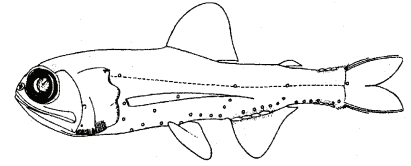


***Bolinichthys* sp.**
Myctophidae (s.f. Lampanyctinae)
 No common name



Meristic Characters

See introductory table for meristic characters in 3 species

Range: Species of *Bolinichthys* occur worldwide, primarily in tropical waters; in the western North Atlantic, 3 species can occur as far north as Grand Bank or Flemish Cap; *Bolinichthys distofax* is a tropical species that has not yet been reported in study area

Habitat: Mesopelagic in maximum depths of 750–850 m (depending on species) during the day, as shallow as 40 m at night

Spawning: *B. indicus*: mid-spring to late fall with a peak in late summer; life cycle one year
B. photothorax: may occur in study area as expatriate; does not reproduce north of 35°N
B. supralateralis: not well understood; possible peak in late spring to early summer, based on sampling north of Bermuda

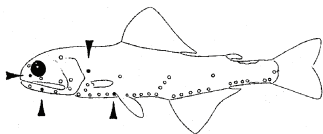
Eggs: – Undescribed; hatching length undescribed

Larvae (Generic Characters):

- Body relatively slender, with nearly parallel dorsal and ventral body margins
- Head moderate with blunt snout; eye round and large
- Flexion occurs at about 4–5 mmSL
- Sequence of fin ray formation: undescribed; C_1 apparently first to form; P_1 fin rays not early forming
- Photophore development: larvae of one species-group of *Bolinichthys* form Br_2 , V_n , PLO and PO_5 during larval stage; photophores are typically very small
- Pigmentation: generally sparse in most; often 1–2 (rarely more) melanophores along venter of caudal peduncle; spots may occur along midline over hindbrain; internal spots may occur over mid-gut
- Transformation occurs at about 12.0 mmSL

- Note:**
1. Larvae of *Bolinichthys distofax* are characterized by a line of melanophores along the horizontal septum on the caudal peduncle, and another series internally along the posterior notochord. *Bolinichthys* larvae that might be collected in study area presumably lack these lines of pigment, but can not presently be identified to species
 2. Another type of *Bolinichthys* larva, typified by *Bolinichthys longipes* from the Pacific and Indian oceans, has similar body shape and sparse pigment, but only forms the Br_2 photophore during the larval stage, and adds the Br_1 , Op_1 and PO_5 during transformation (Moser and Ahlstrom, 1996b). Larvae of the 3 species that occur in the study area are undescribed, but may share characters with either type of *Bolinichthys* larvae.

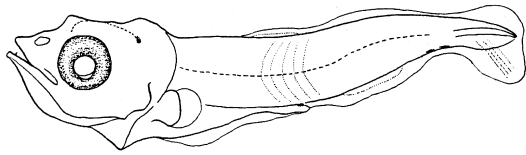
Photophores discussed:



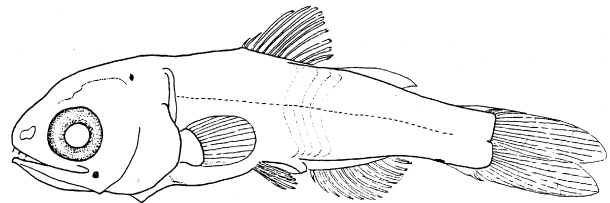
Figures: Adult (*B. supralateralis*) Hulley, 1984b; **A–B, E, G–H:** Ozawa, 1986c (**E** reversed); **C–D:** Moser and Ahlstrom, 1972; **F:** Moser and Ahlstrom, 1974

References: Moser and Ahlstrom, 1972; 1974; Moser *et al.*, 1984; Hulley, 1984b; Ozawa, 1986c; Karnella, 1987; Moser and Watson, 2001

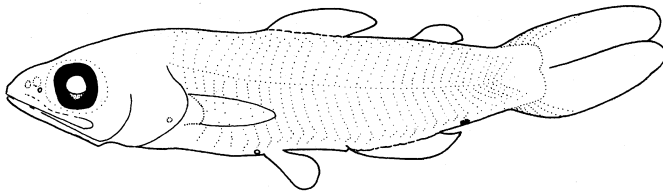
Bolinichthys sp.



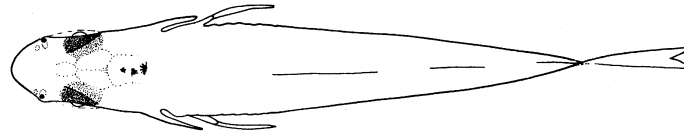
A. 4.0 mmSL



B. 5.8 mmSL

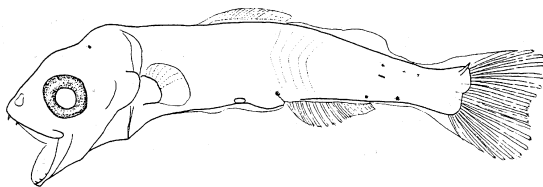


C. 10.6 mmSL

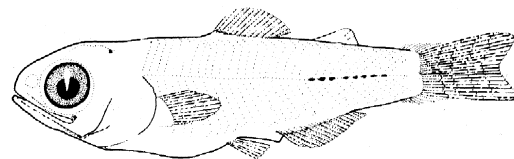


**D. 10.6 mmSL
(Dorsal View)**

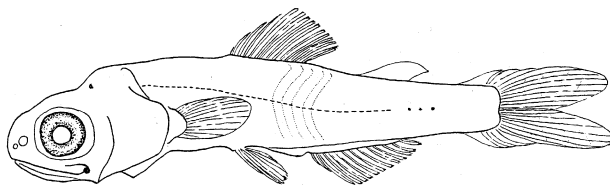
Bolinichthys distofax



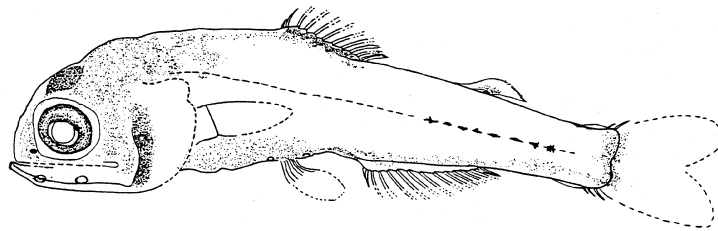
E. 4.8 mmSL



F. 9.4 mmSL

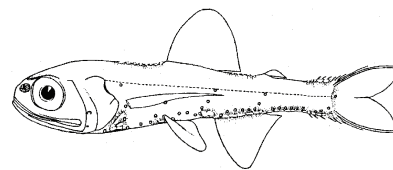


G. 9.7 mmSL



H. 11.5 mmSL

Note: This series is an example of one type of *Bolinichthys* larva; this species does not occur in study area

Ceratoscopelus maderensis* (Lowe, 1839)*Myctophidae (s.f. Lampanyctinae)****Horned lanternfish**

Range: North Atlantic Ocean and Mediterranean Sea; in the western North Atlantic from Flemish Cap to Sargasso Sea; very abundant in continental slope water

Habitat: Mesopelagic in depths of 330–600 m during the day, 0–175 m at night

Spawning: Begins in spring and reaches a strong peak during summer and fall

Eggs: – Undescribed; hatching length <5.0 mmSL

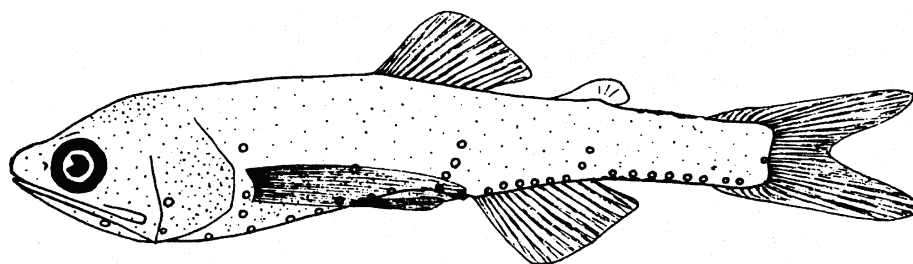
Larvae:

- Body elongate, moderately slender
- Head relatively small, snout lengthens through development; eye round, with sliver of choroid tissue ventrally
- Gut moderately slender; preanus length >50% SL in small larvae, increases to >60% SL in larger larvae
- Flexion occurs at about 6.0 mmSL
- Sequence of fin ray formation: C and P₁ early; all fin rays formed by about 16 mmSL
- Photophore development: Br₂, Vn, PLO and PO₅ form between 7.0 and 11.0 mmSL; photophores very small
- Pigmentation: a series of large spots on venter of the caudal peduncle are joined to a series of smaller spots extending forward to anus in small larvae; the smaller ventral series disappears in larger larvae; 3 or 4 large melanophores on dorsal edge of caudal peduncle throughout development; other melanophores occur on crown, over the anus and on lateral surface of gut
- Transformation occurs at about 16.0 mmSL

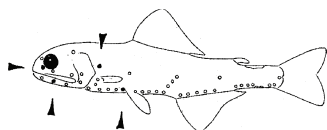
Meristic Characters

Myomeres:	37
Vertebrae:	37
Dorsal fin rays:	13–15
Anal fin rays:	13–15
Pectoral fin rays:	13–14
Pelvic fin rays:	8
Caudal fin rays:	7+10+9+6–7

- Note:**
1. Similar larvae of *Ceratoscopelus warmingi* lack dorsal pigment on caudal peduncle
 2. Larvae of *Lepidophanes guentheri* and *L. gaussi* are slimmer-bodied; *L. guentheri* larvae have a prominent melanophore on lateral surface of foregut, not present in *C. maderensis* larvae

Early Juvenile:**G. 16.0 mmSL**

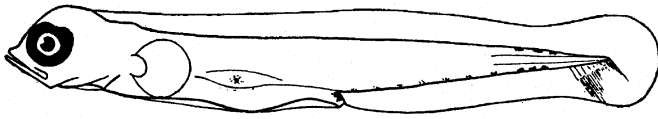
Photophores discussed:



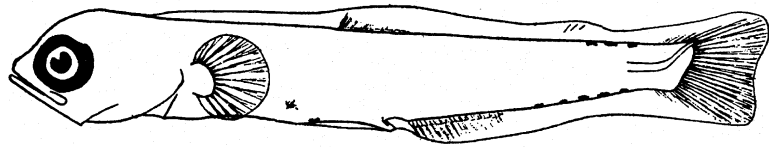
Figures: Adult: Hulley, 1984b; A–C, F–G: Täning, 1918 (G modified); D–E: Moser and Ahlstrom, 1972

References: Moser and Ahlstrom, 1970; 1972; 1974; 1996b; Moser *et al.*, 1984; Hulley, 1984b; Karnella, 1987; Moser and Watson, 2001

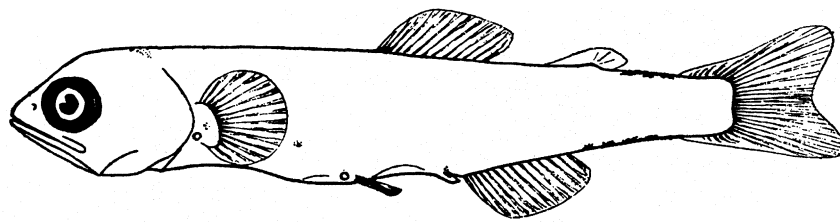
Ceratoscopelus maderensis



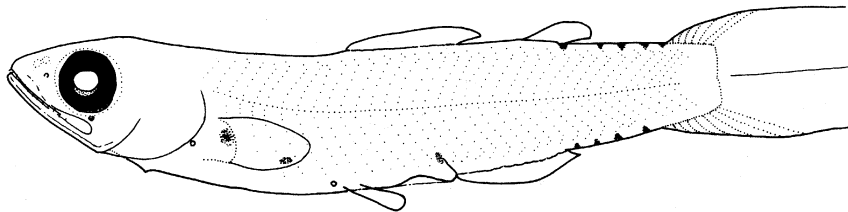
A. 5.0 mmSL



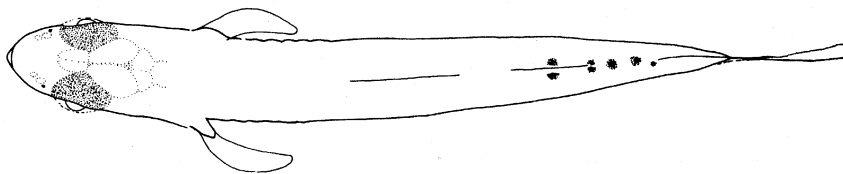
B. 7.0 mmSL



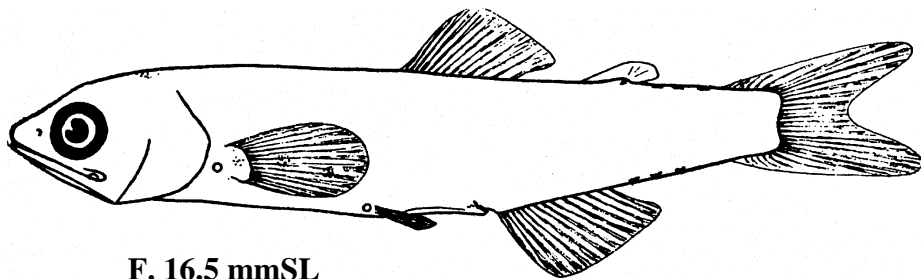
C. 11.5 mmSL



D. 13.4 mmSL



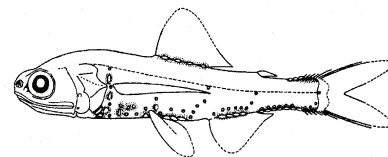
E. 13.4 mmSL
(Dorsal View)



F. 16.5 mmSL

Ceratoscopelus warmingi* (Lütken, 1892)*Myctophidae (s.f. Lampanyctinae)**

No common name



Range: Atlantic, Pacific and Indian oceans in tropical and subtropical waters; in the western Atlantic from SE of Grand Bank to Argentina

Habitat: Mesopelagic in depths of 425–1,000 m during the day, 0–125 m at night

Spawning: Spring to fall with a peak during late spring based on sampling north of Bermuda

Eggs: – Undescribed; hatching length <3.0 mmSL

Larvae:

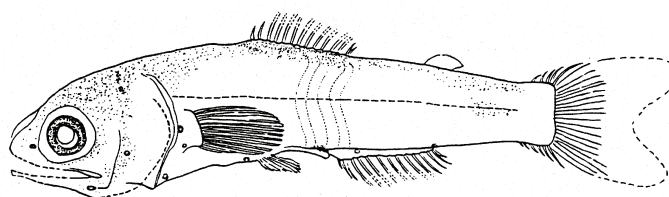
- Body moderately slender
- Head relatively small; pointy snout becomes rounded in later larvae
- Eye large, very slightly elliptical, with small sliver of choroid tissue ventrally in preflexion larvae
- Gut slender; preanus length increases from about 50% SL to <60% SL
- Flexion occurs at 5.0–6.0 mmSL
- Sequence of fin ray formation: C_1 , – P_1 – A, D – P_2 – C_2
- Photophore development: Br_2 and Vn photophores form at about 5.0 mm, PLO and PO_5 at about 8.0 mm; OP and PO_1 form as transformation begins
- Pigmentation: 6–7 ventral melanophores along tail are reduced to a single spot over end of anal fin after flexion; internal pigment over air bladder; pair of spots over anus; internal pigment above terminus of notochord in late flexion larvae; some late larvae develop few spots in otic region and over hindbrain
- Transformation occurs at about 15.0 mmSL

Meristic Characters

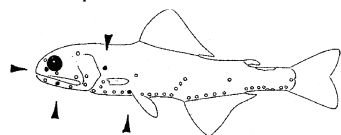
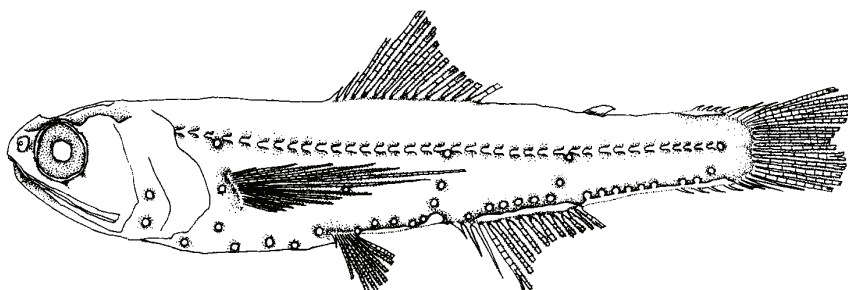
Myomeres:	35–36
Vertebrae:	35–36
Dorsal fin rays:	13–15
Anal fin rays:	13–15
Pectoral fin rays:	12–15
Pelvic fin rays:	8
Caudal fin rays:	6+10+9+6–7

Note: 1. Similar to larvae of *Bolinichthys distofax* (a tropical species), but more slender, with smaller and more narrow eyes and presence of photophores during larval stage; similar *Diaphus* larvae have spots at base of caudal fin

2. See notes on *Ceratoscopelus maderensis* page

Early Juvenile:**E. 14.5 mmSL****Juvenile:**

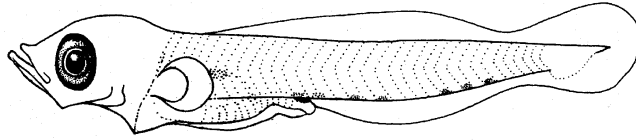
Photophores discussed:

**F. 50.7 mmSL**

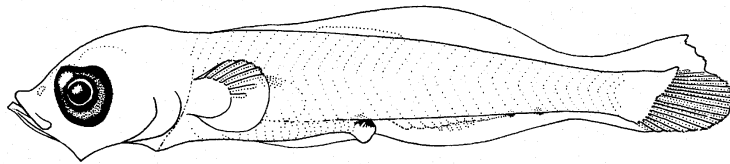
Figures: Adult: Hulley, 1984b; **A–D:** R. C. Walker (Moser and Watson, 2001); **E:** Ozawa, 1986c (reversed); **F:** Y. Karita (Amaoka *et al.*, 1992)

References: Moser and Ahlstrom, 1970; 1972; 1974; 1996b; Moser *et al.*, 1984; Hulley, 1984b; Karnella, 1987; Moser and Watson, 2001

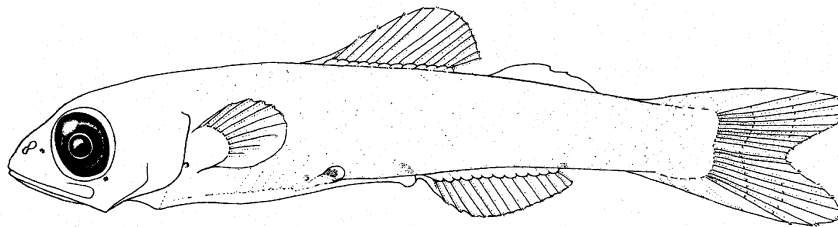
Ceratoscopelus warmingi



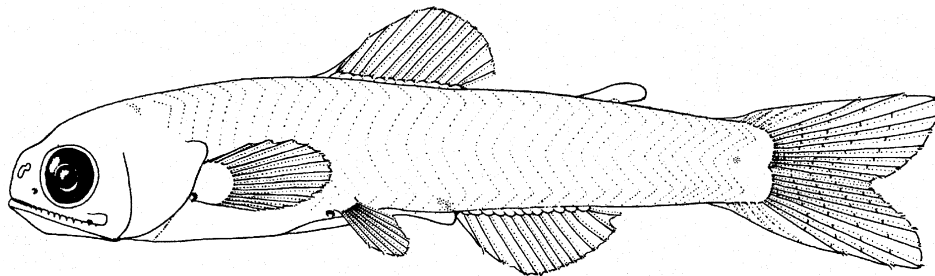
A. 4.4 mmSL



B. 5.5 mmSL



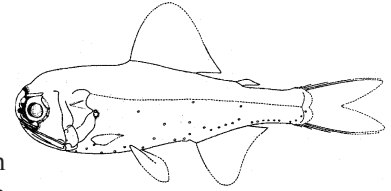
C. 8.1 mmSL



D. 13.5 mmSL

Diaphus metopoclampus* (Cocco, 1829)*Myctophidae (s.f. Lampanyctinae)**

No common name



Range: Atlantic, Pacific and Indian oceans in tropical or subtropical waters; rare in Mediterranean Sea; in the western North Atlantic from east of Flemish Cap to Gulf of Mexico

Habitat: Highly oceanic; mesopelagic in depths of 375–850 m during the day, 90–850 m at night

Spawning: Spring-summer; reproduction in North Atlantic may be restricted to subtropical waters east of 40°W; sampling north of Bermuda suggests possibility of migrations associated with spawning

