

Aulopiformes

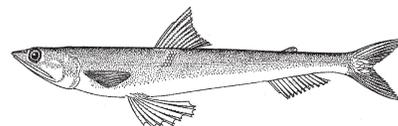
Selected pigment and meristic characters in species belonging to the order Aulopiformes whose adults or larvae have been collected in the study area. Classification and sequence follow Baldwin and Johnson (1996). Primary sources for meristic characters: Hartel and Stiassny, 1986; R.K. Johnson, 1984a; 1984b; 1984c; McEachran and Fecchelm, 1998; Post, 1984a; 1984b; 1984c; 1984d; Rofen, 1966a; 1966b; 1966c; 1966d; 1966e; Sulak, 1977, 1984a, 1984b, 1984c. See species accounts for other sources.

Family <i>Species</i>	Peritoneal Pigment Patches in Larvae	Total Vertebrae	Dorsal Fin Rays	Anal Fin Rays	Pelvic Fin Rays	Pectoral Fin Rays
Synodontidae						
<i>Synodus foetens</i>	6 ventrolateral pairs	56–64	9–13	10–14	8	12–15
<i>Synodus synodus</i>	12–13 pairs	54–57	12–14	8–10	8	11–12
<i>Synodus poeyi</i>	6 pairs	44–46	10–12	9–12	8	10–12
<i>Trachinocephalus myops</i>	6 pairs	54–58	11–13	14–16	8	11–13
Chlorophthalmidae						
<i>Chlorophthalmus agassizi</i>	1 unpaired	47	10–11	7–9	8–9	15–17
<i>Parasudis truculenta</i>	1 unpaired	38–39	10	8–9	9	15–17
Notosudidae						
<i>Ahliesaurus berryi</i>	None	47–50	10–11	19–21	9	10–11
<i>Scopelosaurus argenteus</i>	None	54–57	12–13	17–18	9	12–14
<i>Scopelosaurus lepidus</i>	None	58–61	10–12	17–19	9	13–15
<i>Scopelosaurus maui</i>	None	55–57	10–11	17–20	9	12–13
<i>Scopelosaurus smithii</i>	None	53–56	10–12	17–19	9	11–14
Ipnopidae						
<i>Bathypterois dubius</i>	"Many" 12–20?	61–65	15–16	8–10	8	11–13
<i>Bathypterois grallator</i>	"Many" 12–20?	53–54	12–13	12–13	8	7–10
<i>Bathypterois longipes</i>	None	52–55	12–14	9–10	8–9	11–13
<i>Bathypterois phenax</i>	"Many" 12–20?	53–56	13–15	8–10	9	9–11
<i>Bathypterois quadrifilus</i>	"Many" 12–20?	54–59	12–15	8–9	9	10–12
<i>Bathypterois viridensis</i>	None	50–52	12–13	10–12	8	12–13
<i>Bathyptherops marionae</i>	1	62–65	12–13	13–14	8	12–15
<i>Ipnops murrayi</i>	None	54–61	9	14	8	13
Alepisauridae						
<i>Alepisaurus breviostris</i>	2 distinct sections, overlain by external pigment on abdomen	~50	36–48	13–18	8–10	12–14
<i>Alepisaurus ferox</i>	1 indistinct	47–52	36–45	14–18	8–10	12–15
<i>Omosudis lowei</i>	3 closely spaced	39–41	9–11	13–14	8	12–13

Most fishes in the order Aulopiformes are mesopelagic or demersal in deep waters, although some synodontids occur in shallow, coastal waters. They are usually elongate and compressed, and most have large eyes, modified (tubular) in some families. The large mouths are usually armed with large teeth, although these are lacking in the Notosudidae. Myomere counts range from 36 to >120 in *Stemonosudis*. Head spines only occur in *Alepisaurus*, *Omosudis* and *Sudis*. In all aulopiform larvae, the gut elongates and the anus shifts posteriorly during ontogeny, and this shift is most pronounced in *Stemonosudis*. Almost all aulopiform larvae have peritoneal pigment patches ranging from one to 18 (in *Stemonosudis*). The numbers of these patches increase with development in the Paralepididae. Larvae of Notosudidae and a few unrelated species lack peritoneal pigment. See Paralepididae Introduction pages for more information on ontogeny.

Aulopiformes

Family Species	Peritoneal Pigment Patches in Larvae	Total Vertebrae	Dorsal Fin Rays	Anal Fin Rays	Pelvic Fin Rays	Pectoral Fin Rays
Paralepididae						
<i>Anotopterus pharao</i>	Pigment spreads along dorsal surface of gut	78–83	None	14–16	9–11	12–15
<i>Arctozenus risso</i>	1 to 12	80–85	8–11	31–34	8–12	10–13
<i>Lestidiops affinis</i>	2 to 12	75–85	8–10	27–30	9	10–12
<i>Lestidiops jayakari</i>	2 to 12	76–85	10	27–31	9	11–12
<i>Lestidium atlanticum</i>	4 to 8 then fade	80–83	9–10	29–30	9	12
<i>Lestrolepis intermedia</i>	1 to 8	91–93	9	41–42	9	11
<i>Macroparalepis affinis</i>	2 to 12	96–103	10–14	25–28	9	11
<i>Macroparalepis brevis</i>	4 to 7	81–86	11–13	19–24	9	11
<i>Magnisudis atlantica</i>	1 to 3	63–66	9–11	20–26	9–10	15–17
<i>Paralepis brevirostris</i>	4–9	64–67	10–12	22–24	9	16–17
<i>Paralepis coregonoides</i>	1 to 9	68–74	9–11	22–26	9	14–15
<i>Paralepis elongata</i>	3 to 11–12	65–67	10–12	20–25	9	15–17
<i>Stemonosudis intermedia</i>	16–18	111–121	9–10	41–47	8–9	11–12
<i>Stemonosudis rothschildi</i>	7–11	86–91	8–9	31–34	9	10–12
<i>Sudis atrox</i>	3 to 10	53–54	11	21	9	14
<i>Sudis hyalina</i>	4 to 7	59–60	13	21–23	9	14–15
<i>Uncisudis advena</i>	5 to 7	75–78	9–10	30–31	9	12–13
Evermannellidae						
<i>Coccorella atlantica</i>	3	48–50	10–13	26–30	9	11–13
<i>Evermannella balbo</i>	3	52–54	12–13	34–35	9	11–12
<i>Evermannella indica</i>	3	49–50	12	27–29	9	11–12
<i>Odontostomops normalops</i>	13–15	48–52	11–13	30–35	9–10	11–13
Scopelarchidae						
<i>Benthalbella infans</i>	None	55–58	8–10	19–25	9	24–28
<i>Scopelarchoides danae</i>	1 unpaired + 2 pairs	48–50	7–8	24–27	9	20–22
<i>Scopelarchus analis</i>	1 unpaired + 2 pairs	44–49	7–9	21–26	9	18–22
<i>Scopelarchus michaelisarsis</i>	1 unpaired + 2 pairs	40–44	7–9	18–21	9	18–21
Bathysauridae						
<i>Bathysaurus ferox</i>	6 unpaired	60–63	16–18	11–13	8	15–16
<i>Bathysaurus mollis</i>	6 unpaired	50–52	15–17	11–13	8	16–17
Giganturidae						
<i>Gigantura indica</i>	1 unpaired	30	16–19	11–14	0	36–42

Synodus foetens* (Linnaeus, 1766)*Synodontidae****Inshore lizardfish**

Range: Western North Atlantic Ocean from Massachusetts and Bermuda through the Gulf of Mexico and Caribbean Sea to Brazil; most common south of the Carolinas

Habitat: Demersal in coastal waters, bays, estuaries and lagoons in depths from near shore to 183 m; most common in shallow water on sandy substrates

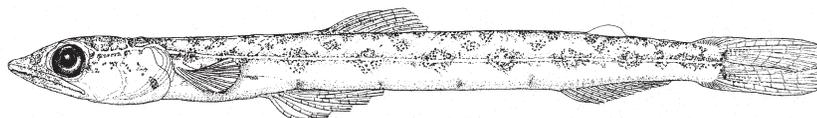
Spawning: Reproductive patterns poorly understood; larvae most commonly occur along the edge of the continental shelf and are probably transported (*via* Gulf Stream) into study area from spawning south of Cape Hatteras; larval occurrences from Mar–Oct indicate prolonged season

Eggs: – Undescribed

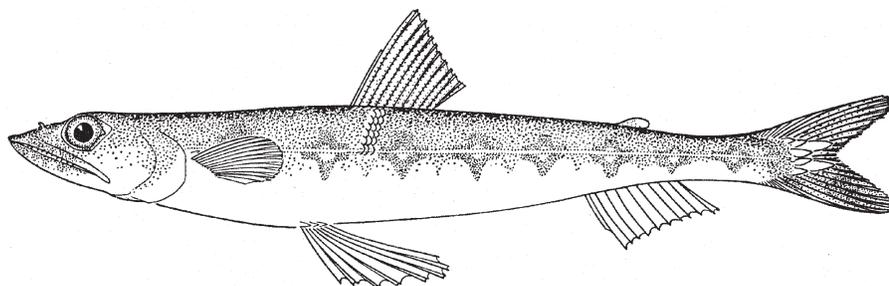
Larvae:

- Elongate body with long gut and pointed head
- Preanus length 72–75% SL
- Mouth large, extending well posterior to eye
- Adipose fin present
- Preanal finfold does not persist as long as it does in *Trachinocephalus*
- Pigmentation includes 6 evenly spaced peritoneal pigment patches; these become prominent ventrolateral external spots; row of smaller melanophores along anal fin base
- Transformation occurs at relatively large size (32–40 mm)

Note: 1. Cross-shaped pigment accumulations occur along midline in juveniles (Figs. D–E)

Early Juveniles:

D. 35.4 mmSL Settlement to bottom occurs at 30–40 mm; often in estuarine habitats



E. 57.0 mmTL

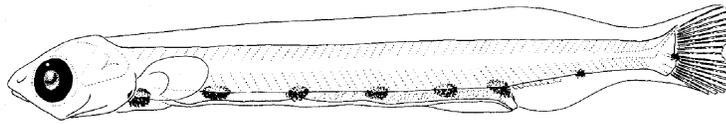
Meristic Characters

Myomeres:	56–61
Vertebrae:	56–64
Dorsal fin rays:	9–13
Anal fin rays:	10–14
Pectoral fin rays:	12–15
Pelvic fin rays:	8
Caudal fin rays:	9–16+10+9+9–14

Figures: Adult: Jack Gehringer (Anderson *et al.*, 1966); **A–B:** Mansueti and Hardy, 1967 (redrawn); **C, E:** Jack Gehringer (Anderson *et al.*, 1966); **D:** Susan Kaiser (Able and Fahay, 1998)

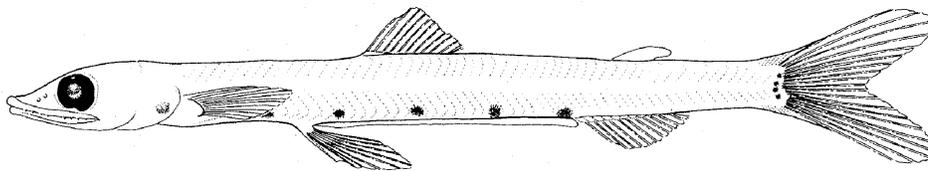
References: Gibbs, 1959; Anderson *et al.*, 1966; Able and Fahay, 1998

Synodus foetens

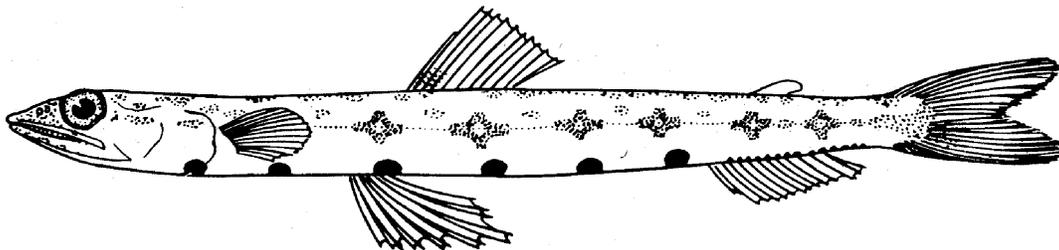


A. 10 mmTL Skin may be inflated in larvae <10 mm

Fin rays may be complete in larvae as small as 10 mm



B. 35.0 mmTL Note adipose fin, flat head and large mouth



C. 40.0 mmTL

Synodus synodus* (Linnaeus, 1758), *Synodus poeyi* Jordan, 1887*and species of *Saurida*****Synodontidae**

Range: These species occur in the western North Atlantic Ocean, mostly in tropical and subtropical waters south of 35°N. *Synodus synodus* also occurs in the eastern Atlantic. They are included here because of the potential for their larvae to drift into the study area *via* the Gulf Stream.

