121, 1, 46.5 mm SL, radiograph, Gulf of Mexico, Florida, Tortugas; USNM 276046, 3, 34.9-39.8 mm SL, radiograph, Carrie Bow Cay, Belize; USNM 198600, 1, 40.9 mm SL, radiograph, Caribbean Lesser Antilles. *Malacoctenus aurolineatus*: USNM 114708, 5, 30.0-34.5 mm SL, radiograph, Caribbean Cuba, Guantanamo Bay. *Malacoctenus delalandei*: USNM 226378, 1, 40.1 mm SL, cleared and stained, (location unknown). *Malacoctenus gilli*: USNM 187764, 7, (lengths unknown), radiograph, (Serrana Bank, Caribbean Sea); USNM 218249, 1, 24.3 mm SL, cleared and stained, (location unknown).

Identification. A comparison of the number of dorsal- and anal-fin elements of the late-stage larva (Table 4) with those of adult blennioids (Appendix II) excludes all families except Chaenopsidae and Labrisomidae. Within the Chaenopsidae (Appendix IV), all genera are excluded except *Coralliozetus* and *Emblemariopsis*. Within *Coralliozetus*, only *C. tayrona* possesses meristic values similar to those of the late-stage larva, although the meristic data are incomplete (Appendix IX). Within *Emblemariopsis*, (Appendix IX) all species are excluded except *E. leptocirris*, *E.*

occidentalis, and *E. signifera*; however, the late-stage larva possesses scales and nuchal cirri, characters that absent in all chaenopsids (Nelson, 1984). The late-stage larva also possesses a relatively high number of procurrent caudal-fin rays (7+7 in the late-stage larva) as compared with (3-4+3-4) those in chaenopsid species of *Coralliozetus* and *Emblemariopsis* for which data are available.

A comparison of the number of dorsal- and anal-fin elements of the late-stage larva with those of adult labrisomids (Appendix VI) excludes all genera except *Labrisomus* and *Malacoctenus*. Within *Labrisomus* (Appendix XI) all species are excluded except *L. bucciferus, L. gobio, L. haitiensis,* and *L. kalisherae*. Within *Malacoctenus* (Appendix XI) all species are excluded except *M. aurolineatus, M. delalandei, M. gilli,* and *M. triangulatus*. The number of principle and procurrent caudal-fin elements may delimit the specimen from some of the above-mentioned species; however, available data for adults is incomplete. Vertebral counts for adults are either based on too few specimens or they encompass the counts from the late-stage larva; no species can be excluded based on number of vertebrae. More information is necessary before a generic identification can be made.

Gross morphology. The late-stage larva (Figs. 12-16) is elongate, slightly laterally compressed, and has a moderate gut. The head lacks spination and rugosity, and is moderately large with a short snout. The maxilla terminates at a vertical from the middle of the eye. The eyes are round and small. The specimen possesses nasal, supraorbital, and nuchal cirri (Figs. 12 & 13). The nasal cirrus is short, simple, and is located on the anterior nostril. The supraorbital cirrus is simple. Nuchal cirri consist of three cirri on each side of nape; one thin cirrus in the middle and two short, wide cirri, on either side. Scales, with radii in anterior field only, are present laterally on the larva but are not found on the abdomen, head, pectoral-fin base, or the bases of the median fins. The lateral line is apparent and extends to a position ventral of the ninth dorsal-fin spine. There is no evident gasbladder. The gill membrane covers the region of the proximal tip of the basipterygia (Fig. 15). There is a genital papilla located immediately posterior to the anus. Sensory pores of the infraorbital, postorbital, lateral, posttemporal, supratemporal, and preoperculomandibular series are apparent. The dermis covering the dorsal-halves of the preopercles is torn, making it difficult to determine if additional pores are present. The spinous dorsal fin is continuous with the soft dorsal fin. The dorsal- and anal-fin membranes are not continuous with the caudal-fin membrane. The pelvic-fin membrane is deeply incised between the first and second rays and weakly incised between the second and third rays.

Pigment. The late-stage larva is lightly pigmented (Figs. 12-15). External pigment is confined to the ventral midline, pelvic-fin base, caudal peduncle, dorsal midline, premaxilla, preopercle, and occiput. There are 20 epidermal melanophores on the ventral midline, one associated with the base of each anal-fin soft ray. All are y-shaped except the posterior-most melanophore which is round. There is one round epidermal melanophore on the ventral midline of the caudal peduncle. There is one round epidermal melanophore on the cleithral symphysis. This melanophore is covered by the gill membrane (Fig. 15). There is one subdermal melanophore immediately posterior to the basipterygia (Fig. 15).

There are 17 round epidermal melanophores on the dorsal midline associated with the four posteriormost dorsal-fin spines and the nine anteriormost dorsal-fin soft rays (Figs. 12 & 14). Each of the four spines has a pair of round epidermal melanophores at its base; one melanophore on each side of the base. There is one oval-shaped epidermal melanophore associated with the base of each dorsal-fin soft ray except the two posterior-most rays. Other dorsal-midline pigment consists of one round dermal melanophore on the caudal peduncle (Fig. 14). There are two round epidermal melanophores positioned near the symphysis of the premaxillae (Fig. 13). There is one small subdermal melanophore on each preopercle, located at a point level with the pupil. There are nine round melanophores on the occiput (Fig. 13); the posteriormost and the four anteriormost melanophores are subdermal. The remaining four melanophores are epidermal. All pigment was lost during clearing and staining; it is not known if any internal pigment was present.

Meristics and morphometrics. Data are summarized in Tables 4, 5, 21-23. The dorsal-fin pterygiophore interdigitation pattern for interneural spaces 1-7 of the larva corresponds with that of *Labrisomus haitiensis* (Table 21). The pterygiophore interdigitation pattern for interhaemal spaces 11-15 of the larva does not correspond with those of the adults examined (Table 22). Pterygiophore interdigitation patterns for interhaemal spaces 27-32 are highly variable, with 10 patterns exhibited for 22 specimens (Table 23); the pattern for the larva corresponds with some specimens of *Malacoctenus gilli* and *M. aurolineatus*. The second pelvic-fin ray is the longest, the third the shortest. The pelvic-fin spine is long and thin, equalling approximately 1/2 the length of the first segmented ray. The longest caudal-fin ray is 3.5 mm (~23% SL).

Osteology. All fin elements are ossified. All dorsal-fin pterygiophores, excluding the posteriormost two, are partially ossified; the posteriormost two pterygiophores were not adequately stained. The anteriormost pterygiophore is wide and consists of three distinct sections (Fig. 16): the anterior section is transparent, the middle section is ossified, and the posterior section is cartilaginous. The anal-fin pterygiophores were not adequately stained. The ventroposterior process of the coracoid is spike-like and projects medially. A foramen is located near the base of this process. Each pterygiophore that supports a dorsal- or anal-fin spine possesses an ossified, spine-like process (possibly the fused distal radials of the preceeding pterygiophore) (Springer, pers. comm.) that projects anteriorly through the basal halves of the supernumerary spine (Fig. 16). The dorsal and ventral hypural plates are partially ossified and fused to each other only proximally; a suture is evident proximally. The ventral hypural plate is ossified anteriorly. There are two foramina in the ventral hypural plate. There is a small foramen located in the dorsal hypural plate (between hypurals 3 and 4?). There is an autogenous hypural 5 which supports the dorsalmost principle caudal-fin ray. There are two partially ossified epurals; the anterior one is bifurcated, with the tines extending anterior and posterior to the posteriormost neural spine. The anterior epural partially supports procurrent ray 6. The posterior epural supports procurrent ray 7 and partially supports procurrent ray 6.

All vertebral centra and neural- and hemal arches are ossified. The anteriormost vertebra does not possess a neural spine (Fig. 16). The anteriormost eight neural spines are ossified; all others are partially ossified. The anteriormost hemal spine is ossified; all others are partially ossified. Beginning with the fifth anteriormost vertebra and continuing posteriorly, the associated posterior neurapophyses become elongate, with the majority extending to the associated neural arch (Fig. 16). The posterior neurapophyses are branched in many cases and connect to two locations on the neural arch (Fig. 16). The posterior neurapophyses of preural centra 2 through 6 are enlarged and extend to the neural spines, forming neural arches that are the length of the vertebrae. The posterior hemapophyses of preural centra 2 through 6 are enlarged and extend to the hemal spines, forming hemal arches that are the length of the vertebrae. The first six vertebrae bear epipleural ribs (Fig. 16) (the posterior two are not shown in Fig. 16); the first one is ossified, the rest are partially ossified. Precaudal vertebrae 3 through 10, and the first caudal vertebra, bear pleural ribs (Fig. 16), which are partially ossified.

Sensory canals that are present and surrounded by bone include the infraorbital, the supraorbital canals in the frontals, the preoperculomandibular, and the supratemporal canal extending over the posterior section of the head. Dentition consists of approximately 18 conical teeth on each dentary, approximately 14 teeth on each premaxilla, and upper and lower pharyngobranchial teeth.

Comments. All Atlantic species of *Labrisomus* possess palatine teeth, and they are relatively large in the four species listed below (Springer, pers. comm.). No species of *Malacoctenus* possesses palatine teeth (Springer, pers. comm.). Larval and juvenile labrisomids need to be examined to determine the size at which palatine teeth are acquired.

Labrisomus bucciferus, *L. gobio*, *L. haitiensis*, *L. kalisherae*, *Malacoctenus aurolineatus*, *M. delalandei*, *M. gilli*, and *M. triangulatus* are all known from Belize. The larva was collected in November in shallow water (1-1.75 m) over coarse sand and gravel, as well as, coral rubble covered with living coral. For a comparison of this labrisomid with the other labrisomid species described within this study, see Comments in the description of *Stathmonotus stahli tekla* (morphotype I).

Figure 12. Unidentified late-stage larva of *Labrisomus* or *Malacoctenus* (Labrisomidae) (morphotype H); VIMS 790, 15.3 mm SL. Scales omitted from illustration. Scale = 1 mm.

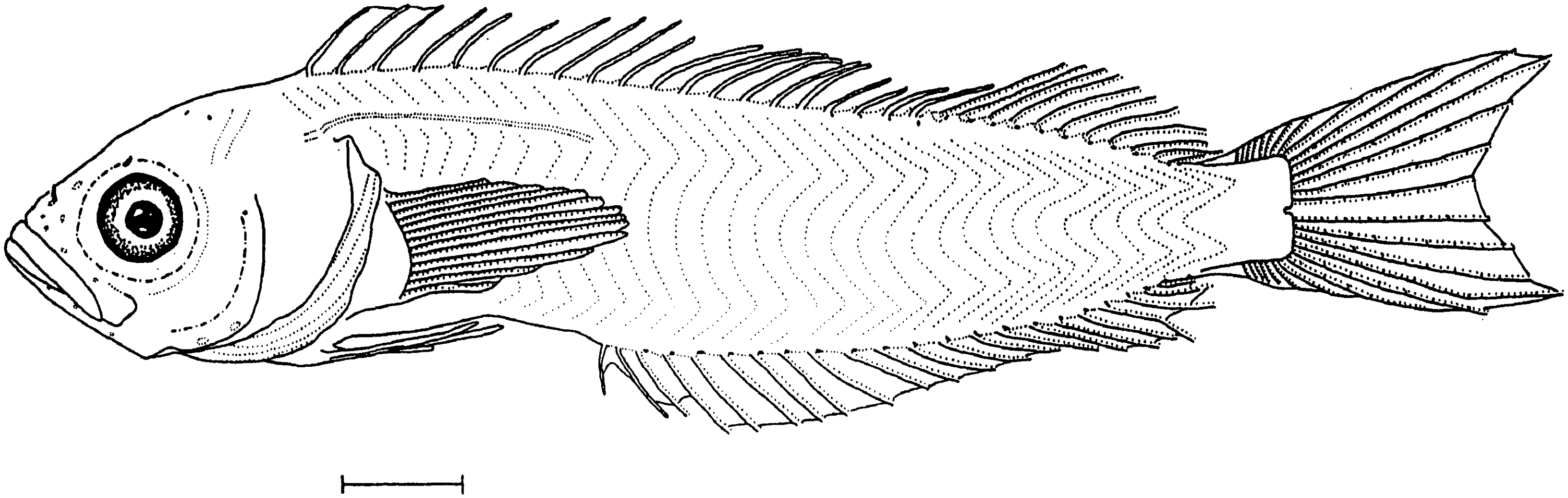


Figure 13. Dorsal view of head of an unidentified late-stage larva of *Labrisomus* or *Malacoctenus* (Labrisomidae) (morphotype H); VIMS 790, 15.3 mm SL. Scale = 1 mm.

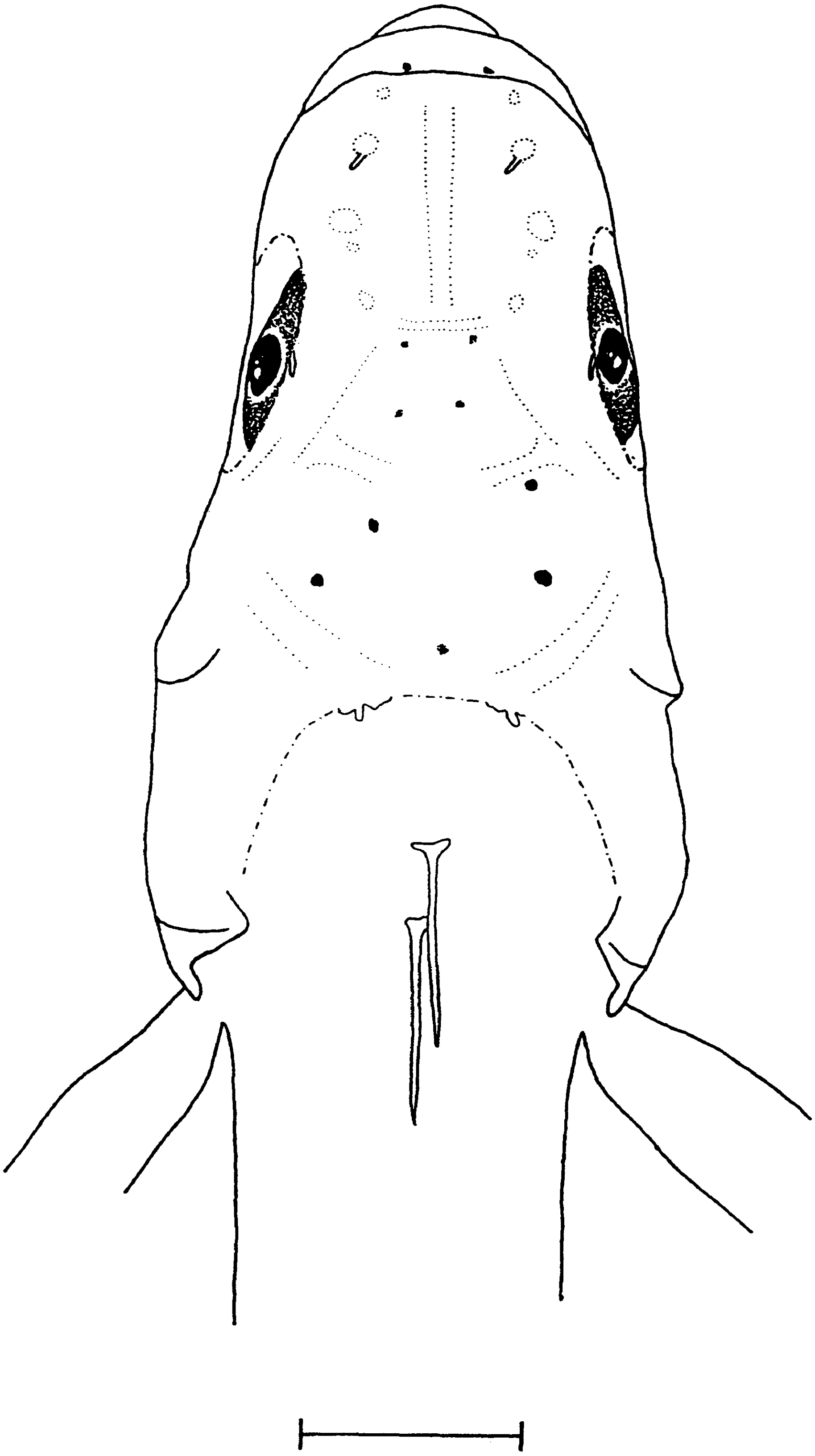


Figure 14. Dorsal-view of the 17 posterior-most dorsal-fin elements of an unidentified late-stage larva of *Labrisomus* or *Malacoctenus* (Labrisomidae) (morphotype H); VIMS 790, 15.3 mm SL. Scale = 1 mm.

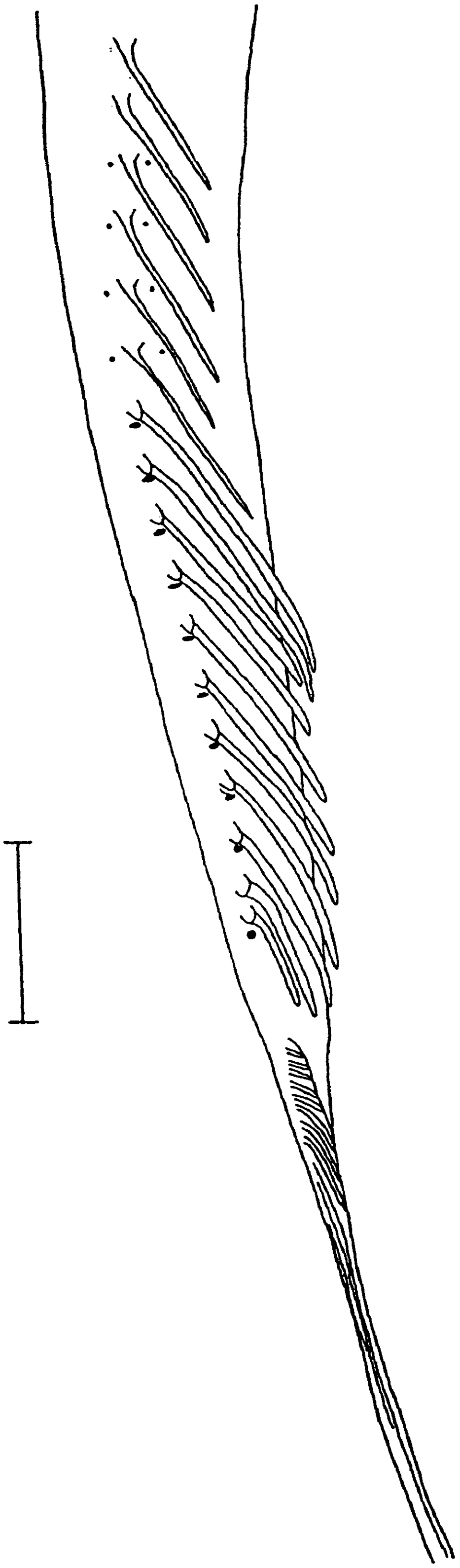


Figure 15. Ventral view of the head and abdomen of an unidentified late-stage larva of *Labrisomus* or *Malacoctenus* (Labrisomidae) (morphotype H); VIMS 790, 15.3 mm SL. Scale = 1 mm.

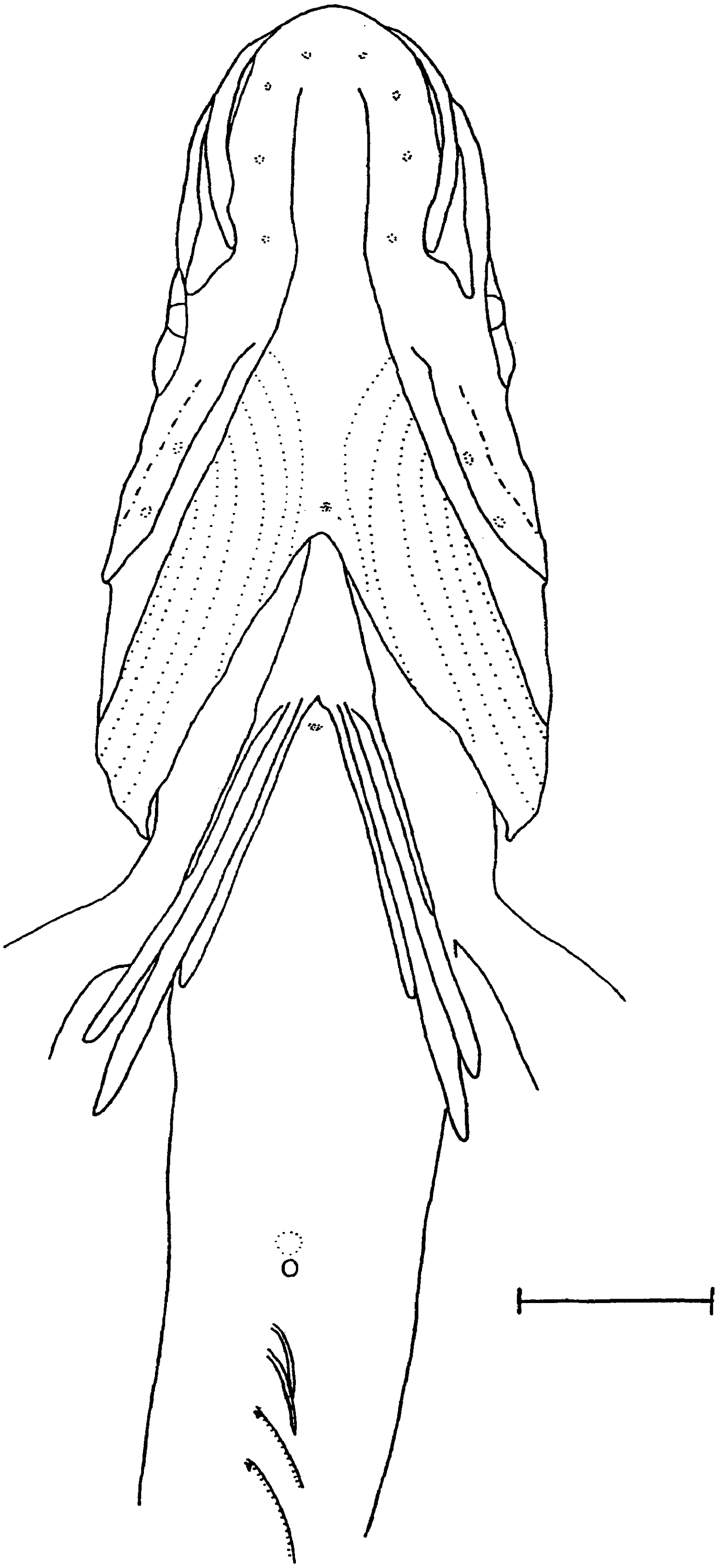


Figure 16. Anterior vertebrae, spines, and supporting elements of an unidentified late-stage larva of *Labrisomus* or *Malacoctenus* (Labrisomidae) (morphotype H); VIMS 790, 15.3 mm SL. Scale = 1 mm.

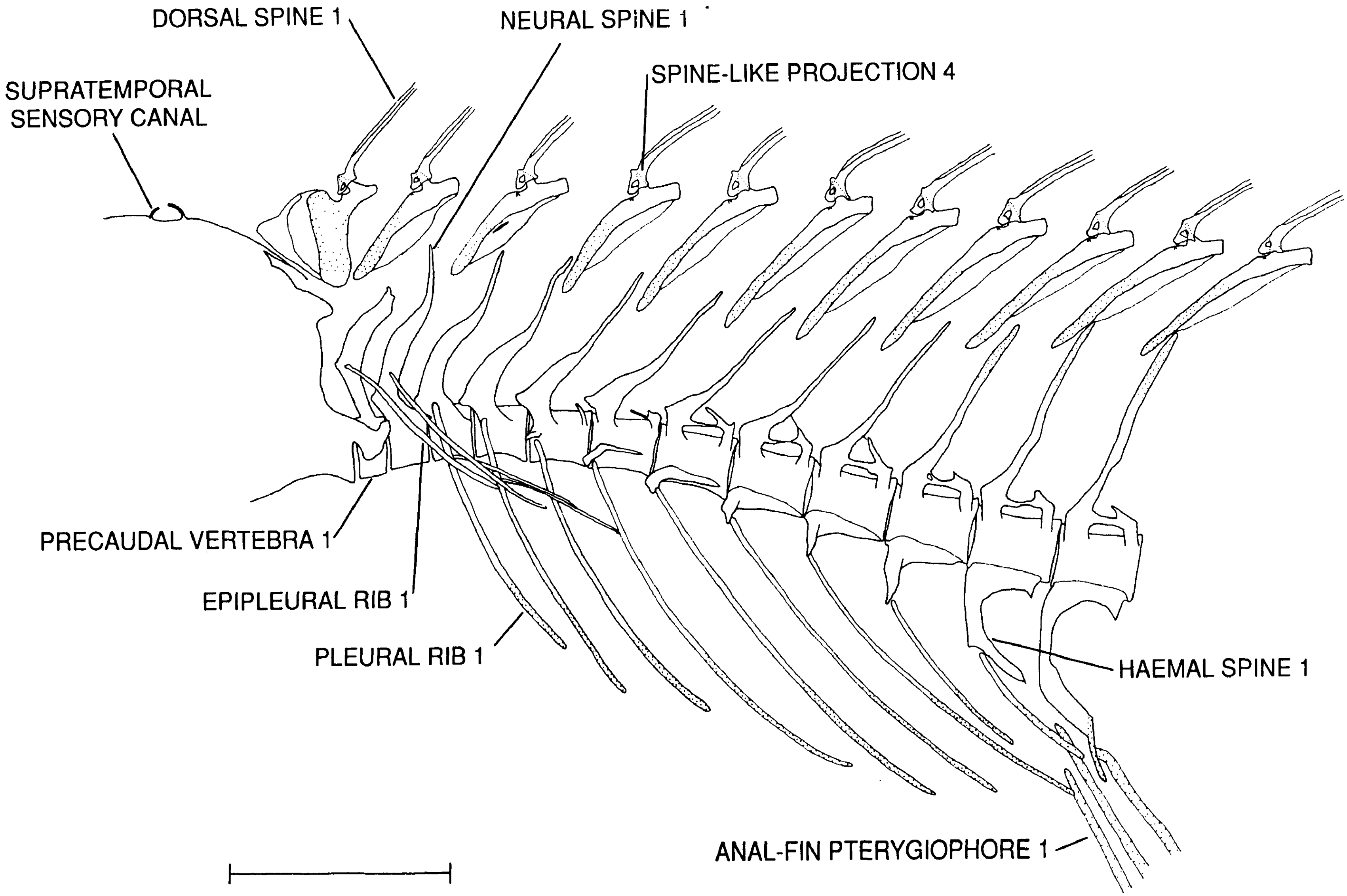

DORSAL SPINE 1
NEURAL SPINE 1
SPINE-LIKE PROJECTION 4
SUPRATEMPORAL SENSORY CANAL
PRECAUDAL VERTEBRA 1
EPIPLEURAL RIB 1
PLEURAL RIB 1
HAEMAL SPINE 1
ANAL-FIN PTERYGIOPHORE 1

Table 21. Numbers of pterygiophores in interneural spaces 1-7 in 17 adults and one larva (morphotype H) (VIMS 790) of Labrisomidae. Numerals in parentheses indicate number of specimens, if more than one. (M.g.)= *Malacoctenus gilli*, (M.d.)= *M. delalandei*, (M.a.)= *M. aurolineatus*, (L.h.)= *Labrisomus haitiensis*.

Interneural space							
1	2	3	4	5	6	7	Material examined
2	0	0	1	1	1	1	USNM 114708 (3) (M.a.) USNM 226378 (M.d), USNM 218249 (M.g.) USNM 187764 (5) (M.g.)
2	0	1	0	1	1	1	VIMS 790, USNM 276046 (3) (L.h.) USNM 129877 (L.h.), USNM 198600 (L.h.)
1	1	0	1	1	1	1	USNM 187764 (2) (M.g.)

Table 22. Numbers of pterygiophores in interhaemal spaces 11-15 in one larva (morphotype H) (VIMS 790) and 10 adults of Labrisomidae. The first interhaemal space with a numeral is anterior to the first caudal vertebra. Numerals within parentheses indicate number of specimens examined, if more than one. (M.g.)= *Malacoctenus gilli*, (L.g.)= *Labrisomus gobio*, (L.h.)= *L. haitiensis*.

Interhaemal space					
11	12	13	14	15	Material examined
	2	1	1	1	USNM 187764 (7) (M.g.)
					USNM 193446 (L.g.)
					USNM 129877 (L.h.)
0	2	1	1	1	VIMS 790
1	1	1	1	1	USNM 218249 (M.g.)

Table 23. Numbers of pterygiophores in interhaemal spaces 27-32 in 21 adults and one larva (morphotype H) (VIMS 790) of Labrisomidae. Numerals in parentheses indicate number of specimens, if more than one. (M.g.)= *Malacoctenus gilli*, (M.d.)= *M. delalandei*, (M.a.)= *M. aurolineatus*, (L.h.)= *Labrisomus haitiensis*, (L.g.)= *L. gobio*.

