

SERRANIDAE**Four Subfamilies****Serraninae**

- Larvae** — Body moderately stubby.
 — Short weak fin spines; or, if elongate, not serrated.
 — Reduced head armature.
 — Pigment variable, usually light.

Meristic features

Vert: 10+14
 D : X, 11-15
 A : III, 6-8

Anthiinae

- Larvae** — Deep-bodied.
 — Strong, barely elongate fin spines.
 — Paired spines on preopercle and interopercle.
 — Pigment usually light, some large blotches.

Meristic features

Vert: 10+16
 D : X, 13-20
 A : III, 7-8

Epinephelinae

- Larvae** — Body moderately long.
 — Dorsal and pelvic spines elongate with serrations.
 — Spines on preopercle.
 — Consolidated pigment patterns, especially on peduncle.

Meristic features

Vert: 10+14
 D : IX-XI, 13-20
 A : III, 7-12

Gonioplectrus hispanus (Cuvier)

(Subfamily Epinephelinae)

- Larvae** — Deep-bodied.
 — Elongate dorsal, anal and pelvic spines.
 — Spines on preopercle and upper opercle.
 — Consolidated pigment especially on peduncle.
 — Exhibit some characters of Anthiinae.

Meristic features

Vert: 10+14
 D : VIII, 13
 A : III, 7

Grammistinae*

- Larvae** — Body moderately long.
 — Dorsal spines (1 or 2) elongate, filamentous, with pigmented sheath.
 — Reduced head armature (spines weak, if present).
 — Reduced pigment.

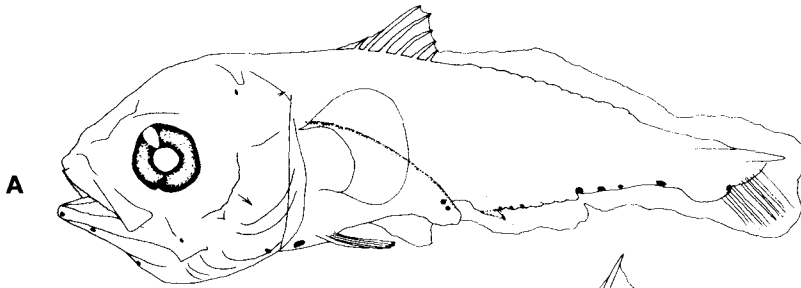
Meristic features

Vert: 10+14-15
 D : II-III or VII-VIII,
 24-26 or 12-15
 A : 0 or III,
 15-17 or 7-8

* Grammistidae in Robins *et al.* (1980).

Genera of Four Subfamilies

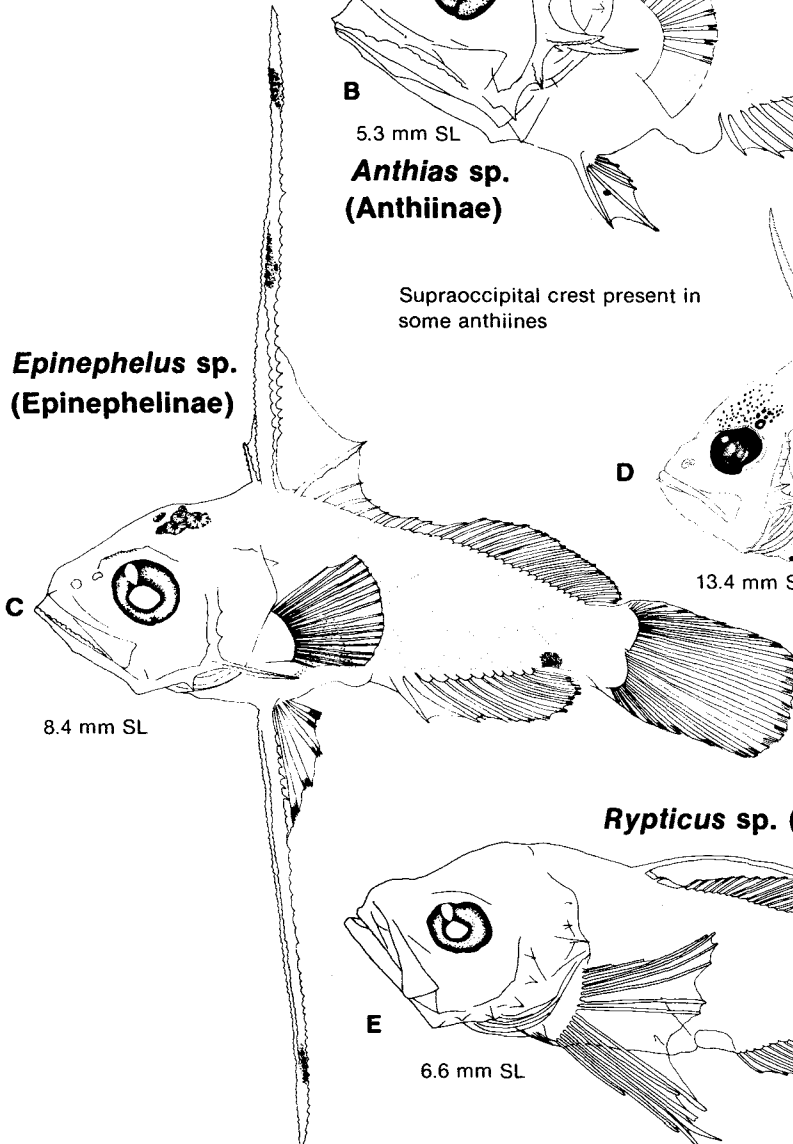
SERRANIDAE



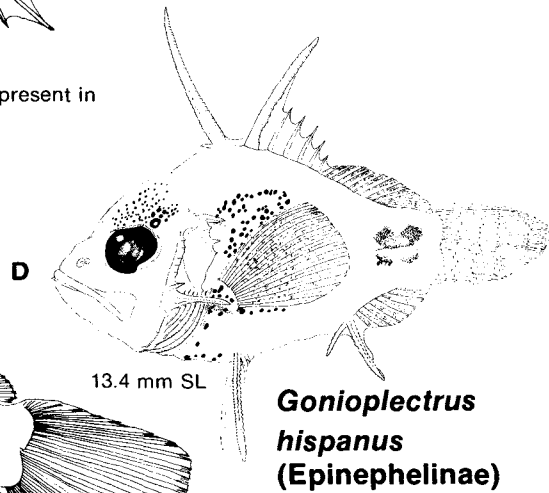
5.8 mm SL

***Diplectrum* sp. (Serraninae)**

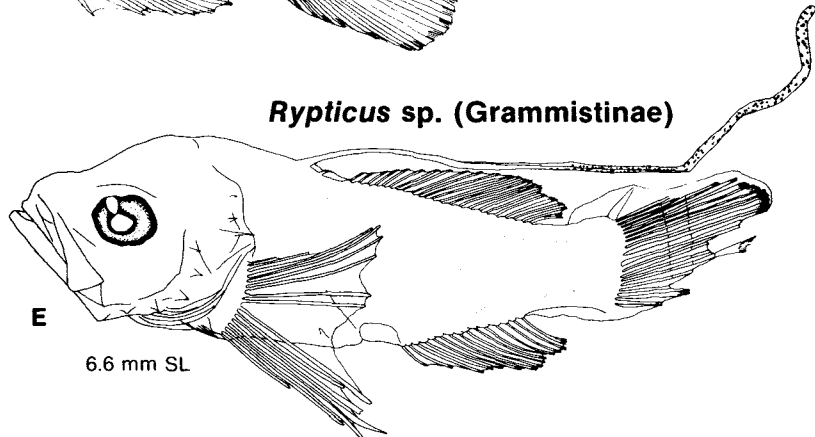
5.3 mm SL

***Anthias* sp.
(Anthiinae)**Supraoccipital crest present in
some anthiines***Epinephelus* sp.
(Epinephelinae)**

8.4 mm SL



13.4 mm SL

***Gonioplectrus*
hispanus
(Epinephelinae)*****Rypticus* sp. (Grammistinae)**

6.6 mm SL

SERRANIDAE
Serraninae

***Centropristis striata* (Linnaeus)**

Spawning: May–November in Mid-Atlantic Bight.

Meristic features

- Eggs** — Pelagic, spherical.
 — Diameter: 0.8–1.0 mm.
 — Shell: smooth.
 — Yolk: homogeneous, amber.
 — Oil globules: 1.
 — O.G. diameter: 0.13–0.19 mm.
 — Perivitelline space: narrow.
- Larvae** — Hatching occurs at about 1.5–2.0 mm.
 — Body stocky, depth 25–27% SL; large head, 33% SL at 2–4 mm and 38% SL at 12 mm.
 — Preanal length increases from 50% SL at 5 mm to 58% SL at 10 mm to 65% SL in juvenile.
 — Lack extensive armature — preopercle and opercle have 4–7 short, widely-spaced spines in specimens >5 mm SL.
 — Most meristic characters develop between 6 and 10 mm SL.
 — Sizes at beginning of ossification and completion of fin rays and vertebrae:

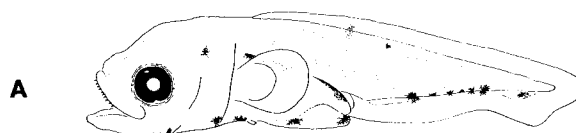
Principal caudal rays	5.0 mm	6.5 mm
Dorsal rays	4.6–5.5	8.7
Anal rays	5.5	6.5*
Pectoral rays (bud at 2.1 mm)	5.2	8.7
Pelvic rays (bud at 4.0 mm)	6.0	7.7
Vertebrae	4.6	6.7–7.0

* Third anal spine begins as a ray and changes at about 7 mm.

- **Pigmentation:** ventral pigment characteristic (note spots from posterior end of anal fin to caudal base); spot(s) under tip of lower jaw; pigment on gut; occasional dorsal pigment.

Fig. — **A, E**, Kendall 1972 (redrawn); **B–C**, Kendall 1979; **D, F**, Lippson and Moran 1974 (redrawn).

Ref. — Kendall 1977.

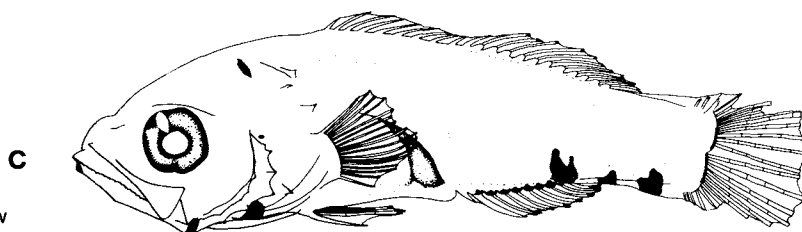
Centropristis striata**SERRANIDAE**

5.1 mm SL

Teeth apparent at 5.0 mm



4.7 mm SL

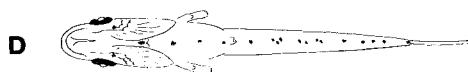


Spots under tip of lower jaw

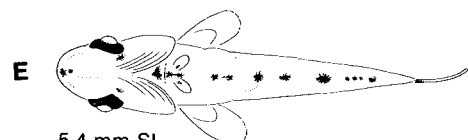
8.3 mm SL

Characteristic spots just anterior to cleithral symphysis and between pelvic bases

Ventral views



5.3 mm SL

Micropogonias undulatus (p. 278)

5.4 mm SL

*Centropristis striata*Note difference in development of pectoral and pelvic fins and space between anus and anal fin origin in *Leiostomus* and *Micropogonias*.

5.6 mm SL

Leiostomus xanthurus (p. 276)

BRANCHIOSTEGIDAE* *Lopholatilus chamaeleonticeps* Goode and Bean

Spawning: Near edge of continental shelf north of Cape Hatteras in summer.

Meristic features

- Eggs**
- Pelagic, spherical and transparent.
 - Diameter: 1.16–1.25 mm.
 - Shell: thin with reticulations visible under low magnification.
 - Yolk: homogeneous (amber).
 - Oil globules: 1.
 - O.G. diameter: 0.18–0.20 mm.
 - Perivitelline space: moderate.
 - Above characteristics are for artificially-fertilized eggs; those caught in the wild are modally 1.3–1.4 mm in diameter, with oil globule modally 0.20–0.24 mm in diameter.

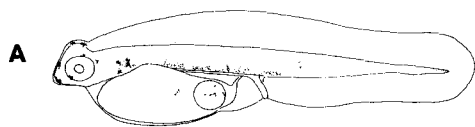
Myomeres : 24
 Vert : 10+14
 D : VII, 15
 A : I, 13–14
 Piv : I, 5
 P : 16–18

- Larvae**
- Hatching occurs at 2.6 mm NL, and flexion at 4.4–5.5 mm NL.
 - Robust body, spiny ridges develop on head, and spinous scales develop on body; preopercle spination develops early, and cranial spines form sequentially in groups, all being well-developed by 5 mm NL.
 - Preanus length increases from about 55% to 70% NL, body depth increases from about 22% to 40% NL, and head length increases from about 30% to 45% NL; all three measurements reach maximum relative proportions at 5–6 mm NL, shortly after notochord flexion.
 - Teeth present at about 5 mm NL, and vertebrae ossified by 8 mm SL.
 - Pelagic juveniles descend to bottom between 9.0 and 15.5 mm SL.
 - Sizes at beginning of ossification and completion of fin rays:

Caudal rays	~4.0 mm NL	5.4 mm SL
Dorsal rays	4.9	8.2
Anal rays	4.9	8.2
Dorsal spines	5.3	8.2
Pectoral rays	5.4	~8.5
Pelvic rays (bud at 4.5 mm NL)	6.5+	9.0

- Pigmentation: in yolk-sac larvae, few spots on head and area of light pigment on body over gut and anus, and few spots on oil globule; in later larvae, body pigment intensifies into dark midline streak and scattered accumulations of melanophores.

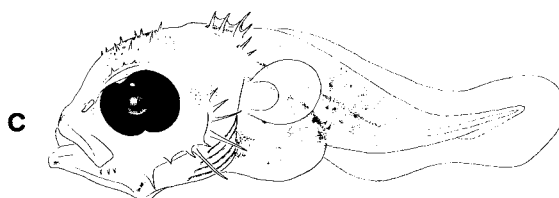
* Malacanthidae in Robins *et al.* (1980).

***Lopholatilus chamaeleonticeps* BRANCHIOSTEGIDAE**

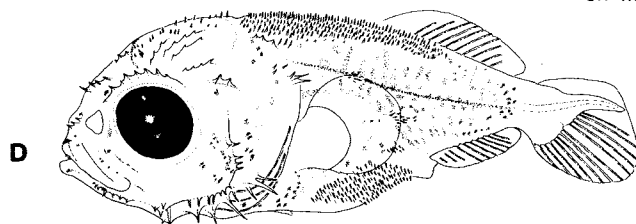
2.6 mm NL



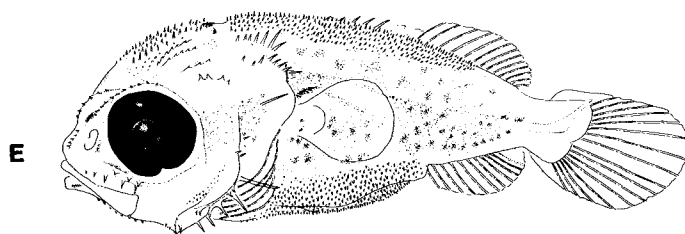
2.8 mm NL



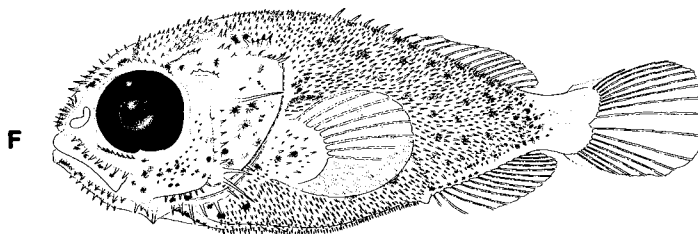
3.7 mm NL



4.8 mm NL



5.3 mm NL



6.0 mm NL

POMATOMIDAE *Pomatomus saltatrix* (Linnaeus)

Spawning: Summer in Mid-Atlantic Bight, earlier in South Atlantic Bight.

Meristic features

- Eggs**
- Pelagic, spherical.
 - Diameter: 0.95–1.00 mm.
 - Shell: smooth and transparent.
 - Yolk: homogeneous.
 - Oil globules: 1.
 - O.G. diameter: 0.26–0.29 mm.
 - Perivitelline space: narrow.

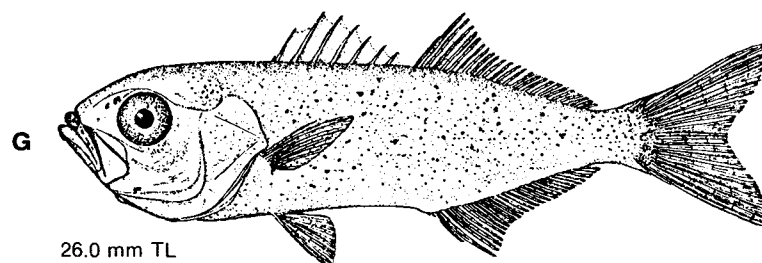
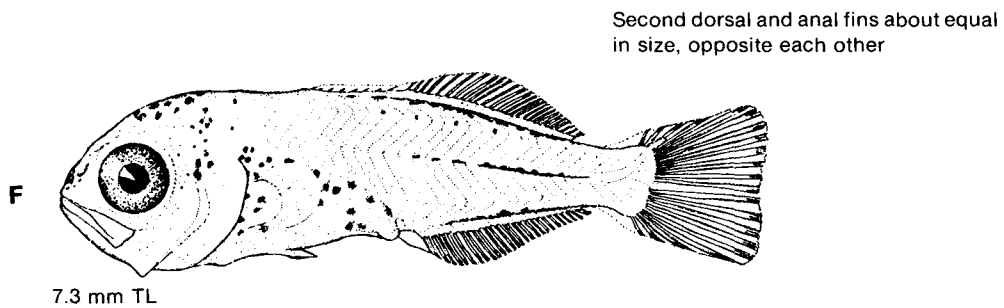
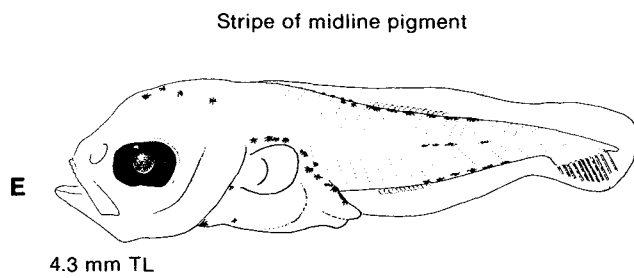
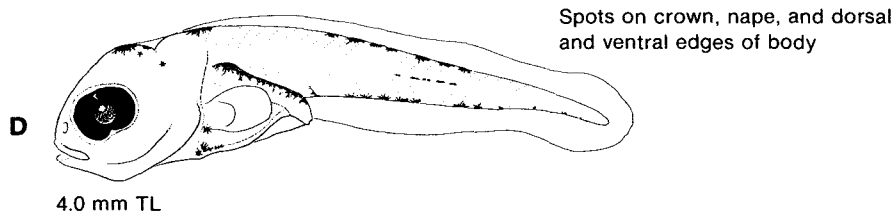
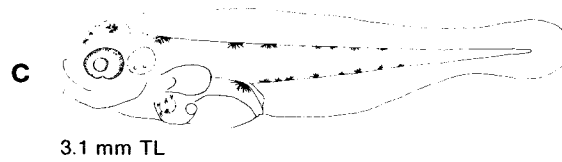
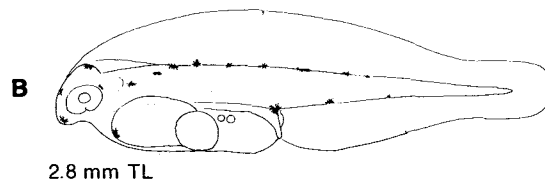
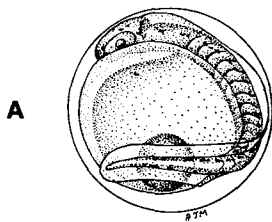
Myomeres: 26
 Vert : 11+15
 D : VII–IX, 23–28
 A : II–III, 24–29
 P : 18
 Plv : I, 5
 C : 9–10+9+8+9–10

- Larvae**
- Hatching occurs at 2.0–2.4 mm, eyes unpigmented, oil globule posterior; yolk absorbed at 3.3–3.6 mm; flexion occurs at 4.3–5.0 mm.
 - Body moderately elongate, with preanal length about 50% SL, decreasing to 33% SL with development and increasing to 50% SL in juvenile stage.
 - Preanal myomeres; 9 at hatching; 12 at 8.5 mm.
 - Teeth well developed at 4.3 mm; body deepens at about 6 mm.
 - Preopercle spines increase from 2 at 4.8 mm to 6 at 9.5 mm and to 7 at 12.8 mm (see note below).
 - Ossification onset sequence: C, D₂, A, D₁, P, Plv.
 - Size at completion of ossification of fin rays: dorsal at 7.0 mm, anal at 7.5 mm, pelvic at 8.5 mm (bud at 6 mm), caudal at 13.0 mm, and pectoral at 14.0 mm.
 - Ossification of vertebrae complete at 6.0–6.5 mm.
 - Pigmentation: (see illustrations opposite).

Note: Preopercle spines (not illustrated) are tiny and about equal in length. Spine at preopercle angle is pronounced in carangids (p. 240–259)

Fig. — **A–C**, Deuel *et al.* 1966; **D**, Norcross *et al.* 1974; **E–G**, Pearson 1941 (**B–E** redrawn).

Ref. — Kendall and Walford 1979.

Pomatomus saltatrix**POMATOMIDAE**

CARANGIDAE 28 Species in Western North Atlantic

General characters

- Eggs** — Pelagic, shell smooth, yolk homogeneous or segmented, 1 oil globule anterior in late eggs and hatchling (eggs described in only a few species).
- Larvae** — Usually 24 myomeres (maximum 26).
 — Principal caudal fin rays (9+8); pelvic fin ray counts (I, 5).
 — First 2 anal spines widely separated from 3rd spine.
 — First dorsal fin has maximum of 8 spines (number less in some species).
 — Median occipital crest present in some species.
 — Orbital crest and posttemporal spines present in some species.
 — Preopercle spines present on margin and on ridge (secondary spination in *Oligoplites*, *Elagatis*, and *Seriola zonata*).
 — Fin ray and gillraker counts are useful in *Caranx* longer than 14 mm SL.

Useful generic characters

a) Number of dorsal and anal rays about equal

- Chloroscombrus** — Relatively deep-bodied, with median occipital crest.
Oligoplites — Relatively elongate body, with no occipital crest.

b) Few more dorsal than anal rays

- Alectis** — Relatively deep-bodied, with median occipital crest.
Caranx — Relatively deep-bodied, with median occipital crest.
Selene — Relatively deep-bodied, with median occipital crest.
*Vomer** — Relatively deep-bodied, with median occipital crest.
Decapterus — Relatively elongate body, with median occipital crest.
*Trachurus** — Relatively elongate body, with median occipital crest.
Selar — Relatively elongate body, with median occipital crest.
Trachinotus — Relatively elongate body, with no occipital crest.
Hemicaranx — Larvae undescribed.

c) Many more dorsal than anal rays

- Naucrates* — Relatively deep-bodied, with median occipital crest.
Elagatis — Relatively elongate body, with median occipital crest.
Seriola — Relatively elongate body, with no occipital crest.
Uraspis — Larvae undescribed.

* Based on larval descriptions of species outside the western North Atlantic.

Meristic characters and sources of larval descriptions

	Source of description ^a	Dorsal		Anal	No. of vertebrae
		First	Second		
<i>Alectis crinitus</i> ^b		VII	I,18-19	II,I,15-16	24
<i>Caranx bartholomaei</i>	3	VIII	I,25-28	II,I,21-24	24
<i>Caranx crysos</i>	3,4	VIII	I,22-25	II,I,19-21	25
<i>Caranx hippos</i>	3?,12,13	VIII	I,19-21	II,I,16-17	24
<i>Caranx latus</i>	3?	VIII	I,19-22	II,I,16-18	24
<i>Caranx lugubris</i>		VIII	I,22	II,I,19	24
<i>Caranx ruber</i>		VIII	I,26-30	II,I,23-26	24
<i>Caranx dentex</i> ^c	11	VIII	I,25-26	II,I,21-23	
<i>Chloroscombrus chrysurus</i>		VII-VIII	I,24-28	II,I,25-27	24
<i>Decapterus macarellus</i>		VIII	I,31-37	II,I,27-31	24
<i>Decapterus punctatus</i>	1,2	VIII	I,27-34	II,I,24-30	25
<i>Decapterus tabl</i>		VIII	I,29-34	II,I,24-27	24
<i>Elagatis bipinnulatus</i>	1,5	V-VI	I,25-30	II,18-22	24
<i>Hemicaranx amblyrhynchus</i>		VII-VIII	I,27-29	II,I,23-25	26
<i>Naucrates ductor</i>	8	III-IV	I-II,26-28	II,II,15-16	25
<i>Oligoplites saurus</i>	1	V-VI	I,19-21	II,I,18-21	26
<i>Selar crumenophthalmus</i>	9,14,15	VIII	I,24-26	II,I,21-23	24
<i>Selene vomer</i>	1	VII-VIII	I,21-23	II,I,18-20	24
<i>Seriola dumerili</i>	2,10	VII	I,29-35	II,I,19-22	24
<i>Seriola fasciata</i>		VII-VIII	I,28-32	II,I,18-21	
<i>Seriola rivoliana</i>		VII-VIII	I,27-33	II,I,19-22	24
<i>Seriola zonata</i>	1	VII-VIII	I,33-40	II,I,19-21	24
<i>Trachinotus carolinus</i>	6	V-VI	I,22-27	II,I,20-23	24
<i>Trachinotus falcatus</i>	6	VI	I,17-21	II,I,16-19	24
<i>Trachinotus goodei</i>	6,7	VI	I,19-20	II,I,16-18	
<i>Trachurus lathami</i>		VIII	I,28-33	II,I,26-30	24
<i>Uraspis heidi</i>		VIII	I,29	O-I,21	
<i>Vomer setapinnis</i> ^d		VIII	I,20-23	II,I,17-20	24

- ^a Sources:
- | | |
|---------------------------------|--------------------------------|
| 1. Aprieto 1974. | 9. Delsman 1926. |
| 2. Hildebrand and Cable 1930. | 10. Sanzo 1933b. |
| 3. Berry 1959. | 11. Schnakenback 1931. |
| 4. McKenney <i>et al.</i> 1958. | 12. Chacko 1950. |
| 5. Okiyama 1970. | 13. Subrahmanyam 1964. |
| 6. Fields 1962. | 14. Miller <i>et al.</i> 1979. |
| 7. deGaetani 1940. | 15. Zvyagina and Rass 1977. |
| 8. Sanzo 1931b. | |

^b = *A. ciliaris*

^c = *Pseudocaranx dentex* (Block and Schneider) (see Berry and Smith-Vaniz 1978).

^d = *Selene setapinnis* (Mitchill) (see Berry and Smith-Vaniz 1978).

CARANGIDAE***Caranx crysos* (Mitchill)**

Spawning: Mostly during January–August, with peak during the summer.

Eggs — Undescribed.

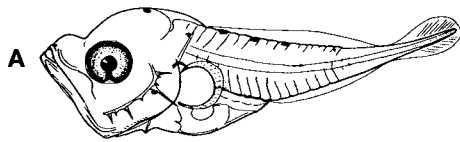
Larvae — Mouth large, nearly vertical.
— Flexion occurs at 4.2–5.3 mm SL, and metamorphosis at about 8 mm SL.
— Body depth and head length proportions:

Meristic features

Myomeres: 25
Vert : 10+15
D : VIII, I, 22–25
A : II, I, 19–21
C : 8–9+9+8+8–9
GR : 10–14+23–28

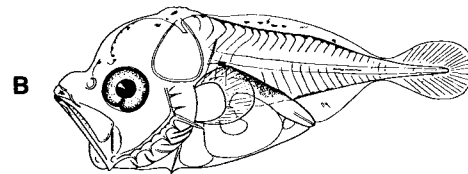
	Preflexion	Flexion	Postflexion
Size range (mm SL)	2.6–4.1	4.2–5.3	5.4–10.8
Body depth at pectoral base (% SL)	30–49	32–58	43–57
Head length (% SL)	35–42	32–42	33–41

- Dorsal and anal spines and principal caudal rays complete at about 5.4 mm SL.
- Pelvic buds form at 5.4 mm, and rays complete at about 6.2 mm SL.
- Dorsal and anal rays complete at 7.5–8.5 mm SL, and pectoral rays formed at about 8.5 mm SL.
- Preopercle spines, in 2 rows with largest spine at angle, form early and reach maximum relative size at 4–5 mm SL.
- Occipital crest with serrate edge forms at about 3.8 mm NL, becomes reduced, and disappears at about 8 mm SL.
- Tiny posttemporal spines present from about 4.2 mm NL until about 8.5 mm SL.
- Few spines along upper jaw in larvae about 4–5 mm SL.
- Pigmentation: row of spots along bases of second dorsal and anal fins and along lateral midline between these fins; spots appear over gut at about 4 mm NL and increase with growth; spots on head increase with development; peduncle unpigmented throughout larval stage.

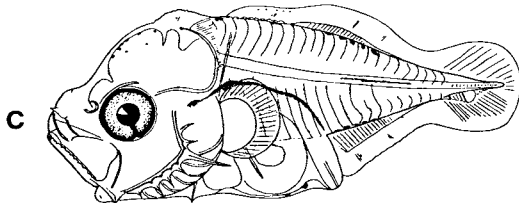
Caranx crysos**CARANGIDAE**

2.6 mm SL

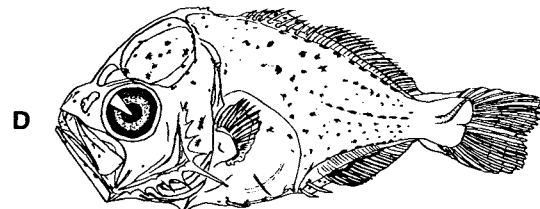
Body depth increases early



3.8 mm SL

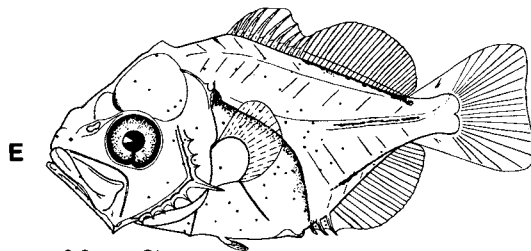


4.2 mm SL

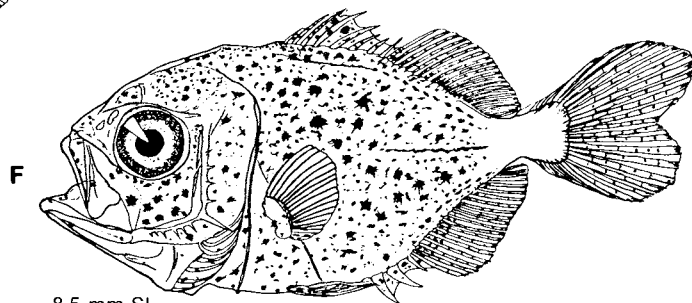
3 rows of spots and
scattered flank spots

5.4 mm SL

Dorsal and anal spine membranes pigmented

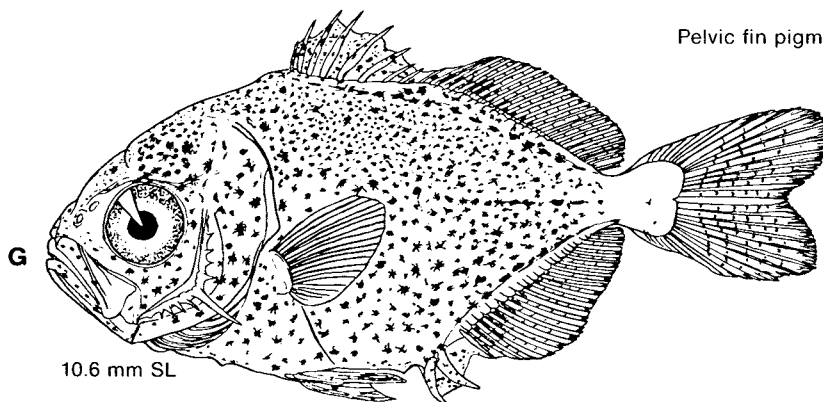


6.2 mm SL



8.5 mm SL

Pelvic fin pigmented



10.6 mm SL

Pigment bars form at 15-19 mm

CARANGIDAE***Caranx bartholomaei* Cuvier****Spawning:** Mainly south of United States in February–October.**Meristic features****Eggs** — Undescribed.

Myomeres: 24

Larvae — Specimen 6.0 mm SL tentatively identified.

Vert : 10+14

- Dorsal and anal spines and pelvic rays complete by about 6 mm SL; dorsal, anal and pectoral rays complete by about 8 mm SL.

D : VIII, I, 25–28

A : II, I, 21–24

C : 8–9+9+8+7–9

GR : 6–8+18–21

- Posttemporal spines and serrate occipital crest present at 6 mm SL, but no posttemporal spines at about 8 mm SL and occipital crest loses serrations.

- Preopercle spines decrease in relative size at about 10 mm.

- Pigmentation: rows of spots along second dorsal fin base and at midline; few spots on dorsal and anal spine membranes, on pelvic fin, and along anal fin base; peduncle unpigmented.

Caranx hippos* (Linnaeus) — *Caranx latus* Agassiz*Spawning:** Mainly south of United States in March–July (*C. latus*) or September (*C. hippos*).**Meristic features***C. hippos**C. latus***Eggs** — Undescribed.

Myomeres: 24

24

Vert : 24

24

Larvae — Similar for both species (not presently separable).

D : VIII, I, 19–21

VIII, I, 19–22

A : II, I, 16–17

II, I, 16–18

GR : 6–9+16–19

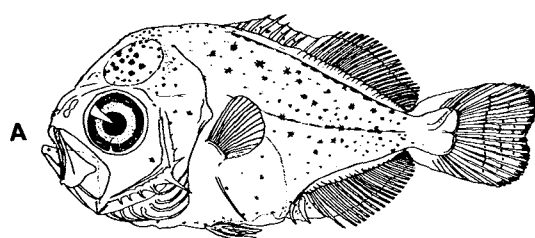
6–7+16–18

- Dorsal and anal spines complete at 5.4 mm; pelvic buds form at 5.4 mm and rays complete at 6.9 mm; principal caudal rays complete at 6.9 mm; dorsal, anal and pectoral rays complete at 8.3 mm.

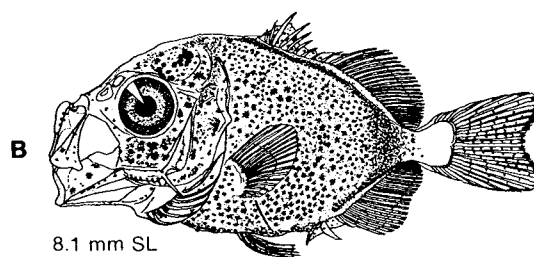
- Preopercle and posttemporal spines present.

- Serrate occipital crest present at 5.4 mm, and lost at 6.2 mm.

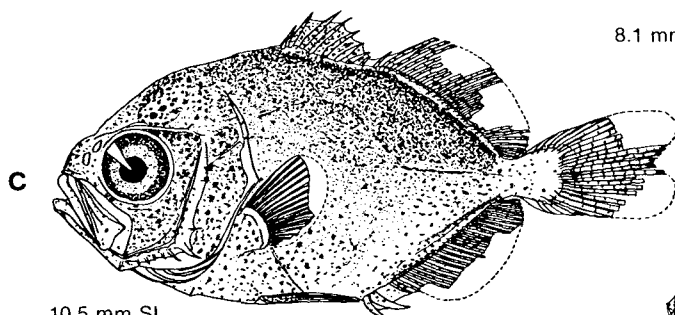
- Pigmentation: spots on membrane of anal spine and first 4 dorsal spines; midline row of spots present at 5.4–6.3 mm but absent by 6.9 mm; spots become scattered on body and head.

Caranx bartholomaei**CARANGIDAE**

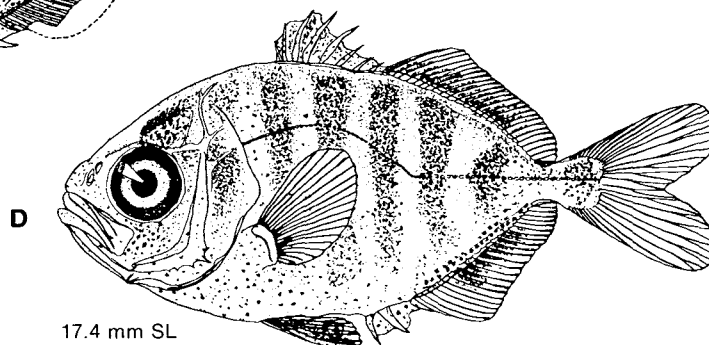
6.0 mm SL



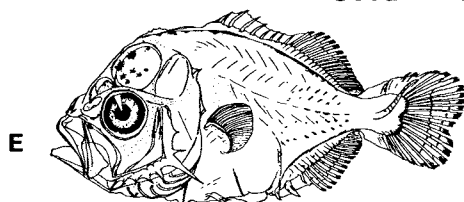
8.1 mm SL



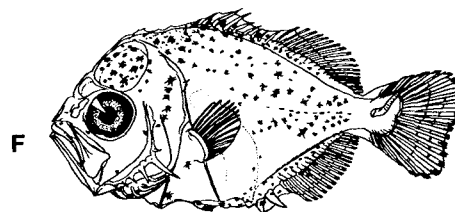
10.5 mm SL



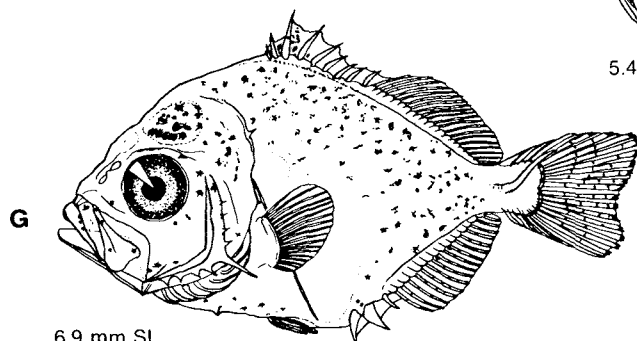
17.4 mm SL

Caranx latus* or *C. hippos

4.9 mm SL



5.4 mm SL



6.9 mm SL

CARANGIDAE***Decapterus punctatus* (Agassiz)****Spawning:** May–November (mainly July–September).**Meristic features****Eggs** — Undescribed.

Myomeres: 25

Larvae — Body shallower and tail longer than *Caranx* (see below).

Vert : 10+15

D : VIII, I, 27–34

A : II, I, 24–30

C : 8–9+9+8+8–9

— Flexion occurs at 4–8 mm, and metamorphosis at 12–14 mm.

— Snout concave, becoming straight at flexion and convex in later larvae.

— Body depth decreases from 35% to 31% SL during larval development and to 28% SL at metamorphosis.

— Head long and deep; length increases from 27% to 35% SL in larvae and becomes 31% SL at metamorphosis.

— Preanal length ranges from 52% to 60% SL in larvae and juveniles.

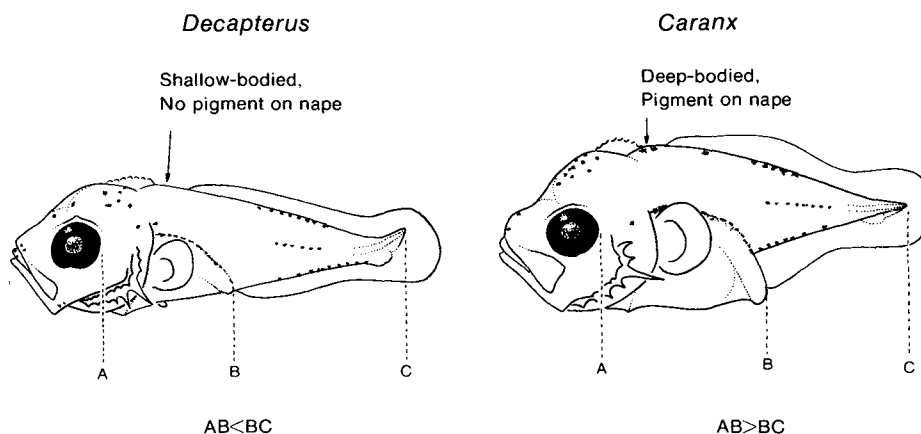
— Sizes at beginning of ossification and completion of fin rays:

Principal caudal rays	4 mm	6 mm
Dorsal rays	5	10
Anal rays	5	9–11
Pectoral rays	5	11
Pelvic rays (bud at 4–5 mm)	7	7

— Dorsal and anal finlets formed before metamorphosis.