Habitat: Demersal on continental shelf; less common in nearshore habitats

Spawning: Undescribed; a *S. synodus* larva (35.8 mm SL) has occurred on Scotian Shelf in Aug (Markle *et al.*, 1980).

Eggs: – Undescribed

Larvae: – Larvae of *Synodus synodus* and *S. poeyi* are not well known, although juveniles of both have been described. Larvae of *Saurida* have been collected in the study area, but have not been identified to the species level (several MCZ collections). Unlike larvae of *Synodus* and *Trachinocephalus*, *Saurida* larvae lack a persistent preanal finfold during ontogeny. Juveniles of 3 species have been illustrated

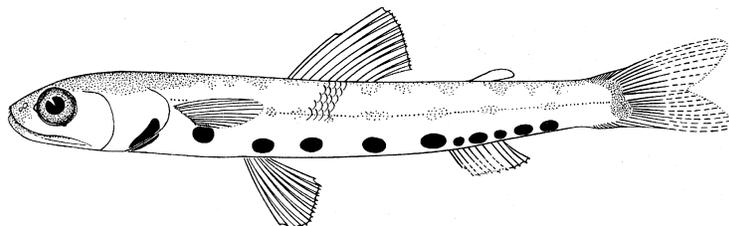
– Meristic characters in 3 species of *Saurida*.

Meristic Characters

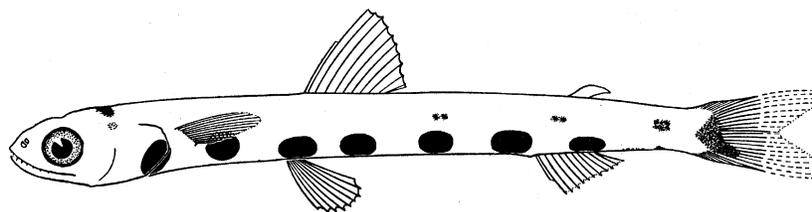
see table below for
3 species of *Saurida*
and Aulopiformes
Introductory table for
2 *Synodus* species

Species	Total Vertebrae	Dorsal Fin Rays	Anal Fin Rays	Pelvic Fin Rays	Pectoral Fin Rays
<i>Saurida brasiliensis</i>	44–50	9–12	10–13	9	11–13
<i>Saurida normani</i>	49–55	10–12	9–11	9	13–14
<i>Saurida suspicio</i>	51–53	10–11	10–12	9	11–12

Note: 1. In juveniles of *Saurida* (below) pigment includes large melanophores over anal fin base. Compare to pattern of small, evenly spaced spots over the anal fin in *Synodus* larvae and juveniles



I. *Saurida brasiliensis* juvenile, 25.0 mmSL

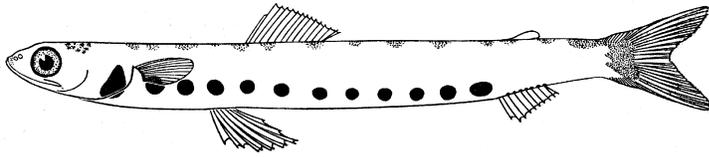


J. *Saurida suspicio* juvenile, 27.0 mmSL

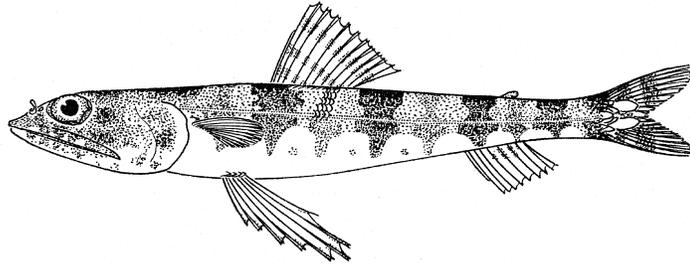
Figures: A–C, I–J: Jack Gehringer (Anderson *et al.*, 1966); D–H: Gibbs, 1959

References: Gibbs, 1959; Anderson *et al.*, 1966; Markle *et al.*, 1980; Ozawa, 1986a

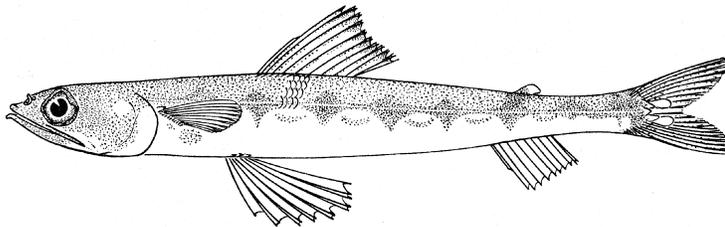
Synodus synodus, *S. poeyi*
and species of *Saurida*



A. *Synodus synodus* juvenile, 37.0 mmSL



B. *Synodus synodus* juvenile, 43.0 mmSL



C. *Synodus poeyi* juvenile, 81.5 mmSL

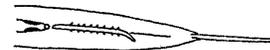
Ventral pigment patterns along the gut and over the anal fin base are helpful in identifying juveniles:



Ventral view
of anal fins



D. *Synodus synodus* 32 mm

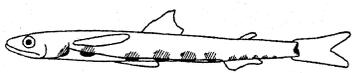


E. *Synodus poeyi* 29 mm

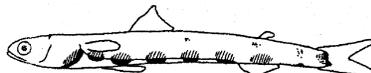
Note series of 12 large spots along gut
Both species have series of small, evenly spaced melanophores along base of anal fin

Note series of 6 large spots along gut

In early stages of *Saurida* species, note enlarged melanophores along anal fin base, continuations of series along gut



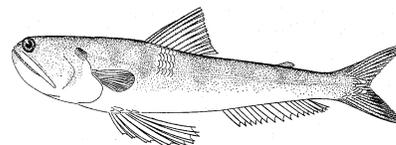
F. *Saurida brasiliensis* 25 mm



G. *Saurida normani* 27 mm



H. *Saurida suspicio* 35m

Trachinocephalus myops* (Forster, 1801)*Synodontidae****Snakefish**

Range: Worldwide in warm oceanic waters (except absent from eastern Pacific Ocean); in the western North Atlantic from Cape Cod to Brazil; larger larvae and juveniles occur as far north as Scotian Shelf

Habitat: Demersal in depths to 387 m, most commonly in middle continental shelf depths; often occur on reefs; larger larvae and juveniles occur in the neuston

Spawning: Not well described; probably summer-fall, but possibly more prolonged

Eggs:

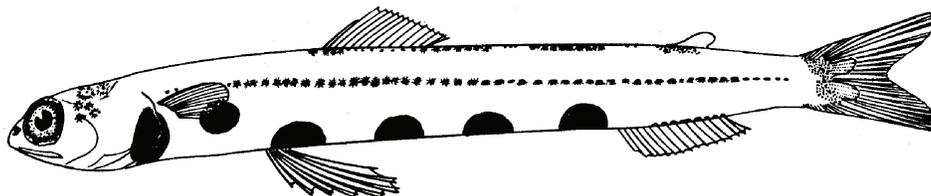
- Pelagic, spherical
- Diameter: 0.95–1.25 mm
- Chorion with hexagonal sculpting
- Oil globule: none
- Yolk: homogeneous
- Perivitelline space: narrow

Larvae:

- Hatching occurs at length of 3.7–4.0 mm; eyes unpigmented
- Body elongate with long gut
- Preanus length about 66% SL
- Blunt, rounded snout
- Anal and caudal fin rays form before dorsal
- Prominent adipose fin present; preanal finfold persists well into larval period
- Pigment includes series of 6 prominent spots (only 4 in early larvae) along dorsal aspect of gut, last one over anus; cluster of small melanophores scattered over mid-tail becomes prominent spot at end of anal fin; cluster of spots at base of adipose fin becomes first of series along dorsum of body; prominent blotch of pigment at base of caudal fin; row of discrete melanophores forms along mid-line in larvae, becomes pronounced in juveniles

Early Juvenile: Pigment along base of anal fin consists of pairs of small, superficial melanophores in juveniles

Meristic Characters	
Myomeres:	54–58
Vertebrae:	54–58
Dorsal fin rays:	11–13
Anal fin rays:	14–16
Pectoral fin rays:	11–13
Pelvic fin rays:	8
Caudal fin rays:	9–16+10+9+9–14

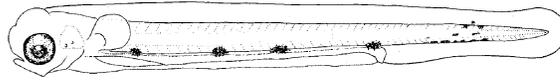


G. 42.5 mmSL

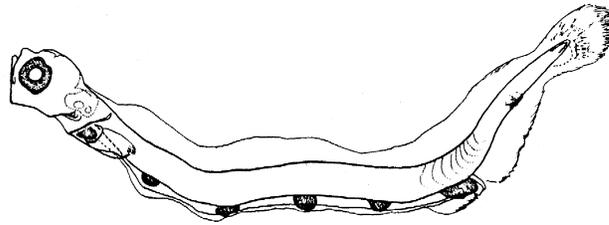
Figures: Adult: Jack Gehring (Anderson *et al.*, 1966); A: Mito, 1961a (redrawn); B–D: Ozawa, 1986a; E: Okiyama, 1974 (redrawn); F: Zvjagina, 1965; G: Anderson *et al.*, 1966

References: Gibbs, 1959; Anderson *et al.*, 1966; Markle *et al.*, 1980; Ozawa, 1986a

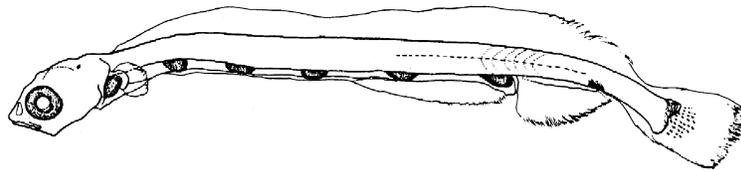
Trachinocephalus myops



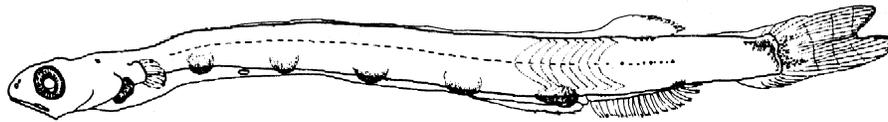
A. 4.0 mmTL



B. 7.0 mmSL



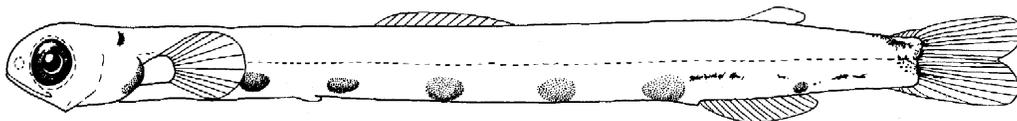
C. 11.0 mmSL



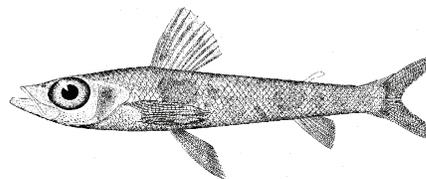
D. 17.0 mmSL



E. 19.8 mmSL



F. 21.3 mmSL

Chlorophthalmus agassizi* Bonaparte, 1840*Chlorophthalmidae****Shortnose greeneye**

