

SYNODONTIDAE**3 Genera, 10 Species****General features**

- Eggs** — Spherical, pelagic.
 — Sculptured with hexagonally-arranged points.
 — Yolk: unsegmented.
 — Perivitelline space: narrow.
- Larvae** — Elongate with long gut and large mouth.
 — Adipose fin present.
 — Transformation occurs at a large size.
 — Myomere number may be helpful:

Meristic features

- D : 10-13
 A : 9-12 (except 2 species)
 C : 9-16+10+9+9-14

<i>Synodus poeyi</i> Jordan	44-46
<i>Saurida brasiliensis</i> Norman	46-50
<i>Synodus intermedius</i> (Agassiz)	47-50
<i>Saurida normani</i> Longley	49-52
<i>Saurida suspicio</i> Breder	49-52
<i>Saurida caribbea</i> Breder	52-58
<i>Synodus synodus</i> (Linnaeus)	54-57
<i>Trachinocephalus myops</i> (Forster)*	54-57
<i>Synodus saurus</i> (Linnaeus)	55-58
<i>Synodus foetens</i> (Linnaeus)	56-61

* See comparative note on *Argentina silus* (p. 64).

- Anal rays 8-9 in *S. synodus* and 14-15 in *T. myops*.
 — Pigmentation: prominent ventrolateral spots, in pairs.

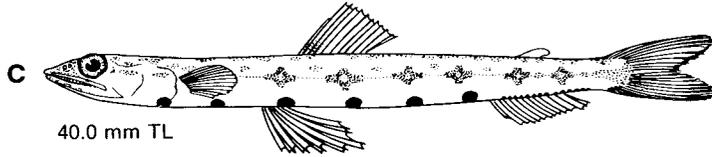
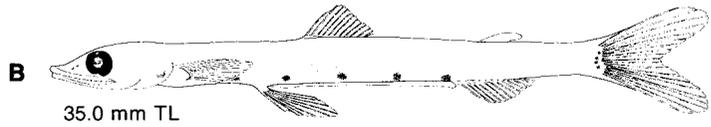
Note: Preanal finfold persists in larvae of *Synodus* and *Trachinocephalus* (M. Okiyama, 1981, pers. comm.).

Fig. — **A-B**, Mansueti and Hardy 1967; **D**, Mito 1961a; **E**, Okiyama 1974 (all redrawn); **C, F-G**, Anderson *et al.* 1966. (Fig. **E** reproduced through the courtesy of Springer-Verlag, New York, Inc.)

Ref. — Gibbs 1959; Rudometkina 1980; Zvyagina 1965.

Synodus foetens

SYNODONTIDAE



Trachinocephalus myops

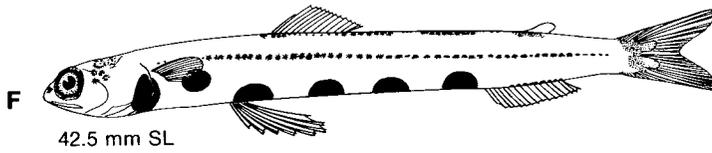


Pigment on dorsal peduncle

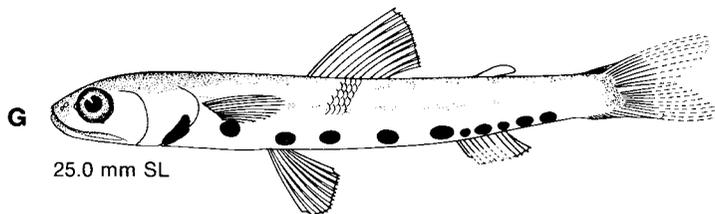
Ventral pigments spots increase in number with development



New spot added at this point in all 3 genera



Saurida brasiliensis



D-E (Pacific material).

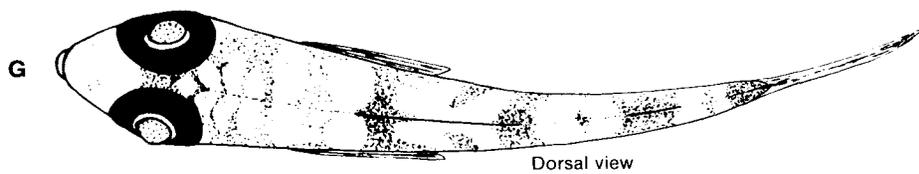
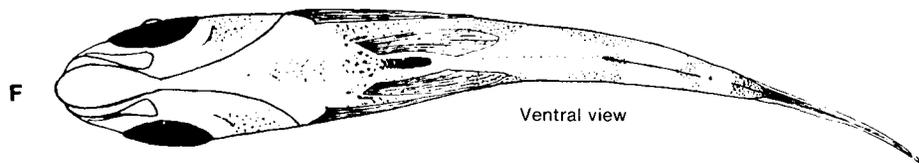
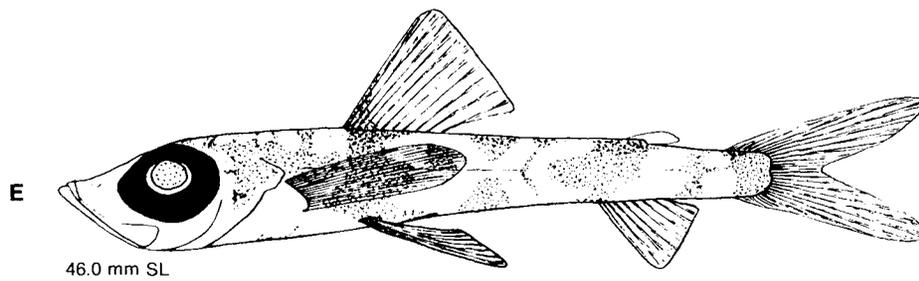
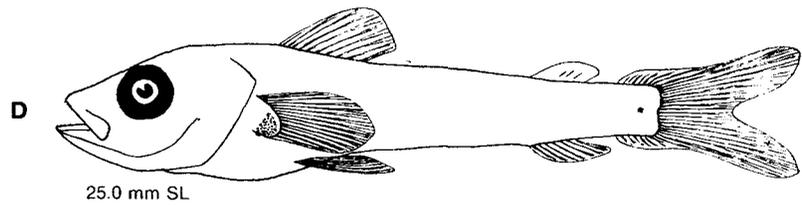
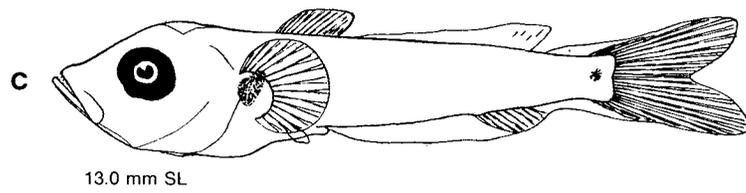
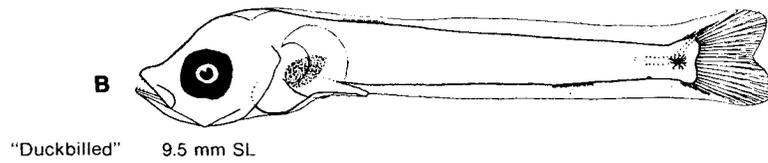
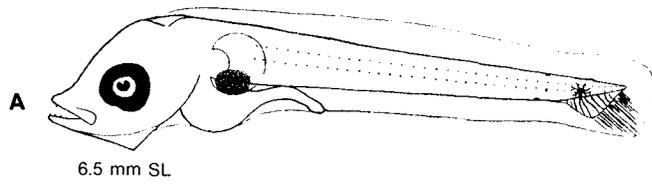
CHLOROPHTHALMIDAE *Chlorophthalmus agassizi* Bonaparte