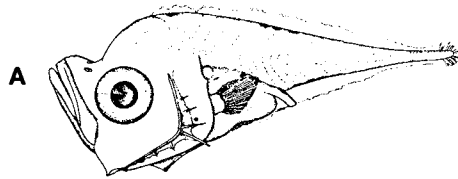
— Occipital crest present, but resorbed at metamorphosis; orbital crest with one weak spine in 3–7 mm larvae, but lost by 10 mm.

— Preopercle spines on edge and ridge (lost at metamorphosis).

— Pigmentation: sparse; paler than in *Elagatis* and *Seriola* (p. 249, 257).**Fig.** — **A**, Hildebrand and Cable 1930; **B–G**, Aprieto 1974.

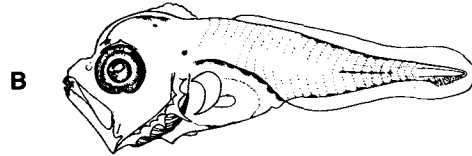
Decapterus punctatus

CARANGIDAE



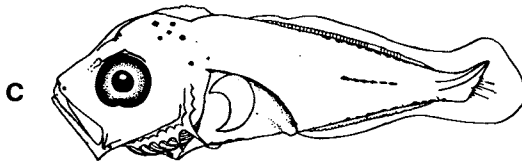
2.3 mm

Scattered spots on head

Specimen A distorted
(possibly dessicated)

B

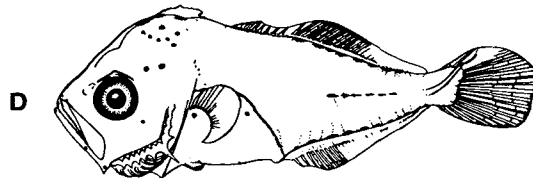
3.1 mm SL

Rows of spots along dorsal and anal bases
and at posterior midline

C

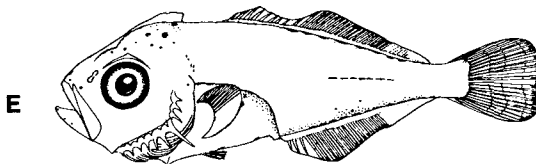
4.2 mm SL

Peritoneal pigment



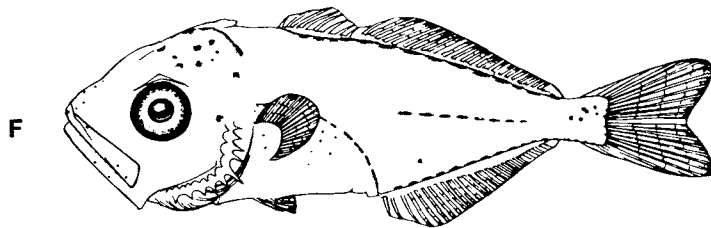
D

5.5 mm SL



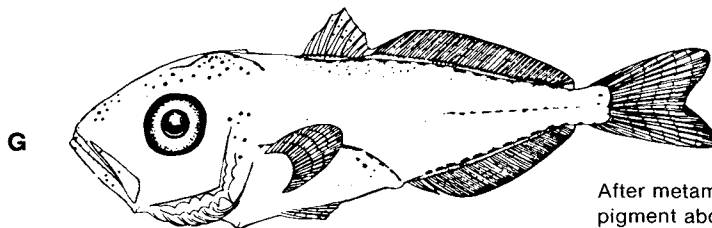
E

6.5 mm SL



F

8.0 mm SL



G

12.0 mm SL

After metamorphosis, most
pigment above midline

CARANGIDAE *Elagatis bipinnulatus* (Quoy and Gaimard)**Spawning:** Year-round in offshore waters.**Eggs** — Undescribed.**Larvae** — Head deeper than long through larval development.

— Snout concave, becoming convex at metamorphosis.

— Flexion occurs at 4.6–8.0 mm SL, and metamorphosis at 10–14 mm.

— Body depth ranges from 32% SL at 3.8 mm to maximum 40% SL at flexion.

— Head length increases from about 32% SL at 3.8 mm to about 35% SL in late larvae and juveniles.

— Sizes at beginning of ossification and completion of fin rays:

Meristic features

Myomeres: 24

Vert: 10+14

D: V–VI, I, 25–30

A: II, 18–22

C: 7–11+9+8+10–11

Principal caudal rays	4.6 mm	7.0 mm
Dorsal spines	5.0	7.0
Anal rays	5.0	8.0–9.0
Dorsal rays	5.0	10.0
Pectoral rays	5.0	9.0
Pelvic rays	6.0	8.0

— Dorsal and anal finlets form after metamorphosis.

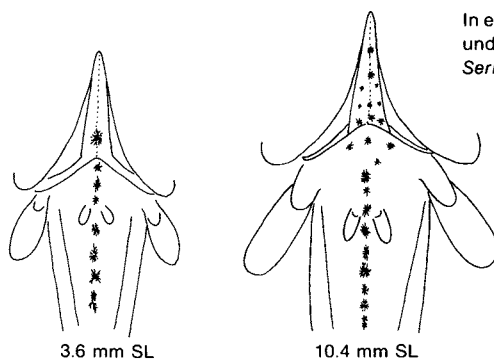
— Only 2 anal spines present; dorsal spines all equal in length.

— Occipital crest present in larvae, but lost at metamorphosis.

— Low orbital crest in early larvae.

— Preopercle angle spine has secondary serrations.

— Pigmentation: dense throughout development (see illustrations opposite).



In early larvae, a mid-ventral row of spots under gut and isthmus (not present in *Seriola*, p. 256).

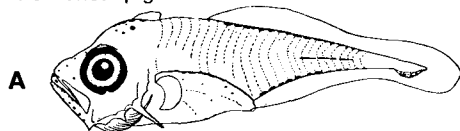
Pacific material (Okiyama 1970)

Fig. — A, D, G, Aprieto 1974; B–C, E–F, H, Okiyama 1970.**Ref.** — Fahay 1975.

Elagatis bipinnulatus

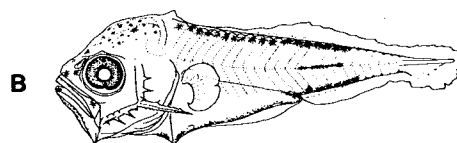
CARANGIDAE

Peritoneal pigment



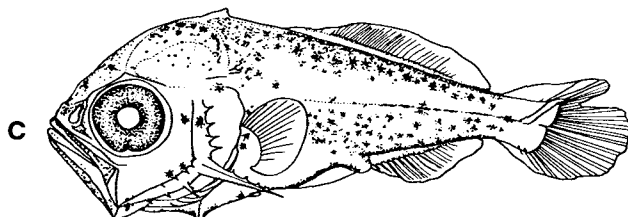
3.8 mm SL

Dorsal row becomes heavy



3.6 mm SL

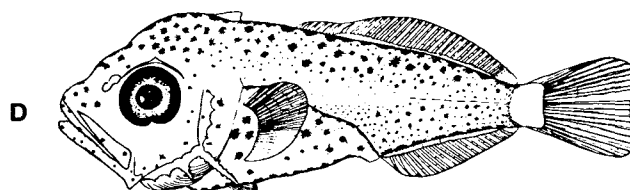
Rows of spots along dorsal and anal bases and at posterior midline



5.5 mm SL

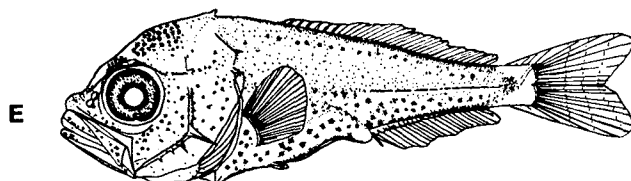
Midventral row of spots under gut

Peduncle unpigmented



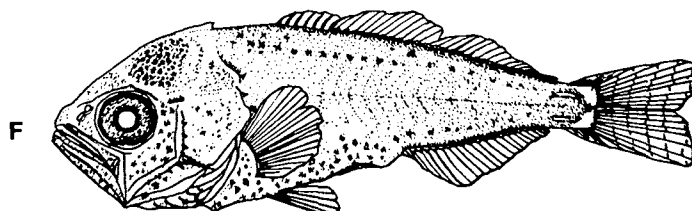
6.3 mm SL

Scattered head pigment



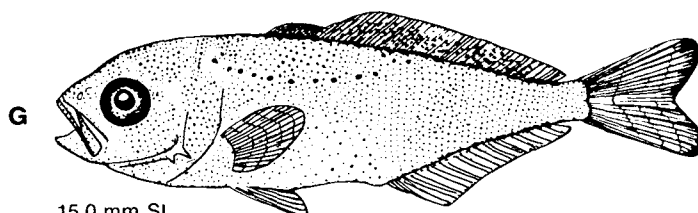
7.7 mm SL

Dorsal spines equal in length



10.4 mm SL

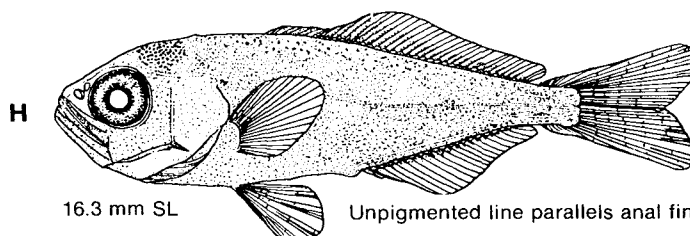
Two parallel, unpigmented lines on caudal peduncle



15.0 mm SL

On upper side of body, row of large spots overlies scattered small spots

Only 2 anal spines



16.3 mm SL

Unpigmented line parallels anal fin base

B, C, E, F, H (Pacific material)

CARANGIDAE***Naucrates ductor* (Linnaeus)**

- | | | |
|---------------|---|--|
| Eggs | <ul style="list-style-type: none">— Pelagic, spherical and transparent.— Diameter: 1.32 mm.— Oil globules: 1.— O.G. diameter: 0.28 mm.— Perivitelline space: narrow. | Meristic features

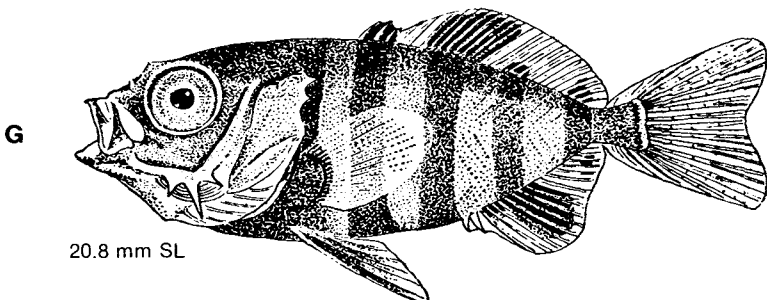
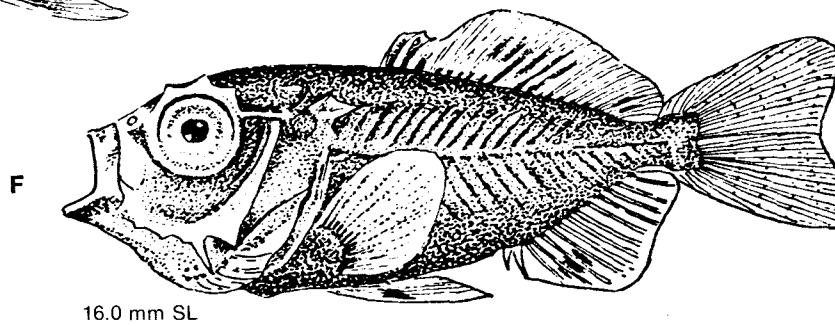
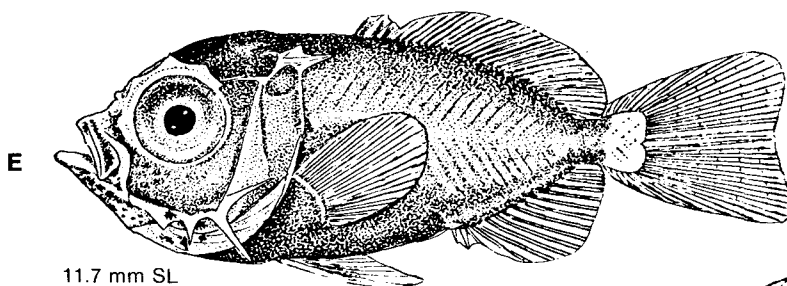
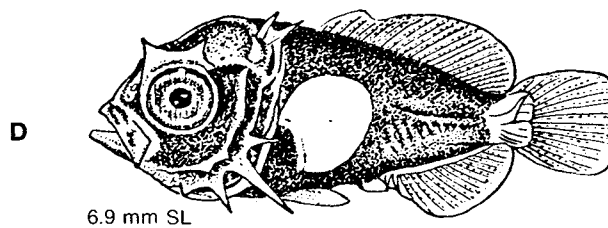
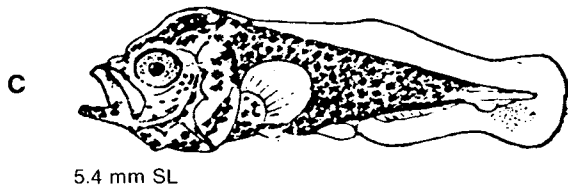
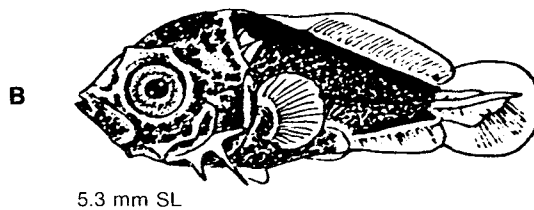
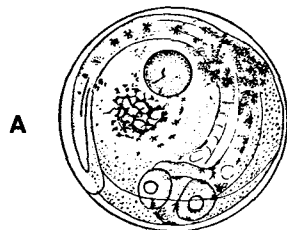
Myomeres: 25
Vert : 10+15
D : III-IV, I-II, 26-28
A : II, II, 15-16 |
| Larvae | <ul style="list-style-type: none">— Deep-bodied with large deep head.— Morphometrics in illustrated specimens:<ul style="list-style-type: none">— Body depth at opercle increases from 29% to about 40% SL.— Preanal length ranges from 64% to 66% SL.— Head length increases from 34% to 40-42% SL.— Flexion complete at about 6.6 mm.— No occipital crest; large orbital crest with 3 spines.— Posttemporal spines (2) pronounced and heavy; preopercle spines pronounced, especially the marginal row.— Dorsal and anal fins complete at about 6.9 mm SL.— Pigmentation: body heavily pigmented except for peduncle; pelvic fins and dorsal spines pigmented at about 11.7 mm SL; pigmented areas on dorsal and anal fins at about 16 mm SL. | |

Fig. — A-G, Sanzo 1931b.

Ref. — Aboussouan 1975.

Naucrates ductor

CARANGIDAE



A-G (eastern Atlantic material)

CARANGIDAE***Oligoplites saurus* (Schneider)**

Spawning: Mostly south of United States in shallow inshore waters in spring-summer.

Meristic features

- Eggs**
- Pelagic, spherical.
 - Diameter: 0.87–0.88 mm.
 - Shell: smooth.
 - Yolk: homogeneous and pigmented.
 - Perivitelline space: narrow.
 - Oil globules: 1 (pigmented).
 - O.G. diameter: 0.33–0.34 mm.

Myomeres: 26
 Vert : 10+16
 D : V–VI, I, 19–21
 A : II, I, 18–21
 C : 9–10+9+8+8–10

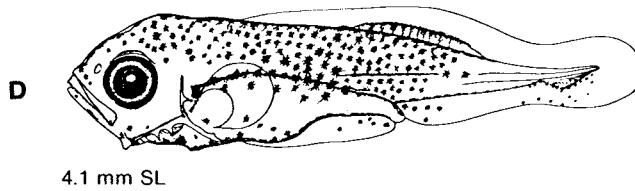
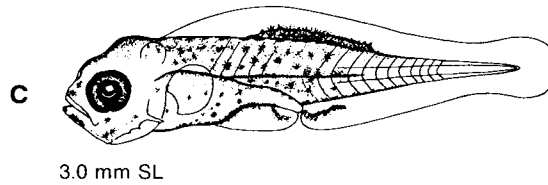
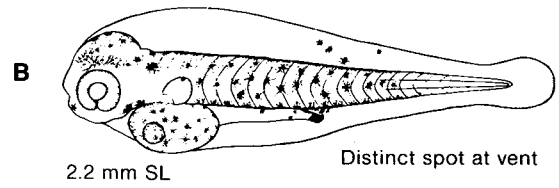
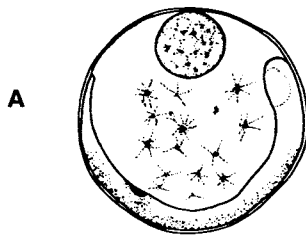
- Larvae**
- Hatching occurs at 1.9–2.0 mm NL; distinct pigment spot at vent.
 - Body relatively slender, depth increasing from 20% SL to maximum 32% SL at metamorphosis.
 - Snout convex; head deep; head length 23–36% SL.
 - Preanal length 51–61% SL in larvae, decreasing slightly at metamorphosis.
 - Flexion occurs at about 4–6 mm SL, and metamorphosis at 7–10 mm SL.
 - Sizes at beginning of ossification and completion of fin rays:

Dorsal and anal rays	5.9 mm	10 mm
Principal caudal rays	5.9	10
Pectoral rays	7.2	10
Pelvic rays (bud at 6 mm)	7.2	10

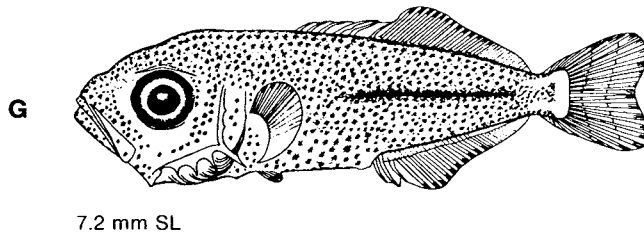
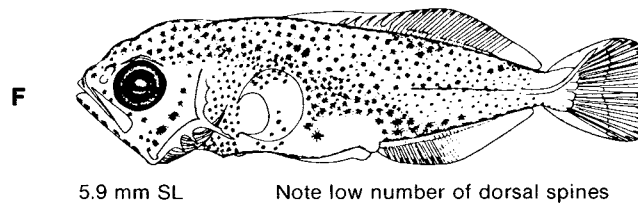
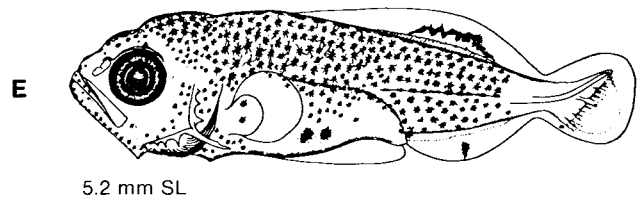
- No occipital crest; serrate orbital crest present from 4 mm to metamorphosis.
- Preopercle angle spine with 1–3 secondary serrations on dorsal surface.
- Pigmentation: uniform dense spots with prominent midline row; unpigmented U-shaped area on peduncle (7.2 to 20 mm); spots on membrane of dorsal and anal spines form after metamorphosis.

Oligoplites saurus

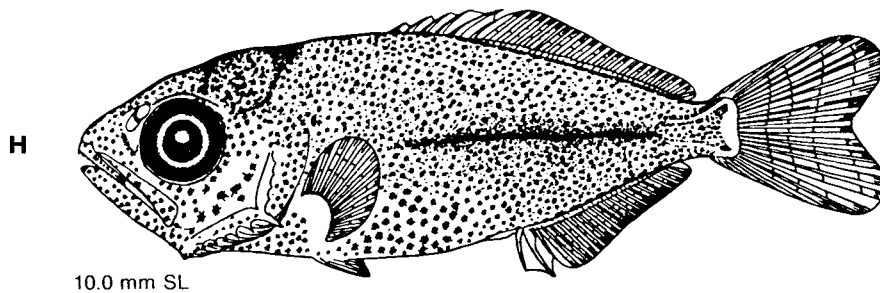
CARANGIDAE



Spine at preopercle angle has 1 to 3
secondary serrations dorsally



Posterior dorsal spine longest



CARANGIDAE***Selene vomer* (Linnaeus)**

Spawning: Probably year-round in the Atlantic.

Eggs — Undescribed.

Larvae — Body deep; head very deep with steep profile, slightly concave in early larvae.
 — Body depth increases from 32% SL at 2.5 mm to maximum 96% SL at 23.9 mm.
 — Preanal length decreases from 56% SL at 2.5 mm to 40% SL at metamorphosis.
 — Head length increases from 31% SL at 2.5 mm to maximum 42% SL at metamorphosis; head deepest relative to head length at about 4.6 mm.
 — Flexion occurs at 4.0–5.5 mm, and metamorphosis at <12 mm.
 — Sizes at beginning of ossification and completion of fin rays:

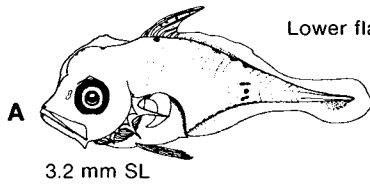
Meristic features

Myomeres : 24
 Vert : 10+14
 D : VII–VIII,
 I, 21–23
 A : II, I, 18–20
 C : 7–9+9+8+7–8

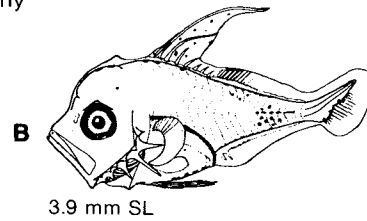
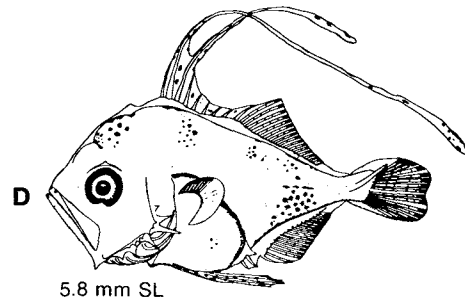
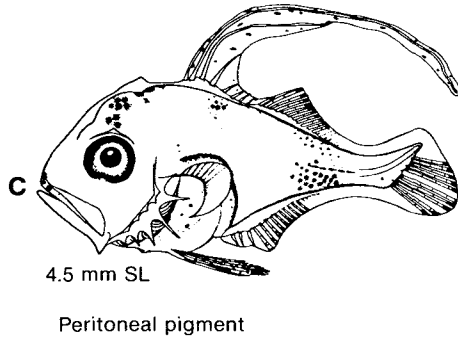
Pelvic rays	...	2.5 mm
Dorsal spines	2.5 mm	4.4
Dorsal rays	4.0	9.0
Principal caudal rays	4.0	7.6
Anal spines	4.0	6.0
Anal rays	4.4	6.0
Pectoral rays	5.0–6.0	9.0

- Occipital and orbital crests well developed in early larvae, and decline at about 5 mm.
- Preopercle spines in 2 rows, with marginal spines (4–7) longest; spines lost at metamorphosis.
- Pigmentation: spots develop early on lower side of tail; other spots scattered on jaw tips, head, pelvic fins, dorsal spines and caudal base; rows of spots along dorsal and anal fin bases and at posterior midline; pigment forms bars at metamorphosis.

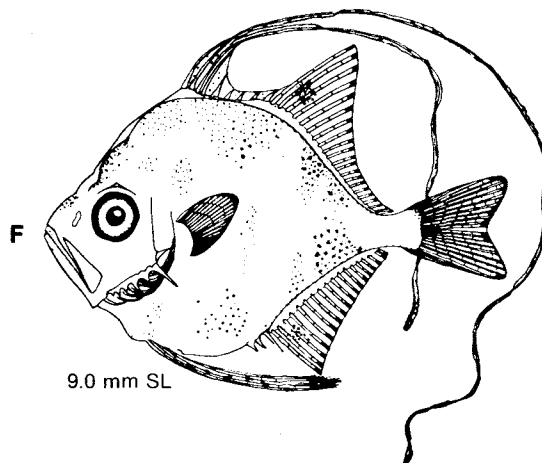
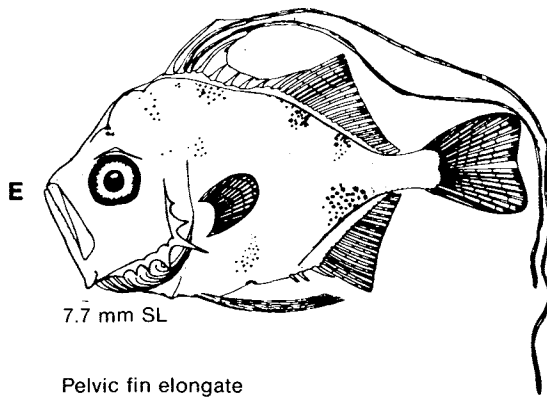
Note: Unusual for carangids to form pelvic rays and dorsal spines early.

Selene vomer**CARANGIDAE**

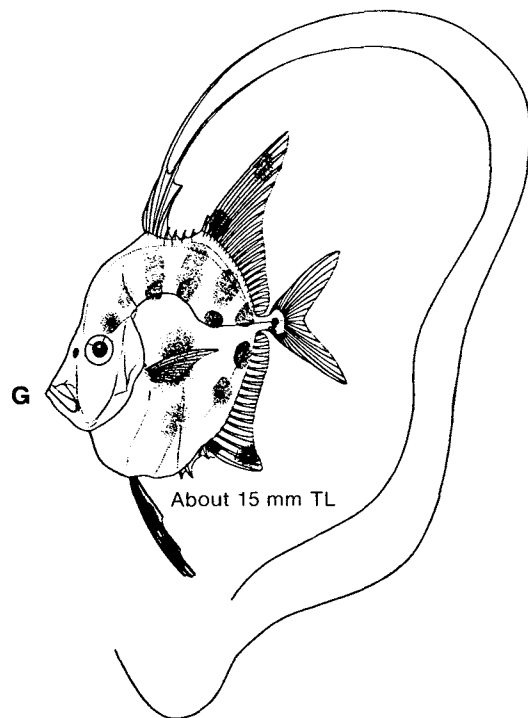
Lower flank spots form early

Midventral row of spots similar to *Elagatis* (p. 248).

2nd and 3rd dorsal spines elongate



Vent located anteriorly, opens near pelvic fin base

Note: In superficially-similar larval *Alectis*, the first 2 dorsal rays are elongate

CARANGIDAE***Seriola zonata* (Mitchill)**

Spawning: Year-round, with possible interruption in summer, in offshore waters south of Cape Hatteras.

Meristic features

Eggs — Undescribed.

Myomeres: 24

Vert : 11+13

Larvae — Fairly deep-bodied with large head; concave snout becomes straight.

D : VII-VIII,

I, 33-40

— Similar to *Elagatis* (p. 248), but lack occipital crest.

A : II, I, 19-21

C : 8-12+9+8+9-11

— Body depth increases from 30% SL at 3.6 mm to 37% SL at flexion and through metamorphosis.

— Preanal length increases from 58% SL at 3.6 mm to 70% at metamorphosis.

— Head length increases from 33% SL at 3.6 mm to maximum 43% SL at 7 mm and then gradually decreases; head depth about equal to head length.

— Flexion occurs at 4.7-7.5 mm, and metamorphosis at about 13 mm.

— Sizes at beginning of ossification and completion of fin rays:

Principal caudal rays	4.4 mm	6.5 mm
Dorsal spines	5.5	8.4
Anal rays	5.5	~9.0
Dorsal rays	6.5	~9.0
Pectoral rays	6.5	11.2
Pelvic rays	7.0	9.5

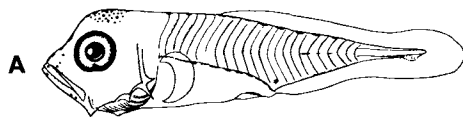
— Second dorsal count highest among western Atlantic *Seriola*.

— No occipital crest; low orbital crest with weak spine in early larvae.

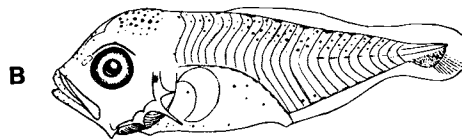
— Smooth spines on preopercle margin and ridge until metamorphosis, and then 2 secondary spines form on longest spine.

— Pigmentation: 5-6 spots form along dorsal base against background of smaller spots in early larvae; rows of spots along dorsal and anal bases and at posterior midline.

Note: Larvae of other western Atlantic *Seriola* species are probably similar, but *S. zonata* is apparently distinguished by large dorsal base spots in early larvae and by high dorsal-ray count in larvae >9 mm.

Seriola zonata**CARANGIDAE**

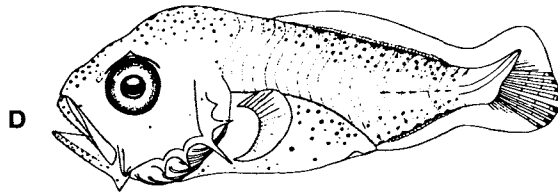
3.6 mm SL



4.8 mm SL



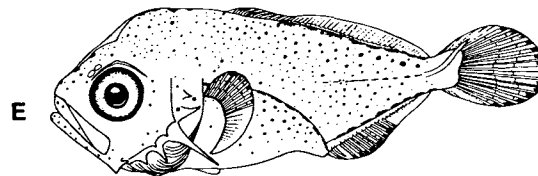
4.8 mm SL



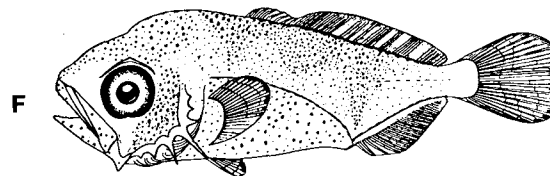
5.5 mm SL

Peritoneal pigment

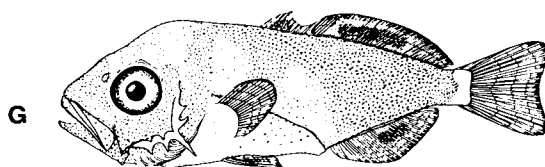
5-6 large spots along base of second dorsal



6.5 mm SL

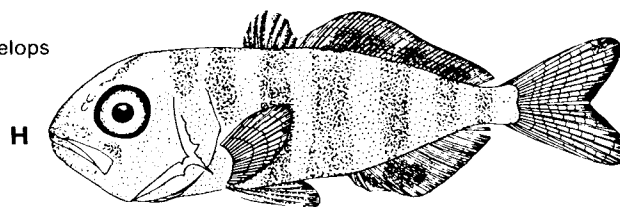
Dorsal spines unequal in length
(compare to *Elagatis*, p. 248).

8.7 mm SL

Banding due to expanded and
contracted melanophores

10.6 mm SL

Nuchal bar develops



18.0 mm SL

True banding begins at about 17 mm

CARANGIDAE***Trachinotus* (3 Species)****Common characteristics** (3 species)

- Larvae**
- Specimens <5 mm SL not identified to species.
 - Flexion completed by about 5 mm SL; teeth present at about 5 mm SL.
 - First dorsal fin high with a short base.
 - No occipital crest; orbital crest long, low and serrated.
 - Preopercle spines on margin and on ridge (3 longer spines at angle with the middle one longest); inner ridge spines conspicuous in small larvae, but lost at about 13 mm.
 - Posttemporal spines small and short (compare to *Naucrates*, p. 250).
 - Head length (in all 3 species) decreases from 39–44% SL in larvae <10 mm to about 25% SL in adults.
 - All fin rays apparently complete at 5–7 mm SL.

Distinguishing features

The 3 species are best distinguished by dorsal and anal fin-ray counts and relative body depth:

	Dorsal fin	Anal fin	Vert.
<i>T. carolinus</i> (Linnaeus)	V–VI, I, 22–27	II, I, 20–23	10+14
<i>T. falcatus</i> (Linnaeus)	VI, I, 17–21	II, I, 16–19	10+14
<i>T. goodei</i> Jordan and Evermann	VI, I, 19–20	II, I, 16–18	10+14

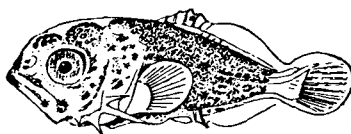
Size (mm SL)	*Body depth as percent of SL		
	<i>T. carolinus</i>	<i>T. falcatus</i>	<i>T. goodei</i>
5.0–6.9	...	30–33	...
7.0–9.9	32	35–44	36
10.0–13.9	28–39	40–48	35
14.0–16.9	31–34	41–53	34–36
17.0–20.0	34	43–55	36

* Body depth at origin of first anal spine.

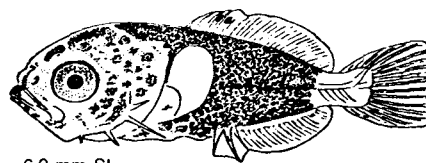
Note: Illustrations of *T. goodei* below (described as *Lichia glauca* by deGaetani 1940) indicate that the dorsal and anal spines form at same time as caudal rays (about 5.4–5.6 mm SL), pigment on dorsal spine membrane at 5.6 mm, and body heavily pigmented except peduncle.



5.4 mm SL



5.6 mm SL



6.9 mm SL

(eastern Atlantic specimens)

Fig. — A–K, Fields 1962.

Ref. — Aboussouan 1975.

Trachinotus carolinus

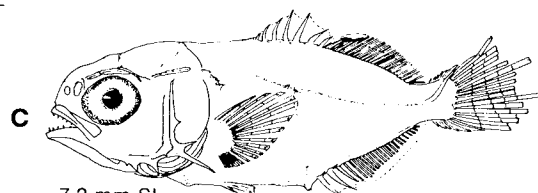
CARANGIDAE



3.1 mm SL

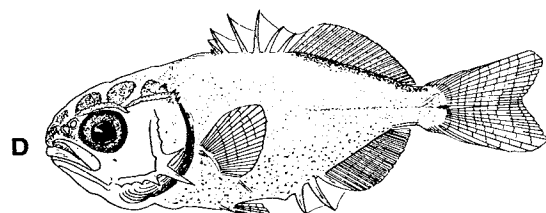


4.7 mm SL

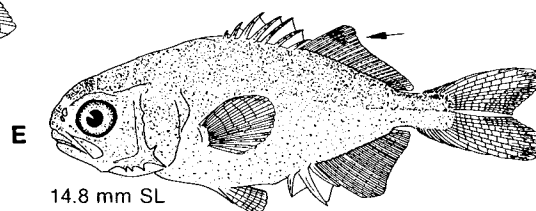
Species uncertain
for A and B

7.2 mm SL

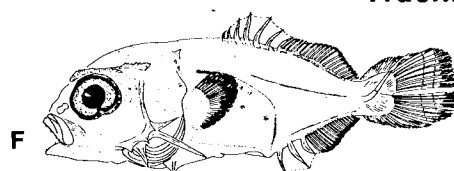
Distinct pigment between first 6-7 rays



11.0 mm SL

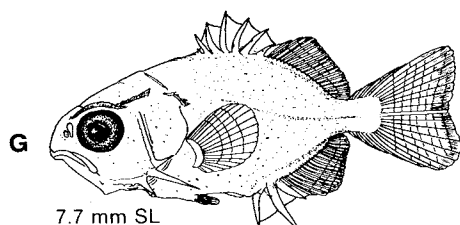


14.8 mm SL

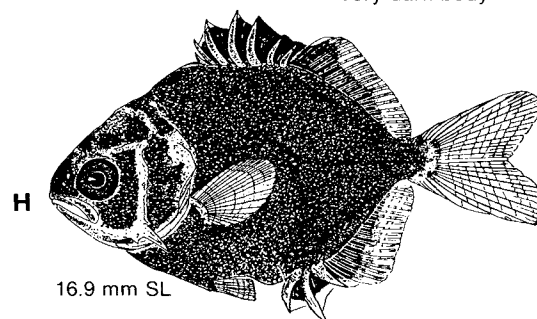
Trachinotus falcatus

5.0 mm SL

Midline pigment present

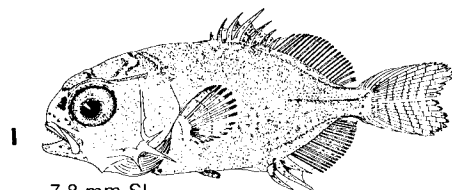


7.7 mm SL

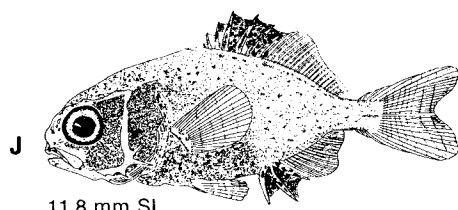


16.9 mm SL

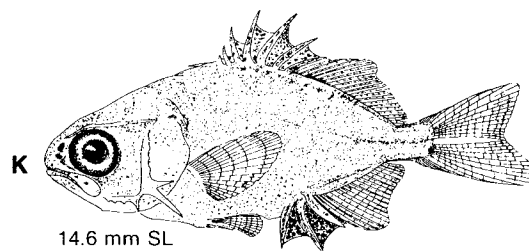
Very dark body

Trachinotus goodei

7.8 mm SL

Dorsal and anal spine membrane darkly
pigmented; body uniformly spotted

11.8 mm SL



14.6 mm SL

BRAMIDAE**Western North Atlantic Species****General characters**

- Six species possible in the area covered by this guide; widely distributed in open ocean.
- High number of myomeres; large fins.
- Preopercle spination varies among species.
- Spines weak or lacking in fins (total ray count is important).
- Pelvic fin rays: 1, 5.
- Principal caudal rays: 9+8.

Meristic characters of six species

Species	Vertebrae			Fin rays		
	Precaudal	Caudal	Total	D	A	P
<i>Pterycombus brama</i> Fries ¹	21-23	25-28	48-51	48-53	38-43	20-23
<i>Pteraclis carolinus</i> Valenciennes ²	24-25	25-28	49-52	48-54	42-47	18-19
<i>Brama brama</i> Bonnaterre ³	16-17	24-25	41-43	35-38	29-32	20-23
<i>Brama dussumieri</i> Cuvier ³	14-17	24-26	40-43	33-35	27-29	19-21
<i>Brama caribbea</i> Mead ³	15-16	21-22	36-38	32-35	27-30	15-16
<i>Taractichthys longipinnis</i> (Lowe) ¹	19-22	25-26	48-51	33-38	27-30	20-22

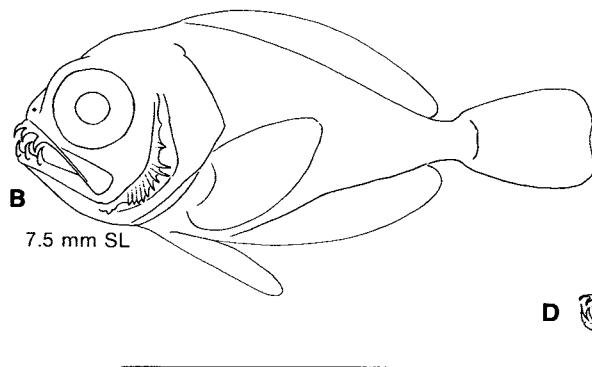
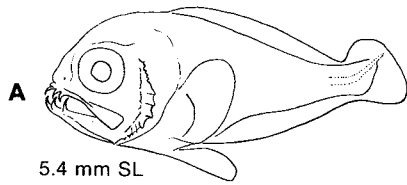
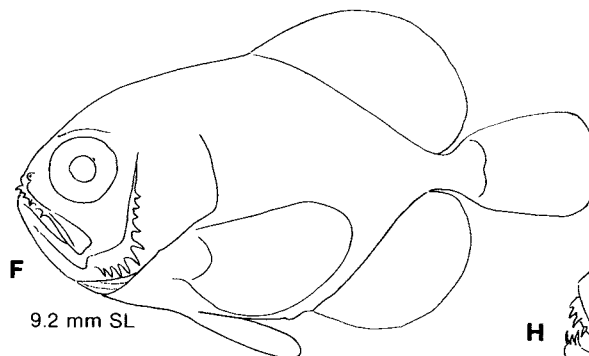
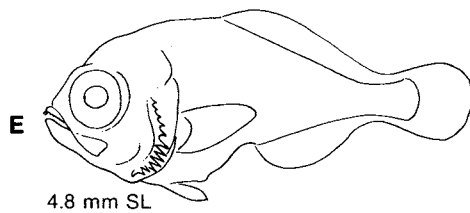
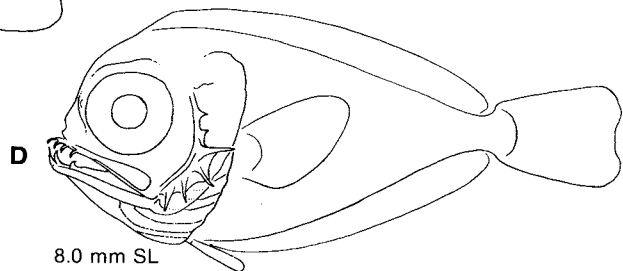
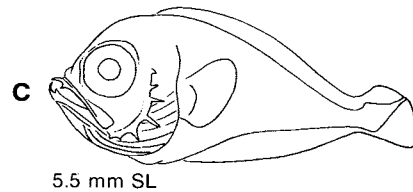
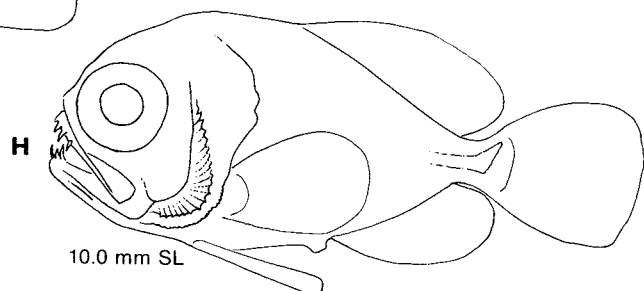
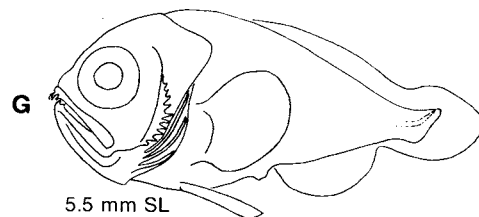
¹ Several oceanic records, Cape Hatteras to Scotian Shelf.