Range: Tropical and warm-temperate Atlantic Ocean; in the western North Atlantic from Sable Island Bank (Scotian Shelf) to Suriname

Habitat: Demersal on mud and clay bottoms in depths of 50–1,000 m

Spawning: Hermaphroditic, otherwise undescribed; larvae collected throughout the year

Eggs: – Undescribed

Larvae:

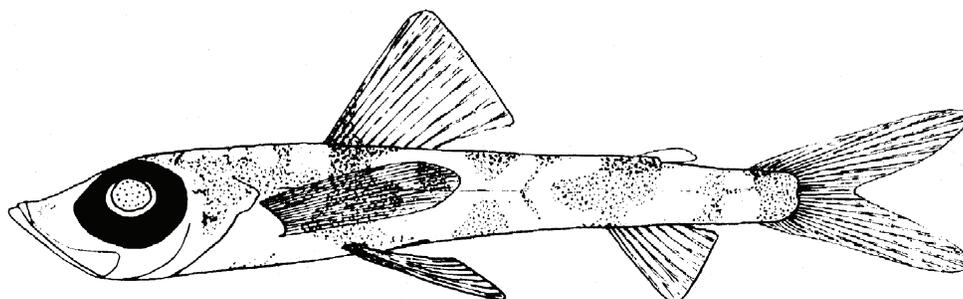
- Body moderately elongate, round in cross-section and segmented; (not compressed as in paralepidids)
- Snout "duckbilled"; eyes round
- Preanus length about 45% SL throughout development
- Large gap between anus and anal fin origin
- Sequence of fin formation: C – A – D – P₁ – P₂
- Note anteriorly placed dorsal and pelvic fins
- Adipose fin present
- Pigmentation includes large melanophore on side of caudal peduncle near base of caudal fin (or several spots in juveniles); 2 small spots on dorsal and ventral edges of caudal peduncle in early larvae; 1 unpaired peritoneal pigment patch present on gut at level of pectoral fin base
- Transformation gradual at about 25 mm; eyes rotate to become oriented dorsally

Note:

1. Eye, head, gut and trunk similar to larvae of the Myctophidae, but in *C. agassizi* the anal fin is more posterior and the dorsal fin is more anterior; most myctophid larvae lack a prominent melanophore on the caudal peduncle
2. Larval series illustrated is based on material collected in the Mediterranean Sea. See Ditty (2006) for original series illustrated by Jack Javech based on western Central Atlantic specimens.

Juvenile: – Juveniles develop a "checkered" pigment pattern

Meristic Characters	
Myomeres:	46–48
Vertebrae:	17+30=47
Dorsal fin rays:	10–11
Anal fin rays:	7–9
Pectoral fin rays:	15–17
Pelvic fin rays:	8–9
Caudal fin rays:	10+9 (PrC)

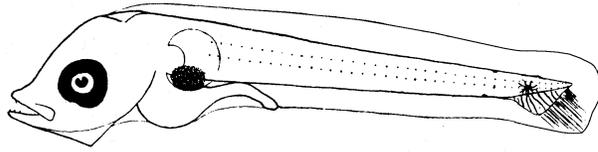


E. 46.0 mmSL

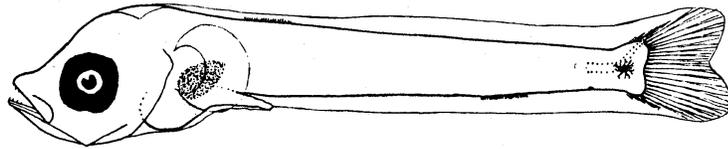
Figures: Adult: A.H. Baldwin (USNM 41600); A–E: Tåning, 1918

References: Sanzo, 1915; Tåning, 1918; Okiyama, 1984a; Hartel and Stiassny, 1986

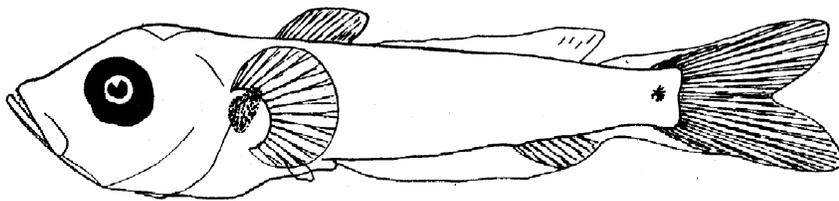
Chlorophthalmus agassizi



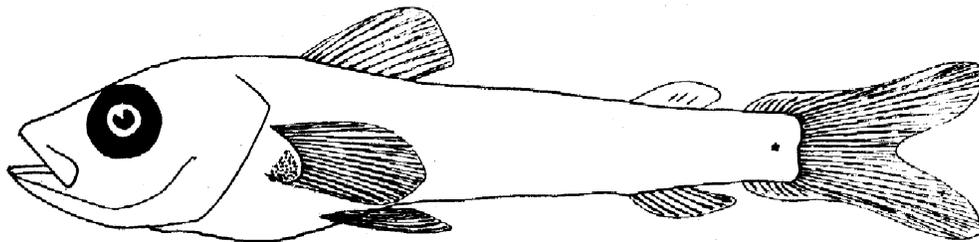
A. 6.5 mmSL



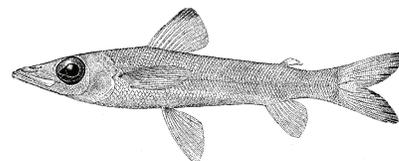
B. 9.5 mmSL



C. 13.0 mmSL



D. 25.0 mmSL

Parasudis truculenta* (Goode and Bean, 1895)*Chlorophthalmidae****Longnose greeneye**

Range: Western North Atlantic Ocean from La Have Bank to Brazil

Habitat: Demersal in depths of 180–480 m; may rise into midwater depths to feed

Spawning: Hermaphroditic; ripe females have been collected winter through spring

Eggs: – Undescribed

Larvae:

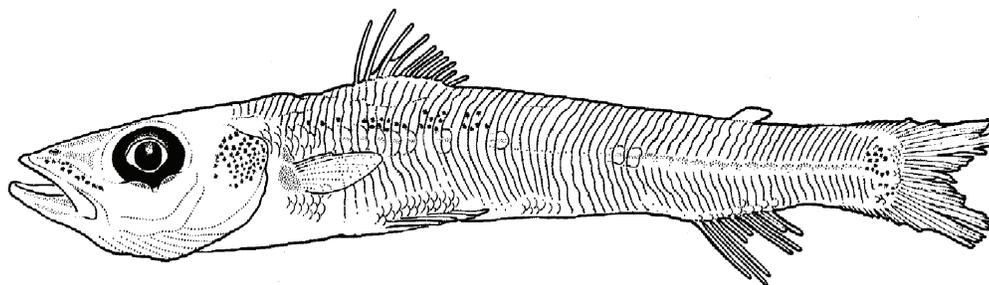
- Body moderately elongate, round in cross-section
- Head >25% SL; snout bulbous and rounded
- Eyes large, moderately stalked
- Flexion occurs at sizes smaller than 10 mm
- Sequence of fin ray formation: (undescribed; most likely C – D – A – P₂ – P₁)
- Anteriorly located dorsal fin placed over pelvic fin
- Anal fin and small adipose fin located far posteriorly; caudal fin forked in all stages
- A single, dense peritoneal pigment patch is present under base of pectoral fin
- Other pigment includes a dense patch of melanophores on opercle, roughly equal to size of eye; small group of melanophores on upper part of caudal peduncle in early larvae spreads downward; a single melanophore on side of snout expands to form a row along maxilla, ending under anterior edge of eye; pigment on body begins as few spots under dorsal fin and a few under the adipose fin; by 40 mmSL, these merge to form an almost continuous band

Meristic Characters

Myomeres:	38–39
Vertebrae:	38–39
Dorsal fin rays:	10
Anal fin rays:	8–9
Pectoral fin rays:	15–17
Pelvic fin rays:	9
Caudal fin rays:	10+9 (PrC)

Note: 1. A preflexion larva (4.5 mmNL) has been illustrated by Jack Javech (Ditty, 2006). It is characterized by an elongate body, small, shallow head with concave profile and preanus length of about 45% NL. Pigment is located at 5 loci: on opercle posterior to eye, an elongate peritoneal patch over mid-gut, a large blotch on dorsal finfold, a large blotch on anal finfold, and a blotch in dorsal finfold over caudal peduncle. This figure may also indicate an early formation of caudal fin rays, but this is equivocal and is not corroborated in the accompanying text.

Early Juvenile: Transformation occurs over a size range of 75–99 mmSL and is characterized by a reduction of the bulbous snout, replaced by more pointed snout; note retention of pigment groups on snout, opercle, midline of body under dorsal fin and at base of caudal fin; scales develop in "herringbone" pattern

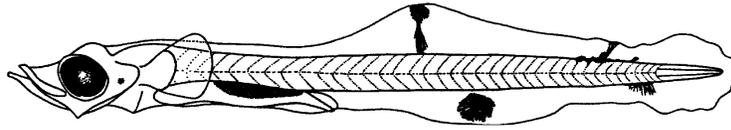


E. 85 mmSL, Transforming Juvenile

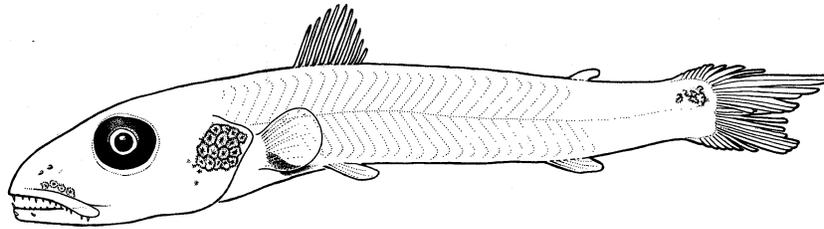
Figures: Adult: Margaret G. Bradbury (Mead, 1966d); **A:** Jack Javech (Ditty, 2006); **B–E:** Sally Landry (Hartel and Stiassny, 1986)

References: Mead, 1966d; Halliday, 1968; Markle *et al.*, 1980; Okiyama, 1984a; Hartel and Stiassny, 1986

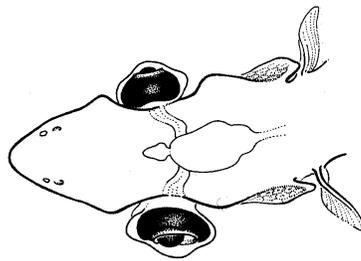
Parasudis truculenta



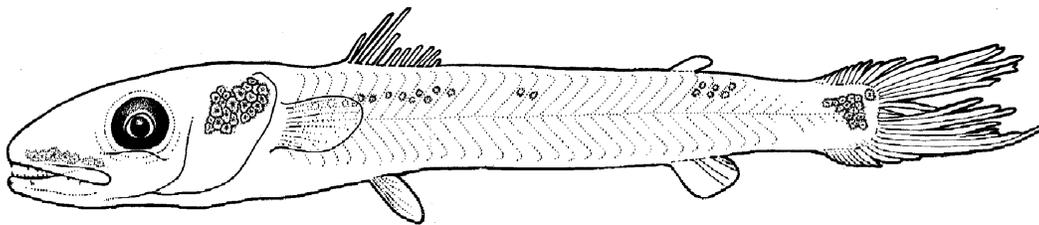
A. 4.5 mmSL



B. 15.4 mmSL



C. 15.4 mmSL, Dorsal View of Head



D. 30.6 mmSL

Ahliesaurus berryi* Bertelsen, Krefft and Marshall, 1976*Notosudidae**

No common name

**Meristic Characters**

Myomeres:	47–50
Vertebrae:	47–50
Dorsal fin rays:	10–11
Anal fin rays:	19–21
Pectoral fin rays:	10–11
Pelvic fin rays:	9
Caudal fin rays:	10+9 (PrC)

