Perciformes
Suborder Stromateoidei

Selected meristic characters in species belonging to the suborder Stromateoidei whose adults or larvae have been collected in the study area. Classification sequence follows Haedrich (2002). See species accounts for precaudal plus caudal vertebral counts. All species have 9+8 principal caudal fin rays and all except *Peprilus* spp. have I,5 spines and rays in the pelvic fin. The latter fin is lacking in the family Stromateidae. Sources: Aboussouan, 1983; Agafonova, 1994; Butler, 1979; Haedrich, 1967; 1968; Haedrich and Horn, 1969; Horn, 1970; 1972; Klein-MacPhee, 2002r; 2002s; 2002t; Smith-Vaniz *et al*., 1999; Watson, 1996ee.

Family *Species*	Vertebrae	Dorsal Fin	Anal Fin	Caudal Fin	Pectoral Fin
Centrolophidae					
Centrolophus niger	25	IV–V, 33–38	III, 20–24	9+8	19–23
Schedophilus medusophagus	25	III, 40–46	27–32 (tot)	9+8	19–22
Hyperoglyphe perciformis	24–25	VI–IX, 19–23	III, 15–17	9+8	18–23
Nomeidae					
Cubiceps capensis	31	XI, I, 20–23	III, 20–21	11–12+9+8+10–12	21–23
Cubiceps gracilis	32–34	XI–XII, I, 21–24	III, 19–22	8–9+9+8+9–10	21–24
Cubiceps pauciradiatus	30–31	XI–XIII, 15–18	II, 14–16	8–10+9+8+8–10	16–20
Nomeus gronovii	41	X–XIII, 24–28	I–II, 24–29	8–9+9+8+8–9	19–24
Psenes cyanophrys	31	IX– X, I, 23–28	III, 23–28	7–9+9+8+7–9	17–20
Psenes maculatus	33–35	X–XI, I, 22–24	III, 21–23	8+9+8+8–9	20–22
Psenes pellucidus	40–42	IX–XII, I, 26–32	III, 26–31	8–10+9+8+8–10	16–20
Ariommatidae					
Ariomma bondi	30–31	XI–XII, 14–17	II–III,12–16	9+8	20–23
Ariomma melanum	30–31	XI, 15–18	III, 13–16	9+8	21–23
Ariomma regulus	30–32	XI–XII, 14–15	III, 14–15	10–12+9+8+9–12	21–24
Tetragonuridae					
Tetragonurus atlanticus	44–51	XIV–XVII, 10–13	I, 9–12	9–10+9+8+9–10	14–18
Tetragonurus cuvieri	51–58	XV–XXI, 10–17	I–II, 9–15	9–12+9+8+9–12	14–21
Stromateidae					
Peprilus paru	29–31	II–IV, 38–49	II–III, 35–45	5–6+9+8+5–6	18–24
Peprilus triacanthus	30–33	II–IV, 40–48	III, 37–44	7–9+9+8+7–8	17–22

Perciformes
Suborder Stromateoidei

The suborder Stromateoidei is composed of 16 genera in 6 families (Haedrich, 1967; 1969; Horn, 1984). 17 species in 9 genera, contained within 5 of these families, occur in the study area. The monotypic family Amarsipidae is restricted to tropical waters of the Indian and Pacific oceans. Larvae of the only species, *Amarsipus carlsbergi* Haedrich, 1969, share several characters with larvae of the Nomeidae (Ahlstrom *et al*., 1976; Horn, 1984.) Most stromateoid species are oceanic and pelagic, and many species occupy wide ranges or occur worldwide. Early stages are reasonably well-described.

Important characters that distinguish the larvae of stromateoids:

- All have well-rounded snout, large eyes, and deep bodies (except *Tetragonurus*)
- Most have a row of very small spines on preopercle, or none at all. If present, none of these spines is pronounced at the preopercle angle, as in carangids and others
- Other head spines are lacking in most taxa, but some centrolophids may have small spines on interopercle and subopercle during postflexion stages (e.g. *Hyperoglyphe* and *Schedophilus*)
- All taxa (except *Amarsipus carlsbergi*) have an early-forming toothed sacular outgrowth in the pharynx immediately posterior to the gill arches. This structure characterizes stromateoids and begins forming in postflexion larvae, but may require clearing and staining to observe
- All taxa have a small air bladder that forms in preflexion stage larvae. It is present in pelagic and neustonic larval and juvenile stages, then regresses as transforming individuals descend to demersal habitats.

Centrolophidae:

- Low number of myomeres (24–25)
- Sequence of fin ray development varies: C – P_1 – D, A – P_2 (*Centrolophus*); C – D, A – P_2 – P_1 (*Schedophilus*)
- D_2 fin rays outnumber A fin rays
- Supraneural patterns vary: 0/0/0/1+1; 0/0+0/1+1+1/; 0/0+0/1+1+1+1/ (patterns vary within *Schedophilus*)

Nomeidae:

- Myomere number moderately high (30–42)
- Sequence of fin ray development differs: C_1 – D_2, A, P_1 – D_1, C_2, P_2 (*Cubiceps*); P_2 – D_1 – C_1 – D_2, A – P_1, C_2 (*Psenes* and probably *Nomeus*)
- Deep-bodied larvae and juveniles (some become slimmer at transformation to adult stage)
- D_2 and A fins similar in outline and fin ray number
- Supraneural patterns vary: 0/0/0+2/ (*Cubiceps and Psenes*); 0/0/0+1 (*Nomeus*)

Ariommatidae:

- Myomere number moderate (30–31)
- Sequence of fin ray development: C_1 – D_2, A – D_1 P_2 – C_2, P_1 (not well described)
- D_2 and A fins similar in outline and fin ray number
- Supraneural bones: 3 (but distribution relative to neural spines undescribed)

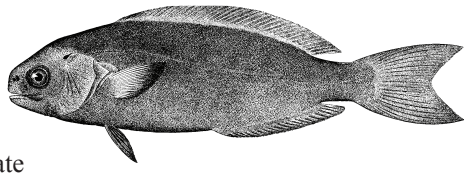
Tetragonuridae:

- High number of myomeres (44–58)
- Sequence of fin ray development: C – D_2, A – D_1 – P_1 – P_2
- Body elongate with long caudal peduncle
- D_2 and A fins similar in outline and fin ray number
- Supraneural bones lacking

Stromateidae:

- Myomere number moderate (29–33)
- Sequence of fin ray development: C_1 – D_2, A, P_1 – D_1, C_2 (P_2 lacking)
- Body deepens early in development
- D_2 and A fins similar in outline and fin ray number
- Supraneural pattern: 0/0/0/1/

Centrolophus niger (Gmelin, 1788)
Centrolophidae
Black ruff



Range: North Atlantic Ocean and western Mediterranean Sea in temperate waters; also known from Adriatic Sea, SouthAfrica, southern Australia, New Zealand; in the western North Atlantic from Grand Bank to New Jersey; young stages rare or absent from study area

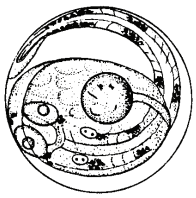
Habitat: Oceanic, mesopelagic, possibly schooling; young stages epipelagic, often associated with jellyfishes or swimming with *Mola mola*; rare in continental shelf depths

Spawning: Fall into winter (Mediterranean Sea); undescribed in study area

Meristic Characters

Myomeres:	25
Vertebrae:	10 + 15 = 25
Dorsal fin rays:	IV–V, 33–38
Anal fin rays:	III, 20–24
Pectoral fin rays:	19–23
Pelvic fin rays:	I, 5
Caudal fin rays:	9 + 8 (PrC)
Supraneurals:	0/0/0/1+1/

Eggs:
- Pelagic, spherical
- Diameter: 1.2 mm
- Chorion: smooth
- Yolk: segmented
- Oil globule: single, 0.32 mm in diameter, pigmented
- Perivitelline space: narrow



Larvae:
- Hatching occurs at about 4.0–5.0 mm; eyes unpigmented, mouth undeveloped
- Head length increases from 18% SL to 34% SL through development
- Body depth increases from 18% SL to 27% SL through development
- Gut initially straight, becomes coiled during flexion stage
- Preanus length decreases from about 65% SL to about 55% SL
- Flexion occurs at 5.0–7.0 mmSL
- Sequence of fin ray formation: C – P_1 – D, A – P_2; fin rays completely formed <13 mm
- Dorsal fin spines feeble; note many more dorsal fin rays than anal fin rays
- In larger larvae and juveniles, posterior D and A fin rays longest
- Head spines lacking
- Lower jaw pigment: mid-ventral line of spots on gular membrane
- Pigment also includes 4 spots along dorsum and venter of body and tail, with cluster of spots around tip of notochord in early larvae; scattered spots on top of head and over gut; body and fin pigment increases at about 14.0 mmSL; faint bars form at D_1 origin, at tip of P_1 and across body at level of mid-anal fin

Head spine checklist:

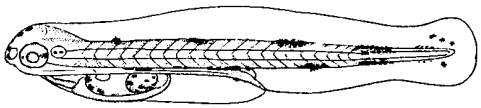
Preopercle: none (unusual for stromateoid larvae)

Note: 1. Larval description based on eastern Atlantic Ocean material

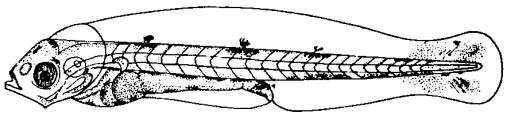
Figures: Adult: Haedrich, 1967: Egg and **A–H**: Sanzo, 1932b

References: Sanzo, 1932b; Padoa, 1956b; Templeman and Haedrich, 1966; Haedrich, 1967; 2002; Ahlstrom *et al*., 1976; Klein-M^{ac}Phee, 2002r

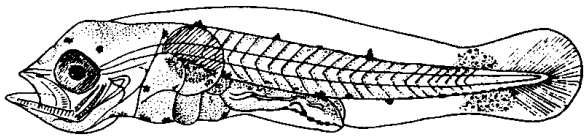
Centrolophus niger



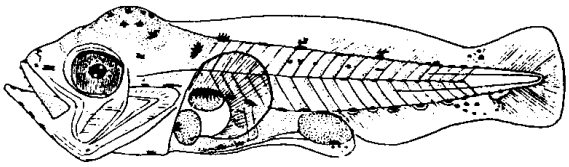
A. 4.4 mmTL



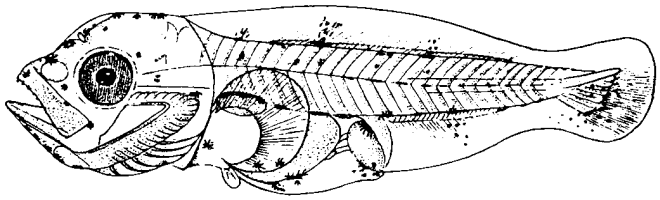
B. 5.0 mmTL



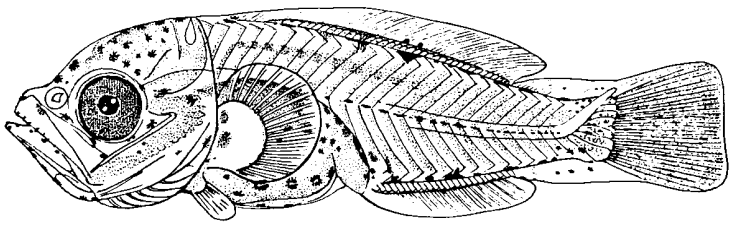
C. 5.6 mmTL



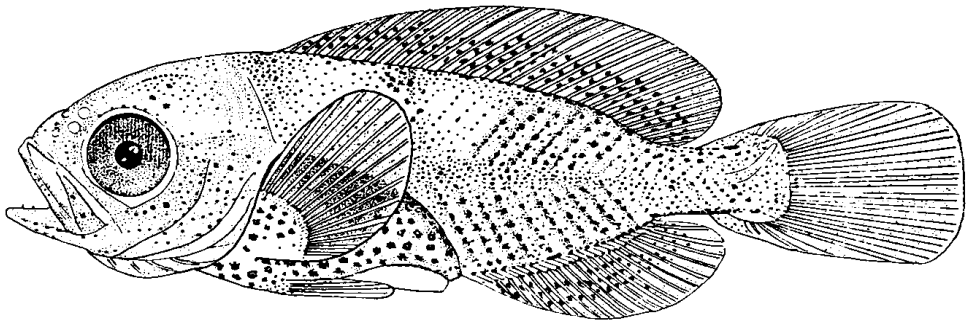
D. 5.4 mmTL



E. 6.7 mmTL

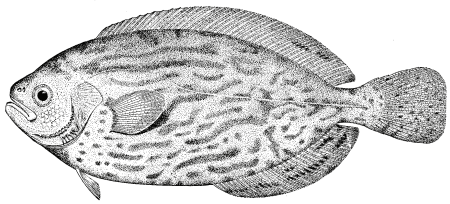


F. 8.3 mmTL



G. 17.2 mmTL

Schedophilus medusophagus Cocco, 1839
Centrolophidae
Brown ruff



Range: North Atlantic Ocean and western Mediterranean Sea mostly in temperate waters; in the study area, occurs most commonly in northern Sargasso Sea, but several records from Grand Bank, Flemish Cap and off North Carolina; best known from juvenile stages (adults enigmatic)

Habitat: Oceanic, mesopelagic; young stages tend to occur in waters closer to the surface than adults and often associate with various medusae, on whose parts they feed

Spawning: Poorly described, but probably at least Apr–Jun in northeast Atlantic

Eggs: – Undescribed

Meristic Characters

Myomeres:	25
Vertebrae:	10 + 15 = 25
Dorsal fin rays:	III, 40–46
Anal fin rays:	27–32 (total)
Pectoral fin rays:	19–22
Pelvic fin rays:	I, 5
Caudal fin rays:	9 + 8 (PrC)
Supraneurals:	0/0+0/1+1+1/
or:	0/0+0/1+1+1+1/

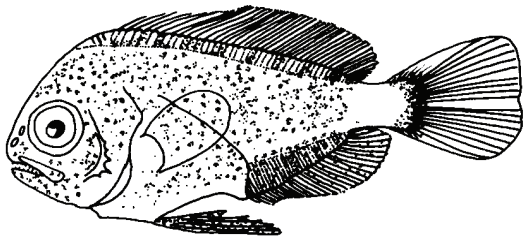
Larvae:
- Body moderately elongate, only slightly deeper through pectoral region
- Gut moderately thick; preanus length 55–60% SL throughout development
- Head length 28–32% SL
- Body depth increases from about 25% SL in early larvae to about 37% SL in late larvae; depth further increases in juveniles (to <50% SL, see Fig. G)
- Flexion occurs at 8.0–9.5 mmSL
- Sequence of fin ray formation: C – D, A – P_2 – P_1
- Dorsal fin origin anterior to pectoral fin base; (posterior in *Centrolophus niger*)
- Head spines restricted to preopercle, visible in larvae >9.5 mmSL; see checklist below
- Lower jaw pigment: absent in early stages; scattered spots present over both dentaries at about 17.3 mmSL
- Pigment also includes 2 series of internal melanophores along dorsum and venter of body and tail; row of small spots along venter of gut; few scattered spots on top of head become more numerous in larger larvae; a mid-lateral row of spots forms at about 11.0 mmSL; scattered spots form at base of caudal fin and on remnants of finfolds near caudal peduncle; pelvic fins lightly pigmented at about 11.0 mm, become more heavily pigmented in early juveniles

Head spine checklist:

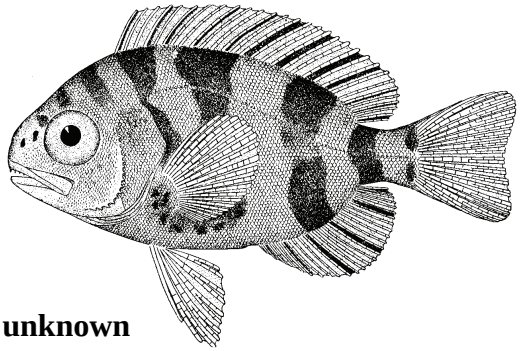
Preopercle: as many as 12 spines present along edge, but none described on lateral ridge

Note: 1. Larvae and juveniles are deeper bodied than comparably sized *Centrolophus niger*

Early and Late Juvenile:



F. 17.3 mmSL

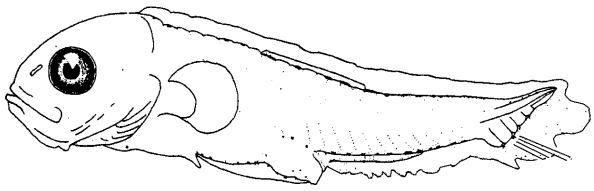


G. Size unknown

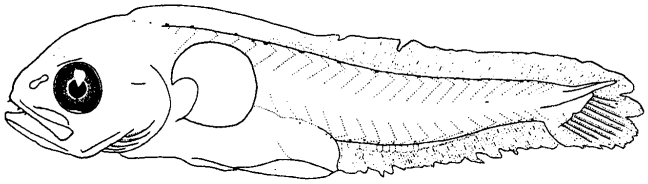
Figures: Adult: Goode and Bean, 1896–1900; **A–D**: John and Karrer, 1987; **E**: Haedrich, 1966; **F**: Aboussouan, 1983; **G**: H. L. Todd (Jordan and Evermann, 1896–1900)

References: Haedrich 1967; 2002; Ahlstrom *et al*., 1976; Aboussouan, 1983; Horn, 1984; John and Karrer, 1987; Olivar and Fortuño, 1991

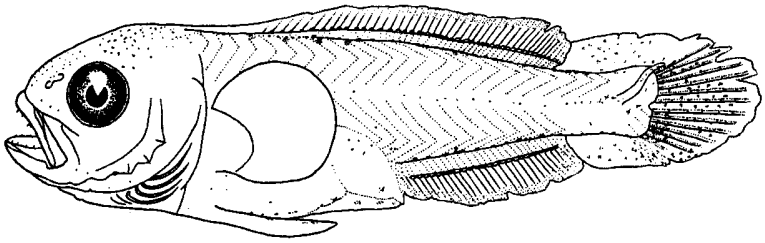
Schedophilus medusophagus



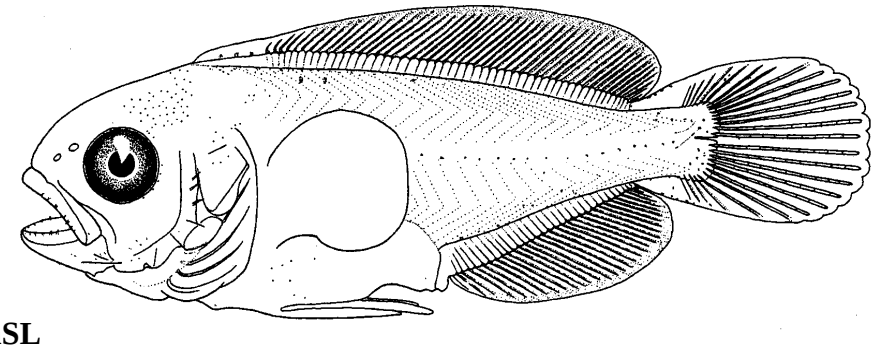
A. 8.6 mmNL



B. 9.5 mmNL

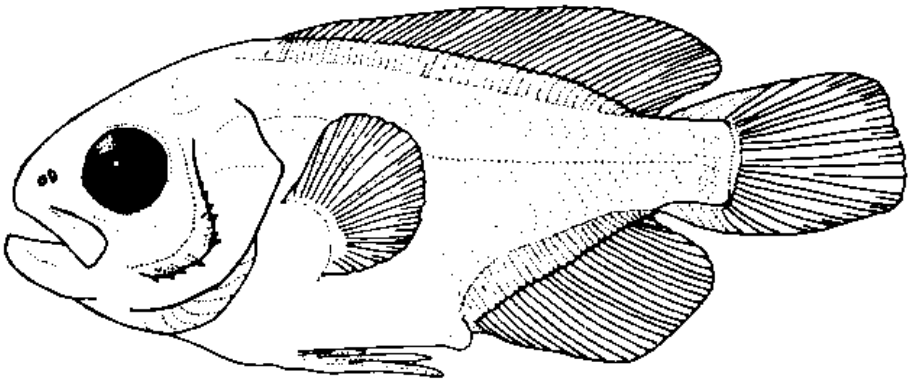


C. 12.1 mmSL



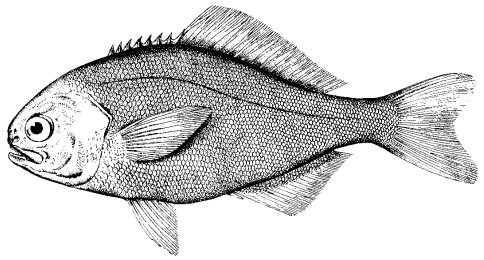
D. 16.8 mmSL

Larvae and juvenile in Figs. A-F collected in eastern Atlantic; juvenile in Fig. G collected over Blake Plateau (27°49'N, 76°12'W)



E. 18.5 mmSL

Hyperoglyphe perciformis (Mitchill, 1818)
Centrolophidae
Barrelfish



Range: Atlantic coast of North America from Grand Bank and Nova Scotia to Key West, Florida; most commonly encountered south of Cape Cod; see comments on figure page regarding the distribution of a presumed congener

Habitat: Mesopelagic in deep water over continental slope or submarine canyons, as deep as 244 m; also typically congregate under flotsam, rafts of seaweed or eelgrass, or under hulls of vessels; juveniles mostly epipelagic, sometimes over continental shelf depths, but do not associate with jellyfishes as do juveniles of other stromateoids

Meristic Characters

Myomeres:	24–25
Vertebrae:	10 + 14–15 = 24–25
Dorsal fin rays:	VI–IX, 19–23
Anal fin rays:	III, 15–17
Pectoral fin rays:	18–23
Pelvic fin rays:	I, 5
Caudal fin rays:	9 + 8 (PrC)
Supraneurals:	0/0/0+2/ ?

(pattern in congener *H. bythites*)

Spawning: Undescribed

Eggs: – Undescribed

Larvae:
- Undescribed; comments below based on a congener, *Hyperoglyphe japonicus*, from the Pacific Ocean
- Body stocky, deep
- Head length about 35% SL
- Preanus length about 50% SL
- Flexion occurs at unknown size
- Sequence of fin ray formation: undescribed
- Head spines present on preopercle, possibly also on other opercular bones (Watson, 1996ee); see checklist below
- Lower jaw pigment: scattered pigment present over dentaries and gular membrane
- Pigment also includes dense scattering of melanophores over much of head and body, forming vague banded pattern; bases of posterior dorsal and anal fin rays covered with pattern of melanophores; pelvic fin pigmented

Head spine checklist:

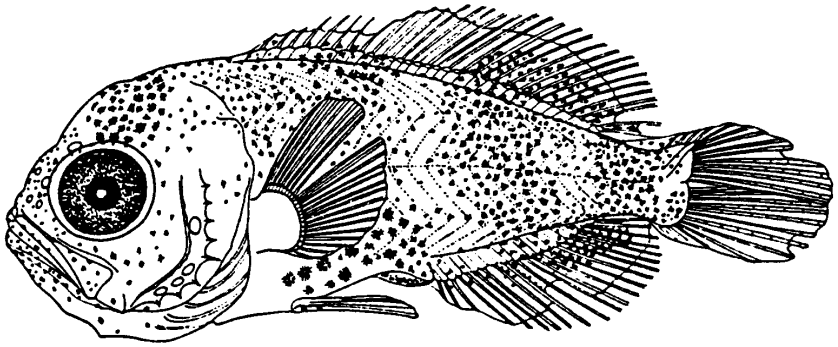
Preopercle:	series of prominent spines along edge, angle spine only slightly longer
Interopercle:	spine may be present
Subopercle:	spine may be present

Note: 1. See comments on figure page

Figures: Adult: Scott and Scott, 1988; **A**: Kimura, 1988 (*In*: Okiyama, 1988)

References: Schwartz, 1963; Haedrich 1967; 2002; Dawson, 1971; Ahlstrom *et al*., 1976; Horn, 1984; Klein-M^{ac}Phee, 2002r

Hyperoglyphe perciformis



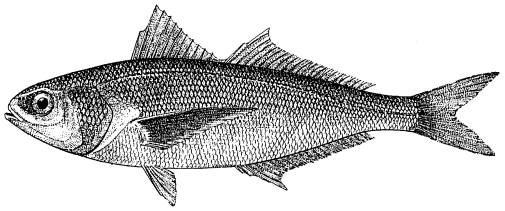
A. 13.2 mmTL

Note: A series of 7 larvae and juveniles (5.7–55.0 mmSL), collected in the Gulf of Mexico and attributed to the enigmatic species *Hyperoglyphe bythites* (Ginsburg, 1954) were reported by Dawson (1971). This species is known only from the Gulf of Mexico, but there are questionable records from the Florida Keys (Bailey *et al*., 1970) and the vicinity of Cape Lookout, North Carolina (Fine, 1970). It differs from *H. perciformis* only in number of dorsal fin rays (22–25 *vs* 19–23) and in relative eye size, although photographs of the two species reveal no differences in this proportion. Pending future systematic studies, the series from the Gulf of Mexico are suspect and may either pertain to early stages of *H. perciformis* or another congener from the South Atlantic Ocean (Haedrich, 2002), or to a series of young *Chaetodipterus faber* (Ephippidae) as suggested by Ditty *et al*. (1993).

All stages in the Dawson (1971) series (represented by photographs) are extremely deep-bodied, narrowing to the caudal peduncle, and have very well-rounded head profiles. The anal fin formula of II, 18 changes to III, 17 in specimens >43 mm. Pigment begins (5.7 mmSL) as a broad swath of spots extending from the anterior dorsal fin to the gut, with pale areas on the head and posterior parts of body. With development, pigment spreads anteriorly and posteriorly until only the caudal peduncle remains clear (7.9 mmSL). A juvenile (54.9 mmSL) is heavily pigmented with a checkered appearance on the body. Dorsal, anal and pelvic fins are dark. No mention is made of spination on the opercular bones, but the photographs clearly indicate a series of prominent spines on the preopercle edge. Caudal, dorsal and anal fin rays apparently form at small sizes and complete complements are present in these fins by about 6.0 mmSL.

The supraneural count (see **Meristic Character** box) was reported by Ahlstrom *et al*. (1976) presumably based on radiographs provided by R. L. Haedrich, but the source of this material is unknown.

Cubiceps capensis (Smith, 1849)
Nomeidae
"Cape cubiceps"



Range: Worldwide in subtropical waters, but distribution not well described; in the western North Atlantic from Grand Bank, Browns Bank and New Jersey to Sargasso Sea, including Bermuda, but rarely recorded from study area

Habitat: Epi- and mesopelagic in subtropical waters; regularly make daily, vertical migrations between these zones

Spawning: Undescribed

Eggs: – Undescribed

Meristic Characters

Myomeres:	31
Vertebrae:	12 + 19 = 31
Dorsal fin rays:	XI, I, 20–23
Anal fin rays:	III, 20–21
Pectoral fin rays:	21–23
Pelvic fin rays:	I, 5
Caudal fin rays:	11–12+9+8+10–12
Supraneurals:	0/0/0 + 2/

Larvae:
- Moderately stocky, deepest through pectoral region
- Body depth at level of pectoral fin base about 43% SL, decreases to about 36% SL in juveniles
- Head length about 33–34% SL in larvae and juvenile at 19.5 mmSL
- Gut shape bulky, approximately triangular
- Preanus length about 56–61% SL in larvae and juveniles
- Flexion occurs at <7.0 mmSL
- Sequence of fin ray formation: $C_1 - D_2$, A, $P_1 - D_1$, C_2, P_2
- Head spines lacking
- Lower jaw pigment: line of spots on mid-ventral gular membrane (might be absent in early larvae) and a pair of spots on inner edge of both dentary bones near symphysis (Figs. A and C)
- Pigment also includes a scattering of melanophores from top of nape, diagonally across gut to well pigmented pelvic fin in early larvae; pigment spreads in later larvae to include much of the midlateral region of body and tail; all stages have scattered pigment on opercle and preopercle; at 19.5 mmSL, most of body covered with fine melanophores, with smaller melanophores over gut and a narrow, unpigmented band at base of caudal

Head spine checklist:

Preopercle: none described

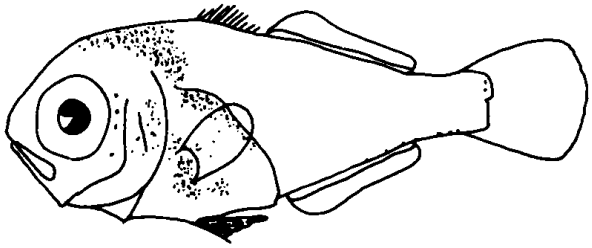
Note:
1. The 19.5-mm specimen (Fig. F) was described as "*Cubiceps* sp. A" (Ahlstrom *et al*., 1976). An early juvenile "*Cubiceps capensis*" described by Ahlstrom *et al*. (1976) refers to *Cubiceps caeruleus* (Butler, 1979). The latter species is restricted to the South Atlantic and South Pacific oceans and has not been recorded from the study area.
2. Common name offered by Agafonova (1994). None other is recognized.