- | | | |
|---------------|---|--------------------------|
| Eggs | — Undescribed. | Meristic features |
| Larvae | — Body slightly elongate, round and segmented (not compressed as in paralepidids). | Myomeres: 46-48 |
| | — Snout "duckbilled"; eyes round. | Vert : 17+30 |
| | — Preanus length about 45% SL throughout development; long gap between anus and anal fin origin. | D : 10-11 |
| | — Fin formation sequence: caudal, dorsal, anal, pectoral, and pelvic (last). | A : 7-9 |
| | — Adipose fin present. | Piv : 8-9 |
| | — Transformation gradual at about 25 mm. | P : 15-17 |
| | — Pigmentation: large spot at caudal base (or several in juveniles); 2 small spots on dorsal and ventral edges of peduncle in early larvae; 1 internal peritoneal pigment patch on gut under pectoral fin; juveniles develop a "checkered" pattern. | |
| Note: | (1) Eye, head, gut and trunk similar to larval myctophids, but in <i>C. agassizi</i> anal fin is more posterior and dorsal fin more anterior; most myctophids lack prominent spot on caudal peduncle (p. 102-143) | |
| | (2) The larvae of the chlorophthalmid <i>Parasudis truculentis</i> (Goode and Bean), which occurs with <i>C. agassizi</i> along the continental slope off eastern United States, are undescribed; the species has 38 vertebrae. | |

Fig. — A-G, Tåning 1918.

Ref. — Mead 1966a.

Chlorophthalmus agassizi CHLOROPHTHALMIDAE



A-G (Mediterranean material)

BATHYPTEROIDAE***Bathypterois* sp.****Eggs** — Undescribed.**Larvae** — Moderately slender, with protruding gut in some species.

— Eye slightly telescopic.

— Body proportions: body depth about 20% SL; pre-anal length about 66% SL; head length about 24% SL; eye diameter about 5% SL; premaxilla length about 10% SL.

— After transformation, body slims as gut is pulled in, eye shrinks, mouth grows larger, and posterior body lengthens.

— Adipose fin present in most species.

— Pectoral fin large, extending posteriorly to dorsal fin insertion; note relative origins of pelvic, dorsal and anal fins (Fig. A, B).

— Pigmentation: no body or peritoneal pigment.

Meristic features*

(western Atlantic)

Myomeres: 49-61

Vert : 49-61

D : 12-16

A : 7-13

Piv : 8-9

P : 7-15 (visible externally)

* Range in genus

Note: (1) Meristic characters and relative positions of dorsal and anal fins indicate larva in Fig. B is *Bathypterois viridensis* (Roule).

(2) This family included in Chlorophthalmidae, as defined by Sulak (1977).

NEOSCOPELIDAE***Scopelengys tristis* Alcock****Eggs** — Undescribed.**Meristic features****Larvae** — Deep, laterally compressed body; large head with long pointed snout.

Myomeres: 29-32

Vert : 29-32

— Eyes small and round; no choroid tissue.

D : 11-13

— Body proportions: body depth 22-28% SL; preanal length 58-67% SL; head length 35% SL; eye diameter 6-8% SL.

A : 12-14

Piv : 8

— Flexion occurs at 5-7 mm.

P : 15-16

— Adipose fin present.

— Large pectoral fin (30-36% SL) forms at about 3.5 mm.

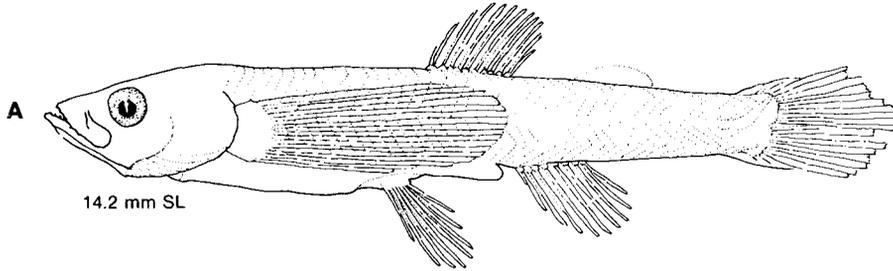
— Dorsal and anal fins form at flexion; pelvic buds form at 6.5-7.0 mm; all fins complete at 10 mm.

— Pigmentation: bar forms from snout to opercle, through eye; may have internal spots on air bladder, but no peritoneal gut pigment as in other myctophiform families; few spots along anal fin base and ventral spots on gut and peduncle (disappear in later larvae).

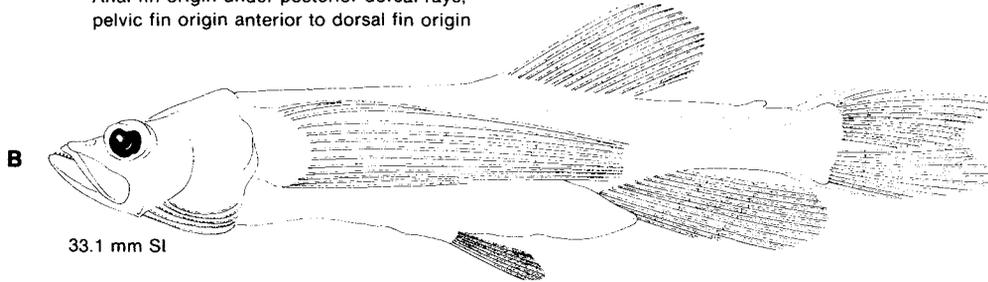
Note: This species is rare in the western Atlantic; smallest Atlantic specimen is 69.5 mm.**Fig.** — **A**, Okiyama 1974 (reversed); **B**, M. P. Fahay (see p. 11); **C**, Okiyama 1974; **D**, Butler and Ahlstrom 1976. (Fig. **A** and **C** reproduced through the courtesy of Springer-Verlag, New York, Inc.)**Ref.** — Mead 1966b; Sulak 1977.

Bathypterois sp.

BATHYPTEROIDAE

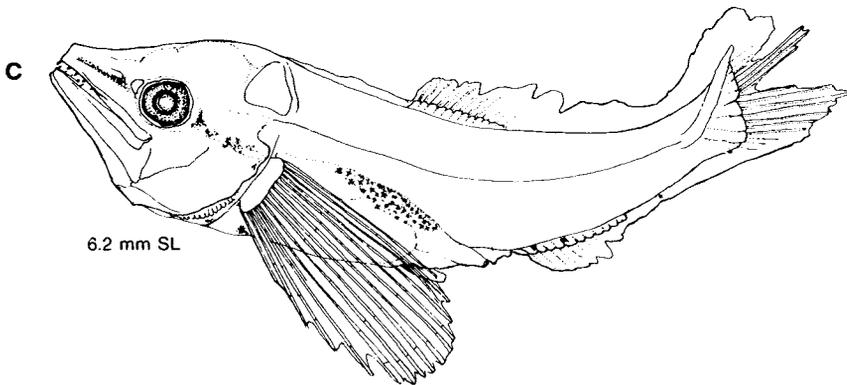


Anal fin origin under posterior dorsal rays;
pelvic fin origin anterior to dorsal fin origin



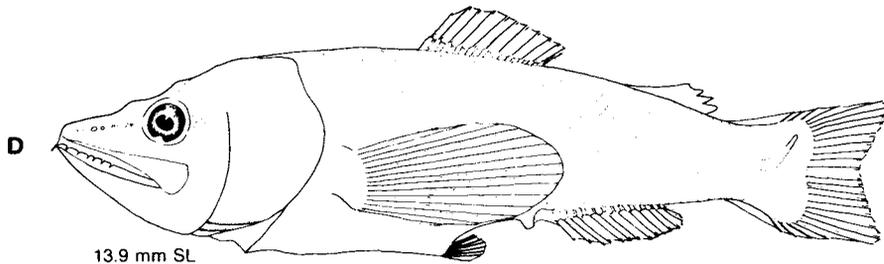
Scopelengys tristis

NEOSCOPELIDAE



Superficially similar to some *Lampanyctus*
(Myctophidae), p. 135

Anal fin origin posterior to dorsal fin; pelvic fin under or
slightly anterior to dorsal fin



Photophores lacking in *Scopelengys*, but present in
neoscopelid genus *Neoscopelus*

Note: Larvae in both families have large pectoral fins, lack peritoneal pigment on gut and have anus immediately anterior to anal fin origin.