Range: Atlantic, Indian and Central Pacific oceans in tropical and subtropical waters; in the western Atlantic from Bear Seamount and Bermuda south to 38°S; juveniles have been collected in the study area between 36°N and 38°N (northern Sargasso Sea)

Habitat: Meso- to bathypelagic in depths below 500 m; juveniles epi- to mesopelagic

Spawning: Across Atlantic Ocean in subtropical waters; season undescribed

Eggs: – Undescribed

Larvae:

- Larvae very long and slender, round in cross-section except slightly compressed near caudal fin; body depth only about 6% SL
- Snout long, flat and wedge-shaped
- Eyes narrow, may be stalked in very early stages
- Preanus length 57–60% SL
- 1–1.5 myomeres between pelvic and dorsal fins; 15–18 myomeres between pelvic and anal fins
- Sequence of fin ray formation: P₁ – C, A, Ad – D, P₂
- Dorsal and pelvic fin rays form late (>20 mm SL)
- Internal pigment occurs as 6 large melanophores under vertebral column
- Other pigmentation restricted to caudal region, where a broad band of many spots covers the caudal peduncle and base of caudal fin rays; few melanophores on adipose and anal fins

Note: 1. Photophores lacking

Juvenile:



F. 37.0 mmSL

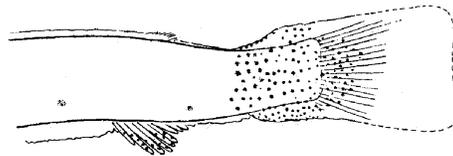
Figures: Adult: Krefft, 1984; A–F: Bertelsen *et al.*, 1976

References: Bertelsen *et al.*, 1976; Krefft, 1984

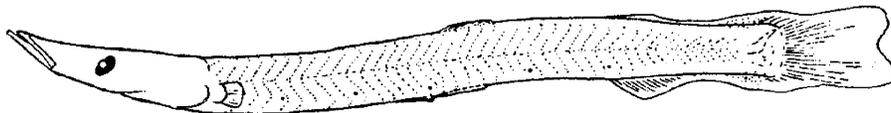
Ahliesaurus berryi



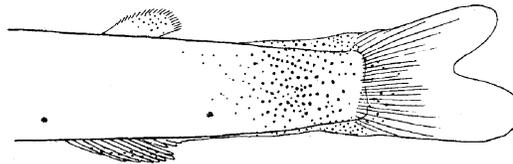
A. 11.8 mmSL



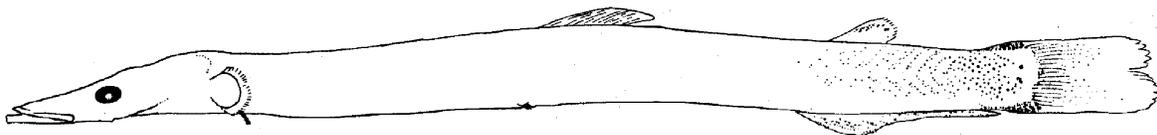
B. 11.8 mmSL, Caudal Area



C. 16.0 mmSL



D. 22.0 mmSL, Caudal Area

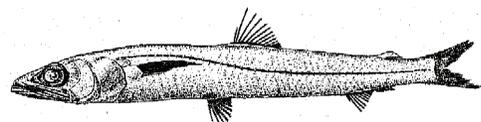


E. 30.5 mmSL

Larvae of *Ahliesaurus* are most readily distinguished from those of *Scopelosaurus* by low total myomere counts and by position of the pelvic fin, only 1-1.5 myomere anterior to dorsal fin origin (cf. 3-7.5 in *Scopelosaurus*)

Scopelosaurus argenteus* (Maul, 1954)*Notosudidae**

No common name



Range: Atlantic Ocean in tropical to warm-temperate waters; in the western North Atlantic from about 42°N (in Gulf Stream) to Brazil

Habitat: Meso- to benthopelagic; adults in depths >500 m, larvae epipelagic, and juveniles in depths of 100–600 m

Spawning: Undescribed

Eggs: – Undescribed

Larvae:

- Larvae very long and slender, round in cross-section except slightly compressed near caudal fin
- Body depth only about 6% SL
- Snout long, flat and wedge-shaped
- Eyes narrow, may be stalked in very early stages
- Preanus length 40–45% SL
- 4–5 myomeres between pelvic and dorsal fins; 21–23 myomeres between pelvic and anal fins
- Sequence of fin ray formation: P₁ – C, A, Ad – D, P₂
- Dorsal and pelvic fins form late (>25 mmSL)
- Pigmentation restricted to region of caudal peduncle in most notosudids; lacking in this species until >28 mm, and then restricted to single melanophore near tip of notochord
- Transformation occurs at about 28 mmSL

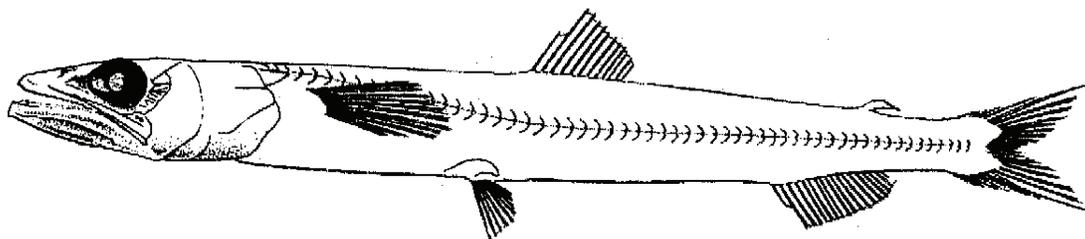
Note:

1. Photophores lacking
2. Larvae <14 mm similar to *Scopelosaurus lepidus*

Juvenile:

Meristic Characters

Myomeres:	54–57
Vertebrae:	54–57
Dorsal fin rays:	12–13
Anal fin rays:	17–18
Pectoral fin rays:	12–14
Pelvic fin rays:	9
Caudal fin rays:	10+9 (PrC)

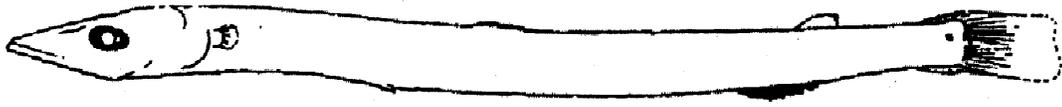


D. 161.5 mmSL

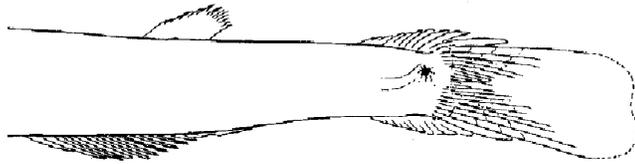
Figures: Adult: Krefft, 1984; A–D: Bertelsen *et al.*, 1976

References: Bertelsen *et al.*, 1976; Krefft, 1984

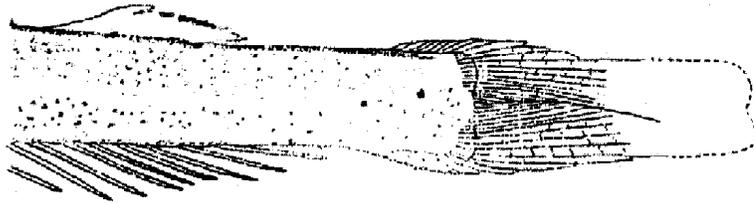
Scopelosaurus argenteus



A. 28.2 mmSL



B. 28.2 mmSL Caudal Area



C. 44.0 mmSL Caudal Area

Scopelosaurus lepidus* Krefft and Maul, 1955*Notosudidae**

No common name

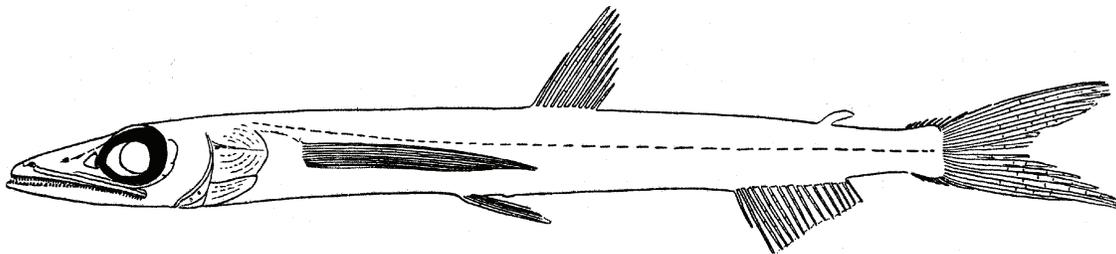
**Range:** Atlantic Ocean from Greenland, Labrador and Iceland south to 30°N**Habitat:** Meso- to benthopelagic in depths of 500–800 m; young stages nearly epi- to mesopelagic between 70 and 200 m**Spawning:** Occurs in midwater, far offshore, possibly centered in Sargasso Sea; season undescribed**Eggs:** – Undescribed

Larvae:

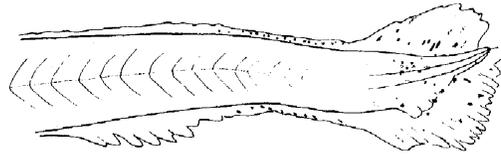
- Larvae very long and slender, round in cross-section except slightly compressed near caudal fin
- Body depth only about 6% SL
- Snout long, flat and wedge-shaped
- Eyes narrow, may be stalked in very early stages
- Preanus length 40–44% SL
- 4–5 myomeres between pelvic and dorsal fins; 21–23 (rarely 20 or 25) myomeres between pelvic and anal fins
- Sequence of fin ray formation; P₁ – C, A, Ad – D, P₂
- Dorsal and pelvic fins form late (22–24 mmSL)
- Internal pigment occurs along mid-dorsal and mid-ventral edges of caudal peduncle
- Other pigment restricted to region of caudal peduncle, where it is light; a line of spots at base of middle caudal fin rays; very small larvae may have scattered spots on caudal and anal finfolds

Note: 1. Photophores lacking2. Very small larvae (<14 mm) similar to *Scopelosaurus argenteus***Juvenile:**

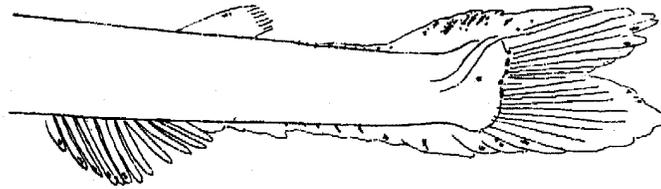
Meristic Characters	
Myomeres:	58–61
Vertebrae:	58–61
Dorsal fin rays:	10–12
Anal fin rays:	17–19
Pectoral fin rays:	13–15
Pelvic fin rays:	9
Caudal fin rays:	10+9 (PrC)

**F. 137.0 mm****Figures:** Adult: Krefft, 1984; A–E: Bertelsen *et al.*, 1976; F: Marshall, 1966**References:** Bertelsen *et al.*, 1976; Krefft, 1984

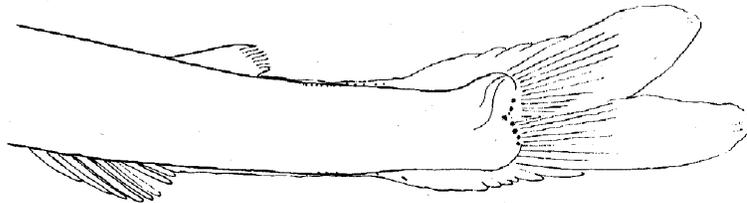
Scopelosaurus lepidus



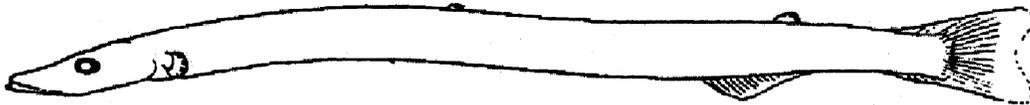
A. 14.0 mmSL, Caudal Area



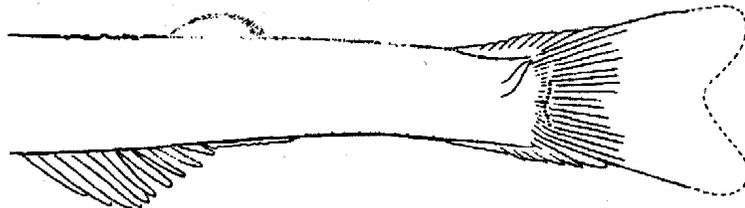
B. 20.0 mmSL, Caudal Area



C. 23.4 mmSL, Caudal Area



D. 36.0 mmSL



E. 36.0 mmSL, Caudal Area

Scopelosaurus mauli* Bertelsen, Krefft and Marshall, 1976*Notosudidae**

No common name

Adult Image Unavailable

Range: Western Atlantic, western Indian and western Pacific oceans; in the western North Atlantic from Grand Bank to Caribbean Sea