Figures: Adult: Haedrich, 2002; **A–E**: Aboussouan, 1983; **F**: Henry Orr (Ahlstrom *et al*., 1976)

References: Haedrich 1967; 1972; 2002; Ahlstrom *et al*., 1976; Butler, 1979; Aboussouan, 1983; Horn, 1984; Agafonova, 1994; Moore *et al*., 2003

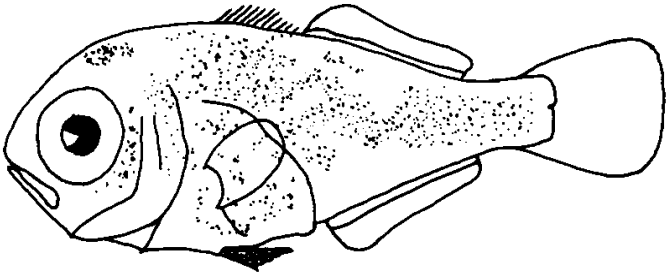
Cubiceps capensis

A. 7.7 mmSL (Venter of Head)

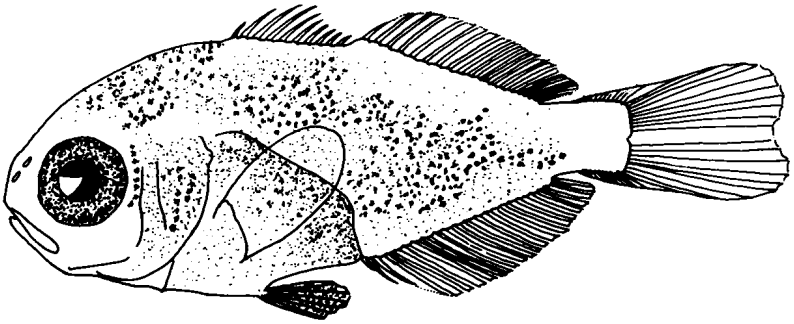


B. 7.7 mmSL

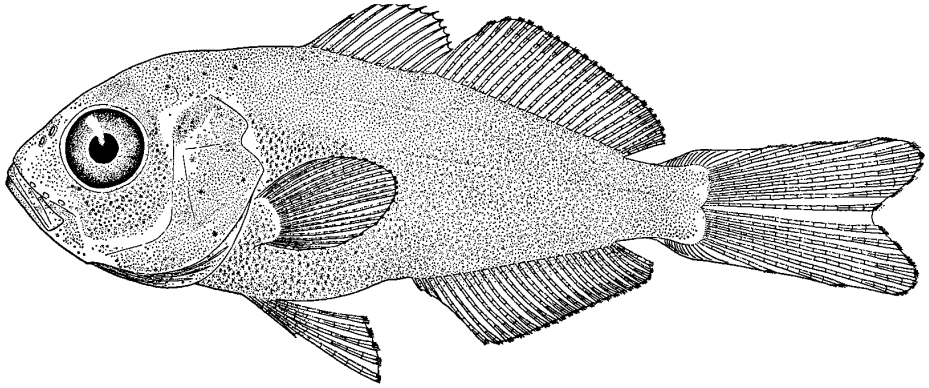
C. 8.2 mmSL (Venter of Head)



D. 8.2 mmSL

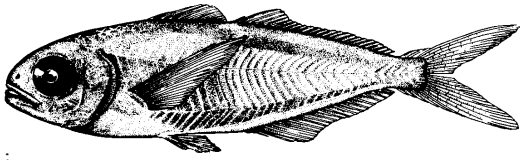


E. 12.2 mmSL



F. 19.5 mmSL

Cubiceps gracilis (Lowe, 1843)
Nomeidae
"Common cubiceps"



Range: North Atlantic Ocean and Mediterranean Sea, mostly in subtropical waters; in the western North Atlantic from Slope Sea south of Grand Bank to vicinity of Norfolk Canyon

Habitat: Epi- to mesopelagic in depths to 900 m; adults solitary, but young stages reported to associate (sometimes in large groups) with medusae

Spawning: Undescribed; young stages reported to be abundant near the Azores in the eastern Atlantic

Eggs: – Undescribed

Meristic Characters

Myomeres:	32–34
Vertebrae:	13 + 19–21 = 32–34
Dorsal fin rays:	XI–XII, I, 21–24
Anal fin rays:	III, 19–22
Pectoral fin rays:	21–24
Pelvic fin rays:	I, 5
Caudal fin rays:	8–9+9+8+9–10
Supraneurals:	0/0/0/2/

Larvae:
- Early larvae moderately elongate, deeper through pectoral region, soon become deep-bodied
- Body depth increases from 29% SL in preflexion larvae to 37% SL postflexion; decreases to 32% SL in juveniles
- Head length increases from 30% SL to 35% SL then decreases to 30% SL in juveniles
- Gut shape bulky, prominent and rounded
- Preanus length increases from 36% SL in preflexion larvae to 55% SL in postflexion
- Flexion occurs between 6.0 and 9.0 mmTL
- Sequence of fin ray formation: $C_1 - D_2$, A, $P_1 - D_1$, C_2, P_2
- Head spines lacking
- Lower jaw pigment: scattered on gular membrane and on dentary bones (based on eastern Atlantic illustrations)
- Pigment also includes scattered, heavy spots on top of head and across opercles; heavy body pigment begins as a bar across tail anterior to caudal peduncle and from dorsum under D_1 fin ventrally across gut; relatively unpigmented area between the aforementioned bars gradually fills in with melanophores; pigment in larger larvae and juveniles dense, including spots covering D_1, P_2, C, and anterior parts of D_2 and A fins; pigment more extensive and heavier than in comparably sized *Cubiceps pauciradiatus*

Head spine checklist:

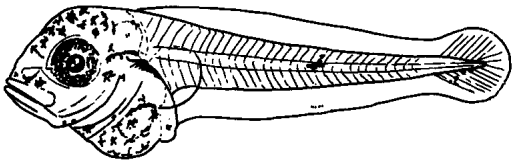
Preopercle: none reported

Note:
1. Higher counts of myomeres/vertebrae than congeners
2. Common name offered by Agafonova (1994). None other is recognized.

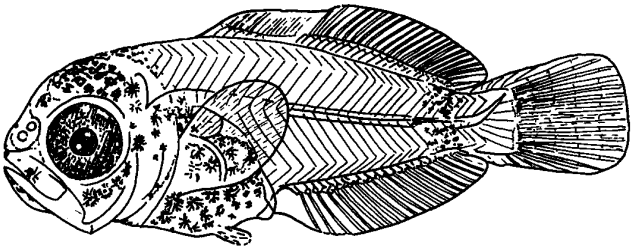
Figures: Adult: Haedrich, 1986; **A–E**: Sparta, 1946

References: Haedrich 1967; 1972; 1986; 2002; Ahlstrom *et al*., 1976; Butler, 1979; Horn, 1984; Olivar and Fortuño, 1991; Agafonova, 1994

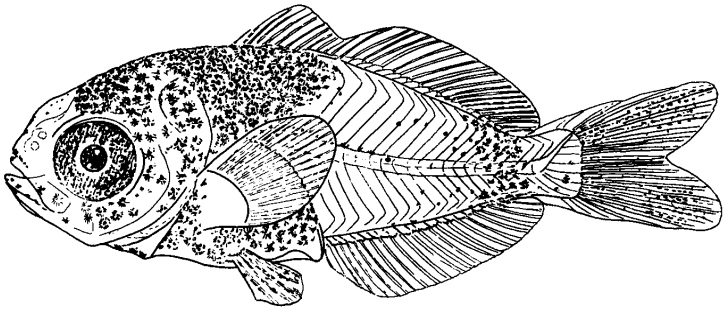
Cubiceps gracilis



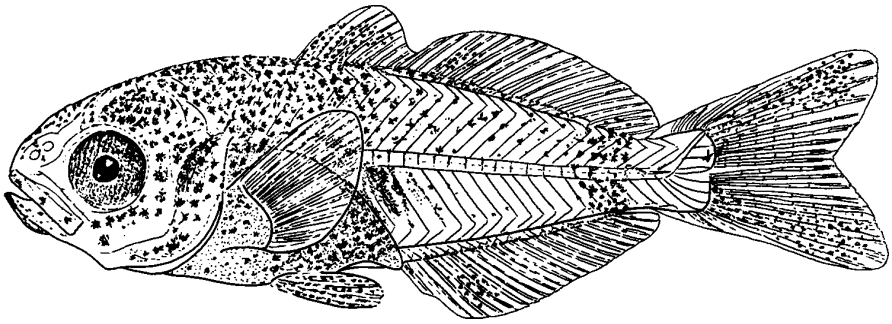
A. 6.2 mmTL



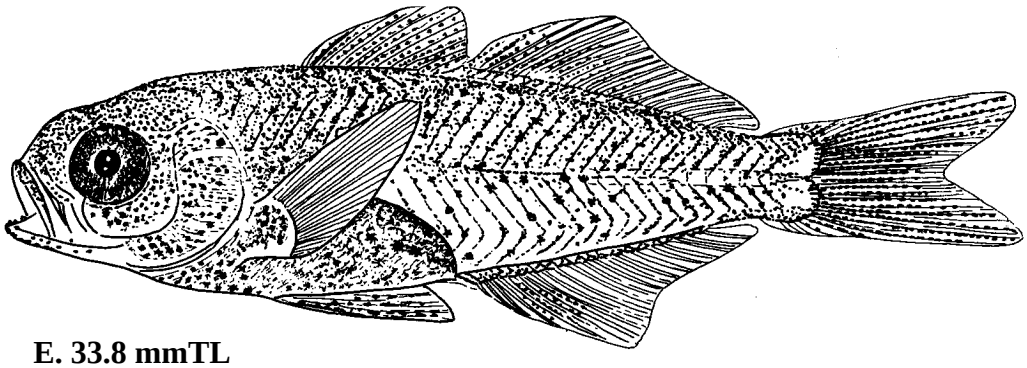
B. 9.1 mmTL



C. 13.2 mmTL

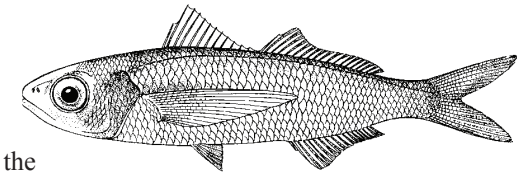


D. 20.6 mmTL



E. 33.8 mmTL

Cubiceps pauciradiatus Günther, 1872
Nomeidae
Bigeye cigarfish



Range: Worldwide in tropical and subtropical waters of all oceans; in the western North Atlantic from Hudson Canyon to Caribbean Sea, including Gulf of Mexico; young stages occur as far north as Newfoundland and Bear Seamount

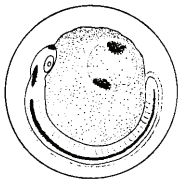
Habitat: Epi- and mesopelagic in depths to 300 m or more

Spawning: Undescribed; juveniles (27–59 mmTL) have been collected Mar–Apr in Canadian Atlantic waters

Meristic Characters

Myomeres:	30–31
Vertebrae:	12 + 18–19 = 30–31
Dorsal fin rays:	XI–XIII, 15–18
Anal fin rays:	II, 14–16
Pectoral fin rays:	16–20
Pelvic fin rays:	I, 5
Caudal fin rays:	8–10+9+8+8–10
Supraneurals:	0/0/0+2/

Eggs:
- Pelagic, spherical
- Diameter: 0.70–0.80 mm
- Chorion: smooth, light pinkish-tan
- Yolk: unsegmented
- Oil globule: single, 0.14–0.20 mm in diameter
- Note characteristic pigment on embryo and oil globule



Larvae:
- Body initially elongate, soon deepens, becoming moderately stocky
- Body depth increases from 32% SL in preflexion larvae (after initial deepening) to 38% SL in postflexion
- Head length increases from 18–29% SL in preflexion to 31–36% SL in postflexion
- Gut shape initially straight, becomes bulky and triangular after coiling
- Preanus length increases from 52–59% SL in preflexion larvae to 59–65% SL in postflexion
- Flexion occurs between 3.7 and 4.3 mmSL
- Sequence of fin ray formation: $C_1 - D_2$, A, $P_1 - D_1$, C_2, P_2
- Full complements of D and A fin rays attained by about 5.0 mmSL
- Head spines weak; see checklist below
- Lower jaw pigment: few small melanophores at symphysis; single spot near cleithral symphysis (Fig. C)
- Pigment also includes melanophores forming as 3 stripes on dorsum, venter and midline of tail (at about the level of myomeres 20–23); top of head and tip of snout well-pigmented; few spots form on opercle and preopercle; body and tail pigment spreads after flexion, but small area anterior to caudal peduncle remains relatively unpigmented; some pigment occurs on pelvic fin in late larvae and juveniles

Head spine checklist:

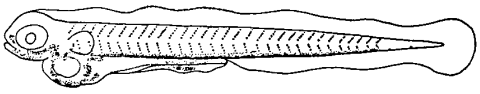
Preopercle: 4–5 weak spines on edge (form at about 5.0 mmSL) and few on lateral ridge (form at about 8.5 mmSL); all spines no longer visible after about 11.2 mmSL

Note:
1. Low counts in D_2 and A fins distinguish this species from other nomeids occurring in study area; presence of only 2 anal fin spines also serve to separate it from congeners

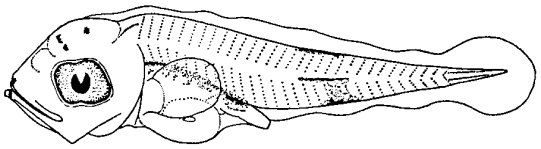
Figures: Adult: Haedrich, 2002; Egg: Barbara Sumida (Ahlstrom *et al*., 1976); **A–G**: Henry Orr (Ahlstrom *et al*., 1976)

References: Haedrich 1967; 2002; Ahlstrom *et al*., 1976; Horn, 1984; Scott and Scott, 1988; Moore *et al*., 2003

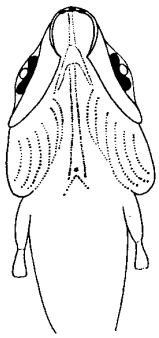
Cubiceps pauciradiatus



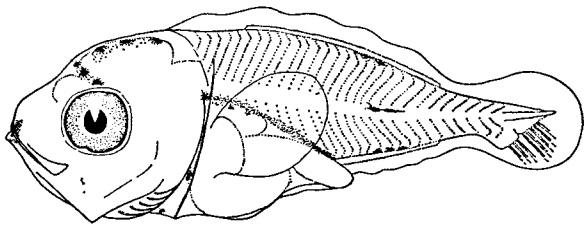
A. 2.1 mmNL



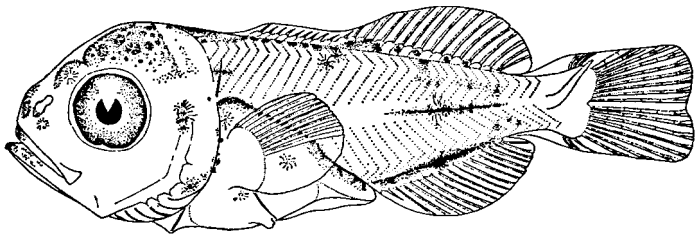
B. 3.1 mmNL



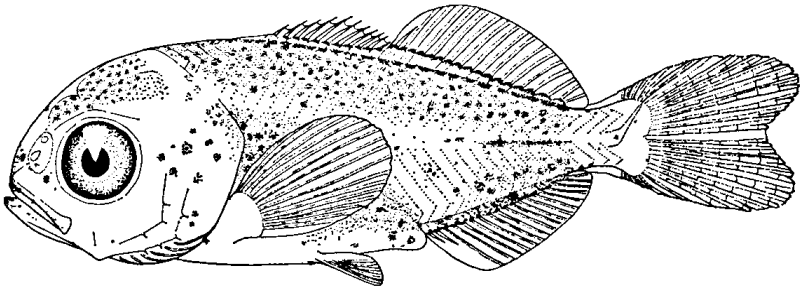
C. 3.8 mmSL (Venter of Head)



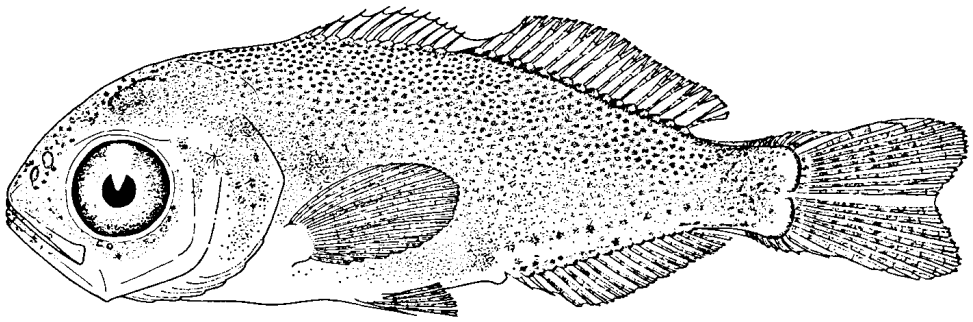
D. 3.8 mmSL



E. 5.1 mmSL



F. 8.6 mmSL



G. 17.5 mmSL

Nomeus gronovii (Gmelin, 1789)

Nomeidae

Man-of-war fish

Adult illustration unavailable

Range: Worldwide in tropical and subtropical waters; in the western North Atlantic recorded from Grand Bank to Brazil, including Bermuda, Sargasso Sea, Gulf of Mexico and Caribbean Sea

Habitat: Pelagic in oceanic waters; young stages commonly associate with Portugese man-of-war (*Physalia* sp.), sometimes in large numbers; eat zooplankton and also parts of its jellyfish hosts; usually immune to toxins of its host, yet are sometimes killed and consumed by them; mature adults demersal in deep water (distribution undescribed)

