Order Myctophiformes

Family Neoscopelidae

Two benthopelagic species in the genus *Neoscopelus* have been reported from the western North Atlantic Ocean north of 35°N. Both species are primarily tropical in their distributions, and have been collected in the study area only as isolated occurrences, or only as young stages (Moore *et al*., 2003). Adults of these two species have ventrolateral rows of photophores on the body and also have light organs on the sides of the tongue. Eggs are undescribed. Larvae are deep-bodied with large guts, large heads and well developed teeth. Spines occur along the edge of the preopercle in *Neoscopelus* larvae. See Moser and Watson (2001) for more detail on ontogenetic development in this tropical family.

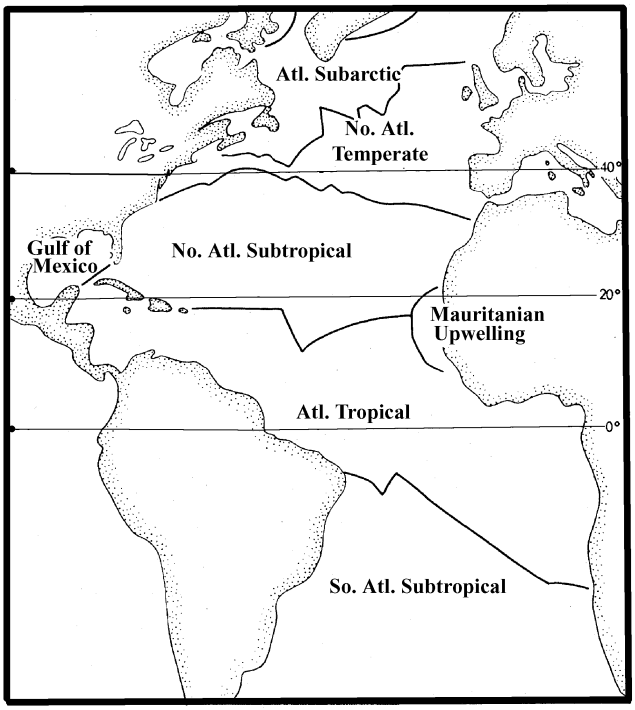
Family Myctophidae

Eighty-two species in 20 genera occur in the North Atlantic Ocean. Seventy species have been reported from the study area, north of 35°N and west of 40°W. Larvae have been described for 48 of these but eggs are undescribed in all myctophids except for those of *Lampanyctodes hectoris* collected off New Zealand (Robertson, 1977). Characters of those eggs are:

Shell:	Weakly oval, fragile	Yolk:	Strongly segmented
Diameter (long):	0.74–0.83 mm	Oil globule:	Single, 0.21–0.23 mm
Diameter (short):	0.65–0.72 mm	Perivitelline space:	Narrow

Myctophid eggs in general (none identified to species), have been described as being about 0.70–0.90 mm in diameter, with a segmented yolk, moderately wide perivitelline space, single oil globule (0.1–0.3 mm in diameter), and a fragile chorion (Moser and Watson, 2001). Presumably, these fragile eggs (and their equally fragile embryos) are damaged during collection in plankton nets, and therefore, none has been identified to species.

Most abundant myctophid species in four Atlantic Ocean regions, based on catches of adults in upper 200 m.



(Map and data after Backus *et al*., 1977)

Region/Species	% of all myctophids
Atl. Subarctic	
Benthosema glaciale	96%
No. Atl. Temperate	
Benthosema glaciale	45%
Ceratoscopelus maderensis	21%
Lobianchia dofleini	12%
Lampanyctus pusillus	6%
No. Atl. Subtropical	
Notolychnus valdiviae	18%
Diogenichthys atlanticus	14%
Ceratoscopelus warmingi	10%
Bolinichthys indicus	7%
Lobianchia dofleini	7%
Lampanyctus pusillus	7%
Benthosema suborbitale	6%
Atl. Tropical	
Lepidophanes guentheri	17%
Diaphus dumerili	12%
Ceratoscopelus warmingi	12%
Notolychnus valdiviae	12%
Benthosema suborbitale	7%
Lampanyctus alatus	4%

Order Myctophiformes

Myctophidae: Larval Characters (after Moser and Ahlstrom 1970; 1972; 1974; Moser and Watson, 2001)

Morphology

- Body ranges from slender-elongate to deep and big-headed
- Head varies from deep and narrow to short and slender
- Eye round or narrowed; some choroid tissue may be present under either type, but is more developed under narrowed eyes; several species have narrow eyes on short stalks (e.g. *Symbolophorus* and *Myctophum*)
- Gut length varies; in most species, preanal length increases relative to SL during larval development; in some species, a gap is present between the anus and anal fin origin
- Size at transformation ranges from about 10 mm (*Electrona*) to >20 mm (*Notolychnus*)

Pigmentation

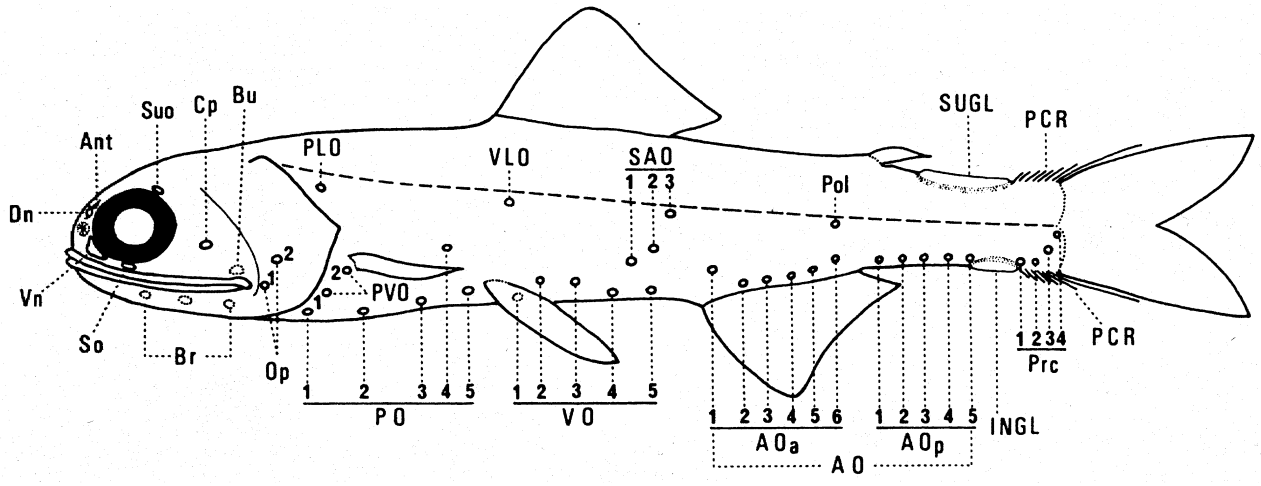
- Variable among species within a genus
- Important series of melanophores on ventral midline of tail present in some; if series is present, the number of melanophores increases or decreases during development
- Pigment pattern usually changes during development

Fin Development

- Adipose fin present
- Pectoral fin: rays develop early, often the first fin to develop rays, or immediately follows the ossification of caudal fin rays in some species; more rays may be present in larvae than in adults (= supernumerary rays)
- Caudal fin: usually the first fin to form ossified rays; all myctophids have 10+9 principal caudal fin rays
- Anal fin: forms in the adult position; rays usually begin ossifying after pectoral and caudal fin rays
- Dorsal fin: forms in the adult position; rays usually begin ossifying after anal fin rays
- Pelvic fin: usually the last fin to form rays; adult complement 8 rays (rarely 6 or 7)
- In most genera, the number of anal fin rays exceed the number of dorsal fin rays, and the difference is greatest in the subfamily Myctophinae; exceptions (in the Lampanyctinae) are *Lobianchia*, *Lampadena* and *Notoscopelus* where the dorsal fin rays outnumber those of the anal fin. In *Diaphus*, *Lepidophanes*, Taaningichthys and *Ceratoscopelus*, the dorsal and anal fin rays are about equal in number.

Photophores

- Photophore group terminology (after Fujii, 1984) based on a hypothetical myctophid. Patterns and presence or absence of photophores in each series vary by species. Numbers of photophores in some series may exceed or be less than the numbers shown here.



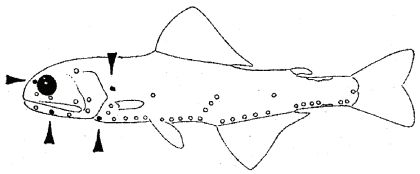
Order Myctophiformes

Myctophidae: Larval Characters (cont.)

Photophore development

- Br_2 is the first photophore to form in all species except *Notolychnus valdiviae* (where Br_2 forms with several other photophores at transformation)
- Other photophores may form sequentially before transformation
- See Subfamily Differences table for information on photophore development
- Note: hypothetical figure at the bottom of each species text page in the Myctophidae section indicates locations of pertinent photophores. Photophores discussed in the larval development paragraph are indicated with solid circle and pointer. Open circles indicate photophores that do not appear until after transformation. The almost-universally first-forming Br_2 photophore originates below and slightly behind the eye, and then migrates to its adult position on the middle of the lower jaw.

In this example, Br_2, PLO, Dn and PO_1 photophores are indicated



Other larval structures

- Lower jaw barbel occurs in larval *Diogenichthys atlanticus*
- Elongate lower pectoral fin rays occur in *Loweina interrupta* and *L. rara*
- Enlarged dorsal finfolds are found in larval *Loweina* and *Benthosema*
- Stalked eyes occur in *Symbolophorus*, some *Hygophum* and some *Myctophum larvae*
- Premaxilla with early-forming cluster of teeth in *Lampanyctus*

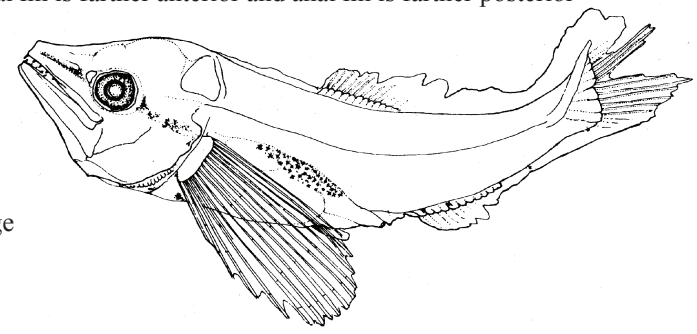
Similar larvae

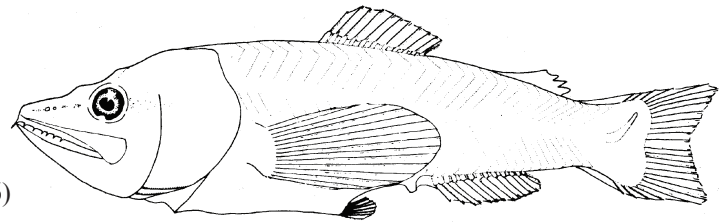
- *Scopelengys tristis* (a rare neoscopelid occurring in tropical waters of the western Atlantic); larvae are superficially similar to those of *Lampanyctus*; photophores are lacking in this genus
- *Chlorophthalmus* and *Parasudis* (Chlorophthalmidae): eye, head, gut and trunk in these larvae are similar to characters in myctophid larvae, but dorsal fin is farther anterior and anal fin is farther posterior

Scopelengys tristis Alcock, 1890

6.2 mmSL
(Pacific Ocean, Okiyama, 1974)

Larvae of this species lack spines on the edge of the preopercle, as found in larvae of the neoscopelid genus *Neoscopelus*





13.9 mmSL
(Indian Ocean, Butler and Ahlstrom, 1976)

Order Myctophiformes

Myctophidae: Subfamily differences

Genera of Myctophidae separate into distinct subfamilies based on characters of larvae and adults. See Paxton (1972) for osteological characters separating the subfamilies.

	Subfamily Myctophinae	Subfamily Lampanyctinae
Larval Eyes	Elliptical, some with choroid tissue, some with stalks	Round, may have small sliver of choroid tissue (*Lobianchia* and *Notolychnus* may have slightly narrowed eyes)
Larval Photophores	Only Br_2 formed in most; 3 species develop other photophores as larvae – *Diogenichthys atlanticus*: Br_2, PO_2, PO_5, and AOa_1, – *Benthosema suborbitale*: Br_2, PO_1, PO_2, Br_1, and Br_3 – *Myctophum asperum*: Br_2, Dn, and PLO	Sequential development of 3 or 4 pairs of photophores in most – *Notoscopelus*: Br_2, PO_5 and Vn form in sequence, followed by PLO later – *Bolinichthys* (with exceptions), *Ceratoscopelus* and *Lepidophanes*: Br_2, Vn, PLO and PO_5 form in sequence; photophores are very small – *Lampadena*: Br_2, PLO and PO_5 form early – *Diaphus*, *Lobianchia*: Br_2, PO_5 and PO_1 form early – *Lampanyctus*: Only Br_2 in larvae – *Notolychnus* and *Taaningichthys*: No photophores in larvae, except – *Taaningichthys* may form Br_2 just before transformation
Adult Prc Photophores	1 or 2, neither far above lateral line	2 to 9; if 2, one positioned well above lateral line; if 3 to 9, none positioned far above lateral line
Dorsal and Anal Fin Rays	Usually many more anal fin rays than dorsal fin rays	Usually a few more anal fin rays than dorsal fin rays; exceptions include *Lobianchia*, *Lampadena* and *Notoscopelus* where dorsal fin rays outnumber anal fin rays; *Diaphus*, *Lepidophanes*, *Taaningichthys* and *Ceratoscopelus* where dorsal and anal fin rays are about equal in number

The genera *Hygophum* (Myctophinae) and *Diaphus* (Lampanyctinae) are especially speciose and their larvae have proven difficult to identify. In *Hygophum*, larvae range from very slender, with pointed snout and a series of melanophores along the gut (e.g. *H. reinhardti*) to larvae with stubby body forms, blunt snouts, and a prominent melanophore over the terminus of the gut (e.g. *H. taaningi*). All *Hygophum* larvae have a series of melanophores along ventral midline of isthmus.

Two larval forms of *Diaphus* have been described (Moser *et al*., 1984; Moser and Ahlstrom, 1996b). The first form is slender-bodied and has numerous persistent, postanal, ventral melanophores. The second form is stout-bodied and has fewer postanal melanophores that coalesce before the flexion stage. Examples of the slender form include *Diaphus holti*, an eastern Atlantic species (Tåning, 1918). Examples of the stout form include *D. rafinesquii* and *D. metopoclampus*.

Order Myctophiformes

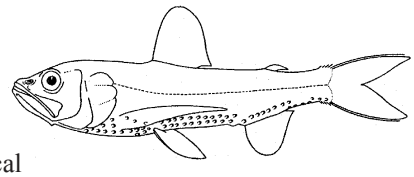
Selected meristic characters in species belonging to the order Myctophiformes whose adults or larvae have been collected in the study area. Classification follows Moser and Ahlstrom (1996b) and Moser and Watson (2001). Genera and species listed alphabetically under subfamily name. Caudal$_2$ = dorsal secondary rays + ventral secondary rays. All have 10+9 principal caudal fin rays. AOa and Aop = photophores in anterior and posterior AO series, respectively

Family-Subfamily *Species*	Vertebrae	Dorsal Fin Rays	Anal Fin Rays	Pectoral Fin Rays	Caudal$_2$ Fin Rays	AOa	AOp
Neoscopelidae							
Neoscopelus macrolepidotus	30–31	12–13	11–13	18–19	6+6	–	–
Neoscopelus microchir	30–31	12–13	10–13	15–17	6+6	–	–
Myctophidae-Myctophinae							
Benthosema glaciale	34–36	12–14	17–19	11–13	–	6–7	7–8
Benthosema suborbitale	33–35	11–14	16–19	12–15	6–8+7–8	5–7	4–6
Centrobranchus nigroocellatus	35–40	9–11	16–19	13–17	5–7+5–7	4–7	8–11
Diogenichthys atlanticus	31–35	10–12	14–18	12–15	8–9+8–9	5–8	2–4
Electrona risso	32–34	12–15	18–20		13–16	6–8+6–7	10–13
total							
Gonichthys cocco	40–41	10–13	20–23	13–16	5–7+5–6	4–8	10–14
Hygophum benoiti	34–37	12–14	19–21	13–15	7–8+7–8	5–7	5–7
Hygophum hygomii	36–38	13–15	20–22	14–17	8–9+7–8	6–8	5–7
Hygophum macrochir	35	12–14	17–21	13–15	9+8	3–5	5–8
Hygophum reinhardti	38–40	13–15	21–25	13–16	7–9+7–8	5–9	6–9
Hygophum taaningi	35–36	12–14	17–23	12–15	8–9+8–9	3–7	3–8
Loweina interrupta	39–40	10–12	15–16	11–12	–	5–8	5–7
Loweina rara	37–39	10–13	13–17	9–13	6–7+6–7	5–7	11–14
Myctophum affine	37–38	12–14	17–20	12–14	8–9+7–8	6–9	3–6
Myctophum asperum	35–38	12–14	17–19	12–16	8–9+8–9	6–8	5–7
Myctophum nitidulum	36–39	12–14	18–21	12–16	7–9+7–9	7–10	4–7
Myctophum obtusirostre	35–36	12–14	17–19	16–20	8–9+7–9	6–8	2–5
Myctophum punctatum	40 (Med)	13–14	20–22	14–15	–	7– 8	9–8
Myctophum selenops	34–35	12–14	17–19	15–18	8+7–8	6–8	2–4
Protomyctophum arcticum	36–41 (genus)	11–13	21–24	15–17	–	15–16	total
Symbolophorus rufinus	37	14–16	20–22	14–17	8–10+8–9	7–9	5–7
Symbolophorus veranyi	39–40 (Med)	12–14	21–23	12–13	–	7–9	7–9
Myctophidae-Lampanyctinae							
Bolinichthys indicus	33–34	11–14	12–14	12–14	6–8+7–8	4–7	3–5
Bolinichthys photothorax	35	12–14	13–15	12–14	7+7	5–8	3–6
Bolinichthys supralateralis	34	12–15	13–15	12–14	6–7+6–7	4–7	3–5
Ceratoscopelus maderensis	37	13–15	13–15	13–14	7+6–7	5–8	5–7
Ceratoscopelus warmingi	35–36	13–15	13–15	12–15	6+6–7	5–9	4–7
Diaphus brachycephalus	33	12–14	12–14	10–12	7–8+7	4–6	3–5
Diaphus dumerili	35	14–15	14–16	10–13	6+6	6–8	4–7
Diaphus effulgens	35–36	15–17	14–16	11–13	6+6	5–7	4–6
Diaphus fragilis	35	17–19	16–18	11–13	6–7+6	5–7	4–6
Diaphus garmani	35–36	14–16	15–17	11–12	5–7+6–7	6–8	4–7
Diaphus lucidus	36	16–18	17–19	11–12	6+6	6–8	4–6
Diaphus luetkeni	34–36	15–17	14–16	11–12	6–7+6	5–7	4–6
Diaphus metopoclampus	35	14–16	14–16	10–11	6+6	5–7	5–7
Diaphus mollis	33–34	12–14	12–14	9–12	7–8+7	4–7	3–5
Diaphus perspicillatus	35–36	15–17	14–16	10–12	6+6	5–7	4–7
Diaphus problematicus	35	15–17	16–19	11–12	6+6	5–7	4–6
Diaphus rafinesquii	33–34	12–14	13–15	9–11	6–8+6–7	5–7	3–5
Diaphus splendidus	36–37	14–16	15–17	11–12	6–7+6–7	5–7	5–7
Diaphus subtilis	34	12–14	13	10–12	7+6–7	5–6	5–7

Order Myctophiformes

Family–Subfamily *Species*	Vertebrae	Dorsal Fin Rays	Anal Fin Rays	Pectoral Fin Rays	$Caudal_2$ Fin Rays	AOa	AOp
Diaphus termophilus	34–35	13–15	15	11–12	6–8+6–7	5–6	4–6
Lampadena anomala	36–37	14–16	13–14	16–18	–	3–4	2
Lampadena luminosa	35–37	14–15	13–15	15–17	8+8	5–7	2
Lampadena speculigera	37	13–15	13–15	13–15	8+8	5–9	2–5
Lampadena urophaos	35–38	14–16	13–14	14–17	8–9+8–9	4–6	2
Lampanyctus alatus	33–36	11–13	16–18	11–13	7+7–8	5–7	5–8
Lampanyctus ater	–	13–15	18–19	11–12	–	6–8	6–8
Lampanyctus crocodilus	35–36	13–15	16–18	13–16	8+8	5–8	7–9
Lampanyctus festivus	34–35	13–14	18–20	15–17	6–7+6–8	6–8	8–10
Lampanyctus intricarius	–	14–16	18–20	13–14	–	8–9	7–9
Lampanyctus macdonaldi	–	13–15	15–18	12–13	–	6–7	7–8
Lampanyctus nobilis	37–39	14–16	17–20	13–15	6–7+6–7	5–7	8–10
Lampanyctus photonotus	34–36	12–15	16–18	11–14	–	5–7	6–8
Lampanyctus pusillus	30–32	11–13	13–16	13–15	–	4–6	5–7
Lampanyctus tenuiformis	34–37	13–15	17–19	12–15	7–8+7–8	6–7	6–8
Lepidophanes gaussi	35–36	12–15	13–15	11–13	7–8+7–8	5–7	5–8
Lepidophanes guentheri	36	13–15	13–16	11–14	7–8+7–8	5–7	4–7
Lobianchia dofleini	33–35	15–17	13–15	11–13	5–6+5	4–6	4–6
Lobianchia gemellarii	34–35	16–18	13–15	11–13	6–7+5–6	4–6	5–7
Nannobrachium atrum	36–39	12–16	17–21	11–12	–	6–9	6–9
Nannobrachium cuprarium	32–34	16–19	17–20	11–12	8–10+8–9	5–7	4–6
Nannobrachium lineatum	37–40	15–19	19–23	12–14	–	7–9	6–9
Notolychnus valdiviae	27–31	10–12	12–15	12–15	6–8+6–8	4	3–4
Notoscopelus bolini	37–38	24–26	19–20	12–14	–	7–9	6–8
Notoscopelus caudispinosus	37	24–27	19–21	11–13	10–11+11–12	6–8	3–5
Notoscopelus elongatus kroeyeri	39–40	21–22	18–20	13	–	8–10	6–8
Notoscopelus resplendens	35–38	21–24	17–20	11–13	11–14+10–14	7–9	4–7
Taaningichthys bathyphilus	34–36	11–14	12–14	12–14	7+6	1–4	1–2
Taaningichthys minimus	39–41	11–13	11–14	15–17	8–10+8–10	4–7	4–6