Interhaemal space						
27	28	29	30	31	32	Material examined
1	1	1	1	1	1	USNM 114708 (M.a.)
1	1	1	1	1	0	USNM 114708 (M.a.)
1	1	1	1	0	0	USNM 187764 (M.g.)
						USNM 114708 (M.a.)
1	1	1	1	2	0	USNM 129877 (L.h.)
						USNM 276046 (L.h.)
1	1	1	2	1	1	USNM 276046 (L.h.)
1	1	1	2	1	0	USNM 276046 (L.h.)
						USNM 198600 (L.h.)
1	1	1	2	0	0	VIMS 790, USNM 218249 (M.g.)
						USNM 114708 (2) (M.a.)
1	1	2	1	0	0	USNM 187764 (M.g.)
						USNM 088121 (L.h.)
1	1	2	0	0	0	USNM 193446 (L.g.)
						USNM 187764 (5) (M.g.)
1	1	0	0	0	0	USNM 226378 (M.d.)

Labrisomidae

Paraclinus sp.

Morphotype F

Material examined. Larvae: VIMS 893, 1, 5.3 mm SL, cleared and stained, station D, 13 August, 1985; VIMS 567, 1, 6.0 mm SL, cleared and stained, station D, 13 August, 1985.

Identification. A comparison of the number of dorsal- and anal-fin elements of the larvae (Table 4) with those of adult blennioids (Appendix II) excludes all families except Labrisomidae. Within the Labrisomidae (Appendix VI), all genera are excluded except *Paraclinus*. Within *Paraclinus* (Appendix XI), only *P. cingulatus* and *P. naeorhegmis* possess a similar dorsal element count. However, the number of anal-fin soft rays (14) of the smaller larva do not correspond with either species. The number of principle caudal-fin rays possessed by both larvae (13) do not correspond with either species (Appendix XI). More information is necessary to resolve this identification.

Morphology. Larvae (Figs. 17 & 18) are naked, laterally compressed, and have a short gut. The head lacks spination or rugosity, is large and broad, with a short, round snout. The eyes are small to moderate in size and round. The posterior nares are relatively large. The anterior naris is slightly raised. There is a single, simple, short supraorbital cirrus. The dorsal and posterior portions of the orbital crest form a right angle above and to the rear of the eye. The posterior portion of the orbital crest is vertical and covers a small posterior portion of the eye. Pores of the preoperculomandibular sensory canal system are apparent in whole specimens. The dorsal fin is continuous with the procurrent caudal-fin membrane. The pelvic fin has two apparent soft rays (see Osteology).

Pigment. The larvae are lightly pigmented (Figs. 17 & 18). External pigment is confined to the ventral midline, pelvic-fin base, caudal peduncle, and the ventral caudal-fin procurrent membrane. There is no other lateral pigment. This description of external pigment is based on the smaller specimen. There are 14 y-shaped, epidermal melanophores on the ventral midline, associated with the bases of the anal-fin elements. A melanophore is posterior to each anal-fin element except the anteriormost spine and the second posteriormost soft ray. There is one dendritic epidermal melanophore on the cleithral symphysis (Figs. 17 & 18), one epidermal melanophore on the caudal peduncle, and one epidermal melanophore on the ventral caudal-fin procurrent membrane.

Internal pigment evident in cleared and stained material includes three pigment patches on the gut: one ventroanteriorly (evident in whole specimens, both laterally and ventrally) (appears as a subdermal melanophore immediately posterior to the pelvic fins); one relatively large pigment patch dorsomedially; one dorsoposteriorly (evident in whole specimens). Additional internal pigment consists of one melanophore associated with each otic capsule (evident in whole specimens when observed dorsally) and one melanophore associated with the dorsoposterior portion of the neurocranium.

Meristics and morphometrics. Data are summarized in Tables 4, 5, 24, and 25. Pterygiophore interdigitation patterns for the anterior portions of both the dorsal- and anal fins are different for each of the larvae (Tables 24 & 25).

The innermost ray of the pelvic fin is longer than the outermost ray. The pelvic-fin spine is thin, relatively long and is approximately 1/2 the length of the shortest ray. The caudal fin is damaged in both specimens; the longest ray is 0.86 mm (16.2 % BL).

Osteology. The following description is based on examination of the larger specimen. Ossification of vertebrae proceeds from anterior to posterior. The six anteriormost vertebrae are completely ossified. All vertebral centra are ossified. Neural spines are absent from the three anteriormost vertebrae. The anteriormost vertebra does not possess a complete neural arch. The anteriormost caudal vertebra lacks a hemal spine. The ural and preural centra are consolidated and ossified, except distally.

Ossification of dorsal-fin spines proceeds from anterior to posterior, and ossification of individual spines appears to proceed from the distal tip towards the base. Each pterygiophore that supports a dorsal- or anal-fin spine possesses an ossified spine-like process (possibly the fused distal radials of the preceeding pterygiophore) (Mooi, 1989) that projects anteriorly through the basal halves of the supernumerary spine. All of these projections are ossified except the three posteriormost projections of the dorsal fin. All of the dorsal- and anal-fin pterygiophores, excluding the spinelike projections, are cartilaginous. The first anal-fin spine is fully ossified and the second is ossified at the basal halves and the distal tip only. Ossification of the caudal-fin rays appears to proceed from the two centermost rays to the outermost rays. The pectoral-fin rays of the ventral half of the fin are ossified to a greater extent than those of the dorsal half. The ventroposterior process of the coracoid is relatively small, tooth-like, and projects medially. The third pelvic-fin ray is composed of nubbins of the proximal halves.

Canals of the sensory system that are present and surrounded by bone include the infraorbital and the preopercular series. Canals present but not ossified include the supratemporal canal and a canal on each frontal extending from the dorsal portion of the infraorbital canal to a point midbody and dorsal of the nasal bone.

Dentition consists of upper and lower pharyngobranchial teeth, five teeth on each premaxilla (two of which are larger than the rest and located at the anterior tip), and five evenly spaced teeth on each dentary.

Comments. Watson (1987) states that the ossified projection (distal radial?) that bisects the basal portion of each dorsal-fin spine in *Enchelyurus brunneolus* (Blenniidae) does not appear to be preceded by a cartilaginous stage. In *Paraclinus*, these structures first appear as cartilage.

Adult *Paraclinus cingulatus* and *P. naeorhegmis* possess both nuchal and supraorbital cirri. It is not known at what size these features are acquired. *Paraclinus cingulatus* is known from Puerto Rico, the Bahamas, the Tortugas, Florida, Cuba, Honduras, and Belize (Springer, 1954; Bohlke & Chaplin, 1968; Greenfield & Johnson, 1981). All collections consisted of 1-7 individuals collected from the shoreline to depths of 6.1 m (Bohlke & Chaplin, 1968; Greenfield & Johnson, 1981).

Paraclinus naeorhegmis is known from the Bahamas, Isla de Providencia, and Belize (Bohlke & Chaplin, 1968; Greenfield & Johnson, 1981). Collections consisted of 1-8 individuals from the shoreline to depths of 11 m.

The larvae were collected only in August over rocky substrate containing corals and sponges. For a comparison of this labrisomid with the other labrisomid species described within this study, see Comments in the description of *Stathmonotus stahli tekla* (morphotype I).

Figure 17. Larva of *Paraclinus* sp. (Labrisomidae) (morphotype F); VIMS 893, 5.3 mm SL. Scale = 1 mm.

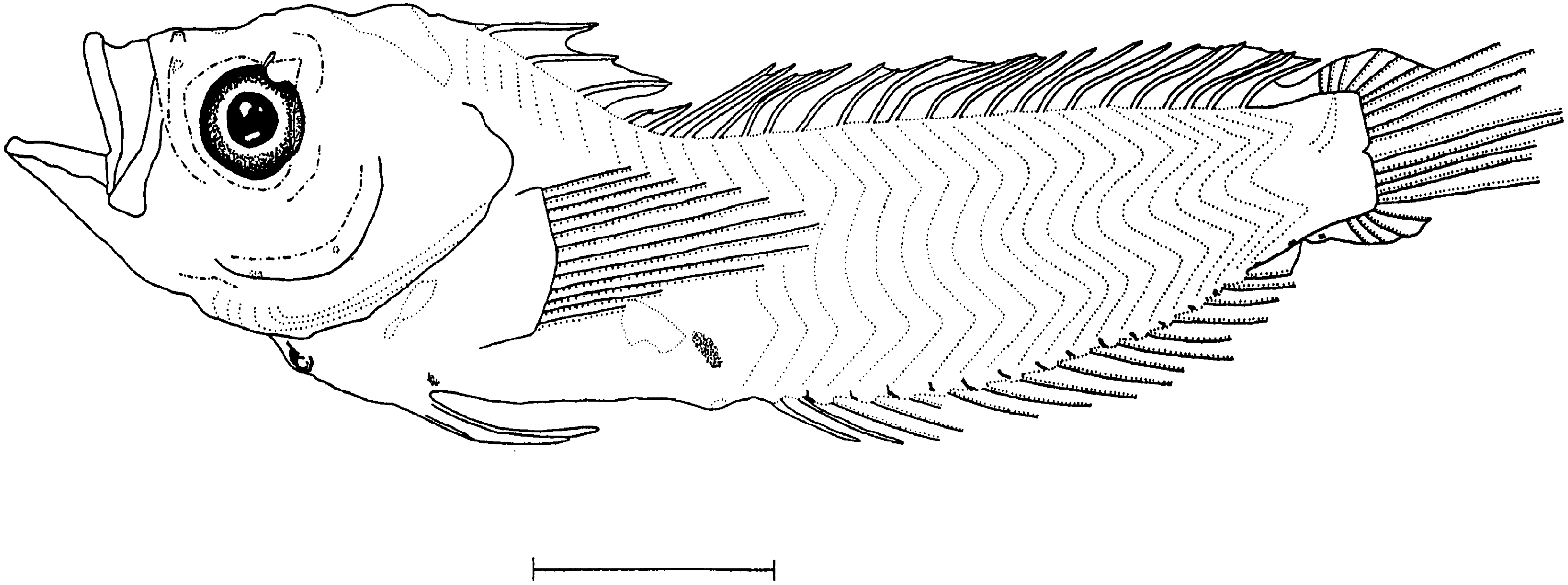


Figure 18. Ventral view of head and pelvic region of larva of *Paraclinus* sp. (Labrisomidae) (morphotype F); VIMS 893, 5.3 mm SL. Scale = 0.5 mm.

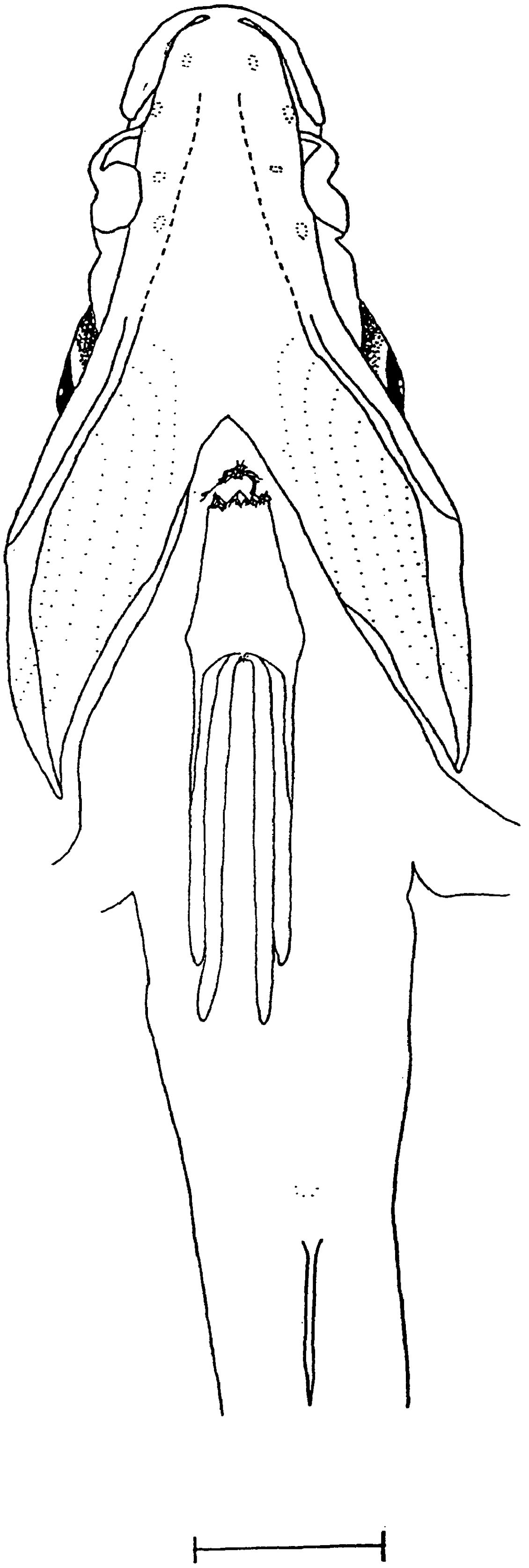


Table 24. Numbers of pterygiophores within interneural spaces 1-6 in larvae of *Paraclinus* sp. (morphotype F).

Interneural space						
1	2	3	4	5	6	Material examined
2	0	1	0	1	1	VIMS 893
2	0	0	1	1	1	VIMS 567

Table 25. Numbers of pterygiophores within interhaemal spaces 11-15 in larvae of *Paraclinus* sp. (morphotype F). The first interhaemal space (11) precedes the first caudal vertebra (11).

Interhaemal space					
11	12	13	14	15	Material examined
0	1	1	0	1	VIMS 893
0	1	1	1	1	VIMS 567

Labrisomidae

Stathmonotus hemphilli

Morphotypes K & L

Material examined. Larvae: VIMS 331, 1, 6.2 mm SL, cleared and stained, station C, 11 April, 1985; VIMS 369, 1, 7.8 mm SL, cleared and stained, station D, 11 April, 1985.

Identification. A comparison of dorsal-, anal-, and pectoral-fin counts of the larvae (Table 4) with those of adult blennioids (Appendix II) excludes all families except Labrisomidae. Within Labrisomidae (Appendix VI), all genera are excluded except *Stathmonotus*. Within *Stathmonotus* (Appendix XI), the unique combination of counts are only within the ranges of S. *hemphilli*.

Morphology. The larvae (Figs. 19-25) are naked, elongate, slightly laterally compressed, and have a long gut. The head lacks spination, rugosity, cirri, and is small to moderate in size with a short snout. Eye size ranges from small to moderate. The maxilla terminates below a vertical from the middle of the pupil. The anterior nostril is raised in the largest specimen. Teeth are not apparent in whole specimens. A gasbladder is present. The dorsal- and anal-fin membranes are continuous with the caudal fin. The pelvic-fin membrane is not incised (Fig. 25).

Pigment. The larvae are lightly pigmented (Figs. 19-25). External pigment is confined to the ventral midline, cleithral symphysis, head, and the caudal fin. There are 23 or

25 pinpoint melanophores associated with the bases of the anal-fin elements (Figs. 19 & 23). Pigment is present on the cleithral symphysis (Figs. 22 & 25). Caudal-fin pigment consists of 1 or 3 epidermal melanophores located proximally on the fin (Figs. 19 & 23). Head pigment consists of one subdermal melanophore on the occiput (Figs. 20 & 24).

The larger larva possesses additional pigment consisting of: one epidermal pinpoint melanophore on the anterior tip of the dentary (Figs. 23 & 24); several pinpoint melanophores on the mid-lateral side of the dentary (Figs. 23 & 25); several epidermal pinpoint melanophores on the posterior portion of the lower jaw, extending dorsally towards the eye (Figs. 23 & 25); and a patch of approximately 12 epidermal pinpoint melanophores located immediately posterior to the eye (Fig. 23).

Internal pigment, all of which is evident in the whole specimen, includes melanophores located in the cranium, gut, and gasbladder, as well as melanophores located interneurally and interhaemally in the body. Pigment in the cranium consists of one melanophore associated with each otic capsule (Fig. 21). Gut pigment is variously distributed with melanophores located anteriorly (Figs. 19 & 23), apparent through the opercle or pectoral fin. There are melanophores associated with the gut. These are located dorsal to the gut, anterior and posterior to the swimbladder (Figs. 19 & 23). Melanophores are variously associated with the gasbladder and consist of one melanophore each located dorsoanteriorly, dorsoposteriorly, and midlaterally (absent in the smaller larva) (Fig. 19 & 23). Interneural and interhaemal melanophores are variously located (Figs. 19 & 23).

Meristics and morphometrics. Data are summarized in Tables 4, 5, 26, and 27. The 6.2 mm SL larva has a relatively larger: snout, preanal length, predorsal length, and eye diameter, as well as, a smaller head size than the 7.8 mm SL larva. The dorsal-fin spines are longer posteriorly on the body. Pterygiophores are absent from the first four interneural spaces (Table 26).

Osteology. Stain reactions were poor in both specimens. Dorsal-fin spine formation begins in the posterior section of the dorsal fin (Fig. 19). Each pterygiophore that supports a dorsal- or anal-fin spine possesses a spine-like process (possibly the fused distal radials of the preceeding pterygiophore) (Mooi, 1989) that projects anteriorly through the basal halves of the supernumerary spine. Formation of the anal-fin elements proceeds from anterior to posterior (Fig. 19). The pelvic fins have not developed in the smaller larva (6.2 mm SL), the pectoral-fin anlage is present although rays are not developed. The ventroposterior process of the coracoid is spike-like, relatively long, and terminates below a vertical from the base of the dorsalmost pectoral ray. The full complement of fin rays is present in the 7.8 mm SL larva (Fig. 23).

The hypural plates are fused to each other proximally. There are two foramina in the ventral hypural plate. Fusion of hypurals is not complete in the dorsal hypural plate of the smaller larva. Neural spines are absent from the three anteriormost vertebrae. The posteriormost hemal spine is large and forked; the posteriormost tine extends ventrally to a caudal-fin procurrent ray. Preural centra two and three appear to be fused in the 6.2 mm SL larva, as the penultimate vertebra bears two neural and hemal spines.

There are no apparent cephalic sensory canals in the smaller larva (6.2 mm SL). Sensory canals apparent in the larger specimen (7.8 mm SL) include the supraorbital, postorbital, preopercular, two canals on the frontals that extend dorsal to the nasal bones, and a canal that branches off the supraorbital canal and extends medially towards the center of the frontals. Dentition of the smaller larva consists of four upper pharyngobranchial teeth, one lower pharyngobranchial tooth, and three canine teeth on each dentary. Dentition of the larger larva consists of upper and lower pharygobranchial tooth patches, five canine teeth on each dentary, and two teeth on each premaxilla.

Comments. *Stathmonotus hemphilli* is known from the Bahamas, Florida, Antigua, St. Croix, Haiti (Springer, 1955; Bohlke and Chaplin, 1968), and recently Belize and Honduras (Greenfield and Johnson, 1981). Adults have been collected at depths of <1.8->24.4 m, and are found associated with eroded limestone slopes, eroded troughs, coral heads, and eroded reef rock (Bohlke and Chaplin, 1968; Greenfield and Johnson, 1981). The smaller larva was collected in shallow water (1-1.75 m) over coarse sand and gravel, as well as, coral rubble covered with living coral. The larger larva was collected over rocky substrate containing corals and sponges in 5-14 m of water. Both larvae were captured in April.

Larvae and adults of *S. hemphilli* do not possess supraorbital or nuchal cirri as do the other species of *Stathmonotus* (Bohlke and Chaplin, 1968). For a comparison of this labrisomid with the other labrisomid species described within this study, see Comments in the description of *Stathmonotus stahli tekla* (morphotype I).

Figure 19. Larva of *Stathmonotus hemphilli* (Labrisomidae) (morphotype L); VIMS 331, 6.2 mm SL. The stippled melanophore in the pectoral fin is an internal melanophore on the gut. Scale = 1 mm.

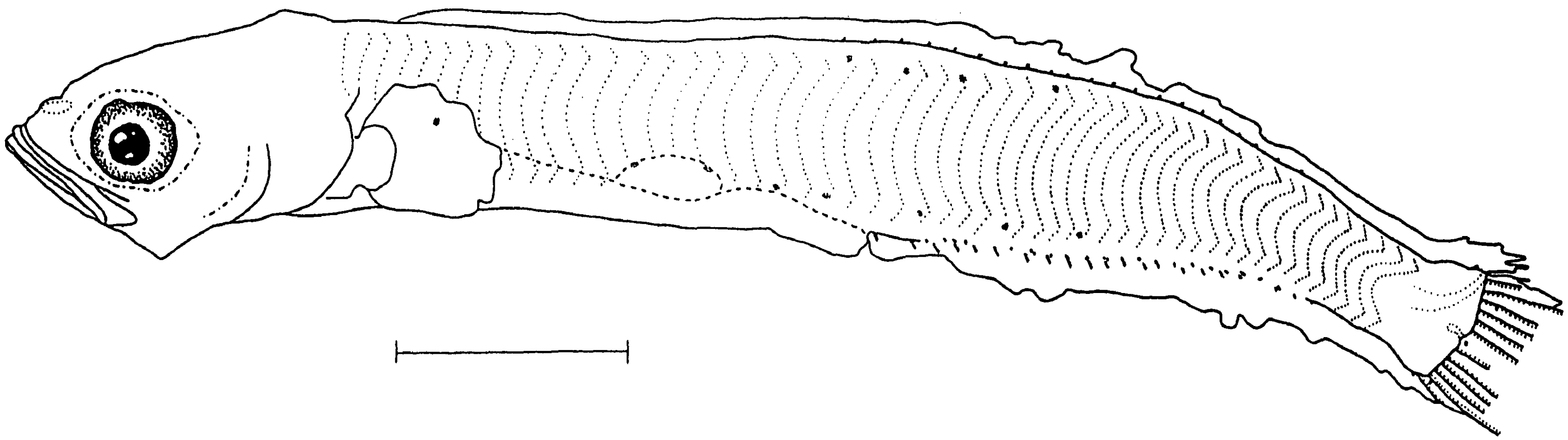


Figure 20. Dorsal view of the head of *Stathmonotus hemphilli* (Labrisomidae) (morphotype L); VIMS 331, 6.2 mm SL. Scale = 0.5 mm.

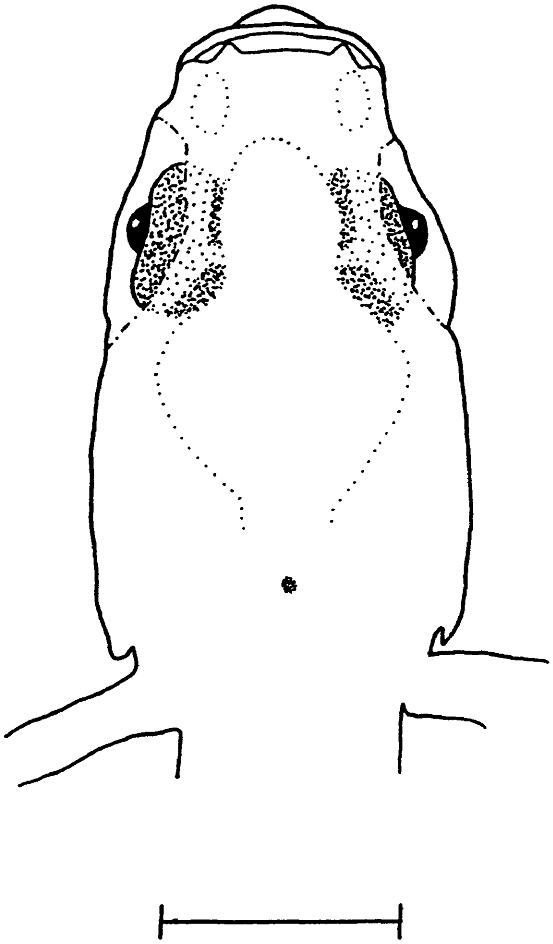


Figure 21. Rotated view of the head of *Stathmonotus hemphilli* (Labrisomidae) (morphotype L); VIMS 331, 6.2 mm SL. Scale = 0.5 mm.

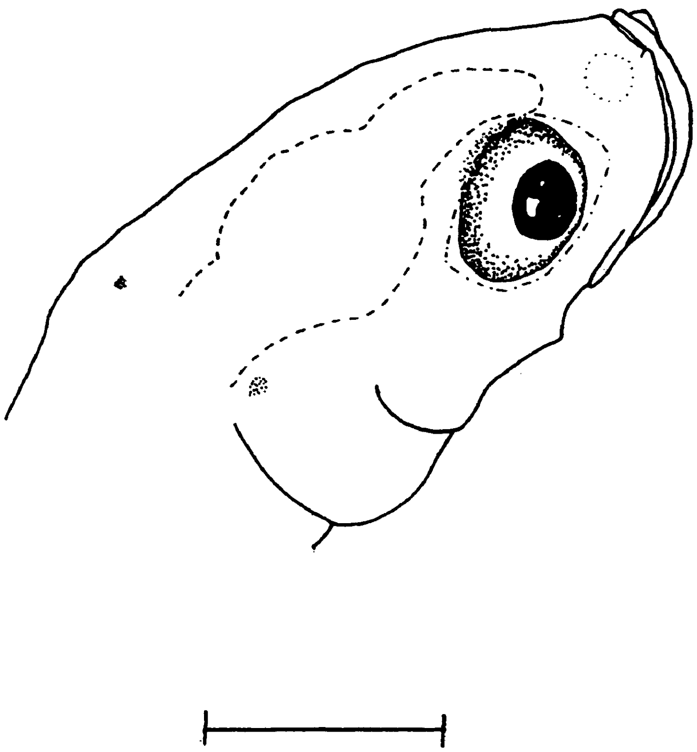


Figure 22. Ventral view of head and pelvic region of *Stathmonotus hemphilli* (Labrisomidae) (morphotype L); VIMS 331, 6.2 mm SL. Scale = 0.5 mm.

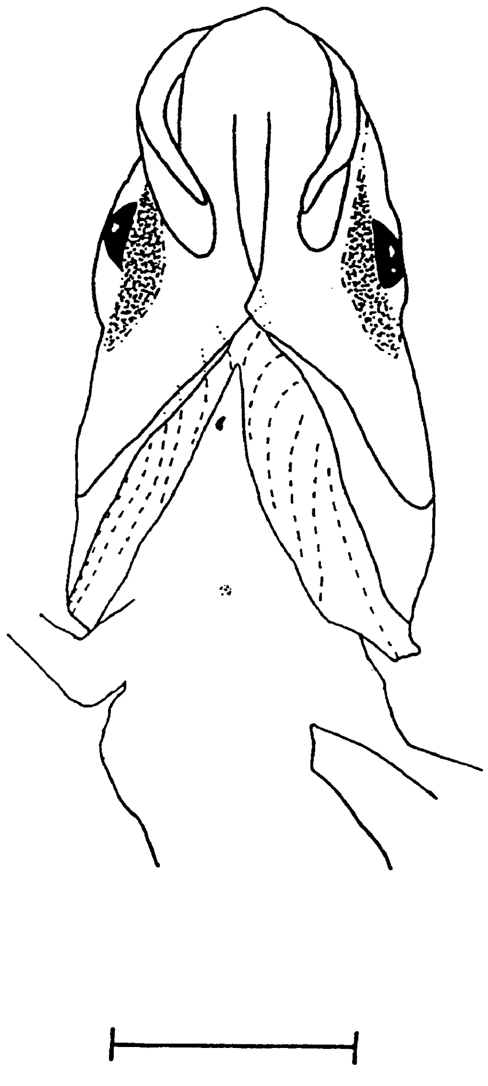


Figure 23. Larva of *Stathmonotus hemphilli* (Labrisomidae) (morphotype K); VIMS 369, 7.8 mm SL. The right side of the specimen was illustrated and photographically reversed. Scale = 1 mm.

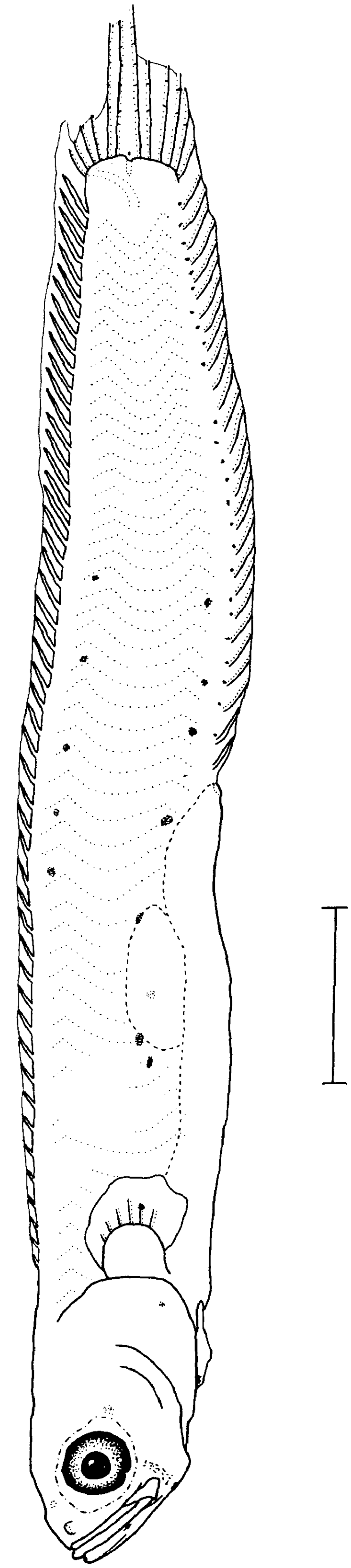


Figure 24. Dorsal view of head of *Stathmonotus hemphilli* (Labrisomidae) (morphotype K); VIMS 369, 7.8 mm SL. Scale = 0.5 mm.

