Perciformes
Suborder Percoidei Part III – Families Malacanthidae through Sciaenidae

Selected meristic characters in species belonging to the percoid families Malacanthidae through Rachycentridae whose adults or larvae have been collected in the study area. Classification sequence is alphabetical. Most taxa have pelvic fin formula of I, 5. See species accounts for sources.

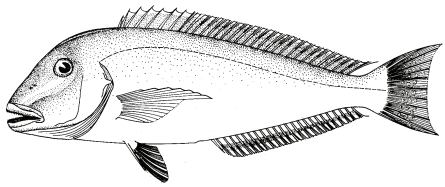
Family *Species*	Vertebrae	Dorsal Fin	Anal Fin	Caudal (Procurrent, Dorsal + Ventral)	Pectoral Fin
Malacanthidae					
Caulolatilus microps	11+16	VII–VIII, 24–27	II, 22–24	10–13+9–13	17–18
Lopholatilus chamaeleonticeps	10+14	VII–VIII, 14–15	I, 13–14	9–13+9–13	16–18
Moronidae					
Morone americana	11+14	VII–XI, I, 11–13	III, 9–10	10–13+9–13	10–18
Morone saxatilis	12+13	VIII–IX, I, 9–14	III, 7–13	10–13+9–13	13–19
Mullidae					
Mullus auratus	10+14	VIII, I, 8	I, 7	9+10	15–17
Pseudupeneus maculatus	10+14	VIII, I, 8	I, 7	9+10	13–16
Upeneus parvus	10+14	VII, I, 8	I, 7	9+10	15–16
Polyprionidae					
Polyprion americanus	13+14	XI–XII, 11–12	III, 9–10	9+9	17–18
Pomatomidae					
Pomatomus saltatrix	11+15	VII–VIII,I,23–28	II, 24–29	9–10+8–9	16–17
Priacanthidae					
Cookeolus japonicus	10+13	X, 12–14	III, 12–14	4+4	18–19
Priacanthus arenatus	10+13	X, 13–15	III, 14–16	5–6+5–6	17
Heteropriacanthus cruentatus	10+13	X, 13–14	III, 14–15	4+4	18–19
Pristigenys alta	10+13	X, 10–12	III, 9–11	4+4	16–19
Rachycentridae					
Rachycentron canadum	11+14	VII–VIII,I,26–34	I–II, 22–28	15–16+12–14	20–21

Perciformes
Suborder Percoidei Part III – Families Malacanthidae through Sciaenidae

Selected meristic characters in species belonging to the percoid family Sciaenidae whose adults or larvae have been collected in the study area. Distributional data after Chao (2002). Classification sequence is alphabetical. See species accounts for sources.

Family *Species*	Vertebrae	Dorsal Fin	Anal Fin	Caudal (Procurrent, Dorsal + Ventral)	Pectoral Fin
Sciaenidae					
Bairdiella chrysoura	11+14	XI–XII,19–23	II, 8–10	8–9+5–8	15–17
Cynoscion nebulosus	12+13	X–XI, 24–28	II, 9–12	6–9+5–7	18–20
Cynoscion nothus	15+12	XI, 26–31	II, 8–10	7–8+6–8	18–19
Cynoscion regalis	13+12	XI, 24–29	II, 10–13	7–9+5–7	18
Larimus fasciatus	11+14	XI–XII, 24–27	II, 6–7	6–7+4–7	16–17
Leiostomus xanthurus	10+15	X–XII, 33–35	II, 12–13	6–8+6–8	21–22
Menticirrhus americanus	10+15	XI, 20–26	I, 6–8	8–9+7	18–24
Menticirrhus littoralis	10+15	XI, 21–26	I, 6–8	7–8+6	18–21
Menticirrhus saxatilis	10+15	XI, 22–27	I, 7–9	6–8+6	18–21
Micropogonias undulatus	10+15	XI, 26–31	II, 7–9	8–9+8	17–18
Pareques acuminatus	10+15	VIII–X, I, 37–41	II, 7–8	7–8+6–7	16–17
Pareques umbrosus	10+15	IX–X, I, 38–40	II, 7	7–8+7	15
Pogonias cromis	10+14	XI, 19–23	II, 5–7	8–9+7	18
Sciaenops ocellata	10+15	XI, 23–25	II, 7–9	8–10+7–9	17
Stellifer lanceolatus	10+15	XI–XII, 19–21	II, 8–10	7–9+6–9	18–20
Umbrina coroides	11+14	IX–X, I, 26–30	II, 6	8–9+7–8	16–18

Caulolatilus microps Goode and Bean, 1878
Malacanthidae (or Branchiostegidae)
Grey tilefish



Range: Western North Atlantic Ocean from latitude of Cape Charles, Virginia to Campeche Banks, Mexico, including Gulf of Mexico

Habitat: Mud and rubble substrates on outer continental shelf and upper continental slope in depths of 30–236 m; probably builds and inhabits burrows

Spawning: Undescribed

Eggs: – Undescribed

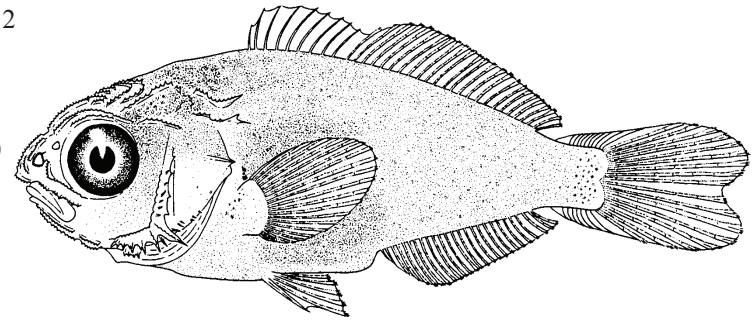
Meristic Characters

Myomeres:	27
Vertebrae:	11 + 16 = 27
Dorsal fin rays:	VII–VIII, 24–27
Anal fin rays:	II, 22–24
Pectoral fin rays:	17–18
Pelvic fin rays:	I, 5
Caudal fin rays:	10–13+9+8+9–13
Supraneurals:	//2+1+1+1+1/1+1 etc

Larvae:
- Undescribed; the following notes refer to a congener, *C. princeps* from the eastern Pacific
- Hatch at <2.6 mmNL; body initially elongate, soon deepens from 26% SL to about 40% NL
- Preanus length increases from about 50% SL to 62% SL
- Flexion occurs at 5.5–7.0 mmSL
- Vertebrae ossified by about 7.0 mmSL
- Sequence of fin ray formation: C – D_2, A – D_1 – P_1 – P_2
- Head spines very extensive, form in several series (see checklist); all series well-developed by 8.0 mmNL
- Spinous scales form over entire body, beginning with series along dorsum and over gut
- Pigment includes melanophores covering much of the gut, extending internally to otic region and ultimately to snout; spots are also present on nape, both surfaces of pectoral fin base, on opercle bones and brain; a series of 11–14 melanophores along ventral edge of tail internalize and become obscure by 7.0 mmSL; trunk pigment extends posteriorly in larger larvae to cover entire body; a cluster of conspicuous spots cover the flank between the D_2 and A fins

Head spine checklist:

Preopercle:	spines at angle and along edge develop early; spine at angle develops secondary spinules
Frontal:	small spines form in 7 series/ridges
Posttemporal:	single, early spine becomes 2 or more
Dentary:	two series of small spines on lower jaw
Supracleithral:	single spine increases to 3 or more
Supraorbital:	strongly serrated crest
Pterotic:	multi-spine ridge
Suborbital:	multi-spine ridge (= upper lachrymal)
Interopercle:	single spine increases to 3
Subopercle:	single spine increases to 2
Opercle:	single spine
Nasal:	three series of spines
Lachrymal:	two series of spines (1 in suborbital position)



Note: 1. See comments on *Lopholatilus chamaeleonticeps* page

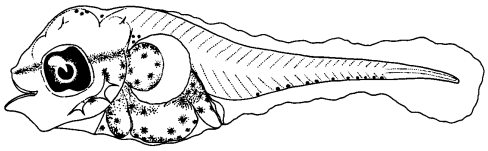
Early Juvenile:

G. 16.8 mmSL

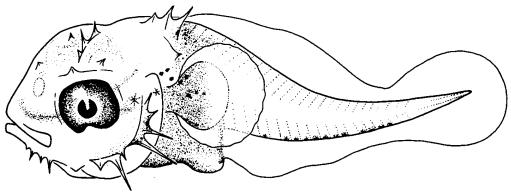
Figures: Adult: Dooley, 2002; **A–G**: Moser *et al.*, 1986

References: Okiyama, 1964; Dooley, 1978; 2002; Fahay and Berrien, 1981; G. D. Johnson, 1984; Moser *et al*., 1986; Moser, 1996j; Berrien and Sibunka, 1999