Neoscopelus macrolepidotus Johnson, 1863
Neoscopelidae
No common name



Range: Atlantic, western Indian and western Pacific oceans in tropical to subtropical waters; in the western North Atlantic from the Caribbean Sea to Suriname with several isolated records as far north as 40°45'N, 66°42'W

Habitat: Benthopelagic in depths of 300–800 m

Spawning: Oviparous with pelagic larvae; season and area undescribed

Eggs:
- Undescribed

Larvae:
- Body moderately elongate with preanus length >60% SL
- Snout pointed, head length 28–36% SL; eye moderately large and round
- Large mouth with short teeth present on premaxilla
- Gut with slightly protruding terminus in early stages
- Air bladder located anteriorly
- Flexion occurs at 6–7 mm
- Spines present along preopercle edge in flexion larvae
- Pectoral fins early-forming, large and fan-shaped
- Sequence of fin ray formation: $P_1 - C_1$, – D and $A - P_2 - C_2$
- Photophore development in specimens >19.8 mm: 7 per side on tongue, 9 along isthmus, 2 on preopercle, 1 PVO and large suborbital photophore under end of maxilla; ventral series forming, but difficult to distinguish from melanophores
- Pigmentation: 2 clusters of melanophores on gut in early larvae, the first over the air bladder, the second on terminus of gut; few spots on top of head in flexion larvae; dense melanophores form over much of body after transformation, following the myosepta on posterior part of body
- Transformation occurs at about 19 mm

Meristic Characters

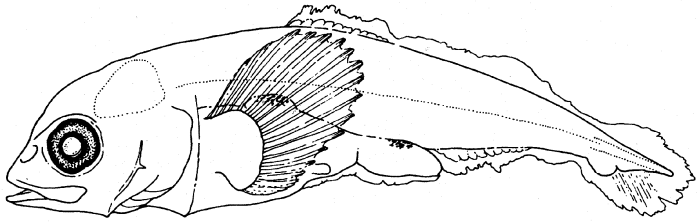
Myomeres:	30–31
Vertebrae:	30–31
Dorsal fin rays:	12–13
Anal fin rays:	11–13
Pectoral fin rays:	18–19
Pelvic fin rays:	8–9
Caudal fin rays:	6+10+9+6

Note:
1. Early juveniles of *Neoscopelus microchir* are similar to those of this species, but the body of *N. microchir* is deeper and the portion posterior to dorsal fin is less elongate; also see pigmentation differences on caudal peduncle, pectoral and pelvic fins, and on posterior myosepta.

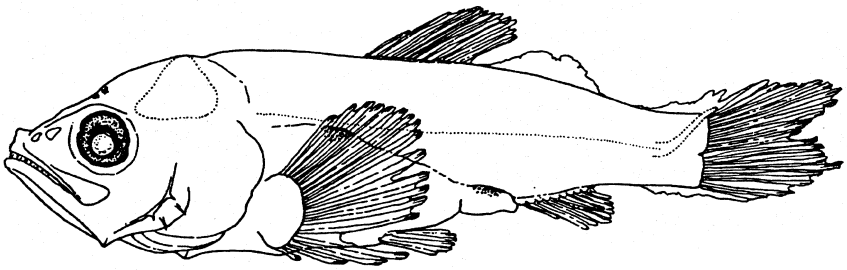
Figures: Adult: Hulley, 1984a; **A**: Okiyama, 1988; **B**: Okiyama, 1984a; **C**: R. C. Walker and William Watson (Moser and Watson, 2001)

References: Okiyama, 1974; 1984a; 1984b; 1988; Hulley, 1984a; Moser and Watson, 2001

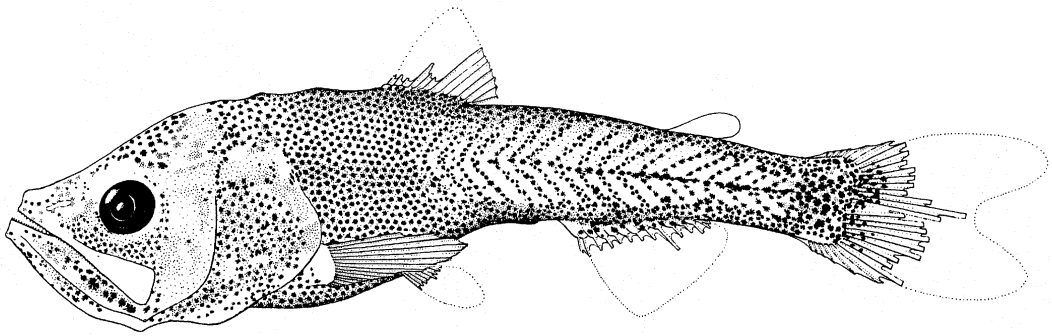
Neoscopelus macrolepidotus



A. 5.3 mmSL

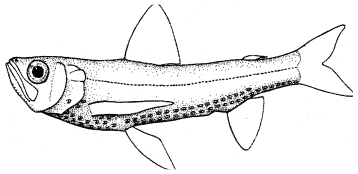


B. 7.9 mmSL



C. 19.6 mmSL

Neoscopelus microchir Matsubara, 1943
Neoscopelidae
No common name



Meristic Characters

Myomeres:	30–31
Vertebrae:	30–31
Dorsal fin rays:	12–13
Anal fin rays:	10–13
Pectoral fin rays:	15–17
Pelvic fin rays:	8–9
Caudal fin rays:	6+10+9+6

Range: Atlantic, Indian and western Pacific oceans in tropical to subtropical waters; in the western North Atlantic adults occur from the Straits of Florida to Caribbean Sea; juveniles have been collected as far north as south of Scotian Shelf (vicinity of Alvin Canyon and La Have Bank)

Habitat: Benthopelagic in depths of 250–700 m

Spawning: Oviparous with pelagic larvae; season and area undescribed

Eggs: – Undescribed

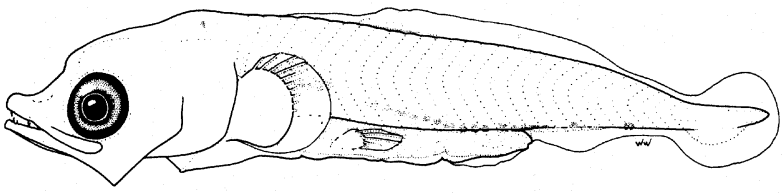
Larvae:
- Body moderately elongate with preanus length >50% SL
- Snout pointed, head length 30–35% SL; eye moderately large and round
- Large mouth with teeth present on anterior part of premaxilla
- Gut with slightly protruding terminus in early stages
- Air bladder located anteriorly
- Flexion occurs at about 7 mm
- Spines present along preopercle edge in postflexion larvae
- Pectoral fins early-forming, large and fan-shaped
- Sequence of fin ray formation: P_1, $P_2 - C_1$, D, $A - C_2$
- Photophore development in specimens >17 mm: large suborbital organ near end of maxilla, 2 form on preopercle, 1 PVO forms; also early formation of photophores on tongue, isthmus and ventral margin of body
- Pigmentation: melanophore over air bladder and pairs of internal spots from air bladder to just beyond anus,become obscured in larger larvae; 1 or 2 spots on ventral margin of tail in early stages; scattered spots form over terminus of gut; scattered melanophores form on head, internally on nape, and on pectoral and pelvic fin rays; dense melanophores form over much of body after transformation
- Transformation occurs at about 18 mm

Note:
1. Early juveniles of *Neoscopelus macrolepidotus* are similar to those of this species, but the body of *N. macrolepidotus* is shallower and more elongate from the dorsal fin to the base of caudal fin; also see pigmentation differences

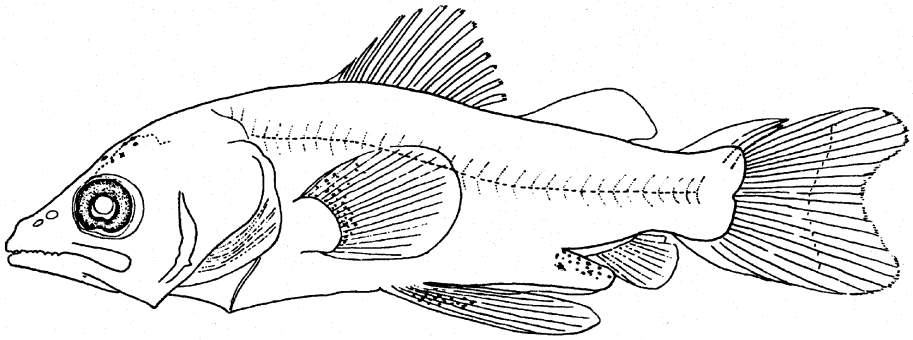
Figures: Adult: Hulley, 1984a; **A**: William Watson (Moser and Watson, 2001); **B**: Okiyama, 1988; **C**: R. C. Walker and William Watson (Moser and Watson, 2001)

References: Okiyama, 1974; 1984a; 1984b; Hulley, 1984a; Moser and Watson, 2001

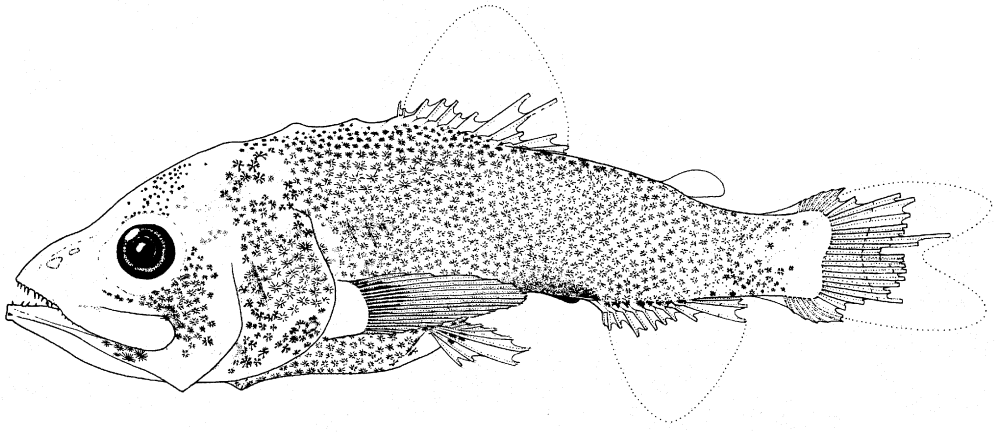
Neoscopelus microchir



A. 5.3 mmSL

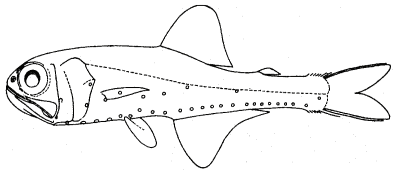


B. 8.6 mm



C. 17.4 mm

Benthosema glaciale (Reinhardt, 1837)
Myctophidae (s.f. Myctophinae)
Glacier lanternfish



Range: Atlantic Ocean and Mediterranean Sea; in the western North Atlantic from Davis Strait to Cape Hatteras; most abundant north of 40°N

Habitat: Mesopelagic in depths of 275–850 m during day, surface to 225 m at night

Spawning: Early spring through fall

Meristic Characters

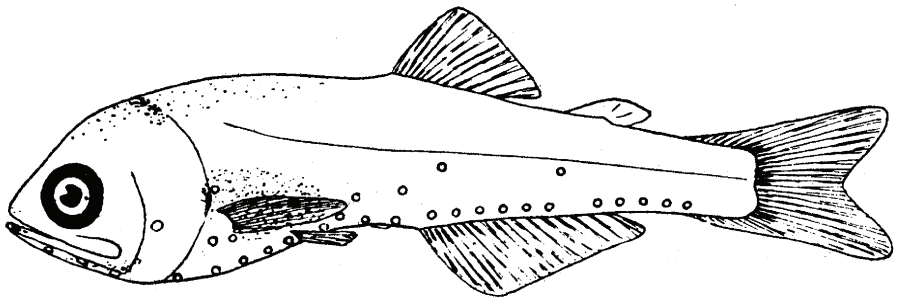
Myomeres:	about 34–36
Vertebrae:	34–36
Dorsal fin rays:	12–14
Anal fin rays:	17–19
Pectoral fin rays:	11–13
Pelvic fin rays:	8
Caudal fin rays:	10+9 (PrC)

Eggs:
- Undescribed; hatching length undescribed

Larvae:
- Body moderately elongate
- Head moderate with pointy snout; eye slightly elliptical with lunate choroid mass ventrally
- Gap between anus and anal fin origin closes at about 8 mm
- Note thick, tapering, jug-shaped gut
- Flexion occurs at 5–7 mm
- Sequence of fin ray formation: C, A, D – P_1 – P_2; dorsal and anal fin rays complete at about 11 mm
- Photophore development: in addition to Br_2, late larvae develop Br_1, OP_2 and PO; AOa may develop before transformation
- Pigmentation: spot at posterior edge of opercle; spots at tips of snout and lower jaw; 3 ventral spots from cleithral symphysis to anus; ventral spots on tail reduce to a single spot over mid-anal fin at about 11 mm; pectoral fin rays pigmented; spot near developing Br_2
- Transformation occurs at about 11 mm (relatively small size for myctophids)

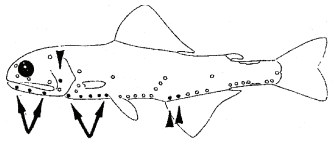
Note: 1. Larvae very commonly collected over continental slope and edge of continental shelf of study area

Early Juvenile:



G. 11.5 mmSL

Photophores discussed:

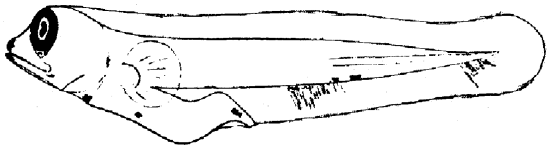


Figures: Adult: Hulley, 1984b; **A–B**, **D**, **F–G**: Tåning, 1918; **C**, **E**: Moser and Ahlstrom, 1974

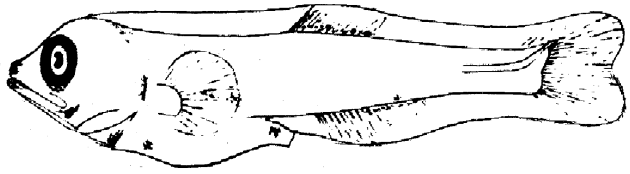
References: Moser and Ahlstrom, 1970; 1972; 1974; Moser *et al.*, 1984; Moser and Watson, 2001

Benthosema glaciale

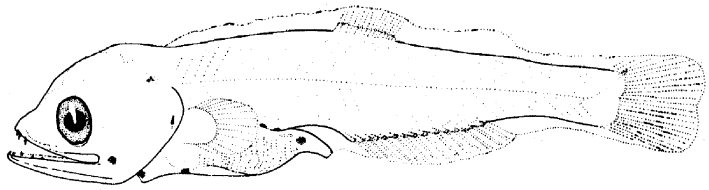
A. 5.0 mmSL



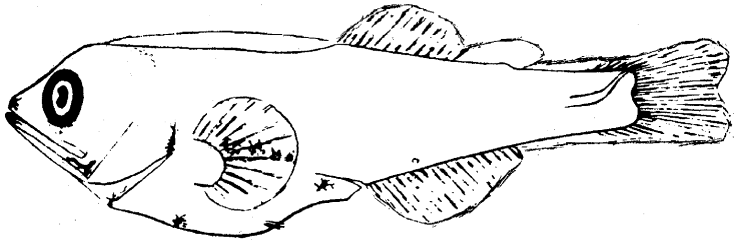
B. 7.0 mmSL



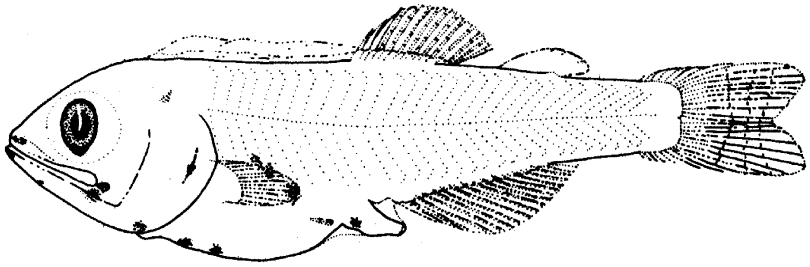
C. 7.2 mmSL



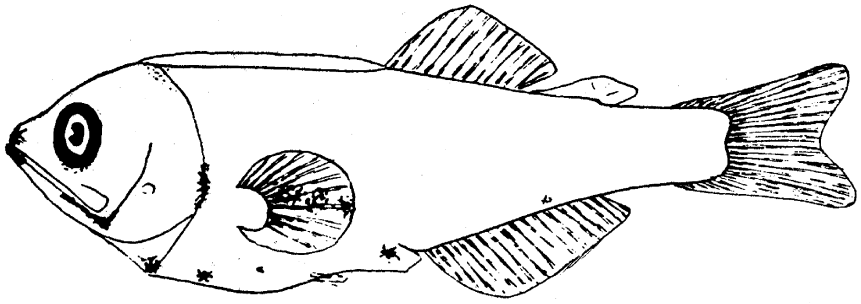
D. 9.0 mmSL



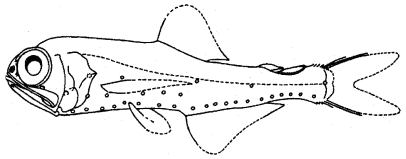
E. 10.5 mmSL



F. 11.0 mmSL



Benthosema suborbitale (Gilbert, 1913)
Myctophidae (s.f. Myctophinae)
No common name



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

Habitat: Mesopelagic in depths of 375–750 m during the day, surface to 125 m at night

Spawning: Presumably year-round, with a peak during spring, based on sampling north of Bermuda

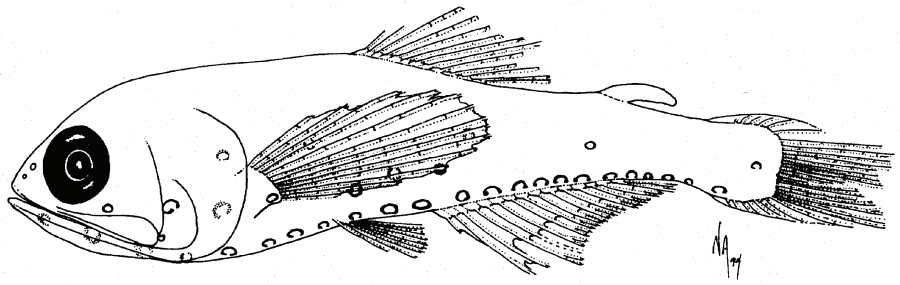
Eggs: – Undescribed; hatching length about 2.0 mm

Meristic Characters	
Myomeres:	33–35
Vertebrae:	33–35
Dorsal fin rays:	11–14
Anal fin rays:	16–19
Pectoral fin rays:	12–15
Pelvic fin rays:	8
Caudal fin rays:	6–8+10+9+7–8

Larvae:
- Body initially elongate, becomes shorter and deeper
- Head moderate with slightly pointy snout; eye elliptical with lunate choroid mass ventrally
- Gap between anus and anal fin origin closes between 9 and 10 mmSL
- Gut short; bulbous anteriorly with narrow posterior section
- Preanus length <50% SL
- Flexion occurs at 5.2–6.5 mm
- Sequence of fin ray formation: P_1, C_1, A, D – C_2, – P_2
- Photophore development: In addition to Br_2, late larvae develop PO_1, PO_2, Br_1 and Br_3
- Pigmentation: ventral pigment lacking; several melanophores on ventral surface of head and on lower pectoral fin bases; another melanophore on upper pectoral fin base; most of body unpigmented
- Transformation occurs at about 10.0 mmSL (relatively small for myctophids)

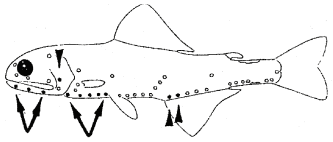
Note: 1. Larvae somewhat similar to those of *Electrona risso*; the latter have longer preanus lengths and have pigment on pectoral fin rays

Early Juvenile:



F. 14.5 mmSL

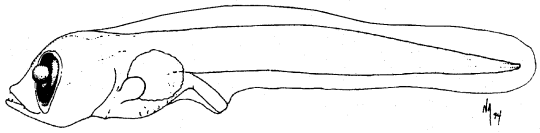
Photophores discussed:



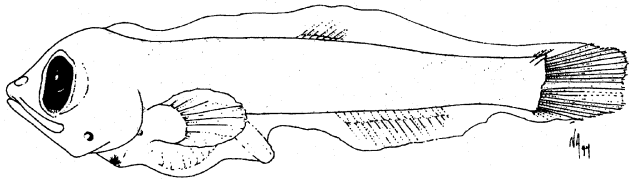
Figures: Adult: Hulley, 1984b; **A–C**, **E–F**: Nancy Arthur (Moser and Ahlstrom, 1996b); **D**: Moser and Ahlstrom, 1974

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

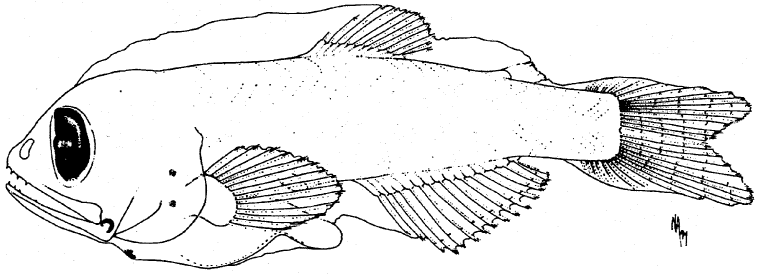
Benthosema suborbitale



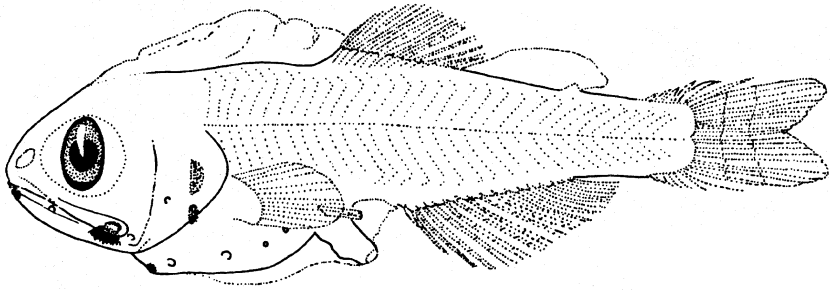
A. 4.5 mmSL



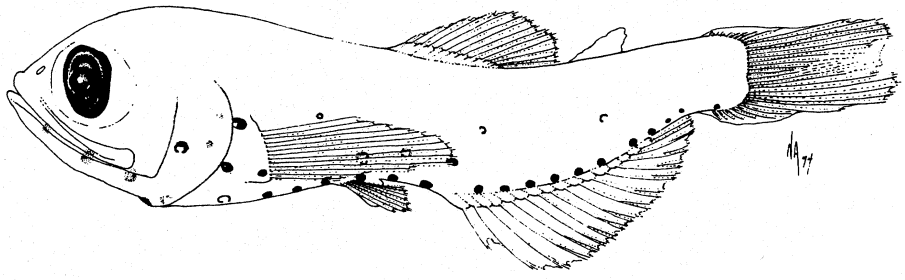
B. 6.5 mmSL



C. 7.3 mmSL



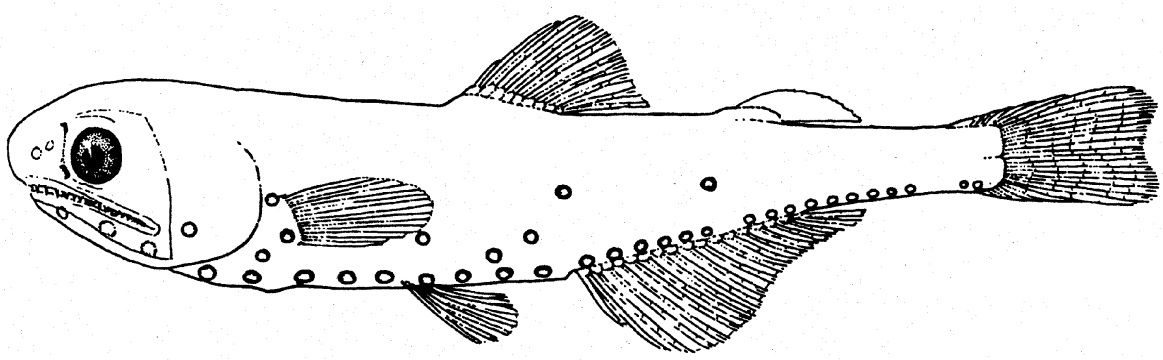
D. 9.2 mmSL



E. 9.7 mmSL

Erratum

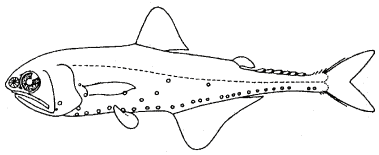
The figure on the lower part of Page 456 is incorrect.
Please insert the following figure in its place.



E. 17.7 mmSL

The remainder of the page is correct, including credits and citations.

Centrobranchus nigroocellatus (Günther, 1873)
Myctophidae (s.f. Myctophinae)
No common name



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

Habitat: Mesopelagic in depths of 375–650 m during the day; close to the surface at night

Spawning: Begins in fall, continues through following summer, with peak in late spring, based on sampling north of Bermuda; life cycle is one year, and most spawners die before summer

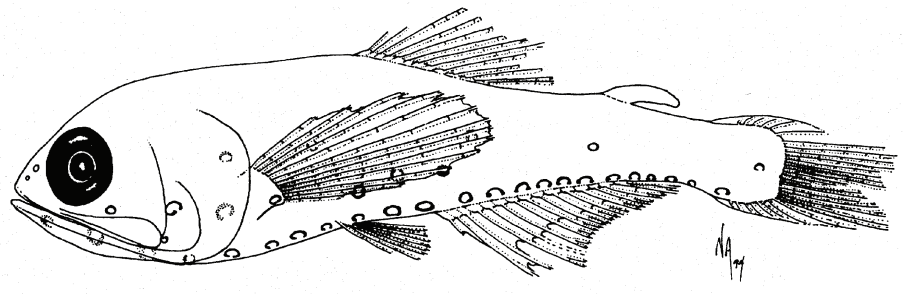
Meristic Characters	
Myomeres:	35–40
Vertebrae:	35–40
Dorsal fin rays:	9–11
Anal fin rays:	16–19
Pectoral fin rays:	13-17
Pelvic fin rays:	8
Caudal fin rays:	5–7+10+9+5–7

Eggs:
- Undescribed; hatching length <2.8 mmSL

Larvae:
- Body elongate in early larvae, becomes very deep and laterally compressed
- Head large with bulbous snout; eye narrow and elliptical, with elongate, pointed, choroid mass directed forward
- Gut thick and only slightly deflected at terminus; no gap between anus and anal fin origin
- Preanus length slightly >50% in early larvae, increases to 60–70%SL in later larvae
- Flexion occurs at 5.4–6.3 mmSL
- Sequence of fin ray formation: C_1, $P_1 - C_2$, D, A – P_2
- Photophore development: Only Br_2 forms in larvae, at about 5.0 mm
- Pigmentation: few spots above pectoral fin base and behind eye in early larvae; later larvae add pigment to branchiostegal ray membrane, on ventrum of liver, and near angle of gape
- Transformation occurs at about 12 mmSL

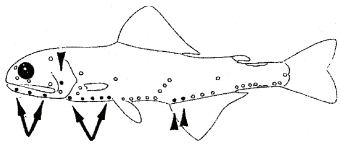
Note: 1. Voluminous dorsal finfold prominent throughout development until transformation

Early Juvenile:



F. 14.5 mmSL

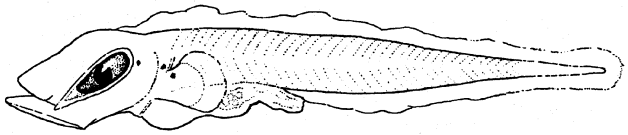
Photophores discussed:



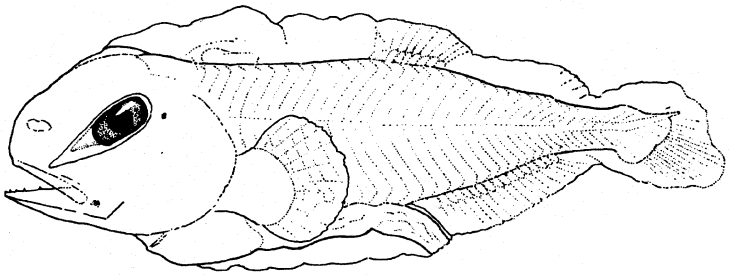
Figures: Adult: Hulley, 1984b; **A–E**: Moser and Ahlstrom, 1970

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

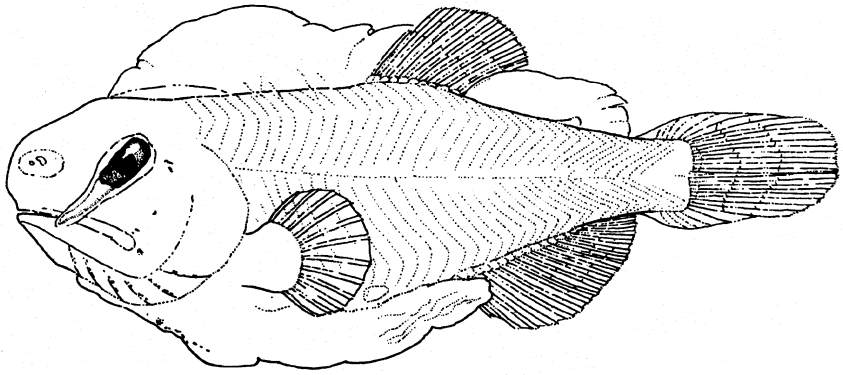
Centrobranchus nigroocellatus



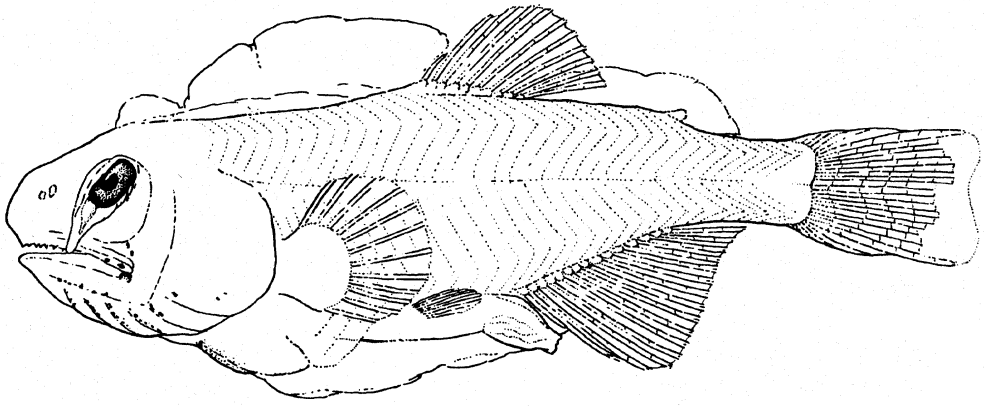
A. 3.9 mmSL



B. 5.8 mmSL

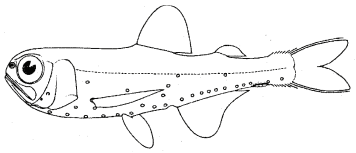


C. 7.3 mmSL



D. 12.0 mmSL

Diogenichthys atlanticus (Tåning, 1928)
Myctophidae (s.f. Myctophinae)
No common name



Range: Widespread in the Atlantic, Indian and Pacific oceans; in the western Atlantic from east of Grand Bank to Argentina

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

Spawning: Presumably year-round with peaks in spring and especially fall, based on sampling north of Bermuda; life cycle is about one year, and most spawners die before winter

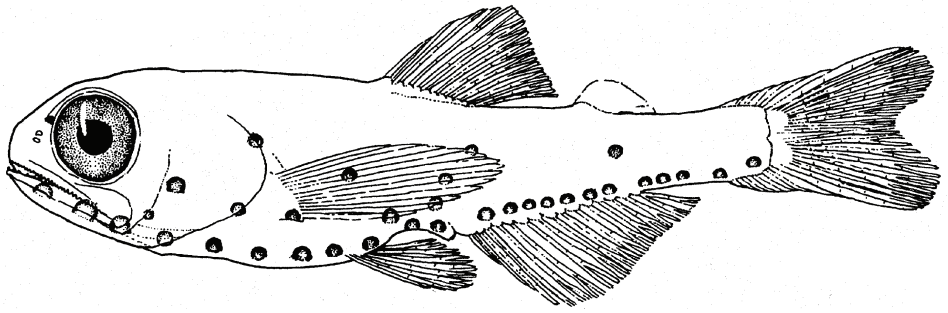
Meristic Characters	
Myomeres:	31–35
Vertebrae:	31–35
Dorsal fin rays:	10–12
Anal fin rays:	14–18
Pectoral fin rays:	12–15
Pelvic fin rays:	8
Caudal fin rays:	8–9+10+9+8–9

Eggs:
- Undescribed; hatching length <2.9 mmSL

Larvae:
- Body elongate, becoming somewhat deeper with development
- Head large with pointy snout; eye slightly elliptical, becoming more round in later larvae
- Gut fairly thick anteriorly, thinner posteriorly; preanus length about 50–60% SL through development
- Flexion occurs at 6.0–6.9 mmSL
- Sequence of fin ray formation: $C_1 - C_2$, A, $P_1 - D$, P_2
- Photophore development: Br_2 forms at about 6.0 mm, followed sequentially by PO_2 (7.0 mm), PO_5 (8.5 mm), AOa_1 (11.0 mm)
- Pigmentation: in early larvae, pairs of melanophores posterior to cleithrum, over terminus of gut, 2 pairs over mid-gut, and about 3 melanophores in ventral series posterior to anus; melanophores present along gut, including 1 over terminus near anus; spots occur on jaw barbel; ventral spots in postanal series increase in number
- Transformation occurs at 13.5–14.5 mmSL

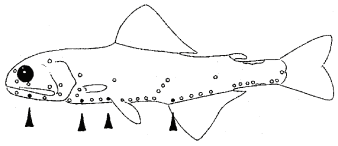
Note: 1. Barbel forms on tip of lower jaw in larvae; disappears at transformation

Early Juvenile:



G. 16.0 mmSL

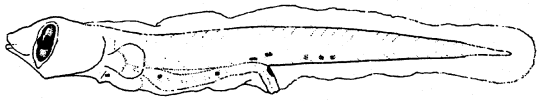
Photophores discussed:



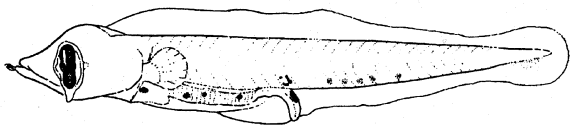
Figures: Adult: Hulley, 1984b; **A–G**: Moser and Ahlstrom, 1996b

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

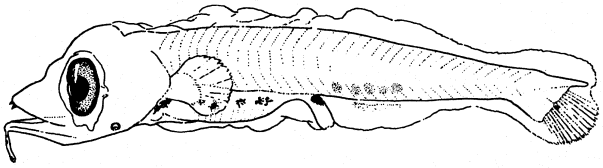
Diogenichthys atlanticus



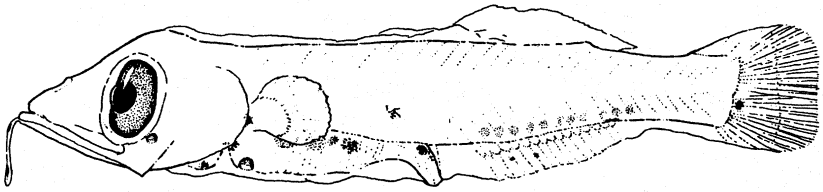
A. 3.6 mmSL



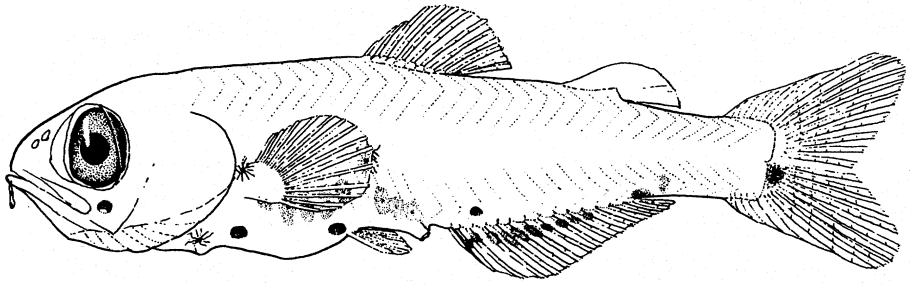
B. 5.1 mmSL



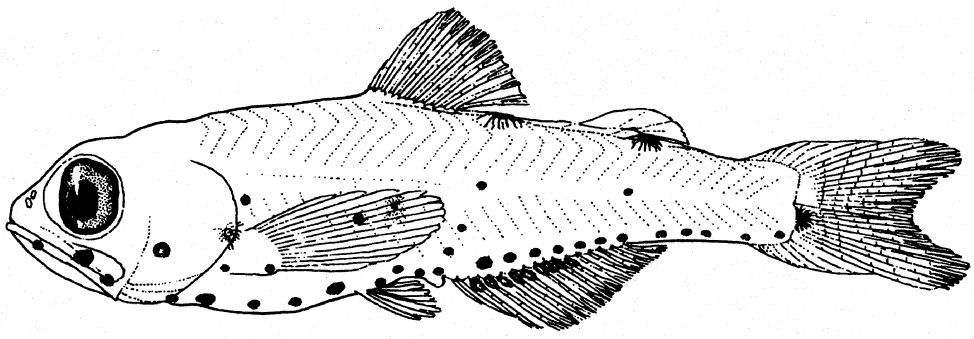
C. 6.0 mmSL



D. 7.2 mmSL

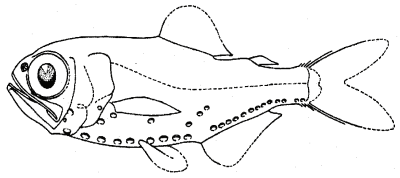


E. 12.8 mmSL



F. 14.5 mmSL Melanophores form on dorsum behind dorsal and adipose fins

Electrona risso (Cocco, 1829)
Myctophidae (s.f. Myctophinae)
No common name



Range: Eastern Atlantic, Indian and Pacific oceans; in the western North Atlantic may be collected in extreme eastern limit of study area (near 40°W)

Habitat: Highly oceanic, mesopelagic in depths of 700–750 m during the day, 150–200 m at night

Spawning: Undescribed in Atlantic; peak during summer–fall in Mediterranean Sea

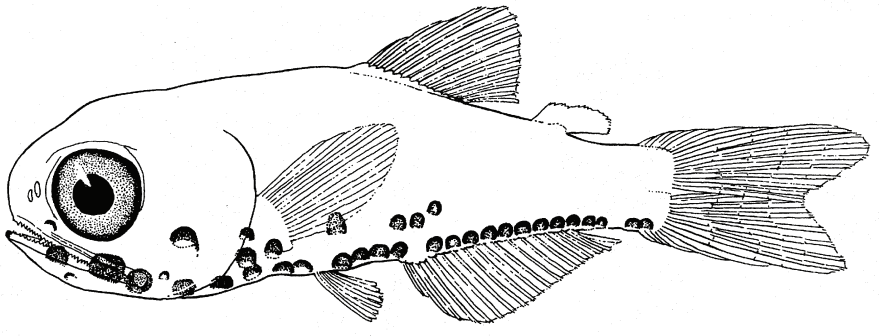
Meristic Characters	
Myomeres:	32–34
Vertebrae:	32–34
Dorsal fin rays:	12–15
Anal fin rays:	18–20
Pectoral fin rays:	13–16
Pelvic fin rays:	8
Caudal fin rays:	6–8+10+9+6–7

Eggs:
- Undescribed; hatching length <3.8 mmSL

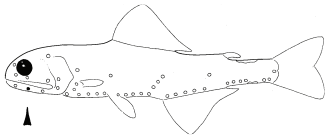
Larvae:
- Body elongate intially, becomes somewhat deeper with development
- Head large and broad, pointy snout becomes rounded; eye large and elliptical, rounds at transformation
- Gut bulbous anteriorly, thinner posteriorly and directed ventrally
- Preanus length 50–60% SL
- Flexion occurs at 6.0–7.0 mmSL
- Sequence of fin ray formation: $C_1 - P_1 - C_2 - A - D - P_2$
- Photophore development: Br_2 forms at about 5.8 mm; PO series begins to form at transformation
- Pigmentation: no pigment until flexion; after flexion, a pair of melanophores forms on tip of jaw, and spots begin to appear on base and rays of pectoral fin; a spot over developing air bladder begins at about 7.0 mm; a prominent melanophore appears on side of foregut in some larger larvae
- Transformation occurs at 9.5–10.0 mmSL (relatively small transformation size for myctophids)

Note:
1. Similar larvae of *Benthosema suborbitale* lack pigment on pectoral fin rays, and have cleithral pigment and shorter preanus lengths

Early Juvenile:



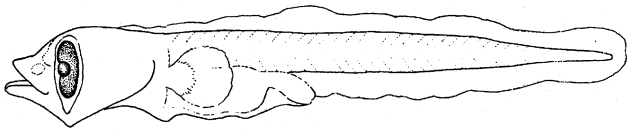
Photophores discussed: **F. 9.9 mmSL**



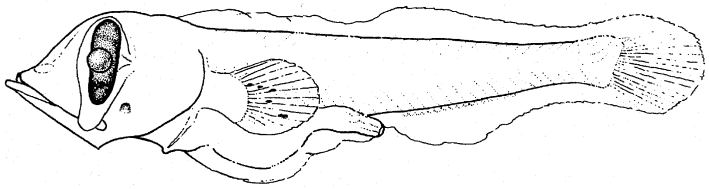
Figures: Adult: Hulley, 1984b; **A–F**: George Mattson (Moser and Ahlstrom, 1970)

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

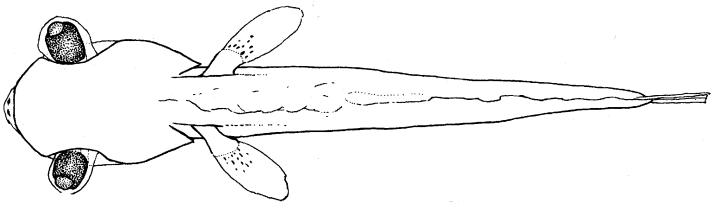
Electrona risso



A. 3.9 mmSL

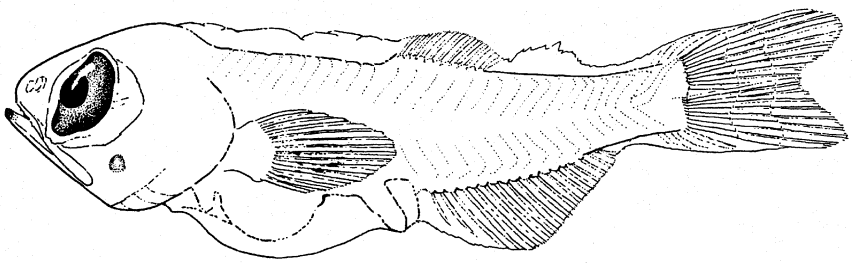


B. 6.3 mmSL

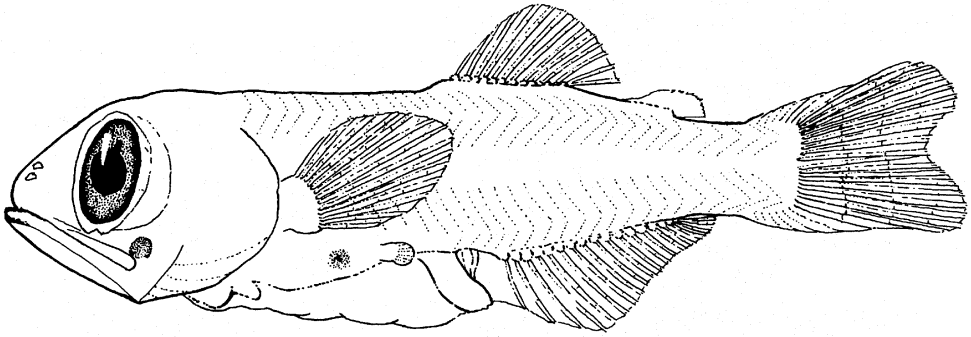


C. 6.8 mmSL
(Dorsal View)

Note pigment on pectoral fin rays

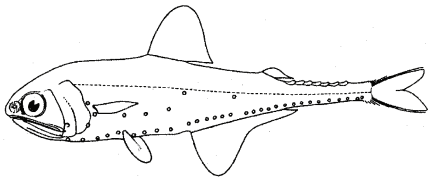


D. 7.9 mmSL



E. 9.2 mmSL

Gonichthys cocco (Cocco, 1829)
Myctophidae (s.f. Myctophinae)
No common name



Range: Atlantic Ocean (except Caribbean Sea) and Mediterranean Sea; in the western North Atlantic from east of Grand Bank to Brazil; abundant in continental slope waters

Habitat: Mesopelagic in depths of 425–1,000 m during the day, 0–175 m at night (often occurs at the surface)

Spawning: Winter to early summer with peak in early spring, based on sampling north of Bermuda; life cycle one year, and most adults die before end of summer

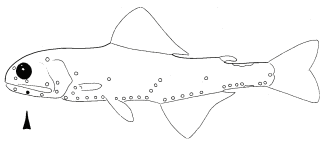
Meristic Characters	
Myomeres:	40–41
Vertebrae:	40–41
Dorsal fin rays:	10–13
Anal fin rays:	20–23
Pectoral fin rays:	13–16
Pelvic fin rays:	8
Caudal fin rays:	5–7+10+9+5–6

Eggs:
- Undescribed; hatching length undescribed

Larvae:
- Body deep and laterally compressed
- Head large and deep with moderately pointy snout; eye elliptical with large, conical choroid mass ventrally
- Gut thick anteriorly, with narrowed posterior portion
- Preanus length 50–60% SL throughout larval development
- Flexion occurs at 5.0–7.5 mmSL
- Sequence of fin ray formation: C_1, P_1 – D, A, C_2 – P_2
- Photophore development: Br_2 forms at sizes near flexion
- Pigmentation: opposing clusters of melanophores on dorsal and ventral edges of body behind level of anus; a series of small melanophores along margins of upper and lower jaws; a spot added to dorsal margin of body anterior to dorsal fin after flexion; a fourth dorsal spot added during postflexion stage; spots develop on anterior anal fin rays and at base of pectoral fin rays; later larvae have melanophores above gut, on ventral surface of gut, and on finfold below gut; scattered spots develop on snout, lower jaw, preopercle and opercle, on branchiostegal rays and a single melanophore at base of caudal fin
- Transformation occurs >12.0 mmSL

Note: 1. Voluminous predorsal and preanal finfolds prominent throughout development, until transformation

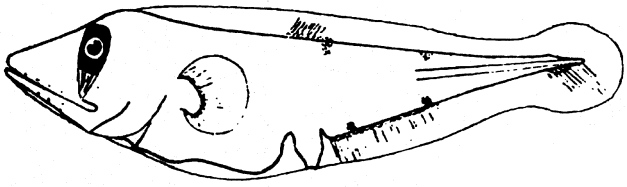
Photophores discussed:



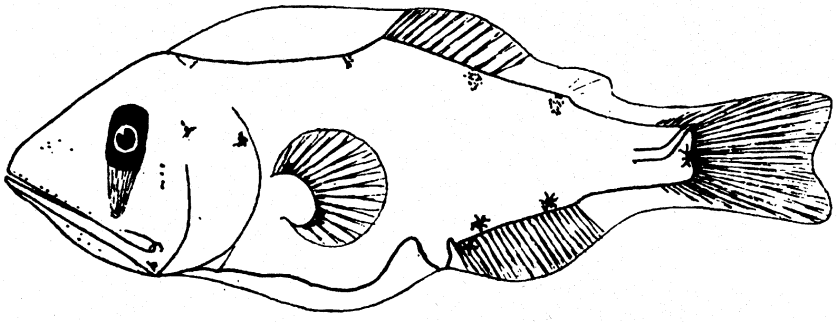
Figures: Adult: Hulley, 1984b; **A–C**: Tåning, 1918

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

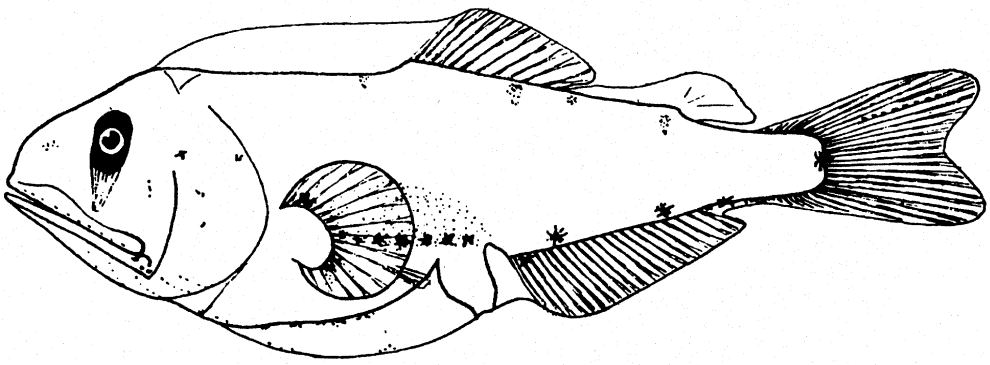
Gonichthys cocco



A. 5.0 mmSL

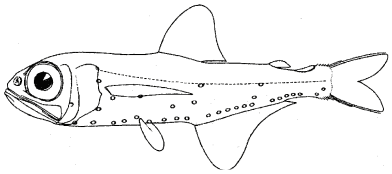


B. 7.5 mmSL



C. 12.0 mmSL

Hygophum benoiti (Cocco, 1838)
Myctophidae (s.f. Myctophinae)
No common name



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

Habitat: Mesopelagic in depths of 225–850 m during the day, 0–250 m at night

Spawning: Winter to summer, with peak during spring (Apr–May), based on sampling north of Bermuda; life cycle one year, and most adults die before end of summer

Meristic Characters

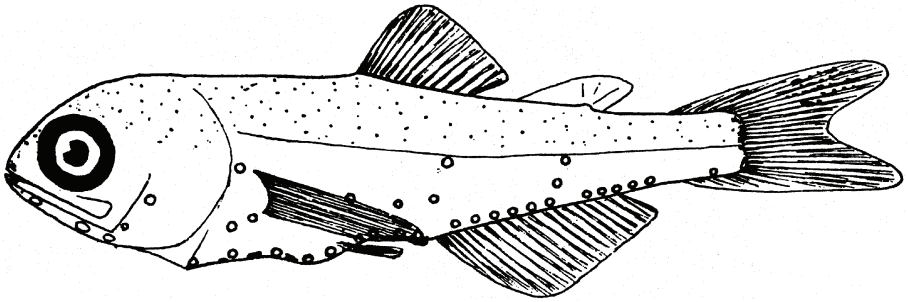
Myomeres:	34–37
Vertebrae:	34–37
Dorsal fin rays:	12–14
Anal fin rays:	19–21
Pectoral fin rays:	13–15
Pelvic fin rays:	8
Caudal fin rays:	7–8+10+9+7–8

Eggs:
- Undescribed; hatching length <2.9 mm

Larvae:
- Body moderate, depth increases from 12% NL to about 30% SL through development
- Head moderate with pointy snout becoming rounded; eye weakly elliptical with conical choroid mass directed ventrally and slightly posteriorly
- Gut thick with visible transverse folds; preanus length increases from about 55% SL to >60% SL
- Flexion occurs at 5.0–5.5 mmSL
- Sequence of fin ray formation: C_1 – A, P_1 – D – C_2 – P_2
- Photophore development: Br_2 usually the only photophore to form in larval stage, but 1 or 2 PO often form immediately before transformation
- Pigmentation: melanophores present along midline of isthmus, anterior to cleithra; series of melanophores along length of gut, with one at anus; dorsally and ventrally on caudal finfold and later on caudal fin rays; melanophore at base of caudal fin rays in some
- Transformation occurs at 10.0–12.5 mmSL

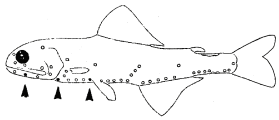
Note: 1. Similar larvae of *Hygophum hygomii* have shorter preanus lengths

Early Juvenile:



F. 11.0 mm

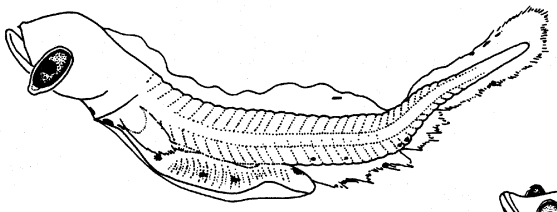
Photophores discussed:



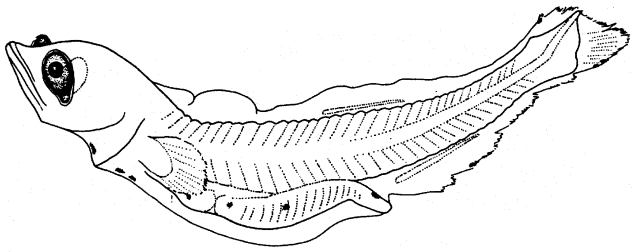
Figures: Adult: Hulley, 1984b; **A–D**: J. Corbera (Olivar and Palomera, 1994); **E–F**: Tåning, 1918

References: Moser and Ahlstrom, 1970; 1972; 1974; 1996b; Moser *et al*., 1984; Hulley, 1984b; Karnella, 1987; Olivar and Palomera, 1994; Moser and Watson, 2001

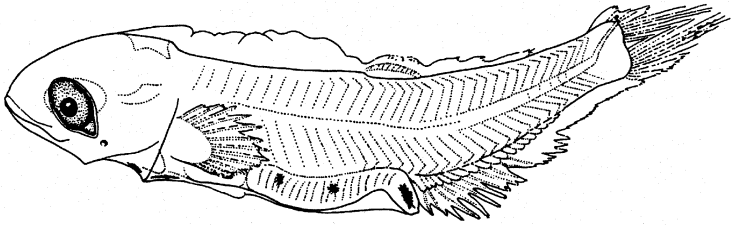
Hygophum benoiti



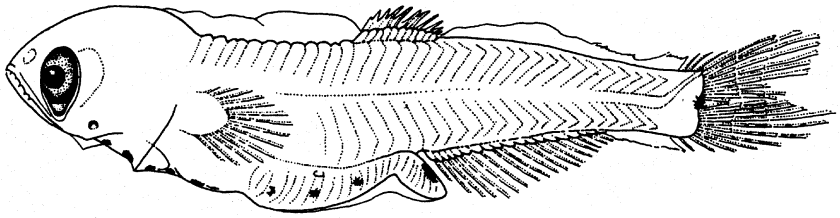
A. 2.9 mmSL



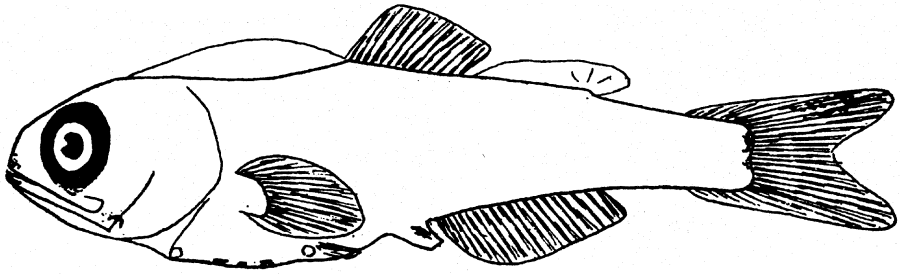
B. 5.5 mmSL



C. 7.8 mmSL

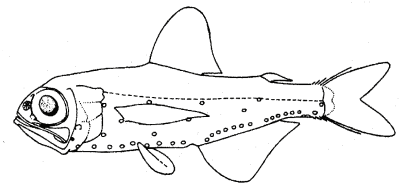


D. 9.2 mmSL



E. 10.5 mmSL

Hygophum hygomii (Lütken, 1892)
Myctophidae (s.f. Myctophinae)
No common name



Range: Atlantic and southern parts of Indian and Pacific oceans; in the western North Atlantic from Flemish Cap to Gulf of Mexico and northern Caribbean Sea

Habitat: Highly oceanic, mesopelagic in depths of 425–750 m during the day, 0–125 m at night

Spawning: Fall–winter with a peak in late fall; life cycle one year and almost all adults die during the winter

Meristic Characters

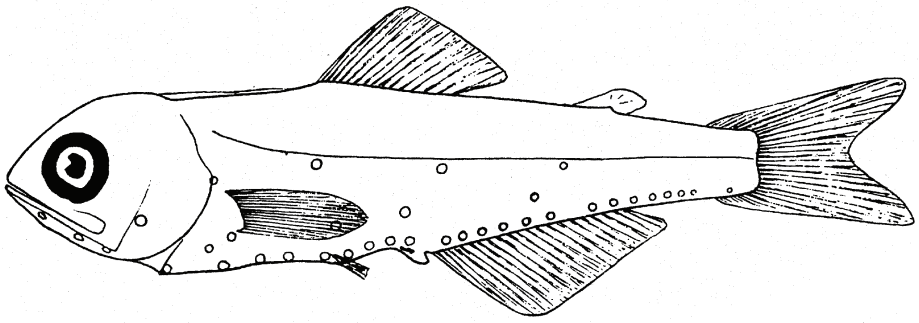
Myomeres:	36–38
Vertebrae:	36–38
Dorsal fin rays:	13–15
Anal fin rays:	20–22
Pectoral fin rays:	14–17
Pelvic fin rays:	8
Caudal fin rays:	8–9+10+9+7–8

Eggs:
- Undescribed; hatching length undescribed

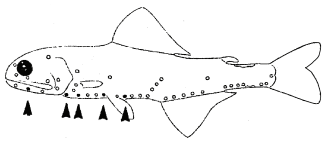
Larvae:
- Body moderately slender, depth increases slightly through development
- Head moderately large, with pointy snout becoming rounded; eye weakly elliptical with small choroid mass ventrally
- Gut thick with visible transverse folds; preanus length <60% SL
- Flexion occurs at 6.0–7.0 mm
- Sequence of fin ray formation: C_1 – A, P_1 – D – C_2 – P_2
- Photophore development: Br_2 usually the only photophore to form in larval stage, but 1 or more PO and a VO may form immediately before transformation
- Pigmentation: melanophores rarely found at tip of snout, lower jaw, and on caudal fin rays; prominent spot at anus; series of 1 or 2 spots along gut; few spots near cleithral symphysis; series of ventral spots, postanally, reduced to a single spot over mid-anal fin (not shown on figures)
- Transfomation occurs at 13–14.5 mmSL

Note: 1. Similar larvae of *Hygophum benoiti* have longer preanus lengths

Early Juvenile:



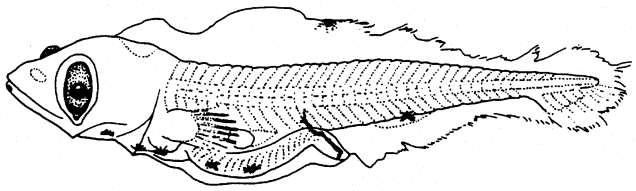
Photophores discussed: **E. 13.0 mmSL**



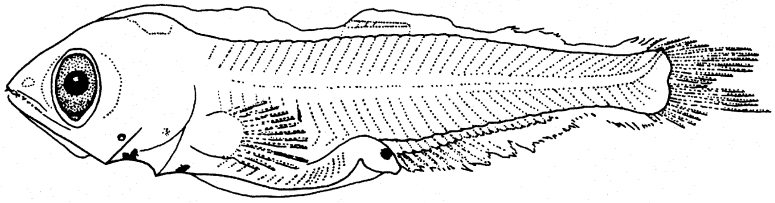
Figures: Adult: Hulley, 1984b; **A–C**: J. Corbera (Olivar and Palomera, 1994); **D–E**: Tåning, 1918

References: Moser and Ahlstrom, 1970; 1972; 1974; Moser *et al.*, 1984; Hulley, 1984b; Karnella, 1987; Olivera and Palomera, 1994; Moser and Watson, 2001

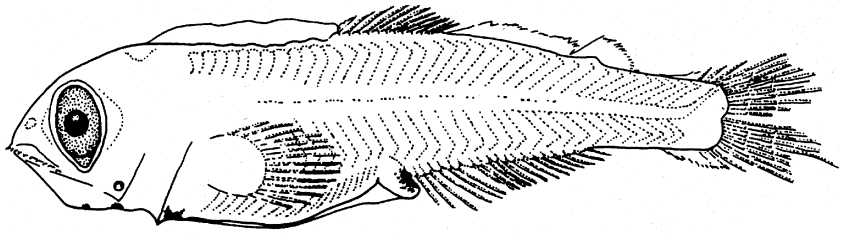
Hygophum hygomii



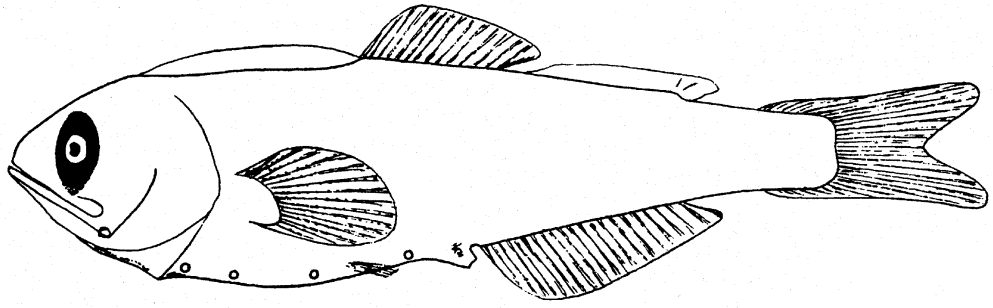
A. 5.3 mmSL Melanophore at edge of dorsal finfold found in some specimens