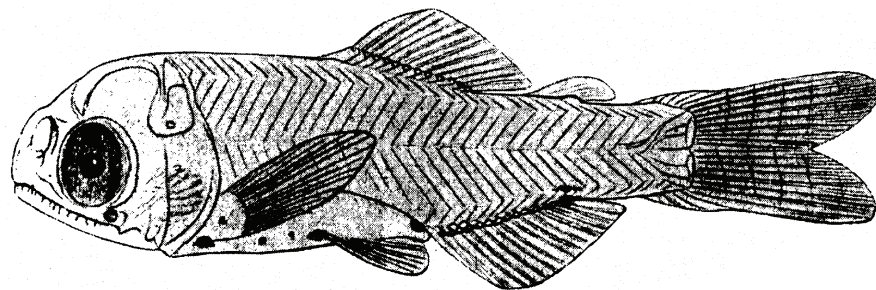
Eggs: – Undescribed; hatching length undescribed, but <4.5 mmSL

Larvae:

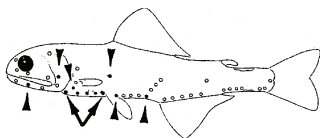
- Body typical of the deep-bodied *Diaphus* larval form (see box)
- Head somewhat bulbous with short snout; eye round, moderately large
- Gut fairly thick anteriorly, narrowed posteriorly; preanus length initially about 50% SL, increases to about 60% SL throughout larval stage
- Flexion occurs at about 5.0 mmSL
- Sequence of fin ray formation, uncertain; possibly C – D, A – P₁ – P₂
- Photophore development: uncertain; based on Sparta's (1952) description, at least the Br₂ and OP₂ form during the larval stage; several photophores in the PO series, and possibly the VLO, probably form as transformation begins
- Pigmentation: a ventral melanophore on mid-tail, near site of anal fin insertion; pair of spots over anus; spots at base of caudal and venter of gut are typical in *Diaphus* larvae, but are not indicated in Sparta's (1952) illustrations. Illustrations may be incomplete (Moser and Watson, 2001)
- Transformation occurs at about 11.0 mmSL

Meristic Characters

Myomeres:	35
Vertebrae:	35
Dorsal fin rays:	14–16
Anal fin rays:	14–16
Pectoral fin rays:	10–11
Pelvic fin rays:	8
Caudal fin rays:	6+10+9+6

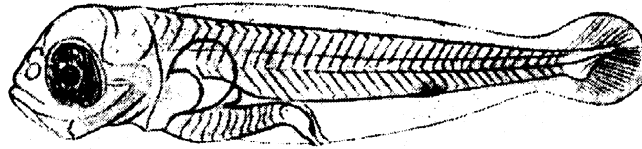
Early Juvenile:**E. 11.4 mmSL**

Photophores discussed:
(pertinent to genus *Diaphus*)

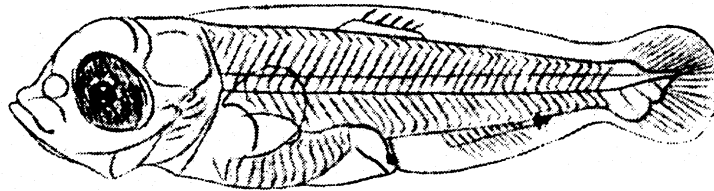


Figures: Adult: Hulley, 1984b; A–E: Sparta, 1952

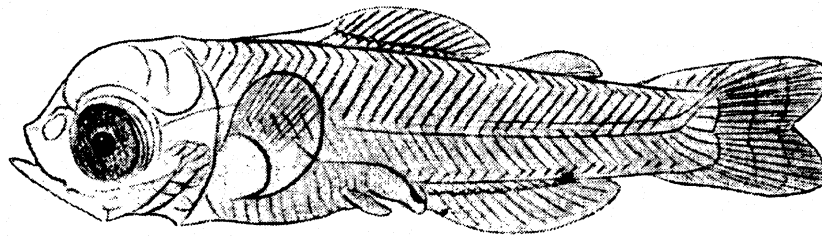
References: Moser and Ahlstrom, 1970; 1972; 1974; 1996b; Moser *et al.*, 1984; Hulley, 1984b; Karnella, 1987; Moser and Watson, 2001

Diaphus metopoclampus

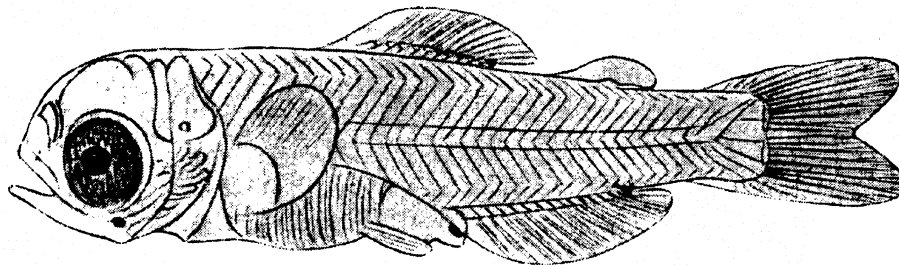
A. 4.5 mmSL



B. 4.8 mmSL



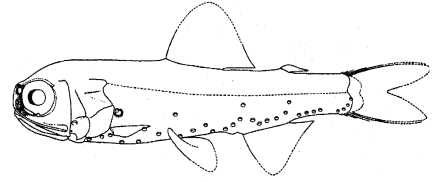
C. 4.9 mmSL



D. 7.9 mmSL

Diaphus larvae can be divided into 2 forms (Moser *et al.*, 1984). The first is slender-bodied, with moderate head, forms as many as 9 photophores before transformation and has numerous, persistent ventral melanophores along the midline posterior to the anus. The second is deeper-bodied, with larger head, forms as many as 6 photophores before transformation and has fewer ventral, postanal melanophores that coalesce into one prominent spot over the anal fin insertion before flexion. Common characters in *Diaphus* larvae include unpigmented head, prominent spot on antero-ventral surface of liver, 1 or more spot at base of caudal fin and internal pigment on air bladder. The larvae of only a few species in *Diaphus* have been described. Larvae of *Diaphus metopoclampus* are representative of the second, deep-bodied form.

***Diaphus mollis* Tåning, 1928**
Myctophidae (s.f. Lampanyctinae)
 No common name



Range: Atlantic, Pacific and Indian oceans, mostly in tropical and subtropical waters; in the western Atlantic from east of Flemish Cap to Argentina

Habitat: Highly oceanic; mesopelagic in depths of 325–650 m during the day, 0–225 m at night

Spawning: Early spring to fall, with a peak in late spring, based on sampling north of Bermuda; life cycle is about one year, and most adults die before winter, although a few adults may live longer and spawn more than once

Eggs: – Undescribed; hatching length undescribed

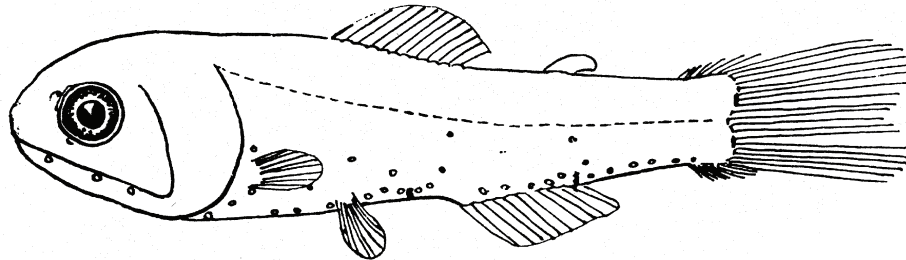
Larvae:

- Body typical of the deep-bodied *Diaphus* larval form (see box)
- Head somewhat bulbous with rounded snout; eye round, moderately large
- Gut fairly thick anteriorly, narrowed posteriorly; preanus length 55–60% SL
- Flexion occurs at <5.1 mmSL
- Sequence of fin ray formation: undescribed
- Photophore development: Br₂, several PO, OP₂, VLO, several VO and some AO may form before transformation (based on illustrations)
- Pigmentation: melanophores at base of caudal fin; a single ventral melanophore over end of anal fin
- Transformation occurs at about 10 mmSL

Meristic Characters

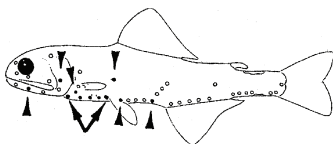
Myomeres:	33–34
Vertebrae:	33–34
Dorsal fin rays:	12–14
Anal fin rays:	12–14
Pectoral fin rays:	9–12
Pelvic fin rays:	8
Caudal fin rays:	7–8+10+9+7

Early Juvenile:



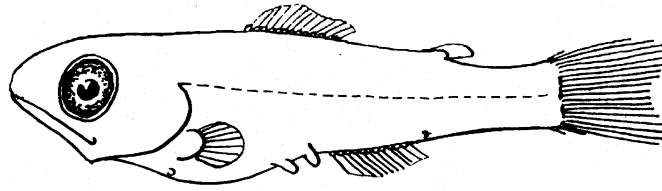
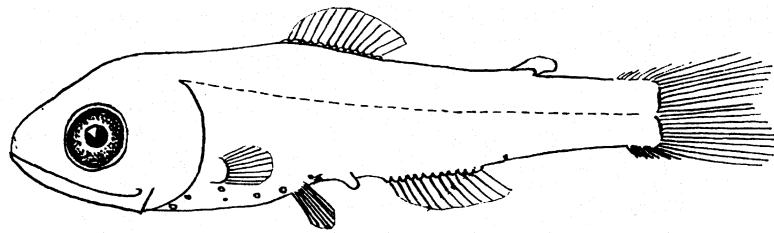
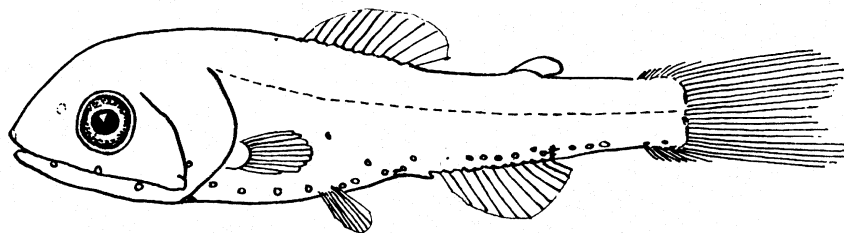
D. 9.6 mmSL

Photophores discussed:
 (pertinent to genus *Diaphus*)



Figures: Adult: Hulley, 1984b; A–D: Shiganova, 1977

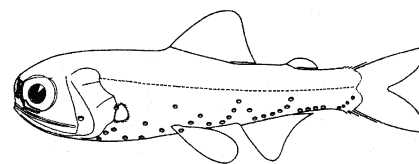
References: Moser and Ahlstrom, 1970; 1972; 1974; 1996b; Moser *et al.*, 1984; Hulley, 1984b; Karnella, 1987; Moser and Watson, 2001

Diaphus mollis**A. 5.1 mmSL****B. 8.0 mmSL****C. 9.4 mmSL**

Diaphus larvae can be divided into 2 forms (Moser *et al.*, 1984). The first is slender-bodied, with moderate head, forms as many as 9 photophores before transformation and has numerous, persistent ventral melanophores along the midline posterior to the anus. The second is deeper-bodied, with larger head, forms as many as 6 photophores before transformation and has fewer ventral, postanal melanophores that coalesce into one prominent spot over the anal fin insertion before flexion. Common characters in *Diaphus* larvae include unpigmented head, prominent spot on antero-ventral surface of liver, 1 or more spot at base of caudal fin and internal pigment on air bladder. The larvae of only a few species in *Diaphus* have been described. Larvae of *Diaphus mollis* are representative of the second, deep-bodied form.

Diaphus rafinesquii* (Cocco, 1838)*Myctophidae (s.f. Lampanyctinae)**

No common name



Range: Atlantic Ocean and Mediterranean Sea in temperate to subtropical waters; in the western North Atlantic from Flemish Cap to Gulf of Mexico

Habitat: Highly oceanic; mesopelagic in depths of 325–750 m during the day, 40–275 m at night

Spawning: Peak in fall-winter but location not well described; may involve spawning migrations into and out of area north of Bermuda

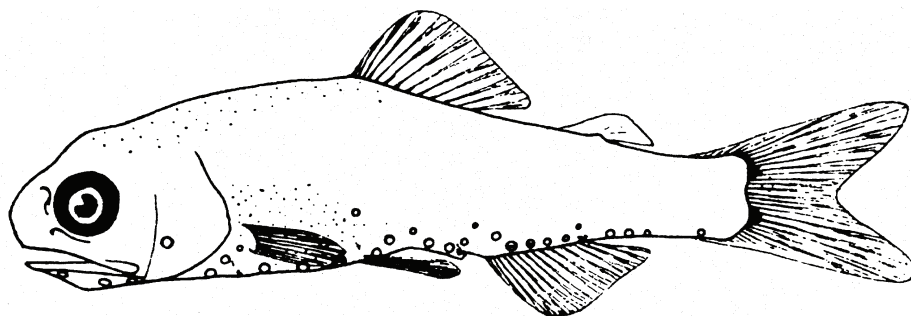
Eggs: – Undescribed; hatching length undescribed

Larvae:

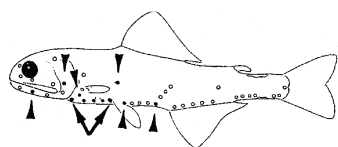
- Body typical of the deep-bodied *Diaphus* larval morph (see box)
- Head somewhat bulbous with pointy snout becoming short and rounded; eye round, moderately large
- Gut thickened anteriorly, more narrow posteriorly; preanus length about 60% SL
- Flexion occurs at 4.0–5.0 mmSL
- Sequence of fin ray formation: $C_1 - D, A - C_2, P_1 - P_2$
- Photophore development: Br_2 and PO_5 form by about 7.0 mm; most others by 10.0 mmSL
- Pigmentation: melanophores at base of caudal fin; a single ventral melanophore over end of anal fin; a single melanophore on venter of gut posterior to cleithral symphysis, a spot on each side of mid-gut and a pair of spots over anus
- Transformation occurs at about 10.0 mmSL

Meristic Characters

Myomeres:	33–34
Vertebrae:	33–34
Dorsal fin rays:	12–14
Anal fin rays:	13–15
Pectoral fin rays:	9–11
Pelvic fin rays:	8
Caudal fin rays:	6–8+10+9+6–7

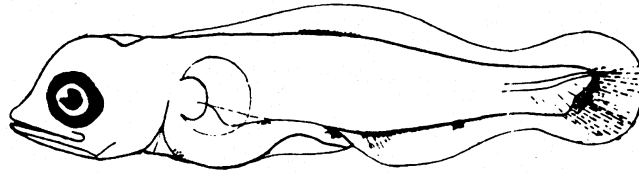
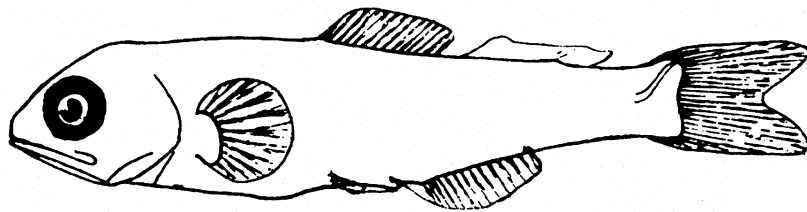
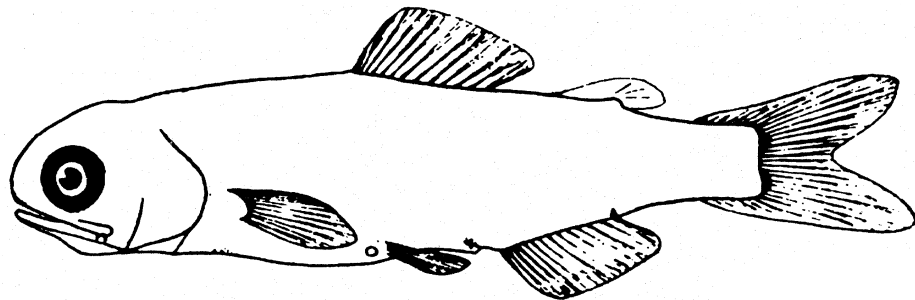
Early Juvenile:**D. 10.0 mmSL**

Photophores discussed:
(pertinent to genus *Diaphus*)



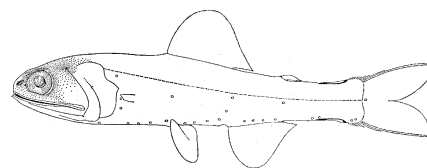
Figures: Adult: Hulley, 1984b; A–D: Tåning, 1918

References: Moser and Ahlstrom, 1970; 1972; 1974; 1996b; Moser *et al.*, 1984; Hulley, 1984b; Karnella, 1987; Moser and Watson, 2001

Diaphus rafinesquii**A. 4.5 mmSL****B. 6.0 mmSL****C. 9.5 mmSL**

Diaphus larvae can be divided into 2 forms (Moser *et al.*, 1984). The first is slender-bodied, with moderate head, forms as many as 9 photophores before transformation and has numerous, persistent ventral melanophores along the midline posterior to the anus. The second is deeper-bodied, with larger head, forms as many as 6 photophores before transformation and has fewer ventral, postanal melanophores that coalesce into one prominent spot over the anal fin insertion before flexion. Common characters in *Diaphus* larvae include unpigmented head, prominent spot on antero-ventral surface of liver, 1 or more spot at base of caudal fin and internal pigment on air bladder. The larvae of only a few species in *Diaphus* have been described. Larvae of *Diaphus rafinesquii* are representative of the second, deep-bodied form.

***Lampadena anomala* Parr, 1928**
Myctophidae (s.f. Lampanyctinae)
 No common name



Range: Atlantic, Pacific and Indian oceans in tropical and subtropical waters; in the western North Atlantic from NE Georges Bank and Hudson Canyon to northern South America

Habitat: Mesopelagic in depths of 800–2,000 m during the day, 330–600 m at night

Spawning: Undescribed

Eggs: – Undescribed; hatching length undescribed

Larvae:

- Body moderately elongate
- Head moderate in size
- Eye round, moderately large
- Note characteristic outline of head and snout
- Gut long and slightly thickened; preanus length <70% SL
- Flexion occurs at about 6.0 mmSL
- Sequence of fin ray formation: undescribed; C_1 presumably first to form, P_2 last
- Photophore development: Br_2 , PO_5 and PLO form early, as in larvae of other species of *Lampadena*
- Pigmentation: as many as 6 pairs of melanophores along dorsum, from nape to end of dorsal fin; irregular number of unpaired spots on dorsum under developing adipose fin; series of internal spots over gut; series of spots along anal fin base; after flexion some of the foregoing melanophores disappear or fade away, and internal, small spots form in various locations around the head; series of spots forms along lateral midline of tail and scattered spots on caudal fin
- Transformation occurs at >11.0 mmSL

Meristic Characters

(of larvae in Figs. A and D)

Myomeres: about 35–36

Vertebrae: 36–37

Dorsal fin rays: 15

Anal fin rays: about 14

Pectoral fin rays: 17

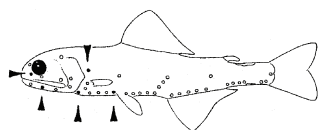
Pelvic fin rays: 8

Caudal fin rays: 6+10+9+6

(compare to meristic characters of adult *L. anomala* in Myctophiformes Introductory Table)

- Note:**
1. The illustrated larvae were described as *Lampadena* sp. I and *Lampadena* sp. by Ozawa (1986c) and Moser and Watson (2001) respectively. The latter authors assigned their larvae to *Lampadena* based on pigmentation characters and the sequential, early development of Br_2 , PLO and PO_5 photophores, followed by V_n and PO_1 . Their suggestion of *L. anomala* as the specific identity was based on larval characters, resemblance of larvae to Ozawa's *Lampadena* sp. I and II, and distribution. Ozawa (1986c) referred to the following characters of *Lampadena* larvae as the basis for assigning 3 kinds of larvae (including the one illustrated here) to that genus: body moderately slender or moderately deep; melanophores on body restricted to dorsal and ventral contours (except a few spots on lateral midline in 1 type of larva); and the sequential development of Br_2 , PVO_2 and PO_5 .
 2. The location of Moser and Watson's (2001) PLO and Ozawa's (1986c) PVO_2 , is the same (middle of pectoral fin base), and therefore refer to the same photophore.

