Stomiatoidea: Development

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FISHES of this group of midwater predators are characterized by their dark coloration, serial photophores, large jaws, fang-like teeth, and chin barbels. Traditionally they have been grouped in six families allied to the lightfishes and hatchetfishes (Weitzman, 1974), and together are now considered monophyletic and given ordinal status (Rosen, 1973; Fink and Weitzman, 1982). Fink (this volume) gives evidence for reducing the six stomiatoid families to one. Because knowledge of stomiatoid ontogeny lags far behind that of the adults, for convenience of discussion we use Weitzman's (1974) grouping of the families

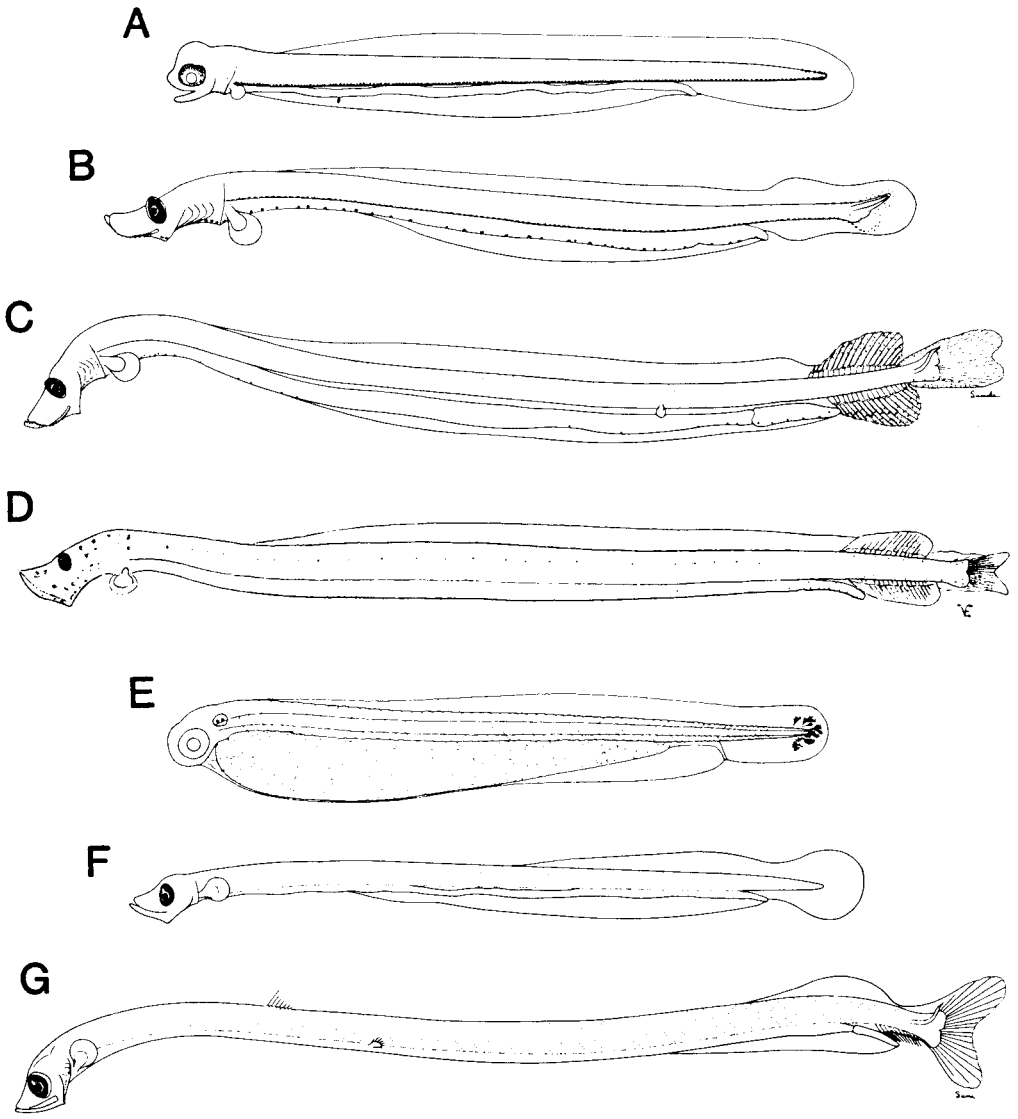

Fig. 89. Larvae of *Stomias* and *Chauliodus*. (A) *S. atriventer*, 4.6 mm, CalCOFI 7501 Sta. 97.60; (B) *S. atriventer*, 10.0 mm, CalCOFI 6604 Sta. 107.65; (C) *S. atriventer*, 22.2 mm; CalCOFI 6604 Sta. 107.65; (D) *S. ferox*, 30 mm, from Ege, (1918); (E) *C. sloani*, 6.0 mm; from Mito (1961a); (F) *C. macouni*, 15.0 mm, CalCOFI 6204 Sta. 60.60; (G) *C. macouni*, 45.2 mm, CalCOFI 5707 Sta. 67.60.

Astronesthidae, Stomiatidae, Chauliodontidae, Melanostomiatidae, Malacosteidae, and Idiacanthidae, in the Superfamily Stomiatoidea.

Eggs

Eggs are known for *Chauliodus, Stomias,* and *Tactostoma* and have in common a round shape, smooth chorion, and segmented yolk, *Chauliodus* eggs have a wide perivitelline space and lack an oil globule. Egg diameters are: *C. sloani*, 2.2–2.5 mm (Sanzo, 1931d); *C. barbatus*, 3.1–3.6 mm (Pertseva-Ostroumova and Rass, 1973); *C. macouni*, 2.7–3.1 mm, with an initial yolk diameter of 1.3–1.5 mm (original data). Mito (1961a) described an egg, referred to *C. sloani*, 2.12 mm in diameter with no oil globule but with a second membrane. *Stomias* eggs have a second membrane, a single oil globule and the following diameters: *S. colubrinus*, 1.3–1.5 mm, with inner membrane 1.05–1.1 mm (Pertseva-Ostroumova and Rass, 1973); *S. atriventer*, 0.88–0.92 mm, inner membrane diameter is 0.82–0.84

TABLE 44. MERISTIC COUNTS OF STOMIATOID GENERA. Most frequent count or range is followed by overall range or infrequent count in parentheses. Data from Gibbs (1964a,b), Gibbs et al. (1983), Morrow (1964a, b, c), Morrow and Gibbs (1964), Bolin (1939a), Imai (1941), original counts.

