Perciformes
Suborder Percoidei Part IV – Families Serranidae through Symphysanodontidae

Selected meristic characters in species belonging to the percoid families Serranidae through Symphysanodontidae whose adults or larvae have been collected in the study area. Classification sequence of families is alphabetical. See species accounts for sources. See following pages and species accounts for subfamily classification of the Serranidae, separated by dashed lines in table below.

Family *Species*	Vertebrae	Dorsal Fin	Anal Fin	Caudal (Procurrent Dorsal + Ventral)	Pectoral Fin
Serranidae					
(s.f. Anthiinae)					
Anthias nicholsi	10+16	X, (14)15	III, 7(6,8)	–	18–21
Hemanthias aureorubens	10+16	X, 14–15	III, 7(9)	9–10+9	15–17
Hemanthias vivanus	10+16	IX–X, 13–14	III, 8–9	12–13+11–13	18–20
Pronotogrammus martinicensis	10+16	X, 13–16	III, 7	9+9	16–18
(s.f. Serraninae)					
Centropristis philadelphica	10+14	X, 11	III, 7	9–10+7–9	18 (15–20)
Centropristis striata	10+14	X, 11	III, 7	9–10+8	16–19
Diplectrum formosum	10+14	X, 12 (11–13)	III, 7(6,8)	11–12+10–11	16–17(18)
Serraniculus pumilio	10+14	IX–X, 10–11	III, 6–7	9–10+7–8	14–15
Serranus phoebe	10+14	X, 12	III, 7–8	10–11+9–10	14–17
Serranus sublingarius	10+14	X, 11–14	III, 6–7	7–8+7	14–17
(s.f. Epinephelinae)					
Epinephelus itajara	10+14	XI, (15)16	III, 8	–	18–19
Epinephelus morio	10+14	XI, 15–17	III, 9(8,10)	–	16–18
Epinephelus nigritus	10+14	X, 14(13–15)	III, 9	8+8	18–19
Epinephelus niveatus	10+14	X, 14(13–15)	III, 9	8–9+7–8	18(17–19)
Gonioplectrus hispanus	10+14	VIII, 13	III, 7	–	16–17
Jeboehlkia gladifer	9+15	VIII, 9	III, 7	–	15
Mycteroperca bonaci	10+14	XI, 15–17	III, 11–13	11+10	16–17
Mycteroperca microlepis	10+14	XI, 16–18	III, 10–13	10–11+9–10	16–18
Mycteroperca phenax	10+14	XI, 16–18	III, 10–12	10–11+9–10	15–17
Sparidae					
Archosargus probatocephalus	10+14	X–XII, 10–13	III, 9–11	8–9+7–9	15–17
Archosargus rhomboidalis	10+14	XIII, 11	III, 10	8–10+7–9	14(15)
Diplodus holbrooki	10+14	XII, 13–16	III, 13–15	8–9+8	15–17
Lagodon rhomboides	10+14	XI–XII, 10–12	III, 10–12	10–11+7–10	(14)16(17)
Pagrus pagrus	10+14	XII–XIII, 9–11	III, 7–9	9–10+9–10	15–16
Stenotomus chrysops	10+14	XII, 12	III, 11–12	9–10+8–10	16
Symphysanodontidae[1]					
Symphysanodon berryi	10+15	VIII–IX, 9–11	III, 7	12–14+12–14	16–18

[1] Eschmeyer (1990) considers this a valid family, whereas some authors (e.g. Nelson, 1994) include three nominal genera (including *Symphysanodon*) in the Acropomatidae. See note on *Symphysanodon berryi* page.

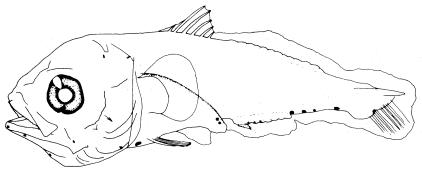
Perciformes
Percoidei Part IV– Serranidae

Larval characters in subfamilies or epinepheline tribes of Serranidae

Serraninae (Fig. A)

Body moderately stubby, with large head
Short, weak fin spines; if elongate, not serrate
Reduced head spines
Pigment variable, usually light
Vert: 10+14; D: IX–X, 10–14; A: III, 6–9

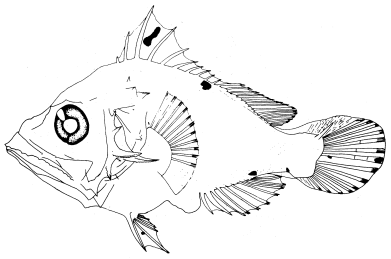
A.



Anthiinae (Fig. B)

Body deep, kite-shaped; head and snout pointy
Strong, barely elongate fin spines
Paired spines on preopercle and interopercle
Pigment usually light, often with some large blotches
Vert: 10+16; D: IX–X, 13–16; A: III, 6–8

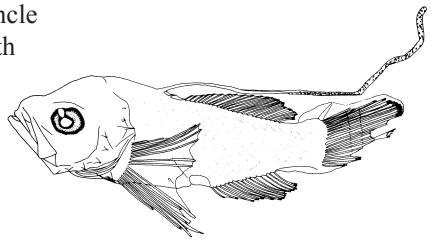
B.



Epinephelinae (Grammistini) (Fig. C)

Body moderately long, laterally compressed, deep caudal peduncle
Single dorsal spine elongate, filamentous, with pigmented sheath
Head spines reduced; weak if present
Pigment reduced and light
Vert: 9+15; D: VIII, 9; A: III, 7

C.



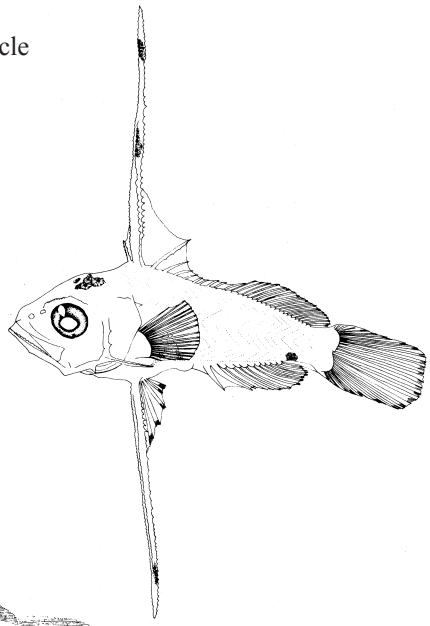
Epinephelinae (Epinephelini) (Fig. D)

Body moderately long, with pointed head and snout
Dorsal and pelvic spines elongate with serrations
Prominent spines present on preopercle
Pigment patterns often consolidated, especially on caudal peduncle
Vert: 10+14; D: X–XI, 13–18; A: III, 7–13

Epinephelinae (Epinephelini: *Gonioplectrus hispanus*) (Fig. E)

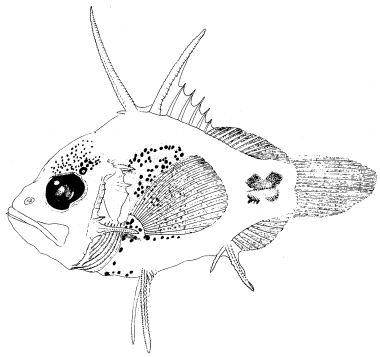
Body very deep
Elongate dorsal, anal and pelvic spines
Prominent spines on preopercle and upper opercle
Pigment includes prominent blotch on caudal peduncle .
(Exhibit some characters of the Anthiinae)
Vert: 10+14; D: VIII, 13; A: III, 7

D.



Larvae of the tribe Liopropomini (subfamily Epinephelinae) are similar to those of tribe Grammistini, but have 1 or 2 elongate dorsal spines equipped with filamentous appendages. Neither adults nor larvae have been collected in present study area.

E.



Figures: **A–D**: Kendall, 1979; **E**: Kendall and Fahay, 1979
(Meristic ranges pertain to taxa in study area)

Family Serranidae

This widespread and diverse family is represented by 19 species in the study area. Several of these are mostly tropical in distribution, but their larval or juvenile stages have been collected as far north as the Scotian Shelf or farther. Serranid larvae are easily allocated to one of four subfamilies (see illustrations and text on previous page) after reference to a set of readily observable characters, several of which are detailed below for larvae of the 3 subfamilies that might occur in the study area.

Characters important for identifying larvae of the family Serranidae, including only those taxa occurring in the study area, are included below. (After Kendall, 1976; 1979; 1984; Kendall and Fahay, 1979; Johnson and Keener, 1984; Baldwin, 1990; Baldwin and Johnson, 1991; 1993; Leis and Carson-Ewart, 2004). See footnotes for abbreviations.

Character	**Serraninae (*Centropristis*, *Diplectrum*, *Serranus*, *Serraniculus*)**	**Anthiinae (*Anthias*, *Hemanthias*, *Pronotogrammus*)**	**Epinephelinae-Epinephelini (*Epinephelus*, *Mycteroperca*, *Gonioplectrus*)**	**Epinephelinae-Grammistini (*Jeboehlkia*)**
Body shape	Moderate	Deep, kite-shaped	Long or deep	Moderate
Elongate dorsal spines	No	2nd or 3rd often elongate	Yes (2nd)	Yes (2nd)
Elongate pelvic spine	No	Moderately	Yes, very elongate	No
Nature of elongate spines	Smooth	Slender or moderate, often serrate	Stout, serrate	Slender to filamentous
Early forming fins	None	Anterior D_1 and P_2	Anterior D_1 and P_2	Anterior D_1 and P_1
Large pectoral fin?	No	In some species	No	Yes
Preopercle spines (outer margin)	<7, weak, spine at angle slightly longer	<12, strong, spine at angle very elongate	2–13, strong, spine at angle very elongate, serrate in postflexion	4–5, moderate, angle spine not long, all smooth
Other prominent head spines[1]	Iop, Op, Sop, Scl, PT, others	Iop, Op, Sop, Scl, PT, many others	Iop, Op, Sop, Scl, PT, others	Iop, Op, Sop, Scl
Dorsal fin spines	10	9–10	(8[2]) 10–11	8[3]
Supraneural pattern	0/0/0+2/1+1/ or: 0/0/1/1+1/	0/0/2/1+1/	0/0/1/1+1/	/0/1/1+1/

[1] Iop = interopercle; Op = opercle; Sop = subopercle; Scl = supracleithrum; PT = posttemporal.
[2] Eight in *Gonioplectrus*; 10–11 in other epinepheline taxa in the tribe Epinephelini
[3] All spines form directly, not from transformed soft rays

Family Serranidae

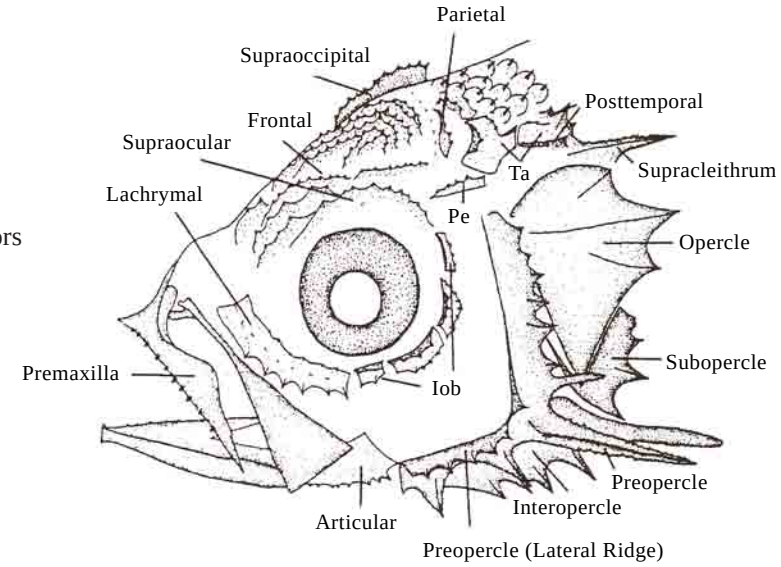
Head spines occur in the larvae of all four nominal subfamilies of Serranidae, but are most highly expressed in the Anthiinae, where many bones bear prominent spines that are often serrated, and many other bones bear serrated ridges. Larvae in this subfamily also develop early forming larval scales, each with a prominent spine emanating from its center or posterior edge. These larval scales are not replaced by, but become the nucleus of, the adult scale.

Head spines in the subfamily Anthiinae
(after Baldwin and Johnson, 1991)

Abbreviations:

Pe	=	Pterotic
Ta	=	Tabulars
Iob	=	Infraorbitals
Supraocular	=	Supraorbital of some authors

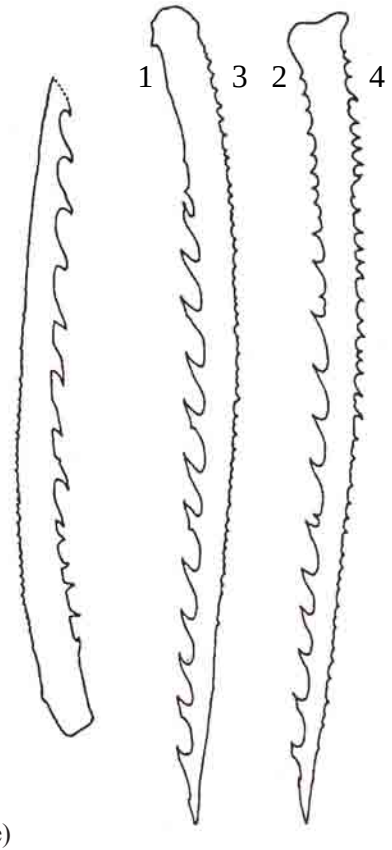
Note long Interopercle spine underlying the equally long Preopercle angle spine, both with serrated edges



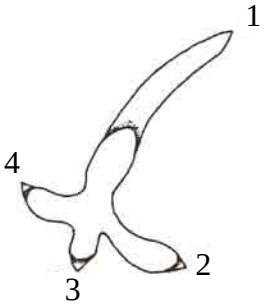
Pronotogrammus eos, 11.5 mmSL, eastern Pacific Ocean. Figure after Baldwin and Johnson (1991)

Epinepheline larval spine terminology
(After Johnson and Keener, 1984)

Cross-section view of 2nd spine of dorsal fin. **A**: small spinelet on apex (anterior) ridge; **B**,**C**: larger spinelets on dosterolateral wings



Left lateral view of 2nd spine of dorsal fin, anterior to the left

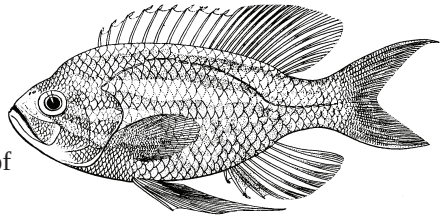


Cross-section view of left pelvic fin spine. Numbers correspond to those in ventromedial and ventrolateral views (left). **1** = dorsomedial (primary) ridge with large spinelet; **2** = ventromedial ridge with small spinelet; **3** = ventrolateral ridge with small spinelet; **4** = dorsolateral ridge with small spinelet

Ventromedial (center) and ventrolateral (right) views of pelvic fin spine

Epinephelus itajara, 16.9 mmSL (example)
All figures after Johnson and Keener (1984)

Anthias nicholsi Firth, 1933
Serranidae (s.f. Anthiinae)
Yellowfin bass



Range: Western North Atlantic Ocean from Nova Scotia to northeastern Gulf of Mexico; also off Nicaragua and Brazil

Habitat: Demersal in depths of 55–430 m; usually near large boulders or deep-water corals

Spawning: Feb–Apr (Gulf of Mexico); undescribed in study area

Eggs: – Undescribed

Meristic Characters

Myomeres:	26
Vertebrae:	10 + 16 = 26
Dorsal fin rays:	X, 14–15
Anal fin rays:	III, 6–8
Pectoral fin rays:	18–21
Pelvic fin rays:	I, 5
Caudal fin rays:	9+8 PrC
Supraneurals:	0/0/2/1+1/

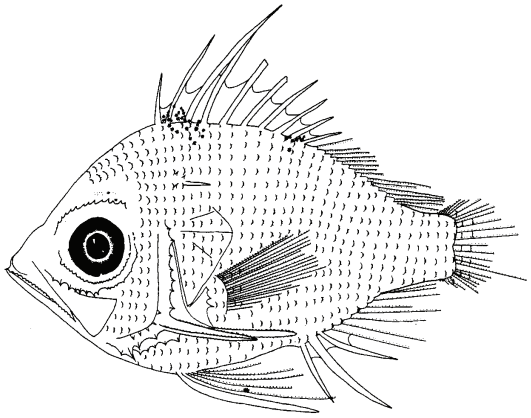
Larvae:
- Body deepest through pectoral region, then tapering to caudal peduncle; becomes very deep and kite-shaped
- Head deep and large; mouth large, extending to posterior edge of eye or more
- Preanus length about 60% SL through development
- Flexion occurs at about 4.0 mmSL
- Head spines well developed and extensive; see checklist below
- Sequence of fin ray formation: D_1, P_2 – D_2, A – C – P_1; 3rd dorsal spine longest, but smooth edged
- Larval scales lacking (compare to larvae of other anthiines); adult scales begin forming at 10.0–11.0 mmSL
- Pigmentation light; includes isolated melanophores on dorsum under origin of D_2 and on membranes of D_1 and P_2; series of small spots along venter decreases to 2 prominent spots at anal fin insertion and on caudal peduncle; ventral pigment absent >10.8 mmSL; usually a spot near base of middle caudal fin rays

Head spine checklist:

Preopercle:	series of spines, some serrate, along edge and lateral ridge; angle spine very long and serrate
Opercle:	3 prominent, low points (see Fig. F)
Subopercle:	1–4 small, smooth spines
Interopercle:	series of 0–5 small, smooth spines and very long, serrate spine lying under preopercle angle spine
Posttemporal:	1 or 2 prominent spines (rarely a few more)
Supracleithrum:	1 prominent spine, smooth except serrate between 7.0 and 20.0 mmSL
Supraocular, Lachrymal and Infraorbitals:	all appear as serrate ridges
Frontals:	rugose posteriorly (complex network of raised ridges), smoother anteriorly
Supraoccipital:	none
Pterotic:	none
Articular:	none

Note: See comparative table on *Hemanthias aureorubens* figure page

Early Juvenile: Pigment on spinous dorsal fin membrane extends onto body at sizes >11.0 mmSL; second dorsal spot becomes smaller

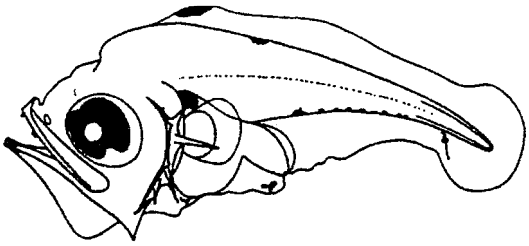


G. 21.0 mmSL

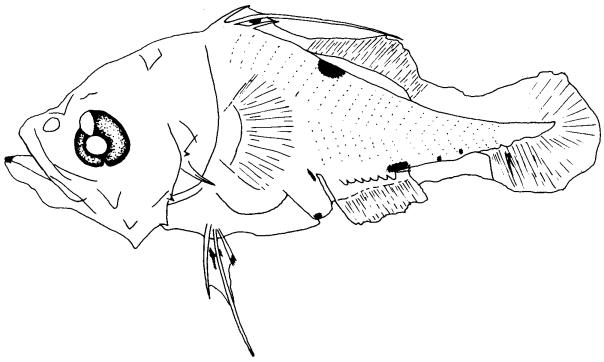
Figures: Adult: Fowler, 1937; **A**, **D**: Richards, 1999; **B–C**, **F**: Kendall, 1979; **E**, **G**: Baldwin, 1990

References: Kendall, 1979; 1984; Baldwin, 1990

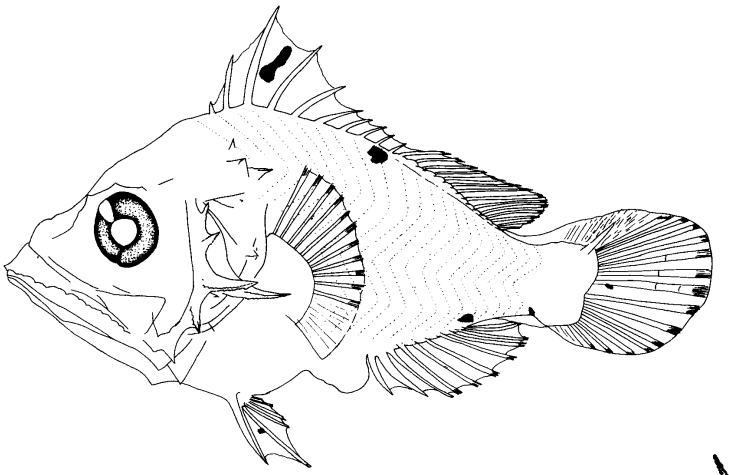
Anthias nicholsi



A. 1.8 mmNL



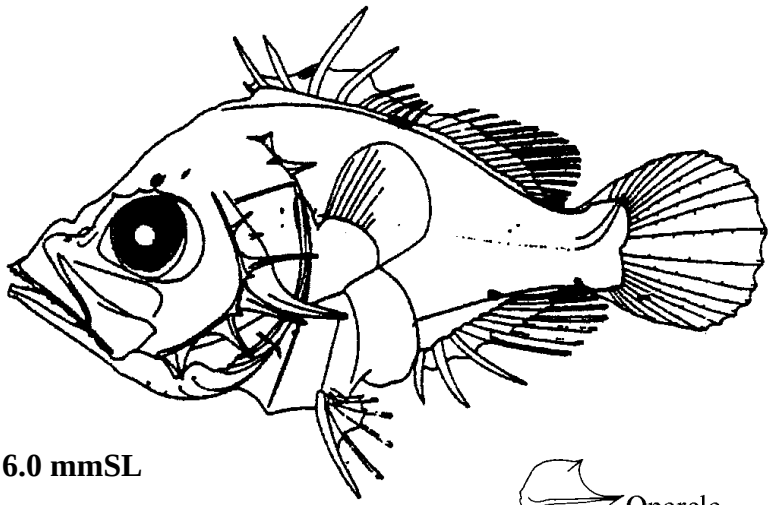
B. 3.8 mmNL



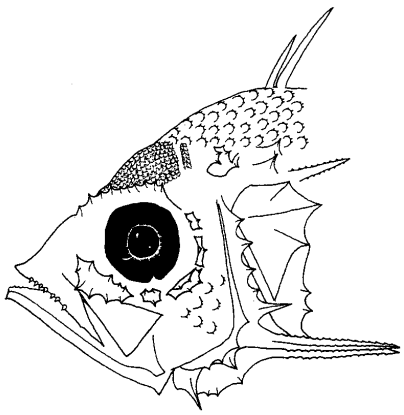
Larval teeth present on premaxilla
< 22.0 mmSL

