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Larvae of Gillellus jacksoni, G-uranidea (Dactyloscopidae), Stathmonotus stahli tekla, and S-hemphilli (Chaenopsidae), with comments on the use of early life history characters for elucidating relationships within the Blennioidei

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LARVAE OF *GILLELLUS JACKSONI*, *G. URANIDEA* (DACTYLOSCOPIDAE), *STATHMONOTUS STAHLI TEKLA*, AND *S. HEMPHILLI* (CHAENOPSIDAE), WITH COMMENTS ON THE USE OF EARLY LIFE HISTORY CHARACTERS FOR ELUCIDATING RELATIONSHIPS WITHIN THE BLENNIOIDEI

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ABSTRACT

Larvae of the families Dactyloscopidae (*Gillellus jacksoni*, *G. uranidea*) and Chaenopsidae (*Stathmonotus stahli tekla*, *S. hemphilli*) are described from specimens collected in Ambergris Cay, Belize. Larvae are characterized by precocious development of fins and sensory canals, and little pigmentation overall, with the majority of pigmentation occurring ventrally. Pigment distributions in larvae are summarized for the six blennioid families. There are no unifying pigment characters among blennioid larvae. Larvae possess the six shared specialized characters or character complexes (as described in adults) currently used to hypothesize the monophyly of the Blennioidei, and thus, provide no new phylogenetic information.

The suborder Blennioidei comprises six families: Blenniidae, Chaenopsidae, Clinidae, Dactyloscopidae, Labrisomidae, and Tripterygiidae (Springer and Freihofer, 1976; George and Springer, 1980; Springer, 1993). There are 127 genera and 732 species recognized (Nelson, 1994) for which early life history information is known for approximately 38 genera and 55 species.

Within the tropical and subtropical western North Atlantic, early life history information is available for only five species of blenniids (*Chasmodes bosquianus*, *C. saburrae*, *Hypsoblennius hentz*, *Hypleurochilus geminatus*, and *Ophioblennius atlanticus macclurei*), and one species of labrisomid (*Paraclinus marmoratus*) (Hildebrand and Cable, 1938; Breder, 1939, 1941; Fritzsche, 1978; Peters, 1981; Fahay, 1983; Labelle and Nursall, 1985). Larvae of the other families are unknown (Richards, 1990).

Herein, I describe four blennioid species, summarize salient pigment characters for the six blennioid families, and discuss the use of ontogeny for elucidating relationships within the suborder. The descriptions of *Gillellus* spp. represent the first descriptions of dactyloscopid larvae.

METHODS

Larvae were captured near Ambergris Cay (18°N, 88°W), Belize, Central America (Maddox, 1992). Specimens were collected with a bridled 1-m ring fitted with a 333-μm mesh NITEX plankton net. The net was towed at the surface immediately after dusk for 10 min by a small boat at a speed of approximately 1 knot. Specimens were fixed in a seawater buffered formalin (5%) solution, and preserved in 70% ethyl alcohol.

Larvae were separated into morphotypes based on pigment characters, and representatives of each morphotype were cleared and stained following procedures outlined in Potthoff (1984) to facilitate meristic counts. Larvae were identified by comparing counts with published meristic data (Böhlke, 1968; Dawson, 1982; Greenfield and Johnson, 1981; Hastings and Springer, 1994; Springer, 1955). Illustrations were made with the aid of a camera lucida mounted on a WILD M5 stereoscope.

Nomenclature regarding sensory pore and canal systems is that of Johnson and Greenfield (1976). Principle caudal-fin rays are defined as those that are supported by the hypural plates. Measurements and descriptions of body shape (e.g., elongate, moderate, deep), head size, and eye size are as defined by Leis and Trnski (1989). Meristic and morphometric data are presented in Tables 1 and 2, respectively. Material examined is listed by institutional abbreviation (Leviton et al., 1985), catalog number,

Table 1. Sizes (mm SL) and meristic data of *Gillellus jacksoni, G. uranidea, Stathmonotus hemphilli* and *S. stahli tekla* larvae captured in Belize, Central America. Data are derived from examination of cleared and stained specimens. ND = no data.

Taxon	Body length	Dorsal fin	Anal fin	Pectoral fin	Pelvic fin	Caudal fin: Principle	Caudal fin: Pro-current	Vertebrae
Dactyloscoidae								
Gillellus jacksoni	7.7	III+XIV,20	II,28	12	I,3	5+5	4+3	10+30
	7.9	III+XVI,19	II,29	12	I,3	5+5	3+3	11+31
	8.2	III+XV,18	II,28	12	I,3	6+5	4+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
	7.3	XV,15*	II,22	13	I,3	5+5	2+2	10+25
	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+5	3+3	10+25
Chaenopsidae								
Stathmonotus hemphilli	7.8	L,0	II,26	5	I,2	5+5	1+1	24+32
	6.2	48†	26†	O	O	6+6	1+1	23+31‡
Stathmonotus stahli tekla	7.5	XLI,0	II,23	8	I,2	6+5	2+1	17+28
	7.5	XL,0	II,23	ND	I,2	6+6	2+1	17+28
	7.6	XLI,0	II,24	ND	I,2	6+6	2+2	17+28
	8.4	XLI,0	II,23	9	I,2	6+6	2+2	17+28

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

number of specimens examined, size range, location of capture, state of material examined (i.e., cleared and stained, radiograph, whole; left blank if whole), and date of collection.