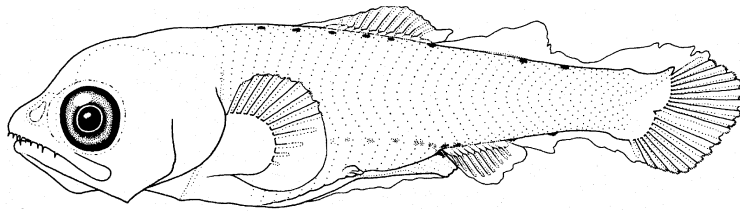
Photophores discussed:



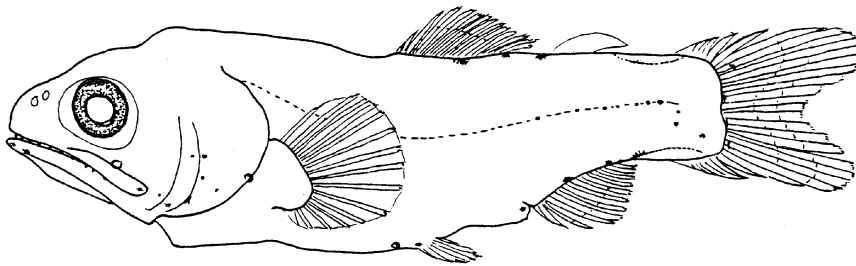
Figures: Adult: Nafpaktitis *et al.*, 1977; **A, D**: William Watson (Moser and Watson, 2001); **B–C**: Ozawa, 1986

References: Moser and Ahlstrom, 1970; 1972; 1974; 1996b; Moser *et al.*, 1984; Hulley, 1984b; Karnella, 1987; Moser and Watson, 2001

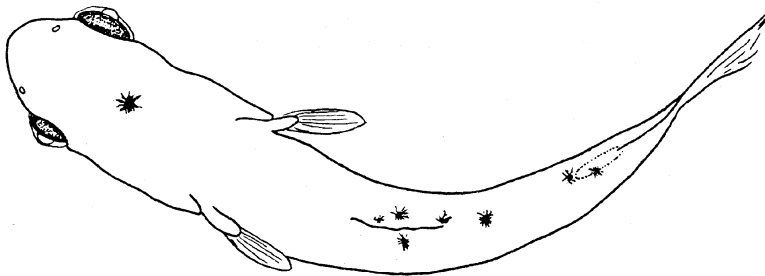
Lampadena anomala
(Putative)



A. 6.4 mmSL



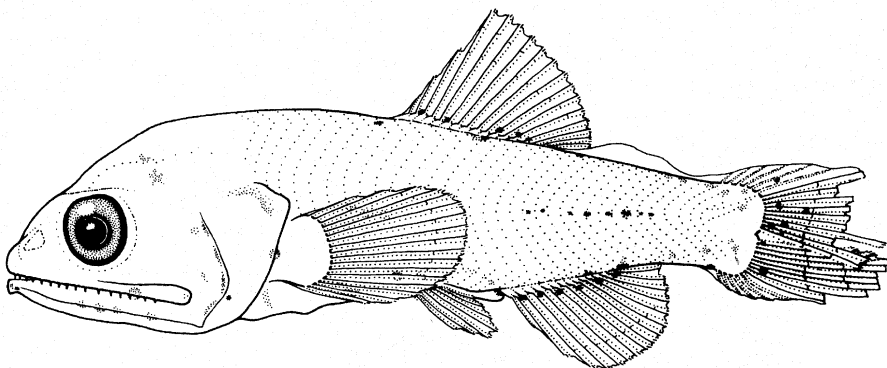
B. 10.1 mmSL



C. 10.1 mmSL (Dorsal View)

Meristic characters
of B and C:

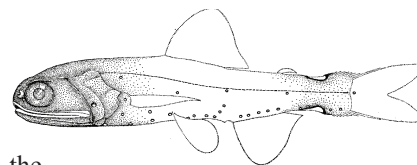
Myomeres: 35
D: 15
A: 13
P₁: 15
P₂: 8



D. 11.2 mmSL

Lampadena luminosa* (Garman, 1899)*Myctophidae (s.f. Lampanyctinae)**

No common name



Range: Atlantic, Pacific and Indian oceans in tropical and subtropical waters; in the western North Atlantic from south of Grand Bank to Lesser Antilles

Habitat: Mesopelagic in depths of 425–850 m during the day, 40–225 m at night

Spawning: Undescribed

Eggs: – Undescribed; hatching length <3.8 mmSL

Larvae:

- Body moderately slender, deepens only slightly through development
- Head moderately small, with rounded snout; eye moderately large and round
- Gut almost uniform in diameter entire length; slightly thicker anteriorly
- Preanus length increases slightly from about 50% SL in preflexion to about 60% SL in larger larvae
- Flexion occurs at about 5.5–6.0 mmSL
- Sequence of fin ray formation: $C_1 - A, D, C_2 - P_1 - P_2$
- Photophore development: Br_2 forms at about 6.0 mm; PLO at about 10.0 mm; PO_5 at about 12.5 mm
- Pigmentation: internal pigment over air bladder, on midline of anterior gut; a series of spots along venter of postanal portion of body becomes reduced in number and coalesce to 2; short series on dorsum of caudal peduncle, eventually reaching from end of dorsal fin to caudal fin base; prominent spot over anus throughout development
- Transformation occurs at about 20 mmSL

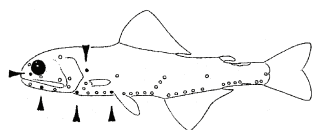
Meristic Characters

Myomeres:	35–37
Vertebrae:	35–37
Dorsal fin rays:	14–15
Anal fin rays:	13–15
Pectoral fin rays:	15–17
Pelvic fin rays:	8
Caudal fin rays:	8+10+9+8

Note:

1. Similar larvae of *Diaphus* have fewer, more irregularly spaced melanophores in venter, postanal series and have a distinct melanophore at edge of developing hypurals.
2. Similar larvae of *Ceratoscopelus* lack melanophore on ventral midline of gut

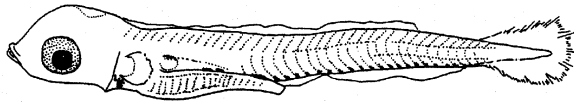
Photophores discussed:



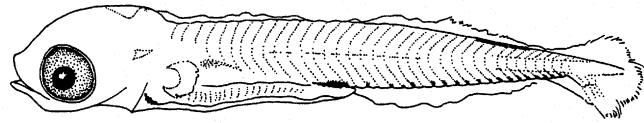
Figures: Adult: Nafpaktitis *et al.*, 1977; **A–F**: J. Corbera (Olivar *et al.*, 1999); **G**: Moser and Ahlstrom, 1974

References: Moser and Ahlstrom, 1970; 1972; 1974; 1996b; Moser *et al.*, 1984; Hulley, 1984b; Karnella, 1987; Moser and Watson, 2001

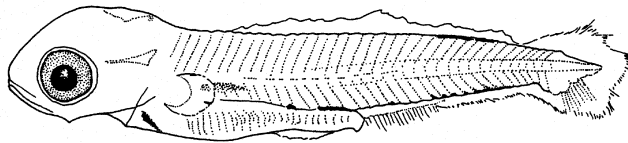
Lampadena luminosa



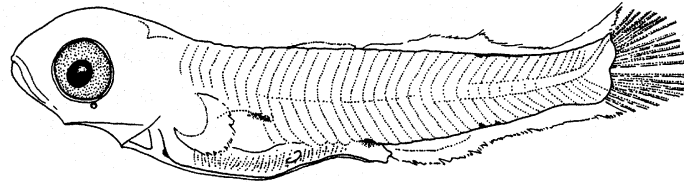
A. 3.8 mmSL



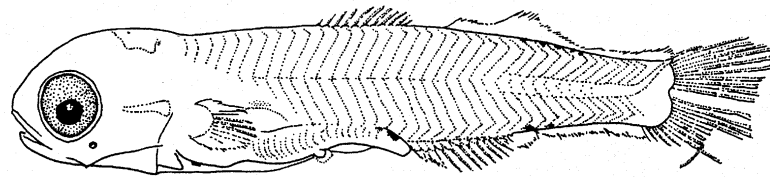
B. 5.0 mmSL



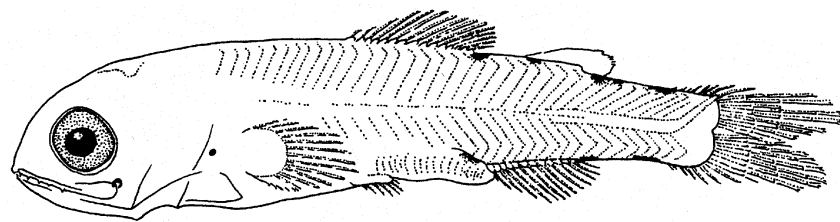
C. 5.7 mmSL



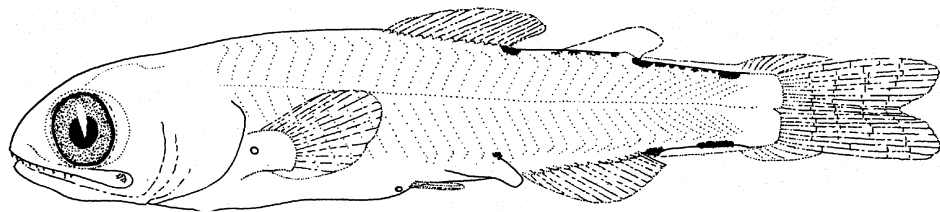
D. 5.8 mmSL



E. 7.5 mmSL



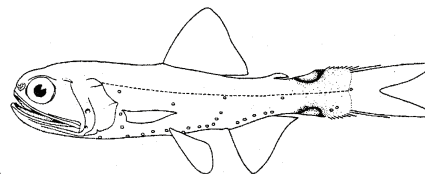
F. 9.2 mmSL



G. 12.8 mmSL

Lampadena urophaos* Maul, 1969*Myctophidae (s.f. Lampanyctinae)**

No common name



Range: Atlantic and Pacific oceans; in the western North Atlantic from Grand Bank to the Bahamas

Habitat: Mesopelagic in depths of 550–1,000 m during the day, 60–225 m at night

Spawning: Uncertain; probably prolonged in northern Sargasso Sea, with peak in late spring or summer

Eggs: – Undescribed; hatching length <2.9 mmSL

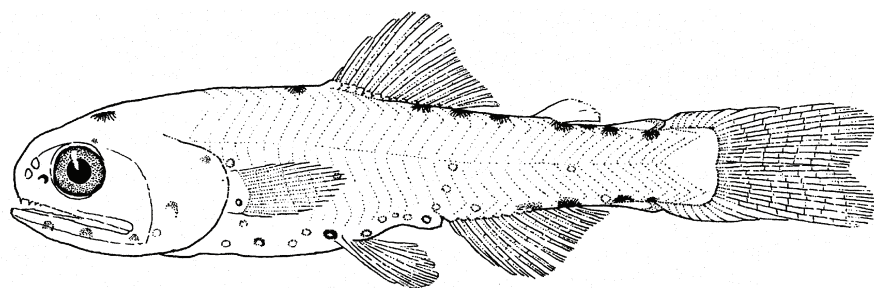
Larvae:

- Body initially elongate, deepens slightly with development
- Head moderate in size, with rounded snout; eye round, becomes larger with development
- Gut fairly uniform in diameter, slightly thicker anteriorly
- Preanus length increases from about 50% SL to about 60% SL
- Flexion occurs at 6.8–8.3 mmSL
- Sequence of fin ray formation: $C_1 - D, A - C_2 - P_2 - P_1$
- Photophore development: Br_2 forms at about 6.5–7.2 mm; PLO at 7.2–8.0 mm; PO_5 at 8.5–9.5 mm; PO_1 and V_n by 13.5 mm
- Pigmentation: initially a melanophore over air bladder, over gut and on venter of mid-tail; an elongate spot forms at mid-dorsum of tail over ventral spot; additional dorsal spots added, as far anteriorly as dorsal fin origin; other spots formed at nape and hindbrain
- Transformation occurs at about 17–21 mmSL

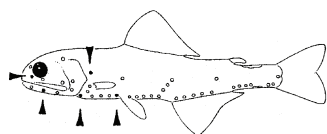
Meristic Characters

Myomeres:	35–38
Vertebrae:	35–38
Dorsal fin rays:	14–16
Anal fin rays:	13–14
Pectoral fin rays:	14–17
Pelvic fin rays:	8
Caudal fin rays:	8–9+10+9+8–9

Note: 1. Heavy dorsal and ventral pigment; photophore development similar to larvae of other *Lampadena* species

Early Juvenile:**F. 20.9 mmSL**

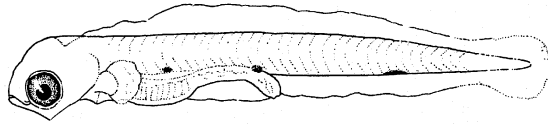
Photophores discussed:



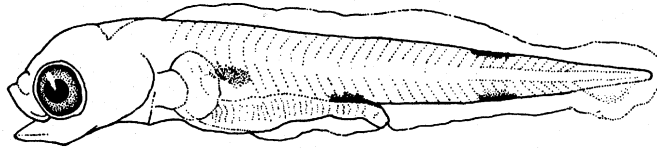
Figures: Adult: Hulley, 1984b; A–F: Moser and Ahlstrom, 1996b

References: Moser and Ahlstrom, 1970; 1972; 1974; 1996b; Moser *et al.*, 1984; Hulley, 1984b; Karnella, 1987; Moser and Watson, 2001

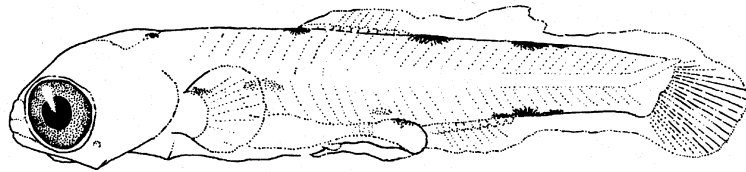
Lampadena urophaos



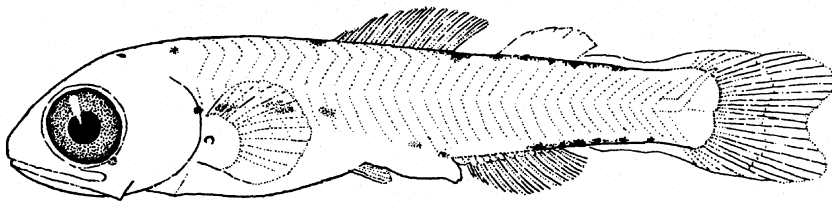
A. 3.7 mmSL



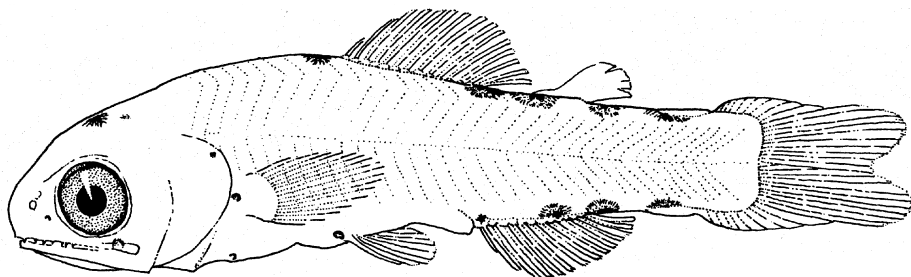
B. 5.6 mmSL



C. 6.8 mmSL



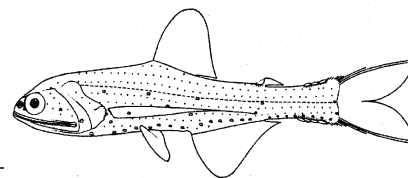
D. 8.8 mmSL



E. 13.4 mmSL

Lampanyctus alatus* Goode and Bean, 1896*Myctophidae (s.f. Lampanyctinae)**

No common name



Range: Atlantic, Pacific and Indian oceans, mostly in tropical waters; in the western North Atlantic mostly in continental slope waters from east of Grand Bank to Brazil

Habitat: Mesopelagic in depths of 275–1,000 m during the day, 40–275 m at night

Spawning: Undescribed in study area

Eggs: – Undescribed; hatching length <2.0 mmSL

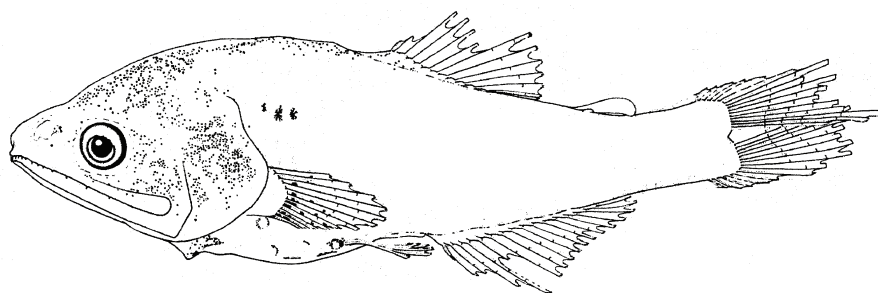
Larvae:

- Body elongate early, becoming deeper with development
- Head moderately large with blunt snout, early forming teeth
- Eye round and moderately large
- Gut initially very short, lengthens during larval period; preanus length increases from 30% SL to <60% SL
- Flexion occurs at 4.5–5.0 mmSL
- Sequence of fin ray formation: C_1 , – D, A – C_2 , P_1 – P_2
- Photophore development: Br_2 forms during flexion stage; other photophores form after transformation
- Pigmentation: prominent melanophore on ventral midline anterior to gut, internal spot anterior to forebrain; more melanophores added to top of head; prominent melanophore over anus; peritoneal pigment present; several spots on isthmus and on pectoral fin blade and lower rays; some pigment on myosepta in late stages
- Transformation occurs at about 11.0 mmSL

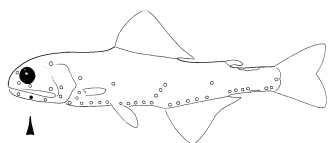
Meristic Characters

Myomeres:	33–36
Vertebrae:	33–36
Dorsal fin rays:	11–13
Anal fin rays:	16–18
Pectoral fin rays:	11–13
Pelvic fin rays:	8
Caudal fin rays:	7+10+9+7–8

- Note:**
1. Body relatively deep and compressed in postflexion and transformation stages
 2. "*Lampanyctus alatus*" as described by Tåning (1918) pertains to *Lampanyctus pusillus*

Early Juvenile:**H. 10.6 mmSL**

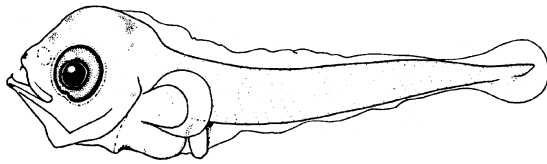
Photophores discussed:



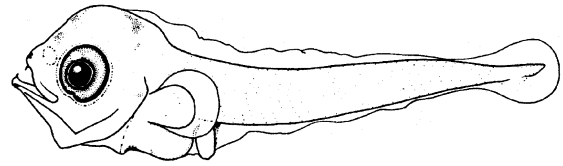
Figures: Adult: Hulley, 1984b; **A–B, G–H:** William Watson (Moser and Watson, 2001); **C–F:** J. Corbera (Olivar and Beckley, 1997)

References: Moser and Ahlstrom, 1970; 1972; 1974; 1996b; Moser *et al.*, 1984; Hulley, 1984b; Karnella, 1987; Moser and Watson, 2001

Lampanyctus alatus

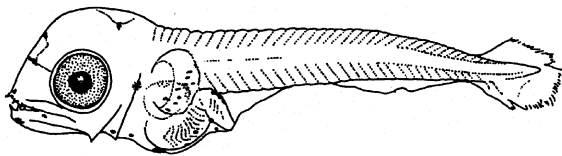


A. 2.0 mmSL



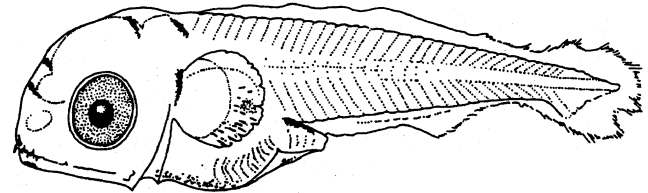
B. 2.9 mmSL

Note mass of early-forming teeth at tip of upper jaw; very short gut lengthens during larval stage