C. 5.3 mmSL

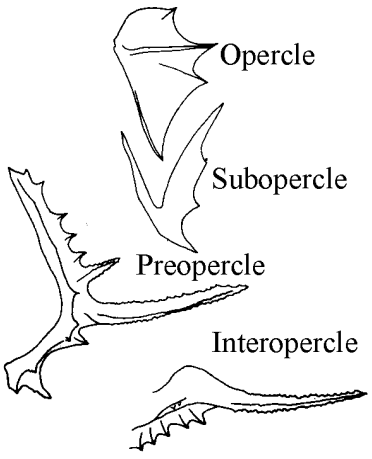
Very few spots on posterior brain
and on frontal bones



D. 6.0 mmSL

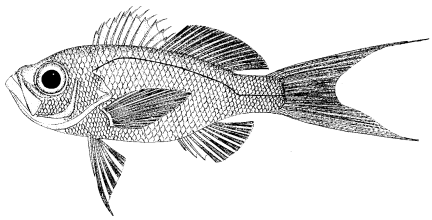


E. 11.8 mmSL
(Head spines)



F. Opercular series of bones
demonstrating spination at 10.2 mmSL

Hemanthias aureorubens (Longley, 1935)
Serranidae (s.f. Anthiinae)
Streamer bass



Range: Western North Atlantic Ocean from New Jersey to Suriname, includin northern Gulf of Mexico; juveniles have been collected as far north as o Massachusetts

Habitat: Demersal, in depths of 91–610 m

Spawning: May (Florida); probably more protracted; undescribed in study area

Eggs: – Undescribed

Larvae: – Early larvae undescribed; development is presumably similar to that of *H. vivanus*; description below follows Baldwin (1990) based on a series between 10.8 and 26.0 mmSL and a single specimen 9.8 mmSL (Kendall, 1984)
– Body deep, kite-shaped
– Head deep and large; mouth large, extending to posterior edge of eye
– Preanus length about 60% SL
– Flexion size undescribed
– Sequence of fin ray formation: $D_1, P_2 – D_2, A – C – P_1$; 3rd dorsal spine longest and serrate; pelvic fin spine also serrate, at least at larger sizes; 1st anal spine serrate (2nd also serrate >20.8 mmSL)
– Larval scales are Type A, where a spine originates near center of scale plate; adult scales form at >14 mmSL
– Pigmentation in later stages includes 3–5 prominent blotches along dorsum from middle of spinous dorsal to caudal peduncle; a few spots (probably remnants of a longer, ventral series) on lower caudal peduncle; a cluster of spots in supracleithral region; pigment present on membrane of spinous dorsal (see Fig. A) and of pelvic fin; spot near base of lower lobe caudal fin ray; many small spots on brain and over frontal bones

Meristic Characters

Myomeres:	26
Vertebrae:	10 + 16 = 26
Dorsal fin rays:	X, 14–15
Anal fin rays:	III, 7–9
Pectoral fin rays:	15–17
Pelvic fin rays:	I, 5
Caudal fin rays:	9+8 PrC
Supraneurals:	0/0/2/1+1/

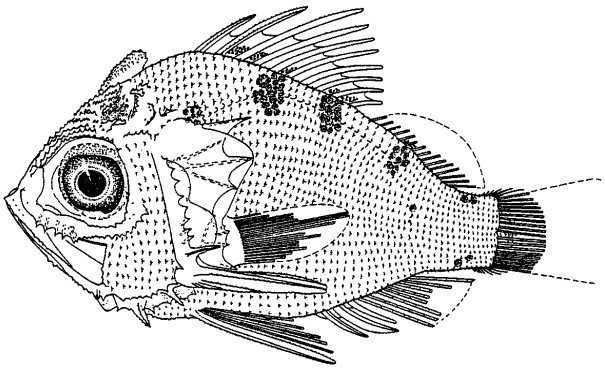
Head spine checklist:

Preopercle:	series of spines, some serrate, along edge and lateral ridge; angle spine very long and serrate
Opercle:	3 prominent, low points
Subopercle:	2–4 small, smooth spines
Interopercle:	series of 5–9 small, smooth spines and very long, serrate spine lying under preopercle angle spine
Posttemporal:	3 spines on dorsal ridge, 4–5 spines on ventral ridge
Supracleithrum:	1 prominent spine, serrate
Supraocular, Lachrymal and Infraorbitals:	all appear as serrate ridges; supraocular with 3 spiny ridges
Frontals:	series of several, serrate ridges (see Fig. B)
Supraoccipital:	spiny edged crest present
Pterotic:	spiny ridge present
Articular:	ventral margin with several spines
Parietal:	a single, vertical, serrate ridge

Note: See comparative table on opposite page

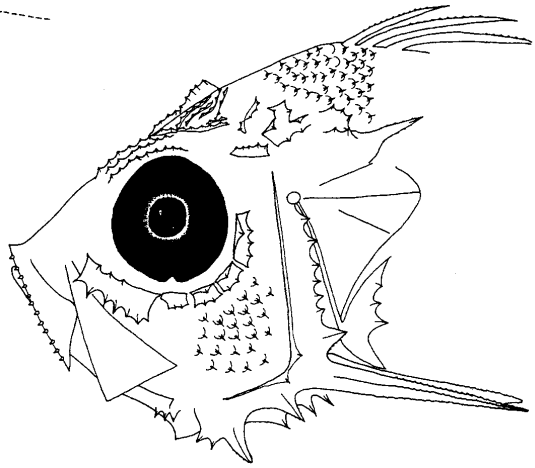
Figures: Adult: Heemstra *et al*., 2002; **A**: Kendall, 1984; **B**: Baldwin, 1990
References: Kendall, 1979; 1984; Baldwin, 1990

Hemanthias aureorubens



A. 9.8 mmSL

Larval teeth present on premaxilla

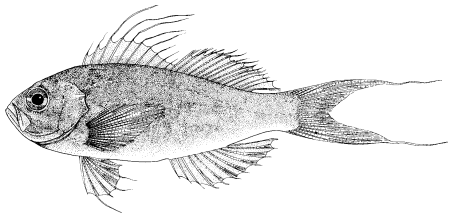


B. 14.2 mmSL
(Head spines)

Selected characters in 2 groups (*sensu* Baldwin, 1990) of anthiine larvae that occur in study area. Characters pertain to larvae about 5.0-15.0 mmSL and may not be applicable to preflexion larvae or early juveniles. (After Baldwin, 1990.)

Character	**Group I** *Hemanthias vivanus, H. aureorubens*	**Group II** *Pronotogrammus martinicensis*	**Group II** *Anthias nicholsi*
Frontal bones	Serrate ridges	Rugose posteriorly	Rugose posteriorly
Larval scales	Type A (spine originates near center of scale plate)	Type B (spine originates from indented posterior margin	None (Adult scales begin forming about 10.0 mmSL)
Supraoccipital crest	Spiny ridge present	None or single spine	No spines
Articular bone	Ventral margin serrate	Ventral margin smooth	Ventral margin smooth
Pterotic	Serrate ridge	No spines	No spines
Dorsal and pelvic fin spines	Serrate (also sometimes anal spines)	Smooth (all fin spines)	Smooth (all fin spines)
Fin pigment	On membrane of spiny dorsal fin	On membrane of spiny dorsal and pelvic fins	On membrane of spiny dorsal and pelvic fins
Dorsal pigment	Near middle or insertion of second dorsal fin	Streak under second dorsal fin	Near origin of second dorsal fin

Hemanthias vivanus (Jordan and Swain, 1885)
Serranidae (s.f. Anthiinae)
Red barbier



Range: Western North Atlantic Ocean from New Jersey to Brazil, including parts of Gulf of Mexico and continental Caribbean Sea

Habitat: Schooling near bottom in depths of 20–430 m

Spawning: Winter-spring (Gulf of Mexico); undescribed in study area

Eggs:
- Undescribed

Larvae:
- Body deep, somewhat less so than larvae of *Anthias nicholsi*
- Head deep and large; mouth large, extending to posterior edge of eye
- Preanus length >50% SL through development
- Flexion occurs at about 4.0–5.5 mmSL
- Head spines well developed and extensive; see checklist below
- Sequence of fin ray formation: D_1, P_2 – D_2, A – C – P_1; 3rd dorsal spine longest and serrate (>4.0 mmSL); pelvic fin spine serrate at 3.5 mmNL to >20.0 mmSL
- Larval scales are Type A, where a spine originates near center of scale plate; form at about 4.8 mmSL; adult scales form at about 23.0 mmSL
- Pigmentation light; includes isolated melanophores on dorsum under mid- to posterior D_2; pigment usually on membranes of D_1, little or none on P_2; ventral pigment includes prominent spot near insertion of anal fin and a series on venter of caudal peduncle, the latter series reducing to a single spot; spot usually on base of caudal fin ray near middle of fin; few spots on brain

Meristic Characters

Myomeres:	26
Vertebrae:	10 + 16 = 26
Dorsal fin rays:	IX–X, 13–14
Anal fin rays:	III, 8–9
Pectoral fin rays:	18–20
Pelvic fin rays:	I, 5
Caudal fin rays:	9+8 PrC
Supraneurals:	0/0/2/1+1/

Head spine checklist:

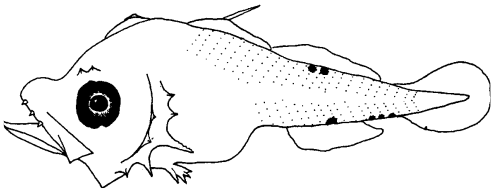
Preopercle:	series of spines, some serrate, along edge and lateral ridge; angle spine very long and serrate
Opercle:	3 prominent, low points, middle longest (see Fig. G)
Subopercle:	1–4 small, smooth spines
Interopercle:	series of 0–5 small, smooth spines and very long, serrate spine lying under preopercle angle spine
Posttemporal:	1–3 spines on dorsal ridge, 2–5 spines on ventral ridge
Supracleithrum:	1 prominent spine, serrate
Supraocular, Lachrymal and Infraorbitals:	all appear as serrate ridges
Frontals:	series of several, serrate ridges (see Fig. F)
Supraoccipital:	spiny edged crest present
Pterotic:	spiny ridge present
Articular:	ventral margin with several spines
Parietal:	a single, vertical, serrate ridge

Note: See comparative table on *Hemanthias aureorubens* figure page

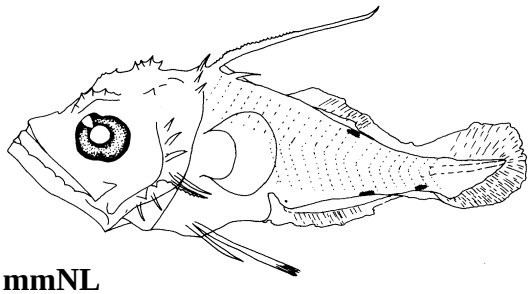
Figures: Adult: Heemstra *et al*., 2002; **A**, **F**: Baldwin, 1990; **B–E**, **G**: Kendall, 1979

References: Kendall, 1979; 1984; Baldwin, 1990

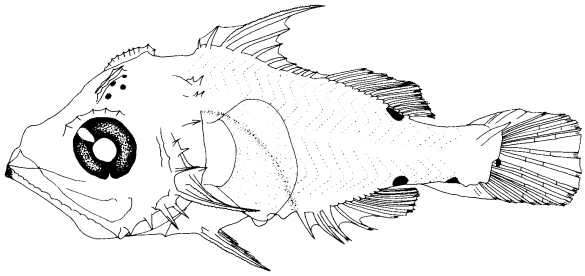
Hemanthias vivanus



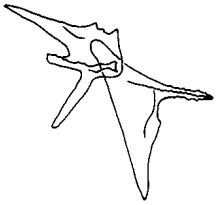
A. 3.0 mmNL
Larval teeth on premaxilla present early



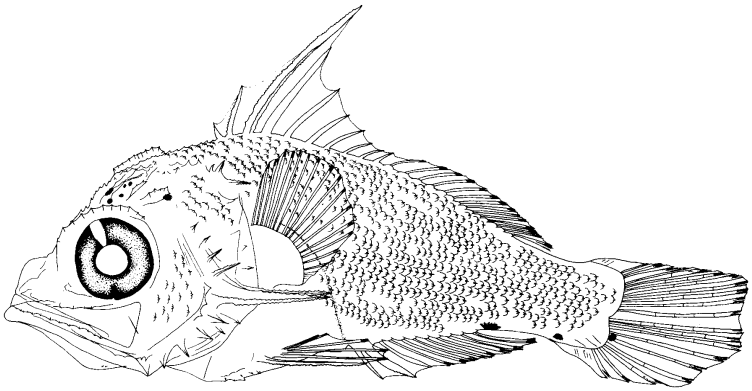
B. 4.2 mmNL



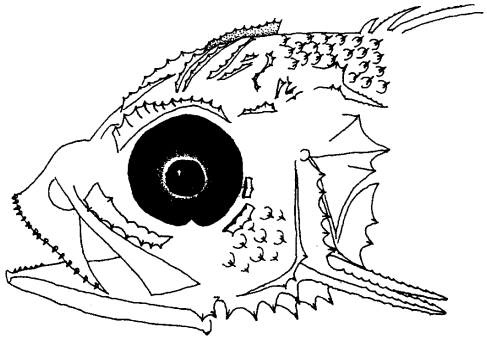
C. 5.3 mmSL Note opposing dorsal and ventral pigment spots



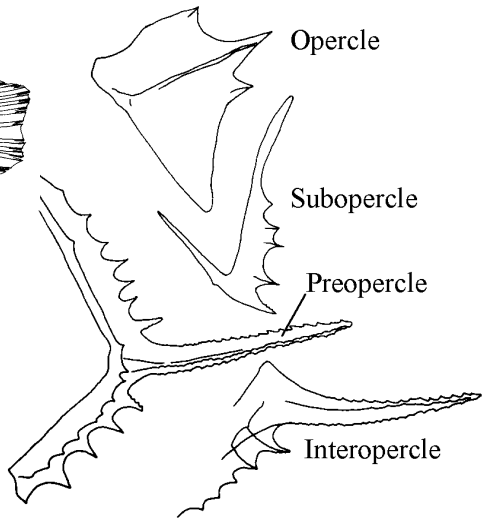
D. Posttemporal and Supracleithral bones at 10.3 mmSL



E. 6.8 mmSL Dorsal pigment spot often lost

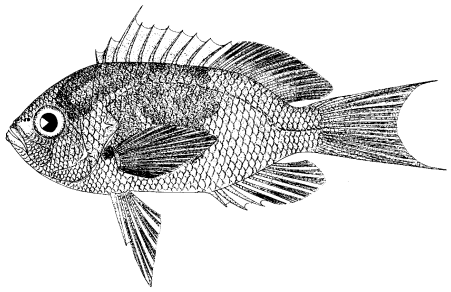


F. 8.0 mmSL
(Head spines)



G. Opercular series of bones demonstrating spination at 10.3 mmSL

Pronotogrammus martinicensis (Guichenot, 1868)
Serranidae (s.f. Anthiinae)
Roughtongue bass



Range: Western North Atlantic Ocean from North Carolina and Bermuda to Brazil, including Gulf of Mexico and Caribbean Sea; larvae have been collected in study area

Habitat: Demersal, often associated with corals, in depths of 55–230 m

Spawning: Feb–Jul (Gulf of Mexico)

Meristic Characters

Myomeres:	26
Vertebrae:	10 + 16 = 26
Dorsal fin rays:	X, 13–16
Anal fin rays:	III, 7
Pectoral fin rays:	16–18
Pelvic fin rays:	I, 5
Caudal fin rays:	9+8
Supraneurals:	0/0/2/1+1/

Eggs:
- Undescribed

Larvae:
- Body deep; body depth up to 50% SL
- Head deep and large; mouth large, extending to posterior edge of eye
- Preanus length about 60% SL
- Flexion occurs at about 4.0 mmSL
- Head spines well developed and extensive; see checklist below
- Sequence of fin ray formation: P_2, D_1 – A, D_2 – C – P_1
- Anterior D_1 and P_2 spines form early; 3rd dorsal fin spine longest, stout; all fin spines with smooth edges
- Larval scales are Type B, where a spine originates from indented, posterior margin of scale; form between 6.0 and 8.0 mmSL; adult scales begin to form at about 10.0 mmSL
- Pigment: 3 prominent spots along ventral edge of tail from insertion of anal fin to end of caudal peduncle, middle one lost; several melanophores on top of head; pigment on dorsum of body in the form of a distinctive streak under the 2nd dorsal fin; pigment on membranes of D_1 and P_2 fins; 1 or 2 spots near base of caudal fin in small larvae; few spots at tip of lower jaw

Head spine checklist:

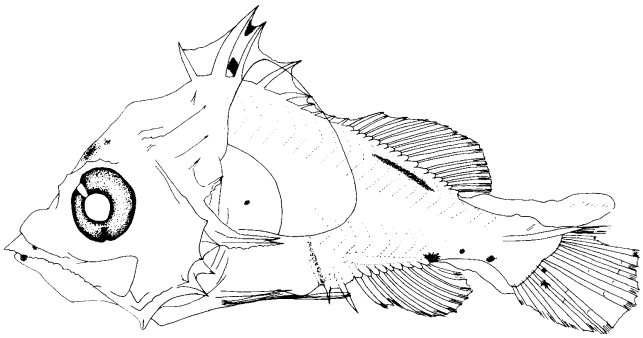
Preopercle:	series of 2–4 spines along ventral limb, a large, stout, serrate spine at angle, 4–7 spines along dorsal limb; lateral ridge with 2–3 small spines ventrally, a single spine dorsally
Opercle:	3 prominent, low points
Subopercle:	1–4 small spines
Interopercle:	long, serrate spine on dorsal margin, 3–4 smaller spines ventrally
Posttemporal:	2 spines
Supracleithrum:	single spine, usually smooth, sometimes slightly serrate
Supraocular:	6–14 spines
Frontals:	smooth anteriorly, rugose posteriorly
Supraoccipital:	small, simple crest, usually unornamented; rarely with a single, small spine
Lachrymal:	serrate ridge
Infraorbitals:	serrate ridge
Pterotic:	none
Articular:	none

Note: See comparative table on *Hemanthias aureorubens* figure page

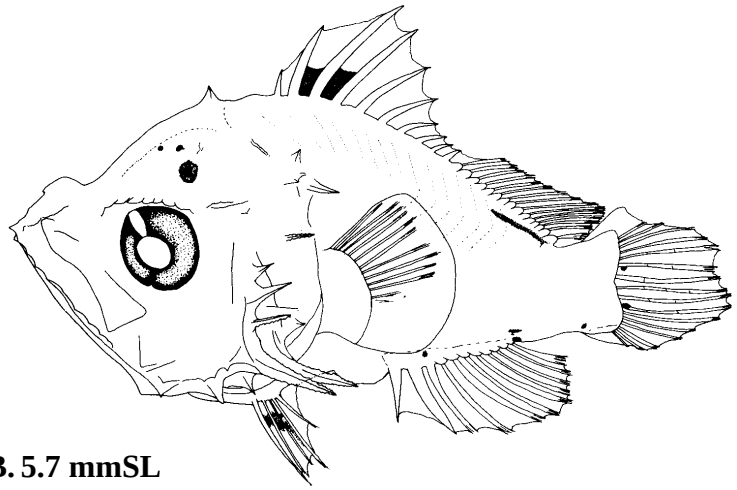
Figures: Adult: Heemstra *et al*., 2002; **A–C**: Kendall, 1979; **D**: Baldwin, 1990

References: Kendall, 1979; Baldwin, 1990; Smith-Vaniz *et al*., 1999; Heemstra *et al*., 2002

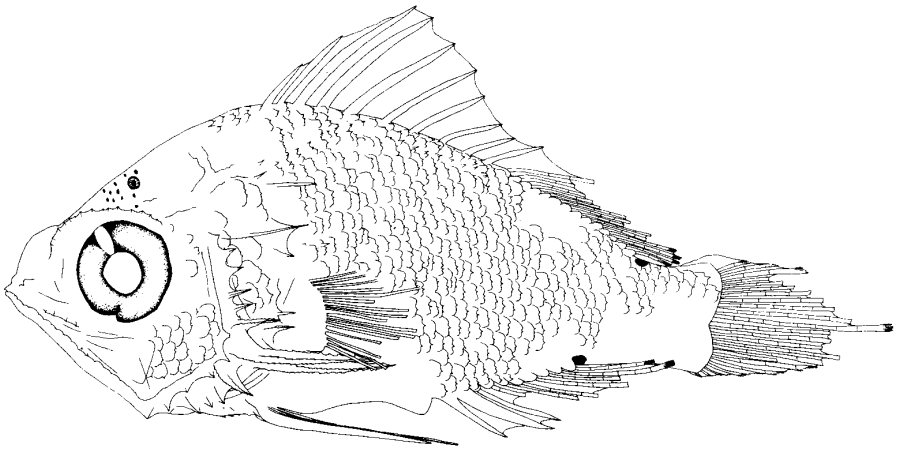
Pronotogrammus martinicensis



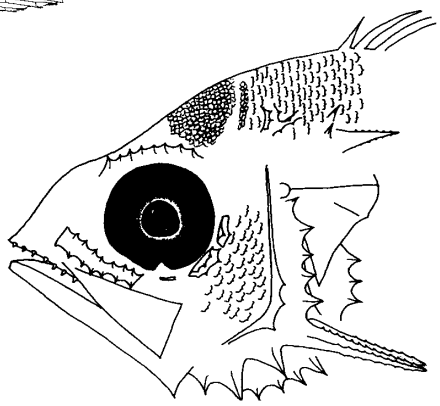
A. 4.7 mmSL



B. 5.7 mmSL

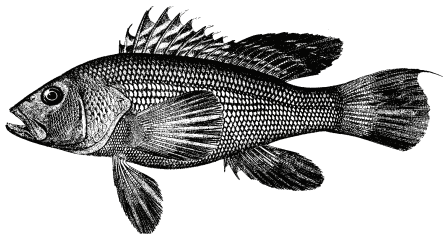


C. 8.4 mmSL



D. 8.7 mmSL
(Head spines)

Centropristis striata (Linnaeus, 1758)
Serranidae (s.f. Serraninae)
Black sea bass



Range: Western North Atlantic Ocean from Gulf of Maine to central Florida and northeast Gulf of Mexico; occasionally to Florida Keys

Habitat: Typically over rocky substrates, around pilings, seawalls, wrecks, reefs or jetties; found in depths from coast to edge of continental shelf; young stages often in estuaries, winter near shelf edge

Spawning: Apr-Nov in study area (peak Jul–Oct) over continental shelf

Meristic Characters

Myomeres:	24
Vertebrae:	10 + 14 = 24
Dorsal fin rays:	X, 11
Anal fin rays:	III, 7
Pectoral fin rays:	16–19
Pelvic fin rays:	I, 5
Caudal fin rays:	9+8 PrC
Supraneurals:	0/0/0+2/1+1/

Eggs:
- Pelagic, spherical
- Diameter: 0.8–1.0 mm
- Chorion: smooth
- Yolk: homogeneous, amber
- Oil globule: single, 0.13–0.19 mm diameter
- Perivitelline space: narrow

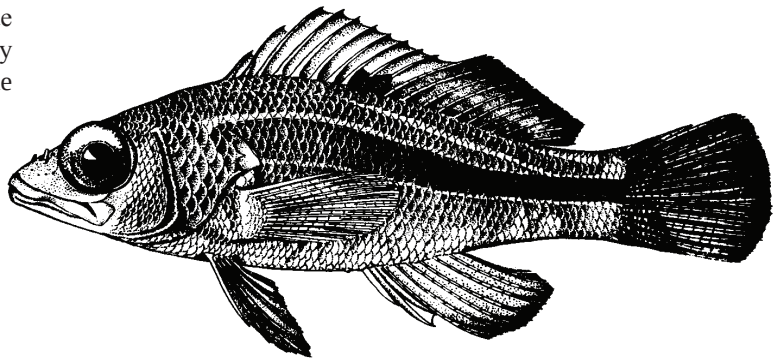
Larvae:
- Hatching occurs at sizes of 1.5–2.0 mmNL
- Body moderately stocky; body depth 25–27% SL
- Head large; head length increases from 33% SL in preflexion to 38% SL in postflexion
- Preanus length increases from about 50% SL at 5.0 mmSL to 65% SL in juvenile
- Flexion occurs at 5.5–6.0 mmSL
- Head lacks extensive spination; see checklist below
- Sequence of fin ray formation: C – D_2, A – D_1 – P_1 – P_2; 3rd anal spine begins as ray, transforms at about 7.0 mm
- Pigmentation generally light; includes series of ventral spots from end of anal fin to caudal fin base; other spots under tip of lower jaw, over gut, and occasionally along dorsum of body

Head spine checklist:

Preopercle:	few short, weak, smooth spines
Opercle:	few weak spines
Subopercle:	simple, weak spine
Interopercle:	simple point, not a definite spine
Posttemporal:	single, small spine
Supracleithral:	single, small spine

Note:
1. Small larvae superficially similar to *Lampanyctus* (Myctophidae) larvae in body shape, ventral pigment, early teeth formation. *Lampanyctus* larvae have >30 myomeres.