² Open ocean, east of Gulf Stream.

³ Most likely in oceanic collections off Cape Hatteras.

Western North Atlantic Species

BRAMIDAE

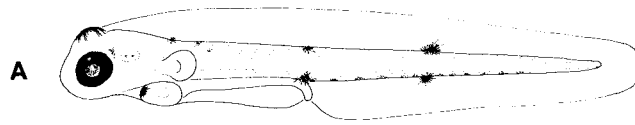
Pterycombus brama*Brama caribbea**Pteraclis carolinus**Taractichthys longipinnis*

HAEMULIDAE *Orthopristis chrysoptera* (Linnaeus)**Spawning:** Spring in Mid-Atlantic Bight.**Meristic features**

- | | | |
|---------------|---|--|
| Eggs | <ul style="list-style-type: none">— Pelagic, spherical.— Diameter: 0.7–0.8 mm.— Oil globules: 1 (usually).— O.G. diameter: 0.16 mm.— Perivitelline space: narrow. | Myomeres: 26
Vert : 10+16
D : XII–XIII, 15–17
A : III, 12–13
Piv : I, 5
C : 12–13+9+8+11–12 |
| Larvae | <ul style="list-style-type: none">— Hatching occurs at about 1.5 mm; eye unpigmented; paired spots over vent and on midline are green chromatophores.— Body elongate; preanal length <50% SL.— Mouth vertical.— Flexion occurs at 5–10 mm.— Fin formation: second dorsal and anal rays formed at 10 mm; caudal complete at about 10 mm; pelvic fin appears at 11 mm; first dorsal forms at 11 mm and is complete at about 20 mm.— Pigmentation: in the preserved specimens of Hildebrand and Cable (1930), there is no pigment until dorsal and ventral edges and midline acquire spots at about 13.5 mm. | |

Orthopristis chrysopterus

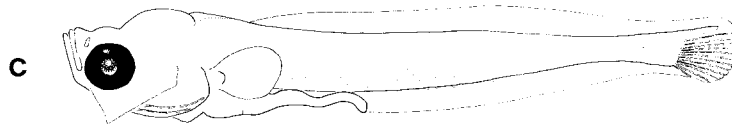
HAEMULIDAE



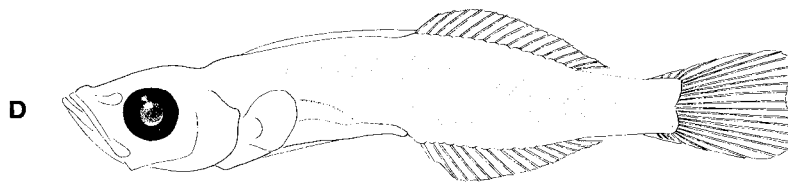
3.0 mm TL



3.1 mm TL



4.9 mm TL



10.0 mm TL



13.5 mm TL

SPARIDAE***Stenotomus chrysops* (Linnaeus)**

Spawning: Late spring and summer in Mid-Atlantic Bight nearshore waters.

Meristic features

- Eggs**
- Pelagic, spherical.
 - Diameter: 0.81–1.00 (average 0.93 mm).
 - Shell: smooth.
 - Yolk: homogeneous.
 - Oil globules: 1 (pigmented).
 - O.G. diameter: 0.17–0.21 mm.

Myomeres: 24
 Vert : 10+14
 D : XII, 12
 A : III, 11–12
 Plv : I, 5
 C : 9–10+9+8+8–10

- Larvae**
- Hatching occurs at about 2 mm NL; eyes unpigmented, and mouth undeveloped.
 - Preanal length <50% TL until after flexion.
 - Flexion occurs at 4.8–5.6 mm SL.
 - Larval sizes and relative body proportions:

	Preflexion	Flexion	Postflexion
Larval size (mm SL)	2.0–4.6	4.8–5.6	6.1–16.9
Preanus length (% SL)	36–42	40–48	48–59
Body depth (% SL)	20–30	22–38	21–33
Head length (% SL)	10–21	20–23	21–30

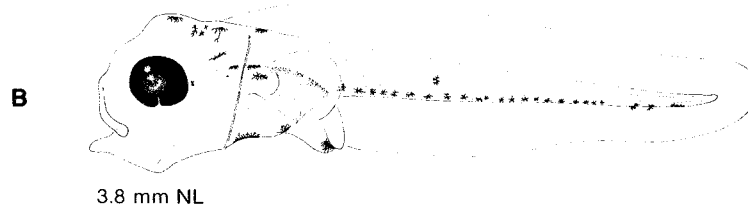
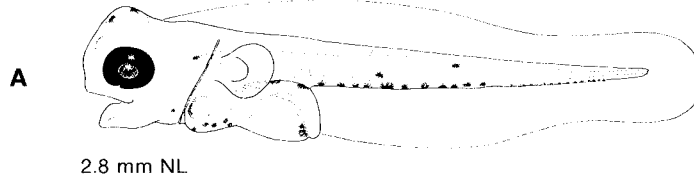
- Fin formation: caudal rays complete at about 5.3 mm SL; dorsal and anal spines and rays complete at about 10 mm SL; pelvic buds form at about 5.7 mm SL, and rays are complete at 12.8 mm SL.
- Weak preopercle spines present.
- Pigment in early larvae (2.0–2.5 mm NL): two dorsal rows of spots from head to myomere 20; no pigment on anterodorsal or ventral parts of head; prominent spot anterior to vent, becomes less intense at 5.0 mm SL.
- Pigment in later larvae: ventral row of spots develops postanally, the number increasing gradually with development; spot at cleithral symphysis and few spots on ventral gut surface; lateral pigment increases after fin rays are ossified.

Sparidae Family Characters

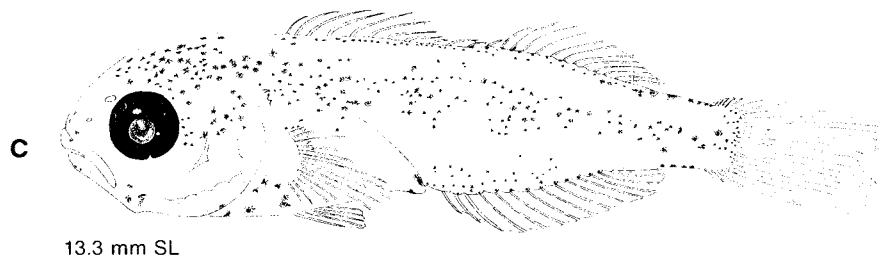
- Larvae**
- Usually 24 myomeres.
 - Oil globule posterior in yolk at hatching.
 - Pigment on yolk and oil globule.
 - Gut <50% TL.
 - Anal and second dorsal fins have about same number of rays.
 - Weak or no head spines.
 - Ventral row of postanal spots.

Fig. — **A–C**, P. L. Berrien (illustrator, reared specimens) (redrawn).

Ref. — C. A. Griswold and T. W. McKenney 1982 (pers. comm.).

Stenotomus chrysops**SPARIDAE**

(See note, p. 345)



SPARIDAE***Lagodon rhomboides* (Linnaeus)****Spawning:** Autumn to winter from North Carolina to Florida.**Meristic features****Eggs** — Diameter: 0.99–1.05 mm (unfertilized).

— Oil globules: 1.

Myomeres: 24

Vert : 10+14

Larvae — Flexion occurs at about 5 mm.— Larvae less deep-bodied than *A. rhomboidalis* at 5–20 mm.

— Teeth present at 10 mm.

— Fin formation: dorsal, caudal and anal rays begin at 5–6 mm and are complete at 10 mm; pelvic bud forms at 7–10 mm and fins complete at >15 mm.

D : XII, 11

A : III, 11

P : 16

Plv : I, 5

C : 10–11+9+8+7–10

— Pigmentation: few spots from isthmus to anus, and ventral row from anus to caudal base; spots appear on nape at 7.0 mm.

Archosargus probatocephalus* (Walbaum)*Spawning:** Spring off Florida.**Meristic features****Eggs** — Pelagic, transparent.

— Diameter: about 0.8 mm.

Myomeres: 24

Vert : 10+14

Larvae — Hatching occurs at about 2.0 mm, and flexion at 6.0 mm.— Larvae deeper-bodied than *A. rhomboidalis* at 6–10 mm.

— Feeble preopercle spines at 6 mm, lost by 15 mm.

— Fin formation: dorsal has 7 spines and 12 rays at 6 mm and fin complete at 12 mm; anal spines and rays complete at 6 mm; pelvic bud at 6.5 mm and rays form at 8 mm.

D : XII, 10–12

A : III, 9–10

P : 15–17

Plv : I, 5

C : 8–9+9+8+7

— Pigmentation: few spots from isthmus to anus and 2 spots on anal base.

Archosargus rhomboidalis* (Linnaeus)*Larvae** — Hatching occurs at 2.0–2.2 mm, and flexion at 4.2–4.4 mm.

— Dorsal spines number 13.

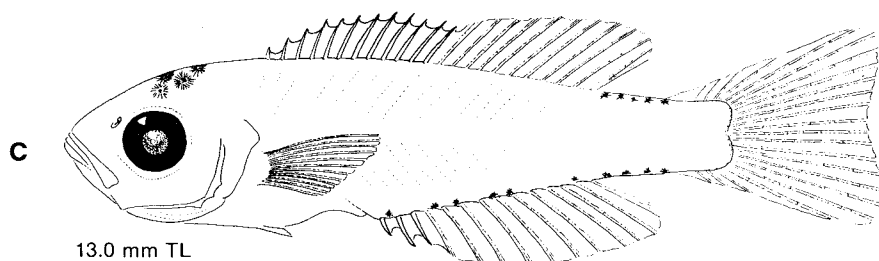
Note: See p. 264 for Sparidae family characters.**Fig.** — A–F, Hildebrand and Cable 1938 (redrawn); G–H, Houde and Potthoff 1976.**Ref.** — Mook 1977.

Lagodon rhomboides**SPARIDAE**

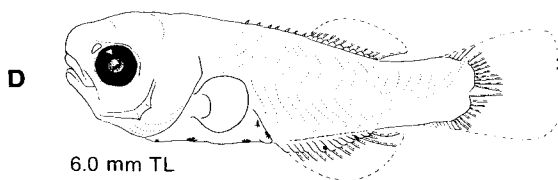
5.0 mm TL



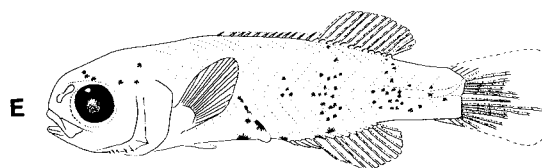
7.0 mm TL



13.0 mm TL

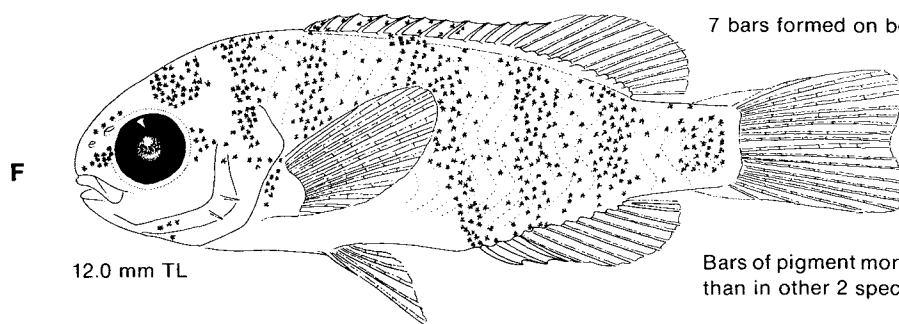
Archosargus probatocephalus

6.0 mm TL



7.5 mm TL

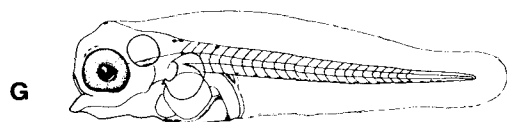
Earlier larvae have spot at angle of jaw



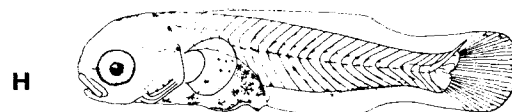
12.0 mm TL

7 bars formed on body by 12.0 mm

Bars of pigment more pronounced than in other 2 species on this page

Archosargus rhomboidalis

2.5 mm SL



4.9 mm SL

SCIAENIDAE**Family Characters****Meristic characters of sciaenids**

Species	Dorsal fin	Anal fin	Vertebrae
<i>Bairdiella chrysoura</i>	X-XI, I, 19-23	II, 8-10	12+13=25
<i>Cynoscion nebulosus</i>	IX-X, 25-28	II, 10-12	13+12(or 12+13)=25
<i>Cynoscion regalis</i>	X, I, 24-29	II, 10-13	13+12(or 12+13)=25
<i>Larimus fasciatus</i>	X, I, 24-27	II, 6-8	10-11+14-15=25
<i>Leiostomus xanthurus</i>	IX-XI, I, 29-35	II, 12-13	10+15=25
<i>Menticirrhus</i> sp.	X, I, 19-27	I, 6-9	10+15=25
<i>Micropogonias undulatus</i>	X, I, 27-30	II, 8-9	10+15=25
<i>Pogonias cromis</i>	X, I, 19-23	II, 5-7	10+14=24
<i>Sciaenops ocellatus</i>	X, I, 23-25	II, 7-9	10+15=25
<i>Stellifer lanceolatus</i>	XI-XII, I, 20-24	II, 7-9	10-11+14-15=25

Larval morphology

- Body shape unspecialized: short gut, deep head, large oblique mouth.
- Range of myomeres: 23-27.
- Small preopercle and posttemporal spines present in all species but highly-developed head spines lacking.
- Early fin development: dorsal and anal fin bases formed at <5 mm and rays complete at <10 mm.
- Usual sequence of fin development: anal and dorsal rays, principal caudal rays, dorsal spines, pelvic spine and rays, pectoral rays, and procurent caudal rays. (*Larimus* differs in forming pectoral rays early, at time of notochord flexion.)
- Second dorsal fin base is at least twice as long as anal fin base, and dorsal rays about twice as numerous as anal rays.
- Marked gap between anus and anal fin origin in most species, except *Menticirrhus* sp. and *Cynoscion nebulosus*.
- Body depth at cleithral symphysis similar in early stages of all species (about 30% SL in larvae <3.5 mm), but later fall into 2 groups:

Shallow-bodied (BD <32% SL)	Deep-bodied (BD >32% SL)
<i>Cynoscion nebulosus</i>	<i>Larimus fasciatus</i>
<i>Leiostomus xanthurus</i>	<i>Stellifer lanceolatus</i>
<i>Micropogonias undulatus</i>	<i>Bairdiella chrysoura</i>
<i>Pogonias cromis</i>	
<i>Sciaenops ocellatus</i>	
<i>Cynoscion regalis</i> and <i>Menticirrhus</i> sp. are intermediate in body depth.	

Family Characters (cont'd)**SCIAENIDAE****Larval pigmentation**

- Ranges from sparse to moderately heavy.
- All have row of spots along ventral midline postanally; with development, this row has fewer spots and forms characteristic sequences relative to anal fin base; a feature useful in separating genera and species.
- Pigment on anterior surface of gut and internally at nape is better developed in sciaenids than in other larvae.
- Similarity to larvae of other families:
 - Pigment at angle of lower jaw and anterior to cleithral symphysis.
 - Pigment on dorsal, ventral and posterior surfaces of gut.
 - Pigment on ventral surface of brain.
 - Pigment at base of ventral lobe of caudal fin.

Similar larvae

- Apogonidae* (early stages): dorsal and anal fins form early (about 5 mm); 2 dorsal fins separated, the second short with low ray count (<10).
- Gerreidae*: distinct spots on dorsal midline behind 2nd dorsal; slimmer-bodied than sciaenids, fin ray counts and greater space between successive rays useful.
- Pomacentridae* (early stages): 2nd dorsal and anal fins form early (about 5 mm); lengths and counts about the same for both fins, 7+6 branched caudal rays.
- Sparidae: shorter gap between anus and anal fin base than in sciaenids; many lack spot at lower jaw angle; slimmer-bodied than sciaenids; fin rays counts and greater space between successive rays useful.
- Stromateidae (early stages): high myomere counts (>30).

* Larvae rarely taken north of Cape Hatteras.

SCIAENIDAE***Bairdiella chrysoura* (Lacépède)**

Spawning: Late spring to summer in estuarine and coastal waters.

Meristic features

- Eggs**
- Pelagic, spherical and transparent.
 - Diameter: 0.66–0.88 mm.
 - Shell: thin and horny.
 - Yolk: homogeneous.
 - Oil globules: 1–2 (sparsely pigmented).
 - O.G. diameter: 0.16–0.22 mm.

Myomeres: 25
 Vert : 12+13
 D : X–XI, I, 19–23
 A : II, 8–10
 Piv : I, 5
 P : 15–17

- Larvae**
- Hatching occurs at 1.5–1.9 mm, and flexion at 4.0–4.5 mm SL.
 - Preanus length increases from about 40% to 58% SL.
 - Body depth (at cleithrum) increases from about 32% to 37% SL.
 - Head length increases from <30% to about 38% SL.
 - Preopercle spines present through larval development, with 5 lateral and 4 marginal at 7.0–8.8 mm SL.
 - Posttemporal spines: 1 at 5.0–7.7 mm SL; 2 at 8.8 mm SL.
 - Fin formation: caudal, dorsal and anal rays and anal spines form during noto-chord flexion; sizes at beginning of ossification and completion of fin rays:

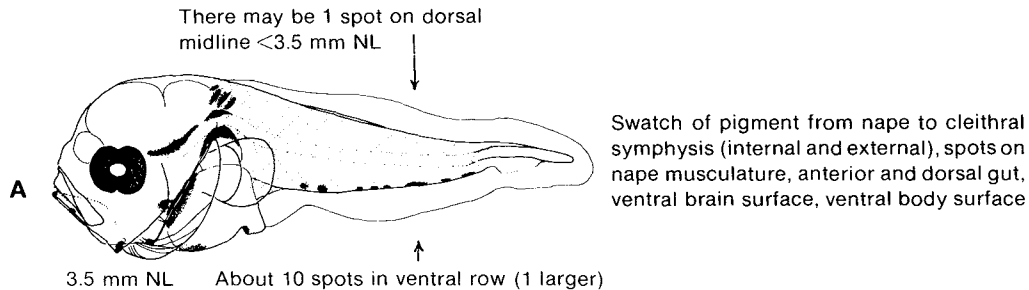
Caudal rays	4.1 mm SL	4.9 mm SL
Dorsal rays	4.1	~5.0
Anal spines and rays	4.1	5.7
Dorsal spines	5.7	5.7 (rapid)
Pectoral rays	5.7	8.8
Pelvic rays	5.7	7.0+

- Pigmentation: ventral row of spots postanally; spot at tip of snout >5.7 mm SL and tip of lower jaw >7.5 mm SL; spot on lower jaw ramus at 3.1–7.0 mm SL (increases to several); brain pigment begins at about 5.7 mm SL and spreads; 1 ventral spot at anus between 3.1 and 5.0 mm SL; 1 spot midway between anus and cleithral symphysis >3.3 mm SL; dark spot forms on gut over anus at >4.9 mm SL.

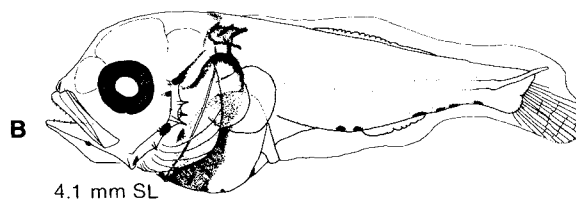
- Note:**
- (1) Larvae of *Menticirrhus* sp. (p. 280) have much darker body pigmentation. Larvae of *Stellifer lanceolatus* (p. 284) have similar meristic characters but different pigment features in early larvae and different caudal fin shape in late larvae.
 - (2) Best characters for *B. chrysoura*: pigment swath from nape to cleithral symphysis; spot anterior to anal fin base and at anal fin origin.

Fig. — A–D, Powles 1980.

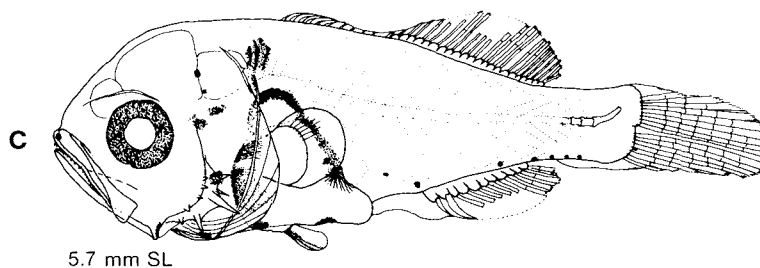
Ref. — Kuntz 1915; Welsh and Breder 1923; Joseph *et al.* 1964; Chao 1978.

Bairdiella chrysoura**SCIAENIDAE**

Spot at angle of lower jaw

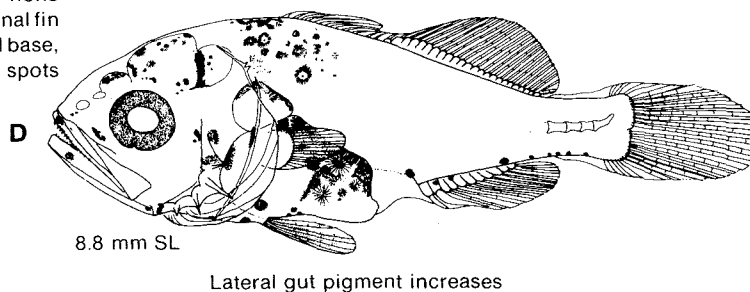


Ventral pigment: 1-2 spots anterior to
anal base, 1 at anal fin origin, 1 at posterior
end of anal base, 3-4 posterior to anal fin



Ventral pigment >7 mm SL: none
anterior to anal base, 1 spot at anal fin
origin, 1 at posterior end of anal base,
3-4 posterior to anal fin, small spots
begin at bases of rays

Dorsal pigment increases anterior to first dorsal fin



SCIAENIDAE *Cynoscion regalis* (Block and Schneider)**Spawning:** Spring through summer.**Meristic features**

- Eggs** — Pelagic, spherical.
 — Diameter: 0.75–0.87 mm.
 — Shell: smooth and transparent.
 — Yolk: homogeneous (amber).
 — Oil globules: 1–6 (usually 1).
 — O.G. diameter: average 0.20–0.25.

Myomeres: 24–25
 Vert : 13+12 or 12+13
 D : X, I, 24–29
 A : II, 10–13

- Larvae** — Hatching occurs at 1.50–1.75 mm, and flexion at 4.0–4.3 mm.
 — Body depth intermediate among sciaenids (29–43% SL).
 — Preanus length increases from <50% SL in small larvae to about 68% SL at 25 mm.
 — “Hump” on dorsal margin of gut over anus; gap between anus and anal fin origin.
 — Preopercle spines increase from 2 at 2.7 mm to 15 at 25 mm; 1 or 2 opercle spines present; 1–4 posttemporal spines present in most larvae 4.8–25.0 mm.
 — Fin formation: second dorsal and anal rays complete at 5.0 mm; pectoral fin bud present at 2.7 mm and complete at 10.1 mm; pelvic fin buds present at 4.3 mm and complete at 9.2 mm.
 — Ventral midline pigment: spot in anus-anal fin gap at <4.7 mm, spot at mid-anal base, and 0–3 spots posterior to anal base; spot on anterior end of anal base at >9.4 mm; 1–4 spots on ventral midline of lower jaw.
 — Midlateral pigment (>6 mm): 1–2 spots above mid-anal base and few below spiny dorsal fin; spots added below anterior part of second dorsal fin at about 8 mm; spot added to urostyle at 10.1 mm; this midlateral pigment not adequately shown in illustrations.
 — Other pigment: spots on dorsal midline at termination of second dorsal fin present at all sizes; spots develop on each side of spiny dorsal fin at about 6.7 mm.

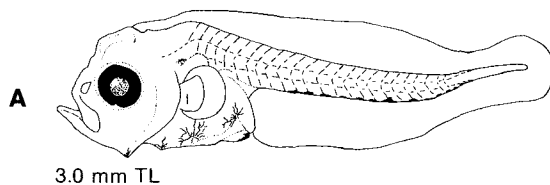
Cynoscion nebulosus* (Cuvier)*Spawning:** Spring and summer south of Chesapeake Bay.**Larvae** — See illustrations opposite.

Fig. — **A, C, D**, Pearson 1941; **B**, Perlmutter 1939; **E–F**, Fable *et al.* 1978; **G–H**, Hildebrand and Cable 1934 (**A–D** and **G–H** redrawn)

Ref. — Powles and Stender 1978.

Cynoscion regalis

SCIAENIDAE



Figures should include internal pigment on and in nape and behind dorsal fin

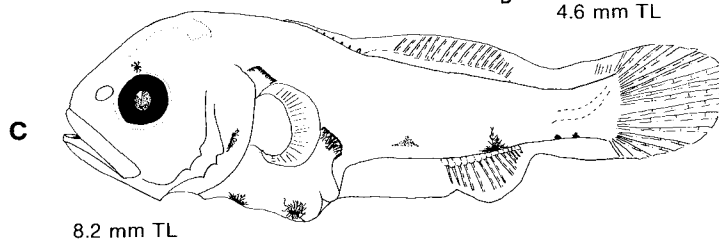
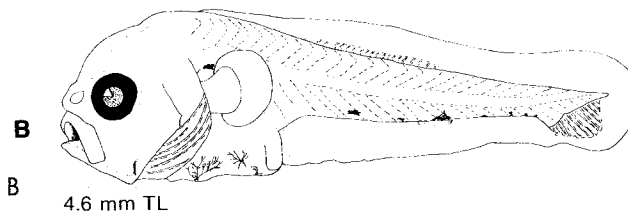
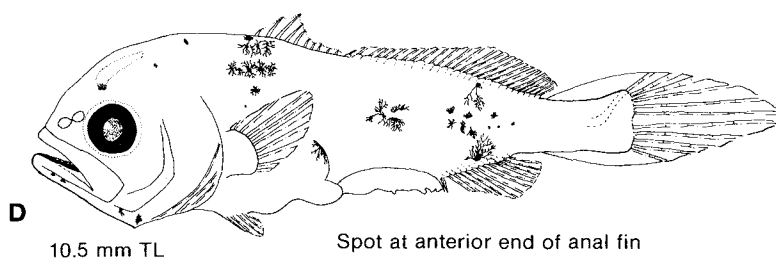
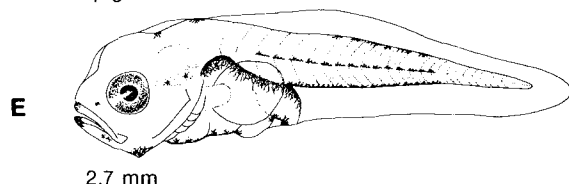


Figure should include spots at sides of spiny dorsal and some pigment along lateral line

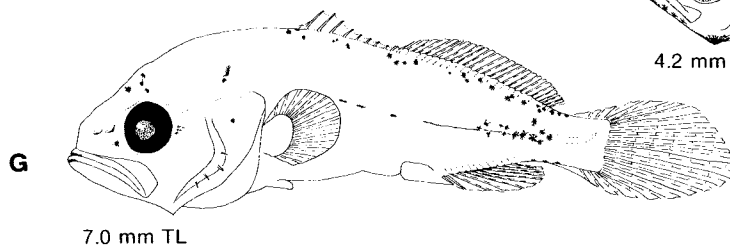
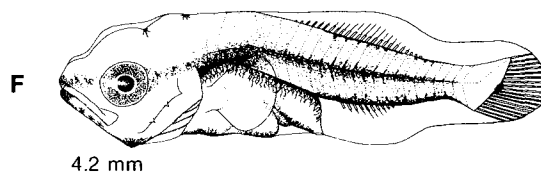
Figures C and D should show spot at tip of upper jaw and spot on each side of lower jaw tip

*Cynoscion nebulosus*

Band of pigment on snout

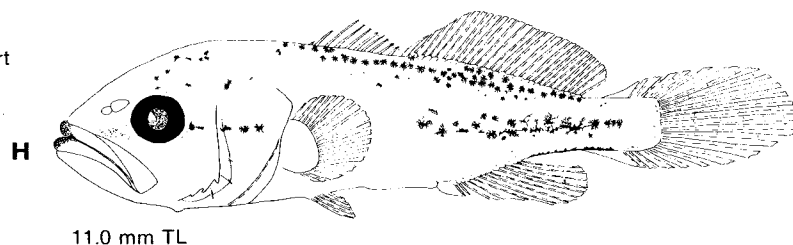


Heavily pigmented row of spots on midlateral line of tail



Dorsal midline pigment

Anus-anal fin gap short



SCIAENIDAE***Larimus fasciatus* Holbrook**

Spawning: Continental shelf south of Chesapeake Bay in April–June and August–October.

Meristic features

Eggs — Undescribed.

Myomeres: 25
 Vert : 10+15 or 11+14
 D : X, I, 24–27
 A : II, 6–8
 Piv : I, 5
 P : 16–17

Larvae — Body depth at cleithrum 40–45% SL in most.
 — Head length increases from about 34% to about 40% SL.
 — Preanus length increases from about 53% SL to >60% SL.
 — Flexion occurs at 3.6–4.0 mm SL.
 — Preopercle spines at all sizes, lateral spines smaller than marginal (not shown in Fig. C).
 — Posttemporal spines (1 or 2) and low supraorbital crest present >5.5 mm SL.
 — Sizes at beginning of ossification and completion of fin rays:

Dorsal rays	3.6 mm SL	4.8 mm SL
Anal spines and rays	3.6	4.9
Caudal rays	3.6	4.9
Pectoral rays	4.0	>6.0
Dorsal spines	4.4	5.8
Pelvic rays (bud at 3.6 mm)	4.9	5.8

— Pigmentation: ventral row of spots postanally; pigment on anterior forebrain, anterior and posterior midbrain, posterodorsal hindbrain, and ventral surface of brain posterior to eye (ring around midbrain seen in dorsal view); heavy pigment on pectoral fin base and fin membrane; spots on lateral gut, under pectoral fin, increase with growth; spots on gular membrane (between lower jaw rami), on preopercle posterior to eye, on lower jaw angle, and 1 spot ventrally anterior to cleithral symphysis; dorsal spot forms anterior to 1st dorsal fin base at >3.8 mm SL (not shown in Fig. C); line of 3 spots on ventral gut between cleithral symphysis and anus at <3.6 mm SL; spot at anus disappears at >3.6 mm SL, but spots posterior to cleithral symphysis increase in number at >4.5 mm SL.

Best Characters

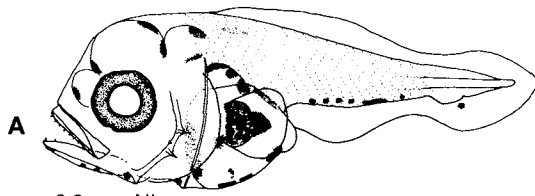
- Early-forming pectoral rays.
- Long preanus length (>50% SL).
- Brain and pectoral fin pigment.

Fig. — **A–B, D**, Powles 1980; **C, E–F**, Hildebrand and Cable 1934 (**C, E, F**, redrawn, with spot added over anal fin origin in **C**).

Ref. — Chao 1978.

Larimus fasciatus

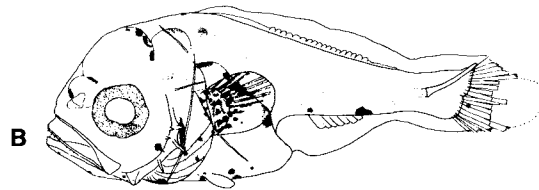
SCIAENIDAE



3.0 mm NL

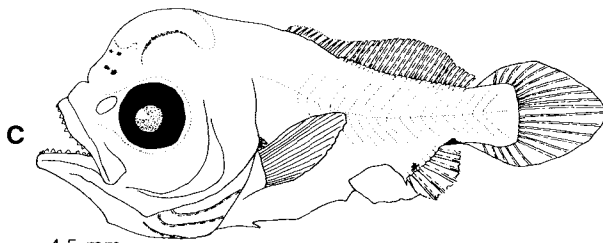
6 spots in ventral row (5th largest)

Dorsal spot anterior to first dorsal fin

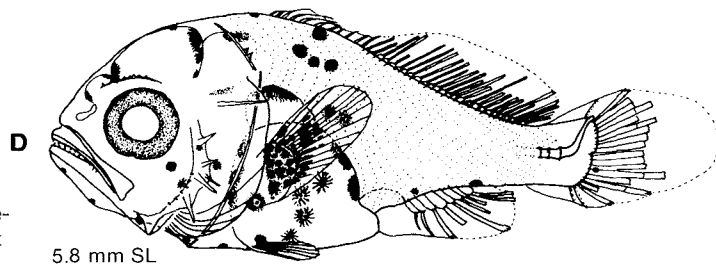


4.0 mm SL

2 spots in ventral row: large one at posterior end of anal fin, and small one just posterior to anterior end of anal fin

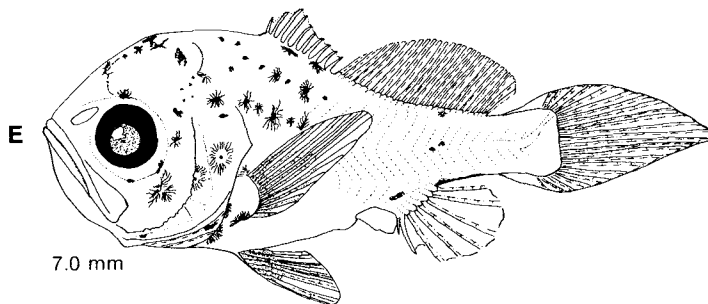


4.5 mm



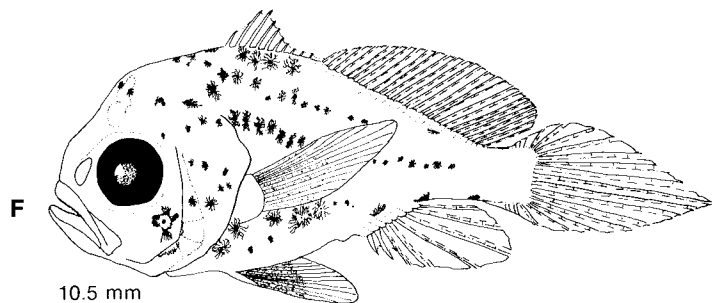
5.8 mm SL

Lateral pigment increases between first dorsal fin and gut



7.0 mm

Dorsal pigment increases



10.5 mm

SCIAENIDAE***Leiostomus xanthurus* Lacépède****Spawning:** Late autumn to early winter.**Meristic features**

- Eggs**
- Pelagic, spherical and transparent.
 - Diameter: 0.72–0.87 mm.
 - Shell: smooth.
 - Yolk: homogeneous (unpigmented).
 - Oil globules: multiple, coalesce to 1 usually, posterior in yolk (yellow with black pigment anteriorly).
 - O.G. diameter: 0.18–0.28 (when 1).
 - Perivitelline space: narrow.

Myomeres: 23–25
 Vert : 10+15
 D : IX–XI, I, 29–35
 A : II, 12–13
 Piv : I, 5
 P : 20–22

- Larvae**
- Hatching occurs at 1.6–1.7 mm SL; eye unpigmented, body lightly pigmented.
 - Body depth increases from about 20% SL at flexion to 30% SL in later larvae.
 - Preanus length increases from about 30% SL (yolk-sac) to about 40% (preflexion) and to 45–50% SL at sizes of 8–14 mm SL.
 - Head length increases from 15% SL (yolk-sac) to about 25% SL (preflexion) and to about 30% SL in later larvae.
 - Flexion occurs at 3.8–5.3 mm SL.
 - Preopercle spines develop at 4.4 mm SL (lost in juvenile), subopercle and interopercle spines at >12 mm SL, and posttemporal spine >14.6 mm SL.
 - Fin development sequence: C–A, D₂–D₁, P–Piv.
 - Sizes at beginning of ossification and completion of fin rays:

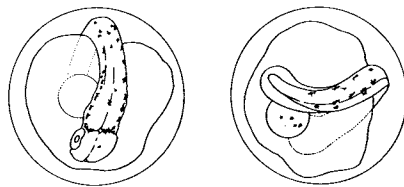
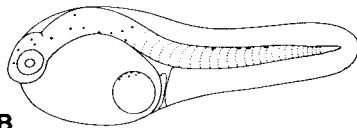
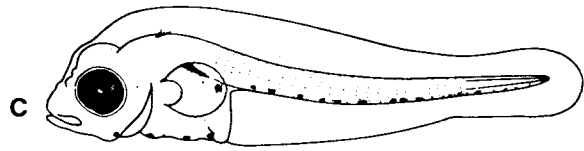
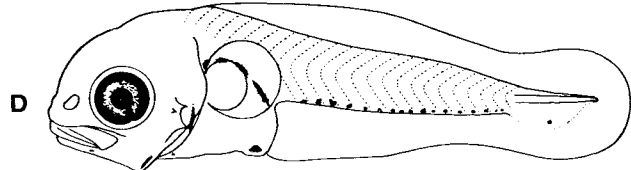
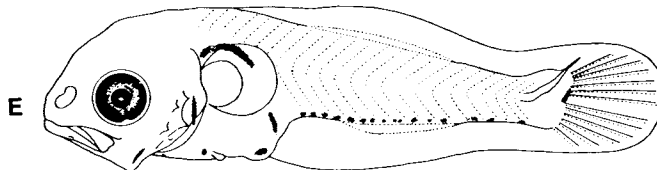
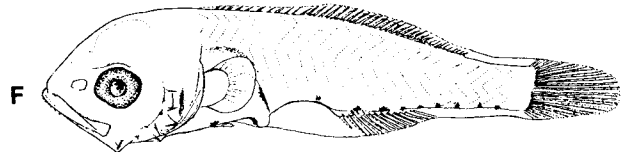
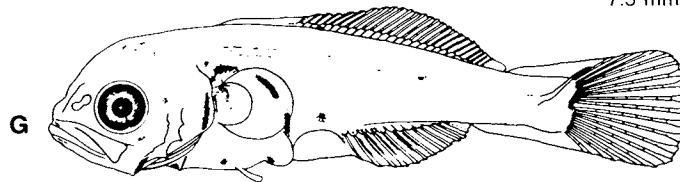
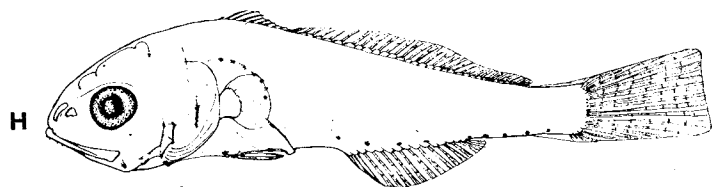
Caudal rays	4.6 mm SL	6.3 mm SL
Anal rays	6.3	8.2
Dorsal rays	6.7	8.8
Dorsal spines	8.0	10.8
Pectoral rays	8.0	~16.0
Pelvic rays (bud at 5.1 mm)	8.2	10.8

- Pigmentation: at hatching, scattered pigment on anterior body, few spots on anterodorsal oil globule, 2–5 dorsal spots on tail (disappear in later larvae); late yolk-sac larvae develop characteristic pigment pattern; row of spots along ventral midline, with at least 1 spot in anus-anal fin gap; internal pigment on air bladder and hindgut, and on anterior surface of gut between cleithra (>4 mm SL); triangle pattern formed by 3 spots anterior to anus (1 spot at anus and 1 at each pelvic fin base), occasional in preflexion larvae and present in all larger larvae (see Fig. K); spot at cleithral symphysis (>3.8 mm SL), and spot at lower jaw angle (>2.6 mm SL); spot at notochord tip, eventually outlines hypural edges; internal pigment on vertebral column (in some larvae 6–9 mm SL, and in most >9.0 mm SL).