Habitat: Meso- to benthopelagic in unknown depth range; larvae epipelagic

Spawning: Undescribed

Eggs: – Undescribed

Larvae:

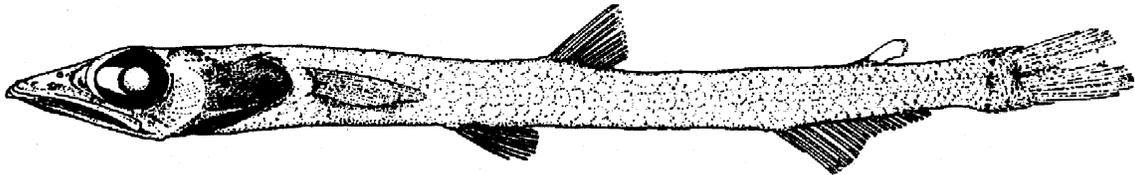
- Larvae very long and slender, round in cross-section except slightly compressed near caudal fin
- Body depth only about 6–7% SL
- Snout long, flat and wedge-shaped
- Eyes narrow, may be stalked in very early stages
- Preanus length 38–40% SL
- 6–7.5 myomeres between pelvic and dorsal fins; 22–23.5 myomeres between pelvic and anal fins
- Sequence of fin ray formation: P₁ – C, A, Ad – D, P₂
- Dorsal and pelvic fins form late (22–24 mmSL)
- Pigmentation restricted to region of caudal peduncle where a line of internal spots forms at base of principal caudal fin rays; 2 short, longitudinal series form above and below the notochord tip and these are joined by a band of spots from dorsal to ventral edge of caudal peduncle, crossing the posterior ends of the short series; a small cluster of spots over the middle caudal fin rays
- Transformation occurs at 27–31 mmSL

Note: 1. Photophores lacking

Juvenile:

Meristic Characters

Myomeres:	55–57
Vertebrae:	55–57
Dorsal fin rays:	10–11
Anal fin rays:	17–20
Pectoral fin rays:	12–13
Pelvic fin rays:	9
Caudal fin rays:	10+9 (PrC)

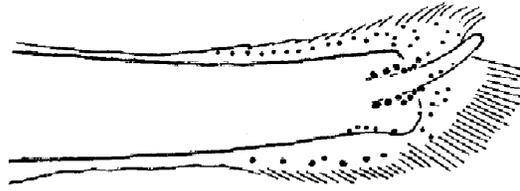


F. 76.5 mmSL

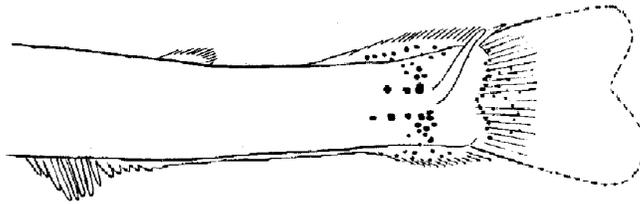
Figures: A, B, D, F: Bertelsen *et al.*, 1976; C, E: Ozawa, 1978

References: Bertelsen *et al.*, 1976; Ozawa, 1978

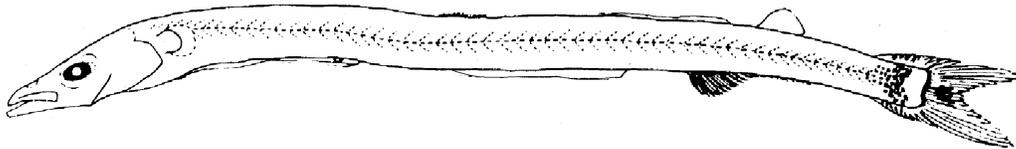
Scopelosaurus mauli



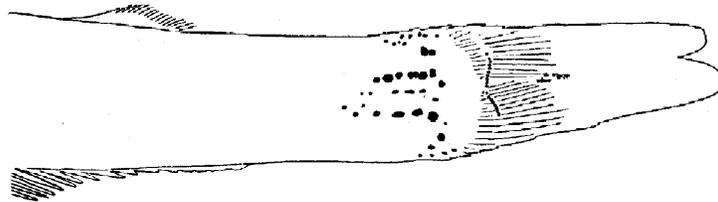
A. 10.5 mmSL, Caudal Area



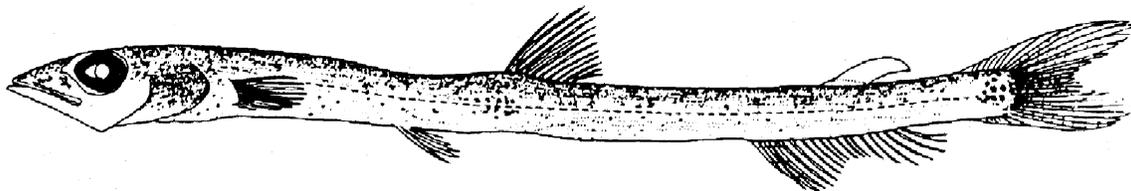
B. 14.4 mmSL, Caudal Area



C. 26.8 mmSL (Pacific specimen)



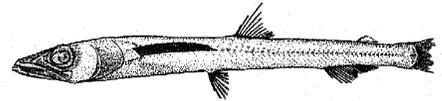
D. 28.0 mmSL Caudal Area



E. 34.0 mmSL (Pacific specimen)

Scopelosaurus smithii* Bean, 1925*Notosudidae**

No common name



Range: Worldwide in tropical waters; in the western North Atlantic from Grand Bank to Brazil; larvae drift as far north as 40°N

Habitat: Meso- to benthopelagic in depths of 200–600 m; young stages epi- to mesopelagic in depths of 50–200 m

Spawning: Mostly in tropical waters of western Atlantic

Eggs: – Undescribed

Larvae:

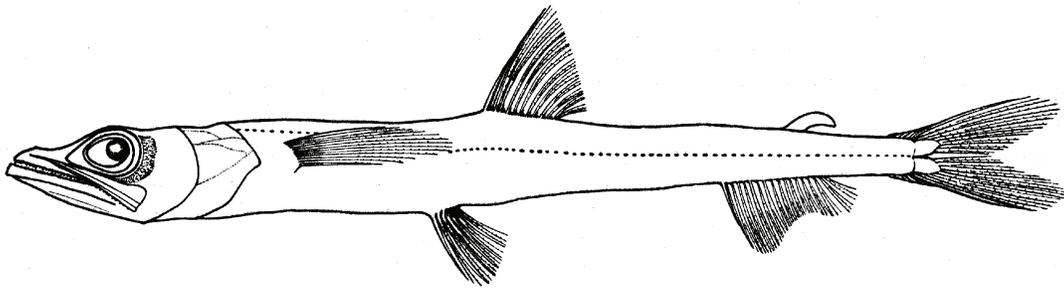
- Larvae very long and slender, round in cross-section except slightly compressed near caudal fin
- Body depth only about 6% SL
- Snout long, flat and wedge-shaped
- Eyes narrow, may be stalked in very early stages
- Preanus length 43–45% SL
- 3–5.5 myomeres between pelvic and dorsal fins; 19–23.5 myomeres between pelvic and anal fins
- Sequence of fin ray formation: P₁ – C, A, Ad – D, P₂
- Dorsal and pelvic fins form late (20–25 mmSL)
- Pigmentation restricted to region of caudal peduncle where a wide band of spots forms from just posterior to adipose fin to base of caudal fin; a few weak spots form a line across bases of mid-caudal fin rays; a small cluster of spots on middle caudal rays, about 25% the distance out from caudal fin base

Meristic Characters

Myomeres:	53–56
Vertebrae:	53–56
Dorsal fin rays:	10–12
Anal fin rays:	17–19
Pectoral fin rays:	11–14(15)
Pelvic fin rays:	9
Caudal fin rays:	10+9 (PrC)

Note: 1. Photophores lacking

Juvenile:

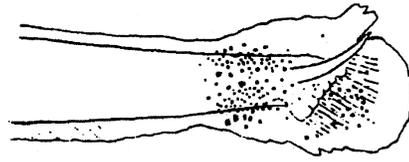


F. 163.5 mmSL

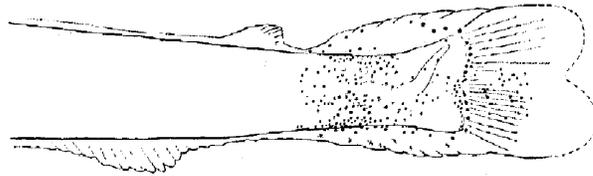
Figures: Adult: Krefft, 1984; A–D: Bertelsen *et al.*, 1976; E: Ozawa, 1978; F: Marshall, 1966

References: Bertelsen *et al.*, 1976; Ozawa, 1978

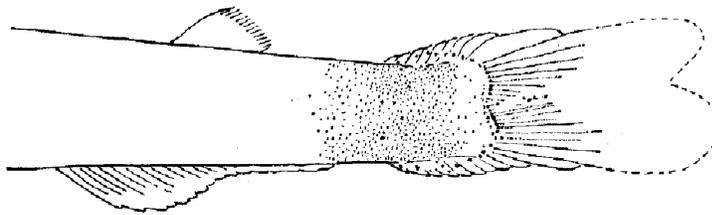
Scopelosaurus smithii



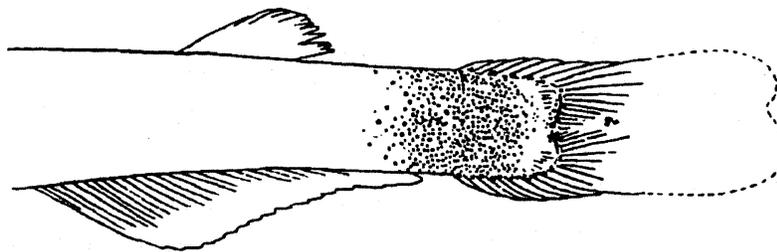
A. 9.5 mmSL Caudal Area



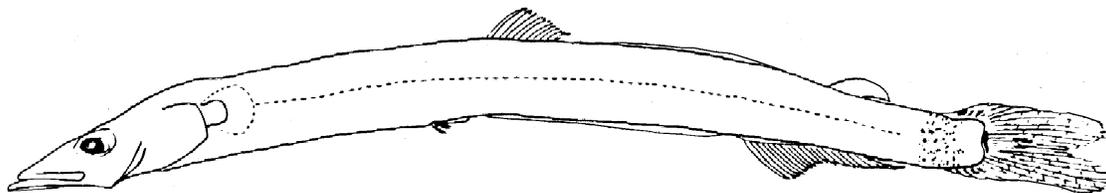
B. 12.0 mmSL Caudal Area



C. 22.0 mmSL Caudal Area



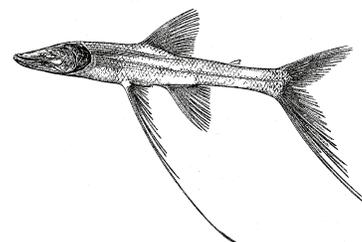
D. 31.0 mmSL Caudal Area



E. 26.0 mmSL (Pacific specimen)

Bathypterois viridensis* (Roule, 1916)*Ipnopidae**

No common name



Range: Atlantic Ocean in tropical to warm-temperate waters; in the western North Atlantic from Georges Bank to northern Brazil