Meristic Characters

Myomeres:	41
Vertebrae:	14 + 27 = 41
Dorsal fin rays:	X–XIII, 24–28
Anal fin rays:	I–II, 24–29
Pectoral fin rays:	19–24
Pelvic fin rays:	I, 5
Caudal fin rays:	8–9+9+8+8–9
Supraneurals:	0/0/0+1/

Spawning: Undescribed

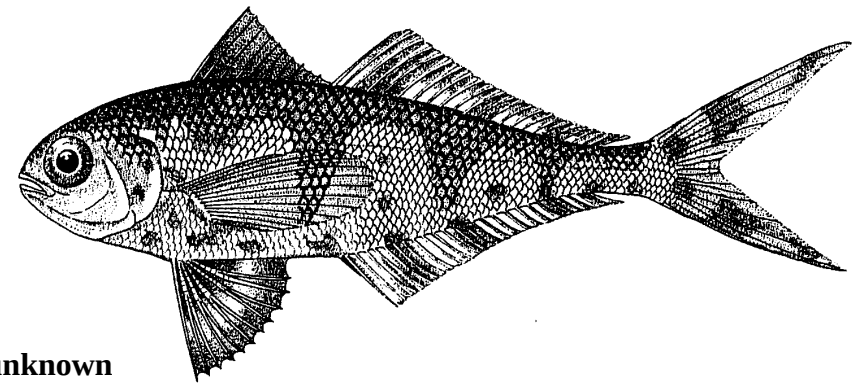
Eggs: – Undescribed

Larvae:
- Preflexion larvae elongate with precocious, darkly pigmented pelvic fin rays
- Postflexion larvae are moderately stocky with large pelvic fins
- Body depth 37–41% SL (similar to larvae of *Cubiceps,* but less than larvae of *Psenes*)
- Head length 30–34% SL
- Gut shape bulky and tightly coiled
- Preanus length 56–59% SL (longer than larvae of *Psenes*)
- Flexion occurs at undescribed size
- Sequence of fin ray formation: P_2 – D, A, P_1, C (putative; see sequences in *Cubiceps* and *Psenes*)
- Head spines weak; see checklist below
- Lower jaw pigment: cluster of small spots near symphysis
- Pigment in preflexion larvae includes a line of spots along ventral edge of tail, scattered spots on top of head, tips of both jaws and well-pigmented pelvic fin; later larvae characterized by a wide, vertical swath from anterior dorsal fin across gut; pelvic fins densely pigmented; top of head and opercles well-spotted; 2 pigment clusters occur on tail, one in 3 parts between D_2 and A fin bases, the other centered on caudal peduncle; latter 2 clusters expand in early juveniles

Head spine checklist:

Preopercle: very small spines (2 on edge; 2 on lateral ridge) illustrated, but not described

Juvenile:

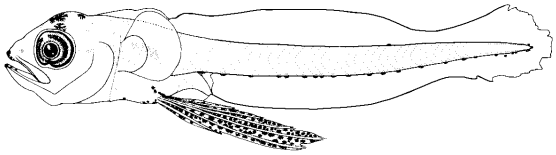


E. Size unknown

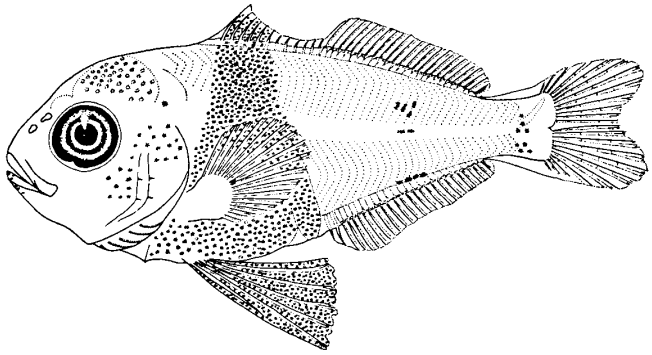
Figures: Adult: Undescribed; **A**: William Watson (Watson, 1996ee); **B–D**: Barbara Sumida (Ahlstrom *et al*., 1976); **E**: Haedrich, 2002

References: Haedrich 1967; 2002; Ahlstrom *et al*., 1976; Horn, 1984; Watson, 1996ee

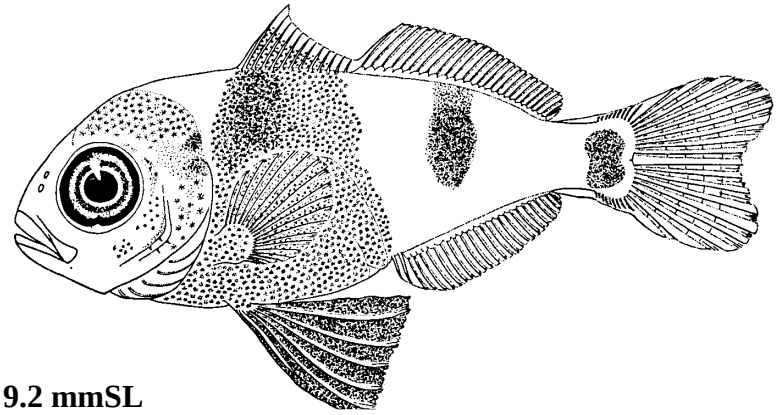
Nomeus gronovii



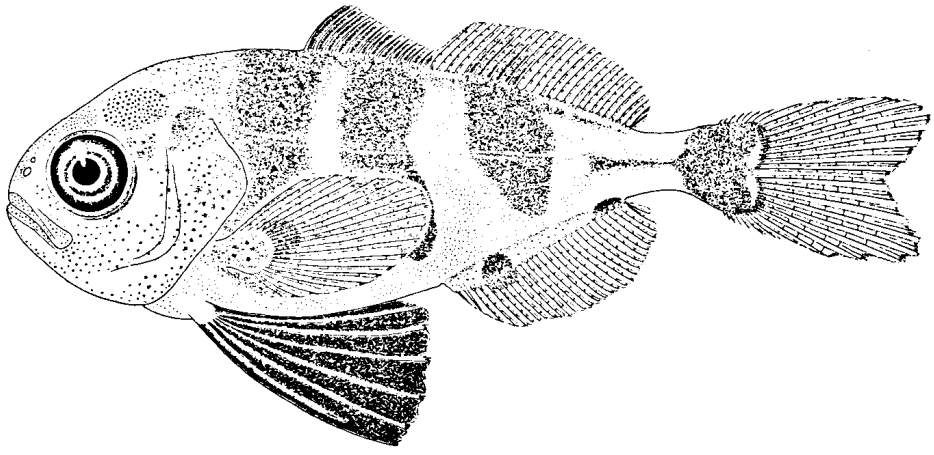
A. 4.4 mmSL



B. 7.3 mmSL



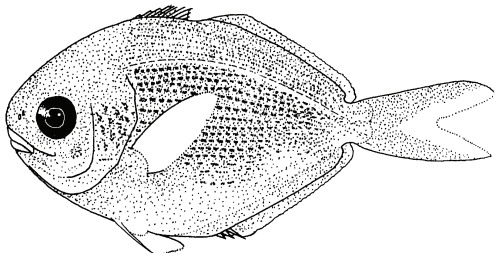
C. 9.2 mmSL



D. 22.7 mmSL

These larvae are distinctive and easily identified, yet there are several gaps in our knowledge of their ontogeny. Eggs remain undescribed and the earliest described stage has well-ossified pelvic fin rays. However, the sequence in which other fins acquire the adult complement is unknown (although the presumed sequence may be the same as in the genus *Psenes*, but not as in the genus *Cubiceps*). Early stages are well known because of their habit of associating with large jellyfish in surface waters. Adults eventually settle to the bottom in deep water and acquire a drab, dark brown coloration, but they have not been described or illustrated (Haedrich, 1967).

Psenes cyanophrys Valenciennes, 1833
Nomeidae
Freckled driftfish



Range: Worldwide, primarily tropical, but extending into subtropical waters; in the western North Atlantic from Browns Bank to Brazil, including Gulf of Mexico and Caribbean Sea

Habitat: Epi- to mesopelagic, oceanic, but probably not far from coasts; known to gather under floating objects

Spawning: Late winter to fall (Florida), based on occurrences of early stages

Eggs: – Undescribed

Meristic Characters

Myomeres:	31
Vertebrae:	12 + 19 = 31
Dorsal fin rays:	IX–X, I, 23–28
Anal fin rays:	III, 23–28
Pectoral fin rays:	17–20
Pelvic fin rays:	I, 5
Caudal fin rays:	7–9+9+8+7–9
Supraneurals:	0/0/0+2/

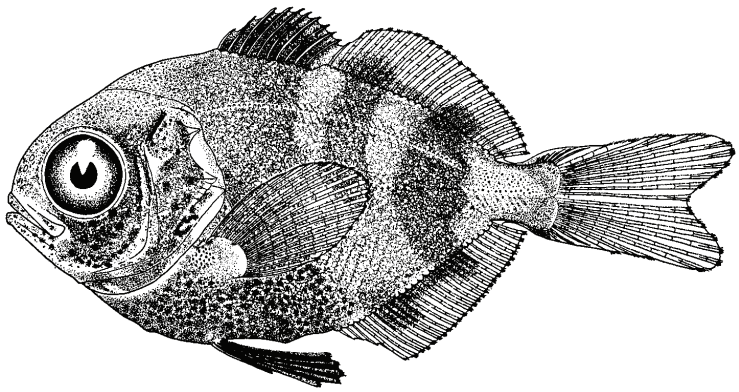
Larvae:
- Body moderately stocky with early-forming pelvic fins
- Body depth increases from 24–29% SL in preflexion larvae to 44–55% SL in postflexion
- Head length increases from 24–27% SL to 31–39% SL in postflexion
- Gut shape bulky and tightly coiled
- Preanus length 48–54% SL in preflexion, 50–59% SL in postflexion
- Flexion occurs at 3.9–4.2 mmSL
- Sequence of fin ray formation: $P_2 - D_1, - C_1 - D_2, A - P_1, C_2$
- Pelvic fin rays early-forming and fairly long
- Head spines weak; see checklist below
- Lower jaw pigment: 2 small spots posterior to symphysis and single spot behind cleithral symphysis (Fig. E)
- Pigment is light before flexion, becomes heavy after flexion; late-forming spots on top of head (absent in preflexion); pigment forms early on pelvic fins; peritoneal pigment on dorsal gut and spot over terminus of gut; a single spot occurs on gut above pelvic fins; a pair of streaks forms mid-laterally and ventrally on about myomeres 20–23; a single spot occurs under notochord tip; pigment in the nape region, and the pair on mid-tail, form bars in flexion larvae; 4–5 well developed bars cross body in later larvae and juveniles, from nape to caudal peduncle; some pigment from these bars crosses onto fins

Head spine checklist:

Preopercle: up to 3 small spines on edge, 3–4 small spines on lateral ridge; all disappear by 9.0 mmSL

Note: 1. A larval series of nominal *P. cyanophrys* illustrated by Legaspi (1956) included 2 *Ariomma* sp. (2.5 and 3.2 mm) and 1 carangid larva (6.9 mm)

Early Juvenile:

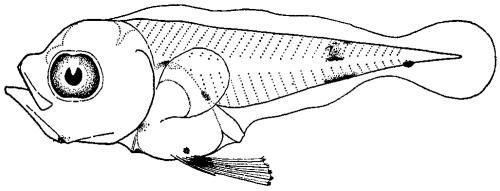


H. 19.1 mmSL

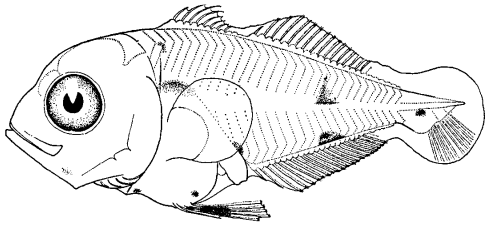
Figures: Adult: Haedrich, 2002; **A–E, G–H**: Henry Orr (Ahlstrom *et al*., 1976); **F**: Barbara Sumida (Ahlstrom *et al*., 1976)

References: Haedrich 1967; 2002; Ahlstrom *et al*., 1976; Horn, 1984

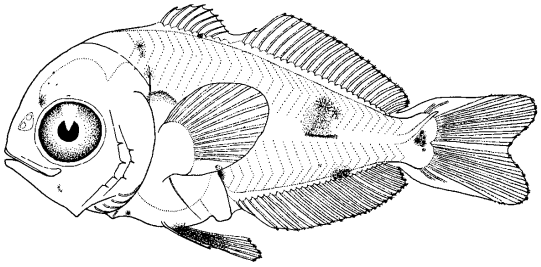
Psenes cyanophrys



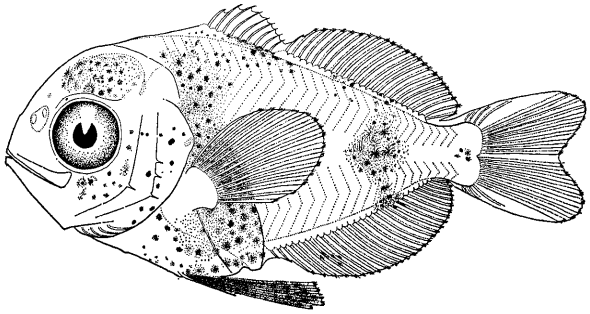
A. 3.3 mmNL



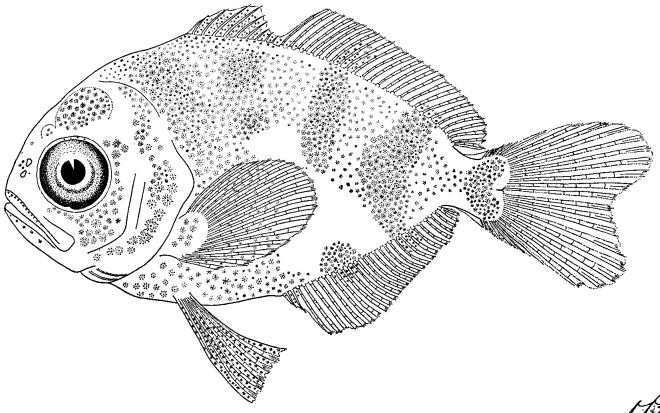
B. 4.2 mmSL



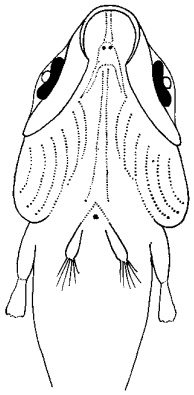
C. 5.0 mmSL



D. 6.8 mmSL

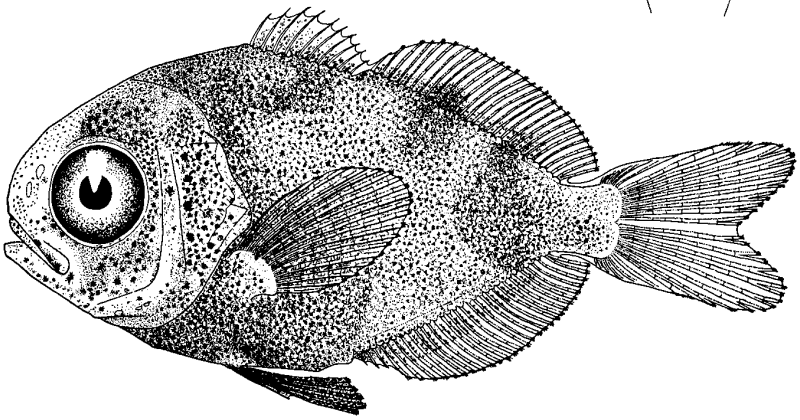


E. 4.4 mmSL
(Venter of Head)



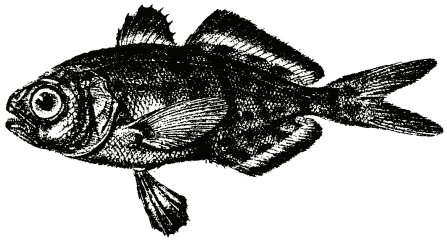
F. 11.7 mmSL

Larva in Fig. F collected from western Atlantic Ocean, all others from eastern Pacific Ocean