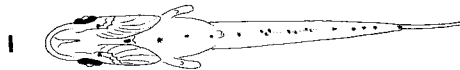
- Note:**
- (1) See p. 278 for characters to separate *Leiostomus* and *Micropogonias*.
 - (2) Anal fin pterygiophores (2 less than total number of anal fin elements) are complete at 6.3 mm SL, and their higher count (12–13) will separate *Leiostomus* from all sciaenids except *Cynoscion*.
 - (3) *Cynoscion nothus* larvae (with 27 vertebrae) may occur at same time as *Leiostomus xanthurus*; other members of the genus *Cynoscion* have 13–15 pre-caudal vertebrae.

Fig. — A–E, G, Powell and Gordy 1980; F, H–I, K, Lippson and Moran 1974; J, Kendall 1972 (redrawn).

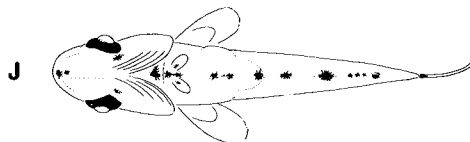
Ref. — Powles and Stender 1978; Fruge and Truesdale 1978; Chao 1978.

Leiostomus xanthurus**SCIAENIDAE****A** Late stage egg (2 views)**B** Newly-hatched larva**C** 2.6 mm SL**D** 4.1 mm SL**E** 5.2 mm SL**F** 7.5 mm SL**G** 8.0 mm SL**H** 12.8 mm SL

Ventral views

**I** 5.3 mm SL *Micropogonias undulatus*

Note difference in development of pectoral and pelvic fins

**J** 5.4 mm SL *Centropristis striata* (p. 234)

Note space between anus and anal fin origin in Fig. I and K

**K** 5.6 mm SL *Leiostomus xanthurus*

Note triangular pigment pattern anterior to anus in Fig. K (compare to usual condition in Fig. I).

SCIAENIDAE *Micropogonias undulatus* (Linnaeus)

Spawning: Continental shelf waters north of Cape Hatteras during September–November (to January or February?)

Meristic features

Eggs — Undescribed.

Myomeres: 23–26

Larvae — Body depth <30% SL; head length varies from 26 to 36% SL.

Vert : 10+15

D : X, I, 27–30

A : II, 8–9

Plv : I, 5

P : 17–18

— Preanus length increases from about 50% SL (small larvae) to 55–60% SL (larger larvae); greater than in *Leiostomus* (p. 276).

— Eye diameter in larvae <4.5 mm SL much smaller than in *Leiostomus*.

— Flexion occurs at 4–5 mm SL.

— Preopercle spines develop at 3–4 mm SL, and posttemporal spines at 8.3 mm SL.

— Fin development sequence: C–A, D₂–D₁, P–Plv.

— Sizes at beginning of ossification and completion of fin rays:

Caudal rays	4.8 mm SL	6.8 mm SL
Anal rays	4.4*	7.1
Dorsal rays	4.4*	10.0+
Dorsal spines	7.4	8.4
Pectoral rays	7.8	11.9
Pelvic rays (bud at 8.4 mm)	9.4	11.8

* Postflexion

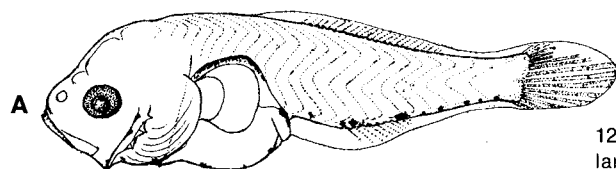
— Pigmentation: row of spots along ventral midline from anus to notochord tip (number decreases with growth); spot at cleithral symphysis; usually 3 ventral spots in line from anus to cleithral symphysis (<9.8 mm SL), although triangle pattern typical of *Leiostomus* sometimes present; no internal pigment on anterior surface of gut between cleithra.

Characters for Distinguishing *Micropogonias* and *Leiostomus* Larvae

Characters	<i>Leiostomus</i>	<i>Micropogonias</i>
Internal pigment		
— Anterior gut	Present	Absent
— Ventral brain	Present	Usually not present
— Vertebral column	In most >9 mm SL.	Absent
Ventral pigment		
— Postanal	Complete row from anus to caudal base including at least 1 spot in anus-anal fin gap.	Gap forms in row over developing anal fin; number of spots decreases with growth.
— Preanal	Triangle pattern; 1 spot at anus and 1 at each pelvic base.	Usually no triangle pattern; 3 spots in line from anus to cleithral symphysis.
— Caudal base	Spot at notochord tip which eventually outlines hypural edges (in all).	May have pigment at notochord tip or caudal base (contrary to published descriptions).
Anal pterygiophores (>6.3 mm SL)	12–13 (two less than total anal fin elements).	Fewer

Fig. — A–D, F, Lippson and Moran 1974; E, Kendall 1972 (redrawn).

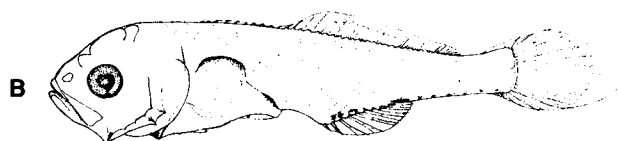
Ref. — Joseph *et al.* 1964; Powles and Stender 1978; Fruge and Truesdale 1978; Chao 1978.

Micropogonias undulatus**SCIAENIDAE**

5.3 mm SL

Spot at angle of lower jaw

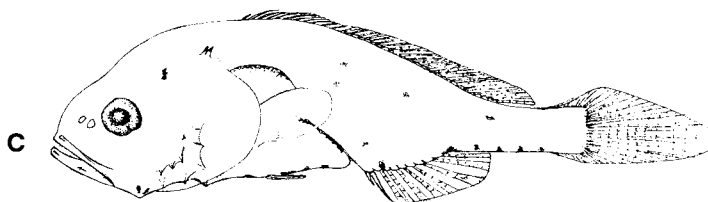
12 or more spots along ventral midline, 1 (or 2) large spot at anal fin origin, 1 large spot at posterior end of anal fin with none between (gap in series not present in *Leiostomus*), 3-6 spots posterior to anal fin.



7.7 mm SL

No dorsal or lateral pigment present <11.8 mm SL

Lateral spots along midline increase from 3 at >11.8 mm SL to 10 by 21.5 mm SL

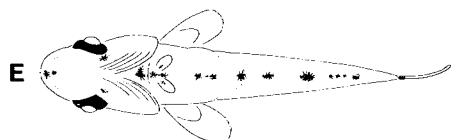


12.2 mm SL

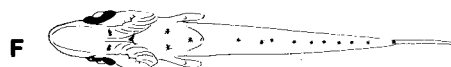
Ventral views

5.3 mm SL *Micropogonias undulatus*

Note difference in development of pectoral and pelvic fins

5.4 mm SL *Centropristis striata* (p. 234)

Note space between anus and anal fin origin in Fig. D and F

5.6 mm SL *Leiostomus xanthurus*

Note triangular pigment pattern anterior to anus in Fig. F (compare to usual condition in Fig. D)

SCIAENIDAE***Menticirrhus* sp.**

Spawning: *M. americanus* (Linnaeus) spawns in coastal waters of Mid-Atlantic Bight during May-June.

M. saxatilis (Block and Schneider) spawns in coastal waters of Mid-Atlantic Bight during May-September.

M. littoralis (Holbrook) spawns in coastal waters of North Carolina during May-August.

Meristic features

Myomeres: 25
 Vert: 10+15
 D : X, I, 19-27
 A : I, 6-9
 Piv : I, 5

(Counts for 3 species)

Generic characters

- Larvae** — Body depth at cleithrum usually >30% SL at sizes <4 mm, decreases to 27-30% SL.
 — Head length varies from 30 to 37% SL; preanus length 53-64% SL.
 — Gap between anus and anal fin short, <5% SL (unusual among sciaenids).
 — Flexion occurs at 3.6-4.1 mm SL.
 — One anal spine (unique among sciaenids).
 — Preopercle spines (lateral and marginal) form at 3.6 mm SL, and increase in number.
 — One to several posttemporal spines form at 6.6 mm SL.
 — Fin formation sequence: C-D₂, A-D₁-P, Piv.
 — Sizes at beginning of ossification and completion of fin rays:

Caudal rays	3.6 mm SL	...
Dorsal rays	4.1	4.4 mm SL
Anal rays	4.1	4.6
Anal spine	...	6.0
Dorsal spines	6.6	...
Pectoral rays	6.8	...
Pelvic fin (bud at 4.1 mm)	...	6.8

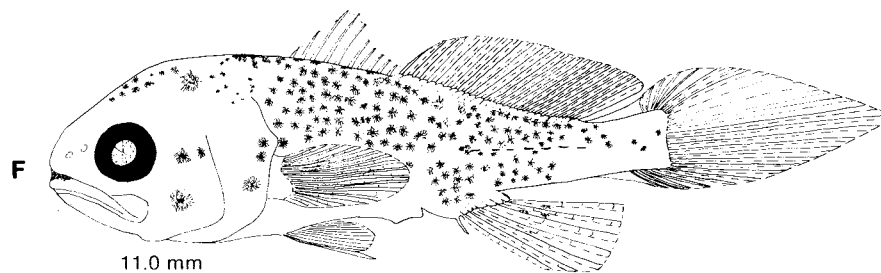
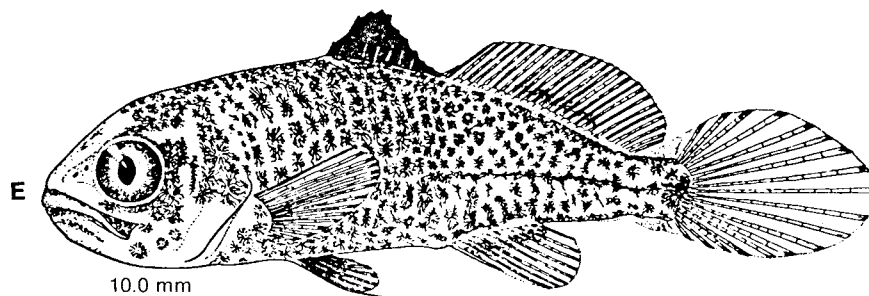
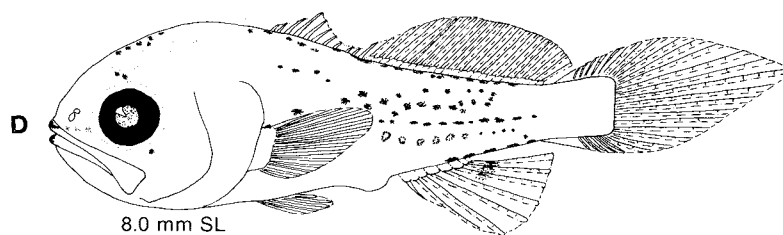
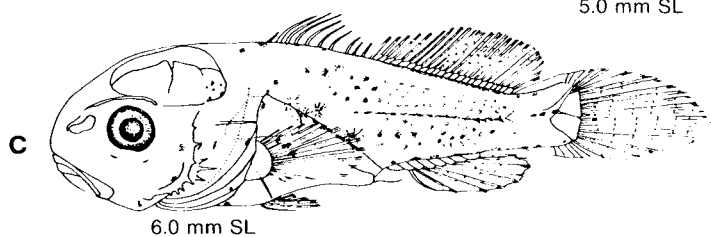
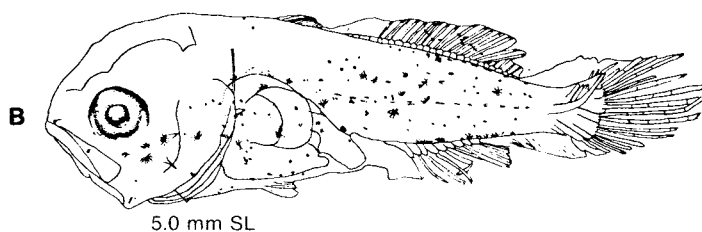
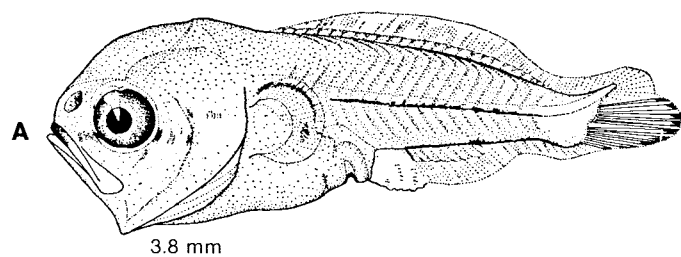
- Pigmentation: heavy on midline of tail, on ventral midline (>2.8 mm SL), on dorsal midline (>6.1 mm SL), overall dusky appearance (>8.0 mm SL); 1-4 spots on nape <3.6 mm SL and 1 spot >3.6 mm SL; no ventral spot anterior to cleithral symphysis; ventral pigment present in anus-anal fin gap at <3.4 mm SL but absent in larger larvae; most specimens (>75%) have well-defined pigment at upper end of pectoral base.

Distribution: *M. americanus* is most abundant from Chesapeake Bay southward, *M. saxatilis* from Chesapeake Bay northward, *M. littoralis* from Cape Hatteras southward.

Note: Published descriptions of *Menticirrhus* larvae do not adequately permit separation to species and some descriptions include a mixture of species. Illustrations on opposite page are nominally *M. americanus* and *M. saxatilis*.

Fig. — A, D-F, Hildebrand and Cable 1934 (D and F redrawn); B, C, Jannke 1971. (A, C, D and F described as *M. americanus*; B and E described as *M. saxatilis*).

Ref. — Powles and Stender 1978; Chao 1978.

Menticirrhus* sp.*SCIAENIDAE**

SCIAENIDAE***Pogonias cromis* (Linnaeus)**

Spawning: Coastal and estuarine waters of Delaware Bay and southward in spring, with possible second spawning in autumn.

Eggs — Pelagic, spherical.
— Diameter: 0.82–1.02 mm.
— Oil globules: 1 to multiple (pigmented).

Larvae — Hatching occurs at 1.9–2.4 mm; eyes unpigmented.
— Slender body (depth 23.0–24.8% SL).
— Dorsal and anal rays complete at 4.6 mm; pelvic buds appear at about 8 mm.
— Pigmentation: very stellate and branching in tail region; 2–5 spots on ventral midline in <6 mm larvae; 1–2 spots along second dorsal fin base.

Meristic features

Myomeres: 24
Vert: 10+14
D : X, I, 19–23
A : II, 5–7

***Sciaenops ocellatus* (Linnaeus)**

Spawning: Coastal waters south of Chesapeake Bay in fall–winter.

Eggs — Pelagic, spherical.
— Diameter: 0.86–1.07 mm.
— Shell: smooth.
— Yolk: homogeneous.
— Oil globules: 1 (usually) to 6.
— O.G. diameter: 0.22–0.36 mm.
— Perivitelline space: narrow.

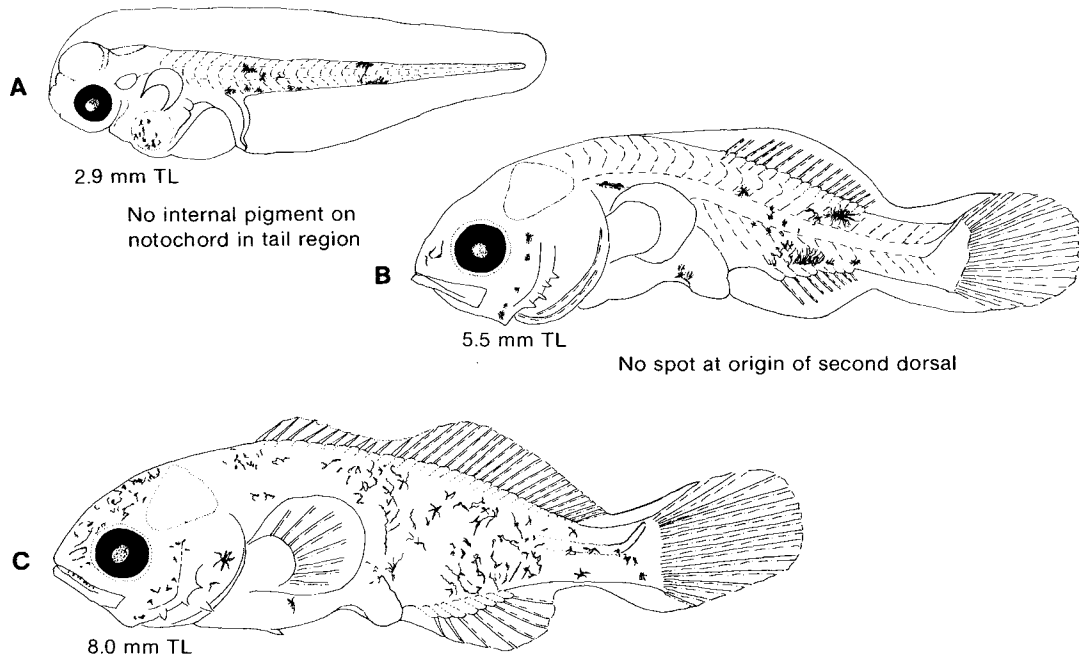
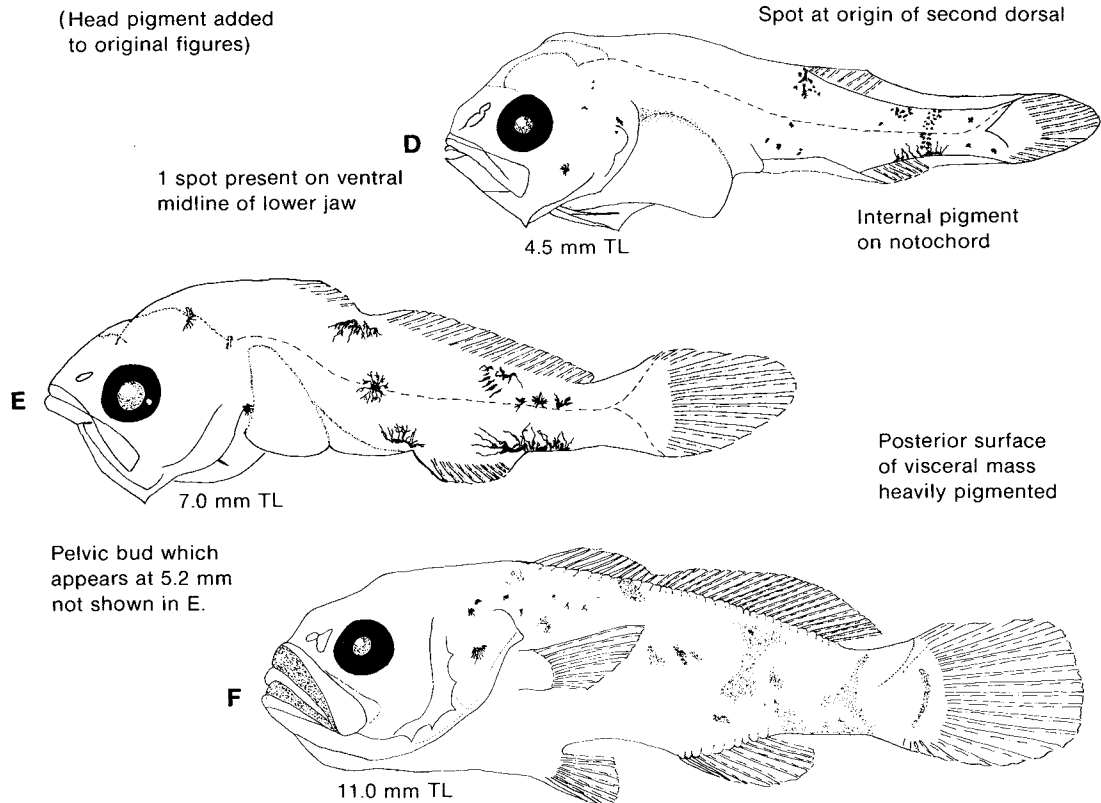
Larvae — Hatching occurs at 1.7–1.8 mm; eyes unpigmented.
— Slender body (depth 26.5–31.1% SL).
— Flexion occurs between 3.2 mm NL and 5.1 mm SL.
— Dorsal rays complete at 6.1 mm, anal rays at 5.2 mm, and pelvic buds appear at 5.2 mm.
— Lateral and marginal preopercle spines present (not illustrated).
— Pigmentation: internal pigment prominent on dorsal surface of notochord; 1–2 spots at posterior end of anal fin base (usually branch up to midlateral line); 1 spot at second dorsal fin origin and one along its base, 1 stellate melanophore often present on midlateral line over anus.

Meristic features

Myomeres: 25
Vert: 10+15
D : X, I, 23–25
A : II, 7–9

Fig. — A–C, Joseph *et al.* 1964; D–F, Pearson 1929 (all redrawn).

Ref. — Powles and Stender 1978; Holt *et al.* 1981.

*Pogonias cromis***SCIAENIDAE***Sciaenops ocellatus*

SCIAENIDAE***Stellifer lanceolatus* (Holbrook)**

Spawning: Estuarine and coastal waters south of Chesapeake Bay in early summer.

Meristic features

Eggs — Undescribed.

Myomeres: 25
 Vert : 10+15 or 11+14
 D : XI-XII, 20-24
 A : II, 7-9
 Plv : I, 5
 P : 19-20

Larvae — Deep body (34-41% SL); head length increases from about 30% SL to 39% SL; preanus length increases from 40-50% SL to 55% SL.
 — Flexion occurs at 3.3-4.3 mm SL.
 — Preopercle spines present through larval development (lateral spines smaller than marginal).
 — Posttemporal spine present at 5.1-7.8 mm SL.
 — Premaxillary and dentary teeth present through larval development.
 — Sizes at beginning of ossification and completion of fin rays:

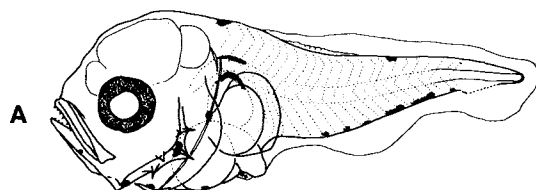
Caudal rays	3.3 mm SL	5.5 mm SL
Dorsal rays	3.3	6.9
Anal spines and rays	3.3	6.9
Dorsal spines	4.5	6.9
Pectoral rays	6.9	14.0
Pelvic rays (bud at 4.9 mm)	6.9	7.8

— Pigmentation: ventral row of spots postanally; spot on dorsal edge of body over posterior end of anal fin (in most at 2.9-6.2 mm SL); internal spot on anterior gut surface between cleithra; spot over posterior gut appears and grows large at >4.1 mm SL; ventral gut spot between cleithral symphysis and anus at 2.9-6.2 mm SL, and spot at anus at 2.9-5.8 mm SL; ventral spot anterior to cleithral symphysis through larval development; spot on lower jaw angle <6.2 mm SL, and dark pigment forms at upper end of opercle >7.4 mm SL.

Note: Spot posterior to anal fin in 9 mm larva (Fig. E) of Hildebrand and Cable (1934) may be an error, according to Powles and Stender (1978).

Fig. — A-D, Powles 1980; E, Hildebrand and Cable 1934 (redrawn).

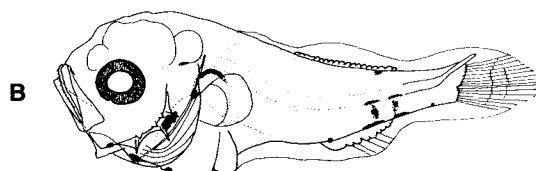
Ref. — Chao 1978.

Stellifer lanceolatus**SCIAENIDAE**

2.9 mm NL

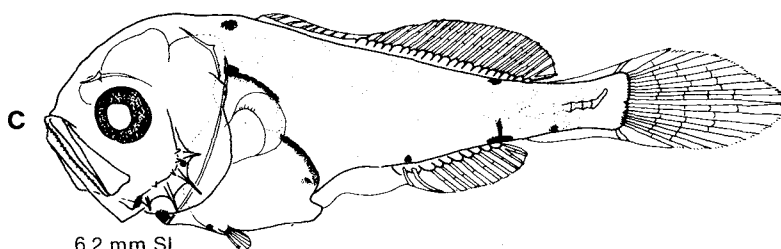
Anterior dorsal spot and internal pigment on notochord in larvae <3.8 mm SL

5-6 ventral spots from anus to notochord tip; 4th (and 5th?) larger



4.3 mm SL

1-3 spots posterior to anal fin



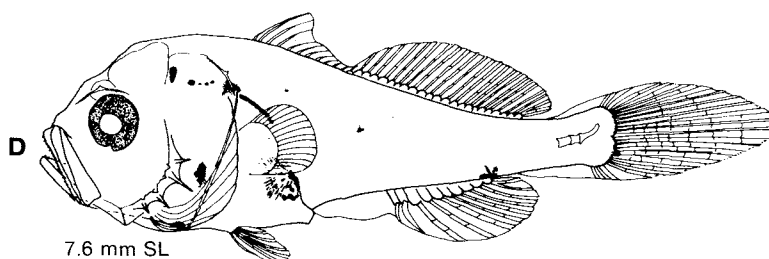
6.2 mm SL

1-2 expanded spots form at posterior end of anal fin (often branched dorsally)

Spot retained at base of second anal spine; none anterior to anal base

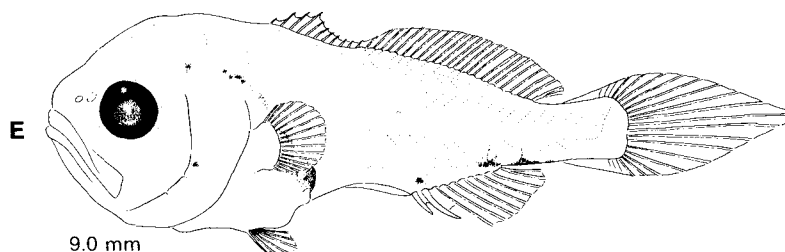
BEST CHARACTERS:

- dorsal spot over posterior anal fin
- no spot anterior to anal fin base



7.6 mm SL

No spots posterior to anal fin >6.9 mm SL; spots reappear after 10 mm SL



9.0 mm

In larvae >10 mm SL, pigment spreads but does not become very heavy

EPHIPPIDAE***Chaetodipterus faber* (Broussonet)**

(=Ephippidae)

Spawning: Maryland and southward in spring-summer.**Meristic features****Eggs** — Undescribed; Smith (1907) noted oocytes <1.0 mm diameter in ripe fish off North Carolina.

Myomeres: 24

Vert : 10+14

Larvae — Hatching occurs at about 2.5 mm.

D : IX, 21-23

— Body stout, deep anteriorly; preanus length about 50% TL; steep profile; large oblique mouth; crest on head.

A : III, 17-20

Plv : I, 5

— Prominent preopercle spines (disappear at about 20 mm).

P : 17-18

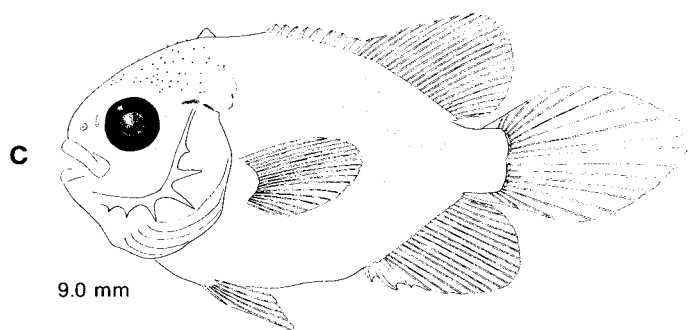
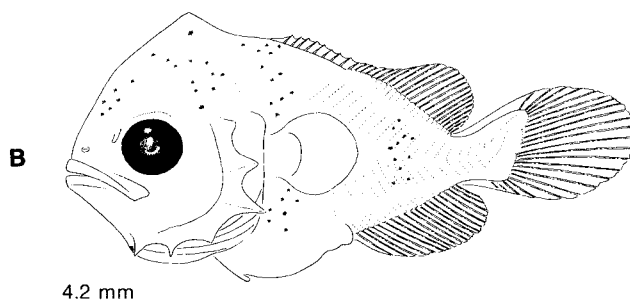
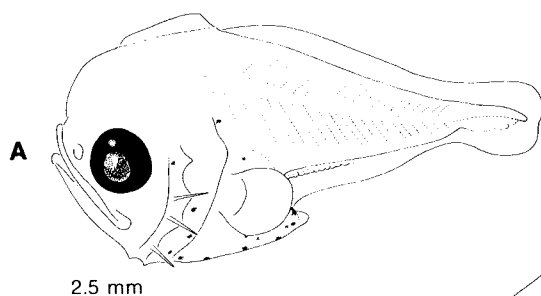
C : 5-6+9+8+5-6

— Flexion occurs at about 4 mm.

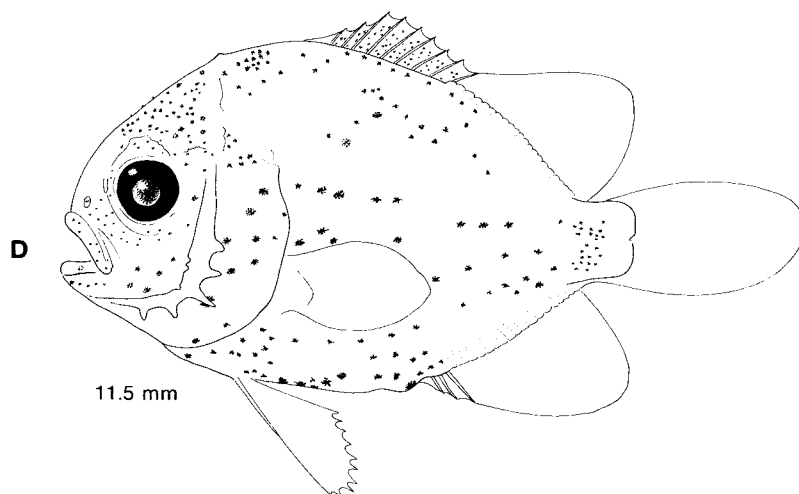
— Dorsal, anal and caudal rays develop early and are complete at about 4 mm; pelvic fin last to form.

— Teeth present at 9 mm.

— Pigmentation: spots scattered around abdomen in 2.5 mm larvae; bars between second dorsal and anal fins and through pectoral base at 4.2 mm; in 9.0-11.5 mm juveniles, body very dark all over, pelvic fins very dark and other fins light.

Chaetodipterus faber**EPHIPPIDAE**

Pigment on body and pelvic fins very dense; lightened on 9.0 mm and 11.5 mm larval illustrations



MUGILIDAE***Mugil cephalus* Linnaeus**

Spawning: Outer continental shelf off United States coast in late autumn to winter.

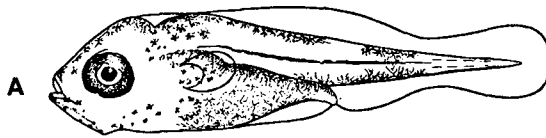
Meristic features

- Eggs**
- Pelagic, spherical.
 - Diameter: 0.91–0.99 mm.
 - Shell: smooth and transparent.
 - Yolk: homogeneous.
 - Oil globules: 1.
 - O.G. diameter: 0.30–0.36 mm.
 - Perivitelline space: narrow.

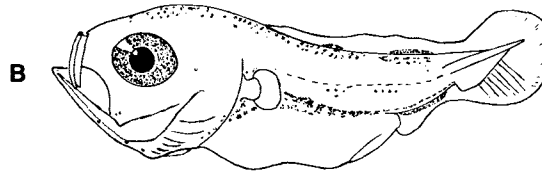
Myomeres: 24
 Vert : 11–12+12–13
 D : IV, I, 7–8
 A : III, 8
 Plv : I, 5
 P : 14–18
 C : 7–8+7+7+7–8

- Larvae**
- Hatching occurs at 2.2–3.6 mm; eyes unpigmented.
 - Body moderately stocky; preanus length >50% SL.
 - Flexion occurs at 4–5 mm TL.
 - Caudal rays first to form; pelvic buds appear at 5.4 mm TL, fins abdominal; anal rays complete at 6.2 mm TL.
 - Dorsal fins well separated and posterior on body; 2nd dorsal rays complete at 5.4 mm TL.
 - Dorsal spine count low (4), formed at 6.7 mm TL.
 - Pectoral fins high on trunk (noticeable early in development).
 - Pigmentation: heavy dorsal pigment from head through 2nd dorsal fin; dorsal surface of gut heavily pigmented; ventral pigment from vent to caudal fin base.

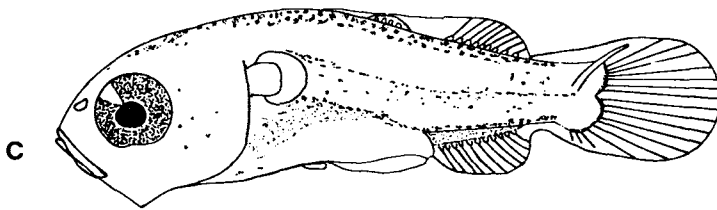
Note: The very similar *Mugil curema* Valenciennes is distinguishable after completion of anal fin development by its higher total count of 12 (rarely 13) elements; usually II, 10 in young.

Mugil cephalus**MUGILIDAE**

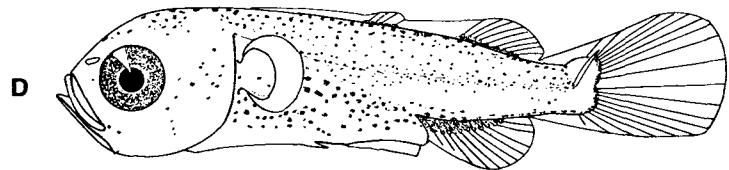
2.8 mm TL



4.0 mm TL

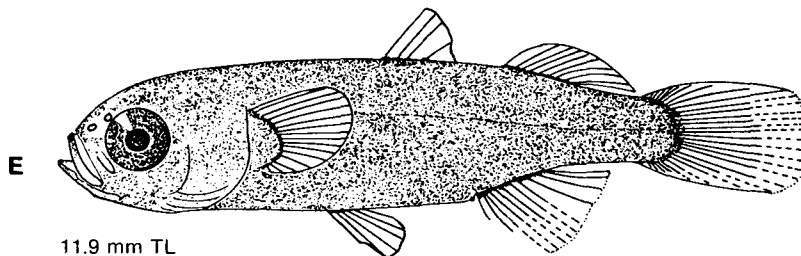


5.4 mm TL



6.7 mm TL

Note low principal caudal ray count (7+7)



11.9 mm TL

A (Black Sea specimen)

SPHYRAENIDAE***Sphyraena borealis* DeKay****Spawning:** Off Florida in winter.**Eggs**

- Pelagic, spherical.
- Diameter: 1.22–1.24 mm.
- Yolk: lightly segmented.
- Oil globules: 1.
- O.G. diameter: 0.27–0.29 mm.
- Perivitelline space: narrow.

Larvae

- Hatching occurs at about 2.6 mm SL; eyes unpigmented, mouth undeveloped, oil globule anterior in yolk and pigmented; 14 preanal and 10 postanal myomeres.
- Body slender, with long gut.
- Mouth forms at about 4 mm SL, with elongate jaws, fleshy tip on lower jaw and teeth develop at about 5 mm SL.
- Flexion occurs at 7.4–9.0 mm SL, and transformation at about 13.5 mm SL (rays complete, and finfold gone).
- Head length increases from 13% SL at hatching to 33% SL in 9 mm larvae.
- Vertebrae and 2nd dorsal fin complete at 10 mm, anal fin at 10–11 mm, caudal fin at 10–12 mm, 1st dorsal at 11–12 mm, pectoral fin at 13–14 mm, and pelvic fin (bud at 9 mm) complete at 14 mm.
- Pigmentation: (see illustrations opposite).

Meristic features

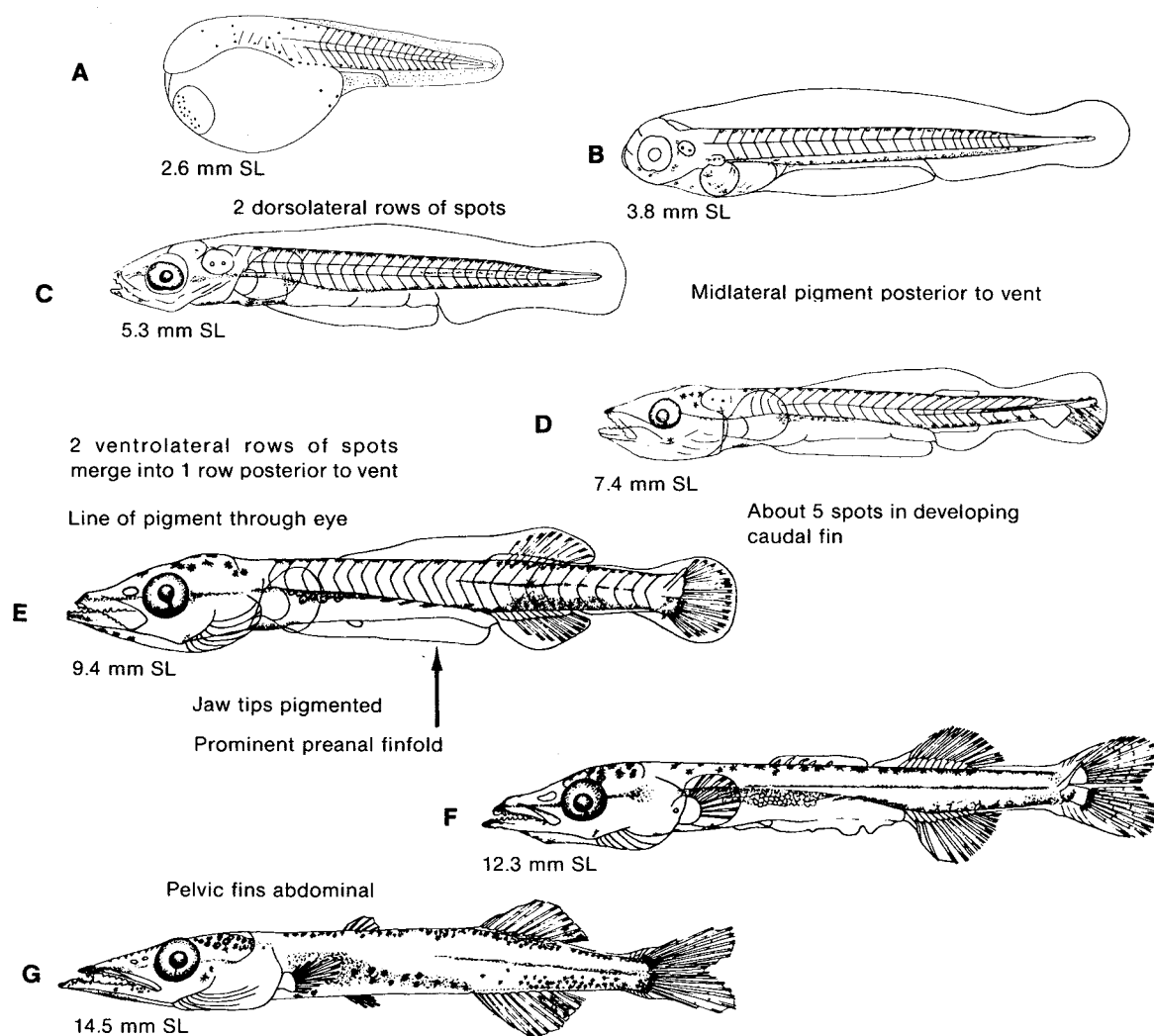
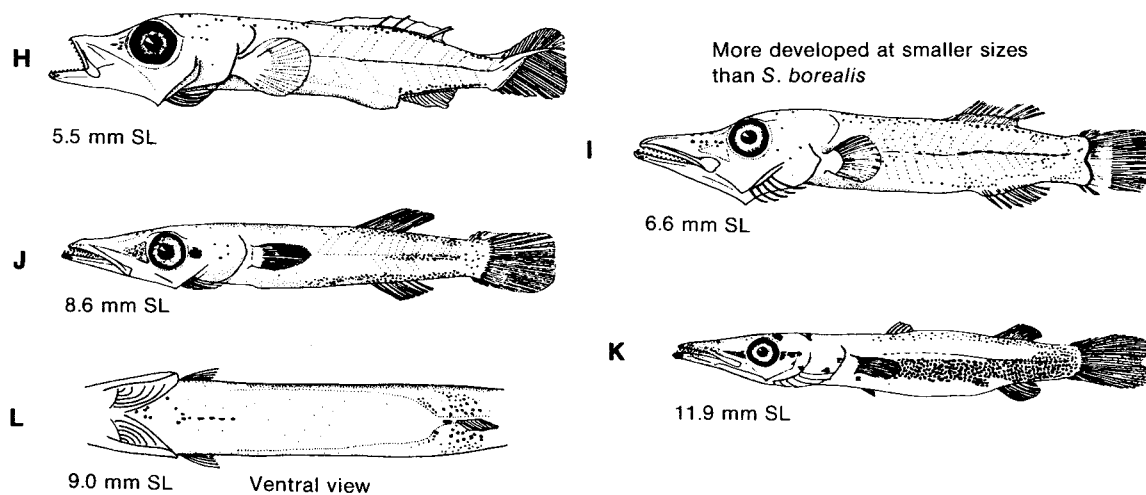
Myomeres: 24
 Vert : 12+12
 D : V–VI, I, 8–9
 A : I–II, 8–9
 Piv : I, 5
 C : 9+9+8+9

Sphyraena barracuda* (Walbaum)*Larvae**

- Body deeper and snout longer than in *S. borealis*.
- Head proportionately longer (36% SL at 5.5 mm) than in *S. borealis*.
- Pigmentation: spots in front of eye, on tip of lower jaw, along anal fin base, and scattered dorsally on body; midlateral line of postanal spots becomes dense.
- May be found as stray north of Cape Hatteras.