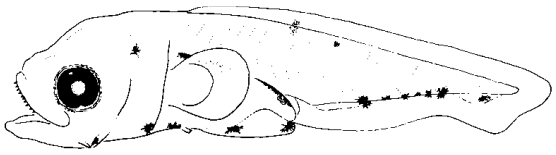
Juvenile: Settlement occurs at sizes of 10–16 mmTL on inner continental shelf, followed by movement into estuaries



F. 58.0 mmTL

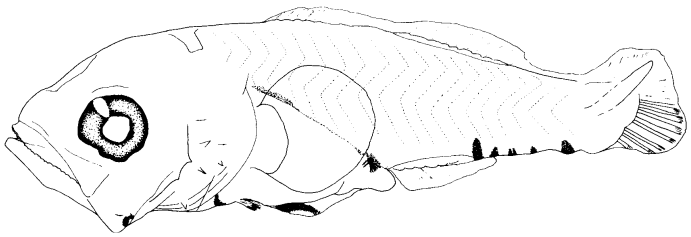
Figures: Adult: H. L. Todd; **A**: Kendall, 1972 (redrawn); **B–E**: Kendall, 1979; **F**: Hildebrand and Schroeder, 1928
References: Kendall, 1972; 1979; 1984; Fahay, 1983; Able *et al*., 1995; Able and Fahay, 1998

Centropristis striata

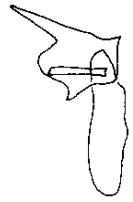


A. 5.1 mmSL

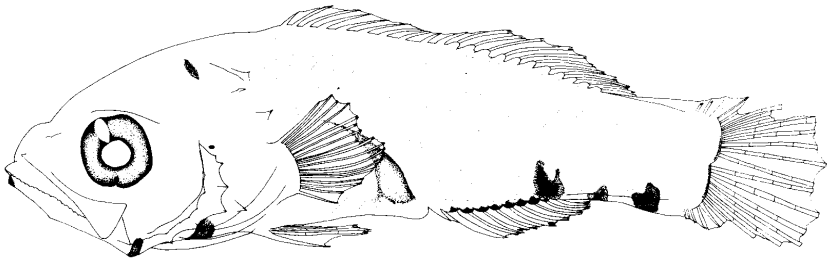
Teeth apparent at 5.0 mmSL



B. 4.7 mmSL

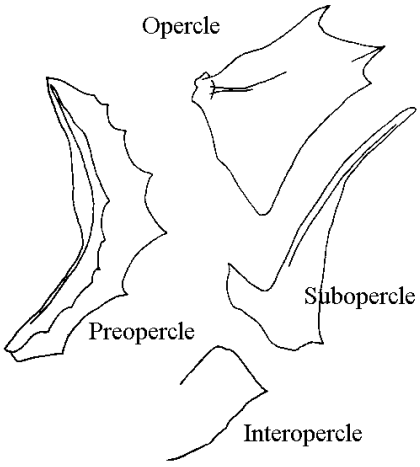


D. Posttemporal and supracleithral bones at 10.6 mmSL

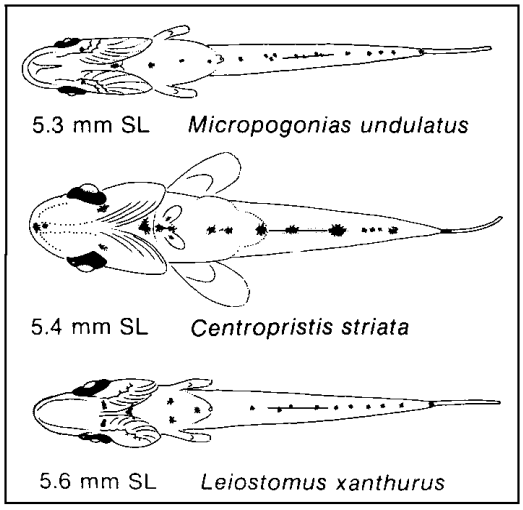


C. 8.3 mmSL

Characteristic melanophore just anterior to cleithral symphysis and between pelvic fin bases

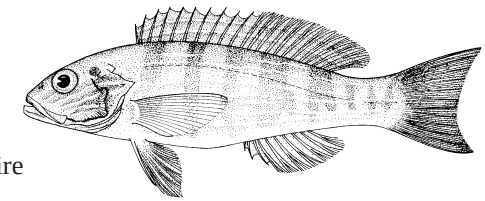


E. Opercular series of bones demonstrating spination at 10.6 mmSL



- Note difference in development of pectoral and pelvic fins in these 3 similar larvae (ventral views)
- Note space between anus and anal fin origin in *M. undulatus* and *L. xanthurus*; no space in *C. striata*
- Note triangular pigment pattern anterior to anus in *L. xanthurus* (compare to pattern in other 2 species)

Diplectrum formosum (Linnaeus, 1766)
Serranidae (s.f. Serraninae)
Sand perch



Range: Western North Atlantic Ocean from Virginia to Florida and the entire Gulf of Mexico; also northeastern South America

Habitat: Inshore grass beds to 73 m offshore; mostly in depths of 7–50 m over sand, mud, shell or rocky rubble substrates near low-lying reefs

Spawning: Mar–Sep (Gulf of Mexico); undescribed in study area

Eggs:
- Undescribed

Larvae:
- Body moderately slender with moderately large, pointy head
- Preanus length about 50% SL
- Head moderately large; mouth reaches mid-point of eye
- Flexion occurs at about 5.5 mmSL
- Head lacks extensive spination; see checklist below
- Sequence of fin ray formation: D_1, P_2 – D_2, A – P_1; no spines or fin rays elongate
- Pigment generally light, consisting of equal-sized melanophores; a series along ventral edge from mid-anal fin to a series of 5 spots on caudal peduncle; series of small spots along lower jaw midline; spot at cleithral symphysis; spots at anus in small larvae; often a prominent spot at base of middle caudal fin ray; scattered pigment on membranes of D_1 and P_1 fins

Meristic Characters

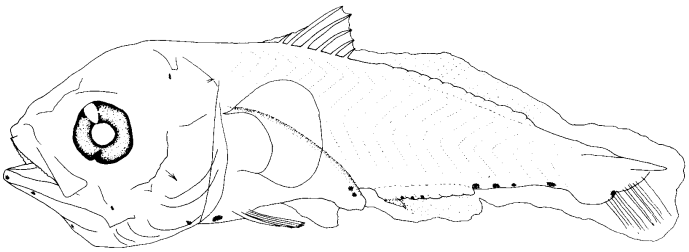
Myomeres:	24
Vertebrae:	10 + 14 = 24
Dorsal fin rays:	X, 11–13
Anal fin rays:	III, 6–8
Pectoral fin rays:	16–18
Pelvic fin rays:	I, 5
Caudal fin rays:	9+8 PrC
Supraneurals:	0/0/0+2/1+1/

Head spine checklist:

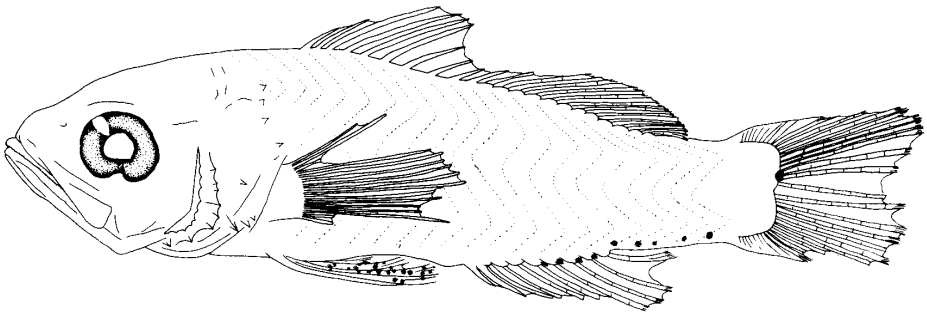
Preopercle:	series of small, smooth spines on edge and on lateral ridge
Opercle:	few small spines at upper angle
Subopercle:	few very small spines
Interopercle:	very low, simple spine
Posttemporal:	very small spine
Supracleithral:	very small spine

Figures: Adult: Heemstra *et al.*, 2002; **A–D**: Kendall, 1979 (as *Diplectrum* type 1)
References: Kendall, 1979; 1984; Heemstra *et al*., 2002; Leis and Carson-Ewart, 2004

Diplectrum formosum

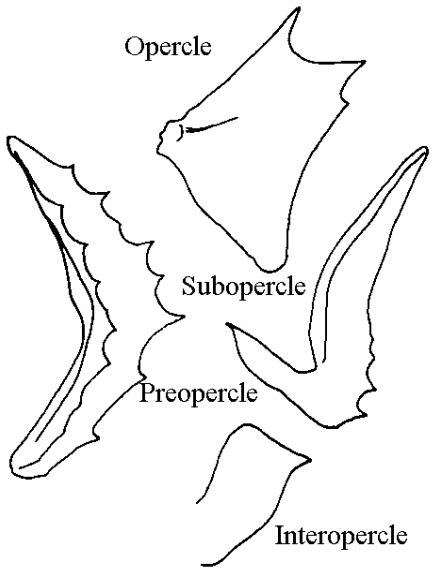


A. 5.8 mmNL



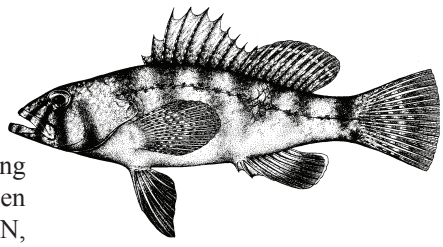
B. 10.0 mmSL

C. Posttemporal and supracleithral bones at 10.3 mmSL



D. Opercular series of bones demonstrating spination at 10.3 mmSL

Serraniculus pumilio Ginsburg, 1952
Serranidae (s.f. Serraninae)
Pygmy sea bass



Range: Western North Atlantic Ocean from North Carolina to Venezuela including Gulf of Mexico; absent from Bahamas and West Indies; larvae have been collected in the study area (over continental slope) as far north as 36°26'N, 75°14'W (MCZ 94285)

Habitat: Occurs in shallow, inshore waters to a maximum depth of 45 m; most frequently in sea grass beds

Spawning: Mar–Sep (Gulf of Mexico)

Eggs: – Undescribed

Meristic Characters

Myomeres:	24
Vertebrae:	10 + 14 = 24
Dorsal fin rays:	IX–X, 10–11
Anal fin rays:	III, 6–7
Pectoral fin rays:	14–15
Pelvic fin rays:	I, 5
Caudal fin rays:	9+8 PrC
Supraneurals:	0/0/1/1+1/

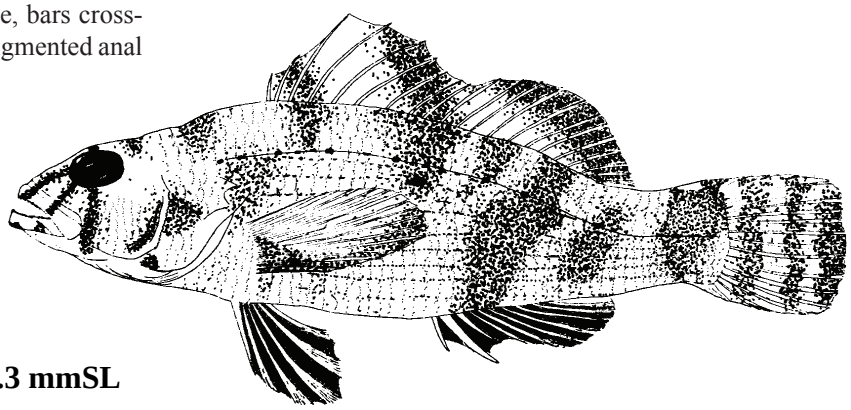
Larvae:
- Body moderately stocky, deepest through pectoral region; body depth about 30% SL
- Head large, moderately deep; mouth large, extending to middle of eye
- Preanus length >60% SL
- Flexion occurs between 4.0 and 5.5 mmSL
- Head lacks extensive spination; see checklist below
- Sequence of fin ray formation: $C - D_2$, $A - D_1 - P_1 - P_2$
- Pigment generally light; early larvae have fine spots in 3 parallel rows along dorsum, along midline of tail along venter from anal fin to caudal base; most prominent pigment a patch of melanophores covering much of flank between D_2 and A fins; spots forming a vague bar from snout, through eye, across opercle; few spots near cleithral symphysis; juveniles develop strong, barred pattern

Head spine checklist:

Preopercle:	series of very small spines along edge; large angle spine lacking; lateral ridge with a single spine
Opercle:	no prominent spines
Subopercle:	a single, very small spine
Interopercle:	none
Posttemporal:	none
Supracleithrum:	a single, very small spine

Note: 1. Six branchiostegal rays visible in larvae >4.0 mmSL and older stages; most serranines have 7

Early Juvenile: Note bars radiating from eye, bars crossing body and fins, densely pigmented anal and pelvic fin membranes

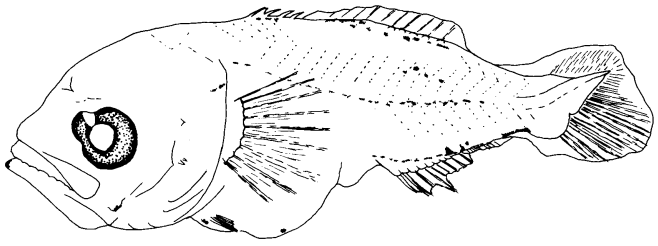


C. 55.3 mmSL

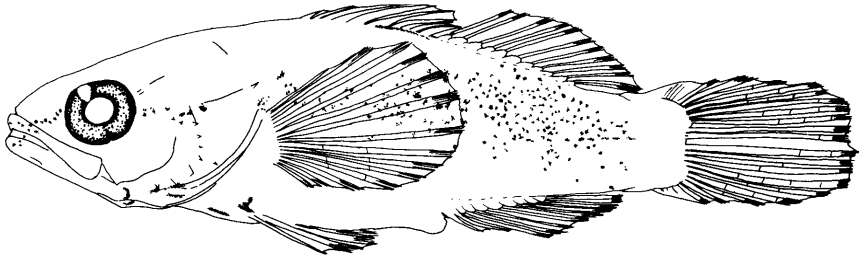
Figures: Adult: Diane Peebles (Bullock and Smith, 1991); **A–C**: Kendall, 1979

References: Kendall, 1979; Smith-Vaniz *et al*., 1999; Heemstra *et al*., 2002

Serraniculus pumilio

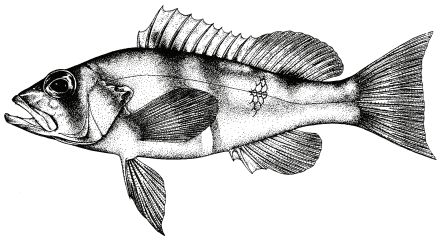


A. 3.8 mmSL



B. 5.8 mmSL

Serranus sp.
Serranidae (s.f. Serraninae)



Serranus phoebe

Range: Both *Serranus phoebe* Poey, 1851 and *S. subligarius* (Cope, 1870) occur along the Atlantic coast of the U.S. as far north as North Carolina. Larvae of *Serranus* sp. have been collected in the present study area, but it is not certain that these larvae represent one of these 2 species. Meristic characters of these species are listed in the introductory table because they are the most likely *Serranus* to produce the larvae that drift into the study area

Habitat: *Serranus subligarius* occurs in shallow, often silty, coastal waters, including rocky reefs, to 18 m; *S. phoebe* over rocky substrates in depths of 27–200 m; a specimen of the latter species has been collected at 34°57' N, 75°26' W, 84 m, 3 miles south of the present study area (USNM 00302414)

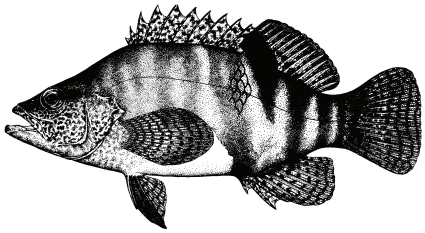
Spawning: Undescribed

Eggs: – Undescribed

Larvae:
- Body moderately stocky, deepest through pectoral region; body depth >30% SL
- Head large, moderately deep; mouth large, extending beyond middle of eye
- Preanus length 55–60% SL
- Flexion occurs between 4.0 and 6.0 mmSL
- Head lacks extensive spination; see checklist below
- Sequence of fin ray formation: C – D_2, A – D_1 – P_1 – P_2
- Pigment generally light with few, prominent melanophores; 2 spots along ventral edge of tail, 1 at anal fin insertion, 1 on caudal peduncle; very few spots on top of head; gut pigment light; pigment on dorsum of body consists of isolated spots on nape (early larvae) and under junction of D_1 and D_2; a spot on lateral surface of tail between posterior parts of D_2 and A fins; few spots near cleithral symphysis and at symphysis of lower jaw; pigment on membranes of D_1 and P_2 fins

Meristic Characters
(Total range in 2 species)

Myomeres:	24
Vertebrae:	10 + 14 = 24
Dorsal fin rays:	X, 11–14
Anal fin rays:	III, 6–8
Pectoral fin rays:	14–17
Pelvic fin rays:	I, 5
Caudal fin rays:	9+8 PrC
Supraneurals:	0/0/1/1+1/



Serranus subligarius

Head spine checklist:

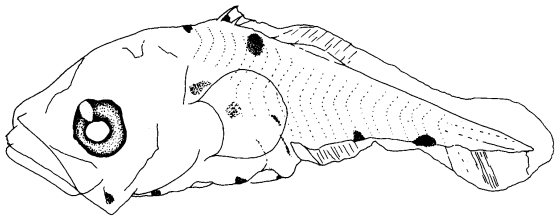
Preopercle:	series of about 6 low spines along edge; no spines on lateral ridge
Opercle:	3 low points at upper angle
Subopercle:	3 very low spines
Interopercle:	small, simple spine at upper angle
Posttemporal:	none
Supracleithrum:	none

Note: 1. Larvae in Figures A–C collected in southern part of study area. See comments above under "Range" and "Habitat".