G. 14.5 mmSL

Psenes maculatus Lütken, 1880
Nomeidae
Silver driftfish



Range: Worldwide in temperate waters; in the western North Atlantic from La Have Bank to northern South America; several records of larvae and juveniles from study area

Habitat: Epi- to mesopelagic in oceanic waters, with several records near submarine canyons and seamounts; preferred habitats not well described

Spawning: Undescribed

Eggs: – Undescribed

Meristic Characters

Myomeres:	33–35
Vertebrae:	15 + 18–20 = 33–35
Dorsal fin rays:	X–XI, I, 22–24
Anal fin rays:	III, 21–23
Pectoral fin rays:	20–22
Pelvic fin rays:	I, 5
Caudal fin rays:	8+9+8+8–9
Supraneurals:	0/0/0+2/

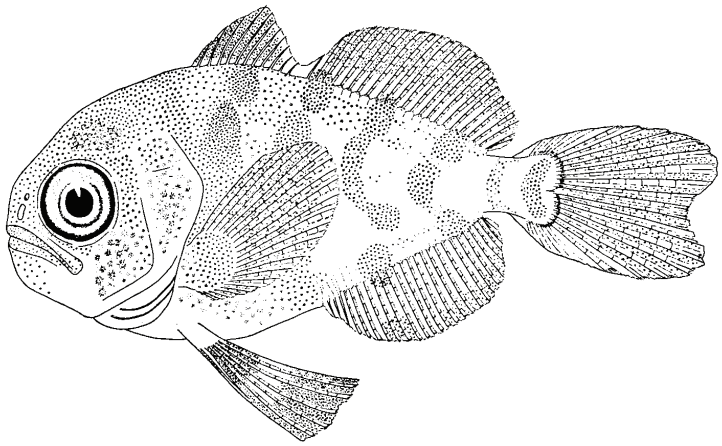
Larvae:
- Body (flexion and postflexion) moderately stocky with early forming pelvic fins; (preflexion larvae not well described)
- Head length increases from about 29% SL in flexion larvae to 37% SL in postflexion
- Body depth increases from about 32% SL in flexion larvae to about 45–52% SL in postflexion
- Gut shape bulky and tightly coiled
- Preanus length increases from 47% SL in flexion larvae to 52–57% SL in postflexion
- Flexion begins at about 3.8 mmNL
- Sequence of fin ray formation: $P_2 - D_1 - C_1 - D_2$, A – P_1, C_2
- Pelvic fin rays early forming and fairly long
- Head spines weak; see checklist below
- Lower jaw pigment: 2 small spots posterior to symphysis and single spot behind cleithral symphysis (Fig. A)
- Pigment is light before flexion, becomes heavy after flexion; line of spots along venter of tail in preflexion; late-forming spots on top of head (absent in preflexion); pigment forms early on middle of pelvic fins; mid-lateral streaks of pigment are origins of later bars; gut well spotted; late larvae and juveniles form 6 bands across body, the 1st under D_1, the 6th at base of caudal fin rays

Head spine checklist:

Preopercle: up to 3 very small, weak spines on edge in larvae 5.0–9.0 mmSL

Note: 1. Myomere/vertebra count of 33–35 unique for *Psenes*

Early Juvenile:

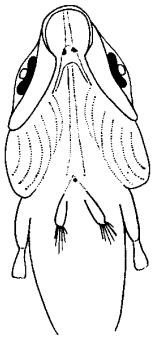


E. 22.2 mmSL

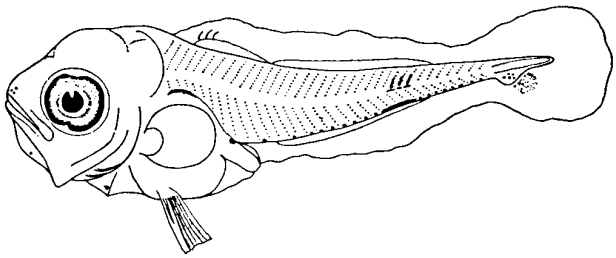
Figures: Adult: Haedrich, 1986; **A–E**: Barbara Sumida (Ahlstrom *et al*., 1976)

References: Haedrich 1967; Ahlstrom *et al*., 1976; Horn, 1984; Scott and Scott, 1988

Psenes maculatus

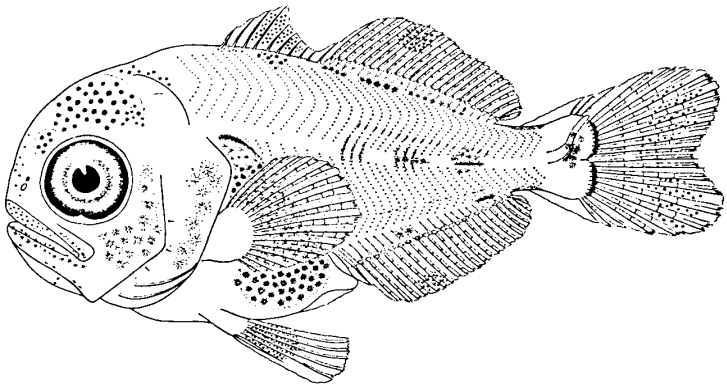


A. 3.8 mmNL
(Venter of Head)

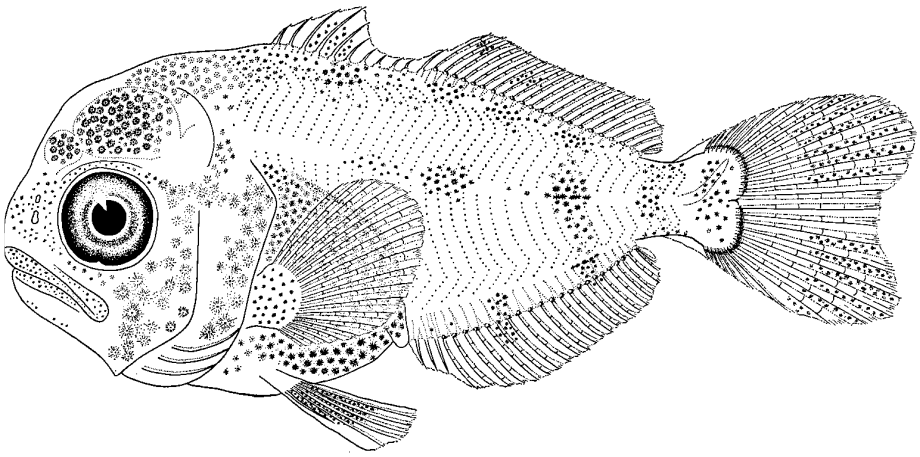


B. 3.8 mmNL

Ventral pigment similar to *Psenes cyanophrys*



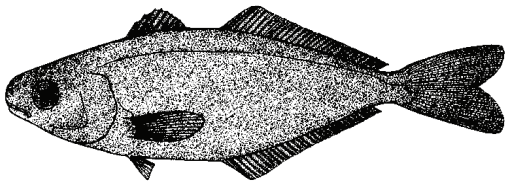
C. 7.6 mmSL



Larva in Fig. D collected from eastern Pacific Ocean, all others from western Atlantic Ocean

D. 11.6 mmSL

Psenes pellucidus Lütken, 1880
Nomeidae
Bluefin driftfish



Range: Worldwide in warm waters; in the western North Atlantic from Sable Island Bank to Gulf of Mexico; young stages have been collected from Georges Bank and Bear Seamount

Habitat: Epi- to mesopelagic (possibly bathypelagic on slope); in the eastern Pacific Ocean, prefers cooler waters associated with upwelling areas; young stages associate with floating weed, but not medusae

Spawning: Undescribed

Eggs:
- (Tentative: spherical, 1.14–1.28 mm in diameter, chorion brownish-rose, single oil globule 0.24–0.28 mm in diameter)

Meristic Characters

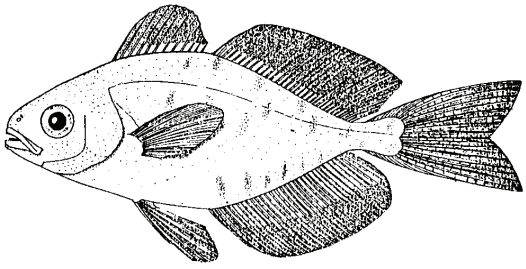
Myomeres:	40–42
Vertebrae:	13 + 27–29 = 40–42
Dorsal fin rays:	IX–XII, I, 26–32
Anal fin rays:	III, 26–31
Pectoral fin rays:	16–20
Pelvic fin rays:	I, 5
Caudal fin rays:	8–10+9+8+8–10
Supraneurals:	0/0/0+2/

Larvae:
- Body elongate, with early forming pelvic fins, becoming moderately stocky
- Body depth increases from 20–24% SL in preflexion larvae to 43–57% SL in postflexion
- Head length increases from 24% SL in preflexion larvae to 27–33% SL in postflexion
- Gut shape bulky and tightly coiled
- Preanus length increases from 39–45% SL in preflexion larvae to 46–53% SL in postflexion
- Flexion occurs at 5.2–5.9 mmSL
- Sequence of fin ray formation: $P_2 - D_1 - C_1 - D_2$, $A - P_1$, C_2
- Pelvic fin rays early forming and fairly long
- Head spines weak; see checklist below
- Lower jaw pigment: few spots on anterior gular membrane and single spot at cleithral symphysis (Fig. E)
- Pigment is light before flexion, becomes heavier after flexion; series of spots along venter of tail in preflexion, this series becomes aligned with lower angle of myomeres; 2 sets of opposing dorsal, midline and ventral-streaks on posterior tail, posterior-most becomes single large spot; pigment forms early on tips, then middle part, of pelvic fins; late-forming spots on top of head (absent in preflexion); vague bars form on body in late stages, not as bold as those in larvae of congeners

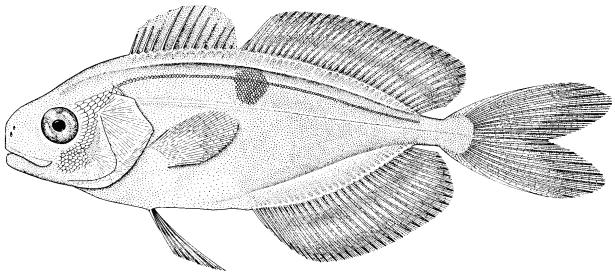
Head spine checklist:

Preopercle: very small spines on edge and midlateral ridge appear at about 5.2 mm, disappear by 9.0 mm

Juveniles: Note long anal fin rays and reduction in body depth from larva to adult (compare Figs. H–J and Adult)



I. 110 mm

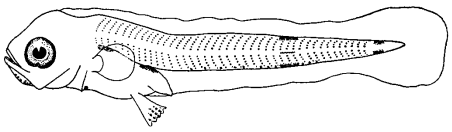


J. 130 mm (patch of scales shown over lateral line)

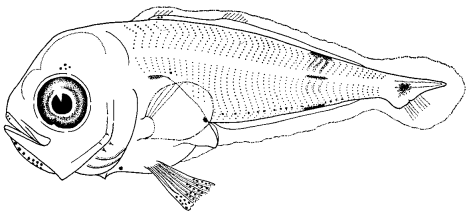
Figures: Adult: Haedrich, 2002; **A–H**: Barbara Sumida (Ahlstrom *et al.*, 1976) **I**: Margaret M. Smith (Haedrich, 1986); **J**: Margaret Bradbury (Haedrich, 1967)

References: Haedrich 1967; 2002; Ahlstrom *et al*., 1976; Horn, 1984

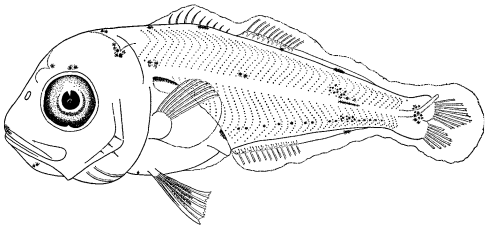
Psenes pellucidus



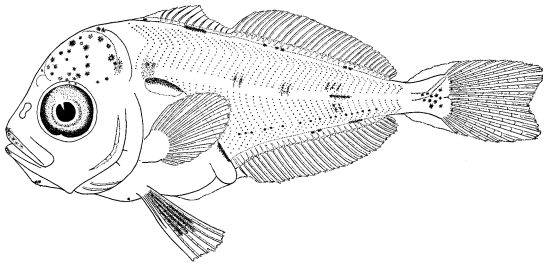
A. 3.8 mmNL



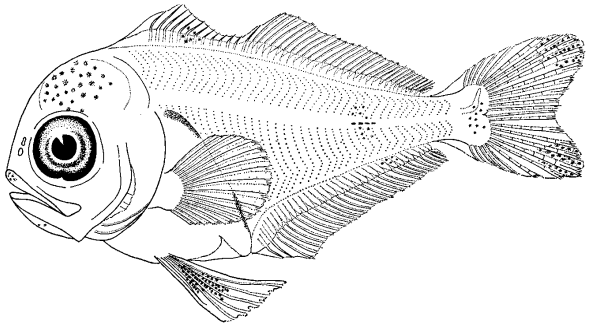
B. 5.2 mmSL

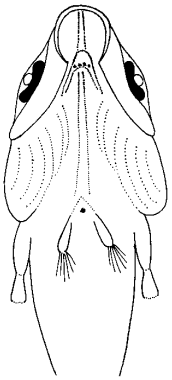


C. 5.9 mmSL



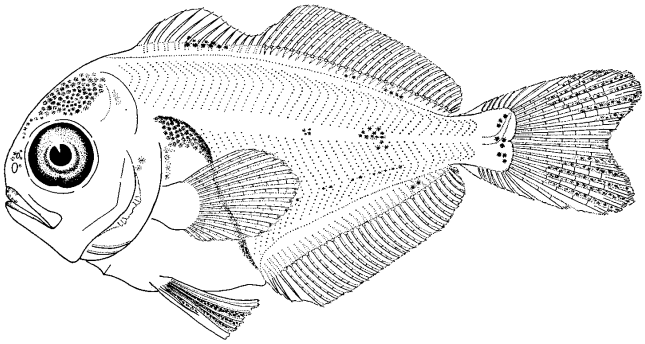
D. 7.4 mmSL





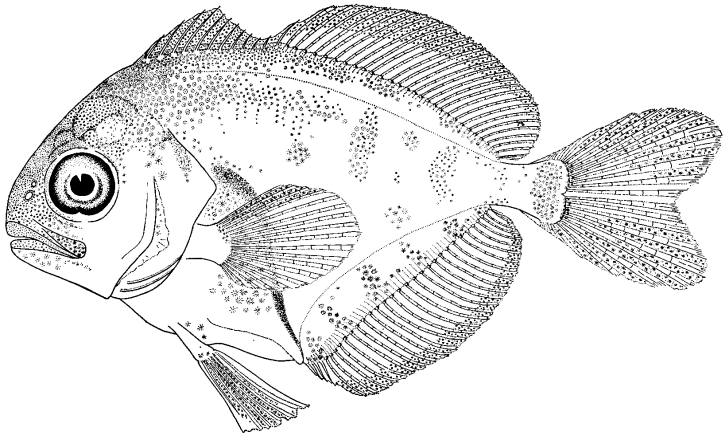
E. 4.2 mmNL (Venter of Head)