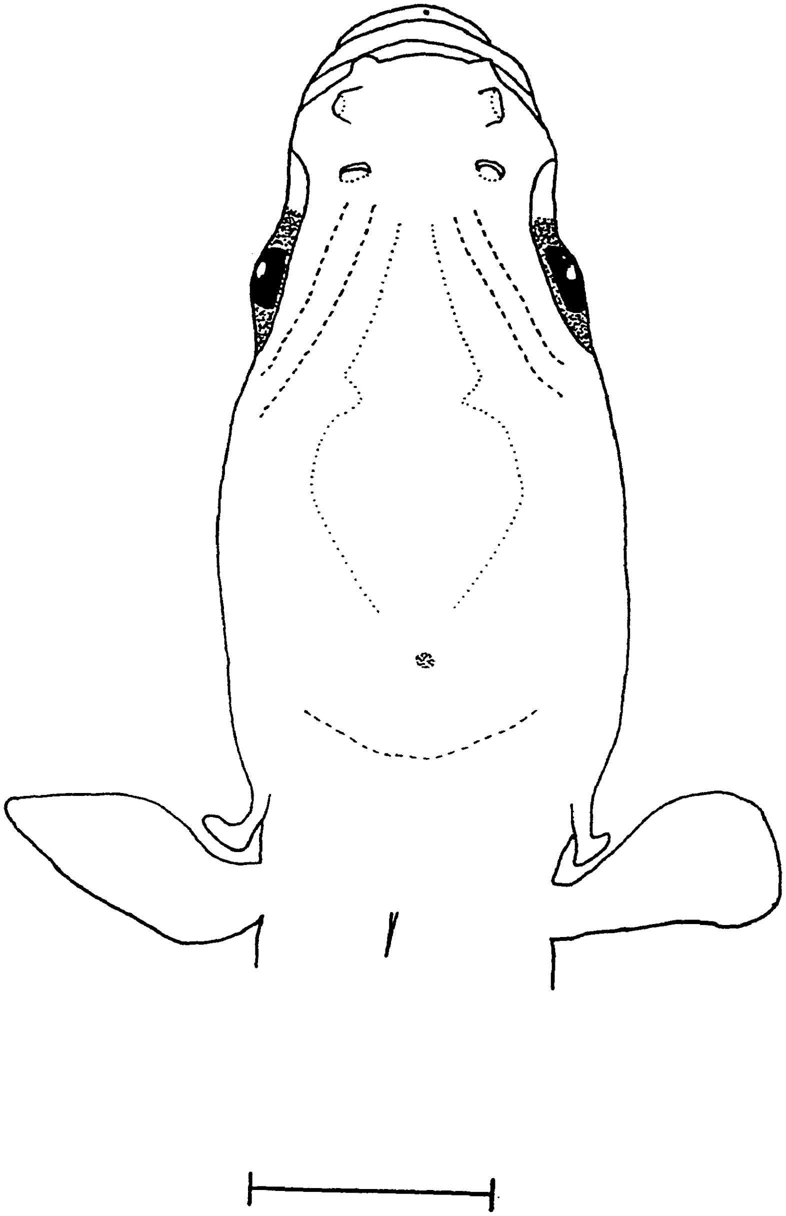


Figure 25. Ventral view of *Stathmonotus hemphilli* (Labrisomidae) (morphotype K); VIMS 369, 7.8 mm SL. Scale = 0.5 mm.

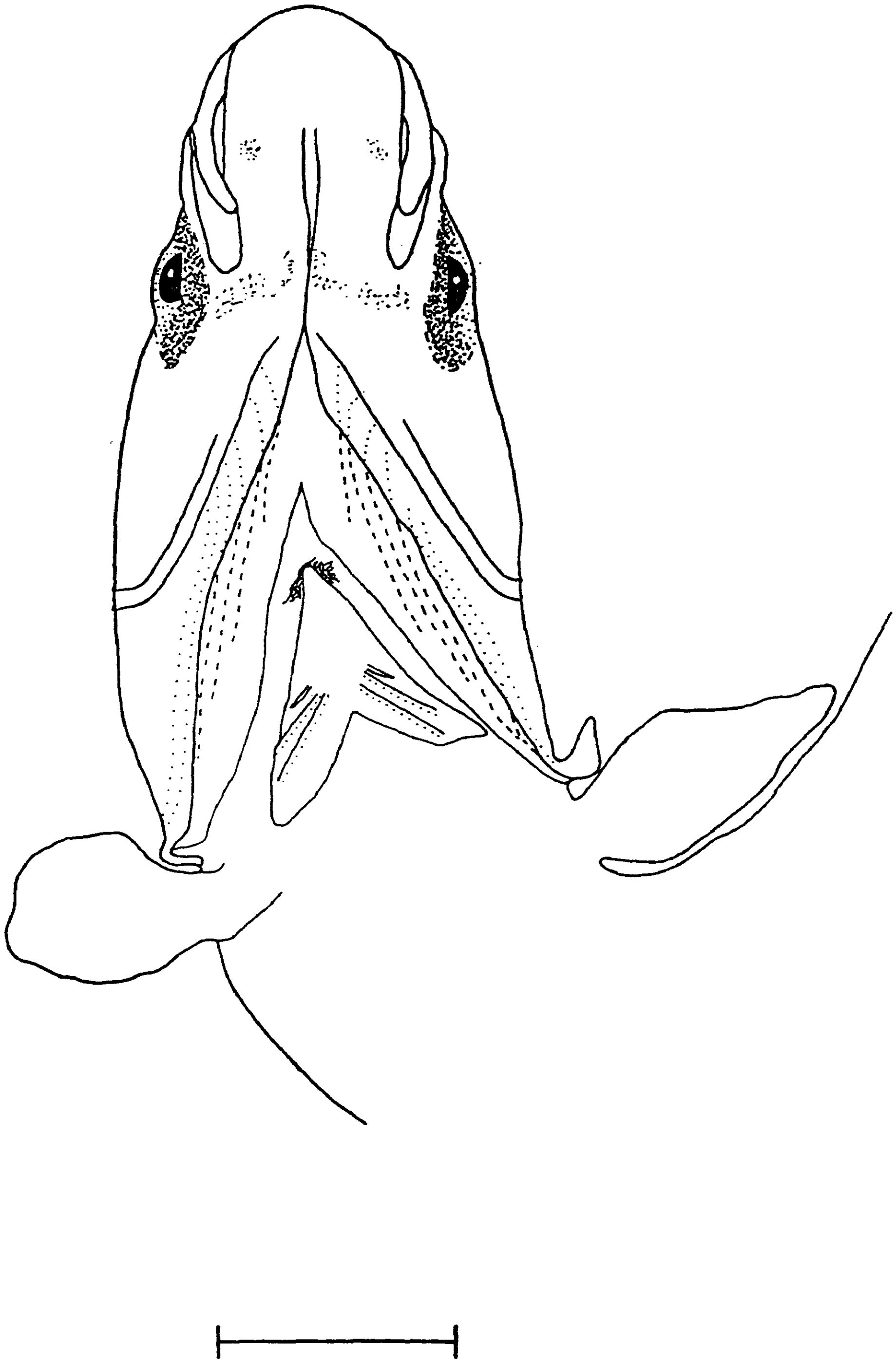


Table 26. Numbers of pterygiophores within interneural spaces 1-8 in one larva of *Stathmonotus hemphilli* (Labrisomidae) (morphotype K); VIMS 369.

Interneural space							
1	2	3	4	5	6	7	8
0	0	0	0	1	1	1	1

Table 27. Numbers of pterygiophores within interhaemal spaces 25-31 in one larva of *Stathmonotus hemphilli* (morphotype K); VIMS 369. The first interhaemal space (25) precedes the first caudal vertebra (25).

Interhaemal space						
25	26	27	28	29	30	31
1	0	1	0	1	1	1

Labrisomidae

Stathmonotus stahli tekla

Morphotype I

Material examined. Larvae: VIMS 606, 2, 7.6 and 8.4 mm SL, cleared and stained, station D, 13 August, 1985; VIMS 1063, 3, 7.4-8.0 mm SL, (7.4 mm SL specimen, cleared and stained), station C, 17 July, 1985; VIMS 600, 1, 7.5 mm SL, cleared and stained, station D, 13 August, 1985; VIMS 579, 7, 6.5-7.9 mm SL, station D, 13 August, 1985; VIMS 1071, 1, 6.6 mm SL, station D, 26 February, 1985.

Identification. A comparison of the number of dorsal-fin elements of the cleared and stained larvae (Table 4) with those of adult blennioids (Appendix II) excludes all families except Labrisomidae. Within the Labrisomidae (Appendix VI), all genera are excluded except *Stathmonotus* (with one exception, see below). Within *Stathmonotus* (Appendix XI), a comparison of dorsal-spine and vertebral counts excludes *S. hemphilli*. *Stathmonotus gymnodermis* is excluded based on a comparison of the number of total vertebrae and the condition of the dorsal- and anal-fin membranes. The dorsal- and anal-fin membranes of *S. gymnodermis* terminate on the bases of the procurrent caudal-fin rays or on the caudal peduncle. The dorsal- and anal-fin membranes of *S. stahli* ssp., as well as those of the larvae being described here, connect to the procurrent caudal-fin rays approximately at their midpoints (Bohlke and Chaplin, 1968). Three of the four cleared and stained larvae have meristic values that correspond with those of *S. stahli stahli*, and *S. stahli tekla*. The fourth larva possesses 40 dorsal-fin spines; this count only fits within the ranges for *S. s. tekla*, but only for those specimens collected in the Bahamas and Haiti (Hastings and Springer, in prep.). Of the five *S. s. tekla* specimens collected in Belize, and examined by Hastings and Springer (in prep.), all possessed 42 dorsal-fin spines. Based on the above-mentioned information and collection records (see Comments), the larvae are tentatively identified as *S. s. tekla* (Springer, 1955).

Gross morphology. There are 14 specimens (6.5- 8.4 mm SL) representing this morphotype. The larvae (Figs. 26-28) are naked, elongate, slightly laterally compressed, and have a long gut. The head is small, laterally compressed, with a short snout. The eyes are small to moderate in size and round. Some larvae possess eyes with a slight invagination on the ventral side. The maxilla extends to an area ranging from below the anterior margin of the eye to the anterior margin of the pupil. There is no head spination or rugosity. The nares are relatively large and raised. There is one simple, short, supraorbital cirrus on each side of the head. A large gasbladder is present. Teeth are not apparent in whole specimens. The dorsal and anal-fin membranes are continuous with the caudal fin. The pectoral fin is relatively short and round.

Pigment. The larvae are lightly pigmented (Figs. 26-28). External pigment is confined to the ventral midline, cleithral symphysis, occiput, and in association with the dorsal midline. There are 19-24 y-shaped, epidermal, ventral midline melanophores associated with the bases of the anal-fin elements (Fig. 26). The number and placement of melanophores is variable, ranging from a melanophore associated with each anal-fin soft ray and the posterior anal-fin spine to no melanophores associated with the posterior anal-fin spine and up to five anal-fin soft rays, in varying locations. Some specimens may possess an epidermal melanophore dorsal to the ventral midline on one side of the body. Some specimens possess a small, round epidermal melanophore located anteriorly on the ventral caudal-fin procurrent membrane (Fig. 26).

There is one epidermal melanophore at the cleithral symphysis (Fig. 28). On the occiput (Fig. 27), there is one melanophore, which can be dermal, subdermal, or extending from dermal to subdermal. Some specimens possess up to 2 melanophores at the bases of the posterior dorsal-fin spines (spines 5, 6, 8, 10, and 13 from the posteriormost) (anterior spines in whole specimens are not discernible, so spines were counted from the posterior). Some specimens (8 of 14) possess epidermal melanophores (no more than 3 melanophores when present) on the dorsoposterior body wall (ventral to spines 2-11 from the last). These melanophores, when present, are not necessarily paired with melanophores on the other side of the body.

Internal pigment includes pigment on the gasbladder, gut, and head. Gasbladder pigment consists of two extensive patches that are concentrated on the dorsoanterior and dorsoposterior sections (apparent in whole specimens) (Fig. 26). Gut pigment consists of one melanophore located ventroanteriorly (apparent in whole specimens in ventral view) (Fig. 28). There is one melanophore located on each side of the posterior portion of the parasphenoid, associated with the otic capsules (apparent in whole specimens when observed dorsolaterally).

Meristics and morphometrics. Data are summarized in Tables 4, 5, and 28. The full complement of fin elements is present by 6.5 mm SL. There are no apparent trends in morphometrics exhibited with growth from 6.5-8.4 mm SL (Table 28). Patterns of pterygiophore interdigitation were not recorded because the anteriormost pterygiophore of the dorsal fin was difficult to see in all specimens. The pectoral fin is relatively short, round, and extends to approximately 28-32% SL. The pelvic fin consists of one spine and two soft rays. The spine is short, not easily seen in whole specimens, and is approximately 1/3 the length of the first ray. The first ray is the shortest and is approximately 5/6 the length of the second ray.

Osteology. Four specimens were cleared and stained, none of which were stained adequately for a detailed description of osteology. Each pterygiophore that supports a dorsal- or anal-fin spine possesses a spine-like process that projects anteriorly through the basal halves of the supernumerary spine. The ventroposterior process of the coracoid is spike-like, relatively long, and terminates at a vertical from the base of the third dorsalmost pectoral-fin ray. Neural spines are absent from the three anteriormost vertebrae.

Canals of the sensory system that are present and surrounded by bone include the supraorbital, preopercular, posttemporal, supratemporal, and a canal that extends across each frontal bone from the supraorbital canal to a position medial and dorsal to the nasal bones. Dentition apparent in cleared and stained specimens consists of upper and lower pharyngobranchial tooth patches, three to six teeth on each premaxilla, and four to seven teeth on each side of the dentary, the anterior three being the largest.

Comments. *Stathmonotus stahli* ssp. larvae are naked, whereas adults are the only scaled species in the genus. The larvae possess a simple, supraorbital cirrus, whereas the adults possess supraorbital, nuchal, nasal (anterior nostril only), and preopercular cirri (Springer, 1955). *Stathmonotus s. stahli* is known from Bonaire, Puerto Rico, Virgin Islands, Martinique, and Venezuela (summary of collection sites from various authors in Greenfield and Johnson, 1981). *Stathmonotus s. tekla* is known from Tortugas, Florida, Haiti, Panama, Bahamas, Cuba, Old Province Island, Belize, and

Honduras (summary of collection sites from various authors in Greenfield and Johnson, 1981).

Adult *S. stahli* ssp. typically inhabit shallow-water coral formations, shallow areas with rock ledges, and live among sponges and dead or living coral (Böhlke and Chaplin, 1968; Greenfield and Johnson, 1981). Specimens have been collected at depths of <3-10 m. All larvae were collected in similar depths over coral reef or rubble bottoms. Spawning appears to be protracted as larvae were captured in winter and summer months.

In addition to meristic variability (Table 4), larvae of the four labrisomid species described within this study can be differentiated from one another based on morphology and pigment. The *Stathmonotus* spp. larvae can be differentiated from the *Paraclinus* sp. and *Labrisomus/Malacoctenus* sp. larvae by the presence of an elongate body and gut, and pigment associated with the gut. *Stathmonotus hemphilli* shares with *Stathmonotus stahli tekla.* (morphotype I) pigment associated with the ventral midline, cleithral symphysis, occiput, gut, and the otic capsules. *Stathmonotus hemphilli* can be differentiated from *Stathmonotus stahli tekla* (morphotype I) by the presence of epidermal abdominal pigment, interhaemal and interneural melanophores, pigment on the caudal-fin rays (proximally), epidermal melanophores on the dentary and ventral to the eye, the absence of subdermal pigment on the abdomen, epidermal melanophores associated with the posterior dorsal-fin spines and dorsoposteriorly on the body, a supraorbital cirrus, and dorsal- and anal-fin membranes that connect with the anteriormost procurrent caudal-fin rays at their midpoints, in *S. hemphilli.* Gut pigment, although present in both species, is not present in the same locations.

The *Labrisomus/Malacoctenus* sp. larva is more developed than the *Paraclinus* sp. larva (15.3 vs. 5.3-6.0 mm SL, respectively) and it is likely that the relative pigment patterns would be different if similar-sized larvae were compared. The *Paraclinus* sp.

larva has in common with the *Labrisomus/Malacoctenus* sp. pigment associated with the ventral midline, cleithral symphysis, abdomen (subdermal), and the ventral midline posterior to the anal fin. In addition the *Paraclinus* sp. larva possesses two melanophores associated with the otic capsules (one on each side of the head) and one melanophore associated with the dorsoposterior portion of the neurocranium. The *Labrisomus/Malacoctenus* sp. possesses epidermal and subdermal dorsal midline melanophores associated with the bases of the dorsal-fin elements and the caudal peduncle, epidermal melanophores located dorsoanteriorly on the premaxilla, one subdermal melanophore on each preopercle, and epidermal and subdermal melanophores located on the occiput.

Figure 26. Larva of *Stathmonotus stahli tekla* (Labrisomidae) (morphotype I); VIMS 1063, 8.0 mm SL. Scale = 1 mm.

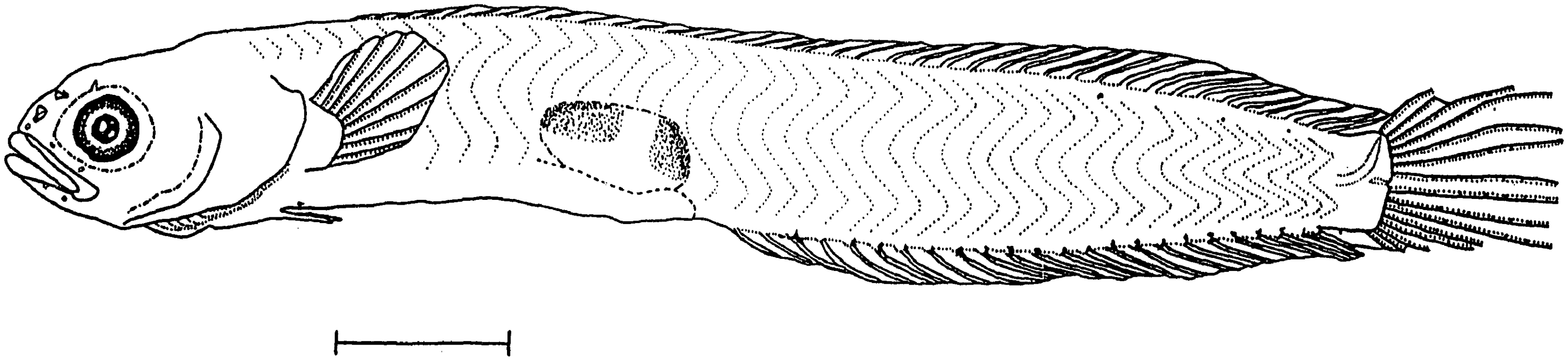


Figure 27. Dorsal view of the head region of *Stathmonotus stahli tekla* (Labrisomidae) (morphotype I); VIMS 579, 7.4 mm SL. Scale = 0.5 mm.

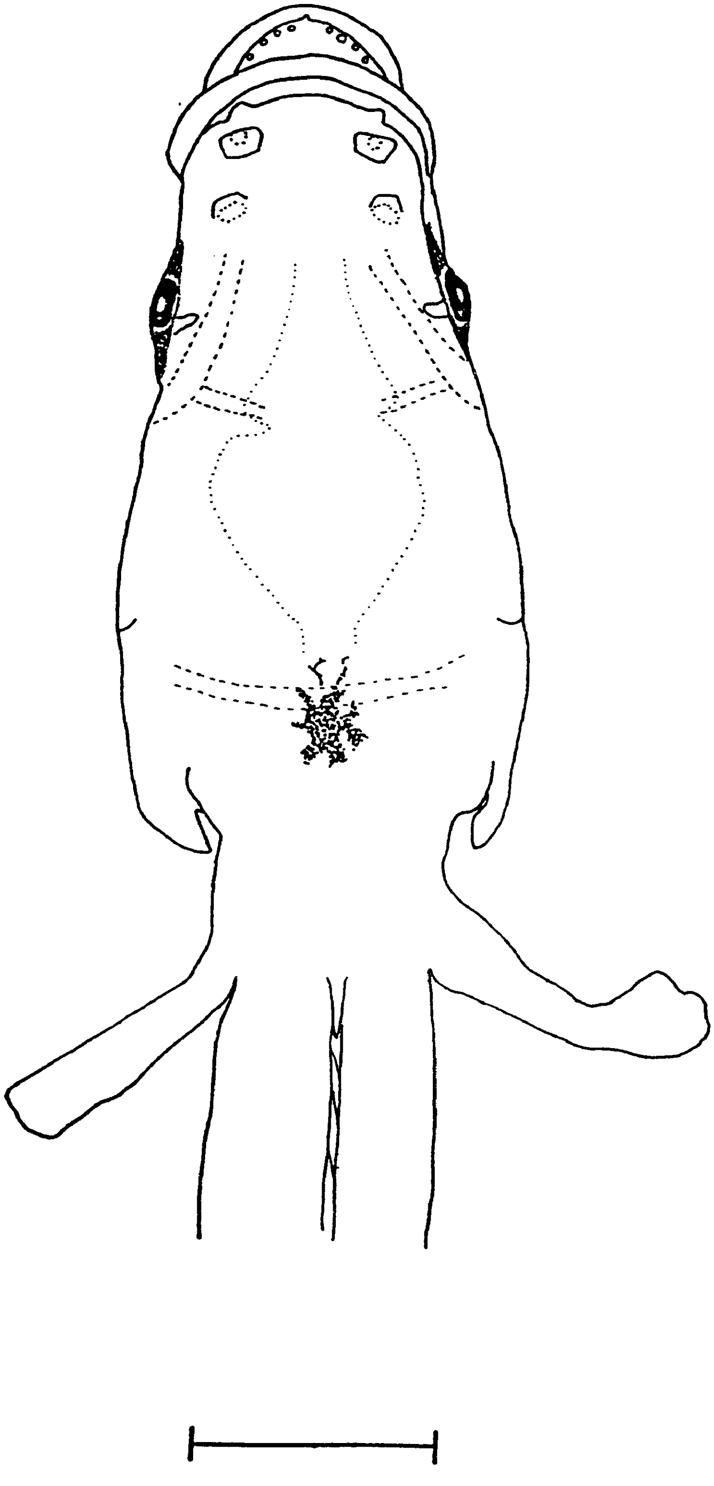


Figure 28. Ventral view of the head and pelvic region of *Stathmonotus stahli tekla* (Labrisomidae) (morphotype I); VIMS 579, 7.4 mm SL. Scale = 0.5 mm.

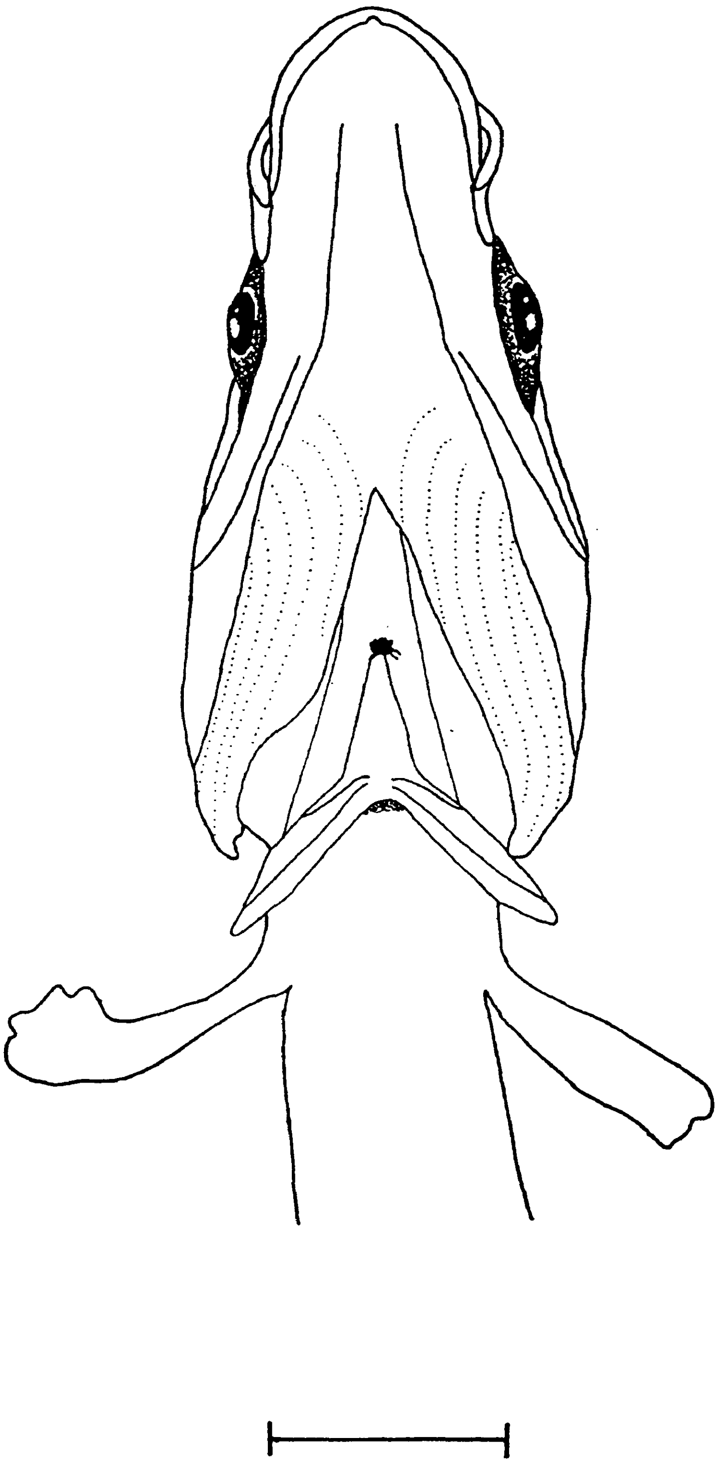


Table 28. Morphometric data from 14 larvae of *Stathmonotus stahli tekla* (morphotype I). Body length is in millimeters. All other values except eye diameter are ratios to body length. Eye diameter is expressed as a ratio to head length

BL	HL	ED	PDL	SnL	PAL	PL	BD
6.5	0.25	0.28	0.25	0.06	0.53	0.06	0.14
6.6	0.23	0.25	0.23	0.05	0.49	0.07	0.16
7.2	0.21	0.24	0.25	0.05	0.49	0.08	0.14
7.3	0.21	0.27	0.26	0.05	0.54	0.08	0.13
7.4	0.23	0.24	0.25	0.05	0.53	0.07	0.13
7.4	0.21	0.27	0.24	0.04	0.54	0.08	0.13
7.5	0.22	0.24	0.26	0.06	0.54	0.07	0.14
7.5	0.22	0.24	0.20	0.05	0.49	0.08	0.14
7.5	0.24	0.24	0.24	0.06	0.52	0.07	0.17
7.6	0.20	0.28	0.23	0.05	0.54	0.08	0.15
7.9	0.21	0.23	0.23	0.05	0.51	0.09	0.13
7.9	0.21	0.24	0.23	0.05	0.47	0.08	0.13
8.0	0.21	0.22	0.24	0.05	0.50	0.08	0.13
8.4	0.22	0.26	0.22	0.05	0.51	0.07	0.14

TRIPTERYGIIDAE

Enneanectes sp. 1

Morphotype E

Material examined. Larvae: VIMS 523, 1, 9.1 mm SL, cleared and stained, station D, 13 August 1985; VIMS 372, 1, 10.2 mm SL, cleared and stained, station D, 11 April 1985; VIMS 580, 1, 8.8 mm SL, station D, 13 August 1985; VIMS 487, 1, 9.3 mm SL, station C, 17 July, 1985.