Meristic features

Myomeres: 24
 (Meristic counts overlap or coincide with those of *S. borealis*)

Sphyraena borealis**SPHYRAENIDAE*****Sphyraena barracuda***

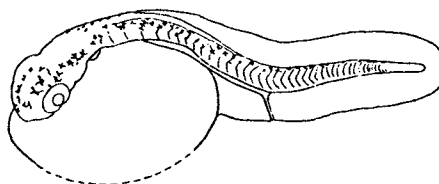
LABRIDAE***Tautoga onitis* (Linnaeus)****Spawning:** Mid-Atlantic Bight during May–August.**Meristic features**

- Eggs**
- Pelagic, spherical.
 - Diameter: 0.97–1.00 mm.
 - Shell: smooth.
 - Yolk: homogeneous.
 - Oil globules: none (unusual for family).
 - Perivitelline space: narrow.

Myomeres: 34–35
 Vert : (16)17+18
 D : XVI–XVII, 10–11
 A : III, 7–8
 Plv : I, 5
 P : 16
 C : 8+7 principal

- Larvae**
- Hatching occurs at about 2 mm (small ratio of hatching size to egg diameter), eyes unpigmented, mouth undeveloped.
 - Preanal length about 50% TL.
 - Flexion occurs between 5 and 10 mm.
 - Dorsal, anal and caudal fins well differentiated by 10 mm; pelvic fins late forming.
 - Posterior caudal region unpigmented.

Embryo excised from egg; heavy pigment between eyes; wide gap between yolk and anus.

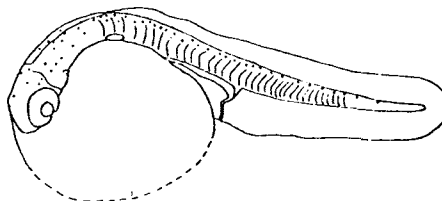
***Tautogolabrus adpersus* (Walbaum)****Spawning:** Mid-Atlantic Bight during May–October (peak in June–August).**Meristic features**

- Eggs**
- Pelagic, spherical.
 - Diameter: 0.84–0.92 mm.
 - Shell: smooth.
 - Yolk: homogeneous.
 - Oil globules: none.
 - Perivitelline space: narrow.

Myomeres: 36
 Vert : 17+19
 D : XVIII, 9–10
 A : III, 8–9
 Plv : I, 5
 P : 16
 C : 8+7 principal

- Larvae**
- Hatching occurs at about 2.2 mm (small ratio of hatching size to egg diameter); eyes unpigmented; mouth undeveloped.
 - Preanal length about 50% TL.
 - Flexion occurs at about 5 mm.
 - Dorsal fin begins to differentiate at 7–8 mm.
 - Band of pigment over gut, pair of spots between anus and caudal fin, and few spots on ventral notochord tip.

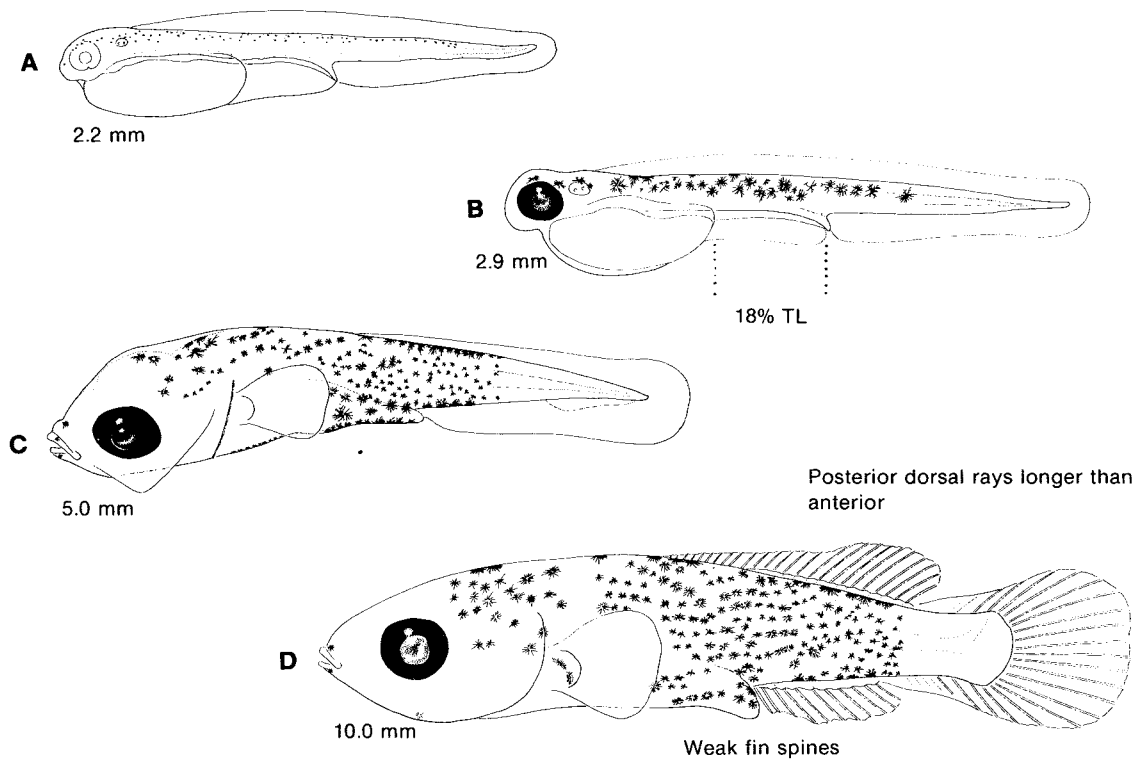
Embryo excised from egg; light pigment between eyes; narrow gap between yolk and anus.

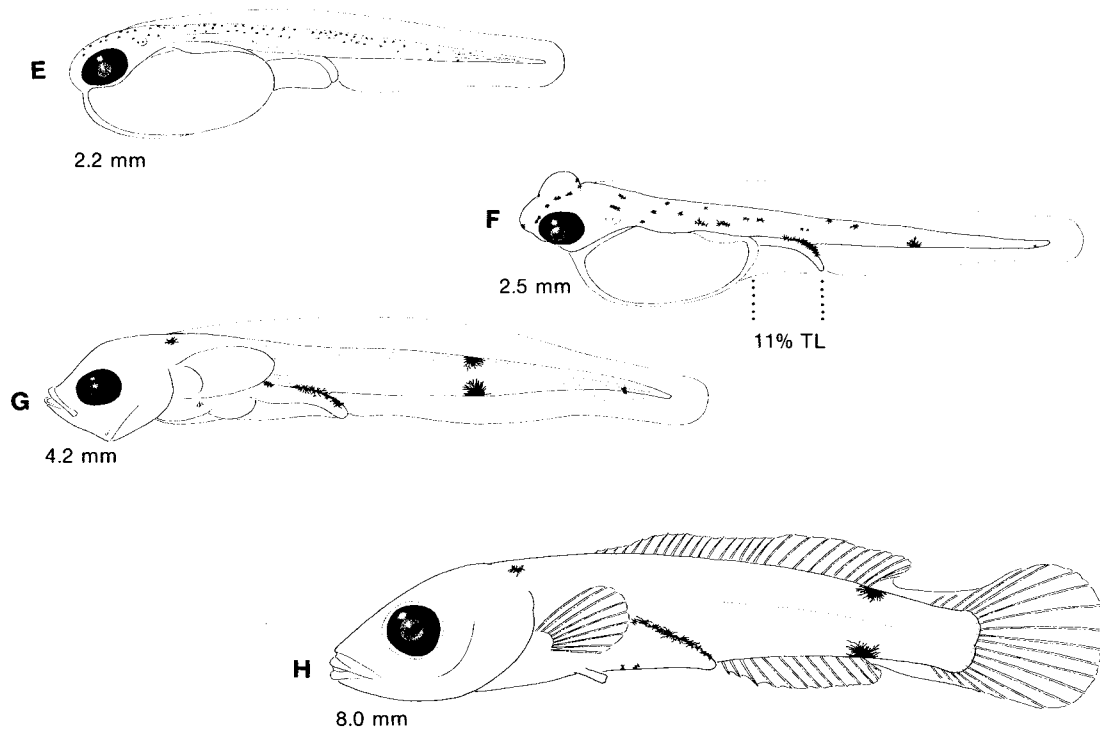


- Note:**
- (1) Early eggs of *T. adpersus* similar to those of *Limanda ferruginea* (p. 380).
 - (2) Other labrid (and very similar scarid) species may drift north with the Gulf Stream.

Fig. — **A**, Agassiz and Whitman 1885; **B–H**, Kuntz and Radcliffe 1917 (all redrawn).

Ref. — Williams 1967; Colton and Marak MS 1969.

Tautoga onitis**LABRIDAE**

Tautogolabrus adspersus

PHOLIDIDAE STICHAEIDAE

Blennioid Larvae (2 Families)

Eggs — Demersal, adhesive.

Larvae — Body elongate with straight gut; snout short but slightly pointed; mouth large.
 — Preanal length $\leq 50\%$ SL (except *Pholis gunnellus* slightly $> 50\%$ SL).
 — Dorsal and anal fins long; pectoral fins wide and fan-shaped, situated just below midline.
 — All 5 species have rows of ventral spots from vent to caudal fin.
 — Meristic characters, pigmentation and range in western North Atlantic:

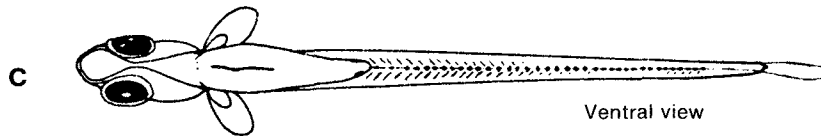
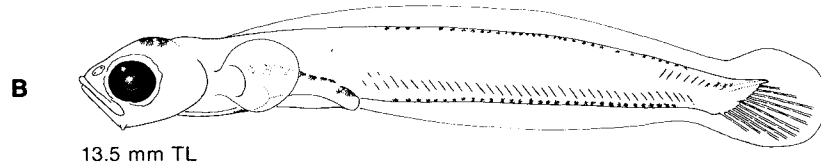
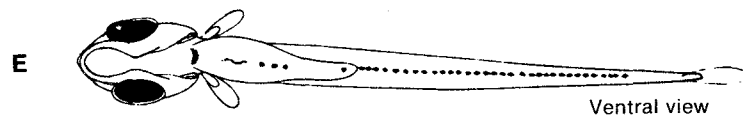
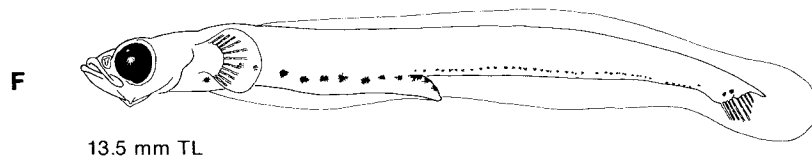
	Pholididae	Stichaeidae			
	<i>Pholis gunnellus</i>	<i>Stichaeus punctatus</i>	<i>Ulvaria subbifurcata</i>	<i>Lumpenus maculatus</i>	<i>Lumpenus Lumpretaeiformis</i>
Meristics					
Myomeres	86-89	51-55	45-49	66-72	80-85
Postanal myomeres	49-51	33-37	28-33	38-44	58-63
Dorsal rays	80-83	46-49	43-44	57-64	68-76
Anal spines, rays	II, 42-44	I-II, 32-35	II, 30-31	I, 34-40	I, 46-53
Pelvic rays	I, 1	I, 4	I, 3	I, 3	I, 3
Pectoral rays	10-12	15-16	15	15	15-16
Pigmentation					
Intestine	Lateral (external)*	Dorsal (internal)	Dorsal (internal)	Lateral (external)	Lateral (external)
Preanal ventral	"Stitching" cleithrum to vent	Middle of gut	Middle of gut and spot near vent	None	None
Head	None	Present	Present	None	None
Dorsal edge	None	Posterior 1/2 in big larvae	Posterior 1/3 in big larvae	None	None
Notochord (internal)	None	At small sizes	At small sizes	None	None
Miscellaneous		Streaks on postanal myomeres	No streaks	About 38-44 postanal ventral spots	About 58-63 postanal ventral spots
Range					
	Delaware Bay and north	Massachusetts Bay and north	Woods Hole, Mass., and north	Cape Cod and north	Cape Cod and north

* Pigment may be faint or absent.

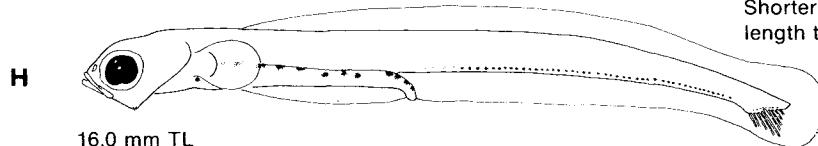
Note: See also Anarhichadidae (Barsukov 1959; McIntosh and Prince 1890).

Fig. — A, Rass 1949; B-I, Faber 1976 (A, B, D, F, H redrawn).

Ref. — Dannevig 1919; Makushok 1958.

Pholis gunnellus* (Linnaeus)*PHOLIDIDAE
STICHAEIDAE*****Stichaeus punctatus* (Fabricius)*****Ulvaria subbifurcata* (Storer)*****Lumpenus maculatus* (Fries)*****Lumpenus lumpretaeformis* (Walbaum)**

Shorter relative preanus
length than *L. maculatus*



A (eastern Atlantic specimen)

BLENNIIDAE**Family Characters****Eggs** — Demersal.

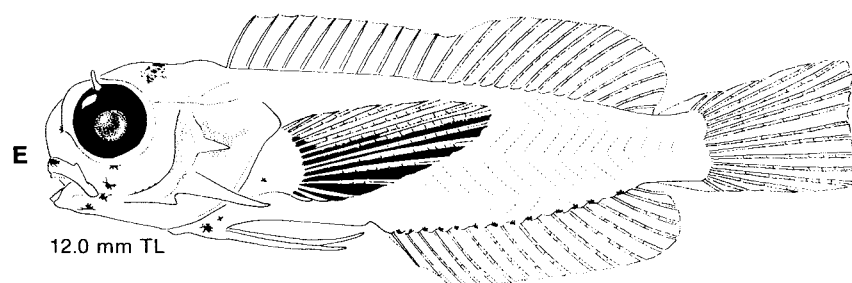
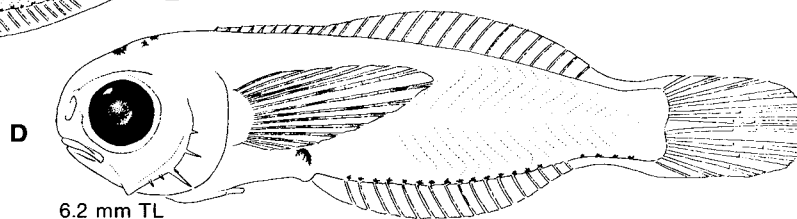
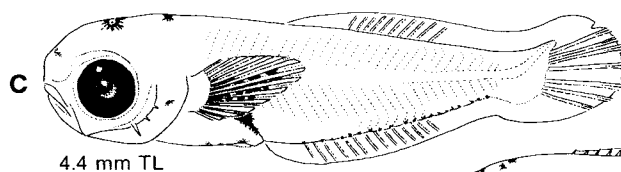
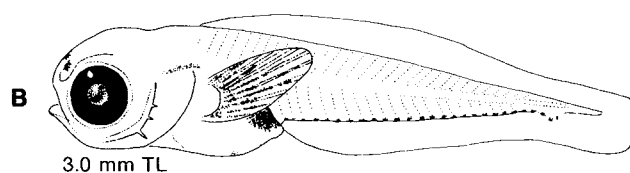
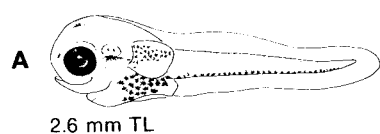
Larvae — Hatching occurs at about 2.5–3.5 mm.
 — Bulbous head, large eyes, short snout, and subterminal mouth.
 — Body fairly elongate, with short gut.
 — Spines present on preopercle; number of dorsal fin spines approximately equal to number of dorsal fin rays.
 — Flexion occurs at about 4–5 mm.
 — Pelvic fin forms late, and reduced to “I, 3”.
 — Pigmentation: usually heavy on pectoral fins; ventral row of spots characteristic of family; location of pigment on head and nape may be specifically diagnostic.

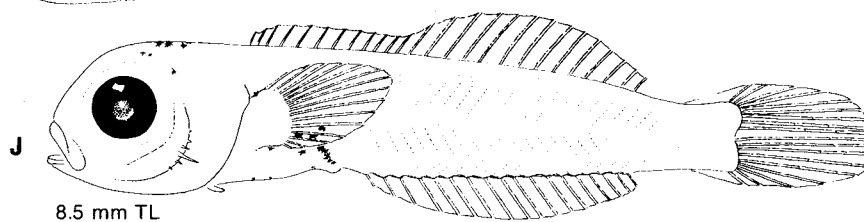
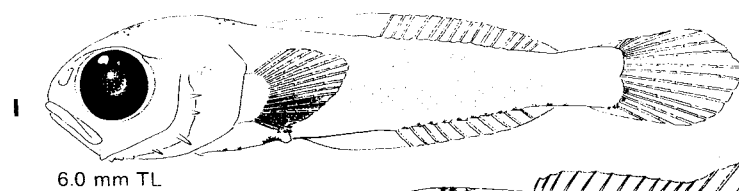
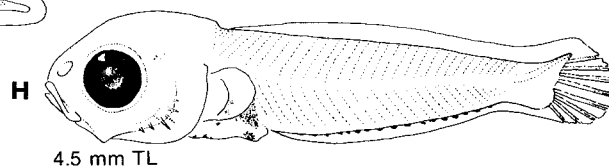
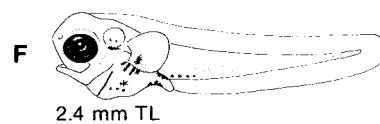
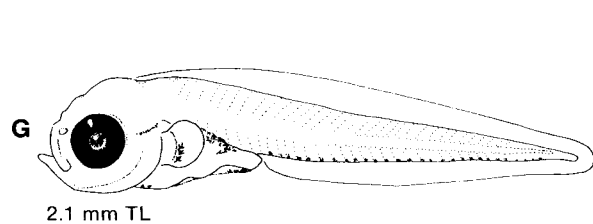
Meristic features *

Vert: 10+22–24
 D : XII, 13–15
 A : II, 16–17
 Piv : I, 3
 P : 13–15
 C : 5–6+7+6+5

* Counts pertain to
Hypsoblennius hentzi
 (Lesueur)

- Note:** (1) Preopercle spine development indicates that Fig. A–E may represent a mixture of 2 species (W. A. Laroche, 1981, pers. comm.).
- (2) Myomere range 32–35 in several blennioid species, the larvae of which may drift north in the Gulf Stream; meristic characters for other species overlap or coincide with those for *H. hentzi*.

Hypsoblennius hentzi**BLENNIIDAE**

Hypleurochilus geminatus

AMMODYTIDAE***Ammodytes* sp.**

Spawning: Mid-Atlantic Bight during winter-spring; later in northern waters.

Meristic features

- Eggs**
- Demersal, irregular shape.
 - Diameter: 0.67–0.91 mm.
 - Shell: sculptured, rough-surfaced (brownish).
 - Yolk: homogeneous (amber).
 - Oil globule: 1 (posterior in yolk sac).
 - O.G. diameter: 0.27 mm.
 - Perivitelline space: fairly wide.

	(1)	(2)	(3)
Myomeres :	59–78 (3 species)		
Vert :	61–68	64–75	61–73
D :	—	55–67	51–62
A :	—	26–35	23–33
P :	~13	~13	~13
Piv :	none (3 species)		
C :	(PrC, 3 species, 8+7)		

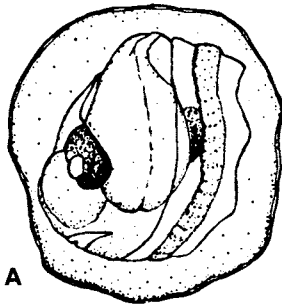
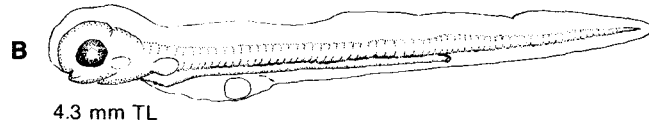
- Larvae**
- Hatching occurs at about 4 mm; no embryonic pigment.
 - Body elongate; vent opens at side of fin-fold (not margin).
 - Long gut (unusual for phylogenetically advanced fish, with internal folds).
 - Lower jaw protrudes anteriorly.
 - Flexion occurs at about 10–12 mm.
 - Caudal rays begin to form at 8 mm, complete at 15 mm, and fin forked at 22 mm.
 - Dorsal and anal rays begin to form at 13 mm, and development proceeds anteriorly; pectoral rays form late.
 - No pelvic fin.
 - Pigmentation: spots along dorsal edge of intestine, ventral row of spots on tail, and spots at base of caudal fin.

(1) = *A. americanus* DeKay
 (2) = *A. dubius* Reinhardt
 (3) = *A. hexapterus* Pallas

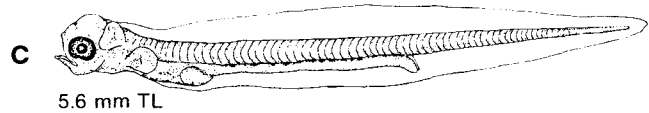
Note: Taxonomy of North American *Ammodytes* is unresolved; the validity of the 3 nominal species is questionable, and larvae should be tentatively identified as *Ammodytes* sp.

Fig. — **A–B**, Williams *et al.* 1964; **C–G**, Norcross *et al.* 1961.

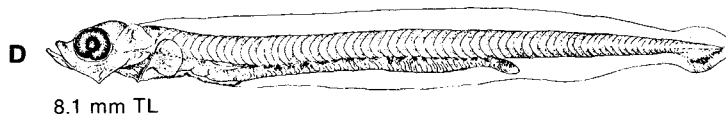
Ref. — Richards *et al.* 1963; Reay 1970.

Ammodytes* sp.*AMMODYTIDAE****A****B**

4.3 mm TL

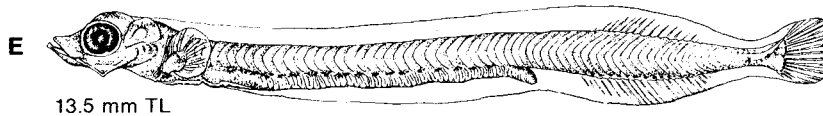
**C**

5.6 mm TL

**D**

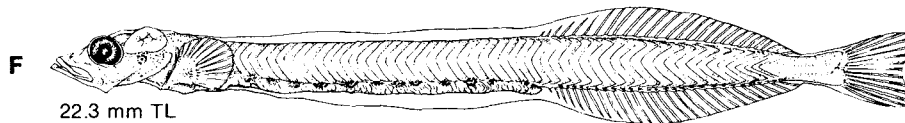
8.1 mm TL

Internal notochord pigment forms at about 9 mm, increases with development

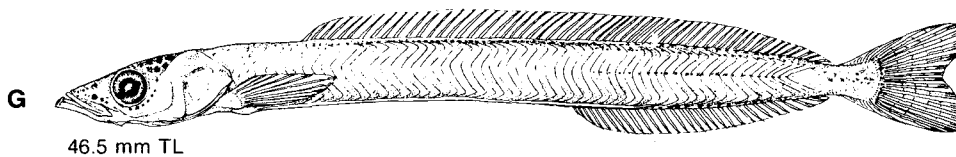
**E**

13.5 mm TL

Dorsal row of spots forms at about 15 mm, extends anteriorly with development.

**F**

22.3 mm TL

**G**

46.5 mm TL

GOBIIDAE***Gobiosoma bosci* (Lacépède)**

Spawning: In estuaries during May–November in Mid-Atlantic Bight.

Eggs — Demersal (attached); shape irregular to elliptical.

Larvae — Hatching occurs at 2.0–2.6 mm; blunt snout; 13 preanal and 13 postanal myomeres; few pigment spots near vent and notochord tip.

— Flexion occurs at 4–5 mm.

— Anal, caudal and 2nd dorsal fins formed at 5.0–6.8 mm; pelvic buds formed at 6.8–7.5 mm; 1st dorsal begins at 6.8 mm and is complete at 10 mm; all fins complete at 10–15 mm.

— Pigmentation: (see illustrations opposite).

Meristic features

Myomeres:	27
Vert:	11+16
D:	VI–VIII, 12–14
A:	10–12
P:	16–19

***Gobionellus boleosoma* (Jordan and Gilbert)**

Spawning: In coastal waters during March–August in Mid-Atlantic Bight.

Eggs — Demersal (attached); shape irregular to elliptical.

Larvae — Hatching occurs at 1.2 mm; preanal length 50% SL.

— Body elongate, head broad, mouth vertical, eyes large.

— Flexion occurs at about 5 mm SL.

— Caudal fin formed and dorsal and anal rays begin at 5.0 mm; 2nd dorsal and anal complete at 7.5 mm; all fins except 1st dorsal complete at 10 mm.

— Pigmentation: forms early over air bladder; 2–3 lines on chest at 5.0 mm; small spot at vent and one halfway to tail tip.

Meristic features

Myomeres:	26
Vert:	10+16
D:	VI, 11
A:	11–13
P:	16

Common Characters for Both Species

Larvae — Body slender and lightly pigmented; preanal length about 50% SL.

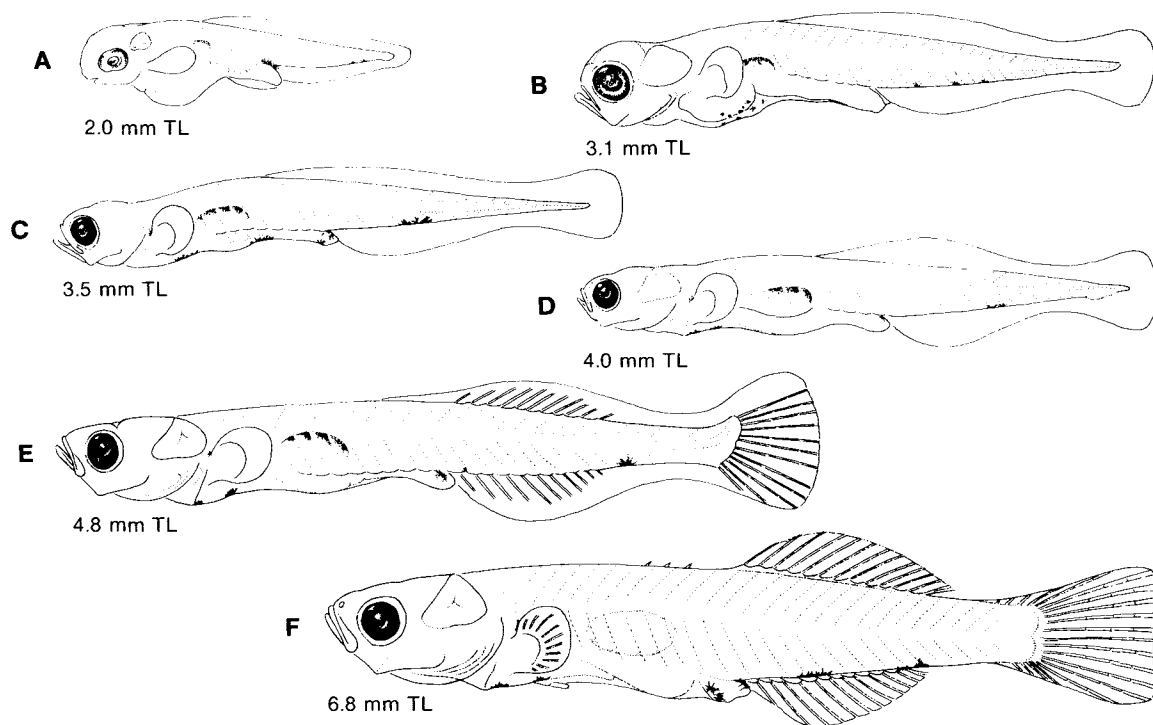
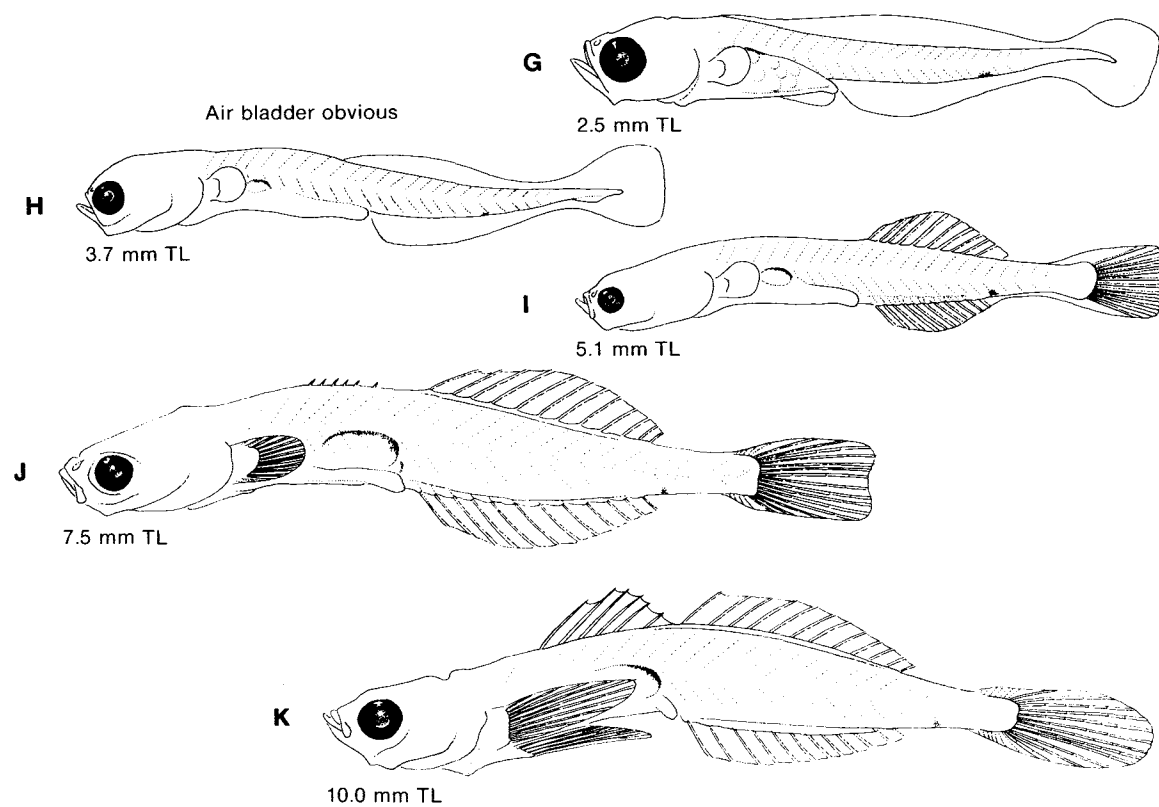
— Air bladder develops early, usually with pigment on dorsal surface.

— Principal caudal rays 8+7.

— Pelvic fin modified as sucking disc.

— Dorsal fins (2) well separated; spiny dorsal last fin to form.

— Occur in bays and coastal waters, and other species often abundant offshore (i.e. Gulf Stream).

Gobiosoma bosci**Gobiidae*****Gobionellus boleosoma***

GEMPYLIDAE***Gempylus serpens* Cuvier**

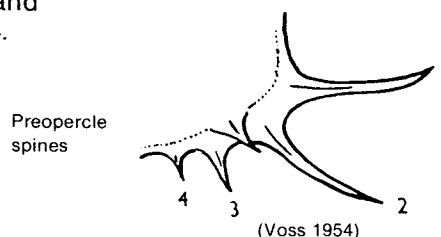
Spawning: Winter-spring in Florida Current and the Caribbean Sea.

Eggs — Undescribed.

Larvae — Pelvic fin rays form sequentially.
 — Pelvic spine shorter than in *Diplospinus multistriatus*.
 — Spiny dorsal fin lower than in *D. multistriatus*.
 — Flexion occurs at 7–8 mm SL.
 — Preopercle spines smooth (all long and slender); spine length order 1–2–3–4.

Meristic features

Myomeres: 49–53
 D : XXX–XXXII, I–II, 10–12
 A : II, I, 9–13
 Plv : I, 0–4
 P : 12–15
 C : 4+9+8+8
 D finlets: 5–7
 A finlets: 5–7

**TRICHIURIDAE*****Diplospinus multistriatus* Maul**

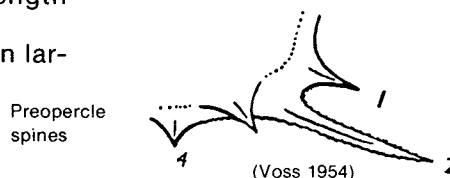
Spawning: ?

Eggs — Undescribed.

Larvae — Deeper-bodied than *Gempylus serpens* and *Nesiarchus nasutus*.
 — No rays behind pelvic spine, which is long and strongly-serrate.
 — Very high spiny dorsal fin.
 — Flexion occurs at 8–10 mm SL.
 — Preopercle spine serrated; spine length order 2–1–4 (3rd missing).
 — Dorsal spine count almost complete in larvae >8 mm SL.

Meristic features

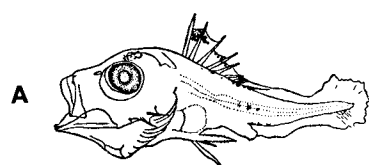
Myomeres: 58–61
 D : XXX–XXXIV, 36–42
 A : II, 29–32
 Plv : I, 0
 P : 12–13
 D finlets: none
 A finlets: none



- Note:** (1) Larvae of both species above have obvious dorsal and pelvic spines, which develop early, become large and have secondary serrations (not present in scombrids).
 (2) Many authors consider *D. multistriatus* a member of the family Gempylidae (Backus *et al.* 1969; Parin and Becker, 1972; Evseenko and Serebryakov, 1974). Larvae more typical of the family Trichiuridae include *Trichiurus lepturus* Linnaeus (described by Mito, 1961b), *Lepidopus caudatus* Euphrasen (described by Schmidt and Strubberg, 1918), and *Benthodesmus elongatus* (Steindachner) (described by Evseenko, 1982).

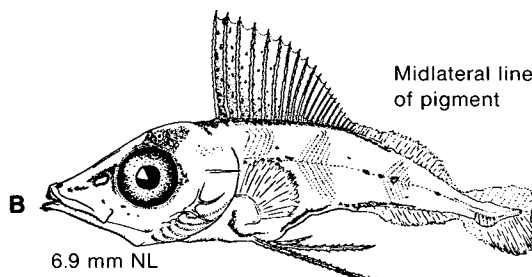
Fig. — A, C, Jones 1960b; B, D–I, Voss 1954; J, Strasburg 1964; K, Evseenko and Serebryakov 1974.

Ref. — Matsubara and Iwai 1952.

Gempylus serpens**GEMPYLIDAE
TRICHIURIDAE**

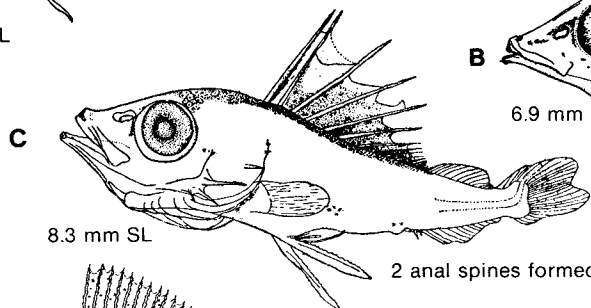
4.9 mm NL

Pelvic rays visible
as early as
5.6 mm SL



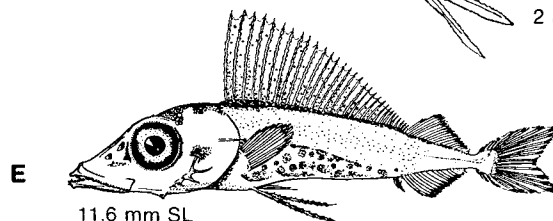
6.9 mm NL

Midlateral line
of pigment



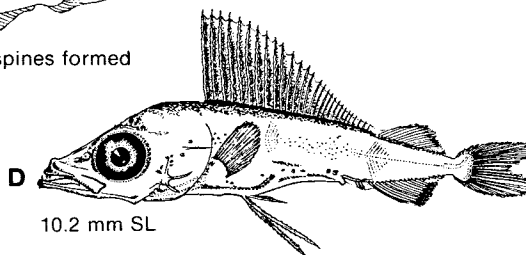
8.3 mm SL

2 anal spines formed

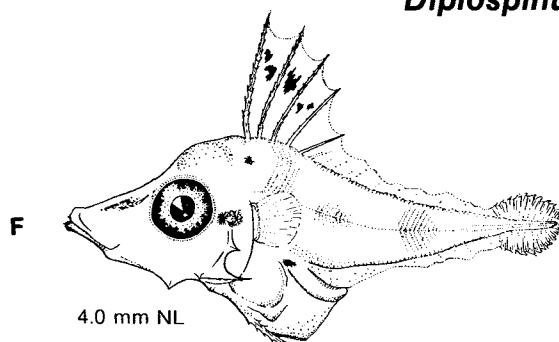


11.6 mm SL

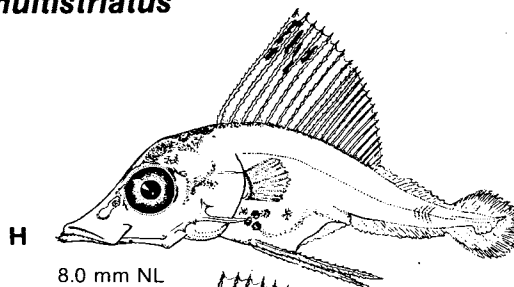
Second anal spine longer and stouter than first



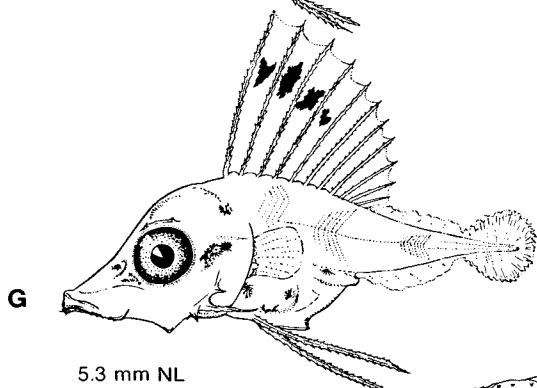
10.2 mm SL

Diplospinus multistriatus

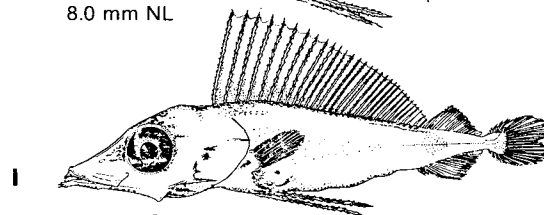
4.0 mm NL



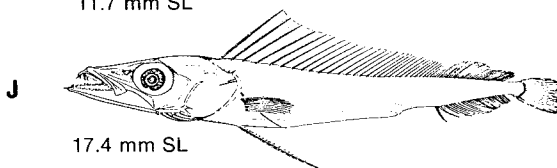
8.0 mm NL



5.3 mm NL

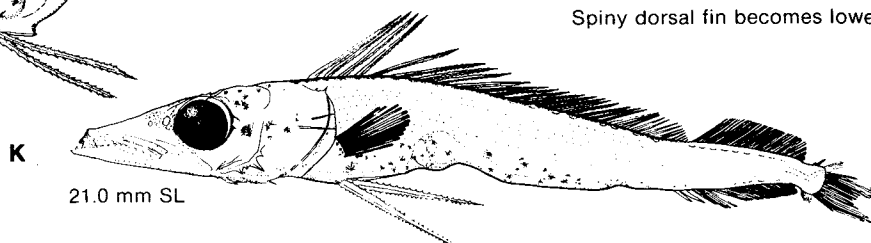


11.7 mm SL



17.4 mm SL

Spiny dorsal fin becomes lower



21.0 mm SL

A, C (Indian Ocean material); J (Pacific specimen)

GEMPYLIDAE***Nesiarchus nasutus* Johnson**

Spawning Probably year-round in the Caribbean Sea and Florida Current.