Gillellus jacksoni (Dactyloscopidae)
Figure 1

Material Examined.—Larvae: VIMS 9508, 11, 6.7–8.4 mm SL (4 specimens, 7.7, 7.9, 8.2, 8.4 mm SL, cleared and stained), 13 August 1985.

Adults: ANSP 144081, 1, 24.9 mm SL, holotype, Lesser Antilles, St. Barthélemy, radiograph; ANSP 105438, 4, 20.1–24.1 mm SL, paratypes, taken with holotype, radiograph; ANSP 116536, 1, 14.8 mm SL, paratype, Lesser Antilles, Anguilla Island, radiograph; ANSP 116535, 1, 16.9 mm SL, paratype, Grenadine Island, radiograph.

General Morphology.—Larvae elongate, slightly laterally compressed, with short gut. Head moderately large with short snout. Maxilla terminates below midpoint of pupil. Lower jaw projects beyond upper jaw. Opercles partially crenulate, extend ventrally beyond body, overlap below isthmus, lack fimbriae on dorsoposterior margin. Eyes lateral, as opposed to superior in adults. Four to eight teeth on each dentary, five or six teeth on each premaxilla, upper and lower pharyngobranchial tooth patches present, in larvae of 7.7–8.4 mm SL. No gas bladder. Full complement of fin rays present by 6.7 mm SL. Anlage of a genital papilla originating on posterior rim of anus. Sensory pores include infraorbital, preopercular, and mandibular series.

Pigment.—"Y"-shaped melanophores (24–28 total) at bases of anal-fin soft rays; number and position variable, ranging from one immediately posterior to base of each soft ray to melanophores absent from one to four soft rays, with the anteriormost soft ray typically lacking a melanophore. Two to four stellate melano-

Table 2. Summary of morphometric data for *Gillellus jacksoni, G. uranidea, Stathmonotus hemphilli,* and *S. stahli tekla* captured in Belize, Central America. 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	Body length	Head length	Eye diameter	Pre-anal length	Pre-dorsal length	Snout length	Pectoral fin length	Body depth
Dactyloscopidae								
Gillellus jacksoni (11)	6.7–8.4	0.27–0.31	0.23–0.25*	0.33–0.37	0.21–0.26	0.05–0.08*	0.14–0.19	0.17–0.23
	7.48	0.29	0.24	0.35	0.24	0.06	0.16	0.19
	0.56	0.01	0.01	0.01	0.02	0.01	0.01	0.01
Gillellus uranidea (13)	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
	7.08	0.31	0.23	0.40	0.27	0.09	0.16	0.21
	1.18	0.02	0.04	0.02	0.03	0.01	0.03	0.02
Chaenopsidae								
Stathmonotus hemphilli (2)	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
Stathmonotus stahli tekla (14)	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
	7.5	0.22	0.25	0.51	0.24	0.05	0.08	0.14
	0.51	0.01	0.02	0.02	0.02	0.00	0.01	0.01

* Ten specimens were used for these measurements.

