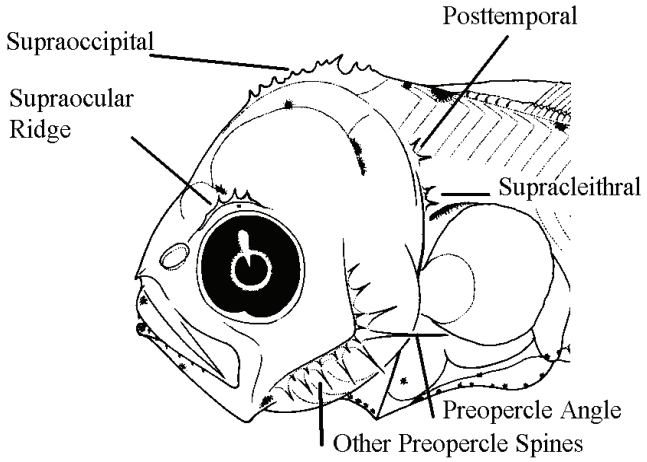
Perciformes
Suborder Percoidei – Carangidae

Twenty–five species in 13 genera of the family Carangidae occur in the present study area, either as adults or as larvae. The family is distributed worldwide, mostly in tropical and warm temperate waters, and larvae are both more speciose, and more abundant, in waters south of Cape Hatteras. Larvae are reasonably well-described, but the eggs of most species are undescribed. Carangid classification used here follows Smith-Vaniz (1984) and Laroche *et al.* (1984). A detailed summary of carangid larval characters prepared by Laroche *et al*. (2006) provided much of the information presented below. That report, and the report by Watson *et al.* (1996) should be consulted for more critical detail regarding carangid larvae from the tropical western Atlantic and the Eastern Pacific oceans, respectively.

Meristic characters: See table of meristic characters in the Introduction to the suborder Percoidei, and the ranges of selected characters in the family Carangidae in the Perciformes Introduction. Meristic characters are fairly conservative in the family, but combinations of all counts are helpful in identifying species. For example, see figures demonstrating distributions of fin rays for species in the genus *Caranx* (after Berry, 1959a) on "*Caranx*" Introduction page.

Head spines: The characters of 3 head spines are important in carangid larvae: the Supraoccipital Crest (present or absent); the spine at the angle of Preopercle (simple, serrate or secondarily ornamented); and the Supraocular Ridge (composed of a small spine, a serrate ridge, or prominent spines). Other head spines that occur in only a few taxa include the Posttemporal, Supracleithral, Pterotic, and smaller spines along the ascending and anterior limbs of the Preopercle.

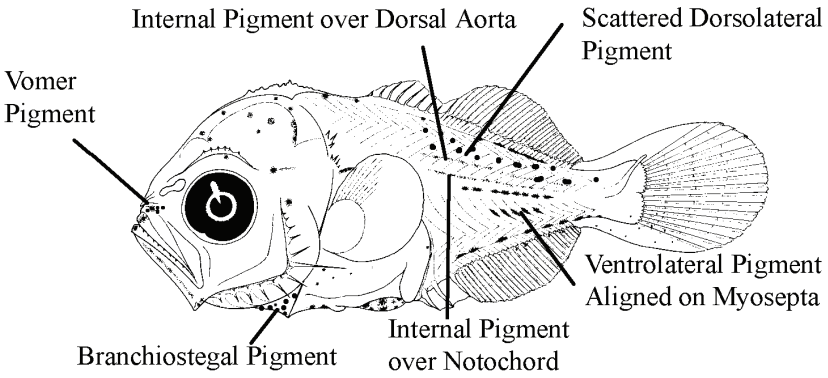
All of the important groups of spines (except Pterotic) are shown on the head of *Chloroscombrus orqueta* from the eastern Pacific Ocean. The Pterotic Ridge (not shown) only occurs in larvae of *Trachinotus*.



Chloroscombrus orqueta
3.7 mmSL. Illustrated by Barbara Sumida (Ahlstrom and Sumida, 1985)

Pigmentation: Carangid larvae are either lightly pigmented, or covered with dense melanophores over much of the head and body. Important loci for melanophore distribution are indicated in the figure below and in the table opposite.

Chloroscombrus orqueta
5.1 mmSL.
Illustrated by
Barbara Sumida
(Ahlstrom and Sumida
1985)



Perciformes
Suborder Percoidei – Carangidae

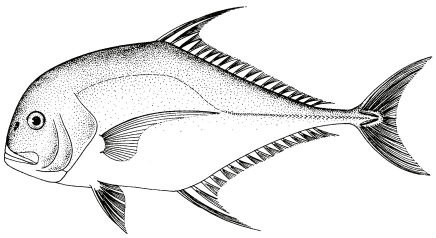
General morphological and spination characters in genera of Carangidae. For Body Depth, Deep = >35%SL; Shallow = <35%SL. Pr = present; Ab = absent. Modified after Laroche *et al*. (2006).

Genus	Body Depth	No. of Myomeres	Finlets	Suprioccipital Crest	Preopercle Angle Spine	Supraocular Ridge
Alectis	Deep	24	Ab	Pr	Simple	Small Spine
Caranx	Deep	24	Ab	Pr	Simple	Small Spine
Chloroscombrus	Deep	24	Ab	Pr	Simple	Small Spine
Decapterus	Shallow	25	Pr	Pr	Simple	Small Spine
Elagatis	Shallow	24	Ab	Pr	Serrated	Small Spine
Naucrates	Deep	25	Ab	Ab	Simple	Prominent
Oligoplites	Shallow	26	Ab	Ab	Spinules	Small Spine
Selene	Deep	24	Ab	Pr	Simple	Small Spine
Selar	Shallow	24	Pr	Pr	Simple	Small Spine
Seriola	Shallow	24	Ab	Ab	Spinules (some)	Small Spine
Trachinotus	Shallow	24	Ab	Ab	Simple	Serrated
Trachurus	Shallow	24	Ab	Pr	Simple	Small Spine
Uraspis	Deep	24	Ab	Unknown	Unknown	Unknown

Pigmentation characters in genera of Carangidae. "Internal" refers to pigment over dorsal aorta or notochord. Brstgl = branchiostegal membrane. Other abbreviations: Pr = present; Ab = absent; Scat = scattered; Myo = melanophores aligned on myosepta; Para = melanophores in parallel rows on either side of midline; Med = melanophores aligned in single row along midline of dorsum. After Laroche *et al.* (2006).

Genus	Over–all	Vomer	Internal	Dorsolateral	Ventrolateral	Dorsum	Brstgl
Alectis	Light	Pr	Ab	Ab	Ab	Para	Ab
Caranx	Light	Pr or Ab	Pr or Ab	Pr	Scat or Myo	Para or Med	Pr or Ab
Chloroscombrus	Light	Pr	Pr	Ab	Myo	Med	Pr
Decapterus	Light	Ab	Ab	Pr/Ab	Ab or Myo	Para	Ab
Elagatis	Dark	Pr	Ab	Pr	Scat	Para	Pr
Naucrates	Dark	Pr	Ab	Pr	Scat	Para or Ab	Pr
Oligoplites	Dark	Pr	Ab	Pr	Scat	Para or Ab	Pr
Selene	Light	Pr	Ab	Ab	Ab	Para	Ab
Selar	Light	Ab	Pr	Ab	Myo	Para	Pr
Seriola	Dark	Pr	Pr	Pr	Ab	Para or Ab	Pr (?)
Trachinotus	Dark	Pr	Pr	Pr	Scat	Para or Ab	Pr
Trachurus	Light	Pr	Ab	Pr	Scat	Med	Ab
Uraspis	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown

Alectis ciliaris (Bloch, 1787)
Carangidae
African pompano



Range: Worldwide in tropical to subtropical waters; in the western North Atlantic larvae and juveniles occur from Massachusetts to Brazil, including Gulf of Mexico; adults do not occur north of Florida

Habitat: Neritic, both pelagic and demersal, in depths to 60 m; often associated with deep, rocky reefs

Spawning: Undescribed; smallest specimens often collected during summer

Eggs: – Undescribed

Meristic Characters

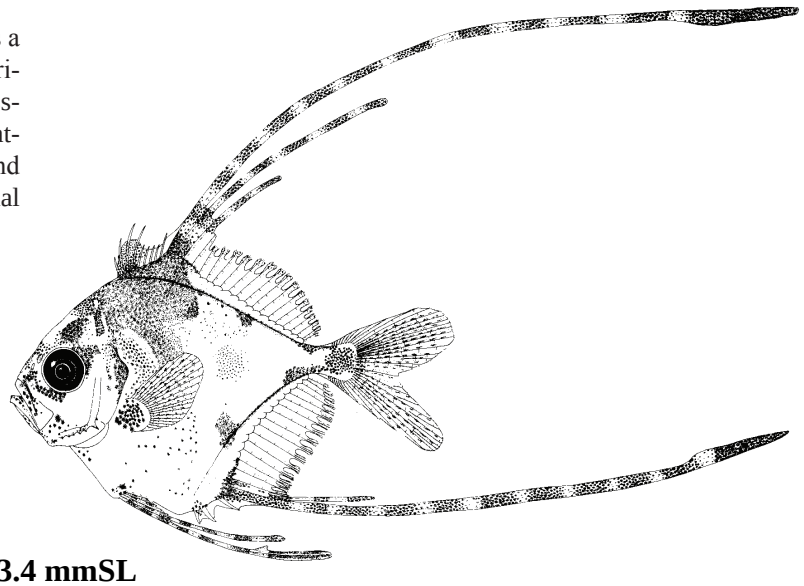
Myomeres:	24
Vertebrae:	10+14 = 24
Dorsal fin rays:	VII–VIII, 18–19
Anal fin rays:	II, I, 15–16
Pectoral fin rays:	19–22
Pelvic fin rays:	I, 5
Caudal fin rays:	9–10+9+8+9
Supraneurals:	0/0+0/1+1/

Larvae:
- Body initially slender, soon becomes very deep
- Head and snout moderately rounded
- Flexion occurs at 4.3–4.7 mmSL
- Head spines most pronounced on preopercle; see checklist below
- Sequence of fin ray formation P_2, D_2 – A, C, – D_1 – P_1
- Finlets absent posterior to dorsal and anal fins; P_2 and anterior D_2 and A fin rays elongate
- Pigment over most of head and body light; vomer pigmented; internal pigment absent; pigment on dorsolateral part of body mostly absent until all fin rays formed, then scattered, beginning under spinous dorsal fin; pigment on ventrolateral part of body absent; pigment along dorsum in parallel lines in early larvae; branchiostegal pigment absent; top of head densely pigmented in later larvae

Head spine checklist:

Supraoccipital:	low, rough-edged ridge, disappears after fin rays formed
Preopercle Angle:	long, simple; other preopercle spines prominent but smaller
Supraocular:	short ridge with small, simple spine in early stages
Posttemporal:	very small
Supracleithral:	very small
Pterotic ridge:	absent

Early Juvenile: Pigment in juveniles includes a bar from eye to dorsal fin origin, a series of 5–6 bars crossing upper body, a barred pattern on the pelvic fin rays and on the elongate dorsal and anal fin rays

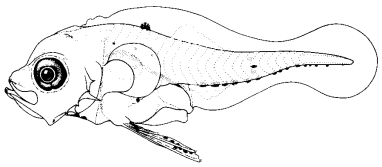


H. 13.4 mmSL

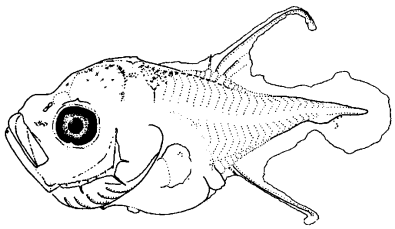
Figures: Adult: Smith-Vaniz, 2002b; **A**, **C**: William Watson (Watson *et al.*, 1996); **B**, **D**, **G**: Wayne Laroche (Laroche *et al.*, 1991); **E**, **H**: R. C. Walker (Watson *et al*., 1996); **F**: Beltran-Leon and Herrera, 2000

References: Fowler, 1944; G.D. Johnson, 1978; Laroche *et al*., 1991; 1984; Watson *et al.*, 1996

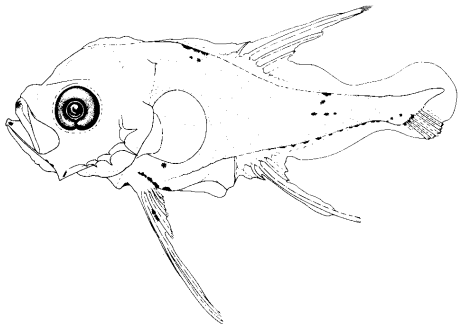
Alectis ciliaris



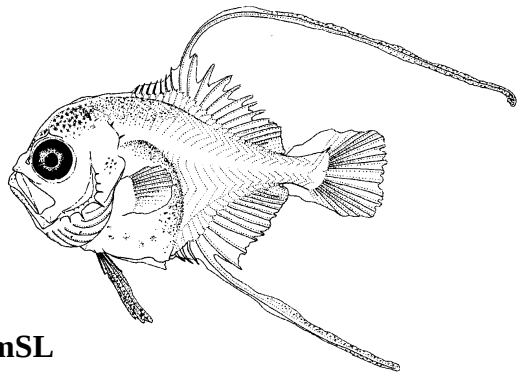
A. 2.7 mmSL



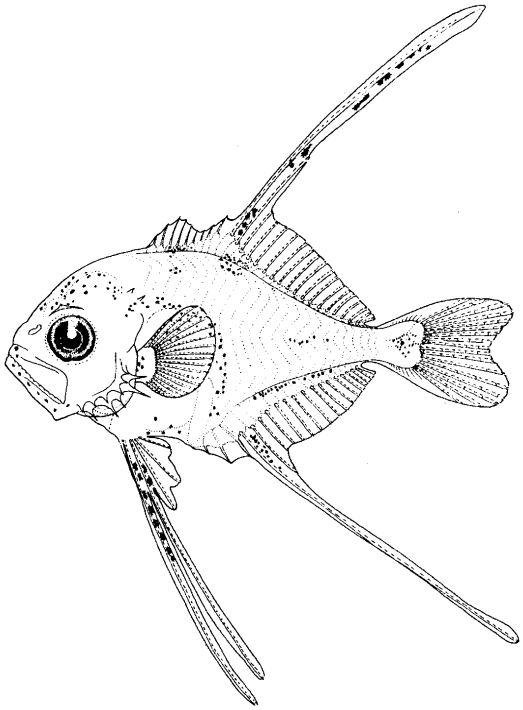
B. 3.1 mmSL



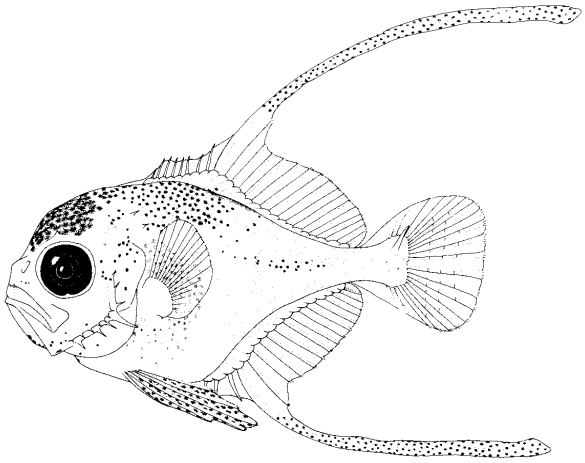
C. 3.9 mmSL



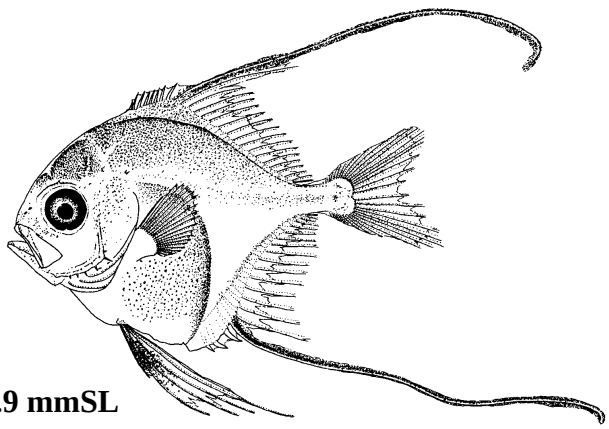
D. 5.4 mmSL



F. 8.4 mmSL



E. 6.9 mmSL



G. 9.9 mmSL

Caranx (species undetermined)
Carangidae
Jacks

The larvae of many carangids can not be identified below the genus level with certainty. Some can be assigned to "species-groups" based on shared characters. Group I is comprised of larvae of either *Caranx bartholomaei* or *C. ruber* or both. Group II is comprised of larvae of either *Caranx hippos* or *C. latus* or both. Small larvae can be assigned to one of these groups on the basis of morphometric, pigmentation, or meristic characters, although caveats are applicable.

- **Morphometric** data are equivocal in these larvae. Proportions of body depth, head length, snout length, eye diameter, or lengths of various spines (e.g. preopercle angle) or fin rays in these small larvae fall out before trends in these species are established. The degree of overlap in these features is too broad in *Caranx* species to be useful. See Berry (1959a) for values of these characters. However, flexion and postflexion larvae of both Group I and Group II have been reported to be deeper bodied than those of *Caranx crysos* (Ditty *et al*., 2004).

- **Pigmentation** characters are of limited value in these species because of the similarities in patterns in most or all of the species. However, patterns on the first dorsal fin may be useful. For example, the specimen in Fig. F has pigment restricted to the webbing between the anteriormost 4 dorsal spines, a pattern typical of larger examples of *Caranx latus*. *Caranx hippos* has more extensive pigment on this fin and other congeners have much lighter pigment in this area. See species accounts for discussions of other areas of pigmentation that may prove to be useful in separating early larvae (e.g. caudal peduncle, dorsum in nape area, ventrally along the gut, midlateral line).

- **Fin ray** counts are useful for separating species of *Caranx* in larvae larger than about 8.0 mm, when adult complements are attained (see table below). Gill raker counts are also useful, but only in juveniles >14 mm and adults (Berry, 1959a).

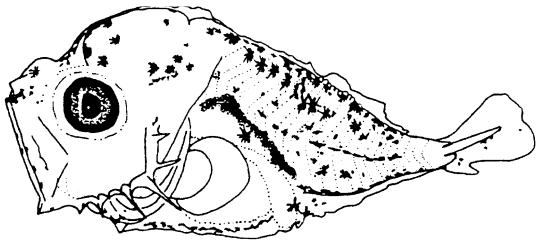
Correlation of dorsal fin rays and anal fin rays in five species of the genus *Caranx*. B = *C. bartholomaei*; C = *C. crysos*; H = *C. hippos*; L = *C. latus*; R = *C. ruber*. (After Berry, 1959a).

	Dorsal Fin Rays											
Anal Fin Rays	19	20	21	22	23	24	25	26	27	28	29	30
26										R		
25									R	R	R	R
24								R	B R	B R	B R	
23							B	B R	B R	B R		
22							B	B	B			
21							C B	C				
20						C	C	C				
19					C	C	C					
18			L	L								
17	H L	H L	H L	L								
16	H	H L	H									

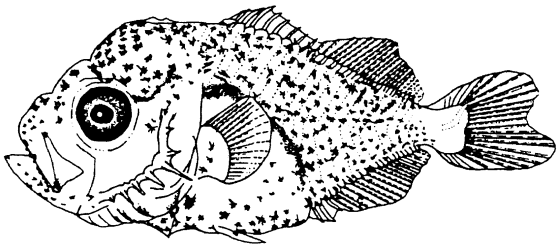
Figures: **A–D**: Ditty *et al*., 2004; **E–G**: Berry, 1959a
References: Berry, 1959a; Ditty *et al*., 2004; Laroche *et al*., 2004

Caranx Species Groups

Group I
(*Caranx bartholomaei* or *Caranx ruber*)

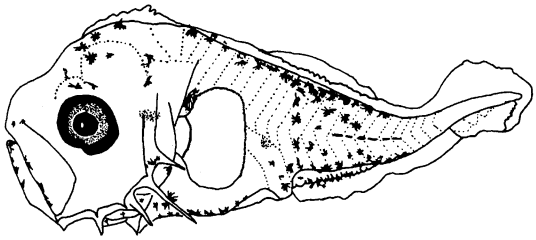


A. 3.8 mmSL

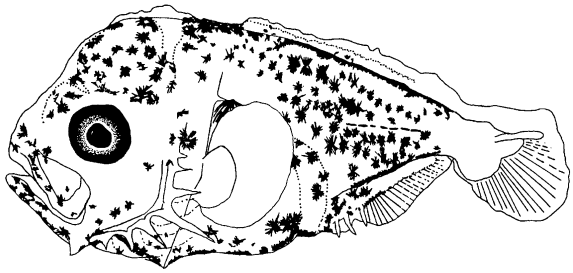


B. 5.5 mmSL

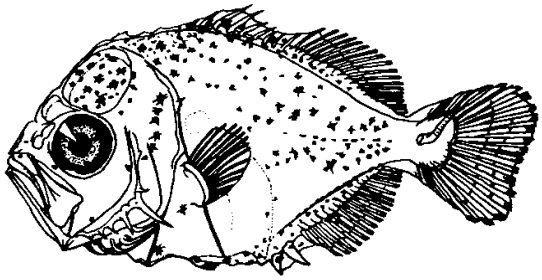
Group II
(*Caranx hippos* or *Caranx latus*)



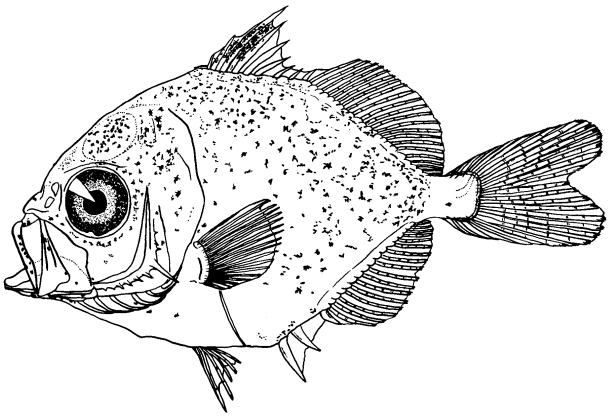
C. 3.6 mmSL



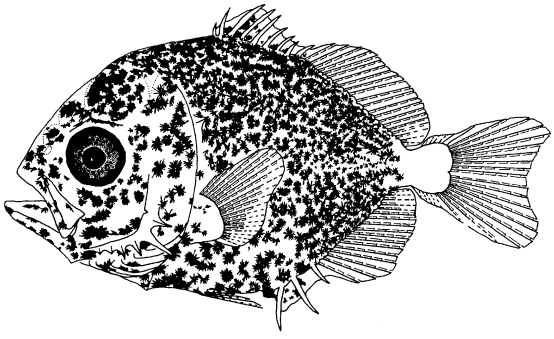
D. 4.7 mmSL



E. 5.4 mmSL

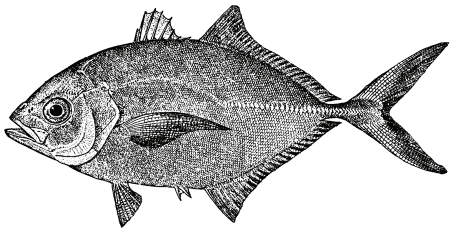


G. 8.3 mmSL



F. 7.1 mmSL

Caranx bartholomaei Cuvier, 1833
Carangidae
Yellow jack



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

Habitat: Demersal on continental shelf, usually not close to shore; often found over offshore reefs; juveniles associate with *Sargassum* weed or jellyfish

Spawning: Jan–Oct in offshore waters; most activity south of United States waters, e.g. Jun–Aug off Cuba

Meristic Characters

Myomeres:	24
Vertebrae:	10+14 = 24
Dorsal fin rays:	VIII,I,25–28
Anal fin rays:	II,I,21–24
Pectoral fin rays:	21–22
Pelvic fin rays:	I, 5
Caudal fin rays:	8–9+9+8+7–9
Supraneurals:	0/0+0/2+1/

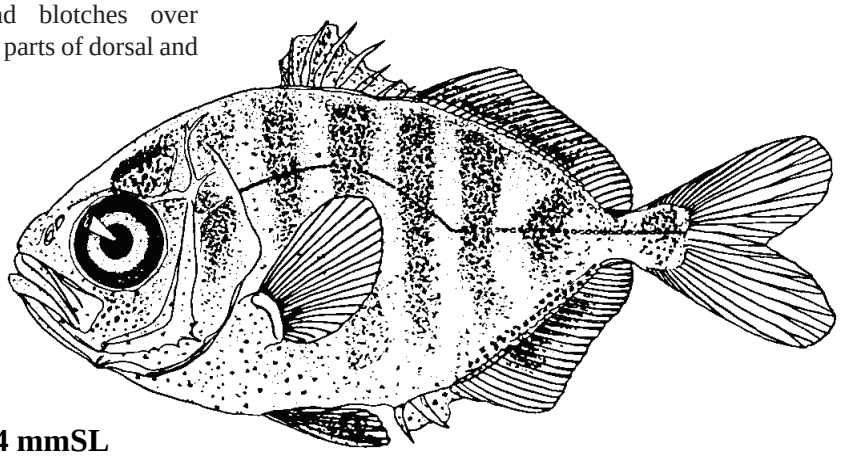
Eggs:
- Undescribed

Larvae:
- Body very deep throughout larval and juvenile stages
- Head and snout moderately rounded
- Flexion occurs at <6.0 mmSL
- Head spines most pronounced on preopercle; see checklist below
- Sequence of fin ray formation: C, D, A – P_1 – P_2
- Finlets absent posterior to dorsal and anal fins
- Pigment over most of head and body heavy; vomer unpigmented; internal pigment absent; pigment scattered on both dorsolateral and ventrolateral parts of body, often with clear, unpigmented caudal peduncle; pigment along dorsum in parallel rows; branchiostegal pigment absent; midline pigment present until obscured by overall body pigment

Head spine checklist:

Supraoccipital:	ridge present in small larvae; disappears at flexion
Preopercle Angle:	long, simple, decreases in size at about 10.0 mmSL
Supraocular:	absent or very small, simple spine
Posttemporal:	present at small sizes (6.0 mmSL) then absent
Supracleithral:	absent
Pterotic ridge:	absent

Early Juvenile: Pigment in juveniles includes bars crossing the body and blotches over proximal parts of dorsal and anal fins



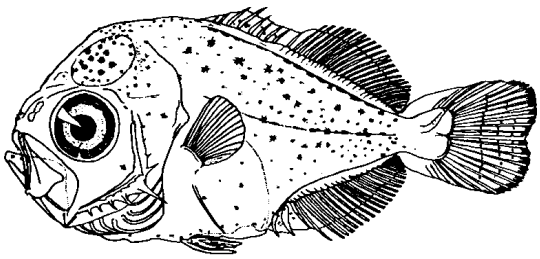
E. 17.4 mmSL

Figures: Adult: Jordan and Evermann, 1896–1900; **A–E**: Berry, 1959a

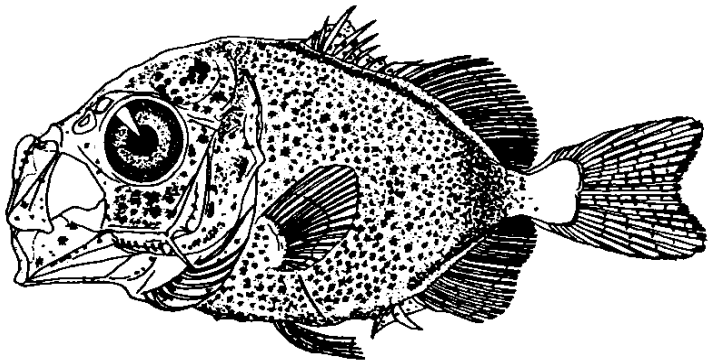
References: Berry, 1959a; Fahay, 1975; Laroche *et al.*, 1984; 1991; Ditty *et al.*, 2004

