Perciformes
Suborder Percoidei Part II – Families Echeneidae through Lutjanidae

Selected meristic characters in species belonging to the percoid families Echeneidae through Gerreidae whose adults or larvae have been collected in the study area. Classification sequence is alphabetical. See species accounts for sources.

Family Species	Vertebrae	Dorsal Fin	Anal Fin	Caudal (Procurrent, Dorsal + Ventral)	Pectoral Fin
Echeneidae					
Echeneis naucrates	29–30	33–45[1]	31–41	10–11+10–12	20–26
Echeneis neucratoides	30	32–41[1]	30–38	13+10	–
Remora australis	27	23–27[1]	20–26	12–15+13–15	21–24
Remora brachyptera	27	27–34[1]	25–34	10–11+9–12	23–27
Remora osteochir	27	20–27[1]	20–26	7–9+7–9	20–24
Remora remora	27	21–27[1]	20–25	11–13+11–13	26–30
Remorina albescens	26	17–22[1]	19–26	9–10+10–12	16–21
Epigonidae[2]					
Epigonus denticulatus	10+15	VII, I, 9–10	II, 8–9	9–10+7–10	18–20
Epigonus pandionis	10+15	VII–VIII, I, 9–11	II, 8–10	9–10+7–10	17–19
Epigonus pectinifer	10+15	VII, I, 9	II, 9	9–10+7–10	15–18
Epigonus telescopus	11+14	VII–VIII, I, 9–11	II, 9	9–10+7–10	19–23
Gerreidae					
Diapterus auratus	10+14	IX, 10	III, 7–8	11+10	15
Eucinostomus argenteus	10+14	IX, 10	III, 7	10–11+10	14–16
Eucinostomus gula	10+14	IX, 10	III, 7	10–11+10	–
Eucinostomus harengulus	10+14	IX, 10	III, 7	–	15
Eucinostomus jonesii	10+14	IX, 10	III, 7	–	–
Eucinostomus melanopterus	10+14	IX, 10	III, 6	–	–

[1] Dorsal fin spines modified into an attachment disk on top of head; modified spines (lamellae) in the disk number 12–29 in the 7 species that occur in the study area; dorsal fin rays are located in the posterior half of body

[2] *Bathysphyraenops simplex*, often included in the family Epigonidae, is here provisionally included in Acropomatidae; it has 3 anal fin spines and its lateral line does not extend onto the caudal fin; larvae are undescribed, but the species most likely belongs in Howellidae (G. D. Johnson, pers. comm., October, 2006)

Perciformes
Suborder Percoidei Part II – Families Echeneidae through Lutjanidae

Selected meristic characters in species belonging to the percoid families Haemulidae through Lutjanidae whose adults or larvae have been collected in the study area. Classification sequence is alphabetical. See species accounts for sources.

Family Species	Vertebrae	Dorsal Fin	Anal Fin	Caudal (Procurrent, Dorsal + Ventral)	Pectoral Fin
Haemulidae					
Haemulon aurolineatum	10+16	XIII, 14–16	III, 7–9	11–12+10–11	16–18
Haemulon plumieri	10+16	XII, 15–17	III, 8–9	9–12+10–11	16–17
Orthopristis chrysoptera	10+16	XII–XIII, 15–16	III, 12–13	12–13+11–12	19
Howellidae					
Howella brodiei	10+16	VIII, I, 9	III, 7	9–10+9–10	13–15
Kyphosidae					
Kyphosus incisor	10+16	IX–XII, 13–15	III, 12–13	10+9	18–20
Kyphosus sectatrix	10+16	X–XI, 11–13	III, 10–12	9+9	17–19
Lobotidae					
Lobotes surinamensis	11+13	XII, 15–16	III, 11–12	3–5+3–5	16
Lutjanidae					
Etelis oculatus	10+14	X, (10)11	III, 8	11–13+11–13	15–17
Lutjanus analis	10+14	X (XI), (13)14	III, (7) 8	8–9+8–9	15–17
Lutjanus apodus	10+14	X, 14	III, 8	8–9+8–9	16–17
Lutjanus buccanella	10+14	X, 14	III, 7–8 (9)	8–9+8–9	16–17
Lutjanus campechanus	10+14	(IX) X, 14	III, (8) 9	10+10	15–18
Lutjanus cyanopterus	10+14	X, 14	III, 7–8	8–9+8–9	16–18
Lutjanus griseus	10+14	X, 14	III, 7–9	8–9+8–9	15–17
Lutjanus jocu	10+14	X, (13) 14	III, 7–9	8–9+8–9	16–17
Lutjanus synagris	10+14	X, 12 (13)	III, 8 (9)	8–9+8–9	15–16
Ocyurus chrysurus	10+14	IX–XI, 12–14	III, (8) 9	8–9+8–9	15–16
Pristipomoides aquilonaris	10+14	X, (10) 11	III, 7–8	11–13+11–13	15–17
Rhomboplites aurorubens	10+14	XII, 11 (10–12)	III, 8 (9)	11+11	16–19

Order Perciformes Suborder Percoidei — Larvae of five similar families

Gerreidae Haemulidae Kyphosidae Sciaenidae Sparidae

Many percoid families lack prominent specializations in their larvae. Similarities in pigmentation and body proportions result in larvae that are difficult to distinguish. Compounding this difficulty in the present study area is the fact that the larvae of many species in these families are undescribed. Meristic characters are critically important, but often overlap broadly between these families. The table below presents ranges in meristic characters and other morphological features that are important in identifying larvae. The figures opposite demonstrate pigmentation patterns and relative body proportions that might also be valuable characters. See species accounts for more developmental details.

Character	Gerreidae	Haemulidae	Kyphosidae	Sciaenidae	Sparidae
Myomeres	24	26–27	26–27	23–27	24–25
Dorsal Spines	IX	XI–XIV	X–XI	VII–XII	XII–XIII
Dorsal Fin Rays	10	13–18	12–14	19+	10–12
Anal Fin Rays	6–8	7–11 (13)	11–13	6–10	8–14
Preopercle Spines	Small	Very weak	Very small	Fairly strong	Small, weak
Other Spines	Supracleithral (small)	Posttemporal, supracleithral, opercle, serrate supraocular	Opercle, possible supracleithral	Posttemporal	Posttemporal, supracleithral in some
Supraneurals	0/0/0+2/1+1/	0/0/0+2/1+1/	0/0/0+2/1/	0/0/0+2/1+1/	0/0+0/2+1/1/
Body	Elongate throughout	Elongate throughout	Elongate, soon deepens	Elongate, deeper anteriorly	Elongate throughout
Mouth	Small, to anterior eye	Larger, to mid-eye	Larger, then decreases to small	Larger, at least to mid-eye	Small, rarely beyond anterior eye
Gut, Preanus Length	Short, coiled; <50% SL	Moderately short; lengthens to >50% SL	Massive, coiled; usually >50% SL SL	Short, coiled; <50% SL	Short; <50%
Anus to Anal Fin	Marked gap	Small (or no) gap	Small (or no) gap	Marked gap	No gap
D_2 – A Lengths	About same	Few more dorsal rays	About same	D_2 about twice length of A	About same
Pigment	Light; ventral row; 2 spots on dorsum of caudal peduncle	Light; ventral row; dorsum none or 1 spot	Usually spaced spots on dorsal and ventral edges; soon spread	Sparse to heavy; series along ventrum; typical spot in nape	Light; ventral rows; spread in later stages

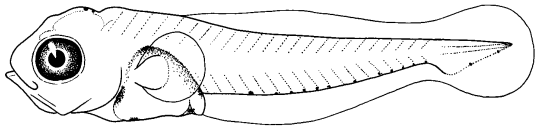
Figures: **A**: Henry Orr (Watson, 1996r); **B**: G. D. Johnson, 1984; **C–D**: Watson, 1983; **E:** Miller *et al*., 1979; **F**: Walker *et al*., 2004; **G–H**: Ditty, 1989; **I–J**: Hildebrand and Cable, 1938 (redrawn)

References: G. D. Johnson, 1978; 1984; Fahay, 1983; Watson, 1996r, s, u: Watson and Sandknop, 1996h; Moser, 1996k; Leis and Carson-Ewart, 2004

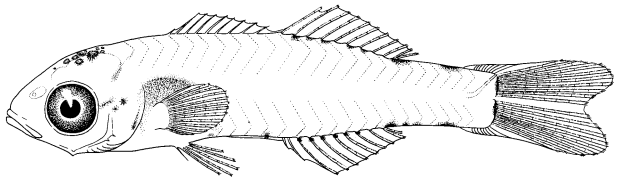
Larvae of five similar families

Order Perciformes Suborder Percoidei

Gerreidae *(Eucinostomus* sp.*)* Eastern Pacific



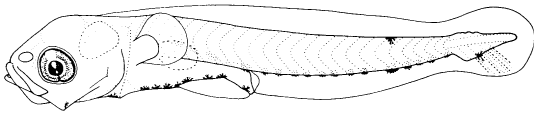
A. 4.0 mmSL Early Flexion



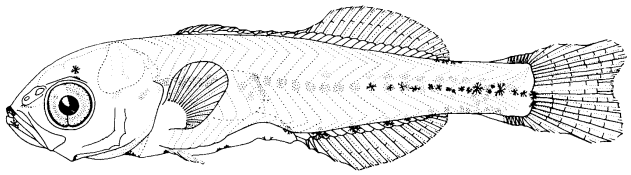
B. 8.7 mmSL Postflexion

Note very elongate ascending process of premaxilla; often 2 spots dorsally on caudal peduncle

Haemulidae *(Orthopristis chrysoptera)* Western Atlantic



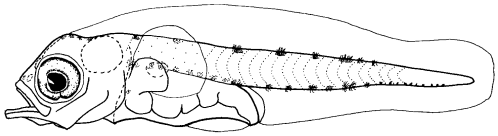
C. 5.6 mmSL Early Flexion



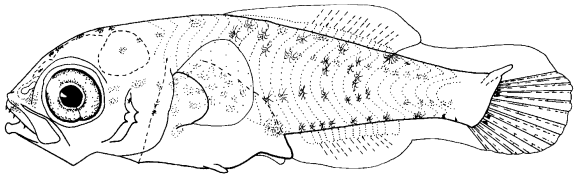
D. 11.1 mmSL Postflexion

Dorsum usually unpigmented; pigment spreads from posterior midline in later stages

Kyphosidae *(Kyphosus vaigiensis)* Indo-Pacific



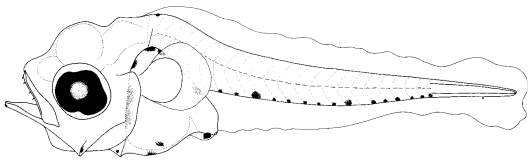
E. 3.0 mmSL Preflexion



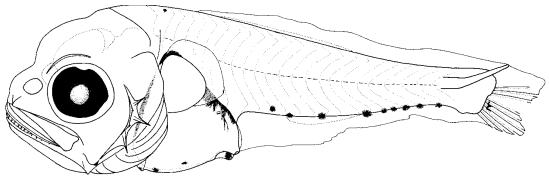
F. 4.9 mmSL Late Flexion

Typically with well-spaced melanophores along dorsal and ventral edges; body deepens early

Sciaenidae *(Leiostomus xanthurus)* Gulf of Mexico



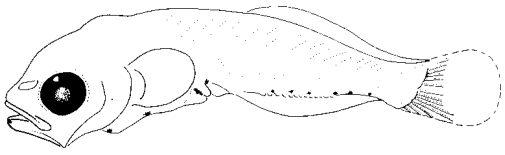
G. 2.8 mmSL Preflexion



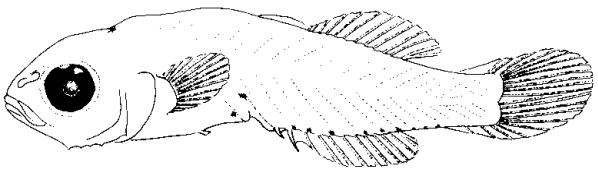
H. 4.3 mmSL Flexion

Wide gap between anus and anal fin; an embedded melanophore often in nape; D_2 about twice length of A

Sparidae *(Lagodon rhomboides)* Western Atlantic



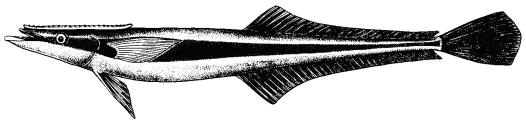
I. 5.0 mmSL Flexion



J. 7.0 mmSL Postflexion

Lightly pigmented; D_2 and A about same length; small mouth

Echeneis naucrates Linnaeus, 1758
Echeneidae
Sharksucker



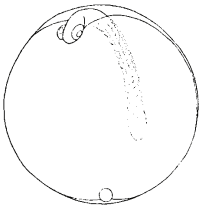
Range: Worldwide, mostly in tropical waters; in the western North Atlantic from Nova Scotia to Brazil, including Gulf of Mexico

Habitat: Rarely free-swimming, but usually 'hitch-hikes' by attaching to gill chambers, mouths, cloacal openings or body surfaces of whale sharks, turtles, sharks, rays or billfishes; other echeneid species are often 'host-specific' on large fishes, turtles or marine mammals

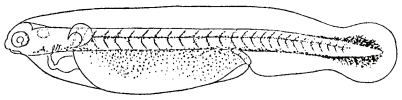
Meristic Characters

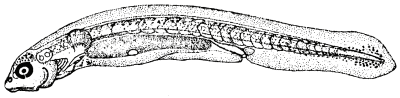
Myomeres:	29–30
Vertebrae:	29–30
Dorsal fin rays:	33–45
Anal fin rays:	31–41
Pectoral fin rays:	20–26
Pelvic fin rays:	I, 5
Caudal fin rays:	10–11+9+8+10–12
Supraneurals:	none

Spawning: Prolonged season; sexually ripe during winter



Eggs:
- Pelagic, spherical; reported to be negatively buoyant (Nakajima *et al.*, 1987)
- Diameter: 2.4–2.7 mm
- Chorion: smooth
- Yolk: homogeneous
- Oil globule: single, 0.16–0.20 mm





Embryo (excised) and yolk sac larva

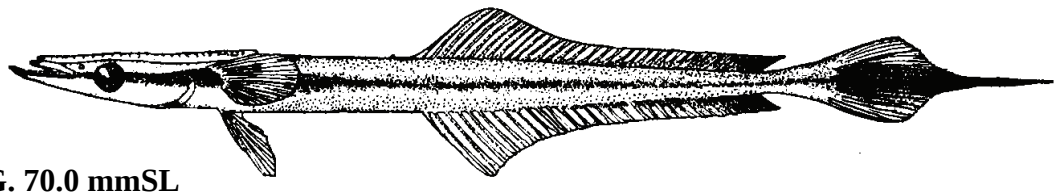
Larvae:
- Hatch at 7.0 mm or larger, with unpigmented eyes, ill-formed mouths
- Body very elongate, shallow
- Gut thickened; preanus length 50–60% SL
- Head and snout very pointy
- Gill arches and filaments visible posterior to edge of opercle
- Flexion occurs soon after hatching
- Sequence of fin ray formation: C, D_2, A – P_1 – P_2 – D_1 (disk)
- Caudal fin large and rounded; central fin rays elongate
- D_2 and A fins opposite each other; anterior rays of both longer
- Spinous dorsal fin rays modified to form attachment disk on top of head; forms well after fin rays
- Larvae have been reported to be greenish or yellowish over-all; pigment includes scattered melanophores on top of head and in blotches on body; pigment consolidates into a pronounced midline stripe extending onto mid-caudal fin in early juveniles

Head spine checklist:

No larval head spines

Note: 1. Late larvae and juveniles somewhat similar to those of *Coryphaena* and *Rachycentron*, but larvae of the latter have a characteristic array of head spines and are covered with 'spicules'. See discussion in G. D. Johnson (1984).

Early Juvenile:

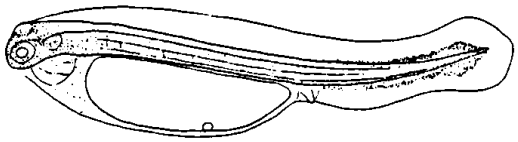


G. 70.0 mmSL

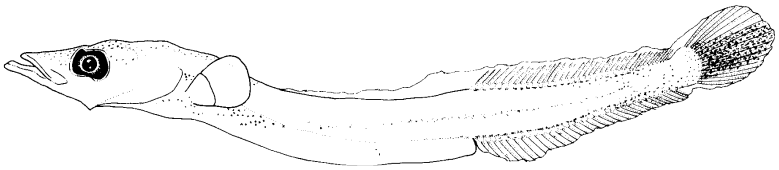
Figures: Adult: Lachner, 1984; Egg, embryo: Delsman, 1931; yolk sac larva: John, 1950; **A**, **C–D**, **F**: Akazaki *et al.*, 1976; **B**: Betsy Washington (G. D. Johnson, 1984); **E**: Tom Trnski and Jeff Leis (Trnski and Leis, 2004); **G**: Gudger, 1926

References: Akazaki *et al.*, 1976; Martin and Drewry, 1978; G. D. Johnson, 1984; Nakajima *et al.*, 1987; O'Toole, 2002; Tom Trnski and Jeff Leis (Trnski and Leis, 2004)

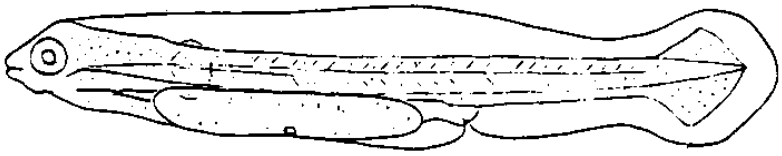
Echeneis naucrates



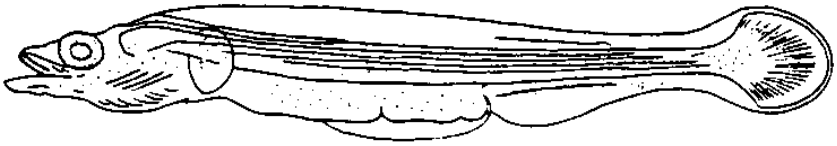
A. 7.5 mmSL



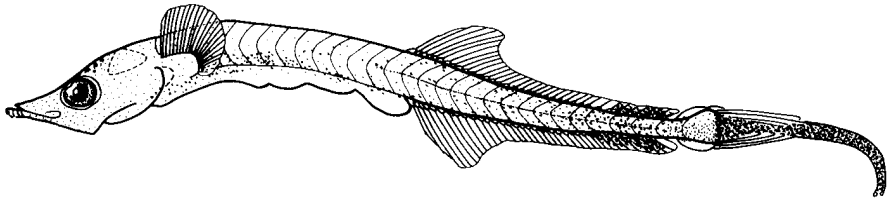
B. 8.8 mmSL (*Echeneis* sp.)



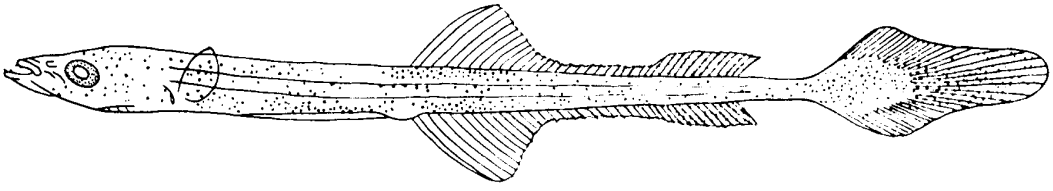
C. 9.0 mmSL



D. 10.5 mmSL

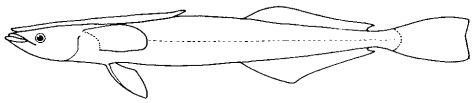


E. 14.6 mmSL



F. 19.8 mmSL

Remora osteochir (Cuvier, 1829)
Echeneidae
Marlinsucker



Range: Worldwide in tropical and warm-temperate waters; in the western North Atlantic from latitude of New Jersey to South America

Habitat: 'Hitch-hikes' by attaching to body or gill cavity of billfishes, especially white marlin (*Tetrapterus albidus*) and sailfish (*Istiophorus platypterus*); feeds on parasitic copepods gleaned from hosts

Spawning: Undescribed

Eggs:
- Undescribed
- Eggs of *Remora remora* are large (1.4–2.6 mm diameter), pelagic and spherical

Meristic Characters

Myomeres:	27
Vertebrae:	27
Dorsal fin rays:	20–27
Anal fin rays:	20–26
Pectoral fin rays:	20–24
Pelvic fin rays:	I, 5
Caudal fin rays:	7–9+9+8+7–9
Supraneurals:	none

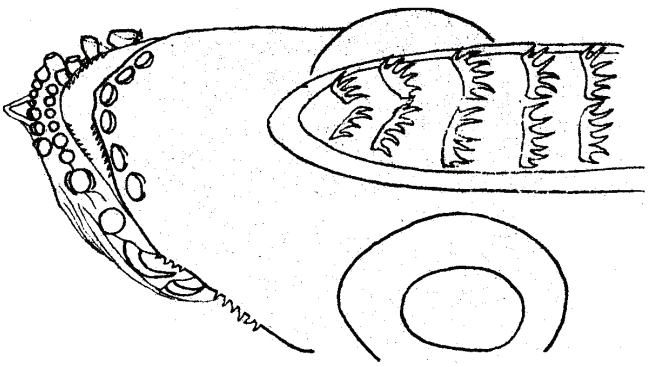
Larvae:
- Hatch at <3.5 mmSL with unpigmented eyes, ill-formed mouths
- Body very elongate, shallow; preanus length decreases from about 75% SL to 50–62% SL
- Gut thickened at several locations along its length
- Head and snout very pointy; note large, recurved teeth on lower jaw (Fig. B–C, dorsal views)
- Gill arches and filaments visible posterior to edge of opercle
- Flexion occurs at about 3.5–8.0 mmSL
- Sequence of fin ray formation: C – D_2, A – D_1 (disk) – P_2 – P_1
- Caudal fin not noticeably large; central fin rays not elongate
- D_2 and A fins opposite each other; anterior rays of both only slightly longer
- Spinous dorsal fin rays modified to form attachment disk on top of head; begins to form at end of preflexion stage (forms much later in *Echeneis naucrates*)
- Pigment includes heavy scattered melanophores over much of head and body, but not on gut; concentrations of pigment form on posterior lobes of D and A fins and on caudal peduncle in later stages

Head spine checklist:

No larval head spines

Note: 1. Larvae of other echeneid species may have lighter pigment, or have series of melanophores along the bases of the D and A fins and along the midline of the posterior body.