F. 9.7 mmSL



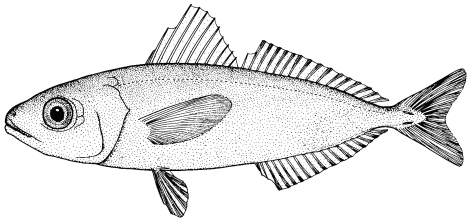
G. 12.4 mmSL

Larvae in Figs. C, D and E collected from western Atlantic Ocean, all others from eastern Pacific Ocean



H. 24.4 mmSL

Ariomma melanum (Ginsburg, 1954)
Ariommatidae
Brown driftfish



Range: Atlantic Ocean; in the western North Atlantic from New York and Bear Seamount to Panama, including Gulf of Mexico and western Caribbean Sea; also continental slope of eastern Atlantic Ocean off West Africa

Habitat: Demersal or benthopelagic in depths of 140–750 m; usually over soft mud substrates on upper continental slope; young stages epipelagic

Spawning: Undescribed; larvae present during Apr–May in Gulf of Mexico

Eggs: – Undescribed

Meristic Characters

Myomeres:	30–31
Vertebrae:	15 + 16 = 30–31
Dorsal fin rays:	XI, 15–18
Anal fin rays:	III, 13–16
Pectoral fin rays:	21–23
Pelvic fin rays:	I, 5
Caudal fin rays:	9+8 (PrC)
Supraneurals:	3 (distribution relative to neural spines undescribed)

Larvae:
- Body moderately deep, especially through pectoral region
- Head length about 40% SL
- Body depth 40–50% SL, becoming slimmer in juveniles and adults
- Gut shape bulky, tightly coiled, protrudes from ventral outline in early stages
- Preanus length increases from about 45% SL to >60% SL
- Flexion occurs at 3.4–3.9 mmSL
- Sequence of fin ray formation: $C_1 - D_2$, $A - D_1$, $P_2 - C_2$, P_1 (not well described)
- Head spines weak; see checklist below
- Lower jaw pigment: short row of melanophores (Fig. E)
- Pigment spreads from a distinct midline blotch between the developing D_2 and A fins, distinct blotches at bases of D_2 and A fins, a large spot on caudal peduncle and a large spot at base of D_1 fin, extending onto the spines; scattered spots on top of head and across opercle; gut overlain with heavy pigment; partial or full bars begin to form over body in larger larvae

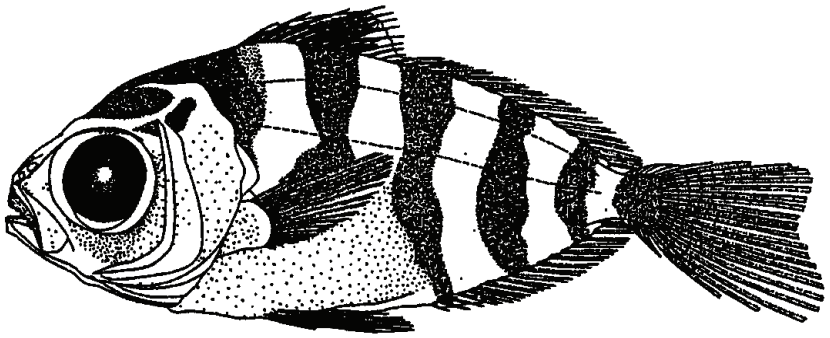
Head spine checklist:

Preopercle: 7–8 small, thin spines develop on edge at about 5.1 mmSL; reduced to ridges at 11.9 mm and no longer visible by 23.9 mm

Note: 1. Also see Aboussouan (1983) for descriptions of larvae 5.0–18.0 mmSL; the 18.0 mmSL larva in this series, combined with the series illustrated here, indicates late formation of the fifth pigment bar (between the posterior parts of D_2 and A fins)

Early Juvenile:

Note formation of 6 bars crossing body between nape and caudal peduncle

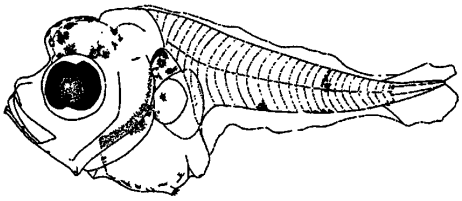


G. 23.9 mmSL

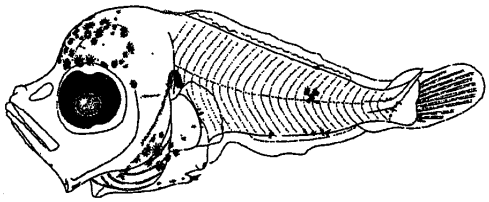
Figures: Adult: Haedrich, 2002; **A–G**: Lamkin, 1997

References: Haedrich 1967; 2002; Ahlstrom *et al*., 1976; Horn, 1972; 1984; Aboussouan, 1983

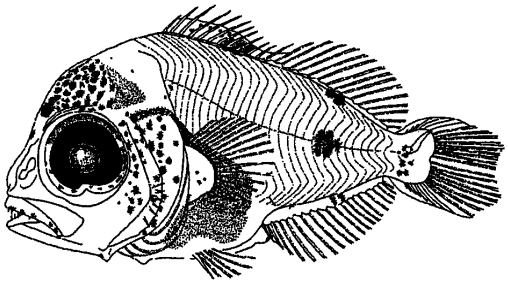
Ariomma melanum



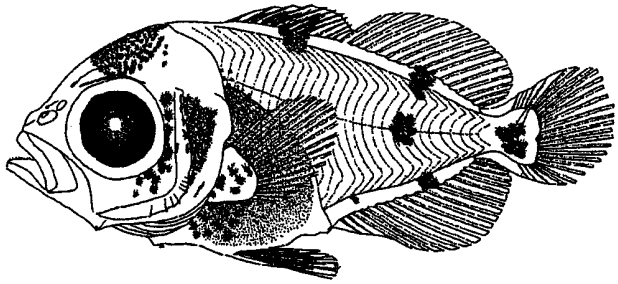
A. 3.5 mmNL



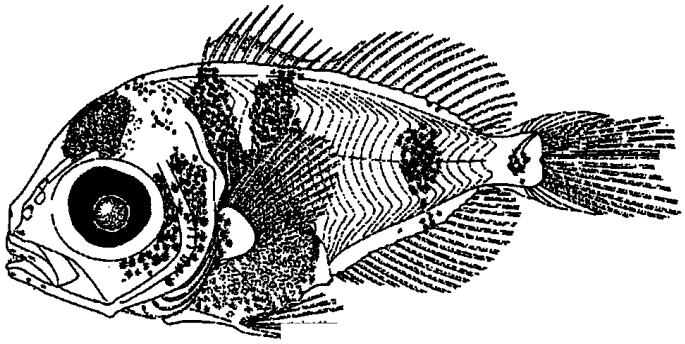
B. 3.9 mmSL



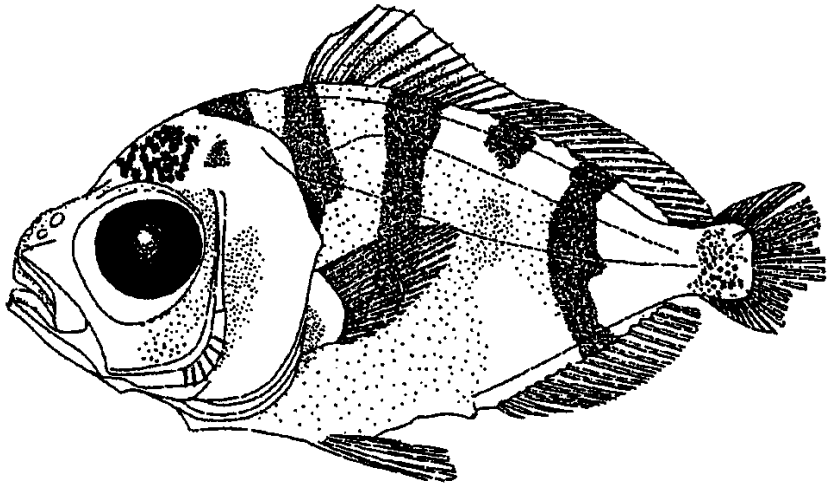
C. 5.6 mmSL



D. 7.2 mmSL

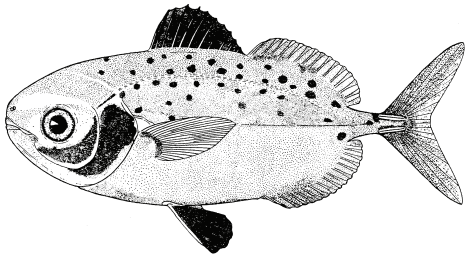


E. 8.8 mmSL



F. 11.9 mmSL

Ariomma regulus (Poey, 1868)
Ariommatidae
Spotted driftfish



Range: Western North Atlantic Ocean from New Jersey to the Guyanas, including Gulf of Mexico and Caribbean Sea (Cuba); primarily tropical, but young stages may be carried into study area *via* Gulf Stream

Habitat: Poorly described, probably benthopelagic; transition from larval and juvenile to adult stage occurs in depths of 200–500 m; adults have also been collected in depths of 25–77 m and a few from near surface

Spawning: Poorly described; possibly prolonged, fall to spring

Eggs:
- Undescribed; ovarian eggs 0.90–1.18 mm in diameter with single or several golden-brown oil globules

Meristic Characters

Myomeres:	30–32
Vertebrae:	30–32
Dorsal fin rays:	XI–XII, 14–15
Anal fin rays:	III, 14–15
Pectoral fin rays:	21–24
Pelvic fin rays:	I, 5
Caudal fin rays:	9+8 (PrC)
Supraneurals:	3 (distribution relative to neural spines undescribed)

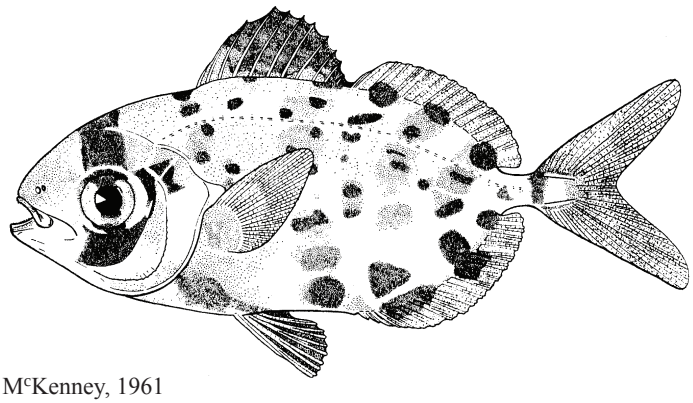
Larvae:
- Body deep, abruptly tapering to narrow caudal peduncle
- Head profile smoothly rounded with blunt snout; head length decreases from 45% SL to about 40% SL in larger larvae and juveniles
- Body depth >50% SL in larval stages; (probably <50% SL in larvae of narrow-bodied congeners; see note box on figure page)
- Preanus length >60% SL
- Flexion occurs at undescribed size (<7.0 mmSL)
- Sequence of fin ray formation: $C_1 - D_2$, $A - D_1$, $P_2 - C_2$, P_1 (tentative)
- Head spines weakly developed; see checklist below
- Lower jaw pigment: none
- Pigment includes heavy scattering of spots on top of head and across opercle; body pigment begins as blotches on caudal peduncle, at midline on posterior body, and as partial bars under developing dorsal fin; pelvic fin well pigmented; venter of head and gut remain unpigmented; note that putative larvae of congeners may have more definite barred pattern (Figs. B–D), whereas in larvae of *Ariomma regulus* the bars may begin as disconnected spots

Head spine checklist:

Preopercle: very small spines occur along edge in early stages; larger larvae have serrated edge, not spines

Note:
1. Larvae identified as "*Ariomma* sp." are frequently collected in the study area and a single early juvenile (34.0 mmSL) identified as *Ariomma bondi* has been collected at 41°24'N, 56°12'W (MCZ 79350). Larvae of the latter species are undescribed.

Juvenile:

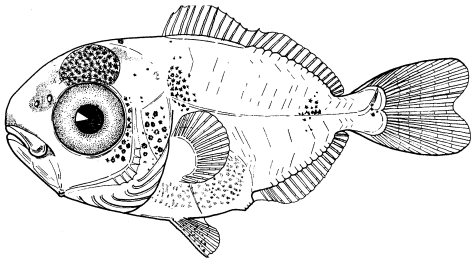


F. 91.2 mmSL

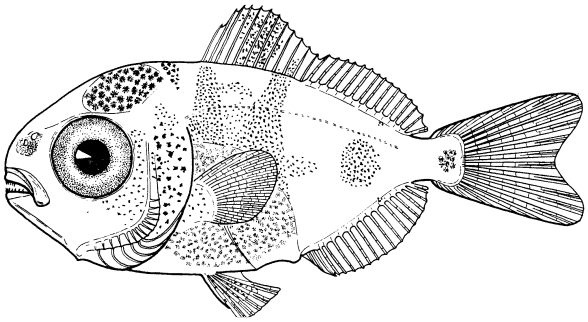
Figures: Adult: McKenney, 1961; **A–F**: McKenney, 1961

References: McKenney, 1961; Haedrich 1967; 2002; Ahlstrom *et al*., 1976; Horn, 1972; 1984

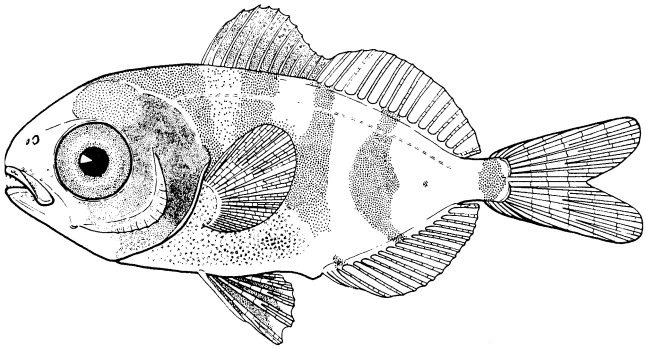
Ariomma regulus



A. 7.0 mmSL

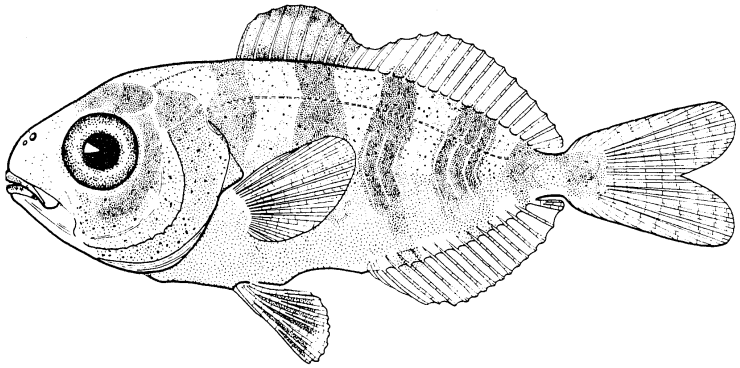


B. 10.2 mmSL

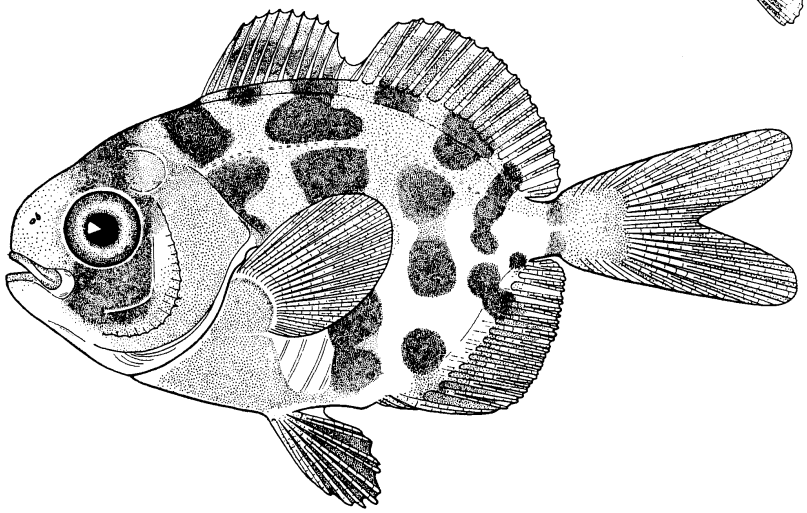


Middle dorsal spines longest
(Compare to *Nomeus gronovii*)

C. 16.4 mmSL



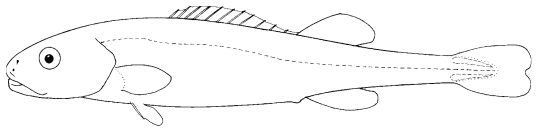
D. 25.8 mmSL



E. 39.7 mmSL

The author of the *Ariomma regulus* larval descriptions acknowledged that the series may have included both deep-bodied larvae of *Ariomma regulus*, and shallow-bodied larvae representing either *Ariomma melanum* or *Ariomma bondi*. (McKenney, 1961). Larvae in Figs. B-D may refer to the latter.