Caranx bartholomaei

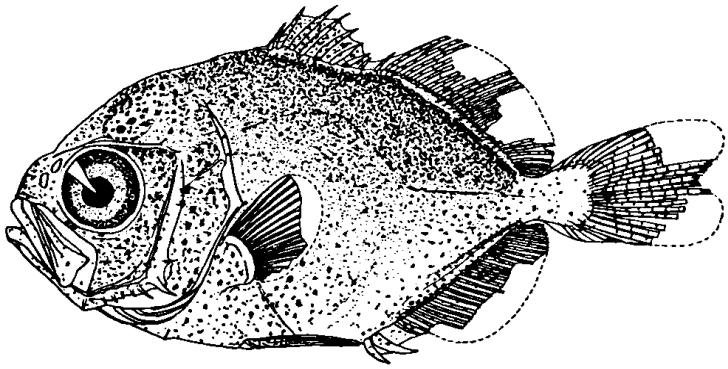
See illustrations and discussion concerning putative earlier stages on *Caranx* (species undetermined) page



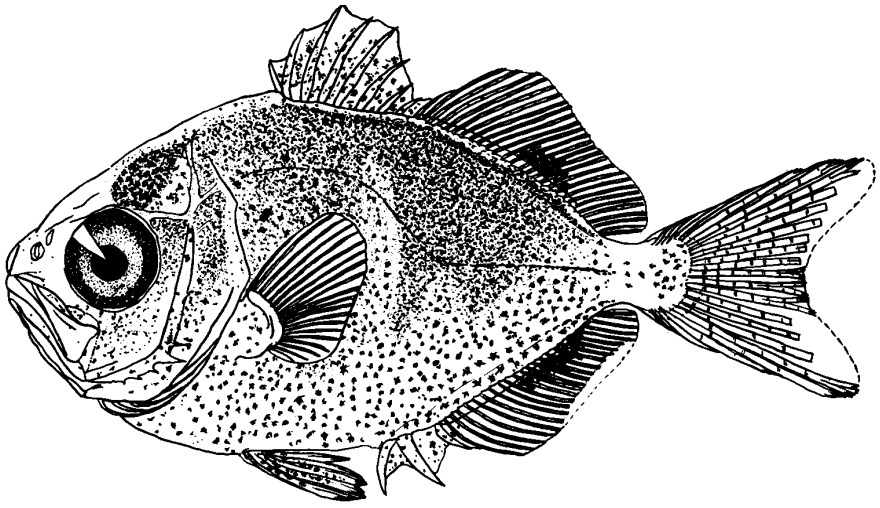
A. 6.0 mmSL
(Tentative identification)



B. 8.1 mmSL

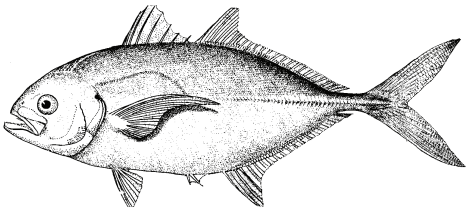


C. 10.5 mmSL



D. 14.3 mmSL

Caranx crysos (Mitchill, 1815)
Carangidae
Blue runner



Range: Atlantic, eastern Pacific (possibly) oceans and Mediterranean Sea; in the western North Atlantic from Nova Scotia to Brazil, including Bermuda, Gulf of Mexico and Caribbean Sea

Habitat: Schooling species in coastal and continental shelf waters; usually occurs in warm waters (20.0–30.8°C)

Spawning: Occurs in offshore waters, primarily south of the United States; possibly year-round, with most activity Jan–Sep

Meristic Characters

Myomeres:	24
Vertebrae:	10+14=24
Dorsal fin rays:	VII–VIII,I,22–25
Anal fin rays:	II,I,19–21
Pectoral fin rays:	19–23
Pelvic fin rays:	I, 5
Caudal fin rays:	8–9+9+8+8–9
Supraneurals:	0/0+0/2+1/

Eggs:
- Undescribed

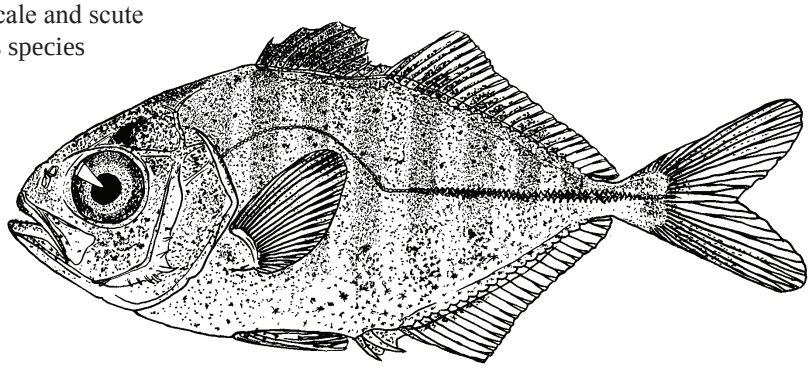
Larvae:
- Body deep throughout larval and juvenile stages, but shallower than larvae of congeners
- Head and snout moderately pointed
- Flexion occurs at 4.2–5.4 mmSL
- Head spines most pronounced on preopercle; see checklist below
- Sequence of fin ray formation C_1, D, A – P_1, P_2
- Finlets absent posterior to dorsal and anal fins
- Pigment over most of head and body heavy; vomer unpigmented; internal pigment absent; scattered pigment on dorsolateral part of body; pigment on ventrolateral part of body scattered; pigment along dorsum of body characterized by gap over nape area in early stages; melanophores present on branchiostegal membrane; midline pigment present until obscured by over-all body pigment; caudal peduncle remains unpigmented until juvenile stage

Head spine checklist:

Supraoccipital:	rough-edged crest present in smaller specimens
Preopercle Angle:	strong spine, with slightly smaller spines elsewhere on preopercle
Supraocular:	low ridge without spine
Posttemporal:	1 very small, simple spine
Supracleithral:	1–2 very small, simple spines
Pterotic ridge:	absent

Note: 1. This species may be conspecific with *Caranx caballus* Günther from the eastern Pacific Ocean (Smith-Vaniz *et al.*, 1999). See Watson *et al*. (1996) for description of a complete larval series of the latter.

Early Juvenile: See Berry (1960) for notes on scale and scute development in juveniles of this species

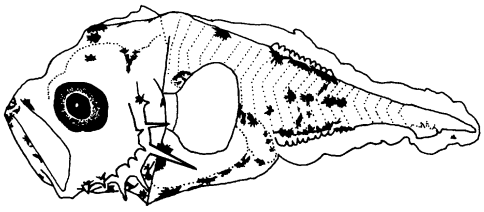


G. 29.1 mmSL

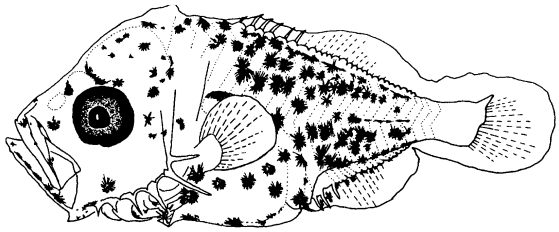
Figures: Adult: Goode, 1884; **A–C**: Ditty *et al*., 2004; **D–G**: Berry, 1959a

References: McKenney *et al*., 1958; Berry, 1959a; 1960; Fahay, 1975; Smith-Vaniz *et al*., 1999; Ditty *et al*., 2004

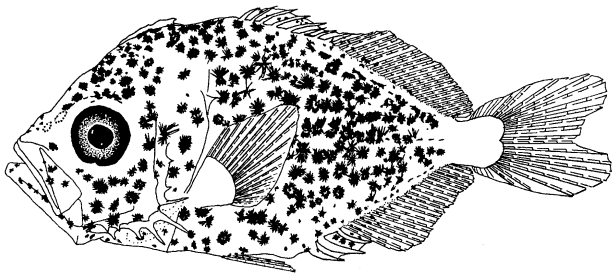
Caranx crysos



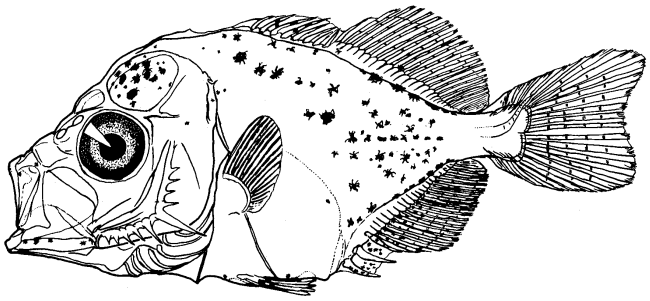
A. 3.4 mmSL



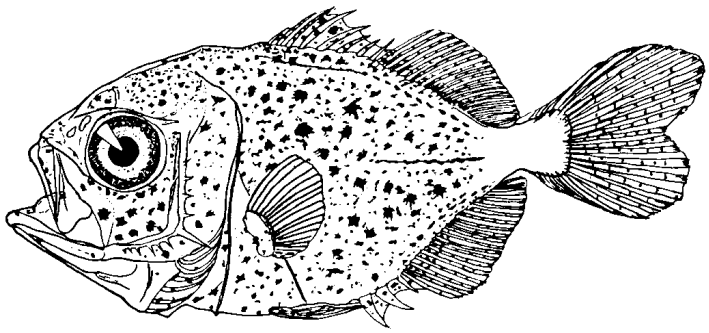
B. 4.8 mmSL



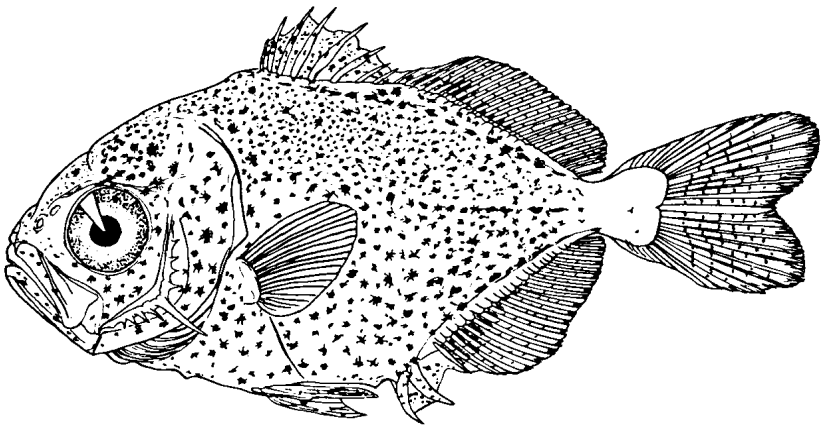
C. 6.8 mmSL



D. 7.0 mmSL

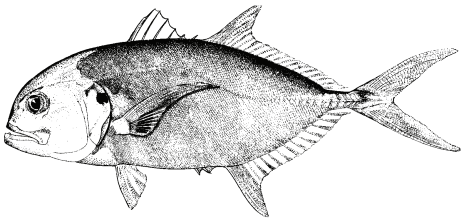


E. 8.5 mmSL



F. 10.6 mmSL

Caranx hippos (Linnaeus, 1766)
Carangidae
Crevalle jack



Range: Western Atlantic Ocean from Nova Scotia to Uruguay, including Caribbean Sea; absent from Bermuda and Bahamas

Habitat: Schooling species in coastal waters and shallow flats, into brackish waters and coastal rivers; large individuals occur farther offshore; larvae occur well offshore, migrate toward coast during juvenile stage; small numbers of juveniles typically disperse to estuaries in the study area, grow to lengths up to 200 mm during the summer, then return to the spawning population south of Cape Hatteras during their first winter

Meristic Characters

Myomeres:	24
Vertebrae:	10+14 = 24
Dorsal fin rays:	VII–VIII,I,19–21
Anal fin rays:	II,I,16–17
Pectoral fin rays:	20–21
Pelvic fin rays:	I, 5
Caudal fin rays:	8–9+9+8+8
Supraneurals:	0/0+0/2+1/

Spawning: Mar–Sep in offshore waters, mostly south of Florida

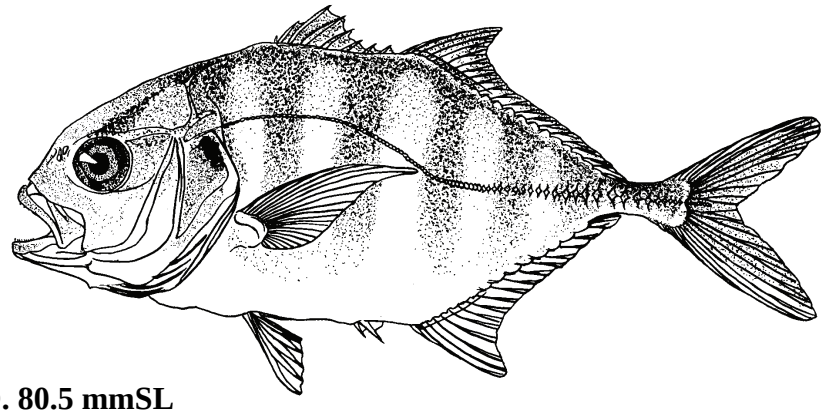
Eggs:
- Undescribed

Larvae:
- Body very deep throughout larval and juvenile stages
- Head and snout moderately rounded
- Flexion occurs at about 4–5 mmSL
- Head spines most pronounced on preopercle; see checklist below
- Sequence of fin ray formation: not well described, possibly C, D, A – P_1 – P_2 as in congeners
- Finlets absent posterior to dorsal and anal fins
- Pigment over most of head and body heavy; vomer unpigmented; internal pigment absent; pigment scattered on both dorsolateral and ventrolateral parts of body; pigment along dorsum initially in parallel rows; branchiostegal pigment absent; midline pigment present until obscured by over-all body pigment

Head spine checklist:

Supraoccipital:	rough-edged ridge present in small larvae; probably disappears at flexion
Preopercle Angle:	long, simple, decreases in size at 15–20 mmSL
Supraocular:	absent
Posttemporal:	present at small size, then absent
Supracleithral:	absent
Pterotic ridge:	absent

Early Juvenile: Pigment in juveniles includes bars crossing body, dark spot on opercle, spinous dorsal fin dark, and a pigmented bar from eye to dorsal fin origin



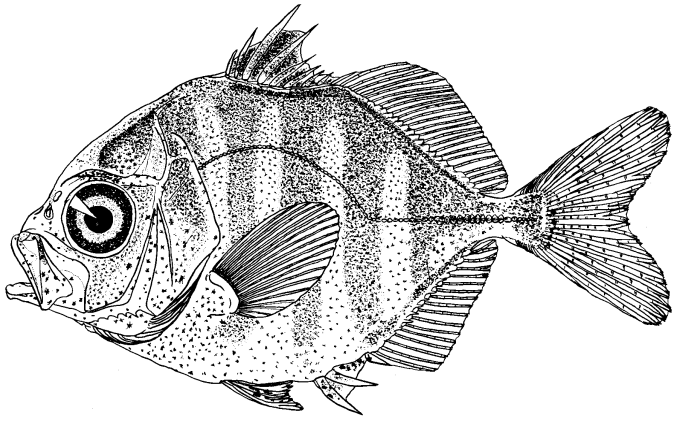
D. 80.5 mmSL

Figures: Adult: Goode, 1884; **A–D**: Berry, 1959a

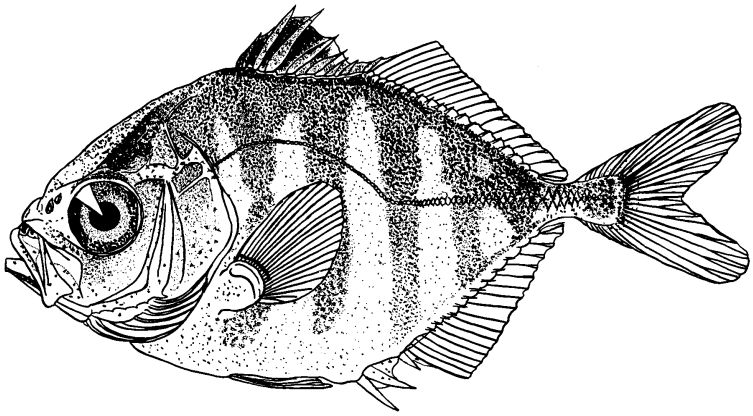
References: Berry, 1959a; Fahay, 1975; Smith-Vaniz *et al*., 1999; McBride and McKown, 2000; Ditty *et al*., 2004

Caranx hippos

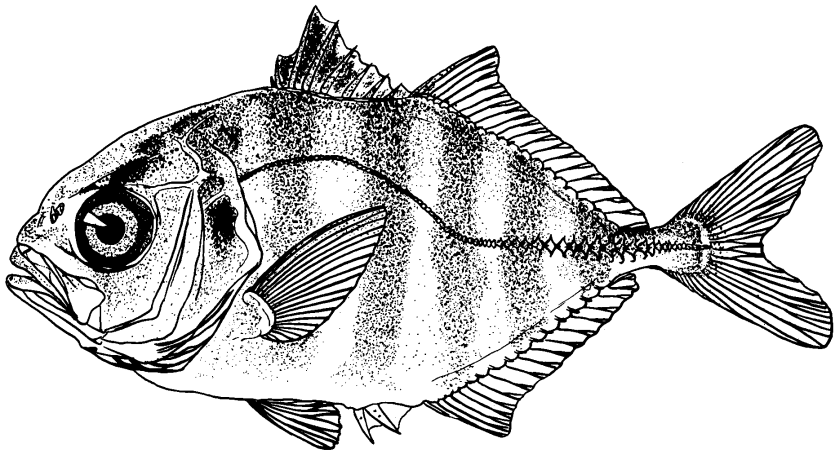
See illustrations and discussion concerning putative earlier stages on *Caranx* (species undetermined) page



A. 15.3 mmSL

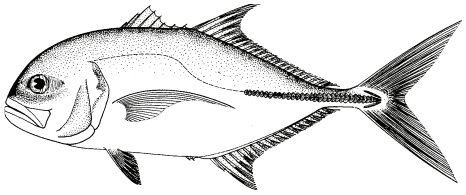


B. 20.4 mmSL



C. 32.6 mmSL

Caranx latus Agassiz, 1831
Carangidae
Horse-eye jack



Range: Western North Atlantic Ocean from New Jersey to Brazil, including Bermuda; also eastern Atlantic

Habitat: Schooling species occurring around islands and along sandy beaches; often penetrate brackish, coastal rivers and streams; larvae occur well offshore, migrate toward coast during juvenile stage

Spawning: Mar–Jul in offshore waters, mostly south of Florida

Meristic Characters

Myomeres:	24
Vertebrae:	10+14 = 24
Dorsal fin rays:	VIII,I,19–22
Anal fin rays:	II,I,16–18
Pectoral fin rays:	19–21
Pelvic fin rays:	I, 5
Caudal fin rays:	8–9+9+8+8
Supraneurals:	0/0+0/2+1/

Eggs: – Undescribed

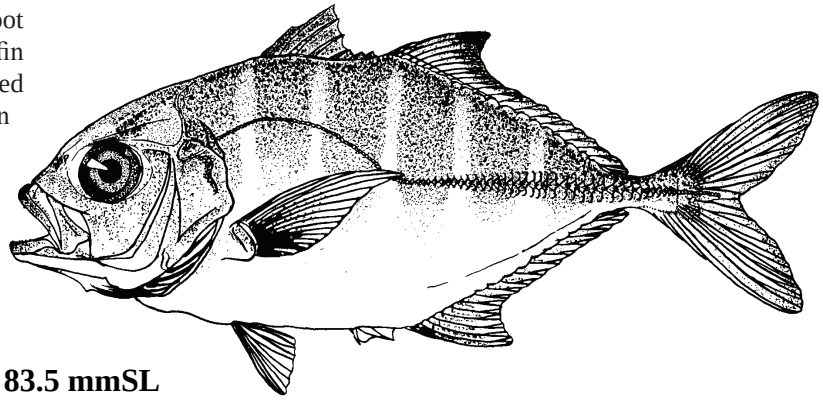
Larvae:
- Body very deep throughout larval and juvenile stages
- Head and snout moderately rounded
- Flexion occurs at about 4–5 mmSL
- Head spines most pronounced on preopercle; see checklist below
- Sequence of fin ray formation: not well described, possibly C, D, A – P_1 – P_2 as in congeners
- Finlets absent posterior to dorsal and anal fins
- Pigment over most of head and body; vomer unpigmented; internal pigment absent; pigment scattered on both dorsolateral and ventrolateral parts of body; pigment along dorsum initially in parallel rows; branchiostegal pigment absent; midline pigment present until obscured by over-all body pigment

Head spine checklist:

Supraoccipital:	rough-edged ridge present in small larvae; probably disappears at flexion
Preopercle Angle:	long, simple spine, decreases in size at <16 mmSL
Supraocular:	absent
Posttemporal:	present at small size, then absent
Supracleithral:	absent
Pterotic ridge:	absent

Note: 1. This species is very similar to *Caranx hippos* in all life history stages. In juveniles >20 mm, the chest is completely scaled (only partially in *C. hippos*); pigment is concentrated between dorsal fin spines I–IV (over entire spinous dorsal fin in *C. hippos*) in specimens 17–45 mmSL; posterior 3 pigment bars on body terminate immediately below lateral line (extend to anal fin base in *C. hippos*) in specimens 20–60 mmSL

Early Juvenile: Pigment in juveniles includes bars crossing body, vague spot on opercle, spinous dorsal fin partially dark, and a pigmented bar from eye to dorsal fin origin



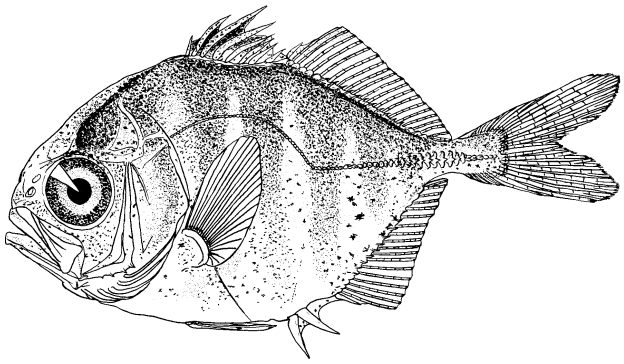
D. 83.5 mmSL

Figures: Adult: Smith-Vaniz, 2002b; **A–D**: Berry, 1959a

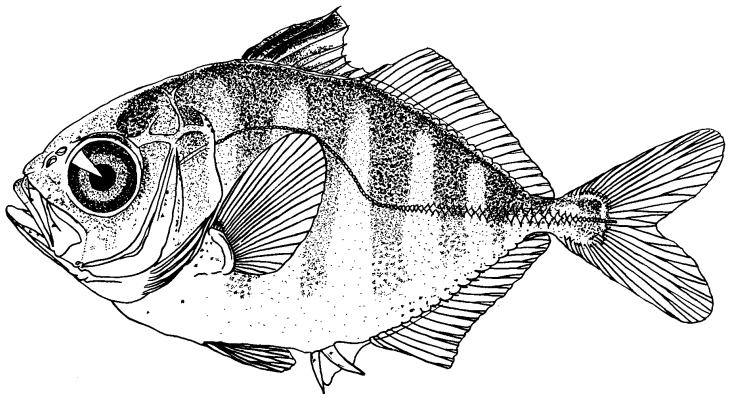
References: Berry, 1959a; Fahay, 1975; Smith-Vaniz, 1999; 2002b; Ditty *et al*., 2004

Caranx latus

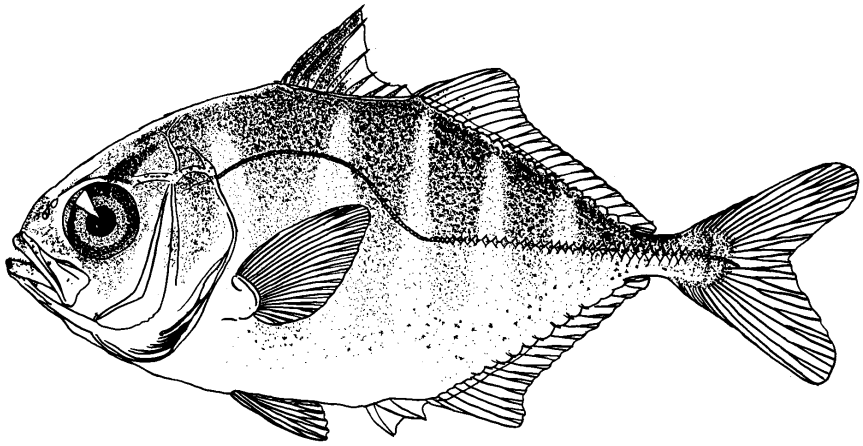
See illustrations and discussion concerning putative earlier stages on *Caranx* (species undetermined) page



A. 16.1 mmSL

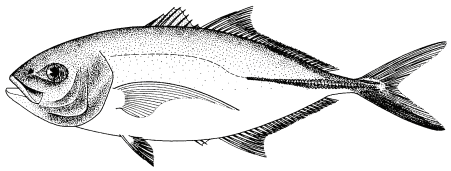


B. 21.8 mmSL



C. 31.9 mmSL

Caranx ruber (Bloch, 1793)
Carangidae
Bar jack



Range: Western North Atlantic Ocean from Georges Bank to Brazil, including Gulf of Mexico and Caribbean Sea; abundant in the West Indies; also eastern Atlantic

Habitat: Schooling species over deeper parts of continental shelf, rare in inshore and coastal waters; occur in depths at least to 55 m; young stages commonly associated with Gulf Stream

Spawning: Probably peaks in summer; juveniles occur in Gulf Stream from Apr–Nov, with a peak in May–Aug

Meristic Characters

Myomeres:	24
Vertebrae:	10 + 14 = 24
Dorsal fin rays:	VIII, I, 26–30
Anal fin rays:	II, I, 23–26
Pectoral fin rays:	19–22
Pelvic fin rays:	I, 5
Caudal fin rays:	7–9+9+8+7–8
Supraneurals:	0/0+0/2+1/