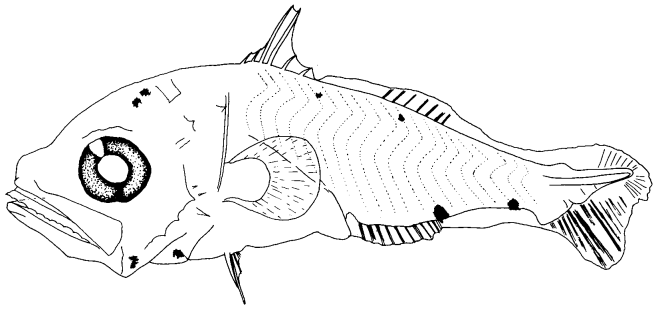
Figures: Adults: Diane Peebles (Bullock and Smith, 1991); **A–E**: Kendall, 1979

References: Kendall, 1979; Baldwin, 1990; Bullock and Smith, 1991; Smith-Vaniz *et al*., 1999; Heemstra *et al*., 2002

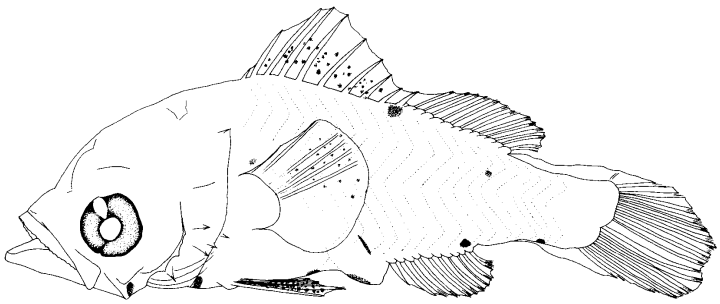
***Serranus* sp.**



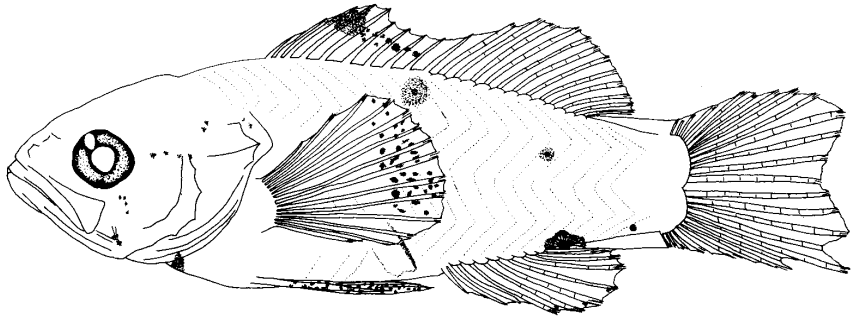
A. 3.7 mmSL



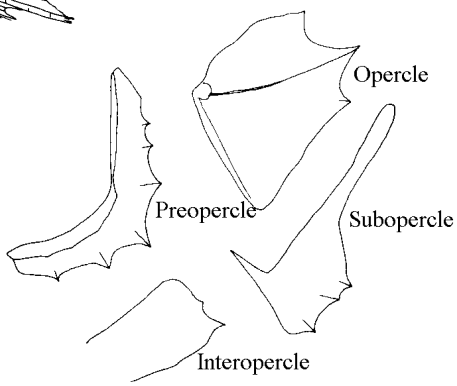
B. 5.0 mmSL



C. 5.5 mmSL



D. 9.4 mmSL



E. Opercular series of bones demonstrating spination at 9.7 mmSL

Jeboehlkia gladifer Robins, 1967
Serranidae (s.f. Epinephelinae)
Bladefin bass

No adult illustration available

Range: Adult known from western Caribbean Sea off Honduras; a single larva collected off Georges Bank (40°42.0' N; 65°400.3' W) in a MOCNESS net sampling between 10 and 302 m; 1982 (MCZ 81740)

Habitat: Not well described; apparently inhabits deep waters of 165 m or more

Spawning: Undescribed

Eggs: – Undescribed

Meristic Characters

Myomeres:	24
Vertebrae:	9 + 15 = 24
Dorsal fin rays:	VIII, 9
Anal fin rays:	III, 7
Pectoral fin rays:	15
Pelvic fin rays:	I, 5
Caudal fin rays:	4+9+8+4
Supraneurals:	/0/1/1+1/

Larvae:
- Body moderately deep, laterally compressed
- Body depth 34.5% SL
- Preanus length 56.5% SL
- Head deep, head length 42.4% SL; eye large, round, diameter greater than snout length
- Mouth large, extending to middle of eye
- Head moderately spiny; see checklist below
- Sequence of fin ray formation undescribed
- Single, elongate, filamentous 2nd dorsal fin spine, sheathed; 1st dorsal fin spine tiny; remaining dorsal fin spines subcutaneous at 10.2 mmSL
- 1st soft ray (and possibly 2nd) of pelvic fin elongate
- Dorsal fin ray count unique for epinephelines from Atlantic
- Fatty tissue parallels dorsal and ventral margins of caudal peduncle between ends of dorsal and anal fins and base of caudal fin; similar tissue covers procurrent and principal rays of caudal fin, over dorsal and anal fin rays and on head
- No scales formed before 10 mmSL
- Pigment: none

Head spine checklist:

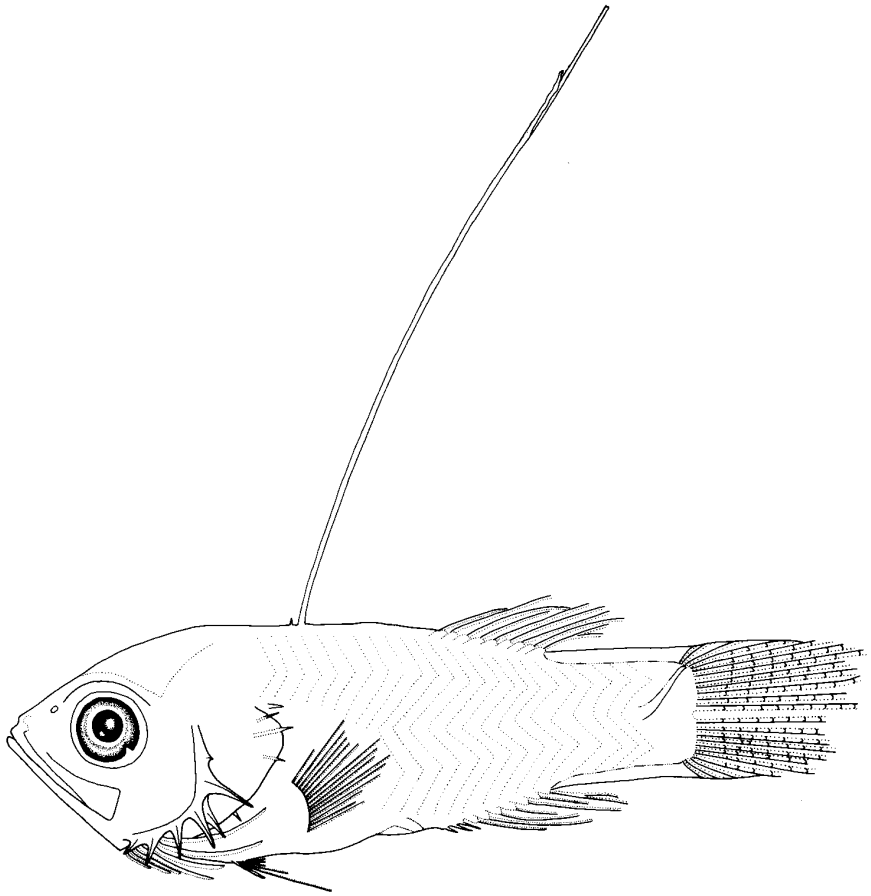
Preopercle:	6 large, smooth spines, lower 3 directed downward or antrorse; angle spine not particularly pronounced; spines lacking on lateral ridge
Opercle:	3 spines at upper angle
Subopercle:	1 small, smooth spine
Interopercle:	1 well-developed, smooth spine
Posttemporal:	none
Supracleithrum:	1 small, smooth spine
Supraocular, Lachrymal and Infraorbitals:	no spines reported
Frontals:	no spines, but vague pattern of shallow pits present
Supraoccipital:	none
Pterotic:	none
Articular:	none

Note: 1. Several characters of adult (small size, elongate, blade-like D_1 spine, elongate pelvic fin rays, large eye), compared to other epinepheline species, suggest that this species is paedomorphic (Kendall, 1984)

Figures: Adult: See Robins (1967) for photo; **A**: Baldwin and Johnson, 1991

References: Robins, 1967; Kendall, 1984; Baldwin *et al*., 1991; Baldwin and Johnson, 1991; 1993

Jeboehlkia gladifer

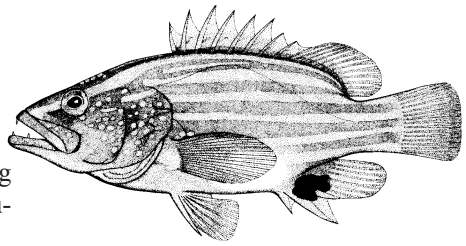


A. 10.2 mmSL

Pigment lacking;
possibly naturally unpigmented

Caudal peduncle depth 15.7 % SL; depth of caudal peduncle plus blade-like sheaths of fatty tissue 18.6% SL

Gonioplectrus hispanus (Cuvier, 1828)
Serranidae (s.f. Epinephelinae)
Spanish flag



Range: Western North Atlantic Ocean from North Carolina to Brazil, including Gulf of Mexico, parts of Caribbean Sea (Cuba, Jamaica, off Venezuela); young stages may drift into study area via Gulf Stream

Habitat: Demersal over rocky substrates, other rough bottoms, in depths of 60 m to upper continental slope

Spawning: Undescribed

Meristic Characters

Myomeres:	24
Vertebrae:	10 + 14 = 24
Dorsal fin rays:	VIII, 13
Anal fin rays:	III, 7
Pectoral fin rays:	16-17
Pelvic fin rays:	I, 5
Caudal fin rays:	4+9+8+4
Supraneurals:	0/0/1/1+1/

Eggs: – Undescribed

Larvae:
- Body robust and deep; body depth 50% SL (deeper than other epinephelines)
- Preanus length 64% SL
- Head length 43% SL
- Mouth large, extending to middle of eye
- Flexion size undescribed
- Head features a few, stout spines; see checklist below
- Sequence of fin ray formation undescribed
- Several fin spines elongate: 2nd and 3rd dorsal, 2nd anal and pelvic; all are stout and triangular in cross section
- Anal fin II, 8; 1st fin ray transforms into a spine at unknown size
- Pectoral fin very long (about 34% SL); much longer than in other epinepheline larvae
- Details of scale formation undescribed
- Pigment consists of melanophores over the hindbrain, pectoral region and venter anterior to pelvic fins; a large "X" shaped blotch present on lateral surface of caudal peduncle; freshly collected larvae have red wash from eye to pectoral region, and on 2nd dorsal and pelvic fin spines

Head spine checklist:

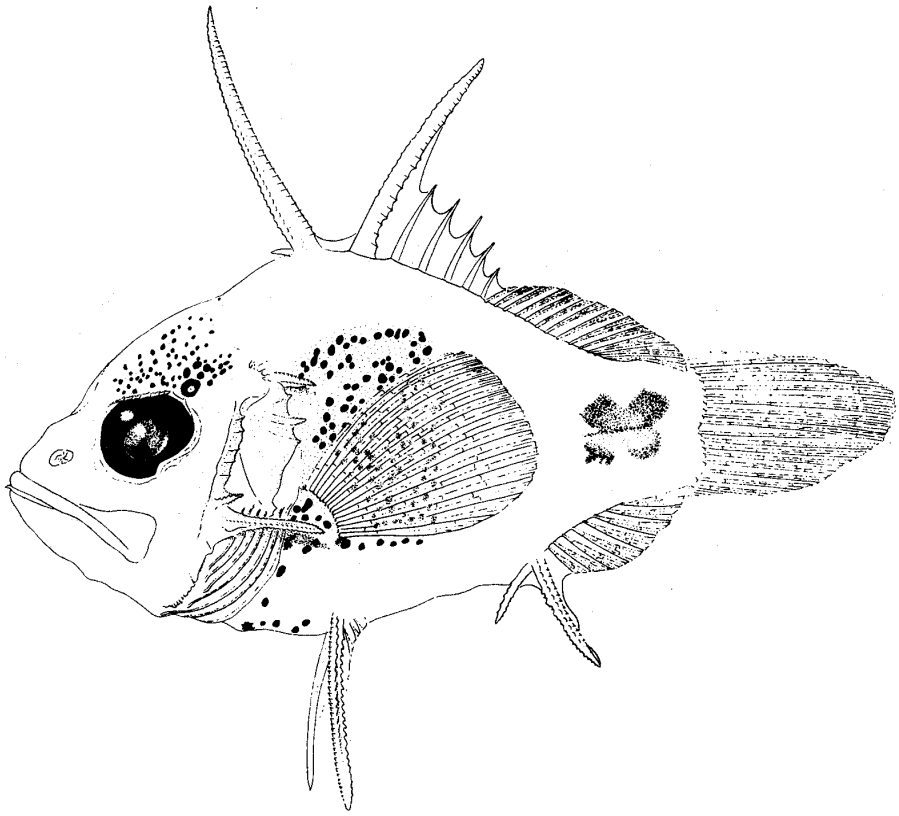
Preopercle:	series of 7 spines; angle spine long, serrate; most anterior ventral spine large and serrate
Opercle:	3 spines at upper angle, middle one serrate
Subopercle:	none
Interopercle:	none or a single small, smooth spine
Posttemporal:	1 small, smooth spine
Supracleithrum:	1 stout, serrate spine
Supraocular:	low, serrate ridge; unknown whether forms initially as a single spine
Frontals:	smooth, no ridges
Supraoccipital:	none
Pterotic:	none
Articular:	none

Figures: Adult: Heemstra *et al*., 2002; **A**: Kendall and Fahay, 1979; **B**: Johnson and Keener, 1984

References: Kendall and Fahay, 1979; G. D. Johnson 1983; 1988; Johnson and Keener, 1984; Baldwin *et al.*, 1991; Baldwin and Johnson, 1993

Gonioplectrus hispanus

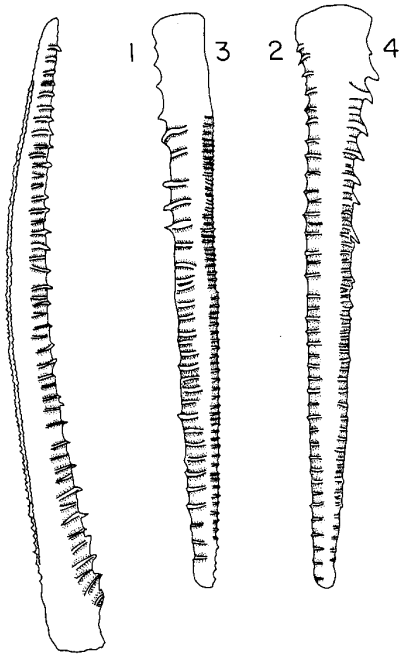
Note third dorsal spine nearly as long as second. In other epinephelines the second spine dominates all other spines in length.



Spines and ridges on the third dorsal spine are identical to those on the second (see box)

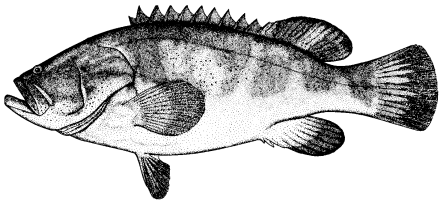
A. 13.4 mmSL

2nd dorsal spine: small bump-like spinelets along apex (anterior) ridge; 2 ridges bearing similar small spinelets parallel each side of apex. Small, straight spinelets along the dorsolateral wings; the bases of these extend anteriorly as raised ridges. **Pelvic spines:** ridges 1,2 and 4 have small, straight spinelets that are enlarged and slightly curved near base of spine; ridge 3 has small, bump-like spinelets similar to those on 2nd dorsal spine. The bases of all of these spinelets extend as raised ridges toward medial (central) portion of spine. See Serranidae Introductory pages.



B. 13.4 mmSL

Epinephelus itajara (Lichtenstein, 1822)
Serranidae (s.f. Epinephelinae)
Jewfish



Range: Tropical and subtropical waters of Atlantic and eastern Pacific oceans; in the western Atlantic Ocean from Bermuda and North Carolina to southern Brazil, including Gulf of Mexico and Caribbean Sea; larvae may occur in study area, transported by Gulf Stream

Habitat: Often in shallow water (<30 m), sometimes near coral reefs; also deeper water near wrecks or other substrates offering high relief

Spawning: May–Aug (Bermuda); Dec–Jan (Bahamas); forms large spawning aggregations, often at sunset

Eggs:
- Pelagic
- Diameter: 0.95 mm
- Oil globule: single

Meristic Characters

Myomeres:	24
Vertebrae:	10 + 14 = 24
Dorsal fin rays:	XI, 15–16
Anal fin rays:	III, 8
Pectoral fin rays:	18–19
Pelvic fin rays:	I, 5
Caudal fin rays:	9+8 PrC
Supraneurals:	0/0/1/1+1/

Larvae:
- Larvae incompletely described; characters below pertain to most *Epinephelus* larvae
- Body moderately elongate, with large head, moderately pointy snout
- Preanus length about 50–60% SL
- Flexion size undescribed
- Sequence of fin ray formation: P_2, D_1 – C – A – D_2 – P_1
- Anterior D_1 and P2 spines form early
- 2nd dorsal fin spine very elongate, stout, serrate edges
- Pelvic fin spine elongate, stout, serrate edges
- Head spines obvious; see checklist below
- Pigmentation includes melanophore at cleithral symphysis (unusual in *Epinephelus*); prominent spot migrates from mid-ventral line of caudal peduncle to mid-lateral line; spots on top of head; dorsum of gut pigmented; no pigment on dorsum of body; pigment typically heavy on membranes of D_1 and P_2 fins

Head spine checklist: (details based on *Epinephelus morio* development, Colin *et al.*, 1996)

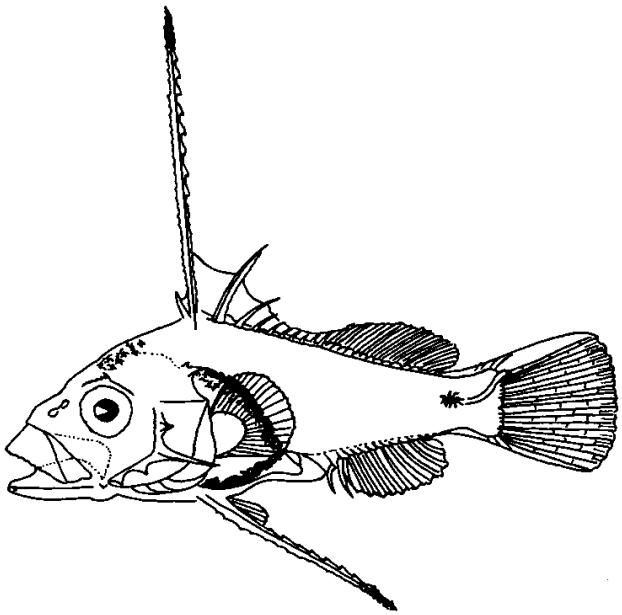
Preopercle:	series of few spines along edge; large, stout, serrate spine at angle; lateral ridge with a single spine
Opercle:	3 low points
Subopercle:	single spine
Interopercle:	single spine
Posttemporal:	none
Supracleithrum:	1–2 small spines
Supraocular:	single spine becomes low, serrate ridge with 1 to many, fine spines

Note: 1. See details of 2nd dorsal and pelvic spine morphology (Fig. B–C)

Figures: Adult: Heemstra *et al*., 2002; **A**: Aboussouan, 1972; **B–C**: Johnson and Keener, 1984

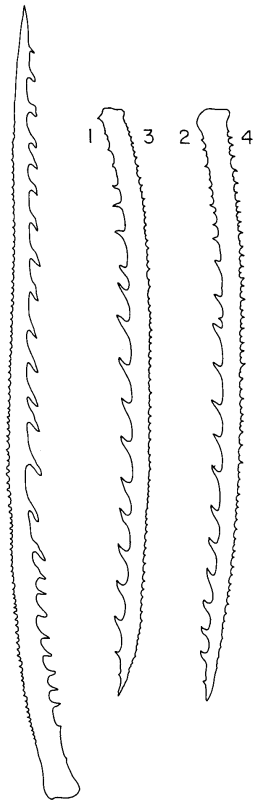
References: G. D. Johnson 1983; 1988; Johnson and Keener, 1984; Baldwin *et al.*, 1991; Baldwin and Johnson, 1993; Colin *et al*., 1996; Heemstra *et al*., 2002

Epinephelus itajara



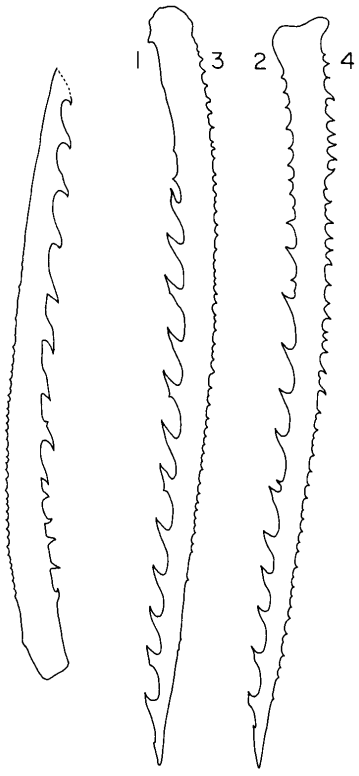
Note: melanophore present at cleithral symphysis in *E. itajara*

A. 9.0 mmSL (*Epinephelus aeneus* [eastern Atlantic] included to demonstrate typical *Epinephelus* larval morphology)



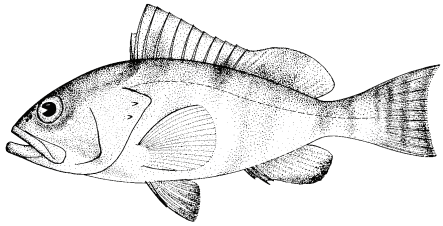
2nd dorsal spine: a single row of small spinelets on apex (anterior) ridge; large, recurved spinelets along dorsolateral wings, smaller and straighter near base. **Pelvic spines:** large, recurved spinelets along ridges 1 and 2 extending from about 25% of length from the base to the tip.
See Serranidae Introductory pages.