Juvenile: Note enlarged, curved, fang-like teeth laterally on lower jaw and small, outward-pointing teeth on lateral edge of premaxilla. Other teeth are very small, with gap over symphysis. Also note "labial suckers", arranged along lower jaw and tip of snout, and early development of attachment disk on top of head. Condition in *R. osteochir* juveniles presumably similar.

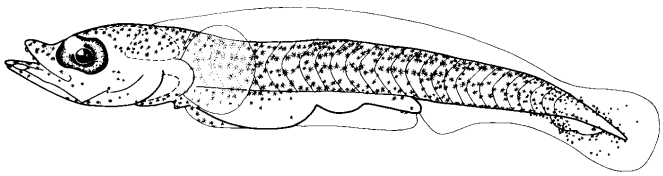


D. 15.0 mmSL (*Remora remora,* Dorsal-oblique View of Head)

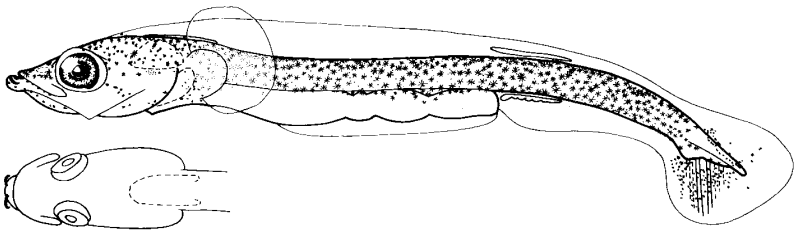
Figures: Adult: Collette, 2002n; **A–C**: Tom Trnski and Jeff Leis (Trnski and Leis, 2004); **D**: Beebe, 1932

References: G. D. Johnson, 1984; Tom Trnski and Jeff Leis (Trnski and Leis, 2004).

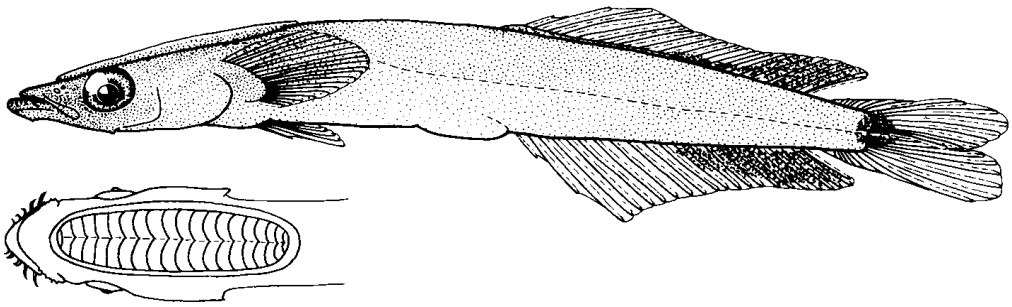
Remora osteochir



A. 3.7 mmSL (*Remora* sp.)



B. 6.4 mmSL (*Remora* sp.)
(Dorsal view of head with anlage of attachment disk))

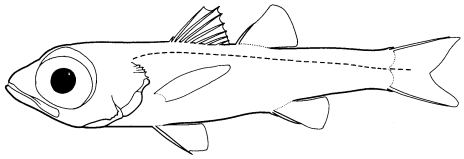


C. 19.0 mmSL (*Remora osteochir*)
(Dorsal view of head and lamellae of attachment disk)

Epigonus sp.

Epigonidae

Deepwater cardinalfishes



Range: Worldwide; 4 species occur within study area (see below)

Habitat: Meso- to benthopelagic on continental and island slopes in depths of 75–3,700 m

Spawning: Undescribed

Eggs: – Undescribed

Larvae:
- Undescribed and poorly known
- Larvae bear a superficial similarity to those of Apogonidae, although body depth is shallower
- Note long caudal peduncle
- D_1, D_2 and A fins short-based; the 2 dorsal fins separated by a very narrow gap
- Snout is relatively long and pointy
- Sequence of fin ray formation undescribed
- Pigmentation may include bold, dark patterns, judging from the few known specimens

Meristic Characters

Myomeres:	24–25
Vertebrae:	10–11 + 14–15
Dorsal fin rays:	VII–VIII, I, 9–11
Anal fin rays:	II, 8–10
Pectoral fin rays:	15–23
Pelvic fin rays:	I, 5
Caudal fin rays:	9–10+9+8+7–10
Supraneurals:	0/0/0+2/1+1/
	or: /0+0/0+2/1+1/

Head spine checklist:

None in *Epigonus*; extensive spination in *Sphyraenops* (Fig. B)

Note:

1. Geographic ranges and habitat characteristics in four species occurring in study area:

   Epigonus denticulatus Dieuzeide, 1950: Atlantic, Pacific oceans and Mediterranean Sea; in the western North Atlantic from near Hudson Canyon, Gulf of Mexico and Caribbean Sea; meso- to benthopelagic in depths of 200–830 m

   Epigonus pandionis (Goode and Bean, 1881): Atlantic Ocean; in the western North Atlantic from southern New England to northern South America including Gulf of Mexico and Caribbean Sea; meso- to benthopelagic in depths of 210–600 m; common in continental slope water

   Epigonus pectinifer Mayer, 1974: Atlantic and Pacific oceans; in the western North Atlantic from Hudson, Baltimore and Norfolk canyons to Gulf of Mexico and Caribbean Sea; meso- to benthopelagic in depths of 280–750 m

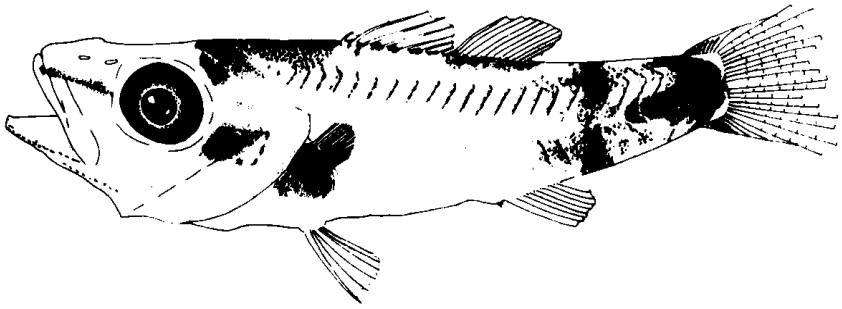
   Epigonus telescopus (Risso, 1810): Southern Hemisphere in Atlantic, Indian and Pacific oceans; also eastern North Atlantic and a single record from the western North Atlantic (MCZ 48825; off Massachusetts); meso- to bentho pelagic in depths of 75–1,200 m

2. *Sphyraenops bairdianus* Poey, 1861: occurs in tropical waters south of the present study area; also parts of Indian and south central Pacific oceans. It is included here because epigonid larvae are so poorly known and to demonstrate the potential for diversity in larval head spination (Fig. B).

Figures: Adult: Gon, 2002; **A–B**: Betsy Washington (G. D. Johnson, 1978)

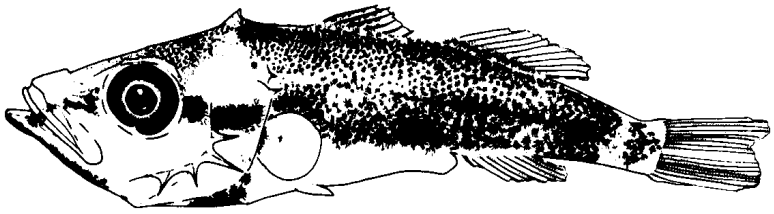
References: Mayer, 1972; 1974; G. D. Johnson, 1978; Abramov, 1992; Moore *et al*., 2003

***Epigonus* sp.**



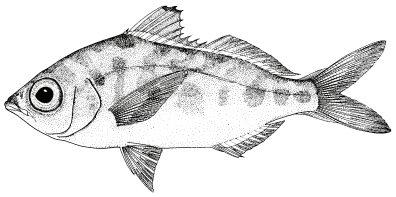
A. 14.0 mmSL

Sphyraenops bairdianus



B. 6.8 mmSL

Diapterus auratus Ranzani, 1842 and *Eucinostomus* sp.
Gerreidae
Mojarras



Range: Worldwide, primarily in tropical, nearshore waters; 6 species have been reported as strays in the study area

Habitat: Usually over sand or mud bottoms in shallow waters; some extend into brackish or freshwater; use downward-directed, protrusible mouths to feed on benthic invertebrates

Spawning: Varies by species; many have prolonged season

Eggs: – Undescribed

Meristic Characters	
Myomeres:	24
Vertebrae:	10 + 14
Dorsal fin rays:	IX, 10
Anal fin rays:	III, 7–8
Pectoral fin rays:	15
Pelvic fin rays:	I, 5
Caudal fin rays:	9+8 (PrC)
Supraneurals:	0/0/0+2/1+1/

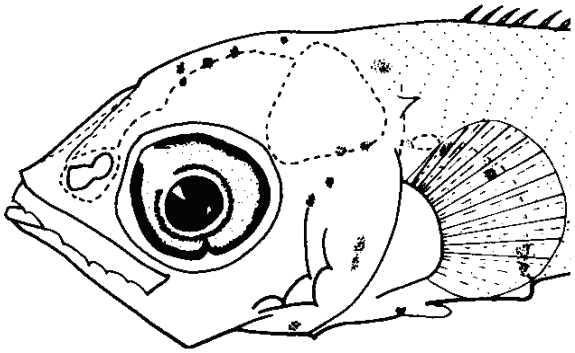
Larvae:
- Larvae are undescribed for all species in the study area
- Gerreid larvae are readily recognizable by the following suite of characters:
- Body form is moderately elongate, but with moderately deep caudal peduncle
- Preanus length is short, usually about 40% SL
- Sequence of fin ray formation: $C - D_2$, $A - D_1 - P_2 - P_1$
- Ascending process of premaxillary very long, extending from the premaxillary symphysis to well above the level of upper eye (see figure below)
- Weak head spines; see checklist below
- Pigment varies by species, but is generally light, with distinct melanophores usually present on dorsal and ventral edges of caudal peduncle, sometimes a series along the midline of the posterior body; early larvae have a series of spots along the ventral edge of tail and these become unevenly distributed in later larvae; scattered melanophores occur on top of head, occasionally on opercle

Head spine checklist:

Preopercle:	very small spines or serrations sometimes present along edge
Supracleithral:	small spines present in a few species

Note:
1. Among larvae collected in the study area, the presence of 1 or 2 melanophores on the dorsal edge of the caudal peduncle, combined with a prominent, easily observed, ascending process of the premaxilla, usually typifies larvae of the Gerreidae.
2. See Okiyama (1988) and Leis and Carson-Ewart (2004) for descriptions of larval *Gerres*

Note elongate ascending process of premaxilla extending to well above level of upper eye; also note moderate to small preopercle and supracleithral spines

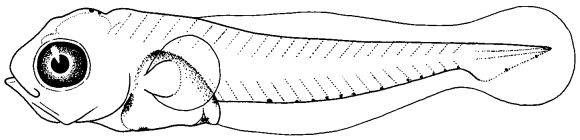


D. 5.2 mmSL (*Gerres* sp.) (Great Barrier Reef, Australia)

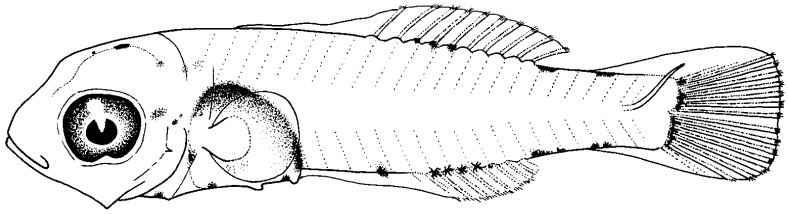
Figures: Adult (*E. argenteus*): Gilmore, 2002; **A–B**: Watson, 1996r; **C**: Betsy Washington (G. D. Johnson, 1984); **D**: Leis and Rennis, 2004i

References: G. D. Johnson, 1984; Okiyama, 1988; Leis and Carson-Ewart, 2004

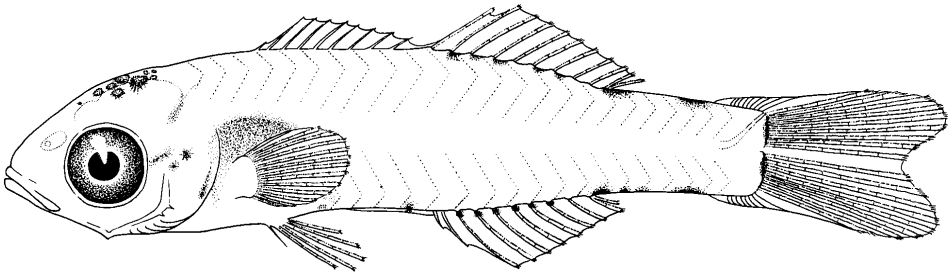
***Eucinostomus* sp.**



A. 4.0 mmSL



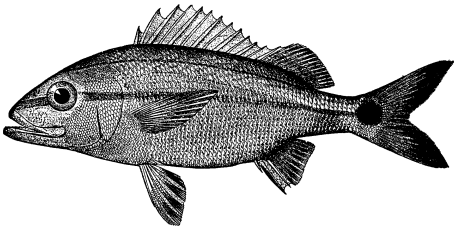
B. 4.6 mmSL



C. 8.7 mmSL

(Figures A-C based on material collected in eastern Pacific Ocean)

Haemulon aurolineatum Cuvier, 1830
Haemulidae
Tomtate



Range: Western North Atlantic Ocean from Cape Cod and Bermuda to Brazil, including the Gulf of Mexico

Habitat: Coastal waters from nearshore to outer reefs; abundant on shrimp grounds of Tortugas; this species and *H. plumieri* are apparently the most cold-tolerant species in *Haemulon*

Spawning: Possibly year-round; ripe females and juveniles observed in most months, in tropical waters

Eggs:
– Undescribed

Larvae:
– See notes on juveniles, and limited notes on postflexion larva in Lindeman and Richards (2006)
– Head spines weakly developed; see checklist below
– Pigment light; series of spots along base of anal fin extend onto venter of caudal peduncle

Meristic Characters

Myomeres:	26
Vertebrae:	10 + 16 = 26
Dorsal fin rays:	XIII, 14–16
Anal fin rays:	III, 7–9
Pectoral fin rays:	16–18
Pelvic fin rays:	I, 5
Caudal fin rays:	11–12+9+8+10–11
Supraneurals:	0/0/0+2/1/1+1/

Head spine checklist:

Preopercle: 5 very small, weak spines along edge; become a serrated edge in juveniles and adults

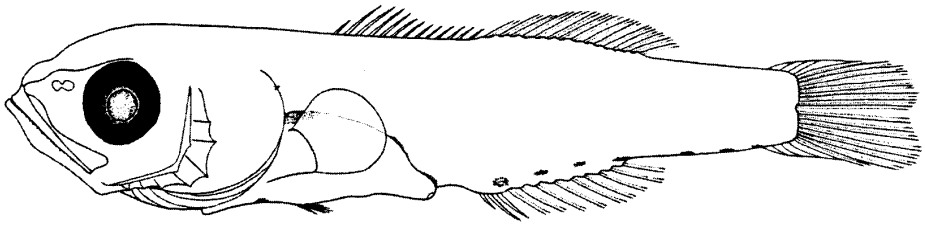
Juvenile: Juveniles of *Haemulon* are distinguishable based on certain meristic characters and pigment patterns (Courtenay, 1961). Two species may occur in the present study area and their characters are compared in the table below. *Orthopristis chrysoptera*, another haemulid occurring in the study area, is distinguishable from *Haemulon* spp. based on anal fin ray counts.

Character	*Haemulon plumieri*	*Haemulon aurolineatum*
Dorsal spines	XII	XIII
Dorsal fin rays	15–17 (usually 16)	14–16 (usually 15)
Scales above lateral line	Larger than those below	Same size as those below
Lateral pigment stripe	Absent	Present
Caudal pigment spot	Round, mostly posterior to edges of hypural bones	Oval or dumbbell-shaped, centered over edges of hypural bones
Head pigment	Scattered, heavy, small melanophores; stripes very vague	Two stripes: one from tip of snout, through eye, across opercle; one beginning over eye, parallel to first

Figures: Adult: Jordan and Evermann, 1896–1900; **A**: Ken Lindeman (Lindeman and Richards, 2006); **B–D**: Courtenay, 1961

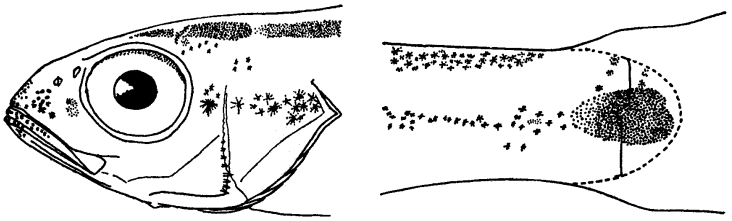
References: Courtenay, 1961; Saksena and Richards, 1975; G. D. Johnson, 1978; 1984; Lindeman and Richards, 2006

Haemulon aurolineatum



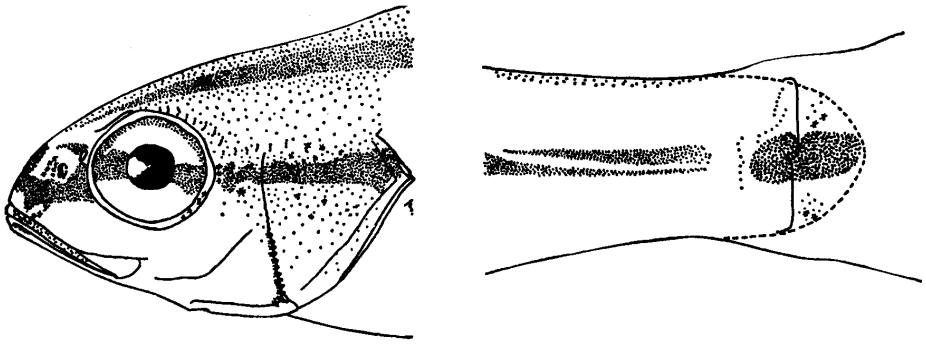
A. 8.7 mmSL

Pigment patterns on head and caudal peduncle in juveniles



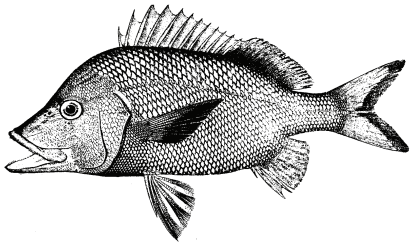
B. 18.5 mmSL

C. 20.9 mmSL



D. 27.4 mmSL

Haemulon plumieri (Lacepède, 1801)
Haemulidae
White grunt



Range: Western North Atlantic Ocean from Chesapeake Bay and Bermuda to Brazil, including Gulf of Mexico

Habitat: Coastal waters in depths of 6–24 m; usually over sand or mud bottoms, grass beds, mangroves

Spawning: Spring to fall; forms schools and moves into deeper water

Meristic Characters

Myomeres:	26
Vertebrae:	10 + 16 = 26
Dorsal fin rays:	XII, 15–17
Anal fin rays:	III, 8–9
Pectoral fin rays:	16–17
Pelvic fin rays:	I, 5
Caudal fin rays:	9–12+9+8+10–11
Supraneurals:	0/0/0+2/1/1+1/

Eggs:
- Pelagic, spherical
- Diameter: 0.90–0.97 mm
- Chorion: smooth, transparent
- Oil globule: single, 0.22–0.24 mm diameter
- Perivitelline space: narrow

Larvae:
- Moderately elongate with moderately pointy head and snout
- Mouth relatively large, gape extends to about mid-eye
- Preanus length short initially, lengthens to >50% SL
- No gap between anus and anal fin origin
- Sequence of fin ray formation: C – D_2, A – D_1, P_2 – P_1; all fin rays complete at 9.8 mmSL
- D_2 base slightly longer than A base
- Head spines weak; see checklist below
- Body deepens well after fin rays completely formed
- Pigmentation in early stages includes a row along ventral edge of tail, a spot at the anus, and a few spots on venter of gut; dorsum of gut pigmented; single spot under tip of notochord; stripe of pigment forms from snout through eye, across opercle; pigment on dorsum begins as single spot, spreads to form 2 lines converging from just behind head to a point at insertion of D_2; lateral pigment begins on posterior midline, spreads anteriorly

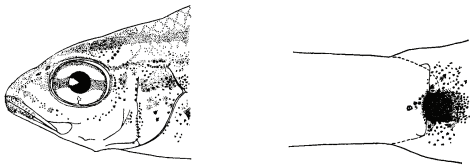
Head spine checklist:

Preopercle: very weak, small spines

Juvenile pigment patterns on head and caudal fin base:

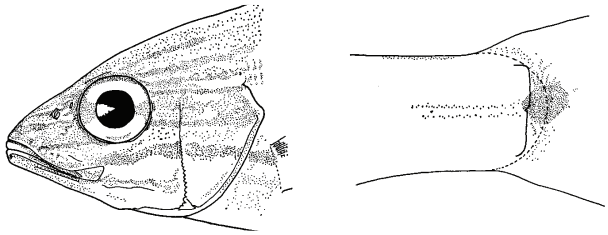
Pigment blotch forms at base of caudal fin

(See comparative table on *Haemulon aurolineatum* page)



H. 19.8 mmSL

I. 23.2 mmSL

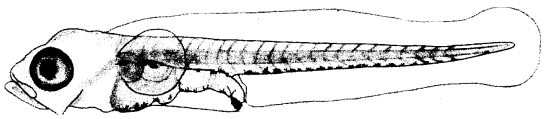


J. 35.6 mmSL

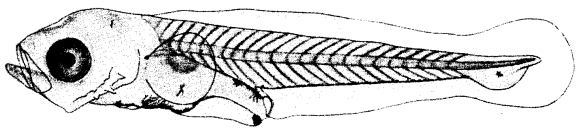
Figures: Adult: Goode, 1884; **A–G**: Saksena and Richards, 1975; **H–J**: Courtenay, 1961