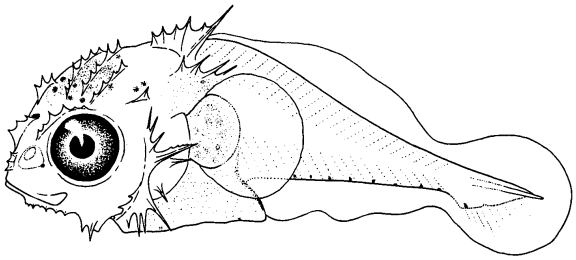
Caulolatilus microps



A. 3.0 mmSL

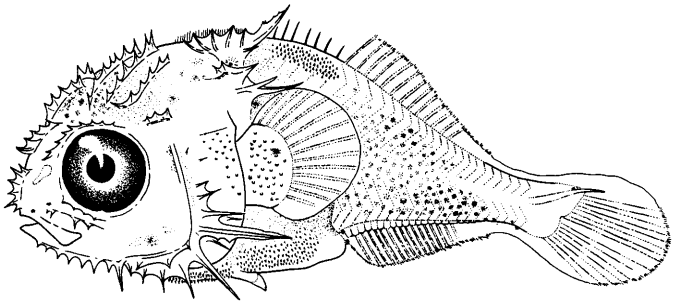


B. 3.8 mmSL

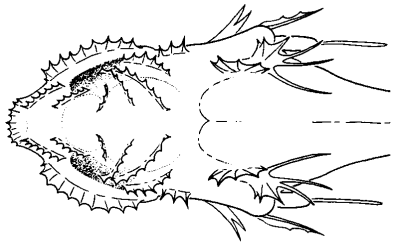


C. 5.3 mmSL

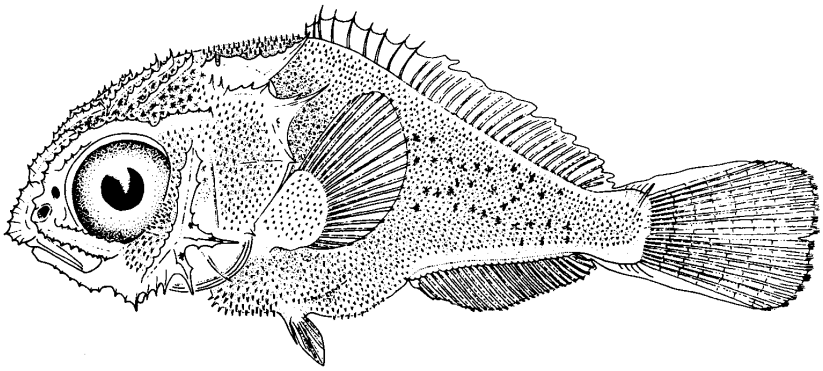
The larvae of *Caulolatilus microps* are undescribed. The larval developmental series of *C. princeps* (an eastern Pacific Ocean species) is included here as representative of the ontogeny of the genus *Caulolatilus*. Except for minor differences in pigmentation, development of *C. microps* is presumably similar.



D. 6.2 mmSL

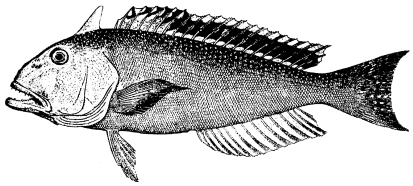


E. 6.2 mmSL
(Dorsal View)



F. 7.9 mmSL

Lopholatilus chamaeleonticeps Goode and Bean, 1879
Malacanthidae (or Branchiostegidae)
Tilefish



Range: Western North Atlantic Ocean from Nova Scotia to Suriname, including Gulf of Mexico and western, southern margin of Caribbean Sea

Habitat: Builds burrows near continental shelf edge in sand, mud or silt-clay substrates in depths of 80–540 m (mostly 100–200 m); often near heads of submarine canyons

Spawning: Mar–Nov with peak in May–Sep; mostly along edge of continental shelf between Georges Bank and Hudson Canyon

Meristic Characters

Myomeres:	24
Vertebrae:	10 + 14 = 24
Dorsal fin rays:	VII–VIII, 14–15
Anal fin rays:	I, 13–14
Pectoral fin rays:	16–18
Pelvic fin rays:	I, 5
Caudal fin rays:	9–13+9+8+9–13
Supraneurals:	0/0/2/1+1/

Eggs:
- Pelagic, spherical, transparent
- Diameter: 1.16–1.25 mm (reared); 1.3–1.4 mm (wild-caught)
- Chorion: thin, reticulations visible under low magnification
- Yolk: homogeneous, amber
- Oil globule: single, 0.18–0.20 mm diameter
- Pervitelline space: moderate

Larvae:
- Hatch at about 2.6 mmNL; body initially elongate, soon deepens from 22% NL to 40% NL
- Preanus length increases from 55% SL to 70% SL
- Flexion occurs at 4.4–5.5 mmNL
- Teeth present by 5.0 mmNL; vertebrae ossified by 8.0 mmSL
- Sequence of fin ray formation: $C - D_2$, $A - D_1 - P_1 - P_2$
- Head spines very extensive, form in several series (see checklist); all series well-developed by 5.0 mmNL
- Spinous scales form over entire body, beginning with series along dorsum and over gut
- Pigment includes melanophores on snout and top of head in preflexion larvae; a line of pigment defines lower edge of body over gut, later becomes mid-lateral stripe; later larvae have a few, scattered accumulations of melanophores on sides of body, including a more prominent patch over anal fin base

Head spine checklist:

Preopercle:	spines along edge develop early
Posttemporal:	single, early spine becomes 2 or more
Supracleithral:	single spine increases to 3 or more
Pterotic:	multi-spine ridge
Frontal:	small spines form in 7 series/ridges
Dentary:	two series of small spines on lower jaw
Supraorbital:	strongly serrated crest
Suborbital:	multi-spine ridge

Note:

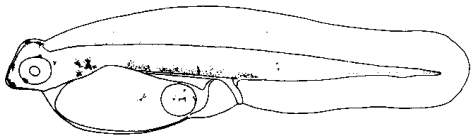
1. Use of the family name Malacanthidae follows Eschmeyer (1990). Several other authors (e.g. Dooley, 2002) use a classification employing 2 subfamilies in the family Branchiostegidae. Ontogenetic data support the separation of taxa into 2 subfamilies (Malacanthinae and Branchiosteginae). Both species reported from the present study area belong to the same sub-family (Branchiosteginae) in the family Malacanthidae (or Branchiostegidae). See further discussion in G. D. Johnson (1984).

2. A recent analysis, based partly on ontogenetic characters (Imamura, 2000), proposes a revised family Dactylopteridae which includes the Malacanthidae and the dactylopterids. This family is further subdivided into 4 subfamilies: Branchiosteginae (*Lopholatilus* and *Branchiostegus*), Malacanthinae (*Caulolatilus* and *Malacanthus*), Hoplolatilinae (*Hoplolatilus*) and Dactylopterinae (*Dactylopterus* and *Dactyloptena*). The nasal bones become fused to form a single element during the larval stages in all these taxa.

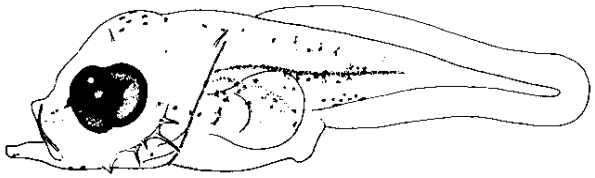
Figures: Adult: H. L. Todd; **A–F**: Fahay and Berrien, 1981

References: Okiyama, 1964; Dooley, 1978; 2002; Fahay and Berrien, 1981; G. D. Johnson, 1984; Moser, 1996j; Berrien and Sibunka, 1999