C. 3.6 mmSL

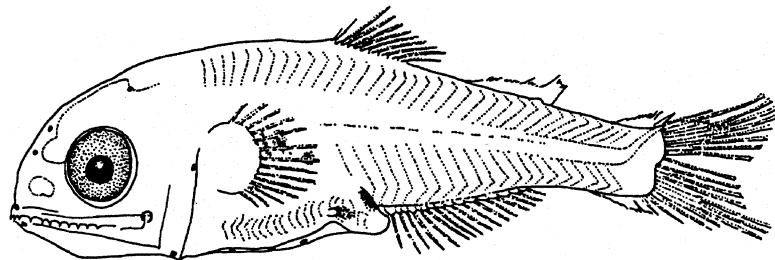
D. 4.3 mmSL



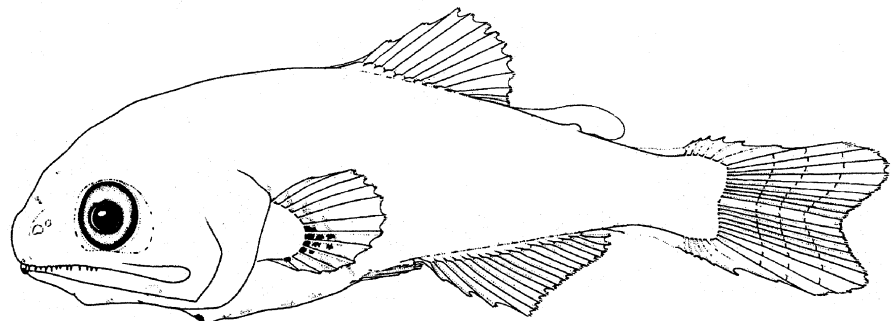
E. 5.5 mmSL

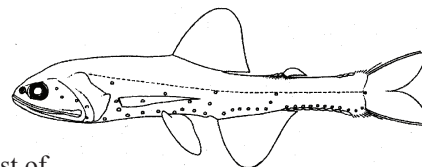
Body posterior to anus relatively unpigmented

F. 6.2 mmSL



G. 8.8 mmSL



Lampanyctus crocodilus* (Risso, 1810)*Myctophidae (s.f. Lampanyctinae)****Jewel lanternfish**

Range: Atlantic Ocean and Mediterranean Sea; in the western North Atlantic east of Flemish Cap to Sargasso Sea

Habitat: Mesopelagic in depths of 275–1,000 m during the day, 0–650 m at night; mostly in high-temperature, high-salinity gyres

Spawning: Winter to summer with peak in winter to late spring, based on sampling north of Bermuda

Eggs: – Undescribed; hatching length undescribed

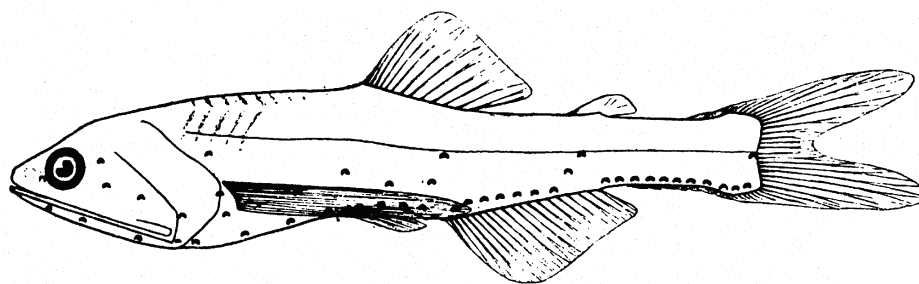
Larvae:

- Body elongate initially, soon deepens, especially through pectoral region
- Head large with pointy snout
- Eye moderately large and round
- Gut thicker anteriorly than at terminus; preanus length increases from about 50% SL to about 60% SL
- Flexion occurs at about 6.0–7.0 mmSL
- Sequence of fin ray formation: C_1 first to form, P_2 last to form
- Photophore development: Br_2 only photophore to form before transformation
- Pigmentation: prominent melanophores on top of head and on dorsum between dorsal and adipose fins; another prominent spot on terminus of gut over anus; peritoneal pigment added in later stages; spots on pectoral fin base; late stages add pigment to anterior myosepta
- Transformation occurs at about 20.0 mmSL

Meristic Characters

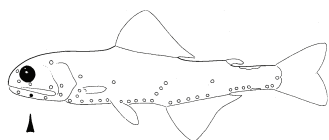
Myomeres:	35–36
Vertebrae:	35–36
Dorsal fin rays:	13–15
Anal fin rays:	16–18
Pectoral fin rays:	13–16
Pelvic fin rays:	8
Caudal fin rays:	8+10+9+8

Note: 1. Larvae of *Lampanyctus pusillus* are similar but are deeper-bodied

Early Juvenile:

E. 23.5 mmSL

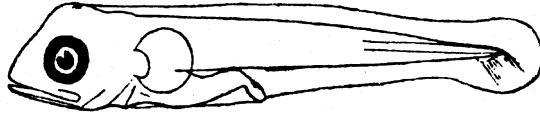
Photophores discussed:



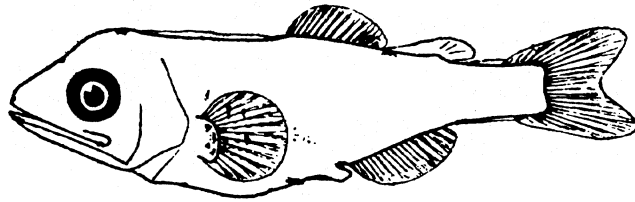
Figures: Adult: Hulley, 1984b; A–E: Tåning, 1918

References: Moser and Ahlstrom, 1970; 1972; 1974; 1996b; Moser *et al.*, 1984; Hulley, 1984b; Karnella, 1987; Moser and Watson, 2001

Lampanyctus crocodilus

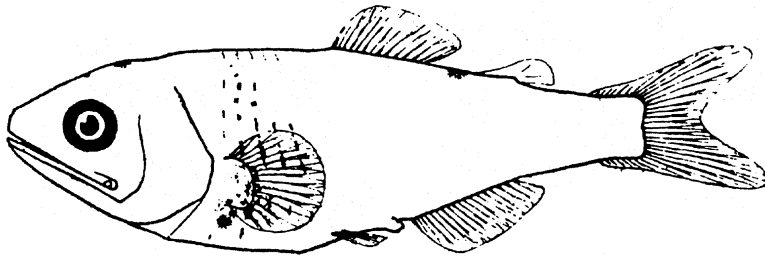


A. 5.5 mmSL

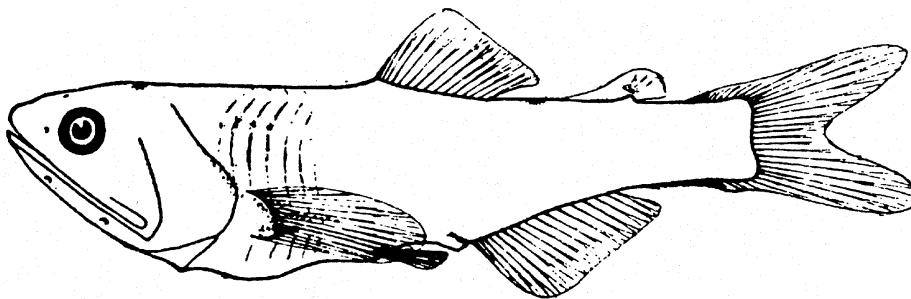


B. 8.0 mmSL

Note mass of early-forming teeth at tip of upper jaw; short gut lengthens during larval stage



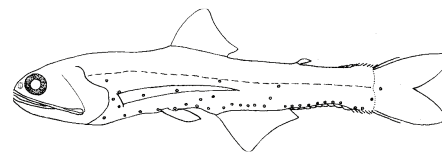
C. 14.0 mmSL



D. 19.0 mmSL

Lampanyctus nobilis* Tåning, 1928*Myctophidae (s.f. Lampanyctinae)**

No common name



Range: Worldwide in tropical waters; in the western North Atlantic from Hudson Canyon to Brazil, but mainly south of 30°N

Habitat: Mesopelagic in depths of 475–750 m during the day, 40–325 m at night

Spawning: Presumably occurs south of Bermuda

Eggs: – Undescribed; hatching length <3.5 mmSL

Larvae:

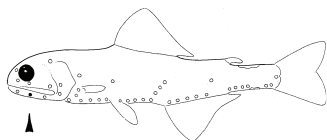
- Body initially elongate, becomes moderately deep, especially through pectoral region
- Head moderately large with massive jaws and slightly pointy snout
- Eye large and round
- Gut with thick anterior section and slender posterior section; preanus length increases from about 40% SL in preflexion stage to about 60% SL in later stages
- Flexion occurs at 5.0–6.5 mmSL
- Sequence of fin ray formation: $C_1 - D, A, C_2 - P_1 - P_2$
- Photophore development: Br_2 forms at about 10 mmSL; other photophores form after transformation
- Pigmentation: melanophores on forebrain and midbrain; spots at tip of lower jaw and 1–4 spots on mid-gular region; internal pigment on air bladder and anterior surface of gut; anterior myosepta become pigmented in larger larvae
- Transformation occurs at about 20 mmSL

Meristic Characters

Myomeres:	37–39
Vertebrae:	37–39
Dorsal fin rays:	14–16
Anal fin rays:	17–20
Pectoral fin rays:	13–15
Pelvic fin rays:	8
Caudal fin rays:	6–7+10+9+6–7

Note: 1. Larvae of this species lack pigment on dorsal surface of gut terminus, although larvae collected from the southwestern Indian Ocean are pigmented in this area (Olivar and Beckley, 1997)

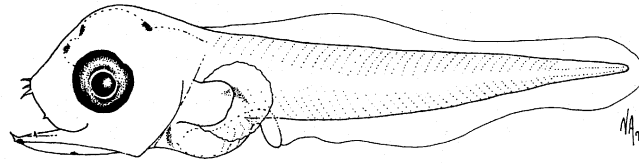
Photophores discussed:



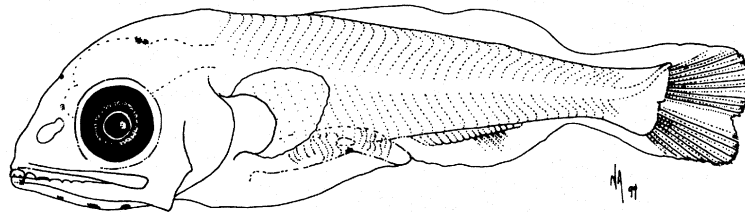
Figures: Adult: Nafpaktitis *et al.*, 1977; **A–B, D:** Nancy Arthur (Moser and Ahlstrom, 1996b); **C:** Henry Orr (Moser and Ahlstrom, 1996b)

References: Moser and Ahlstrom, 1970; 1972; 1974; 1996b; Moser *et al.*, 1984; Hulley, 1984b; Karnella, 1987; Olivar and Beckley, 1997; Moser and Watson, 2001

Lampanyctus nobilis

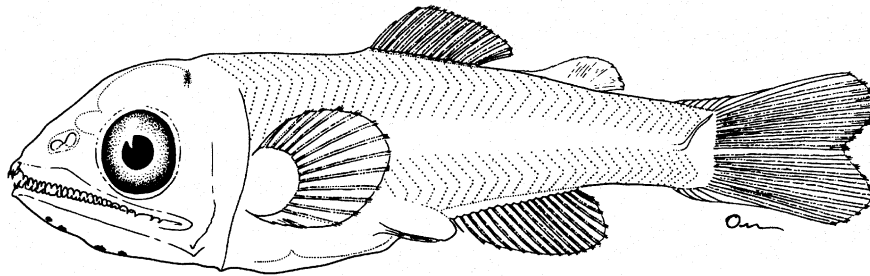


A. 3.5 mmSL



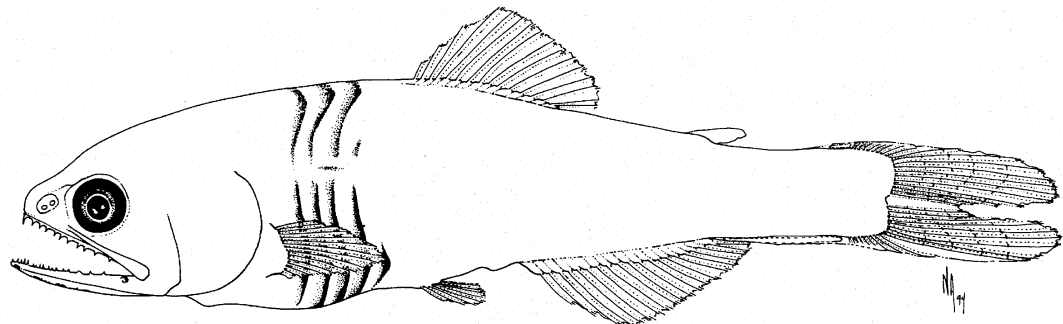
B. 6.2 mmSL

Note mass of early-forming teeth at tip of upper jaw; very short gut lengthens during larval stage



C. 9.6 mmSL

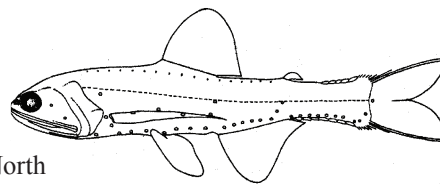
Note line of melanophores along median of gular region



D. 18.3 mmSL

Lampanyctus photonotus* Parr, 1928*Myctophidae (s.f. Lampanyctinae)**

No common name



Range: Atlantic Ocean in tropical and subtropical waters; in the western North Atlantic from east of Flemish Cap to Brazil (absent in Gulf of Mexico)

Habitat: Mesopelagic in depths of 550–1,500 m during the day, 40–175 m at night; common in Slope Water

Spawning: Spring to fall (possibly into winter) with peak in spring or early summer

Eggs: – Undescribed; hatching length undescribed

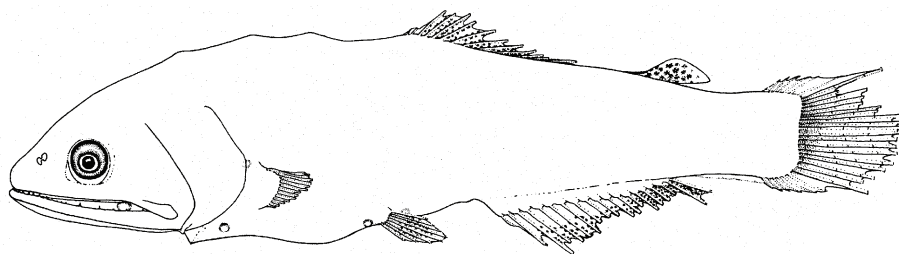
Larvae:

- Body deep, compressed; body depth 30–36% SL until transformation
- Head large, with massive jaws and pointy snout; eye small (compared to most *Lampanyctus* larvae) and slightly off-round
- Gut straight; preanus length decreases from 70% SL to about 60% SL (unusual for *Lampanyctus* larvae)
- Flexion occurs at 4.0–5.0 mmSL
- Sequence of fin ray formation: C, D and A form earliest, P₂ and P₁ form later
- Photophore development: Br₂ only photophore to form before transformation
- Pigmentation: characteristic pattern along dorsum from nape to caudal peduncle; ventral series from gular region to isthmus; several melanophores along midline in brain region; distinct, large spots on predorsal and preanal finfolds; "barred" pattern crosses caudal peduncle; patches of spots on dorsal, anal, pelvic and adipose fins; see figures for other pigment locations
- Transformation occurs at about 20 mmSL

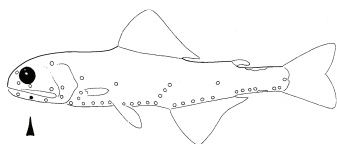
Meristic Characters

Myomeres:	34–36
Vertebrae:	34–36
Dorsal fin rays:	12–15
Anal fin rays:	16–18
Pectoral fin rays:	11–14
Pelvic fin rays:	8
Caudal fin rays:	10+9 (PrC)

Note: 1. This larval series was provisionally assigned to *Lampanyctus photonotus* based on meristic characters and distribution patterns (Moser and Watson, 2001). Larval samples have been collected from western North Atlantic Slope Water between 33° and 39°N (MCZ specimens). They closely resemble larvae of *L. lepidolychnus* from the southwestern Indian Ocean (Olivar and Beckley, 1997).

Early Juvenile:**D. 21.3 mmSL**

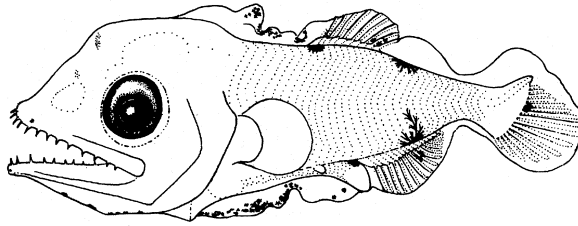
Photophores discussed:



Figures: Hulley, 1984b; **A, C–D:** R. C. Walker (Moser and Watson, 2001); **B:** William Watson (Moser and Watson, 2001)

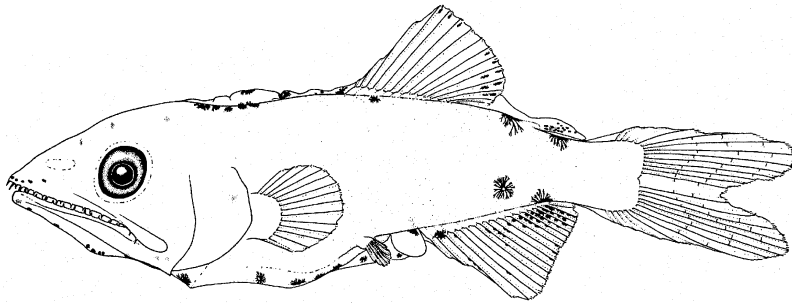
References: Moser and Ahlstrom, 1970; 1972; 1974; 1996b; Moser *et al.*, 1984; Hulley, 1984b; Karnella, 1987; Moser and Watson, 2001

Lampanyctus photonotus
(Putative)

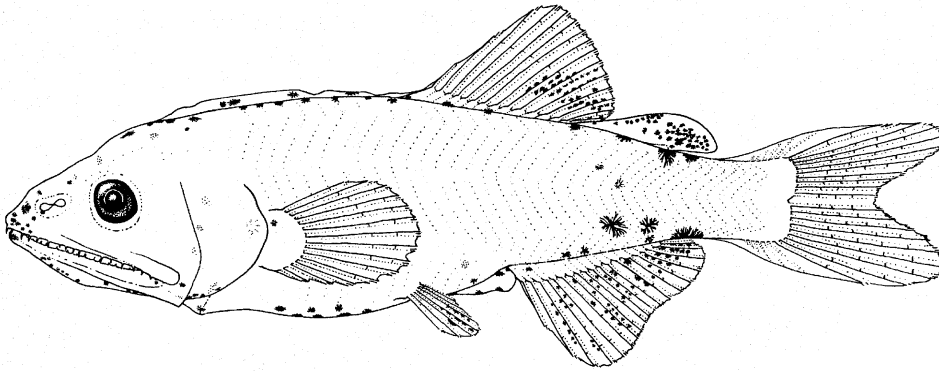


A. 4.3 mmSL

Note mass of early-forming teeth at tip of upper jaw



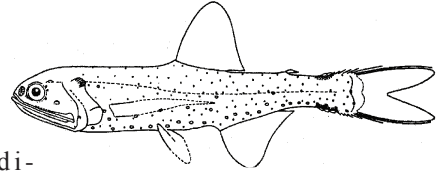
B. 9.8 mmSL



C. 15.4 mmSL

Lampanyctus pusillus* (Johnson, 1890)*Myctophidae (s.f. Lampanyctinae)**

No common name



Range: Worldwide in southern hemisphere; also North Atlantic Ocean and Mediterranean Sea; in the western North Atlantic from Flemish Cap to Sargasso Sea

Habitat: Mesopelagic in depths of 425–850 m during the day, 40–125 m at night

Spawning: Possibly year-round with peak in winter-spring, based on sampling north of Bermuda; life-cycle is about one year, and most spawners die before reaching age 1

Eggs: – Undescribed; hatching length undescribed

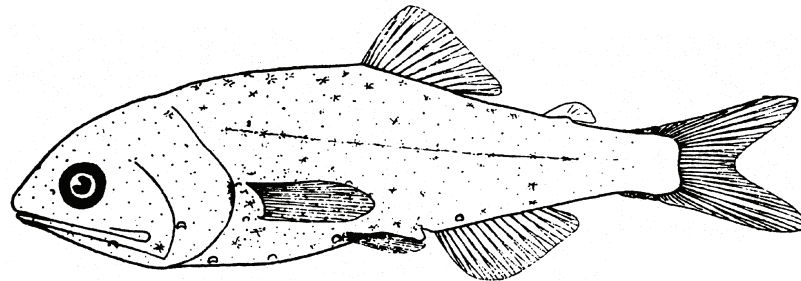
Larvae:

- Body very deep and stout in all early developmental stages, becomes shallow at transformation
- Head large with long gape and blunt, rounded snout (lengthens at transformation)
- Eye large and round
- Gut thick and bulbous, tapers to terminus; preanus length about 65% SL
- Flexion occurs at 4.0–6.0 mmSL
- Sequence of fin ray formation: $C_1 - D, A, C_2, P_1, - P_2$
- Photophore development: Br_2 forms at flexion; other photophores form after transformation
- Pigmentation: 1 to 3 melanophores from snout to top of head; spots at tip of lower jaw; spots over region of opercle, pectoral fin base and anterior gut; internal pigment on air bladder and in otic region; ventral spots from gular region to isthmus; a series of paired melanophores forms along dorsum; lateral series forms along midline
- Transformation occurs at about 12 mmSL

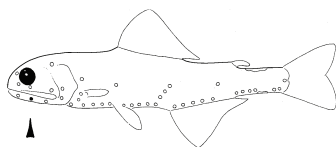
Meristic Characters

Myomeres:	30–32
Vertebrae:	30–32
Dorsal fin rays:	11–13
Anal fin rays:	13–16
Pectoral fin rays:	13–15
Pelvic fin rays:	8
Caudal fin rays:	10+9 (PrC)

Note: 1. Described as *Lampanyctus alatus* by Tåning (1918)

Early Juvenile:**F. 10.0 mmSL**

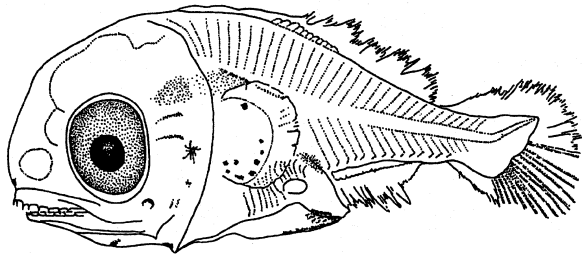
Photophores discussed:



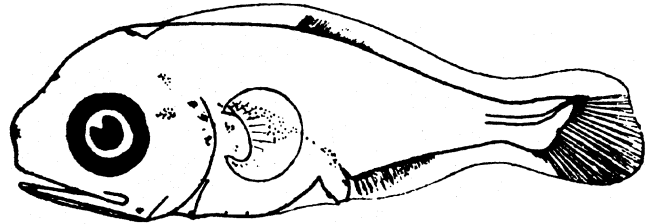
Figures: Adult: Hulley, 1984b; A: J. Corbera (Olivar and Beckley, 1997); B–F: Tåning, 1918

References: Moser and Ahlstrom, 1970; 1972; 1974; 1996b; Moser *et al.*, 1984; Hulley, 1984b; Karnella, 1987; Moser and Watson, 2001

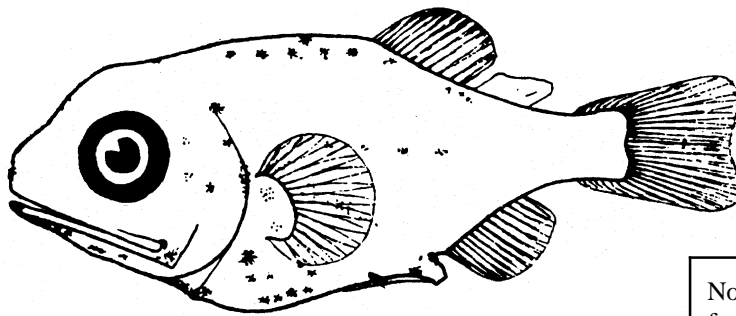
Lampanyctus pusillus



A. 4.8 mmSL

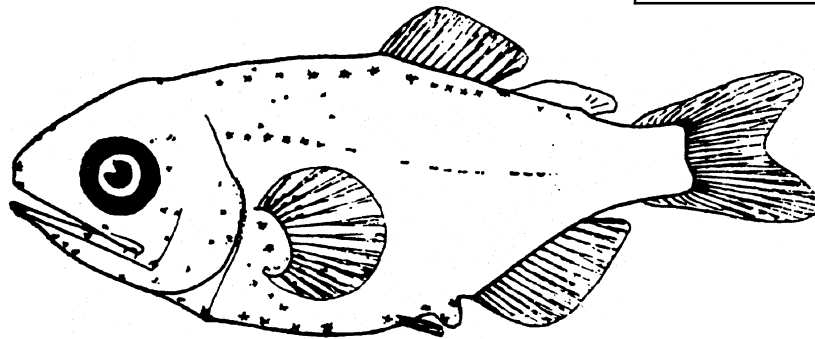


B. 5.0 mmSL

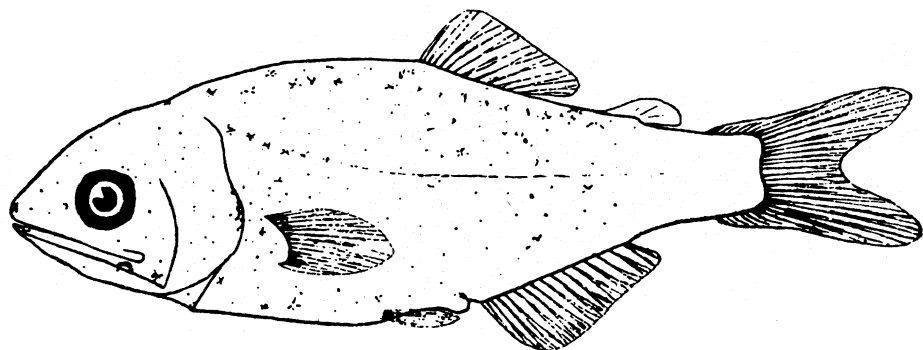


C. 6.5 mmSL

Note mass of early-forming teeth at tip of upper jaw



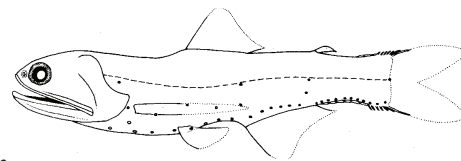
D. 8.5 mmSL



E. 10.0 mmSL

Lampanyctus tenuiformis* (Brauer, 1906)*Myctophidae (s.f. Lampanyctinae)**

No common name



Range: Atlantic, Pacific and Indian oceans in tropical waters; in the western North Atlantic from Georges Bank (rarely) to Brazil

Habitat: Mesopelagic in depths of 300–750 m during the day, 40–325 m at night

Spawning: Undescribed

Eggs: – Undescribed; hatching length <3.0 mmSL

Larvae:

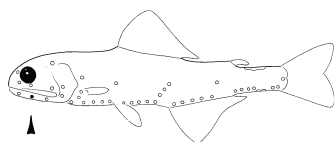
- Body deep and stout, especially anteriorly
- Head large and rounded
- Eye large and round
- Teeth well developed throughout larval stage
- Gut thick anteriorly with slender terminus; preanus length increases from about 55% SL to 65% SL
- Flexion occurs at 4.2–5.0 mmSL
- Sequence of fin ray formation: $C_1 - D, A, P_1, C_2 - P_2$
- Photophore development: Br_2 forms at about 5.0 mmSL; other photophores form after transformation
- Pigmentation: well-developed melanophores in bold series following dorsal outline of gut, one of these on inner pectoral fin base; spots at tips of upper and lower jaw in early larvae; small spot on lateral midline above pectoral fin base; melanophore forms on finfold anterior to anus; few spots on opercle and otic region; during postflexion stage, much of earlier pigment becomes internal and masked; melanophore on upper pectoral fin rays
- Transformation occurs at <20.0 mmSL

Meristic Characters

Myomeres:	34–37
Vertebrae:	34–37
Dorsal fin rays:	13–15
Anal fin rays:	17–19
Pectoral fin rays:	12–15
Pelvic fin rays:	8
Caudal fin rays:	7–8+10+9+7–8

Note: 1. Deep-bodied larvae are similar to those of *Lampanyctus pusillus*, but are more lightly pigmented

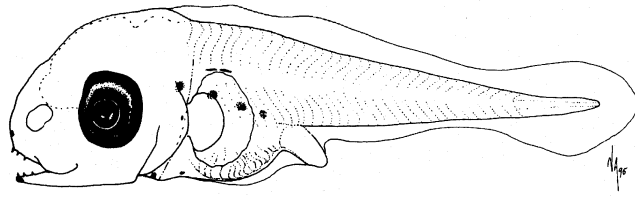
Photophores discussed:



Figures: Adult: Hulley, 1984b; A–C: Nancy Arthur (Moser and Watson, 2001)

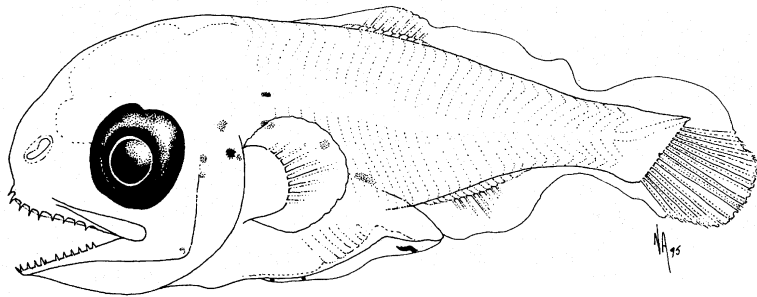
References: Moser and Ahlstrom, 1970; 1972; 1974; 1996b; Moser *et al.*, 1984; Hulley, 1984b; Karnella, 1987; Moser and Watson, 2001

Lampanyctus tenuiformis

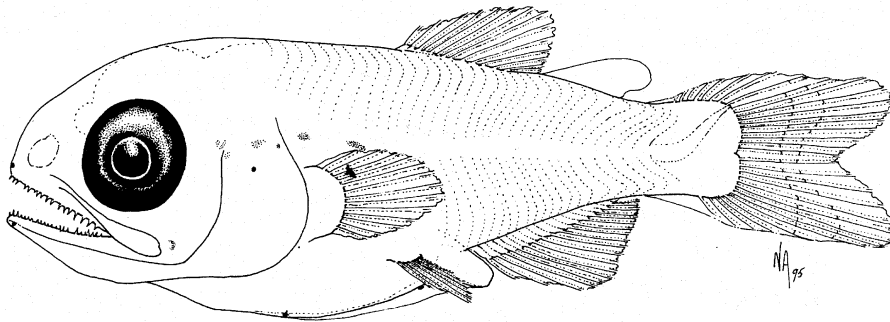


A. 3.8 mmSL

Note mass of early-forming teeth at tip of upper jaw; short gut lengthens during larval stage



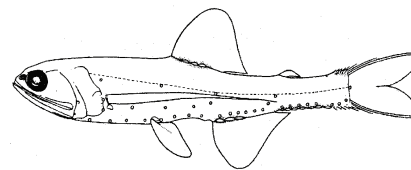
B. 4.7 mmSL



C. 7.1 mmSL

Lepidophanes gaussi* (Brauer, 1906)*Myctophidae (s.f. Lampanyctinae)**

No common name



Range: Atlantic Ocean, in subtropical waters of both hemispheres; in the western North Atlantic from Grand Bank to Caribbean Sea

Habitat: Mesopelagic in depths of 425–850 m during the day, 0–175 m at night

Spawning: Year-round with strong peak in spring, based on sampling north of Bermuda; life cycle one year and almost all adults die by late spring

Eggs: – Undescribed; hatching length undescribed

Larvae:

- Body slender with small head; dorsal and ventral margins of body almost parallel
- Head moderately small, with moderately pointy snout
- Eye large and round
- Gut long and almost equal in diameter its entire length; preanus length increases from about 59% SL to 64% SL in postflexion stage
- Flexion occurs at 5.3–5.6 mmSL
- Sequence of fin ray formation: $C_1 - D, A - P_1, C_2 - P_2$
- Photophore development: Br_2, Vn, PO_5 and PLO form late (about 12.3 mmSL), just before transformation
- Pigmentation: ventral series of melanophores from anus to caudal peduncle is reduced to 2 large spots, one over end of anal fin base; 1, then 2 large spots form on dorsal edge of caudal peduncle, the first under adipose fin; internal pigment present on air bladder; few spots form on top of head and in midline below pectoral fin base
- Transformation occurs at about 13.0 mmSL

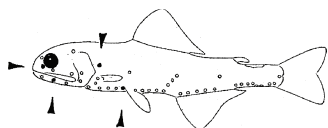
Meristic Characters

Myomeres:	35–36
Vertebrae:	35–36
Dorsal fin rays:	12–15
Anal fin rays:	13–15
Pectoral fin rays:	11–13
Pelvic fin rays:	8
Caudal fin rays:	7–8+10+9+7–8

- Note:**
1. Pigment pattern and photophore formation sequence similar to that of larval *Ceratoscopelus maderensis* but number and position of melanophores on caudal peduncle differ, and *C. maderensis* larvae are deeper-bodied.
 2. Differences between larvae of 2 species of *Lepidophanes*:

Character	<i>Lepidophanes gaussi</i>	<i>Lepidophanes guentheri</i>
Body Depth	11–15% SL	14–16% SL
Preanus Length	59–64% SL	48–58% SL
Lateral Foregut Melanophore	Absent	Present
Flexion Size	5.3–5.6 mmSL	4.1–4.5 mmSL
Photophores Appear	At about 12.3 mmSL	At about 5.6, 7.5 and 9.0 mmSL

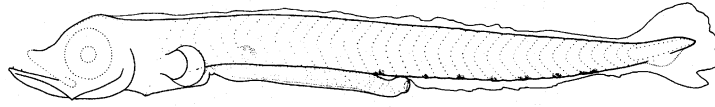
Photophores discussed:



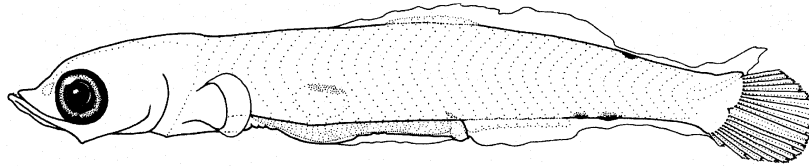
Figures: Adult: Hulley, 1984b; A–C: William Watson (Moser and Watson, 2001); D: Moser and Ahlstrom, 1974

References: Moser and Ahlstrom, 1970; 1972; 1974; 1996b; Moser *et al.*, 1984; Hulley, 1984b; Karnella, 1987; Moser and Watson, 2001

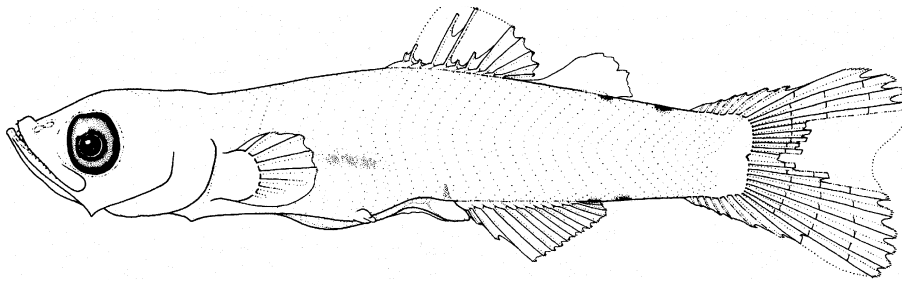
Lepidophanes gaussi



A. 4.6 mmSL

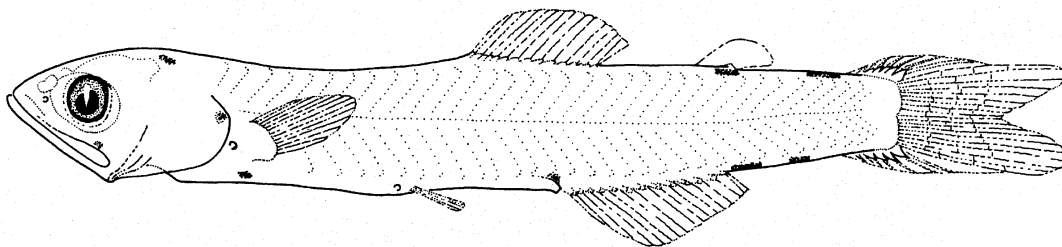


B. 5.3 mmSL



C. 7.8 mmSL

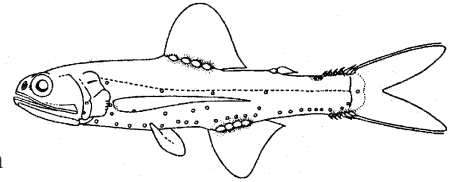
Note 2 melanophores on dorsal edge,
and 2 on ventral edge of caudal peduncle
(Compare to *Lepidophanes guentheri*)



D. 13.5 mmSL

***Lepidophanes guentheri* (Goode and Bean, 1896)**
Myctophidae (s.f. Lampanyctinae)

No common name



Range: Atlantic Ocean mostly in tropical waters; in the western Atlantic from Grand Bank to Argentina

Habitat: Mesopelagic in depths of 700–950 m during the day, 50–175 m at night

Spawning: Possibly summer into winter, with a peak in winter, but location uncertain; sampling north of Bermuda indicates recruitment of young fish may derive from spawning from other oceanic areas

Eggs: – Undescribed; hatching length <3.6 mmSL

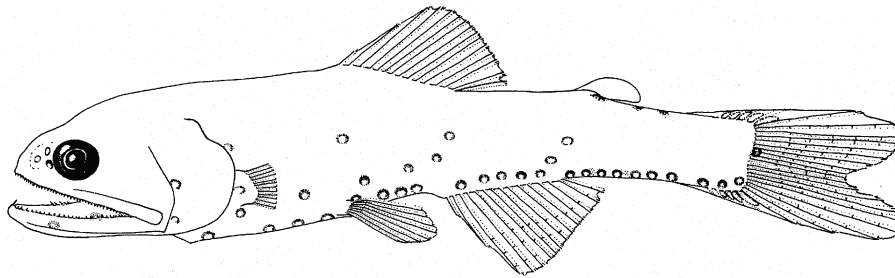
Larvae: – Body slender with small head; dorsal and ventral margins of body almost parallel
 – Head moderately small, with moderately pointy snout
 – Eye large and round
 – Gut long and almost equal in diameter its entire length; preanus length increases from 48% SL to about 58% SL in postflexion stage
 – Flexion occurs at 4.1–5.0 mmSL
 – Sequence of fin ray formation: $C_1 - D, A - P_1, C_2 - P_2$
 – Photophore development: Br_2 forms at about 5.6 mmSL; Vn and PO_5 form at about 7.5 mmSL; PLO forms at about 9.0 mmSL
 – Pigmentation: 1 melanophore laterally on each side of foregut; series of 8–12 ventral spots form on postanal body, number reduced to about 6 in flexion stage, then 2 or 3 in late stages; 1–3 spots form sequentially on dorsum of caudal peduncle posterior to adipose fin; 1 spot in region of nape by late flexion stage
 – Transformation occurs at about 13.0 mmSL

Meristic Characters

Myomeres:	36
Vertebrae:	36
Dorsal fin rays:	13–15
Anal fin rays:	13–16
Pectoral fin rays:	11–14
Pelvic fin rays:	8
Caudal fin rays:	7–8+10+9+7–8

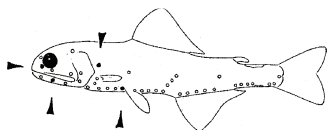
- Note:**
1. Pigment pattern and photophore formation sequence similar to that of larval *Ceratoscopelus maderensis* but number and position of melanophores on caudal peduncle differ, and *C. maderensis* larvae are deeper-bodied
 2. See comparative table on *Lepidophanes gaussi* page

Early Juvenile:



F. 15.4 mmSL

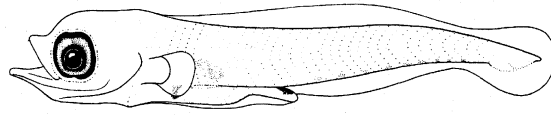
Photophores discussed:



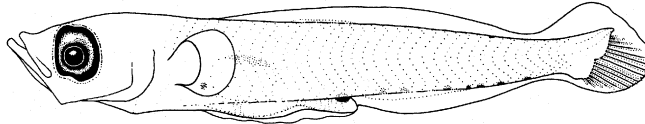
Figures: Adult: Hulley, 1984b; A–B: William Watson (Moser and Watson, 2001); C–F: R. C. Walker (Moser and Watson, 2001)

References: Moser and Ahlstrom, 1970; 1972; 1974; 1996b; Moser *et al.*, 1984; Hulley, 1984b; Karnella, 1987; Moser and Watson, 2001