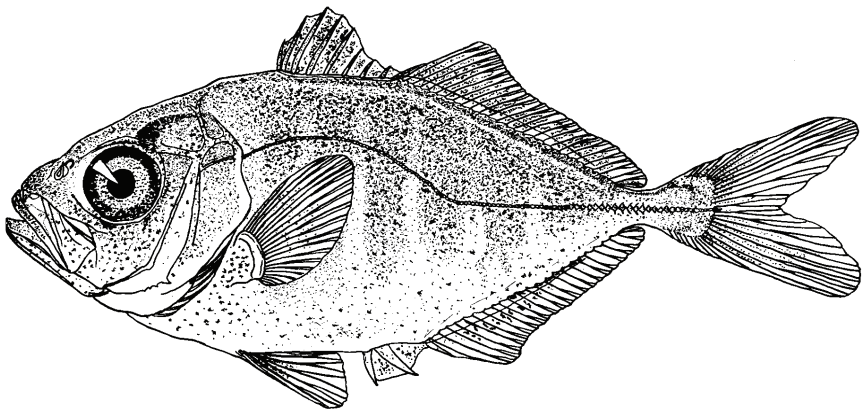
Eggs: – Undescribed

Larvae:
- Body very deep throughout larval and juvenile stages
- Head and snout moderately rounded
- Flexion occurs at <6.0 mmSL
- Head spines most pronounced on preopercle; see checklist below
- Sequence of fin ray formation C, D, A – P_1 – P_2
- Finlets absent posterior to end of dorsal and anal fins
- Pigment over most of head and body heavy; vomer unpigmented; internal pigment absent; pigment scattered on both dorsolateral and ventrolateral parts of body; often less pigmented on caudal peduncle; pigment along dorsum in parallel rows; branchiostegal pigment absent; midline pigment present until obscured by over-all body pigment

Head spine checklist:

Supraoccipital:	ridge present in small larvae; disappears at flexion
Preopercle Angle:	long, simple spine, decreases in size at about 10.0 mmSL
Supraocular:	absent or very small, simple spine
Posttemporal:	present at small sizes (6.0 mmSL), then absent
Supracleithral:	absent
Pterotic ridge:	absent

Early Juvenile: Pigment in juveniles includes vague bars on body and blotches on proximal parts of dorsal and anal fins



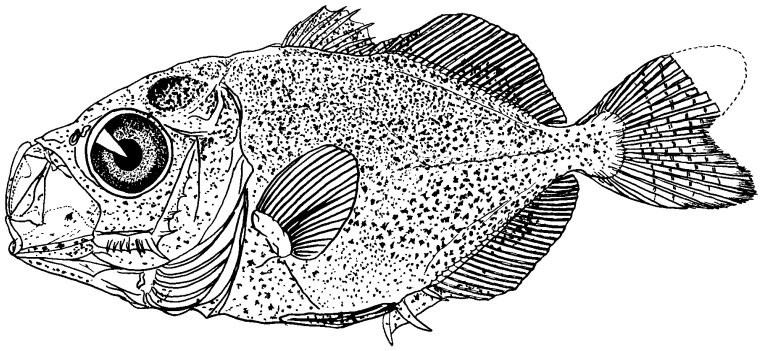
D. 31.9 mmSL

Figures: Adult: Smith-Vaniz, 2002b; **A–D**: Berry, 1959a

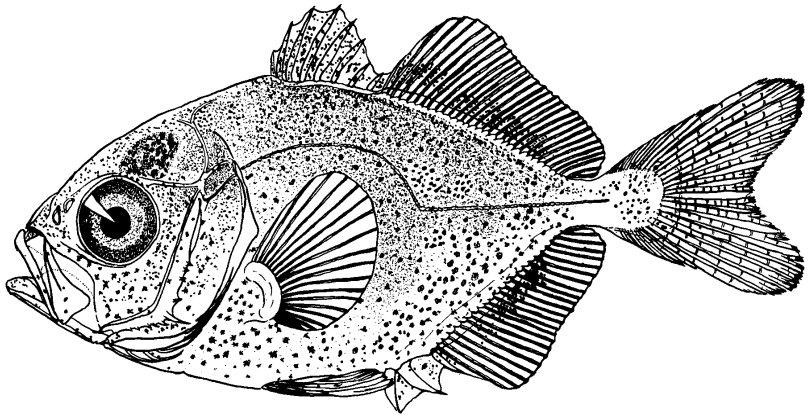
References: Berry, 1959a; Fahay, 1975; Laroche *et al.*, 1984; 1991; Ditty *et al*., 2004

Caranx ruber

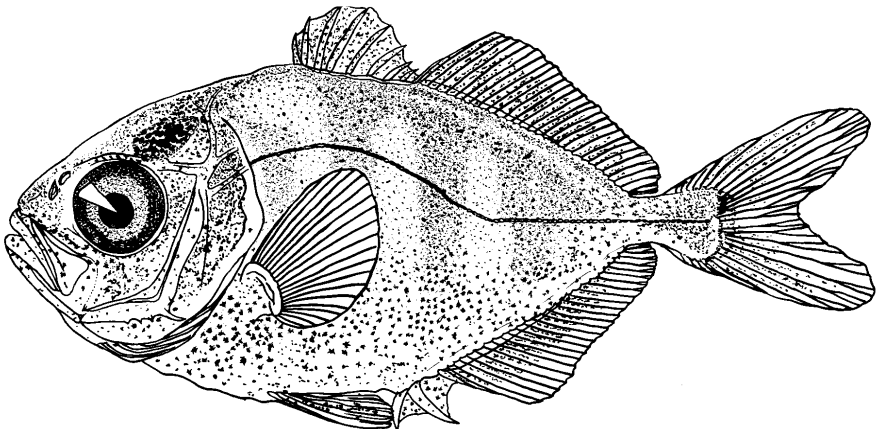
See illustrations and discussion concerning putative earlier stages on *Caranx* (species undetermined) page



A. 12.4 mmSL

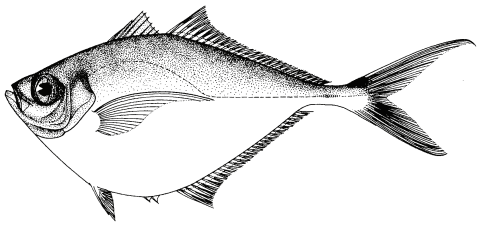


B. 14.9 mmSL



C. 18.0 mmSL

Chloroscombrus chrysurus (Linnaeus, 1766)
Carangidae
Atlantic bumper



Range: Western Atlantic Ocean from Massachusetts to Uruguay, including Gulf of Mexico and Caribbean Sea; uncommon north of South Carolina

Habitat: Schooling species most common over coastal parts of continental shelf and in estuaries; commonly occur around structures such as pilings; juveniles often associated with jellyfish

Spawning: Probably summer in Gulf of Mexico; otherwise undescribed

Eggs:
- Undescribed

Larvae:
- Body moderately deep throughout larval and juvenile stages
- Head and snout moderately pointed; mouth reaches anterior edge of eye
- Note decrease in preanus length as terminus of gut curves anteriad
- Flexion occurs at 3.0–5.0 mmSL
- Head spines weak except for prominent one at preopercle angle; see checklist below
- Sequence of fin ray formation: C – D, A – P_1 – P_2
- Finlets absent posterior to end of dorsal and anal fins
- Pigment over most of head and body light; vomer pigmented; internal pigment present over dorsal aorta and notochord; pigment absent on dorsolateral part of body; pigment on ventrolateral part of body restricted to few spots aligned with myosepta; pigment along dorsum consists of few spots on midline; melanophores present on branchiostegal membrane; midline pigment present

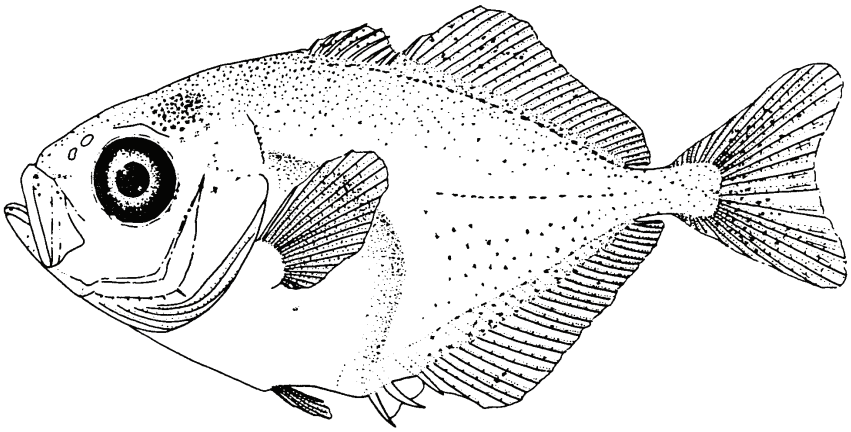
Meristic Characters

Myomeres:	24
Vertebrae:	10+14 = 24
Dorsal fin rays:	VIII, I, 26–28
Anal fin rays:	II, I, 25–27
Pectoral fin rays:	19–20
Pelvic fin rays:	I, 5
Caudal fin rays:	8–9+9+8+7–9
Supraneurals:	0/0/0/+1+1/

Head spine checklist:

Supraoccipital:	rough-edged ridge present in small larvae
Preopercle Angle:	simple spine in small larvae; all preopercle spines small and weak in larger larvae
Supraocular:	small spine on weak ridge
Posttemporal:	tiny spine present
Supracleithral:	tiny spine (1 or more) present
Pterotic ridge:	absent

Early Juvenile:

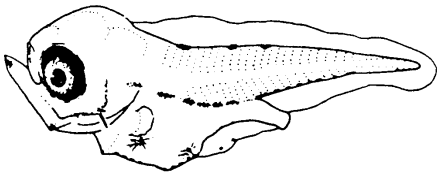


G. 15.2 mmSL

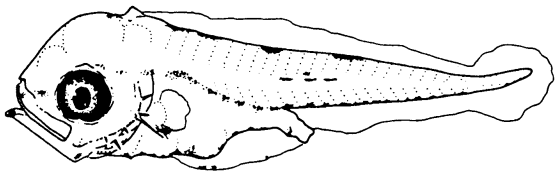
Figures: Adult: Smith-Vaniz, 2002b; **A–C**, **E–G**: Wayne Laroche (Laroche *et al.*, 2004); **D**: Laroche *et al.*, 1984

References: Laroche *et al*., 1984; Sanchez-Ramirez and Flores-Coto, 1993; Ditty *et al*., 2004

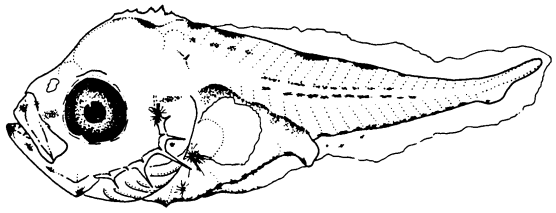
Chloroscombrus chrysurus



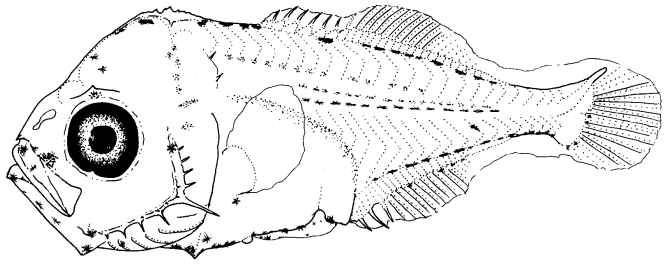
A. 1.7 mmSL



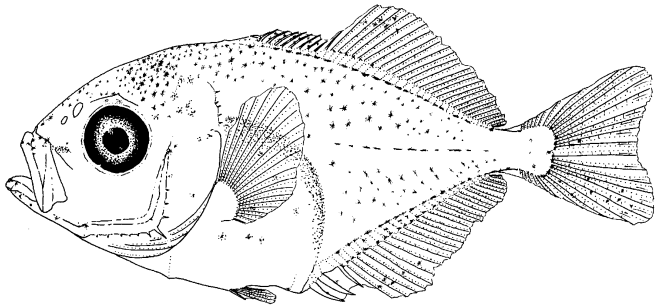
B. 2.3 mmSL



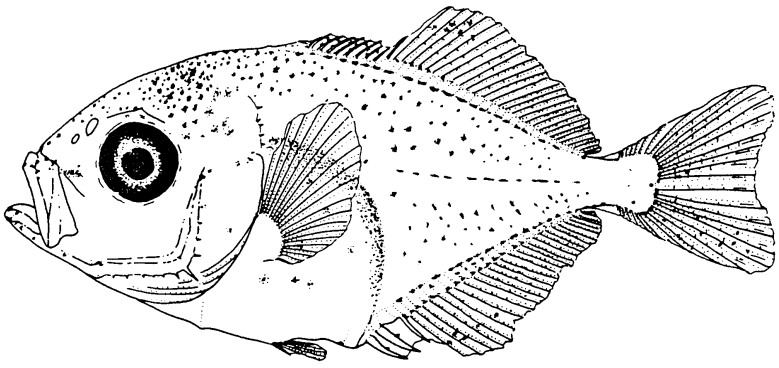
C. 3.3 mmSL



D. 4.6 mmSL

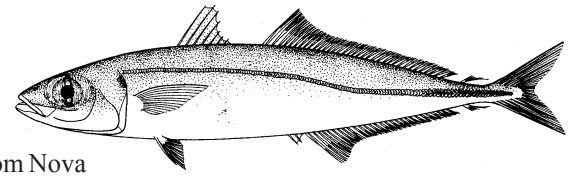


E. 6.4 mmSL



F. 9.5 mmSL

Decapterus macarellus (Cuvier, 1833)
Carangidae
Mackerel scad



Range: Widespread, circumtropical; in the western North Atlantic from Nova Scotia to northern Brazil, including the Caribbean Sea, although absent within many parts of this range (e.g. northern Gulf of Mexico)

Habitat: Pelagic, schooling species occurring mostly in offshore waters; may be more associated with islands than continents

Spawning: Undescribed

Eggs:
- Pelagic, spherical
- Diameter: 0.6–0.64 mm
- Oil globule: single
- Perivitelline space: narrow

Larvae:
- Body compressed and relatively shallow
- Head and snout moderately pointed
- Flexion occurs at 3.5–6.0 mmSL
- Head spines strongest on preopercle; see checklist below
- Sequence of fin ray formation D, A – C – P_2 – P_1
- Finlets present posterior to dorsal and anal fins
- Pigment over most of head and body light; vomer unpigmented; internal pigment absent; pigment on dorsolateral part of body generally arranged in longitudinal row; pigment on ventrolateral part of body aligned with myosepta; pigment along dorsum in parallel rows; no branchiostegal pigment; midline pigment present; a row of melanophores along the anal fin base

Meristic Characters

Myomeres:	24
Vertebrae:	10 + 14 = 24
Dorsal fin rays:	VIII, I, 31–37
Anal fin rays:	II, I, 27–30
Pectoral fin rays:	22–24
Pelvic fin rays:	I, 5
Caudal fin rays:	9–10+9+8+9–10
Supraneurals:	0/0+0/2+1/

(Note distribution of dorsal and pectoral fin rays in *D. macarellus* (M), (*D. punctatus* (P) and *D. tabl* (T) in table below)

Head spine checklist:

Supraoccipital:	rough-edged crest present
Preopercle Angle:	long, simple spine present; other spines also pronounced
Supraocular:	small spine or absent
Posttemporal:	present in small larvae
Supracleithral:	present in small larvae
Pterotic ridge:	absent

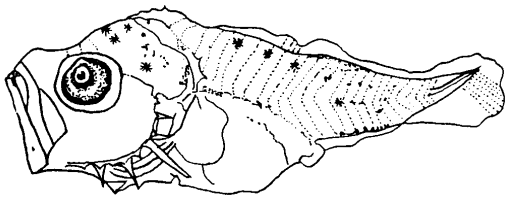
Note: 1. Egg characters based on "*Decapterus macrosoma*" (= *D. macarellus*) (Delsman, 1926); larval series (Figs. A–F) based on western Pacific Ocean material (Ozawa and Manabe, 1986)

Pectoral Fin Rays	Dorsal Fin Rays								
	29	30	31	32	33	34	35	36	37
24			M	M	M	M	M	M	M
23	T	T	MT	MT	MT	MT	M	M	M
22	T	T	MT	MT	MT	MT	M	M	M
21	PT	PT	PT	PT	PT	PT			
20	P	P	P	P	P	P			
19	P	P	P	P	P	P			

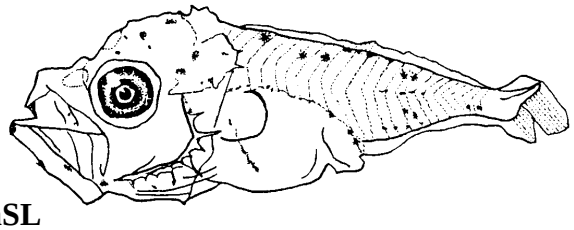
Figures: Adult: Smith-Vaniz, 2002b; **A–F**: Ozawa and Manabe, 1986

References: Delsman, 1926; Ozawa and Manabe, 1986; Smith-Vaniz *et al.*, 1999

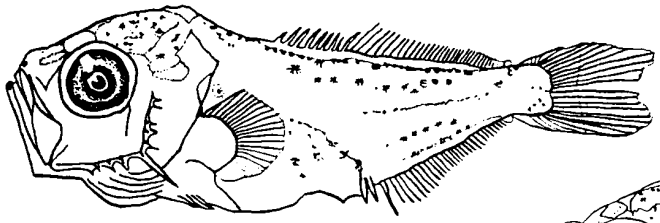
Decapterus macarellus



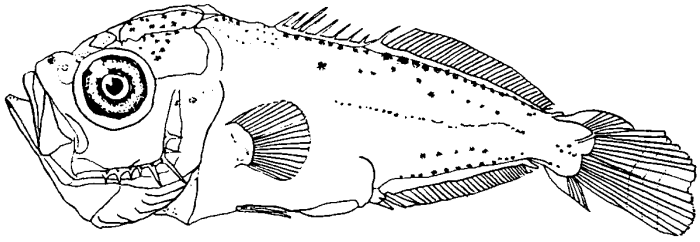
A. 3.5 mmSL



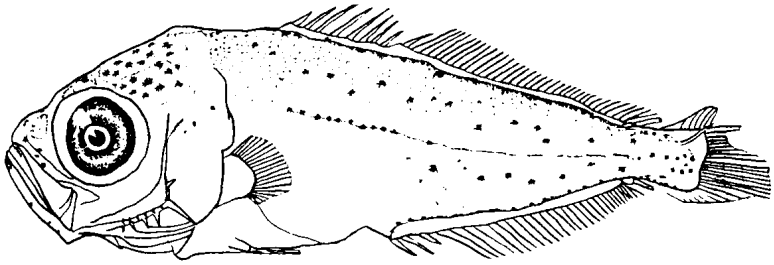
B. 4.4 mmSL



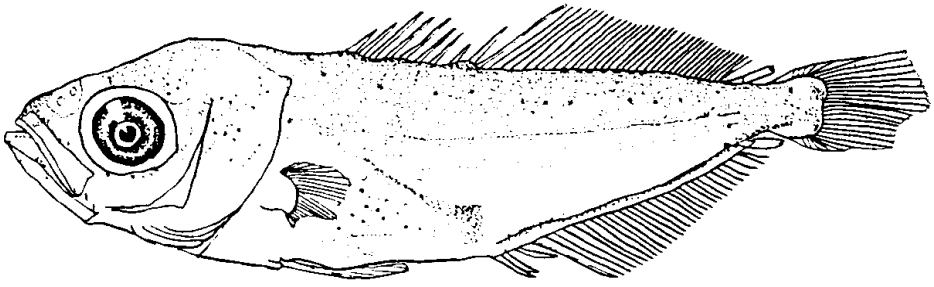
C. 6.3 mmSL



D.8.0 mmSL

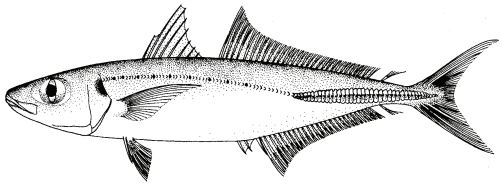


E. 12.0 mmSL



F. 20.9 mmSL

Decapterus punctatus (Cuvier, 1829)
Carangidae
Round scad



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

Habitat: Schooling species found in depths of 9–90 m; juveniles occur near surface during day, descend to bottom at night

Spawning: Year-round with peak in spring; off North Carolina, small larvae collected May–Nov, most abundant Jul–Sep

Meristic Characters

Myomeres:	25
Vertebrae:	10+15 = 25
Dorsal fin rays:	VIII,I, 29–34
Anal fin rays:	II,I,25–30
Pectoral fin rays:	19–21
Pelvic fin rays:	I, 5
Caudal fin rays:	8–9+9+8+8–9
Supraneurals:	0/0/0/2+1/

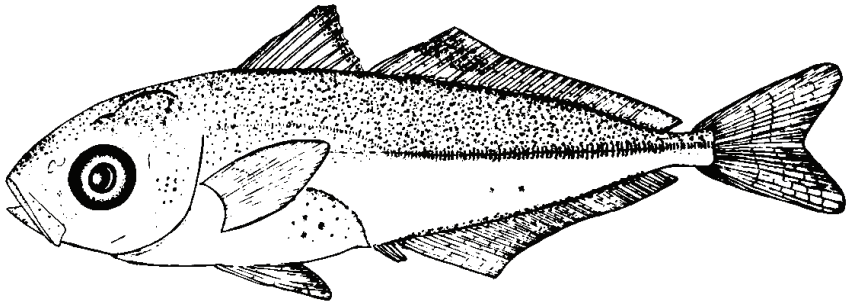
Eggs: – Undescribed

Larvae:
- Body depth relatively shallow throughout all life history stages
- Head and snout moderately pointed
- Flexion occurs at 4.0–6.0 mmSL
- Head spines fairly prominent; see checklist below
- Sequence of fin ray formation: C, D_2, A – D_1, P_1 – P_2
- Finlets present posterior to ends of dorsal and anal fins
- Pigment over most of head and body light; few spots on top of head; vomer unpigmented; internal pigment absent; pigment on dorsolateral part of body absent; ventrolateral body pigment absent or restricted to few spots; pigment along dorsum in parallel rows, situated under dorsal fin rays; branchiostegal pigment absent; midline pigment present

Head spine checklist:

Supraoccipital:	prominent rough-edged crest
Preopercle Angle:	long, simple spine; other preopercle spines also prominent
Supraocular:	low ridge with simple spine
Posttemporal:	tiny spine (1 or 2)
Supracleithral:	tiny spine (1 or 2)
Pterotic ridge:	absent

Early Juvenile: Note pigment on D_1 and D_2 fins; scutes form on posterior lateral line; finlets separate from dorsal and anal fins between 20 and 40 mmSL

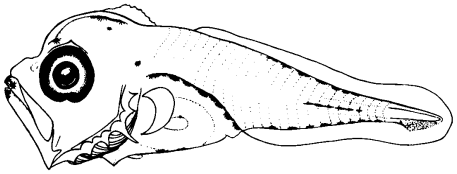


I. 23.0 mmSL

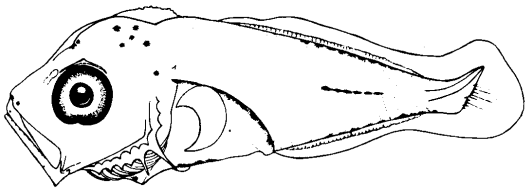
Figures: Adult: Smith-Vaniz, 2002b; **A–B**, **D**, **F**, **I**: Aprieto, 1974; **C**: Wayne Laroche (Laroche *et al*., 1984); **E, G–H**: Wayne Laroche (Laroche *et al*., 2004)

References: Aprieto, 1974; Fahay, 1975; 1983; Laroche *et al*., 1984

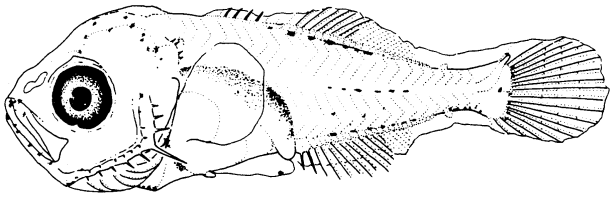
Decapterus punctatus



A. 3.1 mmSL

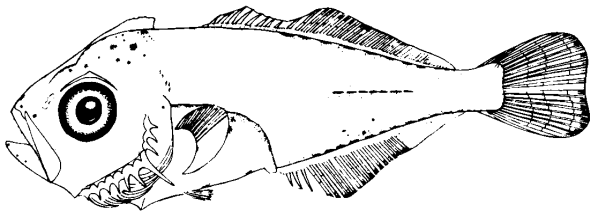


B. 4.2 mmSL

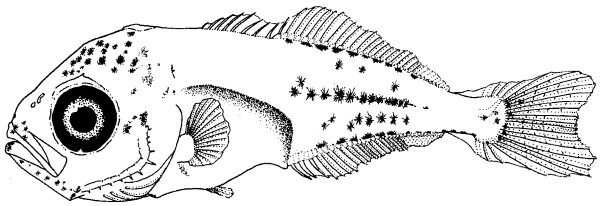


C. 5.5 mmSL

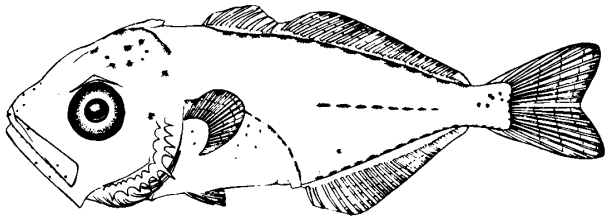
Superficially similar to *Pomatomus saltatrix* but the latter lacks prominent preopercle spines



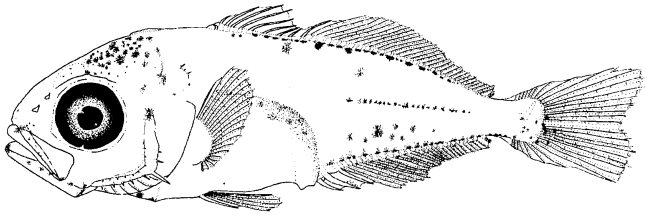
D. 6.5 mmSL



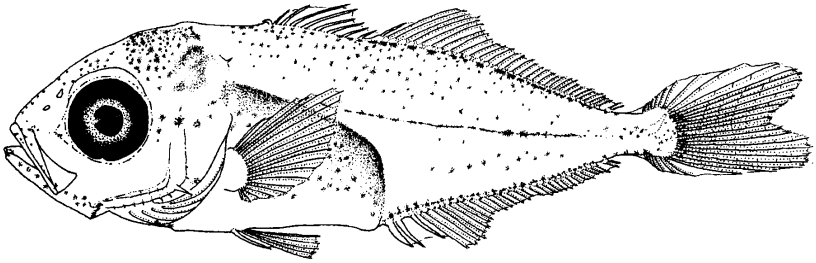
E. 6.8 mmSL



F. 8.0 mmSL

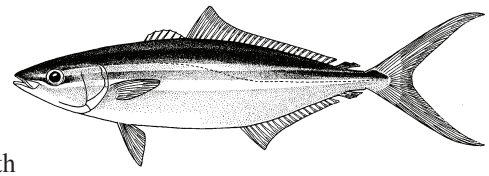


G. 9.4 mmSL



H. 11.7 mmSL

Elegatis bipinnulata (Quoy and Gaimard, 1824)
Carangidae
Rainbow runner



Range: Circumtropical, rarely into temperate waters; in the western North Atlantic from Massachusetts to Brazil

Habitat: Pelagic in oceanic waters, usually far offshore; larvae and juveniles often near floating *Sargassum* beds