Habitat: Demersal in depths of 476–1,477 m; (other *Bathypterois* species occur as deep as 5,990 m); larvae epipelagic

Spawning: Undescribed; larva in Fig. E collected at 26°47'N, 79°50'W in May

Eggs: – Undescribed; ovarian eggs range from 1.0–1.2 mm in diameter, and have a single, large oil globule

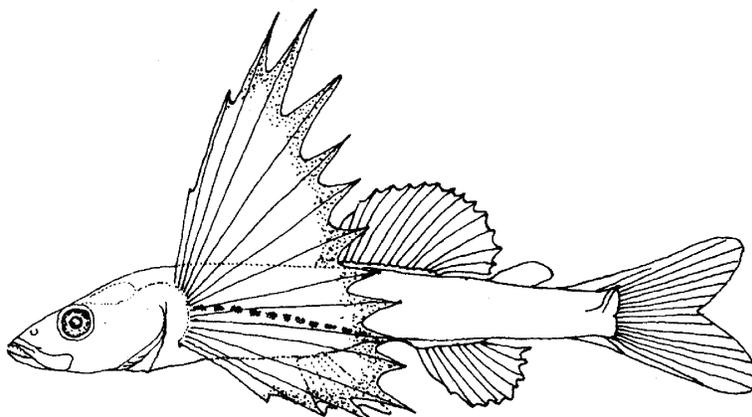
Larvae:

- Body moderately stubby and thick
- Head typically flat topped and somewhat "duckbilled"; maxilla reaches to anterior eye
- Eye slightly telescopic in *B. viridensis* larvae
- Gut is long and slightly trailing in some larvae; anus is close to (or beyond) anal fin origin
- Sequence of fin ray formation: P₁ – C, A – D, P₂
- Pectoral fin rays elongate and fan-shaped; anal fin rays can be slightly elongate in *B. viridensis*
- Note fin placement; anal fin origin under middle or rear of dorsal fin; pelvic fin just anterior to dorsal fin
- External pigmentation lacking or sparse in known larvae of *Bathypterois*; larvae of other species have series (12–20) of peritoneal pigment patches along dorsum of gut, lacking in *B. viridensis*
- Transformation apparently complete by about 43 mmSL, smallest demersal specimen described (Sulak, 1977)

Meristic Characters

Myomeres:	50–52
Vertebrae:	50–52
Dorsal fin rays:	12–13
Anal fin rays:	10–12
Pectoral fin rays:	12–13
	(+3 embedded, rudimentary)
Pelvic fin rays:	8
Caudal fin rays:	5–6+10+9+3–4

- Note:**
1. Larvae of *Bathypterois* either lack peritoneal pigment (as in *B. longipes* and *B. viridensis*) or have a series of peritoneal pigment patches along the dorsum of the gut (Figs. C, D, F)
 2. The 14.2 mm larva (Fig. B) has been referred to *Bathypterois longipes* (Sulak, 1977)
 3. 2 larvae (Figs. A, F) described as "*Aulopus filamentosus*" (Sanzo, 1938) and a larva 28 mmSL described as "*Aulopus filamentosus*" (Tåning, 1918) belong to *Bathypterois*
 4. See Aulopiformes Introductory Table for meristic characters of other species in the study area

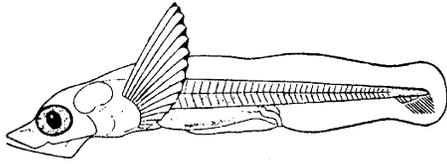


F. 30.9 mm *Bathypterois* sp. (Peritoneal pigment present)

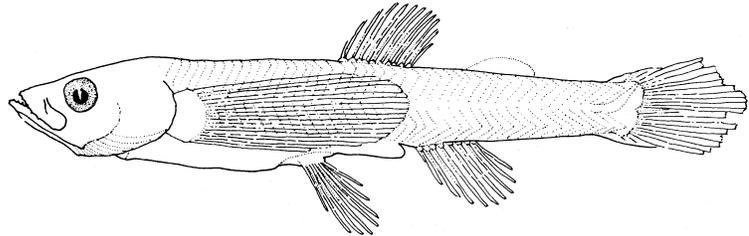
Figures: Adult: Mildred Carrington (Mead, 1966c); **A, F:** Sanzo, 1938; **B:** Okiyama, 1974 (reversed); **C:** Okiyama, 1984a; **D:** Okiyama, 1988; **E:** Fahay, 1983

References: Sanzo, 1938; Mead, 1966c; Sulak, 1977; Okiyama, 1984a, 1984b; Merrett and Nielsen, 1987

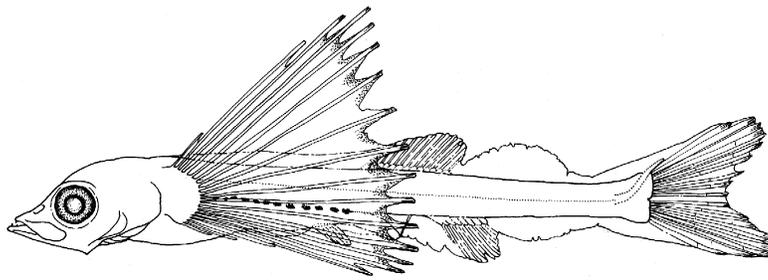
Bathypterois sp.



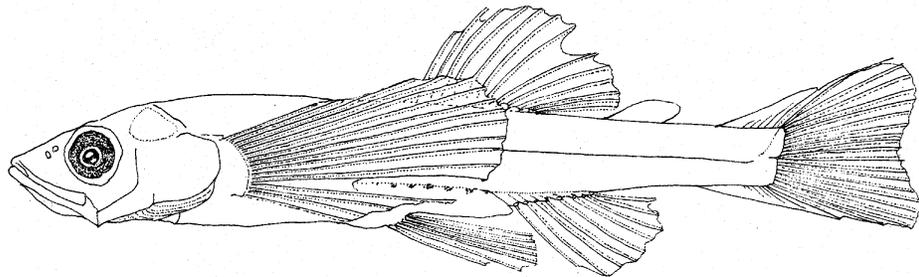
A. 9.4 mm *Bathypterois* sp.
(Probably *B. mediterraneus*)



B. 14.2 mmSL *Bathypterois longipes* (No peritoneal pigment)

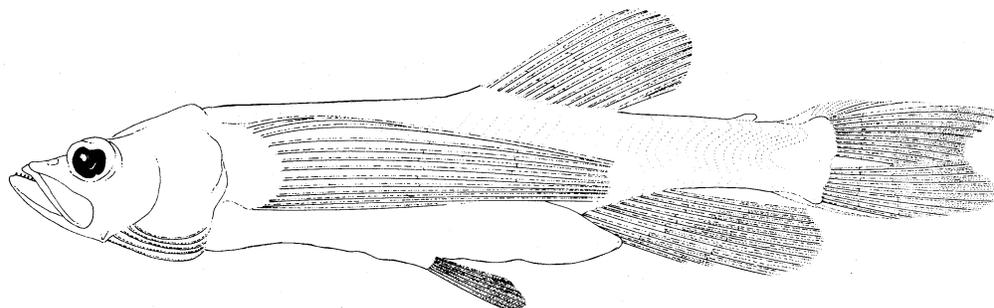


C. size? *Bathypterois* sp. (Peritoneal pigment present)



D. 19.4 mmSL *Bathypterois* sp. (Peritoneal pigment present)

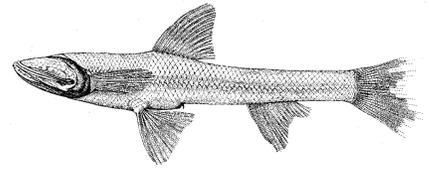
Transformation in *B. viridensis* involves reduction of telescopic eye, retraction of protruding gut, and lengthening of posterior part of body



E. 33.1 mmSL *Bathypterois viridensis* (No peritoneal pigment)

Bathytyphlops marionae* Mead, 1958*Ipnopidae**

No common name

**Meristic Characters**

Myomeres:	63–64
Vertebrae:	24–25+37–40=62–65
Dorsal fin rays:	12–13
Anal fin rays:	13–14
Pectoral fin rays:	12–15
Pelvic fin rays:	8
Caudal fin rays:	6+10+9+5

Range: Tropical waters of the Atlantic, western Indian and Pacific oceans; in the western North Atlantic from Wilmington Canyon to Gulf of Mexico and Caribbean Sea

Habitat: Demersal in depths of 869–2,651 m; larvae epipelagic

Spawning: Undescribed

Eggs: – Undescribed

Larvae:

- Moderately elongate body
- Head flat-topped, snout moderately "duck-billed"
- Preanus length relatively short (compare to larvae of *Bathypterois*)
- Anus closer to pelvic fin bases than to anal fin origin
- Wide space between anus and anal fin origin (compare to larvae of *Bathypterois*)
- Pectoral fin is elongate and fan-shaped
- Sequence of fin ray formation: P₁ – C, A, D – P₂
- Anal fin origin well posterior to level of dorsal fin
- Adipose fin lacking (despite depiction of one in Fig. B)
- Note persistent post-dorsal and preanal finfolds
- A single peritoneal pigment patch occurs over the mid-gut
- Other pigment scant or lacking on body; a series of melanophores occurs on pectoral fin in larger larvae
- Blueish coloration sometimes present on fins (especially pectoral fin) and body in living individuals; this color seldom survives preservation
- Transformation occurs over the size range 43–93 mmSL; eyes reduced in size, larval teeth replaced by adult teeth; develops very large gape (compare to *Ipnows* and *Bathypterois*)

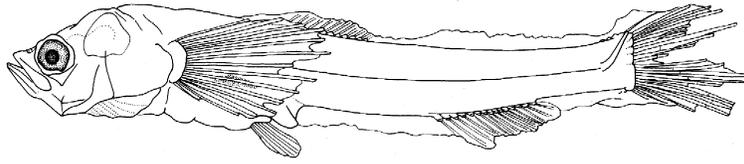
Note:

1. Larvae described as "*Macristiella perluscens*" (Berry and Robins, 1967) belong to this species
2. Larvae of the closely related *Bathymicrops regis* have been described (Nielsen and Merrett, 1992). However, this species has not been collected north of 28°N in the western North Atlantic

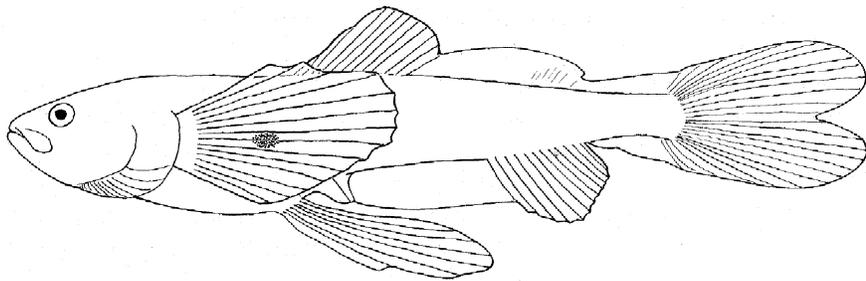
Figures: Adult: Mildred Carrington (Mead, 1966c); **A:** Okiyama, 1972; **B:** Rosen, 1971 (redrawn from Berry and Robins (1967), modified here by reinsertion of peritoneal pigment patch, per original illustration); **C:** G. I. Pokhil'skaya (Parin and Belyanina, 1972)

References: Berry and Robins, 1967; Parin and Belyanina, 1972; Sulak, 1974; Merrett, 1980; Okiyama, 1984a; 1984b; Merrett and Nielsen, 1987