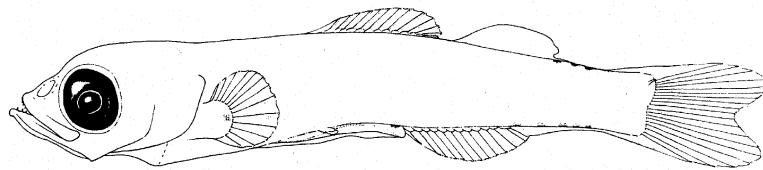
Lepidophanes guentheri



A. 3.6 mmSL

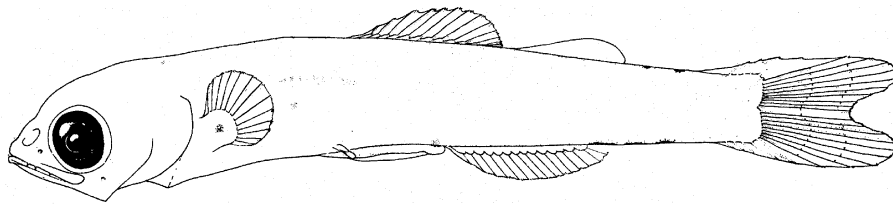


B. 4.3 mmSL

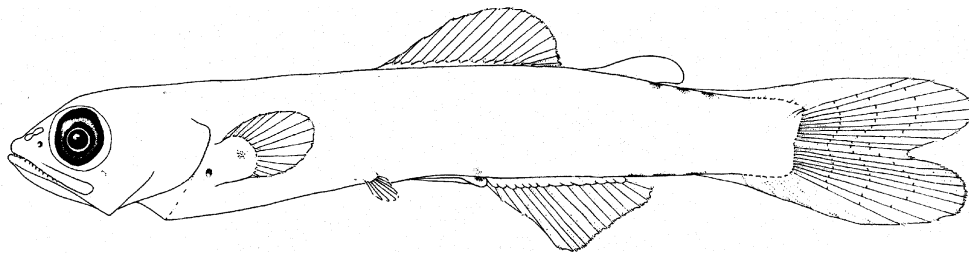


C. 5.6 mmSL

Note 2 or 3 melanophores on dorsal edge,
and 3 on ventral edge of caudal peduncle
(Compare to *Lepidophanes gausi*)



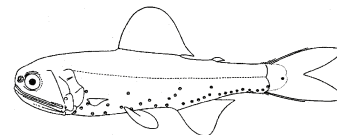
D. 7.5 mmSL



E. 9.2 mmSL

Lobianchia dofleini* (Zugmayer, 1911)*Myctophidae (s.f. Lampanyctinae)**

No common name



Range: Atlantic, southern Pacific and southern Indian oceans, Mediterranean Sea; in the western North Atlantic from east of Flemish Cap to Sargasso Sea

Habitat: Mesopelagic in depths of 375–600 m during the day, 25–400 m (mostly 40–150 m) at night

Spawning: Dec to Jun, with peak during winter, based on sampling north of Bermuda; life cycle one-year and most adults die before end of summer

Eggs: – Undescribed; hatching length undescribed

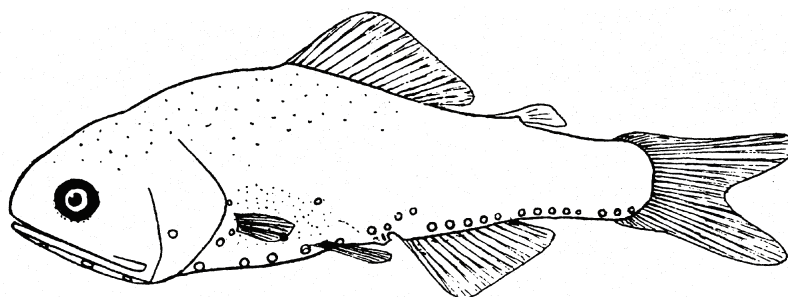
Larvae:

- Body deep and stout, especially through anterior half of body; becomes slimmer at transformation
- Head large and broad with long but rounded snout
- Eye small, round in early stages, becoming slightly elliptical with square mass of choroid tissue ventrally
- Gut thickest anteriorly, with narrow terminus; preanus length about 60% SL
- Flexion occurs at 5.0–6.0 mmSL
- Sequence of fin ray formation: $P_1 - C_1 - C_2, A, D - P_2$
- Photophore development: Br_2, PO_1 and PO_5 form early in postflexion stage
- Pigmentation: air bladder pigmented; 2 spots over anus at gut terminus; 1 or more spots ventrally anterior to anus; spots form on ventral midline anterior to cleithral symphysis, on gut and along anal fin base; spots form on and near pectoral fin base and on rays; spots form on dorsum of body in late stages
- Transformation occurs at 10.0–11.0 mmSL

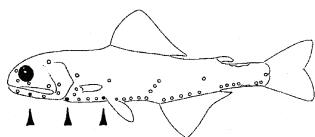
Meristic Characters

Myomeres:	33–35
Vertebrae:	33–35
Dorsal fin rays:	15–17
Anal fin rays:	13–15
Pectoral fin rays:	11–13
Pelvic fin rays:	8
Caudal fin rays:	5–6+10+9+5

Note: Bi-lobed pectoral fin with upper rays early-forming and elongate

Early Juvenile:**E. 11.0 mmSL**

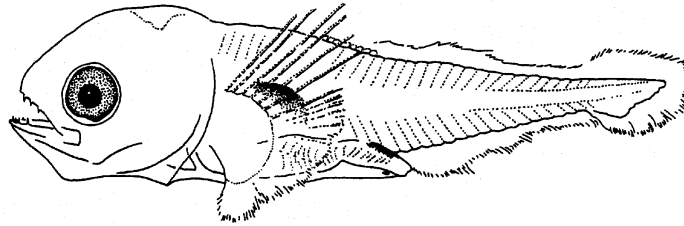
Photophores discussed:



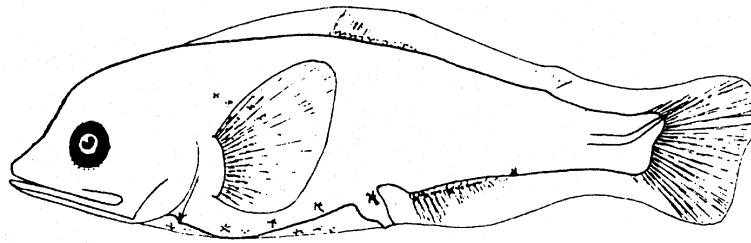
Figures: Adult: Hulley, 1984b; A: J. Corbera (Olivar *et al.*, 1999); B, D–E: Tåning, 1918; C: Moser and Ahlstrom *et al.*, 1974

References: Moser and Ahlstrom, 1970; 1972; 1974; 1996b; Moser *et al.*, 1984; Hulley, 1984b; Karnella, 1987; Moser and Watson, 2001

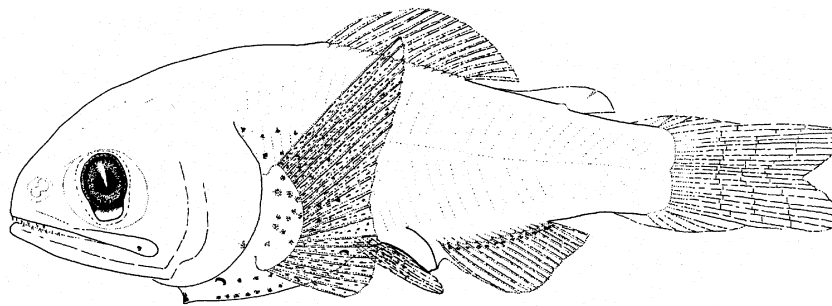
Lobianchia dofleini



A. 4.8 mmSL

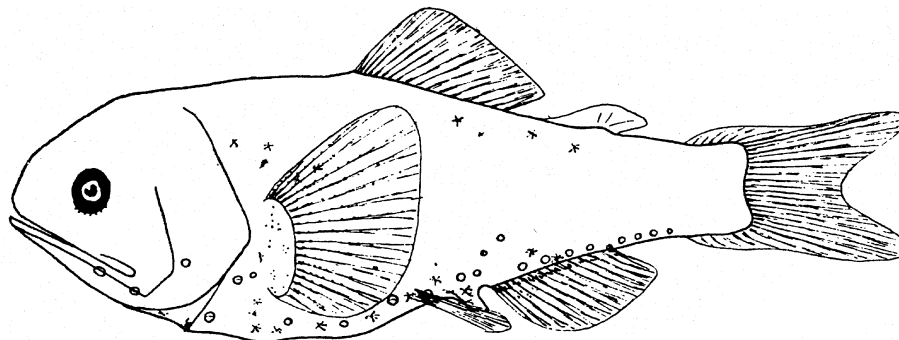


B. 5.5 mmSL



C. 8.2 mmSL

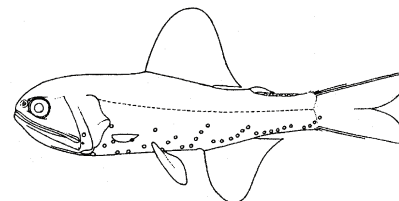
Note accumulation of pigment on anterior part of body, including pectoral fin rays and base



D. 11.5 mmSL

Lobianchia gemellarii* (Cocco, 1838)*Myctophidae (s.f. Lampanyctinae)**

No common name



Range: Atlantic, Pacific and Indian oceans in mostly tropical waters; also eastern Mediterranean Sea; in the western North Atlantic from east of Flemish Cap to Brazil; population in present study area consists of non-spawning expatriates

Habitat: Mesopelagic in depths of 325–550 m during the day, 40–175 m at night

Spawning: Apparently no reproduction north of Bermuda; recruitment in study area is product of spawning south of Bermuda, peaking in the fall

Eggs: – Undescribed; hatching length about 2.0 mmSL

Larvae:

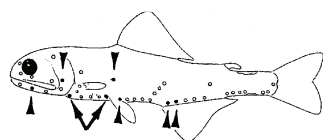
- Body deep and stout, especially through anterior part of body
- Head deep and broad with pointy snout becoming rounded; teeth prominent in small larvae
- Eye large and slightly oval with lunate choroid sliver ventrally
- Gut thick anteriorly with narrow terminal section; preanus length increases from about 52% to about 60% SL
- Flexion occurs at 5.0–6.0 mmSL
- Sequence of fin ray formation: $P_1 - C_1 - D, A - C_2 - P_2$
- Photophore development: Br_2 forms by 6.0 mmSL; PO_1 and PO_5 form by 7.0 mmSL; $VO_1, AOa_1, AOa_2, VLO, OP$ by 11.0 mmSL
- Pigmentation: melanophores on pectoral fin base, anterior to pectoral base, on anterior foregut, on terminus of gut; scattered pigment on pectoral fin rays; internal pigment on air bladder; note spots over end of anal fin base; pigment added to anterior region of body; large spots form at base of caudal fin
- Transformation occurs at 12.0–14.0 mmSL

Meristic Characters

Myomeres:	34–35
Vertebrae:	34–35
Dorsal fin rays:	16–18
Anal fin rays:	13–15
Pectoral fin rays:	11–13
Pelvic fin rays:	8
Caudal fin rays:	6–7+10+9+5–6

Note: 1. Bi-lobed pectoral fin with upper rays early-forming and elongate

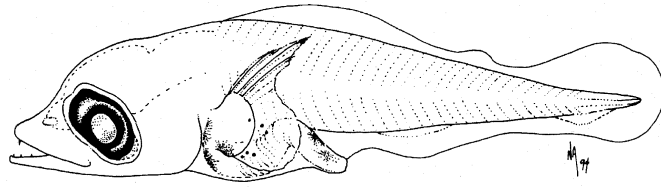
Photophores discussed:



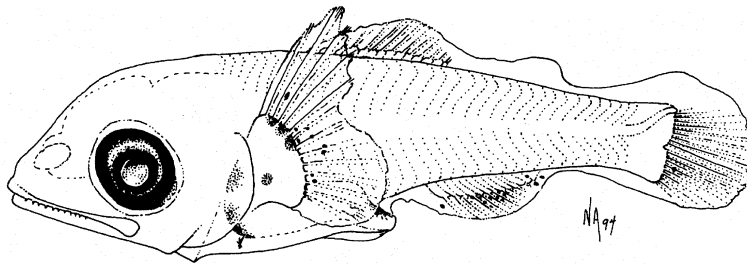
Figures: Adult: Hulley, 1984b; **A–B, D:** Nancy Arthur (Moser and Ahlstrom, 1996b); **C:** Moser and Ahlstrom, 1974

References: Moser and Ahlstrom, 1970; 1972; 1974; 1996b; Moser *et al.*, 1984; Hulley, 1984b; Karnella, 1987; Moser and Watson, 2001

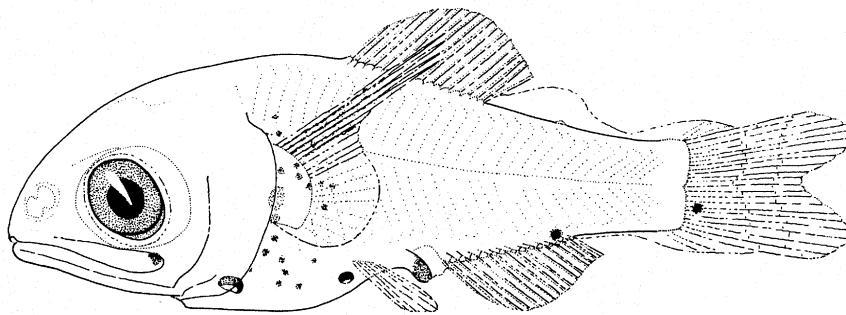
Lobianchia gemellarii



A. 4.2 mmSL

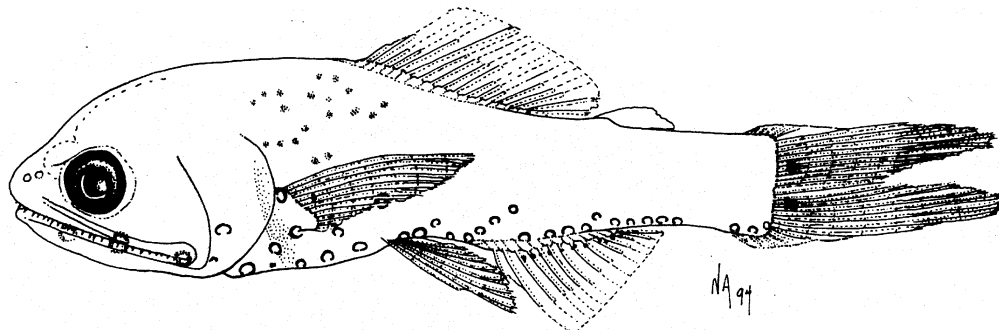


B. 5.6 mmSL



C. 6.7 mmSL

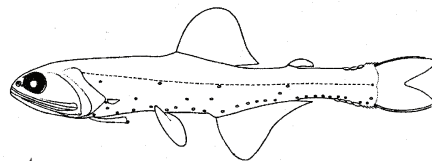
Note accumulation of pigment on anterior part of body, including pectoral fin rays and base



D. 11.8 mmSL

Nannobrachium atrum* (Tåning, 1928)*Myctophidae (s.f. Lampanyctinae)**

No common name



Range: North and South Atlantic, South Pacific and Indian oceans; in the western North Atlantic from Grand Bank to Gulf of Mexico, abundant north of Bermuda

Habitat: Mesopelagic in depths of 550–850 m during the day, 60–850 m at night; reaches a maximum depth of 1,100 m north of Bermuda

Spawning: Mostly during fall, based on sampling north of Bermuda; life cycle 2 or more years and individuals first spawn at age 2

Eggs: – Undescribed; hatching length undescribed

Larvae:

- Body deep anteriorly, tapers to narrow caudal peduncle; body depth becomes shallower through development
- Head large with pointy snout, large jaws
- Eye very slightly elliptical
- Gut thick anteriorly with narrow terminus; preanus length increases from about 60% SL to about 70% SL
- Flexion occurs at 5.0–6.0 mmSL
- Sequence of fin ray formation: $P_1, C_1 - A, D - C_2 - P_2$
- Photophore development: Br_2 only photophore to form before transformation
- Pigmentation: pair of melanophores over hindbrain (Fig. D) may disappear in larger larvae; another pair over terminus of gut (above anus); spots at tips of upper and lower jaws; an internal spot on midline at anterior gut; large melanophore on dorsum at end of dorsal fin; internal pigment over air bladder
- Transformation occurs at >15.0 mmSL

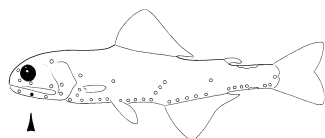
Meristic Characters

Myomeres:	36–39
Vertebrae:	36–39
Dorsal fin rays:	12–16
Anal fin rays:	17–21
Pectoral fin rays:	11–12
Pelvic fin rays:	8
Caudal fin rays:	10+9 (PrC)

Note:

1. Two series of large preopercle spines, one on edge, one on lateral ridge; (this is the only myctophid larva in the present study area with preopercle spines)
2. Distinctive pigment consists of relatively few, bold melanophores

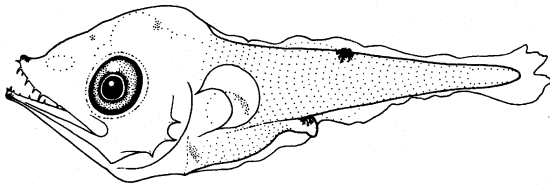
Photophores discussed:



Figures: Adult: Hulley, 1984b; **A–B, F:** William Watson (Moser and Watson, 2001); **C–E:** R. C. Walker (Moser and Watson, 2001)

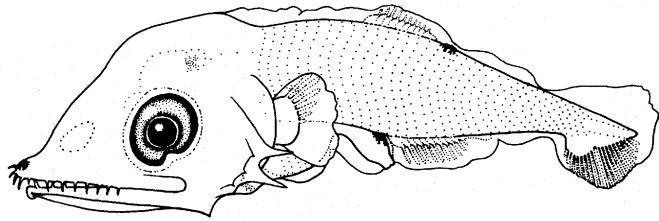
References: Moser and Ahlstrom, 1970; 1972; 1974; 1996b; Moser *et al.*, 1984; Karnella, 1987; Zahuranec, 2000; Moser and Watson, 2001

Nannobranchium atrum

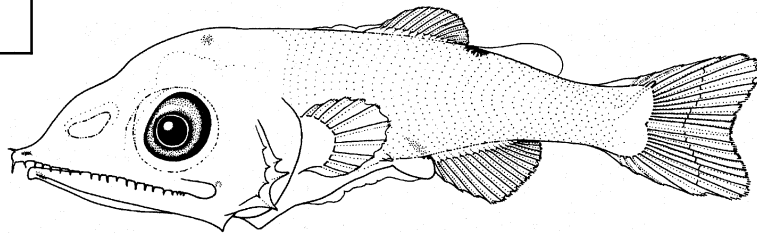


A. 4.0 mmSL

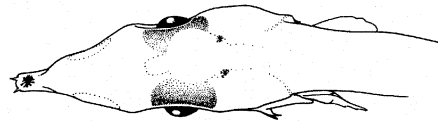
Note mass of early-forming teeth at tip of upper jaw; short, flexed gut becomes elongate in larger larvae



B. 4.6 mmSL

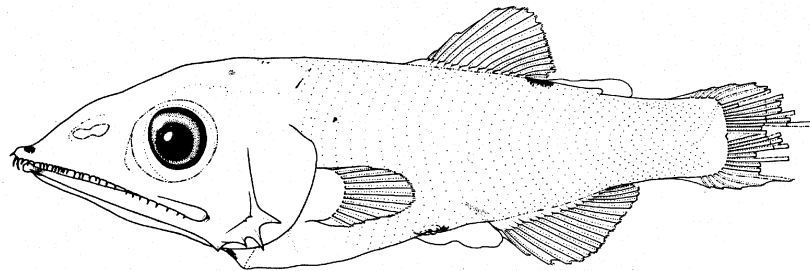


C. 6.5 mmSL

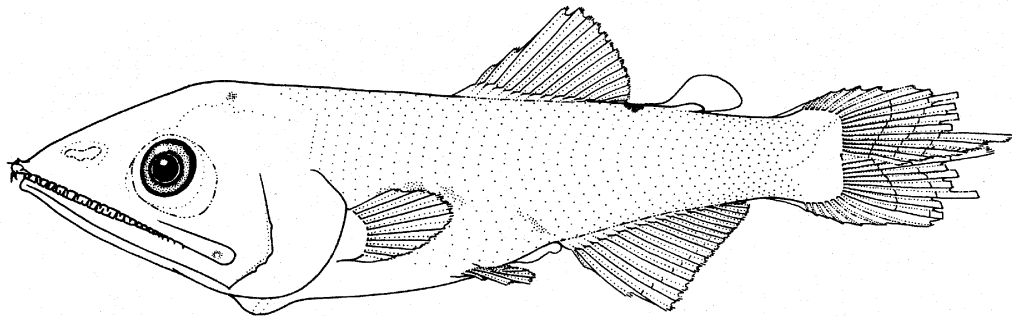


**D. 6.5 mmSL
(Dorsal Head)**

Note characteristic profile of head and snout



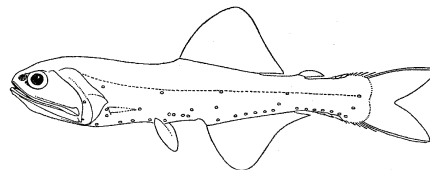
E. 9.6 mmSL



F. 13.7 mmSL

Nannobranchium cuprarium* (Tåning, 1928)*Myctophidae (s.f. Lampanyctinae)**

No common name



Range: Atlantic Ocean in subtropical waters of both hemispheres; in the western North Atlantic from Grand Bank to Lesser Antilles; abundant north of Bermuda