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

SCOPELOSAURIDAE Five Western Atlantic Species (=Notosudidae)

General characteristics

Eggs	— Undescribed.	Meristic features*
Larvae	— Body long, slender, cylindrical and compressed in tail region; brain with posterior "wings".	Myomeres: 47-61
	— Eyes narrowed horizontally, on very short stalks; choroid tissue posteriorly; snout "duckbilled".	D : 10-13
	— Body depth 5-6% SL; preanal length 73-80% SL; head length 15-25% SL (changes with growth).	A : 16-21
	— Preanus length increases slightly early in development, varies with species.	Plv : 9
	— Flexion occurs at about 10-12 mm; transformation at 27-45 mm.	P : 10-15
	— Pectoral fin forms early; caudal, anal and adipose fins form soon after flexion; pelvic and dorsal fins form late (>20 mm).	* Range for western Atlantic species.
	— Pigmentation: best distinguishing character (usually restricted to tail region); no pigment on head or peritoneum until transformation.	

Ahliesaurus berryi Bertelsen, Krefft and Marshall.

- Myomeres 47-50; 1-1.5 myomeres between pelvic and dorsal fin origins at >20 mm; preanus length 57-60% SL.
- Broad band of many small spots on peduncle; about 6 large internal spots spaced along midline (4th above anus); spots on anal and adipose fins.

Scopelosaurus smithii Bean

- Myomeres 53-56; 4-5 myomeres between pelvic and dorsal fin origins at >20 mm; preanus length 43-45% SL.
- Broad band of many small spots on peduncle and vertical line of spots on caudal base (weak or no pigment between these groups); clump of small spots on middle caudal rays (>10 mm); no lateral spots, and anal fin unpigmented.

Scopelosaurus lepidus Krefft and Maul

- Myomeres 58-61; 5-6 myomeres between pelvic and dorsal fin origins at >20 mm; preanus length 40-44% SL.
- Middorsal and midventral lines of spots on finfold of peduncle (become embedded in body); vertical line of 2-10 spots on caudal base; few spots may occur at tips of caudal and anal fins.

Scopelosaurus argenteus (Maul)

- Myomeres 54-57; 5 myomeres between pelvic and dorsal fins origins at >20 mm; preanus length 40-45% SL.
- Most larvae 10-29 mm are totally without pigment; some larvae 15-34 mm have single spot on peduncle (may occur on one side only).

Scopelosaurus maui Bertelsen, Krefft and Marshall

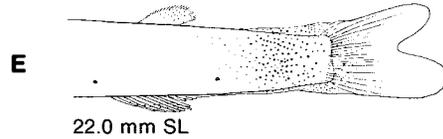
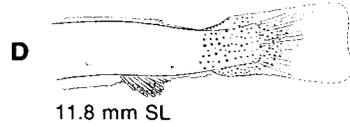
- Myomeres 55-57; 6-7.5 myomeres between pelvic and dorsal fin origins at >20 mm; preanus length 38-40% SL.
- Two short lateral lines of 3-5 large spots above and below midline of peduncle; internal vertical band of spots under posterior ends of lateral lines; groups of spots on upper and lower procurrent caudal rays; vertical line of spots on caudal base; group of spots on middle caudal rays.

Fig. — A-M, Bertelsen *et al.* 1976.

Ref. — Marshall 1966; Ozawa 1978.

Ahliesaurus berryi

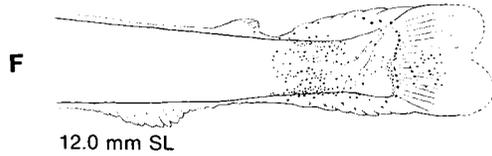
SCOPELOSAURIDAE



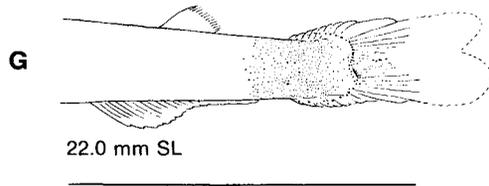
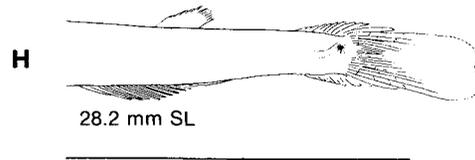
Pigment increases with development

Caudal Peduncle Pigment Patterns in *Scopelosaurus*

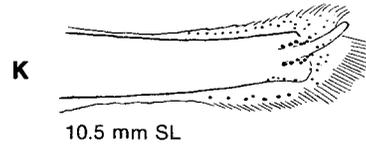
Scopelosaurus smithii



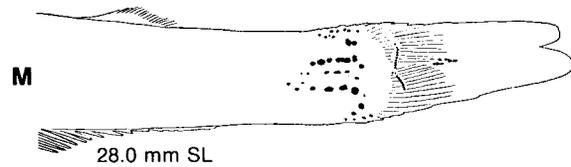
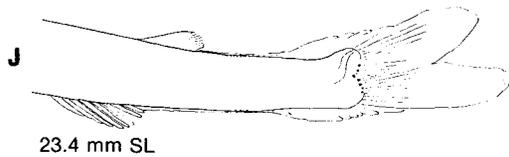
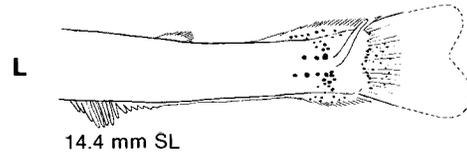
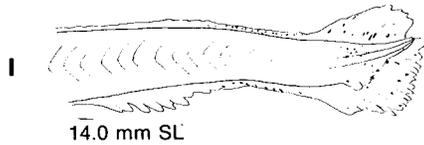
Scopelosaurus argenteus



Scopelosaurus mauii



Scopelosaurus lepidus

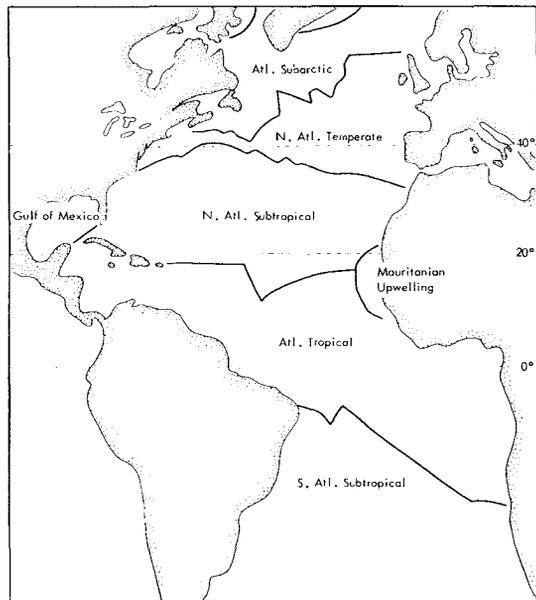


Note: All 5 species occur in western North Atlantic between 20° N and 40° N and *S. lepidus* to 60° N or farther north.

MYCTOPHIDAE**Introduction**

Eight-two species in 20 genera occur in the North Atlantic (Nafpaktitis *et al.*, 1977). Since the larvae of only 33 species have been described (many from Pacific collections), it is clear that many Atlantic larvae cannot be identified to species at this time. However, the larvae of some species in all 20 genera have been described (see table, p. 105-107).

The most abundant myctophid species in five Atlantic Ocean regions (see map below), based on catches of adults in the upper 200 m are listed (at right) as percentages of all myctophids represented by the species within each region (map and table from Backus *et al.*, 1977).