References: Saksena and Richards, 1975; G. D. Johnson, 1978; 1984

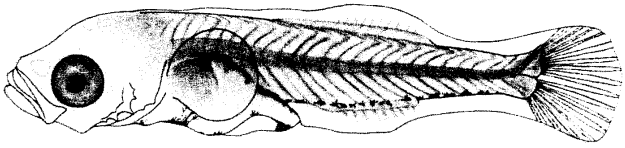
Haemulon plumieri



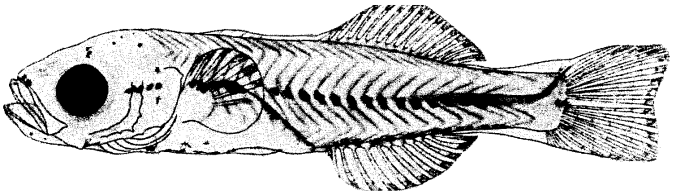
A. 3.7 mmSL



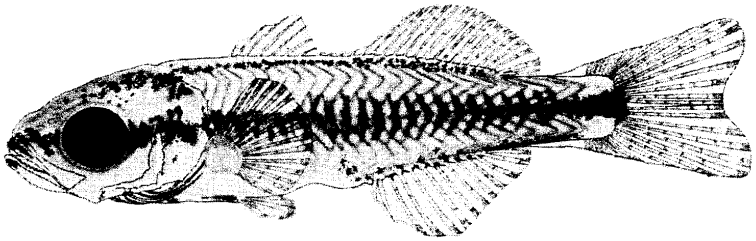
B. 4.6 mmSL



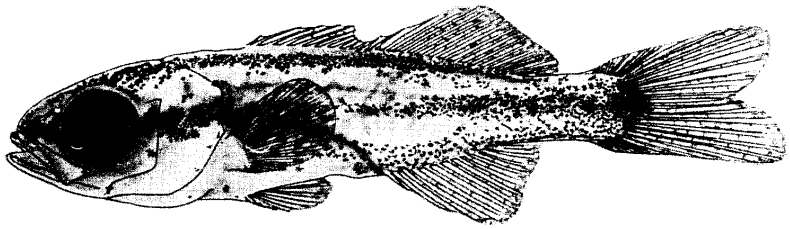
C. 5.8 mmSL



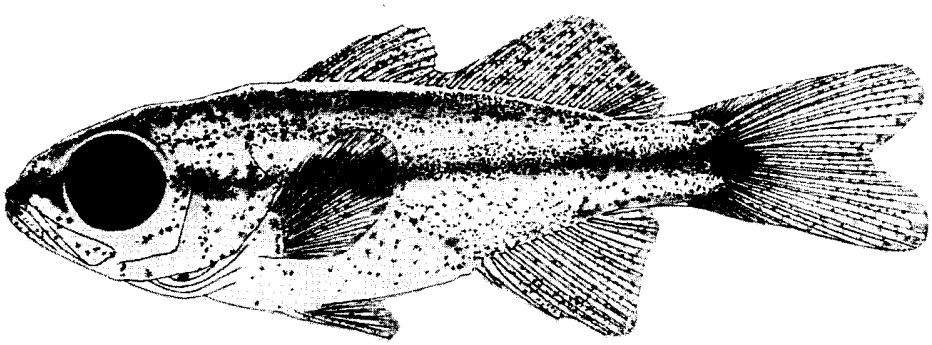
D. 8.2 mmSL



E. 9.8 mmSL

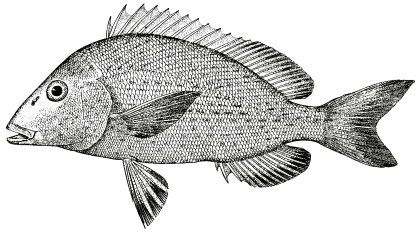


F. 12.5 mmSL



G. 13.6 mmSL

Orthopristis chrysoptera (Linnaeus, 1766)
Haemulidae
Pigfish



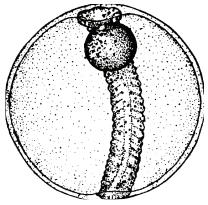
Range: Western North Atlantic Ocean from New York and Bermuda to Cuba and Yucatan Peninsula, including Gulf of Mexico

Habitat: Nearshore oceanic or brackish estuarine waters, typically over soft bottoms; occasionally in mid-continental shelf depths over small reefs

Meristic Characters

Myomeres:	26
Vertebrae:	10+16 = 26
Dorsal fin rays:	XII–XIII, 15–16
Anal fin rays:	III, 12–13
Pectoral fin rays:	19
Pelvic fin rays:	I, 5
Caudal fin rays:	12–13+9+8+11–12
Supraneurals:	0/0/0+2/1/ or: 0/0+0/2+1/1/

Spawning: Spring in North Carolina waters



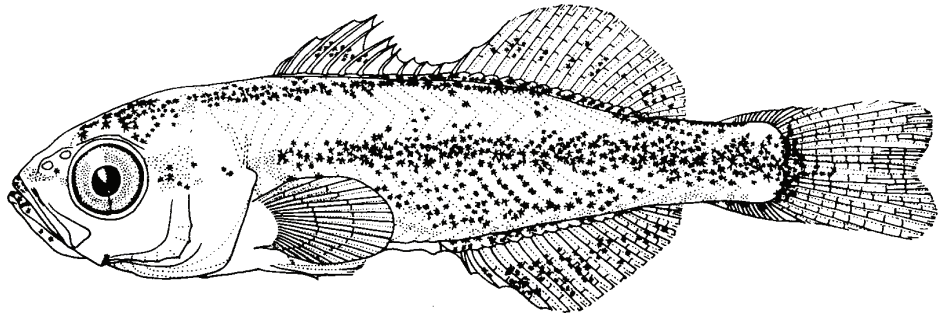
Eggs:
- Pelagic, spherical
- Diameter: 0.7–0.8 mm
- Oil globules: single, 0.16 mm diameter
- Perivitelline space: narrow

Larvae:
- Hatching occurs at size of 1.5 mm; eyes unpigmented
- Body elongate throughout development, until transformation
- Head moderately blunt in early larvae, becomes more pointed in late larvae
- Mouth oriented obliquely
- Preanus length <50% SL
- Flexion occurs at about 5–10 mmSL
- Head spines weakly developed; see checklist below
- Sequence of fin ray formation: $C - D_2$, $A - P_1 - D_1$, P_2
- Pigment in early larvae includes 2 prominent, dorsal melanophores at about myomere 9–10 and between myomere 18–21 (the anterior one soon disappears); a series of melanophores extends from the cleithrum, along venter of gut, and from the anus to developing hypural bones; ventral melanophores between myomeres 17–21 more prominent (Fig. D); a single spot at angle of lower jaw; in larger larvae, a series begins on the lateral midline of the caudal peduncle, expands anteriorly and in width, until it spreads across much of body; 2 melanophores at base of caudal fin rays become a more prominent blotch; pigment on top of head develops late, spreads after fin rays form

Head spine checklist:

Preopercle: very weak spines along edge

Early Juvenile:

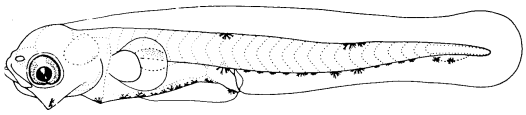


I. 15.8 mmSL

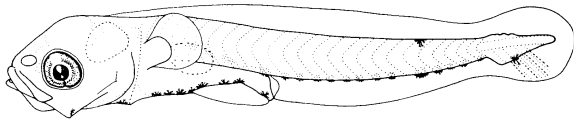
Figures: Adult: Jordan and Evermann, 1896–1900; Egg: Hildebrand and Cable, 1930; **A–I**: Watson, 1983

References: Hildebrand and Cable, 1930; Watson, 1983; G. D. Johnson, 1984

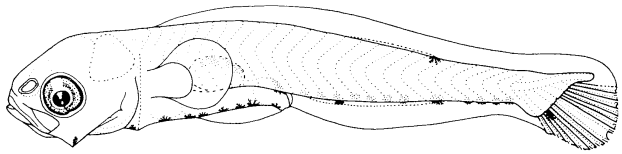
Orthopristis chrysoptera



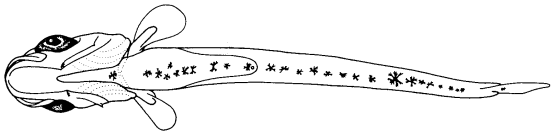
A. 4.2 mmSL



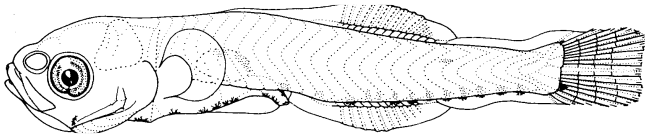
B. 5.6 mmSL



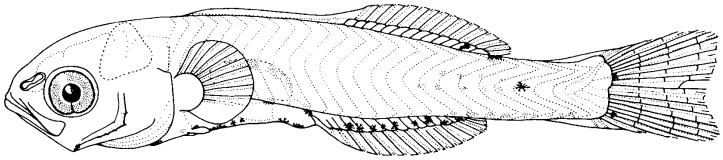
C. 6.4 mmSL



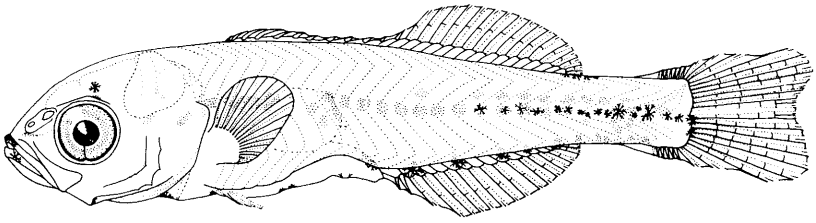
D. 5.6 mmSL (Ventral View)



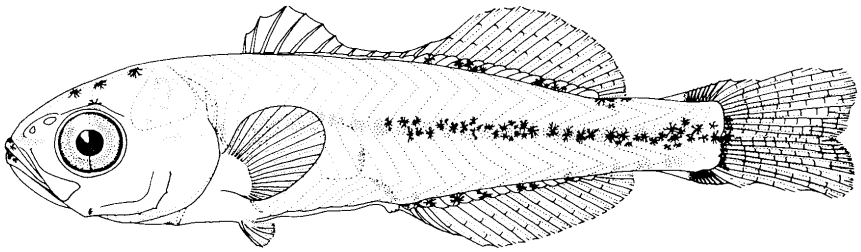
E. 7.3 mmSL



F. 9.2 mmSL

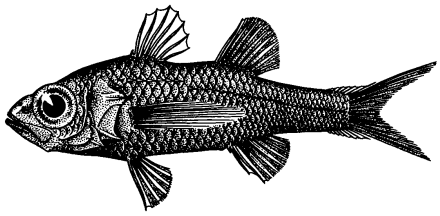


G. 11.1 mmSL



H. 12.7 mmSL

Howella brodiei Ogilby, 1899
Howellidae
Pelagic basslet



Range: Atlantic, Pacific and Indian oceans in tropical to subtropical waters; in the western Atlantic from Iceland to 20°S

Habitat: Mesopelagic in depths of 300–900 m (to maximum depth 1,850 m); may migrate into epipelagic zone at night; juveniles (and larvae) reported to be pelagic in upper 300 m

Spawning: Year-round with peak in late summer in eastern Pacific; undescribed in Atlantic

Meristic Characters	
Myomeres:	26
Vertebrae:	10 + 16 = 26
Dorsal fin rays:	VIII, I, 9
Anal fin rays:	III, 7
Pectoral fin rays:	13–15
Pelvic fin rays:	I, 5
Caudal fin rays:	9–10+9+8+9–10
Supraneurals:	0/0/0+2/1+1/

Eggs:
- Pelagic; otherwise undescribed

Larvae:
- Hatching size <2.0 mmSL
- Body moderately deep (23–26% SL)
- Gut begins as simple, straight tube, coils early in preflexion stage
- Preanus length initially about 62% SL (59–67%), decreases to about 59% SL (52–63%)
- Head relatively large, length increases from 26–33% SL (preflexion) to 33–36% SL (juvenile)
- Mouth terminal and large, barely reaches anterior edge of eye
- Head spines relatively extensive, but small; see checklist below
- Flexion occurs at 4.1–5.4 mmSL
- Sequence of fin ray formation: C, D_2, A – D_1, P_2 – P_1
- Pigment in early stages includes a band composed of melanophores on roof of mouth, under hindbrain, across opercle and dorsum of gut; spots at tips of both jaws and on top of head; a series of spots along lateral midline and over notochord between myomeres 6–8 and 16–18; streaks form on hypaxial and epaxial myosepta; small dorsal patch forms between myomeres 12 and 18; in later stages, pigment increases dorsally (under D_1) and laterally (onto caudal peduncle)

Head spine checklist:

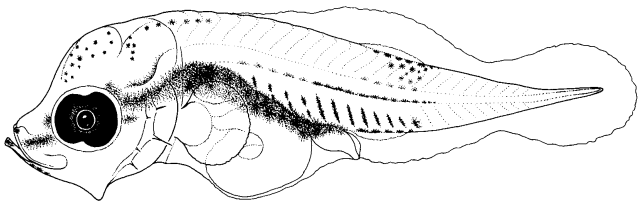
Preopercle:	small spines on posterior margin; retained in adults as serrate edge
Opercle:	1–2 spines on upper corner; retained in adults as discrete spines or a cluster
Interopercle:	small spines
Subopercle:	small spine (possibly)
Posttemporal:	1–2 small spines
Cleithral:	small spine

Note:
1. Juvenile pigment (>13 mmSL) increases over most of body, excluding fins
2. Opinions differ as to family placement of *Howella*. Authors have placed it in Acropomatidae, Moronidae, Percichthyidae, Howellidae or left it without a family, as *incertae sedis*.
3. Juveniles and adults are superficially similar to fishes of Apogonidae, but the latter have 6 dorsal spines, *Howella* have 8; fishes of Epigonidae are also similar in shape and fin placement, but have 2 anal spines and 15–23 pectoral fin rays (*vs*: 3 anal spines and 13–15 pectoral fin rays in *Howella*)
4. This species is considered to be a junior synonym of *Howella atlantica* Post and Quero, 1991 by some authors. The adult figure above portrays *Howella sherborni* (Norman, 1920), a senior synonym of *Howella brodiei* Koefoed, 1952, not of *Howella brodiei* Ogilby, 1899.

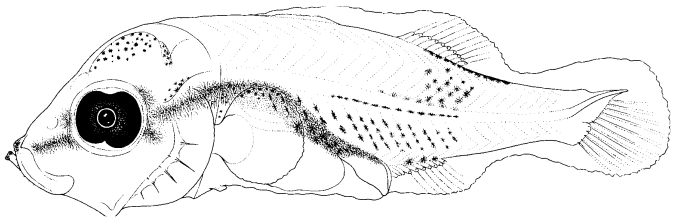
Figures: Adult: Tortonese, 1986; **A–B**, **D–E**: Barbara Sumida M^{ac}Call (Sandknop and Watson, 1996c); **C**: Betsy Washington (G. D. Johnson, 1984)

References: G. D. Johnson, 1984; Post and Quero, 1991; Sandknop and Watson, 1996c; Heemstra and Yamanoue, 2002; Moore *et al*., 2003

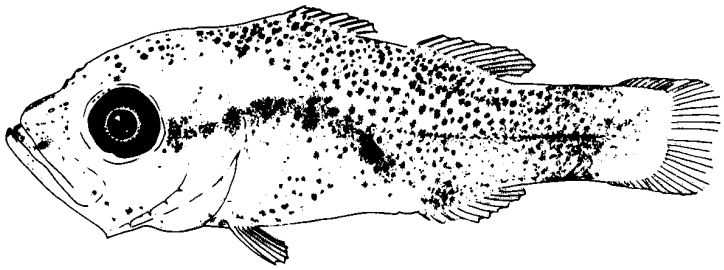
Howella brodiei



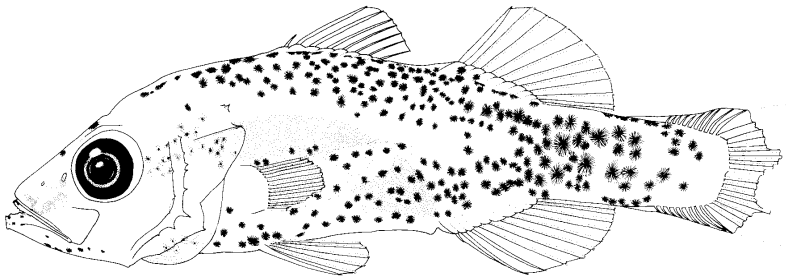
A. 3.2 mmSL



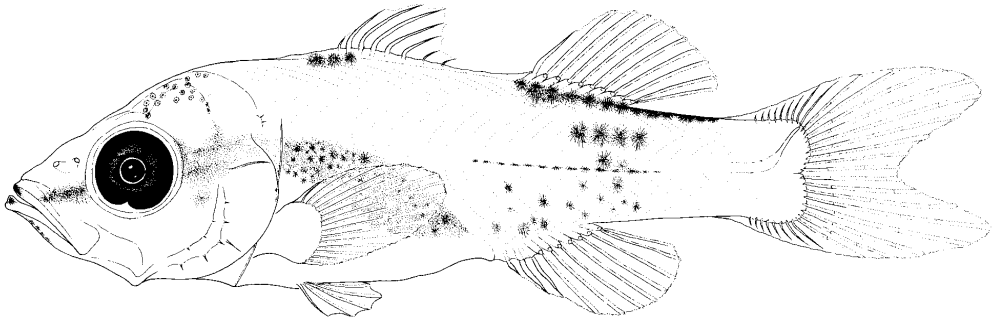
B. 4.6 mmSL



C. 6.0 mmSL
(Howella sp.*)*

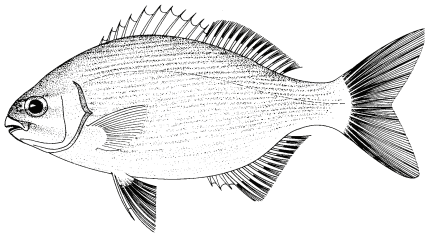


D. 7.9 mmSL



E. 9.3 mmSL

Kyphosus incisor (Cuvier, 1831)
Kyphosidae
Yellow sea chub



Range: Western North Atlantic Ocean from New England and Bermuda to Brazil, including Gulf of Mexico and Caribbean Sea; also eastern Atlantic off northern Africa

Habitat: Coastal waters over hard bottoms; also reported to occur far offshore associated with floating weed beds (e.g. *Sargassum*); feeds on algae

Spawning: Possibly year-round with peak in spring-summer

Meristic Characters

Myomeres:	26
Vertebrae:	10 + 16 = 26
Dorsal fin rays:	IX–XII, 13–15
Anal fin rays:	III, 12–13
Pectoral fin rays:	18–20
Pelvic fin rays:	I, 5
Caudal fin rays:	10+9+8+9
Supraneurals:	0/0/0+2/1/

Eggs: – Undescribed

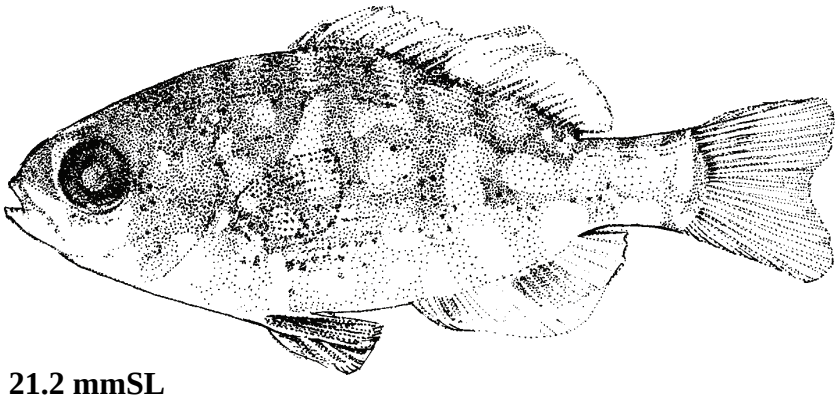
Larvae:
- Early stages undescribed (see "Note" below); description here based in part on preflexion and flexion *Kyphosus* larvae collected in Pacific Ocean
- Preflexion larvae elongate with relatively small head
- Gut begins as tube, coils early; preanus length slightly >50% SL
- Body soon deepens, head becomes rounded and relatively blunt
- Mouth large initially (reaching to levels of mid-eye), becomes relatively smaller with development
- Sequence of fin ray formation: C, D_2, A – D_1, P_2 – P_1
- Dorsal fin rays longer than dorsal spines
- Head spines weakly developed; see checklist below
- Spinous scales reported to occur over larval body (G. D. Johnson, 1984); no other descriptions available
- Pigment in early larvae includes prominent melanophores along dorsal and ventral edges of body; in later stages, scattered, large spots on the dorsal half of body overlie a background of smaller spots

Head spine checklist:

Preopercle:	small spines on edge, none greatly enlarged; retained as serrated edge in juveniles
Opercle:	weak spine at upper angle, retained in juveniles
Subopercle:	spine may be present
Interopercle:	spine may be present
Supracleithral:	small spine

Note: 1. See Drass (2006) for description and original series of illustrations of larvae 4.5–13.5 mmSL collected in Gulf of Mexico