Habitat: Mesopelagic in depths of 650–1,200 m during the day, 40–275 m at night; common in Slope Water

Spawning: Peaks Jul–Sep after weak beginning in spring, based on sampling north of Bermuda; life cycle 2 or more years and individuals first spawn at age 2

Eggs: – Undescribed; hatching length undescribed

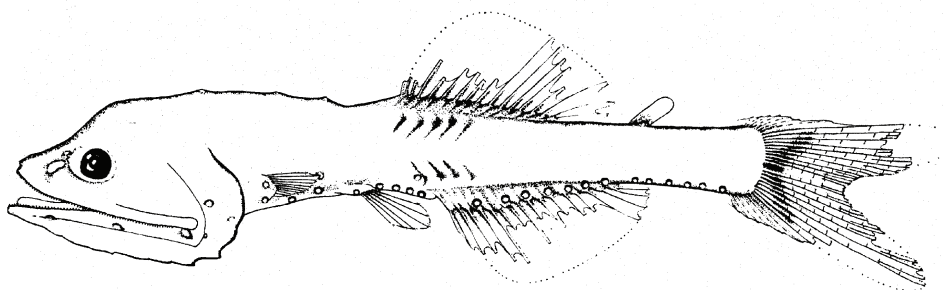
Larvae:

- Body deep and moderately compressed anteriorly, tapers to narrow caudal peduncle
- Head large with long, pointy snout and large jaws
- Eye round to slightly elliptical, initially large
- Gut thick anteriorly with narrow terminus; preanus length increases from 59% SL to 72% SL
- Flexion occurs at 4.0–6.0 mmSL
- Sequence of fin ray formation: $C_1, D, A - P_1, C_2 - P_2$
- Photophore development: Br_2 forms at about 7.0 mmSL; other photophores form after transformation
- Pigmentation: melanophore at tip of lower jaw; pattern of 5 spots surrounds brain (Fig. C); large spot on ventral margin of nostril; series along gular midline; large internal spot on anterior gut; 1 midline spot over anus; bar-shaped melanophore forms on lateral surface of body over anus; internal pigment forms on myosepta in region over anus; bar forms from snout through eye in larger larvae, composed in part of internal pigment; few spots on dorsal and pelvic fin rays
- Transformation occurs at 12.0–15.0 mmSL

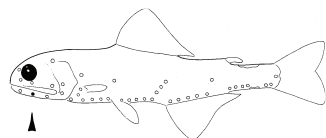
Meristic Characters

Myomeres:	32–34
Vertebrae:	32–34
Dorsal fin rays:	16–19
Anal fin rays:	17–20
Pectoral fin rays:	11–12
Pelvic fin rays:	8
Caudal fin rays:	8–10+10+9+8–9

Note: 1. Preopercle spines lacking in this species; see *Nannobranchium atrum*

Early Juvenile:

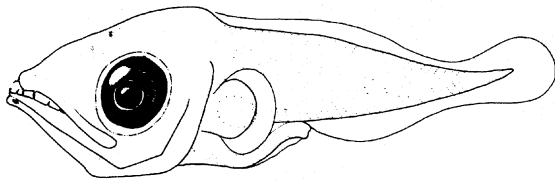
Photophores discussed:

G. 21.1 mmSL

Figures: Adult: Hulley, 1984b; A, C, G: R. C. Walker (Moser and Watson, 2001); B, D–F: William Watson (Moser and Watson, 2001)

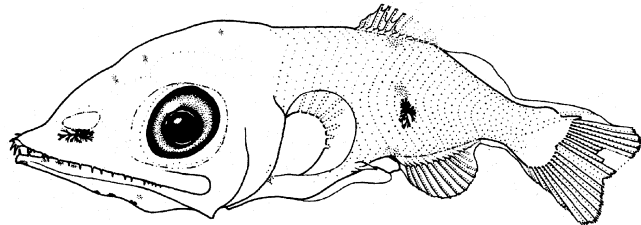
References: Moser and Ahlstrom, 1970; 1972; 1974; 1996b; Moser *et al.*, 1984; Karnella, 1987; Zahuranec, 2000; Moser and Watson, 2001

Nannobranchium cuprarium

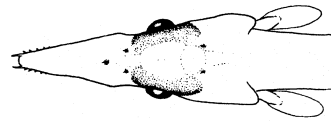


A. 3.4 mmSL

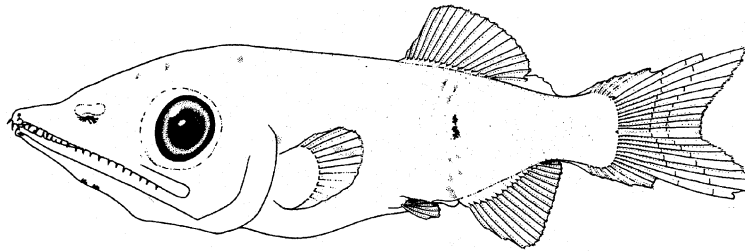
Note mass of early-forming teeth at tip of upper jaw; short, flexed gut becomes elongate in larger larvae



B. 5.1 mmSL

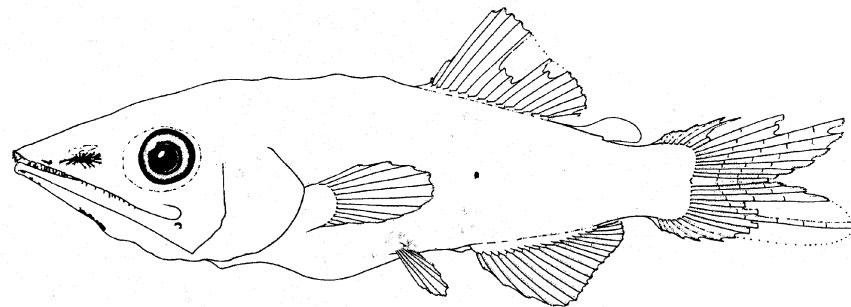


C. 5.1 mmSL (Dorsal Head)

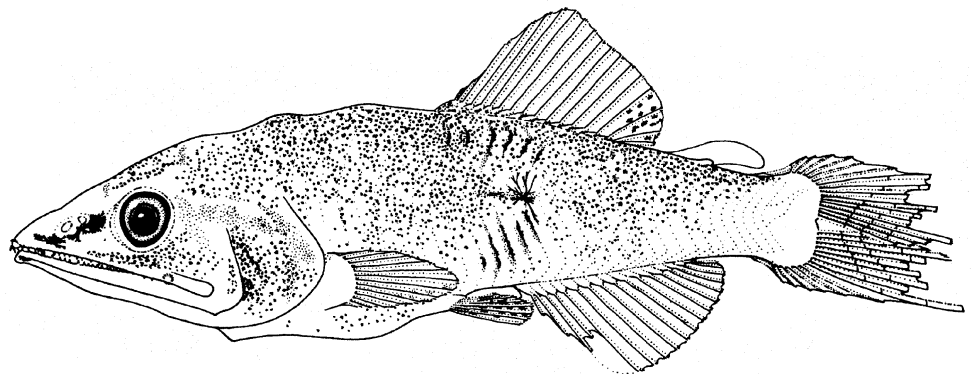


D. 7.1 mmSL

Snout lengthens with development



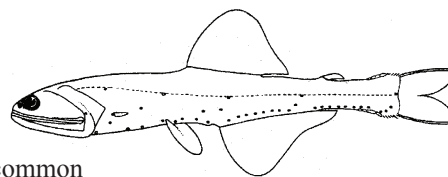
E. 10.5 mmSL



F. 12.7 mmSL

Nannobranchium lineatum* (Tåning, 1928)*Myctophidae (s.f. Lampanyctinae)**

No common name



Range: Pacific, Indian and Atlantic oceans, mostly in tropical waters; more common in eastern Atlantic; in the western North Atlantic from Cape Breton, Nova Scotia to Brazil

Habitat: Mesopelagic in depths of 650–1,000 m during the day, 60–225 m at night

Spawning: Late spring to winter, based on sampling north of Bermuda; life cycle is 3 or more years; sexual maturity is reached at sizes >150 mm

Eggs: – Undescribed; hatching length <2.7 mmSL

Larvae: – Body moderately slender, compressed, deepest anteriorly, tapers to narrow caudal peduncle

– Head large with long, pointy snout and large jaws

– Eye large and slightly elliptical, becomes proportionately smaller with development

– Gut initially short, with thickened anterior part, becomes straighter and more elongate; preanus length increases to about 66% SL

– Flexion occurs at 5.0–6.0 mmSL

– Sequence of fin ray formation: $P_1, C_1 - D, A - C_2 - P_2$

– Photophore development: Br_2 forms at about 12.0 mmSL; other photophores form after transformation

– Pigmentation: lightly pigmented; few spots anterior to midbrain, at tips of upper and lower jaws, internally behind orbit, and above air bladder; pigment increases in snout region; vague bar forms from snout through eye, partly composed of internal pigment; body pigment spreads from midlateral region over end of anal fin; spots spread across caudal fin rays

– Transformation occurs at about 22.0 mmSL

Meristic Characters

Myomeres: 37–40

Vertebrae: 37–40

Dorsal fin rays: 15–19

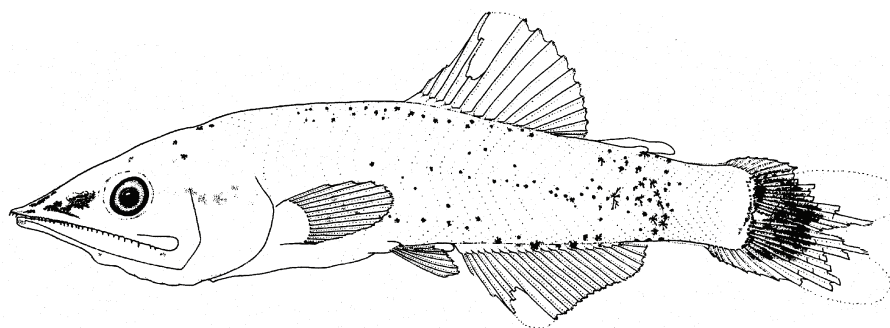
Anal fin rays: 19–23

Pectoral fin rays: 12–14

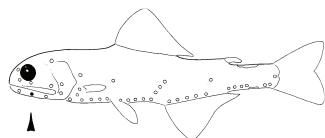
Pelvic fin rays: 8

Caudal fin rays: 10+9 (PrC)

Note: 1. Preopercle spines lacking in this species; see *Nannobranchium atrum*

Early Juvenile:

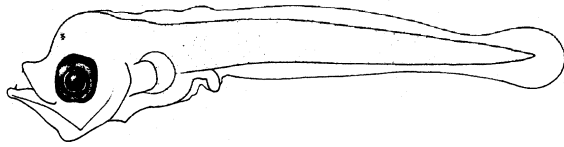
Photophores discussed:

H. 18.4 mmSL

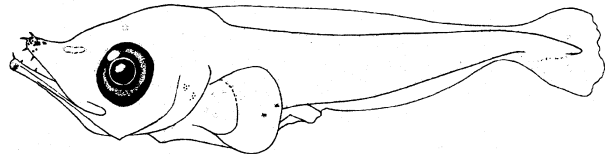
Figures: Adult: Hulley, 1984b; **A–E:** R. C. Walker; **F:** R. C. Walker/William Watson; **G–H:** William Watson (all Moser and Watson, 2001)

References: Moser and Ahlstrom, 1970; 1972; 1974; 1996b; Moser *et al.*, 1984; Karnella, 1987; Zahuranec, 2000; Moser and Watson, 2001

Nannobranchium lineatum

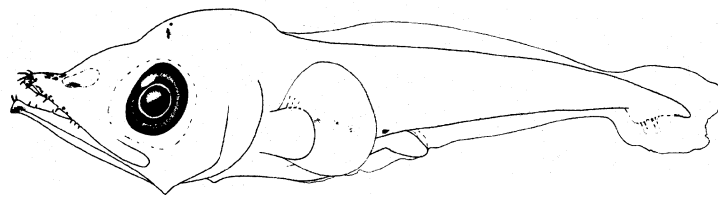


A. 2.7 mmSL

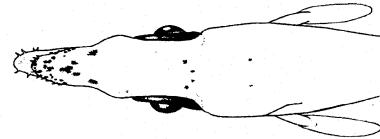


B. 3.7 mmSL

Note mass of early-forming teeth at tip of upper jaw; short, flexed gut becomes elongate in larger larvae

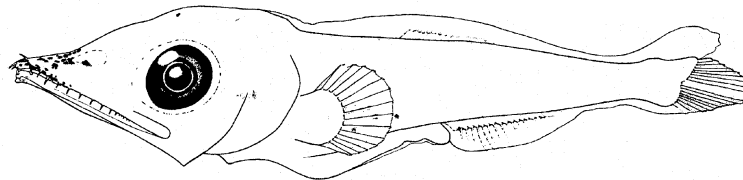


C. 4.6 mmSL

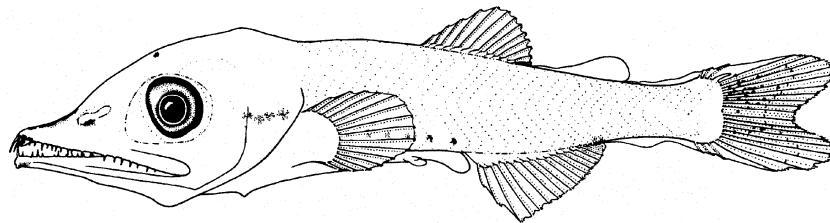


**D. 4.6 mmSL
(Dorsal Head)**

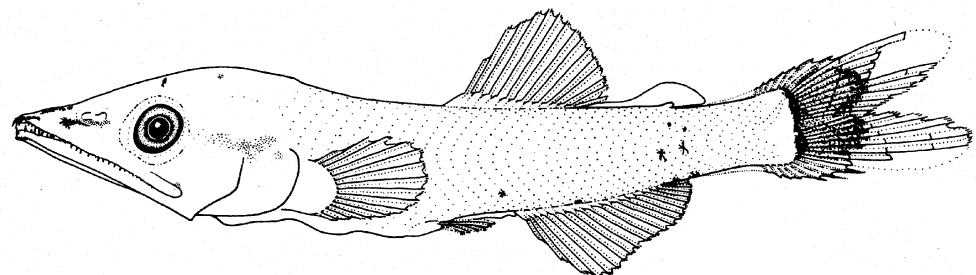
Snout lengthens with development



E. 5.7 mmSL



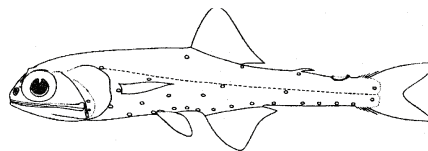
F. 7.2 mmSL



G. 12.2 mmSL

Notolychnus valdiviae* (Brauer, 1904)*Myctophidae (s.f. Lampanyctinae)**

No common name



Range: Widely distributed in Atlantic, Pacific and eastern Indian oceans; in the western North Atlantic from east of Flemish Cap to Brazil

Habitat: Mesopelagic in depths of 375–650 m during the day, 40–125 m at night; abundant in Slope Water

Spawning: Peaks in spring, possibly at low levels year-round, based on sampling north of Bermuda; life cycle is one year for most individuals; maximum size only about 25 mmSL

Eggs: – Undescribed; hatching length <2.8 mmSL

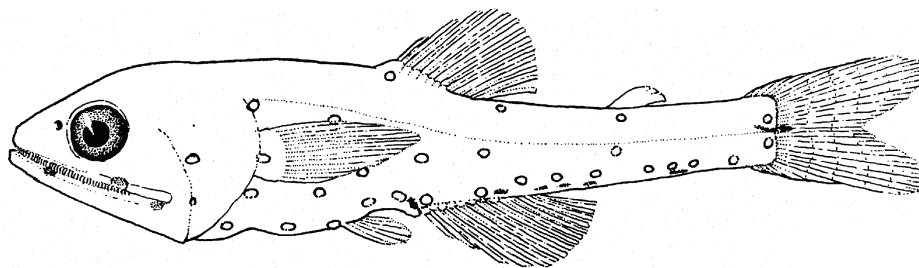
Larvae:

- Body elongate and slender, with long caudal peduncle
- Head moderate in size, with pointy snout
- Eye narrow, becomes slightly oval; a crescent of choroid tissue on dorsal surface of eye at about 4.0 mmSL and on ventral surface of eye at about 6.0 mmSL
- Gut thick anteriorly, tapering to narrow terminus; preanus length 35% SL, only lengthens to about 50% SL
- Flexion occurs at 4.4–6.2 mmSL
- Sequence of fin ray formation: $C_1 - D, A, P_1, C_2 - P_2$
- Photophore development: all photophores form at transformation; Dn, Br_2 , PVO_1 , PVO_2 , VLO, PO_{1-5} form first; Br_2 forms in its adult position below eye; note VLO, SAO_3 and POL form near dorsal margin
- Pigmentation: a lateral spot forms early on midgut, anterior to arch in gut; 1 to 4 (usually 1) ventral midline melanophores form on postanal body; 2 spots over terminus of gut and internal pigment on air bladder; spot forms on base of middle caudal fin rays; in larger larvae, usually 3–4 (range 2–7) spots in postanal midventral series, displaced to either side of anal fin base
- Transformation occurs at about 10.0–10.8 mmSL (small size compared to most myctophid larvae)

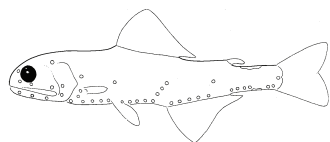
Meristic Characters

Myomeres:	27–31
Vertebrae:	27–31
Dorsal fin rays:	10–12
Anal fin rays:	12–15
Pectoral fin rays:	12–15
Pelvic fin rays:	6
Caudal fin rays:	6–8+10+9+6–8

Note: 1. Low numbers of vertebrae and unusually low pelvic fin ray count (6) are diagnostic

Early Juvenile:**F. 9.7 mmSL**

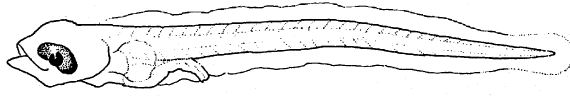
Photophores discussed:



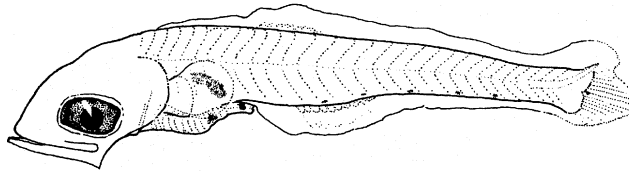
Figures: Adult: Hulley, 1984b; A–F: Moser and Ahlstrom, 1996b

References: Moser and Ahlstrom, 1970; 1972; 1974; 1996b; Moser *et al.*, 1984; Karnella, 1987; Hulley, 1984b; Moser and Watson, 2001

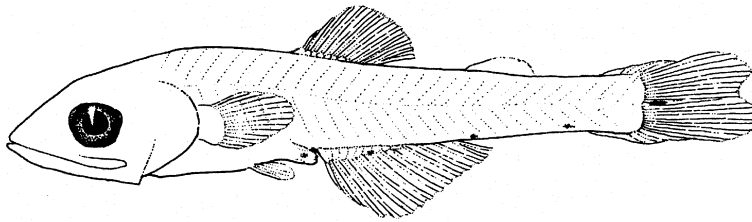
Notolychnus valdiviae



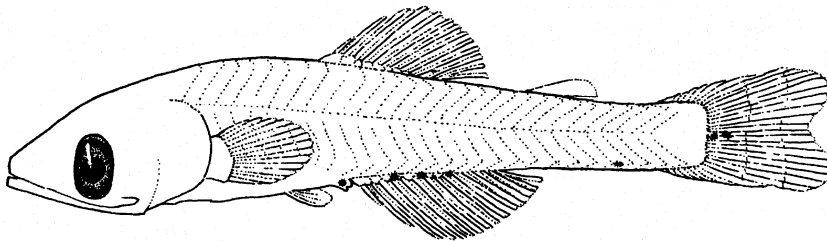
A. 2.8 mmSL



B. 5.4 mmSL

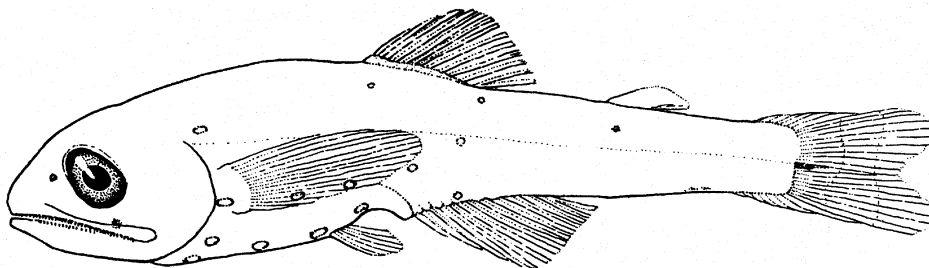


C. 7.2 mmSL



D. 8.7 mmSL

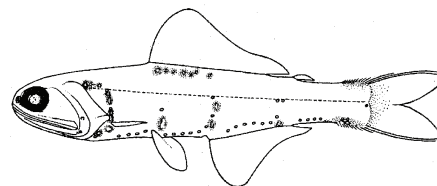
Note high positions of VLO, SAO₃ and POL photophores