B. 9.2 mmSL



C. 16.9 mmSL (2nd dorsal spine broken)

Epinephelus morio (Valenciennes, 1828)
Serranidae (s.f. Epinephelinae)
Red grouper



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

Habitat: Older fish in depths of 50–300 m over sand or mud substrates; larger juveniles in depths of 5–25 m in crevices or under rock ledges; smaller juveniles often in grass beds or inshore reefs in shallow waters

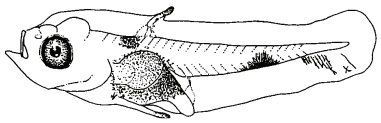
Spawning: Apr–May (Gulf of Mexico); form spawning aggregations

Eggs: – Undescribed

Larvae:
- Body moderately elongate; body depth 30–35% SL
- Head moderately large, head length increases from about 20% to 40% SL; snout pointy, rounded
- Mouth large, extending to middle of eye
- Preanus length 50–60% SL
- Flexion occurs at 4.5–8.0 mmSL
- Sequence of fin ray formation: P_2, D_1 – C – A, D_2 – P_1
- Head spines moderately developed; see checklist below
- Anterior D_1 and P_2 spines form very early; 2nd dorsal fin spine very elongate, stout, serrate edges
- Pigment in early larvae includes bold melanophores at base of D_1 spine and on venter of tail; peritoneum well pigmented; tips of early-forming D_1 and P_2 spines well pigmented; in later larvae, spot on venter of tail migrates to midline of caudal peduncle, becomes very prominent; top of head well pigmented after flexion; no pigment on dorsum of body; pigment on P_2 spreads from tip of spine to fin membranes

Meristic Characters

Myomeres:	24
Vertebrae:	10 + 14 = 24
Dorsal fin rays:	XI, 15–17
Anal fin rays:	III, 8–10
Pectoral fin rays:	16–18
Pelvic fin rays:	I, 5
Caudal fin rays:	9+8 PrC
Supraneurals:	0/0/1/1+1/

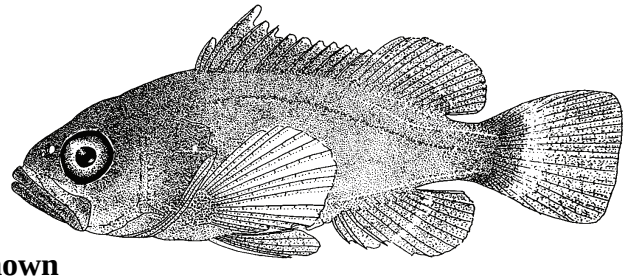


Preflexion larva, 3.5 mmNL

Head spine checklist:

Preopercle:	series of small spines along edge; large, stout, serrate spine at angle; lateral ridge with a single spine
Opercle:	none (or 3 low points)
Subopercle:	single spine
Interopercle:	single spine
Posttemporal:	none or small, serrate spine
Supracleithrum:	1–2 small, serrate spines
Supraocular:	single, small spine becomes low, serrate ridge

Early Juvenile:

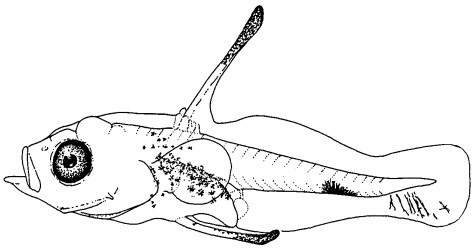


G. Size unknown

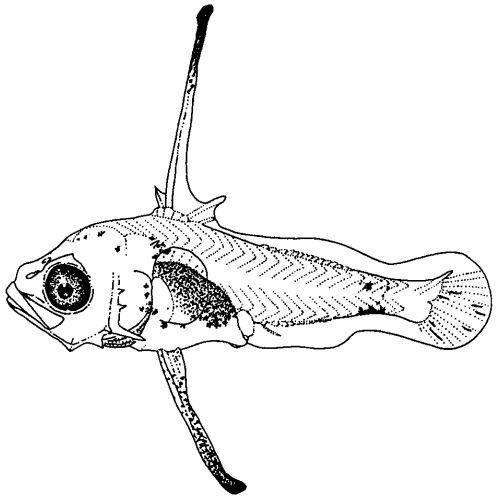
Figures: Adult: Heemstra *et al.*, 2002; Preflexion and **A–E**, **G**: Wayne Laroche (Colin *et al.*, 1996); **F**: Johnson and Keener, 1984

References: Kendall, 1979; G. D. Johnson 1983; 1988; Johnson and Keener, 1984; Baldwin *et al*., 1991; Baldwin and Johnson, 1993; Colin *et al*., 1996; Smith-Vaniz *et al*., 1999; Heemstra *et al*., 2002

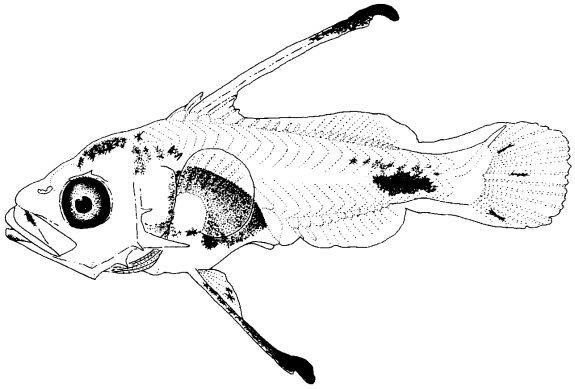
Epinephelus morio



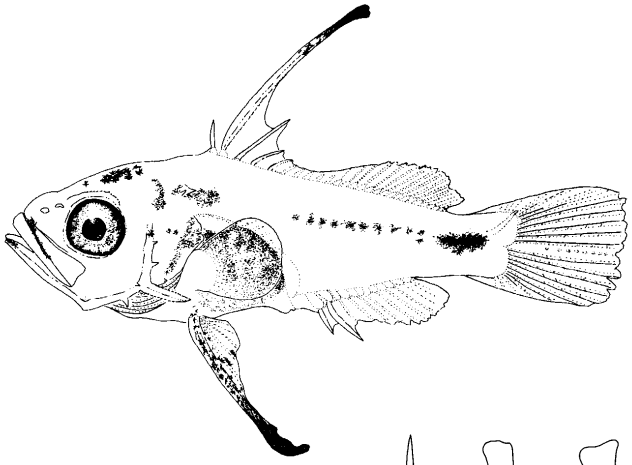
A. 4.1 mmNL



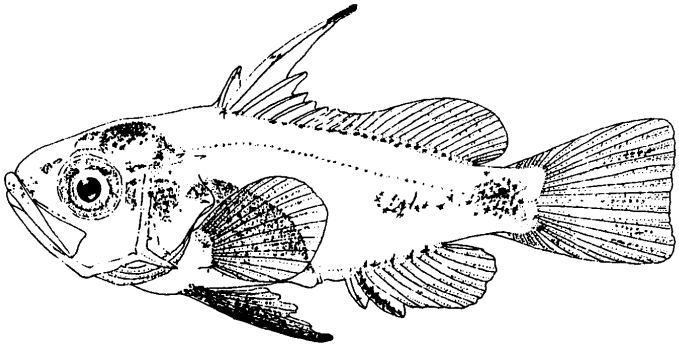
B. 6.5 mmNL



C. 7.4 mmSL

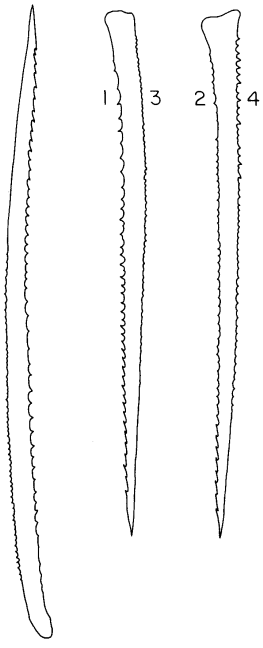


D. 9.8 mmSL



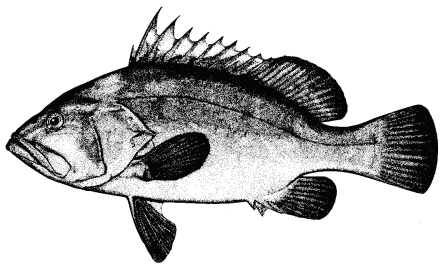
E. 13.9 mmSL

2nd dorsal spine: spinelets on apex (anterior ridge) small, straight, disappear near tip; small, straight spinelets along dorsolateral wings. **Pelvic spines:** all spinelets simple, small, straight.
See Serranidae Introductory pages.



F. 14.4 mmSL

Epinephelus nigritus (Holbrook, 1855)
Serranidae (s.f. Epinephelinae)
Warsaw grouper



Range: Atlantic Ocean; in the western North Atlantic from Massachusetts to Gulf of Mexico, Cuba, Haiti and Venezuela to Brazil; rarely eastern Atlantic (France)

Habitat: Occurs in depths of 55–525 m over rough, rocky substrates; juveniles occasionally near jetties or shallow reefs

Spawning: Not well described

Eggs: – Undescribed

Larvae: – Larvae incompletely described; characters below pertain to most *Epinephelus* larvae
– Body moderately elongate, with large head, moderately pointy snout
– Preanus length about 50–60% SL
– Flexion size undescribed
– Sequence of fin ray formation: P_2, D_1 – C – A – D_2 – P_1
– Anterior D_1 and P_2 spines form early
– 2nd dorsal and pelvic fin spines very elongate, stout, serrate edges
– Head spines obvious; see checklist below
– Pigmentation includes melanophore at cleithral symphysis (unusual in *Epinephelus*); prominent spot migrates from mid-ventral line of caudal peduncle to mid-lateral line; spots on top of head; dorsum of gut pigmented; no pigment on dorsum of body; pigment typically heavy on membranes of D_1 and P_2 fins

Meristic Characters

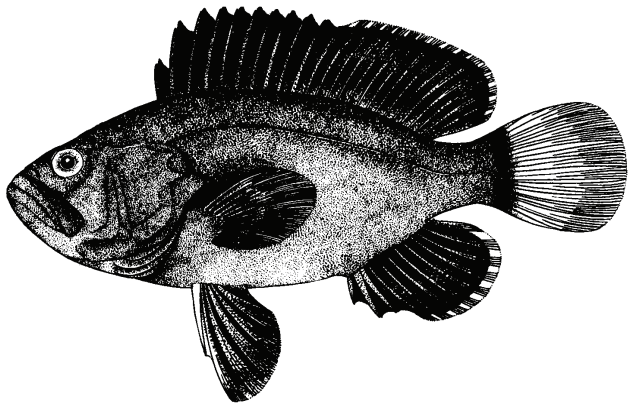
Myomeres:	24
Vertebrae:	10 + 14 = 24
Dorsal fin rays:	X, 13–15
Anal fin rays:	III, 9
Pectoral fin rays:	18–19
Pelvic fin rays:	I, 5
Caudal fin rays:	9+8 PrC
Supraneurals:	0/0/1/1+1/

Head spine checklist: (details based on *Epinephelus morio* development (Colin *et al*., 1996)

Preopercle:	series of few spines along edge; large, stout, serrate spine at angle; lateral ridge with a single spine
Opercle:	3 low points
Subopercle:	single spine
Interopercle:	single spine
Posttemporal:	none
Supracleithrum:	1–2 small spines
Supraocular:	single spine becomes low, serrate ridge with 1 to many, fine spines

Note: 1. See note box on figure page for comments on 2nd dorsal and pelvic spine morphology

Early juvenile:



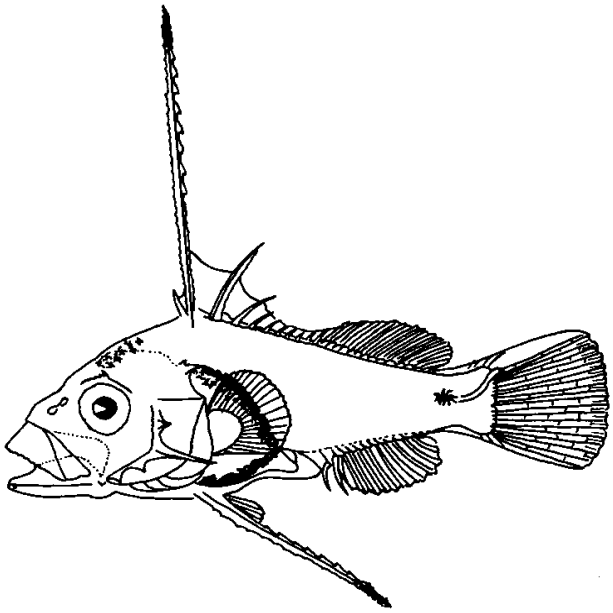
B. 88.0 mmTL

Figures: Adult: Heemstra *et al*., 2002; **A**: Aboussouan, 1972; **B**: Fowler, 1945

References: Kendall, 1979; G. D. Johnson 1983; 1988; Johnson and Keener, 1984; Baldwin *et al*., 1991; Baldwin and Johnson, 1993; Colin *et al*., 1996; Smith-Vaniz *et al*., 1999; Heemstra *et al*., 2002

Epinephelus nigritus

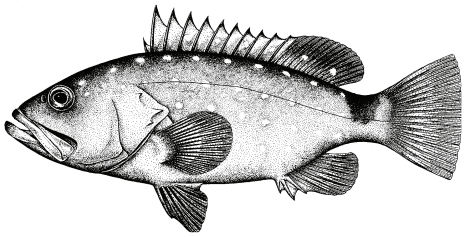
Note: melanophore present at cleithral symphysis in *E. nigritus*



A. 9.0 mmSL (*Epinephelus aeneus* [eastern Atlantic] included to demonstrate typical *Epinephelus* larval morphology)

Morphology of dorsal and pelvic fin spines is inadequately described. **2nd dorsal spine** missing from a single (tentatively) identified larva, 9.1 mmSL. Ridge 1 of the **pelvic spine** has large, very widely spaced, recurved spinelets along its length; several similar spinelets present on ridge 2. Spine morphology probably resembles that of *E. itajara*. See Serranidae Introductory pages.

Epinephelus niveatus (Valenciennes, 1828)
Serranidae (s.f. Epinephelinae)
Snowy grouper



Range: Western North Atlantic Ocean from Massachusetts to Brazil, including Gulf of Mexico and continental Caribbean Sea

Habitat: Adults occur over rocky substrates in depths of 30–400 m; juveniles occur in inshore waters, often reported from study area

Spawning: Apr–Jul (Florida Keys)

Eggs:
- Undescribed

Larvae:
- Larvae incompletely described; characters below pertain to most *Epinephelus* larvae
- Body moderately elongate, with large head, moderately pointy snout
- Preanus length about 50–60% SL
- Flexion size undescribed
- Sequence of fin ray formation: P_2, D_1 – C – A – D_2 – P_1
- Anterior D_1 and P_2 spines form early
- 2nd dorsal fin spine very elongate, stout, serrate edges
- Pelvic fin spine elongate, stout, serrate edges
- Head spines obvious; see checklist below
- Pigmentation includes a prominent spot that migrates from mid-ventral line of caudal peduncle to mid-lateral line; spots on top of head; dorsum of gut pigmented; no pigment on dorsum of body; no pigment at cleithral symphysis

Meristic Characters

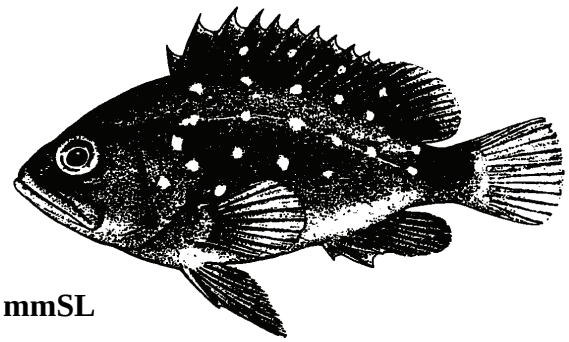
Myomeres:	24
Vertebrae:	10 + 14 = 24
Dorsal fin rays:	X, 13–15
Anal fin rays:	III, 9
Pectoral fin rays:	17–19
Pelvic fin rays:	I, 5
Caudal fin rays:	9+8 PrC
Supraneurals:	0/0/1/1+1/

Head spine checklist: (details based on *Epinephelus morio* development (Colin *et al*., 1996)

Preopercle:	series of few spines along edge; large, stout, serrate spine at angle; lateral ridge with a single spine
Opercle:	3 low points
Subopercle:	single spine
Interopercle:	single spine
Posttemporal:	none
Supracleithrum:	1–2 small spines
Supraocular:	single spine becomes low, serrate ridge with 1 to many, fine spines

Note:
1. Figs. A–C identified as *Epinephelus niveatus* on the basis of fin meristic characters alone. However, values overlap other species broadly, and this identification should be considered putative
2. See note box on figure page for comments on 2nd dorsal and pelvic spine morphology

Early Juvenile:

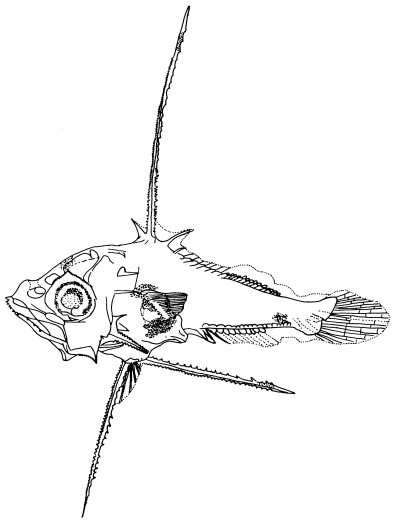


E. 88.0 mmSL

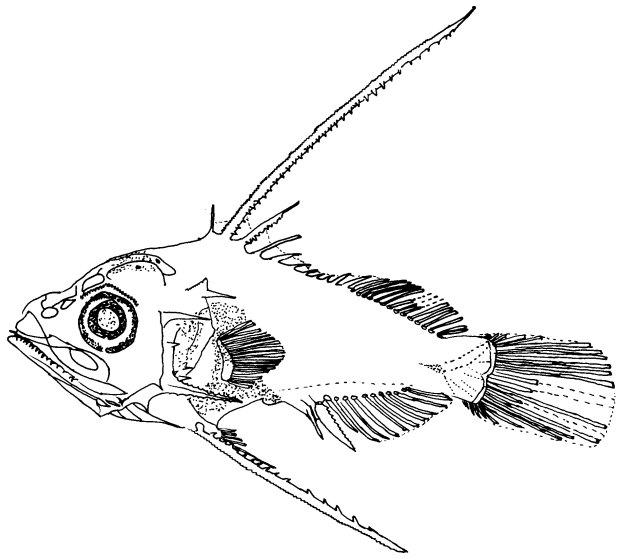
Figures: Adult: Diane Peebles (Bullock and Smith, 1991); **A–C**: Presley, 1970; **D**: Johnson and Keener, 1984; **E:** Heemstra and Randall, 1993

References: G. D. Johnson, 1983; 1988; Johnson and Keener, 1984; Baldwin *et al.*, 1991; Baldwin and Johnson, 1993; Heemstra *et al*., 2002

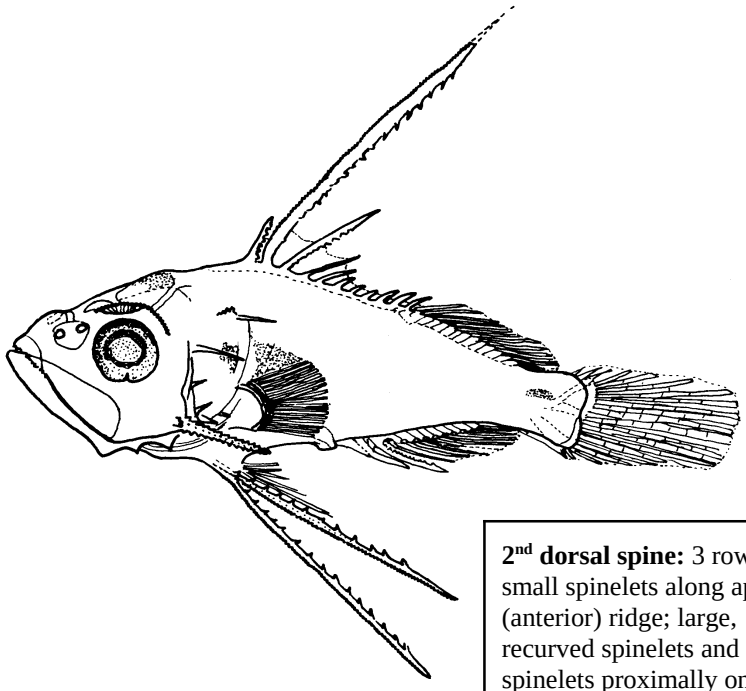
Epinephelus niveatus



A. 5.5 mmSL

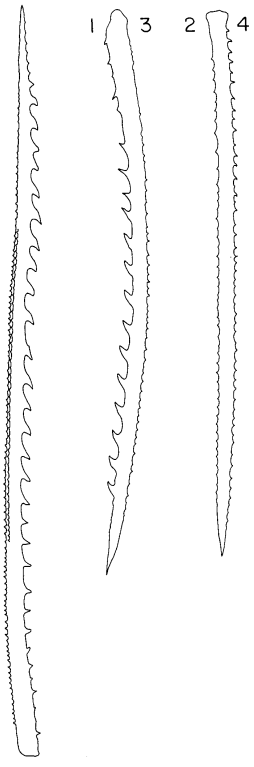


B. 8.2 mmSL



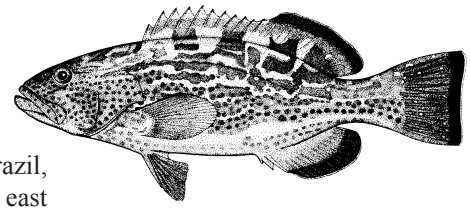
C. 9.3 mmSL

2nd dorsal spine: 3 rows of small spinelets along apex (anterior) ridge; large, recurved spinelets and smaller spinelets proximally on dorsolateral wings. **Pelvic spines:** ridge 1 with enlarged, recurved spinelets; other ridges with small, straight spinelets; spinelets at base of ridge 4 slightly larger.
See Serranidae Introduction



D. 13.1 mmSL

Mycteroperca bonaci (Poey, 1860)
Serranidae (s.f. Epinephelinae)
Black grouper



Range: Western North Atlantic Ocean from Bermuda and Florida Keys to Brazil, including Gulf of Mexico and Caribbean Sea; adults not known from east coast of United States, but juveniles occasionally occur as far north as Massachusetts

Habitat: Occurs over coral reefs and rocky substrates in depths of 10–100 m; juveniles often found in mangrove habitats

Spawning: Jul–Aug (Campeche Banks)

Eggs: – Undescribed

Larvae: – Larvae incompletely described; characters below pertain to most *Mycteroperca* larvae
– Body moderately elongate; body depth about 30–35% SL
– Preanus length about 50–60% SL
– Head length about 32% SL in early larvae, increases in early juveniles
– Mouth large, extending to posterior edge of eye
– Sequence of fin ray formation: P_2, D_1 – C – A – D_2 – P_1
– Anterior D_1 and P_2 spines form early
– 2nd dorsal fin spine very elongate, stout, serrate edges
– Pelvic fin spine elongate, stout, serrate edges
– Head spines strong; see checklist below
– Pigment includes prominent spot along ventral edge of tail that migrates to lateral midline of caudal peduncle in later larvae; a few spots on top of head; dorsal surface of gut pigmented; no pigment on dorsum of body; a single spot at cleithral symphysis; pigment may occur on membranes of dorsal or pelvic fin

Meristic Characters

Myomeres:	24
Vertebrae:	10 + 14 = 24
Dorsal fin rays:	XI, 15–17
Anal fin rays:	III, 11–13
Pectoral fin rays:	16–17
Pelvic fin rays:	I, 5
Caudal fin rays:	9+8 PrC
Supraneurals:	0/0/1/1+1/

Head spine checklist:

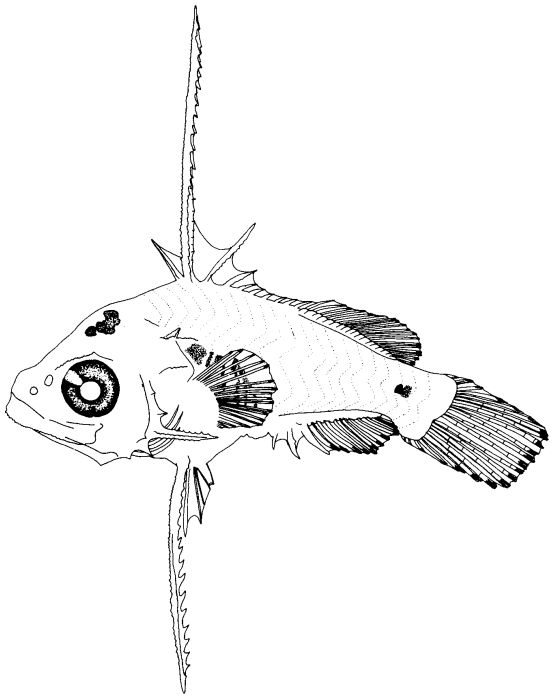
Preopercle:	series of 5 spines along edge; large, stout, serrated spine at angle; lateral ridge with a single spine
Opercle:	single spine at upper angle, with 2 adjacent, smaller spines
Subopercle:	a single, tiny spine
Interopercle:	very small spine at upper angle
Posttemporal:	low spine not obvious or absent
Supracleithrum:	a single large, serrate spine
Supraocular:	single spine becomes low, serrate ridge with few to many low spines

Note: 1. See note box on figure page for comments on 2nd dorsal and pelvic spine morphology

Figures: Adult: Heemstra *et al*., 2002; **A**: Kendall, 1979; **B**: Johnson and Keener, 1984

References: Kendall, 1979; G. D. Johnson, 1983; 1988; Johnson and Keener, 1984; Baldwin *et al*., 1991; Baldwin and Johnson, 1993; Ross and Moser, 1995; Able and Fahay, 1998; Smith-Vaniz *et al*., 1999; Heemstra *et al.*, 2002

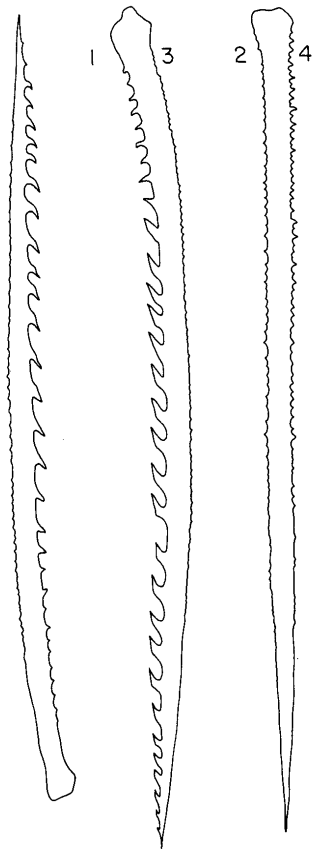
Mycteroperca bonaci



Note: melanophore occurs at cleithral symphysis in larvae of all *Mycteroperca* species

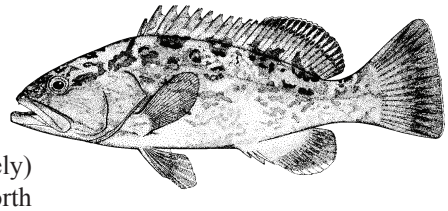
A. 7.4 mmSL (*Mycteroperca microlepis*, included to demonstrate typical *Mycteroperca* larva)

Dorsal and pelvic spine morphology is similar in larvae of all *Mycteroperca* species. The pelvic spine morphology is similar to that of *Epinephelus niveatus.* **2nd dorsal spine:** very small spinelets along apex (anterior) ridge. Large recurved spinelets along the dorsolateral wings (except smaller near base). **Pelvic spines:** ridge 1 has large, recurved spinelets along most of length; other ridges have small, straight spinelets.
See Serranidae Introductory pages.