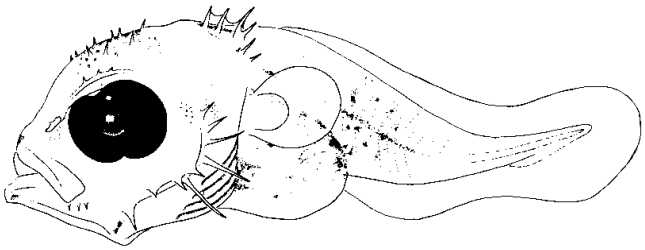
Lopholatilus chamaeleonticeps



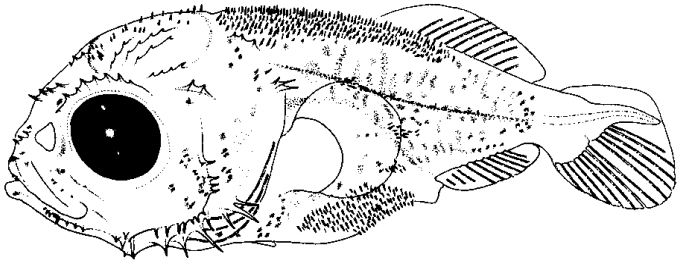
A. 2.6 mmNL



B. 2.8 mmNL

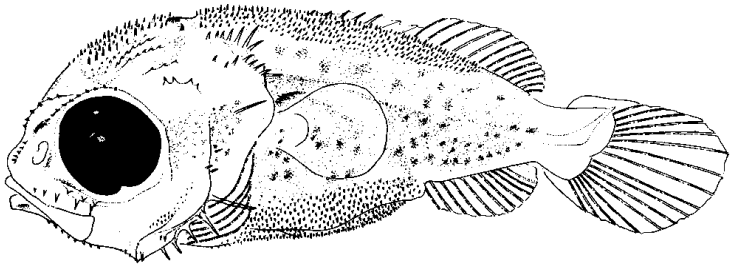


C. 3.7 mmNL



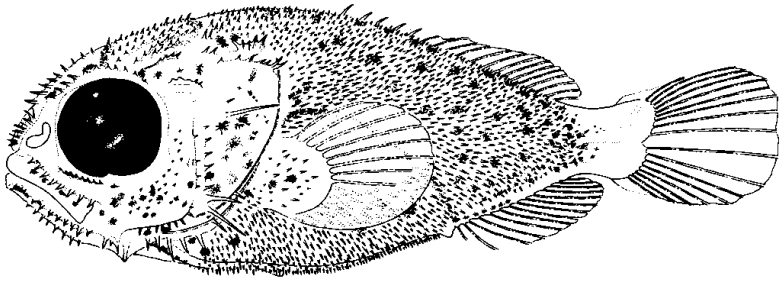
D. 4.8 mmNL

In larvae of *Branchiostegus*, spinous scales begin to form on side of body between D_2 and A fins (see Okiyama, 1964)



E. 5.3 mmSL

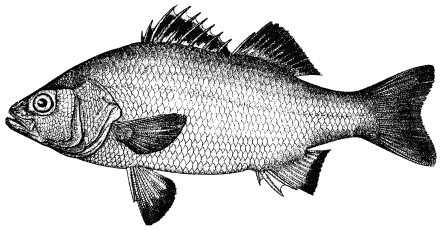
Other series of spines (not included in checklist) form on mesethmoid, nasal, lachrymal, opercle and parietal bones



F. 6.0 mmSL

Pelagic-juveniles descend to bottom at 9.0-15.5 mmSL

Morone americana (Gmelin, 1789)
Moronidae
White perch



Range: Eastern North America from New Brunswick and Nova Scotia to South Carolina; also Lake Erie and Lake Ontario

Habitat: Coastal waters including bays, estuaries, brackish streams; also introduced into freshwater lakes; often around structured habitats

Spawning: Spring-summer in study area; occurs over variety of substrates (sand, gravel, clay, rocky ledges) in brackish to fresh waters

Meristic Characters

Myomeres:	25
Vertebrae:	11+14 = 25
Dorsal fin rays:	VII–XI,I,11–13
Anal fin rays:	III, 9–10
Pectoral fin rays:	10–18
Pelvic fin rays:	I, 5
Caudal fin rays:	10–13+9+8+9–13
Supraneurals:	0/0/0+1/1/1+1/1/

Eggs:
- Spherical, with attachment disk
- Diameter: 0.65–1.09 mm
- Chorion: thick, sculpted, yellowish to brownish
- Yolk: granular, amber-colored
- Oil globule: usually single, 0.2–0.45 mm diameter, sometimes several
- Perivitelline space: narrow

Larvae:
- Hatching occurs at lengths of 1.7–3.0 mm; body slender, preanus length >50% SL
- Flexion occurs at about 6.0–11.0 mm SL
- Sequence of fin ray formation: C – D_2, A – D_1 – P_2 – P_1; D_2 fin base slightly longer than A fin base
- 2nd A spine same length as 3rd and noticeably thicker than 1st or 3rd
- Pigment very light, includes accumulations over air bladder, few spots along ventral edge of tail, on top of head (in early larvae); larger larvae have scattered melanophores along midline and over much of body, forming vague bars in juveniles

Head spine checklist:

Preopercle: very small spines or serrations on edge and on lateral ridge (none prominent)

Note: 1. Interdigitation patterns are critical for accurate identifications of moronid early stages. The following table demonstrates the most frequently observed patterns in two species. (Modified after Olney *et al*., 1983)

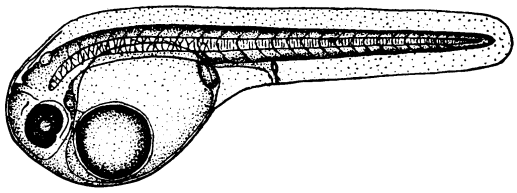
Most Frequently Observed Pattern	*Morone americanus*	*Morone saxatilis*
Dorsal fin interdigitation	0/0/0+**1**/**1**/**1**+**1**/**1**/**1**etc.	0/0/0/**1**+**1**/**1**/**1**+**1**/**1**/**1**etc.
Anal fin interdigitation	\none**1**\2\2\3\2\	\none**1**\3\2\3\2\1\
Only overlapping dorsal pattern	0/0/0+**1**/**1**/**1**+**1**/**1**/**1**etc.	0/0/0+**1**/**1**/**1**+**1**/**1**/**1**etc.
Interneural space 11	No pterygiophores	1 fin ray pterygiophore
Total number anal pterygiophores	10 (rarely 11)	12 (rarely 11)

0 = Supraneural; **Numeral** = spine pterygiophore; numeral = fin ray pterygiophore;
/ = Neural spine; \ = Haemal spine; the first anal spine pterygiophore supports 3 spines

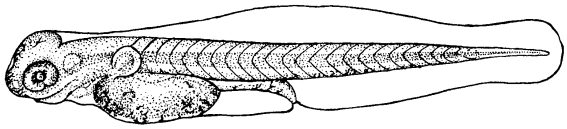
Figures: Adult: Mansueti, 1964; egg and **B–F**: Mansueti, 1964; **A**: Ryder, 1887

References: Mansueti, 1964: Hardy, 1978b; G. D. Johnson, 1984; Able and Fahay, 1998

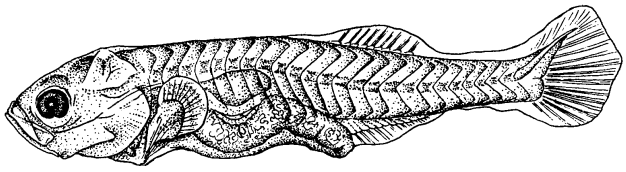
Morone americana



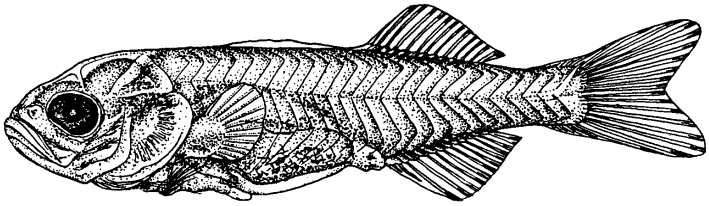
A. 2.3 mmTL



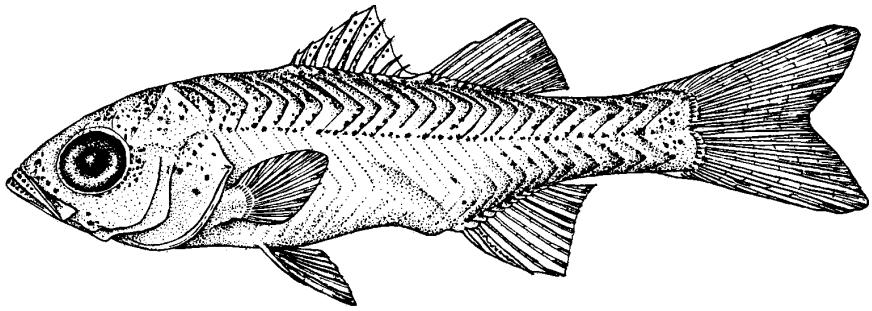
B. 3.8 mmTL



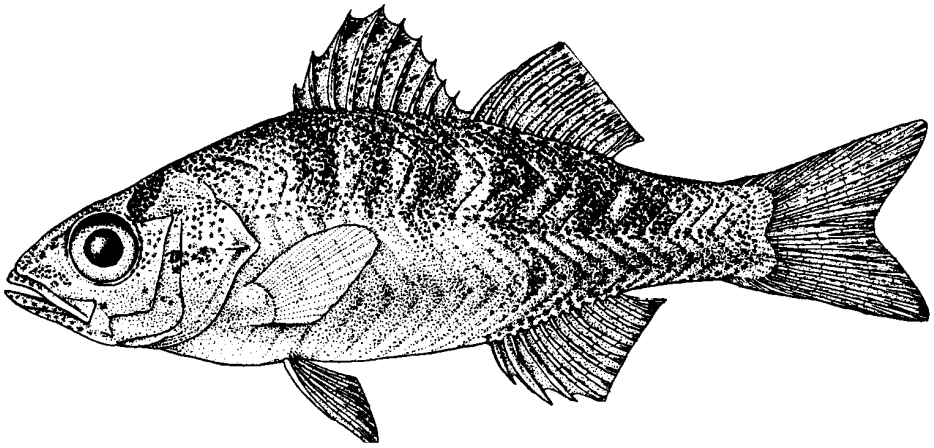
C. 8.6 mmTL



D. 12.2 mmTL

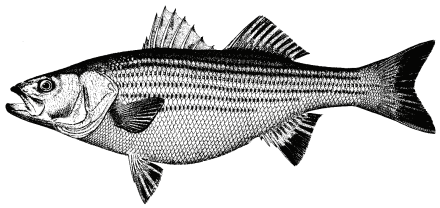


E. 23.3 mmTL



F. 28.0 mmTL

Morone saxatilis (Walbaum, 1792)
Moronidae
Striped bass



Range: Western North Atlantic Ocean from St. Lawrence River, Canada to St. John's River, northern Florida; introduced elsewhere