E. 10.7 mmSL

Notoscopelus caudispinosus* (Johnson, 1863)*Myctophidae (s.f. Lampanyctinae)**

No common name



Range: Locally in Pacific and Indian oceans; widespread in Atlantic Ocean in tropical and subtropical waters; in the western North Atlantic from Grand Bank to Caribbean Sea

Habitat: Mesopelagic in depths of 600–1,150 m during the day, 20–100 m at night

Spawning: Peak in the fall, tapering off into winter, based on sampling north of Bermuda; life cycle probably at least two years; size at maturity unknown; reaches large maximum size (to 140 mmSL)

Eggs: – Undescribed; hatching length < 3.0 mmSL

Larvae:

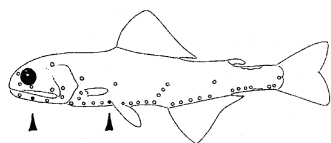
- Body deep and slightly compressed, especially anteriorly
- Head large, with moderately short, rounded or bulbous snout
- Eye large and round early
- Characteristic anteriorly directed, curved teeth form in lower jaw by 3.0 mmSL
- Gut very short initially, preanus length increases from 43% SL to 66% SL in larger larvae
- Flexion occurs at 4.0–5.5 mmSL
- Sequence of fin ray formation: $C_1 - D, A - P_1, C_2 - P_2$
- Photophore development: Br_2 forms by 4.0 mmSL; PO_5 forms by 7.0 mmSL
- Pigmentation: note pairs of spots over fore- and hindbrains; dark, internal melanophore on anterior gut; heavy pigment forms 'shield' over gut; spot over anus; few spots form on midline, just posterior to level of anus and internal spots form above and below these spots; larger larvae have 2 prominent melanophores on top of head
- Transformation occurs at about 16 mmSL

Meristic Characters

Myomeres:	37
Vertebrae:	37
Dorsal fin rays:	24–27
Anal fin rays:	19–21
Pectoral fin rays:	11–13
Pelvic fin rays:	8
Caudal fin rays:	10–11+10+9+11–12

Note: 1. Larvae are deeper-bodied than those of *Notoscopelus resplendens* and flexion occurs at smaller size; larvae also lack many of the characteristic series of melanophores present in *N. resplendens* larvae

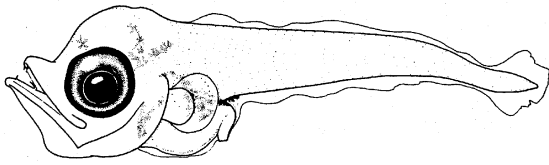
Photophores discussed:



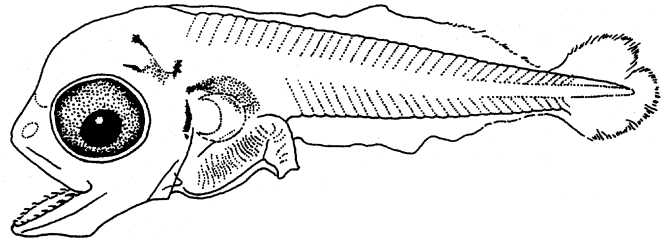
Figures: Adult: Hulley, 1984b; **A, C–F:** William Watson (Moser and Watson, 2001; **B:** J. Corbera (Olivar *et al.*, 1999)

References: Moser and Ahlstrom, 1970; 1972; 1974; 1996b; Moser *et al.*, 1984; Karnella, 1987; Hulley, 1984b; Moser and Watson, 2001

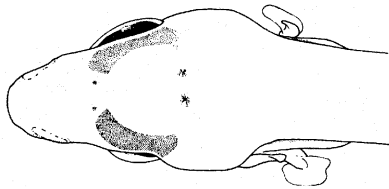
Notoscopelus caudispinosus



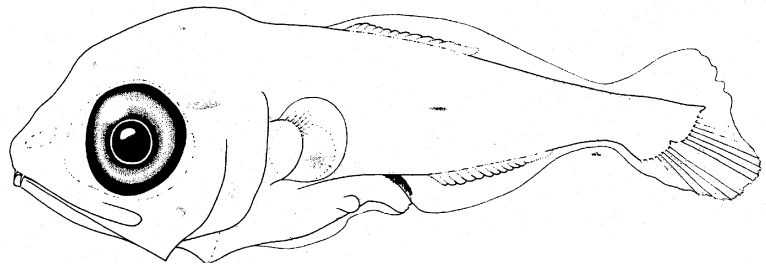
A. 3.2 mmSL



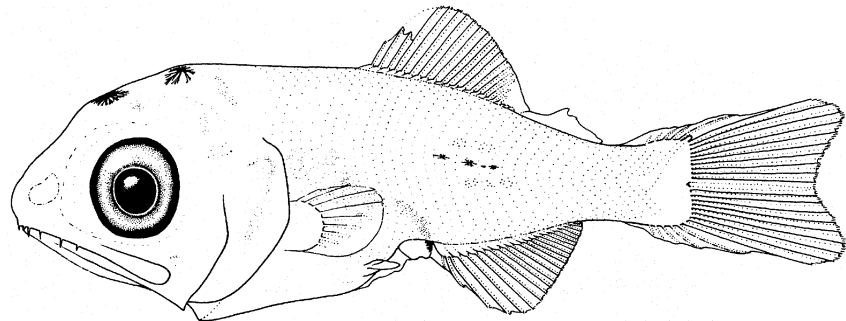
B. 3.9 mmSL



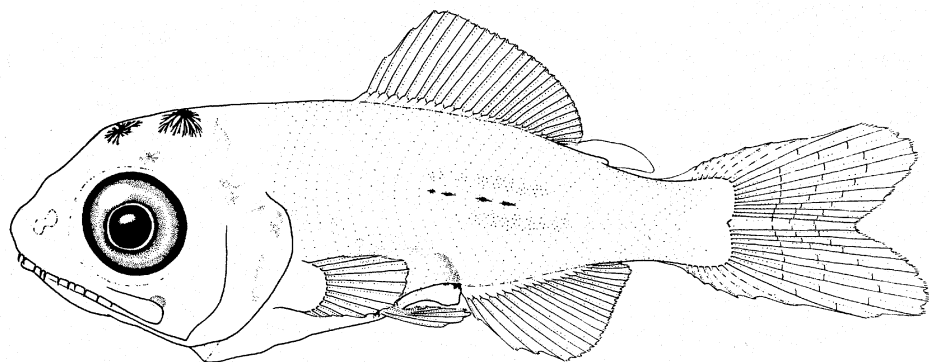
C. 4.1 mmSL
(Dorsal Head)



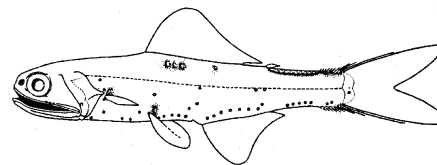
D. 4.1 mmSL



E. 5.6 mmSL



F. 7.5 mmSL

Notoscopelus resplendens* (Richardson, 1845)*Myctophidae (s.f. Lampanyctinae)****Patchwork lanternfish**

Range: Atlantic, Pacific and Indian oceans; avoids oligotrophic (low nutrient) regions; in the western North Atlantic from east of Flemish Cap to Brazil

Habitat: Mesopelagic in depths of 325–750 m during the day, 0–125 m at night; common in Slope Water

Spawning: Winter to spring, with a peak in early spring, based on sampling north of Bermuda; life cycle is two years and maturity is reached at sizes >66 mmSL

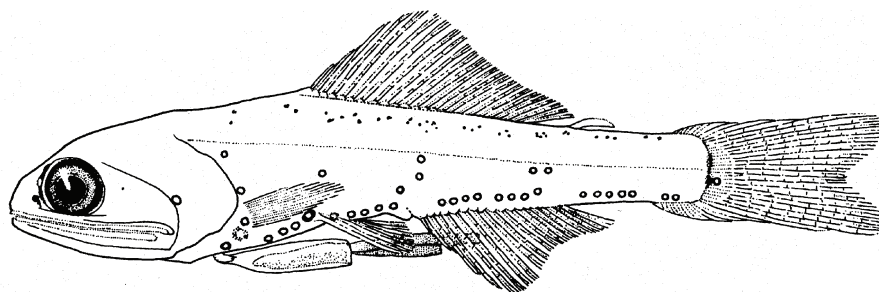
Eggs: – Undescribed; hatching length <2.4 mmSL

Larvae:

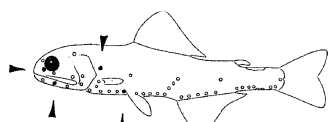
- Body initially slender, becomes deeper-bodied and compressed
- Head deep and compressed, with rounded snout; eye large, very slightly elliptical
- Gut short, with thick anterior part, narrow terminus; preanus length increases from about 40% SL to 60% SL
- Flexion occurs at 5.0–6.5 mmSL
- Sequence of fin ray formation: $C_1 - D, A, C_2, - P_1, P_2$
- Photophore development: Br_2 forms at about 4.2 mmSL; PO_5 at about 6.2 mmSL; V_n at about 9.2; PLO at about 16.2 mmSL; other photophores form after transformation
- Pigmentation: spots at tips of both jaws; internal pigment over air bladder and in otic region; spots on top of head; 2 melanophores on terminus of gut; series of spots along dorsum of body, along venter of body, over anal fin, and along midline; pigment present at base of caudal fin
- Transformation occurs at about 20 mmSL

Note:

1. High numbers of dorsal fin rays (21–24) and secondary caudal fin rays (11–14 and 10–14)
2. Larvae more slender than those of *Notoscopelus caudispinosus*; series of melanophores along dorsum of body and over anal fin base lacking in *N. caudispinosus*; series along midline of body longer than in larvae of *N. caudispinosus*

Early Juvenile:**F. 26.3 mmSL**

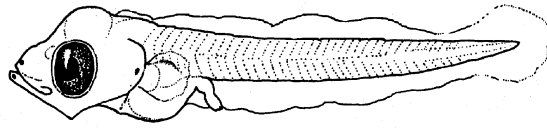
Photophores discussed:



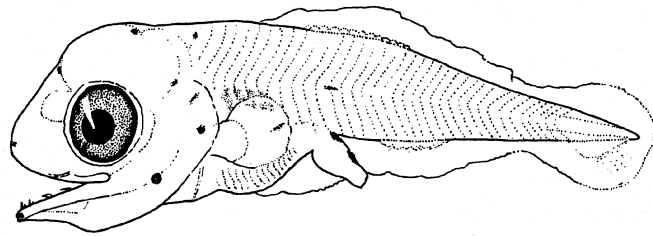
Figures: Adult: Hulley, 1984b; A–F: Moser and Ahlstrom, 1996

References: Moser and Ahlstrom, 1970; 1972; 1974; 1996b; Moser *et al.*, 1984; Karnella, 1987; Hulley, 1984b; Moser and Watson, 2001

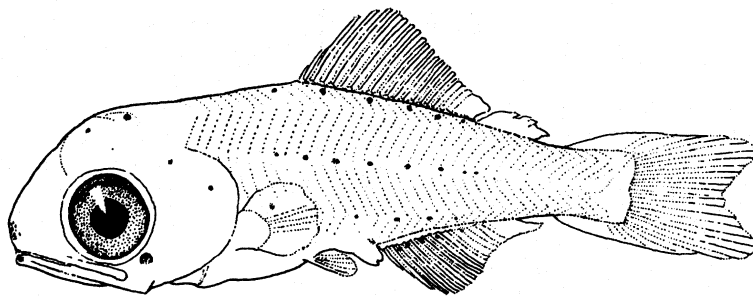
Notoscopelus resplendens



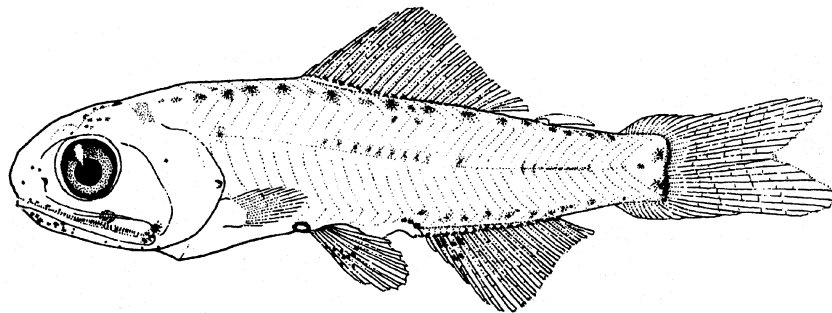
A. 3.1 mmSL



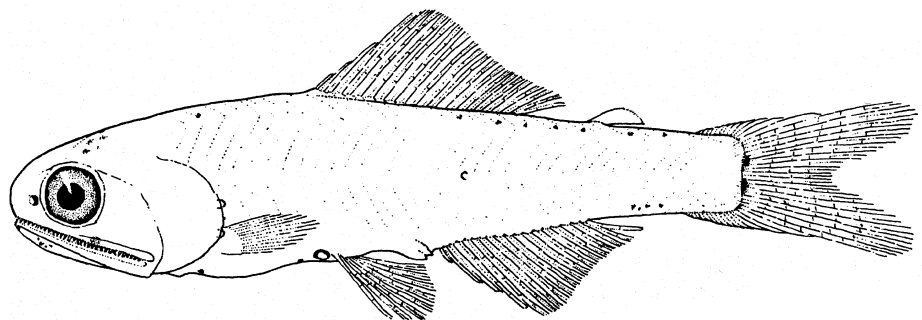
B. 4.8 mmSL



C. 6.5 mmSL



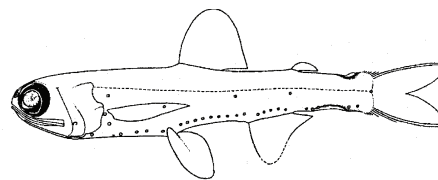
D. 16.2 mmSL



E. 21.0 mmSL

Taaningichthys minimus* (Tåning, 1928)*Myctophidae (s.f. Lampanyctinae)**

No common name



Range: Atlantic, Pacific and Indian oceans mostly in subtropical waters; in the western North Atlantic from Grand Bank to Guyana

Habitat: Mesopelagic in depths of 600–800 m during the day, 90–600 m at night

Spawning: Mostly fall, tapers off to low levels in early winter; life cycle is one year and most adults die before mid-winter

Eggs: – Undescribed; hatching length undescribed

Larvae: – Body elongate; dorsal and ventral margins of body nearly parallel
– Head small with short, moderately pointy snout

– Eye round

– Gut elongate, slender and straight; preanus length 58–65% SL

– Flexion occurs at 7.0–8.5 mmSL

– Sequence of fin ray formation: $C_1 - D, A - C_2, P_1, P_2$

– Photophore development: Br_2 forms immediately before transformation (at about 18.0 mmSL); PO_5 forms at transformation; other photophores form after transformation

– Pigmentation: early larvae have elongate, opposing pigment blotches on dorsal and ventral surfaces of caudal peduncle; 1 melanophore on terminus of gut over anus; internal pigment on air bladder; pigment on nape; internal pigment in otic region, above anterior notochord; larger larvae develop 1–2 large spots on top of head; larger larvae have internal pigment along entire length of notochord; dorsal pigment develops under mid-dorsal fin and just behind adipose fin (Fig. D); few spots over end of anal fin; pigment present at base of caudal fin

– Transformation occurs at about 21.0 mmSL

Note: 1. High number of myomeres (39–41), elongate body, small head, long, straight gut and pigment pattern are diagnostic for these larvae

Meristic Characters

Myomeres: 39–41

Vertebrae: 39–41

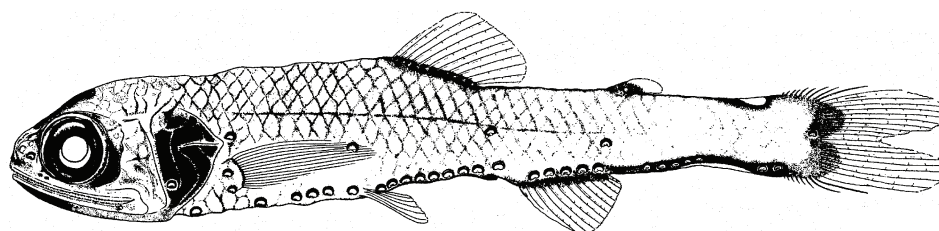
Dorsal fin rays: 11–13

Anal fin rays: 11–14

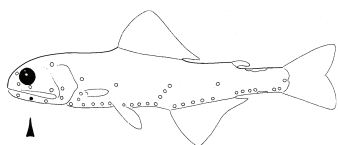
Pectoral fin rays: 15–17

Pelvic fin rays: 8

Caudal fin rays: 8–10+10+9+8–10

Early Juvenile:**F. 21.5 mmSL**

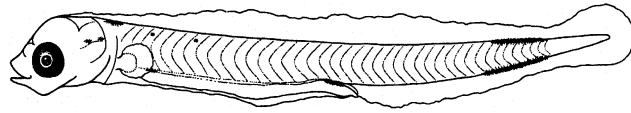
Photophores discussed:



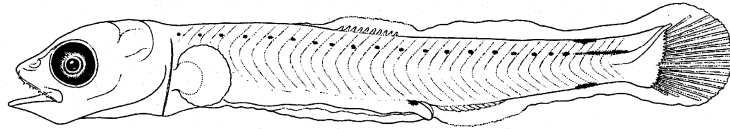
Figures: Adult: Hulley, 1984b; **A–B, E–F:** Moser and Ahlstrom, 1996b; **C–D:** Ozawa, 1986c

References: Moser and Ahlstrom, 1970; 1972; 1974; 1996b; Moser *et al.*, 1984; Karnella, 1987; Hulley, 1984b; Moser and Watson, 2001

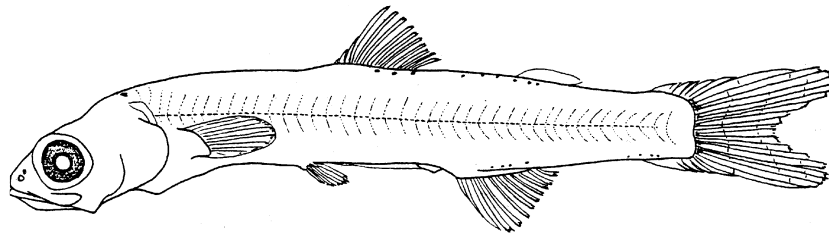
Taaningichthys minimus



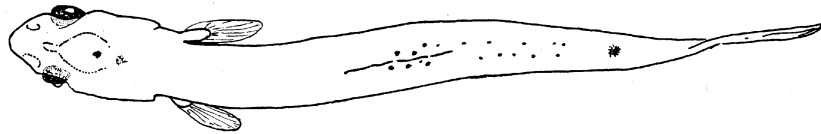
A. 4.9 mmSL



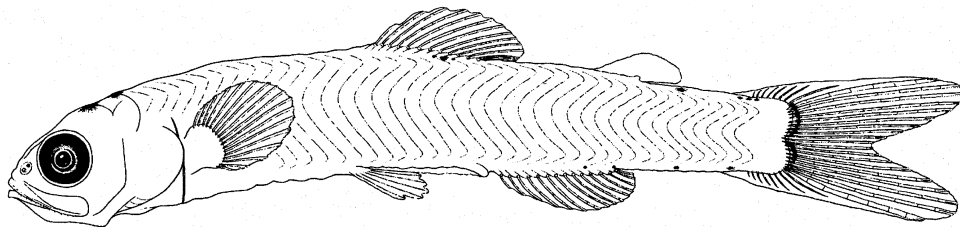
B. 7.2 mmSL



C. 13.1 mmSL



**D. 13.1 mmSL
(Dorsal View)**



E. 16.9 mmSL