Early Juvenile: Pigment includes large, pale areas within dark background

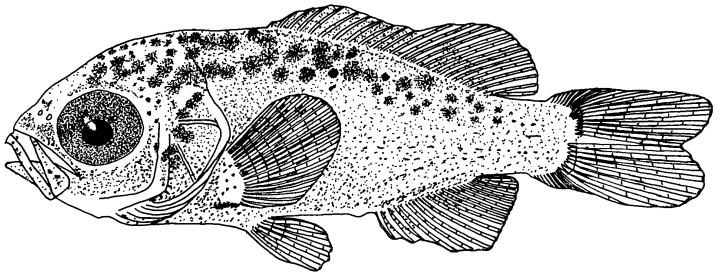


D. 21.2 mmSL

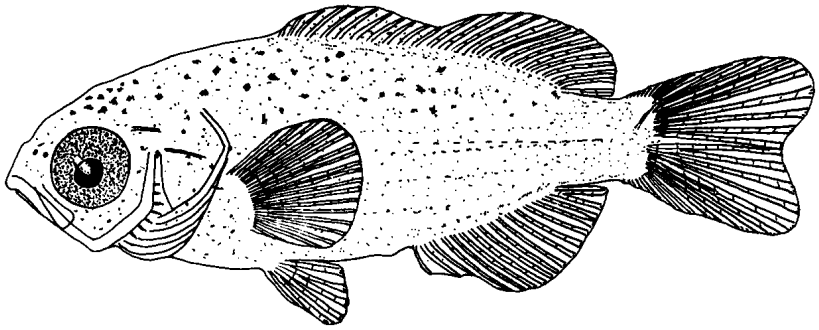
Figures: Adult: Carpenter, 2002d; **A–C**: Moore, 1962; **D**: Joan Ellis (G. D. Johnson, 1978)

References: Moore, 1962; Fahay, 1975; G. D. Johnson, 1978; 1984; Miller *et al.*, 1979; Okiyama, 1988; Carpenter, 2002d; Walker *et al.*, 2004

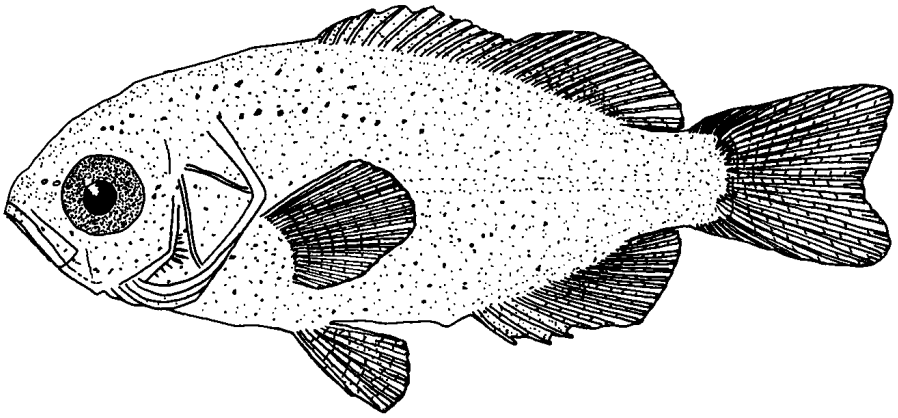
Kyphosus incisor



A. 8.5 mmSL

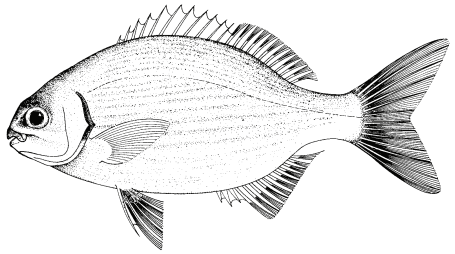


B. 9.8 mmSL



C. 14.7 mmSL

Kyphosus sectatrix (Linnaeus, 1766)
Kyphosidae
Bermuda sea chub



Range: Western North Atlantic Ocean from New England and Bermuda to Brazil, including Gulf of Mexico and Caribbean Sea; also Mediterranean Sea and eastern Atlantic from Spain to Angola

Habitat: Shallow, coastal waters over sand bottoms, grass beds, rocky substrates and around reefs; also well offshore associated with floating weed beds (e.g. *Sargassum*); feeds on algae

Spawning: Probably year-round, based on presence of juveniles

Eggs: – Undescribed

Meristic Characters

Myomeres:	26
Vertebrae:	10 + 16 = 26
Dorsal fin rays:	X–XI, 11–13
Anal fin rays:	III, 10–12
Pectoral fin rays:	17–19
Pelvic fin rays:	I, 5
Caudal fin rays:	9+9+8+9
Supraneurals:	0/0/0+2/1/

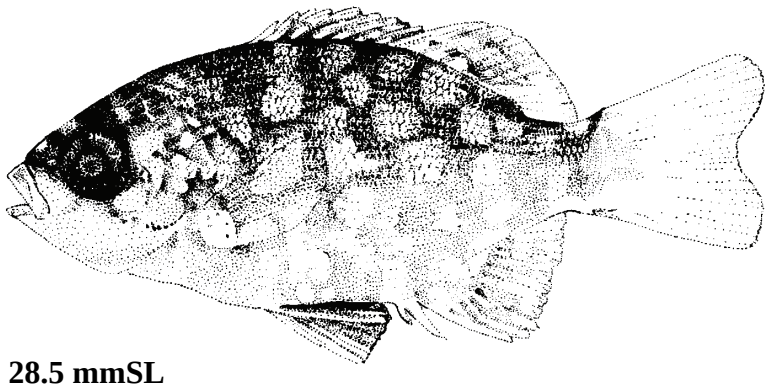
Larvae:
- Early stages undescribed; description based in part on preflexion and flexion *Kyphosus* larvae collected in Pacific Ocean (fig. A–D)
- Preflexion larvae elongate with relatively small head
- Gut begins as tube, coils early; preanus length slightly >50% SL
- Body soon deepens, head becomes rounded and relatively blunt
- Mouth large initially (reaching to levels of mid-eye), becomes relatively smaller with development
- Sequence of fin ray formation: C, D_2, A – D_1, P_2 – P_1
- Dorsal fin rays longer than dorsal spines
- Head spines weakly developed; see checklist below
- Spinous scales reported to occur over larval body (G. D. Johnson, 1984); no other descriptions available
- Pigment in early larvae includes prominent melanophores along dorsal and ventral edges of body; in later stages, scattered, large spots on the dorsal half of body overlie a background of smaller spots

Head spine checklist:

Preopercle:	small spines on edge, none greatly enlarged; retained as serrated edge in juveniles
Opercle:	weak spine at upper angle, retained in juveniles
Subopercle:	spine may be present
Interopercle:	spine may be present
Supracleithral:	small spine

Note: 1. Best distinguished from similar young stages of *Kyphosus incisor* by meristic characters

Early Juvenile: Pigment includes large, pale areas within dark background

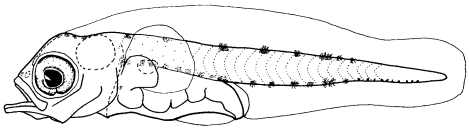


G. 28.5 mmSL

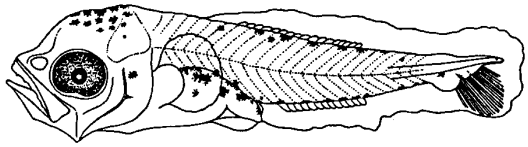
Figures: Adult: Carpenter, 2002d; **A**: Miller *et al*., 1979; **B**, **D**: Okiyama, 1988; **C**: Walker *et al.*, 2004; **E–F**: Moore, 1962; **G**: Joan Ellis (G. D. Johnson, 1978)

References: Moore, 1962; Fahay, 1975; Johnson, 1978; 1984; Miller *et al*., 1979; Okiyama, 1988; Carpenter, 2002d; Walker *et al*., 2004

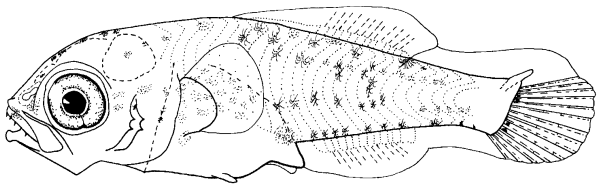
Kyphosus sectatrix



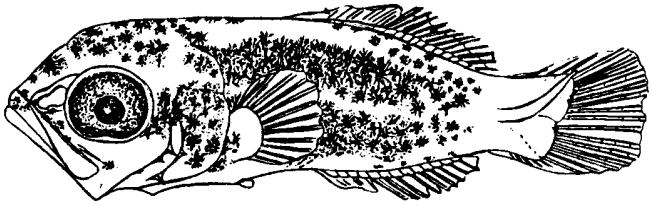
A. 3.0 mmSL *(Kyphosus vaigiensis)*



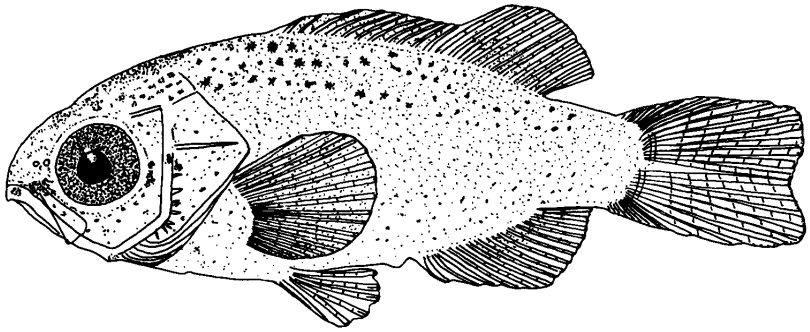
B. 4.5 mmTL *(Kyphosus cinerascens)*



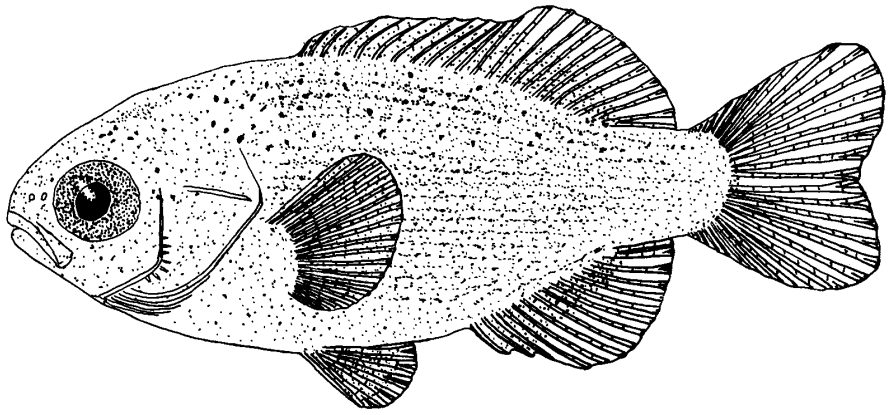
C. 4.9 mmSL *(Kyphosus vaigiensis)*



D. 5.1 mmTL *(Kyphosus cinerascens)*

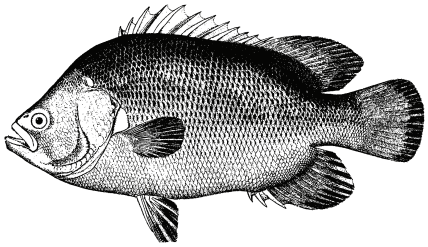


E. 10.5 mmSL *(Kyphosus sectatrix)*



F. 15.0 mmSL *(Kyphosus sectatrix)*

Lobotes surinamensis (Bloch, 1790)
Lobotidae
Atlantic tripletail



Range: Worldwide in warm waters; in the western Atlantic from Nova Scotia and Bermuda to Argentina; more common south of Virginia

Habitat: Mostly offshore waters in near-surface levels where it often floats on side near flotsam or weed beds; young stages float at surface, mimic leaves; juveniles common in estuaries during summer (Gulf of Mexico)

Spawning: Mostly May–Sep with a peak during summer in outer continental shelf and oceanic waters; most larvae in very warm water

Meristic Characters

Myomeres:	24
Vertebrae:	11 + 13 = 24
Dorsal fin rays:	XII, 15–16
Anal fin rays:	III, 11–12
Pectoral fin rays:	16
Pelvic fin rays:	I, 5
Caudal fin rays:	3–5+9+8+3–5
Supraneurals:	0/0/0+2/1+1/

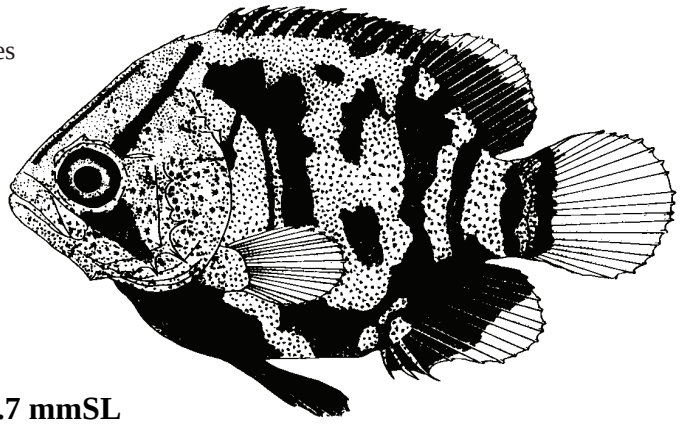
Eggs:
- Pelagic, large (>1.0 mm); otherwise undescribed

Larvae:
- Body elongate, with large, downwardly flexed head including a prominent supraoccipital crest; head length increases from 29% SL to >40% SL
- Body deepens markedly early in development; body depth increases from 25% SL to about 60% SL
- Preanus length increases from about 60% SL to >75% SL
- Mouth relatively large (extends to level of mid-eye)
- Flexion occurs at sizes between 4.0 and 6.3 mmSL
- Sequence of fin ray formation: P_2 – C, D_1 – D_2, A – P_1; precocious pelvic fin rays unusual in percoid larvae
- Head spination extensive; see checklist below
- Pigmentation sparse in earliest stages, but soon increases to cover much of flank; few spots occur (externally and internally) on head, brain, and on nape; pigment heavy on precocious P_2 fins; later larvae and juveniles develop extensive pigment pattern over much of body, extending onto fin bases; most of caudal fin remains without pigment

Head spine checklist:

Preopercle:	2 series of prominent spines, one along edge, one on inner shelf
Supraoccipital:	exaggerated crest consisting of 6–7 obvious spines forms in preflexion larvae; resorbed by 16.0 mmSL
Supraorbital:	ridge with a single spine; retained into early juvenile stage
Posttemporal:	single, weak spine
Supracleithral:	single, weak spine
Pterotic:	low, simple ridge, without spines
Opercle:	small spine near upper angle
Subopercle:	small spine on posterior edge

Early Juvenile: Surface of frontal bone is rugose, or "waffle" patterned; possibly serves to strengthen neurocranium during early development

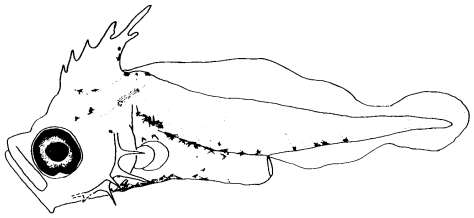


G. 13.7 mmSL

Figures: Adult: Goode., 1884; **A–B**, **D–G**: Ditty and Shaw, 1994a; **C**: Uchida e*t al*., 1958

References: Hardy, 1978b; G. D. Johnson, 1984; Gilhen and M^{c}Allister, 1985; Ditty and Shaw, 1994a; Watson, 1996q; Leis and Carson-Ewart, 2004

Lobotes surinamensis

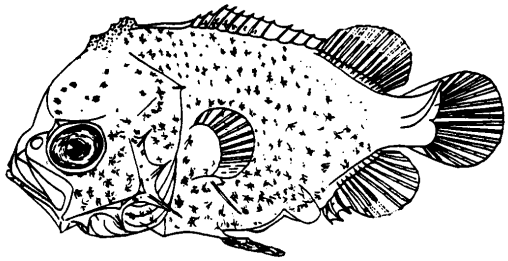


A. 2.2 mmSL

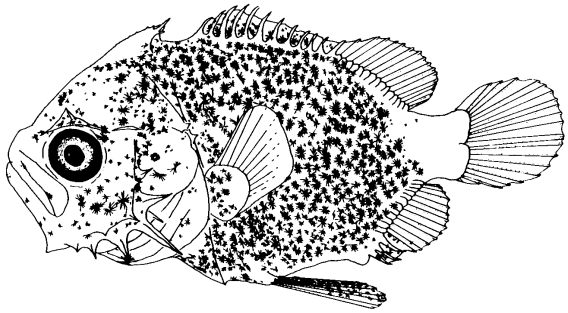
Note early-forming, densely pigmented P_2 fins

B. 4.0 mmSL

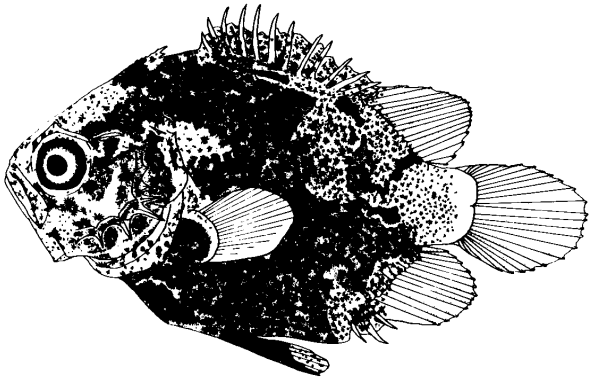
Small larvae superficially similar to those of Holocentridae, but have fewer myomeres, longer preanus length, and lack rostral spine



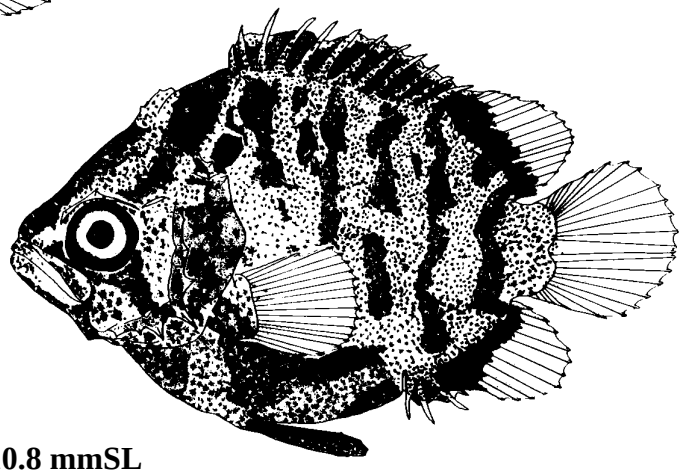
C. 6.0 mmTL



D. 6.3 mmSL



E. 8.5 mmSL



F. 10.8 mmSL

Perciformes
Suborder Percoidei – Family Lutjanidae

Lutjanids are more common in tropical and subtropical waters south of the study area (and worldwide), but several reach their northern limits near 35°N. Members of the family Lutjanidae are contained within five subfamilies. Two of these subfamilies are represented by 12 species that are rarely or regularly found in the present study area. The larvae or juveniles of a few of these are regularly collected here. Larval development in all 5 subfamilies has been intensively studied. See the following sources for ontogenetic information on extralimital taxa:

Subfamily Apsilinae:	Leis *et al*., 1997
Subfamily Paradicichthyinae:	Leis and Bray, 1995
Subfamily Caesioninae:	Reader and Leis, 1996

General characters of lutjanid larvae:

- Body typically very elongate at hatching, then deepens through pectoral region and becomes compressed
- 24 myomeres; preanus length increases from <50% SL to about 60% SL in most
- Pelvic fin spine and 2nd spine of D_1 form early, become elongate
- Pelvic fin rays typically very long, often longer than P_2 spine and equal to length of longest dorsal fin spines
- Third anal fin element begins as fin ray, transforms into a spine; typical anal fin formula III, 7–9
- Serrated edges may occur on leading or trailing surfaces of dorsal, anal or pelvic fin spines
- Head spines and ridges extensive, well-developed; spine on upper postcleithrum unusual for percoid larvae
- Preopercle angle spine smooth, or weakly serrate in some
- Pigment relatively light; typical loci for melanophores include ventral edge of tail, lateral surface of caudal peduncle, brain, cleithral symphysis, dorsal fin membranes, anterior surface of gut (internal)
- Series of melanophores along ventral edge of tail reduces in number after flexion

Characters commonly found in larvae of the subfamily Etelinae (after Leis and Lee, 1994):
(*Etelis oculatus, Pristipomoides aquilonaris*)

Pigment:	early development of spots over brain; *Etelis* has line of spots along longest D spines and P_2 spine; ventral row consists of very few spots, decrease to one or none after flexion
Head spines:	many bones bear spines; weak supraocular ridge without serrations; all head spines smooth edged
Fin formulae and spines:	Dorsal: X, 11; anal: III, 8; relative lengths of 2nd D_1 spine and P_2 spine important; fin spines smooth on anterior surface; spines V-shaped in cross-section, often pigmented along inner surface; fin spines have visible internal structure in *Pristipomoides*, none in *Etelis*
Supraneurals:	0/0+0/2/1+1/
Scales:	early formation (<7.0 mm in *Etelis*; 6.5–9.0 mm in *Pristipomoides*)

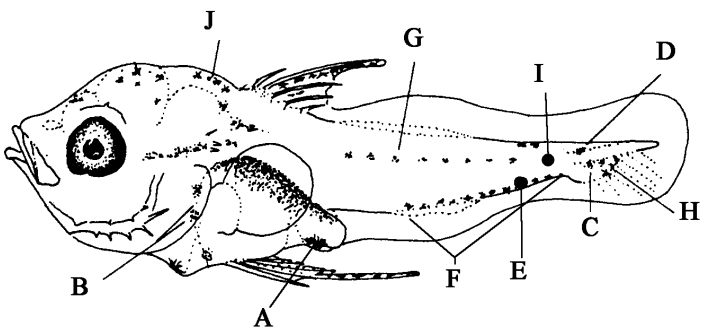
Characters commonly found in larvae of the subfamily Lutjaninae (after Clarke *et al*., 1997; Leis and Rennis, 2004a):
(*Lutjanus* (8 species), *Ocyurus chrysurus, Rhomboplites aurorubens*)