Family and genus	Vertebrae	Fin rays			
		Dorsal	Anal	Pectoral	Pelvic
Stomiatidae					
Macrostomias	164	13,14	16 (15–18)	7 (6)	4
Stomias	64–83	17–20 (16–22)	19–21 (18–25)	6–7 (6–9)	5 (4)
Chauliodontidae					
Chauliodus	51–62	6,7 (5–7)	10–12 (10–13)	12,13 (11–14)	7 (6–8)
Astronesthidae					
Astronesthes	46–58	15 (10–21)	12–22	8 (5–9)	7 (6–8)
Borostomias	53–55	13 (10–14)	13–16 (10–19)	7 (6–9)	7
Heterophotus	66	11 (13)	12–15 (17)	7	7
Neonesthes	53	9–11 (12)	25–27 (22–28)	8 (7)	7 (6–8)
Rhadinesthes	67	11 (12,13)	18 (19–21)	7 (6–8)	7
Melanostomiatidae					
Bathophilus	38–45 (33–50)	13–16 (9–18)	15–16 (9–18)	1–37	11–16 (4–26)
Chirostomias	54–55	18–20	22–26	6	7
Echiostoma	57–59	11–14 (11–16)	13–18 (13–19)	I+3	8
Eustomias	56–69	21–25 (20–30)	32–46	0–13	7 (6–8)
Flagellostomias	65	16 (14–17)	23–25 (21–26)	I+8–9+II	7
Grammatostomias	50–56	18–21	21–23 (20–24)	4–11	7–8
Leptostomias	77–80 (75–83)	16–22	20–29	10 (9–11)	7 (8)
Melanostomias	50–57	12–17	16–20	5 (4–6)	7 (8)
Opostomias	60	21	24	I+4	8
Pachystomias	48	22 (21–24)	27 (25–29)	5–6	8–9 (7)
Photonectes	49–64	15–24	17–24	0–3	7 (6)
Tactostoma	80–82	14–16	19–22	0	8–10
Thysanactis	61	17–18	21–25	I+10,11	7
Trigonolampa	61–62	19–20 (18)	18 (19)	5	7
Malacosteidae					
Aristostomias	44–56	18–26	24–32	6–10 (3–17)	6
Malacosteus	49	14–19 (20)	17–21 (23)	3–4 (5)	6
Photostomias	52–58	22–28	25–32	0	6
Idiacanthidae					
Idiacanthus	79–85	54–74	34 (33–39)	0	6

mm, oil globule diameter of 0.20–0.25 mm, initial yolk diameter of 0.70 mm (original data). *Tactostoma macropus* eggs have a single membrane, 1.44–1.54 mm in diameter, an oil globule 0.30–0.40 mm in diameter and an initial yolk diameter of 0.78–0.80 mm (original data). Eggs of *C. macouni* and *S. atriventer* are illustrated in Matarese and Sandknop (this volume).

LARVAE

Larvae of Stomiatoidea occur in the upper water column, some at the surface. In most groups the larvae are elongate, have a large head, elliptical eyes that protrude slightly from the dorsal head profile, an elongate, straight gut (trailing from the body in some species), a well developed finfold, large paddle-shaped pectoral fins that lack rays until transformation, and late-forming pelvic fins. Melanophore patterns provide a useful set of characters and genera usually have a distinct pattern. The larval melanophores are retained in a subcutaneous position in transforming specimens and provide a means for identifying larvae. During transformation, photophores form simultaneously and initially are unpigmented. Counts of fin rays, vertebrae, and photophores are summarized in Tables 44 and 45.

Stomiatidae (Fig. 89).—Larvae of five species are known (Table 46). Larvae are 3–4 mm at hatching and have an elongate yolk sac. The slender body is round in cross-section, but becomes slightly deeper by late postflexion. The head is relatively small with a slightly flattened snout. The eyes are elliptical. The elongate gut extends almost the entire length of the body and has a slightly enlarged terminal section that reaches the anal fin origin. The median finfold is small and best developed posteriorly. The opposing dorsal and anal fins develop far posteriad on the body in early postflexion larvae, but the pelvic fins do not appear until just before transformation.

Late-stage embryos of *Stomias* have melanophores along the dorsum, which migrate ventrad and form a distinct series between the body and gut. This series extends to the tip of the notochord. The series is lost before notochord flexion but, in most species, another sparser series develops along the ventral midline of the gut, from the isthmus to the anus. *S. boa* and *S. ferox* develop a mid-lateral series of melanophores along the body and *S. colubrinus* has scattered melanophores along the entire hypaxial body region. These species also develop extensive dorsal and lateral head pigment. All species form scattered pigment on the dorsal, anal, and caudal fins.

A 75-mm specimen (MCZ Cat. No. 59858) with an extremely slender body form (body depth 1.3% of body length) has fin and

TABLE 45. PHOTOPHORE COUNTS OF STOMIATOID GENERA. Most frequent count or range is followed by overall range or infrequent count in parentheses. Data sources as in Table 1. Photophore groups as defined by Morrow (1964a).

Family and genus	Photophore groups					
	IP	PV	VAV	AC	OV	VAL
Stomiatidae						
Macrostomias	11 (12)	80–86	58–67	19–22	79–85	58–68
Stomias	9–13	32–51	5–16	14–20	32–50	4–17
Chauliodontidae						
Chauliodus	8–11	17–23	22–30	8–13	17–21	22–29
Astronesthidae						
Astronesthes	5–12	6–20	7–27	7–13	5–19	7–26
Borostomias	10–13	20–31	15–25	9–15	21–29	16–25
Heterophotus	10–11	32–35	13–14	12–15	33–36	16–20
Neonesthes	9–12	14–17	16–21	13–18	13–15	13–21
Rhadinesthes	10 (6)	25 (26)	20–23	16	22–24	27
Melanostomiatidae						
Bathophilus	5 (4–6)	12–18	11–13 (11–17)	5–7 (5–9)	13–14 (10–16)	9–11 (8–17)
Chirostomias	9 (8)	25–27 (28)	19–20 (16)	9 (10)	23 (24–25)	19–20 (16)
Echiostoma	8+2	25–28	14–18	12–13 (11)	24–31	13–17 (18)
Eustomias	7–8 (9)	27–33 (24–36)	13–17 (11–21)	17–23 (15–25)	26–33 (24–37)	13–18 (12–22)
Flagellostomias	9–10 (8)	31–34	14–16	16–18 (15)	31–32 (30)	14–15 (12–17)
Grammatostomias	7 (6)	15–18	19–22	10–13	15–18	19–22
Leptostomias	10 (11)	42–45 (39–48)	20–23 (24)	11–13 (14)	40–43 (39–48)	20–22 (23–24)
Melanostomias	8+2 or 3	23–30	12–15	9–11	22–28	11–15
Opostomias	4+4	27	17	16	27	17
Pachystomias	8–9	14–16 (17)	13–14	8–9	17–18	14–15
Photonectes	8–11	19–24, 34–38	11–15 (16–18)	10–13 (9)	19–24 (17), 30–36	11–14 (15–17)
Tactostoma	8	46	19	12	43	18
Thysanactis	20	31–32	14–16	11–12	30–32	14–16
Trigonolampa	11	23–24 (22)	22 (24)	10–11	22–24	23–24 (26)
Malacosteidae						
Aristostomias	5+3	15–17 (14–19)	15–18	9–11 (12)	16–19 (14–20)	15–17 (14–18)
Malacosteus	(Serial photophores absent or uncountable)					
Photostomias	5+2	13–16	21–25	12–15	12–17	20–23
Idiacanthidae						
Idiacanthus	IP + PV = 31–36		16–18 (15)	13–18	22–25	31–35 (30–36)

vertebral counts that match *Macrostomias longibarbatus*. Its morphology is that of a highly attenuate *Stomias* larva. Pigmentation is restricted to a series of small melanophores along the ventral midline of the gut. The ventral photophore rows are beginning to form.