Spawning: Year-round, usually far from coast

Eggs: – Undescribed

Meristic Characters

Myomeres:	24
Vertebrae:	10+14 = 24
Dorsal fin rays:	VI, I, 25–30
Anal fin rays:	I, I, 18–22
Pectoral fin rays:	19–22
Pelvic fin rays:	I, 5
Caudal fin rays:	10–11+9+8+10–11
Supraneurals:	0/0/0/1+1/

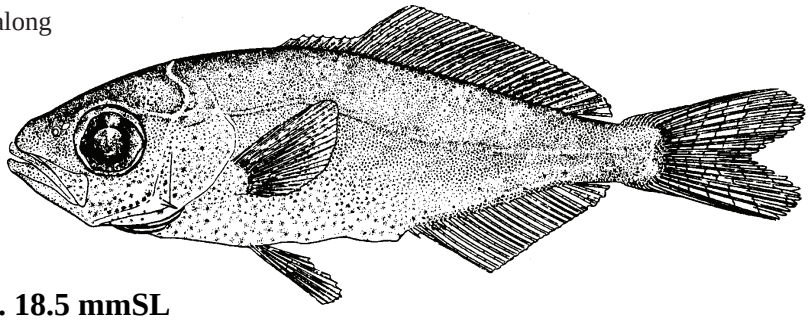
Larvae:
- Body depth shallow throughout development
- Head and snout moderately pointed
- Flexion occurs at 4.0–6.0 mmSL
- Head spines most prominent on preopercle; see checklist below
- Sequence of fin ray formation: C, D_2, A – D_1, P_1 – P_2
- Finlets absent posterior to ends of dorsal and anal fins
- Pigment over most of head and body heavy after earliest stages (although caudal peduncle may remain unpigmented at some sizes); vomer pigmented; internal pigment absent; pigment on dorsolateral part of body becomes heavy (later stages have row of prominent spots overlying background of dark pigment); pigment on ventrolateral part of body scattered and heavy, with prominent row along anal fin base; pigment along dorsum consists of parallel rows of dark pigment, extending from supraoccipital crest to caudal peduncle; melanophores present on branchiostegal membrane; midline pigment present until obscured by over-all body pigment

Head spine checklist:

Supraoccipital:	simple crest present
Preopercle:	long spine at angle, serrated along edges, possibly with secondary spurs along its length; other preopercle spines much smaller
Supraocular:	low ridge with small spine
Posttemporal:	small spine present in early stages
Supracleithral:	absent
Pterotic ridge:	absent

Note: Anal fin spines are I + I, none separated from rest of fin; (other carangids have II + I anal fin spines)

Early Juvenile: Juveniles are dark with 2 unpigmented streaks on caudal peduncle and another unpigmented streak along anal fin base (Fahay, 1975)

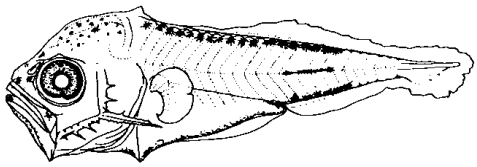


I. 18.5 mmSL

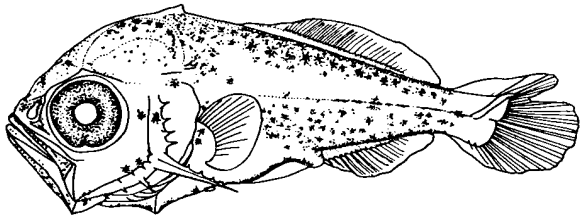
Figures: Adult: Smith-Vaniz, 2002b; **A–C, E–G**: Okiyama, 1970; **D**: Aprieto, 1974; **H**: Wayne Laroche (Laroche *et al*., 1984); **I**: Berry, 1969

References: Okiyama, 1970; Aprieto, 1974; Fahay, 1975; Laroche *et al*., 1984

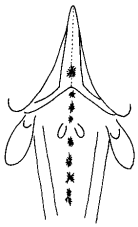
Elegatis bipinnulata



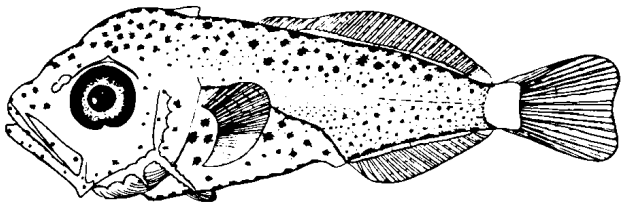
A. 3.6 mmSL



C. 5.5 mmSL

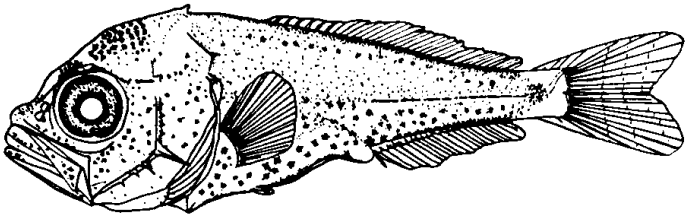


B. 3.6 mmSL
(Ventral View)

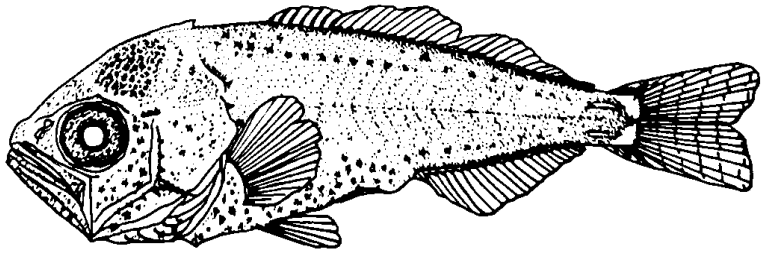


D. 6.3 mmSL

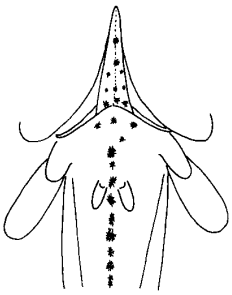
Note midventral row of spots under gut



E. 7.7 mmSL

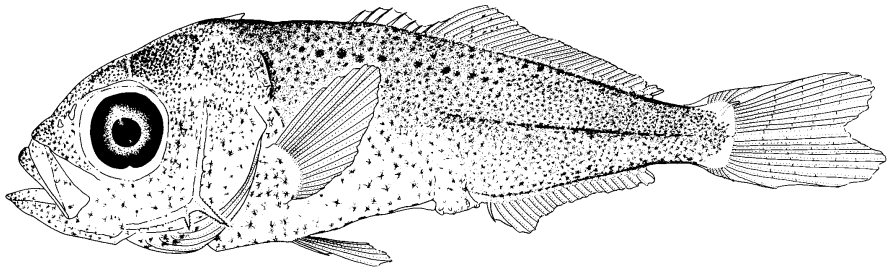


F. 10.4 mmSL



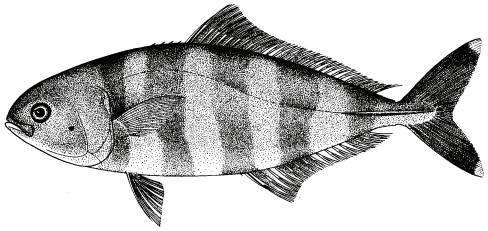
G. 10.4 mmSL
(Ventral View)

Dorsal fin spines nearly equal in length



H. 11.4 mmSL

Naucrates ductor (Linnaeus, 1758)
Carangidae
Pilotfish



Range: Worldwide, primarily in tropical waters; in the western Atlantic from Nova Scotia to Argentina, including Bermuda

Habitat: Epi-pelagic, often associates with jellyfish, floating weed or large fishes (e.g. sharks, tunas and rays)

Spawning: Undescribed

Eggs:
- Pelagic, spherical,
- Diameter: 1.3 mm
- Chorion: smooth
- Oil globule: single, 0.28 mm diameter
- Yolk: segmented
- Perivitelline space: narrow

Meristic Characters

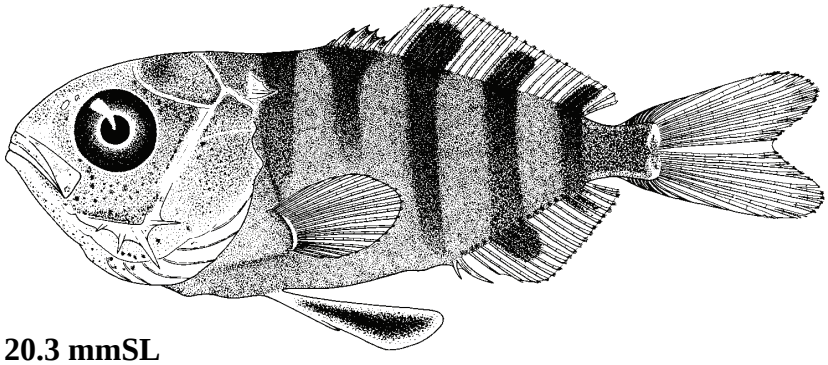
Myomeres:	25–26
Vertebrae:	10 + 15–16
Dorsal fin rays:	III–VI, I, 24–29
Anal fin rays:	II, I, 15–18
Pectoral fin rays:	18–20
Pelvic fin rays:	I, 5
Caudal fin rays:	9–12+9+8+8–11
Supraneurals:	0/0/0/1+1/

Larvae:
- Body depth intermediate between elongate and deep carangid larvae; increases from 29% to 40% SL
- Head and snout blunt to slightly pointed; head length increases from 34% to 40–42% SL
- Flexion occurs at 4.1–6.4 mm
- Head spines strong; see checklist below
- Sequence of fin ray formation: C– D_2, A – D_1 – P_2 – P_1
- Finlets absent posterior to ends of dorsal and anal fins
- Pigment over most of head and body very heavy; vomer pigmented; internal pigment absent; dark pigment on both dorsolateral and ventrolateral parts of body, usually with unpigmented caudal peduncle; pigment along dorsum dense, extends from nape to caudal peduncle; melanophores present on branchiostegal membrane; midline pigment absent; pelvic fins become darkly pigmented in late larvae and juveniles

Head spine checklist:

Supraoccipital:	absent
Preopercle Angle:	simple, long; some secondary preopercle spines also pronounced
Supraocular:	multiple, long spines
Posttemporal:	prominent, with multiple points; persist into juvenile stage
Supracleithral:	absent
Pterotic ridge:	absent

Early Juvenile: Vertical bars form on body at about 20 mmSL

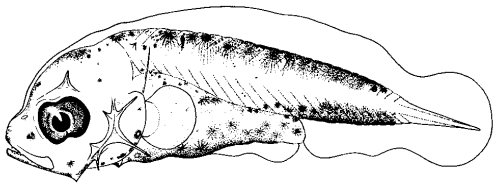


G. 20.3 mmSL

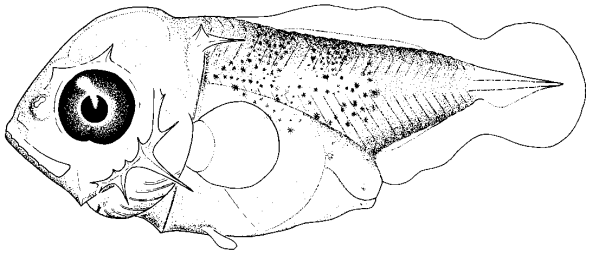
Figures: Adult: Smith-Vaniz, 2002b; Egg: Sanzo, (1931b) ; **A–B, F–G**: Henry Orr (Watson *et al*., 1996); **C**: Wayne Laroche (Laroche *et al*., 2004); **D**: Barbara Sumida (Watson *et al*., 1996) **E**: Sanzo, 1931b

References: Aboussouan, 1975; Laroche *et al.*, 1984; Watson *et al*., 1996

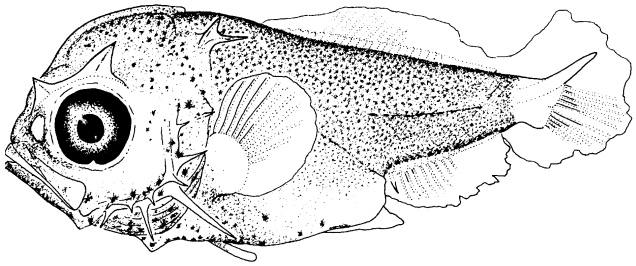
Naucrates ductor



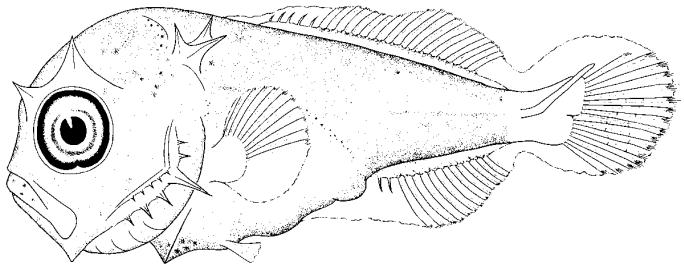
A. 2.9 mmSL



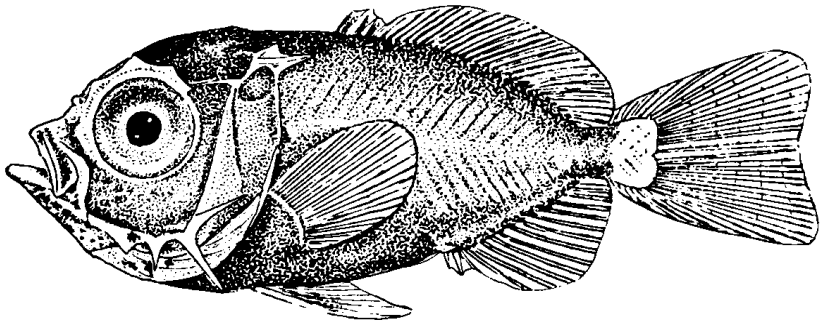
B. 4.1 mmSL



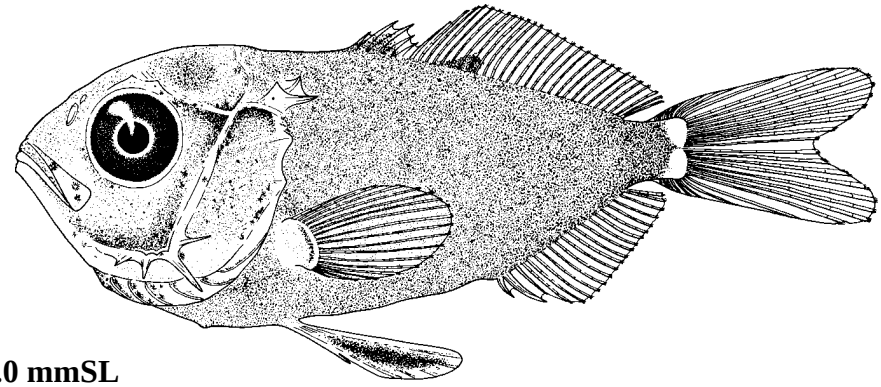
C. 4.7 mmSL



D. 5.9 mmSL

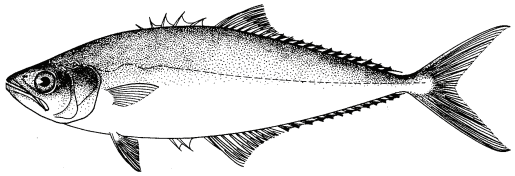


E. 11.7 mmSL



F. 15.0 mmSL

Oligoplites saurus (Schneider, 1801)
Carangidae
Leatherjacket



Range: Western Atlantic Ocean from Maine to Uruguay, including Gulf of Mexico and West Indies; absent from Bahamas

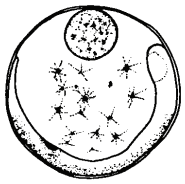
Habitat: Schooling species occurring in coastal ocean, bays and estuaries

Spawning: Early spring through summer in shallow, inshore waters

Meristic Characters

Myomeres:	26–27
Vertebrae:	10 + 16 = 26
Dorsal fin rays:	III–V, I, 19–21
Anal fin rays:	II, I, 18–21
Pectoral fin rays:	16–18
Pelvic fin rays:	I, 5
Caudal fin rays:	9–10+9+8+8–10
Supraneurals:	0/0/0+P/P

Eggs:
- Pelagic, spherical
- Diameter: 0.87–0.88 mm
- Chorion: smooth
- Yolk unsegmented
- Oil globule: single, 0.33–0.34 mm diameter
- Perivitelline space: narrow

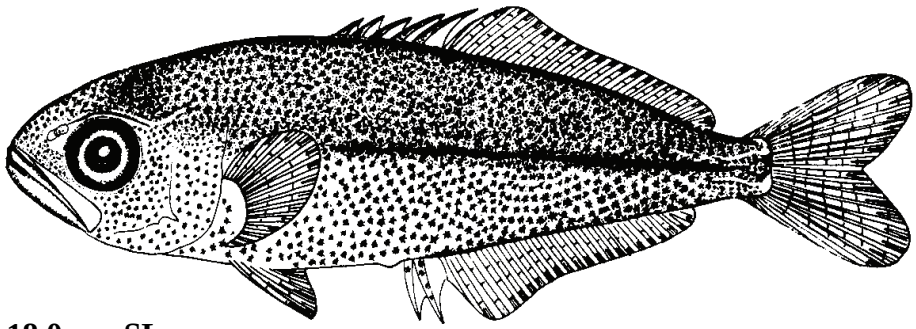


Larvae:
- Body depth shallow throughout larval development
- Head and snout moderately pointed
- Flexion occurs at 4.0–6.0 mmSL
- Head spines most pronounced on preopercle; see checklist below
- Sequence of fin ray formation: $C - D_2$, $A - D_1 - P_1$, P_2
- Finlets absent posterior to ends of dorsal and anal fins
- Pigment over most of head and body very heavy; vomer pigmented; internal pigment absent; pigment on dorsolateral and ventrolateral parts of body scattered and dense; pigment along dorsum well separated in early larvae, becomes dense; melanophores present on branchiostegal membrane; midline pigment present, obscured by over-all body pigment, then prominent in larger larvae

Head spine checklist:

Supraoccipital:	absent
Preopercle Angle:	long spine, with secondary spinules on dorsal edge
Supraocular:	small spine on low ridge
Posttemporal:	absent (but see note-box on figure page)
Supracleithral:	absent
Pterotic ridge:	absent

Early Juvenile:

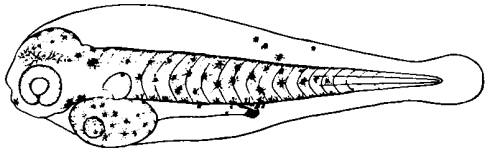


H. 18.0 mmSL

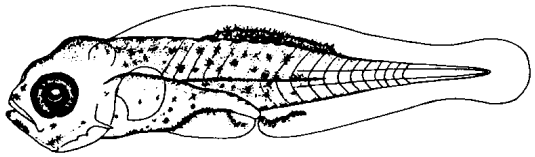
Figures: Adult: Smith-Vaniz, 2002b; Egg and **A–H**: Aprieto, 1974

References: Aprieto, 1974; Laroche *et al*., 1984

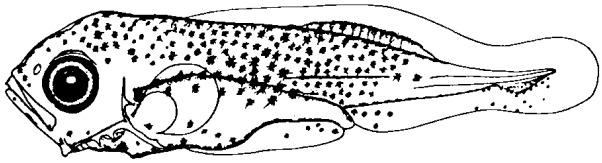
Oligoplites saurus



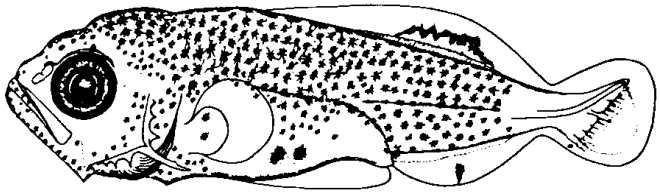
A. 2.2 mmSL



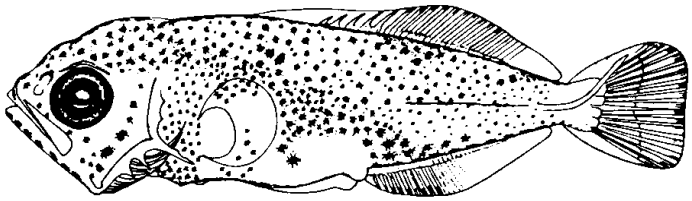
B. 3.0 mmSL



C. 4.1 mmSL

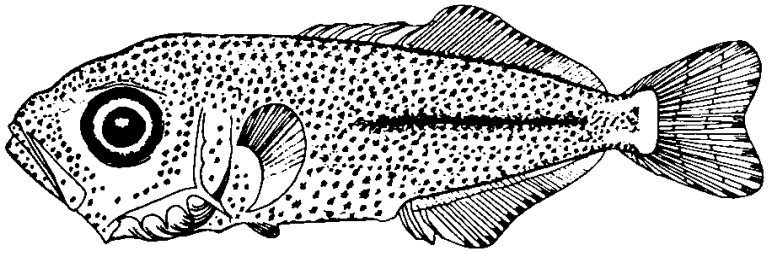


D. 5.2 mmSL

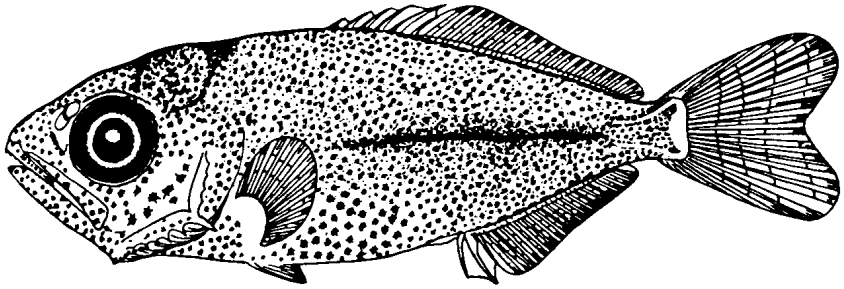


E. 5.9 mmSL

Larvae of the subspecies *Oligoplites saurus inornatus* from the eastern Pacific Ocean have a much larger supraocular crest, well-developed posttemporal spines and prominent secondary spines (spinules) on the preopercle angle spine (Watson *et al.*, 1996)

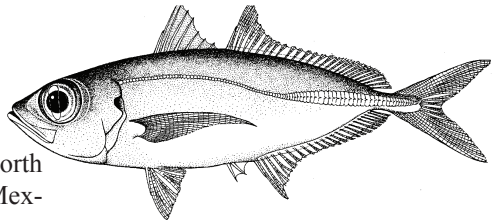


F. 7.2 mmSL



G. 10.0 mmSL

Selar crumenophthalmus (Bloch, 1793)
Carangidae
Bigeye scad



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

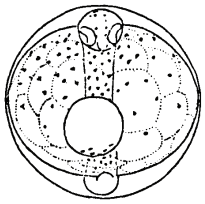
Habitat: Schooling species occurring very close to shore or over shallow reefs; often in turbid waters

Spawning: Not well described; probably occurs well offshore from Jan–Aug with peak in larval occurrences Apr–Aug

Meristic Characters

Myomeres:	24
Vertebrae:	10+14 = 24
Dorsal fin rays:	VIII, I, 24–27
Anal fin rays:	II, I, 20–23
Pectoral fin rays:	19–23
Pelvic fin rays:	I, 5
Caudal fin rays:	7–8+9+8+7–8
Supraneurals:	0/0+0/2+1/

Eggs:
- Pelagic, spherical
- Diameter: 0.78 mm
- Chorion: smooth
- Yolk: segmented
- Oil globule: single, 0.24 mm diameter

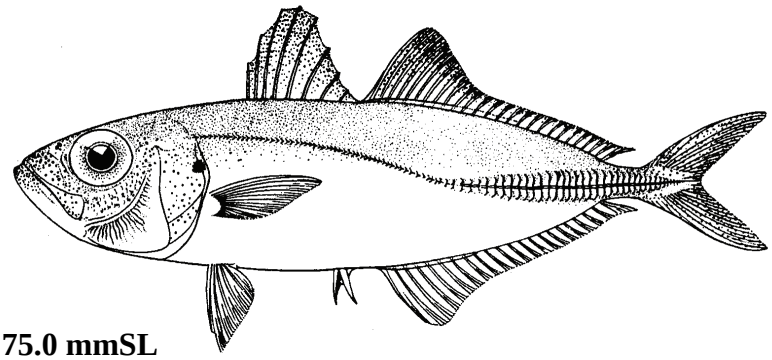


Larvae:
- Body depth shallow to moderately elongate
- Head and snout moderately pointed
- Flexion occurs between 3.7 and 5.6 mm
- Head spines most prominent on preopercle; see checklist below
- Sequence of fin ray formation: C – D_2 and A – D_1 – P_1 – P_2
- Finlets absent posterior to ends of dorsal and anal fins
- Pigment over most of head and body light; vomer unpigmented; internal pigment present on dorsal aorta and notochord; pigment on dorsolateral part of body absent or very few isolated spots; pigment on ventrolateral part of body aligned on myosepta; pigment along dorsum consists of parallel rows, primarily under D_2 fin; melanophores present on branchiostegal membrane; midline pigment consists of short line of spots between D_2 and A fins

Head spine checklist:

Supraoccipital:	low, rough-edged ridge in early stages
Preopercle Angle:	long, simple spine; some other preopercle spines also fairly long
Supraocular:	low ridge with small spine (or none)
Posttemporal:	small spine present
Supracleithral:	small spine present
Pterotic ridge:	absent

Early Juvenile:

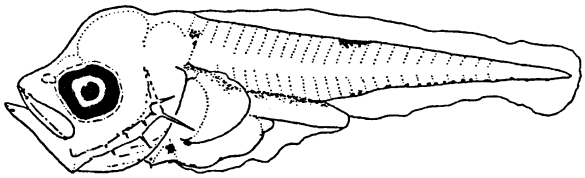


G. 75.0 mmSL

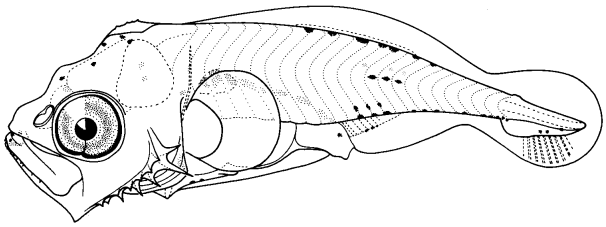
Figures: Adult: Smith-Vaniz, 2002b; Egg: Delsman, 1926; **A, F**: Wayne Laroche (Laroche *et al.*, 2004); **B, E**: Modified after Miller *et al.*, 1979 (in Watson *et al.*, 1996); **C**: Wayne Laroche (Laroche *et al.*, 1984; **D**: Beltran-Leon and Herrera, 2000; **G**: Fowler, 1928