Adults: *Enneanectes altivelis*: USNM 274894, 3, 18.2-21.1 mm SL, radiograph, Carrie Bow Cay, Belize; USNM 274937, 3, 18.5-21.0 mm SL, radiograph, Carrie Bow Cay, Belize; USNM 276047, 1, 19.1 mm SL, radiograph, Carrie Bow Cay, Belize; USNM 297701, 7, 15.9-29.0 mm SL, radiograph, Saco de Atalaia, Fernando de Nornoha Island, 200 miles east of tip of Brazil. *Enneanectes boehlkei*: USNM 195748, 1, 17.7 mm SL, radiograph, Los Canquises, Los Rogues Island, Caribbean Venezuela; USNM 297696, 2, 17.5 and 20.8 mm SL, radiograph, Lesser Antilles, Dominica; USNM 297694, 20, 12.0-23.5 mm SL, radiograph, Lesser Antilles, Dominica. *Enneanectes pectoralis*: USNM 078149, 1, 21.0 mm SL, radiograph, Caribbean West Indies, St. Thomas; USNM 261338, 1, 23.5 mm SL, radiograph, Gulf of Mexico, Florida, Looe Key, Florida; USNM 117451, 2, 17.8 and 18.8 mm SL, radiograph, Caribbean West Indies, Martinique; USNM 167667, 3, 28.7-31.4 mm SL, radiograph, Gulf of Mexico, Florida, patch reef, between Margot Fish Shoal and Long Reef; USNM 276050, 1, 19.7 mm SL, radiograph, Carrie Bow Cay, Belize; USNM 116806, 3, 28.8-30.5 mm SL, radiograph, Gulf of Mexico, Florida, Tortugas.

Identification. The larvae were identified as tripterygiids based on the presence of three distinct, separate, dorsal fins (see Introduction). The family Tripterygiidae is represented solely by the genus *Enneanectes* in the tropical and subtropical western Atlantic. A comparison of the number of dorsal- and anal-fin elements of the larvae (Table 4) with those of *Enneanectes* species (Appendix XII) excludes *E. atrorus* and *E. jordani*. The larvae possess counts that fit within the ranges of all other *Enneanectes* species; *E. boehlkei*, *E. pectoralis*, and *E. altivelis*. The description of *E. atrorus* (Rosenblatt 1960) is based on one specimen. This species may exhibit meristic variation similar to other *Enneanectes* species and could possess extremes that encompass the counts of the larvae.

Gross morphology. The larvae (Figs. 29-34) are naked, elongate, laterally compressed, and have a short gut. The head is moderate with a short, round snout. The maxilla terminates below a vertical from the anterior margin of the pupil. The lower jaw projects anteriorly beyond the upper jaw slightly and is somewhat pointed. The eyes are moderate and round. There is no head spination or rugosity. Cirri consists of one simple supraorbital cirrus, and one simple nasal cirrus located on the posterior rim of the anterior naris. There are three distinct dorsal fins; the two anterior fins contain spines only, the posterior fin contains soft rays only. Dorsal- and anal-fin membranes are not continuous with the caudal-fin membranes. There is no gasbladder. Teeth are not apparent in whole specimens. Sensory pores evident on whole specimens include those of the preoperculomandibular (5 relatively large pores), infraorbital, frontal, nasal, and posttemporal series.

Pigment. The larvae are lightly pigmented (Figs. 30-33). External pigment is confined to the ventral midline, cleithral symphysis, caudal peduncle, caudal-fin rays, occiput, and dorsal midline. There is no other lateral pigment. There are 15 y-shaped, epidermal melanophores on the ventral midline, associated with the bases of the anal-fin rays; one melanophore located immediately posterior to each soft ray excluding the most posterior ray. Other ventral pigment consists of one or two round epidermal melanophores on the ventral midline of the caudal peduncle and one epidermal melanophore on the cleithral symphysis.

There is one epidermal melanophore that may be centered or off-centered on the occiput. There are one or two stellate epidermal melanophores on the dorsal midline located posterior to the soft dorsal fin. Scattered epidermal melanophores are present on the principle caudal-fin rays.

Internal pigment evident in cleared and stained material consists of three pigment patches on the gut, located ventroanteriorly (readily apparent in uncleared specimen), dorsomedially, and dorsoposteriorly. The posterior edges of the hypural plates are pigmented. Additional internal pigment consists of three melanophores located in the posterior portion of the cranium: one melanophore appears to be associated with the notochord and is located ventral to the posterior spine-like projection of the supraoccipital; the other two melanophores are paired and each is associated with an otic capsule (apparent in uncleared specimens when viewed dorsolaterally).

Meristics and morphometrics. Data are summarized in Tables 4, 5, and 29-31. Their are no obvious allometric changes from 8.8-10.2 mm SL. The pattern of dorsal-fin pterygiophore interdigitation in one larva does not correspond with those of adult *E. altivelis*, *E. pectoralis*, and *E. boehlkei* specimens examined, although numbers of pterygiophores in interneural spaces 1 and 2 are similar in larvae and adults (Table 30). The dorsal-fin interdigitation pattern of the other larva examined corresponds with specimens of *E. boehlkei* and *E. altivelis* (Table 30). Patterns of anal-fin pterygiophore interdigitation differ between larvae (Table 31). Anal-fin pterygiophore interdigitation patterns are not obtainable from the radiographs of adults.

The pectoral fins are long, approximately 50-56% SL. The first pelvic-fin ray is 3/4 the length of the second ray. The pelvic-fin spine is short, approximately 1/3 the length of the shortest segmented ray.

Osteology. This description is based on one cleared and stained specimen (10.2 mm SL). All fin elements are ossified. Each pterygiophore that supports a dorsal- or anal-fin spine possesses an ossified spine-like process (distal pterygiophore of the preceeding pterygiophore?) (Mooi, 1989) that projects anteriorly between the basal halves of the supernumerary spine. In all but the three anteriormost and the four posteriormost dorsal-fin spines, this spine-like projection extends anteriorly through the basal halves of its associated spine, curves ventrally and connects to another dorsally extending spine-like projection of the proximal pterygiophore, forming what Springer (1968) terms a "ring joint". Each cleared and stained larva possesses one pterygiophore anterior to the soft dorsal fin that does not support an element (Fig. 29). All pterygiophores of the dorsal- and anal fins are cartilaginous excluding the ossified spine-like projection discussed above. The last dorsal- and anal-fin soft rays are split to their bases.

All vertebral centra are ossified. The first five vertebrae possess ossified neural arches; each pair of neurapophyses join together to form ossified tips, but do not possess neural spines as are evident in the succeeding spines (Fig. 34). The proximal ends of neurapophyses of all vertebrae are cartilaginous. Beginning with vertebra 6 and proceeding posteriorly along the vertebral column, the neural spines increase in length until vertebra 20, then decrease in length posteriorly, with the exception of the third preural centrum, which possesses a neural spine that is longer than those immediately preceeding. All neural spines are cartilaginous (Fig. 34). There are epipleural ribs (not well stained) located on the first two vertebrae and pleural ribs on vertebrae 3 through 10, which are cartilaginous (Fig. 34). The first hemal arch is fully ossified, while the remainder of the hemal arches (excluding the first four) possess cartilaginous proximal ends. The hemal spine of preural centrum 2 is partially ossified, long, relatively wide, and possesses a cartilaginous extension distally that apparently supports procurrent caudal-fin rays 3-6; all other hemal spines are cartilaginous.

The dorsal- and ventral hypural plates are fused to each other proximally, and the ventral hypural plate possesses two foramina. The dorsal hypural plate is cartilaginous. The ventral hypural plate is cartilaginous except anteriorly, where it is ossified (parhypural?). There are two epurals (not well stained); the posterior one is broad. An ossified arch is present on the urostylar complex and extends along 3/4 its length.

The pectoral-fin radials and scapula are ossified only on their dorsal and ventral perimeters. The scapula possesses a small ossified medial process near its distal end. The ventroposterior process of the coracoid is blade-like and ossified. A foramen is located dorsal to the base of this process. The rest of the coracoid is cartilaginous. The other bones of the pectoral-fin girdle are ossified. The basipterygia are cartilaginous, except for the anterior processes. The pelvic-fin spine possesses an ossified wing-like structure located laterally, that is approximately 2/3 the length of the spine. There is a greatly reduced, nubbin-like, third pelvic-fin ray, which is not evident in whole specimens.

The hyoid arches, branchial basket, premaxillary processes, and the posterior section of the cranium are cartilaginous. The dentary is ossified except for a rod-like section (Meckel's cartilage) anteriorly.

Canals of the sensory system that are present and surrounded by bone include the supraorbital, infraorbital, preoperculomandibular, supratemporal, and a canal that extends from the supraorbital canal anteriorly to a location inward and dorsal to the nasal bone. Dentition consists of approximately 18 variously sized teeth on each premaxilla, approximately 13 variously sized teeth on each dentary, and upper and lower pharyngobranchial teeth.

Comments. Adult *E. altivelis*, *E. atrorus*, *E. boehlkei* (Bohlke & Robins 1974), and the larvae described here, all possess three pelvic-fin rays; the third being greatly reduced. All five species of Caribbean *Enneanectes* are known to occur in Belize (Greenfield and Johnson, 1981). *Enneanectes altivelis* is known from Central America and the Bahamas, and inhabits areas with richly developed coral formations. *Enneanectes atrorus* is known from Belize, Honduras, and the Bahamas, and inhabits reef-front drop-off zones. *Enneanectes boehlkei* is known from Central America, Venezuela, Puerto Rico, Florida, Virgin Islands, and the Bahamas, and inhabits areas with richly developed coral formations or rocky ledges. *Enneanectes jordani* is known from Belize, Honduras, Venezuela, Puerto Rico, and the Bahamas, and inhabits areas with rocky or coral bottoms. *Enneanectes pectoralis* is known from Central America, Venezuela, Martinique, Aruba, Virgin Islands, Florida, and the Bahamas, and inhabits areas of richly developed reef formations.

Enneanectes boehlkei, *E. jordani*, and *E. pectoralis* are relatively shallow water species, the majority of capture depths do not exceed 5.5 m. *Enneanectes atrorus* is a relatively deep water species, found at depths of 9-30 m, with most being collected at depths greater than 18 m. *Enneanectes altivelis* is known from a wide range of depths (<1-33m). The larvae were collected over reef or rubble bottoms in depths of 1-1.75 and 5-14 m. Spawning appears to be protracted since larvae were captured in the months of April, July, and August. For a comparison of this tripterygiid with the other tripterygiid species described within this study, see Comments in the description of *Enneanectes* sp. (morphotype U).

Figure 29. Spines, rays, and supporting elements of the posterior portion of the second spinous dorsal fin and the anterior portion of the soft dorsal fin in a larva of *Enneanectes* (Tripterygiidae) (morphotype E); VIMS 372, 10.2 mm SL. Scale = 0.5 mm.

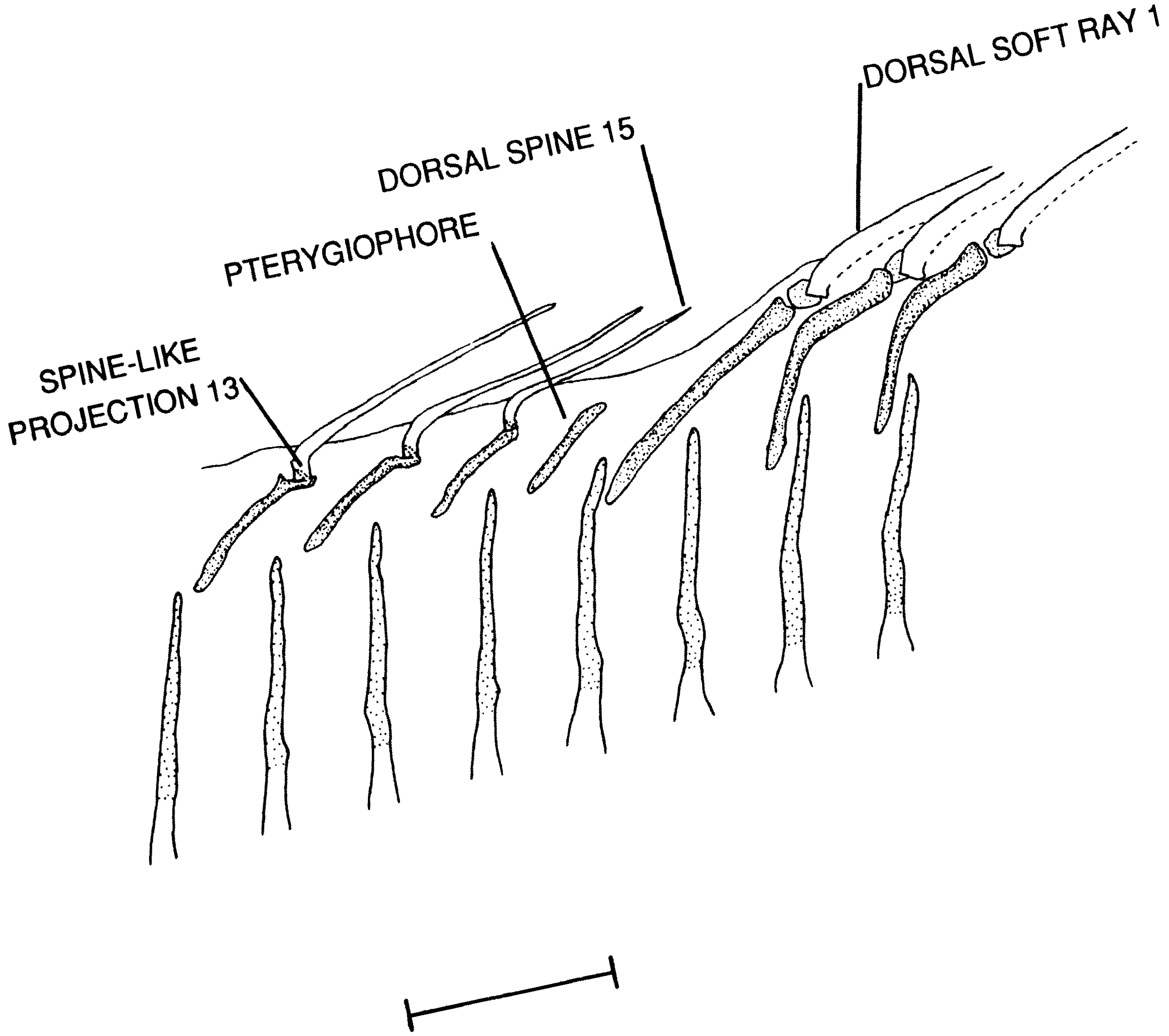

DORSAL SOFT RAY 1
DORSAL SPINE 15
PTERYGIOPHORE
SPINE-LIKE PROJECTION 13

Figure 30. Larva of *Enneanectes* (Tripterygiidae) (morphotype E); VIMS 487, 9.3 mm SL. Scale = 1 mm.

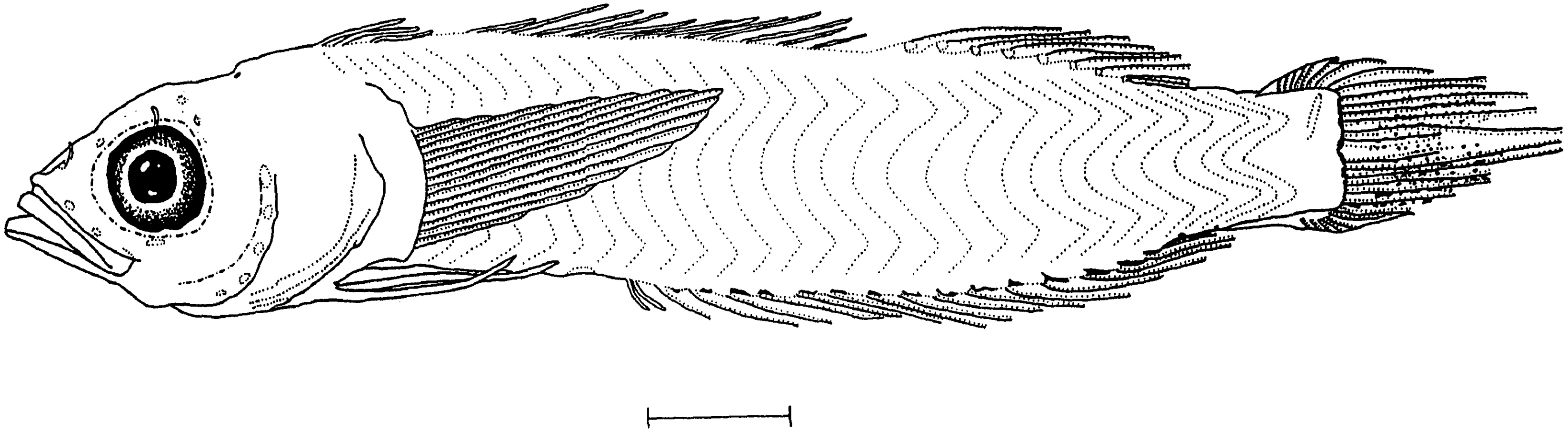


Figure 31. Ventral view of head and pelvic region of *Enneanectes* (Tripterygiidae) (morphotype E); VIMS 487, 9.3 mm SL. Scale = 0.5 mm.

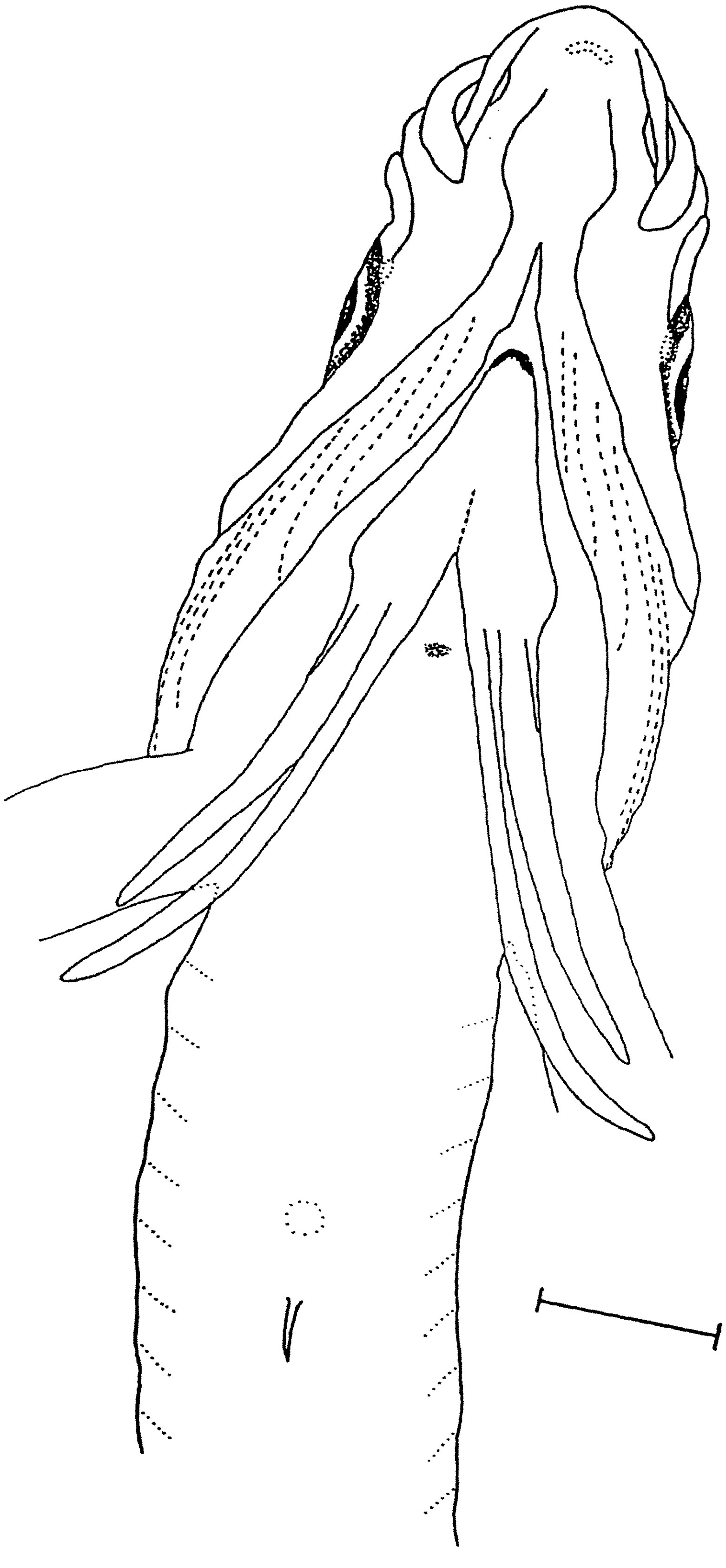


Figure 32. Dorsal view of head of *Enneanectes* (Tripterygiidae) (morphotype E); VIMS 580, 8.8 mm SL. Scale = 0.5 mm.

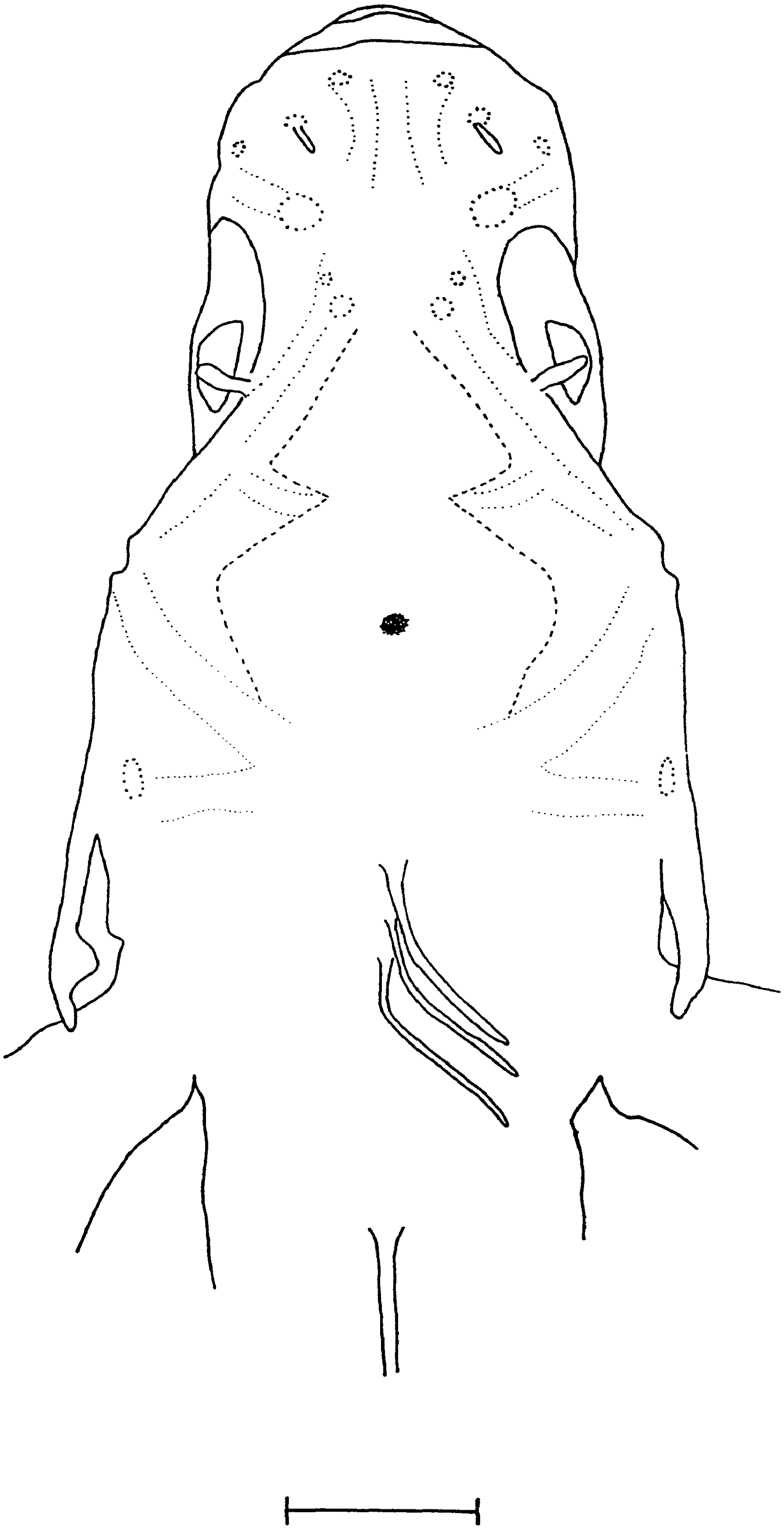


Figure 33. Dorsal view of the posterior dorsal-fin soft rays and caudal peduncle of *Enneanectes* (Tripterygiidae) (morphotype E); VIMS 487, 9.3 mm SL. Scale = 1 mm.

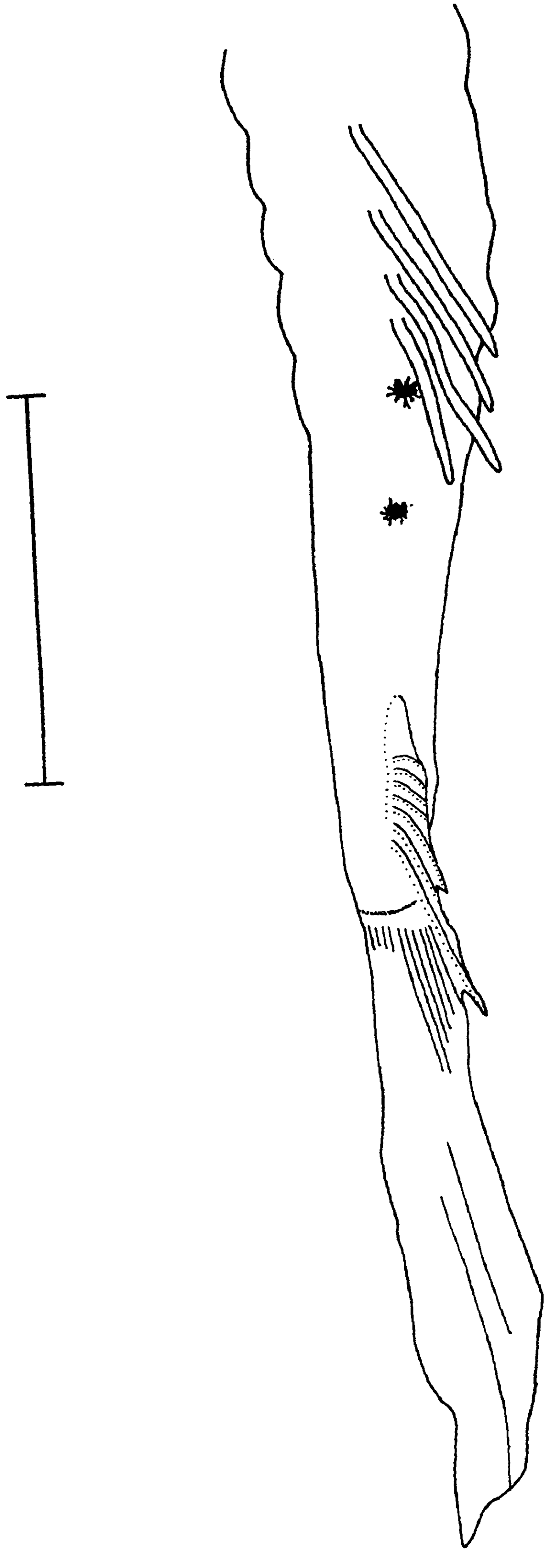


Figure 34. Anterior vertebrae of Enneanectes (Tripterygiidae) (morphotype E); VIMS 372, 10.2 mm SL. Scale = 0.5 mm.