Chauliodontidae (Fig. 89).—Larvae of five species are known (Table 46). Larvae are 6–7 mm long at hatching, with an elongate yolk sac. The body is slender with a circular cross-section, and remains so throughout development. The head is relatively small, with elliptical eyes and a short, acute snout. The gut has a smaller diameter than in *Stomias* but is relatively longer. The short terminal section extends beyond the anal fin origin. The median finfold is small and best developed rearward on the body. The dorsal, anal, and pelvic fins form in late postflexion larvae in the adult position. A fan-shaped array of melanophores occurs in the caudal region of yolk-sac larvae but is soon lost. No other pigment develops. Larvae of some species reach 46 mm SL and there appears to be marked shrinkage at transformation.

Astronesthidae (Fig. 90).—Astronesthid larvae have been illustrated and described briefly by Roule and Angel (1930), Whitley (1941), Pertseva-Ostroumova and Rass (1973), and Belyanina (1982b); however only two of these were identified to genus (Table 46). We have examined more than 10 types of astronesthid larvae, 7 of which are listed in Table 46. Astronesthid larvae display a great variety of structure and pigmentation, but hold in common the advanced position of the dorsal fin, in contrast to other Stomiatoidea, except *Chauliodus*. The types differ fundamentally in gut shape and body form: Types I and II are laterally compressed, relatively deep-bodied, and have a non-trailing or slightly trailing gut with terminal section as in melanostomiatids; Types III–VII have a slender body and a trailing gut; in Types III–V the gut is deflected ventrad from the body just anterior to the anal fin base and in Type VI and VII at midbody, anterior to the dorsal fin (Figure 90).

Type I (Fig. 90A).—larvae up to 26.5 mm; laterally compressed; head shallow with acute snout; eyes relatively large, slightly

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Fig. 90. Larvae of Astronesthidae. (A) Type I, 23.7 mm, ORI A105; (B) Type II, SIO Tasaday I A3; (C) Type IV, 33.0 mm, MCZ Cat. No 59855; (D) Type V, 22.0 mm, Dana Sta. 3931; (E) Type VII, 28 mm, MCZ Cat. No. 59856.

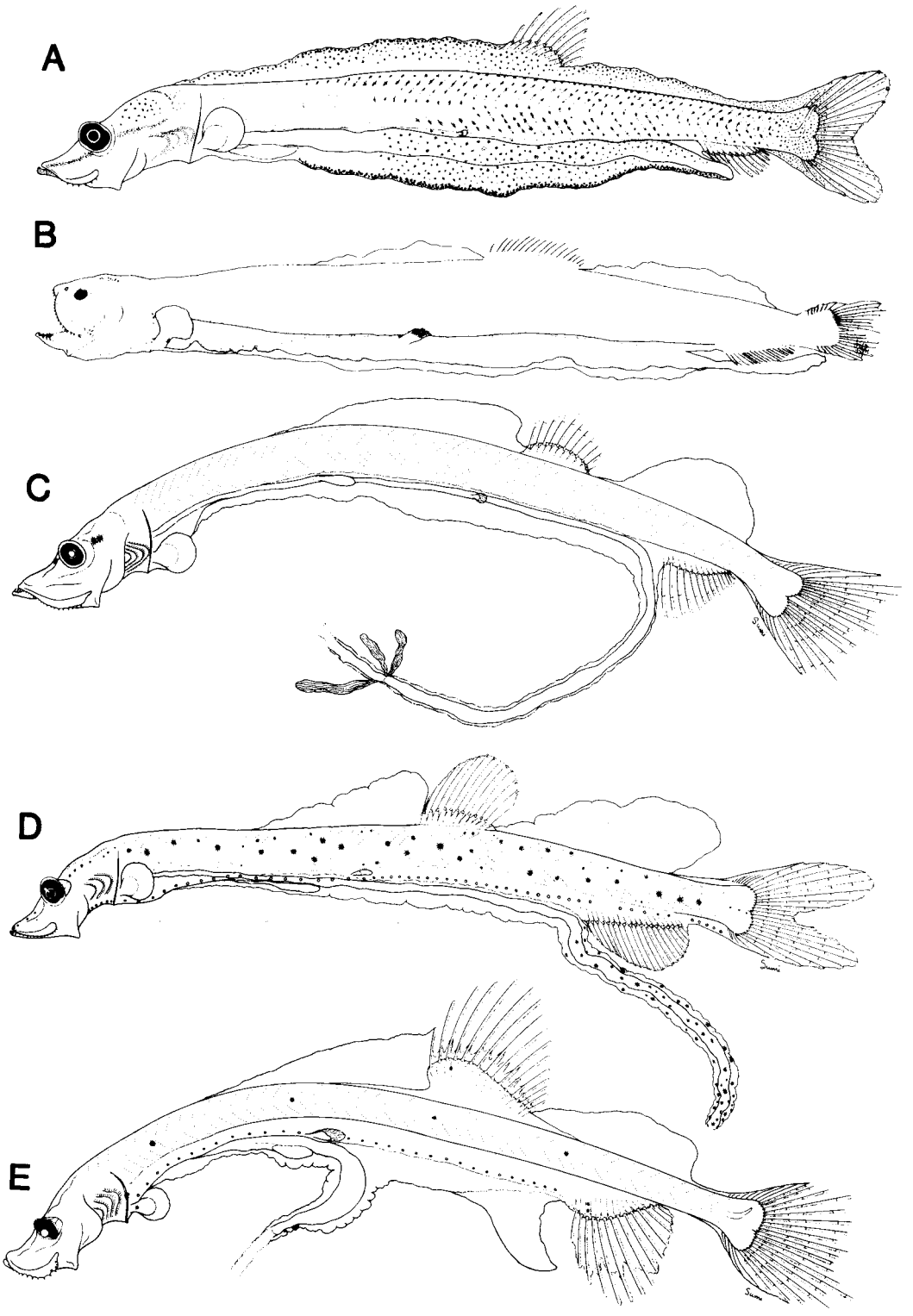
A
B
C
D
E

TABLE 46. PIGMENT CHARACTERS AND GUT STRUCTURE IN LARVAE AND TRANSFORMING SPECIMENS OF STOMIATOIDEA. (NT = not trailing, ST = slightly trailing, T = trailing freely).