Pigment:	typically light in early stages; preflexion larvae have series of many spots along ventral edge, number of spots decreases at flexion; pigment on top of head forms later, patterns vary; melanophore on caudal peduncle typical, usually spreads anteriorly along midline; prominent spot usually forms at cleithral symphysis
Head spines:	many bones bear spines; a few have serrated edges; posttemporal and supracleithral spines often multiple
Fin formulae and spines:	Dorsal: IX–XII, 10–14 and anal: III, 7–9; fin spines may be serrated along edge; pelvic fin rays often longer than pelvic spine
Supraneurals:	0/0/0+2/1+1/
Scales:	form at transformation (about 10.0 mmSL) in those described

Perciformes
Percoidei – Family Lutjanidae

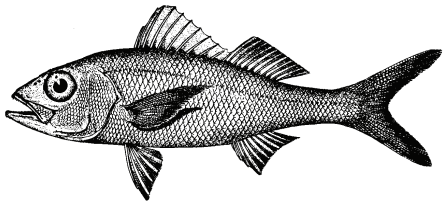
Comparison of characters in lutjanid larvae that occur in study area. Vertical border separates Etelinae from Lutjaninae. Ab = absent; Pr = present; noto = notochord; YS = yolk sac larva

Character	*Etelis oculatus*	*Pristipomoides aquilonaris*	*Lutjanus analis*	*Lutjanus campechanus*	*Lutjanus griseus*	*Lutjanus synagris*	*Ocyurus chrysurus*	*Rhomboplites aurorubens*
P_2 ray length	Long >30% SL	Short 25-30% SL	Long ~30% SL	Very long >33%	Long ~30% SL	Short ~24% SL	Very long >33% SL	Short <20% SL
Preopercle angle spine	Smooth	Smooth?	Smooth	Smooth	Smooth	Smooth	Smooth	Serrated
D_1 spine serrations	None	None	Small	Anterior edge only	Small	Small	Small	Prominent
D_1 spines	X	X	X	X	X	X	X	XII
D_2 rays	11	11	12-13	14	14	12-13	12-13	11
Supraneurals	0/0+0/2/1+ 1/	0/0+0/2/1+1/	0/0/0+2/1+1 /	0/0/0+2/1+1/	0/0/0+2/1+1 /	0/0/0+2/1+1 /	0/0/0+2/1+ 1/	0/0/0+2/1+1/
Pigment								
Anterior to vent gut spot **A**	Ab?	Unknown	Ab	Ab	Pr	Pr	Ab	Ab
Spot on anterior surface of gut **B**	Ab?	Pr?	Pr	Ab	Ab?	Pr	Pr	Ab?
Internal spots under noto. tip **C**	Ab	Ab?	Pr	Ab	Pr	Ab	Ab	Ab
Dorsal noto. tip **D**	?	Ab?	Ab	Ab	Ab	Ab	in YS	Ab
Larger spot in ventral series **E**	Unknown	Unknown	3/4 dist to noto tip	None enlarged	None enlarged	2/3 dist to noto tip	None enlarged	None enlarged
# ventral spots in preflexion **F**	Short-lived	Short-lived	13-23 (usu. 16-17)	Usually 16-18	Usually 17-18	15-25 (usu. 19-21)	13-19 (usu. 14-16)	About 14
Internal over notochord **G**	Unknown	Unknown	Absent	Absent	Absent	~6.2 mm	~6.3 mm	Absent
Spot under hypurals **H**	Pr?	Unknown	~5.8 mm	Ab	Ab	Ab	Ab	Ab
Spot on lateral peduncle **I**	Ab	Pr	Pr	Faint	Pr	Pr (light)	Pr	Pr
External spot over nape **J**	Ab	Ab	~3.5 mm	Pr early	Pr?	Ab	Ab	Ab



Selected loci for important pigment characters. Modified after Clarke *et al.* (1997); see the latter for other important pigmentation characters.

Etelis oculatus (Valenciennes, 1828)
Lutjanidae (s.f. Etelinae)
Queen snapper



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

Habitat: Rocky substrates in depths of 135–450 m

Spawning: Not well known; possibly peaks during summer, most likely seaward of continental shelf edge

Meristic Characters

Myomeres:	24
Vertebrae:	10 + 14 = 24
Dorsal fin rays:	X, (10) 11
Anal fin rays:	III, 8
Pectoral fin rays:	15–17
Pelvic fin rays:	I, 5
Caudal fin rays:	9+8 (PrC)
Supraneurals:	0/0+0/2/1+1/

Eggs: – Undescribed

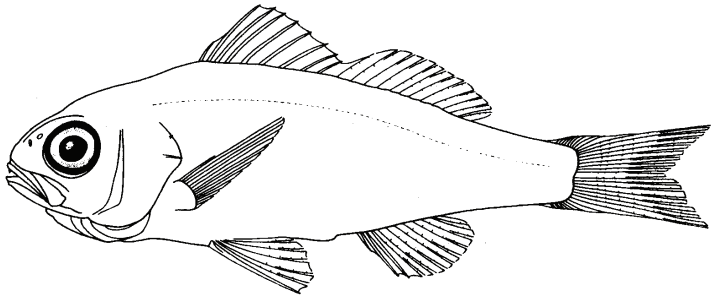
Larvae:
- Preflexion larvae initially very elongate, but body soon deepens, especially through pectoral region, and becomes laterally compressed
- Gut coils soon after hatching and becomes compact and triangular in shape; preanus length 50 to 60% SL
- Small air bladder located over anterior gut
- Head moderate to large, snout pointy, mouth moderately large, extending to middle of eye
- Head spines well-developed; see checklist below
- Flexion occurs at lengths of about 4.0–5.0 mmSL
- Sequence of fin ray formation: P_2 spine, 2nd spine of D_1 – D_1, P_2, C – D_2, A – P_1
- P_2 fin rays very long; P_2 spine equal to, or slightly longer than, 2nd spine of D_1 into juvenile stage
- Third anal fin element changes from fin ray to spine soon after flexion
- Pigment is light over-all in early larvae; 1 or 2 melanophores along ventral edge of tail disappear after flexion; spots typically form early over brain and at cleithral symphysis <7.0 mm; pigment on dorsal fin membranes and series of spots along 2nd spine of D_1 and P_2 spine; pigment lacking along dorsum of body

Head spine checklist:

Preopercle:	2 series of smooth spines; angle spine longest
Posttemporal:	1 or 2 simple spines
Supracleithrum:	1 or 2 simple spines
Opercle:	spine forms at upper angle
Interopercle:	series of spines increase from 4 to about 10 in juveniles
Postcleithrum:	single, smooth spine situated on body above P_1 base
Subopercle:	series of spines increase from 2 to about 10 in juveniles

Note: 1. See Lutjanidae introductory pages for general characters of Lutjanidae and Etelinae larvae

Early Juvenile: Size at settlement unknown, but congeners remain pelagic until about 50 mm

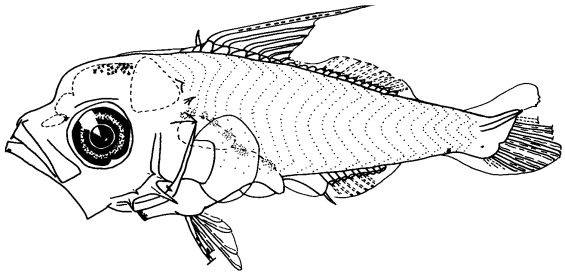


E. 39.0 mmSL

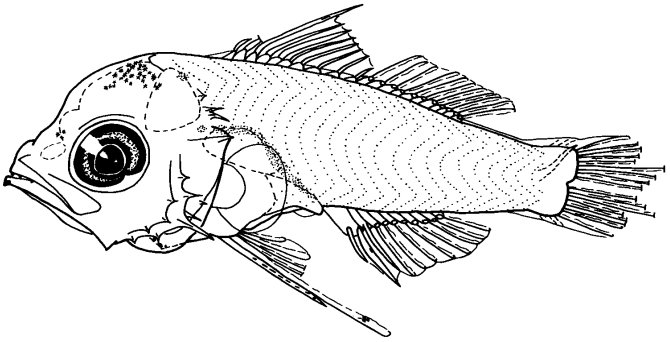
Figures: Adult: Jordan and Evermann, 1896–1900; **A–D**: Leis and Lee, 1994; **E:** Richards *et al*., 1994

References: G. D. Johnson, 1980; 1984; Richards *et al*., 1994; Leis and Lee, 1994; Watson and Brogan, 1996; Anderson, 2002a; Leis and Rennis, 2004a

Etelis oculatus

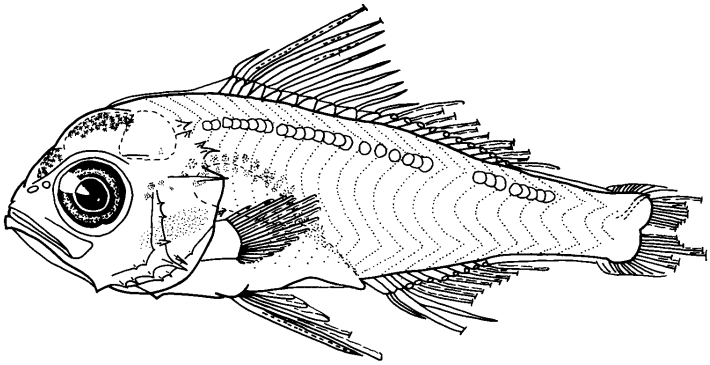


A. 4.4 mmSL *(Etelis* sp.)



B. 4.9 mmSL *(Etelis* sp.)

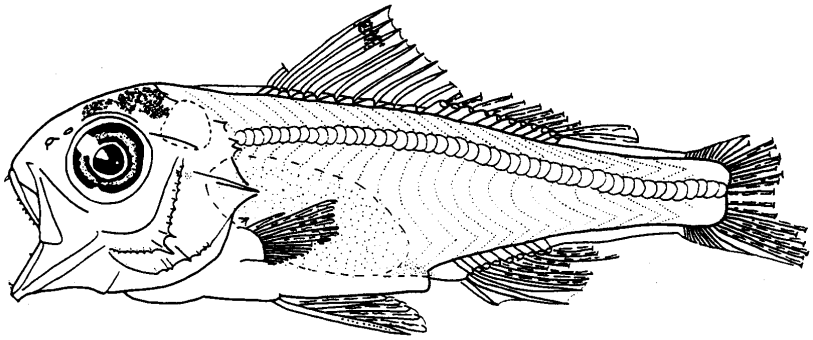
Ridges (without spines) form on supraocular, frontal and pterotic just before, or just after, flexion



C. 8.3 mmSL *(Etelis* sp.)

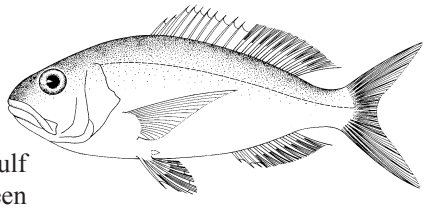
Note: specimens in figs. A-C from Indo-Pacific, not identified to species

Note: larvae in figs C and D are fully scaled, but only those scales along lateral line are illustrated



D. 15.7 mmSL *(Etelis oculatus)*

Pristipomoides aquilonaris (Goode and Bean, 1896)
Lutjanidae (s.f. Etelinae)
Wenchman



Range: Western North Atlantic Ocean from North Carolina to Brazil, including Gulf of Mexico and Caribbean Sea; pelagic-juveniles (up to 40 mm) have been collected as far north as Scotian Shelf

Habitat: Demersal or "semi-pelagic" on slopes in depths of 24–488 m; probably feed well above bottom substrates

Spawning: Not well described; possibly peaks in warmer months; eggs in multiple batches; most likely seaward of continental shelf edge

Meristic Characters

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

Eggs:
– Undescribed

Larvae:
– Preflexion larvae initially very elongate, but body soon deepens, especially through pectoral region, and becomes laterally compressed
– Gut coils soon after hatching and becomes compact and triangular in shape
– Preanus length <50% SL in larvae to about 55% SL in juveniles
– Short gap between anus and anal fin origin closes just after flexion
– Small air bladder located over anterior gut
– Head moderate to large, snout initially pointy, becomes more rounded; mouth moderately large, extending to middle of eye
– Head spines well-developed; see checklist below
– Flexion occurs at lengths of 3.7–5.2 mmSL
– Sequence of fin ray formation: P_2 spine, 2^{nd} spine of D_1 – D_1, P_2, C – D_2, A – P_1
– P_2 fin rays very long; P_2 spine equal to, or slightly longer than 2^{nd} spine of D_1 into juvenile stage
– Highly structured, "honeycomb" internal texture apparent in D_1 and P_2 spines (>7.0 mm)
– Third anal fin element changes from fin ray to spine at about 5.2 mmSL (early postflexion)
– Pigment is light over-all in early larvae; 1 or 2 melanophores along ventral edge of tail remain after flexion,one at insertion of anal fin; spots typically form early over brain and at cleithral symphysis (lost at about 9.0 mm); pigment very sparse on anterior dorsal fin membranes; a short series of melanophores along dorsum of body under posterior dorsal fin; few spots on midline of caudal peduncle form after flexion; tips of caudal fin rays pigmented at 10.5 mm or earlier

Head spine checklist:

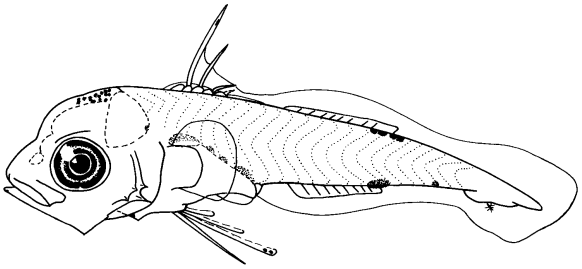
Preopercle:	numerous (up to 20 on outer edge) smooth spines in 2 series; angle spine longest, forms at 3.0 mm
Posttemporal:	1 to several spines form at 4.0–6.0 mmSL
Supracleithrum:	2 or more spines form at about 4.0–5.0 mmSL
Opercle:	single, smooth spine forms in preflexion; 2^{nd} spine forms at 16–21 mm
Interopercle:	single, smooth spine forms before flexion, increases to 5–10 spines in juveniles
Postcleithrum:	single, smooth spine situated on body above P_1 base
Subopercle:	single, smooth spine forms after flexion (some individuals to 10 mm lack spine), increases to 5–8 spines in juveniles

Note:
1. See Lutjanidae introductory pages for general characters of Lutjanidae and Etelinae larvae
2. Size at settlement unknown, but pelagic-juveniles have been collected up to 42 mmSL
3. Individual spines in larvae become serrated edges of preopercle, subopercle and interopercle in juveniles

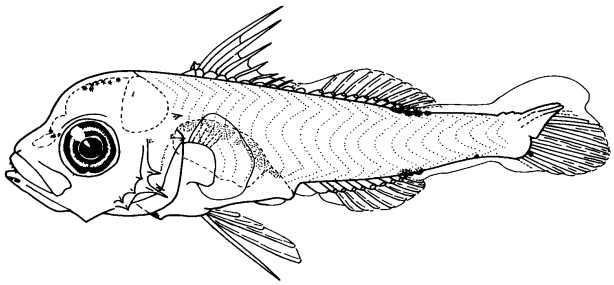
Figures: Adult: R. Vergara, 1978; **A–F**: Leis and Lee, 1994

References: G. D. Johnson, 1980; 1984; Scott and Scott, 1988; Richards *et al.*, 1994; Leis and Lee, 1994; Watson and Brogan, 1996; Anderson, 2002a; Leis and Rennis, 2004a

Pristipomoides aquilonaris

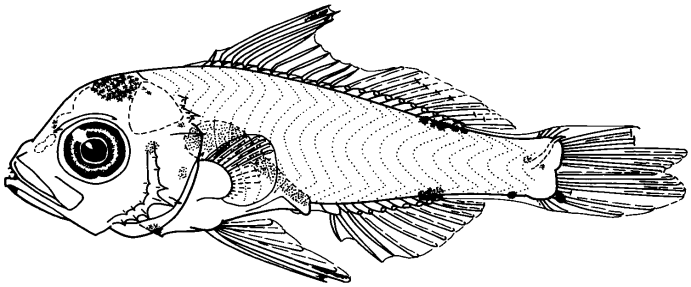


A. 4.1 mmSL

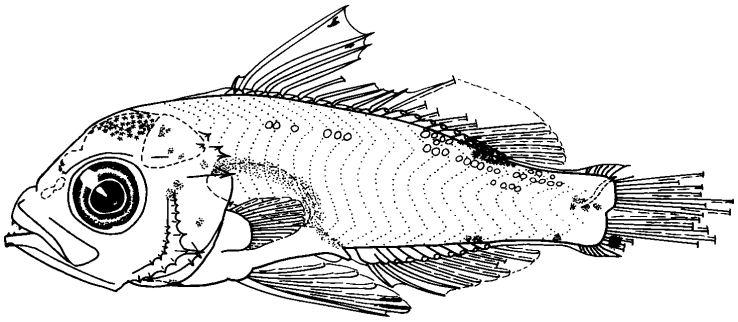


B. 4.9 mmSL

Ridges (without spines) form on supraocular, frontal and pterotic just before, or just after, flexion

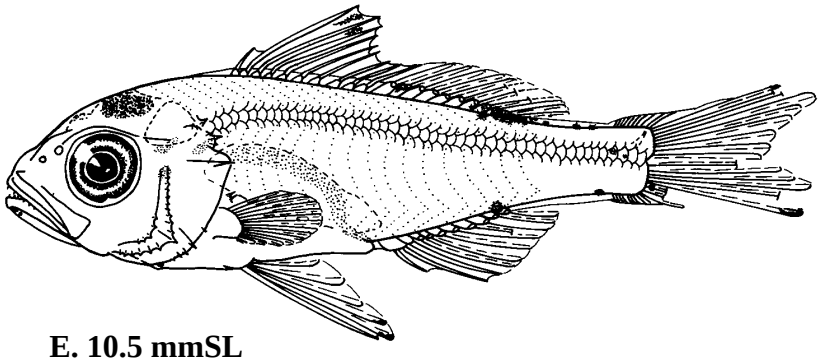


C. 6.2 mmSL

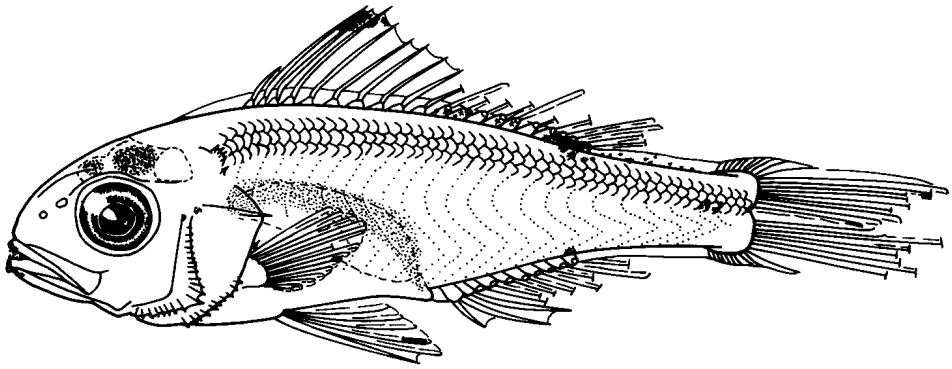


D. 7.4 mmSL

Specimens in figs. E and F are fully scaled, but only those scales along lateral line are illustrated

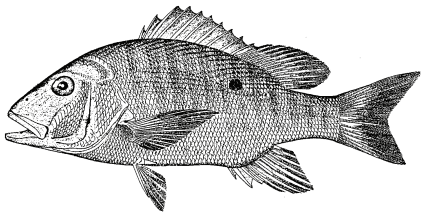


E. 10.5 mmSL



F. 19.0 mmSL

Lutjanus analis (Cuvier, 1828)
Lutjanidae (s.f. Lutjaninae)
Mutton snapper



Range: Western North Atlantic Ocean from New England and Bermuda (rarely) to Brazil, including Gulf of Mexico (except western part) and Caribbean Sea (except southwestern part)

Habitat: Most common over vegetated, sand bottoms in bays and estuaries; also over reefs; usually solitary

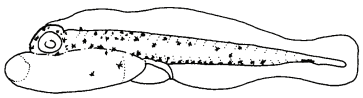
Spawning: Forms large aggregations; peaks early spring

Meristic Characters

Myomeres:	24
Vertebrae:	10 + 14 = 24
Dorsal fin rays:	X(XI), (13)14
Anal fin rays:	III, (7)8
Pectoral fin rays:	15–17
Pelvic fin rays:	I, 5
Caudal fin rays:	9+8 (PrC)
Supraneurals:	0/0/0+2/1+1/

Eggs:
- Single oil globule 0.13–0.22 mm; otherwise undescribed

Larvae:
- Preflexion larvae initially very elongate, but body soon deepens, especially through pectoral region, and laterally compressed
- Small air bladder located over anterior gut
- Gut coils soon after hatching and becomes compact and triangular in shape; preanus length <50% SL to about 60% SL in postflexion
- Head moderate to large, snout pointy, mouth moderately large, extending to middle of eye
- Head spines well-developed; see checklist below
- Flexion occurs at lengths of 4.4 to 5.5 mmSL
- Sequence of fin ray formation: P_2 spine, 2nd spine of D_1 – D_1, P_2, C – D_2, A – P_1
- Pelvic fin rays very long (longer than P_2 spine)
- 2nd spine of D_1 longer than P_2 spine until about equal in length at transformation
- Third anal fin element changes from fin ray to spine at about 6.4–8.2 mmSL
- Pigment is light over-all in early larvae; series of melanophores along ventral edge of tail decrease in number before flexion; spots typically occur over brain, at cleithral symphysis and on lateral surface of caudal peduncle; pigment on dorsal fin membranes



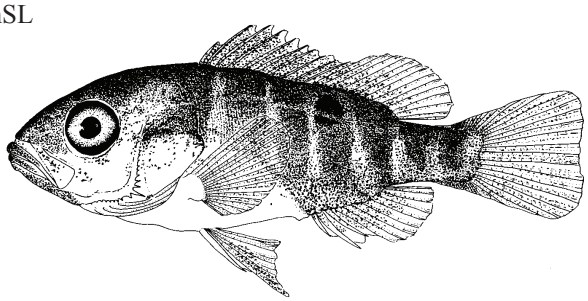
Yolk-sac larva, 2.2 mmNL

Head spine checklist:

Preopercle:	early forming (~3.0 mm), beginning with spine at angle; maximum 2–4 spines form on anterior limb, maximum 5–8 form along posterior edge until transformation
Supraocular:	low ridge with single, smooth spine
Posttemporal:	1 to 3 simple spines form at flexion
Supracleithrum:	1 to 3 simple spines form at flexion
Opercle:	simple spine forms at about 10.0 mmSL
Interopercle:	simple spine forms at about 10.0 mmSL
Postcleithrum:	single spine forms dorsal to P_1 fin base
Subopercle:	simple spine forms at about 10.0 mmSL

Note: 1. See Lutjanidae introductory pages

Early Juvenile:

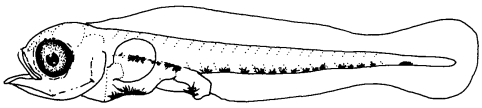


H: 18.5 mmSL

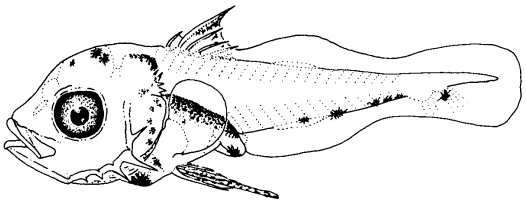
Figures: Adult: Jordan and Evermann, 1896–1900; Yolk-sac larva and **A–H**: Wayne Laroche (Clarke *et al*., 1997)

References: G. D. Johnson, 1980; 1984; Richards *et al.*, 1994; Watson and Brogan, 1996; Clarke *et al*., 1997; Anderson, 2002a; Leis and Rennis, 2004a

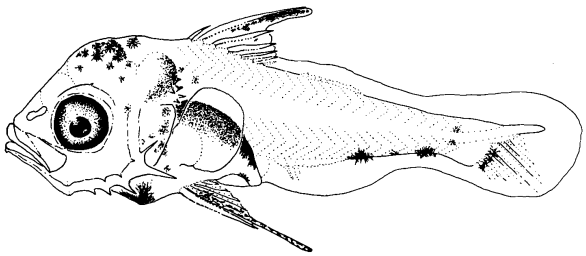
Lutjanus analis



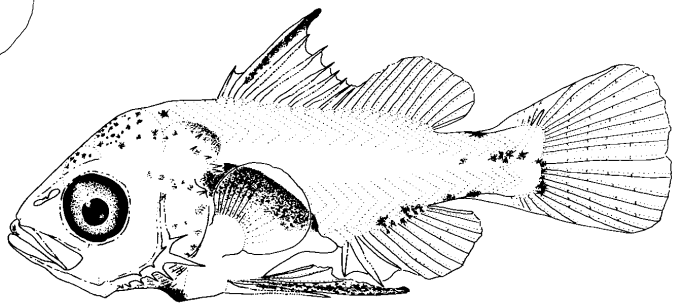
A. 3.3 mmSL



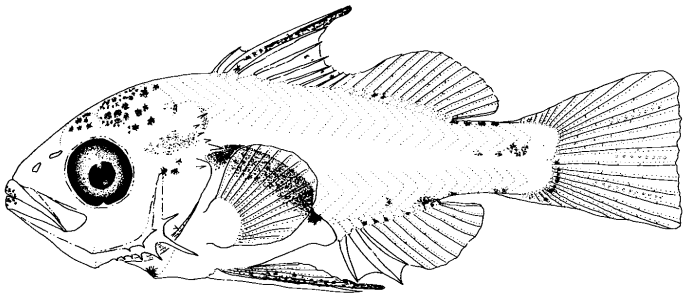
B. 4.9 mmSL



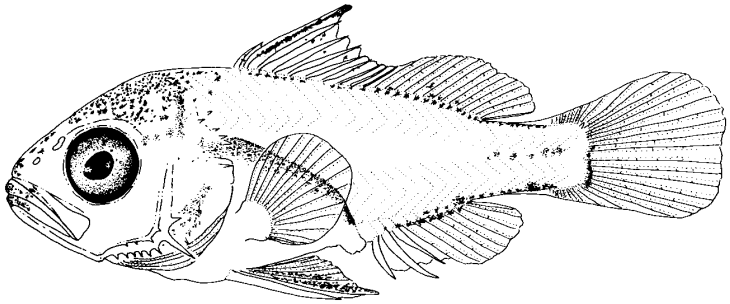
C. 5.8 mmSL



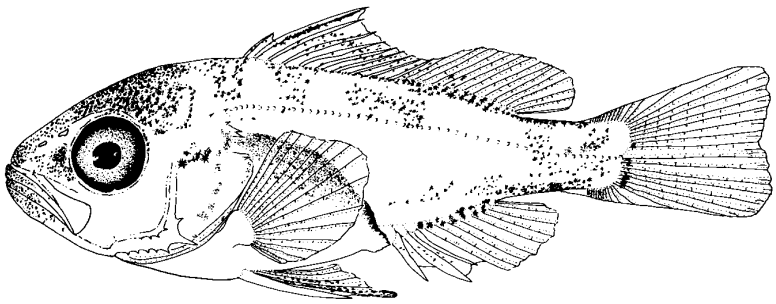
D. 8.1 mmSL



E. 9.8 mmSL

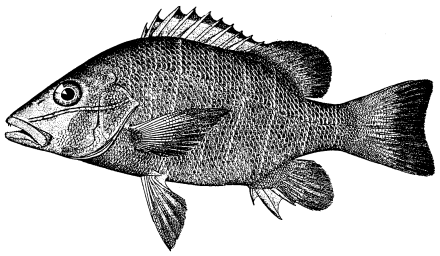


F. 11.5 mmSL



G. 15.0 mmSL

Lutjanus apodus (Walbaum, 1792)
Lutjanidae (s.f. Lutjaninae)
Schoolmaster snapper



Range: Western North Atlantic Ocean from Massachusetts (occasional pelagic-juveniles) and Bermuda to N.E. Brazil, including Gulf of Mexico (except western) and Caribbean Sea

Habitat: Coastal waters over a variety of substrates, including mud, vegetated sand, coral reefs, mangroves; usually in shallows; young stages may enter brackish habitats

Spawning: Peaks in spring and fall

Eggs: – Undescribed

Larvae: – Undescribed

Meristic Characters

Myomeres:	24
Vertebrae:	10 + 14 = 24
Dorsal fin rays:	X, 14
Anal fin rays:	III, 8
Pectoral fin rays:	16-17
Pelvic fin rays:	I, 5
Caudal fin rays:	9+8 (PrC)
Supraneurals:	0/0/0+2/1+1/

Head spine checklist: Spines presumably occur on the following bones, but number and size at formation unknown

Preopercle:
Supraocular:
Posttemporal:
Supracleithrum:
Opercle:
Interopercle:
Postcleithrum:
Subopercle:

Note: 1. See Lutjanidae introductory pages

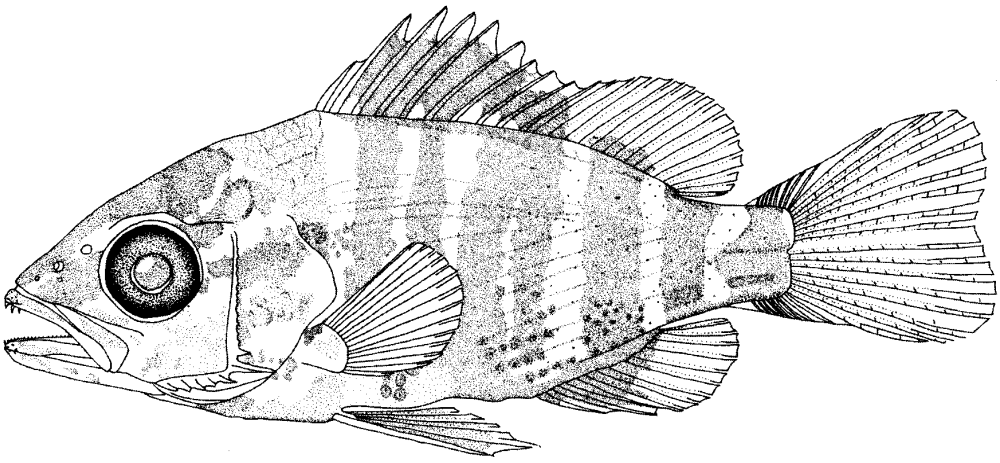
Early Juvenile: See Fig. A

Dark body bands and fins change to yellow with growth
Often an oblique stripe through eye
Pectoral fin yellow at 25 mm; dorsal and anal fins yellow at 35 mm
Pectoral fins longer than in comparably sized *Lutjanus griseus*
Lateral bands always present on body; no dorsolateral spot

Figures: Adult: Jordan and Evermann, 1896–1900; **A**: Ken Lindeman (Lindeman *et al.*, 2006)

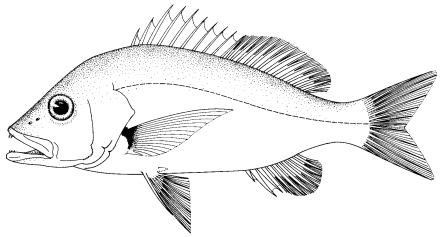
References: G. D. Johnson, 1980; 1984; Richards *et al.*, 1994; Watson and Brogan, 1996; Anderson, 2002a; Leis and Rennis, 2004a

Lutjanus apodus



A. 17.8 mmSL

Lutjanus buccanella (Cuvier, 1828)
Lutjanidae (s.f. Lutjaninae)
Blackfin snapper



Range: Western North Atlantic Ocean from Massachusetts (rare) and Bermuda to Brazil, including Gulf of Mexico and Caribbean Sea

Habitat: Sandy or rocky substrates in depths of 60–230 m; also near drop-offs and ledges; young stages occur in shallower waters

Spawning: Year-round with peak in Apr and Sep (Jamaica)

Eggs: – Undescribed

Larvae: – Undescribed

Meristic Characters

Myomeres:	24
Vertebrae:	10 + 14 = 24
Dorsal fin rays:	X, 14
Anal fin rays:	III, 7–8 (9)
Pectoral fin rays:	16–17
Pelvic fin rays:	I, 5
Caudal fin rays:	9+8 (PrC)
Supraneurals:	0/0/0+2/1+1/

Head spine checklist: Spines presumably occur on the following bones, but number and size at formation unknown

Preopercle:
Supraocular:
Posttemporal:
Supracleithrum:
Opercle:
Interopercle:
Postcleithrum:
Subopercle:

Note: 1. See Lutjanidae introductory pages

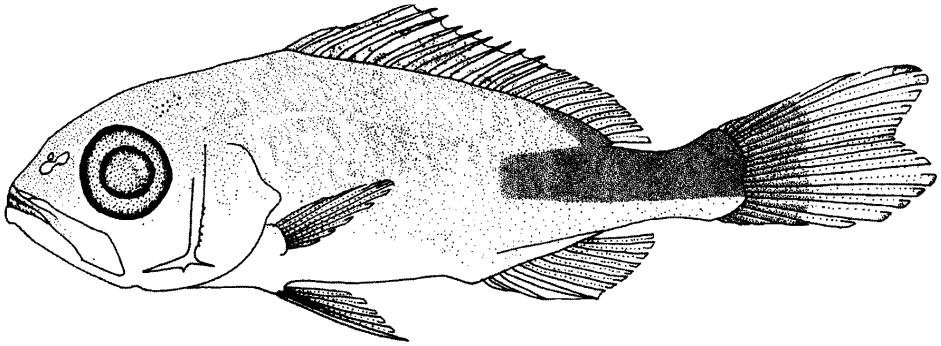
Early Juvenile: See Fig. A

Pale blue with wide yellow stripe extending along dorsum from anterior dorsal fin to upper lobe of caudal fin
Dark spot forms on base of pectoral fin in larger juveniles
No dorsolateral spot on body

Figures: Adult: R. Vergara, 1978; **A**: Ken Lindeman (Lindeman *et al*., 2006)

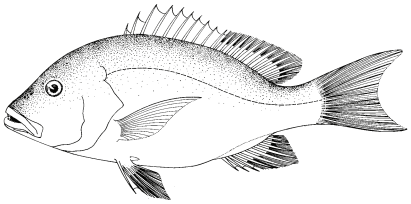
References: G. D. Johnson, 1980; 1984; Richards *et al*., 1994; Watson and Brogan, 1996; Anderson, 2002a; Leis and Rennis, 2004a

Lutjanus buccanella



A. 25.6 mmSL

Lutjanus campechanus (Poey, 1860)
Lutjanidae (s.f. Lutjaninae)
Northern red snapper



Range: Western North Atlantic Ocean from Massachusetts to Gulf of Mexico

Habitat: Rocky substrates in depths of 10–190 m (mostly 30–130 m); juveniles shallower, over sand or mud bottoms or oyster-shell substrates

Spawning: May–Sep off S.E. United States, longer duration in Gulf of Mexico

Eggs: – Undescribed

Meristic Characters	
Myomeres:	24
Vertebrae:	10 + 14 = 24
Dorsal fin rays:	(IX)X, 14
Anal fin rays:	III, (8) 9
Pectoral fin rays:	15–18
Pelvic fin rays:	I, 5
Caudal fin rays:	9+8 (PrC)
Supraneurals:	0/0/0+2/1+1/

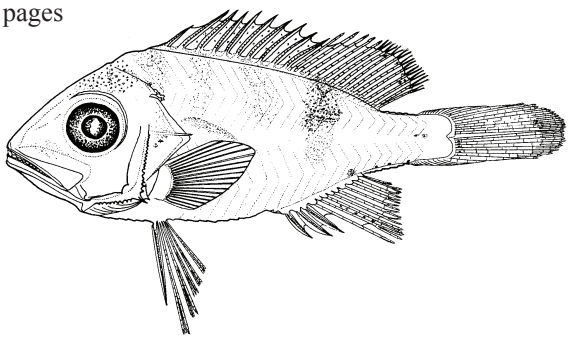
Larvae:
- Preflexion larvae initially very elongate, but body soon deepens, especially through pectoral region, and becomes laterally compressed
- Gut coils soon after hatching and becomes compact and triangular in shape; preanus length increases from 47% SL in preflexion to 67% SL in juveniles
- Small air bladder located over anterior gut
- Head moderate to large, snout pointy, mouth moderately large, extending to middle of eye
- Flexion occurs at lengths of 4.2–5.4 mmSL
- Sequence of fin ray formation: P_2 spine, 2nd spine of $D_1 - D_1$, P_2, $C - D_2$, $A - P_1$
- Pelvic fin rays very long (longer than P_2 spine)
- Third anal fin element changes from fin ray to spine at about 6.5–7.0 mmSL
- Pigment is light over-all in early larvae; series of melanophores along ventral edge of tail decrease in number until flexion; 2 melanophores persist on ventral edge at insertion of anal fin and lower edge of caudal peduncle; very few spots typically occur over brain, until increase in number during postflexion; a spot occurs anterior to cleithral symphysis from preflexion to about 9.0 mmSL; a single, isolated spot present on lateral surface of caudal peduncle; pigment on anterior dorsal fin membranes

Head spine checklist:

Preopercle:	early forming (about 2.5 mm), beginning with spine at angle; maximum 7 spines form on outer edges, number of spines increases in juveniles; maximum 4 spines on lateral ridge until transformation
Supraocular:	low ridge with a few serrations until juvenile stage, when it becomes a simple, smooth ridge
Posttemporal:	1 simple spine forms at about 7.3 mmSL, a second forms at about 9.5 mmSL
Supracleithrum:	a simple spine forms early (about 4.0 mmSL), increase to as many as 5
Opercle:	1 large, simple spine present at all sizes at upper angle
Interopercle:	simple, small spine forms early, present at all sizes
Postcleithrum:	single spine forms dorsal to P_1 fin base
Subopercle:	spines not described, but may be present as in other lutjanine larvae

Note: 1. See Lutjanidae introductory pages

Early Juvenile:

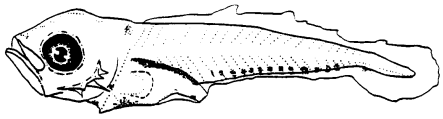


G. 22.4 mmSL

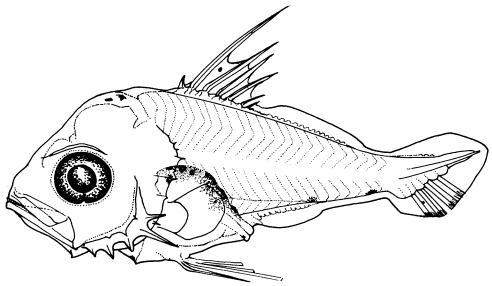
Figures: Adult: R. Vergara, 1978; **A**: Richards *et al*., 1994; **B–G**: Collins *et al*., 1980

References: G. D. Johnson, 1980; 1984; Potthoff *et al*., 1988; Watson and Brogan, 1996; Anderson, 2002a; Leis and Rennis, 2004a

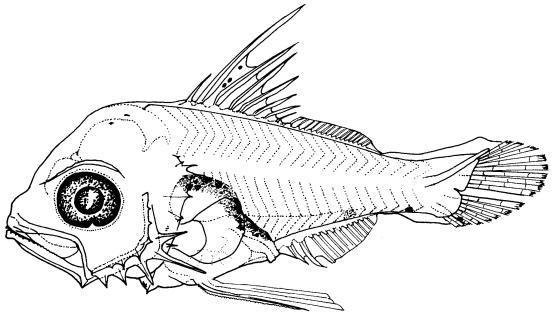
Lutjanus campechanus



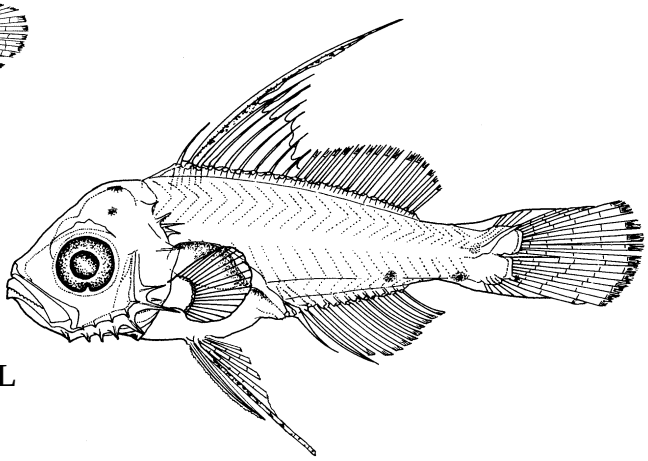
A. 3.6 mmNL



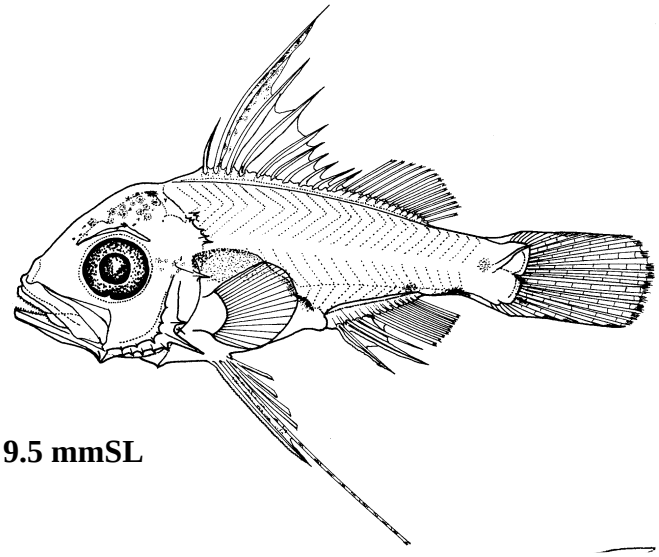
B. 4.2 mmSL



C. 4.9 mmSL

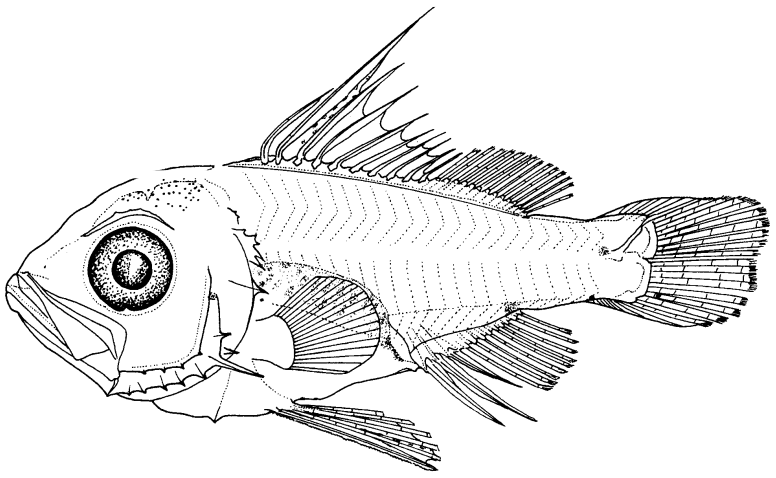


D. 7.3 mmSL



E. 9.5 mmSL

See next pages for more illustrations of early development, based primarily on a series of larvae reared in the laboratory. Many of these represent preflexion larvae, before development of fin rays.