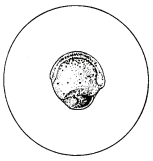
Habitat: Coastal waters including bays, estuaries, rivers; sandy beaches, rocky areas, tolerates turbidity; also land-locked populations; winter in depths up to 37 m

Spawning: Anadromous, most reproduction in rivers or heads of estuaries, Feb–Jul

Meristic Characters

Myomeres:	25 (23–27)
Vertebrae:	12+13 = 25
Dorsal fin rays:	VIII–IX,I,9–14
Anal fin rays:	III, 7–13
Pectoral fin rays:	13–19
Pelvic fin rays:	I, 5
Caudal fin rays:	10–13+9+8+9–13
Supraneurals:	0/0/0/1+1/1/1+1/

Eggs:
- Spherical, non-adhesive, transparent, (semi) buoyant
- Chorion: ranges from thin, smooth, delicate to heavily corrugated
- Diameter: 1.3–4.6 mm (varies with salinity): e.g. North Carolina: 2.4–2.6 mm; Delaware River: 2.9 mm
- Yolk: greenish
- Oil globule: single, 0.40–0.85 mm
- Perivitelline space: very wide (65%–85% of diameter)



Larvae:
- Hatching occurs at lengths of 2.0–3.7 mm; body slender, preanus length >50% SL
- Flexion occurs at 6.0–9.0 mm SL
- Sequence of fin ray formation: C – D_2, A – D_1 – P_2 – P_1; D_2 fin base slightly longer than A fin base
- 2nd A spine shorter than 3rd A spine and about the same thickness
- Pigment includes accumulations over air bladder, along ventral edge of tail, on top of head and on opercle; larger larvae have scattered melanophores along midline and over much of body

Head spine checklist:

Preopercle: very small spines or serrations on edge and on lateral ridge (none prominent)

Note: 1. Interdigitation patterns are critical for accurate identifications of moronid early stages. The following table demonstrates the most frequently observed patterns in two species. (Modified after Olney *et al.*, 1983)

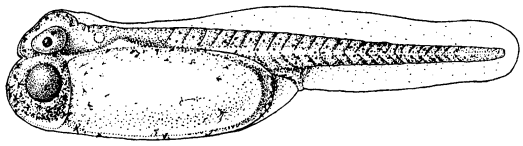
Most Frequently Observed Pattern	*Morone americanus*	*Morone saxatilis*
Dorsal fin interdigitation	0/0/0+**1**/**1**/**1**+**1**/**1**/**1**etc.	0/0/0/**1**+**1**/**1**/**1**+**1**/**1**/**1**etc.
Anal fin interdigitation	\none**1**\2\2\3\2\	\none**1**\3\2\3\2\1\
Only overlapping dorsal pattern	0/0/0+**1**/**1**/**1**+**1**/**1**/**1**etc.	0/0/0+**1**/**1**/**1**+**1**/**1**/**1**etc.
Interneural space 11	No pterygiophores	1 fin ray pterygiophore
Total number anal pterygiophores	10 (rarely 11)	12 (rarely 11)

0 = Supraneural; **Numeral** = spine pterygiophore; numeral = fin ray pterygiophore;
/ = Neural spine; \ = Haemal spine; the first anal spine pterygiophore supports 3 spines

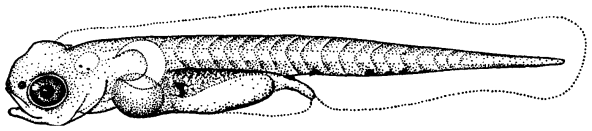
Figures: Adult: H. L. Todd (Goode, 1884); egg and **A**: Mansueti, 1958; **B–E**: Pearson, 1941; **F**: Doroshev, 1970

References: Pearson, 1941; Mansueti, 1958; Hardy, 1978b; G. D. Johnson, 1984; Able and Fahay, 1998

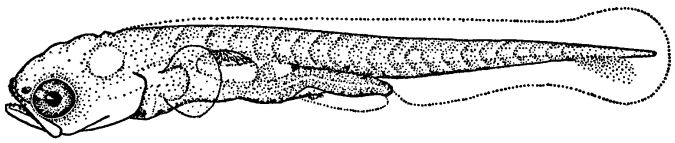
Morone saxatilis



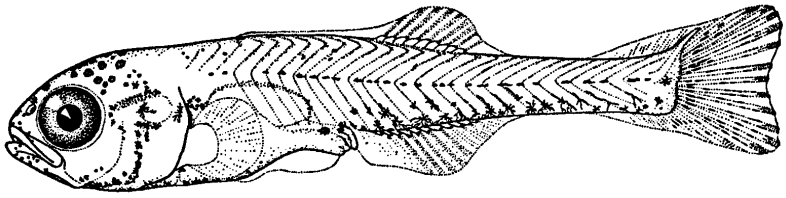
A. 3.3 mmTL



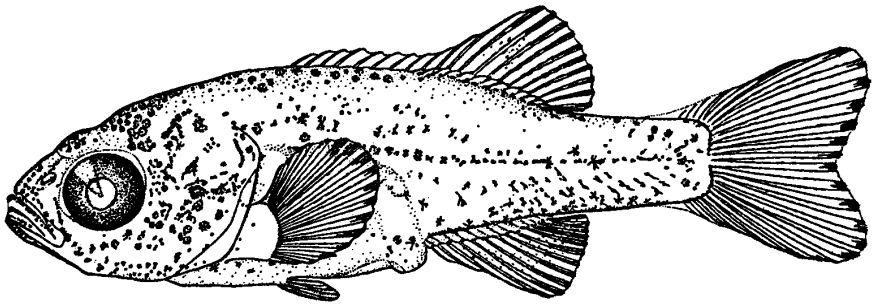
B. 5.8 mmTL



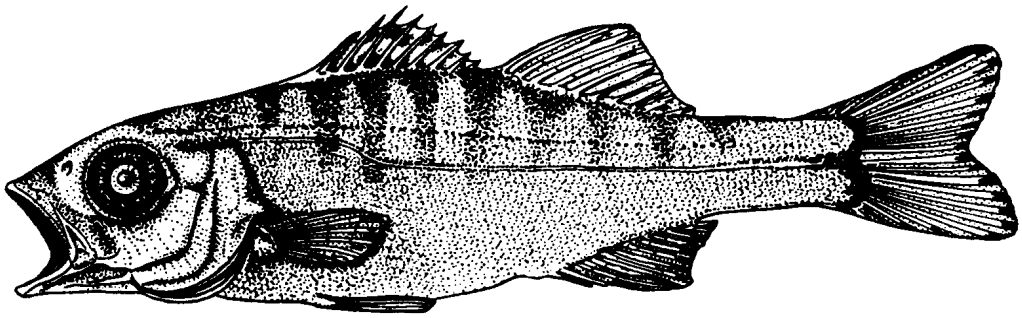
C. 6.0 mmTL



D. 9.0 mmTL

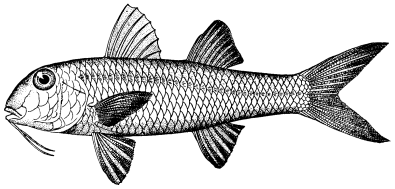


E. 13.0 mmTL



F. 46.0 mmTL

Mullidae *Three species*
Goatfishes



Meristic Characters

Myomeres:	24
Vertebrae:	10+14
Dorsal fin rays:	VII–VIII, I, 8
Anal fin rays:	I, 7
Pectoral fin rays:	13–17
Pelvic fin rays:	I, 5
Caudal fin rays:	9+8+7+10
Supraneurals:	0/0/0+2/1+1/
	or: 0/0/0+1/1+1/
	or: 0/0/2/1+1/

Range: *Mullus auratus* Jordan and Gilbert, 1882: Nova Scotia to Guyana including Gulf of Mexico – *Pseudupeneus maculatus* (Bloch, 1793): New Jersey and Bermuda to Brazil, including Gulf of Mexico and Caribbean Sea – *Upeneus parvus*, Poey, 1853: North Carolina to Brazil, including Gulf of Mexico and eastern Caribbean Sea

Habitat: Demersal on sand or mud substrates, or near coral reefs where sand is dominant, mostly in shallow depths, rarely >100 m; barbels used to find food in substrate; early juveniles strongly pelagic; pelagic-juveniles attracted to night lights