Species	Length of larvae (mm)	Length of transforming specimens (mm)	Dorsal myomere melanophores (no./myomere)	Epaxial myoseptum melanophores (no./myoseptum)	Hypaxial myoseptum melanophores (no./myoseptum)	Gut structure	Source
Stomiatidae							
Stomias boa	—	38	0	0	0	NT	Sanzo, 1912a
Stomias boa	10.4–30.4	41.5	0	0	0	NT	Sanzo, 1931d
Stomias boa	9.0–32	—	0	0	0	NT	Ege, 1918
Stomias ferox	9.0–44	—	0	0	0	NT	Ege, 1918
Stomias colubrinus	3.3–16	—	0	0	0	NT	Pertseva-Ostroumova and Rass, 1973
Stomias atriventer	4.6–32	—	0	0	0	NT	original
Macrostomias longibarbatus	—	75	0	0	0	NT	original
Chauliodontidae							
Chauliodus sloani	33.6	41.6	0	0	0	NT	Sanzo, 1915a
Chauliodus sloani	5.7–41.6	27.1	0	0	0	NT	Sanzo, 1931d
Chauliodus sloani	2.1	—	0	0	0	NT	Mito, 1961a
Chauliodus danae	22.5–25	—	0	0	0	NT	Belyanina, 1977
Chauliodus macouni	38.0–49	35–44	0	0	0	NT	Belyanina, 1977
Chauliodus minimus	23.5–35	—	0	0	0	NT	Belyanina, 1977
Chauliodus pammelas	10.6–40	—	0	0	0	NT	Belyanina, 1977
Chauliodus sloani	7.4–35	27–34.2	0	0	0	NT	Belyanina, 1977
Chauliodus macouni	5.6–46	—	0	0	0	NT	original
Astronesthidae							
Unidentified	14.0–23	—	0	0	0	T, NT	Roule and Angel, 1930
Astronesthes lupina	20	—	0	0	0	T	Whitley, 1941
Borostomias panamense	5.0–17	—	0	0	0	T	Pertseva-Ostroumova and Rass, 1973
Unidentified	16	—	?	+	+	NT	Belyanina, 1982b
Unidentified	17.7	—	2 total	0	0	T	Belyanina, 1982b
Type I	12.3–26.5	—	several	several to many	several to many	NT	original
Type II	14.9–26	29, 40	0	0	0	ST	original
Type III	16.2	20.5, 22.5	0	0	0	T	original
Type IV	14.4–34.5	40.5	0	0	0	T	original
Type V	17.4–19.4	20, 22	0	0	0	T	original
Type VI	—	28	0	0	0	T	original
Type VII	—	28	0	0	0	T	original
Melanostomiatidae							
Tactostoma macropus	5.0–44	49	0–1	0	1–3	NT	original
Melanostomias spilorhynchus	17	21–32	1	0	ca. 3	NT	Beebe and Crane, 1939
Melanostomias biseriatus	—	21–25	1	0	ca. 3	NT	Beebe and Crane, 1939
Melanostomias valdiviae	—	25	1	0	2–3	NT	original
Melanostomias sp.	13.4–17.2	16.4–22	1	0	2–4	NT	original
Echiostoma tanneri	20, 25	—	1	0	2–5	NT	Beebe and Crane, 1939
Echiostoma sp.?	13.8	—	1	0	2–4	NT	Belyanina, 1982b
Echiostoma barbatum	—	34	1	0	1–2	NT	original
Photonectes dinema	—	24 and >	1 (?)	0	3–4	NT	Beebe and Crane, 1939
Photonectes leucospilus	—	25 and >	1 (?)	0	3–4	NT	Beebe and Crane, 1939
Photonectes albipinnis	—	16–22	1	0	2–3	NT	original
Photonectes sp.	11.0–12.5	—	1	0	4–5	NT	original
Photonectes parvimanus	12.0–26	25	3–6	0	3–4	NT	Beebe and Crane, 1939
Photonectes parvimanus	27	—	3–4	0	2–4	NT	original
Photonectes parvimanus	—	28	1–2	0	2–4	NT	original
Photonectes sp.	5.4–22.2	—	ca. 7	0	5–7	NT	original
Opostomias mitsuii	15.0–21	—	1	0–1 (2–3 posteriorly)	1–2 (3–5 post.)	NT	original
Flagellostomias boureei	20.0–21	34, 39	1	0	1	NT	Beebe and Crane, 1939
Flagellostomias boureei	10.8–36.4	—	1	0	1–2	NT	original
Odontostomias micropogon	—	42	1	1–?	2–4	NT	Beebe and Crane, 1939
Leptostomias gladiator	12.0–30	38–45	1+several	1–5	2–4	NT	Beebe and Crane, 1939
Leptostomias gracilis	—	37.8	1+1–5	5–7	6–9	NT	original
Leptostomias sp.	25	—	1+1–3	4–5	4–6	NT	original
Bathophilus nigerrimus	11.6	21.7	1 or >	0	0	NT	Sanzo, 1915a
Bathophilus nigerrimus	5.9, 14.0	19.2–21.7	1 or >	0	0	NT	Sanzo, 1931d

TABLE 46. CONTINUED.

Species	Length of larvae (mm)	Length of transforming specimens (mm)	Dorsal myomere melanophores (no./myomere)	Epaxial myoseptum melanophores (no./myoseptum)	Hypaxial myoseptum melanophores (no./myoseptum)	Gut structure	Source
Bathophilus metallicus	—	25	3 or >	0	0	NT	Beebe and Crane, 1939
Bathophilus sp.	11, 12	—	1 or >	0	0	NT	Beebe and Crane, 1939
Bathophilus sp.	7	—	1 or >	0	0	NT	Beebe and Crane, 1939
Bathophilus sp.	15	—	(?)	0	0	NT	Roule and Angel, 1930
Bathophilus sp.	18.2	—	1 or >	0	0	NT	de Sylva and Scotten, 1972
Bathophilus filifer	4–10	—	1 or >	0	0	NT	Pertseva-Ostroumova and Rass 1973
Bathophilus brevis	15.7	—	1 or >	0	0	NT	original
Bathophilus flemingi	2.9–23.8	—	1 to several	0	0	NT	original
Eustomias sp.	33	—	7 total	0	0	T	Regan, 1916
Eustomias sp.	13	—	7 total	0	0	T	Beebe and Crane, 1939
Eustomias spp. (4 types)	6.0–45	—	5–11 total	0	0	T	original
Malacosteidae							
Aristostomias scintillans	4.3–47	45	14 total to many	0	0	T	original
Photostomias guernei	20.0–27.5	30, 31	8 pairs total	0	0	T	original
Unidentified	12	—	12 total	0	0	T	Beebe and Crane, 1939
Unidentified	34.5	—	0	0	0	T	original
Idiacanthidae							
Idiacanthus fasciola	16.0–28	35–48	0	0	1	T	Beebe, 1934
Idiacanthus sp.	7.0–39	—	0	0	1	T	Pertseva-Ostroumova and Rass, 1973
Idiacanthus antrostomus	4.5–71	67–>	0	0	1	T	original

elliptical; gut moderately slender, thin-walled; finfold moderate; pigment pattern consists entirely of minute melanophores, increasing in number with development, principally in the expaxial and hypaxial myosepta; other pigment above brain, paired internal streaks in snout, melanophores in dorsal and ventral finfold, dorsal fin base, and on posterior half of gut.

Type II (Fig. 90B).—larvae reach at least 26 mm; deep-bodied and laterally compressed in late-stage larvae; head deep; eyes small, slightly elliptical; gut slightly trailing and with larger diameter than in Type I; dorsal finfold relatively deep; pigment above brain, along lower jaw and at angular and gular region; blotch at posterior margin of superior hypural complex and one midway out on inferior group of caudal rays; fin ray and vertebral counts and photophore counts match *Astronesthes gemmifer*.

Type III.—larvae reach at least 16.2 mm; body slender; head and eyes moderate in size; eyes elliptical; slender gut trails free from body at anal fin origin; finfold moderately developed, except posterior to dorsal fin the finfold appears as an enlarged adipose fin; pigment restricted to a series of melanophores along lower jaw and between upper and lower hypural complexes; counts match *Astronesthes richardsoni*.