Eggs — Undescribed.

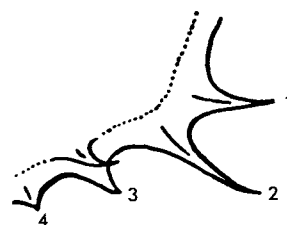
Larvae — Development much more rapid than *G. serpens* and *D. multistriatus* (p. 302); protruding lower jaw teeth lost earlier; fins and fangs develop sooner.

- Relatively low spiny dorsal fin, develops early.
- Relatively short pelvic spine, followed by rays, develops early.
- Preopercle spine length order 2-1-3-4 (1st, 2nd and 3rd usually upturned).
- Flexion begins at about 6 mm SL.
- 20 dorsal spines formed by 7.5 mm SL, and 2 anal spines form at about 8 mm SL (2nd being larger).
- Greatest body depth at pelvic base; head length about 50% SL at 7.5–11.3 mm SL.

Meristic features

Myomeres: 36
 D : XXII–XXIII, 22–23
 A : III, 18–19
 Plv : I, 5
 C : 7–8+9+8+9
 D finlets: 2
 A finlets: 2

Preopercle spines



(Voss 1954)

Best characters for 3 gempylid-trichiurid species

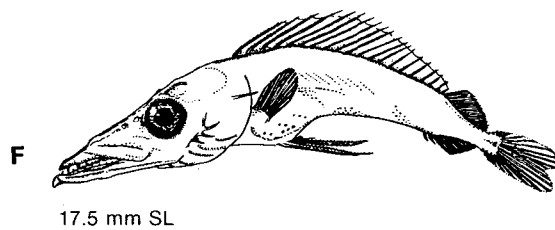
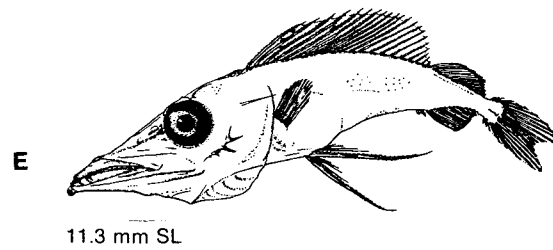
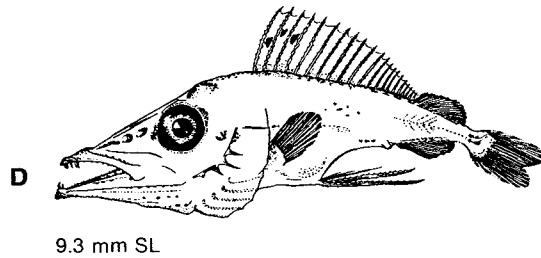
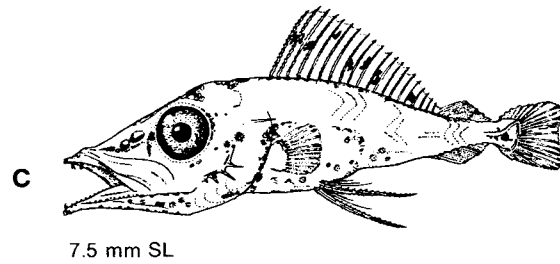
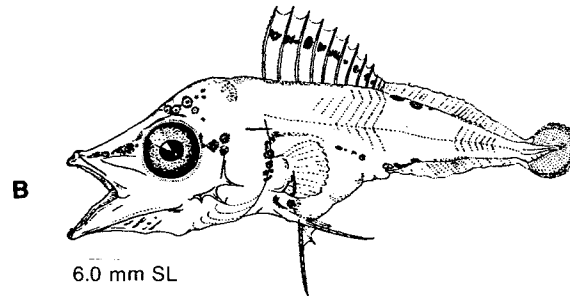
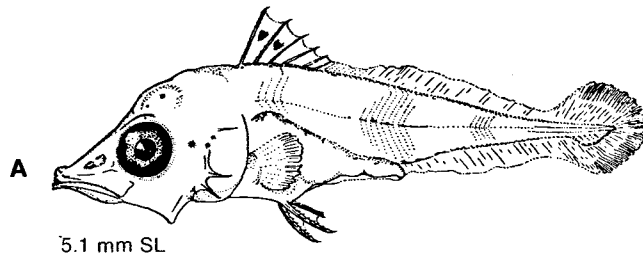
- Myomere number.
- Relative spiny dorsal fin height.
- Relative pelvic spine length.
- Preopercle spine pattern.

Fig. — A–F, Voss 1954.

Ref. — Strasburg 1964.

Nesiarchus nasutus

GEMPYLIDAE



SCOMBRIDAE**General Characters****Morphology**

- Head large, body deep; snout pronounced, may be elongate (i.e. *Acanthocybium*); jaws well-developed.
- Most with well-developed preopercle spines (also opercle, supraocular, and posttemporal or pterotic spines).
- Myomere number relatively high (31–66).
- Vertebral number usually stable within a species (range usually narrow).

Fin formation

- Caudal fin first to form; 9+8 principal rays.
- First dorsal fin forms before second (except in *Scomber*).
- Pelvic fin always I,5; forms at same time as first dorsal fin (except delayed in *Acanthocybium*).
- Gap between anus and anal fin origin (except in *Acanthocybium*).
- Number of pectoral fin rays important (development starts at top and proceeds ventrally).
- Finlets present posterior to dorsal and anal fins.
- Full complement of fin rays usually complete by ~15 mm SL.

Pigmentation

- Variable but important in some locations.
- Head pigment always present (except in some preflexion larvae); top of head to in front of the eyes in *Euthynnus*; top of head but not in front of eyes in *Auxis*.
- Ventral pigment on tail in early larvae coalesces in later larvae, then spots increase again and dorsal pigment added.

Meristic Characters

Meristic characters for species in 8 genera occurring in the western North Atlantic (Matsumoto 1967; Potthoff and Richards 1970; Miller and Jorgenson 1973; Potthoff 1974; Collette and Chao 1975; Berrien 1978).

Genus	First dorsal spines	Second dorsal rays	Dorsal finlets	Anal spines and rays	Anal finlets	Pectoral rays	Vertebrae
<i>Scomber</i>	10–17	9–15	4–6	11–14	4–6	17–22	31
<i>Auxis</i>	10–12	10–12	8–9	12–14	7–8	24–25	39
<i>Euthynnus</i>	15–16	11–12	7	12	7	26–27	39
<i>Thunnus</i>	13–16*	12–17	7–10	12–16	7–10	30–36	39
<i>Katsuwonus</i>	15–16	12–16	7–8	14–18	6–8	26–27	41
<i>Sarda</i>	20–23	13–18	6–9	14–17	6–8	23–26	50–55
<i>Scomberomorus</i>	14–19	14–19	8–11	16–21	6–10	20–23	41–53
<i>Acanthocybium</i>	21–27	12	9	12–13	9	23	62–66

* Usually 14.

Developmental Characters**SCOMBRIDAE**

Selected developmental characters in 8 genera (various sources, synthesized by Okiyama and Ueyanagi 1978)

Characters	<i>Scomber</i>	<i>Auxis</i> <i>Euthynnus</i> <i>Katsuwonus</i> <i>Thunnus</i>	<i>Sarda</i>	<i>Scomberomorus</i>	<i>Acanthocybium</i>
Morphological features					
Dorsal fin development	D ₂ first	D ₁ first	D ₁ first	D ₁ first	D ₁ first
Myomeres	31	39–41	50–55	41–53	62–66
Head/SL ratio	<1/3	>1/3	>1/3	>1/3	>1/3
Snout	Rounded	Pointed	Elongate	Elongate	Elongate
Jaws	Equal-sized	Equal-sized	Equal/unequal	Equal/unequal	Upper longer
Premaxillary teeth	Minute	Large	Large	Large	Large
Gut	Space between anus and anal fin origin	Space between anus and anal fin origin	Space between anus and anal fin origin	Space between anus and anal fin origin	Anus adjacent to anal fin origin
Spines					
Supraoccipital	Absent	Absent	Absent	Present	Absent
Preopercular	Absent	Present	Present	Present	Present
Supraorbital	Absent	Absent	Crest present	Crest present	Absent
Pterotic	Absent	Present	Present	Present	Present
Pigment					
Dorsal body	Heavy	Light	Light	Heavy	Light
Postanus	Extensive	Present in all but few spots (or absent) in <i>Thunnus</i> and <i>Katsuwonus</i>	Extensive	Extensive	Extensive
Cleithral symphysis	Yes (in <i>S. scombrus</i>) No (in <i>S. japonicus</i>)	Yes (in <i>Auxis</i> and <i>Euthynnus</i>); No (in <i>Katsuwonus</i> and <i>Thunnus</i>)	Yes	Yes	No

SCOMBRIDAE**Genus *Thunnus***

Pigmentation notes on identification of larvae (Matsumoto *et al.* 1972; Richards and Potthoff 1974)

A. Black pigment on trunk and tail: *T. thynnus*; *T. obesus*; *T. atlanticus*.

Body area	Number of black pigment cells in larvae 3–10 mm SL	
	<i>T. thynnus</i>	<i>T. obesus</i> , <i>T. atlanticus</i> ^a
Upper jaw tip	Few (>6 mm SL)	Few (>5 mm SL)
Lower jaw tip	2 inner edge	0–2 inner edge (>4 mm SL) ^b
Dorsal edge trunk	1–2 ^c	0
Lateral line	0–2 (mid-trunk) ^c	0
Ventral edge trunk	1–4 ^c	1 or more (to 6)
Internal	0; 1–2 in some ^c	0
Caudal fin area	Rarely present (3–6 mm SL)	1–2 (in 66% of specimens)

^a See discussion of *T. atlanticus* larvae next page.

^b May not form until 7.5 mm SL.

^c Richards and Potthoff (1974) analyzed 83 *T. thynnus* specimens, of which all had ventral edge pigment, 78 had dorsal edge pigment, 45 had lateral pigment, and 41 had internal pigment.

B. No black pigment on trunk and tail: *T. albacares*; *T. alalunga*.

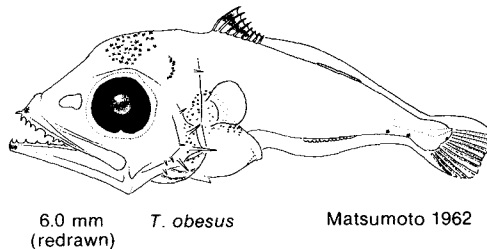
Body area	Size at which pigment appears in larvae 4–10 mm SL	
	<i>T. albacares</i>	<i>T. alalunga</i>
Upper jaw	Usually >6.0 mm SL	About 5.0 mm SL
Lower jaw	Sometimes <3.0 mm SL; usually 4.5–6.0 mm SL (at tip on inner edge, migrates to outer edge with growth)	9–10 mm SL (at tip on outer edge)
Caudal fin (both species)	3.0–8.5 mm SL; 1 (rarely 2) spots usually present	

Genus *Thunnus*

SCOMBRIDAE

Osteological characters

- Both *T. atlanticus* and *T. obesus* require further study and more complete series; based on pigment characters alone, either species may resemble *T. obesus*.
- Pigmentation characters may be unreliable, because *T. atlanticus* may lack ventral pigment and some *T. albacares* and *T. alalunga* may have ventral pigment (Richards and Potthoff 1974).
- Osteological characters in tunas >6.0 mm SL must be examined for accurate identification (Potthoff 1974, 1975; Richards and Potthoff 1974).



Matsumoto 1962

	<i>T. thynnus</i>	<i>T. alalunga</i>	<i>T. atlanticus</i>	<i>T. albacares</i> <i>T. obesus</i>
Precaudal plus caudal vertebrae	18+21=39 (95%)	18+21=39 (97%)	19+20=39 (98%)	18+21=39 (85%)
First closed haemal arch on vertebra #	10 (88%)	10 (99%)	11 (94%)	11 (93%)
Ceratobranchial (lower limb) gill rakers	17-20	14-16	11-13	14-16

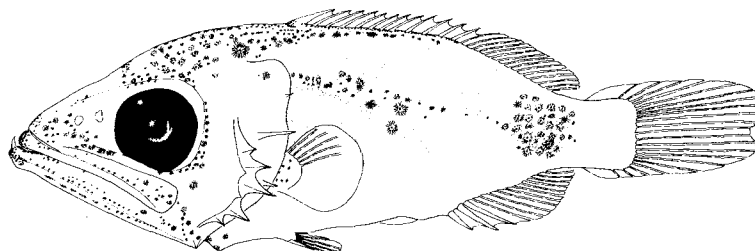
- For description of relationship between fin pterygiophores and interneural spaces see Potthoff (1974).
- Lacking positive osteological evidence, *Thunnus* larvae should be identified as *Thunnus* sp.

Similar larvae (*Scombrolabrax heterolepis*)

- This species (family Scombrolabracidae) is tropical and subtropical and spawns year-round; larvae are similar to scombrids.
- Low myomere count, body shape and pigment pattern separates this larva from all scombrids.
- Larvae less than 5.0 mm SL similar to *Thunnus* larvae in pigmentation, but pigment soon forms on cleithral symphysis, over forebrain, on lateral jaw rami, gular membrane, and laterally anterior to caudal peduncle; first dorsal fin unpigmented.
- Sequence of fin formation: caudal, dorsal and anal rays, dorsal and anal spines, pelvic, pectoral.
- All fin rays complete at about 7.5 mm SL, except pectoral complete at about 14 mm SL.

Meristic features

Myomeres: 30
 Vert : 13+17=30
 D : XII, 15-16
 A : III, 16-17
 Piv : I, 5
 P : 18-19
 C : 8-9+9+8+9-10
 (No finlets)

7.2 mm SL
(redrawn)

Potthoff et al. 1980

SCOMBRIDAE *Acanthocybium solanderi* (Cuvier)

Spawning: Near Cuba, Yucatan and Florida during May–October (peak in June).

Eggs — Undescribed.

Larvae — Snout elongate, with upper jaw longer than lower.
 — Long gut; anus forms just anterior to anal fin origin.
 — Head length increases from 30% SL to about 50% SL at 9–10 mm and then decreases.
 — Body depth increases from 6% SL to 8–10% SL at 9–10 mm.
 — Preanus length increases from 60% SL to about 73% SL at 9–10 mm.
 — High number of dorsal spines and myomeres; 26–30 preanal myomeres.
 — Two preopercle spines form at 4.1 mm SL, increasing to 6 at 9.4 mm.
 — Pterotic spines present; supraorbital and supraoccipital spines absent.
 — Flexion occurs at about 6 mm SL.
 — Vertebrae ossify from 6.8 to 17.8 mm SL.
 — Sizes at beginning of ossification and completion of fin rays:

Meristic features

Myomeres: 62–66
 Vert : 31–33+30–34
 D : XXI–XXVII, 12+9
 A : 12–13+9
 Piv : I, 5
 P : 23

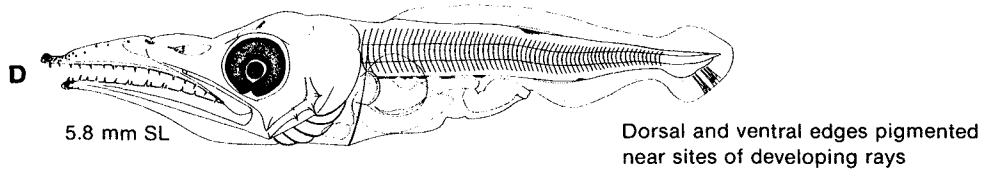
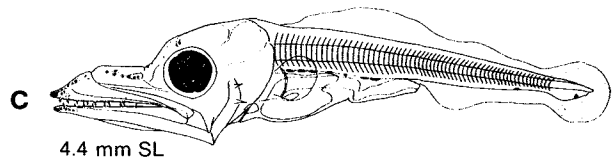
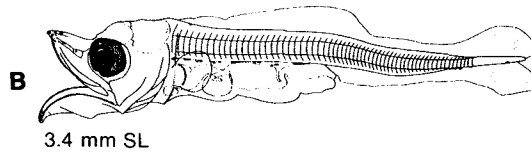
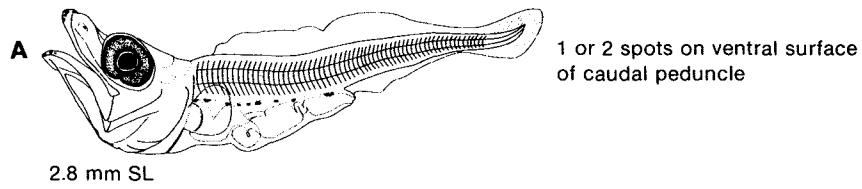
Caudal rays (principal)	5.8 mm SL	8.4 mm SL
Second dorsal rays	6.6	10.2
Anal rays	6.6	13.2
Pectoral rays	6.6	23.7
First dorsal spines	6.8	13.2
Pelvic rays (bud at 6.8 mm SL)	10.2	13.2

— Pigmentation: no spot at cleithral symphysis; see illustrations and notes on opposite page.

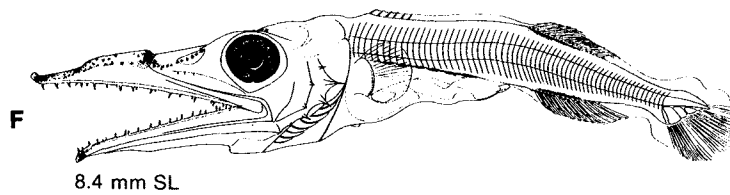
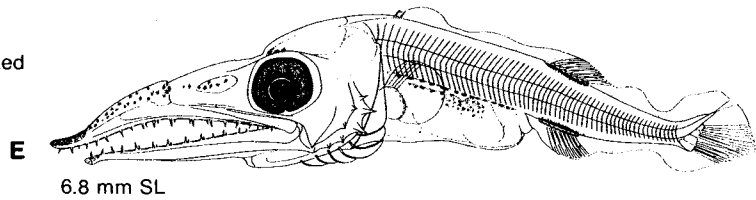
Note: See introduction to Scombridae section (p. 306).

Fig. — A–H, Matsumoto 1967.

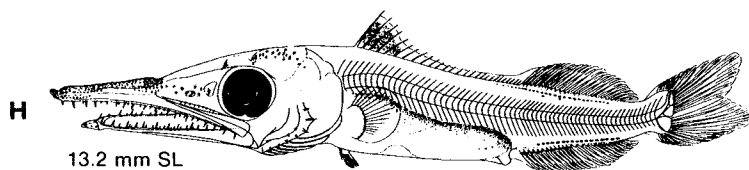
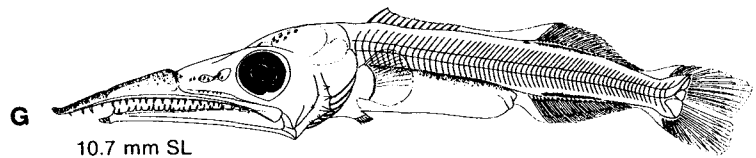
Ref. — Wollam 1969.

*Acanthocybium solanderi***SCOMBRIDAE**

Midbrain pigmented



Dorsal spines pigmented before 10 mm in Atlantic



A-H (Pacific material)

SCOMBRIDAE***Auxis* sp. (Types I and II)**

Spawning: Florida Current, probably during summer.

Meristic features**Eggs**

- Pelagic, spherical.
- Diameter: 0.82–1.10 mm.
- Yolk: homogeneous.
- Oil globules: 1 (or up to 5 smaller).
- O.G. diameter: 0.24–0.29 mm.
- Perivitelline space: very narrow.

Myomeres: 39
 Vert : 20+19 or 19+20
 D : X–XII, 10–12+8–9
 A : 12–14+7–8
 Plv : I, 5
 P : 24–25

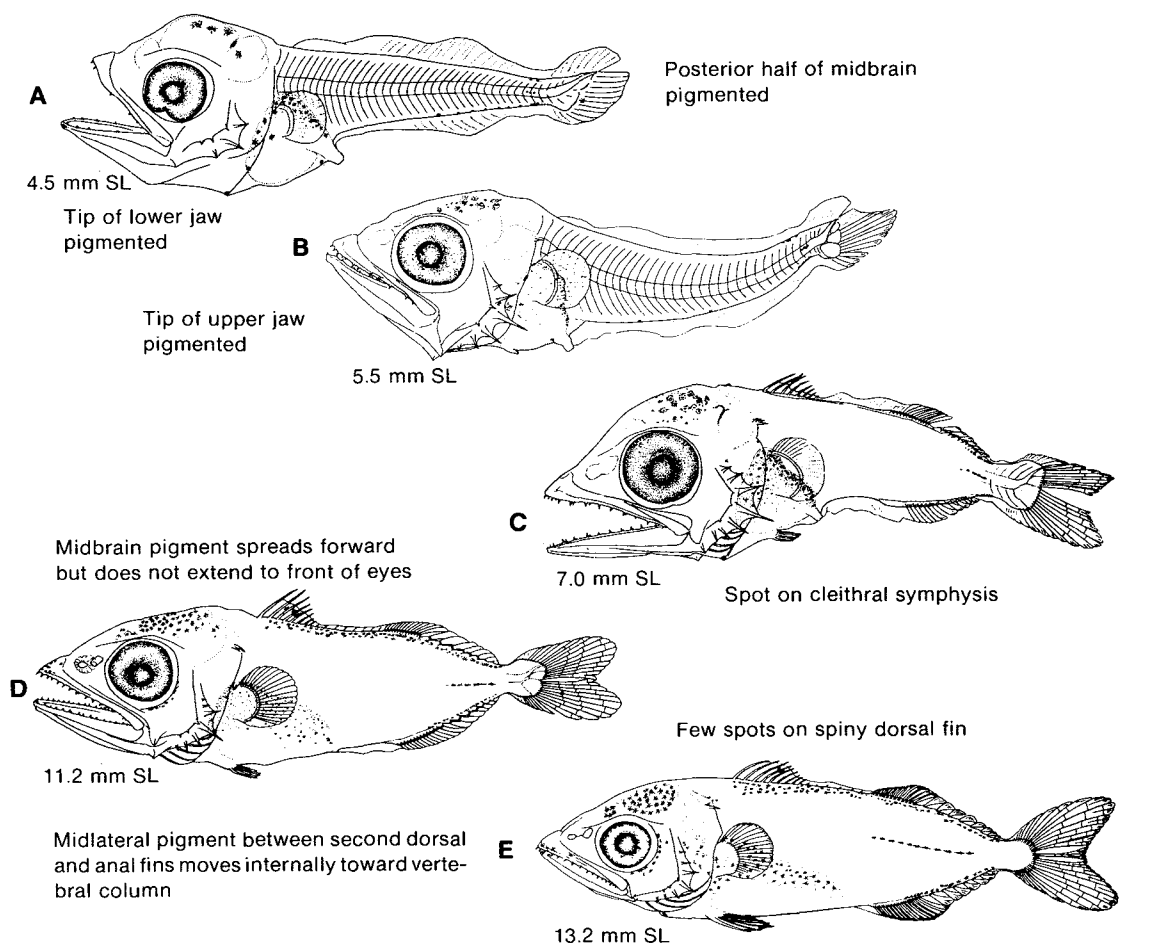
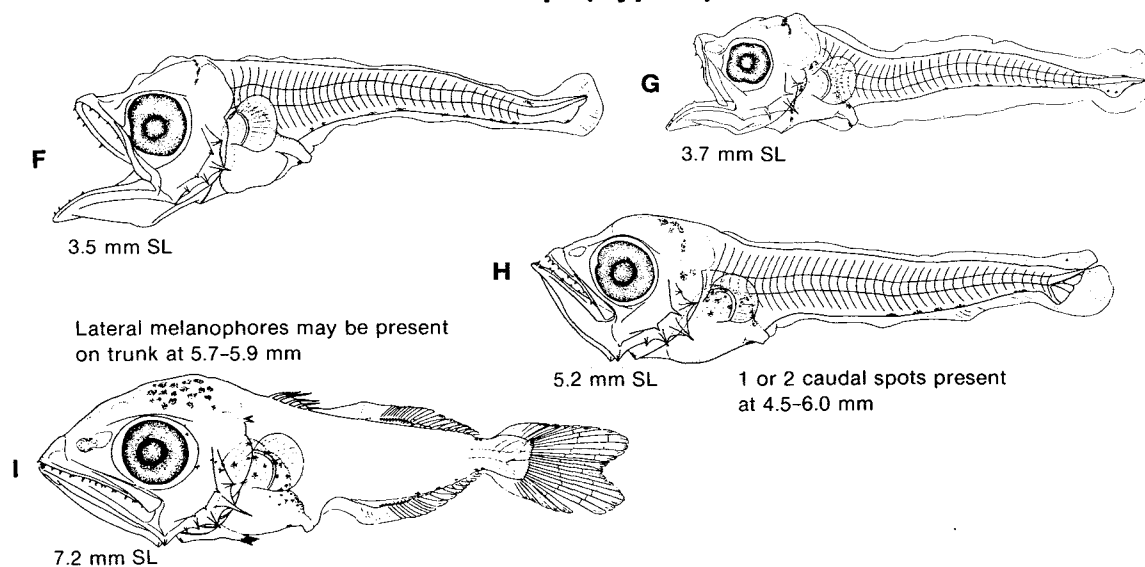
Larvae

- Hatching occurs at 2.0–2.5 mm; preanal length 37–50% SL.
- Similar to *Scomber* (p. 318), but head bigger, snout pointed, and head spines present.
- Upper and lower jaws about equal in size.
- Flexion occurs at 4.5–6.0 mm.
- Dorsal, anal and pelvic fin rays begin to form at 6.0 mm, and pelvic well formed at 8.7 mm.
- Low number of dorsal spines (10–12) discernible at 7–8 mm.
- Preopercle and pterotic spines present, but supraoccipital and supraorbital spines absent.
- Space between 1st and 2nd dorsal fins (after juvenile stage).
- Pigmentation: spots on cleithral symphysis; pigment on top of head does not extend in front of eyes; few spots on spiny dorsal fin develop at about 8–10 mm; row of ventral trunk spots decrease in number between 4 and 8 mm, and then increase during subsequent growth; spots on dorsal trunk appear at about 6 mm, and increase with growth; pelvic fins unpigmented (compare to *Sarda sarda*, p. 314).

- Note:**
- (1) Larvae of Type II usually lack spots at side of caudal peduncle. The two types may refer to variants of the same species.
 - (2) See introduction to Scombridae section (p. 306).

Fig. — A–D, G, I, Matsumoto 1958; E, F, H, Matsumoto 1959.

Ref. — Potthoff and Richards 1970.

Auxis* sp. (Type I)*SCOMBRIDAE*****Auxis* sp. (Type II)**

A-I (Atlantic, Pacific and Gulf of Mexico material)

SCOMBRIDAE *Euthynnus alletteratus* (Rafinesque)**Spawning:** Florida Strait during spring-summer.**Meristic features**

- Eggs** — Pelagic, spherical.
 — Diameter: 0.84–1.08 mm.
 — Yolk: homogeneous.
 — Shell: smooth and transparent.
 — Oil globules: 1.
 — O.G. diameter: 0.28.
- Larvae** — Hatching occurs at about 3 mm, with 34 myomeres.
 — Body stubbier, head bigger, and lower jaw more pigmented than in *Auxis* (p. 312).
 — Flexion occurs at 5.5–7.5 mm.
 — Pigmentation: spots form early on lower jaw and tip of upper jaw; spots on top of head extend to front of eyes; spot on cleithral symphysis (not present in *Thunnus* or *Katsuwonus*); caudal spot present throughout development; ventral row of spots decrease in number from 7.5 to 9.3 mm SL.

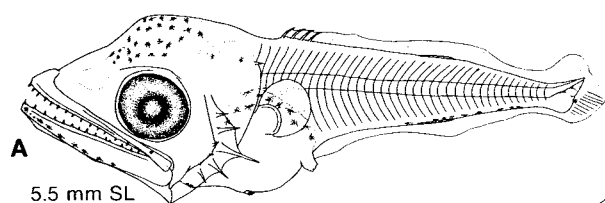
Myomeres: 39
 Vert : 19+20 or 20+19
 D : XV–XVI, 11–12+7
 A : 12+7
 Plv : I, 5
 P : 26–27

Sarda sarda* (Bloch)*Spawning:** Usually in summer (June–July), but in winter south of Cape Hatteras.**Meristic features**

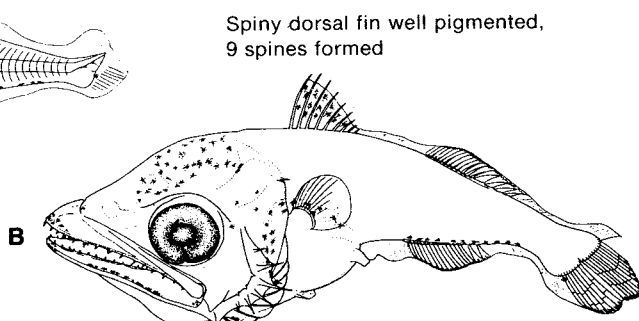
- Eggs** — Pelagic, spherical and transparent.
 — Diameter: 1.15–1.30 mm.
 — Yolk: homogeneous.
 — Shell: smooth (or finely striated?).
 — Oil globules: Multiple, coalesce to 1.
 — O.G. diameter: 0.22–0.26 mm (as 1).
 — Perivitelline space: narrow.
- Larvae** — Hatching occurs at about 4.3 mm; eye unpigmented; pigment on yolk and oil globule.
 — Snout elongate; upper jaw may be longer than lower; head length >33% SL.
 — Preopercle and pterotic spines present; supraoccipital spine absent; supra-orbital crest present.
 — Pigmentation: spot on cleithral symphysis, at tip of snout, and on lower jaw tip and ramus; pigment on pelvic and first dorsal fins, and spots on caudal fin base over developing hypurals; dorsal pigment light (forms later in juvenile stage); postanus ventral pigment present, some spots become embedded in muscle tissue.

Myomeres: 50–55
 Vert : 50–55
 D : XX–XXIII, 13–18+6–9
 A : 14–17+6–8
 Plv : I, 5
 P : 23–26

Note: See introduction to Scombridae section (p. 306).**Fig.** — **A–E**, Matsumoto 1959; **F–H**, M. P. Fahay (see p. 11).**Ref.** — Sanzo 1932a; Sette 1943; Vodianitskii and Kazanova 1954; Klawe and Shimada 1959; Klawe 1961; Demir 1963; Potthoff and Richards 1970.

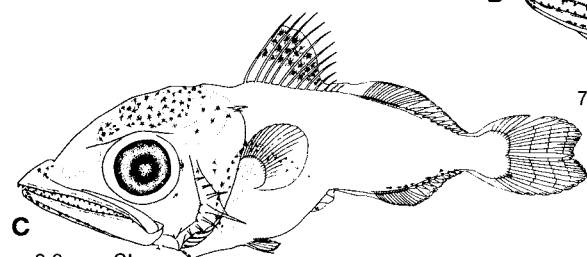
Euthynnus alletteratus**SCOMBRIDAE**A
5.5 mm SL

Lower jaw pigmented early



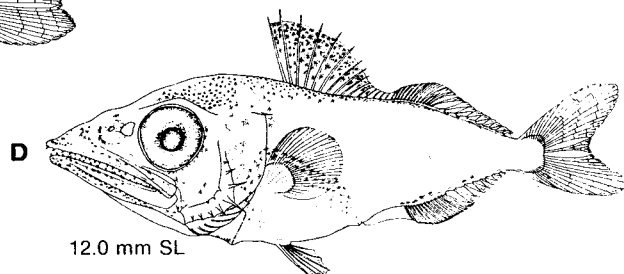
B

7.5 mm SL

Spiny dorsal fin well pigmented,
9 spines formed

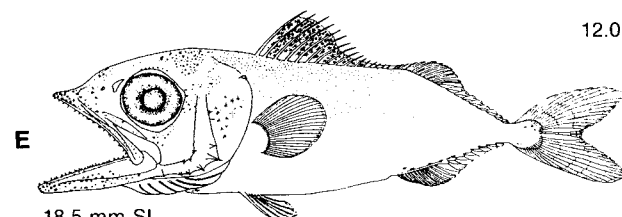
C

9.3 mm SL

Pigment over midbrain
spreads to front of eyes

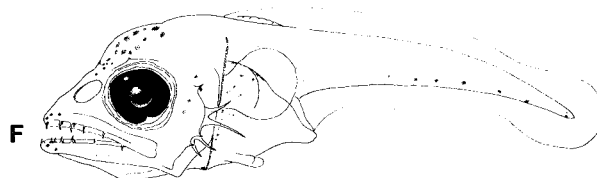
D

12.0 mm SL



E

18.5 mm SL

Sarda sarda

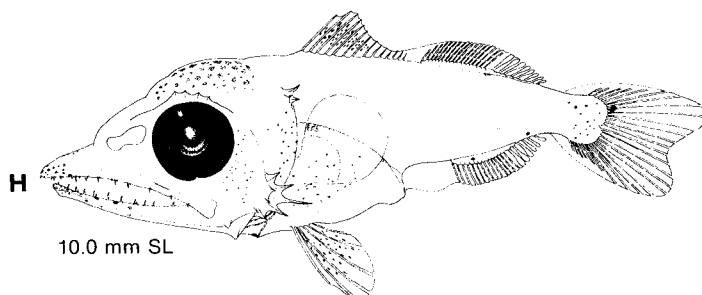
F

5.3 mm SL



G

9.8 mm SL



H

10.0 mm SL

SCOMBRIDAE***Katsuwonus pelamis* (Linnaeus)**

Spawning: Florida Current to North Carolina (well off-shore) in summer.

Meristic features

- Eggs**
- Pelagic, spherical.
 - Diameter: 0.93–1.09 mm.
 - Oil globules: 1.
 - O.G. diameter: 0.22–0.27 mm.

Myomeres: 41
Vert : 20+21
D : XV–XVI, 12–16+7–8
A : 14–18+6–8
Plv : I, 5
P : 26–27

- Larvae**
- Hatching occurs at 2.44–3.04 mm.
 - Head very large, and mouth with large gape.
 - Diagnostic myomere count (41) present at 5.4 mm TL.
 - Preopercle spines increase from 3 at 3.7 mm to 8 or 9 in later larvae.
 - Pterotic spines present; supraoccipital and supraorbital spines absent.
 - Flexion occurs at about 5.5 mm TL.
 - Dorsal spines begin to form at 6.5 mm TL.
 - Anus moves close to anal fin origin at 10–14 mm TL.
 - Pigmentation: no spot on cleithral symphysis, and none on isthmus or directly anterior to anus; single spot on ramus of lower jaw (compare to *Euthynnus*, p. 314); pigment only on outer edge of spiny dorsal fin; few spots appear along anal fin base at about 9 mm TL; ventral spot (usually large) on caudal peduncle throughout development; no dorsal pigment until about 9 mm TL, when spots form under 1st dorsal fin and spread posteriorly; no midlateral pigment until 10.9 mm TL.

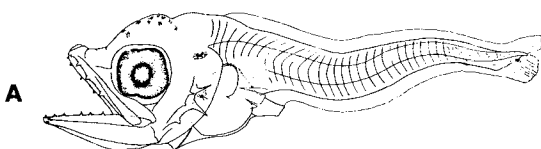
Note: *Scomberomorus cavalla* (p. 320) has similar myomere count (41–42). See introduction to Scombridae section (p. 306) for comparison of other characters.

Fig. — A–G, Matsumoto 1958.

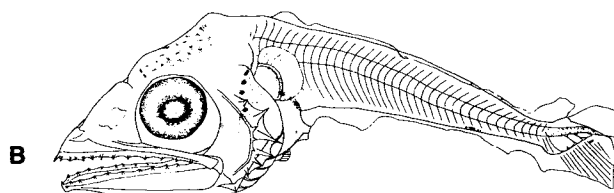
Ref. — Jones 1960a; Potthoff and Richards 1970.

Katsuwonus pelamis

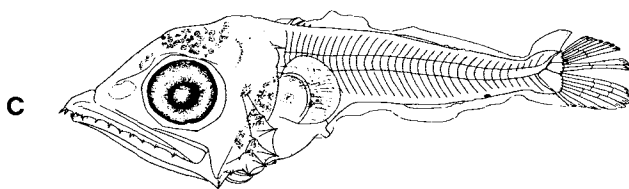
SCOMBRIDAE



3.7 mm TL

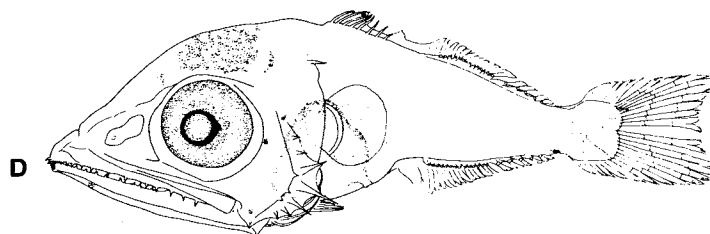


5.35 mm TL

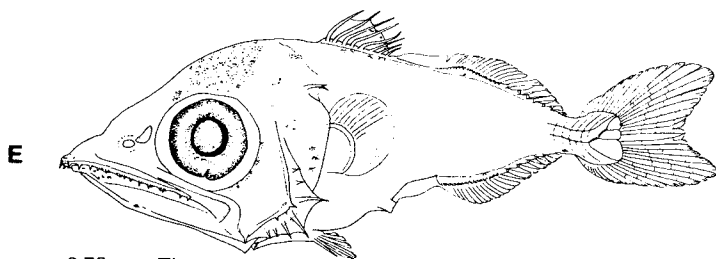


6.7 mm TL

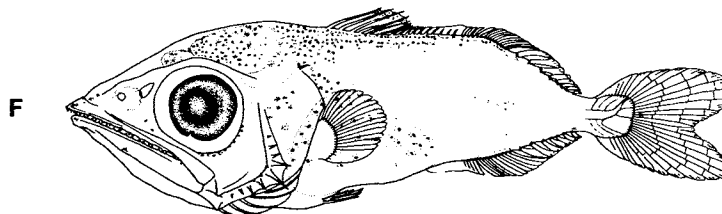
Single spot on ramus of lower jaw



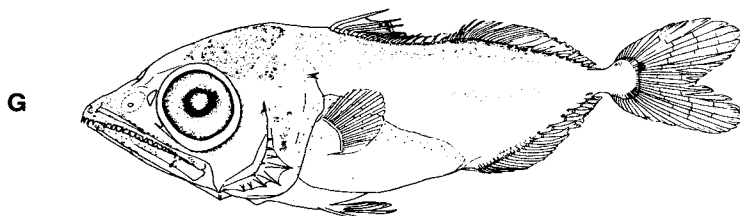
7.1 mm TL



8.75 mm TL



10.9 mm TL



14.5 mm TL

A-G (Pacific material)

SCOMBRIDAE***Scomber japonicus* Hottuyn**

Spawning: Winter-spring; larvae more common south of Cape Hatteras.

Eggs — Similar to *S. scombrus*, but yolk pigmented with several melanophores.

Larvae — Hatching occurs at about 3 mm.
 — Prominent teeth from about 4 mm to juvenile stage; no head spines.
 — Deeper-bodied than *S. scombrus* between 4 and 11 mm.
 — Preanus length longer than *S. scombrus* between 3 and 15 mm.
 — Vertebrae complete at 7.6 mm; D₁ spines complete at 13 mm; caudal rays begin forming at 5 mm.
 — Pigmentation: (see table below).

Meristic features

Myomeres: 31
 Vert : 14+17
 D : X-XI,12+4-5
 A : II, 11+5

***Scomber scombrus* Linnaeus**

Spawning: Spring-summer; larvae more common north of Cape Hatteras.

Eggs — Pelagic, spherical.
 — Diameter: 1.09-1.36 mm.
 — Yolk: homogeneous.
 — Shell: smooth and transparent.
 — Oil globules: 1.
 — O.G. diameter: 0.26-0.37 mm.
 — Embryo: no yolk pigment until just before hatching, when one spot per side appears just posterior to head.

Larvae — Hatching occurs at about 3 mm.
 — Prominent teeth from about 4 mm to juvenile stage; no head spines.
 — Shallower-bodied than *S. japonicus* between 4 and 11 mm.
 — Preanus length less than *S. japonicus* between 3 and 15 mm.
 — Vertebrae complete at 8.6 mm; D₁ spines complete at 17 mm; caudal rays begin forming at 7 mm.
 — Pigmentation: dorsal trunk and cleithral symphysis more heavily pigmented than *S. japonicus* (cleithral symphysis pigment may be lacking in *S. scombrus* specimens from the Scotian Shelf) (see table below).