References: Miller *et al.*, 1979; Laroche *et al.*, 1984; Watson *et al.*, 1996

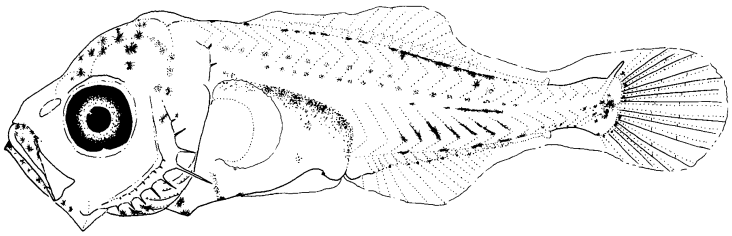
Selar crumenophthalmus



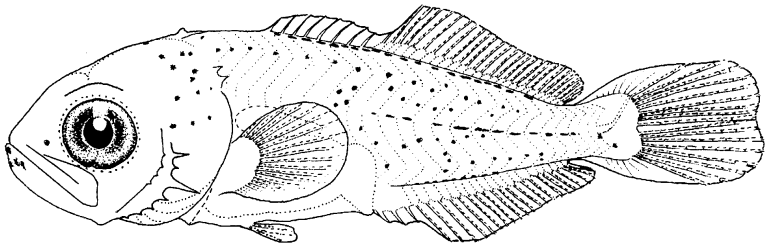
A. 2.5 mmSL



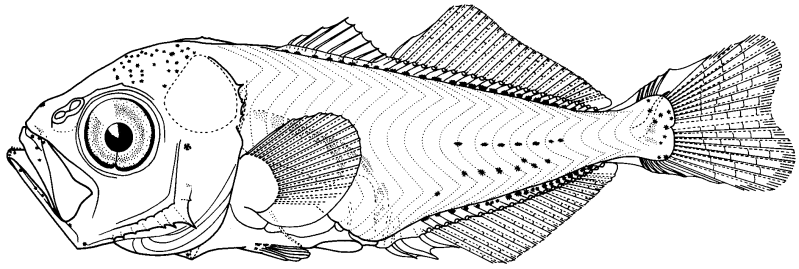
B. 3.8 mmSL



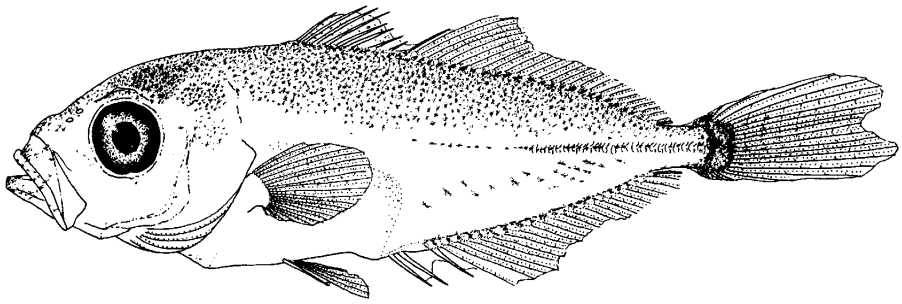
C. 5.6 mmSL



D. 7.2 mmSL

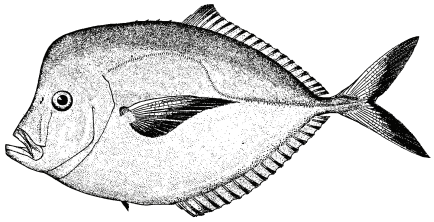


E. 8.1 mmSL



F. 17.6 mmSL

Selene setapinnis (Mitchill, 1815)
Carangidae
Atlantic moonfish



Range: Western Atlantic Ocean from Nova Scotia to Argentina including Gulf of Mexico and Caribbean Sea

Habitat: Adults school from near surface to depths of 54 m, usually in coastal waters with high salinity; juveniles occur in bays and estuaries, often seen associated with piers during late summer, early fall in study area

Spawning: Undescribed

Eggs: – Undescribed

Meristic Characters

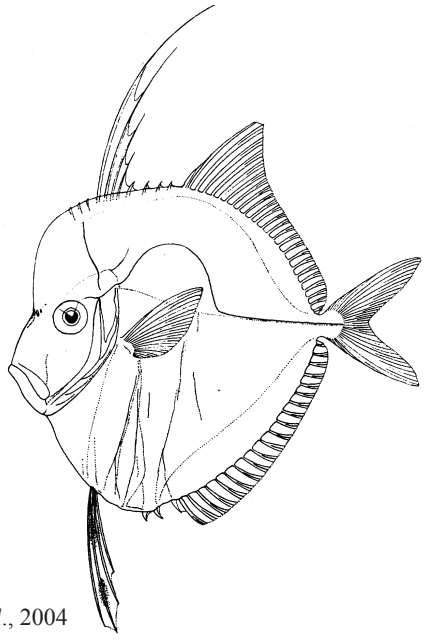
Myomeres:	24
Vertebrae:	10 + 14 = 24
Dorsal fin rays:	VIII, I, 21–24
Anal fin rays:	II, I, 16–19
Pectoral fin rays:	19–20
Pelvic fin rays:	I, 5
Caudal fin rays:	8–9+9+8+7–8
Supraneurals:	0/0+0/2+1/1/1/

Larvae:
- Body becomes very deep at small size; body depth increases from 29% SL in preflexion larvae to >75% SL in juveniles
- Preanus length decreases from about 51–57% SL in preflexion larvae to 32–35% SL in juveniles
- Head and snout moderately rounded, snout to eye distance long
- Flexion occurs at 4.3–6.3 mmSL
- Head spines most prominent on preopercle; see checklist below
- Sequence of fin ray formation: $P_2 - D_1 - C - A, D_2 - P_1$
- Finlets absent posterior to ends of dorsal and anal fins; dorsal fin spines and pelvic fin rays elongate
- Pigment over most of head and body light; vomer pigmented; small patch of internal pigment on peritoneum; preflexion larvae have row of spots along ventral edge of body, disappear later; pigment on dorsolateral part of body consists of scattered spots on nape, under D_1 and under D_2; pigment on ventrolateral part of body consists of scattered spots over anal fin; pigment along dorsum absent until early juvenile stage; a prominent patch of melanophores forms on body between D_2 and A fins; no melanophores on branchiostegal membrane; midline pigment present as a short dash in early larvae

Head spine checklist:

Supraoccipital:	present in early larvae, disappears by 5.2 mmNL
Preopercle Angle:	well developed spine only slightly longer than other preopercle spines
Supraocular:	low ridge with simple spine, forms early, persists until juvenile stage
Posttemporal:	single, small spine
Supracleithral:	single, small spine
Pterotic ridge:	absent

Early Juvenile: Note elongate dorsal spines and pelvic fin rays in juveniles; both become greatly reduced in adults.

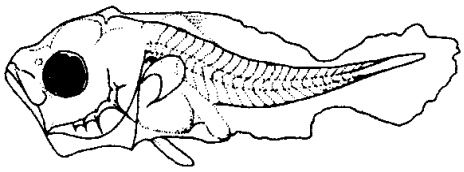


H. 30.0 mmSL

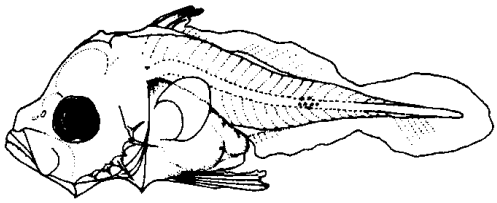
Figures: Adult: Goode, 1884; **A–G**: Katsuragawa, 1997; **H**: Fowler, 1936

References: Sanchez-Ramirez and Flores-Coto, 1993; Katsuragawa, 1997; Laroche *et al*., 2004

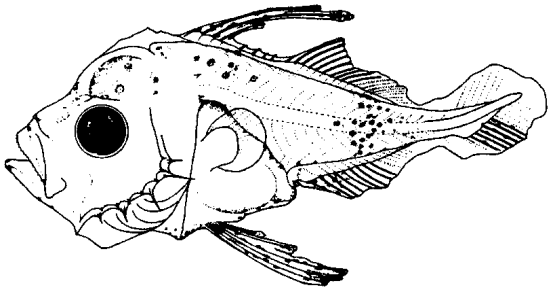
Selene setapinnis



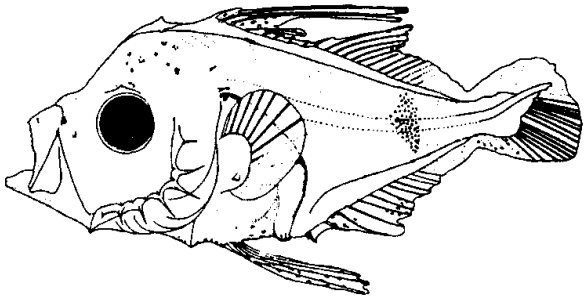
A. 2.9 mmNL



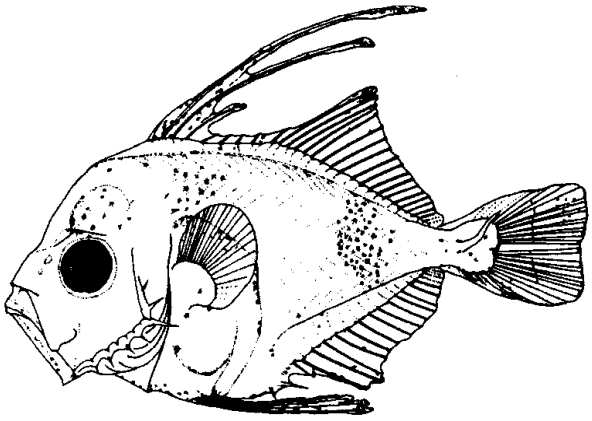
B. 3.4 mmNL



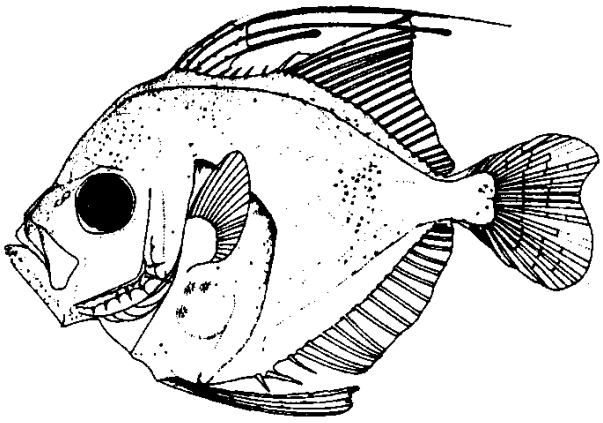
C. 4.2 mmNL



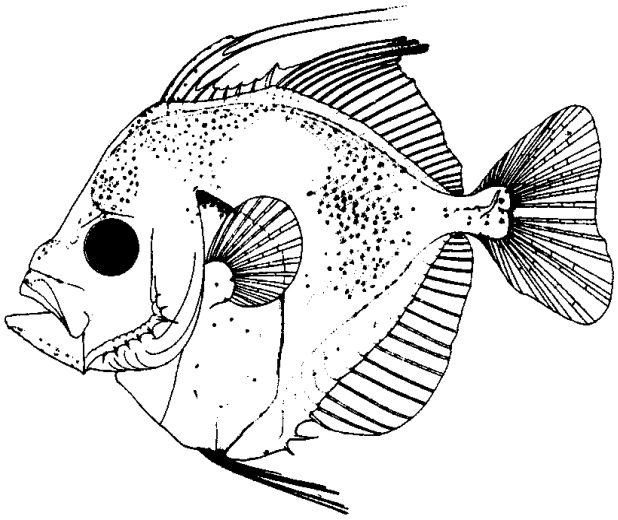
D. 5.2 mmNL



F. 7.4 mmSL

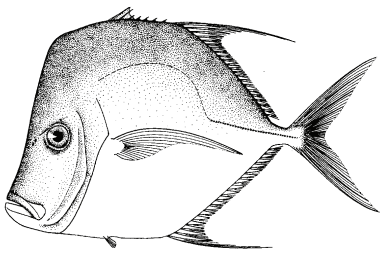


E. 6.2 mmNL



G. 9.1 mmSL

Selene vomer (Linnaeus, 1758)
Carangidae
Lookdown



Range: Western Atlantic Ocean from Nova Scotia to Uruguay including Gulf of Mexico, rare in West Indies

Habitat: Sandy shores, bays; juveniles occur in coastal or estuarine waters over sand or mud bottoms

Spawning: Probably year-round in some areas of range; possibly peaks in summer-fall in Gulf of Mexico

Eggs: – Undescribed

Meristic Characters

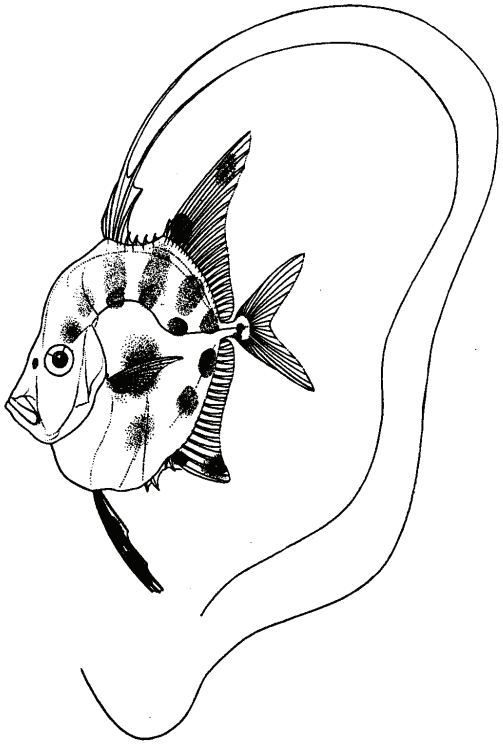
Myomeres:	24
Vertebrae:	10 + 14 = 24
Dorsal fin rays:	VIII, I, 21–23
Anal fin rays:	II, I, 18–20
Pectoral fin rays:	21–22
Pelvic fin rays:	I, 5
Caudal fin rays:	7–9+9+8+7–8
Supraneurals:	0/0+0/2+1/

Larvae:
- Body depth becomes deeper through development, tapers strongly
- Head and snout moderately pointed
- Flexion occurs at 4.0–5.5 mmSL
- Head spines most prominent on preopercle; see checklist below
- Sequence of fin ray formation: P_2, $D_1 - D_2 - C$, $A - P_1$
- Finlets absent posterior to dorsal and anal fins; dorsal spines very long and filamentous; pelvic fin rays elongate
- Pigment over most of head and body light with distinct patterns of melanophores; vomer pigmented; internal pigment absent (except peritoneal); pigment on dorsolateral part of body in small patches under dorsal fin; pigment on ventrolateral part of body mostly in large patch of melanophores over anal fin (spots form early); pigment along dorsum consists of few melanophores in short, parallel rows in early larvae; no branchiostegal pigment; midline pigment present in early larvae; midventral row of spots (similar to that in *Elegatis bipinnulata*) present in early stages

Head spine checklist:

Supraoccipital:	low ridge with simple spiny point
Preopercle Angle:	long, simple spine; other spines shorter
Supraocular:	low ridge with small, simple spine
Posttemporal:	absent
Supracleithral:	absent
Pterotic ridge:	absent

Early Juvenile: Note anterior rays of D_2 and A fins become elongate in juvenile and adult stages; elongate dorsal spine filaments lost in adults

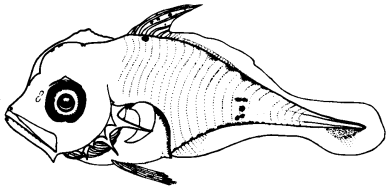


G. 15.0 mmSL

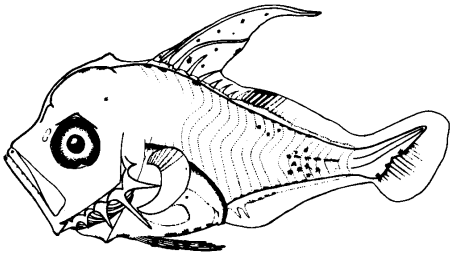
Figures: Adult: Smith-Vaniz, 2002b; **A–F**: Aprieto, 1974; **G**: Fowler, 1936

References: Aprieto, 1974; Laroche *et al*., 1984

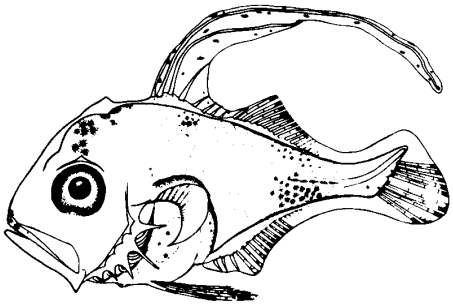
Selene vomer



A. 3.2 mmSL

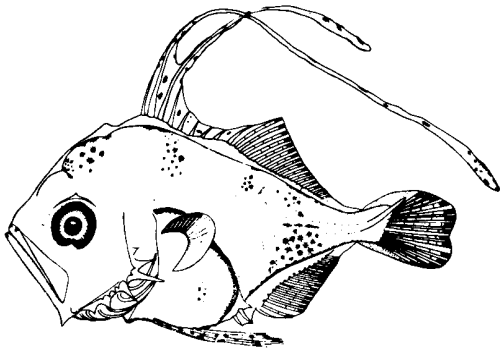


B. 3.9 mmSL



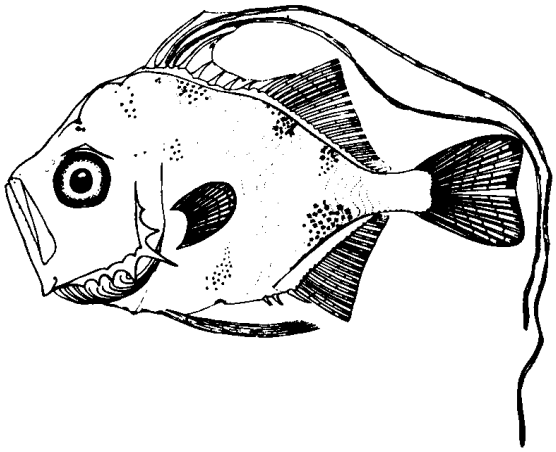
C. 4.5 mmSL

Dark peritoneum pigment

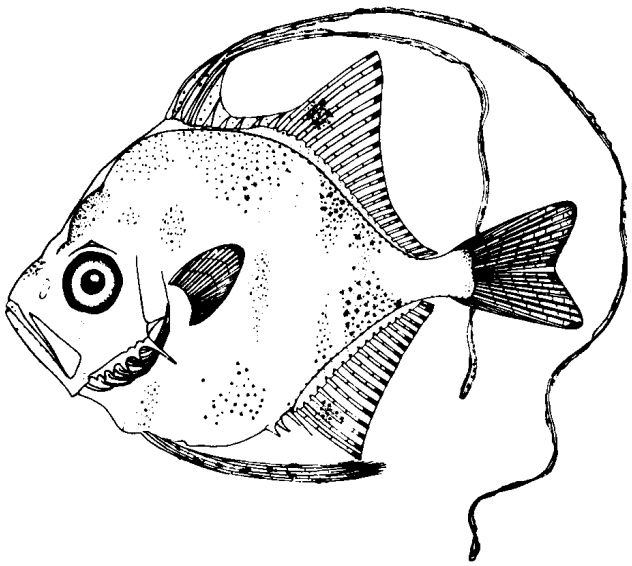


D. 5.8 mmSL

2^{nd} and 3^{rd} dorsal spines with elongate filaments



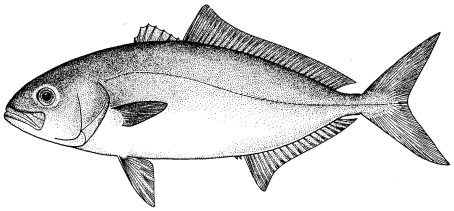
E. 7.7 mmSL



Anus situated anteriorly, opens near base of pelvic fin rays

F. 9.0 mmSL

Seriola dumerili (Risso, 1810)
Carangidae
Greater amberjack



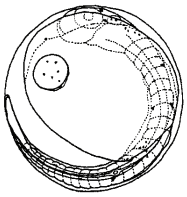
Range: North Atlantic Ocean; in the western North Atlantic from Cape Cod to Brazil including Bermuda; also eastern Atlantic and Mediterranean Sea

Habitat: Open ocean; pelagic to depths of 450 m

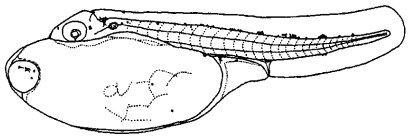
Spawning: Probably fall through winter into spring in offshore waters

Meristic Characters

Myomeres:	24
Vertebrae:	10+14 = 24
Dorsal fin rays:	VII,I, 30–35
Anal fin rays:	II,I, 19–22
Pectoral fin rays:	20–23
Pelvic fin rays:	I, 5
Caudal fin rays:	10–11+9+8+10–11
Supraneurals:	0/0/0+1+1/



Eggs:
- Pelagic, spherical, transparent
- Diameter: 1.0–1.1 mm
- Chorion striated
- Oil globule: single, 0.28 mm in diameter
- Perivitelline space: narrow



Yolk-sac larva, 2.9 mm TL

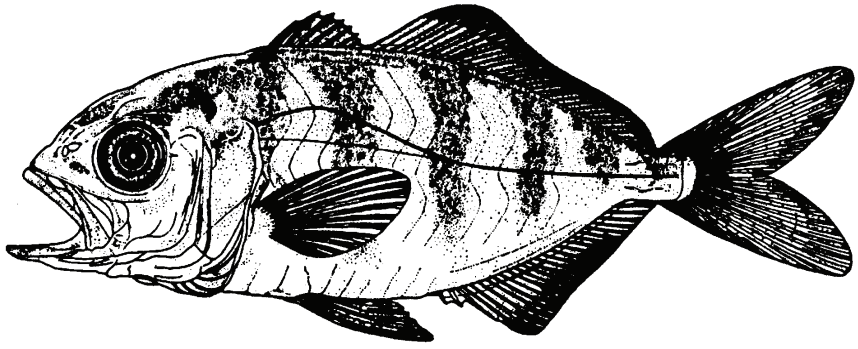
Larvae:
- Hatching length about 2.9 mmTL
- Body depth moderately shallow
- Head and snout slightly pointed
- Flexion occurs at 5.0–7.0 mmSL
- Head spines most prominent on preopercle; see checklist below
- Sequence of fin ray formation: C – D_2, A – D_1 – P_1, P_2
- Finlets absent posterior to ends of dorsal and anal fins
- Pigment over most of head and body heavy except for unpigmented caudal peduncle; vomer pigmented; internal pigment present; dense pigment on dorsolateral part of body occurs from nape to caudal peduncle; dense pigment on ventrolateral part of body including over gut; pigment along dorsum in dense, parallel rows; melanophores present on branchiostegal membrane; midline pigment present until obscured by over-all body pigment; larger larvae develop blotches over dorsal and anal fin rays

Head spine checklist:

Supraoccipital:	absent
Preopercle Angle:	long, simple spine with shorter spines along edges
Supraocular:	very small spine
Posttemporal:	small spine
Supracleithral:	small spine (?)
Pterotic ridge:	absent

Early Juvenile:

Note formation of 7 bars across body including a nuchal bar from eye to D_1 origin

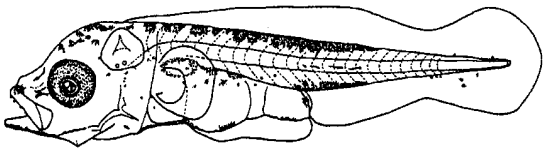


G. 52.1 mmSL

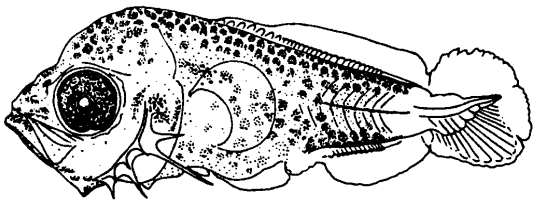
Figures: Adult: Smith-Vaniz, 2002b; egg, yolk-sac larva and **A, F**: Masuma *et al*., 1990; **B–E**: Okiyama, 1988; **G**: Tachihara *et al*., 1993

References: Sanzo, 1933b; Okiyama, 1988; Masuma *et al*., 1990

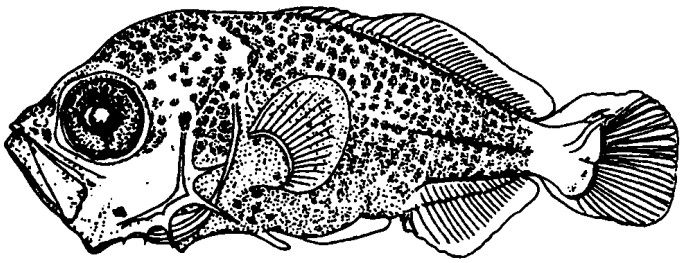
Seriola dumerili



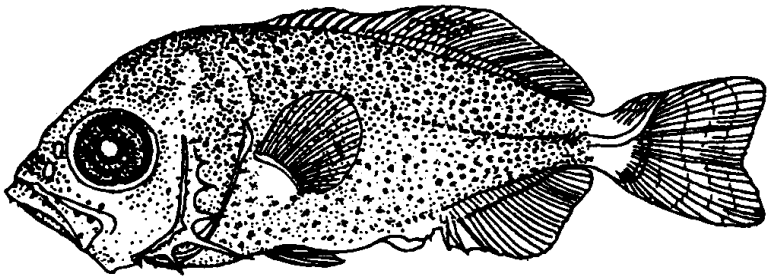
A. 4.6 mmTL



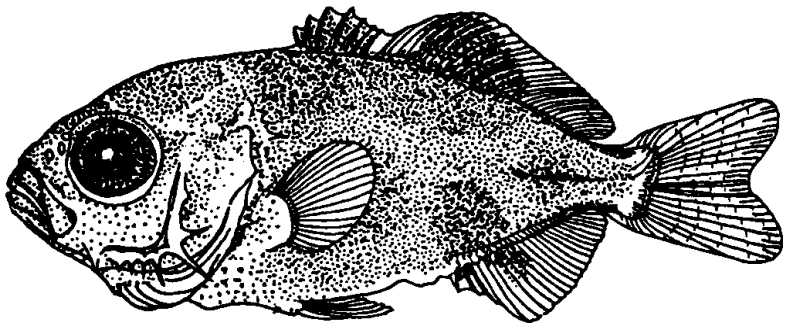
B. 5.5 mmTL



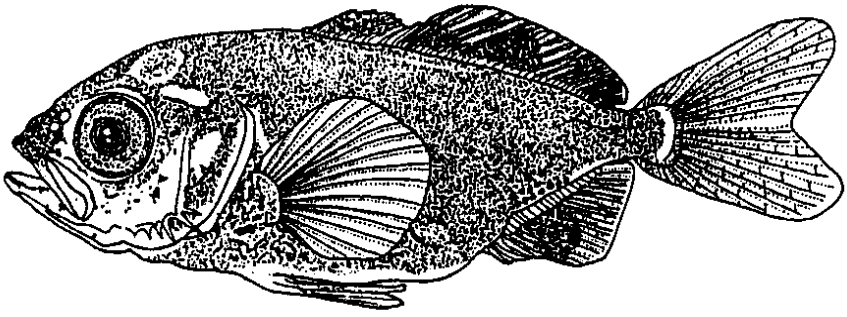
C. 6.5 mmTL



D. 9.0 mmTL

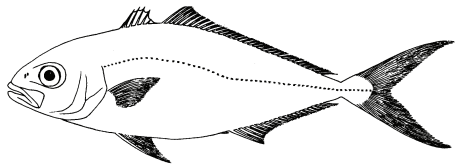


E. 12.5 mmTL



F. 17.3 mmTL

Seriola fasciata (Bloch, 1797)
Carangidae
Lesser amberjack



Range: Western North Atlantic Ocean from Massachusetts to Brazil including Gulf of Mexico; also Mediterranean Sea and islands in eastern Atlantic Ocean