Spawning: Not well described; prolonged season or focused during spring

Eggs:
- Small in the family: 0.6–0.9 mm in diameter

Larvae:
- Undescribed; generalizations below largely based on extralimital material
- Body elongate, laterally compressed; head moderate, rounded dorsally, with short, steep snout
- Mouth small to moderate, terminal and oblique; extends beyond anterior edge of eye
- Preanus length very short in early larvae (30–40% SL), increases slightly through development
- Sequence of fin ray formation: C – D_2, A – D_1 – P_2 – P_1 (all fin rays formed by about 9.0 mm)
- Note short based D_1 and D_2 fins, separated by wide gap
- No pterygiophores occur in D_1 to D_2 gap
- D_2 and A fins about same size
- No head spines in larvae (unusual for percoids)
- Chin barbels begin to form at about 9–10 mm, as thickenings along edge of branchiostegals; do not become free from branchiostegal membrane and easily visible until 17–20 mm; barbels move forward during pelagic juvenile stage, reach tip of chin at settlement
- 8+7 principal caudal fin rays (unusual count for percoids)
- Pigment usually includes a stripe along midlateral line, spots along anal fin base, on top of head and a concentration on opercle; internal pigment forms over notochord; often a dense concentration of pigment along dorsum, entire length of body

Head spine checklist:

None

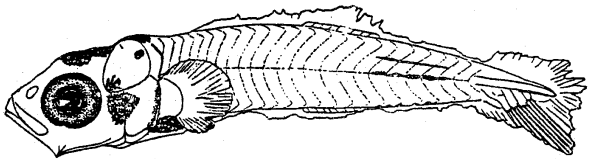
Note:
1. Early stages remain pelagic until sizes of about 70.0 mm

Early Juvenile: Pelagic juveniles very highly modified; body very slim, with dorsal and ventral edges nearly parallel; pigment is silvery with dark blue dorsum; resemble mugilid pelagic-juveniles, but the latter are deeper-bodied; note also dorsal fin spine counts
Body depth increases when juveniles settle to bottom

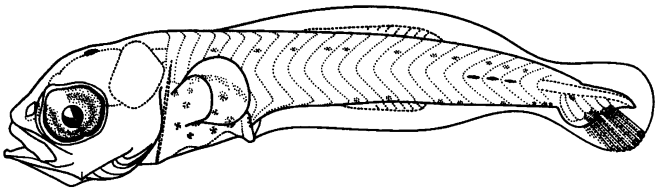
Figures: Adult (*M. Auratus*): Jordan and Evermann, 1896–1900; **A**, **D**: Uchida *et al*., 1958; **B–C**: Miller *et al*., 1979

References: M. C. Caldwell, 1962; G. D. Johnson, 1984; Randall, 2002b; Leis and Schmidt, 2004

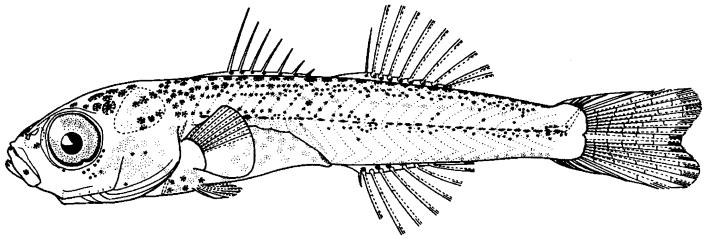
Mullidae (Species undetermined)



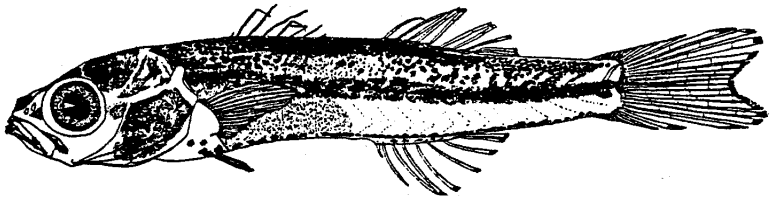
A. 3.7 mmTL



B. 5.1 mmSL



C. 8.2 mmSL

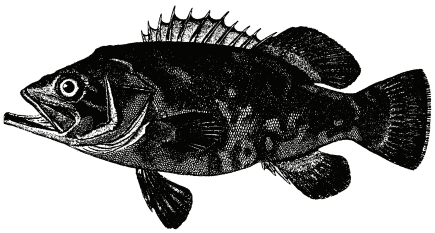


D. 10.0 mmTL

Characters in pelagic-juveniles of 3 species occurring in study area:

	Pseudupeneus maculatus	*Mullus auratus*	*Upeneus parvus*
First Dorsal Fin	8 spines, 1st minute	8 spines, 1st minute	7 spines
Second Dorsal Fin	I, 8	I, 8	I, 8
Pectoral Fin Rays	13-16	15-17	15-16
Gill Rakers (total)	29-32	18-21	24-27
Gill Rakers (lower limb)	19-24	12-15	17-19
Opercular spine	Present (>21.9 mm)	Absent	Absent
Supracleithrum	Serrated edge (>50 mm)	Smooth	Smooth
Juvenile Color Pattern	3 dark blotches on sides	Pale yellow	3 or 4 black bars on ventral lobe of caudal fin

Polyprion americanus (Bloch and Schneider, 1801)
Polyprionidae
Wreckfish



Range: Western Atlantic Ocean from Grand Bank, Newfoundland, and Bermuda to Argentina, but not including intervening tropical waters; also S.W. Pacific, southern Indian and eastern Atlantic oceans, Mediterranean Sea and islands associated with Mid-Atlantic Ridge

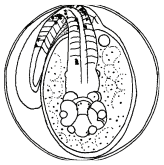
Habitat: Deep, rocky, sloping substrates in depths of 50–800 m; pelagic-juveniles widely dispersed in near-surface layers: common in eastern North Atlantic, rare in western North Atlantic

Spawning: Dec–Apr; location not well described

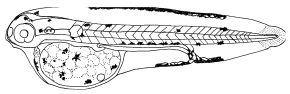
Eggs:
- Pelagic, spherical
- Chorion: smooth
- Oil globule: 1 large, 1–8 smaller
- Diameter: 1.60–1.64 mm
- Yolk: granular
- Perivitelline space: wide

Meristic Characters

Myomeres:	27
Vertebrae:	13+14 = 27
Dorsal fin rays:	XI–XII, 11–12
Anal fin rays:	III, 9–10
Pectoral fin rays:	17–18
Pelvic fin rays:	I, 5
Caudal fin rays:	9+9+8+9
Supraneurals:	0/0/0+2/1+1/



Egg



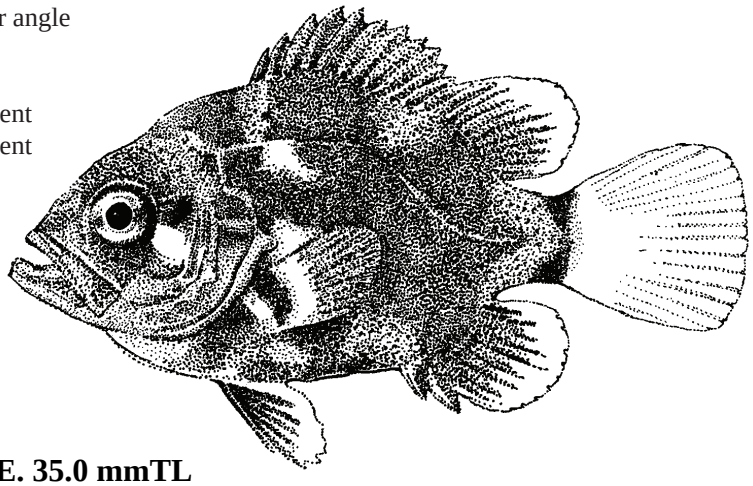
Yolk-sac Larva

Larvae:
- Deep-bodied, robust, long thick gut
- Preanus length decreases from 75% SL to <65% SL
- Head large, moderately blunt; mouth large, extends to mid-eye
- Sequence of fin ray formation: C – D_2, A – D_1, P_2, P_1
- Many head bones bear spines (see checklist below)
- Pigmentation heavy over head and much of body, except for caudal peduncle; melanophores may extend onto finfolds and bases of D_2 and A fins; opercle and branchiostegal region densely pigmented;

Head spine checklist:

Preopercle:	large, simple spine at angle, few smaller spines on edges and lateral surface
Supraorbital:	moderately pronounced serrate crest forms
Opercle:	single spine at upper angle
Subopercle:	spine present
Interopercle:	spine present
Posttemporal:	multiple spines present
Supracleithral:	multiple spines present

Early Juvenile: Juveniles remain pelagic until settlement to bottom habitats at about 60 cm