B. 7.0 mmSL Pigment on pectoral fin rays

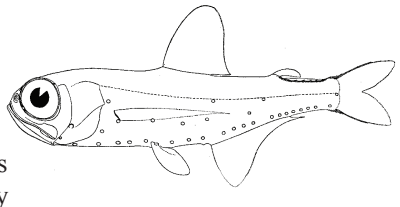


C. 9.9 mmSL Melanophore usually persists at base of mid-anal fin (not shown on figures)



D. 14.5 mmSL

Hygophum macrochir (Günther, 1864)
Myctophidae (s.f. Myctophinae)
No common name



Range: Atlantic Ocean in tropical waters; in the western North Atlantic from Straits of Florida to Brazil; however, several juveniles have been collected in study area, the northernmost off LaHave Bank, Nova Scotia

Habitat: Mesopelagic in depths of 275–750 m during the day, 0–125 m at night

Spawning: Undescribed

Meristic Characters

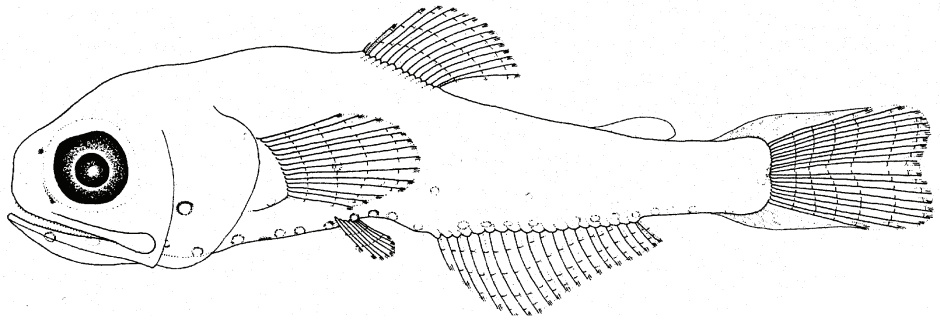
Myomeres:	35
Vertebrae:	35
Dorsal fin rays:	12–14
Anal fin rays:	17–21
Pectoral fin rays:	13–15
Pelvic fin rays:	8
Caudal fin rays:	9+10+9+8

Eggs:
- Undescribed; hatching length undescribed

Larvae:
- Body moderately deep and compressed through development; body depth ranges from about 20% SL in flexion stage larvae to 22–25% SL in post-flexion stage larvae
- Head moderate in size, slightly pointy snout; eyes only slightly elliptical, with no choroid tissue
- Gut thick, including terminal section; narrowest anteriorly
- Preanus length about 60% SL
- Flexion occurs at 5.5–6.0 mmSL
- Sequence of fin ray formation: C, – A, P_1 – D – C_2 – P_2
- Photophore development: Br_2 only photophore to form during larval stage
- Pigmentation: cluster of melanophores over posterior portion of gut; few very small melanophores on ventral edge of tail in small larvae; few spots on venter between isthmus and anus; some postflexion larvae have single melanophore at base of caudal fin
- Transformation occurs at 11.0–13.0 mmSL

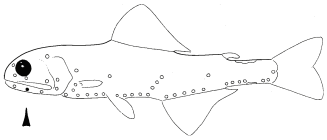
Note:
1. Body shape and proportions similar to larvae of *Hygophum taaningi*; larvae of the latter have slightly deeper bodies and a single melanophore over terminus of gut

Early Juvenile:



F. 12.1 mmSL

Photophores discussed:

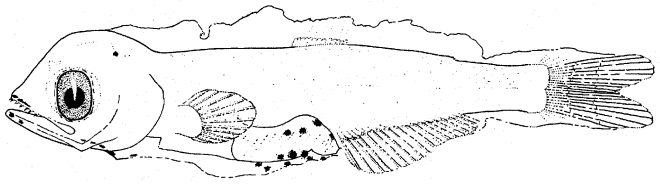


Figures: Adult: Nafpaktitis *et al*., 1977; **A**: Olivar, 1988; **B**: Moser and Ahlstrom, 1974; **C–F**: C. Manning (Moser and Watson, 2001)

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

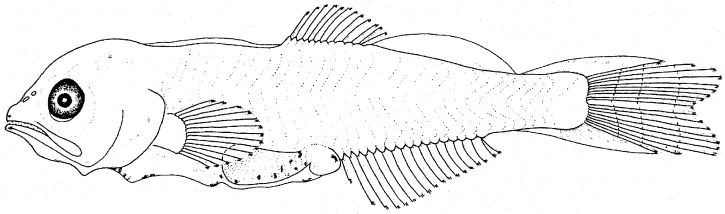
Hygophum macrochir

A. 3.5 mmSL

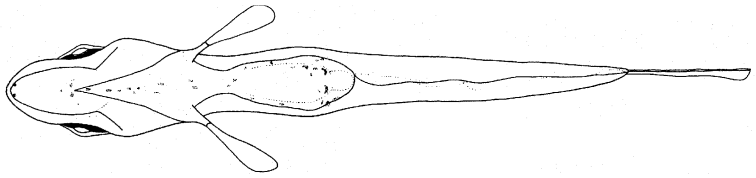


Note enlarged posterior portion of gut, covered with cluster of melanophores

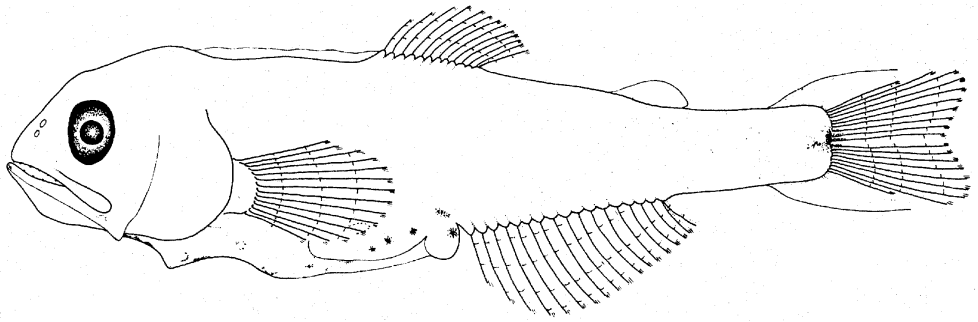
B. 7.3 mmSL



C. 8.5 mmSL

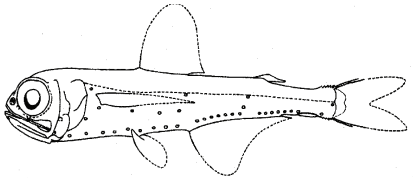


D. 8.5 mmSL
(Ventral View)



E. 10.0 mmSL

Hygophum reinhardti (Lütken, 1892)
Myctophidae (s.f. Myctophinae)
No common name



Range: Atlantic, Pacific and southern Indian oceans, absent in equatorial waters; in the western North Atlantic from off southern New England to Guyana

Habitat: Highly oceanic; mesopelagic in depths of 475–850 m during the day, 0–175 m at night

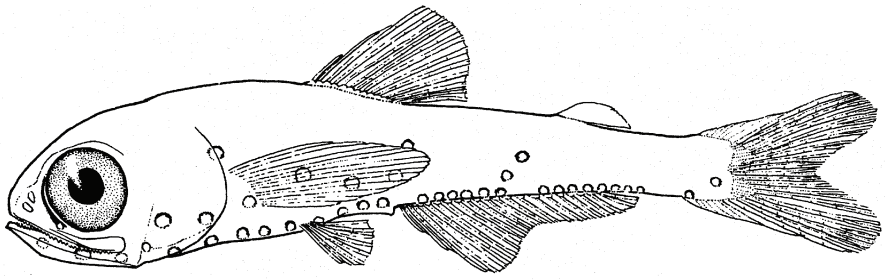
Spawning: Not well understood; possibly year-round with a peak in fall, based on sampling north of Bermuda

Meristic Characters	
Myomeres:	38–40
Vertebrae:	38–40
Dorsal fin rays:	13–15
Anal fin rays:	21–25
Pectoral fin rays:	13–16
Pelvic fin rays:	8
Caudal fin rays:	7–9+10+9+7–8

Eggs:
- Undescribed; hatching length <3.4 mm

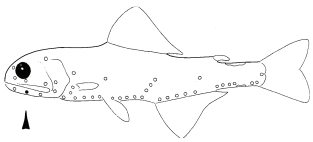
Larvae:
- Body more elongate than larvae of congeners; body depth <10% SL until body deepens before transformation
- Head shallow and long, initially flattened with pointy snout; eye strongly elliptical, on short stalk; prominent choroid tissue
- Gut elongate, thin, nearly straight; preanus length ranges from 55–65% SL through development
- Flexion occurs at 8.8–10.3 mmSL
- Sequence of fin ray formation: $C_1 - P_1$, $C_2 - A - D$, P_2
- Photophore development: Br_2 only photophore to form during larval stage
- Pigmentation: pairs of ventral melanophores behind cleithrum, at terminus of gut, and along mid-portion of gut; 2 median ventral spots on isthmus; 2 postanal melanophores along ventral edge of tail increase in number through development; 1 or 2 melanophores on dorsum, near caudal tip, disappear in older larvae; 1 melanophore at base of caudal fin; in later larvae, pigment spreads onto myosepta above end of anal fin; spots increase in number along lateral gut
- Transformation occurs at 14.9–16.4 mmSL

Early Juvenile:



G. 16.0 mm

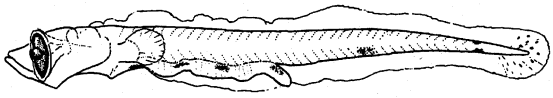
Photophores discussed:



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

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

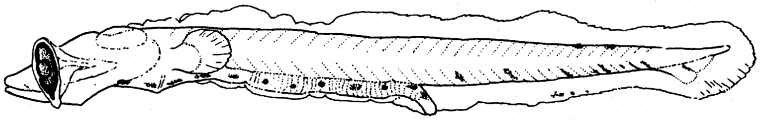
Hygophum reinhardti



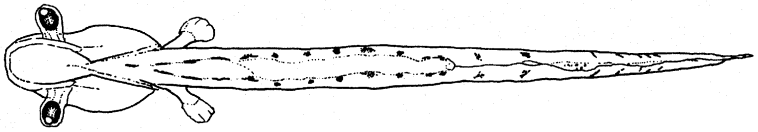
A. 3.4 mmSL

B. 6.7 mmSL

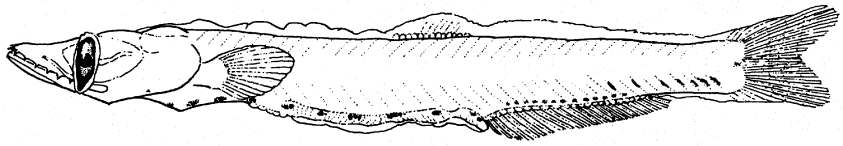
C. 7.4 mmSL



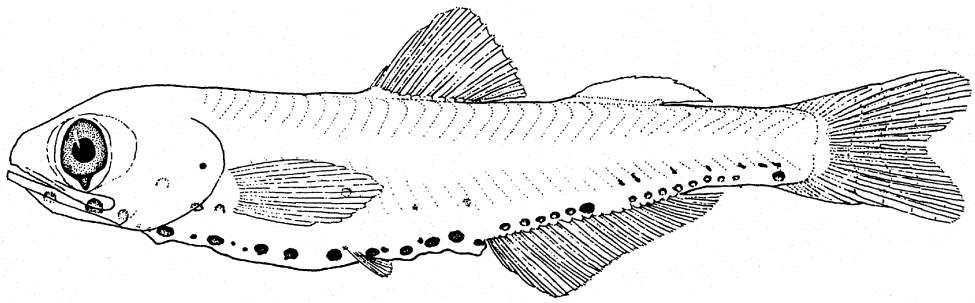
D. 7.4 mmSL (Ventral View)



Melanophores along gut increase in number

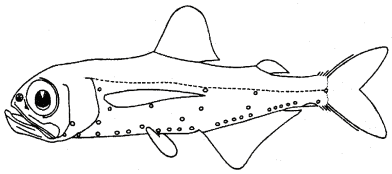


E. 12.8 mmSL Series of melanophores along anal fin base



F. 14.9 mmSL

Hygophum taaningi Bekker, 1965
Myctophidae (s.f. Myctophinae)
No common name



Range: Atlantic Ocean; in the western North Atlantic from La Have Basin, Nova Scotia and Georges Bank to the Caribbean Sea

Habitat: Highly oceanic; mesopelagic in depths of 475–1,000 m during the day, 0–125 m at night

Spawning: Undescribed

Eggs: – Undescribed; hatching length undescribed

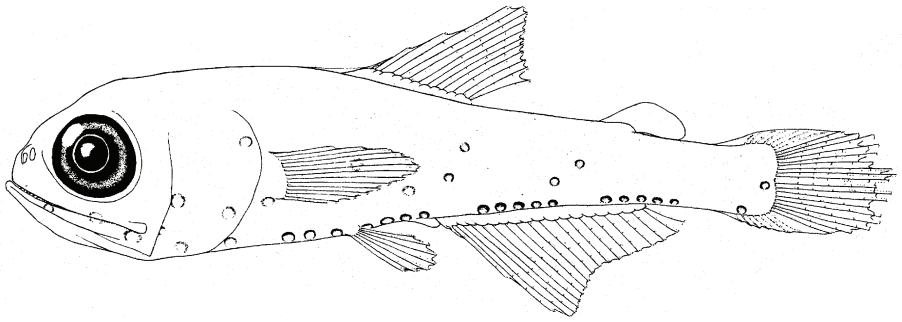
Meristic Characters

Myomeres:	35–36
Vertebrae:	35–36
Dorsal fin rays:	12–14
Anal fin rays:	17–23
Pectoral fin rays:	12–15
Pelvic fin rays:	8
Caudal fin rays:	8–9+10+9+8–9

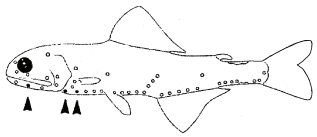
Larvae:
- Body relatively deep and compressed; body depth 27–28% SL in flexion stage, 25–31% SL in postflexion stage
- Head moderate in size, slightly pointy snout; eyes only slightly elliptical with little or no choroid tissue
- Gut thick, including terminal section; narrowest anteriorly
- Preanus length 60–65% SL
- Flexion occurs at 4.2–6.0 mmSL
- Sequence of fin ray formation: $C_1 - P_1$, A – D, $C_2 - P_2$
- Photophore development: Br_2 formed during early postflexion stage; PO_1 and PO_2 appear late in postflexion stage
- Pigmentation: prominent melanophore (with a few minor ones) at terminus of gut near anus; pair of spots on isthmus, and another posterior to cleithrum; a spot under mid-gut and 1 or 2 embedded spots anterior to pectoral fin base; internal pigment over air bladder during flexion stage
- Transformation occurs at 10.0–12.0 mmSL

Note: 1. Larvae similar to those of *Hygophum macrochir*, but the latter are slimmer bodied and have cluster of spots over anus

Early Juvenile:



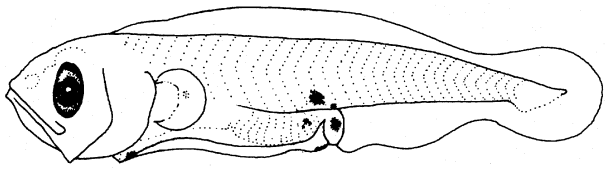
Photophores discussed: **E. 12.2 mmSL**



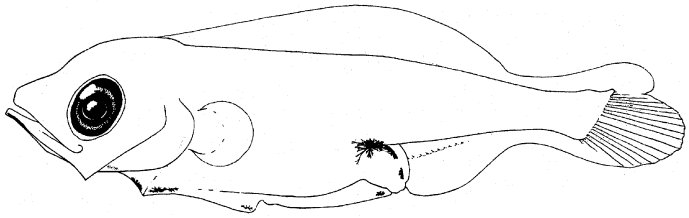
Figures: Adult: Hulley, 1984b; **A–B**, **E**: R.C. Walker (Moser and Watson, 2001); **C**: Moser and Ahlstrom, 1996b; **D**: William Watson (Moser and Watson, 2001)

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

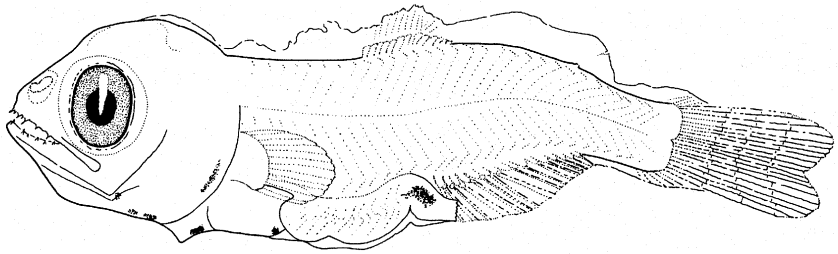
Hygophum taaningi



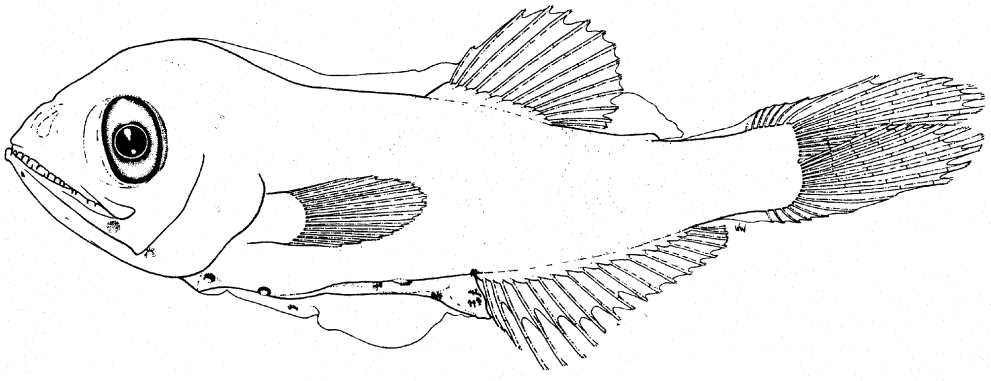
A. 4.1 mmSL



B. 4.6 mmSL

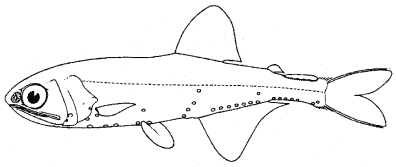


C. 6.8 mmSL



D. 9.3 mmSL

Loweina interrupta (Tåning, 1928)
Myctophidae (s.f. Myctophinae)
No common name



Range: Southern Indian and Pacific oceans and temperate waters of the Atlantic Ocean; in the western North Atlantic from near Bermuda; rarely as far north as slope of Georges Bank; a rare species

Habitat: Highly oceanic; mesopelagic in depths of 60–175 m at night

Spawning: Undescribed

Eggs:
– Undescribed; hatching length undescribed

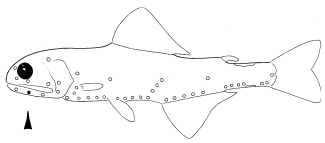
Larvae:
– Body deep, laterally compressed
– Head large with pointy snout and long lower jaw; eye wide, almost round, no choroid tissue
– Gut thick, with large terminal section
– Preanus length >70% SL in larger larvae (undescribed in early stages)
– Flexion occurs at <12.6 mmSL
– Sequence of fin ray formation: Undetermined; P_1, D and A before C and P_2
– P_1 large, pedunculate; lower ray elongate and may be ornamented (see *Loweina rara*)
– Note posterior positions of D and A fins
– Photophore development: Br_2 only photophore to form in larval stage
– Pigmentation: transverse bar of pigment between fore- and midbrains; lighter pigment over-all than in *Loweina rara*; pigment blotch on body posterior to dorsal fin; internal blotch of pigment anterior to P_1 base; pair of spots straddle hindbrain and single spot over middle of hindbrain; elongate blotch over terminus of gut
– Transformation occurs at >17.2 mmSL

Meristic Characters

Myomeres:	39–40
Vertebrae:	39–40
Dorsal fin rays:	10–12
Anal fin rays:	15–16
Pectoral fin rays:	11–12
Pelvic fin rays:	8
Caudal fin rays:	10+9 (PrC)

Note: 1. Voluminous predorsal and preanal finfolds throughout development, until transformation

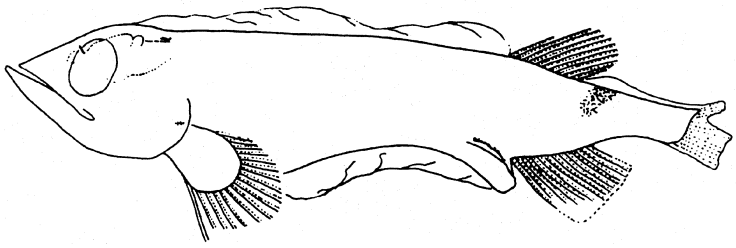
Photophores discussed:



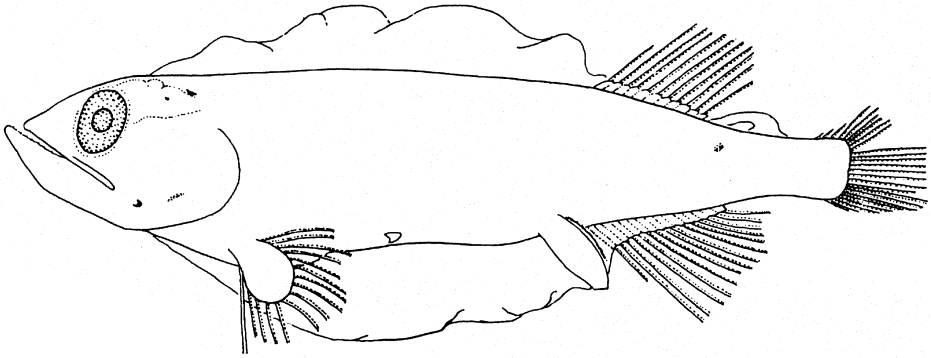
Figures: Adult: Hulley, 1984b; **A–C**: Evseenko *et al*., 1998