Habitat: Near bottom in depths of 55–125 m; juveniles epipelagic in oceanic waters

Spawning: Undescribed; possibly peaks in summer

Eggs: – Undescribed

Meristic Characters

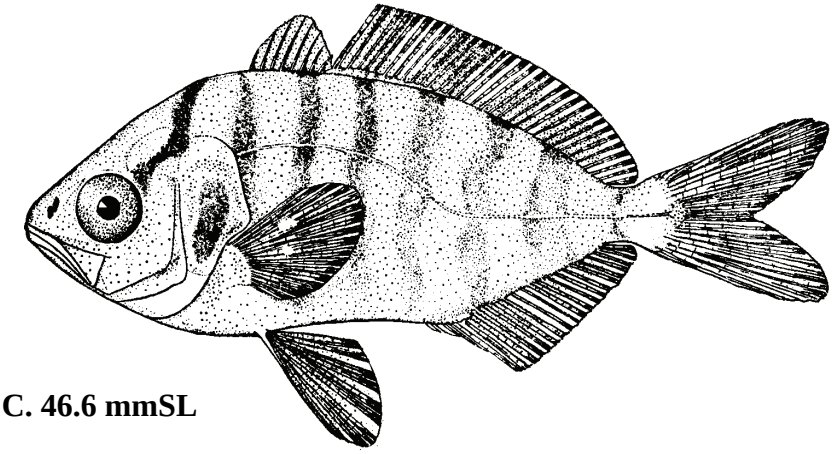
Myomeres:	24
Vertebrae:	10+14 = 24
Dorsal fin rays:	VIII,I, 30–32
Anal fin rays:	II,I, 19–20
Pectoral fin rays:	20–22
Pelvic fin rays:	I, 5
Caudal fin rays:	9+8 PrC
Supraneurals:	0/0/0+1+1/

Larvae:
- Early ontogeny undescribed; smallest larva described is 11.2 mmSL
- Body depth moderately shallow
- Head and snout moderately pointed
- Flexion occurs at unknown size
- Head spines most prominent on preopercle; see checklist below
- Sequence of fin ray formation: undescribed (see other species of *Seriola*)
- Finlets absent posterior to ends of dorsal and anal fins
- Pigment over most of head and body heavy; vomer pigmented; internal pigment present; pigment on dorsolateral part of body scattered and heavy; pigment on ventrolateral part of body scattered and heavy; pigment along dorsum unknown in early stages, probably in parallel rows; melanophores present on branchiostegal membrane; midline pigment probably present until obscured by over-all body pigment

Head spine checklist:

Supraoccipital:	absent
Preopercle Angle:	long, simple spine, with shorter spines along edges
Supraocular:	low ridge
Posttemporal:	unknown
Supracleithral:	unknown
Pterotic ridge:	absent

Early Juvenile: Note formation of 9 bars across body including a nuchal bar from eye to D_1 origin

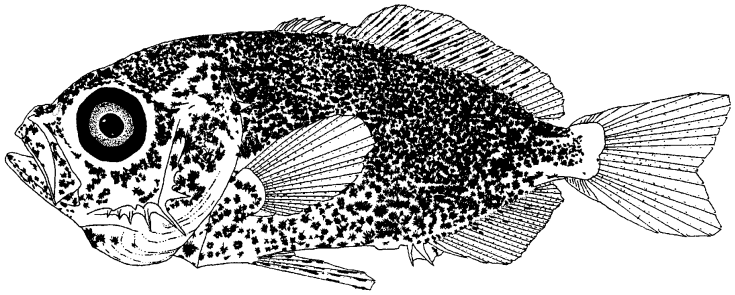


C. 46.6 mmSL

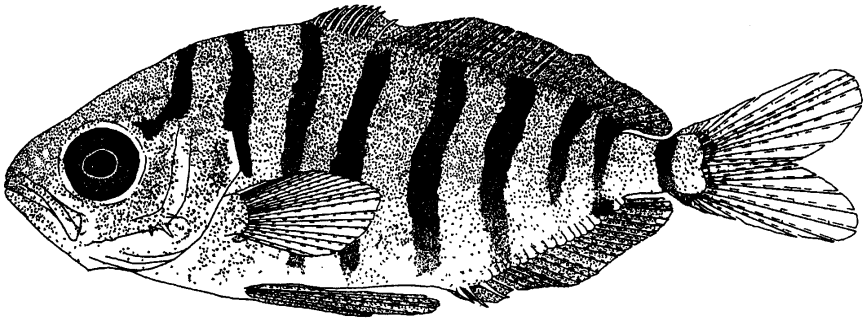
Figures: Adult: F. H. Berry (G. D. Johnson, 1978); **A–B**: Jim Ditty (Laroche *et al.*, 2004); **C**: Ginsburg, 1952

References: Fahay, 1975; Laroche *et al.*, 1984; 2004

Seriola fasciata

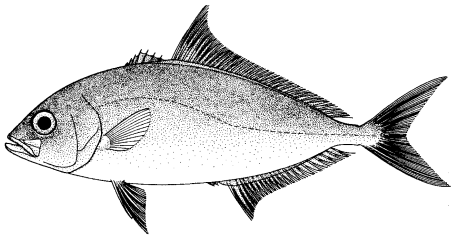


A. 11.2 mmSL



B. 26.5 mmSL

Seriola rivoliana Valenciennes, 1833
Carangidae
Almaco jack



Range: Worldwide in tropical and temperate waters; in the western Atlantic from Massachusetts to Argentina including the Gulf of Mexico

Habitat: Oceanic, rarely in shallow water; juveniles may use drifting *Sargassum*

Spawning: Undescribed; probably spring through fall

Eggs:
- Undescribed

Larvae:
- Body depth moderately shallow
- Head and snout slightly pointed
- Flexion occurs at about 5.0–8.0 mmSL
- Head spines most pronounced on preopercle; see checklist below
- Sequence of fin ray formation: $C - D_2$, $A - D_1 - P_1 - P_2$
- Finlets absent posterior to ends of dorsal and anal fins
- Pigment over most of head and body heavy except for unpigmented caudal peduncle; vomer pigmented; internal pigment present; pigment on dorsolateral part of body scattered and heavy; pigment on ventrolateral part of body scattered and heavy, slightly lighter over gut; pigment along dorsum consists of dense melanophores on both sides of mid-dorsal line; melanophores present on branchiostegal membrane; midline pigment present until obscured by over-all body pigment; larger larvae develop blotches over dorsal and anal fins

Meristic Characters

Myomeres:	24
Vertebrae:	10+14 = 24
Dorsal fin rays:	VII–VIII,I,28–32
Anal fin rays:	II,I, 19–22
Pectoral fin rays:	20–23
Pelvic fin rays:	I, 5
Caudal fin rays:	11–13+9+8+8–12
Supraneurals:	0/0/0+1+1/

Head spine checklist:

Supraoccipital:	absent
Preopercle Angle:	long, simple spine with shorter spines along edges
Supraocular:	low ridge with simple spine
Posttemporal:	simple spine
Supracleithral:	simple spine
Pterotic ridge:	absent

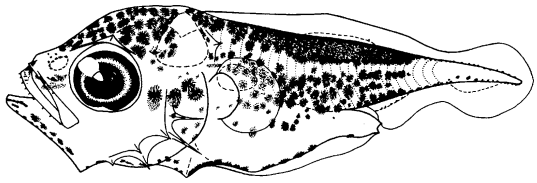
Note:
1. The larvae illustrated in Figs. A–C and E are tentatively identified as *Seriola rivoliana* whereas the 8.2 mmSL larva in Fig. D is *Seriola hippos*, a carangid species endemic to Australia and New Zealand (Tom Trnski, pers. comm.).

Juvenile: Note formation of 8 bars across body including a nuchal bar from eye to D_1 origin in juveniles (not illustrated)

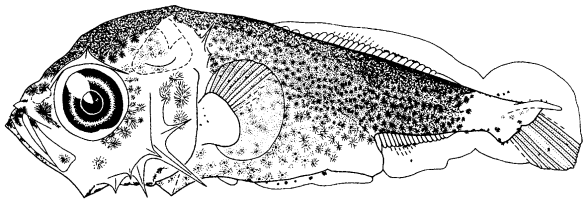
Figures: Adult: Smith-Vaniz, 2002b; **A–E**: Tom Trnski (Trnski, 1998)

References: Fahay, 1975; Trnski, 1998

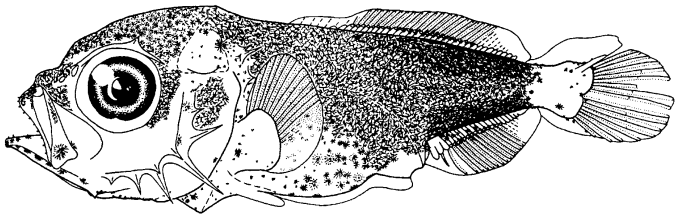
Seriola rivoliana



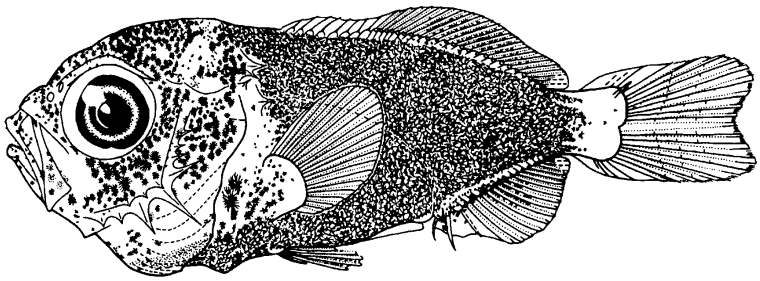
A. 3.9 mmSL



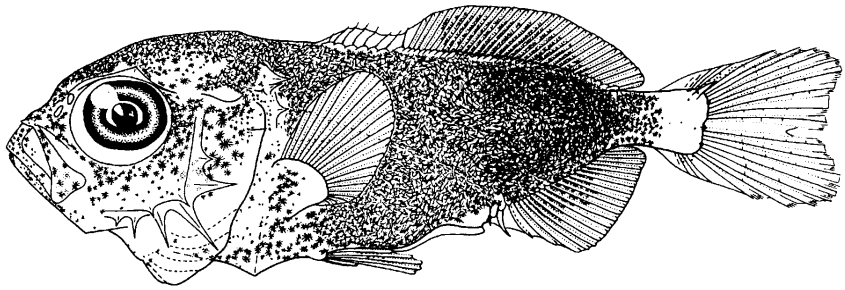
B. 5.2 mmSL



C. 6.5 mmSL

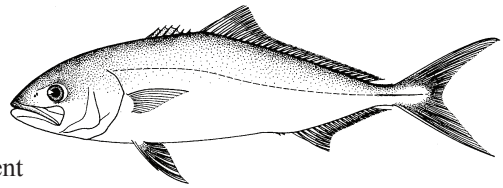


D. 8.2 mmSL



E. 9.0 mmSL

Seriola zonata (Mitchill, 1815)
Carangidae
Banded rudderfish



Range: Western North Atlantic Ocean from Nova Scotia to Brazil; absent from Bermuda, Bahamas and much of Caribbean Sea

Habitat: Pelagic, mostly in coastal waters; juveniles often associate with larger fishes (e.g. sharks), drifting weed or jellyfish

Spawning: Possibly year-round or in 2 parts (winter-spring and fall); mostly in offshore waters along edge of continental shelf

Meristic Characters

Myomeres:	24
Vertebrae:	10+14 = 24
Dorsal fin rays:	VII–VIII, I, 33–40
Anal fin rays:	II, I, 27–30
Pectoral fin rays:	19–22
Pelvic fin rays:	I, 5
Caudal fin rays:	10–11+9+8+9–10
Supraneurals:	0/0/0+1+1/

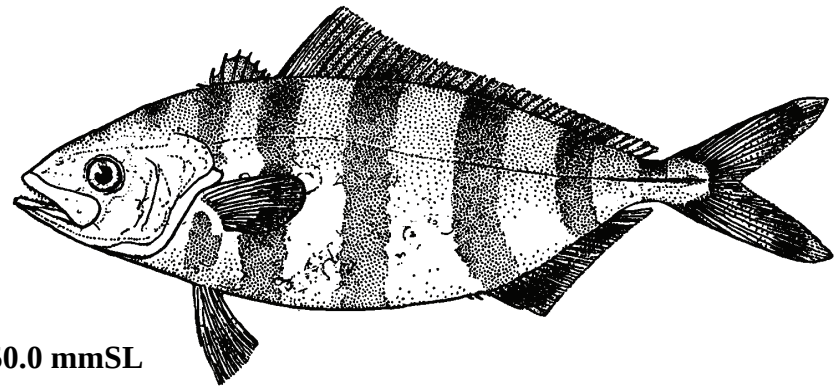
Eggs: – Undescribed

Larvae:
- Body depth moderately shallow
- Head and snout moderately pointed
- Flexion occurs at about 5.0–7.0 mmSL
- Head spines most prominent on preopercle; see checklist below
- Sequence of fin ray formation: $C - D_2$, $A - D_1 - P_2 - P_1$
- Finlets absent posterior to ends of dorsal and anal fins
- Pigment over most of head and body heavy; vomer pigmented; internal pigment present; pigment on dorsolateral part of body scattered and heavy; pigment on ventrolateral part of body scattered and heavy; pigment along dorsum consists of single row of spots along mid-dorsal line until obscured by increasing body pigment; melanophores present on branchiostegal membrane; midline pigment present until obscured by over-all body pigment; larger larvae develop blotches on dorsal and anal fins

Head spine checklist:

Supraoccipital:	absent
Preopercle Angle:	long, simple spine with smaller spines along edges
Supraocular:	low ridge with small, simple spine
Posttemporal:	prominent spine (possibly forked)
Supracleithral:	small spine present
Pterotic ridge:	absent

Early Juvenile: Note formation of 7 bars across body including a nuchal bar (possibly vague) from eye to D_1 origin

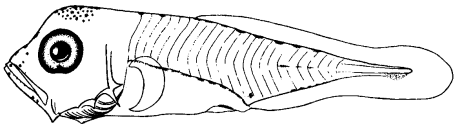


I. 50.0 mmSL

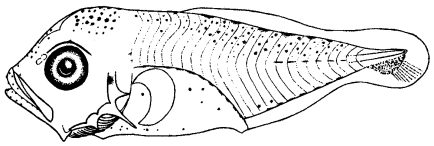
Figures: Adult: Smith-Vaniz, 2002b; **A–C**, **G–H**: Aprieto, 1974; **D–E**: Jim Ditty (Laroche *et al*., 2004); **F**: Wayne Laroche (Laroche *et al*., 1984; **I**: Bigelow and Schroeder, 1953

References: Aprieto, 1974; Fahay, 1975; Laroche *et al.*, 1984; 2004

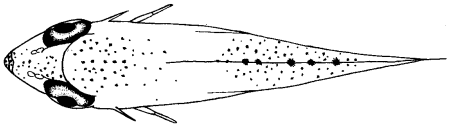
Seriola zonata

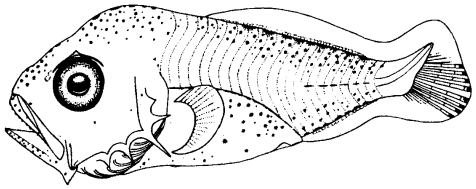


A. 3.6 mmSL

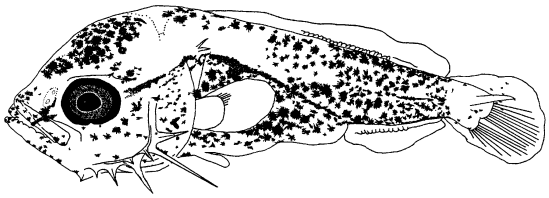


B. 4.8 mmSL
(Lateral and Dorsal)

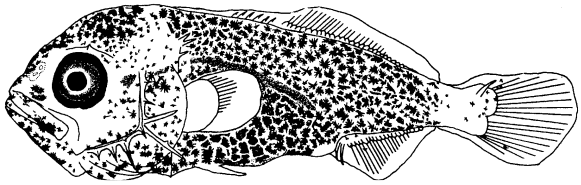




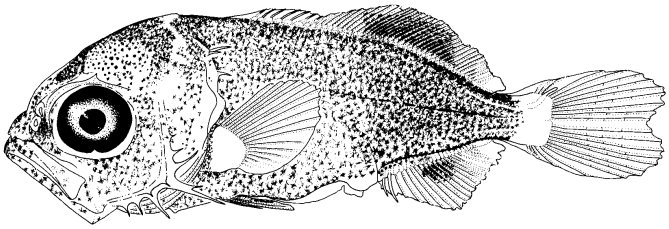
C. 5.5 mmSL



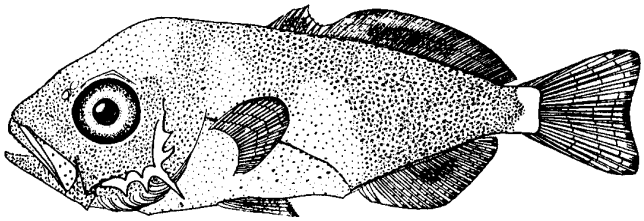
D. 6.3 mmSL



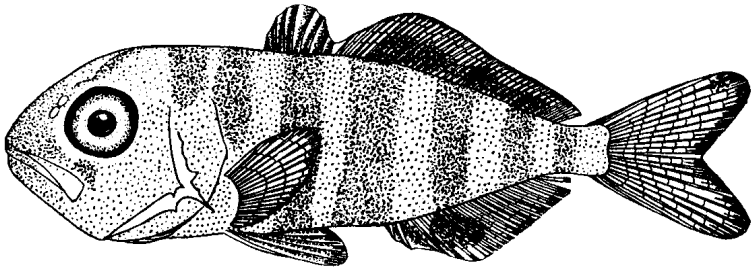
E. 8.0 mmSL



F. 9.5 mmSL

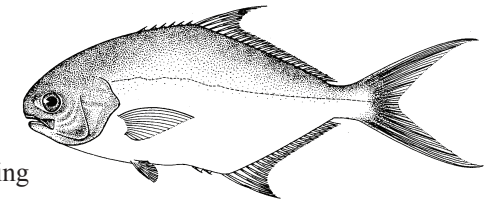


G.
10.6 mmSL



H. 18.0 mmSL

Trachinotus carolinus (Linnaeus, 1766)
Carangidae
Florida pompano



Range: Western North Atlantic ocean from Massachusetts to Brazil, including Bermuda and Gulf of Mexico; rare in Caribbean Sea

Habitat: Sandy beaches, inlets, often associated with turbid water; juveniles often occur in surf zone

Spawning: Mar–Sep (or more protracted) off southeast United States; mostly well offshore

Meristic Characters

Myomeres:	24
Vertebrae:	10+14 = 24
Dorsal fin rays:	V–VI, I, 22–27
Anal fin rays:	II, I, 20–23
Pectoral fin rays:	18–20
Pelvic fin rays:	I, 5
Caudal fin rays:	8+9+8+7–8
Supraneurals:	0/0/0+P/1+1/

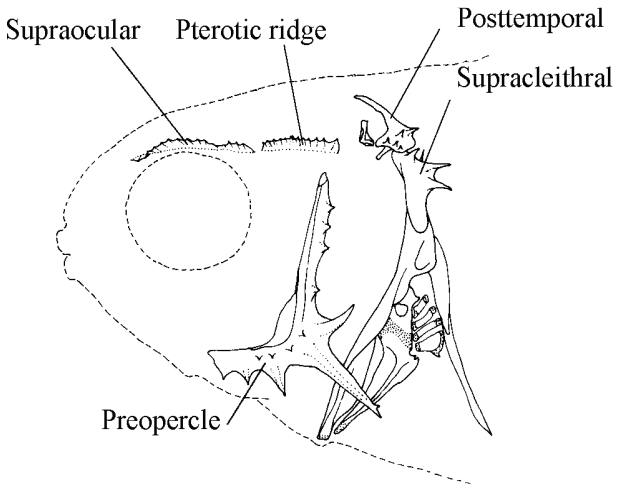
Eggs:
- Pelagic, spherical
- Diameter: 0.7 mm (unfertilized)
- Chorion: smooth
- Oil globule: single
- Perivitelline space: narrow

Larvae:
- Body depth moderately shallow, becomes deeper; note characteristic body shape with long predorsal length, low number of dorsal spines, rounded snout
- Head and snout blunt and rounded
- Flexion occurs at about 4.0–5.0 mmSL
- Head spines most prominent on preopercle; see checklist below
- Sequence of fin ray formation: C – D_1, A(spines) – D_2, A – P_1 – P_2
- Finlets absent posterior to ends of dorsal and anal fins
- Pigment over most of head and body heavy; vomer pigmented; internal pigment present; pigment on dorsolateral part of body scattered and heavy; pigment on ventrolateral part of body scattered and heavy; pigment along dorsum initially absent, then becomes dense; melanophores present on branchiostegal membrane; midline pigment present and remains prominent against scattered background pigment; a faint blotch forms on anterior dorsal fin rays in larger larvae

Head spine checklist:

Supraoccipital:	absent
Preopercle Angle:	very long, simple spine
Supraocular:	long, serrated ridge
Posttemporal:	small spine
Supracleithral:	small spines
Pterotic ridge:	long, serrated ridge

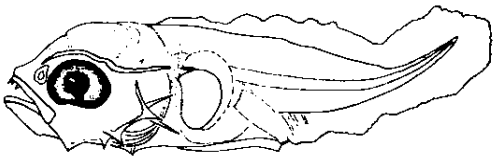
Larvae of *Trachinotus* differ from those of other carangids in the presence of a prominent pterotic ridge, as shown in this illustration of *Trachinotus blochii* from coastal Japan (modified after Kojima, 1985)



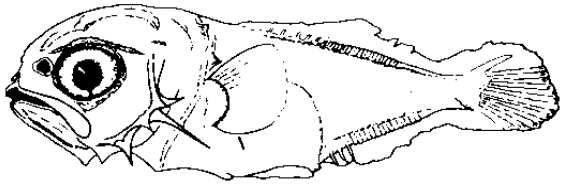
Figures: Adult: Smith-Vaniz, 2002b; **A–B**, **D–F**: Fields, 1962; **C**: Wayne Laroche (Laroche *et al.*, 1984)

References: Fields, 1962; Fahay, 1975; Laroche *et al*., 1984; Kojima, 1985

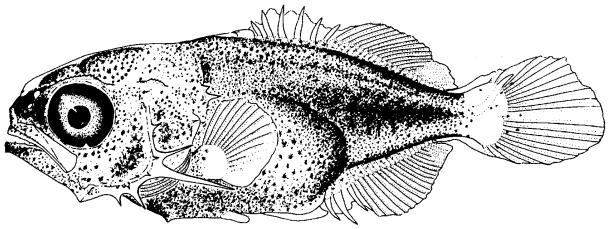
Trachinotus carolinus



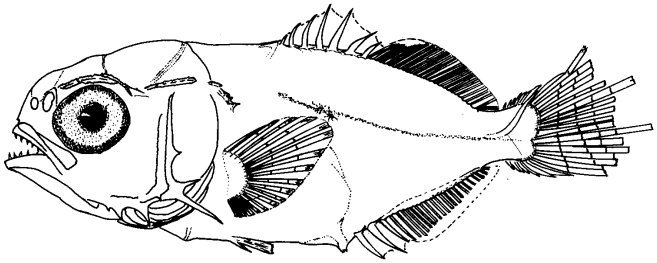
A. 3.1 mmSL



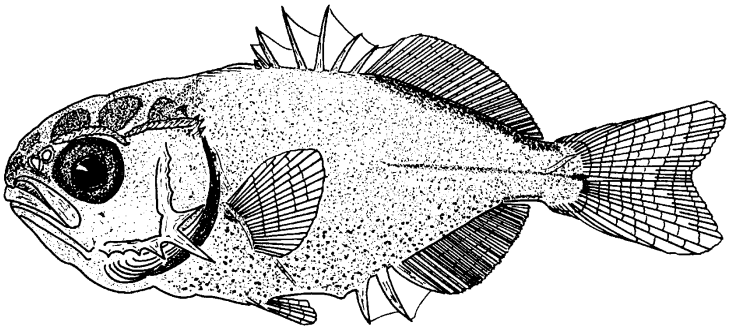
B. 4.7 mmSL



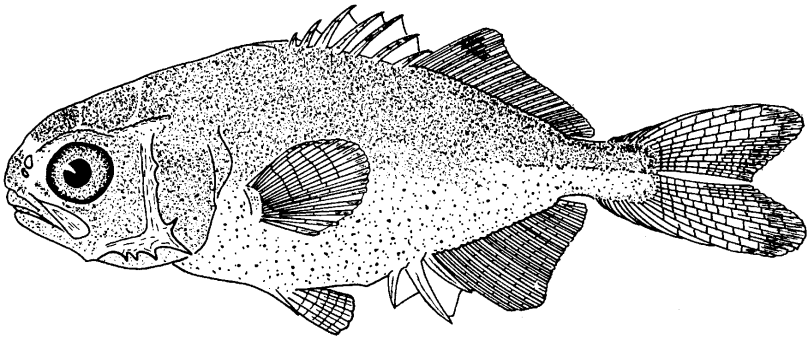
C. 5.9 mmSL



D. 7.2 mmSL

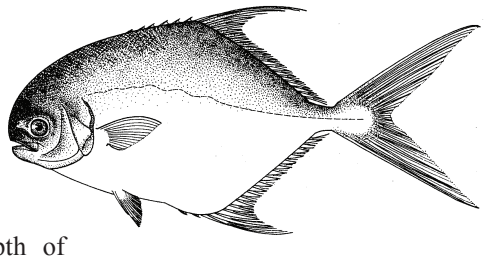


E. 11.0 mmSL



F. 14.8 mmSL

Trachinotus falcatus (Linnaeus, 1758)
Carangidae
Permit



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

Habitat: Sand flats, mud bottoms, surf zone and over reefs to a depth of 30 m; juveniles often occur in small schools off sandy beaches

Spawning: Dec–Sep, with most activity Apr–Jun; in close proximity to Gulf Stream; young stages move inshore at 12–50 mm

Meristic Characters

Myomeres:	24
Vertebrae:	10+14 = 24
Dorsal fin rays:	VI, I, 18–20
Anal fin rays:	II, I, 17–18
Pectoral fin rays:	19–21
Pelvic fin rays:	I, 5
Caudal fin rays:	7+9+8+8
Supraneurals:	0/0/0+P/1+1/