**Atl. Subarctic**

<i>Benthosema glaciale</i>	96
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N. Atl. Temperate

<i>Benthosema glaciale</i>	45
<i>Ceratoscopelus maderensis</i>	21
<i>Lobianchia dofleini</i>	12
<i>Lampanyctus pusillus</i>	6

N. Atl. Subtropical

<i>Notolychnus valdiviae</i>	18
<i>Diogenichthys atlanticus</i>	14
<i>Ceratoscopelus warmingii</i>	10
* <i>Bolinichthys indicus</i>	7
<i>Lobianchia dofleini</i>	7
<i>Lampanyctus pusillus</i>	7
<i>Benthosema suborbitale</i>	6

Atl. Tropical

<i>Lepidophanes guentheri</i>	17
<i>Diaphus dumerili</i>	12
<i>Ceratoscopelus warmingii</i>	12
<i>Notolychnus valdiviae</i>	12
<i>Benthosema suborbitale</i>	7
* <i>Lampanyctus alatus</i>	4
* <i>Diaphus vanhoeffeni</i>	4

Gulf of Mexico

<i>Notolychnus valdiviae</i>	27
* <i>Lampanyctus alatus</i>	24
<i>Benthosema suborbitale</i>	22
<i>Ceratoscopelus warmingii</i>	6
* <i>Diaphus mollis</i>	4
<i>Lepidophanes guentheri</i>	3
<i>Notoscopelus resplendens</i>	3

* Larvae undescribed.

Egg Characteristics

With the exception of one species, myctophid eggs are virtually unknown. Characteristics of *Lampanyctodes hectoris* eggs, taken in a surface plankton tow near New Zealand, have been described (Robertson, 1977).

- Shell: weakly oval, fragile.
- Long diameter: 0.74-0.83 mm.
- Short diameter: 0.65-0.72 mm.
- Yolk: strongly segmented.
- Oil globule: single, 0.21-0.23 mm.
- Perivitelline space: narrow.

Larval Characteristics**MYCTOPHIDAE**

(Ref: Moser and Ahlstrom 1970, 1972, 1974)

Morphology

- Body ranges from slender and elongate to deep and big-headed.
- Head varies from deep and narrow to short and slender.
- Eye round or narrow; some choroid tissue may be present under either type, but more developed under narrow eyes; several species have narrow eyes on short stalks (*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 anus and anal fin origin.
- Size at transformation ranges from about 10 mm (*Electrona*) to more than 20 mm (*Notolychnus*).

Pigmentation

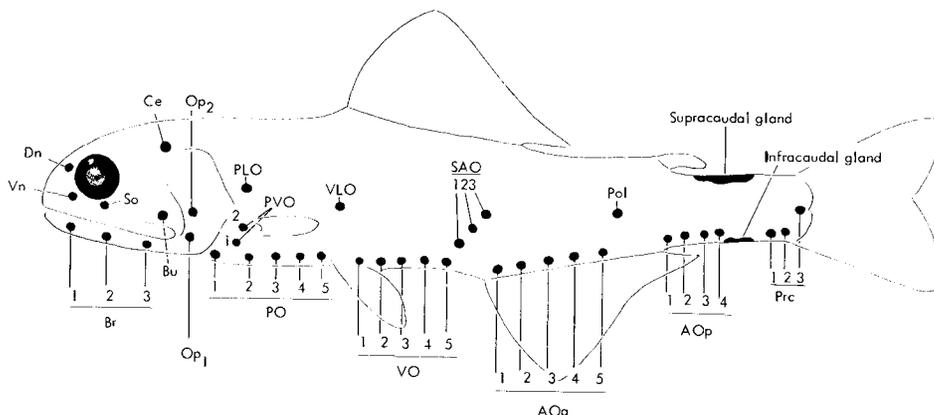
- Variable among species within a genus.
- Important series of spots on ventral midline of tail; if series present, the number of spots increases or decreases during development.
- Pigment pattern usually changes during development.

Fin development

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

Photophores

- Photophore group terminology (Moser and Ahlstrom 1972).



MYCTOPHIDAE**Larval Characteristics****Photophore development**

- Br₂ is the first to form in all species except *Notolychnus valdiviae*.
- Other photophores may form sequentially before transformation.
- See table below.

Other larval structures

- Lower jaw barbel (*Diogenichthys*).
- Elongate lower pectoral rays (*Loweina*).
- Enlarged dorsal finfold (*Loweina* and *Benthoosema*).
- Stalked eyes (*Symbolophorus*, some *Hygophum* and *Myctophum*).

Similar larvae

- *Scopelengys* (Neoscopelidae) (p. 98): similar to *Lampanyctus*.
- *Chlorophthalmus* (Chlorophthalmidae): eye, head, gut and trunk similar, but dorsal origin farther anterior and anal (p. 96) farther posterior.

Subfamily Differences

Subfamily Myctophinae	Subfamily Lampanyctinae
Eyes: elliptical, some with choroid tissue, some with stalks.	Eyes: round, may have small sliver of choroid (<i>Lobianchia</i> and <i>Notolychnus</i> may have slightly narrowed eyes).
Larval photophores: only Br ₂ formed in most; 3 species develop other photophores.	Larval photophores: sequential development of 3 or 4 pairs in most.
1. <i>Diogenichthys atlanticus</i> : Br ₂ , PO ₂ , PO ₅ and AOa ₁ .	1. <i>Notoscopelus</i> : Br ₂ , PO ₅ , and Vn form in sequence followed by PLO later.
2. <i>Benthoosema suborbitale</i> : Br ₂ , PO ₁ , PO ₂ , Br ₁ and Br ₃ .	2. <i>Bolinichthys</i> (with exceptions), <i>Ceratoscopelus</i> and <i>Lepidophanes</i> : Br ₂ , Vn, PLO and PO ₅ form in sequence; photophores very small.
3. <i>Myctophum asperum</i> : Br ₂ , Dn and PLO.	3. <i>Lampadena</i> : Br ₂ , PLO and PO ₅ form early.
	4. <i>Diaphus</i> , <i>Lobianchia</i> : Br ₂ , PO ₅ , and PO ₁ form early.
	5. <i>Lampanyctus</i> : only Br ₂ in larvae.
	6. <i>Notolychnus</i> and <i>Taaningichthys</i> : no photophores in larvae, except <i>Taaningichthys</i> may form Br ₂ just before transformation.

North Atlantic Species

MYCTOPHIDAE

The 82 myctophid species occurring in the North Atlantic (Nafpaktitis *et al.* 1977) are listed below, with sources of larval descriptions and meristic counts for vertebrae, gillrakers and fin rays. Tribal organization in the subfamily Lampanyctinae is after Moser and Ahlstrom (1974). Vertebral counts followed by an asterisk (*) are from Tåning (1918), based on Mediterranean material.