References: Moser and Ahlstrom, 1970; 1972; 1974; 1996b; Moser *et al.*, 1984; Hulley, 1984b; Karnella, 1987; Evseenko *et al.*, 1998; Moser and Watson, 2001

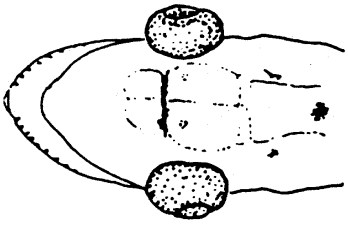
Loweina interrupta



A. 12.6 mmSL

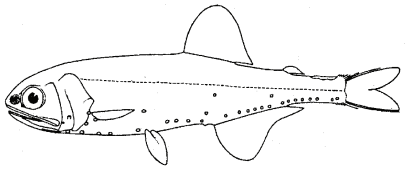


B. 17.2 mmSL



C. 17.2 mmSL
(Dorsal View of Head)

Loweina rara (Lütken, 1892)
Myctophidae (s.f. Myctophinae)
No common name



Range: Southern Indian, Pacific, and Atlantic oceans, primarily in tropical waters; in the western North Atlantic from south of Georges Bank to southern Sargasso Sea

Habitat: Mesopelagic in depths of 550–1,000 m during the day, 0–175 m at night

Spawning: Not well described; possibly year-round with a peak in summer

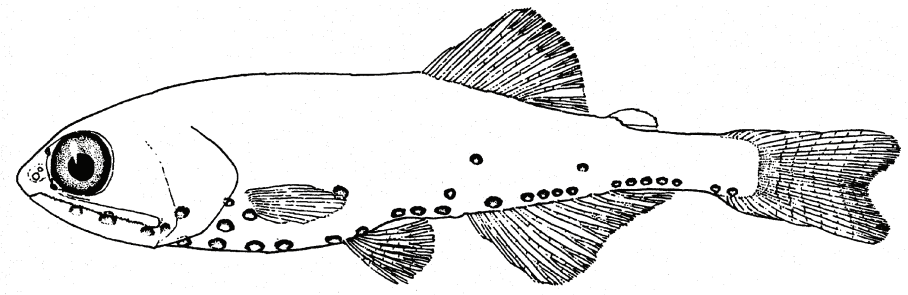
Eggs: – Undescribed; hatching length <2.8 mm

Meristic Characters	
Myomeres:	37–39
Vertebrae:	37–39
Dorsal fin rays:	10–13
Anal fin rays:	13–17
Pectoral fin rays:	9–13
Pelvic fin rays:	8
Caudal fin rays:	6–7+10+9+6–7

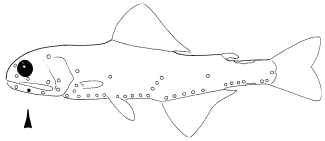
Larvae:
- Body initially elongate, becomes deeper and laterally compressed
- Head large with pointy snout, gape directed upwards; eye almost round
- Gut tapers to somewhat trailing terminal section
- Preanus length 60–80% SL (including trailing section) until transformation when it is reduced to 60% SL
- Flexion occurs at 8.4–10.8 mmSL
- Sequence of fin ray formation: P_1 – C_1, A, D – C_2, P_2
- P_1 large, fan-shaped, pedunculate; lower ray elongate and ornamented with pigmented spatulate end or series of swellings
- Note posterior and opposing positions of D and A fins
- Photophore development: Br_2 only photophore to form during larval stage
- Pigmentation: early larvae have transverse bar between fore- and midbrain; internal blotch anterior to P_1 base; blotch above midgut and 2 melanophores on tail: 1 on dorsal edge, 1 forming a band crossing body; blotch over terminus of gut retained through development; internal spot on isthmus and pigment on swelling at end of elongate P_1 ray as well as on P_1 fin base; finfold with numerous melanophores in older larvae, eventually restricted to finfold edges
- Transformation occurs at 20.0–21.0 mmSL

Note: 1. Voluminous predorsal and preanal finfolds throughout larval development until transformation

Early Juvenile:



Photophores discussed: **E. 24.5 mmSL**

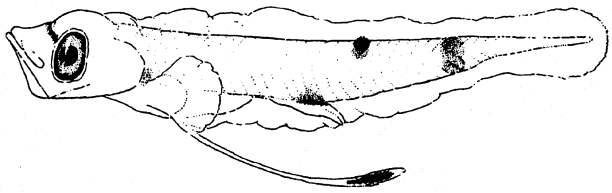


Figures: Adult: Hulley, 1984b; **A–E**: Moser and Ahlstrom, 1996b

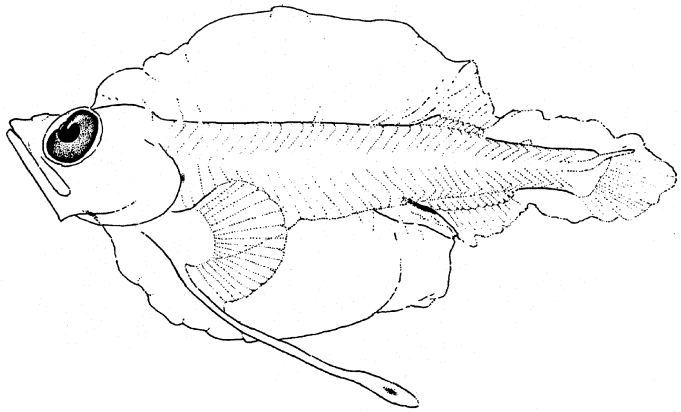
References: Moser and Ahlstrom, 1970; 1972; 1974; 1996b; Moser *et al.*, 1984; Hulley, 1984b; Karnella, 1987; Moser and Watson, 2001

Loweina rara

A. 4.8 mmSL

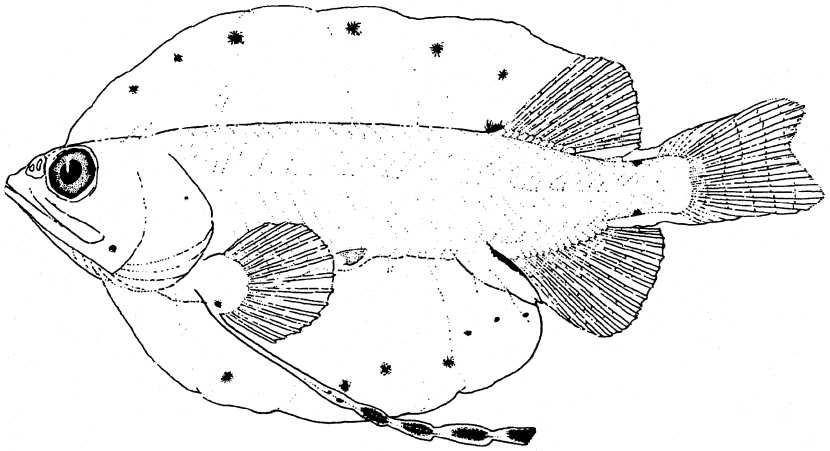


B. 8.5 mmSL



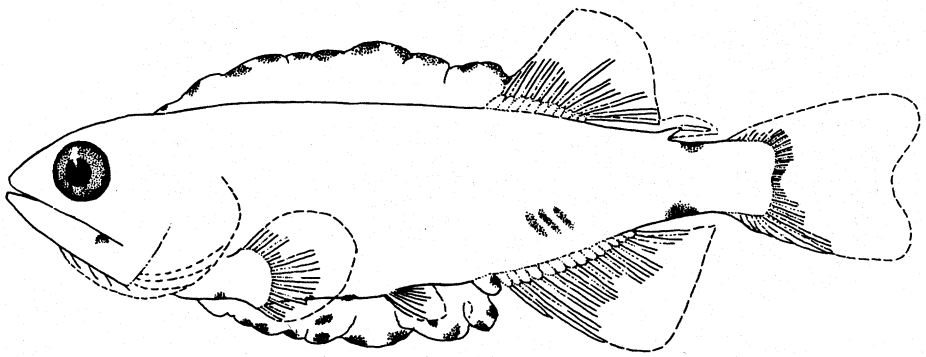
Note opposing melanophores on caudal peduncle

C. 17.6 mmSL

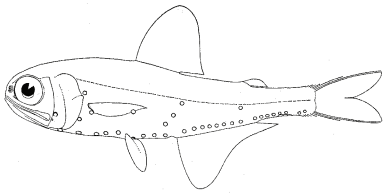


Pigment occurs on some myosepta over anal fin

D. 20.0 mmSL



Myctophum affine (Lütken, 1892)
Myctophidae (s.f. Myctophinae)
Metallic lanternfish



Range: Atlantic Ocean, mainly in tropical waters; in the western North Atlantic from Flemish Cap to Caribbean Sea

Habitat: Mesopelagic in depths of 300–650 m during the day, 0–275 m at night

Spawning: Undescribed

Meristic Characters

Myomeres:	37–38
Vertebrae:	37–38
Dorsal fin rays:	12–14
Anal fin rays:	17–20
Pectoral fin rays:	12–14
Pelvic fin rays:	8
Caudal fin rays:	8–9+10+9+7–8

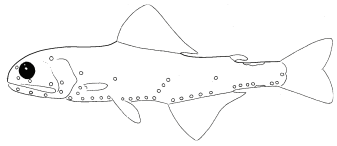
Eggs:
- Undescribed; hatching length <2.5 mmSL

Larvae:
- Body stout, deepest anteriorly
- Head very large and wide, with pointy snout
- Eye slightly elliptical, stalked, with small choroid mass
- Gut large with prominent terminal section; preanus length increases from 48–56% SL to 60–67% SL
- Flexion occurs at 4.2–6.0 mmSL
- Sequence of fin ray formation: $P_1 - C_1$, D, A – $C_2 - P_2$
- Photophore development: Br_2 and all others form together at transformation
- Pigmentation: spots on upper and lower jaws, cleithrum, branchiostegal membranes, and on gular; a row along isthmus and venter of gut; a few spots around nostrils; spots on front and sides of forebrain and internally on hindbrain; spots on P_1 base; single melanophores on ventral margin of tail over mid-anal fin and on dorsum near adipose fin; large melanophores form at base of caudal fin in larger larvae
- Transformation occurs at 11.5–13.0 mmSL

Note: 1. Larvae similar to those of *Myctophum nitidulum*, but body deeper, head wider:

Morphometric Proportion	Preflexion	Flexion	Postflexion
Body Depth: *M. affine*	19–22%SL	24–30%SL	27–33%SL
Body Depth: *M. nitidulum*	14–19%SL	20–27%SL	24–30%SL
Head Width: *M. affine*	75–83%HL	72–77%HL	62–75%HL
Head Width: *M. nitidulum*	60–78%HL	56–68%HL	56–64%HL

Photophores discussed:

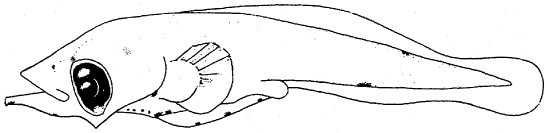


(All photophores formed at transformation)

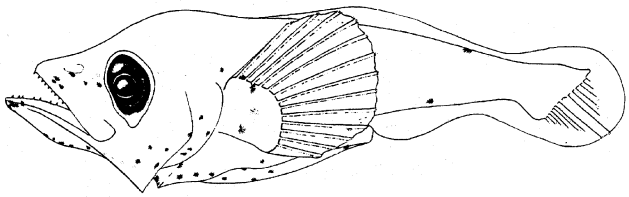
Figures: Adult: Nafpaktitis *et al.*, 1977; **A–H**: R. C. Walker (Moser and Watson, 2001)

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

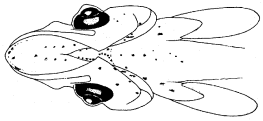
Myctophum affine



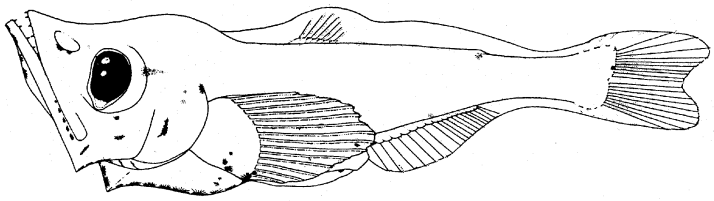
A. 2.6 mmSL



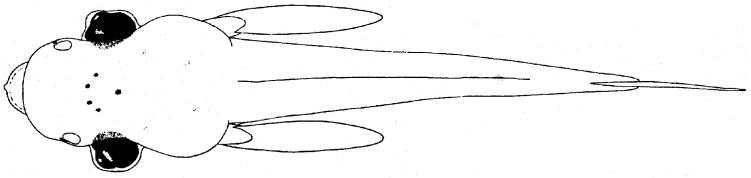
B. 3.9 mmSL



C. 3.9 mmSL
(Ventral View of Head)

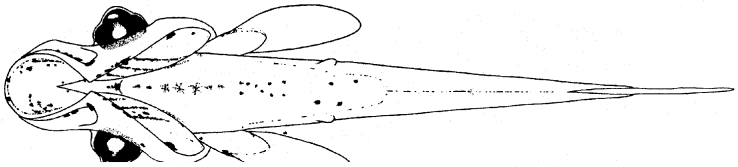


D. 5.1 mmSL

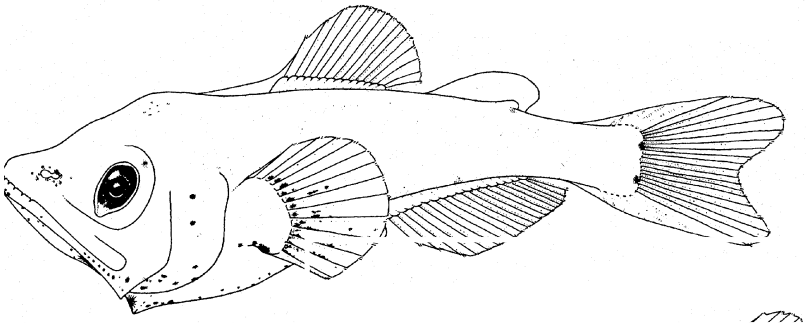


E. 5.1 mmSL
(Dorsal)

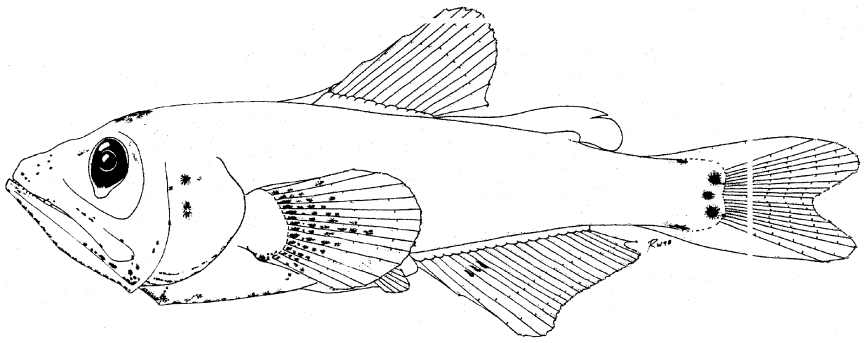
Note wide head



F. 5.1 mmSL
(Ventral)

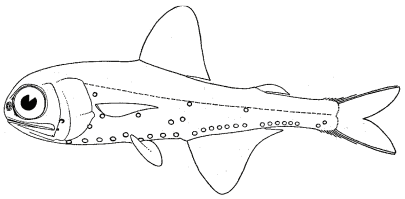


G. 7.8 mmSL



H. 11.5 mmSL

Myctophum asperum Richardson, 1845
Myctophidae (s.f. Myctophinae)
No common name



Range: Tropical waters of the Indian, Pacific and Atlantic oceans; in the western North Atlantic from east of Flemish Cap to Brazil; absent in Sargasso Sea and coastal waters

Habitat: Mesopelagic in depths of 425–750 m during the day, 0–125 m at night

Spawning: Undescribed

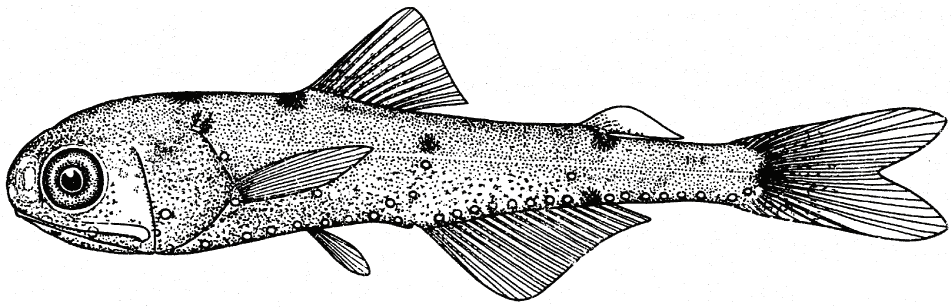
Eggs:
- Undescribed; hatching length <2.3 mmSL

Larvae:
- Body initially elongate, becomes deep and robust
- Head large and broad; pointy snout becomes rounded; eye narrow, with short choroid mass ventrally
- Gut bulging anteriorly, with thinner terminal section
- Preanus length slightly <50% SL in preflexion larvae, increases to 56–64% SL in later larvae
- Flexion occurs at 4.5–6.0 mmSL
- Sequence of fin ray formation: $P_1 - C_1$, D, A – $C_2 - P_2$; pectoral fin large and fan-shaped
- Photophore development: Br_2 forms during early flexion; Dn forms late in flexion stage; PLO may form just before transformation
- Pigmentation: characteristic pattern of discrete, well-separated melanophores; note locations of melanophores on head, body, base of caudal fin, a few internal spots on epaxial myosepta
- Transformation occurs at 10.0–13.0 mmSL

Meristic Characters	
Myomeres:	35–38
Vertebrae:	35–38
Dorsal fin rays:	12–14
Anal fin rays:	17–19
Pectoral fin rays:	12–16
Pelvic fin rays:	8
Caudal fin rays:	8–9+10+9+8–9

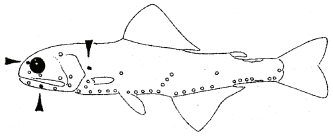
Note:
1. Body depth 17–24% SL in preflexion, reaches 31–40% SL in postflexion; deepest among congeners in study area.