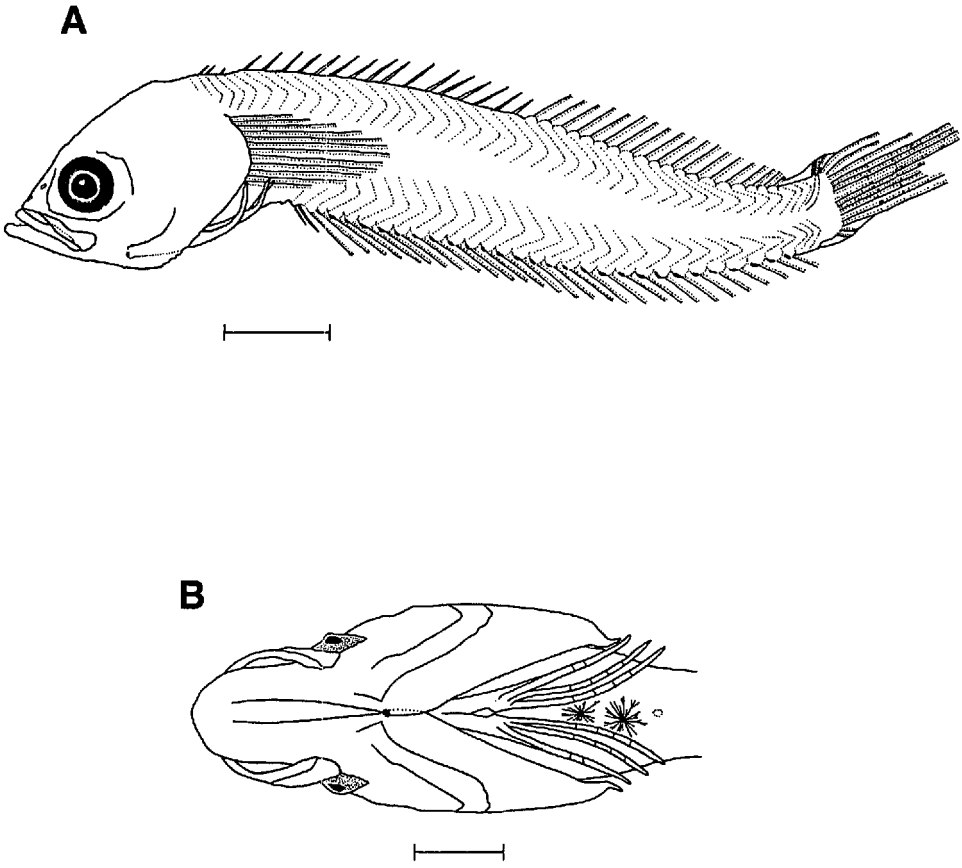

Figure 1. Postflexion larva of *Gillellus jacksoni* (Dactyloscopidae) (VIMS 9508, 7.6 mm SL). A) lateral view, scale = 1 mm; B) ventral view of head and pelvic region, scale = 0.5 mm.

phores on abdomen and one at cleithral symphysis. One 6.9 mm SL specimen with ventral midline melanophore on caudal peduncle.

Internal pigment in ventroanterior, dorsoanterior, and dorsoposterior patches on gut. One internal stellate melanophore in dorsoposterior area of parasphenoid.

Comments.—*Gillellus jacksoni* has been reported only from the vicinity of the Lesser Antilles (Dawson, 1982); its collection in Belize represents a significant range extension (~1900 km). All larvae were collected in August over rocky substrate containing corals and sponges.

Gillellus uranidea (Dactyloscopidae)
Figure 2

Material examined.—Larvae: VIMS 9509, 12, 3.6 mm NL–8.4 mm SL, (5 specimens, 6.7, 7.3, 7.9, 8.3, 8.4 mm SL, cleared and stained), 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.

General Morphology.—Larvae moderate to elongate, slightly laterally compressed, with short gut. Head moderately large with short snout. Maxilla termi-