B. 16.0 mmSL
(*Mycteroperca* sp.)

Mycteroperca microlepis (Goode and Bean, 1879)
Serranidae (subfamily Epinephelinae)
Gag grouper



Range: Western North Atlantic Ocean from North Carolina and Bermuda (rarely) to Gulf of Mexico (Yucatán Peninsula); juveniles may occur as far north as Massachusetts

Habitat: Usually found over rocky substrates in depths of 40–80 m; also inshore waters over rocky or grassy substrates; juveniles in estuaries and seagrass beds

Spawning: Dec–Apr (Gulf of Mexico); forms spawning aggregations

Eggs:
- Undescribed

Meristic Characters

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

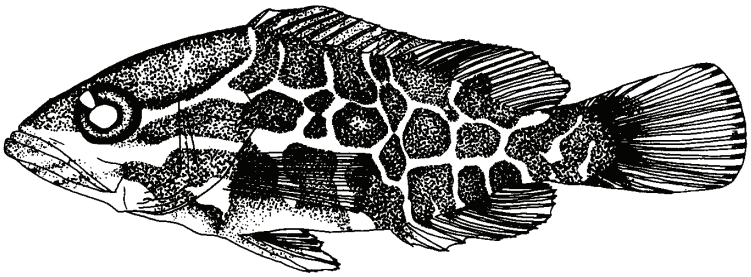
Larvae:
- Body moderately elongate; body depth about 30–35% SL in all stages
- Preanus length about 50–55% SL in early larvae, increasing slightly to >60% SL in early juveniles
- Head length about 32% SL in early larvae, increases to 36–42% SL in early juveniles
- Mouth large, extending to posterior edge of eye
- Sequence of fin ray formation: P_2, D_1 – C – A – D_2 – P_1
- Anterior D_1 and P_2 spines form early
- 2nd dorsal fin spine very elongate, stout, serrate edges
- Head spines strong; see checklist below
- Pigment includes prominent spot along ventral edge of tail that migrates to lateral midline of caudal peduncle in later larvae; a few spots on top of head; dorsal surface of gut pigmented; no pigment on dorsum of body; a single spot at cleithral symphysis; pigment on membranes of dorsal or pelvic fin not reported

Head spine checklist:

Preopercle:	series of 5 spines along edge; large, stout spine at angle; lateral ridge with a single spine
Opercle:	single spine at upper angle, with 2 adjacent, smaller spines
Subopercle:	a single, tiny spine
Interopercle:	very small spine at upper angle
Posttemporal:	low spine not obvious
Supracleithrum:	a single large, serrate spine
Supraocular:	low, serrate ridge with few to many low spines

Note:
1. Specimens in Fig. A–E identified on the basis of meristic characters and collection location. Larvae of other species of *Mycteroperca* may be similar.
2. See note box on figure page for comments on 2nd dorsal and pelvic spine morphology

Early Juvenile: Color pattern of juvenile more closely resembles photographs of juvenile *Mycteroperca bonaci* (Ross and Moser, 1995)

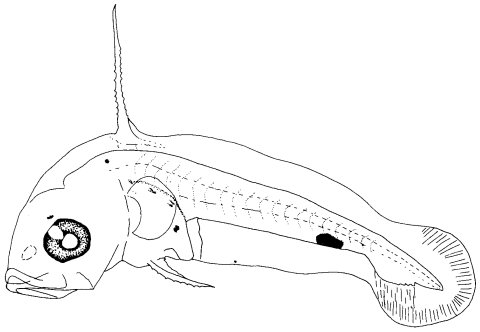


E. 22.6 mmSL

Figures: Adult: Heemstra *et al*., 2002; **A–E**: Kendall, 1979

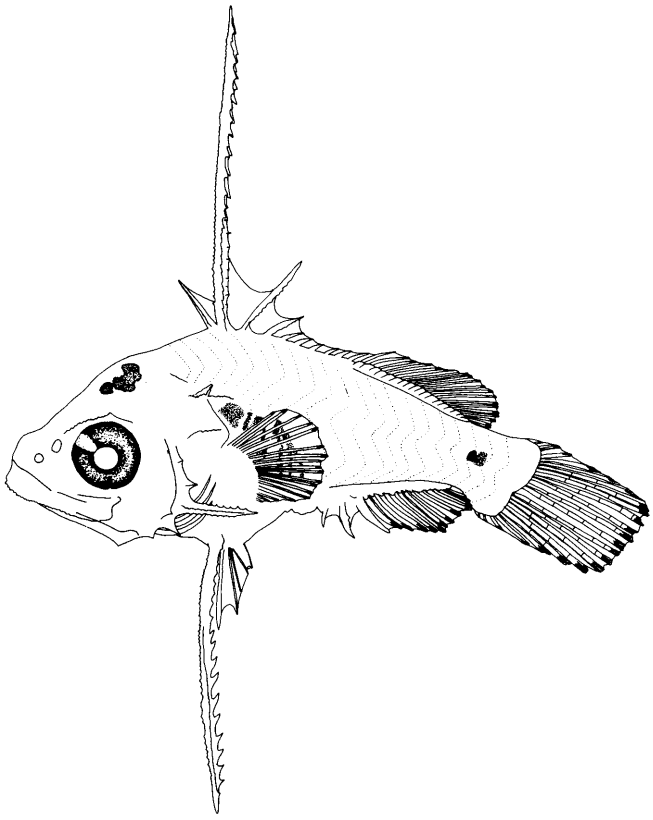
References: Kendall, 1979; G. D. Johnson, 1983; 1988; Johnson and Keener, 1984; Keener *et al*., 1988; Baldwin *et al*., 1991; Baldwin and Johnson, 1993; Ross and Moser, 1995; Able and Fahay, 1998; Smith-Vaniz *et al.*, 1999; Heemstra *et al.*, 2002

Mycteroperca microlepis

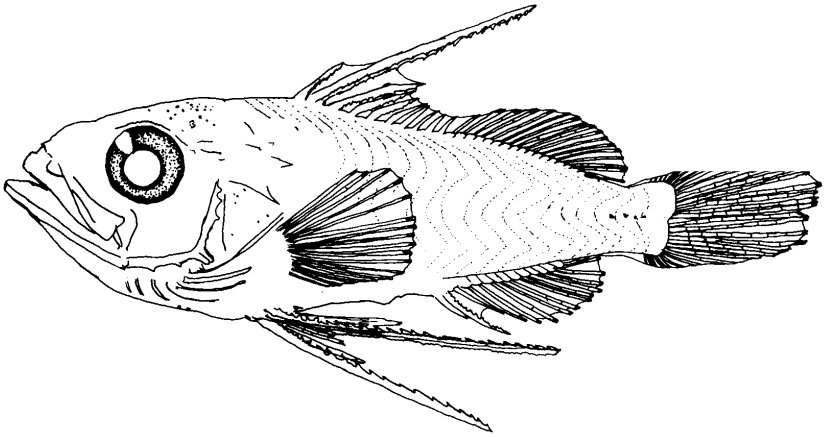


A. 4.0 mmSL

Note: melanophore occurs at cleithral symphysis in larvae of all *Mycteroperca* species



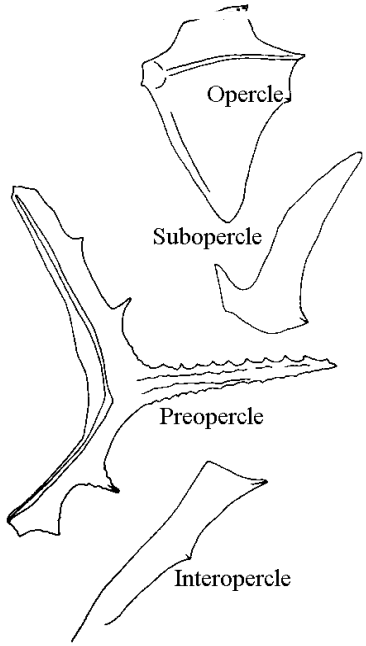
B. 7.4 mmSL



C. 14.2 mmSL

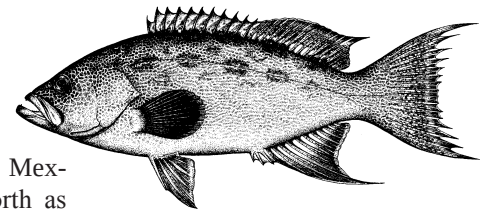
(See photograph of 14.4 mmSL late larva in Keener *et al.*, 1988)

2nd dorsal and pelvic spine morphology is similar in larvae of all *Mycteroperca* species. See *M. bonaci* figure page.



D. Opercular series of bones demonstrating spination at 9.8 mmSL

Mycteroperca phenax Jordan and Swain, 1884
Serranidae (s.f. Epinephelinae)
Scamp



Range: Western North Atlantic Ocean from North Carolina to Gulf of Mexico and southern Caribbean Sea; juveniles may occur as far north as Massachusetts

Habitat: Occurs over rocky ledges and high-relief substrates (Gulf of Mexico), or low-relief substrates in depths of 30–100 m (North Carolina to Georgia); elsewhere, often near corals; juveniles often near mangroves or rock jetties

Spawning: Apr–Aug (off Carolinas)

Eggs:
- Pelagic
- Diameter: 0.75–1.23 mm
- Oil globule: single

Meristic Characters

Myomeres:	24
Vertebrae:	10 + 14 = 24
Dorsal fin rays:	XI, 16–18
Anal fin rays:	III, 10–12
Pectoral fin rays:	15–17
Pelvic fin rays:	I, 5
Caudal fin rays:	9+8 PrC
Supraneurals:	0/0/1/1+1/

Larvae:
- Larvae incompletely described; characters below pertain to most *Mycteroperca* larvae
- Body moderately elongate; body depth about 30–35% SL
- Preanus length about 50–60% SL
- Head length about 32% SL in early larvae, increases in early juveniles
- Mouth large, extending to posterior edge of eye
- Sequence of fin ray formation: P_2, D_1 – C – A – D_2 – P_1
- Anterior D_1 and P_2 spines form early
- 2nd dorsal fin spine very elongate, stout, serrate edges
- Pelvic fin spine elongate, stout, serrate edges
- Head spines strong; see checklist below
- Pigment includes prominent spot along ventral edge of tail that migrates to lateral midline of caudal peduncle in later larvae; a few spots on top of head; dorsal surface of gut pigmented; no pigment on dorsum of body; a single spot at cleithral symphysis; pigment may occur on membranes of dorsal or pelvic fin

Head spine checklist:

Preopercle:	series of 5 spines along edge; large, stout, serrated spine at angle; lateral ridge with a single spine
Opercle:	single spine at upper angle, with 2 adjacent, smaller spines
Subopercle:	a single, tiny spine
Interopercle:	very small spine at upper angle
Posttemporal:	low spine not obvious or absent
Supracleithrum:	a single large, serrate spine
Supraocular:	single spine becomes low, serrate ridge with few to many low spines

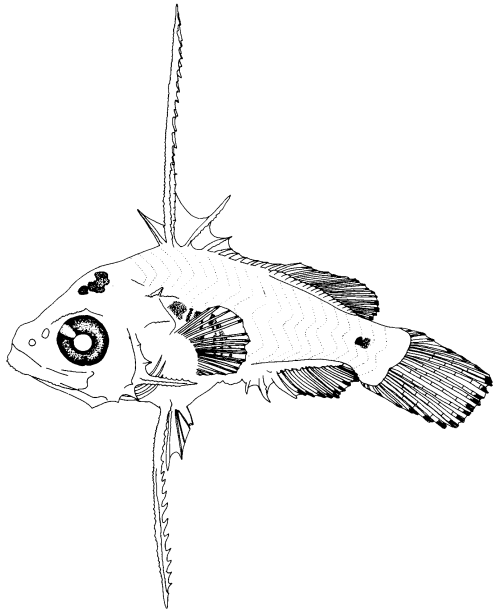
Note: 1. See note box on figure page for comments on 2nd dorsal and pelvic spine morphology

Figures: Adult: Diane Peebles (Bullock and Smith, 1991); **A**: Kendall, 1979; **B**: Johnson and Keener, 1984

References: Kendall, 1979; G. D. Johnson, 1983; 1988; Johnson and Keener, 1984; Baldwin *et al*., 1991; Baldwin and Johnson, 1993; Smith-Vaniz *et al.*, 1999; Heemstra *et al.*, 2002

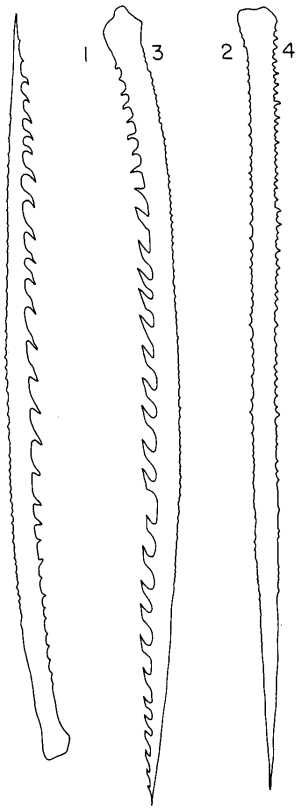
Mycteroperca phenax

Note: melanophore occurs at cleithral symphysis in larvae of all *Mycteroperca* species



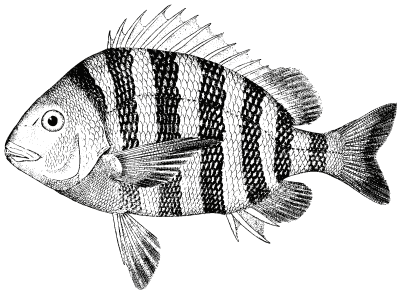
A. 7.4 mmSL (*Mycteroperca microlepis*, included to demonstrate typical *Mycteroperca* larva)

Dorsal and pelvic spine morphology is similar in larvae of all *Mycteroperca* species. The pelvic spine morphology is similar to that of *Epinephelus niveatus.* **2nd dorsal spine:** very small spinelets along apex (anterior) ridge. Large recurved spinelets along the dorsolateral wings (except smaller near base). **Pelvic spines:** ridge 1 has large, recurved spinelets along most of length; other ridges have small, straight spinelets. See Serranidae Introductory pages.



B. 16.0 mmSL
(*Mycteroperca* sp.)

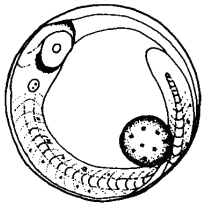
Archosargus probatocephalus (Walbaum, 1792)
Sparidae
Sheepshead



Range: Western North Atlantic Ocean from Nova Scotia to Florida and Gulf of Mexico; rare and scattered from Honduras to Brazil; some authors consider 3 subspecies

Habitat: Coastal ocean to brackish, estuarine and bay waters, usually over rock or other hard substrates

Spawning: Feb–Apr in offshore waters

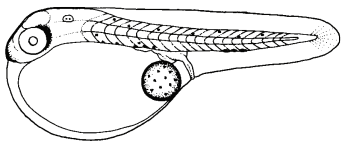


Eggs:
- Pelagic, spherical
- Diameter: 0.8–0.9 mm
- Chorion: smooth, transparent
- Yolk: homogeneous, unpigmented
- Oil globule: single, pigmented, 0.2 mm in diameter
- Perivitelline space: very narrow

Meristic Characters

Myomeres:	24
Vertebrae:	10 + 14 = 24
Dorsal fin rays:	X–XII, 10–13
Anal fin rays:	III, 9–11
Pectoral fin rays:	15–17
Pelvic fin rays:	I, 5
Caudal fin rays:	8–9+9+8+7–9
Supraneurals:	0/0+0/2+1/1/ (Mook, 1977, indicates /0+0+0/2+1/1/1/etc.)

Larvae:
- Hatching occurs at about 1.6–1.7 mm, eyes unpigmented, mouth unformed
- Body moderately deep with small head, rounded snout
- Body depth (at anus) increases from about 15% SL to >30% SL
- Head length increases from <20% SL to >30% SL
- Mouth small, barely reaching anterior edge of eye
- Preanus length increases from <50% SL to >60% SL
- Flexion occurs at 4.7–5.4 mmSL
- Sequence of fin ray formation: C – D_2, A, P_1 – D_1 – P_2
- Note about equal number of fin rays in D_2 and A fins
- Weak head spination; see checklist below (also see *Pagrus pagrus*)
- Pigment in larvae with yolk remaining includes series of melanophores along venter beginning over gut and extending to notochord tip; later larvae have series of unevenly spaced melanophores along venter of gut and tail; spot at cleithral symphysis, under P_1 base, and anterior to anus; ventral pigment is reduced in larger larvae, but spots on top of head increase in number; lateral pigment begins in scattered clumps, soon form vague bars

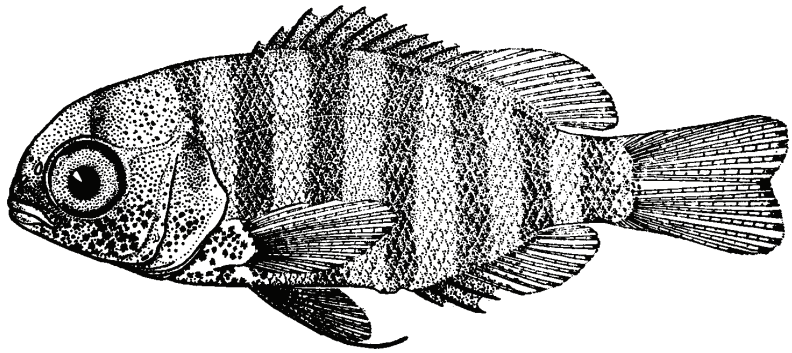


Yolk-sac larva, 1.6 mmNL

Head spine checklist:

Preopercle: weak spines on edge
No other head spines present

Early Juvenile: Juveniles from Atlantic typically have 6 bars from dorsal fin origin to caudal peduncle; those from Gulf of Mexico have 5

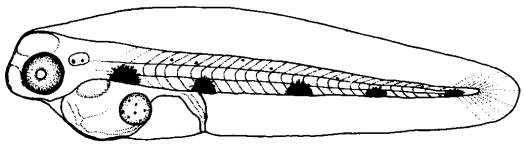


E. 17.0 mmSL

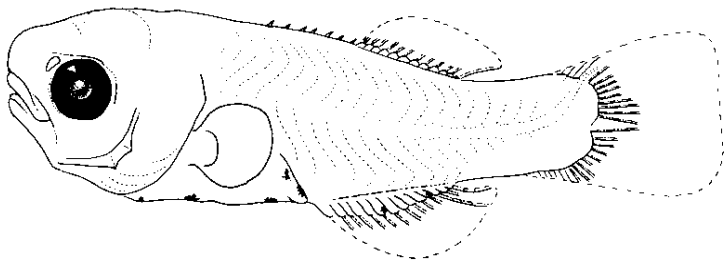
Figures: Adult: Goode, 1884; egg, yolk-sac larva and **A**: Tucker and Alshuth, 1997; **B–E**: Hildebrand and Cable, 1938 (**B–D** redrawn)

References: Hildebrand and Cable, 1938; Mook, 1977; Fahay, 1983; G. D. Johnson, 1978; 1984; Tucker and Alshuth, 1997; Carpenter, 2002c