Early Juvenile:



F. 11.4 mmSL Note retention of larval pigment pattern, after acquisition of full complement of photophores

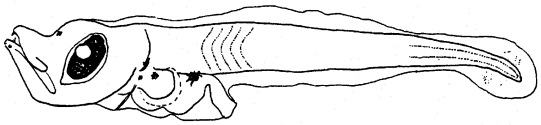
Photophores discussed:



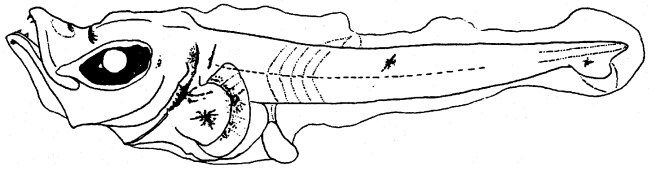
Figures: Adult: Nafpaktitis *et al*., 1977; **A–C**, **E**: Ozawa, 1986c; **D**: Moser and Ahlstrom, 1974; **F**: Pertseva-Ostroumova, 1974

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

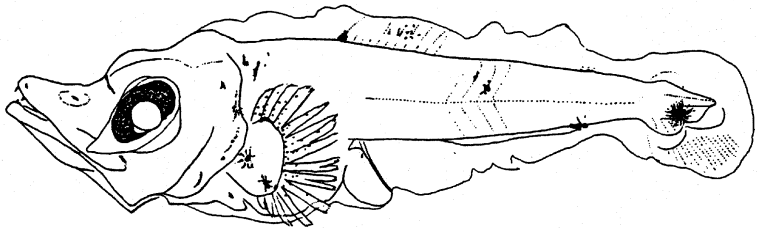
Myctophum asperum



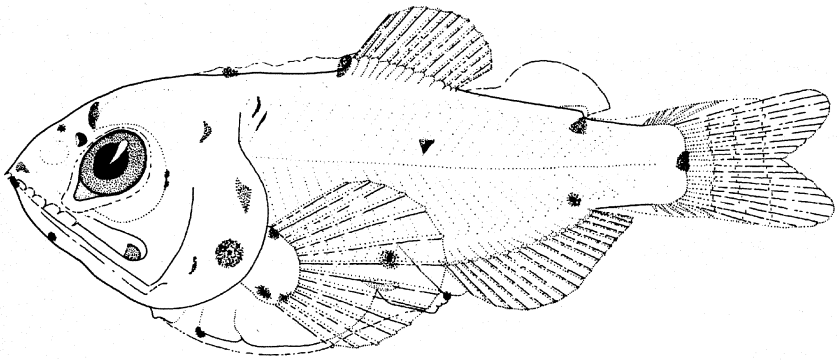
A. 3.0 mmSL



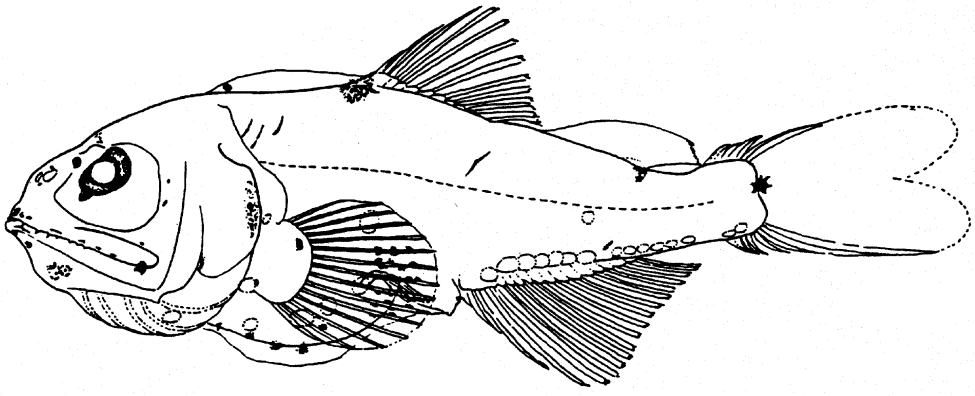
B. 3.9 mmSL



C. 4.5 mmSL

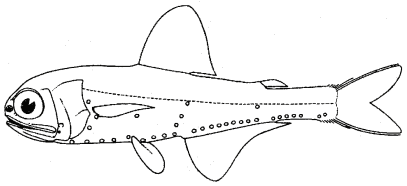


D. 6.8 mmSL



E. 10.1 mmSL

Myctophum nitidulum Garman, 1899
Myctophidae (s.f. Myctophinae)
No common name



Range: Mostly tropical to subtropical waters in the Atlantic, Indian and Pacific oceans; in the western North Atlantic from Flemish Cap to Brazil

Habitat: Highly oceanic, mesopelagic in depths of 475–850 m during the day, near surface at night

Spawning: Spring to fall with peak in late spring to early summer, based on sampling north of Bermuda

Meristic Characters	
Myomeres:	36–39
Vertebrae:	36–39
Dorsal fin rays:	12–14
Anal fin rays:	18–21
Pectoral fin rays:	12–16
Pelvic fin rays:	8
Caudal fin rays:	7–9+1–+9+7–9

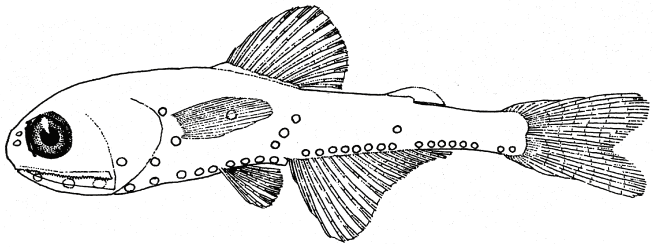
Eggs:
- Undescribed; hatching length <3.1 mmSL

Larvae:
- Body fairly stout, deepest anteriorly
- Head very large and wide, with pointy snout; eye elliptical, stalked, with fairly prominent choroid mass
- Gut large with prominent terminal section
- Preanus length about 50% SL in preflexion larvae, increases to about 65% SL before transformation
- Flexion occurs at 6.5–7.0 mmSL
- Sequence of fin ray formation: $P_1 - C_1 - C_2$, A, D – P_2; pectoral fin early-forming, large and fan-shaped
- Photophore development: Br_2 only photophore to form during larval stage (at about 7.0 mmSL)
- Pigmentation: melanophores at tip of lower jaw, near nostril, behind eye, on isthmus, on ventral edge over end of anal fin, inner surface of P_1 base, near anus; 2 melanophores on dorsum under ends of dorsal and adipose fins; 2 pairs on ventral surface of anterior gut, become 2 parallel lines of spots in larger larvae; spots form on crown in larger larvae
- Transformation occurs at about 11.0 mmSL

Note: 1. Larvae similar to those of *Myctophum affine*. See comparative table on *M. affine* page.

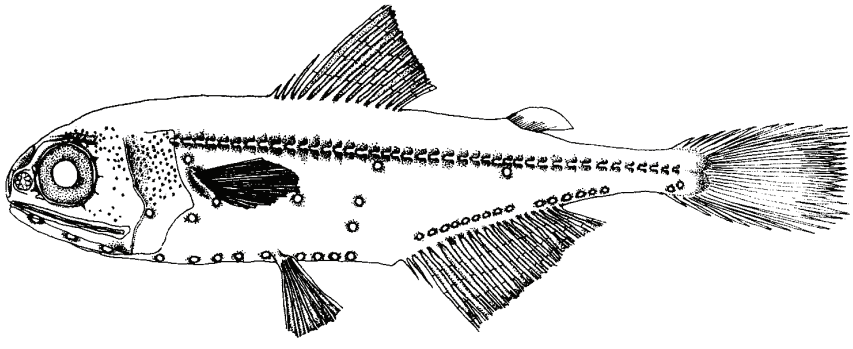
Early Juvenile:

G. 18.8 mmSL

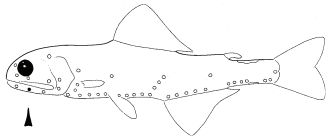


Juvenile:

H. 46.6 mmSL



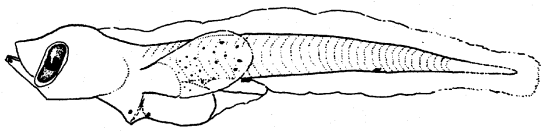
Photophores discussed:



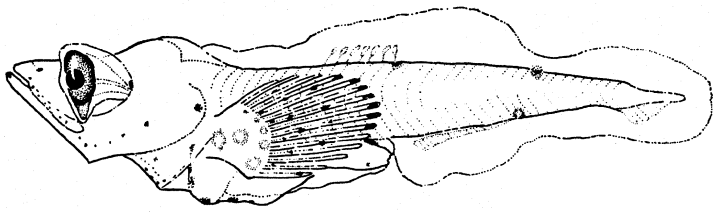
Figures: Adult: Hulley, 1984b; **A–C**, **F–G**: Moser and Ahlstrom, 1996; **D–E**: Moser and Watson, 2001; **H**: Y. Karita (Amaoka *et al.*, 1992)

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

Myctophum nitidulum

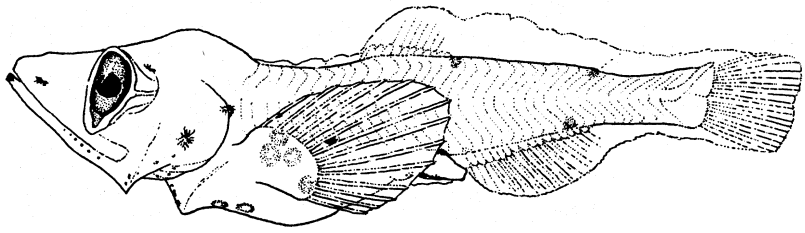


A. 3.8 mmSL



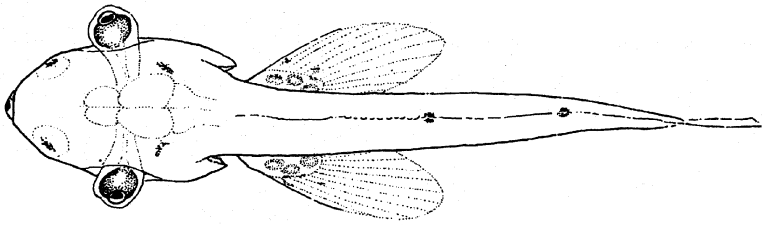
B. 3.9 mmSL

Note pigment pattern of 4 opposing melanophores on dorsal & ventral edges of body



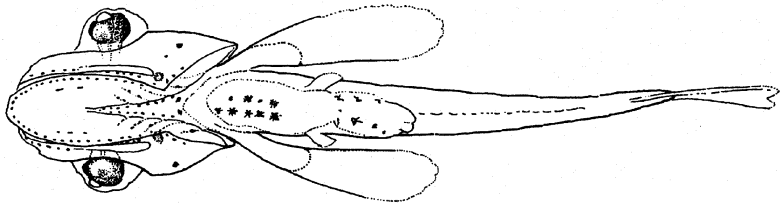
Prominent pigment spot on opercle

C. 7.0 mmSL



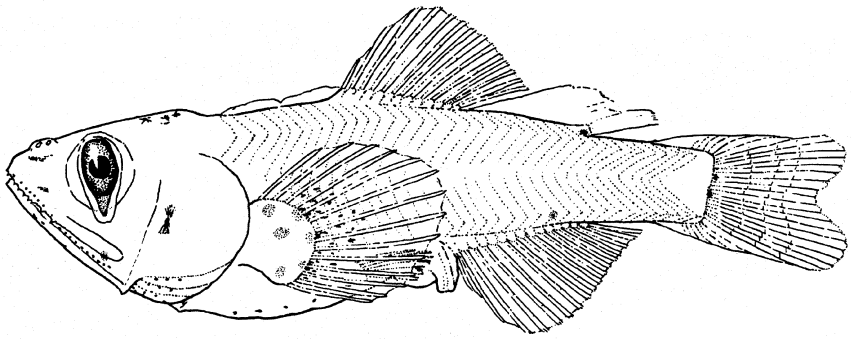
D. 7.0 mmSL (Dorsal)

Head not quite as wide as in *M. affine*; note internal spots alongside hindbrain



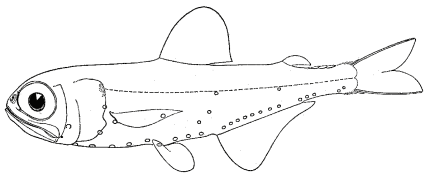
E. 8.2 mmSL (Ventral)

Few melanophores form at base of caudal fin



F. 11.7 mmSL

Myctophum obtusirostre Tåning, 1928
Myctophidae (s.f. Myctophinae)
No common name



Range: Atlantic, Pacific and Indian oceans in tropical waters; in the western North Atlantic from east of Flemish Cap to Brazil; absent in Sargasso Sea

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

Meristic Characters

Myomeres:	35–36
Vertebrae:	35–36
Dorsal fin rays:	12–14
Anal fin rays:	17–19
Pectoral fin rays:	16–20
Pelvic fin rays:	8
Caudal fin rays:	8–9+10+9+7–9

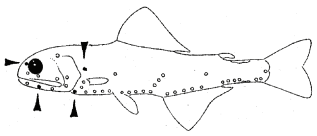
Spawning: Undescribed

Eggs:
- Undescribed; hatching length <2.5 mmSL

Larvae:
- Body stout and deep, especially anteriorly
- Head deep and broad, with large jaws; eye elliptical with small choroid mass ventrally
- Gut round with short terminal section
- Preanus length increases from <50% SL in preflexion to >60% SL in postflexion stages
- Flexion occurs at 4.0–4.6 mmSL
- Sequence of fin ray formation: P_1 – C1 – D, A – C_2 – P_2; pectoral fin base broad
- Photophore development: Br_2 and Dn form early in flexion stage; PLO and PO_1 may form late in flexion stage
- Pigmentation: melanophores at tips of upper and lower jaws, middle of forehead, anterior to forebrain, on sides of gut anterior to terminal section, internal spots anterior to P_1 base; before transformation, pigment spreads across P_1 base and posterior head, and pigment develops on mid-dorsal ridge anterior to dorsal fin
- Transformation occurs at 10.0–13.0 mmSL

Note: 1. Body shape similar to larvae of *Myctophum asperum*, but larvae of *M. asperum* are more densely pigmented

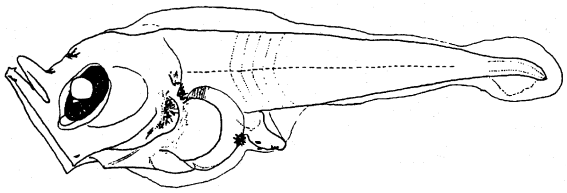
Photophores discussed:



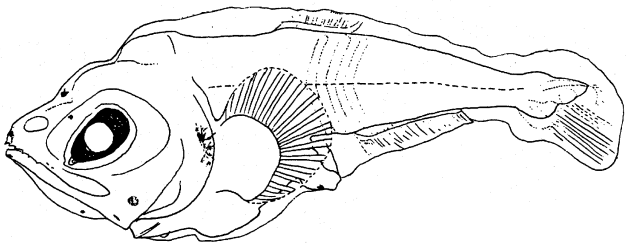
Figures: Adult: Nafpaktits *et al*., 1977; **A–C**: Ozawa, 1986c (**A** and **B** reversed); **D**: Moser and Ahlstrom, 1974; **E**: C. Manning (Moser and Watson, 2001)

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

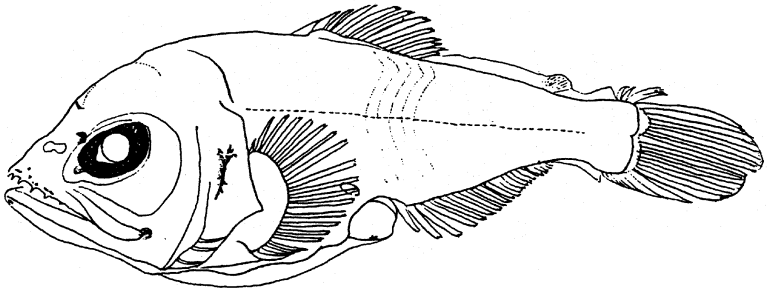
Myctophum obtusirostre



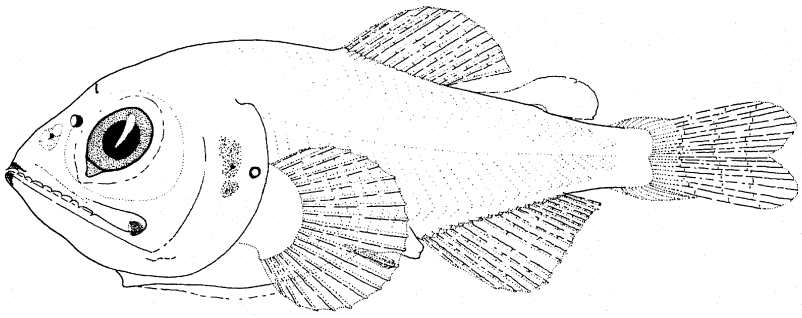
A. 3.3 mmSL



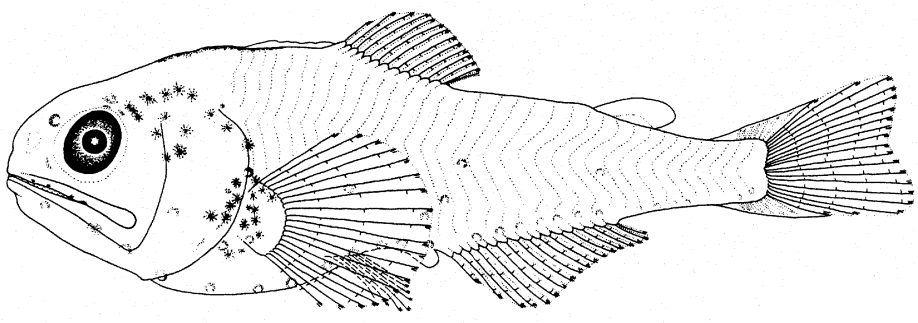
B. 4.5 mmSL



C. 5.2 mmSL

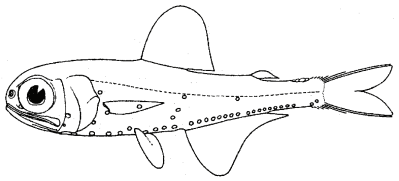


D. 7.6 mmSL



E. 12.3 mmSL

Myctophum punctatum Rafinesque, 1810
Myctophidae (s.f. Myctophinae)
Spotted lanternfish



Range: Northern Atlantic Ocean and Mediterranean Sea; in the western North Atlantic from Greenland to Bermuda

Habitat: Highly oceanic; mesopelagic in depths of 225–750 m during the day, 0–125 m at night

Spawning: In eastern Atlantic in late winter-early spring; in Mediterranean Sea spawning continues into summer; evidence suggests that this species does not reproduce in the western North Atlantic (Zurbrigg and Scott, 1972); juveniles have been collected in Slope Waters in the study area (Jahn, 1976) suggesting more study is required to describe this species' reproductive status (Karnella, 1987)

Meristic Characters

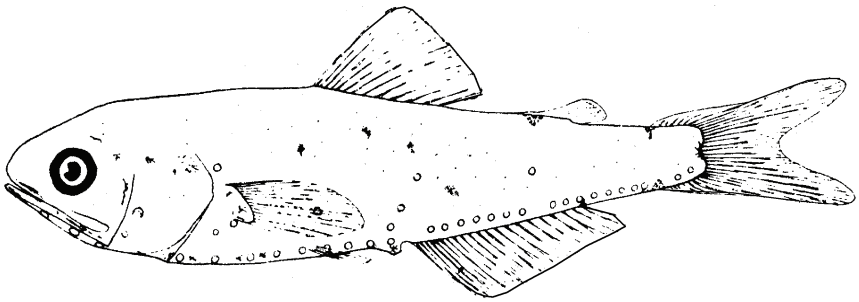
Myomeres:	about 40
Vertebrae:	40 (Mediterranean)
Dorsal fin rays:	13–14
Anal fin rays:	20–22
Pectoral fin rays:	14–15
Pelvic fin rays:	8
Caudal fin rays:	10+9 (PrC)

Eggs:
- Undescribed; hatching length

Larvae:
- Body elongate initially, becomes slightly deeper, but shallower-bodied than congeners
- Head large with pointy, flat and broad snout; eye slightly narrow, stalked, with tapered choroid mass
- Gut moderate, preanus length about 60% SL through development
- Flexion occurs at about 7.0 mmSL
- Sequence of fin ray formation: C_1, P_1, D, A – C_2 – P_2
- Photophore development: Br_2 only photophore to form during larval stage
- Pigmentation: ventral series of spots from anus to head; note characteristic arrangement of spots in caudal peduncle region; pigment may occur on posterior rays of dorsal, anal and adipose fins; pigment also on rays and base of pectoral fin; spots occur on edges of both jaws and on upper part of opercle
- Transformation occurs at 21.0–22.0 mmSL

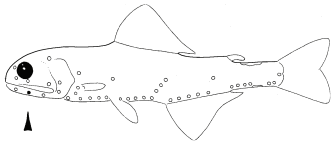
Note: 1. Similar larvae of *Myctophum affine* have different pattern of melanophores at caudal fin base

Early Juvenile:



E. 18.0 mmSL

Photophores discussed:

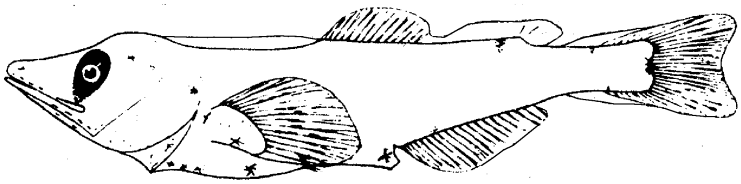


Figures: Adult: Nafpaktitis *et al*., 1977; **A–B**, **D–E**: Tåning, 1918); **C**: Moser and Ahlstrom, 1974

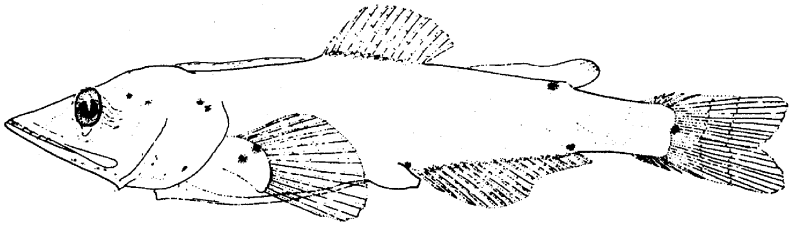
References: Moser and Ahlstrom, 1970; 1972; 1974; 1996b; Moser *et al.*, 1984; Hulley, 1984b; Karnella, 1987; Moser and Watson, 2001

Myctophum punctatum

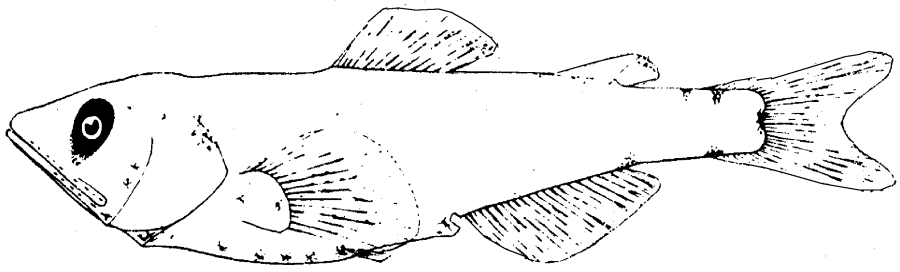
A. 5.7 mmSL Melanophores along ventral edge disappear in later stages



B. 10.5 mmSL Pigment on dorsal edge near adipose fin

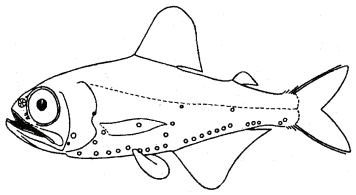


C. 13.6 mmSL Pigment on dorsal and ventral edges of caudal peduncle, and prominent spot at mid-caudal fin base



D. 16.0 mmSL

Myctophum selenops Tåning, 1928
Myctophidae (s.f. Myctophinae)
No common name



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

Habitat: Highly oceanic; mesopelagic in depths of 225–450 m during the day, 40–225 m at night