Type IV (Fig. 90C).—larvae reach 40 mm; morphology similar to Type III, except head relatively longer and eyes almost round; gut with leaf-like appendages on trailing section; pigment restricted to postorbital blotch and interorbital band; fin and vertebral counts and photophore arrangement match *Heterophotus*.

Type V (Fig. 90D).—larvae reach about 20 mm; morphology as in Types III and IV; eyes slightly elliptical; pigment heavy; melanophores on head, lateral to posterior brain region, on snout and lower jaw symphysis; lateral surface of body covered with an irregular pattern of large melanophores; melanophores on trailing gut. Pertseva-Ostroumova and Rass (1973) identified larvae of this type as *Borostomias panamense*.

Type VI.—specimen transforming at 28 mm; morphology similar to Types II–V, except trailing gut deflected from body far in advance of anal fin origin; eyes elliptical; dorsal finfold highly developed and ventral finfold anterior to anal fin is rudder-like; pigment lacking; meristics indicate it is in the genus *Astronesthes*.

Type VII (Fig. 90E).—specimen transforming at 28 mm; morphology similar to Type VI; dorsal and anal fins supported on cartilaginous pedestals; a series of 4 melanophores along horizontal septum; some melanophores on anterior region of dorsal and anal fin bases and on preanal finfold. Whitley (1941) described a larva similar to this as *Astronesthes lupina*.

Melanostomiatidae (Figs. 91–92).—Larvae have been identified for 10 of the 15 genera (Table 46). *Bathophilus* was the first to be identified (Sanzo, 1915a). The only comprehensive work on melanostomiatid ontogeny is that of Beebe and Crane (1939) who identified larvae of 8 genera and 5 species by the use of transforming series. Since then, the only other melanostomiatid larvae that have been described are *Bathophilus filifer* (Pertseva-Ostroumova and Rass, 1973), *Bathophilus* sp. (de Sylva and Scotten, 1972), and *Echiostoma* (?) sp. (Belyanina, 1982b). De-

scriptions of *Opostomias* and *Tactostoma* are included in this paper. Larvae of *Tactostoma* were initially identified by E. H. Ahlstrom.

Larval representatives of the 10 genera are highly various in form and pigmentation, however, with the exception of *Eustomias*, they share the following structural features: body elliptical in cross-section; head laterally compressed; eyes small and elliptical; gut terminated in an elongate muscular bulb that may extend beyond the anal fin origin but not beyond the margin of the finfold; dorsal and anal fins form in adult position posteriorly on the body; body pigment consists of one or more melanophores dorsal to each myomere, one or more melanophores on the hypaxial myosepta and, in some genera, on the epaxial myosepta. Dorsal and lateral pigmentation tends to be heavier in forms with higher meristic counts. The genera differ principally in body size, relative body depth, relative head size, jaw size, gut diameter, size and shape of the terminal gut section, finfold height, and pigment pattern.

Present knowledge indicates that genera apparently have distinct facies, tentative descriptions of which are presented below. Confirmation awaits identification of additional species.

Tactostoma (Fig. 91A).—larvae reach 44 mm in length; body extremely slender; head flat and elongate initially, becoming less flat and relatively smaller with development; eye size moderate; gut slender; finfold moderate; pectoral fin lost at transformation; early larvae develop one melanophore per myomere along dorsum and 1–3 melanophores on the hypaxial myosepta; postflexion larvae gradually lose the dorsal melanophores and then the hypaxial myosepta pigment, in contrast with other genera in which body pigment increases with development; pigment on lower jaw symphysis, isthmus, pectoral fin base, cleithrum, and above gut terminus; dorsal and ventral pigment accentuated at caudal peduncle.

Melanostomias (Fig. 91B).—transforming specimens as small as 16.4 mm; body slender; head small; snout short; eye size moderate; gut slender; finfold relatively small; one melanophore per myomere along dorsum in one form and in another form the zone between the 7th–10th myomere and the dorsal fin lacks dorsal pigment; 2–3 melanophores in hypaxial myosepta; pigment above and below head, below liver, on terminal gut section, and along finfold margins. Larvae tentatively identified as *Echiostoma* have similar characters (Table 46).

Photonectes (Fig. 91C).—larvae of different forms transform at sizes between 16 and 28 mm; body somewhat deep; head size and snout length moderate; eyes small, highly elliptical; several forms of dorsal myomere pigment (1 melanophore per myomere in Subgenus *Photonectes* and 3–7 per myomere in Subgenus *Trachinostomias*); hypaxial myosepta with 2–7 melanophores depending on form (Table 46); extensive pattern of minute melanophores on head, finfold, and median fins.

Flagellostomias (Fig. 91D).—larvae may reach 30–40 mm; body somewhat deep; head large, deep, with steeply sloping snout and large jaws; eyes small; gut diameter relatively large; finfolds large, accentuating body depth; one large melanophore per myomere along dorsum; 1–3 melanophores in hypaxial myosepta; some scattered lateral melanophores in median fin region; other pigment scant; a few melanophores in head region, some on finfold in posterior gut region, and on dorsal and anal fins.

Opostomias (Fig. 91E).—body moderately deep; head large, deep posteriorly with elongate sloping snout; eyes small; gut slender; finfold large; one melanophore per myomere along dorsum; 1–2 melanophores in hypaxial myosepta; epaxial and hypaxial myosepta below dorsal fin base have several melanophores, giving this region a banded appearance; melanophores on dorsal head region, gill arch and gut terminus.

Leptostomias (Fig. 91F).—larvae may reach about 40 mm; body somewhat deep; head moderately large, deep; eyes small; gut slender; finfold moderate; pigmentation heavy; one large melanophore and 1–5 smaller ones per myomere along dorsum; numerous melanophores on epaxial and hypaxial myosepta, increasing with development to completely outline myosepta; pigment extensive on dorsal and ventral head regions, on gill arches; pigment below liver, on finfold margins, above gut terminus and on dorsal and anal fins.

Bathophilus (Figs. 92A–C).—larvae transform at 25 mm or less; deep-bodied compared with other genera; head and jaws large; barbel forms in late postflexion larvae, particularly in *B. brevis*; eye size moderate; gut large to voluminous, with highly developed s-shaped terminal section; finfolds, particularly dorsal, large; one or several melanophores per myomere along dorsum and an opposing series of melanophores along ventral surface of myomeres; no lateral pigment; head, finfolds and median fins pigmented.

Eustomias (Fig. 92D).—larvae of some species reach 45 mm; body slender, and round in cross-section; head elongate and flat with large spatulate snout; large jaws; eyes moderate in size, slightly elliptical to round; gut slender, deflected ventrad at anal fin origin and trailing from body; body pigment consists of 5–11 large melanophores along the dorsal midline; usually pigment at lower jaw symphysis.

Malacosteidae (Fig. 93).—Larvae of this group have not been described, although the 12-mm larva illustrated by Beebe and Crane (1939) and referred to "?*Eustomias*" is apparently *Aristostomias*. We have examined larval series and transforming specimens of *A. scintillans* and *Photostomias guernei* (Table 46).