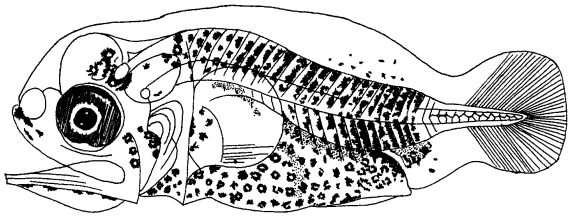


E. 35.0 mmTL

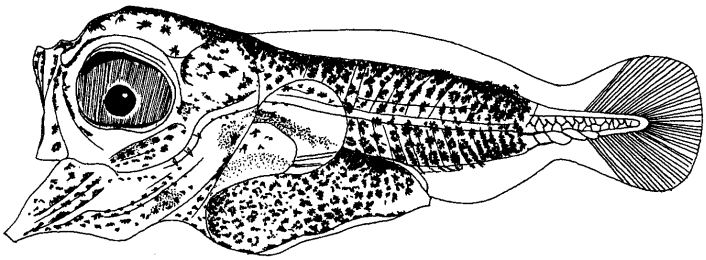
Figures: Adult: J. LeGall (Hardy, 1978b); Egg, yolk-sac larva and **A–D**: Tamiko Karr (redrawn after Sparta, 1939); **E**: Joan Ellis (redrawn after Bertolini, 1933)

References: Sparta, 1939; Hardy, 1978b; G. D. Johnson, 1984; Sedberry, 2002

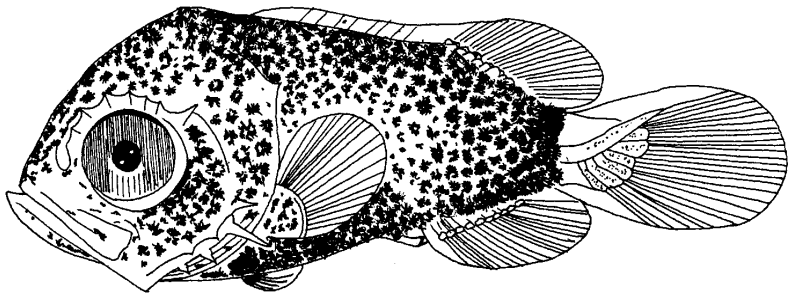
Polyprion americanus



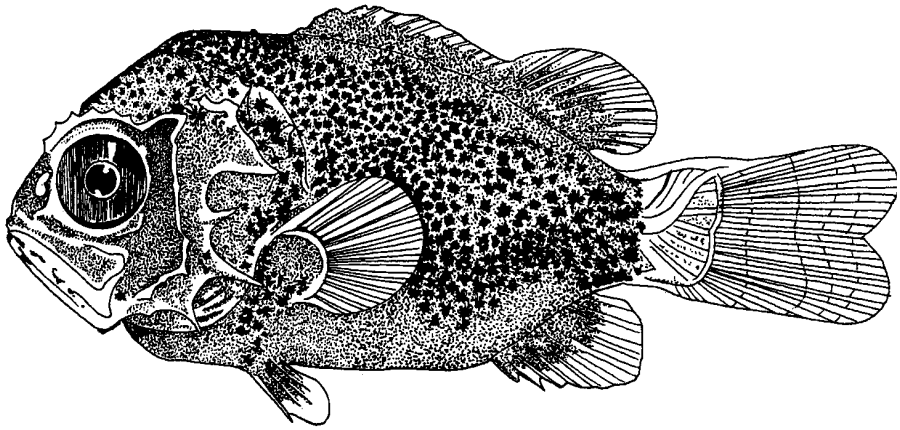
A. 3.5 mmTL



B. 4.5 mmTL

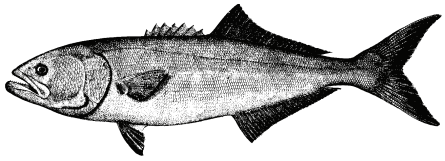


C. 8.1 mmTL



D. 12.3 mmTL

Pomatomus saltatrix (Linnaeus, 1766)
Pomatomidae
Bluefish



Range: Worldwide in temperate and subtropical coastal waters (except absent from eastern Pacific and Indo-Pacific north of equator); in the western North Atlantic from Nova Scotia and Bermuda through Gulf of Mexico; also northern coast of South America

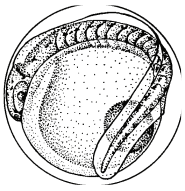
Habitat: Coastal and continental shelf waters, bays, estuaries; occurs in fast-swimming schools or small groups

Spawning: Summer in study area; earlier in areas south of Cape Hatteras

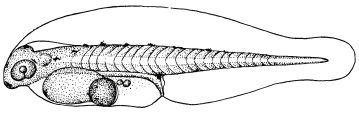
Meristic Characters

Myomeres:	26
Vertebrae:	11 + 15 = 26
Dorsal fin rays:	VII–VIII, I, 23–28
Anal fin rays:	II, 24–29
Pectoral fin rays:	16–17
Pelvic fin rays:	I, 5
Caudal fin rays:	9–10+9+8+8–9
Supraneurals:	0/0/0+1/1+1/

Eggs:
- Pelagic, spherical
- Diameter: 0.95–1.00 mm
- Chorion: smooth, transparent
- Yolk: homogeneous
- Oil globule: single, 0.26–0.29 mm in diameter
- Perivitelline space: narrow



Egg



Yolk-sac larva

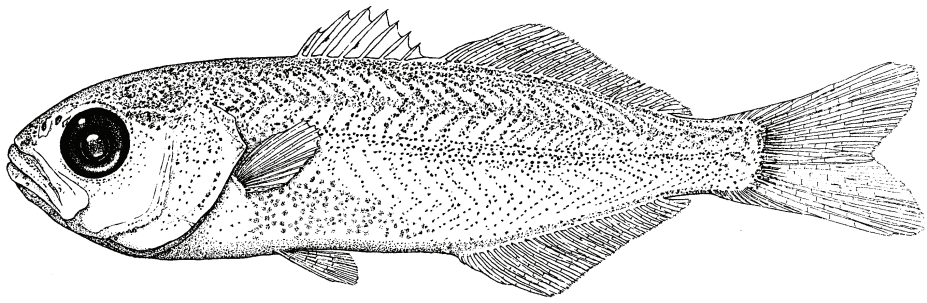
Larvae:
- Hatching occurs at size of 2.0–2.4 mm, eyes unpigmented, mouth unformed
- Yolk absorbed at 3.3–3.6 mm
- Body moderately elongate, preanus length decreases from 50% SL to 33% SL, then to 50% SL in juveniles
- Flexion occurs at 4.3–5.0 mm
- Teeth well developed at 4.3 mm; mouth extends to about level of mid-eye
- Sequence of fin ray formation: C – D_2, A – D_1 – P_2 – P_1
- Note relatively long D_2 and A fin bases, short D_1 fin base
- Very small preopercle spines (see checklist below); spine at angle not enlarged
- Pigmentation includes spots on top of head, nape, and dorsal and ventral edges of body, with short line of pigment along midline of tail; spots cover much of gut; as pigment spreads in larger larvae, melanophores aligned on myosepta

Head spine checklist:

Preopercle: very small spines on posterior edge, resemble a serrated edge; 2 spines at 4.8 mm, 7 at 12.8 mm

Note: Scales begin forming at about 12 mm on posterior part of lateral line; scales spread anteriorly until head completely scaled at about 37 mm

Early Juvenile:

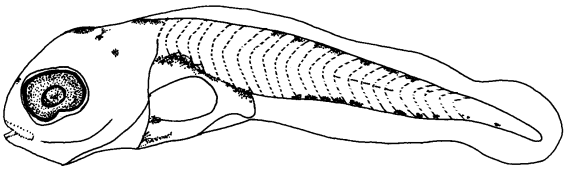


G. 24.3 mmSL

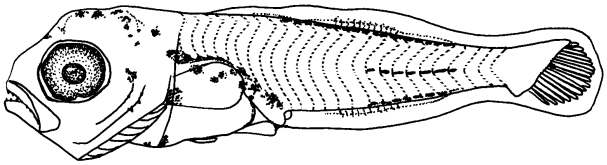
Figures: Adult: Goode, 1884; Egg and yolk-sac larva: Deuel *et al*., 1966; **A–F**: Norcross *et al*., 1974 (modified); **G**: Susan Kaiser (Able and Fahay, 1998)

References: Pearson, 1941; Deuel *et al*., 1966; Norcross *et al*., 1974; Silverman, 1975; Hardy, 1978b; G. D. Johnson, 1984; Hare and Cowen, 1996; Fahay *et al*., 1996b; Able and Fahay, 1998