	Source of descriptions ^a	Vert – ebrae	Gill rakers	Fin rays		
				D	A	P
Subfamily Myctophinae						
Tribe Myctophini						
<i>Protomyctophum arcticum</i>	1	...	4-5+1+14-15	11-13	21-24	15-17
<i>Electrona risso</i>	1,2	32-34	8-9+1+17-20	13-14	18-19	13-16
<i>Hygophum benoiti</i>	1,6	35-36*	4-5+1+13-14	12-14	19-21	13-15
<i>Hygophum hygomii</i>	1,4,5	36-37*	5+1+13-15	13-15	20-22	15-16
<i>Hygophum macrochir</i>	4	...	5+1+13-15	12-14	18-20	13-15
<i>Hygophum reinhardtii</i>	2,4	38-39	4-5+1+12-14	13-14	22-24	13-15
<i>Hygophum taaningi</i>	4	...	4+1+11-13	13-14	19-20	13-14
<i>Myctophum affine</i>	—	...	5-6+1+12-15	12-13	18-20	13-14
<i>Myctophum asperum</i>	4,5	35-38	4-5+1+9-11	12-14	17-18	14-15
<i>Myctophum nitidulum</i>	2,4,5	37-39	5-6+1+12-15	13-14	19-20	13-14
<i>Myctophum obtusirostre</i>	4	...	6-7+1+15-17	12-13	17-19	16-18
<i>Myctophum punctatum</i>	1,4,9	40*	6-8+1+16-18	13-14	20-22	13-14
<i>Myctophum selenops</i>	4,5	...	6-7+1+14-16	12-14	17-18	16-18
<i>Symbolophorus rufinus</i>	—	...	5-6+1+14-15	14-16	20-21	14-16
<i>Symbolophorus veranyi</i>	1,8	39-40*	5-6+1+12-14	12-14	21-23	12-13
<i>Diogenichthys atlanticus</i>	1,2,5	32-35	2+1+9-11	11-12	15-16	12-13
<i>Bethosema glaciale</i>	1,4,7,11	34-36*	4-5+1+10-12	12-14	17-19	11-13
<i>Bethosema suborbitale</i>	4,5,13	34	3+1+9-11	11-14	16-17	12-14
Tribe Gonichthyini						
<i>Loweina rara</i>	2,4	37-39	2+1+5-6	11-13	15-16	10-12
<i>Loweina interrupta</i>	—	...	3+1+7-10	11-12	15-16	11-12
<i>Gonichthys cocco</i>	1	40-41*	3-4+1+5-6	11-12	20-23	13-15
<i>Centrobranchus nigroocellatus</i>	—	...	None	10-11	16-19	13-15
Subfamily Lampanyctinae						
Tribe Notolychnini						
<i>Notolychnus valdiviae</i>	1,4	28-30	2+1+7-8	10-12	12-14	12-13
Tribe Lampanyctini						
<i>Lampanyctus alatus</i>	—	...	3-4+1+9-10	11-13	16-18	11-13
<i>Lampanyctus ater</i>	—	...	5+1+10-12	13-15	18-19	...
<i>Lampanyctus crocodilus</i>	1	36-37*	4-5+1+10-12	13-15	17-18	14-16
<i>Lampanyctus cuprarius</i>	—	...	5+1+11-12	16-18	17-19	11-12
<i>Lampanyctus festivus</i>	—	...	4+1+8-9	13-14	18-20	15-17
<i>Lampanyctus intracarius</i>	10	...	4+1+10-11	14-16	18-20	13-14
<i>Lampanyctus isaacsi</i>	—	...	5-6+1+12-13	14-16	17-19	11-13

MYCTOPHIDAE

North Atlantic Species

	Source of descriptions ^a	Vertebrae	Gill rakers	Fin rays		
				D	A	P
<i>Lampanyctus lineatus</i>	—	...	5-6+1+11-13	16-18	19-22	12-14
<i>Lampanyctus macdonaldi</i>	—	...	6-8+1+14-18	13-15	15-18	12-13
<i>Lampanyctus nobilis</i>	—	...	3-4+1+9-10	14-16	17-20	13-15
<i>Lampanyctus photonotus</i>	—	...	3-5+1+8-10	12-14	16-17	12-14
<i>Lampanyctus pusillus</i>	1	32-34*	3+1+7-9	12-13	14-16	13-15
<i>Lampanyctus tenuiformis</i>	—	...	4+1+9	13-14	17-18	13-14
Tribe Diaphini						
<i>Lobianchia dofleini</i>	1,4	33-35*	5-6+1+12-15	15-17	13-15	11-13
<i>Lobianchia gemellarii</i>	1,4	36*	4-6+1+10-14	17-18	13-15	11-12
<i>Diaphus dumerilii</i>	—	...	5-9+1+13-18	14-15	14-15	11-12
<i>Diaphus garmani</i>	—	...	6-8+1+12-15	14-16	15-17	11-12
<i>Diaphus problematicus</i>	—	...	4+1+8-9	16-17	16-18	11-12
<i>Diaphus adenomus</i>	—	...	5+1+11	14-15	15-16	11-12
<i>Diaphus splendidus</i>	—	...	5-6+1+11-13	14-15	15-17	11-12
<i>Diaphus taaningi</i>	—	...	6-8+1+12-14	14	14-15	11
<i>Diaphus bertelseni</i>	—	...	5+1+12	14-15	15	11
<i>Diaphus luetkeni</i>	—	...	6-7+1+13-15	15-17	14-16	11
<i>Diaphus termophilus</i>	—	...	7-9+1+14-16	13-14	15	11-12
<i>Diaphus minax</i>	—	...	5-6+1+11-14	13-14	13-14	11
<i>Diaphus lucidus</i>	—	...	5-6+1+10-12	17	17-18	11-12
<i>Diaphus fragilis</i>	—	...	5-6+1+11-12	17-19	17-18	11-13
<i>Diaphus perspicillatus</i>	—	...	9-10+1+16-18	15-17	14-16	11-12
<i>Diaphus effulgens</i>	—	...	6-7+1+12-14	15-16	14-15	11-12
<i>Diaphus roei</i>	—	...	6-8+1+15-16	15	13-14	11-12
<i>Diaphus metopoclampus</i>	12	...	7-9+1+13-16	15-16	14-16	10-11
<i>Diaphus vanhoeffeni</i>	—	...	7-8+1+14-15	13-14	14-15	10-11
<i>Diaphus rafinesquii</i>	1	33-34*	7-8+1+14-16	13-14	13-15	10-11
<i>Diaphus mollis</i>	—	...	4-5+1+10-12	13	12-13	10-11
<i>Diaphus holti</i>	1	32-34*	5-6+1+11-13	13-14	12-14	10-12
<i>Diaphus subtilis</i>	—	...	6-7+1+13-15	12-13	13	10-12
<i>Diaphus brachycephalus</i>	—	...	5-7+1+12-14	12-13	13-14	10-12
<i>Diaphus anderseni</i>	—	...	5+1+11	12-13	12	10-11
Tribe Gymnoscopelini						
<i>Lampadena anomala</i>	—	36	5+1+10-12	14-16	13-14	16-18
<i>Lampadena chavesi</i>	—	37-38	6-7+1+12-14	13-15	12-14	15-17
<i>Lampadena luminosa</i>	4	36-37	4+1+8-10	14-15	13-15	15-17
<i>Lampadena speculigera</i>	—	38-40	6-7+1+12-14	13-15	14-15	13-15
<i>Lampadena urophaos atlantica</i>	3	36-38	3-4+1+8-9	15-16	14	16-17
<i>Taaningichthys bathyphilus</i>	—	34-36	2-4+1+5-9	11-14	12-14	12-14
<i>Taaningichthys minimus</i>	3	40-41	4-5+1+10-13	11-13	11-14	15-17
<i>Taaningichthys paurolychnus</i>	—	35-36	3-4+1+8-11	11-13	11-14	13-15
<i>Bolinichthys distofax</i>	—	...	5-6+1+11-12	12-14	13-15	12-13
<i>Bolinichthys indicus</i>	—	...	3-4+1+10-12	11-13	12-14	12-14
<i>Bolinichthys photothorax</i>	—	...	5-7+1+13-15	12-14	13-15	12-14
<i>Bolinichthys supralateralis</i>	4	...	5-6+1+12-13	13-15	13-15	13-14
<i>Lepidophanes guentheri</i>	3	...	4+1+9-10	13-15	14-15	12-13