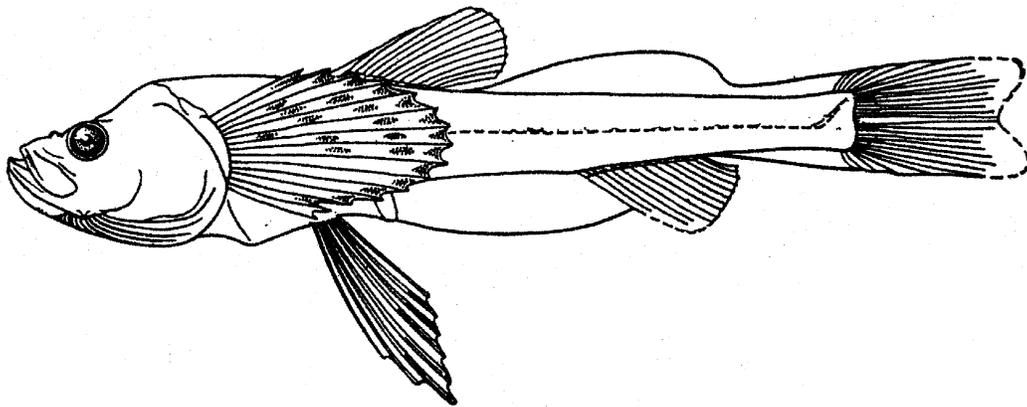
Bathytyphlops marionae



A. 13.1 mmSL



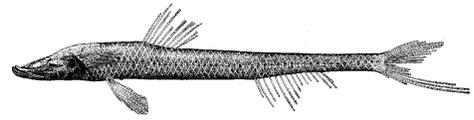
B. 28.5 mmSL



C. 42.5 mmSL

Ipnops murrayi* Günther, 1878*Ipnopidae**

No common name



Range: Atlantic Ocean in tropical to warm-temperate waters; in the western North Atlantic from vicinity of Hudson Canyon (1 specimen) and Gulf of Mexico to Brazil

Habitat: Demersal in depths of 1,463–3,518 m

Spawning: Undescribed

Eggs: – Undescribed

Larvae:

- Larvae of *Ipnops murrayi* are undescribed; illustration and description of larvae refer to *Ipnops agassizi* from the western Pacific. See discussion regarding validity of 2 species on facing page.
- Body elongate with very short preanus length
- Head flat-topped, snout short
- Note bulging eyes
- Anus much closer to pelvic fin than to anal fin
- Wide space between anus and anal fin origin
- Pectoral fin in 2 lobes; rays of upper lobe very long
- Sequence of fin ray formation: P₁ – C, A, D – P₂
- Adipose fin lacking
- Pelvic fin forms just anterior to dorsal fin origin
- Peritoneal pigment patches absent
- Pigment on body very scant or absent
- Transformation complete at about 42 mmSL; pectoral fin loses several rays and the bi-lobed shape disappears; eyes are transformed into flattened, dorsally directed plaques

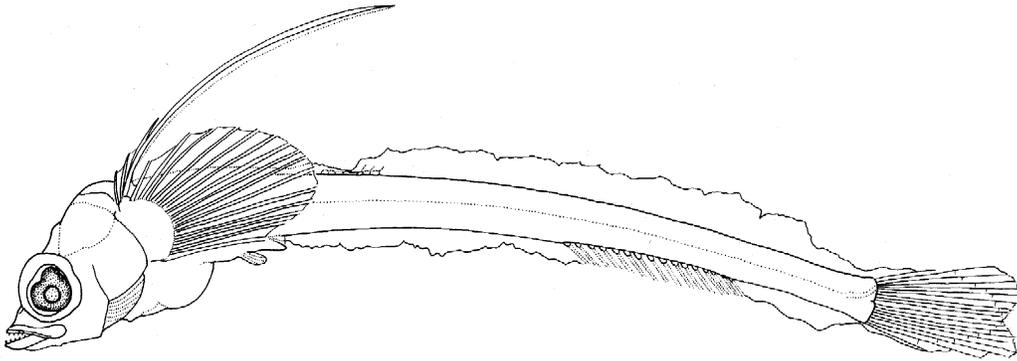
Meristic Characters

Myomeres:	54–61
Vertebrae:	54–61
Dorsal fin rays:	9
Anal fin rays:	14
Pectoral fin rays:	13
Pelvic fin rays:	8
Caudal fin rays:	2+10+9+1

- Note:**
1. Low number of procurrent caudal fin rays (compare to *Bathypterois* and *Bathytrophops*)
 2. See *Stemonosudis rothschildi* (Paralepididae) for notes on larvae of *Bathymicrops* (Ipnopidae) found in the eastern Atlantic and Pacific oceans

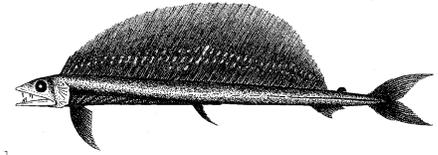
Figures: Adult: Margeret G. Bradbury (Mead, 1966c); A: Okiyama, 1981

References: Mead, 1966c; Sulak, 1977; Okiyama, 1984a; 1984b; Merrett and Nielsen, 1987; Nielsen and Merrett, 1992

Ipnops agassizi**A. 13.9 mmSL**

Ipnops agassizi has been reported from the Indo-Pacific and the Atlantic; *Ipnops murrayi* from the Atlantic only. However, as shown by Okiyama (1981) the differences between the two species are insignificant and specimens with intermediate characters have been collected. The two nominal species may be conspecific. See also the discussion in Nielsen (1966) suggesting the possibility of hybridism between the forms. The range in meristic characters, combined for the two nominal species, are as follows:

Vertebrae:	54-61
Dorsal fin rays:	8-11
Anal fin rays:	13-19
Pectoral fin rays:	12-16
Principal caudal fin rays:	17-20
Gill rakers, 1 st arch	20-24

Alepisaurus brevirostris* Gibbs, 1960*Alepisauridae****Shortnose lancetfish**

Range: Western North Atlantic Ocean from region of Flemish Cap south to 36°N; also South Pacific Ocean

Habitat: Mesopelagic, mostly in depths of 100–1,000 m, sometimes shallower

Spawning: Undescribed

Eggs: – Undescribed

Larvae:

- Moderate body with large head and mouth
- Snout to top of head curved (compare to *Omosudis* larvae)
- Teeth small in early larvae; large, depressed canines form along lower jaw in larger larvae
- Adipose fin present
- Pectoral fin rays form early; fin is large, on a long pedicel (base); tip extends posterior to anus >20 mm
- Sequence of fin ray formation: P₁, C – D – A – P₂
- Dorsal fin origin over edge of opercle; dorsal fin base long (compare to *Omosudis*)
- Pigmentation includes 2 very distinct peritoneal pigment patches on dorsum of gut, overlain by external pigment on abdomen; early larvae have pigment mainly restricted to eye and pectoral fin rays (compare to *Omosudis*); saddle of pigment forms under adipose fin; no pigment on caudal peduncle or lower body posterior to anus; later larvae have melanophores along edge of upper jaw, top of head, nape and along dorsum to adipose fin
- Transformation is gradual

Meristic Characters

Myomeres: about 50

Vertebrae: about 50

Dorsal fin rays: 36–48

Anal fin rays: 13–18

Pectoral fin rays: 12–14

Pelvic fin rays: 8–10

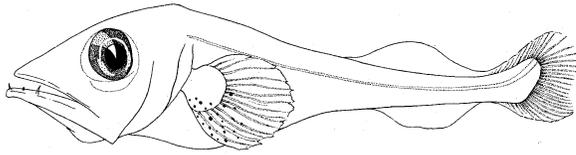
Caudal fin rays: 10+9 (PrC)

Note: 1. Larvae are superficially similar to larvae of Scombridae, but note presence of adipose fin and lack of fin spines

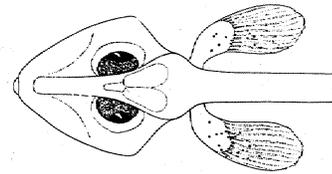
Figures: Adult: Gibbs, 1960; A–E: Rofen, 1966b

References: Haedrich, 1964; Gibbs and Wilimovsky, 1966; Okiyama, 1984a; 1984b

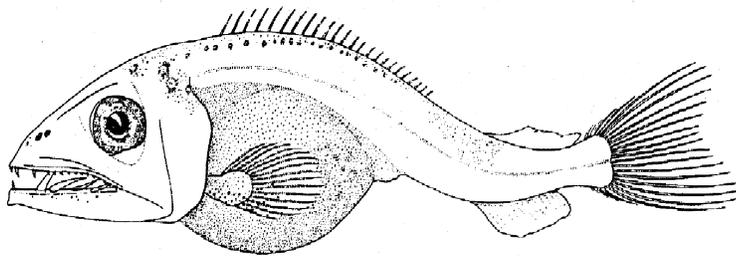
Alepisaurus brevirostris



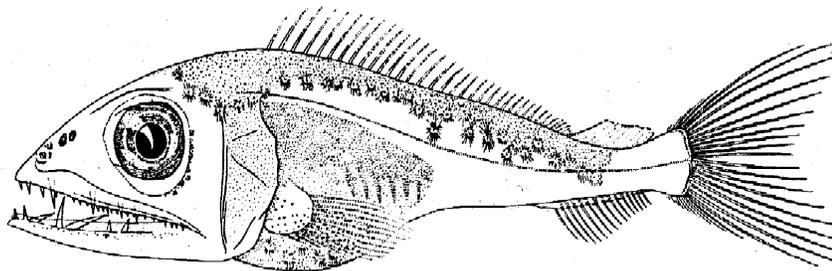
A. 6.9 mmSL



**B. 6.9 mmSL
(Dorsum of Head)**

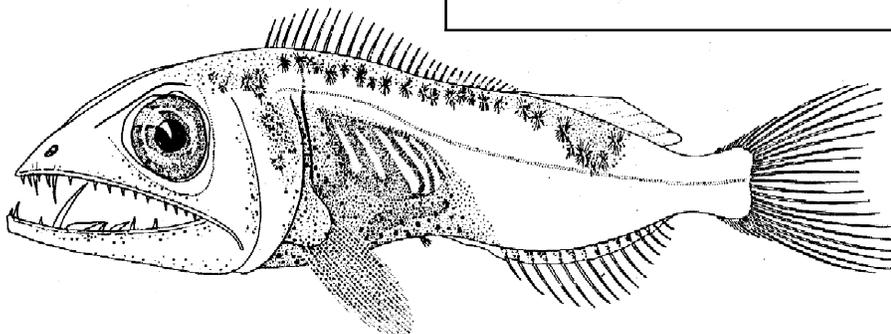


C. 12.1 mmSL

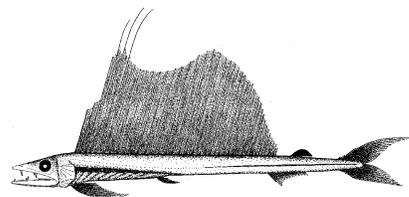


D. 17.2 mmSL

Note blind, pigmented, sacular outgrowth on left side of gut (Fig. E); this structure also occurs in larval *Omosudis* and a similar structure (pyloric caecum) occurs in *Coccorella atlantica* larvae.