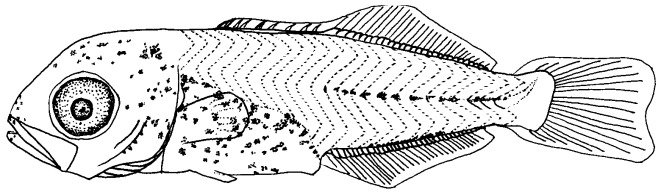
Pomatomus saltatrix



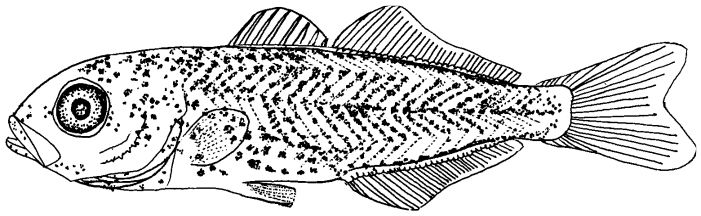
A. 4.0 mmTL



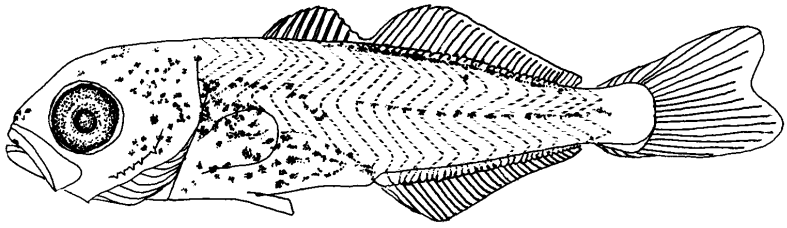
B. 6.0 mmTL



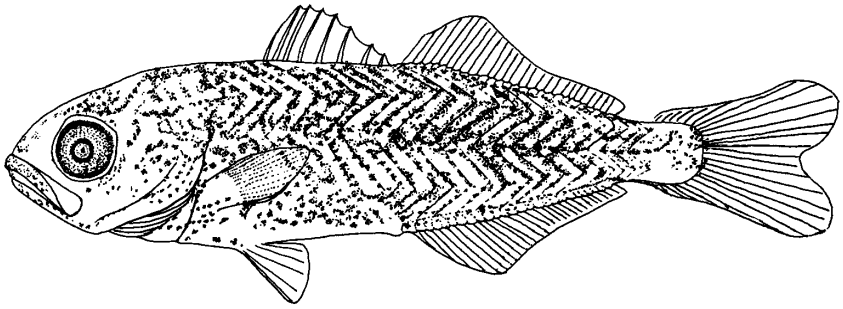
C. 8.5 mmTL



D. 12.2 mmTL

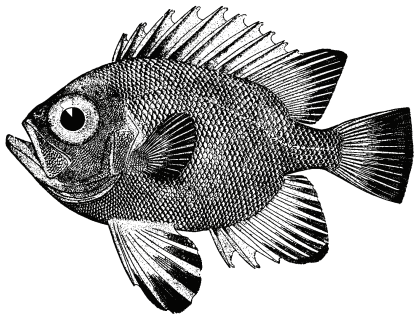


E. 16.5 mmTL



F. 20.9 mmTL

Pristigenys alta (Gill, 1862)
Priacanthidae
Short bigeye



Range: Western Atlantic Ocean from North Carolina and Bermuda to Brazil, including Gulf of Mexico and Caribbean Sea; juveniles occur as far north as Gulf of Maine

Habitat: Solitary near rocky outcrops in depths of 5–125 m; larvae and juveniles pelagic to a size of 60 mm or more

Spawning: Summer-early fall

Eggs: – Undescribed

Larvae:
- Body deep through pectoral region, laterally compressed
- Head broad and large, with large mouth reaching level of mid-eye
- Gut is coiled, deep, broad; preanus length usually >50% SL
- Sequence of fin ray formation: $C - D_2$, $A - D_1 - P_2 - P_1$
- Fin spines may have serrated edges
- Head with many spines (see checklist below)
- Spinous scales form early over much of body
- Pigment on top of head, over gut and usually a line along ventral edge of tail; larger larvae and pelagic-juveniles become densely pigmented over body and fin membranes

Meristic Characters

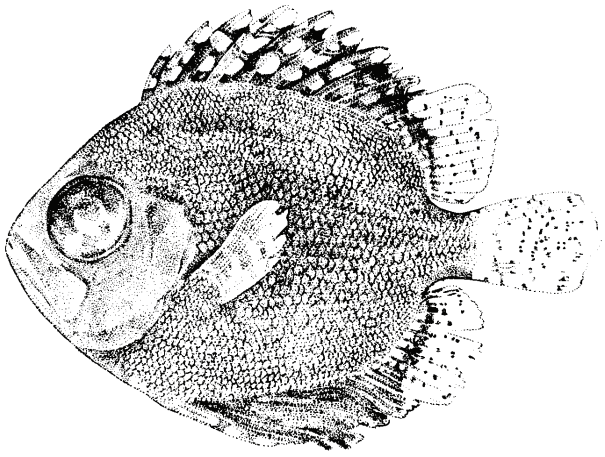
Myomeres:	23
Vertebrae:	10 + 13 = 23
Dorsal fin rays:	X, 10–12
Anal fin rays:	III, 9–11
Pectoral fin rays:	16–19
Pelvic fin rays:	I, 5
Caudal fin rays:	4+8+8+4
Supraneurals:	0+2/1/1/1/ (2/1/1/1/ in other genera)

Head spine checklist:

Supraoccipital:	conspicuous crest with serrated edge forms early in development
Preopercle:	prominent, early-forming serrated spine at angle; shorter, smooth spines along posterior edges
Supraorbital:	early-forming, long, serrated crest (followed by short, serrated, pterotic crest)
Dentary:	small spines along length of lower jaw
Posttemporal:	cluster of small spines
Supracleithral:	cluster of small spines
Interopercular:	small spine
Opercular:	small spine
Frontal:	short, serrated ridges may be present

Note: 1. Larvae of other priacanthid genera in study area are undescribed, but head spination and other characters are probably similar

Early Juvenile:

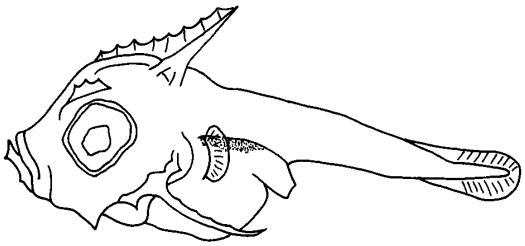


F. 34.0 mmSL

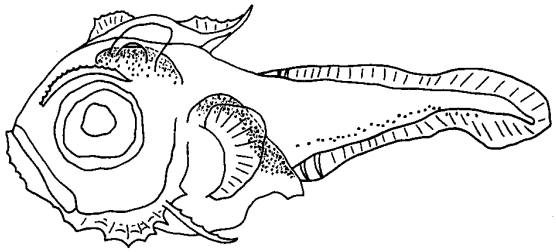
Figures: Adult: Jordan and Evermann, 1896–1900; **A–B**, **D**: D. K. Caldwell, 1962; **C**: Jack Javech (Powell, 2006); **E**: H. L. Todd (Starnes, 1988); **F**: Joan Ellis (Hardy, 1978b; redrawn from D. K. Caldwell, 1962)

References: D. K. Caldwell, 1962; Fahay, 1975; Leis and Rennis, 1983; G. D. Johnson, 1984; Starnes, 1988; Leis and Carson-Ewart, 2004

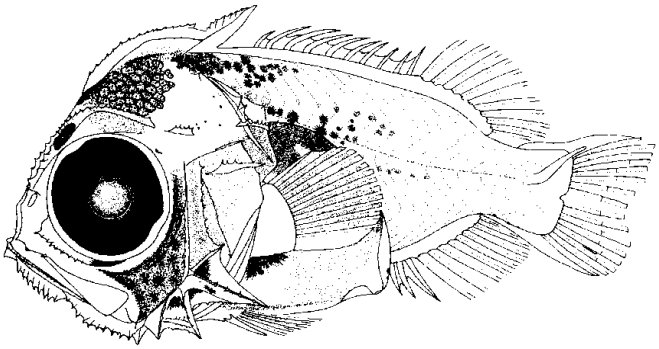
Pristigenys alta



A. 2.2 mmSL

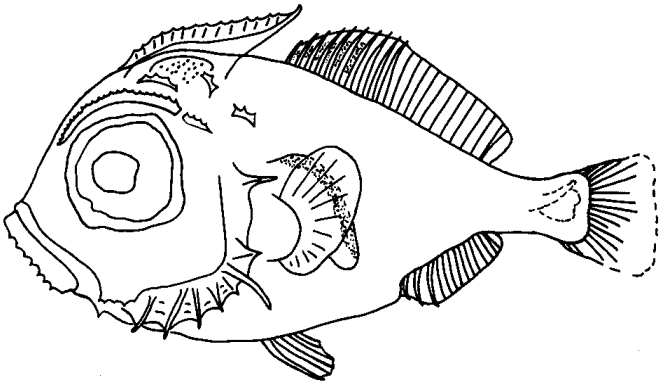


B. 3.2 mmSL

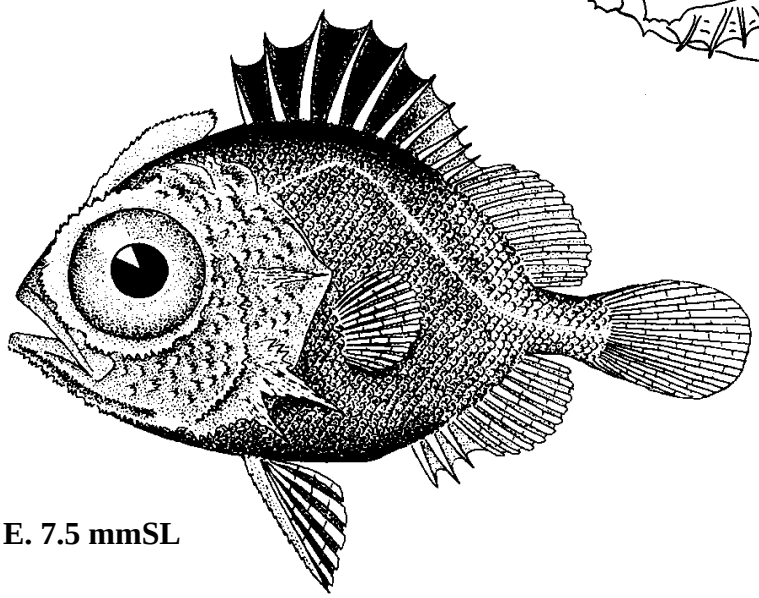


Note: larvae illustrated in Figs A, B, and D are based on faded specimens and do not adequately portray pigmentation patterns. See comments in Powell (2006).