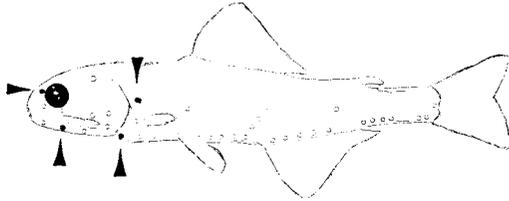
North Atlantic Species

MYCTOPHIDAE

	Source of descriptions ^a	Vert – ebrae	Gill rakers	Fin rays		
				D	A	P
<i>Lepidophanes gaussi</i>	4	...	3+1+8	13–14	13–15	12–13
<i>Ceratoscopelus maderensis</i>	1,3	35–38	5–6+1+12–15	13–14	13–15	13–14
<i>Ceratoscopelus warmingii</i>	14	...	3–4+1+8–10	13–15	13–15	13–15
<i>Notoscopelus bolini</i>	—	37–38	8–10+1+17–19	23–26	19–20	12–14
<i>Notoscopelus caudispinosus</i>	—	36	4+1+9–10	25–27	20–21	11–13
<i>Notoscopelus resplendens</i>	3,4,13	36–37	5–7+1+12–15	21–23	18–20	12–13
<i>Notoscopelus elongatus kroeyeri</i>	—	39–40	8–9+1+17–20	21–22	18–20	13

- ^a Sources:
- | | |
|---|--|
| 1. Tåning 1918 (Med.) | 8. Mazzeilli 1912 (Med.) |
| 2. Moser and Ahlstrom 1970 (Pac.) | 9. Sanzo 1915 (Med.) |
| 3. Moser and Ahlstrom 1972 (most Pac.) | 10. Legendre 1934 (E. Atl.) |
| 4. Moser and Ahlstrom 1974 (all oceans) | 11. Sparta 1951 (E. Atl.) |
| 5. Pertseva-Ostroumova 1974 (Pac. & Ind.) | 12. Sparta 1952 (E. Atl.) |
| 6. Shiganova 1974 (Atl.) | 13. Badcock and Merrett 1976 (E. Atl.) |
| 7. Holt 1898 (E. Atl.) | 14. Miller <i>et al.</i> 1979 (Pac.) |

Note: Hypothetical figure at the bottom of each text page of the myctophid section shows location of the pertinent photophores. Photophores discussed in the larval development section are indicated by a solid circle and pointer. Open circles indicate photophores which do not appear until after transformation. The almost-universally first-forming Br₂ 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, Br₂, PLO, Dn and PO₁ photophores are indicated.

MYCTOPHIDAE *Protomyctophum arcticum* (Lütken)
Myctophinae

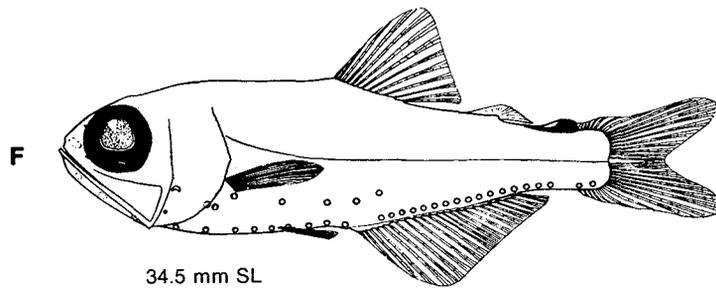
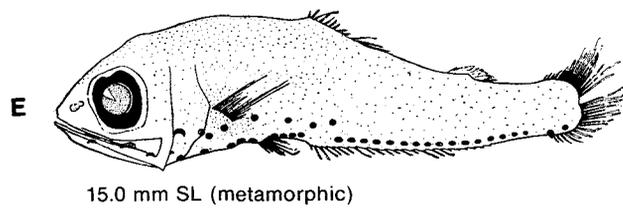
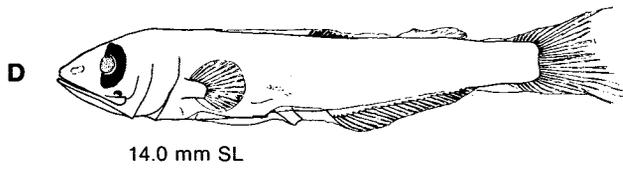
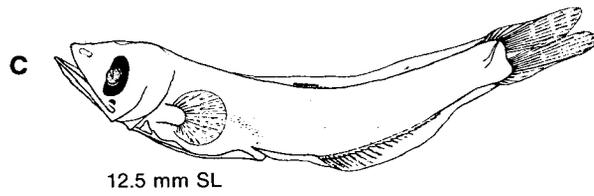
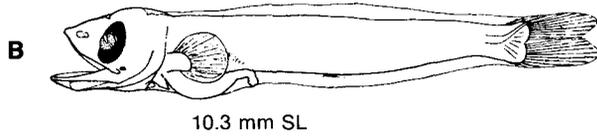
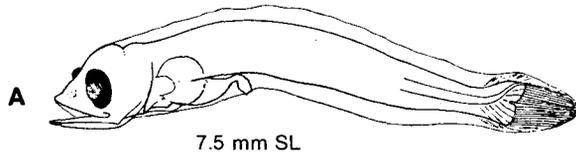
- | | | |
|---------------------|--|--|
| Morphology | <ul style="list-style-type: none"> — Body slender. — Short gut in early larvae, lengthens in late larvae. — Marked space between anus and anal fin origin. — Eye oblong, with no choroid tissue. — Transforms at about 15 mm. | Meristic features |
| | | <ul style="list-style-type: none"> Vert: 36–41 (genus) D : 11–13 A : 21–24 P : 15–17 |
| Photophores | <ul style="list-style-type: none"> — Br₂ forms early in larval stage; all other photophores form after metamorphosis. | |
| Pigmentation | <ul style="list-style-type: none"> — Unpigmented, except Tåning (1918) noted faint internal pigment in abdomen and in some specimens faint internal melanophores in caudal region, ventral to urostyle. | |
| Distribution | <ul style="list-style-type: none"> — Subpolar-temperate. | |



Fig. — A-F, Tåning 1918.

Protomyctophum arcticum

MYCTOPHIDAE



MYCTOPHIDAE
Myctophinae

***Electrona risso* (Cocco)**

- Morphology**
- Body more robust than *P. arcticum* (p. 108).
 - Unique gut shape, broad anteriorly and narrows in posterior third; gut length about 50% SL at 3.4 mm, 53–58% SL during flexion, and 57–62% during later stages.
 - Head large and broad, its length 26–27% SL during preflexion and about 30% SL during postflexion.
 - Dorsal snout concave during preflexion and rounded during postflexion.
 - Eye moderately narrow, with small choroid mass.
 - Slight space between anus and anal fin origin.
 - Flexion occurs at 6.2–7.0 mm, and transformation at about 10 mm (small).
- Meristic features**
- Vert : 32–34
D : 13–14
A : 18–19
P : 13–16

- Ossification**
- Sizes at beginning of ossification and completion of fin rays and vertebrae:

Primary caudal rays	5.7 mm	7.5 mm
Pectoral rays	5.0	~7.8
Anal rays	7.0	~9.0
Dorsal rays	9.0	10.0
Pelvic rays (bud at 6.2 mm)	9.0	10.0
Vertebrae	8.2	9.0

- Photophores** — Br₂ forms early in larvae (5.8 mm) at posteroventral margin of orbit.
- Pigmentation** — Very scant; some spots on pectoral rays beginning at about 6 mm; one spot at symphysis of lower jaw; possibly on snout tip; embedded in dorsal surface of air bladder.
- Distribution** — Eastern Atlantic; collected occasionally in western Atlantic (Nafpaktitis *et al.* 1977).