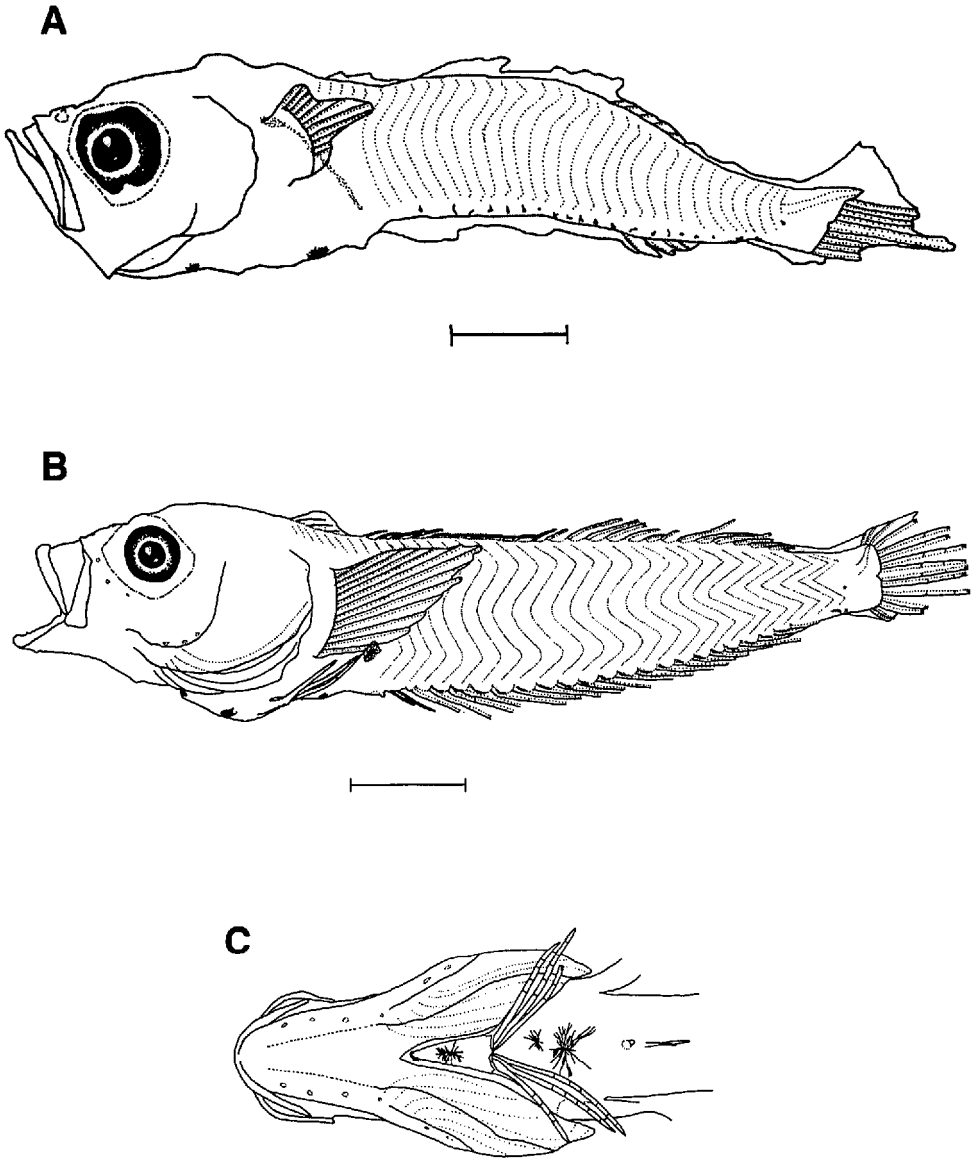

Figure 2. Flexion larva of *Gillellus uranidea* (Dactyloscopidae). A) VIMS 9509, 3.6 mm NL, lateral view: right side of specimen was illustrated and photographically reversed, scale = 0.5 mm; B) composite illustration, VIMS 9509, 7.4 mm SL, dorsal and anal fins drawn from a 7.1 mm SL larva (VIMS 9509), scale = 1 mm; C) VIMS 9509, 7.6 mm SL, ventral view of head and pelvic region, scale = 0.5 mm.

nates below anterior margin of eye. Lower jaw projects beyond upper jaw. Two to six teeth on each dentary, one to three teeth on each premaxilla, upper and lower pharyngobranchial tooth patches, in larvae of 6.7–8.4 mm SL. Eyes lateral, as opposed to superior in adults. Pelvic fins undeveloped in flexion larva. No gas bladder. Flexion begins at length less than 3.6 mm NL; 3.6 mm NL larva is nearing end of flexion. Full complement of fin elements present by 6.7 mm SL. Majority of postflexion larvae with anlage of genital papilla immediately posterior

to anus. Sensory pores include infraorbital, preopercular, and mandibular series. Pectoral-fin length increases, eye diameter decreases in relative size from flexion to postflexion; other morphometric values do not change (Table 2).

Pigment.—Melanophores (18–22 total) at bases of anal-fin rays; small and round during flexion, becoming elongate or "Y"-shaped after flexion. Number and position variable, ranging from one melanophore at each soft ray to none at first and/or second anterior- and posteriormost rays. One round melanophore on ventral midline of caudal peduncle. Some specimens with melanophore on membrane of ventral procurrent caudal-fin rays. One to three dendritic melanophores ventrally on abdomen, one on cleithral symphysis. One dendritic melanophore overlying basipterygia.

One melanophore internally on perimeter of anteriormost foramen in ventral hypural plate. Elongate dorsal pigment patch on gut. Internal stellate pigment patch in dorsoposterior area of parasphenoid.

Comments.—All larvae were collected in August over rocky substrate containing corals and sponges. Larvae of *G. uranidea* differ from *G. jacksoni* in having pigment overlying the basipterygia, a melanophore 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 the three distinct pigment patches of *G. jacksoni.*

Stathmonotus hemphilli (Chaenopsidae)
Figures 3 and 4

Material Examined.—Larvae: VIMS 9514, 1, 6.2 mm SL, cleared and stained, 11 April 1985; VIMS 9515, 1, 7.8 mm SL, cleared and stained, 11 April 1985.

General Morphology.—Larvae elongate, slightly laterally compressed, with long gut. Head small to moderate with a short snout. Eye small to moderate. Maxilla terminates below middle of pupil. Anterior naris raised. The 6.2 mm SL larva with four upper pharyngobranchial teeth, one lower pharyngobranchial tooth, three teeth on each dentary. The 7.8 mm SL larva with upper and lower pharygobranchial tooth patches, five teeth on each dentary, two teeth on each premaxilla. Gas bladder present. Pelvic fins and pectoral fin rays undeveloped in 6.2 mm SL larva. Pelvic-fin membrane not incised in 7.8 mm SL larva. Larvae described here, as well as adults of *S. hemphilli,* do not possess supraorbital or nuchal cirri as do the other species of *Stathmonotus* (Hastings and Springer, 1994). There are no apparent sensory canals in the 6.2 mm SL larva. Sensory pores in the 7.8 mm SL larva include the supraorbital, anterofrontal, infraorbital, preopercular, and supratemporal series.

Pigment.—Melanophores (23 or 25 total) at bases of anal-fin elements. Melanophore present at cleithral symphysis. Round melanophores (1 or 3) proximally on caudal fin. One melanophore on occiput. Larger larva with one melanophore on anterior tip of dentary and several midlaterally on dentary, several on posterior portion of lower jaw, extending dorsally towards eye, and a patch of approximately 12 melanophores located immediately posterior to the eye.

One melanophore in each otic capsule. Melanophores anteriorly on gut. Two melanophores dorsal to gut; both posterior to gas bladder in smaller specimen, and one each anterior and posterior to gas bladder in larger specimen. Melanophores midlaterally (not present in smaller larva), dorsoanteriorly, and dorsoposteriorly on gas bladder. Four interneural and three interhaemal melano-