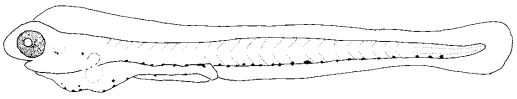


F. 12.4 mmSL

***Lutjanus campechanus* (Poey, 1860)**
Lutjanidae (s.f. Lutjaninae)
Northern red snapper

Additonal illustrations of early development, based on larvae reared in the laboratory

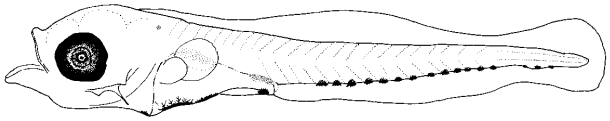
A. 2.5 mmNL, 1 DAH



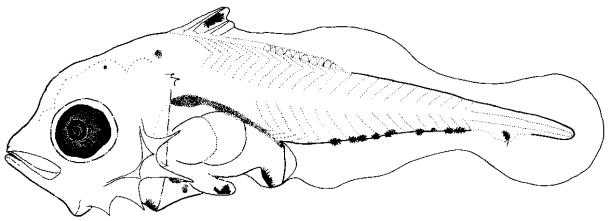
B. 2.6 mmNL, 3 DAH

C. 2.8 mmNL, 5 DAH

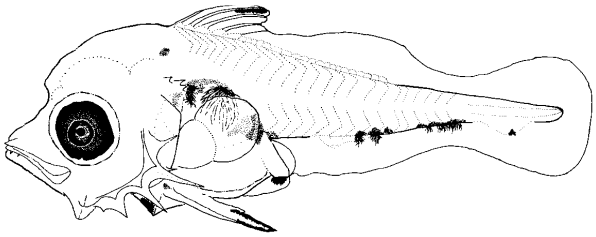
D. 2.4 mmNL, 6 DAH



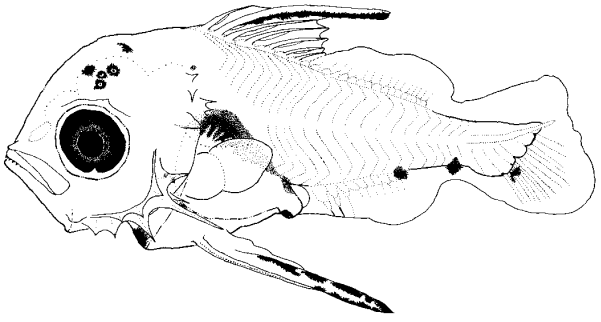
E. 3.1 mmNL, 12 DAH



F. 3.6 mmNL, 10 DAH



G. 3.5 mmNL, 11 DAH

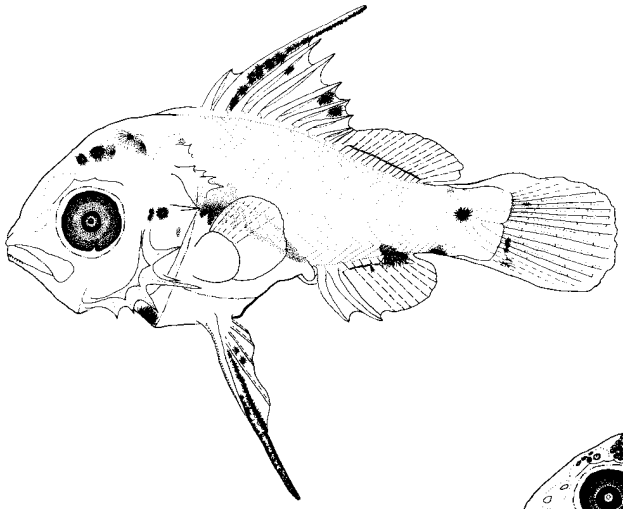


H. 4.4 mmNL, 13 DAH

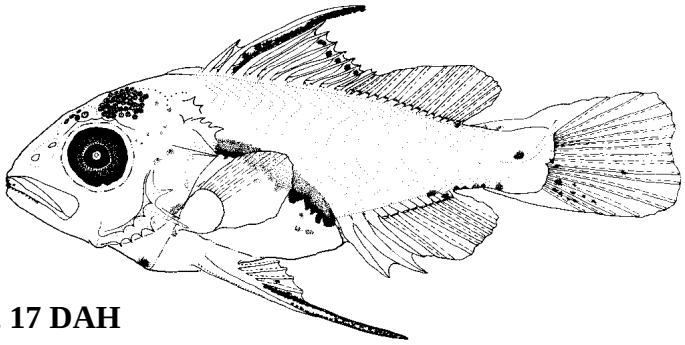
DAH = Days after hatching

Figures: **A–H**: Denice Drass (Drass *et al*., 2000)
References: Drass *et al*., 2000; Lindeman *et al*., 2006

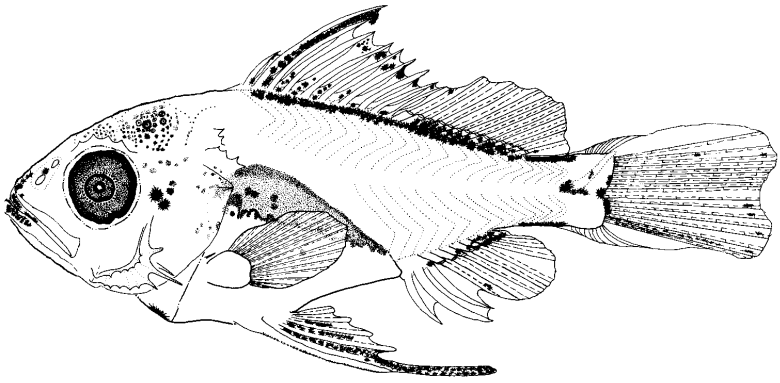
Lutjanus campechanus



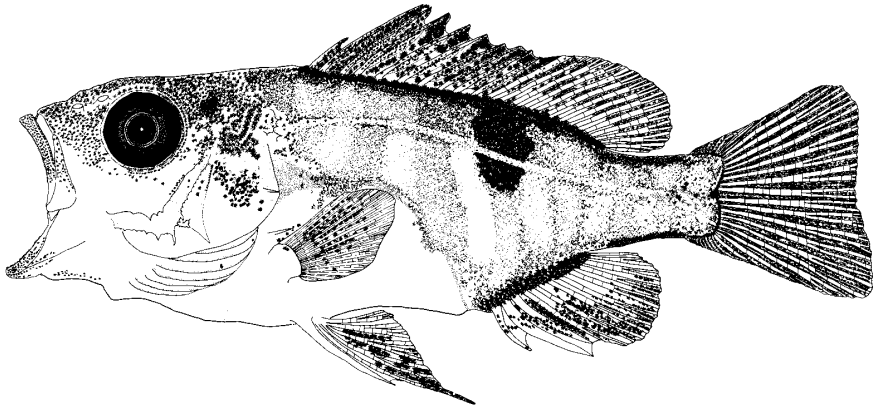
I. 5.5 mmSL, 15 DAH



J. 9.6 mmSL, 17 DAH

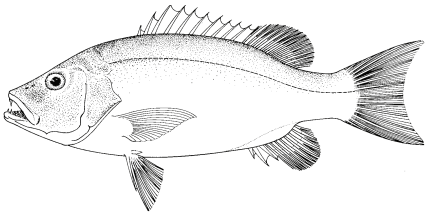


K. 12.2 mmSL, 26 DAH



L. 26.3 mmSL, 34 DAH

Lutjanus griseus (Linnaeus, 1758)
Lutjanidae (s.f. Lutjaninae)
Grey snapper



Range: North Atlantic Ocean; in the western North Atlantic from Massachusetts and Bermuda to Brazil, including Gulf of Mexico and Caribbean Sea; uncommon north of Florida (except for larvae and juveniles); also eastern Atlantic off west Africa

Habitat: Continental shelf waters, larger individuals farther offshore, in depths to 180 m; found over coral reefs, rocky substrates, mangroves, sea grass beds, estuaries, tidal creeks; young stages may enter estuaries (or fresh-water) in study area after Gulf Stream transport

Spawning: May–Sep, especially during new and full moons; often over outer reefs

Eggs:
- Pelagic, spherical
- Diameter: 0.70–0.85 mm
- Yolk: homogeneous
- Oil Globule: single, diameter 0.12–0.18 mm

Meristic Characters

Myomeres:	24
Vertebrae:	10 + 14 = 24
Dorsal fin rays:	X, 14
Anal fin rays:	III, 7–9
Pectoral fin rays:	15–17
Pelvic fin rays:	I, 5
Caudal fin rays:	9+8 (PrC)
Supraneurals:	0/0/0+2/1+1/

Larvae:
- Preflexion larvae initially very elongate, but body soon deepens, especially through pectoral region, and becomes laterally compressed; body depth increases from 15% SL to about 40% SL
- Gut coils soon after hatching and becomes compact and triangular in shape; preanus length increases from 44% SL in preflexion to 66% SL in early juveniles
- Head moderate to large, snout pointy, mouth moderately large, extending to beyond anterior edge of eye
- Flexion occurs at lengths of about 4.2–6.2 mmSL
- Sequence of fin ray formation: P_2 spine, 2nd spine of $D_1 - D_1$, P_2, $C - D_2$, $A - P_1$
- Pigment is light over-all in early larvae; series of melanophores along ventral edge of tail decrease in number until flexion; spots typically occur over brain, at cleithral symphysis and on lateral surface of caudal peduncle; pigment at base of dorsal fin membranes

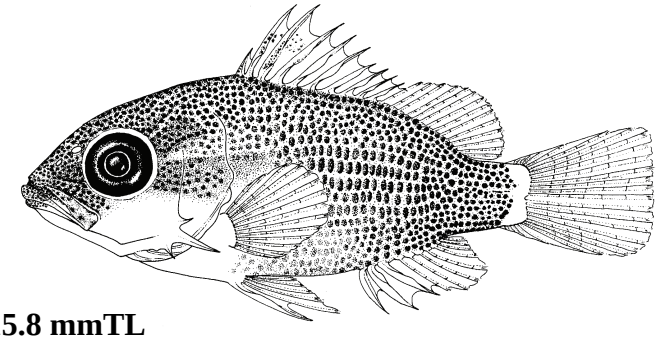
Head spine checklist:

Preopercle:	early forming (3.0 mm), longest spine at angle
Supraocular:	low ridge with single, smooth spine
Posttemporal:	1 to 3 simple spines form at flexion
Supracleithrum:	1 to 3 simple spines form at flexion
Opercle:	simple spine may be present at upper angle
Interopercle:	simple spine may be present, not reported
Postcleithrum:	single spine forms dorsal to P_1 fin base
Subopercle:	simple spine present

Settlement in North Carolina estuaries occurs after 22–32 days as pelagic larvae and at sizes >20 mm SL. Juveniles regularly settle in estuaries in study area Jul–Sep at sizes about 20 mm, remain until Nov at sizes to 110 mm

Note: 1. See Lutjanidae introductory pages

Early Juvenile: Heavily pigmented except clear areas on caudal peduncle and lower parts of cheek

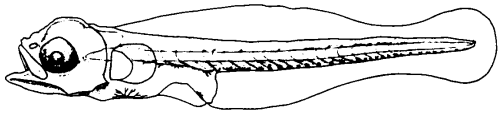


G. 15.8 mmTL

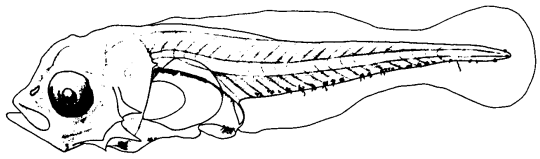
Figures: Adult: R. Vergara, 1978; **A–F**: Richards and Saksena, 1980; **G**: Nancy Arthur (Able and Fahay, 1998)

References: G. D. Johnson, 1980; 1984; Richards and Saksena, 1980; Watson and Brogan, 1996; Able and Fahay, 1998; Anderson, 2002a; Leis and Rennis, 2004a; Denit and Sponaugle, 2004

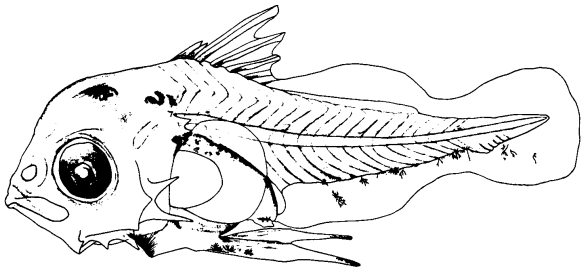
Lutjanus griseus



A. 2.8 mmNL

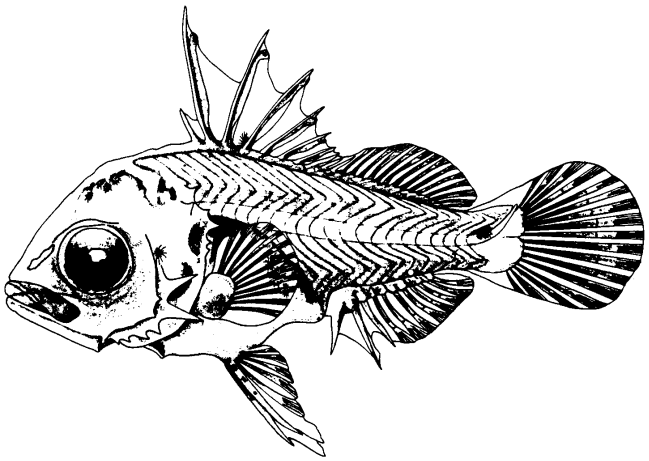


B. 3.7 mmNL

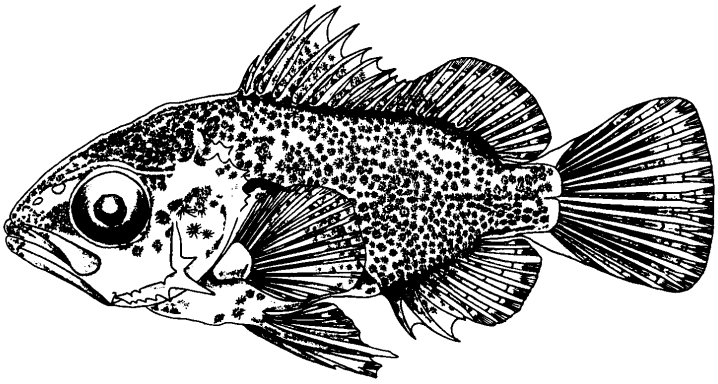


C. 4.2 mmNL

Pelvic fin rays longer than pelvic fin spine



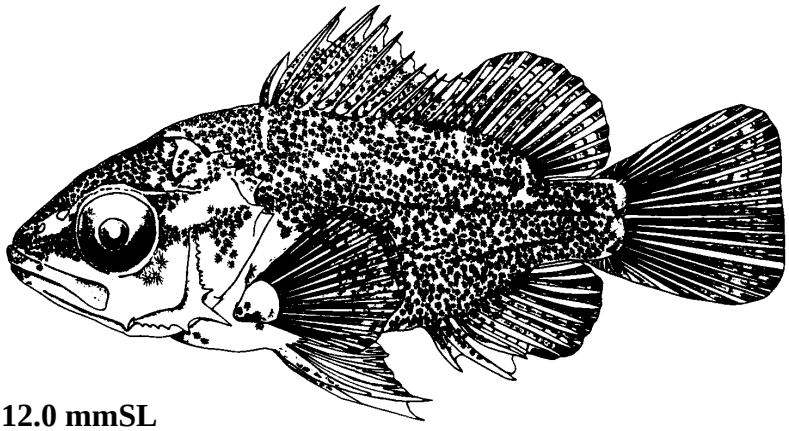
D. 6.2 mmSL



Heavy pigment (on body and fin membranes), acquired at small sizeS

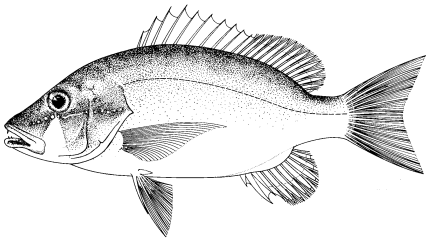
E. 9.6 mmSL

Pelvic spine and dorsal fin spines 1-6 have serrated edges



F. 12.0 mmSL

Lutjanus jocu (Bloch and Schneider, 1801)
Lutjanidae (s.f. Lutjaninae)
Dog snapper



Range: Western North Atlantic Ocean from New England to Brazil, including Gulf of Mexico (except western) and Caribbean Sea; rare north of Florida

Habitat: Coral reefs; young in coastal waters, estuaries, sometimes freshwater rivers; solitary

Spawning: Mar and Nov (Jamaica); possible spawning aggregations

Eggs: – Undescribed

Larvae: – Undescribed

Meristic Characters
Myomeres: 24
Vertebrae: 10 + 14 = 24
Dorsal fin rays: X, (13) 14
Anal fin rays: III, 7–9
Pectoral fin rays: 16–17
Pelvic fin rays: I, 5
Caudal fin rays: 9+8 (PrC)
Supraneurals: 0/0/0+2/1+1/

Head spine checklist: Spines presumably occur on the following bones, but number and size at formation unknown

Preopercle:
Supraocular:
Posttemporal:
Supracleithrum:
Opercle:
Interopercle:
Postcleithrum:
Subopercle:

Note: 1. See Lutjanidae introductory pages

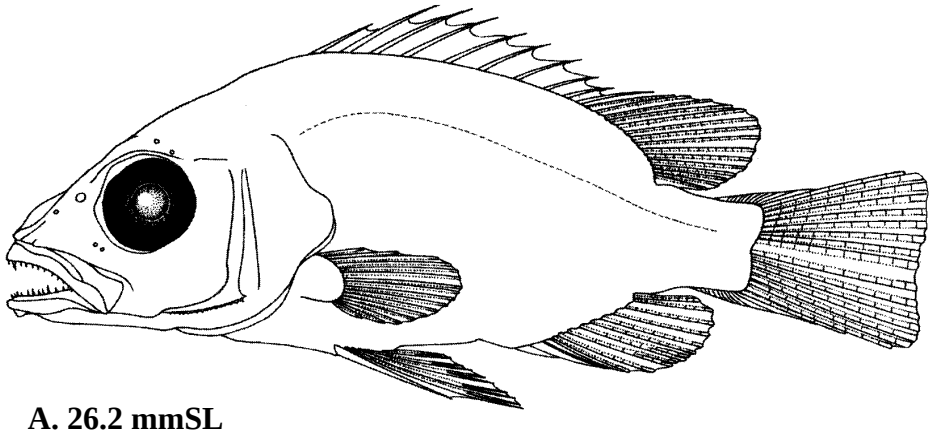
Early Juvenile: See Fig. A

Reddish brown laterally with yellow pelvic fins
Oblique eye stripe sometimes present
Pale triangle pattern forms below eye (by 60.0 mmSL)
No dorsolateral spot

Figures: Adult: R. Vergara, 1978; **A**: Ken Lindeman (Lindeman *et al*., 2006)

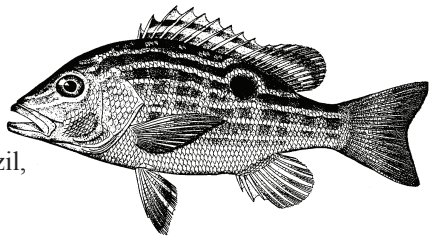
References: G. D. Johnson, 1980; 1984; Richards *et al.*, 1994; Watson and Brogan, 1996; Anderson, 2002a; Leis and Rennis, 2004a

Lutjanus jocu



A. 26.2 mmSL

Lutjanus synagris (Linnaeus, 1758)
Lutjanidae (s.f. Lutjaninae)
Lane snapper



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

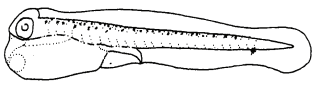
Habitat: Coral reefs or shallow, sandy, vegetated substrates, in depths of <1–400 m

Spawning: Forms large aggregations; year-round in tropics, Mar–Aug off Florida

Meristic Characters

Myomeres:	24
Vertebrae:	10 + 14 = 24
Dorsal fin rays:	X, 12(13)
Anal fin rays:	III, 8(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: 0.65–0.80 mm
- Yolk: homogeneous, clear
- Oil globule: single, 0.13–0.22 mm



Yolk-sac larva, 2.2 mmNL

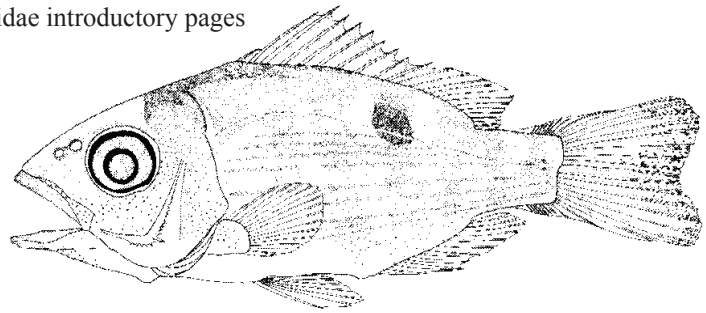
Larvae:
- Preflexion larvae initially very elongate, but body soon deepens, especially through pectoral region, and becomes laterally compressed
- Gut coils soon after hatching, becomes compact and triangular in shape; preanus length <50% SL to 60% SL
- Head moderate to large, snout pointy, mouth moderately large, extending to anterior edge of eye
- Flexion occurs at lengths of 3.8–5.5 mmSL
- Sequence of fin ray formation: P_2 spine, 2nd spine of $D_1 - D_1$, P_2, $C - D_2$, $A - P_1$
- Third anal fin element changes from fin ray to spine at about 8.0–9.0 mmSL
- Pigment is light over-all; series of melanophores along ventral edge of tail decrease in number until flexion; spots typically form over brain at flexion, increase in postflexion; spots present at cleithral symphysis; very few spots on lateral surface of caudal peduncle; pigment on dorsal and pelvic fin membranes in the form of a few, isolated spots

Head spine checklist:

Preopercle:	early forming (about 3.0 mm), beginning with spine at angle; maximum 2–4 spines form on anterior limb, maximum 5–8 form along posterior edge until transformation
Supraocular:	low ridge with single, smooth spine
Posttemporal:	1 to 3 simple spines form at flexion
Supracleithrum:	1 to 3 simple spines form at flexion
Opercle:	simple spine forms at about 10.0 mmSL
Interopercle:	simple spine forms at about 10.0 mmSL
Postcleithrum:	single spine forms dorsal to P_1 fin base at postflexion
Subopercle:	simple spine forms at about 10.0 mmSL

Note: 1. See Lutjanidae introductory pages

Early Juvenile:

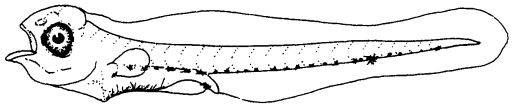


H. 21.3 mmSL

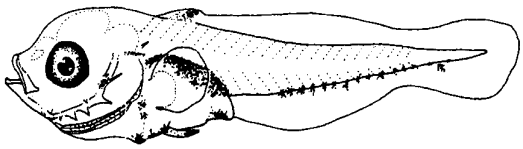
Figures: Adult: Jordan and Evermann, 1896; Yolk-sac larva and **A–G**: Wayne Laroche (Clarke *et al.*, 1997); **H**: Ken Lindeman (Lindeman *et al*., 2006