Aristostomias scintillans (Fig. 93A).—larvae reach 47 mm length; body slender; head large, flat; snout elongate; jaws large; eyes slightly elliptical; opercle markedly reduced; gut slender, deflected ventrad at anal fin origin and trailing from body; finfold moderate; dorsal and anal fins form in adult position at about flexion stage; pelvics form late; initial pigment pattern is a series of paired melanophores along the dorsum, beginning with 14

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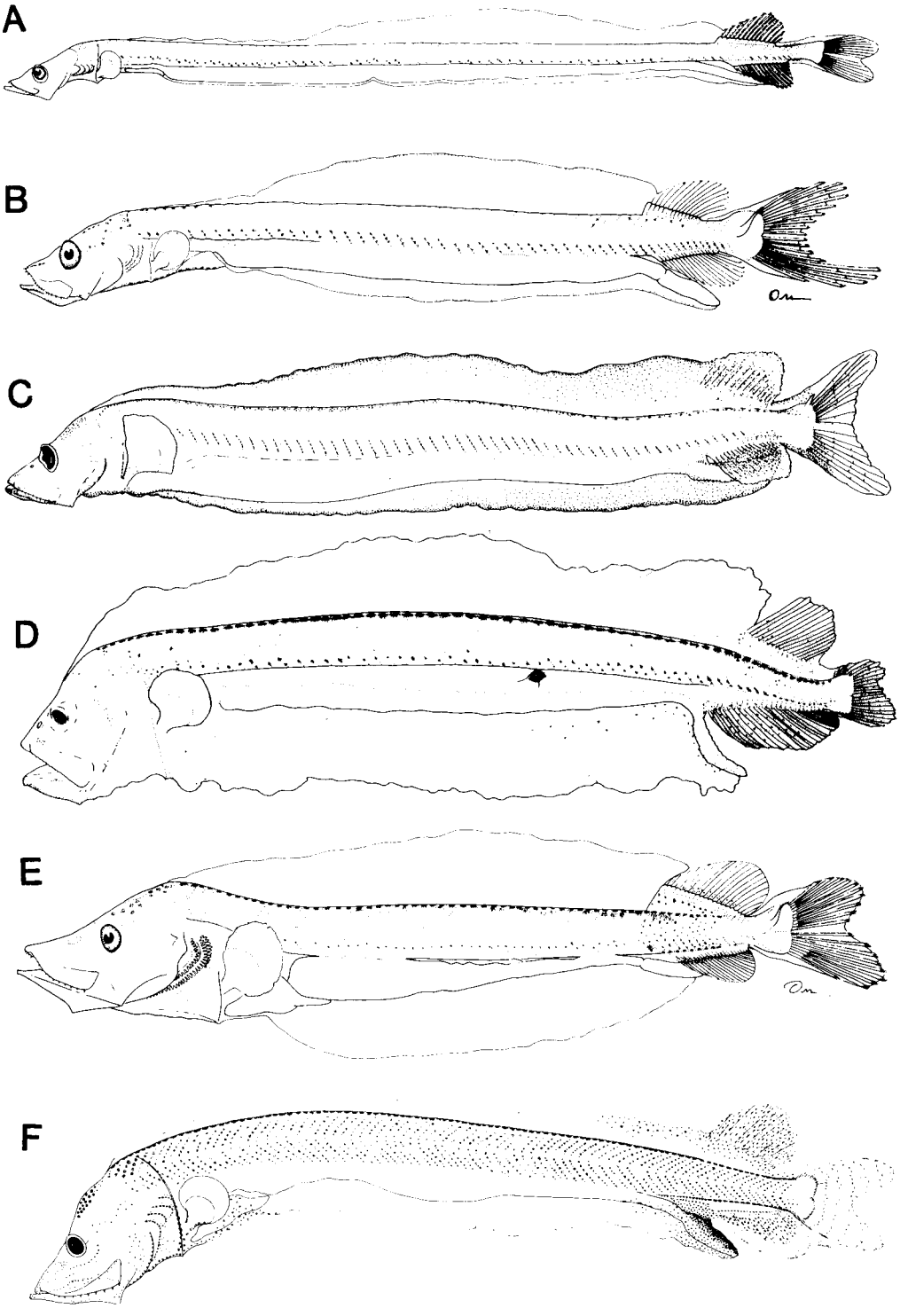