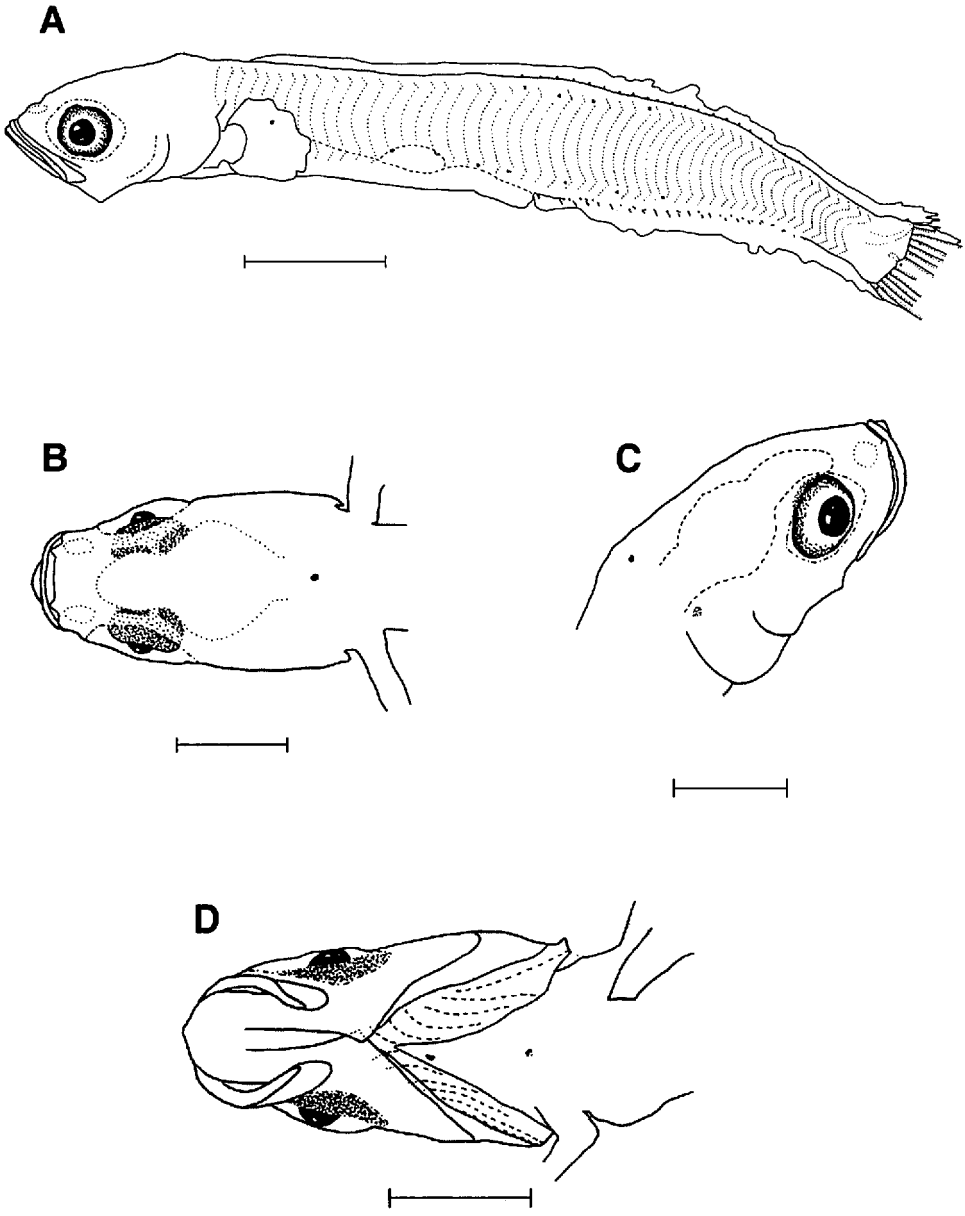

Figure 3. Postflexion larva of *Stathmonotus hemphilli* (Chaenopsidae) (VIMS 9514, 6.2 mm SL). A) lateral view, scale = 1 mm; B) dorsal view of head, scale = 0.5 mm; C) rotated view of head, scale = 0.5 mm; D) ventral view of head and pelvic region, scale = 0.5 mm.

phores in smaller larva, five and three, respectively, in larger larva; located at midbody.

Comments.—The smaller larva was collected in shallow water (1–1.75 m) over coarse sand and gravel and 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.