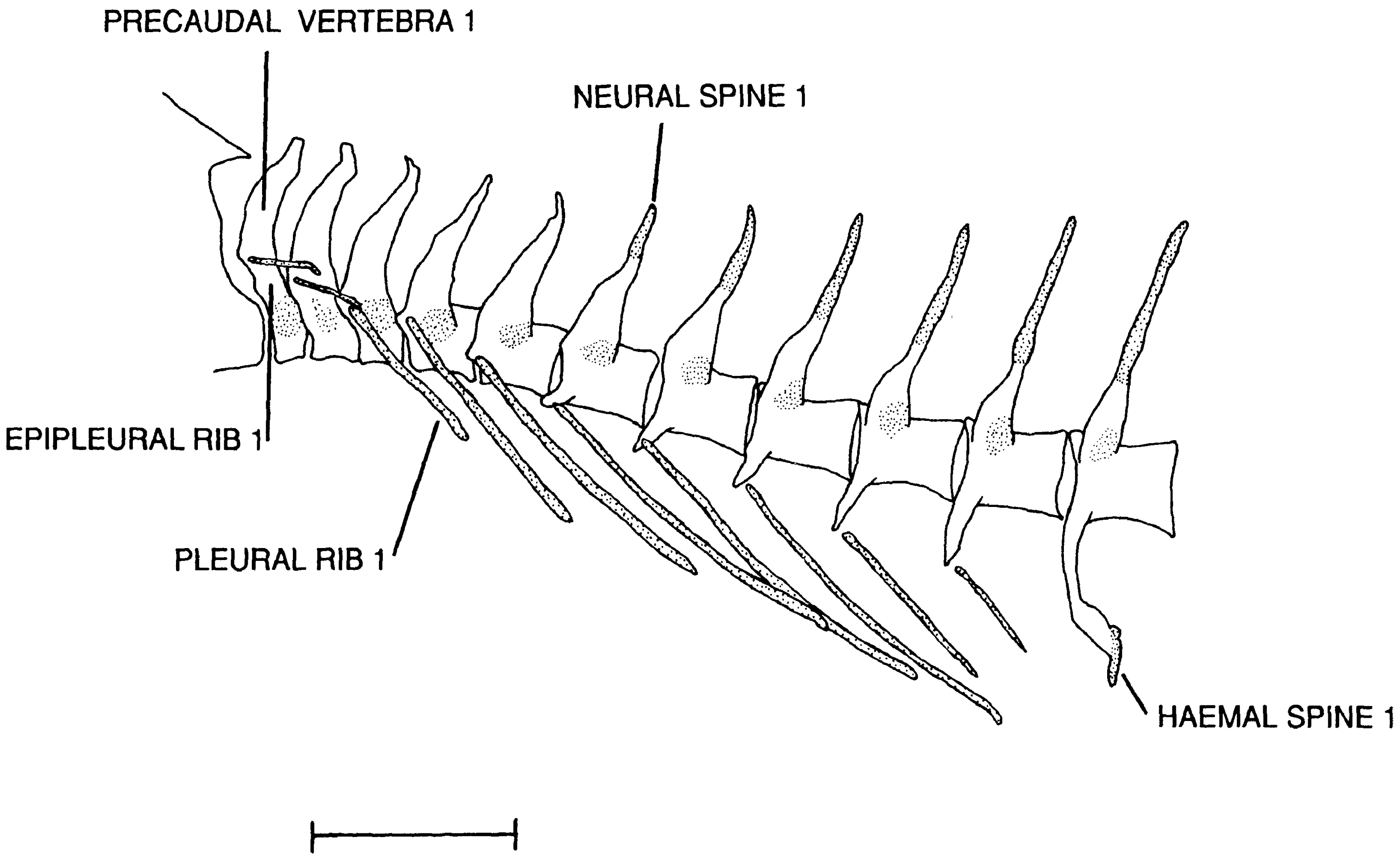

PRECAUDAL VERTEBRA 1
NEURAL SPINE 1
EPIPLEURAL RIB 1
PLEURAL RIB 1
HAEMAL SPINE 1

Table 29. Morphometric data from four larvae of *Enneanectes* sp. (morphotype E). Body length is in millimeters. All other values except eye diameter are ratios to body length. Eye diameter is expressed as a ratio to head length.

BL	HL	ED	PDL	SnL	PAL	PL	BD
8.8	0.28	0.26	0.22	0.07	0.42	0.24	0.17
9.1	0.27	0.29	0.24	0.07	0.45	0.25	0.17
9.3	0.28	0.27	0.22	0.06	0.42	0.22	0.17
10.2	0.26	0.29	0.22	0.06	0.44	0.23	0.17

Table 30. Numbers of pterygiophores within interneural spaces 1-7 in 14 adults and one larva (morphotype E) of *Enneanectes* sp. (Tripterygiidae). Numerals within parentheses indicate number of specimens examined, if more than one. (E.b.)= *E. boehlkei*, (E.a.)= *E. altivelis*, (E.p.)= *E. pectoralis*.

Interneural space							
1	2	3	4	5	6	7	Material examined
3	0	1	0	1	0	1	VIMS 372
3	0	0	1	0	1	1	VIMS 523; USNM 297696 (2) (E.b.); USNM 297694 (3) (E.b.); USNM 297701 (E.a.)
3	0	0	0	1	1	1	USNM 261338 (E.p.); USNM 117451 (2) (E.p.)
3	0	0	1	1	1	1	USNM 297701 (E.a.); USNM 170316 (E.a.)
3	0	0	0	1	1	1	USNM 274894 (2) (E.a.); USNM 274937 (E.a.)

Table 31. Numbers of pterygiophores in interhaemal spaces 10-13 in two larvae of *Enneanectes* sp. (Tripterygiidae) (morphotype E). The first interhaemal space for each specimen (11 and 10, respectively) precedes the first caudal vertebra (11 and 10, respectively).

Interhaemal space				
10	11	12	13	Material examined
	2	1	1	VIMS 372
0	2	1	1	VIMS 523

TRIPTERYGIIDAE

Enneanectes sp. 2

Morphotype N

Material examined. Larva: VIMS 945, 1, 7.1 mm SL, cleared and stained, station D, 26 February, 1985.

Identification. The larva was identified as a tripterygiid based on the presence of three distinct, separate, dorsal fins (see Introduction). The family Tripterygiidae is represented solely by the genus *Enneanectes* in the tropical and subtropical western Atlantic. A comparison of the number of dorsal- and anal-fin elements of the larvae (Table 4) with those of *Enneanectes* species (Appendix XII) excludes *E. atrorus* and *E. boehlkei*. The larva possesses counts that fit within the ranges of all other *Enneanectes* species; *E. altivelis*, *E. jordani*, and *E. pectoralis*. The description of *E. atrorus* (Rosenblatt, 1960) is based on one specimen. This species may exhibit meristic variation similar to other *Enneanectes* species and may possess extremes that encompass the counts of the larvae.

Gross morphology. The 7.1 mm SL larva (Figs. 35-38) is naked, elongate, slightly laterally compressed, and has a short gut. The head is moderate in size with a short, round snout. The lower jaw projects slightly beyond the upper jaw and is relatively pointed. The maxilla terminates below a vertical from midway between the anterior margin of the eye and the pupil. The eyes are moderate in size. There are no head cirri, spination, or rugosity. Teeth are not apparent in the whole specimen. There are three distinct dorsal fins; the two anterior fins contain spines only, the posterior fin contains soft rays only. Dorsal- and anal-fin membranes are not continuous with the caudal-fin membranes. A gasbladder is present.

Pigment. The larva is lightly pigmented (Figs. 35-38). External pigment is confined to the ventral midline, cleithral symphysis, caudal peduncle, occiput, and dorsal midline. There is no other lateral pigment. There are 10 epidermal melanophores on the ventral midline, associated with the bases of the anal-fin rays; rays 6-10 are damaged and most likely possessed melanophores. There are two epidermal pigment patches on the ventral midline of the caudal peduncle (Fig. 35).

There is one epidermal melanophore at the cleithral symphysis (Fig. 37). There is one subdermal melanophore on the abdomen immediately posterior to the pelvic fins. There is one epidermal dendritic melanophore on the occiput (Fig. 36). There is scattered epidermal pigment located on the dorsal midline posterior to the third dorsal fin (Fig. 38). The posterior edges of the hypural plates are pigmented (Fig. 35).

Internal pigment, all of which is evident in the whole specimen, consists of head, gut and hypural plate pigment. There are two melanophores on the gut, located anterior and posterior to the gasbladder, respectively (Fig. 35). Internal head pigment consists of one pigment patch associated with each otic capsule, and one pigment patch located on the dorsal side of the anterior portion of the notochord (Fig. 36).

Meristics and morphometrics. Data are summarized in Tables 4 and 5. The specimen was poorly stained and patterns of pterygiophore interdigitation could not be obtained.

Osteology. Stain reactions were poor in the larva. There is a greatly reduced, nubbin-like, third pelvic-fin ray, which was not evident in the whole specimen. The larva possesses one pterygiophore anterior to the soft dorsal fin that does not support an element. Dorsal-fin pterygiophores, each possessing a spine-like process that projects anteriorly between the basal halves of the associated supernumerary dorsal-fin spine, are apparent, but their number is unknown due to the poor condition of the specimen. Neural spines are absent from the two anteriormost vertebrae. The posteriormost dorsal- and anal-fin soft rays are split to their bases. The ventroposterior process of the coracoid is spike-like and relatively long. The dorsal- and ventral hypural plates are fused to each other proximally; the plates are widely separated posteriorly. The ventral hypural plate possesses two foramina, of which the anterior one is approximately four times larger than the posterior one. The dorsal hypural plate possesses one small foramen (between hypural plates 3 & 4?). The hemal spine of preural centrum 2 is long, relatively wide, and supports procurrent caudal-fin rays 4 and 5. An arch extends 3/4 the length of the urostylar complex. Dentition consists of three relatively small teeth on each side of the dentary, one small tooth on each side of the premaxilla, and upper and lower pharyngobranchial teeth.

Comments. Adult *E. altivelis*, *E. atrorus*, and *E. boehlkei* (Bohlke & Robins, 1974), and larva described here, all possess three pelvic-fin rays; the third being greatly reduced. For comments on distribution and habitat of the five species of Caribbean *Enneanectes*, see Comments in description of *Enneanectes* sp. 1. The larva was captured in February over rocky substrate covered with corals and sponges in 5-14 m of water. For a comparison of this tripterygiid with the other tripterygiid species described within this study, see Comments in the description of *Enneanectes* sp. (morphotype U).

Figure 35. Larva of *Enneanectes* (Tripterygiidae) (morphotype N); VIMS 945, 7.1 mm SL. Scale = 1 mm.

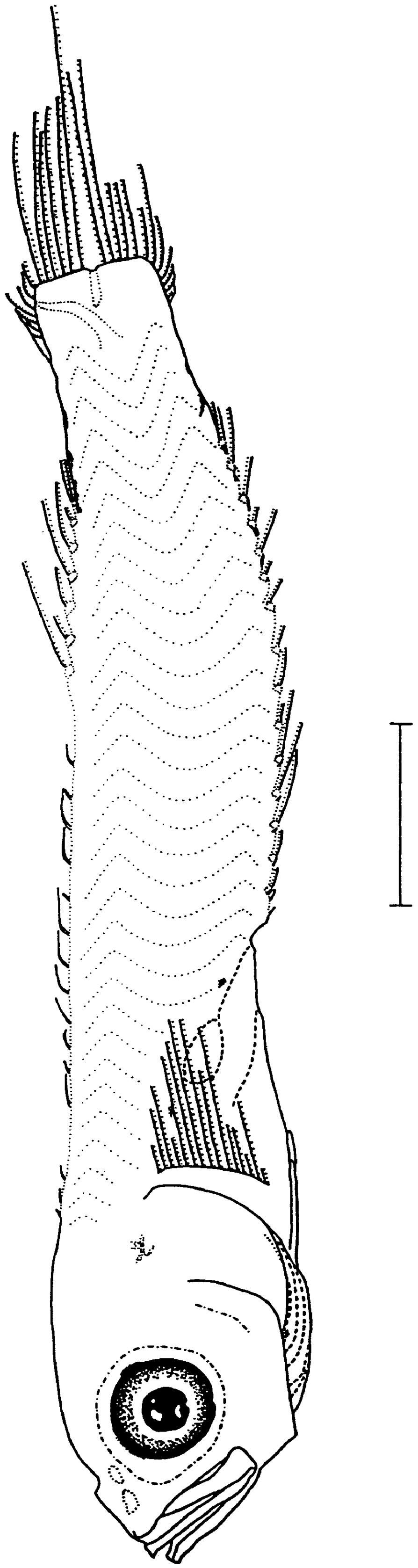


Figure 36. Dorsal view of the head of *Enneanectes* (Tripterygiidae) (morphotype N); VIMS 945, 7.1 mm SL. Scale = 0.5 mm.

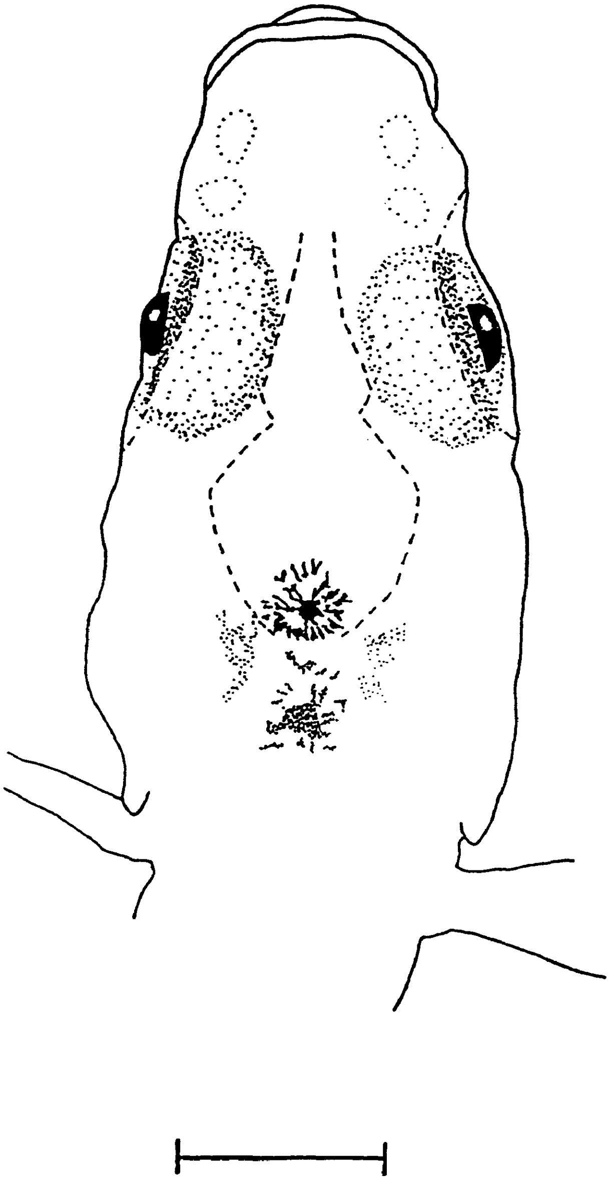


Figure 37. Ventral view of the head and pelvic region of *Enneanectes* (Tripterygiidae) (morphotype N); VIMS 945, 7.1 mm SL. Scale = 0.5 mm.

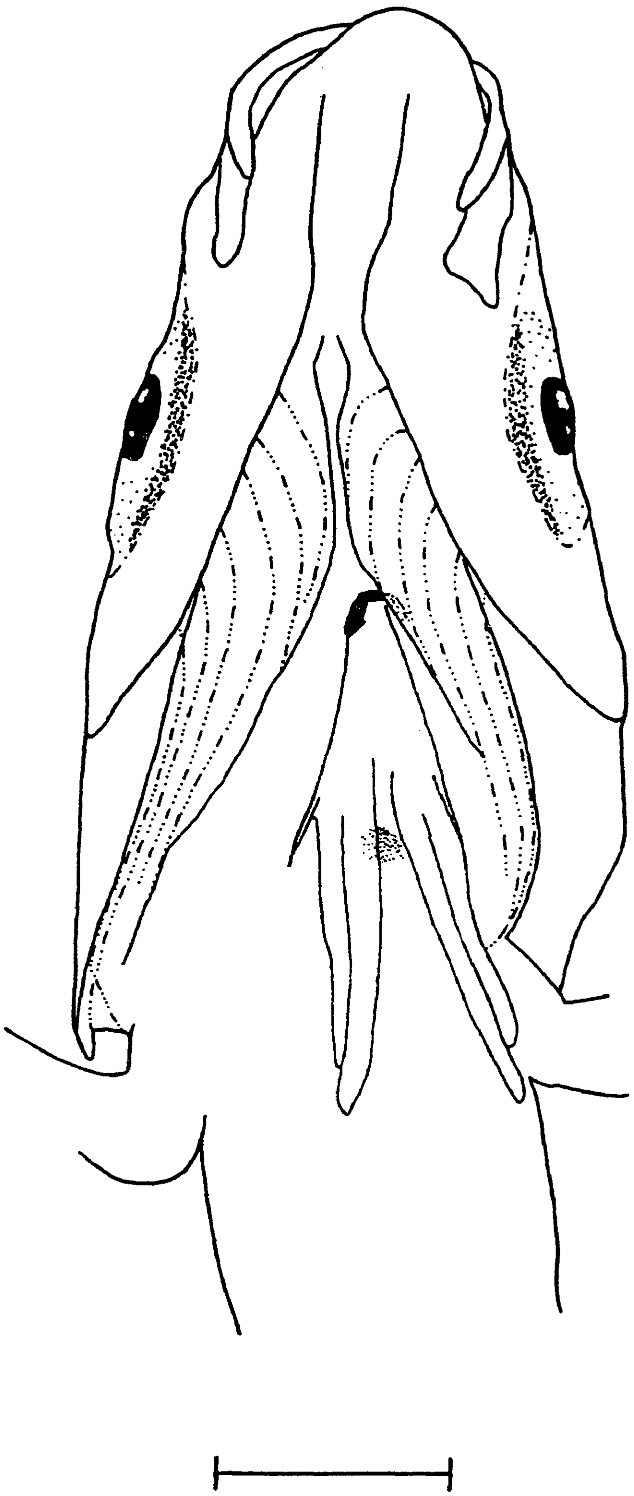
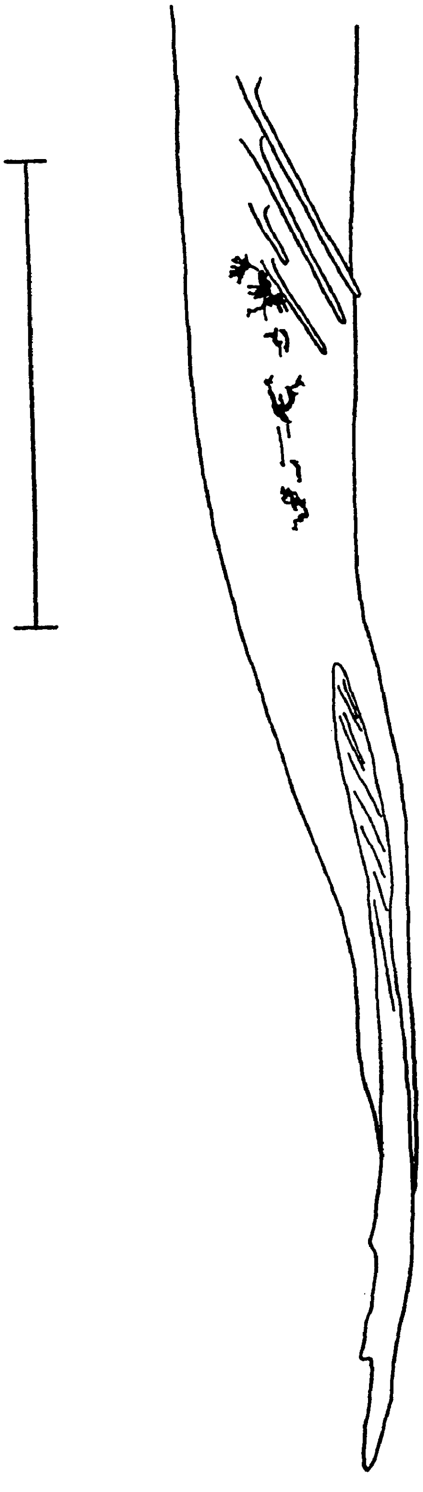


Figure 38. Dorsal view of the posterior dorsal-fin soft rays and caudal peduncle of *Enneanectes* (Tripterygiidae) (morphotype N); VIMS 945, 7.1 mm SL. Scale = 1 mm.



TRIPTERYGIIDAE

Enneanectes sp. 3

Morphotype U

Material examined. Larva: VIMS 1095, 1, 8.7 mm SL, station C, 29 March, 1985.

Identification. The larva was identified as a tripterygiid based on the presence of three distinct, separate, dorsal fins (see Introduction). The family Tripterygiidae is represented solely by the genus *Enneanectes* in the tropical and subtropical western Atlantic. A comparison of the number of dorsal and anal-fin elements of the larva (Table 4) with those of *Enneanectes* species (Appendix XII) excludes *E. atrorus* and *E. boehlkei*. The larva possesses counts that fit within the ranges of all other *Enneanectes* species; *E. altivelis*, *E. jordani*, and *E. pectoralis*. The description of *E. atrorus* (Rosenblatt, 1960) is based on one specimen. This species may exhibit meristic variation similar to other *Enneanectes* species and may possess extremes that encompass the counts of the larva.

Gross morphology. The larva (Figs. 39-43) is naked, elongate, slightly laterally compressed, and has a short gut. The head is moderate in size with a short, round snout. The maxilla terminates below a vertical from the middle of the pupil. The eyes are small and round. There is no head spination or rugosity. Cirri consists of one simple supraorbital cirrus, and one simple cirrus on the posterior rim of each naris. Teeth are not apparent in the uncleared specimen. There are three distinct dorsal fins; the two anterior fins contain spines only, the posterior fin contains soft rays only. The last ray of both the anal- and soft-dorsal fins is split to the base. Dorsal- and anal-fin membranes are not continuous with the caudal-fin membranes. There is no gasbladder. Pores of the preoperculomandibular (5 relatively large pores), frontal, nasal, supraorbital, and infraorbital sensory canal systems are evident in the whole specimen.

Pigment. The larva is lightly pigmented (Figs. 39-42). External pigment is confined to the ventral midline, cleithral symphysis, caudal peduncle, occiput, dorsal midline, and above the eye. There is no other lateral pigment. There are 13 epidermal melanophores on the ventral midline associated with the bases of the anal-fin rays; one located immediately posterior to each soft ray, excluding rays 6, 15, and 16. These melanophores are y-shaped, except for the posterior-most melanophore, which is round. There are two round epidermal ventral midline melanophores located on the caudal peduncle (Fig. 39).

There is one epidermal melanophore at the cleithral symphysis (Fig. 41). There is one epidermal dendritic melanophore on the occiput (Fig. 40). There are three epidermal melanophores located on the dorsal midline posterior to the third dorsal fin (Fig. 42). There are scattered, pinpoint, epidermal melanophores in a crescent shape located dorsal to the eye (Fig. 39).

Internal pigment, evident in whole specimens, consists of one melanophore located dorsally on the anterior portion of the notochord, one melanophore associated with each otic capsule (Fig. 39), one melanophore located dorsoposteriorly on the gut (apparent in ventral view), and light pigment on the posterior edges of the hypural plates (Fig. 39).

Meristics and morphometrics. Data are summarized in Tables 4, 5, 32, and 33. The pterygiophore interdigitation pattern of interneural spaces 1-7 of the larva (Table 32) corresponds with some adults of *Enneanectes altivelis* (Table 30).

Osteology. Stain reactions were poor in the larva. Each pterygiophore that supports a dorsal-fin spine possesses a spine-like process (distal pterygiophore of the preceeding pterygiophore?) (Mooi, 1989) that projects anteriorly between the basal halves of the supernumerary spine. In all but the two posteriormost dorsal-fin spines, this spine-like projection extends anteriorly through the basal halves of its supernumerary spine, curves ventrally and connects to another dorsally projecting spine-like projection of the proximal pterygiophore, forming a "ring joint" (Springer (1968). The anteriormost vertebra does not possess a neural spine. The first two caudal vertebrae (9 and 10) lack hemal spines.

The larva possesses one pterygiophore anterior to the soft dorsal fin that does not support an element. The last dorsal- and anal-fin soft rays are split to their bases. The ventroposterior process of the coracoid is blade-like and relatively short. A foramen is located dorsal to the base of this process. The third pelvic-fin ray is a nubbin and was not evident in the whole specimen.

The ventral hypural plate possesses two foramina; the anterior one is the larger of the two. There are two epurals; the posterior one is broad with two ventral extensions. An arch extends 3/4 the length of the urostylar complex, and possesses a foramen anteriorly. A scale covers the bases of the middle principle caudal-fin rays (Fig. 43).

Canals of the sensory system that are apparent include the preopercular, supraorbital, infraorbital, and two canals located on the frontals extending from the anterior edge of the eye dorsal to the nasal bones. Dentition consists of 10 teeth on each dentary, 8 teeth on each premaxilla, and upper and lower pharyngobranchial teeth.

Comments. Larvae of the three *Enneanectes* species treated here are similar in shape (Table 5); although the ratios of HL, PAL, and PDL to body length are greater, and the ratio of PL to body depth is less for *Enneanectes* sp. 2, as compared with the other *Enneanectes* spp. With the exception that *Enneanectes* sp. 2 is slightly less developed, all specimens are in the same ontogenetic stage. Differences in the number of vertebrae, caudal-fin procurrent rays, and dorsal- and anal-fin soft rays are apparent among the *Enneanectes* spp. Pigment posterior to the dorsal-fin soft rays of *Enneanectes* sp. 2 (Fig. 38) is distinct. The three tripterygiid morphotypes (E, N, and U) have in common pigment associated with the ventral midline, cleithral symphysis, occiput, ventral midline posterior to the soft rays, dorsal midline, otic capsules, notochord, and the posterior edge of the hypural plates. Morphotype E differs from morphotypes N and U in that it does not possess gut pigment apparent in whole specimens when viewed laterally. Morphotype U differs from morphotypes E and N in that it does not possess subdermal abdominal pigment located immediately posterior to the pelvic fins. Matarese et al. (1984) state that tripterygiids do not possess pigment on the posterior margin of the hypural plates. Larvae of the three tripterygiid morphotypes (E, N, and U) all possess pigment on the posterior margin of the hypural plates.

Adult *E. altivelis*, *E. atrorus*, and *E. boehlkei* (Bohlke & Robins, 1974), and larva described here, all possess three pelvic-fin rays; the third being greatly reduced. For comments on distribution and habitat of the five species of Caribbean *Enneanectes*, see Comments in description of *Enneanectes* sp. 1. The larva was captured in March over coarse sand and gravel, as well as coral rubble covered with living corals at depths of 1-1.75 m.

Figure 39. Late-stage larva of *Enneanectes* (Tripterygiidae) (morphotype U); VIMS 1095, 8.7 mm SL. Right side of specimen was illustrated and then photographically reversed. Scale = 1 mm.

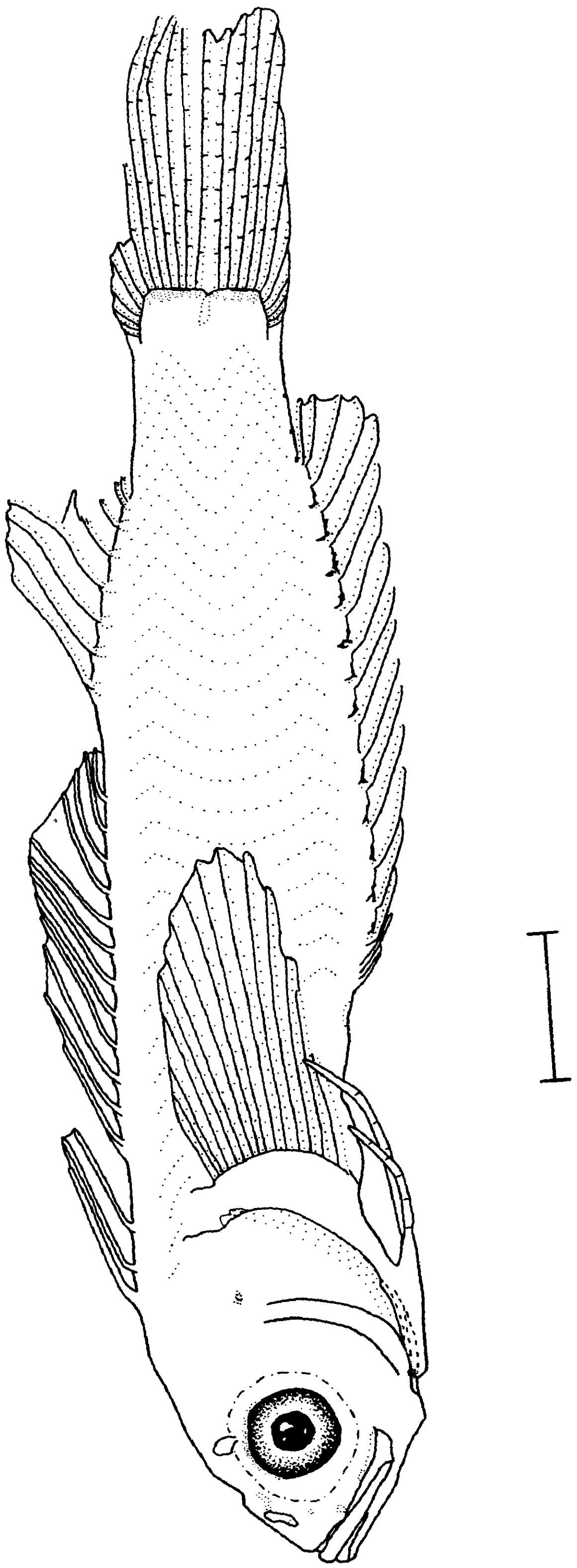


Figure 40. Dorsal view of the head of *Enneanectes* (Tripterygiidae) (morphotype U); VIMS 1095, 8.7 mm SL. Scale = 1 mm.