Fig. 91. Larvae of Melanostomiatidae. (A) *Tactostoma macropus*, CalCOFI Norpac Sta. 14; (B) *Melanostomias* sp., 16.0 mm, ORI KH73-2, Sta. 49-7; (C) *Photonectes* sp., 22.2 mm, SWFC, Albacore Oceanography Cruise 71, Sta. 99; (D) *Flagellostomias boureii*, 36.4 mm, SIO Cat. No. 73-329, Tasaday I, Tow 42; (E) *Opostomias mitsuii*, 15.0 mm, ORI KH 73-2 Sta. 2–3; (F) *Leptostomias* sp., 24.5 mm, MCZ Cat No. 59857.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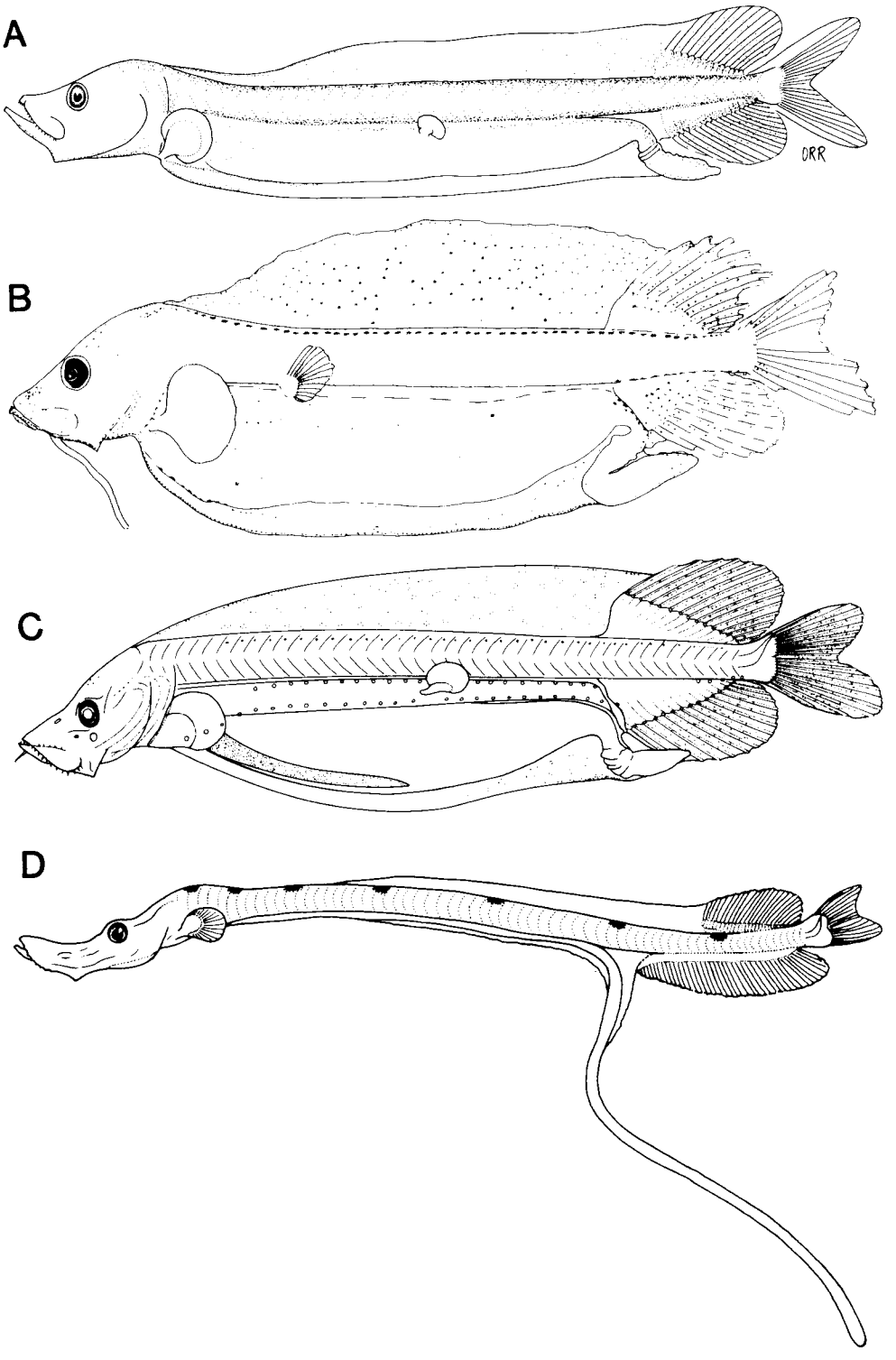
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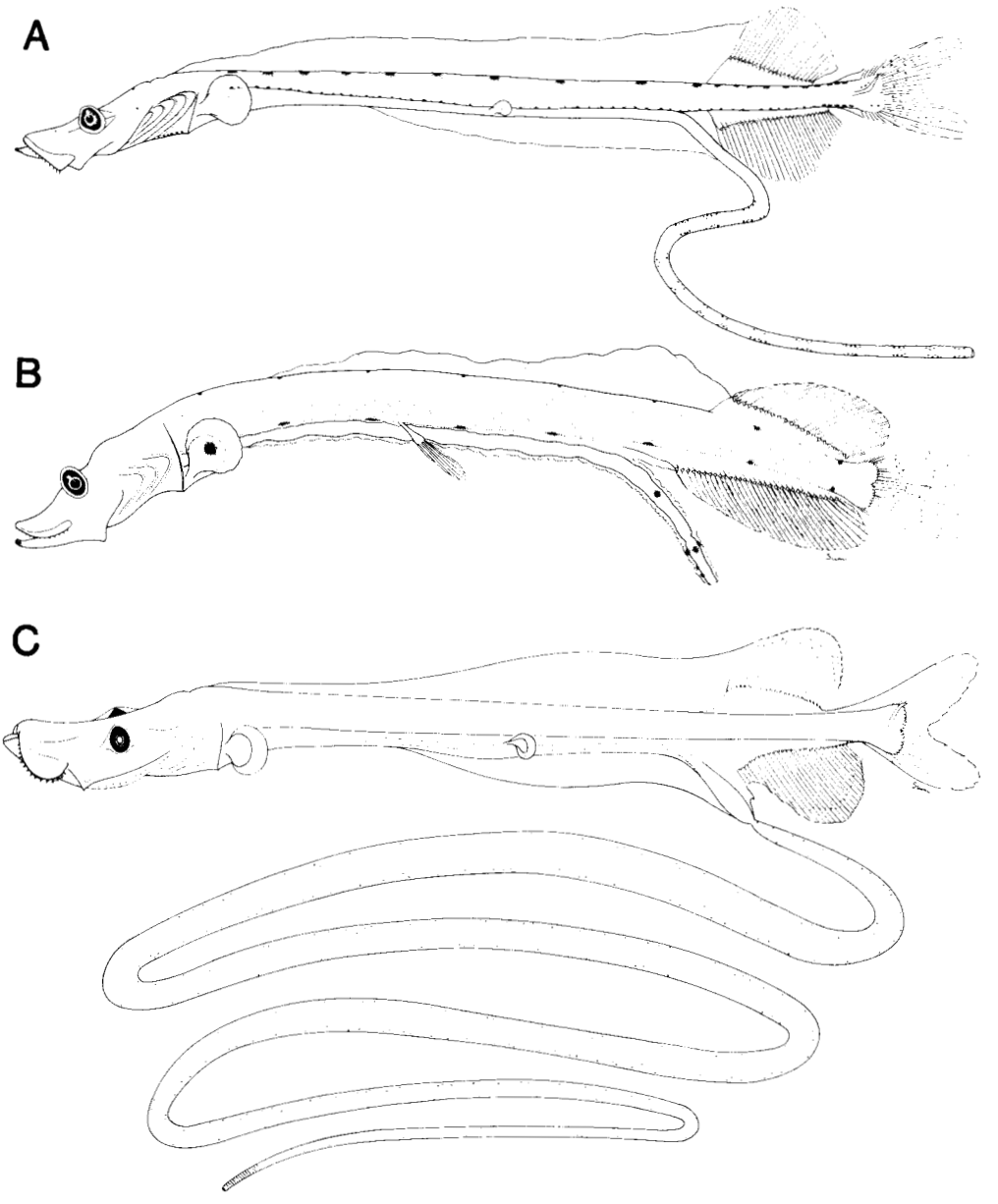