Tetragonurus atlanticus Lowe, 1839
Tetragonuridae
Bigeye squaretail



Range: Atlantic, Pacific and Indian oceans in warm waters; in the western North Atlantic from Grand Bank and Nova Scotia to Caribbean Sea

Habitat: Epi- to mesopelagic in depths to 800 m

Spawning: Winter-spring in Sargasso Sea and Caribbean Sea

Meristic Characters

Myomeres:	44–51
Vertebrae:	23–24 + 20–22 = 44–51
Dorsal fin rays:	XIV–XVII, 10–13
Anal fin rays:	I, 9–12
Pectoral fin rays:	14–18
Pelvic fin rays:	I, 5
Caudal fin rays:	9–10+9+8+9–10
Supraneurals:	none

Eggs:
- Pelagic, spherical
- Diameter: 1.10 mm
- Chorion: smooth, golden-pink
- Yolk: homogeneous
- Oil globule: single, 0.24 mm in diameter
- Perivitelline space: moderate

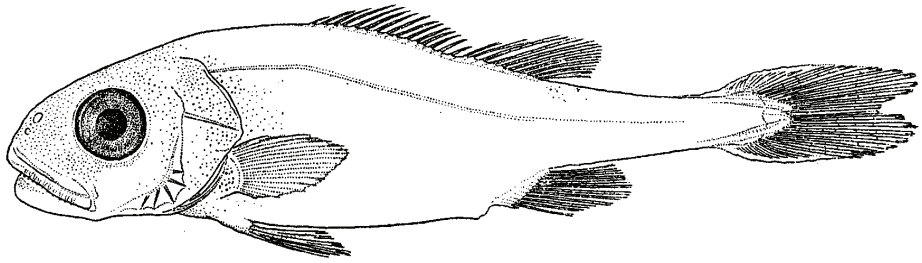
Larvae:
- Body moderately elongate with long, narrow caudal peduncle in later larvae
- Head length increases from 14% SL to 35% SL
- Body depth 13–20% SL in preflexion, 24–28% in postflexion
- Gut shape long, straight and thick
- Preanus length 63–69% SL in preflexion, 64–71% SL in postflexion
- Flexion occurs at about 5.0–8.0 mmSL
- Sequence of fin ray formation: C – D_2, A – D_1 – P_1 – P_2
- Dorsal fin spines shorter than fin rays; anal fin origin slightly posterior to D_2 fin origin
- Head spines weakly developed; see checklist below
- Lower jaw pigment: scattered
- Pigment includes scattering of spots on top of head and along dorsum of gut; preflexion and early flexion larvae have melanophores in a short row on dorsum of caudal peduncle and a longer row along venter of tail continuous with a row over gut; few spots across body at level of anus spread to form uniform scattering on most of head and body, but pigment lacking on caudal peduncle

Head spine checklist:

Preopercle: small spines along edge form at about 7.0 mmSL; few at angle slightly larger; disappear during juvenile stage

Note: 1. Egg characters based on Pacific Ocean material; pigment pattern described above differs in some details from that described for Pacific Ocean larvae (Ahlstrom *et al.*, 1976)

Juvenile:

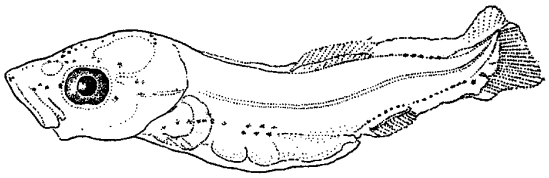


G. 43.6 mmSL

Figures: Adult (*Tetragonurus* sp.): Haedrich, 2002; **A–G**: Grey, 1955

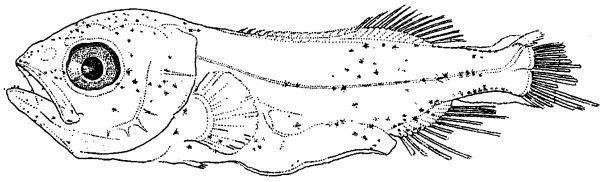
References: Grey, 1955; Haedrich 1967; 2002; Ahlstrom *et al*., 1976; Horn, 1984; Scott and Scott, 1988

Tetragonurus atlanticus

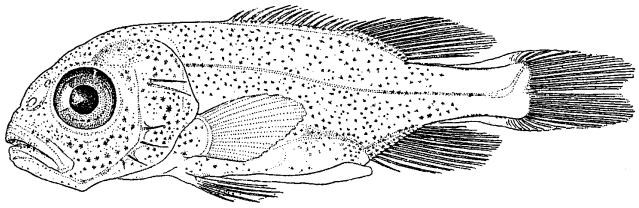


A. 5.3 mmSL

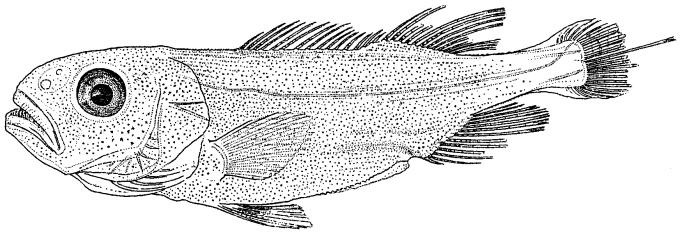
Note line of melanophores along midline of caudal peduncle



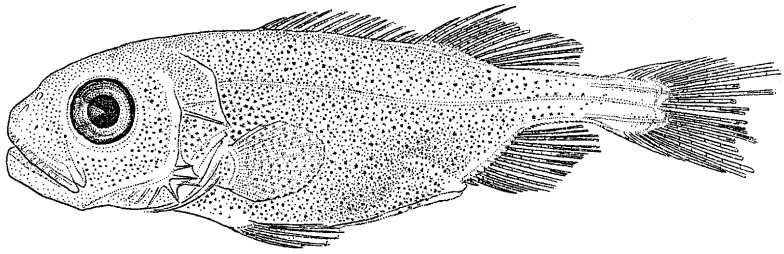
B. 8.5 mmSL



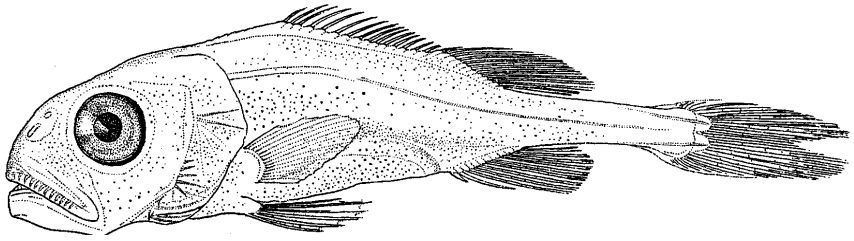
C. 11.5 mmSL



D. 20.0 mmSL

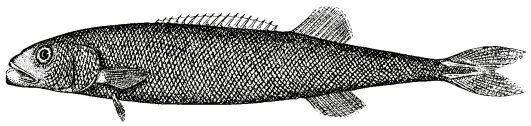


E. 23.0 mmSL



F. 29.1 mmSL

Tetragonurus cuvieri Risso, 1810
Tetragonuridae
Smalleye squaretail



Range: Atlantic and Pacific oceans and Mediterranean Sea; in the western North Atlantic from Grand Bank and Woods Hole, Massachusetts to extreme eastern edge of study area in northern Sargasso Sea; more common in temperate, eastern Atlantic, but not abundant in any part of range

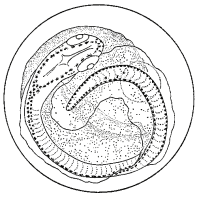
Habitat: Oceanic in temperate waters; young stages epipelagic, often associated with pelagic tunicates (e.g. *Salpa, Pyrosoma*); adults mesopelagic and solitary

Spawning: Spring-summer in the Atlantic; year-round in Mediterranean Sea

Meristic Characters

Myomeres:	51–58
Vertebrae:	51–58
Dorsal fin rays:	XV–XXI, 10–17
Anal fin rays:	I–II, 9–15
Pectoral fin rays:	14–21
Pelvic fin rays:	I, 5
Caudal fin rays:	9–12+9+8+9–12
Supraneurals:	none

Eggs:
- Pelagic, spherical
- Diameter: 1.10–1.28 mm
- Chorion: golden-pink
- Yolk: homogeneous
- Oil globule: single, 0.25–0.30 mm in diameter
- Perivitelline space: moderate



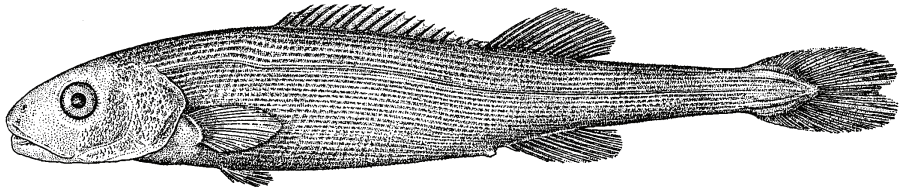
Larvae:
- Body moderately elongate with long, narrow caudal peduncle in later larvae
- Head length increases from 11–23% SL in preflexion to 25–32% SL in postflexion
- Body depth 10–18% SL in preflexion, 20–25% in postflexion
- Gut shape long, straight and thick
- Preanus length 57–64% SL in preflexion, 58–67% SL in postflexion
- Flexion occurs at 7.6–10.1 mmSL
- Sequence of fin ray formation: C – D_2, A – D_1 – P_1 – P_2
- Dorsal fin spines shorter than fin rays; anal fin origin slightly posterior to D_2 fin origin
- Head spines weakly developed; see checklist below
- Lower jaw pigment: scattered
- Pigment uniform but light; rows of pigment spots along venter from cleithrum to tail tip, along dorsum of caudal peduncle and along posterior midline are similar to those in *Tetragonurus atlanticus* but with added melanophores around tip of notochord, beginning in preflexion stages; scattered pigment on top of head; late larvae are uniformly pigmented, including the caudal peduncle

Head spine checklist:

Preopercle: small spines form along edge at about 10.0 mmSL; become embedded in late larvae

Note: 1. Egg characters based on Pacific ocean material

Juvenile:

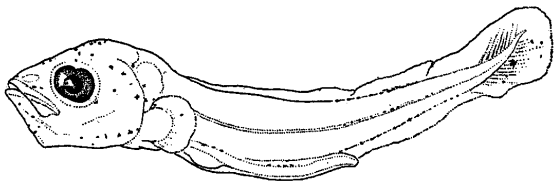


G. 127.8 mmSL

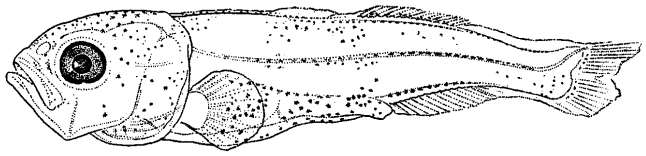
Figures: Adult: Bon Harriott (Hart, 1973); Egg: Barbara Sumida (Ahlstrom *et al.*, 1976); **A–G**: Grey, 1955

References: Dannevig, 1919; Grey, 1955; Haedrich 1967; 2002; Ahlstrom *et al*., 1976; Horn, 1984; Scott and Scott, 1988

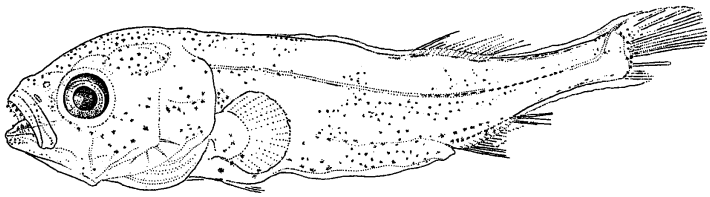
Tetragonurus cuvieri



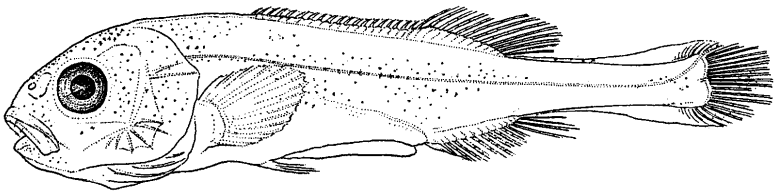
A. 6.6 mmSL



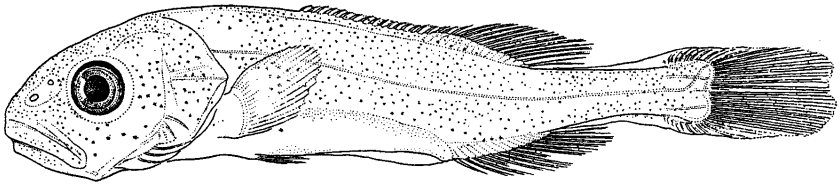
B. 7.1 mmSL



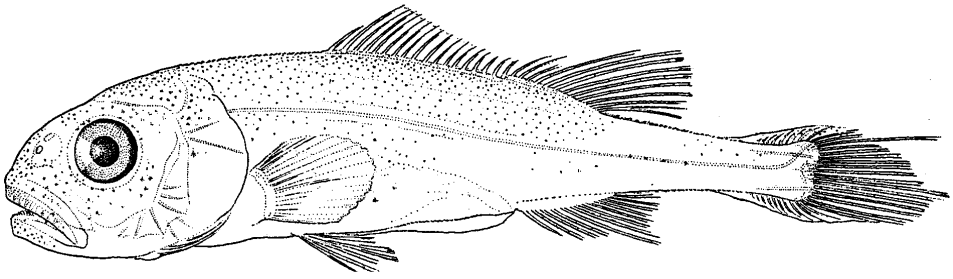
C. 9.4 mmSL



D. 17.5 mmSL

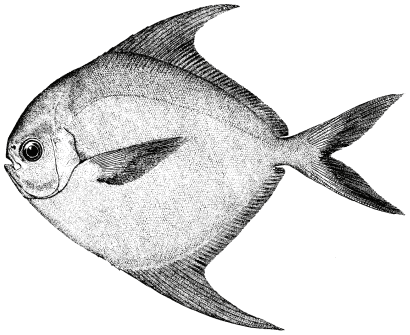


E. 21.0 mmSL



F. 23.6 mmSL

Peprilus paru (Linnaeus, 1758)
Stromateidae
American harvestfish



Range: Western Atlantic Ocean from Chesapeake Bay (rarely Gulf of Maine) to Argentina, including Gulf of Mexico, but absent from Bermuda and Bahamas