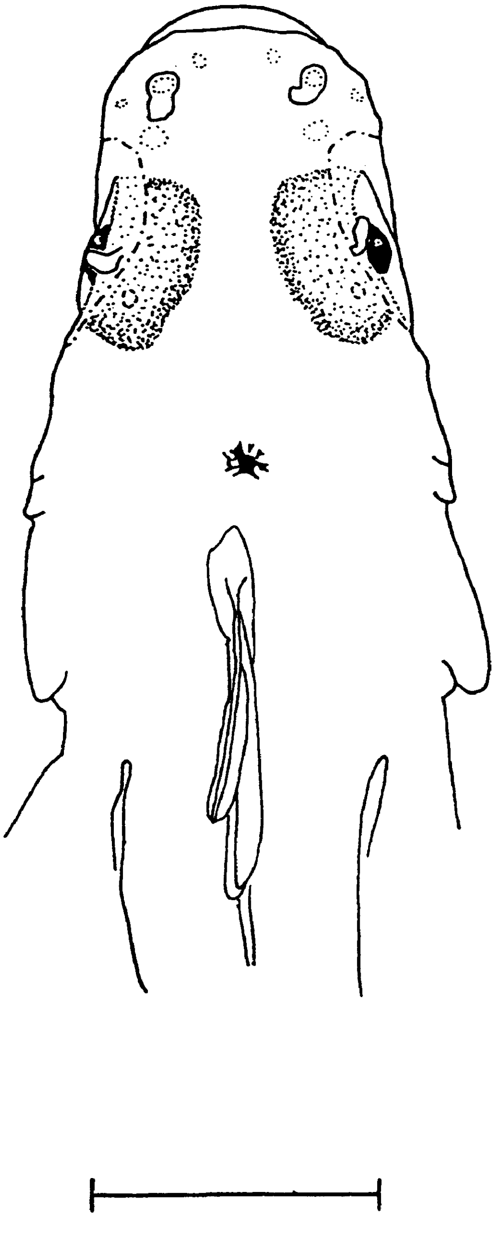


Figure 41. Ventral view of the head and pelvic region of *Enneanectes* (Tripterygiidae) (morphotype U); VIMS 1095, 8.7 mm SL. Scale = 1 mm.

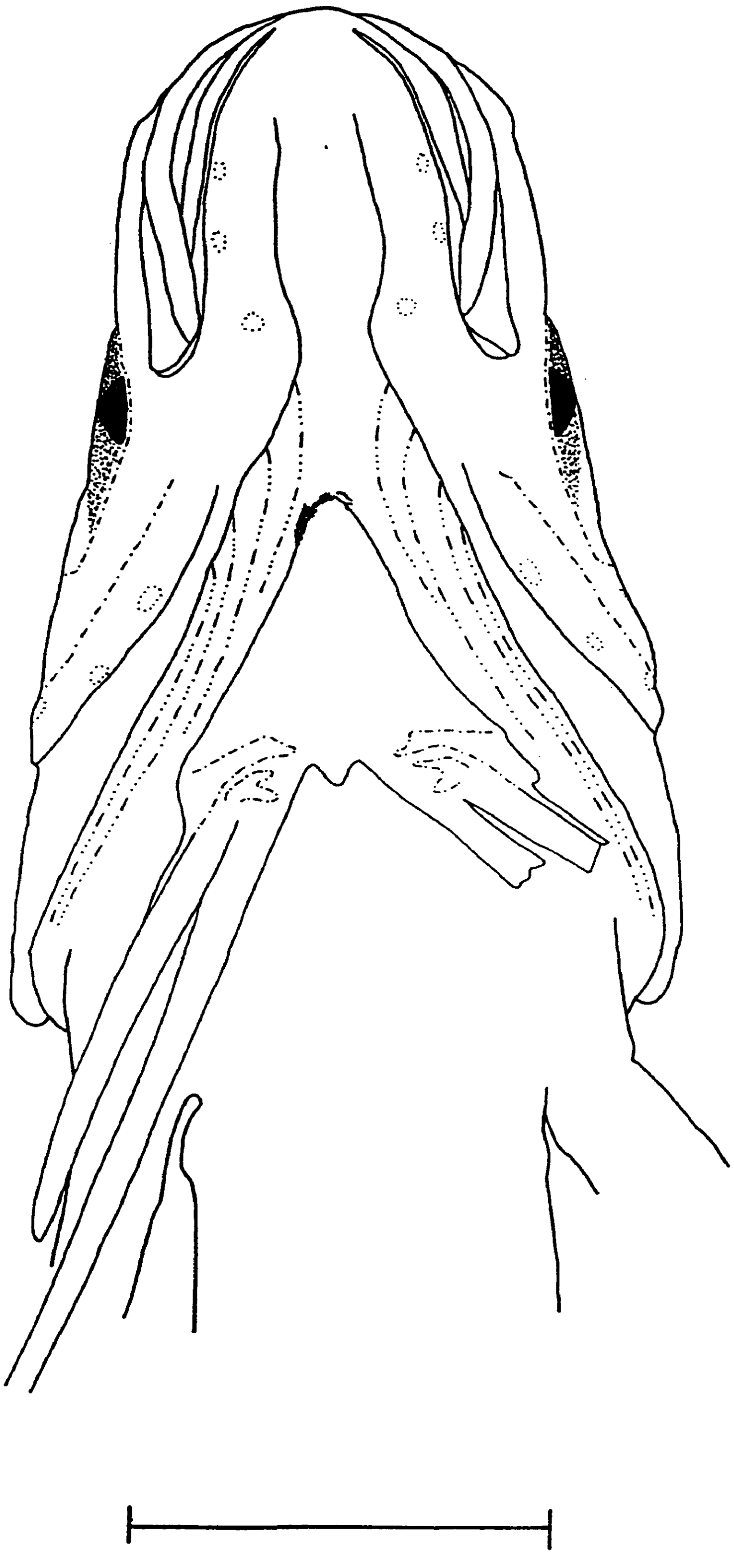


Figure 42. Dorsal view of the posterior dorsal-fin soft rays and caudal peduncle of *Enneanectes* (Tripterygiidae) (morphotype U); VIMS 1095, 8.7 mm SL. Scale = 1 mm.

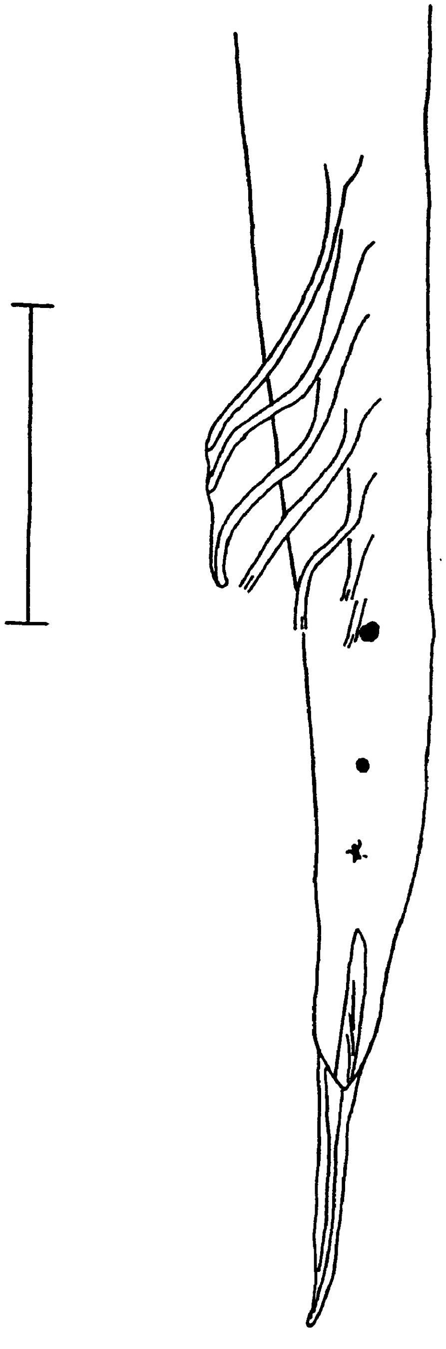


Figure 43. Posterior vertebrae and caudal fin of *Enneanectes* (Tripterygiidae) (morphotype U); VIMS 1095, 8.7 mm SL. Scale = 0.5 mm.

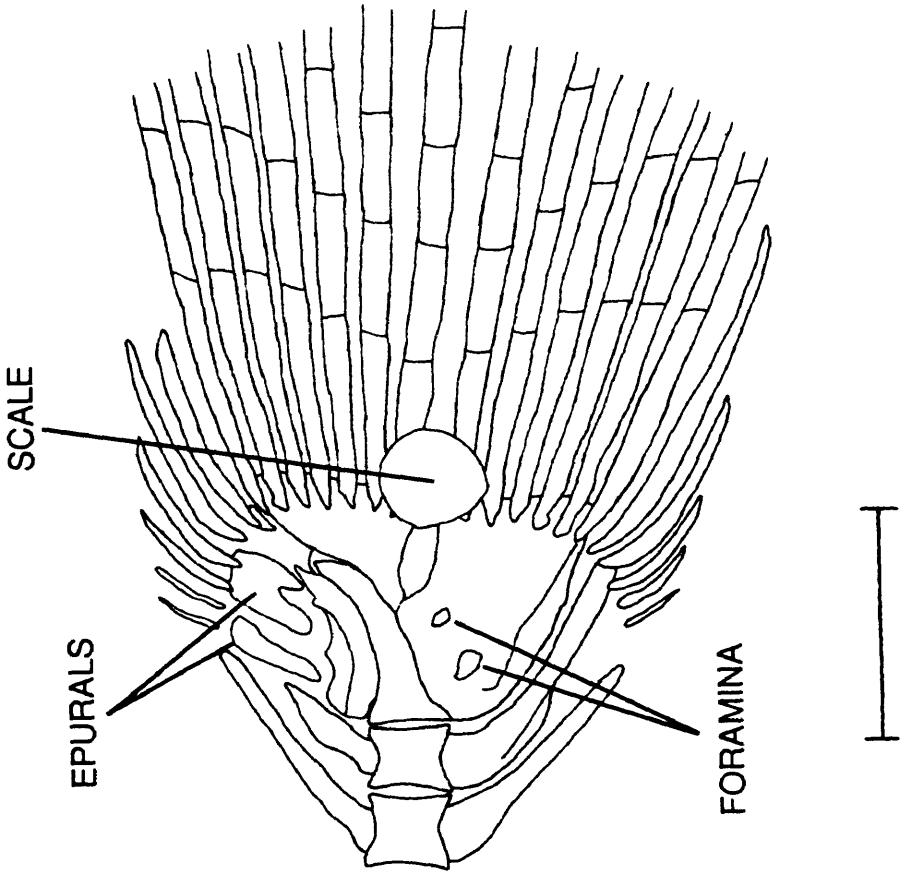

SCALE
EPURALS
FORAMINA

Table 32. Numbers of pterygiophores within interneural spaces 1-7 in one larva of *Enneanectes* sp. (Tripterygiidae) (morphotype U).

Interneural space							
1	2	3	4	5	6	7	Material examined
3	0	0	0	1	1	1	VIMS 1095

Table 33. Numbers of pterygiophores in interhaemal spaces 9-13 in one larva of *Enneanectes* sp. (Tripterygiidae) (morphotype U). The first interhaemal space (9) precedes the first caudal vertebra (9).

Interhaemal space					
9	10	11	12	13	Material examined
0	0	2	1	1	VIMS 1095

DISCUSSION

The faunal list generated in this study represents the most complete listing of blennioid species of the tropical and subtropical western Atlantic, and expands a previous list (Richards, 1990) to 5 families, 33 genera, and 122 species. Meristic data (Appendices 2-12) are not complete, however, because counts of precaudal and caudal vertebrae, as well as caudal-fin rays, are needed for many species. Most authors report the number of principle caudal-fin rays as the total number of segmented or branched rays. These data offer limited utility in identifying early-stage larvae that may not possess these features. Available meristic data for some species are based on few specimens, and do not account for geographic or intraspecific variation. Intraspecific meristic variation is significant in blennioids fishes (i.e. see Springer and Gomon, 1975b), particularly between localities. The identification of larvae in my study was based primarily on exclusion of taxa using meristic differences, which were slight in some cases. For example, the identification of morphotype J as a chaenopsid, excluded species of the genera *Coralliozetus*, *Protemblemaria*, and *Emblemariopsis* on the basis of a single fin element (dorsal-fin spine or ray, anal-fin ray, pectoral-fin ray). Intra- and interspecific variation could account for such differences, but this aspect was beyond the scope of my study. Thus, only tentative identifications could be made in some cases.

There are several osteological characters common in both larval and adult blennioid fishes. All blennioids lack a neural spine on the anteriormost vertebra, and may lack spines on several succeeding vertebrae (Johnson, in press). This character, which is readily apparent in cleared and stained larvae, also varies within and among families (Table 35), and will be discussed later. In addition, blennioids possess a spine-like process on each proximal pterygiophore that supports a dorsal- or anal-fin spine in supernumerary position. The spine-like process projects anteriorly between the basal halves of each spine, and is apparent in larvae. In some larvae (i.e. some *Enneanectes* spp.), these processes curve ventrally and reattach to the proximal pterygiophore to form what Springer (1968) terms a "ring joint".

One unifying pigment character possessed by most blennioid larvae is the possession of ventral midline melanophores associated with the bases of the anal-fin elements. This pigment may be very diffuse and difficult to discern, or absent in larvae of the highly derived blenniids of the tribes Salariini and Nemophini (Leis and Rennis, 1983). Blennioid larvae, in general, are lightly pigmented. The majority of pigment is located ventrally (i.e. ventral midline, cleithral symphysis, caudal peduncle) (Table 34). The majority of morphotypes examined in my study possess epidermal pigment at the cleithral symphysis. There is little or no lateral pigment. Pigment on the caudal fin, preopercle, dorso- and ventroposterior body wall are exceptions, but pigment is light when present. Many larvae possess gut- or gasbladder pigment that can be seen in whole specimens. Table 34 summarizes internal and external pigment locations for the six blennioid families.

Springer (in press) and Johnson (in press) hypothesize the monophyly of the Blennioidei based on the possession of apomorphic states in six character complexes: caudal fin, anal fin, pelvic fin and girdle, pectoral fin and girdle, dorsal gill arches, and vertebrae. Larvae described in this study possess five of these character complexes (dorsal gill arches were not examined). The configuration of the caudal fin and supporting structures of the larvae differ from those of adults in that segmented or branched caudal-fin rays may be absent, the dorsal- and ventral hypural plates may contain one and two foramina, respectively, and all caudal-fin structures may be at various stages of ossification. The configurations of the pelvic fin and basipterygia, the anal fin, and the pectoral fin and girdle, as described by Springer (in press), are present in larvae, with the exception that the structures may not be fully developed (particularly the pelvic fin) or ossified. The presence of the above-mentioned character complexes in larvae supports the identifications made in this study as blennioids. In addition, the presence of these character complexes in larvae confirms that there is no ontogenetic transformation.

The current classifications (Nelson, 1984; Eschmeyer, 1990) of the Blennioidei comprises six families: Blenniidae, Chaenopsidae, Clinidae, Dactyloscopidae, Labrisomidae, and Tripterygiidae. The Blennioidei of Greenwood et al. (1966) comprises 15 families: Blenniidae, Anarhichadidae, Xenocephalidae, Congrogadidae, Notograptidae, Peronedysidae, Ophiclinidae, Tripterygiidae, Clinidae, Chaenopsidae, Stichaeidae, Ptilichthyidae, Pholididae (Pholidae), Scytalinidae, and Zaproridae. Of these 15 families: Peronedysidae and Opiclinidae are included in the family Clinidae (George and Springer, 1980); the status of Xenocephalidae, currently in the suborder Trachinoidei (Eschmeyer, 1990), remains unresolved, although it is clearly not a blennioid (Springer, in press); the families Stichaeidae, Pholidae, Anarhichadidae, Ptilichthyidae, Scytalinidae, and Zaproridae are placed in the suborder Zoarcoidei (Eschmeyer, 1990); Congrogadidae has been lowered to subfamily rank (Congrogadinae) of the family Pseudochromidae (suborder Percoidei) (Eschmeyer, 1990); and Notograptidae is in the family Plesiopidae (subfamily Acanthoclininae) (Gill and Mooi, in press) in the suborder Percoidei (Eschmeyer, 1990).

From the above-mentioned group, only the families Stichaeidae and Pholidae have larvae that bear close morphological resemblance to blennioid larvae; and only to larvae of *Stathmonotus* (Labrisomidae). Stichaeid larvae closely resemble *Stathmonotus* larvae in that they have elongate bodies, a dorsal-fin consisting of spines and no rays, individual ventral midline melanophores associated with the bases of the anal-fin rays, and elongate guts. They can be differentiated from *Stathmonotus* larvae based on the lack of an obvious gas bladder, dorsolateral pigment extending almost the entire length of the body, extensive gut pigment located dorsally, extensive pigment on the head and/or the nape (some species), no pelvic fins or pelvic fins consisting of one spine and no rays (*Alectrias*, *Opisthocentrus*, and *Dictyosoma* spp.), one anal-fin spine and one naris on each side of the head (*Bryozoichthys*, *Chirolophis*, *Gymnoclinus*, *Lumpenus*, and *Ernogrammus* spp.), the number of pectoral- or anal rays (*Stichaeopsis* spp.), and the relatively large size at which they develop fin elements: first formation of fin elements occurs for many species between 11 and 18 mm TL (Okiyama, 1988).

Pholid larvae closely resemble *Stathmonotus* larvae in that they have elongate bodies and ventral midline melanophores associated with the bases of the anal-fin rays. They can be differentiated from *Stathmonotus* larvae based on the relatively large size at which they acquire fin elements (first formation of fin elements for some species occurs between 14 and 18 mm TL), absence of ribs (Nelson, 1984), pelvic fins absent or consisting of one spine and one ray (Nelson, 1984), more than 80 vertebrae, more than 73 dorsal-fin spines, evenly spaced melanophores dorsally and ventrally on the gut (extending the entire length), and in many species, the possession of midlateral pigment extending almost the entire length of the body.

The presence of ventral midline melanophores associated with the bases of the anal-fin elements is not unique to blennioid larvae, and is present in at least 22 non-blennioid families: Sillaginidae, Mugiloididae, Stichaeidae, Pholididae, Bythitidae, Bathymasteridae, Cryptacanthodidae, Pholidae, Scombridae, Pholidichthyidae, Gonostomatidae, Oryziatidae, Hypoptychidae, Moridae, Gadidae, Ambassidae, Leiognathidae, Gerreidae, Girellidae, Teraponidae, Nemipteridae, and Cottidae. The morphologies of these melanophores may be different and should be examined. In addition, their presence in various taxa may elucidate homologies. Of these families, only Sillaginidae, Mugiloididae, Stichaeidae, and Pholididae have larvae that morphologically resemble blennioid larvae in general body shape (Stichaeidae and Pholididae discussed previously), and all can be differentiated from blennioid larvae. Preflexion sillaginids can be differentiated from blennioid larvae based on the presence of evenly-spaced melanophores extending anteriorly onto the abdomen (in most cases), and an elongate head, snout, and body (Leis and Trnski, 1989). Postflexion sillaginids are easily distinguished from blennioid larvae in that the pelvic fins, which contain one spine and five rays, are posterior to the pectoral fins. Preflexion mugiloidid larvae can be differentiated from blennioid larvae based on the presence of one of the ventral midline melanophores being large and stellate, as well as the presence of preopercular and opercular spination (Leis and Rennis, 1983). Postflexion mugiloidid larvae can be differentiated from blennioid larvae based on the relatively small size that they attain the full complement of fin rays (~6.0 mm SL), the possession of one anal-fin spine, five pelvic-fin rays, few dorsal-fin spines, and long preopercular spines (*Parapercis* spp.) (some Omobranchini larvae possess long preopercular spines (Springer and Gomon, 1975a).

With the descriptions of chaenopsid and dactyloscopid larvae presented within this study, larvae have been described for all blennioid families, enabling interfamilial comparisons to be made. Early-stage chaenopsid larvae have not been described and are not considered in the following discussion. Early-stage blenniid larvae can be differentiated from the other blennioid families by one or more of the following features: pigmented pectoral fins, elongate pectoral-fin rays, heavily pigmented occiput, or large recurved teeth. Early stage larvae of the families Tripterygiidae, Clinidae, and Labrisomidae, closely resemble one another and differentiation between these larvae may be difficult. Early-stage dactyloscopid larvae can be differentiated from early-stage tripterygiid, clinid, and labrisomid larvae by the possession of a more robust head and a relatively deep body anteriorly. Differentiation of later-stage larvae is enhanced by the presence of fin elements and other morphological features such as cirri and scales. These features were discussed previously for all families except Chaenopsidae and Dactyloscopidae. There are no distinguishing pigment characters that differentiate late-stage larvae of the families Chaenopsidae and Labrisomidae. Dactyloscopid larvae can be differentiated from all other blennioid larvae by the possession of a stellate melanophore located on the dorsoposterior portion of the parasphenoid. Other dactyloscopid species need to be examined to determine the usefulness of this character. Matarese et al. (1984) state that chaenopsid larvae are unpigmented, and Stephens (1963) states that larvae of three eastern Pacific species, *Acanthemblemaria crockeri*, *A. macrospilus*, and *Ekemblemaria myersi* lack body pigment. The chaenopsid larvae examined in my study possess similar amounts of pigment as other blennioid larvae.

Characters other than melanophores, such as absence of neural spines on vertebrae, pterygiophore interdigitation patterns, and morphometrics, may further delineate families. The number of vertebrae not bearing neural spines varies within and among families, genera, and species (Table 35). Adult specimens of these species need to be examined to see if these patterns persist. The number of dorsal-fin pterygiophores in interneural spaces 1 and 2 (Table 36) may have taxonomic importance, but more larval and adult specimens need to be examined to determine the usefulness of this character.

Morphometrics are useful in the differentiation of postflexion blennioid larvae (Figs. 44-46). Larvae of *Gillellus* spp. (morphotypes A and B), *Stathmonotus* spp. (morphotypes K, L, and I), two *Enneanectes* spp. (morphotypes E and U) can be differentiated from one another and other blennioid larvae of similar size by the ratio of pectoral-fin length to body length (Fig. 44); there is a wide range of values for this ratio and groupings of other morphotypes are evident. All tripterygiid larvae (morphotypes E, N, and U) exhibit the same ratio of body depth to body length and, as a group, can be differentiated from the majority of other morphotypes (Fig. 45). Differentiation between other groups (e.g. morphotypes F and K) are also evident (Fig. 45). The ratio of preanal length to body length (Fig. 46) can also be used to differentiate larvae. For example, labrisomid larvae (morphotypes F, K and I) and dactyloscopid larvae (morphotype A) can be differentiated from the majority of other larvae by their high- and low preanal length to body length ratios, respectively (Fig. 46). Unfortunately, for the above-mentioned comparisons, many of the morphotypes are represented by one specimen; more specimens need to be examined to elucidate trends, as well as intraspecific variation.

The full utility of pigmentation characters for the identification of larvae of the suborder Blennioidei has yet to be determined. Within the families of Blennioidei, pigment characters may be useful at the specific or generic level. Meristics can be used to a limited degree in the identification of blennioid larvae but can only be used with later stage larvae that possess developed fin elements. Identification to the species level is made more difficult because of the high number of species within a family that have overlapping meristic extremes. For example, in *Labrisomus* and *Malacoctenus* species (Labrisomidae), identification to the species level in many cases is based on adult pigmentation characters or other morphological features that may not be present in larvae. It is possible that the use of pigment characters of larvae coupled with meristic data will allow for greater identification success, but more research needs to be performed. Additional features that may help differentiate larvae within and among families include the number and position of sensory pores, and the number of dorsal-fin pterygiophores within interneural spaces 1 and 2 (Table 36). These features are of taxonomic value and should be given more attention.

To date, ontogeny has contributed little to analyses of blennioid relationships. Characters described and discussed in this study may have phylogenetic significance and hopefully can be used to further examine the hypothesized monophyly of the suborder Blennioidei.

Table 34. Distribution of pigment in larvae of six blennioid families. All taxa within a family may not possess all pigment. Sources include this study, Olivar and Fortuno, 1991; Fritzsche, 1978; Leis and Rennis, 1983; Matarese et al., 1989; Matarese et al., 1984.

	Blenniidae	Chaenopsidae	Clinidae	Dactyloscopidae	Labrisomidae	Tripterygiidae
Ventral midline	X	X	X	X	X	X
Cleithral symphysis	X	X	0	X	X	X
Abdomen (epidermal)	X	X	0	X	X	0
Abdomen (subdermal)	0	0	0	0	X	X
Basipterygia	0	X	0	X	0	0
Occiput	X	0	X	0	X	X
Ventral midline of caudal peduncle	X	X	0	X	X	X
Dorsal midline	X	0	X	0	X	X
Posterior edge of hypural plates	X	0	0	0	0	X
Caudal fin	X	0	X	0	X	X
Pectoral fin	X	0	0	0	0	0
Preopercle	X	0	X	0	X	0
Premaxilla	0	0	0	0	X	0
Dentary	0	0	0	0	X	0
Dorsolateral wall (epidermal)	X	0	X	0	X	0
Caudal-fin procurrent membrane	0	0	0	X	X	0
Dorsal midline of caudal peduncle	0	0	0	0	X	X
Dorsal-fin spines	0	0	0	0	X	0
Posterior to eye	0	0	0	0	X	0
Dorsal to eye	0	0	0	0	0	X

Table 34 (cont.)

	Blenniidae	Chaenopsidae	Clinidae	Dactyloscopidae	Labrisomidae	Tripterygiidae
Ventral to eye	X	0	0	0	X	0
Opercle	X	0	0	0	0	0
Upper jaw	X	0	0	0	0	0
Gut	X	0	X	X	X	X
Cranium	X	0	0	X	X	X
Interhaemal melanophores	0	0	0	0	X	0
Interneural melanophores	0	0	0	0	X	0
Perimeter of foramen in caudal fin	0	0	0	X	0	0
Gasbladder	X	X	X	0	X	X
Otic capsules	X	0	0	0	X	X
Dorsal surface of parasphenoid	0	0	?	X	0	0
Notochord	X	0	X	0	0	X
Dorsoposterior portion of neurocranium	0	0	0	0	X	0
Roof of mouth	X	0	0	0	0	0

Table 35. Absence of neural spines on vertebrae 1 through 5 in larvae of Dactyloscopidae, Chaenopsidae, Labrisomidae, and Tripterygiidae. X indicates absence of neural spine.

	1	2	3	4	5	6	Standard length
Dactyloscopidae							
morphotype A	X	X	X	X			7.9, 8.2
morphotype B	X	X	X				7.9
morphotype B	X	X	X	X			8.3
morphotype B	X	X	X	X	X		8.4
Chaenopsidae							
morphotype C	X						13.2
morphotype J	X	X	X	X			8.7
Labrisomidae							
morphotype H	X						15.3
morphotype F	X	X	X				6.0
morphotype K	X	X	X				7.8
morphotype I	X	X	X				8.4
Tripterygiidae							
morphotype E	X	X	X	X	X		9.1, 10.2
morphotype N	X	X					7.1
morphotype U	X						8.7

Table 36. Numbers of pterygiophores in interneural spaces 1 and 2 in larvae of Chaenopsidae, Dactyloscopidae, Labrisomidae, and Tripterygiidae.

	Interneural space 1	Interneural space 2
Dactyloscopidae		
morphotype A	2	0
morphotype B	2	0
Labrisomidae		
morphotype F	2	0
morphotype H	2	0
morphotype K	0	0
Chaenopsidae		
morphotype C	3	1
morphotype J	3	1
Tripterygiidae		
morphotype E	3	0
morphotype U	3	0

Figure 44. Ratio of pectoral-fin length to body length for postflexion larvae of the families Dactyloscopidae, Chaenopsidae, Labrisomidae, and Tripterygiidae.