Meristic features

Myomeres: 31
 Vert : 13+18
 D : XII-XVII,11+5
 A : II, 11+5

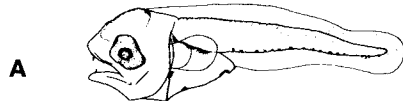
Pigment Acquisition in *Scomber*

Location	<i>S. japonicus</i>		<i>S. scombrus</i>	
	Present in some	Present in all	Present in some	Present in all
Forebrain	5.2 mm	8.7 mm	3.7 mm	5.7 mm
Hindbrain	3.5	5.5	(Present in all)	
Snout	5.2	10.5	4.3	6.3
Cleithral symphysis	(Lacking in all)		3.7	8.0
Lower jaw tip	8.3	11.7	4.6	6.2
Dorsal trunk	5.0	7.0	?	2.6

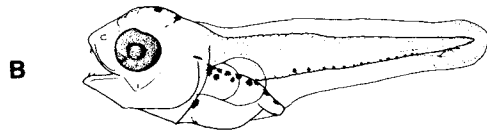
- Note:** (1) *Sebastes* larvae (p. 218) are similar but lack teeth at sizes <9 mm, are more slender, have shorter preanus length, and have posttemporal, supraoccipital and preopercle spines.
 (2) See note on *Brosme brosme* (p. 170).
 (3) See Scombridae introductory pages (p. 306-307).

Fig. — A-L, Berrien 1978.

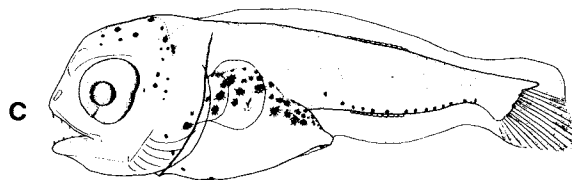
Ref. — Kramer 1960.

Scomber japonicus**SCOMBRIDAE**

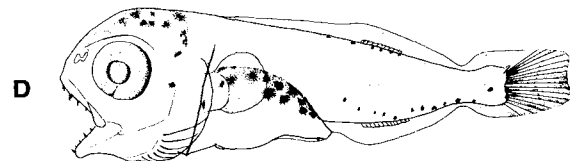
2.9 mm SL



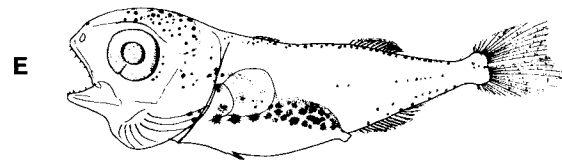
3.8 mm SL



5.3 mm SL



7.3 mm SL



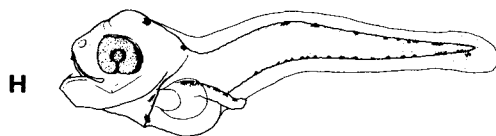
11.3 mm SL



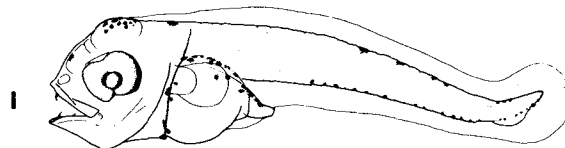
14.7 mm SL

Scomber scombrus

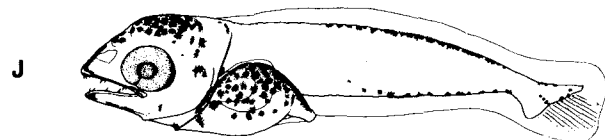
2.9 mm SL



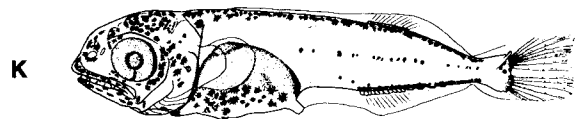
3.8 mm SL



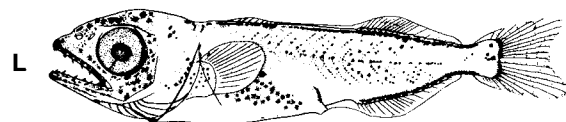
4.8 mm SL



7.2 mm SL



11.7 mm SL



15.1 mm SL

SCOMBRIDAE *Scomberomorus maculatus* (Mitchill)**Spawning:** Spring-summer.**Meristic features**

- Eggs** — Pelagic, spherical.
 — Diameter: 1.02–1.27 mm.
 — Shell: smooth and transparent.
 — Yolk: homogeneous.
 — Oil globules: 1.
 — O.G. diameter: 0.25 mm.
 — Perivitelline space: narrow.
- Larvae** — Myomere count 51 at 3.1 mm.
 — Prominent preopercle spines: 3 at 3.1 mm, increasing to 7 at 29 mm.
 — High fin-ray counts; development begins at 7–9 mm SL.
 — Pigmentation: spot on lower jaw between rami and on cleithral symphysis; ventral row of postanal spots; few spots on dorsal fin base; midlateral row of spots evident at 13.5 mm.
- Myomeres: 50–53
 D : XVI–XVIII, 15–18+8–9
 A : II, 14–17+8–10
 Plv : I, 5
 P : 20–23

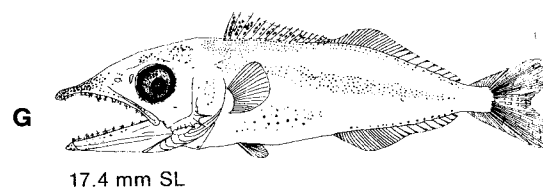
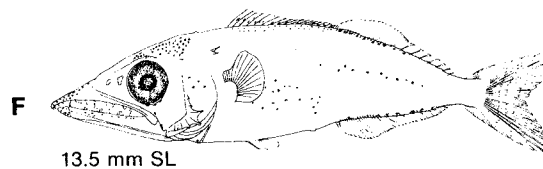
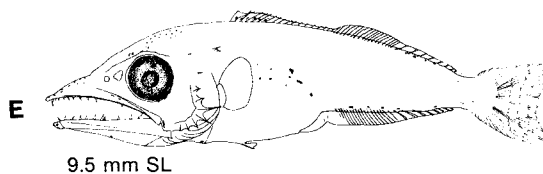
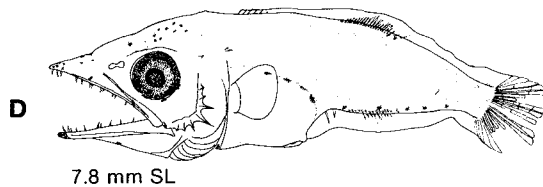
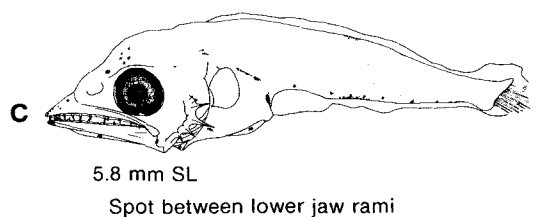
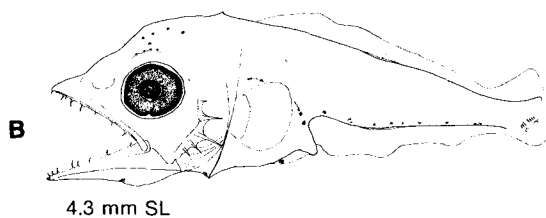
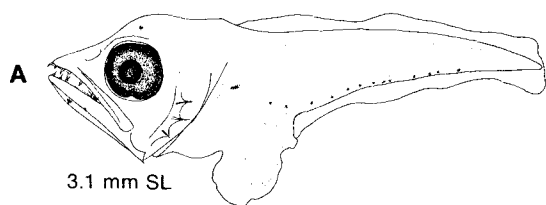
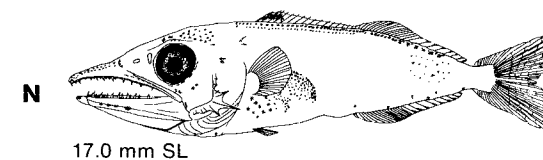
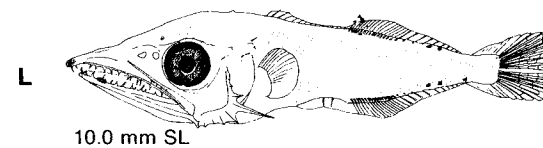
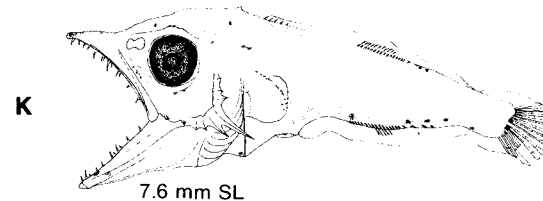
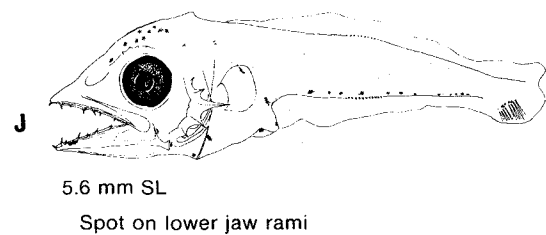
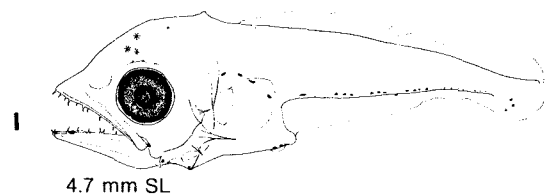
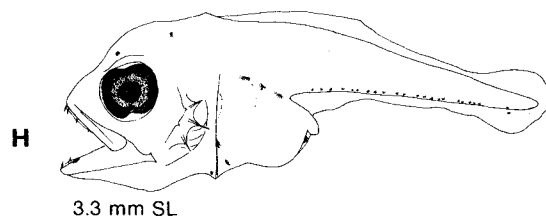
Scomberomorus cavalla* (Cuvier)*Spawning:** April–November, with peaks.**Meristic features**

- Eggs** — Undescribed.
- Larvae** — Myomere count 42 at 3.3 mm.
 — Prominent preopercle spines: 3 at 3.3 mm, 10 at 16.5 mm, and 5 at 31 mm.
 — High fin-ray counts; development begins at 7–10 mm SL.
 — Pigmentation: spot on ramus of lower jaw as small as 3.3 mm and on cleithral symphysis; ventral row decreases from 29 spots to 4–5 at 7.6 mm SL; dorsal body spots at 7.6 mm and larger spread to form a saddle.
- Myomeres: 41–42
 D : XV–XVI, 16–17+8–9
 A : II, 14–17+8–10
 Plv : I, 5
 P : 20–23

Common Features for Both Species

- Larvae** — Large mouth with prominent teeth; snout elongate (upper jaw may be longer than lower).
 — Flexion begins at 4.2 mm SL.
 — Supraorbital crest, and supraoccipital and pterotic spines present.
 — Pigmentation: spots on snout, tip of lower jaw, and on preanal finfold just anterior to vent; fin pigment restricted to first dorsal.
- Note:** (1) Small larvae not likely north of Cape Hatteras; see Richardson and McEachran (1981) for separation of larvae <3 mm SL.
 (2) See Scombridae introductory pages (p. 306–307).

Fig. — A–N, Wollam 1970.**Ref.** — Devaraj 1975; Collette and Russo 1979.

Scomberomorus maculatus**SCOMBRIDAE*****Scomberomorus cavalla***

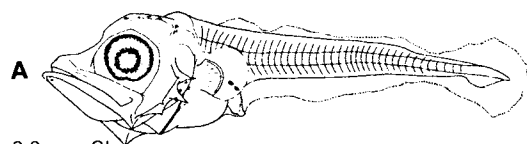
SCOMBRIDAE ***Thunnus albacares* (Bonnaterre)****Spawning:** Spring-summer.**Meristic features**

- Eggs** — Pelagic, spherical.
 — Diameter: 0.90–1.04 mm.
 — Oil globules: 1.
- Larvae** — Hatching occurs at 2.6 mm TL.
 — Abdomen triangular, vent points downward.
 — Preanus length <50% SL at hatching, becoming longer with growth.
 — Preopercle spines increase from 3 at 3.9 mm to 9 with growth; teeth form at 4.75 mm.
 — Flexion occurs at about 5 mm SL.
 — Pelvic fins emerge at 4.75 mm and are complete at 9 mm; 1st dorsal forms at 5.9 mm.
 — Pigmentation: tip of lower jaw pigmented at 4.5–6.0 mm and tip of upper jaw at 7.0 mm; distal 1st dorsal prominently dark; no spots on cleithral symphysis, and no black pigment on trunk.
- Myomeres: 39
 Vert : 18+21*
 D : XIII–XIV, 13–16+8–10
 A : 12–15+7–10
 Piv : I, 5
 P : 33–36
- * 1st haemal arch on vertebra No. 11.

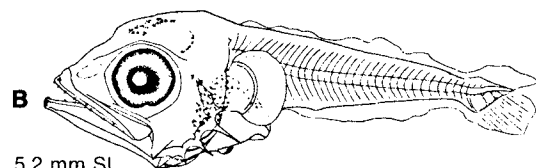
Note: Very similar to *T. alalunga* larvae; see Scombridae introductory pages (p. 306–309)***Thunnus thynnus* (Linnaeus)****Spawning:** Spring-summer.**Meristic features**

- Eggs** — Pelagic, spherical.
 — Diameter: 0.6(0.94)–1.12 mm.
 — Shell: sculptured.
 — Yolk: homogeneous.
 — Oil globules: 1.
 — O.G. diameter: 0.18–0.32 mm.
- Larvae** — Hatching occurs at about 2–3 mm.
 — Preanus length 47% TL at hatching.
 — Preopercle spines increase from 5 at 3.8 mm to 15 with growth.
 — Flexion occurs at about 5–6 mm SL.
 — Pelvic fins complete at 8 mm SL, and 1st dorsal forms at 8 mm SL.
 — Pigmentation: 2 spots on inner edge of lower jaw tip; 0–2 spots laterally near mid-trunk; 1–3 spots on dorsal edge of trunk (rarely 0 or 4); 1–3 spots on ventral edge of trunk (rarely 4, 5 or 6); 1st dorsal membrane prominently dark; upper jaw tip pigmented at 6–7 mm; internal pigment may be present near vertebral column; no spot on cleithral symphysis.
- Myomeres: 39
 Vert : 18+21*
 D : XIII–XIV, 13–15+8–10
 A : 13–16+7–9
 Piv : I, 5
 P : 30–36
- * 1st haemal arch on vertebra No. 10

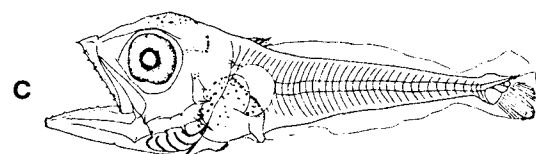
Note: See Scombridae introductory pages (p. 306–309)**Fig.** — A–G, Matsumoto 1958; H–O, Yabe *et al.* 1966.**Ref.** — Potthoff 1974; Richards and Potthoff 1974.

Thunnus albacares**SCOMBRIDAE**

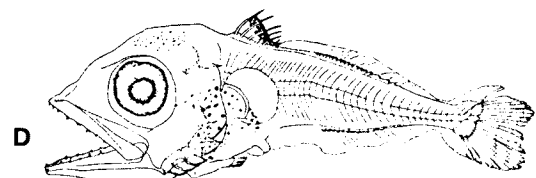
3.8 mm SL



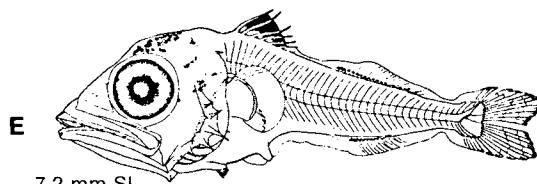
5.2 mm SL



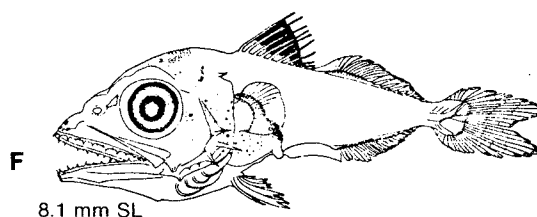
5.9 mm SL



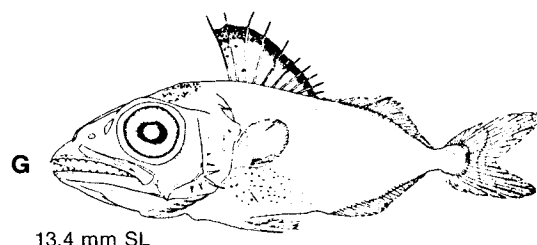
6.5 mm SL



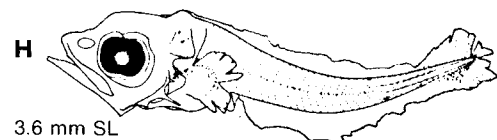
7.2 mm SL



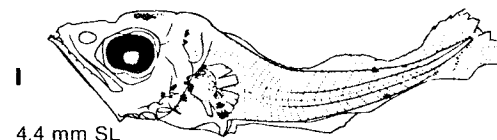
8.1 mm SL



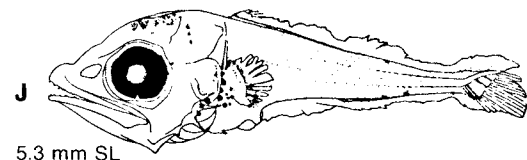
13.4 mm SL

Thunnus thynnus

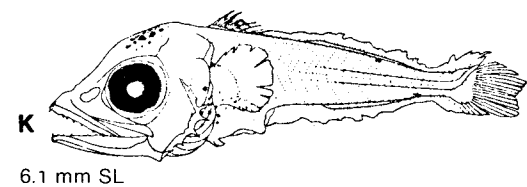
3.6 mm SL



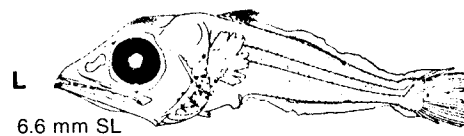
4.4 mm SL



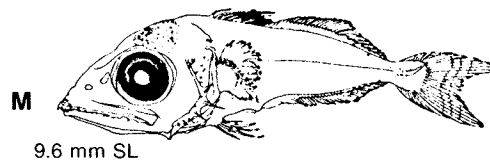
5.3 mm SL



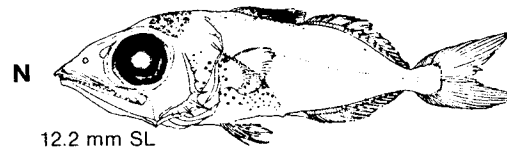
6.1 mm SL



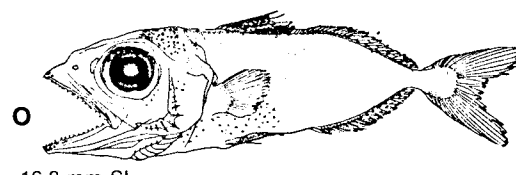
6.6 mm SL



9.6 mm SL



12.2 mm SL



16.8 mm SL

A-O (Pacific material)

XIPHIIDAE***Xiphias gladius* Linnaeus**

Spawning: Gulf Stream, Florida Strait and south, in December-September (peak during April-September).

Eggs — Pelagic, spherical.
 — Diameter: 1.60–1.87 mm.
 — Oil globules: 1.
 — O.G. diameter: 0.50–0.52 mm.

Larvae — Hatching occurs at 4.0–4.5 mm.
 — Body stubby, becoming more elongate with growth.
 — Gut long and thick; anus moves anteriorly with growth.
 — Teeth present at 6.0 mm TL.
 — Flexion occurs at about 12 mm.
 — No pelvic fin.
 — Head spines present on dorsal snout, preorbital ridge, supraorbital ridge, preopercle, posttemporal area, and below angle of jaws; these spines increase with larval growth, and then decrease in juveniles.
 — Spinous scales in rows appear at 12–15 mm.
 — Pigmentation: bars evident on body at about 12 mm; at about 16 mm, pigment absent from spiny ridges and pectoral fins but heavy on dorsal snout, between the eyes and on the head; fin pigment concentrated at posterior end of dorsal and anal fins.

Meristic features

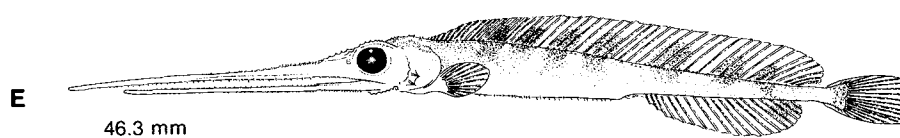
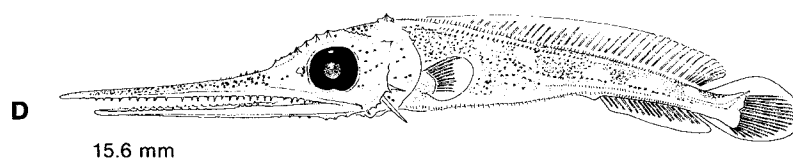
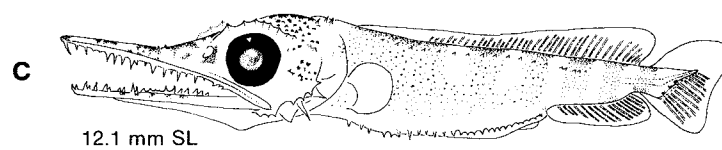
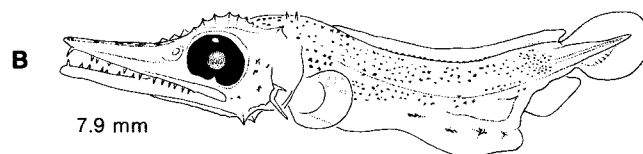
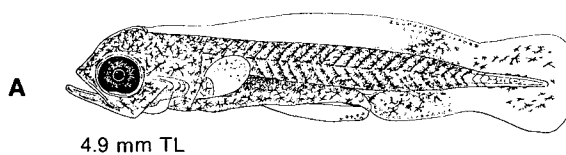
Myomeres: 26
 Vert : 15–16+10–11=26*
 D : 38–49+4–5
 A : 12–18+3–4
 Piv : none
 P : 17–19
 C : 7–9+9+8+7

* Rarely 25 or 27 (Potthoff and Kelley, 1982)

Note: Eggs and newly-hatched larvae of *Xiphias* from Mediterranean Sea are illustrated in Yasuda *et al.* (1978).

Fig. — **A**, Sanzo 1922; **B, D, E**, Tåning 1955; **C**, Arata 1954 (**B–E** redrawn).

Ref. — Yasuda *et al.* 1978; Potthoff and Kelley 1982.

Xiphias gladius**XIPHIIDAE**

A (Mediterranean specimen)

ISTIOPHORIDAE *Istiophorus americanus* (Cuvier)**Spawning:** Offshore during spring and summer.**Meristic features****Eggs** — Undescribed.

Myomeres: 24

Larvae — Body robust, with elongate snout.

Vert : 12+12

— Teeth well developed.

D : 37-49+6-8

— Gape extends to well behind the eye with development.

A : 8-16+6-8

— Flexion occurs at about 5-6 mm.

Plv : 1, 2

P : 17-21

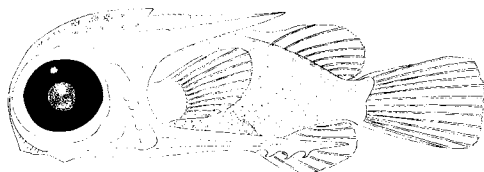
— Spination includes serrated supraorbital ridge, pair of pterotic spines with 3 edges; preopercle spine with 3 edges; secondary preopercle spine which reduces with growth; serrated ridge on lower jaw.

— Pelvic buds form at about 5 mm and rays complete at about 8 mm.

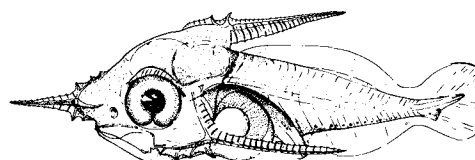
— Dorsal fin (42 rays) formed at 8.1 mm and becomes very high at 18.2 mm.

— Anal fin (10 rays) formed at 8.1 mm.

— Pigmentation: large spots on head, spreading to dorsal snout and body with growth; lower jaw unpigmented.

Note: Some authors recognize one species worldwide (*I. platypterus*), while others refer Pacific form to *I. platypterus* and Atlantic form to *I. americanus*.**Similar Larvae**Paired opercle spines,
no rostral spine.

7.4 mm

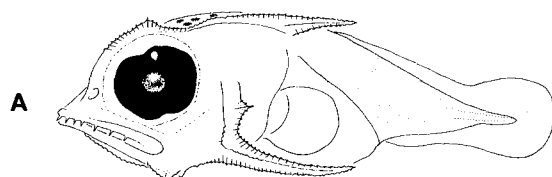
Dactylopteridae
(Sanzo 1934)
(redrawn)Single spine top of head,
rostral spine present.

5.0 mm SL

Holocentridae
(McKenney 1959)

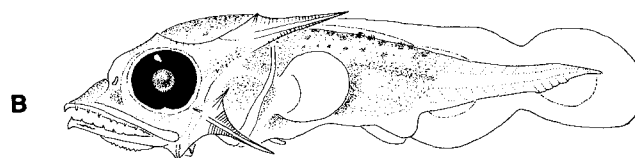
Istiophorus americanus

ISTIOPHORIDAE

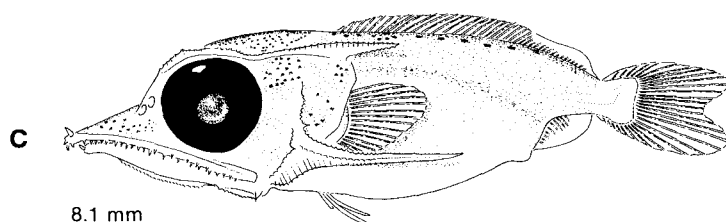


3.6 mm

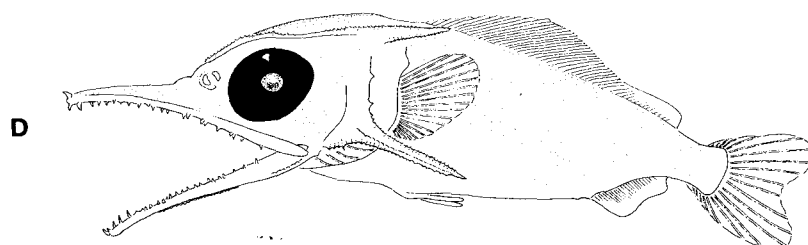
Smaller larvae lack supraorbital ridge,
pterotic and preopercle spines



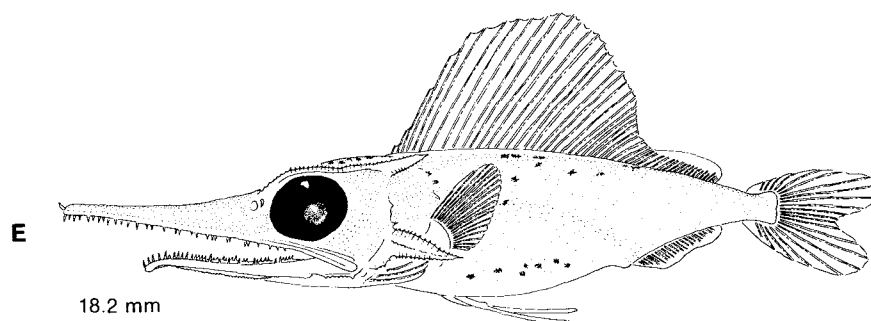
5.1 mm



8.1 mm



11.3 mm



18.2 mm

B (Pacific specimen)

STROMATEOIDEI**Five Families**

Families: Centrolophidae, Nomeidae, Ariommidae, Tetragonuridae, and Stromateidae.

Distribution:

- Most species in these families are highly oceanic and many are circumglobal. Approximately 13 species in 9 genera of stromateoid fishes are known from the western North Atlantic, excluding tropical species and those restricted to the Gulf of Mexico (Haedrich 1967, 1968; Haedrich and Horn 1972; Horn 1970; Ahlstrom *et al.* 1976; Butler 1979). The larvae of 10 of these species have been described.

General characters:

- Pelagic eggs of 4 (and tentatively a 5th) species of Atlantic stromateoids are known. Common characters (also shared with Pacific species) (Ahlstrom *et al.* 1976) include:
 - Shell: spherical, unsculptured, usually colored.
 - Diameter: range 0.7–1.8 mm.
 - Yolk: unsegmented.
 - Oil globules: single (posterior in yolk sac).
 - Perivitelline space: moderate.
 - Pigment: forms in middle and late stages on embryo and oil globules but usually not on yolk.
- Larvae of the families Nomeidae, Ariommidae and Stromateidae are deep-bodied, large-eyed, and have a characteristic rounded snout.
- Larvae of the families Tetragonuridae and Centrolophidae are more elongate but nevertheless retain the characteristic facial appearance of the suborder, the "stromateoid look". As described by Haedrich (1967), "it is a fat-nosed, wide-eyed, stuffed-up look, smug and at the same time apprehensive. Some stromateoids might even be accused of a certain prissiness".
- The airbladder in preflexion larvae is lost during the transition from juvenile to adult stages (Horn 1975).
- In most species, the numbers of rays in the second dorsal and anal fins are about equal. Exceptions are *Peprilus*, in which the number of dorsal fin rays barely outnumber the anal fin rays, and *Centrolophus*, in which there are nearly twice as many dorsal rays as anal rays.
- Tiny spines appear along the preopercle margin at some point during larval development of all species considered here, except *Centrolophus*. Stromateoid larvae, however, never have the large spine at the preopercle angle, which is characteristic of carangids, scorpaenids and some serranids.
- Helpful characters are numbers of myomeres (or vertebrae) and the sequence of fin formation:

Family	Species	Myomeres	Sequence of fin formation
Centrolophidae	<i>Centrolophus niger</i>	25	C, P-D ₂ , A, Plv
Nomeidae	<i>Cubiceps pauciradiatus</i>	31	C, D ₂ -A, P-D ₁ -Plv
	<i>Psenes maculatus</i>	35	Plv, D ₁ -C-D ₂ , A-P
	<i>Psenes cyanophrys</i>	31	Plv-D ₁ -D ₂ , A, C-P
	<i>Psenes pellucidus</i>	40–42	Plv, D ₁ -?
	<i>Nomeus gronovii</i>	41	Plv-?
Ariommidae	<i>Ariomma</i> sp.	30–32	?
Tetragonuridae	<i>Tetragonurus atlanticus</i>	45–48	C-D ₂ , A-D ₁ -P-Plv
Stromateidae	<i>Peprilus triacanthus</i>	30–33	C, D ₂ -A, P (no Plv)
	<i>Peprilus alepidotus</i>	29–31	C, D ₂ -A, P (no Plv)

Five Families**STROMATEOIDEI****Similar larvae:**

- Sciaenidae and Sparidae, but these have fewer myomeres.
- Carangidae, but these have large spine at preopercle angle, stronger anal spines and fewer myomeres.

Note: Precaudal and caudal vertebral counts for the nomeids, described later in this guide under NOMEIDAE, are from Ahlstrom *et al.* (1976). Discrepancies (if any) between these counts and those reported elsewhere may be due to difficulty in determining the position of the first caudal vertebrae, because, in nomeids, the first 1–5 caudal vertebrae bear pleural ribs as well as haemal spines. Furthermore, the first several haemal spines in nomeids are typically crowded together. See discussion in Ahlstrom *et al.* (1976).

CENTROLOPHIDAE *Centrolophus niger* Gmelin**Distribution:** Oceanic species.**Eggs**

- Pelagic, spherical.
- Diameter: 1.2 mm.
- Oil globules: 1 (pigmented).

Larvae

- Hatching occurs at about 4.4 mm, eyes unpigmented and mouth undeveloped.
- Flexion occurs at 5–7 mm SL.
- Preanus length ranges from 56% to 65% SL throughout development.
- Eye diameter decreases slightly from 37% HL at 4.2 mm SL to 33% HL at 14.0 mm SL.
- Head length and body depth at anus increase with development.

Meristic features

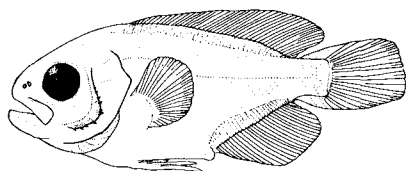
Myomeres: 25
 Vert : 10+15
 D : 37–41*
 A : III, 20–23
 P : 19–22

* Dorsal count includes 3 feeble spines.

mm TL	4.4	5.0	5.6	5.4	6.7	8.3	17.2
mm SL	4.2	4.8	5.3	5.2	6.3	7.0	14.0
HL % SL	18	20	26	33	33	34	34
BD % SL	18	18	20	22	28	30	27

- Fin formation sequence: C, P, D, A, Plv.
- Pigmentation: in early larvae, 4 spots along dorsal margin, 4 along ventral margin, and cluster of spots at caudal tip; body and fin pigment increases at about 14 mm SL; faint bars at dorsal origin, over end of pectoral fin, and across body over midanal fin.

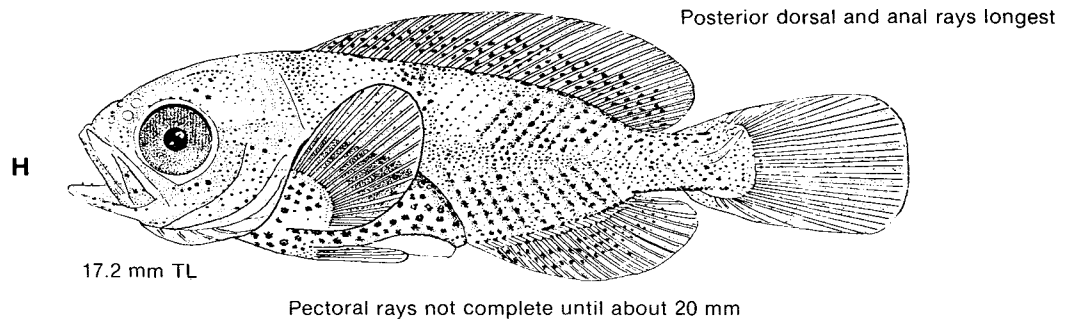
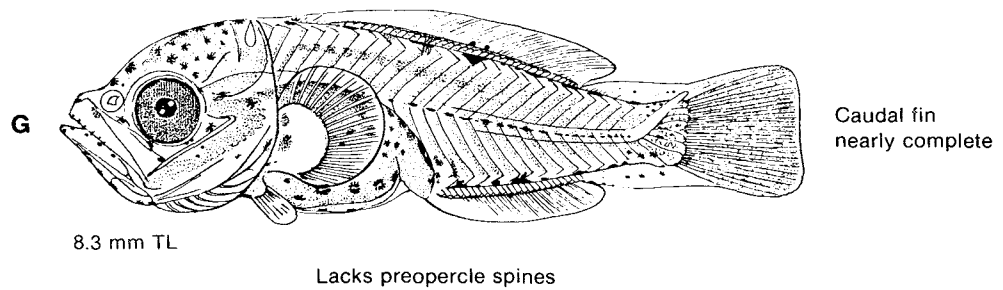
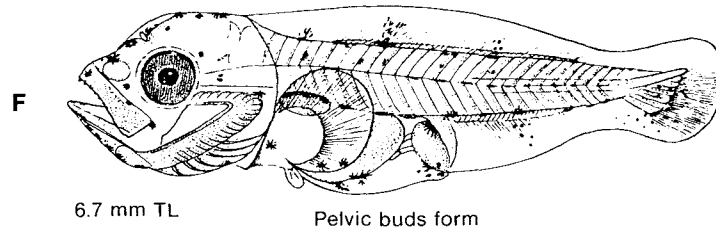
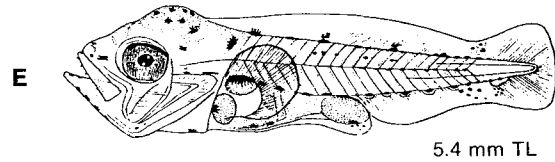
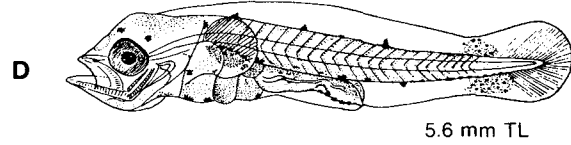
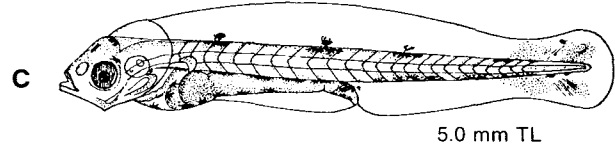
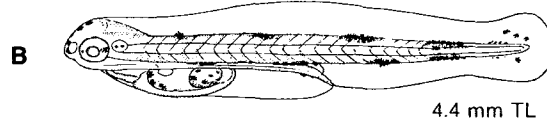
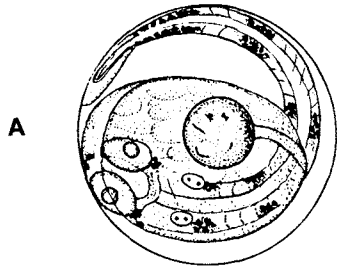
Note: Haedrich (1966) figured a 13 mm *Centrolophus niger* and an 18.5 mm *Schedophilus medusophagus*, the larvae of which are undescribed. In the 13 mm *C. niger*, all fins are apparently complete and body proportions coincide with the values given above. The body is finely speckled with no indication of bars or fin pigment, and preopercle spines are lacking. The 18.5 mm SL *S. medusophagus* (below) has a deeper body, dorsal fin origin is farther anterior, and preopercle spines are present.



Schedophilus medusophagus Cocco
 (Haedrich 1966)

Fig. — A–H, Sanzo 1932b.

Ref. — Haedrich and Horn 1969; Ahlstrom *et al.* 1976.

Centrolophus niger**CENTROLOPHIDAE**

A-H (eastern Atlantic material)

NOMEIDAE***Cubiceps pauciradiatus* (Günther)****Distribution:** Oceanic species.**Meristic features**

- Eggs** — Pelagic, spherical.
 — Diameter: 0.70–0.80 mm.
 — Shell: pinkish tan.
 — Yolk: homogeneous.
 — Oil globules: 1 (pigmented with 2 opposing patches).
 — O.G. diameter: 0.14–0.20 mm.

Myomeres: 31
 Vert : 13+17–18
 D : X–XII, I, 15–17
 A : II, 14–16
 P : 17–20
 C : 8–10+9+8+8–10

- Embryo** — Pigment patch on snout and nape, and along mid-dorsal line to tip of notochord (starts as 2 parallel lines).

- Larvae** — Hatching occurs at 1.5–2.2 mm; eyes unpigmented.
 — Flexion occurs at 3.7–4.3 mm NL.
 — Relative body proportions for preflexion and postflexion stages:

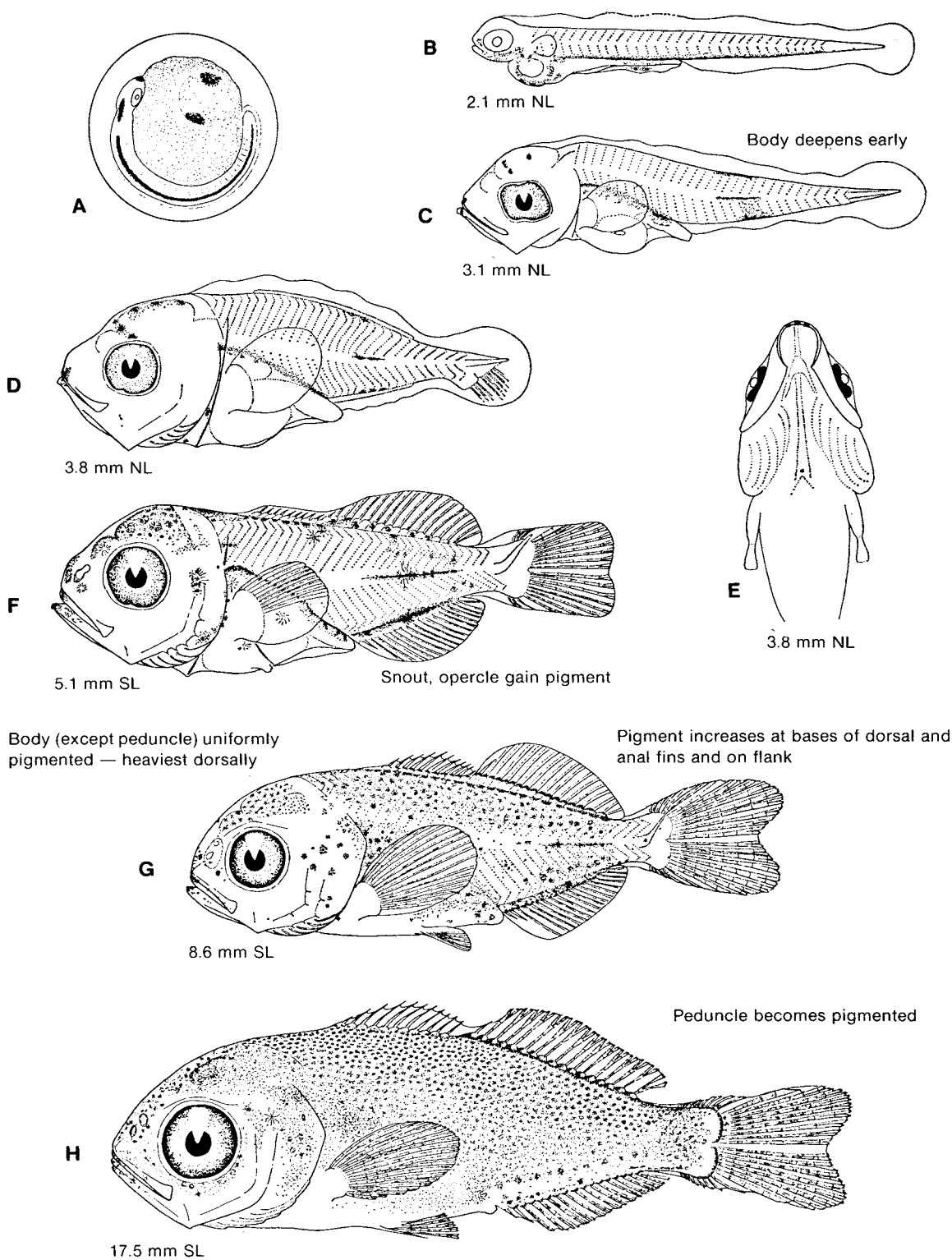
Preanus length	52–59% NL	59–65% SL
Head length	18–29% NL	31–36% SL
Body depth (at pectoral)	9–32% NL	28–38% SL
Eye diameter	32–46% HL	32–37% HL

- Weak preopercle spines (4–5) present at 5–11 mm SL.
 — Teeth begin to form at 6.2 mm SL.
 — Sizes at beginning of ossification and completion of fin rays and vertebrae:

Vertebrae	3.7 mm NL	6.2 mm SL
Caudal rays	3.7 mm NL	4.5 mm SL
Dorsal rays	4.5 mm SL	5.0 mm SL
Anal rays	4.5 mm SL	6.2 mm SL
Pectoral rays	4.5 mm SL	10.0 mm SL
Dorsal spines	5.0 mm SL	6.2 mm SL
Pelvic rays	6.2 mm SL	8.8 mm SL

- Pigmentation: dorsal line of embryonic pigment moves to ventral edge shortly after hatching; characteristic dorsal, lateral and ventral streaks at myomeres 20–23; single midventral spot anterior to cleithral symphysis (Fig. E); spots on head and body increase with development.