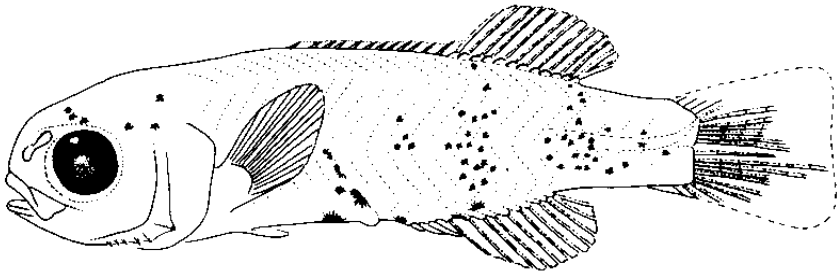
Archosargus probatocephalus



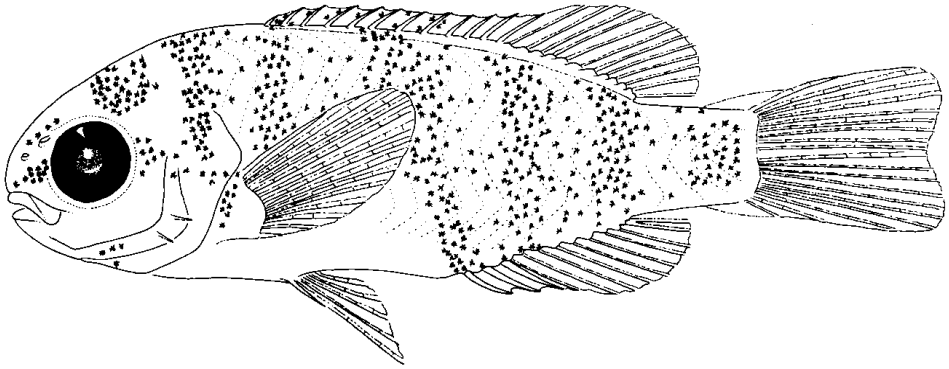
A. 2.5 mmNL (Late yolk-sac stage)



B. 6.0 mmTL

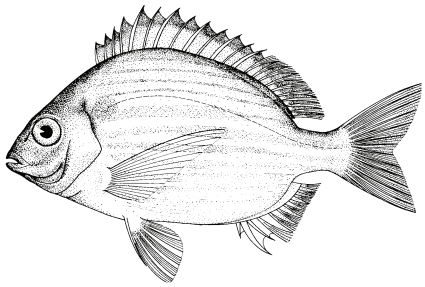


C. 7.5 mmTL



D. 12.0 mmTL

Archosargus rhomboidalis (Linnaeus, 1758)
Sparidae
Sea bream



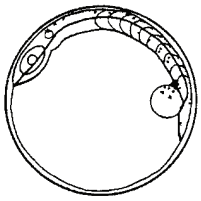
Range: Western North Atlantic Ocean from New Jersey to Brazil, including Gulf of Mexico and Caribbean Sea; absent from Bermuda and Bahamas

Habitat: Shallow waters over mud substrates, or associated with mangroves, vegetated sand or coral reefs; sometimes in brackish habitats

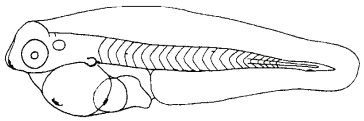
Spawning: Sep–May; spawn in bays (e.g. Biscayne Bay, Florida)

Meristic Characters

Myomeres:	24
Vertebrae:	10 + 14=24
Dorsal fin rays:	XIII, 11
Anal fin rays:	III, 10
Pectoral fin rays:	14–15
Pelvic fin rays:	I, 5
Caudal fin rays:	8–10+9+8+7–9
Supraneurals:	0/0+0/2+1/1/

Eggs:

- Pelagic, spherical
- Diameter: 0.8–0.9 mm
- Chorion: smooth, unpigmented
- Yolk: homogeneous
- Oil globule: single, 0.21–0.26 mm in diameter

Larvae:
- Hatching occurs at about 2.1–2.3 mmNL
- Body moderately elongate with small head, rounded snout
- Body depth increases from 16–18% SL to <35% SL in juveniles
- Preanus length increases from about 40% SL to >60% SL in juveniles
- Flexion occurs at 4.2–4.5 mmSL
- Sequence of fin ray formation: C – P_1, D_2, A, – D_1 – P_2
- Note about equal number of fin rays in D_2 and A fins
- Weak head spination; see checklist below
- Pigment includes isolated spots at tip of snout and lower jaw, scattered on top of head and a row of spots along venter over anal fin base; many scattered spots on body, some aligned with myosepta; spots scattered over gut; pigment becomes more dense in larger larvae and 5–6 vague bars form over body; the venter of head and gut remains relatively unpigmented

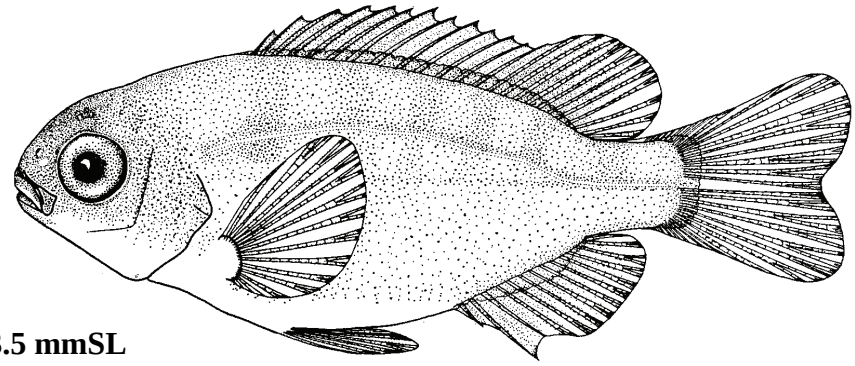


Yolk-sac larva, 2.2 mmNL

Head spine checklist:

Preopercle: up to 5–6 weak spines on edge and 2–3 on lateral ridge; 1st spine develops at about 3.3 mm
No other head spines present; see *Pagrus pagrus*

Early Juvenile:

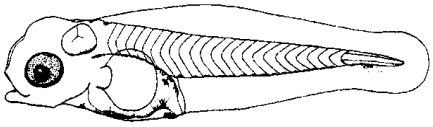


I. 33.5 mmSL

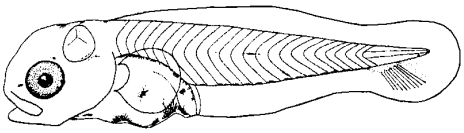
Figures: Adult: Carpenter, 2002c; egg, yolk-sac larva and **A–I**: Houde and Potthoff, 1976

References: G. D. Johnson, 1984; Houde and Potthoff, 1976; Tucker and Alshuth, 1997; Carpenter, 2002c

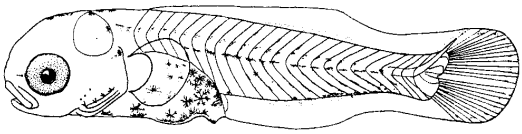
Archosargus rhomboidalis



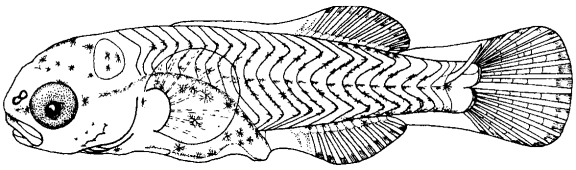
A. 3.2 mmNL



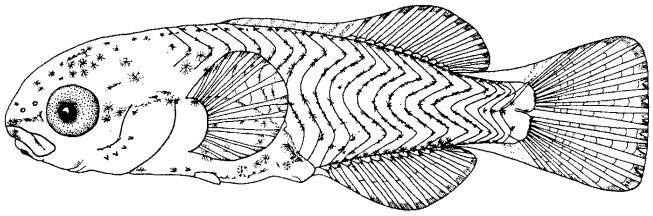
B. 4.1 mmNL



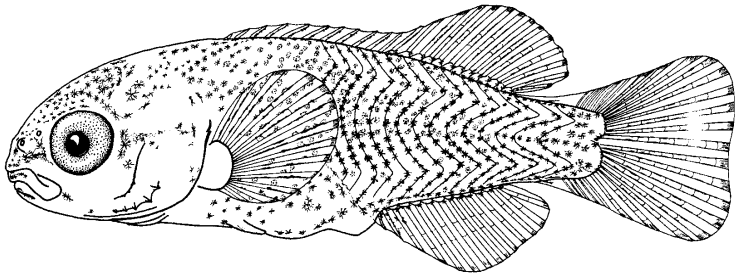
C. 4.9 mmSL



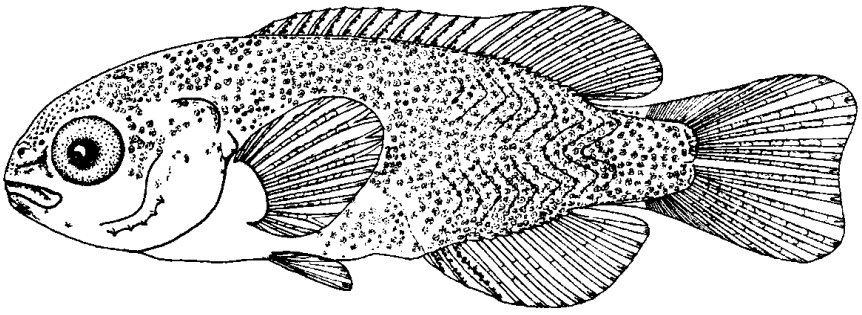
D. 5.8 mmSL



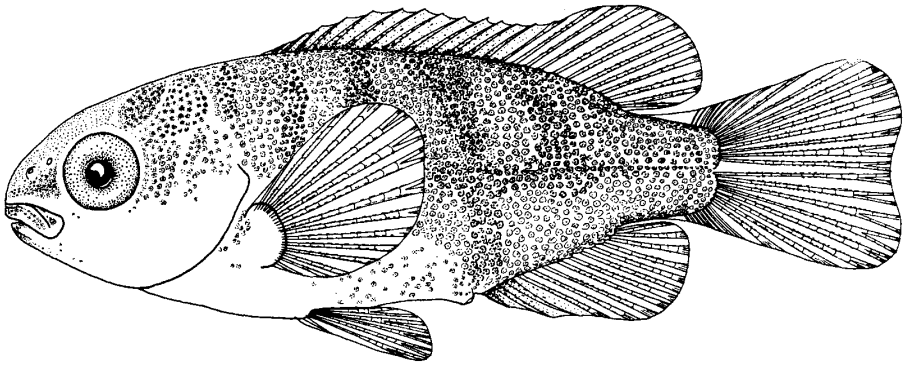
E. 6.9 mmSL



F. 8.0 mmSL

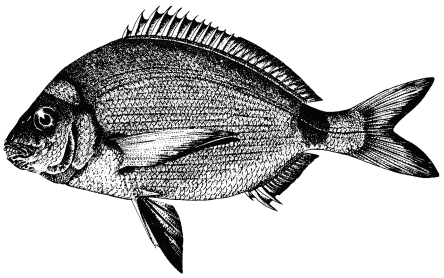


G. 10.3 mmSL



H. 13.7 mmSL

Diplodus holbrooki (Bean, 1878)
Sparidae
Spottail pinfish



Range: Western North Atlantic Ocean from Chesapeake Bay (rarely New Jersey) to Florida and northeastern Gulf of Mexico; rare in study area

Habitat: Shallow, coastal waters, mostly over flat, vegetated substrates to a maximum depth of 27 m; also bays and estuaries; rarely in brackish water

Spawning: Dec–Feb in offshore ocean waters (Florida)

Meristic Characters

Myomeres:	24
Vertebrae:	10 + 14 = 24
Dorsal fin rays:	XII, 13–16
Anal fin rays:	III, 13–15
Pectoral fin rays:	15–17
Pelvic fin rays:	I, 5
Caudal fin rays:	8–9+9+8+8
Supraneurals:	0/0+0/2+1/1/

Eggs: – Undescribed

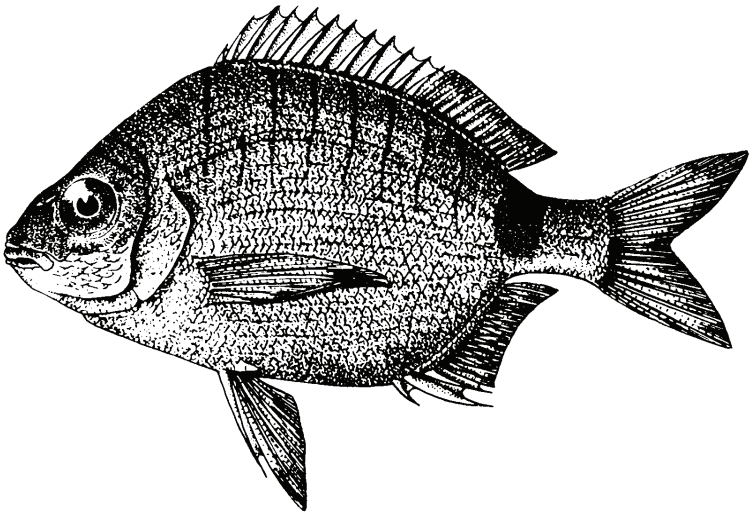
Larvae:
- Hatching occurs at unknown size
- Body elongate with small, rounded head
- Preanus length about 45% SL in illustrated larvae
- Flexion occurs at unknown size
- Sequence of fin ray formation: C – D_2, A, P_1 – D_1 – P_2
- Note about equal number of fin rays in D_2 and A fins
- Weak head spination; see checklist below
- Pigment consists of dense melanophore on peritoneum above anus, a ventral spot anterior to cleithral symphysis, few spots on venter of gut, few spots over mid- and hindbrain; series of spots along venter, with a few over anal fin and 3–4 on venter of caudal peduncle; a pair of melanophores (right and left sides) anterior to cleithrum, at level of lower pectoral fin base (visible by lifting the opercle); a line of spots just above midline of tail may internalize

Head spine checklist:

Preopercle: small spines on edge and smaller spines on lateral ridge
No other head spines present; see *Pagrus pagrus*

Juvenile:

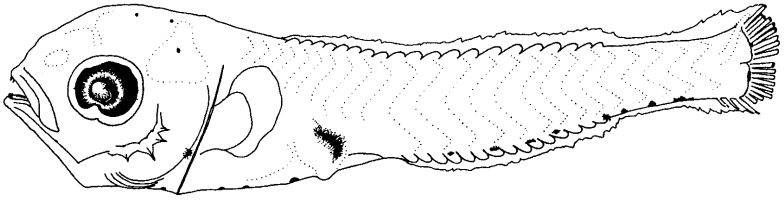
C. 53.0 mmSL



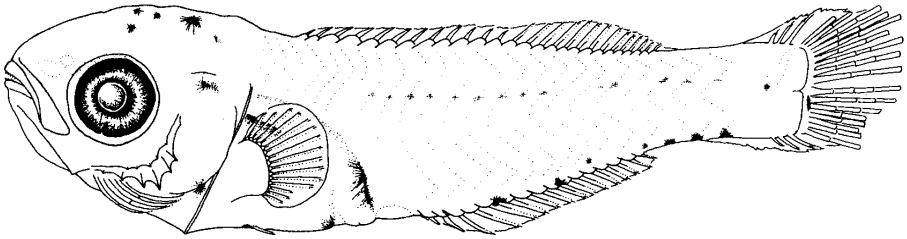
Figures: Adult: Paz, 1975; **A–B**: Michael Greene (Powell and Greene, 2002); **C**: Paz, 1975

References: G. D. Johnson, 1978; 1984; Powell and Greene, 2002; Carpenter, 2002c

Diplodus holbrooki

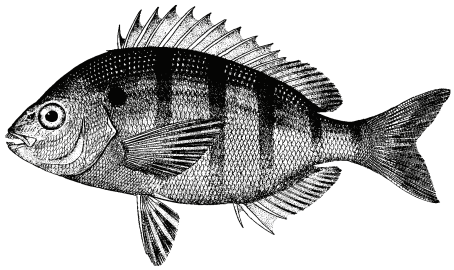


A. 7.6 mmSL



B. 9.3 mmSL

Lagodon rhomboides (Linnaeus, 1766)
Sparidae
Pinfish



Range: Western North Atlantic Ocean from Bermuda and Cape Cod (rarely) to Gulf of Mexico and northern coast of Cuba

Habitat: Shallow water over vegetated substrates; occasionally over rocks or in mangroves, may enter brackish or fresh waters

Spawning: Oct–Mar (Florida); moves offshore into deep water

Meristic Characters

Myomeres:	24
Vertebrae:	10 + 14 = 24
Dorsal fin rays:	XI–XII, 10–12
Anal fin rays:	III, 10–12
Pectoral fin rays:	14–17
Pelvic fin rays:	I, 5
Caudal fin rays:	10–11+9+8+7–10
Supraneurals:	0/0+0/2+1/1/

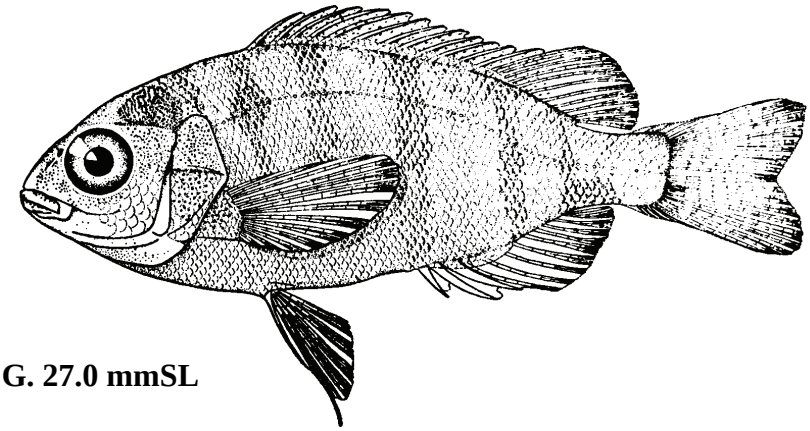
Eggs:
- Pelagic, spherical
- Diameter: 0.99–1.05 mm
- Oil globule: single

Larvae:
- Hatching occurs at unknown size
- Body elongate with small head, slightly rounded snout
- Mouth moderate, barely extending beyond anterior edge of eye
- Preanus length 45–50% SL
- Flexion occurs at about 5.0 mmSL
- Sequence of fin ray formation: C – D_2, A, P_1 – D_1 – P_2
- Note about equal number of fin rays in D_2 and A fins
- Weak head spination; see checklist below
- Pigmentation generally light; series of melanophores along venter of tail decreases in number through development; in postflexion larvae, 5–6 melanophores along base of anal fin, 3–4 on venter of caudal peduncle; dorsal pigment limited to 2–5 spots on caudal peduncle that begin to form during flexion; peritoneal pigment over anus; a spot at cleithral symphysis; spots on midbrain and nape, the latter becoming embedded; ventral gut pigment includes 1–2 spots anterior to anus, another spot posterior to cleithral symphysis; vertical bars characterizing juveniles begin to form as early as 11.0 mm

Head spine checklist:

Preopercle: weak spines on edge and fewer weak spines on lateral ridge; develop at about 5.0 mm
No other head spines present; see *Pagrus pagrus*

Early Juvenile: 5 or 6 indistinct pigment bars form between 13 and 30 mmTL

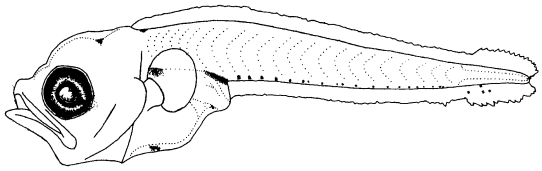


G. 27.0 mmSL

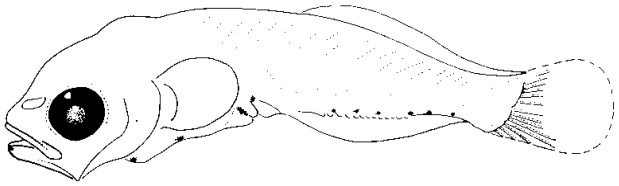
Figures: Adult: Goode, 1884; **A**, **C**, **E**: Michael Greene (Powell and Greene, 2002); **B**, **D**, **F**, **G**: Hildebrand and Cable, 1938 (**B**, **D**, **F** redrawn, **D** reversed)

References: G. D. Johnson, 1978; 1984; Tucker and Alshuth, 1997; Carpenter, 2002c; Powell and Greene, 2002

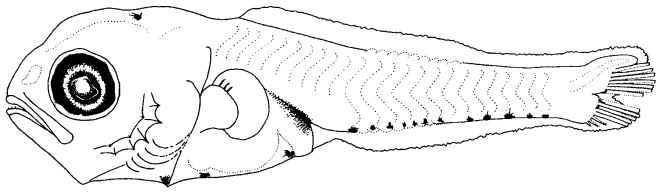
Lagodon rhomboides



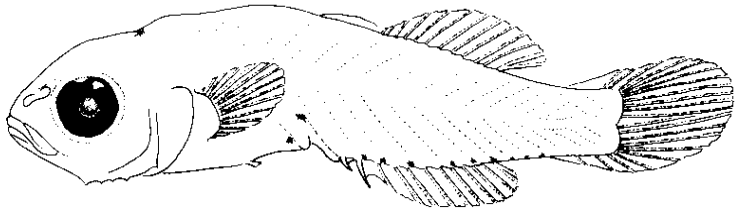
A. 2.8 mmNL



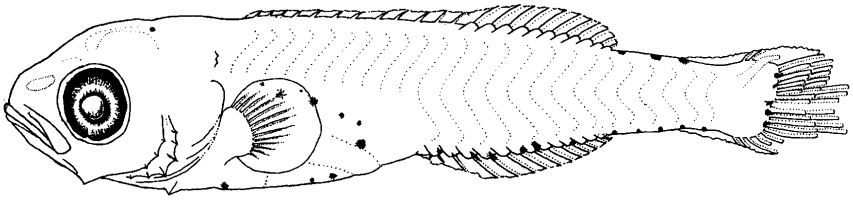
B. 5.0 mmTL



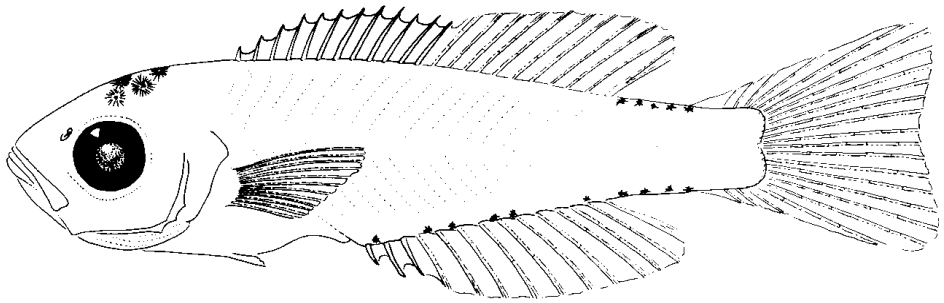
C. 5.6 mmSL



D. 7.0 mmTL

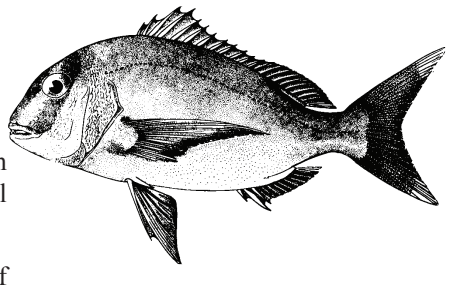


E. 8.1 mmSL



F. 13.0 mmTL

Pagrus pagrus (Linnaeus, 1758)
Sparidae
Red porgy



Range: Atlantic Ocean and Mediterranean Sea; in the western Atlantic from New York to Argentina, including Gulf of Mexico and continental Caribbean Sea; absent from Bermuda and Bahamas