Eggs: – Undescribed

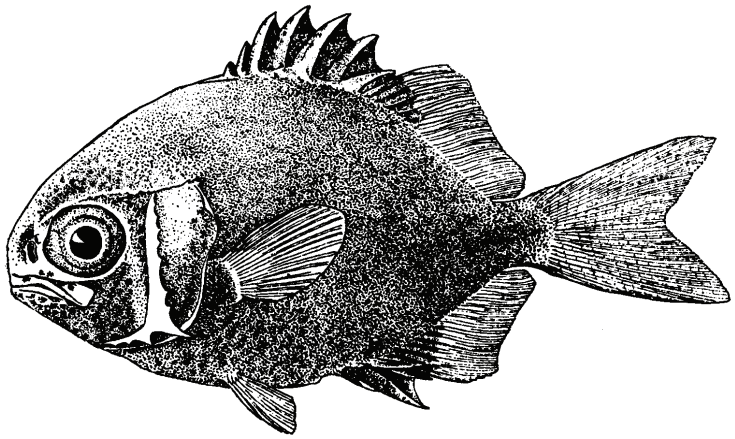
Larvae:
- Body moderately shallow, soon becomes deep; (body deeper than in comparably sized congeners)
- Head and snout blunt and rounded
- Flexion occurs at about 4.0–5.0 mmSL
- Head spines most prominent on preopercle; see checklist below
- Sequence of fin ray formation: C – D_1, A(spines) – D_2, A – P_1 – P_2
- Finlets absent posterior to ends of dorsal and anal fins
- Pigment over most of head and body heavy; vomer pigmented; internal pigment present; pigment on dorso lateral part of body scattered and heavy; pigment on ventrolateral part of body scattered and heavy; pigment along dorsum in parallel rows until obscured by heavy pigment; melanophores present on branchiostegal membrane; midline pigment present until obscured by over-all body pigment; dark pigment covers membranes of dorsal and anal fin spines and proximal portions of dorsal and anal fin rays

Head spine checklist:

Supraoccipital:	absent
Preopercle Angle:	long, simple spine, with shorter adjacent spines
Supraocular:	low, serrated ridge
Posttemporal:	1 or more small spines
Supracleithral:	1 or more small spines
Pterotic ridge:	low, serrated ridge

Early Juvenile:

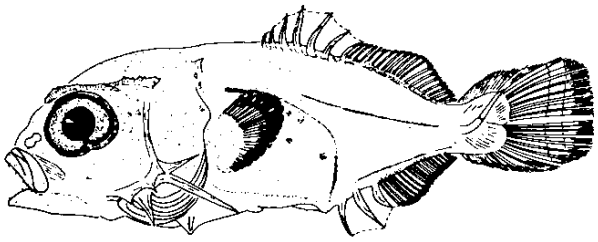
D. 18.0 mmSL



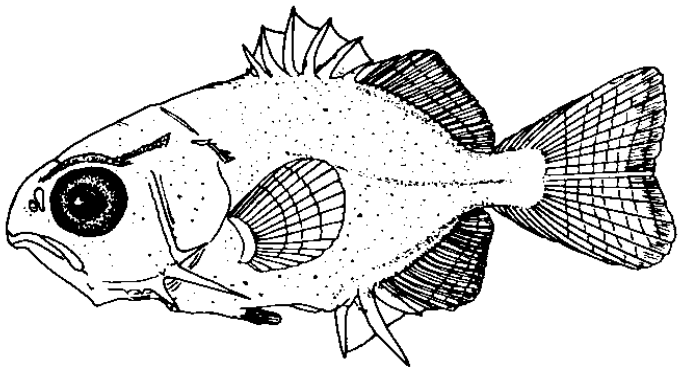
Figures: Adult: Smith-Vaniz, 2002b; **A–C**: Fields, 1962; **D**: Hildebrand and Schroeder, 1928

References: Fields, 1962; Fahay, 1975; Laroche *et al*., 1984

Trachinotus falcatus

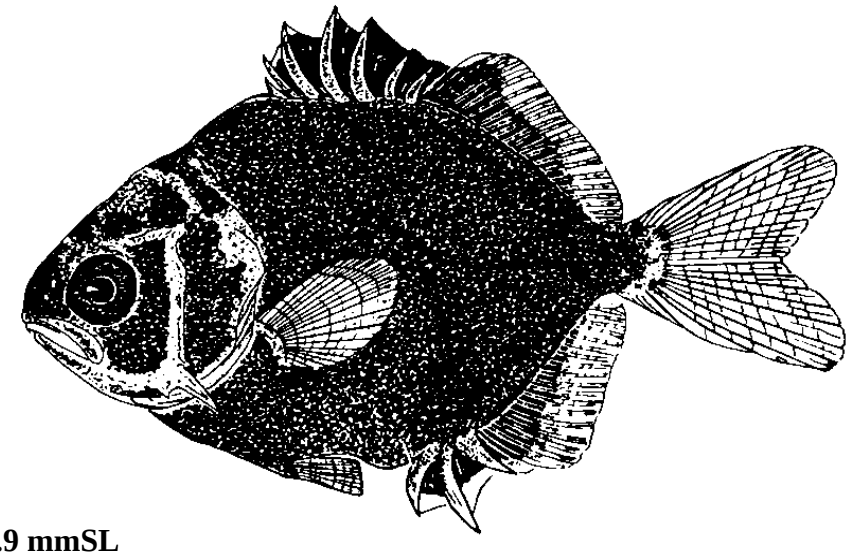


A. 5.0 mmSL



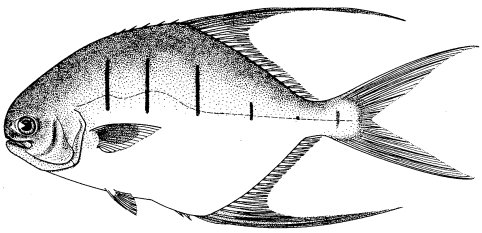
B. 7.7 mmSL

Note deeper body than in *Trachinotus carolinus* or *T. goodei*



C. 16.9 mmSL

Trachinotus goodei Jordan and Evermann, 1896
Carangidae
Palometa



Range: Western Atlantic ocean from Massachusetts to Argentina, including Bermuda and Gulf of Mexico; rare along coast of United States, except juveniles common in southeast Florida, spring-summer

Habitat: Sandy beaches, usually in clear water

Spawning: Spring-summer; no other information

Eggs: – Undescribed

Larvae:
- Body depth moderately shallow, deepens during development
- Head and snout moderately blunt and rounded
- Flexion occurs at about 5.0–7.0 mmSL
- Head spines most pronounced on preopercle; see checklist below
- Sequence of fin ray formation: C– D_1, A(spines) – D_2, A – P_1 – P_2
- Finlets absent posterior to ends of dorsal and anal fins
- Pigment over most of head and body heavy; vomer pigmented; internal pigment present; pigment on dorso lateral part of body scattered and heavy; pigment on ventrolateral part of body scattered and heavy; pigment along dorsum in dark, parallel rows; melanophores present on branchiostegal membrane; midline pigment present until obscured by over-all body pigment; dark pigment on membrane between dorsal and anal fin spines

Meristic Characters

Myomeres:	24
Vertebrae:	10+14 = 24
Dorsal fin rays:	VI, I, 19–20
Anal fin rays:	II, I, 16–18
Pectoral fin rays:	17–20
Pelvic fin rays:	I,5
Caudal fin rays:	7–8+9+8+7
Supraneurals:	0/0/0+P/1+1/

Head spine checklist:

Supraoccipital:	absent
Preopercle Angle:	long, simple spine with shorter spines along edge
Supraocular:	low, serrated ridge
Posttemporal:	small spine
Supracleithral:	small spine
Pterotic ridge:	low, serrated ridge

Note: Larvae of the 3 species of *Trachinotus* are best distinguished by dorsal and anal fin ray counts and relative body depth (table below)

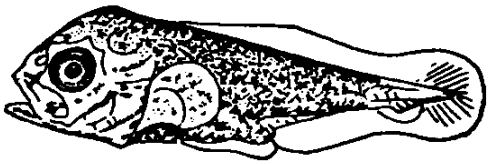
Body Depth at origin of 1st anal fin spine as percent of SL

Size Range (mmSL)	*Trachinotus carolinus*	*Trachinotus falcatus*	*Trachinotus goodei*
5.0–6.9	–	30–33	–
7.0–9.9	32	35–44	36
10.0–13.9	28–39	40–48	35
14.0–16.9	31–34	41–53	34–36
17.0–20.0	34	43–55	36

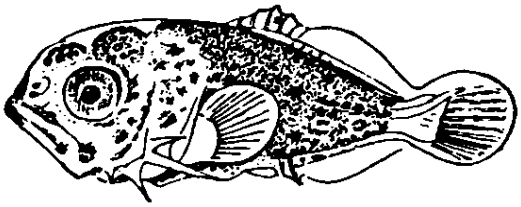
Figures: Adult: Smith-Vaniz, 2002b; **A–C**: de Gaetani, 1940; **D–F**: Fields, 1962

References: de Gaetani, 1940; Fields, 1962; Aboussouan, 1975; Fahay, 1975; Laroche *et al.*, 1984

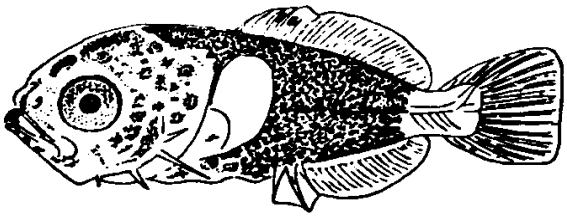
Trachinotus goodei



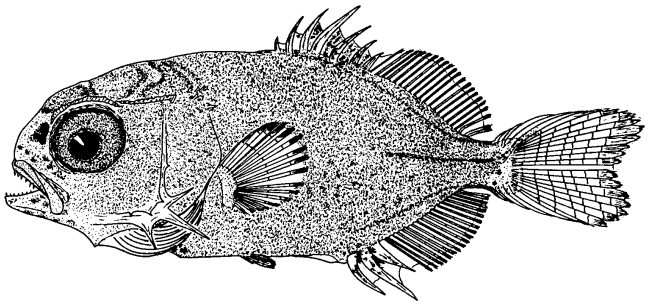
A. 5.4 mmSL



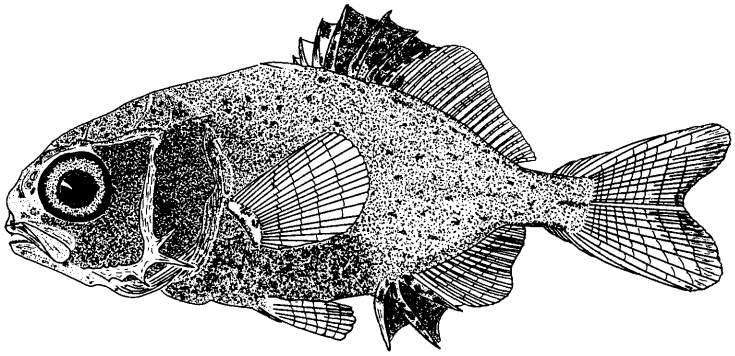
B. 5.6 mmSL



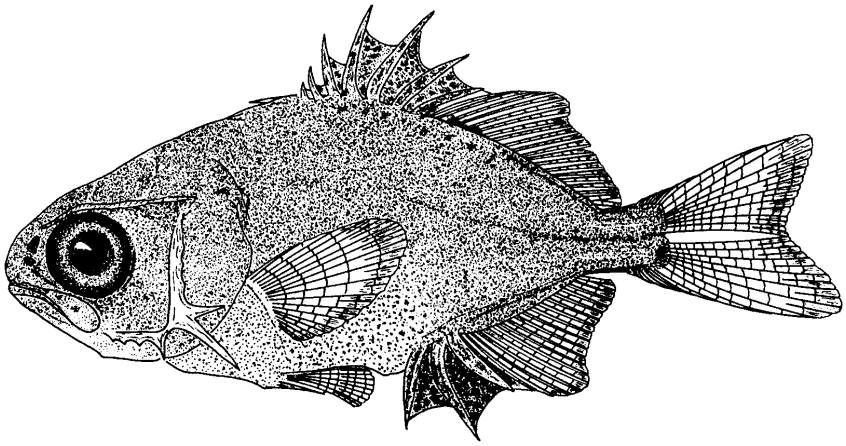
C. 6.9 mmSL



D. 7.8 mmSL

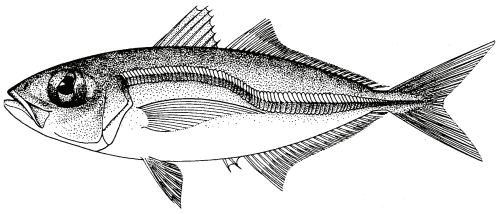


E. 11.8 mmSL



F. 14.6 mmSL

Trachurus lathami Nichols, 1920
Carangidae
Rough scad



Range: Western Atlantic Ocean from Gulf of Maine and Scotian Shelf to northern Argentina, including Gulf of Mexico

Habitat: Usually on or near bottom (sometimes nearer the surface) in depths of 50–90 m; uncommon close to coast

Spawning: Dec–Apr in Gulf of Mexico; undescribed elsewhere

Eggs: – Undescribed

Larvae:
- Body depth shallow; gradually deepens and tapers to narrow caudal peduncle
- Head and snout moderately pointed
- Flexion occurs at about 4.0–6.0 mmSL
- Head spines most prominent on preopercle; see checklist below
- Sequence of fin ray formation: $C - D_2$, $A - D_1 - P_1 - P_2$
- Finlets absent posterior to ends of dorsal and anal fins
- Pigment over most of head and body light; top of head with scattered melanophores; vomer pigmented; internal pigment absent; pigment on dorsolateral part of body scattered and sparse; pigment on ventrolateral part of body scattered and sparse; pigment along dorsum occurs in a single row along the dorsal midline; branchiostegal membrane unpigmented; midline pigment begins as few dashes between D_2 and A fins, becomes streak of pigment visible until lateral line scales form

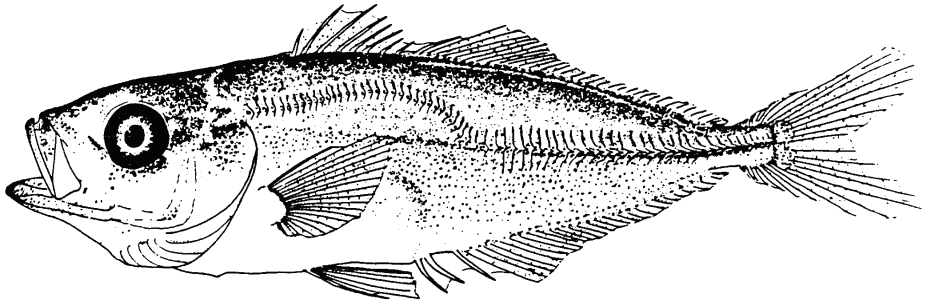
Meristic Characters

Myomeres:	24
Vertebrae:	10+14 = 24
Dorsal fin rays:	VIII, I, 28–33
Anal fin rays:	II, I, 26–30
Pectoral fin rays:	22–23
Pelvic fin rays:	I, 5
Caudal fin rays:	9–10+9+8+9–10
Supraneurals:	0/0+0/2+1/

Head spine checklist:

Supraoccipital:	low, rough-edged ridge present until fin rays formed
Preopercle Angle:	long, simple spine with series of shorter spines along both limbs
Supraocular:	very small spine in early stages
Posttemporal:	small spine
Supracleithral:	small spine
Pterotic ridge:	absent

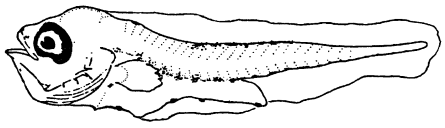
Early Juvenile:



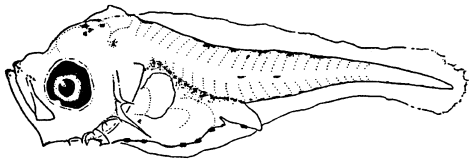
H. 39.2 mmSL

Figures: Adult: Smith-Vaniz, 2002b; **A–H**: Wayne Laroche (Laroche *et al*., 2004)
References: Scott and Scott, 1988; Laroche *et al.*, 1984; 2004

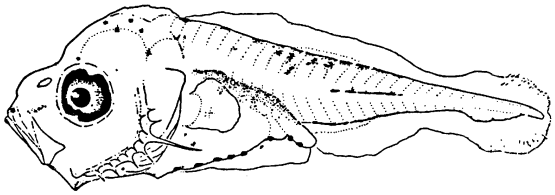
Trachurus lathami



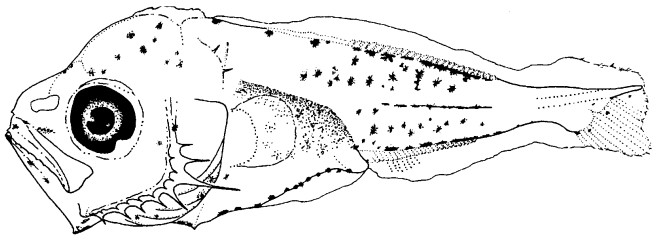
A. 2.3 mmSL



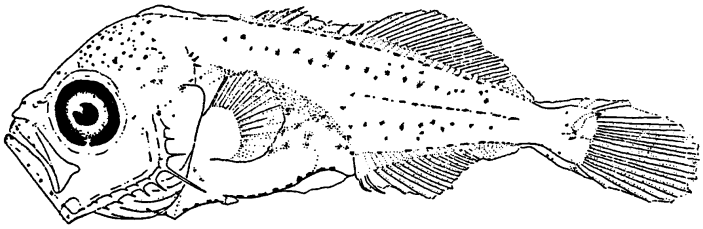
B. 3.4 mmSL



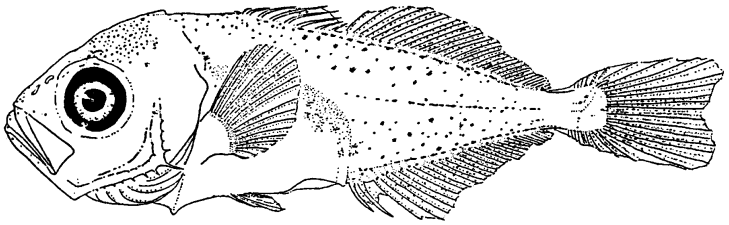
C. 4.5 mmSL



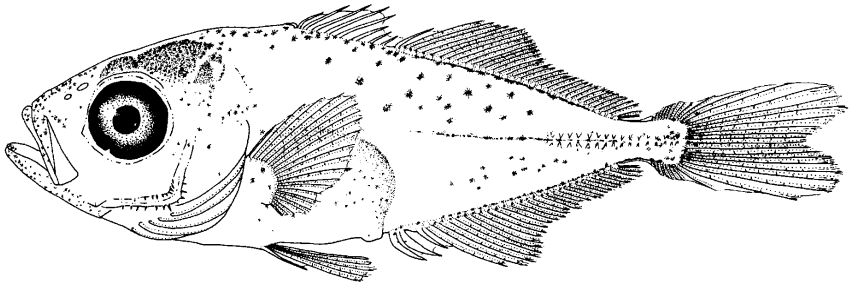
D. 5.4 mmSL



E. 6.4 mmSL

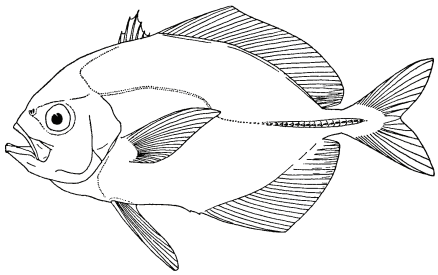


F. 10.2 mmSL



G. 16.4 mmSL

Uraspis secunda (Poey, 1860)
Carangidae
Cottonmouth jack



Range: Worldwide in tropical and subtropical waters; in the western North Atlantic from Massachusetts to Brazil, including discrete locations in the Gulf of Mexico; known from scattered locations, not common anywhere

Habitat: Offshore waters and near oceanic islands in depths of 40–50 m

Spawning: Undescribed

Eggs: – Undescribed

Larvae:
- Larvae unknown; smallest individual described is 25.6 mmSL
- Body depth in larvae presumably deep, based on juvenile form
- Flexion occurs at unknown size
- Head spines unknown; see characteristics of other carangid larvae
- Sequence of fin ray formation: unknown
- Finlets absent posterior to ends of dorsal and anal fins
- Pigmentation patterns in larvae unknown; juveniles develop strongly barred pattern that crosses body and extends into D_2 and A fins; membranes between D_1 spines; pelvic fin elongate and densely pigmented

Meristic Characters

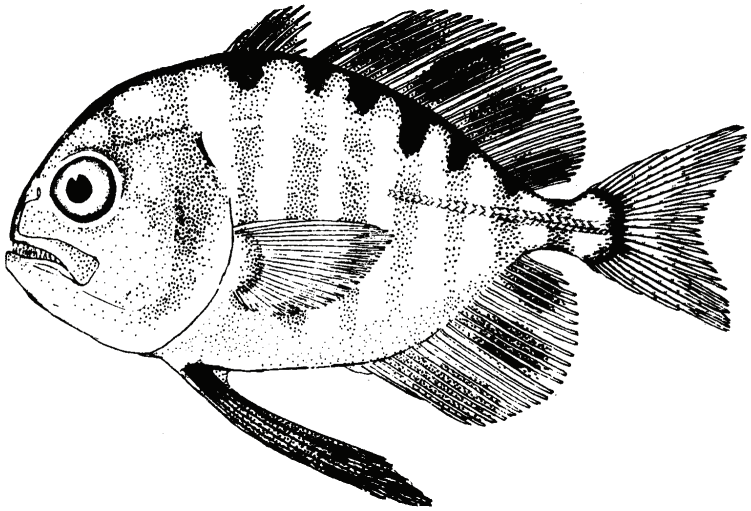
Myomeres:	24
Vertebrae:	10+14 = 24
Dorsal fin rays:	VIII, I, 27–32
Anal fin rays:	II, I, 19–23
Pectoral fin rays:	24
Pelvic fin rays:	I, 5
Caudal fin rays:	9+8 PrC
Supraneurals:	0/0+0/2+1+1/

Head spine checklist:

Supraoccipital:	unknown
Preopercle Angle:	unknown
Supraocular:	unknown
Posttemporal:	unknown
Supracleithral:	unknown
Pterotic ridge:	unknown

Note: A single larva has been collected at 07°30'N, 13°15'W (MCZ 84181)

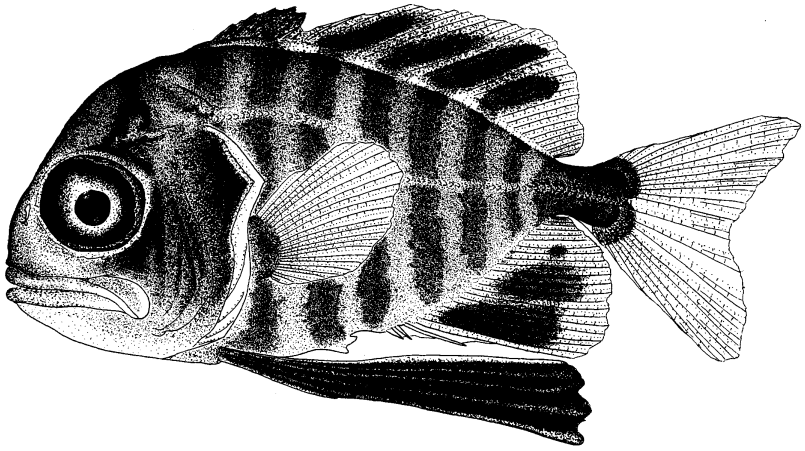
Early Juvenile:



B. 49.3 mmSL

Figures: Adult: Blache, Cadenat and Stauch, 1970; **A**: Wayne Laroche (Laroche *et al.*, 2004); **B**: Fred Berry (G. D. Johnson, 1978)
References: Berry, 1959a; G. D. Johnson, 1978; Laroche *et al.*, 2004

Uraspis secunda

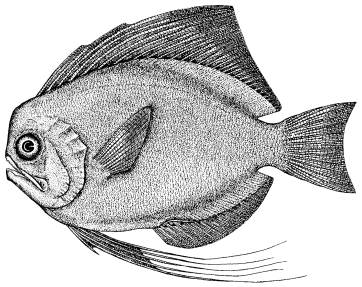


A. 25.6 mmSL

Larvae (<25 mm) are undescribed. Based on characters of the juveniles, the following characters may pertain to younger stages:

1. Pelvic fins may be precocious, elongate and darkly pigmented
2. Eye may be noticeably large
3. The preopercle presumably has a large spine at the angle, with smaller spines along both the ascending and anterior limbs
4. The body is probably deep, as in species of *Caranx*

Caristius macropus (Beloitti, 1903)
Caristiidae
No common name



Range: Not well known; possibly widespread in Atlantic and Pacific oceans; see "Note" on *Caristius maderensis* page

Habitat: Pelagic or mesopelagic in depths of 300–600 m; this characterization subject to change after revision of family

Spawning: Undescribed

Eggs: – Pelagic; otherwise undescribed

Larvae:
- Eyes pigmented and mouthparts fully formed at hatching
- Body depth moderate, increases after fin ray formation
- Short preanus length
- Flexion occurs at <7.7 mmTL
- Sequence of fin ray formation: D_2, A, C – P_2, P_1
- Pigmentation includes 3 prominent bars crossing body at the caudal peduncle, over mid-anal fin, and at level of pectoral fin base; scattered pigment on top of head and on preopercle and opercle; scattered pigment on gut; 2 bands of pigment cross pelvic fin rays

Meristic Characters

Myomeres:	39–40
Vertebrae:	39–40
Dorsal fin rays:	33–35
Anal fin rays:	21–23
Pectoral fin rays:	17–19
Pelvic fin rays:	I, 5
Caudal fin rays:	6–7+9+8+6
Supraneurals:	None

Head spine checklist:

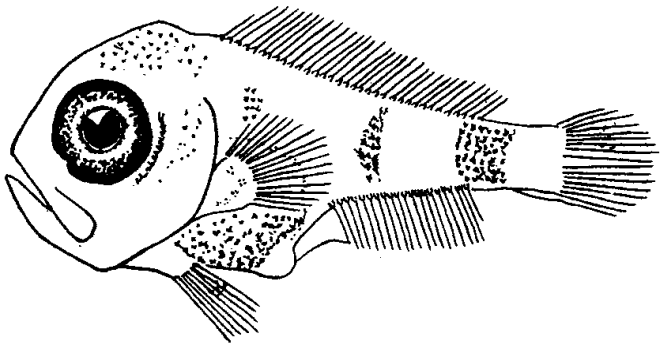
Absent, although tiny spines may occur along preopercle margin in some caristiid larvae (G. D. Johnson, 1984)

Note: 1. See note on *Caristius maderensis* page concerning distribution of nominal caristiid species

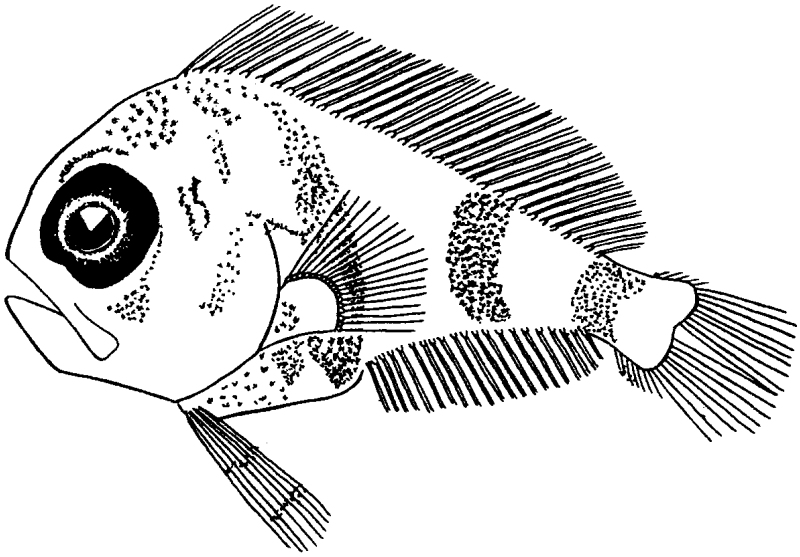
Figures: Adult: D. R. Harriott (Hart, 1973); **A–B**: Belyanina, 1982