Fig. — A–H, Ahlstrom *et al.* 1976.**Ref.** — Butler 1979.

Cubiceps pauciradiatus**NOMEIDAE****A-H** (Pacific material)

NOMEIDAE***Nomeus gronovii* (Gmelin)****Distribution:** Oceanic species.**Meristic features****Eggs** — Undescribed.

Myomeres: 41

Larvae — Preflexion stage undescribed for the Atlantic.

Vert : 14+27

— Relative body proportions for postflexion larvae:

D : (IX)XI-XII, 24-28

A : II, 24-26(29)

P : 21-23

C : 8-9+9+8+8-9

Preamble length 56-59% SL

Head length 30-34% SL

Body depth (at pectoral) 37-41% SL

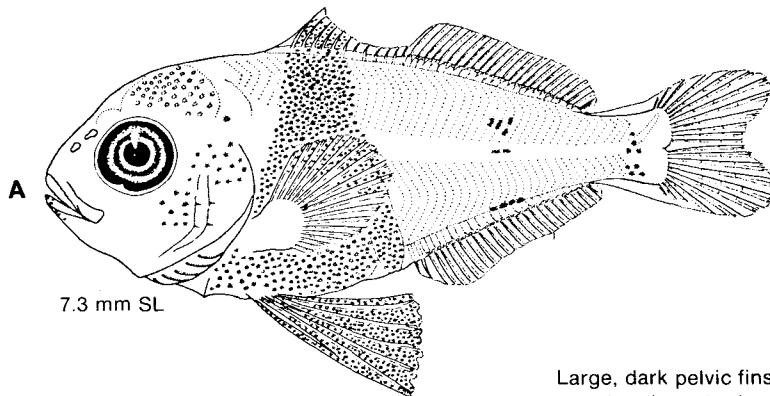
Eye diameter 38-44% HL

- Relative preamble length longer and body depth less than in *Psenes* (p. 336-339).
- Tiny preopercle spines present at 7-9 mm.
- Pigmented pelvic fins well developed (first to form).
- All fin rays and vertebrae complete by 7.3 mm.
- Pigmentation: lateral and ventral spots over midanal fin becomes a blotch under second dorsal fin; spots on hypurals become a prominent blotch; band of pigment spots extends from anterior dorsal fin to gut; nape unpigmented; juvenile is characterized by 4-banded pattern on body, large heavily-pigmented pelvic and first dorsal fins, 2 bands under first dorsal (1 in *Psenes*) and 1 band under second dorsal (2-3 in *Psenes*) which extends onto fin; hyural area well pigmented; nape develops spots; 2 small patches at base of anal fin; ventral edge of abdomen unpigmented.

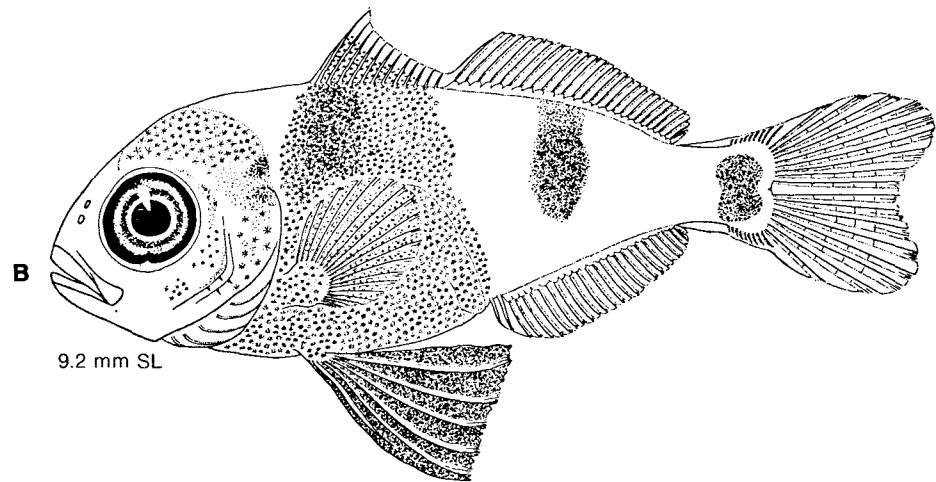
Note: *N. gronovii* of 7-8 mm may resemble *Psenes cyanophrys* (p. 338), but the latter has fewer myomeres and stockier body.

Fig. — A-C, Ahlstrom *et al.* 1976.

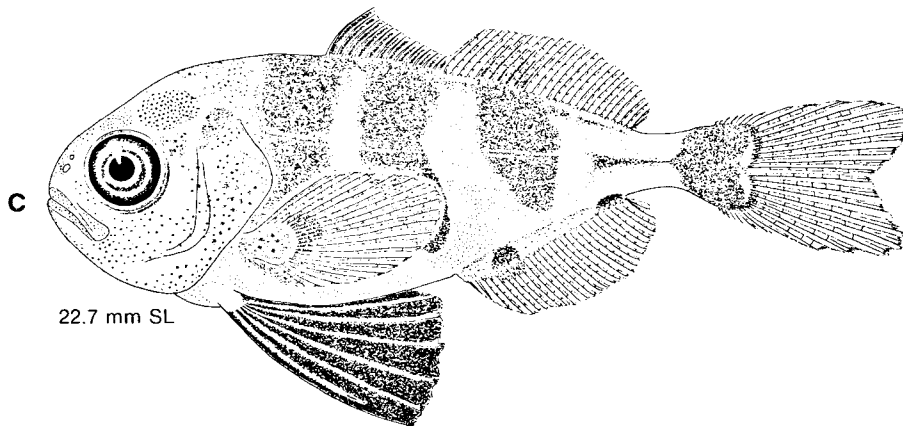
Ref. — Pertseva-Ostroumova and Rass 1973.

Nomeus gronovii**NOMEIDAE**

Large, dark pelvic fins and prominent bands on body



Anal and caudal fins unpigmented



NOMEIDAE***Psenes maculatus* Ginsburg****Distribution:** Temperate oceanic species.**Eggs** — Undescribed.

Larvae — Flexion occurs at about 4–5 mm NL.
 — Tiny, weak preopercle spines present at 5–9 mm SL.
 — Relative body proportions for preflexion and post-flexion stages:

Preanus length	47% NL	52–57% SL
Head length	29% NL	33–37% SL
Body depth (at pectoral)	32% NL	45–52% SL
Eye diameter	36% HL	34–41% HL

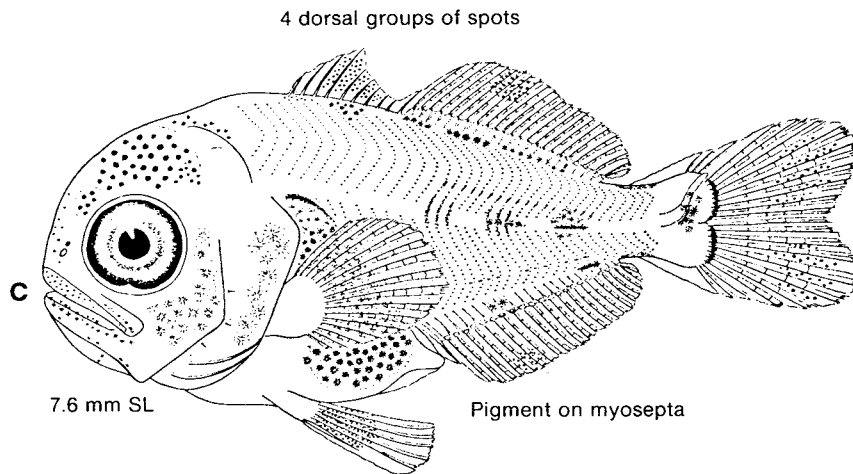
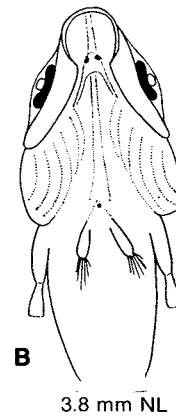
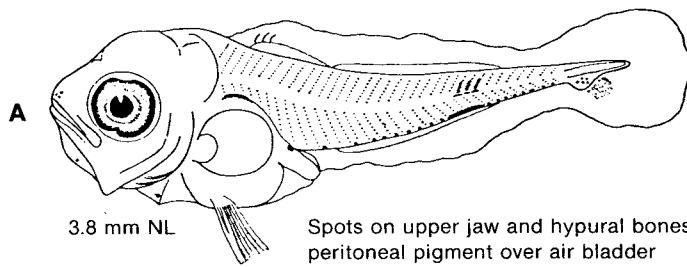
- Pelvic fin (pigmented) is well developed before flexion; dorsal spines begin to form early, but they are not elongate.
 — Sizes at beginning of ossification and completion of fin rays:

Pelvic rays	?	3.8 mm NL
Dorsal spines	<3.8 mm NL	5.8 mm SL
Caudal rays	?	5.8 mm SL
Dorsal rays	5.8 mm SL	7.8 mm SL
Anal rays	5.8 mm SL	7.8 mm SL
Pectoral rays	5.8 mm SL	9.0 mm SL

- Ossification of vertebrae complete at 5.8 mm SL.
 — Pigmentation: early larvae have row of spots along ventral edge with thicker band at myomeres 23–26; lateral spot at myomeres 25–27 with pigment spreading dorsally along myosepta; single spot near cleithral symphysis and 2 spots on isthmus (Fig. B); similar to *P. cyanophrys* but latter lacks midventral row of spots; juveniles develop 6 bands of body pigment, including the 5th on the peduncle (compare to *P. cyanophrys*, p. 338); see illustrations opposite for other pigment.

Meristic features

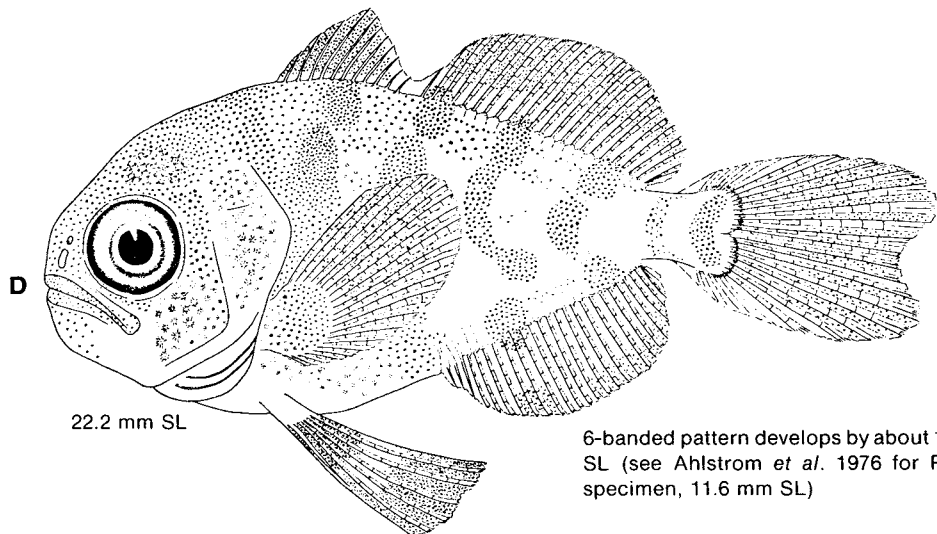
Myomeres: 34–35
 Vert : 12+23
 D : X–XI, I, 22–24
 A : III, 21–23
 P : 20–22
 C : 8+9+8+8–9

Psenes maculatus**NOMEIDAE**

Pigment at base of caudal fin
and heavy on head, jaws,
opercle and abdomen

Lateral line pigment at myomeres
18-22 and 26-28

2 ventral groups of spots over anal
rays 6-8 and 17-20



NOMEIDAE***Psenes pellucidus* Lütken****Distribution:** Oceanic species.**Meristic features**

- Eggs** — (Tentative identification).
 — Diameter: 1.14–1.28 mm.
 — Shell: brownish rose.
 — Oil globules: 1.
 — O.G. diameter: 0.24–0.28 mm.
 — Embryonic pigment heavy under head, on snout, and back of head; 3 concentrations on body, and posterior part of tail.

Myomeres: 40–42
 Vert: 13+27–29
 D: IX–XII, I, 27–32
 A: III, 26–31
 P: 16–20
 C: 8–10+9+8+8–10

- Larvae** — Flexion occurs at 5.2–5.9 mm NL.
 — Note high myomere count relative to that for *P. cyanophrys* below.
 — See tables below for morphometrics and fin formation.
 — Pigmentation: lateral groups at myomeres 2–3, 16–17, 29–32, and over peduncle.

Psenes cyanophrys* Valenciennes*Distribution:** Oceanic species.**Meristic features**

- Eggs** — Undescribed.

Myomeres: 31

- Larvae** — Flexion occurs at 3.9–4.2 mm NL.
 — Note low myomere count relative to that for *P. pellucidus* above.
 — See tables below for morphometrics and fin formation.
 — Pigmentation: early stages (Pacific) lack ventral row of postanal spots and have no spots on top of head and upper jaw; peritoneal pigment present over air bladder, lateral and ventral streaks at about myomeres 20–23, and a spot under notochord tip; during flexion, lateral and notochord tip pigment spreads dorsally, becomes heavy after flexion.

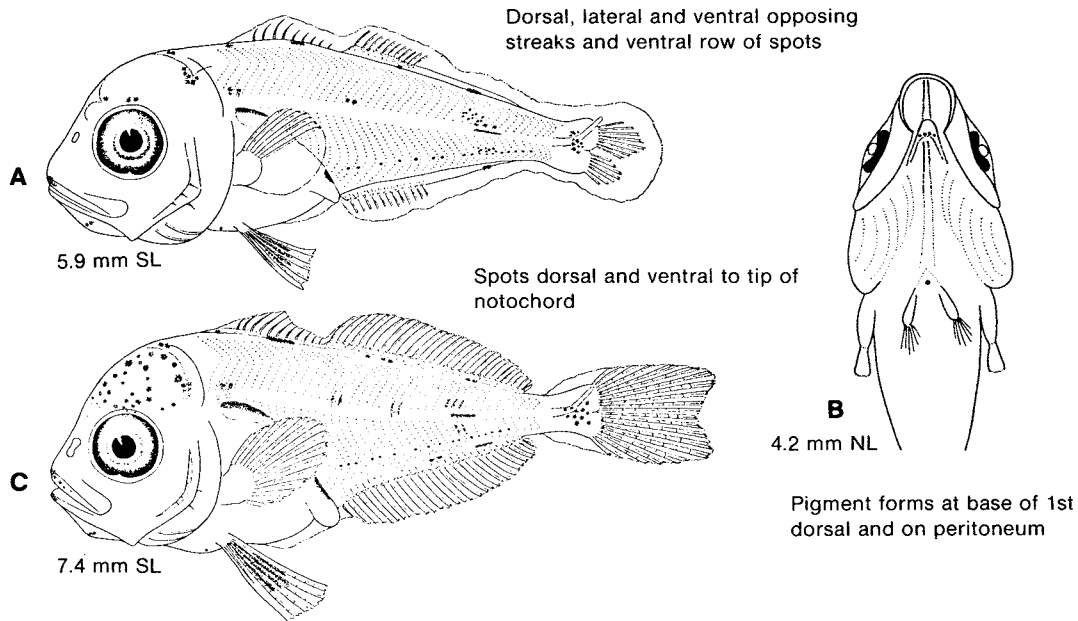
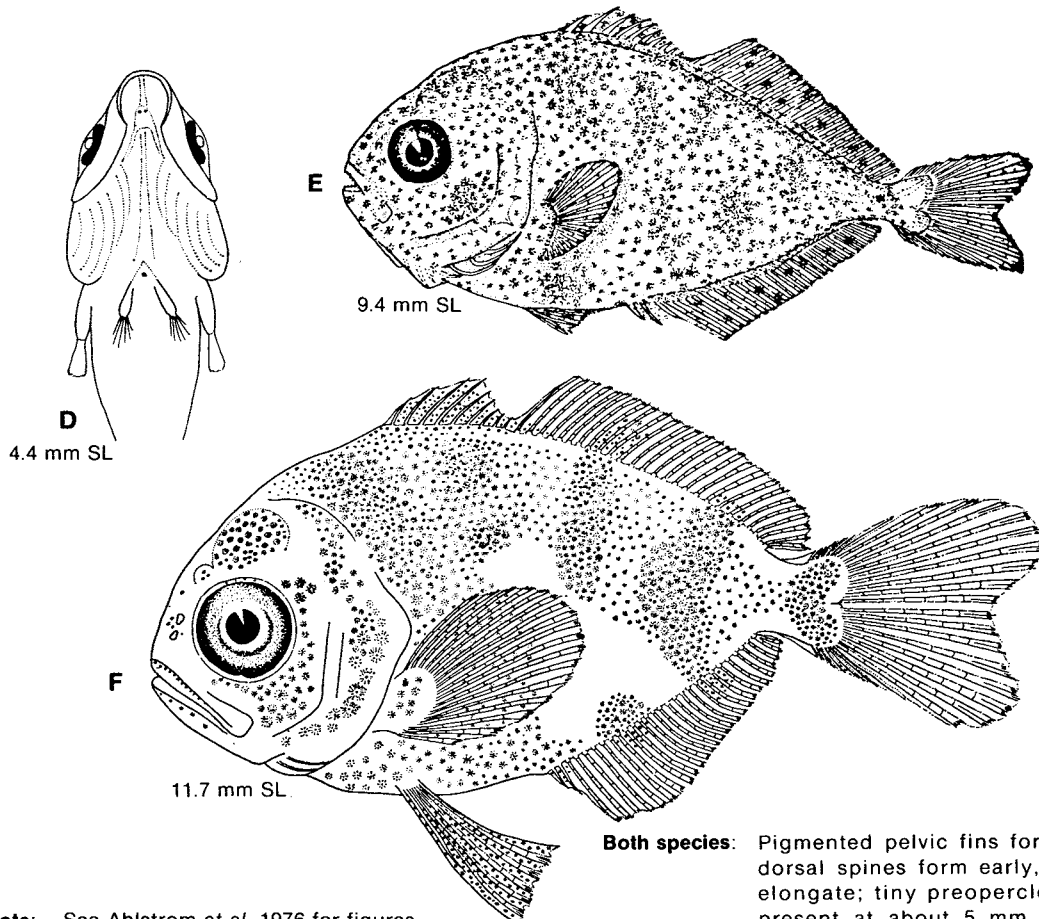
Vert: 12+19
 D: IX–X, I, 23–28
 A: III, 23–28
 P: 17–20
 C: 7–9+9+8+7–9

Morphometrics and Fin Formation

	<i>P. pellucidus</i>		<i>P. cyanophrys</i>	
	Preflexion	Postflexion	Preflexion	Postflexion
Preanus length	39–45% NL	46–53% SL	48–54% NL	50–59% SL
Head length	24% NL	27–33% SL	24–27% NL	31–39% SL
Body depth	20–24% NL	43–57% SL	24–29% NL	44–55% SL
Eye diameter	37–40% HL	35–44% HL	39–42% HL	37–47% HL

	<i>P. pellucidus</i>		<i>P. cyanophrys</i>	
	Begin to ossify	Complete	Begin to ossify	Complete
Pelvic rays	?	3.8 mm NL	2.7 mm NL	3.6 mm NL
Dorsal spines	5.2 mm NL	<9.7 mm SL	3.6 mm NL	4.7 mm SL
Dorsal rays	5.2 mm NL	<9.7 mm SL	4.2 mm SL	4.7 mm SL
Pectoral rays	5.2 mm SL	<9.7 mm SL	4.7 mm SL	9.7 mm SL
Caudal rays	5.9 mm SL	9.7–10.0 mm SL	4.2 mm SL	4.7 mm SL
Anal rays	5.9 mm SL	9.7–10.0 mm SL	4.2 mm SL	4.7 mm SL
Anal spines	5.5 mm SL	>12.0 mm SL	4.2 mm SL	6.9 mm SL
Vertebrae	5.5 mm SL	12.0 mm SL	3.6 mm SL	4.7 mm SL

Fig. — A–D, F, Ahlstrom *et al.* 1976; E, Legaspi 1956.

Psenes pellucidus**NOMEIDAE*****Psenes cyanophrys***

Both species: Pigmented pelvic fins form early; dorsal spines form early, but not elongate; tiny preopercle spines present at about 5 mm, become embedded at about 9 mm.

Note: See Ahlstrom *et al.* 1976 for figures of early stages from the Pacific

ARIOMMIDAE***Ariomma* sp.**

- Species** — The oceanic and coastal genus *Ariomma* is represented in the western North Atlantic by a deep-bodied species, *A. regulus*, and two closely-related, more elongate species, *A. bondi* and *A. melanum* (Haedrich and Horn 1972; Horn 1972).
- McKenney (1961) in his description of *A. regulus* larvae, acknowledged that both the deep-bodied form and one or both of the elongate forms were included in his series. Examination of the illustrations and body depth measurements in table 2 of McKenney (1961) indicates that the 7.0 and 39.7 mm specimens, as well as four other specimens (46.0–120.5 mm), may represent the deep-bodied form, whereas the remaining examples may represent developing elongate ariommids.
- Pigment** — As many as 6 bars from dorsal fin origin to caudal fin base (may be broken into blotches).
- No pigment on abdomen and ventrum of head.
- Pelvic fin pigment gradually acquired (none at 5.3 mm).
- Dorsal spines pigmented in larvae >10 mm, becoming denser with development.

Meristic and other characters of adults

	<i>A. regulus</i> (Poey)	<i>A. melanum</i> (Ginsburg)	<i>A. bondi</i> Fowler
Vertebrae	30–32	30–31	30–31
Dorsal fin	XI–XII, 14–15	XI, 15–18	XI, 14–17
Anal fin	III, 14–15 (total 17–18)	III, 13–16 (total 16–19)	III, 12–16 (total 15–19)
Pectoral fin rays	21–24	21–23	20–23
Body depth	>33% SL	<28% SL	<28% SL
Lateral line scales		50–65	30–45
Depth range (m)		200–600	<200

Comparison with other larvae

- Nomeus* — Larger and darker pelvic fins, anterior dorsal spines longest, and more myomeres (p. 334).
- Psenes* — Ventrums of head pigmented, and pelvic fins pigmented early (p. 336, 338).
- Cubiceps* — Slimmer body, and late-forming pelvic fins (p. 332).
- Centrolophus* — Slimmer body, fewer myomeres, and late forming pelvic fins (p. 330).
- Tetragonurus* — Slimmer body, more myomeres, long peduncle, and late-forming pelvic fins (p. 342).

Fig. — A–E, McKenney 1961.

Ref. — Haedrich 1968; Haedrich and Horn 1972; Horn 1972.

Ariomma* sp.*ARIOMMIDAE**

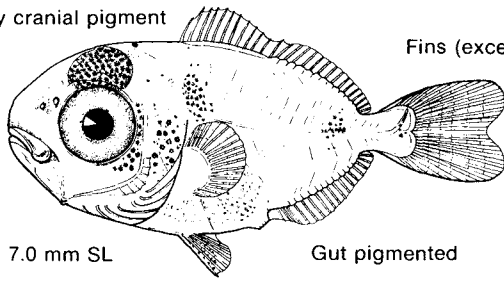
Heavy cranial pigment

Fins (except pelvic) unpigmented

A

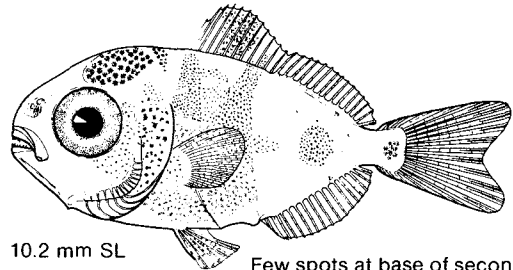
7.0 mm SL

Gut pigmented

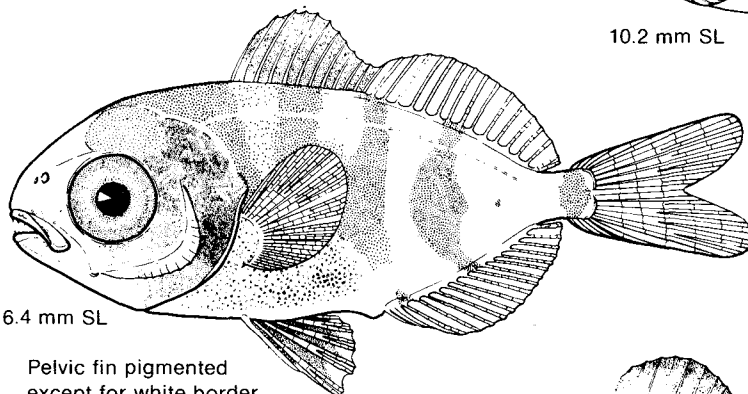
**B**

10.2 mm SL

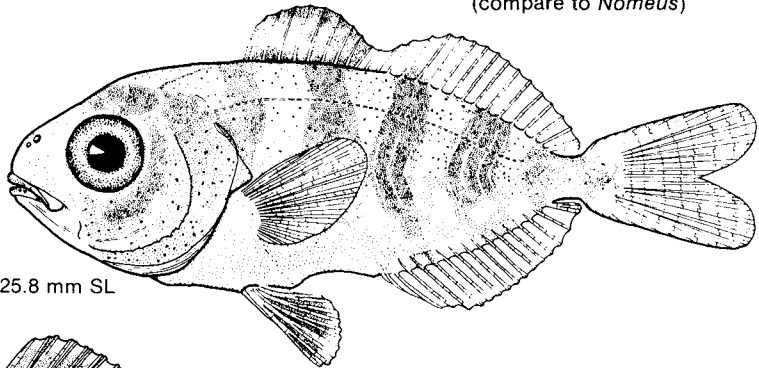
Few spots at base of second dorsal and anal fins

**C**

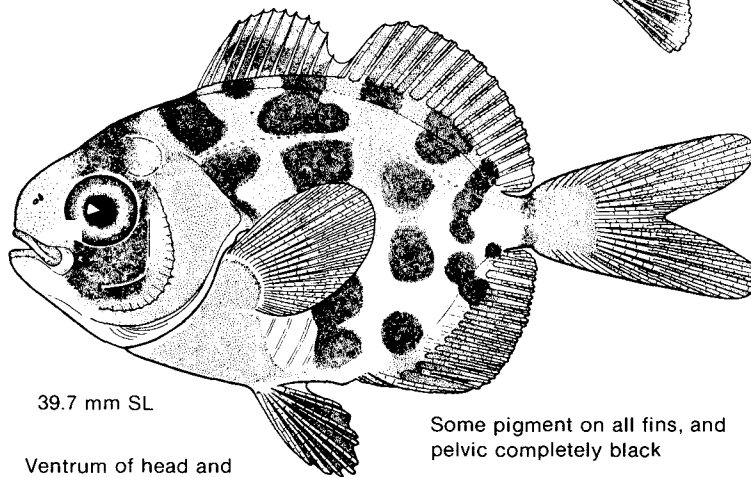
16.4 mm SL

Pelvic fin pigmented
except for white borderMiddle dorsal spines longest
(compare to *Nomeus*)**D**

25.8 mm SL

**E**

39.7 mm SL

Ventrums of head and
abdomen unpigmentedSome pigment on all fins, and
pelvic completely black

Preopercle weakly serrate

TETRAGONURIDAE***Tetragonurus atlanticus* Lowe**

Distribution: Oceanic species.

Spawning: Winter-spring in Sargasso Sea and Caribbean Sea.

Meristic features

- Eggs**
- Pelagic, spherical.
 - Diameter: 1.10 mm.
 - Shell: smooth (golden-pink).
 - Yolk: homogeneous.
 - Oil globules: 1.
 - O.G. diameter: 0.24 mm.
 - Perivitelline space: moderate.
 - Embryonic pigment similar to 3.0 mm NL larva plus patch on snout.
- Larvae**
- Gut long and straight, and peduncle long.
 - Flexion occurs at about 5–8 mm NL.
 - Relative morphometric characters during preflexion and postflexion stages:

Myomeres: 45–48
 Vert: 45–48
 D: XIV–XVII, 10–13
 A: I, 9–12
 P: 14–18
 C: 9–10+9+8+9–10

Preanus length	63–69% NL	64–71% SL
Head length	14–26% NL	30–35% SL
Body depth (at pectoral)	13–20% NL	24–28% SL
Eye diameter	24–48% HL	29–34% HL

- Tiny preopercle spines present from about 7 mm to juvenile stage.
- Sizes at beginning of ossification and completion of fin rays:

Caudal rays	7.2 mm NL*	8.6 mm SL
Dorsal and anal rays	7.2 mm NL*	8.6 mm SL
Dorsal spines	~8.0 mm SL	10.5 mm SL
Pectoral rays	8.0 mm SL	13.2 mm SL
Pelvic rays (bud at 6 mm)	8.5 mm SL	13.2 mm SL

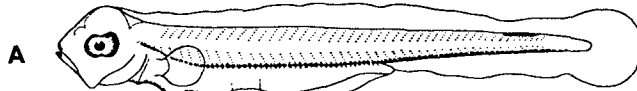
* 5.3 mm SL according to Grey (1955).

- Dorsal spines shorter than rays; dorsal fin origin over middle or anterior half of pectoral fin.
- Anal fin origin slightly posterior to 2nd dorsal fin origin; pelvic fin origin under pectoral fin base.
- Pigmentation: Tip of tail (preflexion) and peduncle (postflexion) unpigmented; dorsal pigment confined to last 8–12 myomeres through flexion; conspicuous line of pigment on upper gut and ventral edge of tail during preflexion.

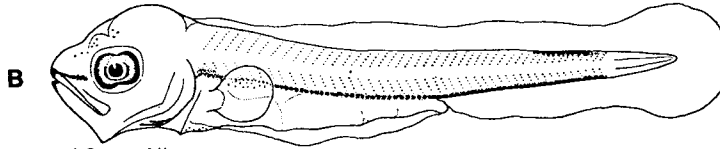
- Note:**
- (1) Egg description based on Pacific material.
 - (2) Larvae of *T. cuvieri* (eastern Atlantic) are more elongate and relatively less developed at similar sizes than *T. atlanticus*; they have pigment on tip of notochord and on peduncle; myomeres = 51–57.

Tetragonurus atlanticus

TETRAGONURIDAE

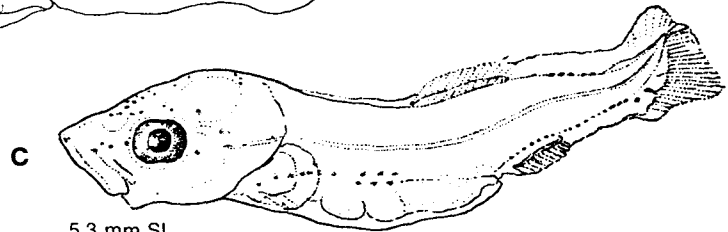


3.0 mm NL

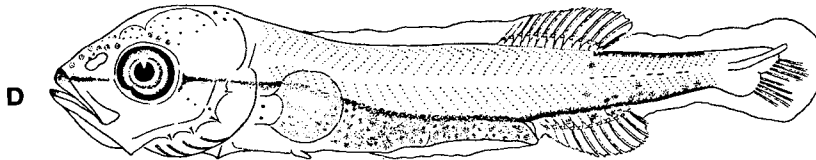


4.6 mm NL

Line of pigment from snout
to anterior eye

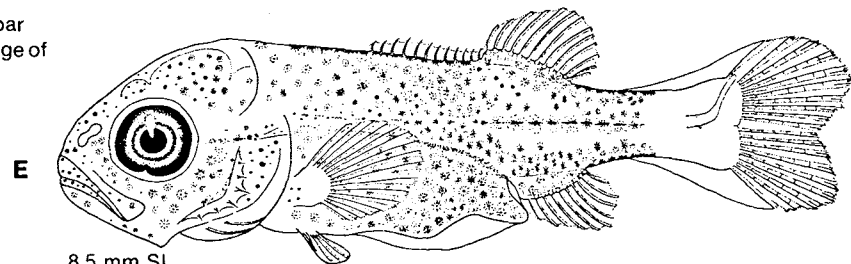


5.3 mm SL



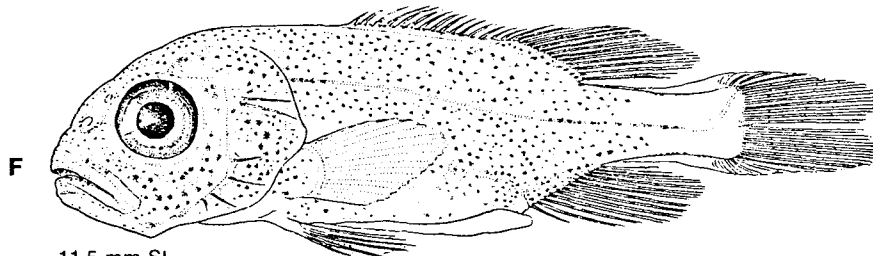
7.6 mm SL

Scattered head spots; bar
forms through eye to edge of
opercle



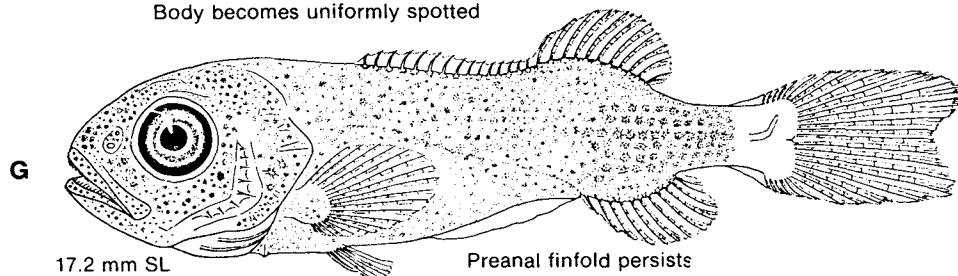
8.5 mm SL

Dorsal pigment spreads anteriorly



11.5 mm SL

Body becomes uniformly spotted



17.2 mm SL

Preanal finfold persists

A, B, D, E, G (Pacific material)

STROMATEIDAE***Peprilus triacanthus* (Peck)**

Spawning: Summer along the coasts of Middle Atlantic Bight and Gulf of Maine (coastal species).

Eggs — Pelagic, spherical.
 — Diameter: 0.68–0.82 mm.
 — Shell: smooth and transparent.
 — Yolk: homogeneous and unpigmented (amber).
 — Oil globules: 1 (usually).
 — O.G. diameter: 0.17–0.21 mm.
 — Perivitelline space: narrow.

Larvae — Hatching occurs at 1.68–1.75 mm TL; eyes unpigmented.
 — Body deepens early in development; preanus length about 50% TL; small terminal mouth.
 — Tiny opercle spines (3) present at about 7 mm (not illustrated).
 — Dorsal and anal fin rays begin to form at about 5 mm, and complete at 12–18 mm; no pelvic fins.
 — Pigmentation: row of postanal spots ventrally; spots develop on top of head and on opercle margin; ventral margin of gut pigmented (like a solid line of “stitching”).

Meristic features

Myomeres: 32(30–33)
 Vert : 13+17–20
 D : II–IV, 40–48
 A : II–III, 37–44
 Plv : None
 P : 17–22
 C : 7–9+9+8+7–8

***Peprilus alepidotus* (Linnaeus)
 (= *Peprilus paru*)**

Spawning: Delaware Bay to Brazil (coastal species).

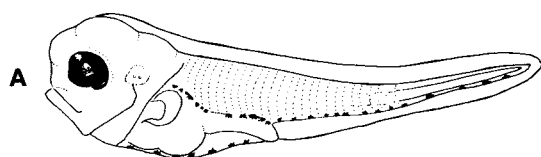
Larvae — Note pigment on body in early larvae; trunk heavily pigmented in later larvae (7 mm), but lacks ventral row of spots present in *P. triacanthus*.

Meristic features

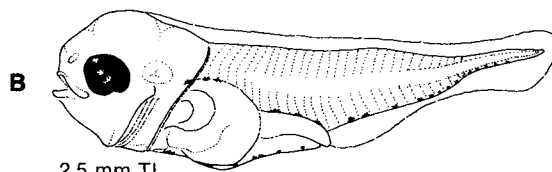
Myomeres: 30(29–31)
 Vert : (12)13+16–18
 D : II–IV, 38–47
 A : II–III, 35–45
 Plv : None
 P : 18–24
 C : 7–9+9+8+7–8

Fig. — A–E, Lippson and Moran 1974; F–I, Pearson 1941 (A–H redrawn).

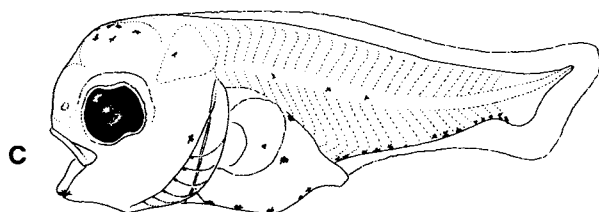
Ref. — Colton and Honey 1963; Horn 1970; Ditty MS 1981.

Peprilus triacanthus**STROMATEIDAE**

2.3 mm TL

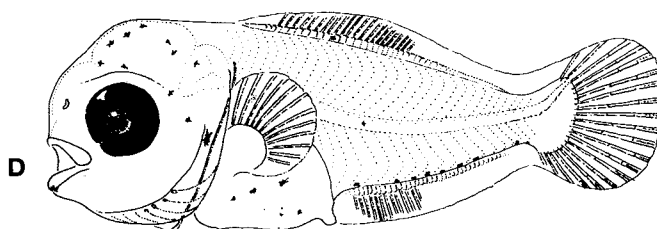


2.5 mm TL

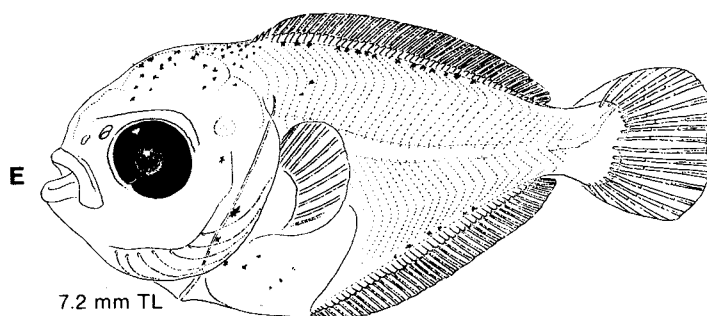


3.8 mm TL

Ventral spots separate, not 1 per
myomere as in *Stenotomus*
chrysops (p. 264)



4.5 mm TL



7.2 mm TL

Peprilus alepidotus

1.8 mm TL



3.5 mm TL



2.5 mm TL



7.0 mm