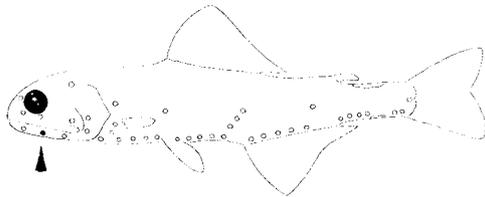
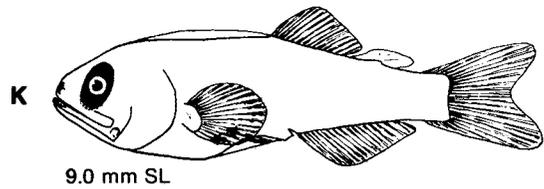
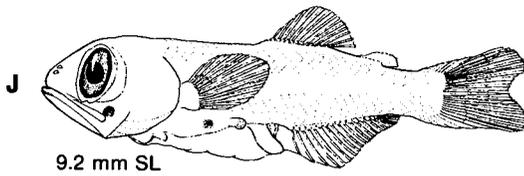
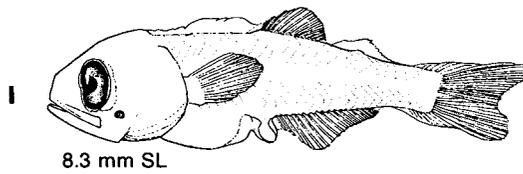
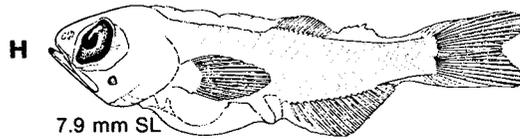
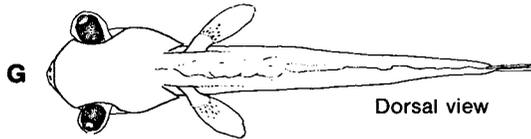
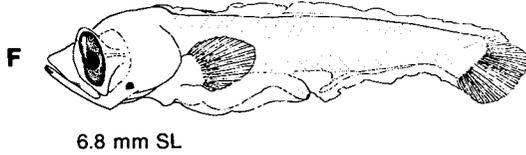
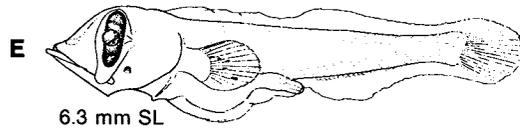
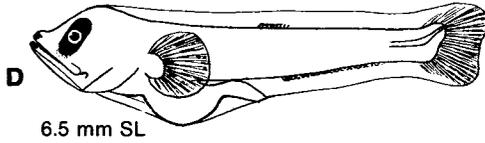
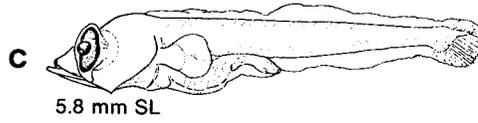
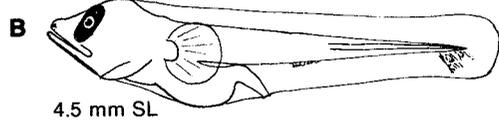
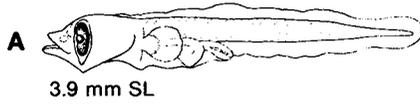


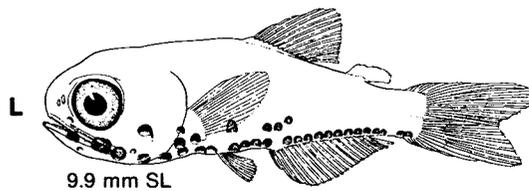
Fig. — A, C, E–J, L, Moser and Ahlstrom 1970; B, D, K, Tåning 1918.

Electrona risso

MYCTOPHIDAE



One larva (9.5 mm) reported with pairs of PO_2 , PO_3 and PO_4 developed (Moser and Ahlstrom, 1970).



MYCTOPHIDAE
Myctophinae

***Hygophum benoiti* (Cocco)**

- Morphology** — Snout more rounded than in *H. hygomii*, and eye slightly wider.
— Body depth increases from 12% NL to 28–29% SL.
— Preanus length increases from 50% NL to 62% SL.
— Head length increases from 17% NL to 30% SL.
— Transformation occurs at 10.0–12.5 mm (11.0–13.6 mm, Shiganova 1974).
- Ossification** — Fins develop at smaller size than in *H. hygomii*; all dorsal rays formed at 8 mm (10 mm, Shiganova 1974).
- Pigmentation** — Spots at posterior margin of jaw, tip of snout and lower jaw.
— Spots at caudal base and anus, and 8–9 spots anterior to anus.

Meristic features

Vert: 35–36
D : 12–14
A : 19–21
P : 13–15

***Hygophum hygomii* (Lütken)**

- Morphology** — Snout more pointed than in *H. benoiti*, and eye narrower.
— Transformation occurs at 13.0–14.5 mm.
- Ossification** — Development of fins later than in *H. benoiti*; only anterior dorsal ray base formed at 8 mm.
- Pigmentation** — Spots rarely found on snout tip, lower jaw, and caudal rays.
— Spot present at anus.

Meristic features

Vert: 36–37
D : 13–15
A : 20–22
P : 15–16

Common Characters for Both Species

- Morphology** — Body moderately slender, with anus at anterior margin of anal fin (no gap).
— Eyes unstalked, moderately narrow with prominent choroid tissue.
- Ossification** — Dorsal fin forms late in larval period.
- Photophores** — Br₂ usually the only photophore to form in the larval stage.
- Pigmentation** — Pigment decreases through larval development; most pigment on head and gut; melanophores present on isthmus (see illustration at right).
- Distribution** — Temperate-semisubtropical



(Badcock and Merrett 1976)

Note: Larvae somewhat similar to *Benthosema suborbitale*, (p. 124), but choroid tissue more extensive in *Hygophum*. Compare ventral views of head in both genera.

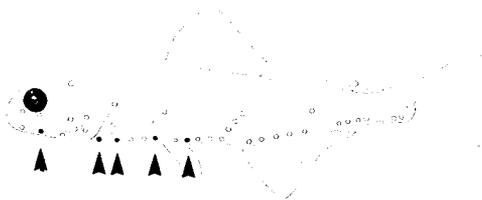
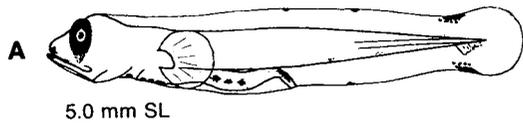


Fig. — A-E, H-J, Tåning 1918; F, Pertseva-Ostroumova 1974; G, Moser and Ahlstrom 1974.

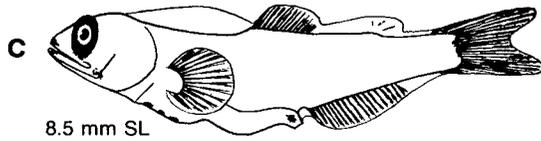
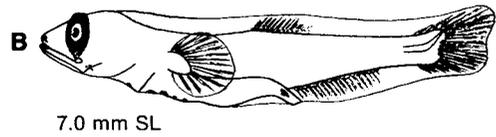
Ref. — Shiganova 1974.