Spawning: Not well described; possibly spring or summer. Late summer and fall collections north of Bermuda consist of 2 year classes, therefore life cycle is more than 1 year

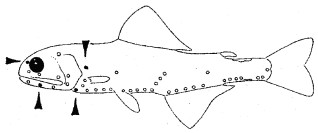
Meristic Characters	
Myomeres:	34–35
Vertebrae:	34–35
Dorsal fin rays:	12–14
Anal fin rays:	17–19
Pectoral fin rays:	15–18
Pelvic fin rays:	8
Caudal fin rays:	8+10+9+7–8

Eggs:
- Undescribed; hatching length <2.3 mmSL

Larvae:
- Body becomes stout and deep, especially anteriorly
- Head large, broad and deep with large jaws; eye elliptical with elongate, pigmented, choroid mass ventrally
- Gut moderate, narrow terminal section
- Preanus length 50–53% SL in early larvae, increases to 61–64% SL in postflexion
- Flexion occurs at 4.5–6.0 mmSL
- Sequence of fin ray formation: P_1, C_1 – D, A – C_2 – P_2
- Photophore development: Br_2 and Dn form in early flexion stage; PLO and PO_1 form in early postflexion stage
- Pigmentation: midline pigment anterior to forebrain becomes paired, a pair of spots lateral to midbrain; a few spots over mid-gut, on pectoral fin base and internally on body above pectoral fin base; P_1 rays with scattering of pigment; scattered spots on nostrils, gular region, opercle, upper jaw; pigment on crown increases in older larvae
- Transformation occurs at 10.0–13.0 mmSL

Note:
1. Body depth 16–24% SL in preflexion, increases to 31–36% Sl in postflexion (similar to *Myctophum obtusirostre*)
2. Choroid mass much more elongate than in *Myctophum obtusirostre*

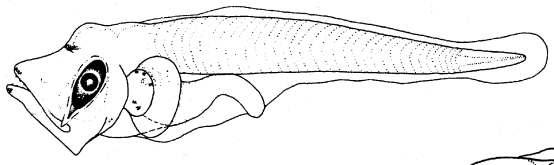
Photophores discussed:



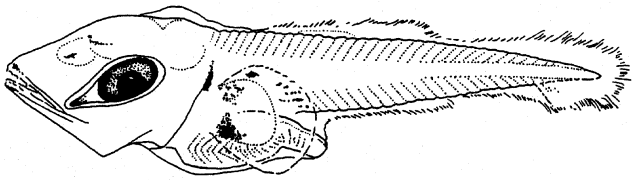
Figures: Adult: Hulley, 1984b; **A**, **C**, **F**: C. Manning (Moser and Watson, 2001); **B**, **D**: J. Corbera (Olivar *et al*., 1999); **E**: Moser and Ahlstrom, 1974

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

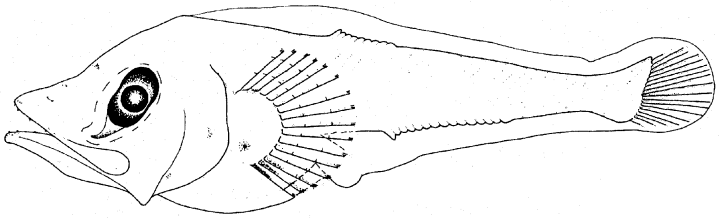
Myctophum selenops



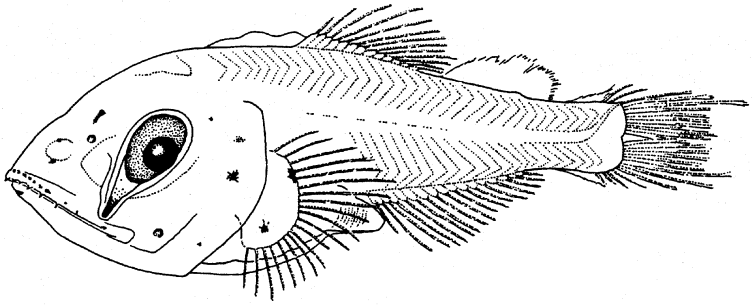
A. 3.9 mmSL



B. 4.1 mmSL

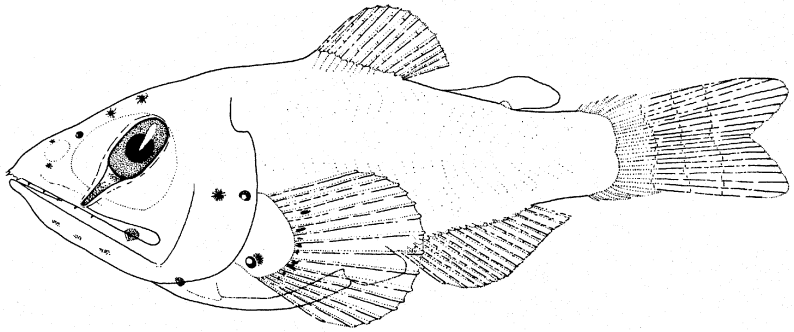


C. 4.9 mmSL

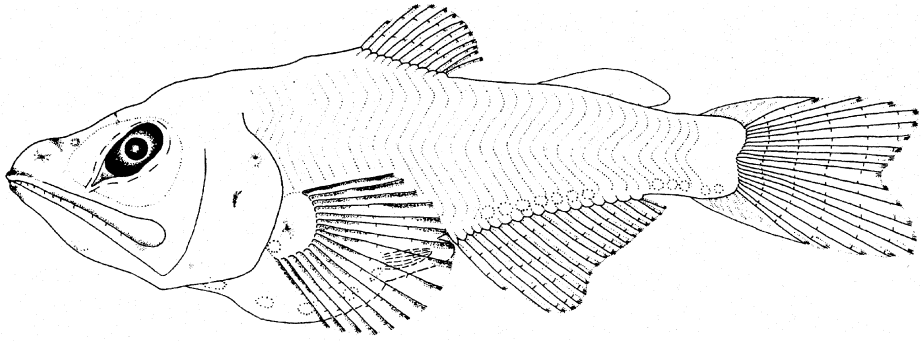


D. 6.6 mmSL

Body relatively unpigmented compared to congeners

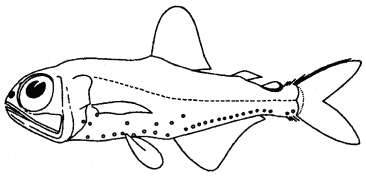


E. 7.8 mmSL



F. 9.6 mmSL

Protomyctophum arcticum (Lütken, 1892)
Myctophidae (s.f. Myctophinae)
No common name



Range: Northern Atlantic Ocean in subpolar and temperate waters; in the western North Atlantic from Davis Strait to offings of Delaware Bay

Habitat: Highly oceanic; mesopelagic in depths of 250–850 m during the day, 90–325 m at night

Spawning: Undescribed

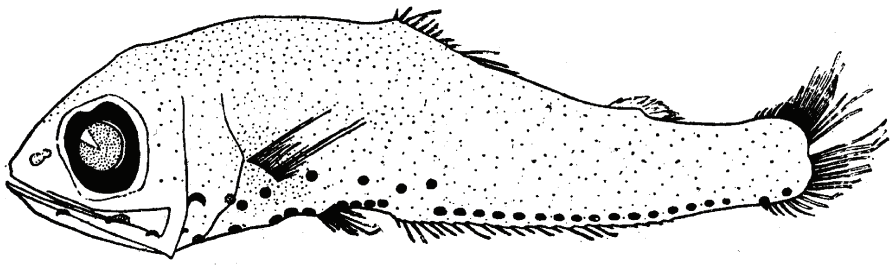
Eggs:
- Undescribed; hatching length undescribed

Meristic Characters

Myomeres:	about 36–41
Vertebrae:	36–41 (genus)
Dorsal fin rays:	11–13
Anal fin rays:	21–24
Pectoral fin rays:	15–17
Pelvic fin rays:	8
Caudal fin rays:	10+9 (PrC)

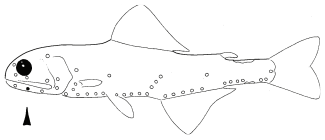
Larvae:
- Body slender; body depth almost uniform throughout length
- Head moderately sized with pointy snout; eye slightly elliptical, no choroid tissue
- Gut moderately thick and short in early larvae; wide gap between anus and anal fin origin
- Preanus length increases from about 40% SL in early larvae to 50% SL before transformation
- Flexion occurs at about 7.0 mmSL
- Sequence of fin ray formation: $C_1 - P_1 - D, A, C_2 - P_2$
- Photophore development: Br_2 forms early in larval stage; all other photophores form after transformation
- Pigmentation: mostly without pigment in larval stage; possible faint pigment in abdominal region; some specimens have faint internal melanophores in caudal peduncle area, ventral to urostyle
- Transformation occurs at about 15 mmSL

Early Juvenile:



E. 15.0 mmSL

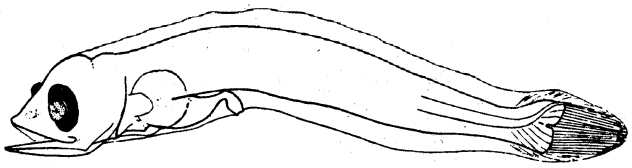
Photophores discussed:



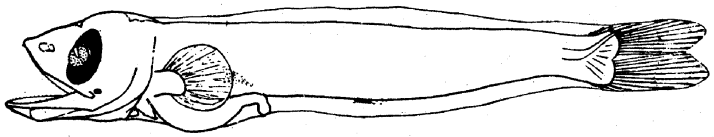
Figures: Adult: Hulley, 1984b; **A–E**: Tåning, 1918

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

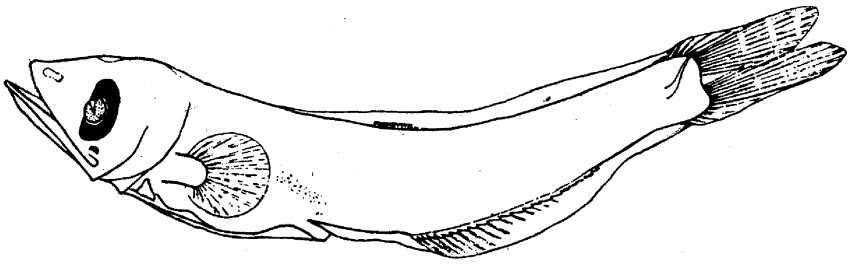
Protomyctophum arcticum



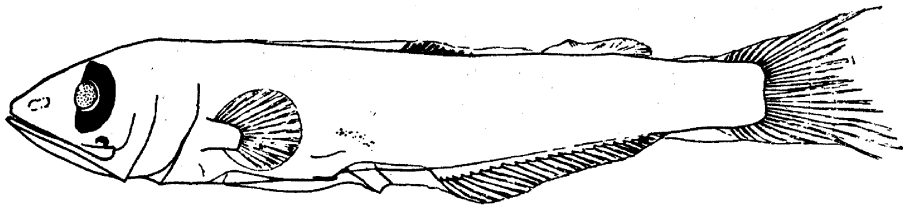
A. 7.5 mmSL



B. 10.3 mmSL

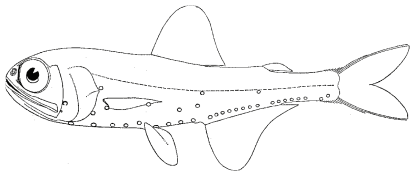


C. 12.5 mmSL



D. 14.0 mmSL

Symbolophorus rufinus (Tåning, 1928)
Myctophidae (s.f. Myctophinae)
No common name



Range: Atlantic and western Indian oceans in tropical to subtropical waters; in the western North Atlantic mostly from Bermuda to Brazil with isolated occurrences as far north as LaHave Bank, Nova Scotia (39°30'N, 64°14'W)

Habitat: Mesopelagic in depths of 425–850 m during the day, 0–125 m at night

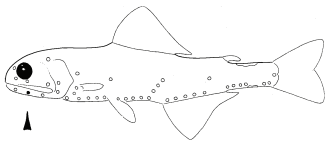
Spawning: Not well understood; possibly throughout most of the year based on sampling north of Bermuda

Eggs:
- Undescribed; hatching length <4.9 mmSL

Larvae:
- Body slim and elongate in preflexion larvae, becomes slightly deeper with development; body depth uniform along length
- Head broad and flat; eye elliptical, with small choroid mass, on long stalks until postflexion stage
- Gut long and slender, about 67–71% SL (compare to shorter gut length in *Symbolophorus veranyi*)
- Flexion occurs at 6.5–7.5 mmSL
- Sequence of fin ray formation: P_1, C_1 – C_2, A – P_2, D
- Pectoral fin early forming, large and on elongate base; D late forming
- Photophore development: Br_2 only photophore to form in larval stage; present by flexion stage
- Pigmentation: pair of melanophores on isthmus, anterior to cleithra; series of 2–3 spots on lateral gut and above terminus of gut; spot on tip of lower jaw in some specimens; 2–4 ventral melanophores along tail posterior to anus; after flexion, lateral gut and postanal pigment disappears; some larger larvae have pigment on pectoral fin base
- Transformation occurs at >15.7 mmSL

Meristic Characters	
Myomeres:	37
Vertebrae:	37
Dorsal fin rays:	14–16
Anal fin rays:	20–22
Pectoral fin rays:	14-17
Pelvic fin rays:	8
Caudal fin rays:	8–10+10+9+8–9

Photophores discussed:

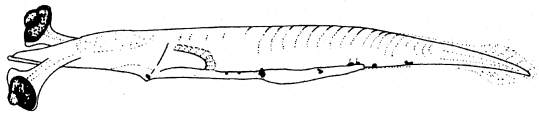


Figures: Adult: Nafpaktitis *et al*., 1977; **A–F**: Zelck *et al*., 1993

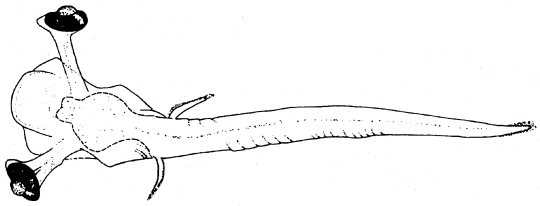
References: Moser and Ahlstrom, 1970; 1972; 1974; 1996b; Moser *et al*., 1984; Hulley, 1984b; Karnella, 1987; Zelck *et al*., 1993; Moser and Watson, 2001

Symbolophorus rufinus

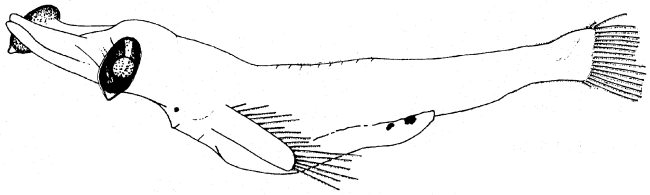
A. 4.9 mmSL



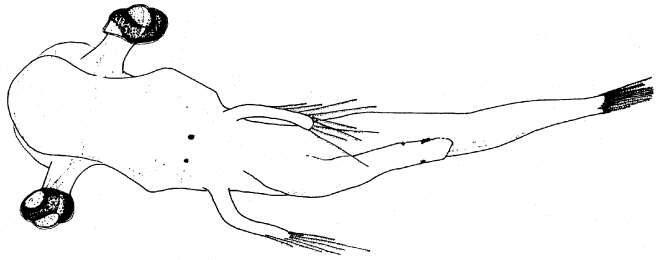
B. 4.9 mmSL (Dorsal View)

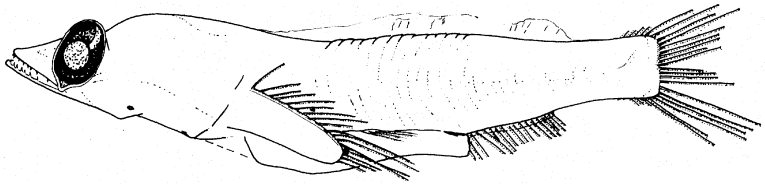


C. 6.6 mmSL

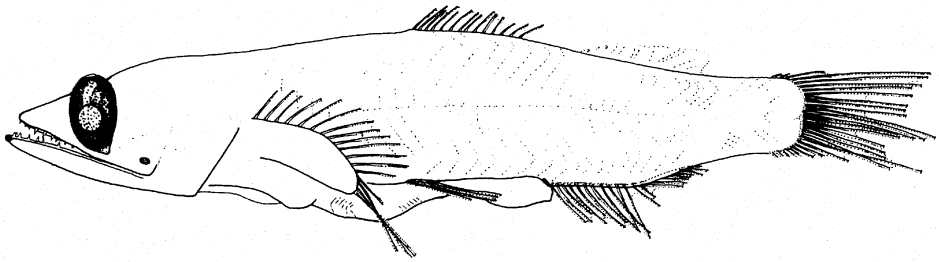


D. 6.6 mmSL (Ventral View)



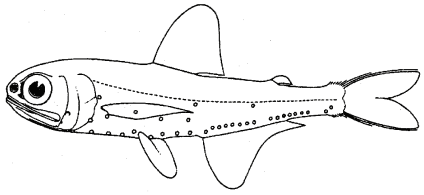


E. 8.5 mmSL



F. 12.8 mmSL

Symbolophorus veranyi (Moreau, 1888)
Myctophidae (s.f. Myctophinae)
No common name



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

Habitat: Mesopelagic in depths of 550–750 m during the day, 0–90 m at night

Spawning: Undescribed

Eggs: – Undescribed; hatching length undescribed

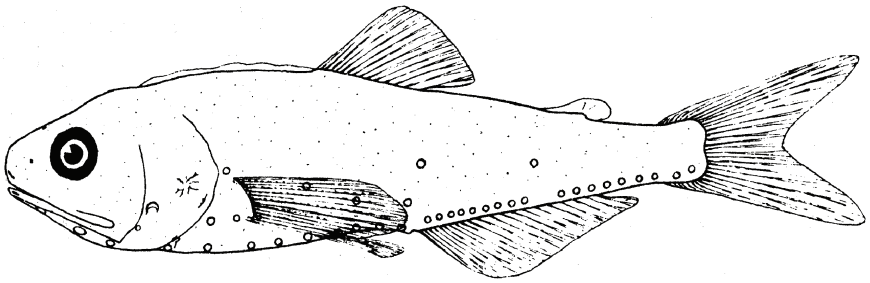
Meristic Characters

Myomeres:	about 39–40
Vertebrae:	39–40 (Mediterranean)
Dorsal fin rays:	12–14
Anal fin rays:	21–23
Pectoral fin rays:	12–13
Pelvic fin rays:	8
Caudal fin rays:	10+9 (PrC)

Larvae:
- Body moderately elongate, somewhat deeper anteriorly
- Head moderately large with pointy, flattened snout in early larvae; snout becomes more rounded in larger larvae; eye only slightly elliptical, on short stalks with small choroid mass
- Gut tapers from bulging anteriorly to narrow at terminus
- Preanus length >60% SL
- Flexion occurs at <8.0 mmSL
- Sequence of fin ray formation: P_1, C_1 – A, D, C_2 – P_2
- Pectoral fin early forming, large, on elongate base
- Photophore development: Br_2 only photophore to form in larval stage, at about 12.0 mmSL
- Pigmentation: few ventral spots anterior to anus; large spot on edge of opercle; spots on tips of lower jaw and snout; pigment forms on pectoral fin rays (heavier near base of rays); all pigment reduced toward end of larval stage
- Transformation occurs at about 20.0 mmSL

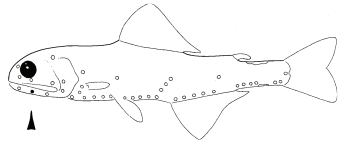
Note: 1. Persistent predorsal finfold

Early Juvenile:



C. 20.0 mmSL

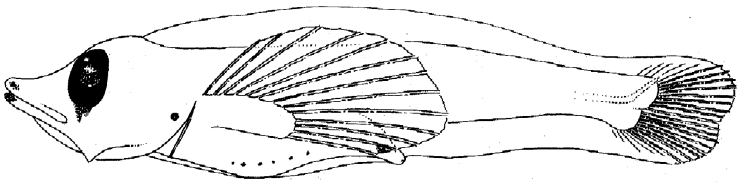
Photophores discussed:



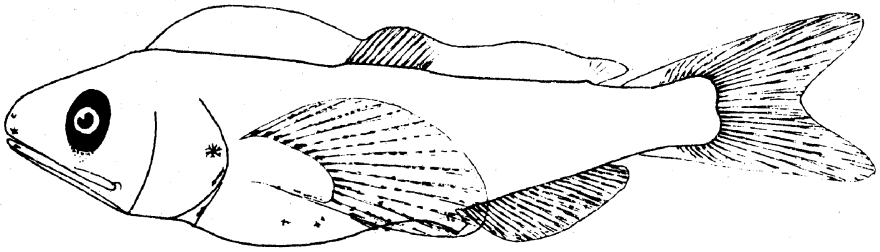
Figures: Adult: Nafpaktitis *et al*., 1977; **A–C**: Tåning, 1918 (**A** redrawn)

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

Symbolophorus veranyi



A. 8.3 mmSL



B. 17.0 mmSL