C. 4.5 mmSL

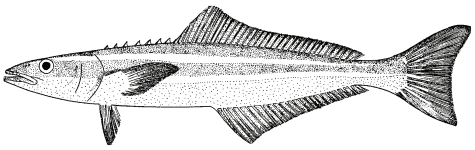


D. 6.6 mmSL



E. 7.5 mmSL

Rachycentron canadum (Linnaeus, 1766)
Rachycentridae
Cobia



Range: Worldwide (except eastern Pacific) in tropical and subtropical waters; in the western Atlantic from Massachusetts and Bermuda to Argentina including Gulf of Mexico and Caribbean Sea

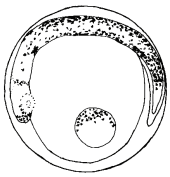
Habitat: Pelagic in coastal and offshore, oceanic waters over depths of 50–1,200 m; also over shallow coral reefs and occasionally in estuaries

Spawning: Summer in present study area, possibly focused near mouth of Chesapeake Bay

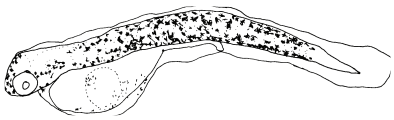
Meristic Characters

Myomeres:	25
Vertebrae:	11 + 14 = 25
Dorsal fin rays:	VII–VIII, I, 26–34
Anal fin rays:	I–II, 22–28
Pectoral fin rays:	20–21
Pelvic fin rays:	I, 5
Caudal fin rays:	15–16+9+8+12–14
Supraneurals:	/1+1/1/1/

Eggs:
- Pelagic, spherical
- Diameter: 1.16–1.42 mm
- Chorion: smooth
- Yolk: segmented
- Oil globule: single, mean diameter 0.38 mm
- Perivitelline space: narrow
- Hatch at 2.5 mmSL



Egg



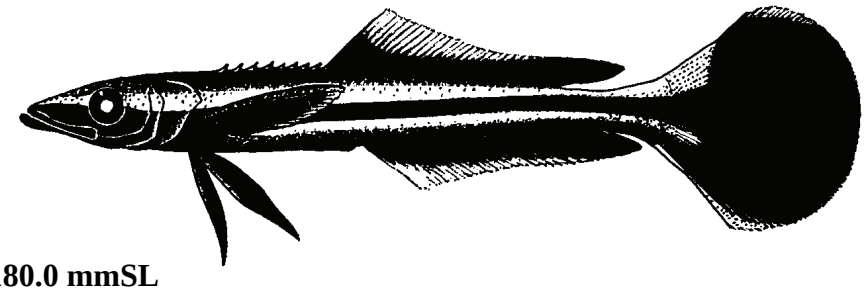
Yolk-sac larva, 2.6 mmSL

Larvae:
- Embryo and yolk-sac larvae heavily pigmented, except for caudal peduncle
- Body very elongate with relatively large head; head length about 30% SL, decreasing to about 24 % SL
- Preanus length initially about 62% SL; decreases to about 56% SL in late larvae
- Obvious head spines (see checklist below); pterotic region 'swollen'
- Sequence of fin ray formation: C – A – D_2 – P_2 – P_1 – D_1
- Tiny spinous 'spicules' cover body early in development
- Pigment dense over gut and ventral parts of tail; base of caudal fin dark; few spots on top of head and on opercle; pigment spreads dorsally to area under posterior dorsal fin, then anteriorly to cover most of body

Head spine checklist:

Preopercle:	series of small spines along edge and lateral ridge; angle spine slightly longer
Supraorbital:	ridge with single prominent spine
Posttemporal:	1 or 2 small, simple spines
Supracleithral:	small spine present at 10.5–11.0 mmSL

Early Juvenile: Note expanded caudal fin and striped pigment pattern

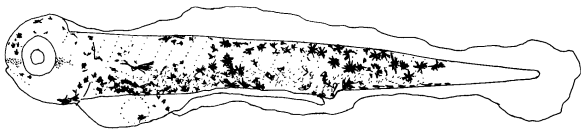


H. 180.0 mmSL

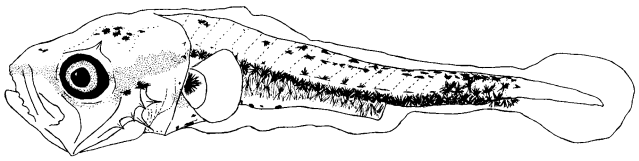
Figures: Adult: Collette, 2002o; Egg, yolk-sac larva and **A–C, E–G**: Cathy Grouchy (Ditty and Shaw, 1992); **D**: Betsy Washington (G. D. Johnson, 1984); **H**: Joseph *et al*., 1964a

References: Joseph *et al*., 1964a; G. D. Johnson, 1984; Ditty and Shaw, 1992

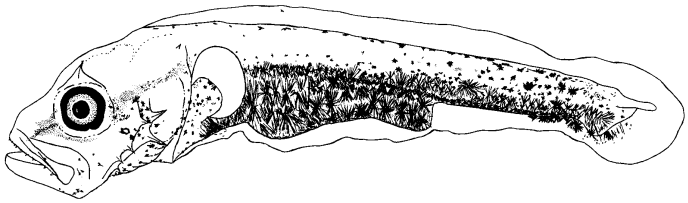
Rachycentron canadum



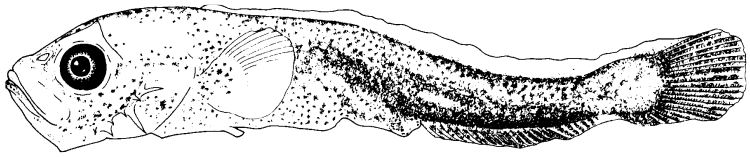
A. 3.0 mmSL



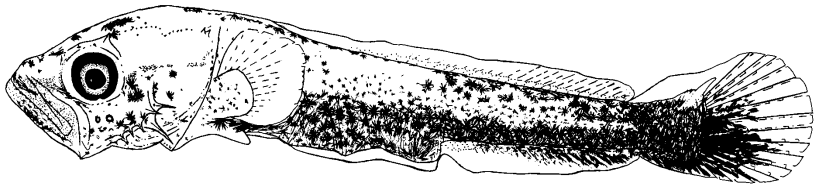
B. 4.5 mmSL



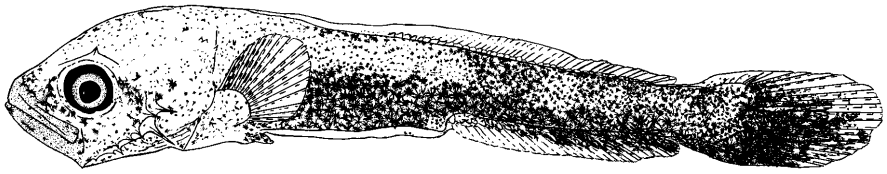
C. 6.8 mmSL



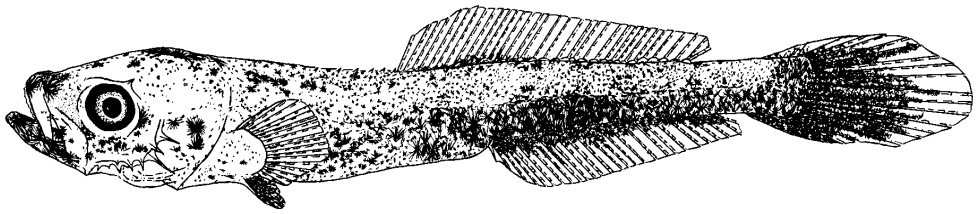
D. 9.0 mmSL



E. 10.0 mmSL



F. 14.1 mmSL



G. 18.9 mmSL