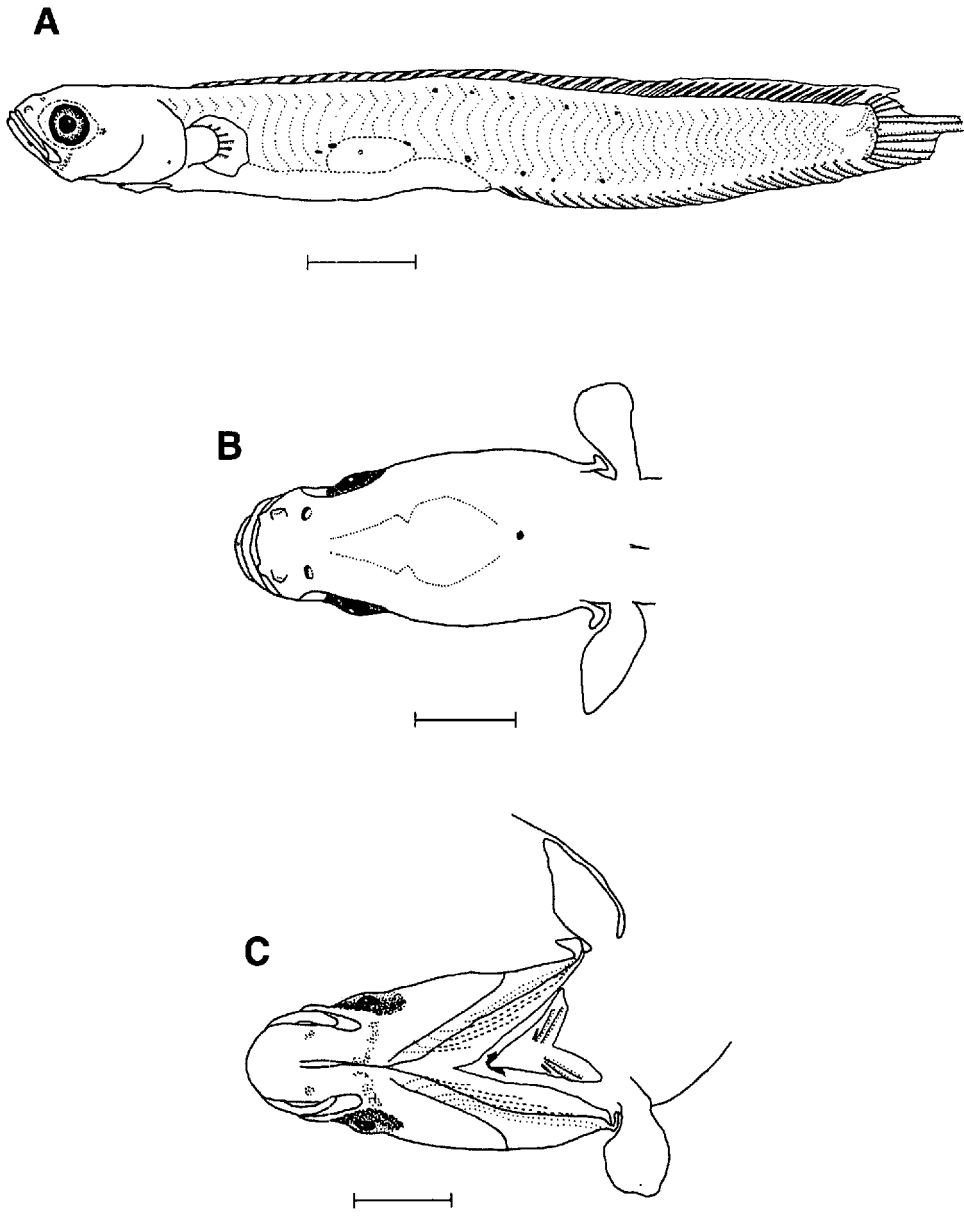

Figure 4. Postflexion larva of *Stathmonotus hemphilli* (Chaenopsidae) (VIMS 9515, 7.8 mm SL). A) lateral view: right side of the specimen was illustrated and photographically reversed, scale = 1 mm; B) dorsal view, scale = 0.5 mm; C) ventral view, scale = 0.5 mm.

Stathmonotus stahli tekla (Chaenopsidae)
Figure 5

Material Examined.—Larvae: VIMS 9516, 10, 6.5–8.4 mm SL, (3 specimens, 7.5, 7.6, 8.4, cleared and stained), 13 August 1985; VIMS 9517, 3, 7.4–8.0 mm SL, (7.4 mm SL specimen, cleared and stained), 17 July 1985; VIMS 9518, 1, 6.6 mm SL, 26 February 1985.