References: G. D. Johnson, 1980; 1984; Richards *et al.*, 1994; Watson and Brogan, 1996; Clarke *et al.*, 1997; Anderson, 2002a; Leis and Rennis, 2004a

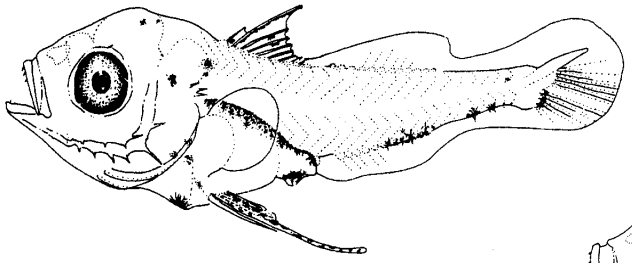
Lutjanus synagris



A. 2.8 mmSL

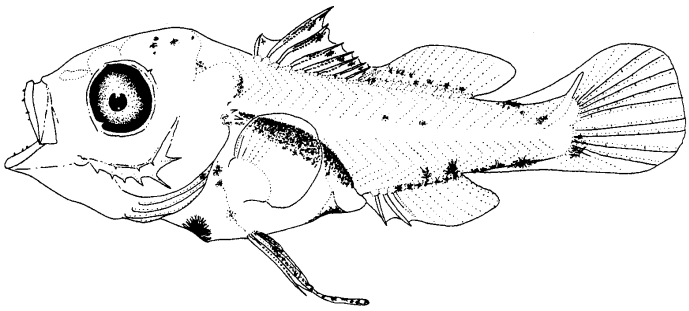


B. 3.8 mmSL



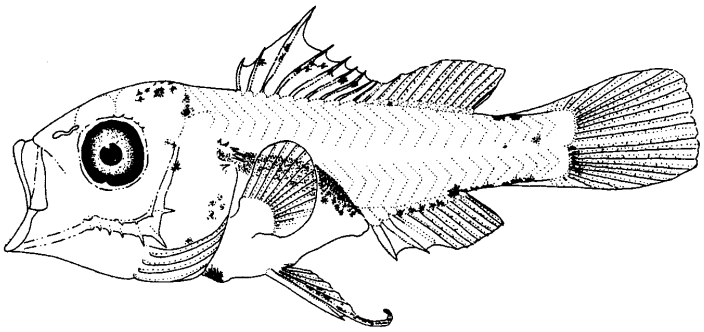
C. 5.2 mmSL

2^{nd} spine of D_1 longer than P_2 spine until flexion, then P_2 spine longer

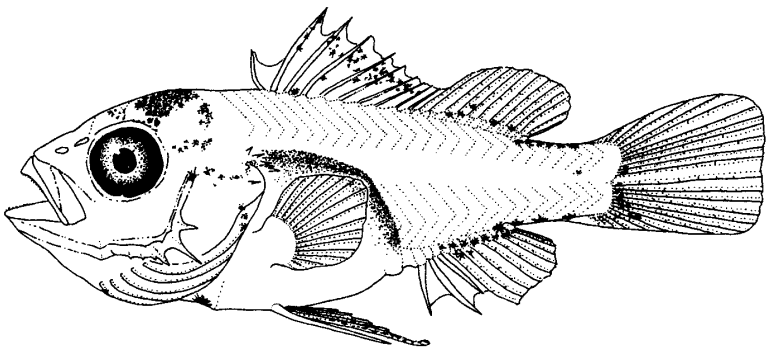


D. 6.2 mmSL

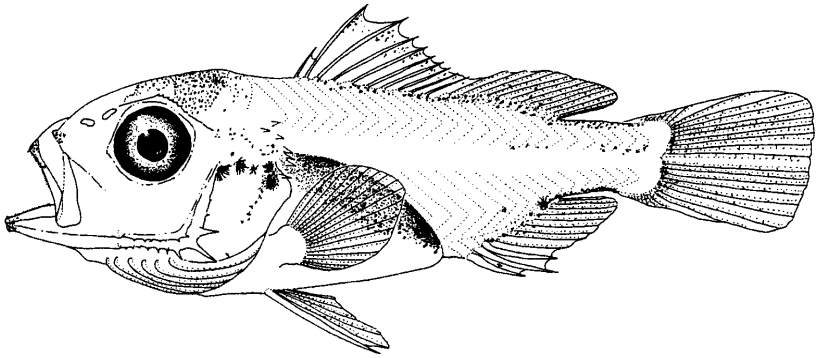
Small air bladder located over anterior gut;
Pelvic fin rays very long (longer than P_2 spine)



E. 7.7 mmSL

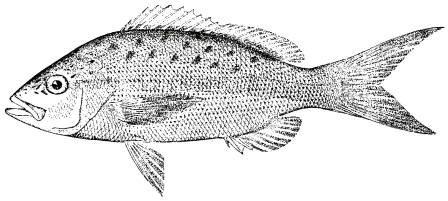


F. 9.8 mmSL



G. 12.2 mmSL

Ocyurus chrysurus (Bloch, 1791)
Lutjanidae (s.f. Lutjaninae)
Yellowtail snapper



Range: Western North Atlantic Ocean from Massachusetts and Bermuda to Brazil, including Gulf of Mexico and Caribbean Sea; also Cape Verde Islands

Habitat: Over coral reefs in depths of <1–165 m, but usually well off the bottom; very common; juveniles usually associated with weed beds

Spawning: Year-round, with spring and fall peaks (Jamaica) or Mar–Sep (Florida); multiple egg batches

Meristic Characters

Myomeres:	24
Vertebrae:	10 + 14 = 24
Dorsal fin rays:	IX–XI, 12–14
Anal fin rays:	III, (8) 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: – Undescribed

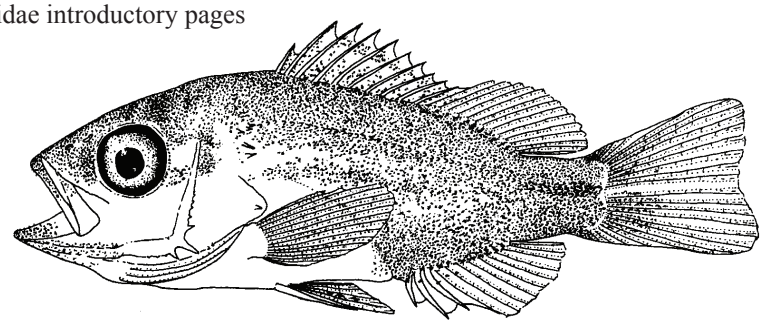
Larvae:
- Preflexion larvae initially very elongate, but body soon deepens, especially through pectoral region, and becomes laterally compressed
- Gut coils soon after hatching and becomes compact and triangular in shape; preanus length <50% SL to about 60% SL
- Small air bladder located over anterior gut
- Head moderate to large, snout pointy, mouth moderately large, extending to beyond anterior edge of eye
- Flexion occurs at lengths of 3.6–5.3 mmSL
- Sequence of fin ray formation: P_2 spine, 2nd spine of $D_1 - D_1$, P_2, $C - D_2$, $A - P_1$
- Third anal fin element changes from fin ray to spine at about 7.4–11.5 mmSL
- Pigment is light over-all in early larvae; series of melanophores along ventral edge of tail decrease in number until flexion; spots typically form over brain in preflexion; spots at cleithral symphysis and on lateral surface of caudal peduncle; pigment on anterior dorsal fin membranes and few spots on P_2 membranes

Head spine checklist:

Preopercle:	early forming (about 3.0 mm), beginning with spine at angle; maximum 2–4 spines form on anterior limb, maximum 5–8 form along posterior edge until transformation
Supraocular:	low ridge with single, smooth spine
Posttemporal:	1 to 3 simple spines form at flexion
Supracleithrum:	1 to 3 simple spines form at flexion
Opercle:	simple spine forms at about 10.0 mmSL
Interopercle:	simple spine forms at about 10.0 mmSL
Postcleithrum:	single spine forms dorsal to P_1 fin base at postflexion
Subopercle:	simple spine forms at about 10.0 mmSL

Note: 1. See Lutjanidae introductory pages

Early Juvenile:

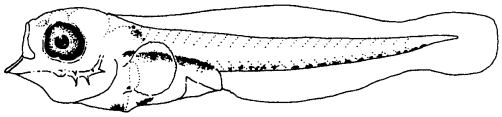


H. 14.3 mmSL

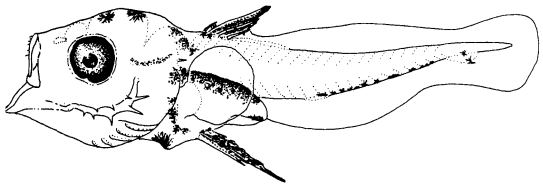
Figures: Adult: Jordan and Evermann, 1896–1900; **A–H**: Wayne Laroche (Clarke *et al*., 1997)

References: G. D. Johnson, 1980; 1984; Richards *et al*., 1994; Watson and Brogan, 1996; Clarke *et al*., 1997; Anderson, 2002a; Leis and Rennis, 2004a

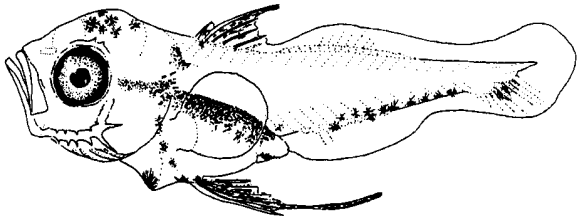
Ocyurus chrysurus



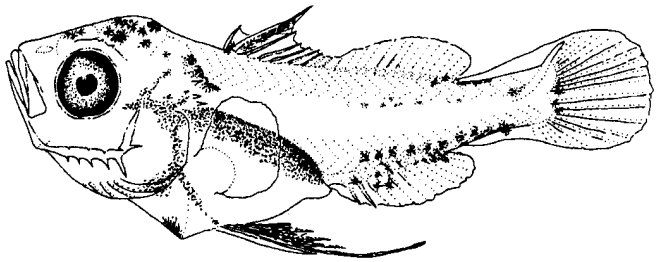
A. 3.5 mmSL



B. 4.5 mmSL

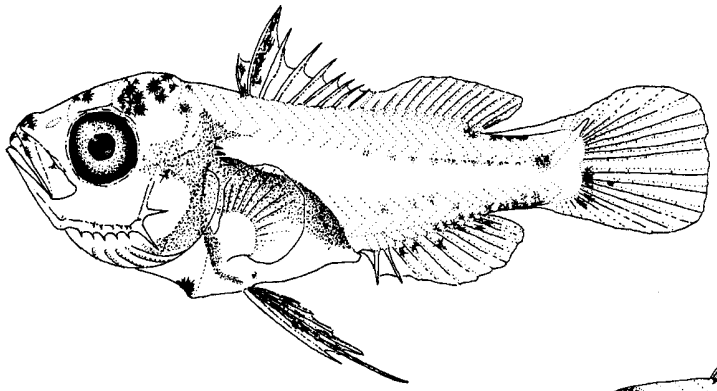


C. 5.3 mmSL

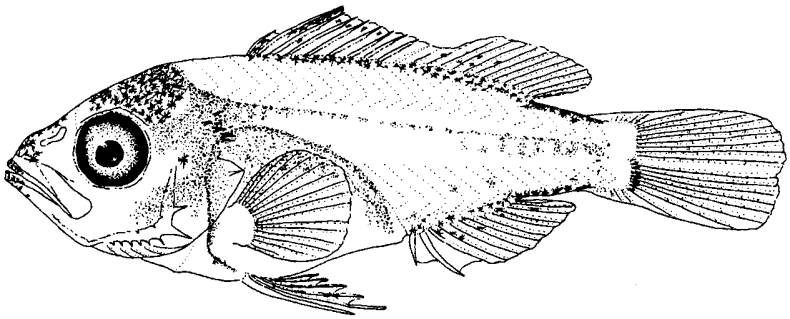


D. 6.3 mmSL

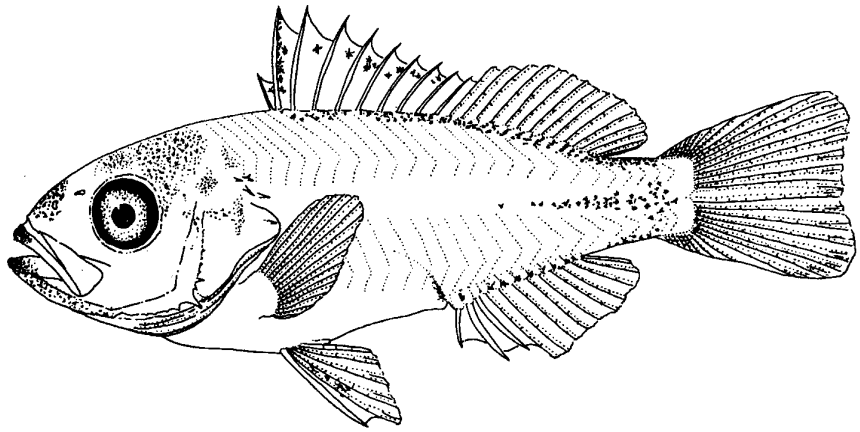
Pelvic fin rays very long (longer than P_2 spine) until postflexion, when P_2 spine becomes longer



E. 7.2 mmSL

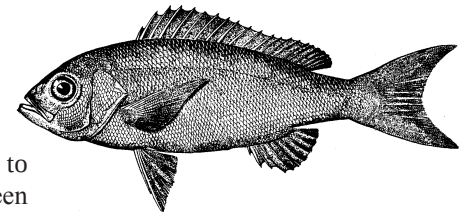


F. 11.5 mmSL



G. 13.9 mmSL

Rhomboplites aurorubens (Cuvier, 1829)
Lutjanidae (s.f. Lutjaninae)
Vermillion snapper



Range: Western North Atlantic Ocean from North Carolina and Bermuda to Brazil, including Gulf of Mexico and Carribean Sea; larvae have been collected in study area as far north as 40°13'N, 69°59'W

Habitat: Usually over rocky substrates in mid-depths to edges of continental and island shelves; juveniles often form large schools

Spawning: Apr–Sep with peaks during spring and fall; eggs in multiple batches

Eggs: – Undescribed

Meristic Characters

Myomeres:	24
Vertebrae:	10 + 14 = 24
Dorsal fin rays:	XII, 11(10–12)
Anal fin rays:	III, 8 (9)
Pectoral fin rays:	16–19
Pelvic fin rays:	I, 5
Caudal fin rays:	9+8 (PrC)
Supraneurals:	0/0/0+2/1+1/

Larvae:
- Preflexion larvae initially very elongate, but body soon deepens, especially through pectoral region, becomes laterally compressed
- Gut coils soon after hatching and becomes compact and triangular in shape; preanus length increases from 50% SL in preflexion stage to >60% SL at 10–11 mmSL
- Head moderate to large, snout pointy, mouth moderately large, extending to beyond anterior edge of eye
- Flexion occurs at lengths <5.0 mmSL
- Sequence of fin ray formation: P_2 spine, 2nd spine of D_1 – C, D_1, P_2,– D_2, A – P_1
- Pelvic fin rays shorter than pelvic spine (compare to *Lutjanus* spp.); pelvic spine V-shaped with serrations along all 3 edges
- Dorsal spines V-shaped, with serrations on posterior edges; larger spines have few serrations along anterior edges near their bases
- Third anal fin element changes from fin ray to spine at about 8.3 mmSL; all 3 spines serrate along posterior edges and larger spines have a few serrations along anterior edge; 2nd spine longest in young stages, 3rd spine longest in adults
- Pigment is light over-all in early larvae; peritoneum heavily pigmented; series of melanophores along ventral edge of tail decrease in number until flexion, after which a spot persists at insertion of anal fin, and 2–3 spots along lower edge of caudal peduncle; spots typically occur over brain (beginning as triangular pattern), on opercle, anterior to cleithral symphysis and a melanophore on lateral surface of caudal peduncle; pigment lacking on dorsal fin membranes

Head spine checklist:

Preopercle:	2 series of spines form early; angle spine longest, has serrated edge; numbers increase
Supraocular:	low ridge with 2–7 serrations, number increases with growth
Posttemporal:	1 or 2 simple spines form at early flexion
Supracleithrum:	2 to 5 simple spines form at early flexion, number increases with growth
Opercle:	simple, small spine at upper angle through all stages
Interopercle:	spine may be present, not reported
Postcleithrum:	spine not reported; forms dorsal to P_1 fin base in other lutjanine larvae
Subopercle:	spine may be present, not reported

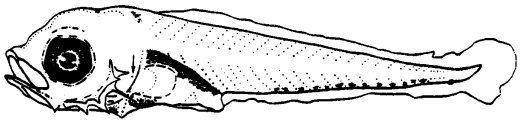
Note: 1. See Lutjanidae introductory pages

Juvenile: At 25 mm, pale pink to red dorsally with thin, yellow stripes on body; no dorsolateral spot

Figures: Adult: Jordan and Evermann, 1896–1900; **A**: Joanne Lyczkowski-Shultz (Lindeman *et al.*, 2006; **B–G**: Laroche, 1977

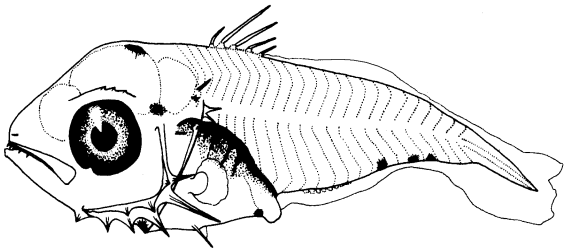
References: Laroche, 1977; G. D. Johnson, 1980; 1984; Grimes and Huntsman, 1980; Richards *et al*., 1994; Watson and Brogan, 1996; Clarke *et al*., 1997; Anderson, 2002a; Leis and Rennis, 2004a; Lindeman *et al*., 2006

Rhomboplites aurorubens

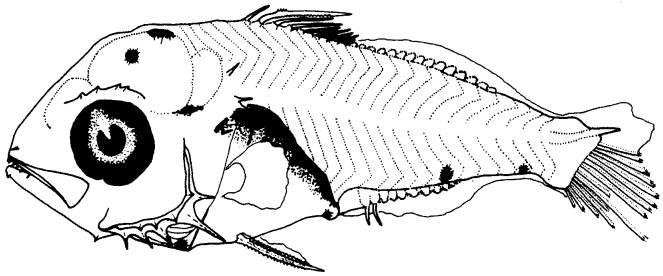


A. 3.6 mmNL

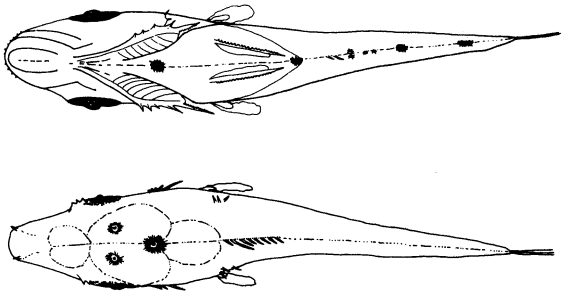
Small air bladder located over anterior gut



B. 4.0 mmSL



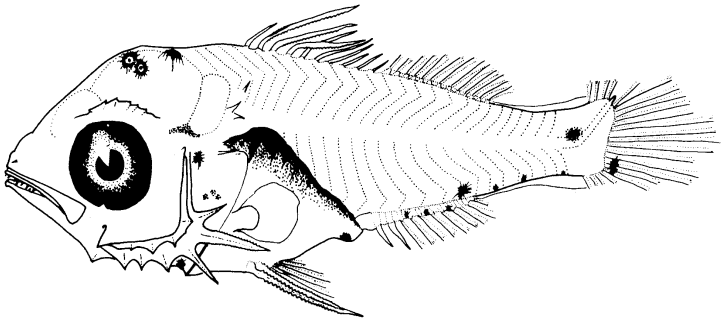
C. 4.7 mmSL



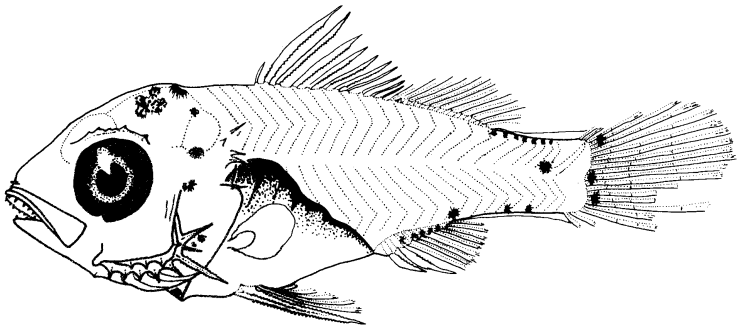
D. 4.7 mmSL (Ventral and Dorsal Views)

Tips of lachrymal bones protrude as spines on sides of snout

Dorsal, anal and pelvic spines have serrated edges

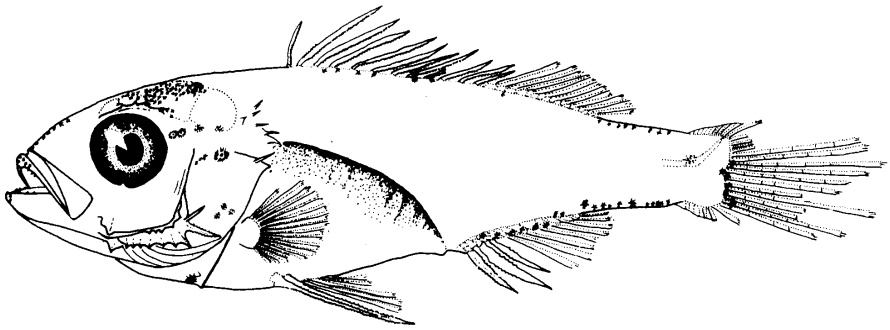


E. 5.1 mmSL



F. 6.9 mmSL

Note presence of 12 dorsal spines (usually 10 in *Lutjanus* spp.)



G. 14.2 mmSL