Habitat: Pelagic, schooling, in bays, estuaries, inner continental shelf over moderate depths (50–70 m); juveniles occur in shallower water, often under floating weed or in association with medusae

Spawning: Spring-early summer in continental shelf or lower bay waters between Delaware Bay, Chesapeake Bay and Brazil

Meristic Characters

Myomeres:	29–31
Vertebrae:	12–13 + 16–18 = 29–31
Dorsal fin rays:	II–IV, 38–49
Anal fin rays:	II–III, 35–45
Pectoral fin rays:	18–24
Pelvic fin rays:	none
Caudal fin rays:	5–6+9+8+5–6
Supraneurals:	0/0/0/1

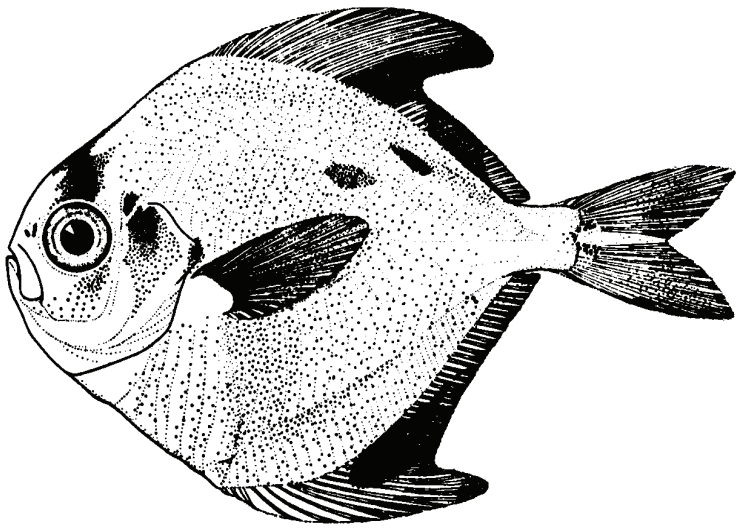
Eggs:
- Pelagic, spherical
- Diameter: about 1.0 mm
- Other characters undescribed

Larvae:
- Body moderately deep with round head; body deepens early in development
- Body depth increases from about 30% SL in preflexion to about 70% SL in juveniles
- Head length increases from about 32% SL in preflexion to about 40% SL in juveniles
- Gut bulky with posterior extension; becomes compact and round
- Preanus length decreases from about 59% SL in preflexion to about 51% SL in juveniles
- Flexion occurs at 3.5–4.3 mmSL
- Sequence of fin ray formation: $C_1 - D_2$, A, $P_1 - D_1$, C_2
- Head spines weakly developed; see checklist below
- Pigment in early larvae concentrated into 2 irregular rows on middle parts of flank from head to the halfway point of tail; few large spots cover the gut; after flexion, head and body covered with uniform scattered spots except for unpigmented region between posterior D and A fins;

Head spine checklist:

Preopercle: small spines along edge

Juvenile:

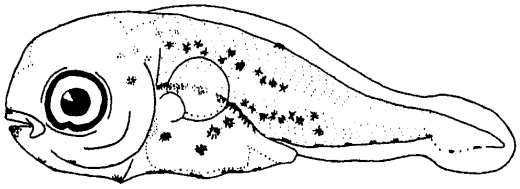


F. 62.0 mmTL

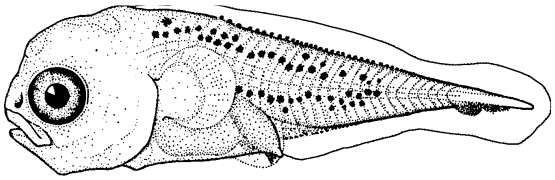
Figures: Adult: H. L. Todd (Klein-M^{ac}Phee, 2002t); **A–B**, **F**: Pearson, 1941; **C–E**: James Ditty (Ditty and Truesdale, 1983)

References: Pearson, 1941; Haedrich 1967; 2002; Lippson and Moran, 1974; D'Vincent *et al.*, 1980; Ditty and Truesdale, 1983; Horn, 1970; 1984

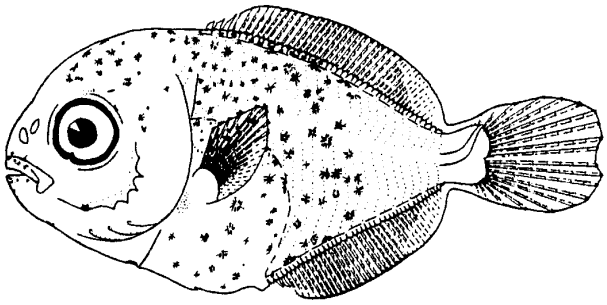
Peprilus paru



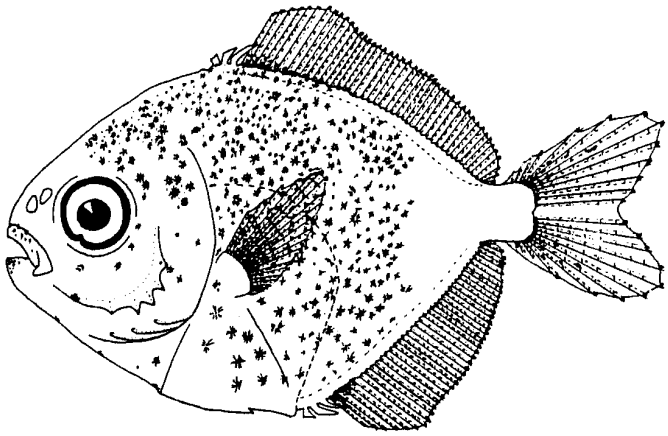
A. 2.8 mmSL



B. 3.5 mmTL

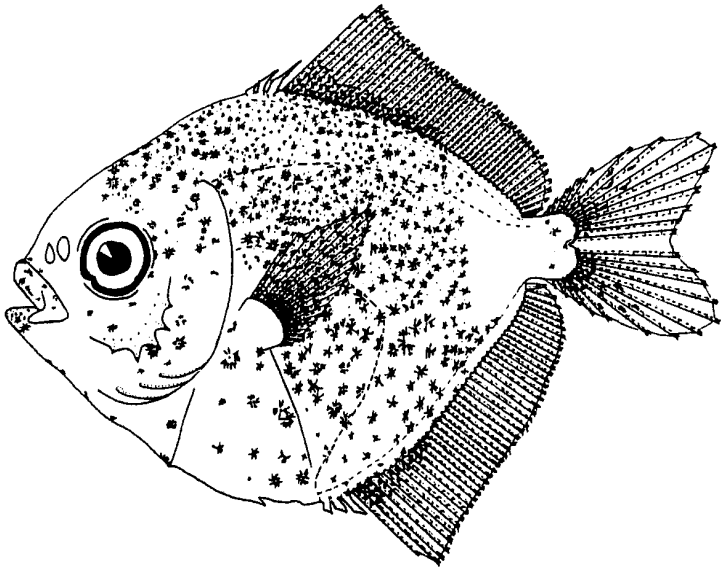


C. 6.6 mmSL



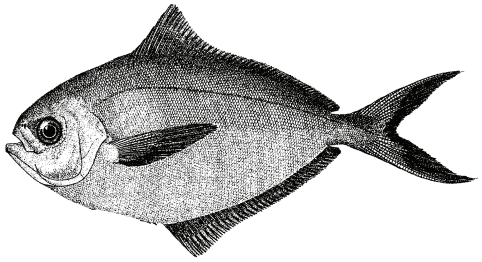
D. 9.8 mmSL

Similar, scattered pigment on the mid-flank occurs in larvae of *Calamus* sp. (Sparidae). The latter larvae also have pronounced spines along edge of preopercle, but have fewer myomeres (24) and less pigment on the head. They have not yet been reported from the study area. See Powell and Greene (2006).



E. 14.8 mmSL

Peprilus triacanthus (Peck, 1804)
Stromateidae
Atlantic butterfish



Range: Western North Atlantic Ocean from Gulf of St. Lawrence to Gulf of Mexico; most abundant Maine to Cape Hatteras, small population off Newfoundland; absent from Bermuda, Bahamas

Habitat: Occurs near bottom over sand or mud substrates in depths of 30–270 m; eggs and larvae occur in offshore waters, juveniles occur in estuaries, bays and coastal waters; off Florida, a deep-bodied form without spots occurs over shallow (<50 m) sand bottoms and a shallow-bodied form with spots occurs over deep (>250 m) mud bottoms

Spawning: Spring-summer in study area, as early as Feb off southern United States; spawning proceeds in northerly progression along edge of continental shelf

Meristic Characters

Myomeres:	30–33
Vertebrae:	13 + 17–20 = 30–33
Dorsal fin rays:	II–IV, 40–48
Anal fin rays:	III, 37–44
Pectoral fin rays:	17–22
Pelvic fin rays:	none
Caudal fin rays:	7–9+9+8+7–8
Supraneurals:	0/0/0/1

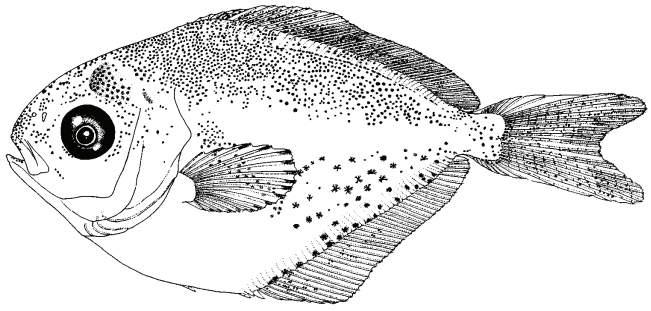
Eggs:
- Pelagic, spherical
- Diameter: 0.68–0.83 mm
- Chorion: smooth, transparent
- Yolk: homogeneous, amber
- Oil globule: single, 0.17–0.21 mm in diameter
- Perivitelline space: narrow

Larvae:
- Body moderately deep with round head; body deepens early in development
- Body depth increases from about 30% SL in preflexion to about 52% SL in postflexion
- Head length increases from about 30% SL in preflexion to about 35% SL in postflexion
- Gut bulky with posterior extension; becomes compact and round
- Preanus length decreases from about 56% SL in preflexion to about 46% SL in postflexion
- Flexion occurs at about 3.8–4.8 mmSL
- Sequence of fin ray formation: $C_1 - D_2$, A, $P_1 - D_1$, C_2
- Head spines weakly developed; see checklist below
- Pigment light initially; row of spots along venter of tail; venter of gut pigmented, similar to line of "stitching"; scattered pigment on top of head and over gut; later larvae become uniformly pigmented

Head spine checklist:

Preopercle: tiny spines form along edge at about 7.0 mm

Early Juvenile:

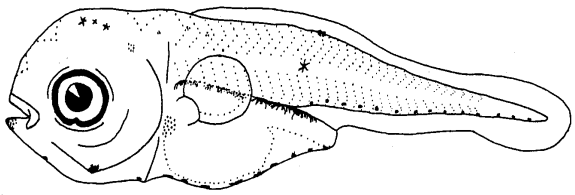


F. 24.0 mmTL

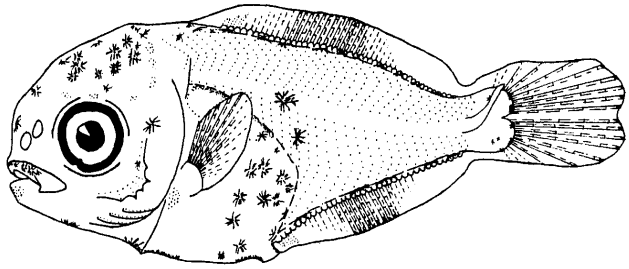
Figures: Adult: H. L. Todd (Klein-M^{ac}Phee, 2002t); **A–B**, **D–E**: James Ditty (Ditty and Truesdale, 1983); **C**: Lippson and Moran, 1974 (redrawn); **F**: Nancy Arthur (Able and Fahay, 1998)

References: Pearson, 1941; Haedrich 1967; 2002; Lippson and Moran, 1974; D'Vincent *et al*., 1980; Ditty and Truesdale, 1983; Horn, 1970; 1984; Rotunno and Cowen, 1997; Able and Fahay, 1998; Hare *et al*., 2001

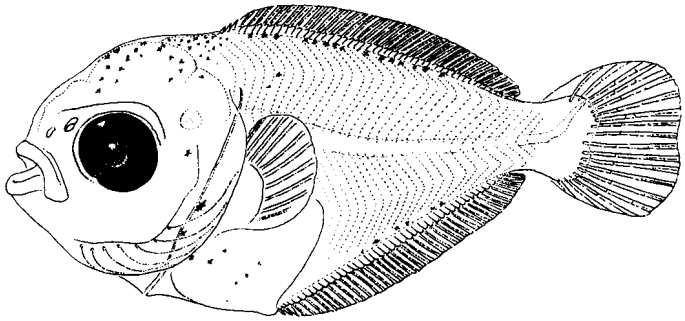
Peprilus triacanthus



A. 3.0 mmSL

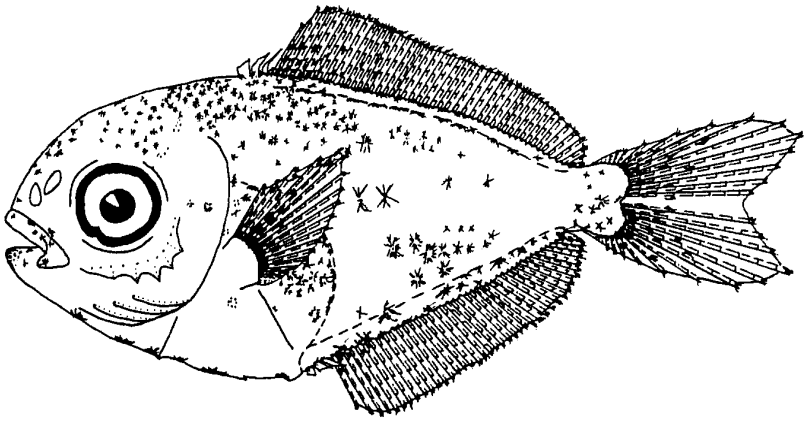


B. 6.6 mmSL

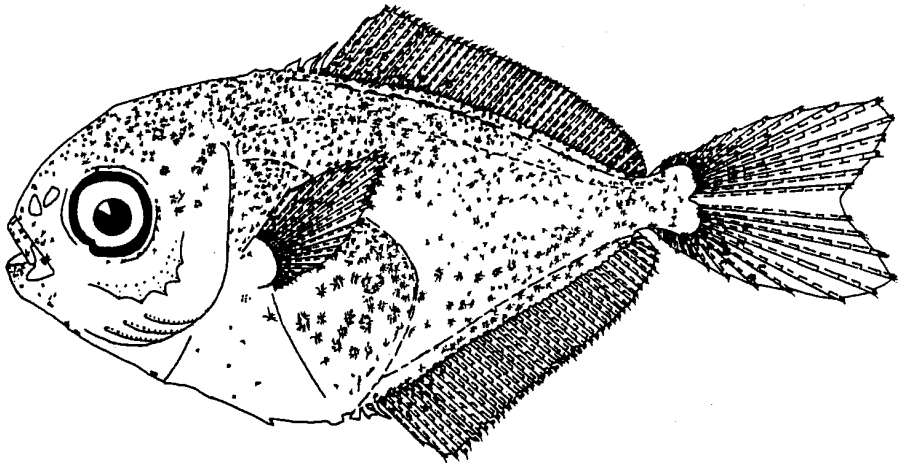


Ventral spots separate, not
1 per myomere as in
Stenotomus chrysops (Sparidae)

C. 7.2 mmTL



D. 9.8 mmSL



E. 14.7 mmSL