General Morphology.—Larvae elongate, slightly laterally compressed with long

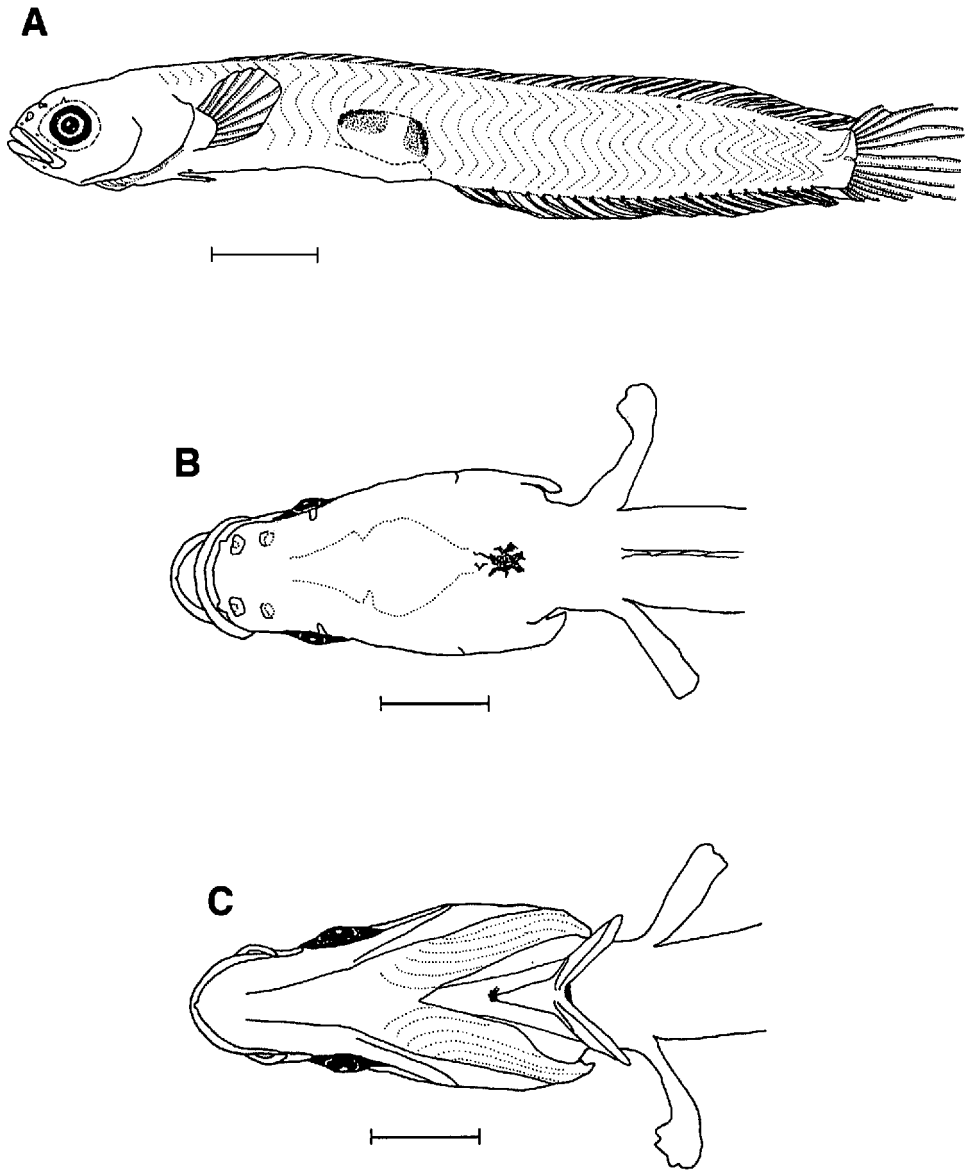

Figure 5. Postflexion larva of *Stathmonotus stahli tekla* (Chaenopsidae). A) VIMS 9517, 8.0 mm SL, scale = 1 mm; B) VIMS 9516, 7.4 mm SL, dorsal view of head region, scale = 0.5 mm; C) VIMS 9516, 7.4 mm SL, ventral view of head and pelvic region, scale = 0.5 mm.

gut. Head small, laterally compressed, with short snout. Eyes round, small to moderate. One simple, short, supraorbital cirrus on each side of head. Maxilla terminates between anterior margin of eye and anterior margin of pupil. Nares relatively large and raised. Large gas bladder. Upper and lower pharyngobranchial tooth patches present, three to six teeth on each premaxilla, four to seven teeth on each side of the dentary, in larvae of 7.5–8.4 mm SL. Dorsal and anal-fin membranes continuous with caudal fin. Full complement of fin elements present

by 6.5 mm SL. Sensory pores include anterofrontal, commissural, preopercular, and supratemporal series.

Pigment.—"Y"-shaped melanophores (19–24 total) associated with bases of anal-fin elements. Number and placement is variable, ranging from one at second spine and each soft ray to melanophores absent from second spine and up to five soft rays, in varying locations. Five of 14 specimens with one or two melanophores on dorsal fin; each melanophore located basally on spine (spines 28–37 from anterior). One 8.0 mm SL larva with small, round melanophore on ventral midline of caudal peduncle. One 7.5 mm SL larva with one melanophore on ventroposterior body wall dorsal to anal-fin soft ray 15 from anterior. Eight of 14 specimens with up to three melanophores on the dorsoposterior body wall in the area ventral to the 12 posteriormost dorsal-fin spines. One melanophore on occiput. One melanophore at cleithral symphysis.

Two extensive pigment patches concentrated dorsoanteriorly and dorsoposteriorly on gas bladder. One melanophore ventroanteriorly on gut. One melanophore in each otic capsule.

Comments.—Adult *S. stahli* sp. typically inhabit shallow-water (<3–10 m) coral formations and rock ledges, and live among sponges and dead or living coral (Böhlke and Chaplin, 1993; Greenfield and Johnson, 1981). Larvae were collected during winter and summer in similar depths over coral reef or rubble bottoms.

Stathmonotus hemphilli shares with *S. s. tekla* pigment on the ventral midline, cleithral symphysis, occiput, gut, and otic capsules, but can be differentiated from *S. s. tekla* by having interhaemal and interneural melanophores, pigment on the caudal-fin rays (proximally), melanophores on the dentary, and melanophores ventral and posterior to the eye. *Stathmonotus hemphilli* does not possess melanophores associated with the dorsal-fin soft rays, melanophores on the dorso- and ventroposterior lateral body wall, or the supraorbital cirrus that characterizes *S. s. tekla.*

Discussion

Our present knowledge of the ontogeny of the suborder does not contribute substantially to existing hypotheses of relationships. Blennioid larvae exhibit no specialized larval characters which provide evidence for the monophyly of the suborder. The only larval specializations (e.g., preopercular spination, elongate pectoral fins, large, hooked teeth) are variously found in the blenniid tribes Blenniini, Salariini, Omobranchini, and Nemophini (Leis and Rennis, 1983). However, the sequence and pattern of ossification, which has been largely ignored in studies of blennioid fishes may prove useful in phylogenetic studies (Johnson, 1993). Additional information may be provided by the testing of homology of osteological characters (Johnson, 1993), but due to the rapid development rate exhibited by blennioid larvae, this may only be possible with a large number of specimens representing a small size range.