Habitat: Continental shelf over rock or hard-sand substrates in depths of 10–250 m, mostly <80 m

Spawning: Jan–Apr over continental shelf

Meristic Characters

Myomeres:	24
Vertebrae:	10 + 14 = 24
Dorsal fin rays:	XII–XIII, 9–11
Anal fin rays:	III, 7–9
Pectoral fin rays:	15–16
Pelvic fin rays:	I, 5
Caudal fin rays:	9+8 PrC
Supraneurals:	0/0+0/2+1/1/

Eggs:
- Pelagic, spherical
- Diameter: 0.64–0.92 mm
- Oil globule: single, 0.25 mm in diameter

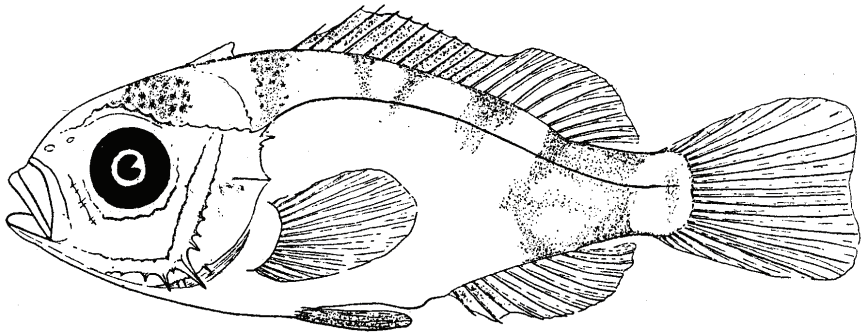
Larvae:
- Moderately deep through pectoral region with large head
- Mouth moderate, extending past the anterior edge of eye
- Preanus length 40% SL, increasing to 60% SL in late larvae and juveniles
- Flexion occurs at about 4.0 mmSL
- Sequence of fin ray formation: C – P_1 – D_2, A – D_1 – P_2
- Head spination extensive; see checklist below (compare to larvae of other sparids in study area)
- Pigmentation light; dorsum of gut pigmented; single spots at tip of snout and under tip of lower jaw; series of 3 or 4 melanophores along venter of tail reduces to 2 or 3, 1 over anal fin, 1 or 2 on venter of caudal peduncle; 1 to few spots anterior to anus; a spot at cleithral symphysis and base of pelvic fin; few spots on top of head

Head spine checklist:

Preopercle:	prominent spines on edge and lateral ridge; spine at angle longest
Interopercle:	small spines
Supraoccipital:	prominent, rough-edged crest; retained to juvenile stage
Supraocular:	crest composed of several spines
Posttemporal:	single spine
Supracleithral:	2–3 spines
Pterotic:	1 to few spines
Tabular:	1 or more small spines
Frontals:	pitted on posterior part

Early Juvenile:

Late larvae and juveniles develop minute spinous scales along dorsal and ventral midlines

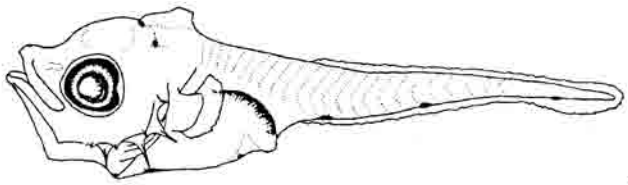


F. 15.0 mmSL

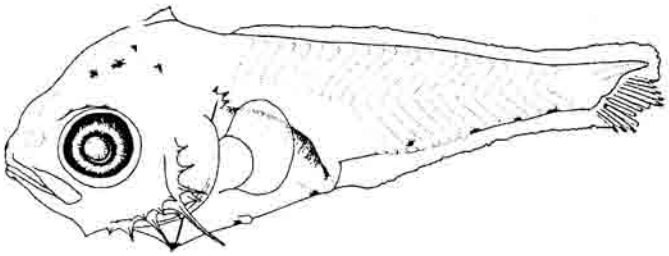
Figures: Adult: Bauchot and Hureau, 1986; **A–C**: Michael Greene (Powell and Greene, 2002); **D**, **F**: Fage, 1918; **E:** Leis *et al.*, 2002 (labels added)

References: Fage, 1918; Karrer, 1984; G. D. Johnson, 1984; Hood and Johnson, 2000; Carpenter, 2002c; Leis *et al.*, 2002; Powell and Greene, 2002

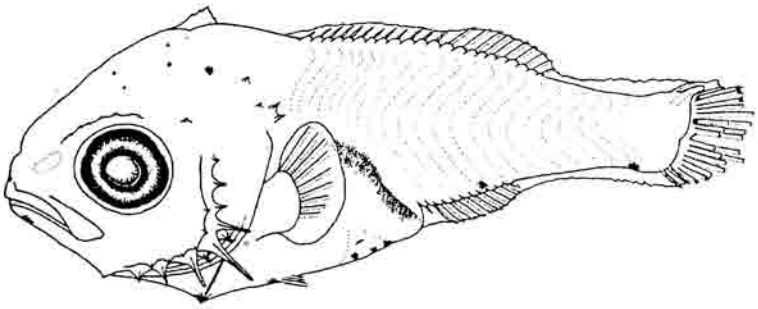
Pagrus pagrus



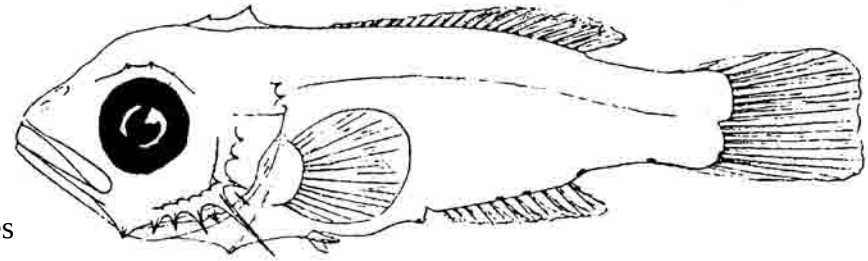
A. 3.6 mmNL



B. 5.9 mmSL

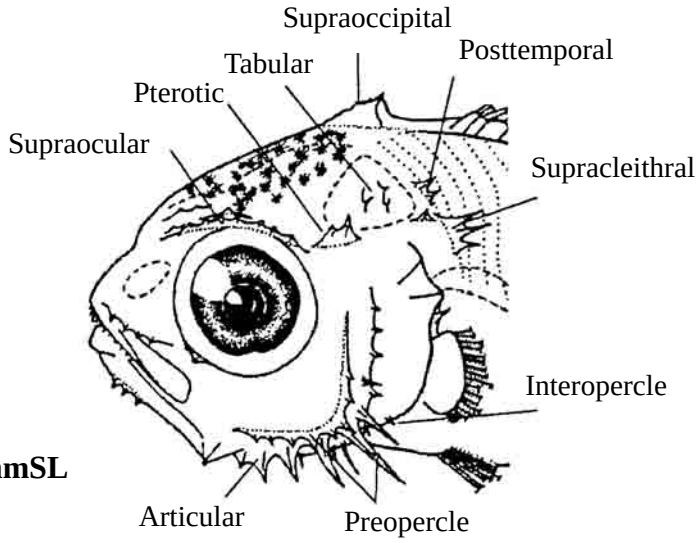


C. 6.1 mmSL



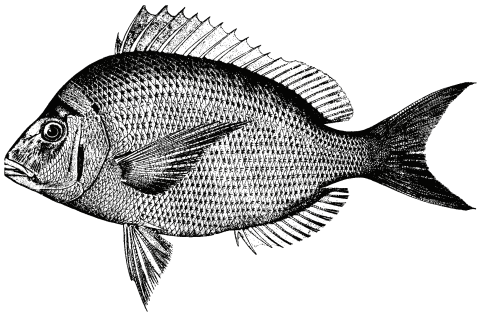
D. 9.0 mmSL
(illustration underestimates body depth)

The larvae of this species have extensive head spination, in contrast to those of other sparid species that might be collected in the study area. This suggests that *P. pagrus* is closely related to several other sparid species with spiny larvae (Leis *et al*., 2002) and that the family, certain subfamilies, and some genera, are para- or polyphyletic. Fig. E is an unidentified sparid larva from the eastern Atlantic exhibiting extensive spination. Spines germane to the present discussion are labeled.



E. 9.6 mmSL

Stenotomus chrysops (Linnaeus, 1766)
Sparidae
Scup



Range: Western North Atlantic Ocean; east coast of North America from Nova Scotia to Florida; uncommon north of Cape Cod and rare south of North Carolina

Habitat: Inner continental shelf and bay waters, typically over hard substrates and structured habitats

Spawning: May–Aug with peak in Jun; location not well described, possibly near bay/ocean interface; eggs and larvae uncommonly collected

Meristic Characters

Myomeres:	24
Vertebrae:	10 + 14 = 24
Dorsal fin rays:	XII, 12
Anal fin rays:	III, 11–12
Pectoral fin rays:	16
Pelvic fin rays:	I, 5
Caudal fin rays:	9–10+9+8+8–10
Supraneurals:	0/0+0/2+1/1/

Eggs:
- Pelagic, spherical
- Diameter: 0.8–1.0 mm
- Chorion: smooth
- Yolk: homogeneous
- Oil globule: single, 0.17–0.21 mm in diameter

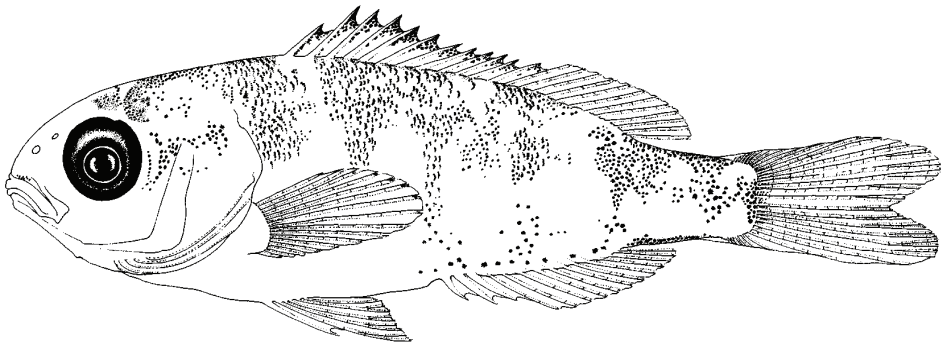
Larvae:
- Hatching occurs at about 2.0 mm; eyes unpigmented, mouth undeveloped
- Body elongate with small head, short, rounded snout
- Preanus length 50% TL until after flexion
- Flexion occurs at 4.8–5.6 mmTL
- Sequence of fin ray formation: C – D_2, A, P_1 – D_1 – P_2
- Note about equal number of fin rays in D_2 and A fins
- Weak head spination; see checklist below
- Pigment consists of 2 dorsal rows of spots from head to myomere 20 (in larvae <2.5 mmSL); prominent spot anterior to anus becomes less intense >5.0 mmSL; number of melanophores in ventral row on tail increases with development until about 1 per myomere; spot at cleithral symphysis and few spots on venter of gut; lateral pigment increases after fin rays formed

Head spine checklist:

Preopercle: weak spines on edge and lateral ridge; develop about 4.0 mm; become serrate edge >10.0 mmSL

No other head spines present; see *Pagrus pagrus*

Early Juvenile:

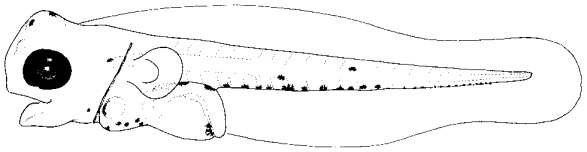


F. 26.0 mmSL

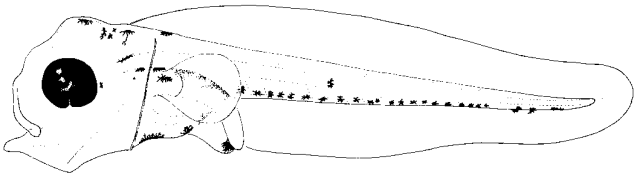
Figures: Adult: Goode, 1884; **A**, **B**, **E**: Peter Berrien (Fahay, 1983); **C–D**: Griswold and McKenney, 1984; **F**: Nancy Arthur (Able and Fahay, 1998)

References: Fahay, 1983; Griswold and McKenney, 1984; G. D. Johnson, 1978; 1984; Able and Fahay, 1998; Carpenter, 2002c

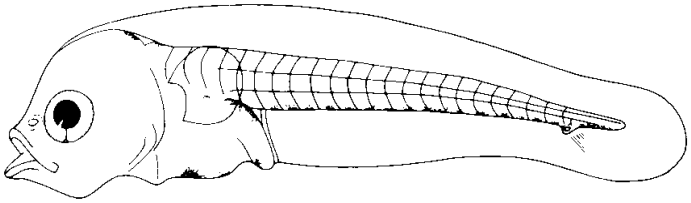
Stenotomus chrysops



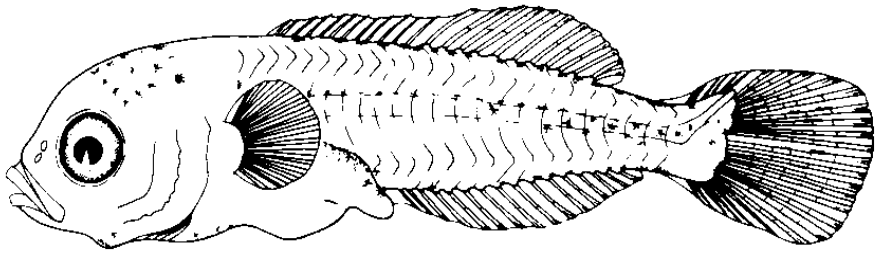
A. 2.8 mmNL



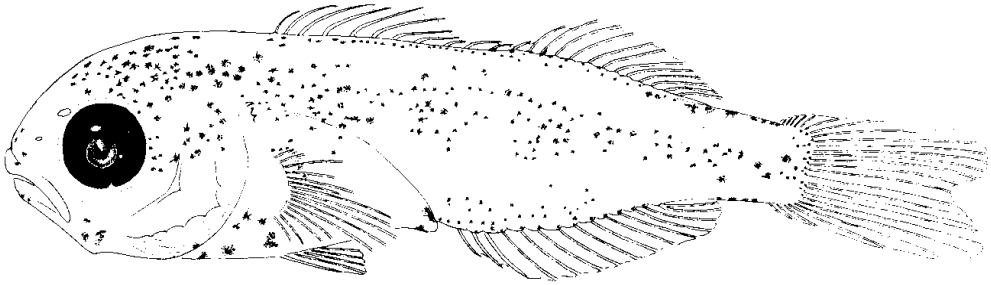
B. 3.8 mmNL



C. 4.2 mmSL

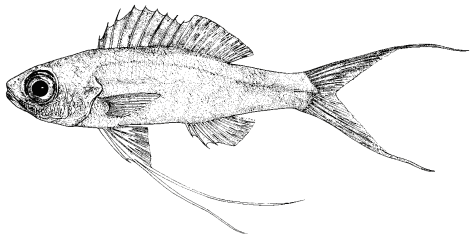


D. 7.3 mmSL



E. 13.3 mmSL

Symphysanodon berryi Anderson, 1970
Symphysanodontidae
Slope bass



Range: Western, central and eastern Atlantic at isolated, scattered locations; in the western North Atlantic from North Carolina to Venezuela; young stages, possibly pertaining to this species, have been collected as far north as Browns Bank; also recorded from the Indian Ocean

Habitat: Not well known; collected from depths of 100–475 m

Spawning: Undescribed

Eggs:
- Pelagic, spherical (otherwise undescribed)

Larvae:
- (Characters based on Pacific series of larvae)
- Hatching occurs at <2.0 mmNL
- Head large, deep, well-armored; body tapers to slender caudal peduncle
- Preanus length increases from 50% SL to 60% SL
- Flexion occurs at about 4.0–6.0 mmSL
- Sequence of fin ray formation: C, D_2, A – D_1 – P_2 – P_1
- Extensive, strong head spination; see checklist below
- Pigment includes rows of melanophores along dorsum of body and venter of tail; cluster of spots on side of caudal peduncle; pigment 'shield' covers gut and air bladder; small pigment cluster on opercle; dorsum pigment spreads onto lateral part of body in larger larvae

Meristic Characters

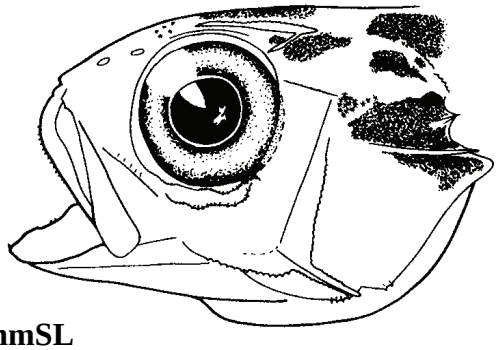
Myomeres:	25
Vertebrae:	10 + 15 = 25
Dorsal fin rays:	VIII–IX, 9–11
Anal fin rays:	III, 7
Pectoral fin rays:	16–18
Pelvic fin rays:	I, 5
Caudal fin rays:	12–14+9+8+12–14
Supraneurals:	0/0/0+2+1/1/

Head spine checklist:

Preopercle:	very long, serrate spine at angle, shorter, serrate spines on edges and lateral ridge
Opercle:	1–2 prominent spines at upper angle
Subopercle:	small spines in postflexion
Interopercle:	small spines in postflexion
Frontal:	prominent, long, serrate spines extend posteriorly to level of anus
Posttemporal:	few, prominent spines
Supracleithral:	simple spine as early as preflexion
Pterotic:	serrate ridge present flexion to juveniles (about 30 mm)
Lachrymal:	cluster of small spines
Infraorbital:	few small spines posteroventral corner of eye
Maxilla:	1–2 spines form early
Dentary:	serrate ridge in early stages
Cleithral:	spine present in postflexion

Early Juvenile (head):

Remnant larval spines in juveniles include frontal, preopercle, lachrymal, pterotic, opercle, subopercle and interopercle

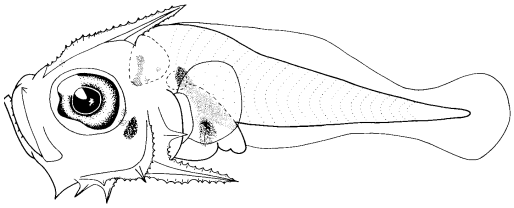


F. 39.5 mmSL

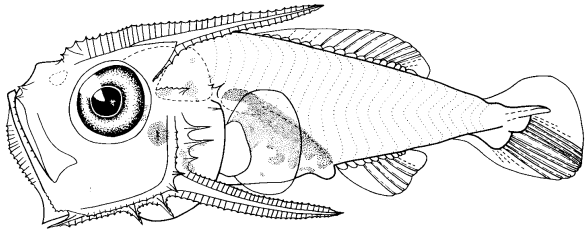
Figures: Adult: Anderson, 2002b; **C**: Betsy Washington (G. D. Johnson, 1984); **A–B**, **D–F**: Leis and Trnski, 2004b

References: Fourmanoir, 1973; G. D. Johnson, 1984; Anderson, 2002b; Leis and Trnski, 2004b; Moore *et al*., 2003

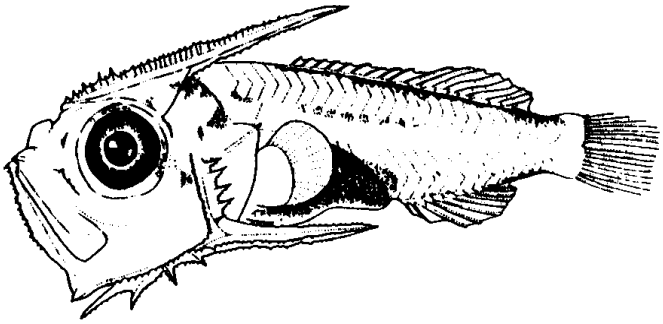
Symphysanodon berryi



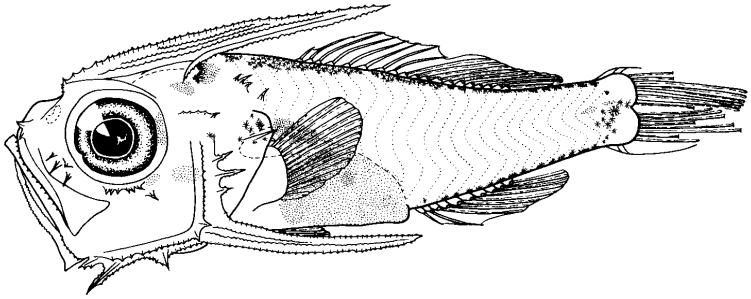
A. 2.3 mmNL



B. 4.3 mmNL

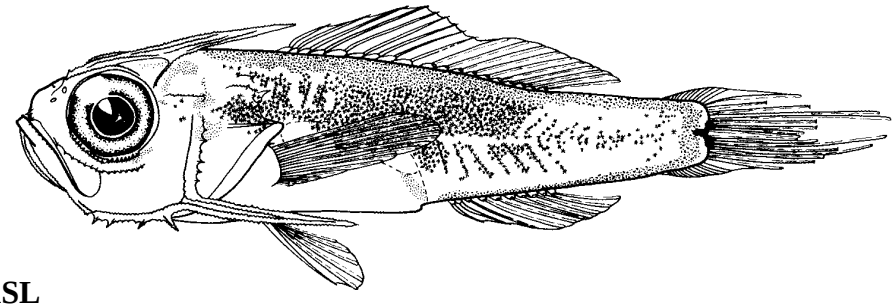


C. 5.1 mmSL



D. 6.8 mmSL

The family status of *Symphysanodon* is uncertain (G.D. Johnson, 1984) and although larvae are similar to those of Acropomatidae, evidence of a relationship has not been presented. See Leis and Trnski (2004b) for discussion of similarities between these larvae and those of several other families.



E. 16.1 mmSL