Fig. 93. Larvae of Malacosteidae. (A) *Aristostomias scintillans,* 34.7 mm, CalCOFI 5008 Sta. 70.30; (B) *Photostomias* sp., 26.7 mm, ORI KH 73-5 Sta. 55-13, Bn 24-12; (C) Malacosteidae, 34.5 mm, from Moser (1981).

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Fig. 92. Larvae of Melanostomiatidae. (A) *Bathophilus flemingi,* 25.5 mm, CalCOFI 4910, Sta. 80.137; (B) *B. brevis,* 15.7 mm, ORI KH 81-1, Sta. 17; (C) *B. nigerrimus,* 21.7 mm, redrawn from Sanzo (1931d); (D) *Eustomias* sp. 33 mm, redrawn from Regan (1916).

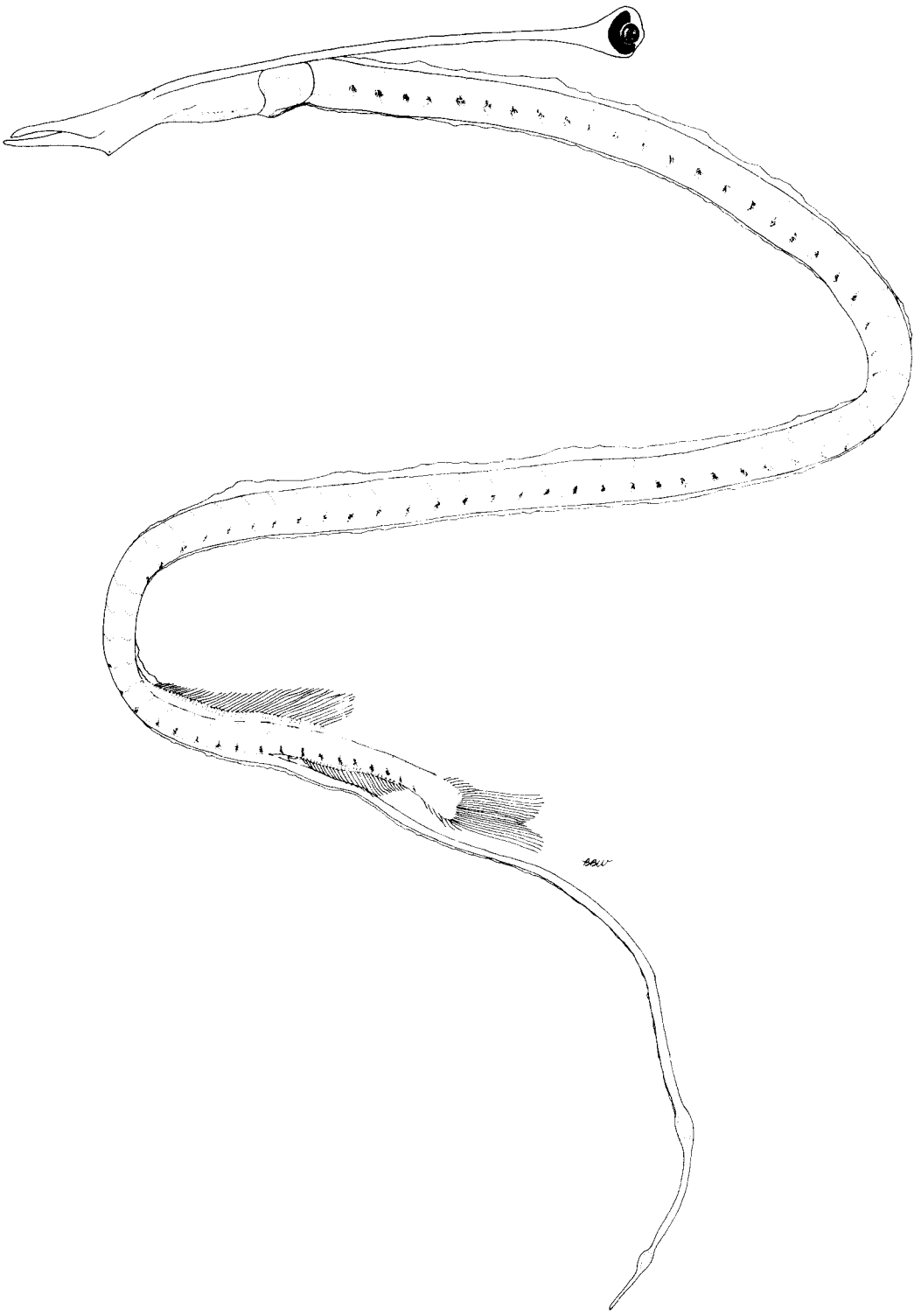

Fig. 94. Larva of *Idiacanthus antrostomus*, 55 mm, CalCOFI 6207 Sta. 90.120.

pairs and increasing in numbers with development to cover the entire dorsum; paired ventral series develop, initially posteriorly, and increase in numbers so that all myomeres have melanophores on the ventral surface; pigment on brain, snout, lower jaw, gular-isthmus region, otic region, caudal fin, and in vague rings along trailing gut. *Aristostomias* larvae were identified initially by E. H. Ahlstrom.

Photostomias guernei (Fig. 93B).—larvae reach about 30 mm; morphology similar to *A. scintillans* except eyes smaller and narrower and pelvic fins somewhat elongate; body pigment consists of a series of 8 minute dorsal melanophore pairs and 8 slightly larger opposing pairs along the ventral surfaces of the myomeres; melanophores at lower jaw symphysis, large melanophore on each pectoral fin base, sparse melanistic rings along trailing gut.

Malacosteid C (Fig. 93C).—intact specimen (captured by Dr. Richard Harbison, WHOI) has morphological and meristic characters of malacosteid larvae but lacks pigment except on the extensive gut. Shallow capture locality of this specimen and our capture of large *A. scintillans* larvae in MANTA nets indicates late-stage malacosteid larvae have a shallow distribution in the water column.

Idiacanthidae (Fig. 94).—Brauer (1906, 1908) described the remarkable larvae of *Idiacanthus* and named them *Stylophthalmus paradoxus*. Beebe (1934) correctly identified the larvae and described them in detail. *Idiacanthus* larvae are extremely slender, reaching a length of 35–70 mm depending on the species. Other characteristics are: elongate and extremely flat head; elliptical eyes on long stalks with cartilaginous supporting rods; stalk length up to 27% of body length in *I. antrostomus* (Weihs and Moser, 1981); gut slender, deflected at anal fin origin and trailing; finfold small; dorsal fin begins forming in preflexion larvae; dorsal fin larger than anal fin and slightly in advance of it in postflexion larvae; during transformation, rays added sequentially anteriad so that in adults the dorsal extends about ⅔ of the body length and the anal about ⅓; pectoral fins well developed but lost at transformation and pelvic fins develop in transforming females, but not at all in males; pigment pattern consists of a melanophore on the posterior margin of each hypaxial myomere, spreading into the myosepta when expanded, several elongate internal blotches in the isthmus region, and a series of melanophores along the trailing gut; adult males of *I. fasciola* reach 32–42 mm SL, lack teeth and paired fins and have relatively larger eyes and an enormous luminous gland.

Relationships

Information on larval characters of 18 of the 26 stomiatoid genera recognized by Fink (this volume), representing all 6 of the families recognized by Weitzman (1974), permits some preliminary generalizations and conclusions: (1) Larvae of Stomiatidae and Chauliodontidae are similar in morphology and are distinct from other stomiatoids. Pigmentation provides further evidence of this; *Chauliodus* larvae are unique among known stomiatoids in lacking pigment after the yolk-sac stage and the median series of gut melanophores of *Stomias* also appear to be unique. (2) Larvae of Astronesthidae are diverse in morphology and pigmentation and most of the larval specializations that appear in other stomiatoid families are found among astronesthid genera. Larval specializations of some genera (e.g., ornamented trailing gut, trailing gut deflected at mid-body, rudder-like finfolds) are not found elsewhere in Stomiatoidea. Heterogeneity of larval characters in Astronesthidae supports Fink's view that the group is paraphyletic. (3) In the Melanostomiatidae, larvae of *Melanostomias, Photonectes, Echiostoma, Opostomias, Flagellostomias, Odontostomias* and *Leptostomias* are similar in morphology, have paired melanophore series on the dorsum, and differ chiefly in head size, body depth, and in the extent of myosepta pigment. *Tactostoma* larvae have the characters of this group of genera except that the body is extremely slender and the pigmentation is lost in the postflexion stage. Larvae of *Bathophilus* differ from those of the above group in a number of characters (voluminous gut with specialized terminal section, melanophore series on the ventral surface of the myomeres, lack of myosepta pigment). Larvae of *Eustomias* are different from all known larvae of Melanostomiatidae in having a trailing gut, flat head and snout, and a pigment pattern consisting of a median series of up to 11 large melanophores on the dorsum. Except for this latter feature, *Eustomias* larvae are similar to those of Malacosteidae. (4) *Idiacanthus* larvae have a combination of characters unique among stomiatoids. The stalked eyes are autapomorphic. Larval characters provide no support for Fink's hypothesis that this genus is closely related to *Tactostoma*.

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