E. 21.8 mmSL

Alepisaurus ferox* Lowe, 1933*Alepisauridae****Longnose lancetfish**

Range: Atlantic and Pacific oceans in tropical to warm temperate waters; in the western North Atlantic from Nova Scotia to Gulf of Mexico and Caribbean Sea

Habitat: Meso- to bathypelagic in depths from near surface to >1,000 m

Spawning: Undescribed

Eggs: – Undescribed; length at hatching <5.0 mm

Larvae:

- Moderately elongate body with large head and mouth
- Snout to top of head straight (compare to *Omosudis* larvae)
- Distinct bony ridges form on top of head (compare to *Alepisaurus brevirostris* and *Omosudis* larvae)
- Teeth small in early larvae; large, depressed canines form along lower jaw in larger larvae
- 4 small spines appear on edge of preopercle in small larvae; later larvae display serrated preopercle edge; (preopercle edge described as spineless in *A. brevirostris*; compare to preopercle in *Omosudis*)
- Adipose fin present
- Flexion occurs between 6.0 and 8.5 mm
- Pectoral fin rays form early; fin is large, on a pedicel (base); tip extends almost to anus >20 mm
- Dorsal fin origin over edge of opercle; dorsal fin base long (compare to *Omosudis*)
- Sequence of fin ray formation: C – P₁ – A – D – P₂
- Pigmentation includes 1 indistinct peritoneal pigment patch on dorsum of gut, overlain by external pigment on abdomen; early larvae have pigment mainly restricted to eye and pectoral fin rays (compare to *Omosudis*); saddle of pigment forms under adipose fin; no pigment on caudal peduncle or lower body posterior to anus except small patch of melanophores at anal fin origin; later larvae have melanophores on top of head, on opercle and along dorsum to adipose fin; proximal dorsal fin membranes densely pigmented
- Transformation is gradual; occurs between 16 and 30 mm

Meristic Characters

Myomeres:	47–52
Vertebrae:	19–26+24–31=47–52
Dorsal fin rays:	36–45
Anal fin rays:	14–18
Pectoral fin rays:	12–15
Pelvic fin rays:	8–10
Caudal fin rays:	10+9 (PrC)

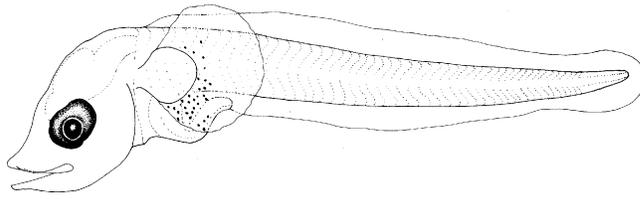
Note:

1. Larvae are superficially similar to larvae of Scombridae, but note presence of adipose fin and lack of fin spines
2. Pacific Ocean specimens have been described as lacking peritoneal pigment

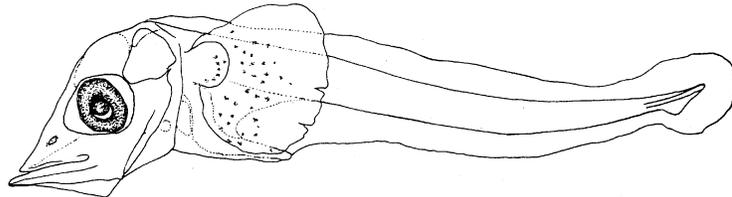
Figures: Adult: Gibbs and Wilimovsky, 1966; **A, C, E:** Nancy Arthur (Ambrose, 1996g); **B:** Okiyama, 1988; **D:** Okiyama, 1984a

References: Okiyama, 1984a; 1984b; Ambrose, 1996g

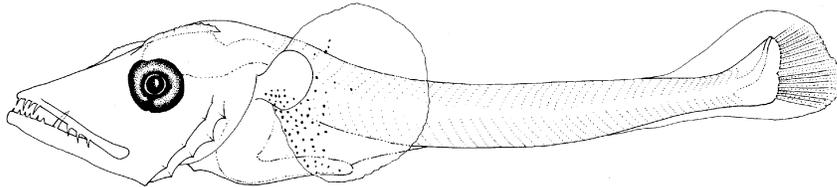
Alepisaurus ferox



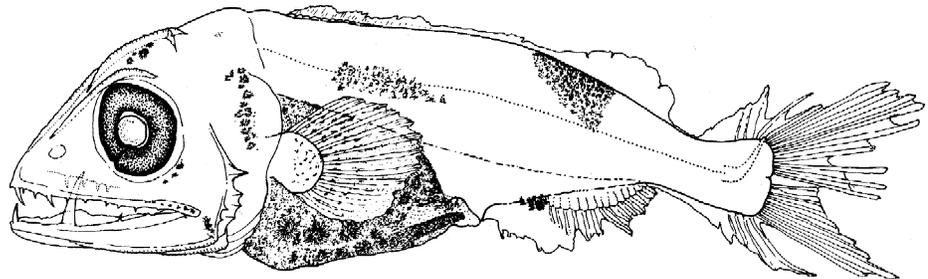
A. 5.2 mmSL



B. 6.4 mmSL

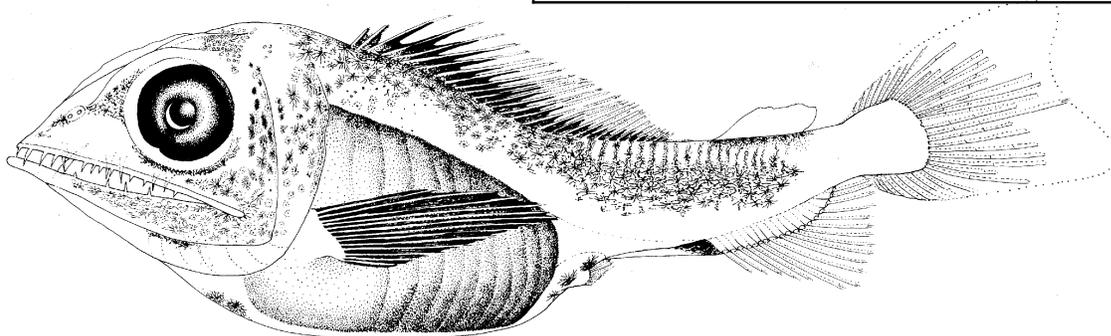


C. 8.4 mmSL

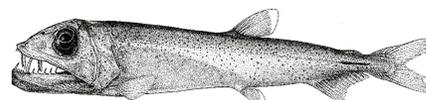


D. 10.0 mmSL

Note blind, pigmented, sacular outgrowth on left side of gut (Fig. D); this structure also occurs in larval *Omosudis* and a similar structure (pyloric caecum) occurs in *Coccorella atlantica* larvae.



E. 20.5 mmSL

Omosudis lowei* Günther, 1887*Alepisauridae****Hammerjaw**

Range: Worldwide in tropical to warm-temperate waters; in the western North Atlantic from Flemish Cap to Caribbean Sea; early stages particularly abundant near Bermuda

Habitat: Meso- to bathypelagic in depths of 700–1,800 m

Spawning: Year-round, with peak in spring–summer

Eggs: – Undescribed

Larvae:

- Body shape similar to larvae of *Alepisaurus*, but head and mouth larger and teeth (at about 6 mm) more prominent
- Outline of snout to top of head almost straight (compare to *Alepisaurus*)
- Single large canine tooth on lower jaw and large palatine canines
- Anus well posterior to tips of pectoral fin rays; pectoral fins much smaller than in *Alepisaurus*
- Sequence of fin ray formation: C – D, A – P₂ – P₁
- Caudal, dorsal and anal fin rays formed by 12 mmSL; pectoral fin rays form last
- Small dorsal fin situated at about mid-body
- Adipose fin present; note pelvic fin origin at about same level as dorsal fin origin
- Pigmentation includes 3 (rarely 4) peritoneal pigment patches, visible in larvae >6.0 mm; these become indistinct in larvae >30 mm; 4–5 ventral melanophores behind anus in small larvae; pigment lacking on pectoral fins (compare to *Alepisaurus*); few spots on caudal peduncle
- Transformation gradual

Meristic Characters

Myomeres: about 39–41

Vertebrae: 39–41

Dorsal fin rays: 9–11

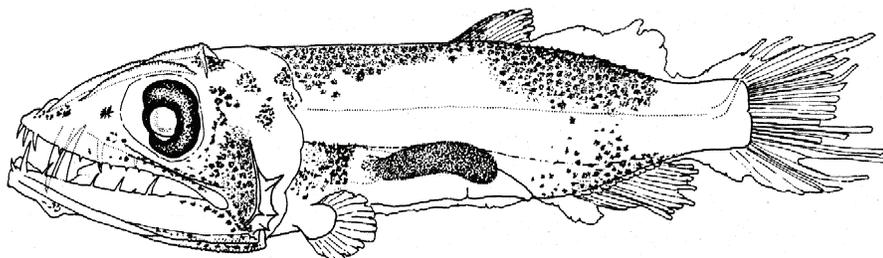
Anal fin rays: 13–14

Pectoral fin rays: 12–13

Pelvic fin rays: 8

Caudal fin rays: 10+9 (PrC)

- Note:**
1. Larvae are superficially similar to larvae of Scombridae, but note presence of adipose fin and lack of fin spines
 2. Well-developed ridges on head and spines along edge of preopercle best displayed in specimen from tropical western Pacific (Fig. G–H); pigment also better developed than described for larvae from the Atlantic; these differences, and differences in meristic characters, suggest possibility of more than a single species in *Omosudis*

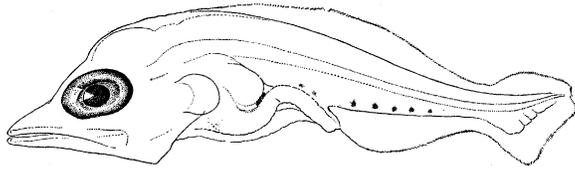
G. 22.5 mm**H. 22.5 mm
(Dorsum of Head)**

– Note blind, pigmented, sacular outgrowth on left side of gut; this structure also occurs in larval *Alepisaurus*; a similar structure (pyloric caecum) occurs in larvae of *Coccorella atlantica*; see Wassersug and Johnson, 1976

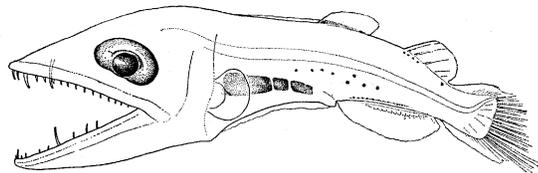
Figures: Adult: Janet Roemhild Canning (Rofen, 1966b); A–F: Ege, 1958; G–H: Okiyama, 1984a

References: Ege, 1958; Rofen, 1966b; Wassersug and Johnson, 1976; Post, 1984a; Okiyama, 1984a; 1984b

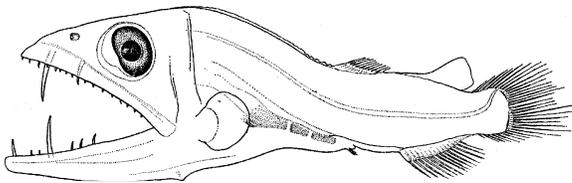
Omosudis lowei



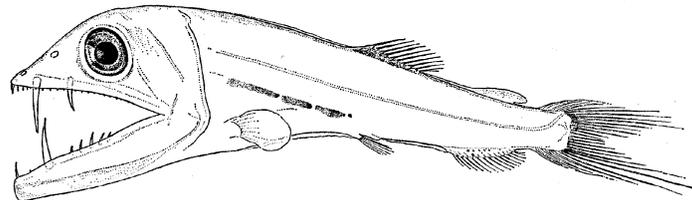
A. 5.1 mm



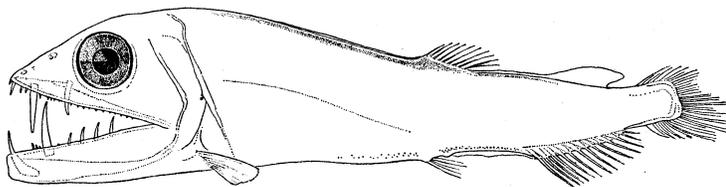
B. 6.6 mm



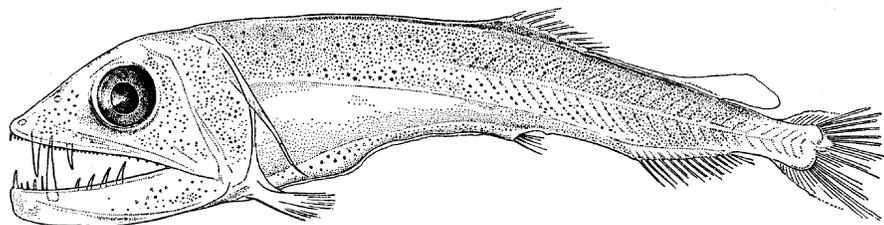
C. 11.8 mm



D. 23.7 mm



E. 44.1 mm



F. 75.2 mm (Specimen from South China Sea)