Specialized characters that presently define the Blennioidei (Johnson, 1993; Springer, 1993) are fully developed in chaenopsid, dactyloscopid, labrisomid, and tripterygiid larvae examined (5.3–15.3 mm SL), and no transformations of these derived characters were noted. These characters, as described in adults, involve the caudal fin, anal fin, pectoral fin and girdle, pelvic fin and girdle, dorsal gill arches, and vertebrae. The larval condition differs from that of the adult only in the caudal fin and pectoral girdle.

The caudal fin of most larvae examined possesses a ventral hypural plate with two foramens (one foramen in adults) which I presume lie at the former sutures

Table 3. Distribution of pigment in larvae of six blennioid families. All taxa within a family may not possess all pigment. Sources included in this study: Fritzsche, 1978; Leis and Rennis, 1983; Matarese et al., 1984; Labelle and Nursall, 1985; Watson, 1987; Matarese et al., 1989; Gunn and Thresher, 1991; Olivar and Fortuno, 1991; Sabates, 1994; Herrera and Lavenberg, in press; Herrera, pers. comm.

	Blenniidae	Chaenopsidae	Clinidae	Dactyloscopidae	Labrisomidae	Tripterygiidae
Ventral midline associated with bases of anal-fin elements	X	X	X	X	X	X
Cleithral symphysis	X	X	0	X	X	X
Basipterygia	0	X	0	X	X	0
Abdomen (external)	X	X	0	X	X	X
Ventral midline of caudal peduncle	X	X	X	X	X	X
Dorsal midline of caudal peduncle	X	X	0	0	X	X
Occiput	X	0	X	X	X	X
Nape	X	X	X	X	X	X
Dorsal midline associated with bases of dorsal-fin elements	X	X	X	X	X	X
Posterior edge of hypural plates	X	X	0	X	X	X
Between hypural plates	0	0	0	X	X	0
Caudal fin	X	0	X	0	X	X
Pectoral fin	X	0	0	0	0	0
Pelvic fin	X	0	0	0	0	0
Dorsal fin	X	0	0	0	X	0
Caudal-fin procurrent membrane	X	0	0	X	X	0
Preopercle	X	X	X	0	X	0
Opercle	X	X	X	X	X	0
Premaxilla	X	0	X	0	X	X
Dentary	X	X	X	0	0	0
Dorsolateral wall	X	X	X	0	0	0
Midlateral wall	X	0	0	0	0	0
Ventrolateral wall	X	X	0	0	0	0
Ventral to eye	X	X	0	0	0	0
Snout	X	0	0	0	0	0
Roof of mouth	X	0	0	0	0	0
Angular	X	X	X	0	0	0
Gut	X	X	X	X	X	X
Anteroventral surface of liver	X	0	0	0	0	0
Gas bladder	X	X	X	X	X	X
Cranium	X	0	0	X	X	X
Hyoid arch	X	0	0	0	0	0
Interhaemal melanophores	X	X	0	0	0	0
Interneural melanophores	0	X	0	0	0	0
Perimeter of foramen in caudal fin	0	0	0	X	0	0
Urostyle	X	0	0	0	X	0
Otic capsule	X	X	0	0	X	X
Dorsoposterior area of parasphenoid	0	0	X	X	0	0
Notochord	X	X	X	0	X	X

between the parhypural and hypural 1, and hypurals 1 and 2, respectively. Some larval tripterygiids and labrisomids also possess a third foramen in the dorsal hypural plate which I presume lies at the suture between former hypurals 3 and 4. The larval pectoral girdle differs from that of the adult in that the ventroposterior process of the coracoid is long and spike-like, and is resorbed to form the relatively shortened process of adults (Peters, 1981).

This study updates and revises the pigment distribution synopsis of Matarese et al. (1984) to include many new pigment characters and dactyloscopid traits (Table 3). Blennioid larvae are lightly pigmented, primarily on the ventral midline, cleithral symphysis, and caudal peduncle (Table 3). There is little lateral pigment except occasionally on the head, caudal fin, and the dorso- and ventroposterior body wall, although some species of the blenniid tribe Nemophini have heavy lateral banding (Leis and Rennis, 1983).

The phylogenetic significance of pigment characters among blennioid fishes has yet to be determined. There are no pigment characters shared by all blennioid larvae. The most prevalent pigment character is the possession of ventral midline melanophores associated with the bases of the anal-fin rays; this character is absent in the highly derived blenniids of the tribes Salariini and Nemophini (Leis and Rennis, 1983). Furthermore, this character is present in at least 21 non-blennioid families (Fahay, 1983; Moser et al., 1984; Matarese et al., 1989). Characters that are unique to a particular family (Table 3) are not present in all genera and species. Pigmentation may be more important for inter- and intrageneric comparisons, but more research needs to be performed.

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ADDENDUM

A description of another species of *Gillellus* and illustrations of three other dactyloscopid species were recently published by H. G. Moser. 1966. The early stages of fishes in the California Current region. CalCoFI Atlas (33):1505p.