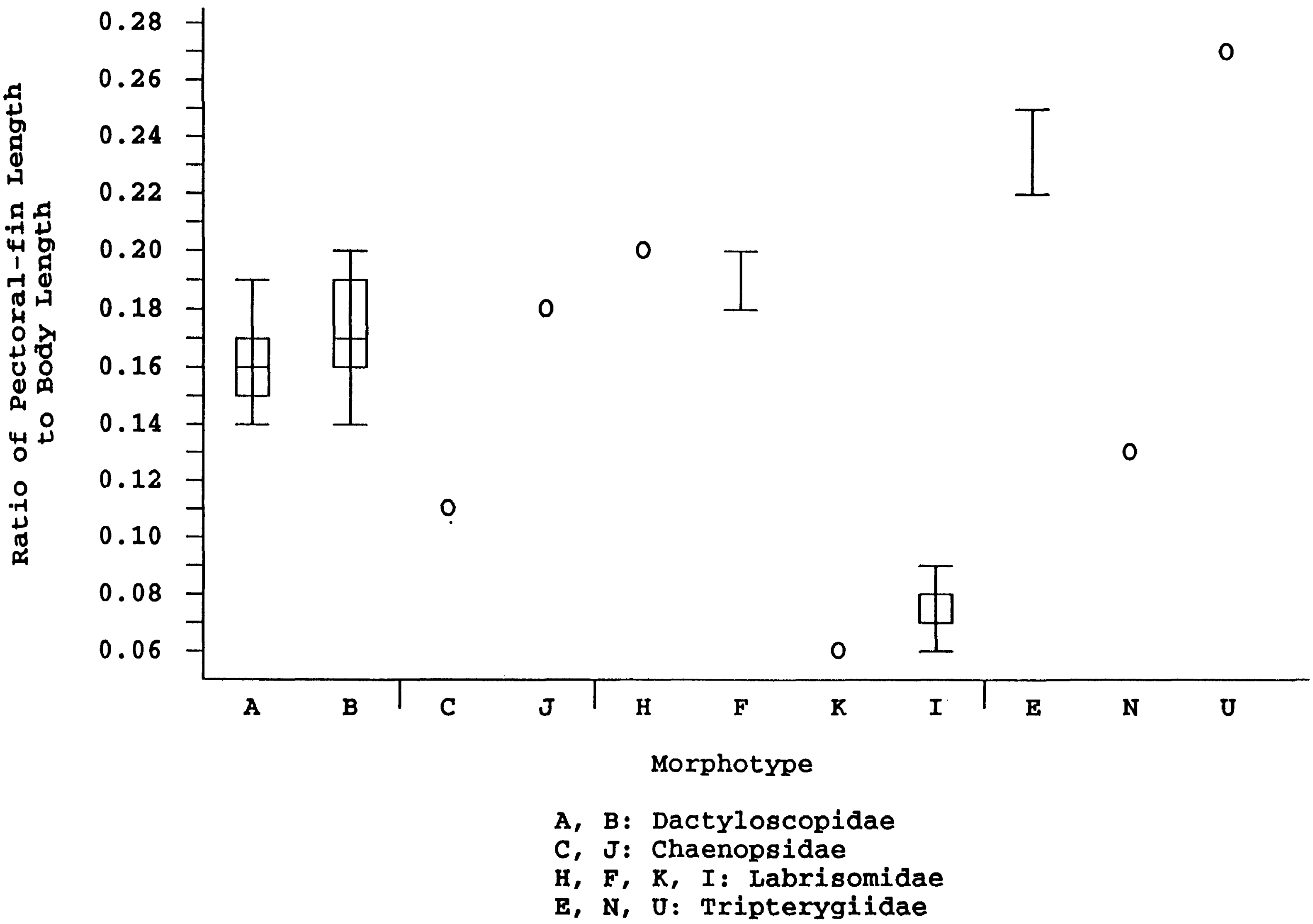

Ratio of Pectoral-fin Length to Body Length
0.28
0.26
0.24
0.22
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
A
B
C
J
H
F
K
I
E
N
U
Morphotype
A, B: Dactyloscopidae
C, J: Chaenopsidae
H, F, K, I: Labrisomidae
E, N, U: Tripterygiidae

Figure 45. Ratio of body depth to body length for postflexion larvae of the families Dactyloscopidae, Chaenopsidae, Labrisomidae, and Tripterygiidae.

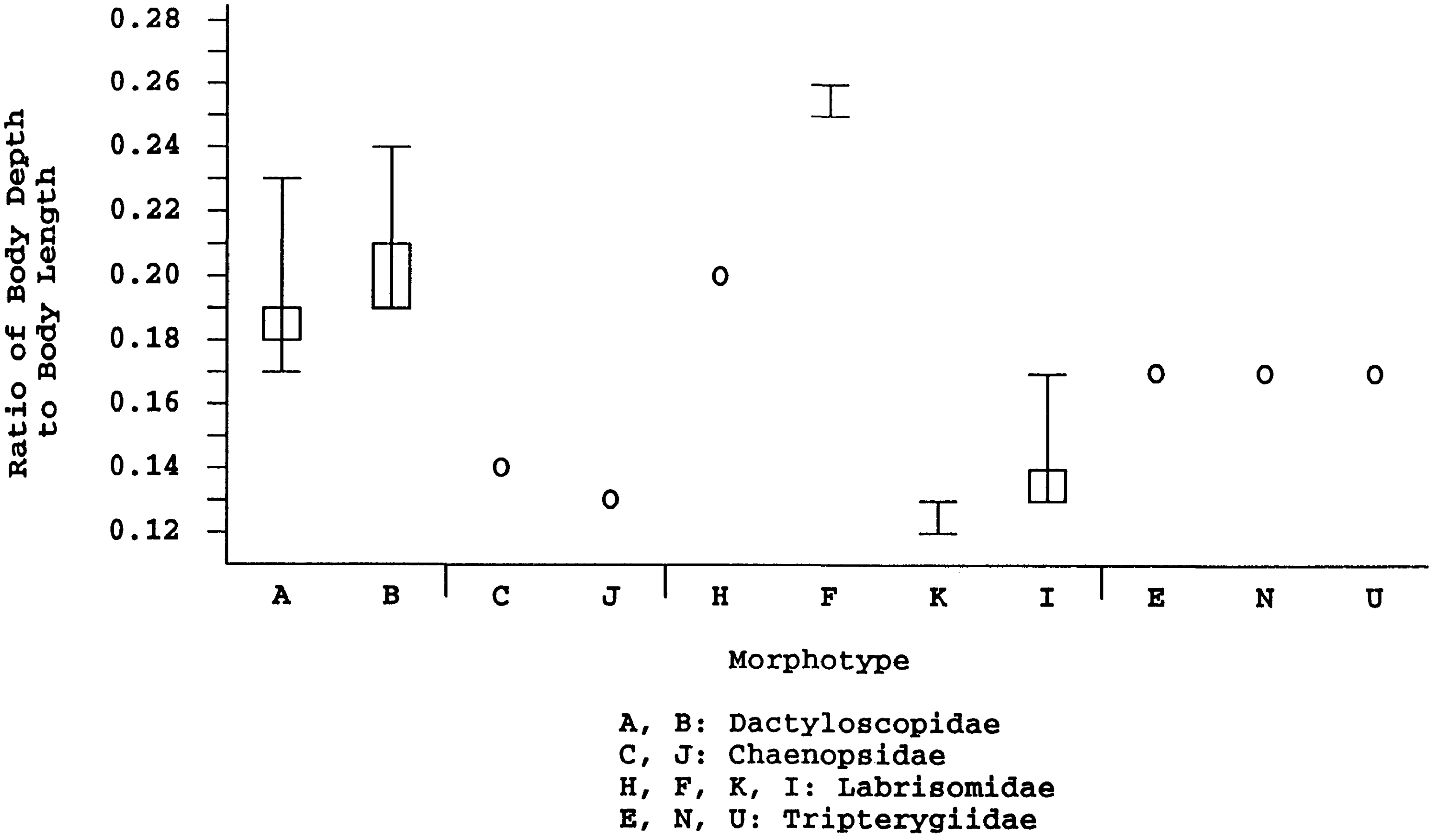
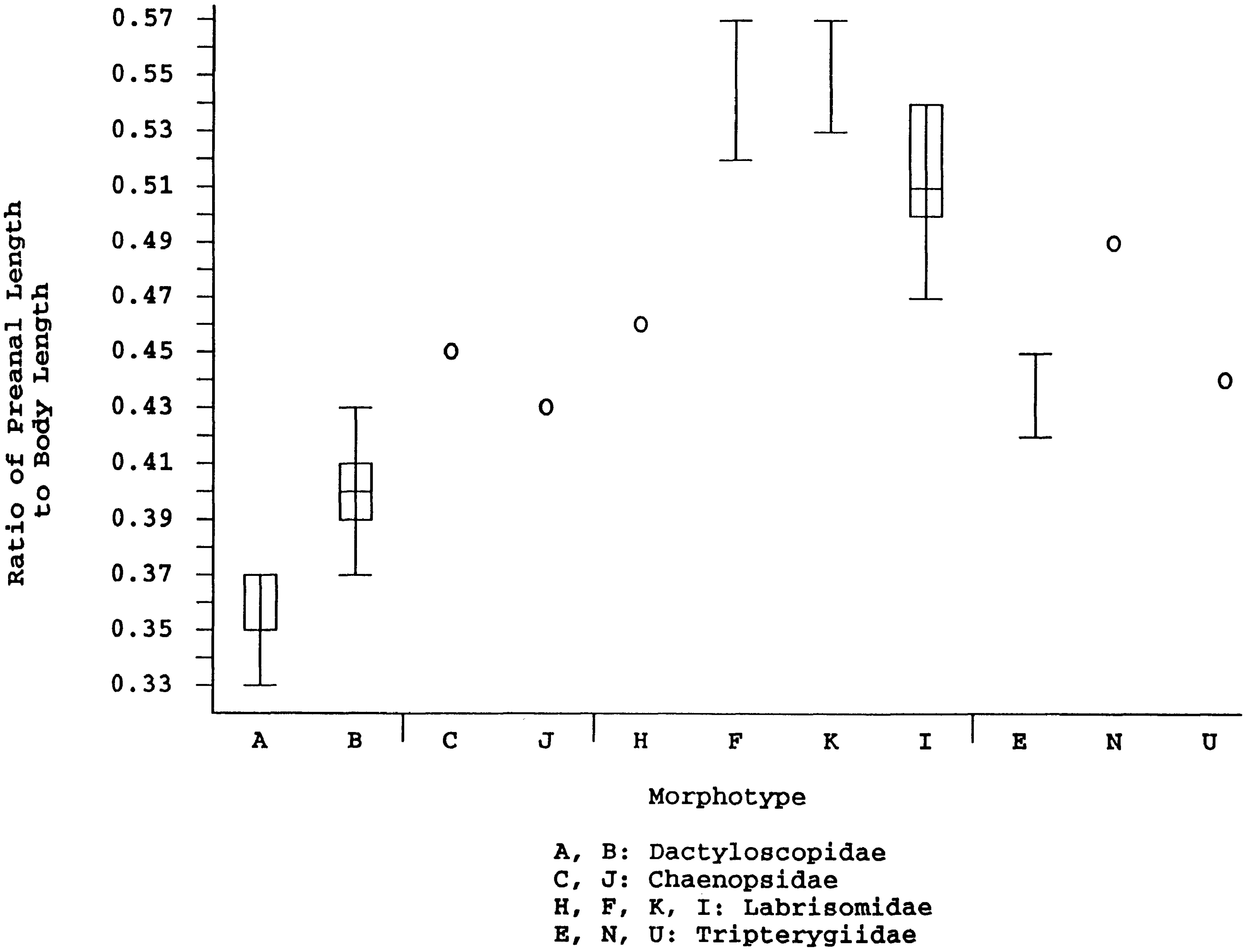

Ratio of Body Depth to Body Length
0.28
0.26
0.24
0.22
0.20
0.18
0.16
0.14
0.12
A
B
C
J
H
F
K
I
E
N
U
Morphotype
A, B: Dactyloscopidae
C, J: Chaenopsidae
H, F, K, I: Labrisomidae
E, N, U: Tripterygiidae

Figure 46. Ratio of preanal length to body length for postflexion larvae of the families Dactyloscopidae, Chaenopsidae, Labrisomidae, and Tripterygiidae.


Ratio of Preanal Length to Body Length
0.57
0.55
0.53
0.51
0.49
0.47
0.45
0.43
0.41
0.39
0.37
0.35
0.33
A
B
C
J
H
F
K
I
E
N
U
Morphotype
A, B: Dactyloscopidae
C, J: Chaenopsidae
H, F, K, I: Labrisomidae
E, N, U: Tripterygiidae

APPENDIX I. Literature used for constructing a list of the nominal species of blennioids of the tropical and sub-tropical western Atlantic.

1. Acero, 1984a
2. Acero, 1984b
3. Acero, 1987
4. Bohlke, 1957a
5. Bohlke, 1957b
6. Bohlke, 1959
7. Bohlke, 1968
8. Bohlke and Chaplin, 1968
9. Bohlke & Robins, 1974
10. Bohlke & Springer, 1961
11. Bohlke & Springer, 1975
12. Cervigon, 1965
13. Cervigon, 1966
14. Dawson, 1970
15. Dawson, 1982
16. Evermann & Marsh, 1900
17. Fowler, 1954
18. Gilbert, 1965
19. Gilbert, 1971
20. Greenfield, 1975
21. Greenfield, 1979
22. Greenfield & Johnson, 1981
23. Hoese & Moore, 1977
24. Johnson & Brothers, 1989
25. Jordan & Evermann, 1898
26. Longley, 1927
27. Nelson, 1984
28. Palacio, 1974
29. Randall, 1966
30. Randall, 1983
31. Richards, 1990
32. Robins, 1971
33. Robins & Randall, 1965
34. Rosenblatt, 1960
35. Smith-Vaniz, 1980
36. Smith-Vaniz & Palacio, 1974
37. Smith-Vaniz & Springer, 1971
38. Springer, 1954
39. Springer, 1955
40. Springer, 1958
41. Springer, 1959a
42. Springer, 1959b
43. Springer, 1967
44. Springer, 1978a
45. Springer, 1978b

APPENDIX I. (continued)

46. Springer & Gomon, 1975b
47. Stephens, 1961
48. Stephens, 1963
49. Stephens, 1970
50. Tavolga, 1954

APPENDIX II. Summary of meristic data for the families of the suborder Blennioidei (excluding Clinidae) occurring in the tropical and subtropical western Atlantic. Data summarized from appendices VIII-XII.

FAMILY	DORSAL	ANAL	PECTORAL	PELVIC	CAUDAL	VERTEBRAE
BLENNIIDAE 9 genera 18 species 3 sub-species	X-XIV,11-22 23-36 total, not complete	II,13-24	11-16	I,2-4	4-7+10-13+3-7 12-15 segmented 13 articulated not complete	10-12+20-30 30-36 total 38-40 total not complete
CHAENOPSIDAE 9 genera 37 species	XVII-XXV,10-22 XVII-XVIII,26-28 XVII-XXI,30-37 28-45,47,51-56 total	II,18-31 II,33-37	11-15	I,3 not complete	3-5+11-14+3-5 11-13 segmented 13-14 principle not complete	10-17+25-36 20+38 39-49,58 total not complete
DACTYLOSCOPIDAE 7 genera 17 species	VII-XX,12-32 27-33,36-44 total	II,21-36	12-15	I,3	1-4+5-6+5-6+1-4 not complete 10-12 segmented	10-12+23-36
LABRISOMIDAE excluding *Stathmonotus* & *Paraclinus* 5 genera 34 species	XVII-XXIII,6-14 25-33 total	II,14-23	11-17	I,3 I,2?	1-8+7-8+6-7+2-8 12-14 segmented not complete	10-13+21-29 30,32-39 total not complete

Appendix II (continued)

FAMILY	DORSAL	ANAL	PECTORAL	PELVIC	CAUDAL	VERTEBRAE
LABRISOMIDAE	XXV-XXXI,0-1	II,15-29	3-9	I,2-3	1-4+6-8+6-7+0-3	10-11+21-23
Stathmonotus &	26-31 total		11-14		10-14 segmented	10+25
Paraclinus	XXXIX-LIII,0				10-13 articulated	33-35 total
11 species	39-53 total				not complete	16-25+27-34
2 sub-species						44-58 total
						not complete
TRIPTERYGIIDAE	III+X-XIII,6-9	II,14-17	13-16	I,3	5+9+8+5	10+23
1 genus	20-25 total			I,2?	15 segmented	not complete
5 species					not complete	

APPENDIX III. Summary of meristic data for the genera of the family Blenniidae occurring in the tropical and subtropical western Atlantic. Data summarized from Appendix VII.

BLENNIIDAE	DORSAL (mode)	ANAL (mode)	PECTORAL (mode)	PELVIC	CAUDAL	VERTEBRAE
Chasmodes 2 species	X-XI,16-20 27-31 total	II,16-20	11-13	I,3	4-5+10-13+3-5	10+24-26
Entomacrodus 2 species	XII-XIII,14-15	II,15-17 (II,16)	13-14	I,4	13 articulated	
Hypleurochilus 4 species	XI-XIII,12-14 XI,15	II,14-16 II,18	13-15 not complete	I,4 not complete	13 segmented not complete	30-33 total
Hypsoblennius 4 species	XI-XIII,13-16 XI-XII,11-12 23-28 total	II,13-17	13-15	I,3-4	5-7+13+4-7 not complete	10+20-24
Lupinoblennius 2 species	XII-XIII,13-15	II,14-17	12-14	I,3-4	13-15 segmented	10-12+21-23
Omobranchus 1 species	XI-XIII,19-22	II,21-24	12-14	I,2 not complete	12-14 segmented 13 articulated	10-11+27-30 38-40 total not complete
Ophioblennius 1 species 2 sub-species	31-36 total XII,20-21	22-26 total II,20-21	14-16	I,4	13 segmented	

Appendix III (continued)

BLENNIIDAE	DORSAL (mode)	ANAL (mode)	PECTORAL (mode)	PELVIC	CAUDAL	VERTEBRAE
Parablennius 1 species	XI-XII,17-18 (XII,18)	II,19-20	14	I,3		
Scartella 1 species	XII,14-15	II,15-17	14	I,3		

APPENDIX IV. Summary of meristic values for the genera of the family Chaenopsidae occurring in the tropical and subtropical western Atlantic. Data summarized from Appendix IX.

CHAENOPSIDAE	DORSAL (mode)	ANAL (mode)	PECTORAL (mode)	PELVIC	CAUDAL (mode)	VERTEBRAE (mode)
Acanthemblemaria 9 species	XVIII-XXV,11-22 33-44 total	II,21-30	11-14	I,3	3-5+11-14+4-5 11-13 segmented not complete	10-14+28-36 39-49 total
Chaenopsis 5 species	XVII-XVIII,26-28 XVII-XXI,30-37 44-45,47,51-56 total	II,29-31 II,33-37	12-14	I,3	13 segmented not complete	16+32-33 20+38 48-49, 58 total not complete
Coralliozetus 2 species	XVII-XXI,10-13 28-33 total	II,18-24	11-14	I,3 not complete	4+13+3-4 not complete	11+27 not complete
Ekemblemaria 1 species	XIX-XXII,15-19 (XXI,17) 37-40 total	II,23-25 (II,24)	13-15 (14)	I,3	4+12-14+4 (4+13+4)	13+30
Emblemaria 9 species	XVIII-XXIII,13-17 32-38 total	II,19-24	12-14	I,3 not complete	4+13+3-4 13 segmented not complete	14+25 or 28 13+26 or 28 ?+30 40-42 total not complete
Emblemariopsis 8 species	XIX-XXI,10-14 30-35 total	II,19-23	12-15	I,3	3-4+13+4 12-13 segmented not complete	11+27-28 & 39 total not complete

Appendix IV (continued)

CHAENOPSIDAE	DORSAL (mode)	ANAL (mode)	PECTORAL (mode)	PELVIC	CAUDAL (mode)	VERTEBRAE (mode)
Hemiemblemaria monotypic	XXII-XXIII,16-17 39-40 total	II,22-23	14	I,3	4+13+4 4+8+7+4 13 segmented	15-16+29
Lucayablennius monotypic	XVIII-XX,19-21 (XIX,20) 38-40 total	II,21-23 (II,23)	13	I,3	13 segmented 5+8+7+4	40-44 total (42 total) 16+27
Protemblemaria 1 species	XIX,15-17 XX,14-16 XXI,13-16 34-37 total	II,21-24 (II,23)	13-15 (14)	I,3	13-14 principle (13 principle)	

APPENDIX V. Summary of meristic values for the genera of the family Dactyloscopidae occurring in the tropical and subtropical western Atlantic. Data summarized from Appendix X.

DACTYLOSCOPIDAE	DORSAL (mode)	ANAL (mode)	PECTORAL (mode)	PELVIC	CAUDAL (mode)	VERTEBRAE (mode)
Dactylagnus 1 species	IX-X,28-30 (X,28-29) 38-40 total	II,33-35 (II,34-35)	13	I,3	(10 segmented)	(11)+35-36 (11+36)
Dactyloscopus 7 species	IX-XIV,25-32 36-44 total	II,28-36	12-14	I,3	1-3+5-6+5-6+1 not complete (10 segmented)	(11)+29-36
Gillellus 4 species	III+XV-XVII,20-24 III+VIII-X,27-29 III+XIV-XVI,18-20 III+X-XII,14-17 28-32,36-43 total	II,21-24 II,28-35	12-14	I,3	2-4+10+2-3 not complete (10 segmented)	(11)+23-26 (11)+29-36
Leurochilus monotypic	III+XI-XIV,12-14 (XV,14) 27-30 total	II,22-24 (II,24)	13-14 (13)	I,3	11-12 segmented (11 segmented)	(10)+25-26 (10+26)
Myxodagnus 1 species	VII-IX,29-31 (VIII,30) 38-39 total	II,34-36 (II,35)	12-14 (13)	I,3	4+10+4 (10 segmented)	(12)+35-36 (12+35)
Platygillellus 2 species	XV-XVII,14-17 29-33 total	II,22-27	13-15	I,3	(11 segmented)	(10)+23 (10)+25-28

Appendix V (continued)

DACTYLOSCOPIDAE	DORSAL (mode)	ANAL (mode)	PECTORAL (mode)	PELVIC	CAUDAL (mode)	VERTEBRAE (mode)
Storrsia monotypic	XIV,26* 40 total XIV,16* 30 total	II,26	13	I,3	10 segmented	11+28

* Dawson (1982) contains an error regarding the number of dorsal-fin elements; both counts are listed here.

APPENDIX VI. Meristic values for the genera of the family Labrisomidae occurring in the tropical and subtropical western Atlantic. Data summarized from Appendix XI.

LABRISOMIDAE	DORSAL (mode)	ANAL (mode)	PECTORAL (mode)	PELVIC	CAUDAL (mode)	VERTEBRAE (mode)
Haptoclinus monotypic	III-I-XIII,14 III-I-XIV,13 31 total	II,20-21	13	I,3	(6-7)+7+6+5	13+
Labrisomus 9 species	XVII-XXII,10-13 28-33 total	II,16-22	12-15	I,3	2-8+8+7+4-8 12-13 segmented	10-12+22-25 32-38 total
Malacoctenus 8 species	XVIII-XXIII,8-13 28-33 total	II,17-23	13-17	I,3	1-8+8+7+2-7 13 segmented	10-11+24-29 not complete 34-39 total
Nemaclinus monotypic	XXI-XXIII,7-9 (XXII,8) 28-32 total	II,18-19 (II,19)	11-12 (12)	I,3	5-7+13+(5-7) (6+13+5-7)	11+22-24 (11+23)
Paraclinus 8 species	XXV-XXXI,0-1 26-31 total	II,15-21	11-14	I,3	1-4+8+7+2-3 12-14 segmented	10-11+21-23 10+25 33-35 total not complete
Starksia 15 species	XVIII-XXII,6-9 25-31 total	II,14-20	11-15	I,3 I,2?	4-6+7-8+6-7+4-6 12-14 segmented not complete	10-11+21-25 30, 32-35 total not complete

Appendix VI (continued)

LABRISOMIDAE	DORSAL (mode)	ANAL (mode)	PECTORAL (mode)	PELVIC	CAUDAL (mode)	VERTEBRAE (mode)
Stathmonotus 3 species 2 sub-species	XXXIX-LIII,0 39-53 total	II,21-29	3-9	I,2	1+6-7+6+0-2 not complete 10-13 articulated 10-13 segmented	16-25+27-34 44-58 total

APPENDIX VII. Meristic values for the genera of the family Tripterygiidae occurring in the tropical and subtropical western Atlantic. Data summarized from Appendix XII.

TRIPTERYGIIDAE	DORSAL (mode)	ANAL (mode)	PECTORAL (mode)	PELVIC	CAUDAL (mode)	VERTEBRAE (mode)
Enneanectes 5 species	III+X-XIII,6-9 20-25 total	II,14-17	13-16	I,3 I,2?	5+9+8+5 15 segmented 5-8+7+6+5-7 not complete	8-9+22 10+23 29-31,33-35 total not complete

APPENDIX VIII. Meristic values for species of Blenniidae that inhabit the tropical and sub-tropical western Atlantic. Numerals in parentheses beneath taxa correspond with literature cited at end of table.

BLENNIIDAE	DORSAL (mode)	ANAL (mode)	PECTORAL (mode)	PELVIC	CAUDAL (mode)	VERTEBRAE (mode)
Chasmodes						
C. bosquianus						
C. b. longimaxilla (11,16)	X-XI,16-19 (XI,18) 28-30 total	II,16-20 (II,18)	11-13 (12)	I,3	4-5+10-13+3-5 (4-5+11+3-5)	10+24-25
C. saburrae (7,11,16)	X-XI,16-20 (XI,18) 27-31 total	II,17-20 (II,18)	11-13 (12)	I,3	4-5+10-13+3-5 (4-5+11+3-5)	10+24-26 (10+24)
Entomacrodus						
E. nigricans (3,9,13)	XII-XIII,13-16 (XII-XIII,14-15)	II,14-17 (II,16)	13-14	I,4	13 articulated	33-35 total (34 total)
E. vomerinus (13)	XII-XIV,15-17 (XIII,16)	II,15-18 (II,17)	12-15 (14)	I,4	7+6 13 segmented central 9 branched	34-36 total (35 or 36 total)
Hypleurochilus						
H. aequipinnis (3,6,8)	XI-XII,13-14 (XII,13-14)	II,14-16 (II,15-16)	13-15 (14)	I,4	13 segmented	31-33 total (31-32 total)

Appendix VIII (continued)

BLENNIIDAE	DORSAL (mode)	ANAL (mode)	PECTORAL (mode)	PELVIC	CAUDAL (mode)	VERTEBRAE (mode)
Hypleurochilus (continued)						
H. bermudensis (7,8)	XI-XII,12-13 (XII,13)	II,14-15 (II,15)	13-14 (14)	I,4		30-31 total (31 total)
H. geminatus (1,7,8)	XI,15 XIII,14 26-28 total	II,18 14-18 total		I,3-4		
H. springeri (8)	XI-XIII,12-13 (XII,13)	II,14-16 (II,14-15)	13-15 (14)	I,4	13 segmented	32 total
Hypsoblennius						
H. exstochilus (2,10)	XI-XII,13-15 (XII,14)	II,15-16 (II,16)	13-15 (14)	I,3	5-6+13+5-6 5-7?+13+5-6	10+22-23
H. hentz (5,7,10)	XI-XIII,13-16 (XII,14) 25-28 total	II,14-17 (II,16)	13-15 (14)	I,3	5-6+13?+5-6	10+21-24 (10+22)
H. invemar (10)	XI-XII,11-12 (XII,12) 23-24 total	II,13-14 (II,14)	13-15 (14)	I,4	6-7+13+6-7	10+20-22 (10+21)

Appendix VIII (continued)

BLENNIIDAE	DORSAL (mode)	ANAL (mode)	PECTORAL (mode)	PELVIC	CAUDAL (mode)	VERTEBRAE (mode)
Hypsoblennius (continued)						
H. ionthas (7,10)	XI-XIII,13-15 (XII,14) (25-27 total)	II,14-17 (II,15-16)	13-15 (14)	I,3	5-6+13+4-6	10+20-23 (10+21-22)
Lupinoblennius						
L. dispar (4)	XII,13-14	II,14-16	12-14 (13)	I,4	13-15 segmented (13 segmented)	10+21-22
L. nicholsi (6,15)	XII-XIII,13-15	II,16-17	13	I,3	13-14	11-12+21-23 32-35 total
Omobranchus						
O. punctatus (14)	XI-XIII,19-22 (XII,21) 31-34 total	II,22-24	12-14 (13)	I,2	12-14 segmented (13 segmented)	10-11+27-30 38-40 total

Appendix VIII (continued)

BLENNIIDAE	DORSAL (mode)	ANAL (mode)	PECTORAL (mode)	PELVIC	CAUDAL (mode)	VERTEBRAE (mode)
Ophioblennius						
O. atlanticus						
*O. a. atlanticus** (12,13)	33-36 total	25-26 total (15)	14-16	I,4	13 segmented	
*O. a. macclurei** (3,12)	31-33 total XII,20-21	22-24 total II,20-21	14-16 (15)	I,4	13 segmented	
Parablennius						
P. marmoreus (3,7,9,15)	XI-XII,17-18 (XII,18)	II,19-20	14	I,3		
Scartella						
S. cristata (3,9)	XII,14-15	II,15-17	14	I,3		

* Meristic values for pectoral, pelvic, and caudal fins are for genus *Ophioblennius*.

Appendix VIII (continued)

1. Bath, H. Unpublished meristic data, from V.G. Springer
2. Bohlke, 1959
3. Cervigon, 1966
4. Dawson, 1970
5. Gilhen et al., 1976
6. Greenfield & Johnson, 1981
7. Hoese & Moore, 1977
8. Randall, 1966
9. Randall, 1983
10. Smith-Vaniz, 1980
11. Springer, 1959b
12. Springer, 1962
13. Springer, 1967
14. Springer & Gomon, 1975a
15. Tavolga, 1954
16. Williams, 1983

APPENDIX IX. Meristic values for species of Chaenopsidae known to inhabit the tropical and sub-tropical western Atlantic. Numerals in parentheses correspond with literature cited at end of table.