References: Belyanina, 1982; G.D. Johnson, 1984; Post, 1986; Matarese *et al*., 1989; Moser, 1996i

Caristius macropus

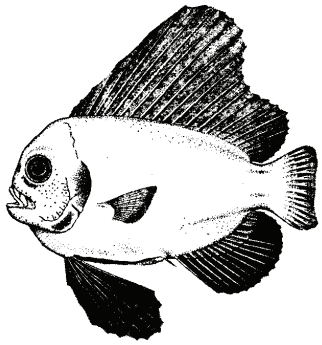


A. 7.7 mmTL



B. 11.8 mmTL

Caristius maderensis Maul, 1949
Caristiidae
No common name

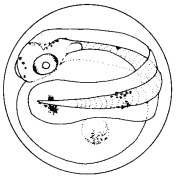


Range: Worldwide in tropical to warm temperate waters; in the western North Atlantic from off Nova Scotia; range possibly affected by Gulf Stream

Habitat: Pelagic or bathypelagic in depths of 100–2,000 m; possibly associate with siphonophores

Spawning: Undescribed (possibly year-round in the Pacific Ocean)

Eggs:
- Pelagic, spherical
- Diameter: 1.9–2.0 mm
- Chorion: smooth; orange tints
- Oil globules: single, 0.34 mm diameter
- Perivitelline space: moderate



Meristic Characters

Myomeres:	35–36
Vertebrae:	16–17+18–20=35–36
Dorsal fin rays:	26–31
Anal fin rays:	15–20
Pectoral fin rays:	16–18
Pelvic fin rays:	I, 5
Caudal fin rays:	6–8+9+8+7
Supraneurals:	None
*/1/1/	

*= 4–6 pterygiophores anterior to first neural spine

Larvae:
- Late embryos have pigment pattern similar to larvae at hatching
- Size at hatching is about 4.0 mmSL; eyes are pigmented and mouth parts fully formed
- Body moderately elongate until depth increases after fin ray formation
- Short preanus length
- Flexion occurs at 6.0–7.0 mmSL
- Sequence of fin ray formation: C_1, P_1, A, D, $P_2 - C_2$
- Pigmentation includes 3 prominent bars; 2 on body, 1 at tip of notochord; a 4th bar forms at level of pectoral fin base; scattered melanophores in a belt across gut; pigment also forms on body under anterior dorsal fin; dark blotches form on dorsal and anal fin rays and across the pelvic fin rays

Note:

1. Of 5 nominal species in the Caristiidae, only *Caristius groenlandicus* is usually reported from the western Atlantic. However:
   - Scott *et al*. (1970) suggest *C. macropus* is wide-ranging in Atlantic and Pacific oceans
   - Uyeno *et al*. (1983) report the collection of an undescribed *Caristius* off Suriname
   - Tolley *et al*. (1990) suggest there are several undescribed species in the family, based on Gulf of Mexico collections
   - Okamura *et al.* (1995) report the collection of *Caristius* sp. off southeast Greenland; this is within the range of, and the specimen is possibly conspecific with, *Platyberyx opalescens*
   - Hartel and Triant (1998) relegate *Pteraclis fasciatus* (nominally Bramidae) to the Caristiidae and suggest that *C. groenlandicus* is a junior synonym of this species (as *Caristius fasciatus*)
   - Moore *et al*. (2003) record *C. japonicus* from south of New England, and opine that some nominal species are invalid. Abe (1957) suggests that *C. macropus* and *C. japonicus* are synonymous
   - Trunov and Kukuev (2004) record *C. maderensis* from waters off Nova Scotia

   Therefore, because of taxonomic confusion, potential for undescribed species, questions regarding the range of all taxa, and need for a revision of this family, all known species are included in the table of meristic characters and checklist of fishes from the study area. Information on eggs and larvae is limited to *Caristius maderensis* and *C. macropus*.

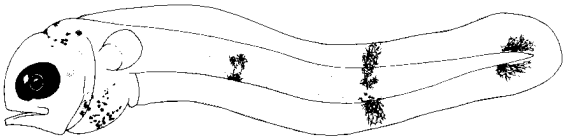
Head spine checklist:

Absent in this species; tiny spines along preopercle margin in some caristiid larvae (G. D. Johnson, 1984)

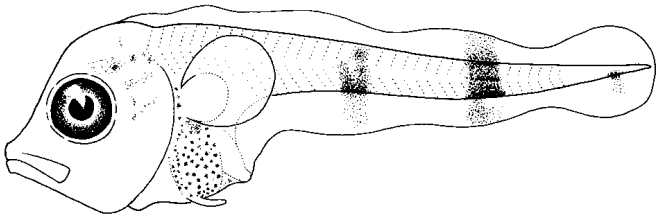
Figures: Adult: Post, 1986; egg and **A, C, E**: R. C. Walker (Moser, 1996i); **B**: Henry Orr (Moser, 1996i); **D**: Henry Orr (G. D. Johnson, 1984)

References: Koefoed, 1953; Belyanina, 1982; G. D. Johnson, 1984; Post, 1986; Moser, 1996i

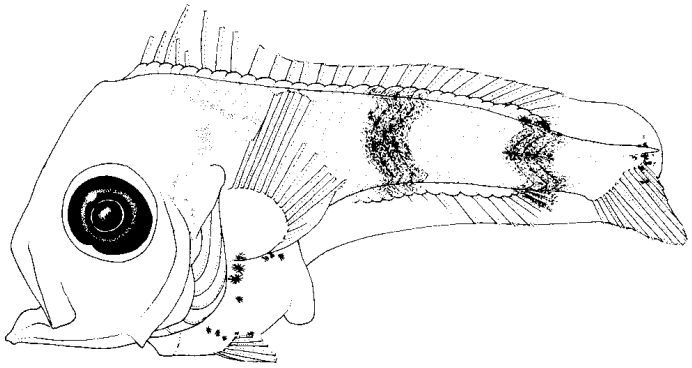
Caristius maderensis



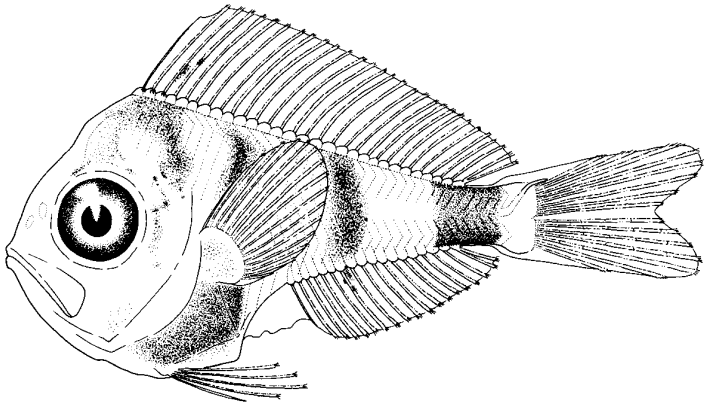
A. 4.2 mmSL



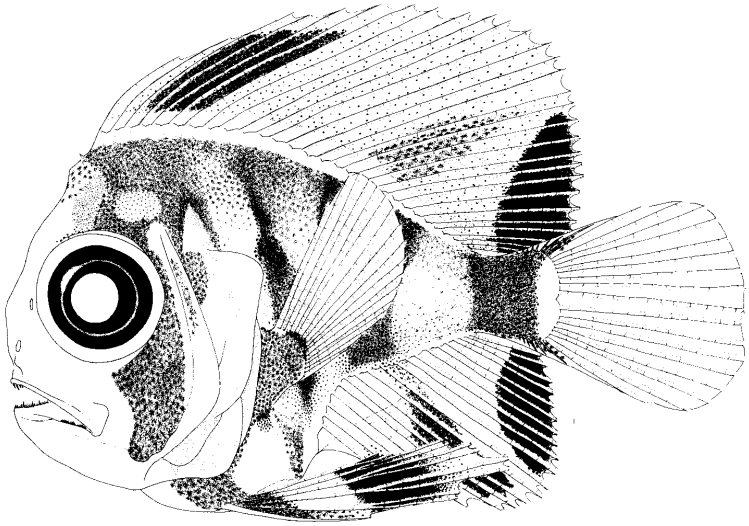
B. 5.8 mmSL



C. 6.5 mmSL

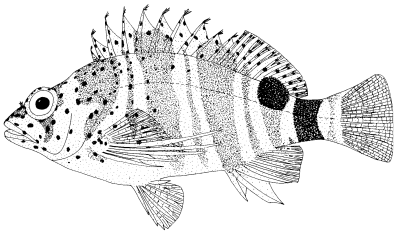


D. 7.8 mmSL



E. 18.0 mmSL

Amblycirrhitus pinos (Mowbray, 1927)
Cirrhitidae
Redspotted hawkfish



Range: Western North Atlantic Ocean from Bermuda and southern Florida to northern South America, including Gulf of Mexico and Caribbean Sea; also island of St. Helena in the SE Atlantic; several records of early stages in study area (see Note below)

Habitat: Demersal, near rock or coral reefs in maximum depth of 46 m

Spawning: Undescribed

Meristic Characters

Myomeres:	26
Vertebrae:	10+16
Dorsal fin rays:	X, 11
Anal fin rays:	III, 6
Pectoral fin rays:	14
Pelvic fin rays:	I, 5
Caudal fin rays:	8+7 (PrC)

Eggs:
- Undescribed; others in family are pelagic, spherical, and small (0.68–0.88 mm)

Larvae:
- Body initially very elongate, becomes deeper and laterally compressed, with very deep caudal peduncle
- Head moderate in size, with elongate, pointed snout, slightly oval eyes
- Mouth terminal, reaching anterior edge of eye; lower jaw projects markedly
- Gut initially long and straight, then coils; preanus length 55–58% SL
- Tip of anus may be moderately trailing in early larvae; anterior anal fin spines may form anterior to tip of anus
- Conspicuous air bladder over anterior portion of gut is lost at transformation
- Head spination weak; see checklist below
- Sequence of fin ray formation: C, D_2, A – D_1 – P_2 – P_1
- Lowermost 5 pectoral fin rays unbranched, thickened (in juveniles and adults)
- Initial ray count in anal fin may be II, 7; first ray transforms to a spine in postflexion larvae
- Note origin of pelvic fin is well posterior to origin of pectoral fin
- Barbel (pigmented) at tip of lower jaw forms early in larval stage
- Pigmentation includes a series of melanophores along venter of tail and 2 series along dorsal edge of body; peritoneal pigment heavy in preflexion stage; postflexion larvae have several clumps of melanophores associated with the upper and lower angles of myosepta (see illustrations); other pigment occurs on nape and hindbrain, lower jaw, in a vague bar anterior to eye, on dorsal fin spines and on dorsal, anal and pelvic fin rays; few spots at tips of caudal fin lobes

Head spine checklist:

Preopercle: very small spines or serrations may occur along edge

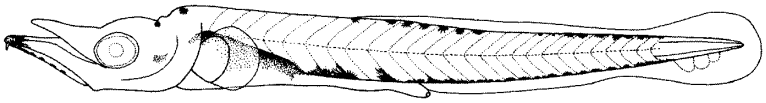
Note:
1. A postflexion larval specimen (14.0 mmSL) has been collected on Georges Bank (23 May, 1999). At least 6 other specimens have also been collected from the study area, as far north and east as the Gulf Stream south of Grand Bank (MCZ 75142; MCZ 75147; MCZ 75148; MCZ 75152; MCZ 75153; and MCZ 75154).

Early Juvenile:

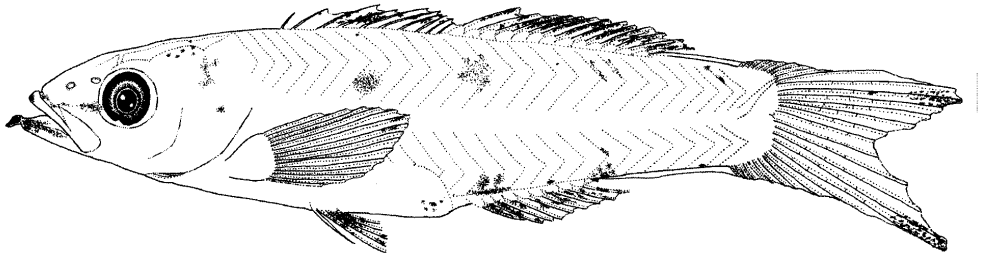
Juveniles and adults have tufts of cirri at the tip of each dorsal fin spine

Figures: Adult: Randall, 2002c; **A**: Criales, 2006; **B**: Betsy Washington (G. D. Johnson, 1984)

References: Leis and Rennis, 1983; Johnson, 1984; Randall, 2002; Criales, 2006

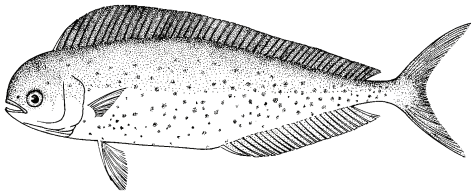


A. 4.2 mmNL



B. 13.2 mmSL

Coryphaena equiselis Linnaeus, 1758
Coryphaenidae
Pompano dolphin



Range: Worldwide in tropical and subtropical waters; in the western North Atlantic from New Jersey to Brazil

Habitat: Epipelagic in continental shelf and oceanic waters

Spawning: Year-round in warm temperatures (>21°C)

Eggs:
- Pelagic, spherical
- Diameter: 1.35 mm (no other information)

Larvae:
- Elongate body with moderately blunt head (head length about 25–30% SL)
- Preanus length about 60% SL
- Single, long dorsal fin, lacking spines
- Flexion occurs at 7.5–9.0 mmSL
- Head spines composed of preopercle and other spines; see checklist below
- Sequence of fin ray development: C, A, D – P_2, P_1; dorsal fin rays complete 13–18 mmSL
- Pigment heavy on head and body; small larvae have pigment on caudal peduncle; melanophores lacking on pelvic fin in larvae and juveniles; pigment on body dark and uniform, although faint pigment bars may cross the fins; caudal fin tends to be dark, except for a clear band along the entire edge of fin

Meristic Characters

Myomeres:	33–34
Vertebrae:	13–14+19–20=33–34
Dorsal fin rays:	52–59
Anal fin rays:	23–29
Pectoral fin rays:	18–21
Pelvic fin rays:	I, 5
Caudal fin rays:	10–13+9+8+10–14
Supraneurals:	None
*/1+1+1/1+1+1/1+1/etc	

* = 7–11 pterygiophores anterior to first neural spine

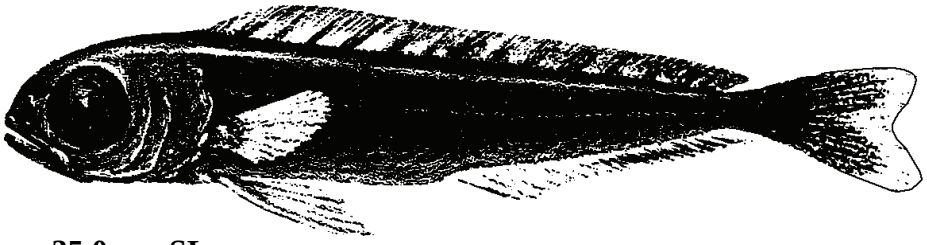
Note:
1. Larvae are similar to those of the closely related *Rachycentron canadum*
2. 7–11 pterygiophores anterior to 1st neural spine begin forming at 10–11 mm (These are not supraneurals because they support dorsal fin rays)

Head spine checklist:

Preopercle:	moderate to large spines on posterior margin; smaller spines laterally
Supraocular:	single, small spine on low ridge
Posttemporal:	small spine
Pterotic:	low, thick and moundlike 'spine'
Articular:	low spine at lower angle of mandible

(See illustration of head spines on *Coryphaena hippurus* page)

Early Juvenile: Bars of pigment less obvious on body and fin rays (See *C. hippurus*)

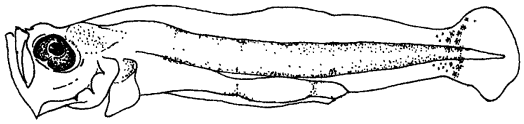


G. ca. 35.0 mmSL

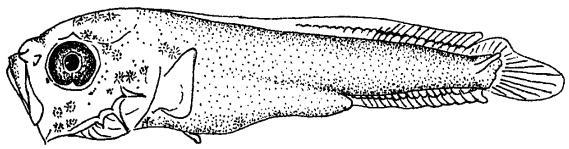
Figures: Adult: Collette, 1978; **A–C**: Aoki and Ueyanagi, 1989; **D–F**: Ditty *et al*., 1994; **G**: G. G. Pasley (Gibbs and Collette, 1959)

References: Gibbs and Collette, 1959; Collette *et al*., 1969; Potthoff, 1971; 1980; G.D. Johnson, 1984; Aoki and Ueyanagi, 1989; Ditty *et al*., 1994

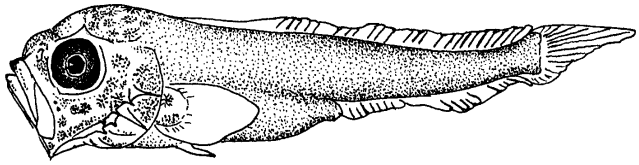
Coryphaena equiselis



A. 3.6 mmSL

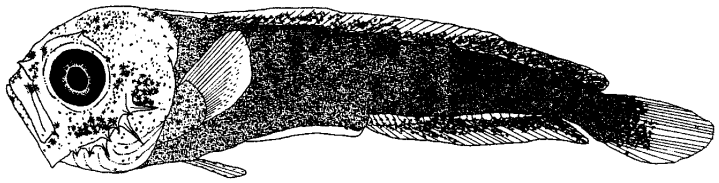


B. 5.8 mmSL



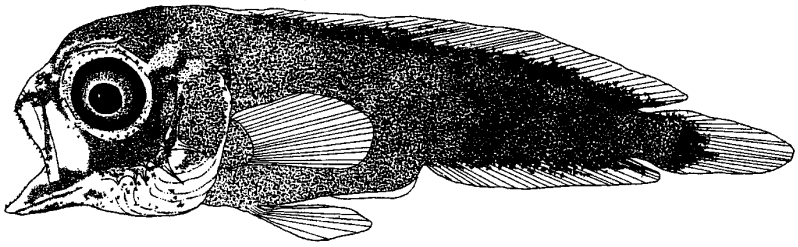
C. 7.8 mmSL

Dorsal and anal fin rays begin forming in posterior third of fins; development proceeds anteriorly and posteriorly



D. 9.7 mmSL

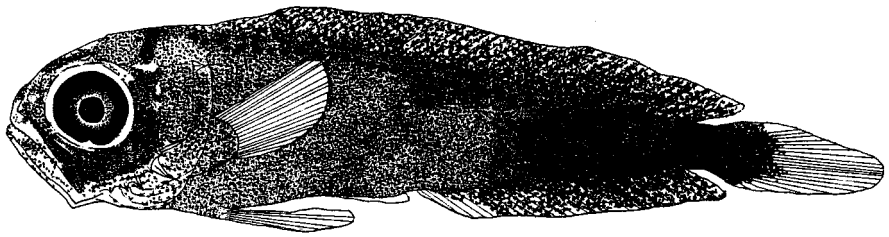
Note uniform dark pigmentation Especially on posterior part of body



E. 11.5 mmSL

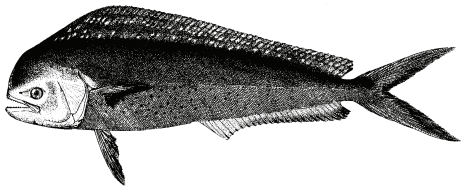
Deeper bodied than comparable sizes of *Coryphaena hippurus*

Larvae of *Coryphaena* (and *Rachycentron*) have modified epithelial cuticle (crown-shaped 'spicules') covering entire head and body; appear at about 8 mm, retained until about 100 mm; larvae appear 'bristly' under magnification



F. 15.0 mmSL

Coryphaena hippurus Linnaeus, 1758
Coryphaenidae
Common dolphin



Range: Worldwide in tropical and subtropical waters; in the western North Atlantic from Nova Scotia to southeast Brazil

Habitat: Epipelagic in continental shelf and oceanic waters

Spawning: Year-round in warm temperatures (>21°C)

Meristic Characters

Myomeres:	30–31
Vertebrae:	13–14+17–18=30–31
Dorsal fin rays:	58–66
Anal fin rays:	25–31
Pectoral fin rays:	18–21
Pelvic fin rays:	I, 5
Caudal fin rays:	10–14+9+8+11–14
Supraneurals:	None
*/1+1+1/1+1+1/1+1/etc	

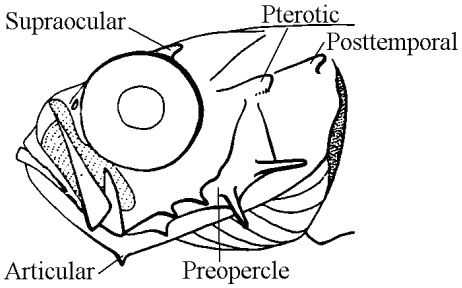
* = 10–14 pterygiophores anterior to first neural spine

Eggs:
- Pelagic, spherical
- Diameter: 1.3 mm
- Chorion: unsculptured, clear
- Oil globules: single, 0.3–0.4 mm in diameter
- Yolk: segmented

Larvae:
- Elongate body with moderately blunt head (head length about 25–30% SL)
- Preanus length about 60% SL
- Single, long dorsal fin, lacking spines
- Flexion occurs at 7.5–9.0 mmSL
- Head spines composed of preopercle and other spines; see checklist below
- Sequence of fin ray development: C, A, D – P_2, P_1; dorsal fin rays complete 18–24 mmSL
- Pigment heavy on head and body; small larvae lack pigment on caudal peduncle; melanophores on pelvic fin rays >8.0 mmSL; pigment on body arranged in vague bars; caudal fin tends to be dark, except for the tips of each lobe which are clear of pigment

Head spine checklist:

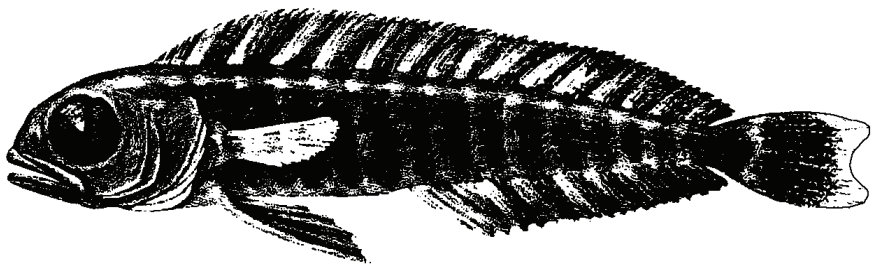
Preopercle:	moderate to large spines on posterior margin; smaller spines laterally
Supraocular:	single, small spine on low ridge
Posttemporal:	small spine
Pterotic:	low, thick and moundlike 'spine'
Articular:	low spine at lower angle of mandible



G. 13.8 mmSL

Note:
1. Larvae are similar to those of the closely related *Rachycentron canadum*
2. 10–14 pterygiophores anterior to 1st neural spine begin forming at 17–18 mm (These are not supraneurals because they support dorsal fin rays)

Early Juvenile: Bars of pigment extend onto fins

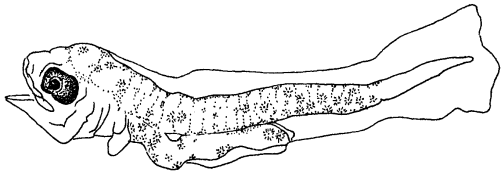


H. about 35.0 mmSL

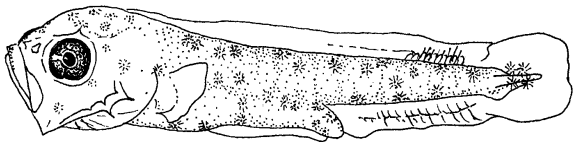
Figures: Adult: H. L. Todd (Collette 2002e); **A–C**: Aoki and Ueyanagi, 1989; **D–F**: Ditty et al., 1994; **G–H**: G. G. Pasley (Gibbs and Collette, 1959)

References: Gibbs and Collette, 1959; Collette *et al*., 1969; Potthoff, 1971; 1980; G. D. Johnson, 1984; Aoki and Ueyanagi, 1989; Ditty *et al.*, 1994

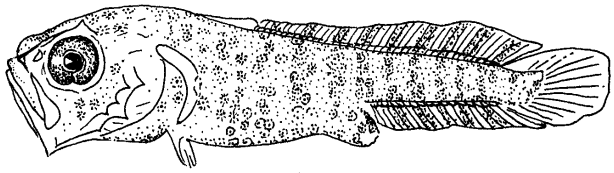
Coryphaena hippurus



A. 3.8 mmSL

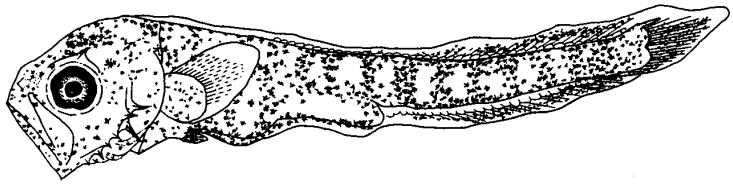


B. 5.5 mmSL



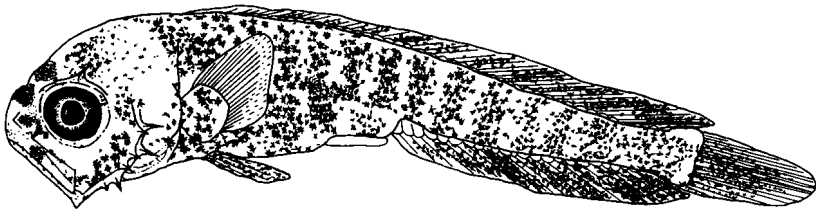
C. 8.0 mmSL

Dorsal and anal fin rays begin forming in posterior third of fins; development proceeds anteriorly and posteriorly



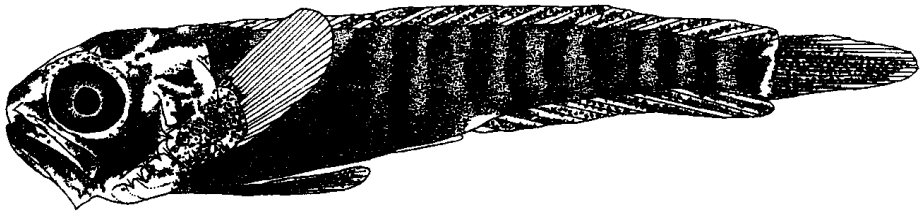
D. 9.5 mmSL

Note vague barred pattern on body



E. 11.0 mmSL

Larvae of *Coryphaena* (and *Rachycentron*) have modified epithelial cuticle (crown-shaped 'spicules') covering entire head and body; appear at about 8 mm, retained until about 100 mm; larvae appear 'bristly' under magnification



F. 14.0 mmSL