CHAENOPSIDAE	DORSAL (mode)	ANAL (mode)	PECTORAL (mode)	PELVIC	CAUDAL (mode)	VERTEBRAE (mode)
Acanthemblemaria						
A. aspera (2,5,6,11,17,21,25,28)	XIX-XXII,14-17 (XIX-XXII,16) 34-38 total (36-37 total)	II,21-25 (II,23-24)	12-14 (13)	I,3	4+11-14+4 (4+12+4)	12-13+28-31 40-43 total
A. betinensis (2,25)	XXII-XXV,13-16 (XXIII,15) 36-40 total (38-39 total)	II,22-26 (II,24-25)	12-14 (13)	I,3	13 segmented	13-14+28-30 42-44 total
A. chaplini (5,6,11,25,28)	XX-XXIII,17-22 (XXII,18) 38-44 total	II,25-30 (II,27-28)	12-14 (13)	I,3	5+12-13+4 (5+13+4)	12-14+32-36 44-49 total
A. greenfieldi (11,25)	XXI-XXIV,15-19 38-41 total (39-40 total)	II,25-28 (II,26-27)	12-14 (13)	I,3	13 segmented 3+7+6+4	12-13+31-34 44-46 total
A. maria (5,6,25,26,28)	XXI-XXIII,12-15 34-38 total (35-36 total)	II,22-26 (II,23-24)	11-14 (13)	I,3	4-5+12-13+4 (4-5+13+4)	10-11+29-32 12+30-31 rarely 10+? 40-43 total

Appendix IX (continued)

CHAENOPSIDAE	DORSAL (mode)	ANAL (mode)	PECTORAL (mode)	PELVIC	CAUDAL (mode)	VERTEBRAE (mode)
Acanthemblemaria (continued)						
A. medusa (25)	XXI-XXIII,15-17 37-39 total	II,25-27	12-14 (13)	I,3	12-13 segmented (13 segmented)	11-12+31-33 42-44 total
A. paula (17)	XVIII-XXI,15-19 (XIX,17) 35-37 total	II,22-25 (II,23)	12-14 (13)	I,3	11-13 segmented (12-13 segmented)	12-13+28-30 40-42 total (41 total)
A. rivasi (2,25,29)	XXI-XXIII,11-14 (XXII,13) 32-36 total (34-35 total)	II,21-24 (II,22-23)	11-14 (13)	I,3	4+12-13+4 or 4+15+4 (4+13+4)	11+28-30 39-41 total
A. spinosa (5,6,11,17,21,25,28)	XX-XXII,13-16 (XXI,14-15) 33-37 total	II,21-26 (II,23-24)	12-14 (13)	I,3	4-5+13+4 3-4+8+6+4-5	11-12+28-31 (11+28-31) 39-42 total
Chaenopsis						
C. limbaughi (3,20,22,24,26)	XVII-XXI,31-37 (XIX-XX,33-34) 51-54 total	II,33-37 (II,35)	12-14	I,3	13 segmented	20+38
C. ocellata (3,4,24,26)	XVII-XX,32-37 (XVIII,34)	II,33-37	12-14 (13)	I,3	13 segmented	

Appendix IX (continued)

CHAENOPSIDAE	DORSAL (mode)	ANAL (mode)	PECTORAL (mode)	PELVIC	CAUDAL (mode)	VERTEBRAE (mode)
Chaenopsis (continued)						
C. resh (3,9,10,16,23,24)	XVII-XIX,35-37 53-55 total	II,36-37	12-13 (13)	I,3	13 segmented	
C. roseolla (15)	XVII-XVIII,26-28 44-45 total	II,29-30	12-14	I,3		16+32-33
C. stephensi (15,23,24)	XVII,28 or 30 45 or 47 total	II,30-31	13	I,3		49 total
Coralliozetus						
C. cardonae (3,5,14,26,28)	XVII-XIX,10-13 (XVIII,12) 28-31 total	II,18-24 (II,20)	11-13	I,3	4+13+3-4	11+27
C. tayrona (3)	XIX-XXI,11-13 (31-33 total)	II,18-22	13-14			
Ekemblemaria						
E. nigra (2,5,26,28,29)	XIX-XXII,15-19 (XXI,17) 37-40 total	II,23-25 (II,24)	13-15 (14)	I,3	4+12-14+4 (4+13+4)	13+30

Appendix IX (continued)

CHAENOPSIDAE	DORSAL (mode)	ANAL (mode)	PECTORAL (mode)	PELVIC	CAUDAL (mode)	VERTEBRAE (mode)
Emblemaria						
E. atlantica (1,5,26,28,29)	XIX-XXII,14-16 (XXII,15) 34-38 total	II,21-23 (II,23)	13-14 (14)	I,3	4+13+4	14+25
E. biocellata (1,29)	XXII,14-15 36-37 total	II,22-23	13	I,3	4+13+3-4	
E. caldwelli (1,8,18,26,29)	XXI-XXIII,13-15 (XXII,14) 34-37 total	II,21-23 (II,22)	14	I,3	13 segmented	14+28
E. caycedoi (1)	XIX-XXI,14-15 (34-36 total)	II,22-23	13			
E. culmenis (1,29)	XXII,15 37 total	II,24	13	I,3	4+13+4	
E. diphyodontis (1,26,29)	XX,15-16 XXI,14-16 35-37 total (36 total)	II,22-24 (II,23)	13	I,3	13 segmented	+30
E. hyltoni (1,14,18)	XXI-XXIII,14-16 36 or 37 total	II,22-23 (II,23)	14	I,3		40-42 total

Appendix IX (continued)

CHAENOPSIDAE	DORSAL (mode)	ANAL (mode)	PECTORAL (mode)	PELVIC	CAUDAL (mode)	VERTEBRAE (mode)
Emblemaria (continued)						
E. pandionis (1,5,11,16,22,26,28,29)	XIX-XXII,13-17 (XX,14) 33-38 total	II,20-24 (II,21)	12-14 (13)	I,3	4+13+4	13+26 or 28
E. piratula (1,5,14,18,28,29)	XVIII-XX,13-16 32-34 total	II,19-21	12-13 (13)	I,3	4+13+4	
Emblemariopsis						
E. bahamensis (26,27,28,29)	XX-XXI,12-13 32-34 total	II,21-22	13	I,3	3-4+13+4	11+28
E. bottomei (10,26,27,28,29)	XX-XXI,12-13 32-33 total	II,21	13	I,3	4+13+4	
E. diaphana (5,19,26,27,28,29)	XX-XXI,12-14 32-34 total	II,21-23	12-13 (13)	I,3	3+13+4	

Appendix IX (continued)

CHAENOPSIDAE	DORSAL (mode)	ANAL (mode)	PECTORAL (mode)	PELVIC	CAUDAL (mode)	VERTEBRAE (mode)
Emblemariopsis (cont.)						
E. leptocirris (14,26,29)	XIX,12 XX,10-12 XXI,11 ?,13 (XX,11-12) 30-32 total XIX-XXI,11 or 13 (31-33 total)	II,19-22 (II,20)	12-14 (13)	I,3	12-13 segmented (13 segmented)	11+27
E. occidentalis (8,29)	XIX,13 XX,11-12 or 14 XXI,11 31-34 total	II,20-21	13-14 (13)	I,3	12-13 segmented (13 segmented)	
E. pricei (13,14)	XX,13-14 XXI,12-14 (XXI,13) 33-35 total	II,22-23	14	I,3		39 total
E. randalli (9,10,26,29)	XX-XXI,12-13 32-34 total	II,20-23	14-15 (14)	I,3		11+27
E. signifera (20,26,28,29)	XIX-XXI,10-13 (XX,11) 30-33 total	II,19-21 (II,20)	12-13 (13)	I,3	4+13+4	11+27

Appendix IX (continued)

CHAENOPSIDAE	DORSAL (mode)	ANAL (mode)	PECTORAL (mode)	PELVIC	CAUDAL (mode)	VERTEBRAE (mode)
Hemiemblemaria (monotypic)						
H. simulus (5,11,26,28)	XXII-XXIII,16-17 39-40 total	II,22-23	14	I,3	4+13+4 4+8+7+4, 13 are segmented	15-16+29
Lucayablennius (monotypic)						
L. zingaro (2,4,11,12,20,24,26,28)	XVIII-XX,19-21 (XIX,20) 38-40 total	II,21-23 (II,23)	13	I,3	13 segmented 5+8+7+4	40-44 total (42 total) 16+27 17+26
Protemblemaria						
P. punctata (7,9,10,14)	XIX,15-17 XX,14-16 XXI,13-16 34-37 total	II,21-24 (II,23)	13-15 (14)	I,3	13-14 principle rays (13 principle rays)	

Appendix IX (continued)

1. Acero, 1984a
2. Acero, 1984b
3. Acero, 1987
4. Bohlke, 1957a
5. Bohlke, 1957b
6. Bohlke, 1961
7. Bohlke & Cervigon, 1967
8. Bohlke & Robins, 1974
9. Cervigon, 1965
10. Cervigon, 1966
11. Cleared and stained material
12. Greenfield, 1972
13. Greenfield, 1975
14. Greenfield & Johnson, 1981
15. Hastings & Shipp, 1980
16. Hoese & Moore, 1977
17. Johnson & Brothers, 1989
18. Johnson & Greenfield, 1976
19. Longley, 1927
20. Palacio, 1974
21. Radiograph material
22. Randall, 1983
23. Robins, 1971
24. Robins & Randall, 1965
25. Smith-Vaniz & Palacio, 1974
26. Springer, unpublished data
27. Stephens, 1961
28. Stephens, 1963
29. Stephens, 1970

APPENDIX X. Meristic values for species of Dactyloscopidae known to inhabit the tropical and sub-tropical western Atlantic. Numerals in parentheses beneath taxa correspond with literature cited at end of table.

DACTYLOSCOPIDAE	DORSAL (mode)	ANAL (mode)	PECTORAL (mode)	PELVIC	CAUDAL (mode)	VERTEBRAE (mode)
Dactylagnus						
D. peratikos (3)	IX-X,28-30 (X,28-29) 38-40 total	II,33-35 (II,34-35)	13	I,3	(10 segmented)	(11)+35-36 (11+36)
Dactyloscopus						
D. boehlkei (3)	IX-XI,28-31 (X,30) 39-41 total	II,32-33 (II,32)	12-13 (13)	I,3	(10 segmented)	(11)+32-34 (11+33-34)
D. comptus (3)	X-XII,25-28 (XI,27) 36-39 total	II,28-30 (II,30)	12-14 (13)	I,3	10 segmented	(11)+29-32 (11+31)
D. crossotus (2,3)	XI-XIV,27-31 (XII,29) 39-44 total	II,31-36 (II,33)	12-14 (13)	I,3	(10 segmented) 2+6+6+1	(11)+32-36 (11+33)
D. foraminosus (3)	X-XI,29-32 (X,31) 40-42 total	II,33-34 (II,33)	13-14 (13)	I,3	(10 segmented)	(11)+33-35 (11+35)

Appendix X (continued)

DACTYLOSCOPIDAE	DORSAL (mode)	ANAL (mode)	PECTORAL (mode)	PELVIC	CAUDAL (mode)	VERTEBRAE (mode)
Dactyloscopus (continued)						
D. moorei (3)	IX-XIII,26-30 (XI-XII,29) 38-41 total	II,30-34 (II,32)	12-14 (13)	I,3	(10 segmented)	(11)+31-34 (11+33)
D. poeyi (3)	XI-XIV,26-30 (XII-XIII,29) 40-43 total (41 total)	II,32-35 (II,33)	12-14 (13)	I,3	(10 segmented)	(11)+33-36 (11+34)
D. tridigitatus (2,3)	X-XIII,26-31 (XII,28) 38-42 total (40 total)	II,30-34 (II,32)	12-14 (13)	I,3	(10 segmented) 1+5+5+1 3+6+6+1	(11)+31-35 (11+33)
Gillellus						
G. greyae (3)	III+XV-XVII,20-24 (III+XVI,21) 39-43 total	II,31-35 (II,32)	12-14 (13)	I,3	(10 segmented)	(11)+31-36 (11+33)
G. healae (3)	III+VIII-X,27-29 (III+IX,29) 39-41 total	II,31-33 (II,32)	13-14 (13)	I,3	(10 segmented)	(11)+32-34 (11+33)

Appendix X (continued)

DACTYLOSCOPIDAE	DORSAL (mode)	ANAL (mode)	PECTORAL (mode)	PELVIC	CAUDAL (mode)	VERTEBRAE (mode)
Gillellus (continued)						
G. jacksoni (3)	III+XIV-XVI,18-20 (III+XV,20) 36-38 total	II,28-30 (II,29-30)	12-14 (13)	I,3	(10 segmented)	(11)+29-31 (11+31)
G. uranidea (1,3)	III+X-XII,14-17 (III+XI,16) 28-32 total	II,21-24 (II,23)	12-14 (13)	I,3	(10 segmented) 2-4+10+2-3 (3+10+2)	(11)+23-26 (11+25)
Leurochilus (monotypic)						
L. acon (1,3)	III+XI-XIV,12-14 (III+XII,14) 27-30 total	II,22-24 (II,24)	13-14 (13)	I,3	11-12 segmented (11 segmented)	(10)+25-26 (10+26)
Myxodagnus						
M. belone (1,3)	VII-IX,29-31 (VIII,30) 38-39 total	II,34-36 (II,35)	12-14 (13)	I,3	(10 segmented) 4+10+4	(12)+35-36 (12+35)
Platygillellus						
P. rubrocinctus (3)	III+XII-XIV,14-17 (III+XIII,15-16) 30-33 total	II,23-27 (II,25)	13-15 (14)	I,3	(11 segmented)	(10)+25-28 (10+26)

Appendix X (continued)

DACTYLOSCOPIDAE	DORSAL (mode)	ANAL (mode)	PECTORAL (mode)	PELVIC	CAUDAL (mode)	VERTEBRAE (mode)
Platygillellus (continued)						
P. smithi (3)	XV,14 29 total	II,22	14	I,3	11 segmented	10+23
Storrsia (monotypic)						
S. olsoni (3)	XIV,26* 40 total XIV,16* 30 total	II,26	13	I,3	10 segmented	11+28

* Dawson (1982) lists two different values for dorsal-fin soft rays; both are listed here.

1. Bohlke, 1968
2. Cleared and stained material
3. Dawson, 1982

APPENDIX XI. Meristic values for species of Labrisomidae known to inhabit the tropical and sub-tropical western Atlantic. Numerals in parentheses beneath taxa correspond with literature cited at end of table.

LABRISOMIDAE	DORSAL (mode)	ANAL (mode)	PECTORAL (mode)	PELVIC	CAUDAL (mode)	VERTEBRAE (mode)
Haptoclinus (monotypic)						
H. apectolophus (2,4)	III+I+XIII,14 III+I+XIV,13 31 total	II,20-21	13	I,3	(6-7)+7+6+5	13+
Labrisomus						
L. albigenys (10,14,19)	XVIII,11 29 total	II,16 or 18	13-14 (13)	I,3	12-13 segmented 2+8+7+2	11+23
L. bucciferus (6,19)	XIX,11-12 XX,10-12 XXI,10 (XX,11) 30-32 total	II,19-21 (II,20)	12-14 (13)	I,3	7+8+7+7 13 segmented	37 total ~12+25
L. filamentosus (6,14,19,21)	XXI,12 33 total	II,19-22	13-14	I,3	13 segmented 7+6 7-8+8+7+4-7	37-38 total 12+25
L. gobio (6,14,19)	XVIII,12 XIX,10-12 XX,10-11 (XIX,11) 29-31 total	II,18-20 (II,19)	12-13 (13)	I,3	13 segmented 5+8+7+7	10-11+24

Appendix XI (continued)

LABRISOMIDAE	DORSAL (mode)	ANAL (mode)	PECTORAL (mode)	PELVIC	CAUDAL (mode)	VERTEBRAE (mode)
Labrisomus (continued)						
L. guppyi (5,6,14,19)	XVIII,11-12 XIX,10-12 (XIX,11) 29-31 total	II,18-20 (II,19)	12-14 (13)	I,3	13 segmented 2-8+8+7+4-8 (6-8+8+7+6-8)	11+24 not complete
L. haitiensis (6,14,19)	XX,10-12 XXI-XXII,10-11 (XX-XXI,10-11) 30-33 total	II,18-22 (II,20-21)	13-15 (14)	I,3	13 segmented 7+8+7+7	38 total 11+25
L. kalisherae (5,14,19)	XVIII,11-12 XIX,10-12 (XIX,11) 29-31 total	II,18-20 (II,19)	13-14 (13)	I,3	12-13 segmented 7+8+7+7	10+25
L. nigricinctus (6,14,19)	XVII,11 XVIII,10-12 XIX,11 (XVIII,11) 28-30 total	II,17-20 (II,18)	13	I,3	13 segmented 5-6+8+7+5-7 (6+8+7+6)	32-34 total 11+22-23 (11+23)

Appendix XI (continued)

LABRISOMIDAE	DORSAL (mode)	ANAL (mode)	PECTORAL (mode)	PELVIC	CAUDAL (mode)	VERTEBRAE (mode)
Labrisomus (continued)						
L. nuchipinnis (5,6,12,14,15,19)	XVII,12-13 XVIII,10-13 XIX,11-12 XX,12 (XVIII,12) 28-32 total	II,17-19 (II,18-19)	13-15 (14)	I,3	13 segmented 7+8+7+6-7	33-35 total 11+23-24
Malacoctenus						
M. aurolineatus (6,16,19,20)	XVIII,10-11 XIX-XX,10-12 XXI,10-11 (XIX-XX,11) 28-32 total	II,17-21 (II,19-20)	13-15 (14)	I,3	13 segmented 7+8+7+6	35-39 total (36-38 total)
M. boehlkei (6,14,19)	XX,13 XXI,11-12 XXII,11 32-33 total	II,20-23 (II,22)	(15)	I,3	13 segmented 6-8+8+7+5-7	10+28 11+27-28
M. delalandei (5,6,19,20)	XIX-XX,9-11 XXI,9 (XX,10) 28-31 total	II,17-20 (II,19)	13-15 (14)	I,3	13 segmented 6+8+7+6	35-39 total (36-38 total)

Appendix XI (continued)

LABRISOMIDAE	DORSAL (mode)	ANAL (mode)	PECTORAL (mode)	PELVIC	CAUDAL (mode)	VERTEBRAE (mode)
Malacoctenus (continued)						
M. erdmani (6,14,16,19)	XX,9-10 XXI,8-10 XXII,8-9 (XXI,9) 29-31 total	II,17-20 (II,18-19)	15-17 (16)	I,3	13 segmented 5-6+8+7+4-6	10-11+24-25 (11+24)
M. gilli (5,6,14,19)	XVIII,10 XIX,10-11 XX,9-11 XXI,9-10 (XX,10) 28-31 total	II,17-21 (II,18-20)	13-16 (14)	I,3	13 segmented 1-6+8+7+2-6	10+24 11+24-25
M. macropus (6,14,19)	XXI,9-11 XXII,8-10 XXIII,9-10 30-33 total	II,18-22 (II,20-21)	14-16 (15)	I,3	13 segmented 6+8+7+6	36 total 11+26

Appendix XI (continued)

LABRISOMIDAE	DORSAL (mode)	ANAL (mode)	PECTORAL (mode)	PELVIC	CAUDAL (mode)	VERTEBRAE (mode)
Malacoctenus (continued)						
M. triangulatus (5,6,15,19,20)	XIX,12-13 XX,11-13 XXI,11 (XX,12) 29-33 total XVIII,11-13* XIX-XXI,10-13*	II,18-22 (II,20-21)	13-15 (14)	I,3	13 segmented 6+8+7+6	10+26-29 (10+27)
M. versicolor (6,19,20)	XVIII-XIX,11-12 (XVIII,12) 29-31 total	II,18-19	13-14	I,3	13 segmented 7+8+7+6-7	34-36 total
Nemaclinus (monotypic)						
N. atelestos (4)	XXI-XXIII,7-9 (XXII,8) 28-32 total	II,18-19 (II,19)	11-12 (12)	I,3	5-7+13+(5-7) (6+13+5-7)	11+22-24 (11+23)

* Dorsal element counts from reference #20 differ from the other sources and are listed separately.

Appendix XI (continued)

LABRISOMIDAE	DORSAL (mode)	ANAL (mode)	PECTORAL (mode)	PELVIC	CAUDAL (mode)	VERTEBRAE (mode)
Paraclinus						
P. barbatus (10,13,14,17)	XXVIII-XXIX,1 29-30 total	II,19-20	13	I,3	12-13 segmented 2+8+7+2	?+23
P. cingulatus (2,6,10,14,17)	XXVII-XXIX,0 27-29 total	II,15-16	11-12	I,2	13 segmented 1-3+8+7+2-3	11+22-23
P. fasciatus (2,5,6,15,17)	XXVIII-XXXI,0 (XXIX,0) 28-31 total	II,17-20 (II,19)	12-14 (13)	I,2	12-14 segmented (13 segmented) 2+8+7+3	34-35 total
P. grandicomis (14,17)	XXV-XXVII,1 26-28 total	II,16-18	12	I,3	12 segmented 2+7+7+2	10+22
P. infrons (1,6,10)	XXVI-XXVIII,1 27-29 total	II,17-18 (II,18)	12	I,3	12-13 segmented (13 segmented) 2+8+7+2 4+8+7+2	10+22-23
P. marmoratus (6,10,17)	XXVII-XXX,1 (XXIX,1) 28-31 total	II,19-21 (II,20)	12-14 (13)	I,3	12-13 segmented (13 segmented) 2+8+7+2	10+25
P. naeorhegmis (1,6,10)	XXVI-XXVII,0 26-27 total	II,15-17	12-13	I,2	13 segmented 2+8+7+2	10+21-22

Appendix XI (continued)

LABRISOMIDAE	DORSAL (mode)	ANAL (mode)	PECTORAL (mode)	PELVIC	CAUDAL (mode)	VERTEBRAE (mode)
Paraclinus (continued)						
P. nigripinnis (5,6,17)	XXIX-XXXI,0-1 (XXIX,1) 29-31 total	II,15-19 (II,17-18)	12-14 (13)	I,3	12-13 segmented (13 segmented) 3+8+7+3	33-34 total
Starksia						
S. atlantica (3,10,14)	XVIII-XX,7-8 (XIX,7-8) 25-28 total	II,15-16 (II,16)	13-15 (14)	I,3	12-13 segmented (13 segmented)	10+22-23
S. brasiliensis (9,23)	XX-XXI,7-9 (XXI,8) 27-29 total	II,16-18 (II,17)	13-14 (14)	I,3	13 segmented 5-6+7+6+4-6 (6+7+6+5)	10+23-25 (10+24)
S. culebrae (9)	XX-XXII,7-9 (XXI,8) 27-31 total	II,17-19 (II,18)	13-14 (14)	I,3	13 segmented	34-35 total (34 total)
S. elongata (8,10)	XX-XXI,8 28-29 total	II,17-18	14-15 (14)	I,2?	13 segmented 7+6	
S. fasciata (3,6)	XIX-XX,7-8 26-28 total	II,15-16 I-I,16	12-14 (13)	I,3	13 segmented 5+8+7+4	11+21 10+22

Appendix XI (continued)

LABRISOMIDAE	DORSAL (mode)	ANAL (mode)	PECTORAL (mode)	PELVIC	CAUDAL (mode)	VERTEBRAE (mode)
Starksia (cont.)						
S. guttata (3,9)	XX-XXI,8-9 (XXI,8) 28-30 total	II,17-18 (II,18)	13-15 (14)	I,3	12-13 segmented (13 segmented)	33-34 total (34 total)
S. hassi (3,8)	XIX-XX,8-9 XXI,9 (XX,8) 27-30 total	II,16-18 (II,18)	12-14 (13)	I,3	13 segmented	10-11+?
S. lepicoelia (3,6)	XIX-XXI,7-9 (XX,8) 26-30 total	II,16-19 (II,17)	11-14 (13)	I,3	5-6+7+6+5-6 (5+7+6+5) 13-14 segmented 4+8+7+4 articulated	10+23
S. nanodes (3,6)	XIX-XXI,7-8 (XX,7) 26-29 total	II,16-17	12-13 (13)	I,3	5+7+6+5 13 segmented 5+8+7+4 articulated	10+22-23
S. occidentalis (9)	XX-XXI,7-9 (XXI,8) 27-30 total	II,16-19 (II,17)	13-14 (14)	I,3	13 segmented	32-35 total (33 total)
S. ocellata (3,5,9,12,15)	XX-XXII,6-9 (XXI,8-9) 26-31 total	II,16-20 (II,18-19)	12-15 (14)	I,3	12-13 segmented (13 segmented)	33-35 total (34 total)

Appendix XI (continued)

LABRISOMIDAE	DORSAL (mode)	ANAL (mode)	PECTORAL (mode)	PELVIC	CAUDAL (mode)	VERTEBRAE (mode)
Starksia (cont.)						
S. sluiteri (3,5,6)	XIX,7-9 XX,8 26-28 total	II,15-16	12-13 (13)	I,3	13 segmented 5+8+7+4	10+22
S. starcki (8,10)	XX-XXI,8-9 (XX,9) 28-30 total	II,18-19	13	I,2?	13 segmented 7+6	
S. variabilis (9)	XX-XXI,7-9 (XXI,8) 27-30 total	II,17-18 (II,18)	13-15 (14)	I,3	13 segmented	33-34 total
S. y-lineata (7)	XVIII-XX,7-8 (XIX,8) 25-28 total	II,14-16 (II,15-16)	12-14 (13)	I,3	7+6 segmented 25 total elements	
Stathmonotus						
S. gymnodermis (5,6,10,11,18,22)	XLI-XLVI,0 (XLII-XLIV,0) 41-46 total	II,21-26 (II,24)	8-9	I,2	11 articulated 10-13 segmented (11 segmented) 1+7+6+2	17-20+27-31= 46-51 total

Appendix XI (continued)

LABRISOMIDAE	DORSAL (mode)	ANAL (mode)	PECTORAL (mode)	PELVIC	CAUDAL (mode)	VERTEBRAE (mode)
Stathmonotus (continued)						
S. hemphilli (6,10,11,18,22)	XLV-LIII,0 45-53 total	II,23-29	3-6	I,2	10-13 articulated 1+6+6+1 10-12 segmented	20-25+30-34= 50, 52-58 total
S. stahli stahli (11,18)	XLI-XLIV,0 41-44 total	II,22-25	6-9	I,2	10-12 articulated (12 articulated) 11-13 segmented (12 segmented)	17-19+28-31 45-49 total
S. stahli tekla (6,11,18,22)	XXXIX-XLIV,0 39-44 total	II,21-25	6-9	I,2	10-12 articulated (10-11 articulated) 10-12 segmented (11 segmented) 1+7+6+0	16-18+27-31= 44-48 total

1. Bohlke, 1960
2. Bohlke & Robins, 1974
3. Bohlke & Springer, 1961
4. Bohlke & Springer, 1975
5. Cervigon, 1966
6. Cleared and stained material
7. Gilbert, 1965
8. Gilbert, 1971
9. Greenfield, 1979
10. Greenfield & Johnson, 1981

Appendix XI (cont.)

11. Hastings & Springer, unpublished data
12. Hoese & Moore, 1977
13. Palacio, 1974
14. Radiograph material
15. Randall, 1983
16. Smith, 1957
17. Springer, 1954
18. Springer, 1955
19. Springer, 1958
20. Springer & Gomon, 1975b
21. Springer & Rosenblatt, 1965
22. Springer, unpublished data
23. Williams & Smart, 1983

APPENDIX XII. Meristic values for species of Tripterygiidae known to inhabit the tropical and sub-tropical western Atlantic. Numerals in parentheses beneath taxa correspond with literature cited at end of table.

TRIPTERYGIIDAE	DORSAL (mode)	ANAL (mode)	PECTORAL (mode)	PELVIC	CAUDAL (mode)	VERTEBRAE (mode)
Enneanectes						
E. altivelis (1,4,6)	III+X-XII,7-8 (III+XI,8) 20-23 total	II,14-16 (II,15)	13-15	I,3	5-7+7+6+5-6	29-31 total
E. atrorus (1,6)	III+XI,9 23 total	II,16	15	I,3		
E. boehlkei (1,2,3,4,6)	III+XI-XIII,7-9 (III+XII,8) 21-25 total	II,16-17 (II,16)	14-16 (15)	I,3	15 segmented 5+9+8+5 6-8+7+6+6-7?	33-35 total 10+23
E. jordani (6)	III-XI-XII,7-8 21-23 total	II,15	14-15	I,2?		
E. pectoralis (2,4,5,6)	III+XI-XII,6-8 20-23 total	II,14-16 (II,15)	15-16 (15)	I,2?	5-6+7+6+5-6	8-9+22= 30-31 total

1. Bohlke & Robins, 1974
2. Cervigon, 1966
3. Cleared and stained material from USNM
4. Radiograph material from USNM
5. Randall, 1983
6. Rosenblatt, 1960

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