Hygophum benoiti

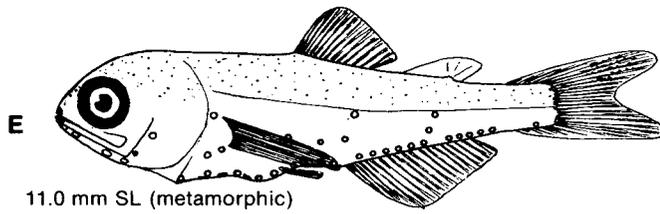
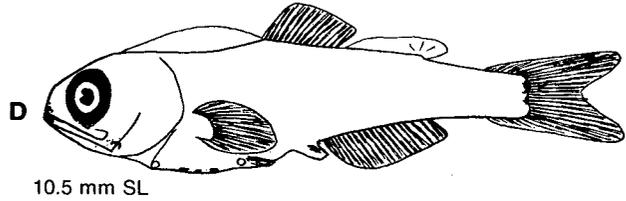
MYCTOPHIDAE



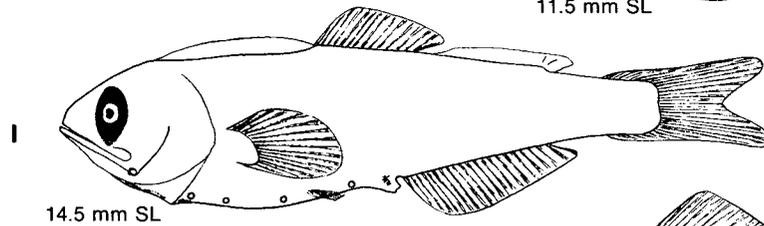
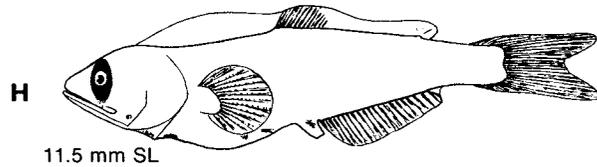
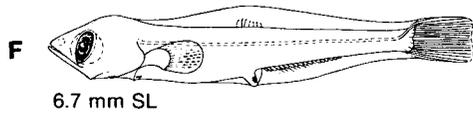
Br₂ forms about 6.0 mm SL



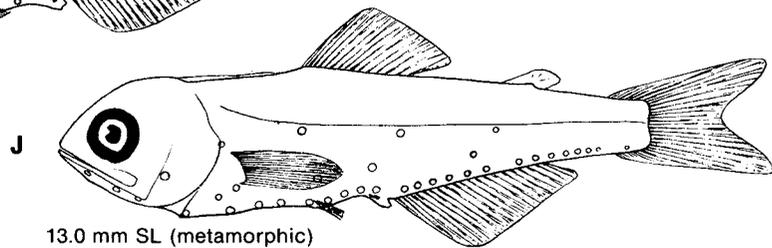
One or two PO photophores may develop just before transformation



Hygophum hygomii



Two or three PO and one VO photophore may develop just before transformation



MYCTOPHIDAE
Myctophinae

***Hygophum reinhardtii* (Lütken)**

- Morphology** — Body elongate, with very long gut.
— Very narrow eye on short stalk, prominent choroid tissue.
— Flexion occurs at 8.8–10.3 mm, and transformation at 15.0–16.4 mm.
- Ossification** — Sizes at beginning of ossification and completion of fin rays:

Meristic features

Vert: 38–39
D : 13–14
A : 22–24
P : 13–15

Primary caudal rays	8.0 mm	9.0 mm
Pectoral rays	9.0	12.0
Anal rays	10.0	13–14
Dorsal rays (form late)	14.0	15+ (at transformation)
Pelvic rays (buds at 11.0 mm)	14.4	15.2

- Pigmentation** — Pigment increases through development; median spot at midpoint of isthmus; 9–10 bars of pigment form on tail myosepta; no spots on tip of jaw; 4 pairs of spots on gut increase to 10–11 in larvae >10 mm.
- Distribution** — Subtropical.

***Hygophum macrochir* (Günther) and *H. taaningi* Bekker**

- Morphology** — Body deeper than *H. reinhardtii*.
— Eyes large and relatively wide; little or no choroid tissue.
— Gut narrow anteriorly, and enlarged posteriorly; the enlarged part in *H. macrochir* covered with melanophores.
- Distribution** — *H. macrochir* tropical, and *H. taaningi* subtropical.

Meristic features

	<i>macrochir</i>	<i>taaningi</i>
D:	12–14	13–14
A:	18–20	19–20
P:	13–15	13–14

Note: In all three species above, only Br₂ photophore forms during larval stage.

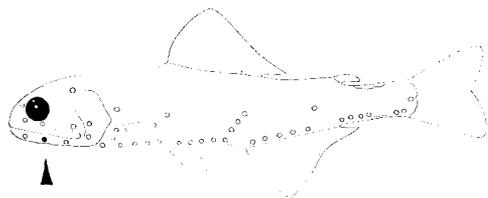
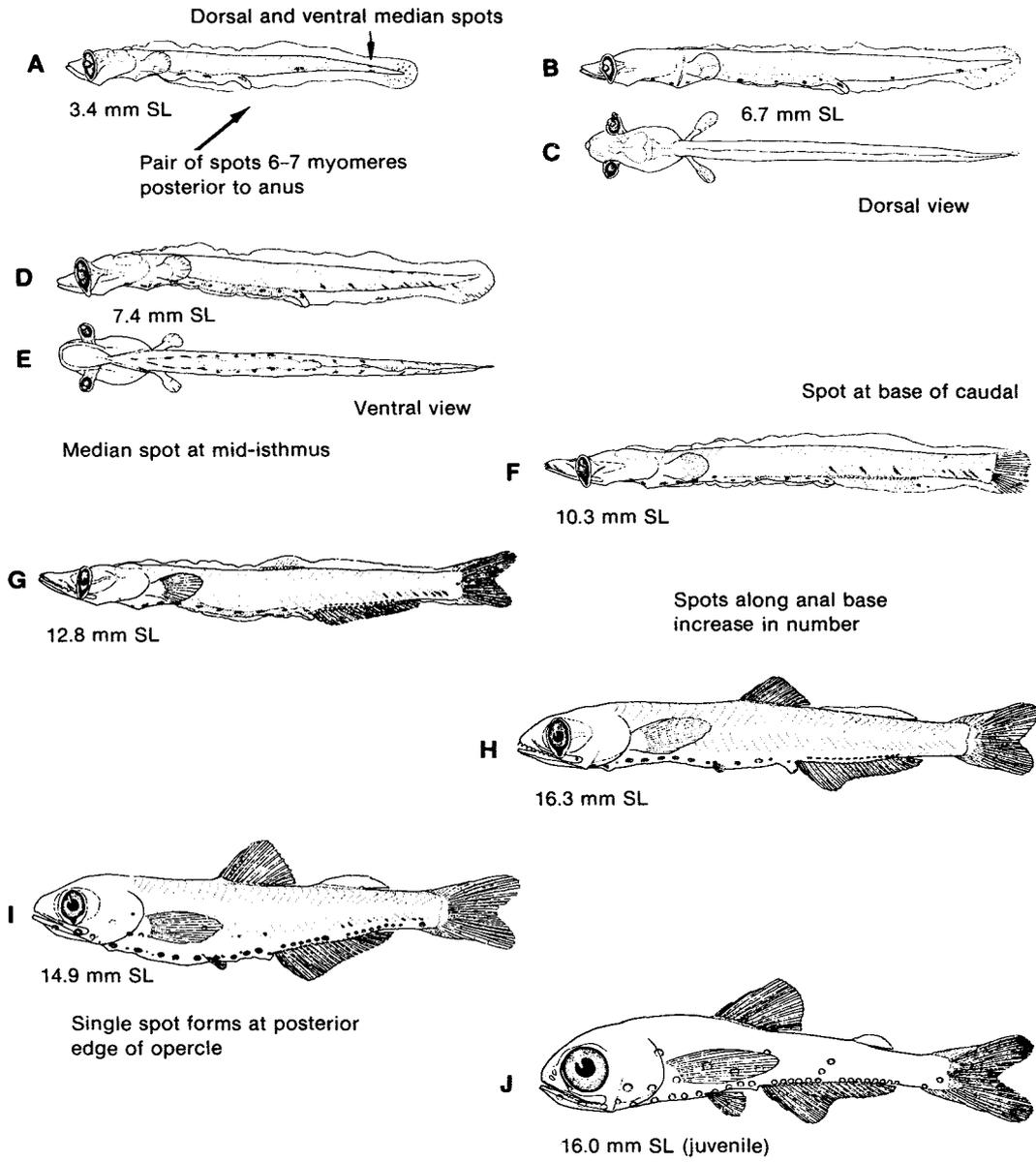


Fig. — A–J, Moser and Ahlstrom 1970; K–L, Moser and Ahlstrom 1974.

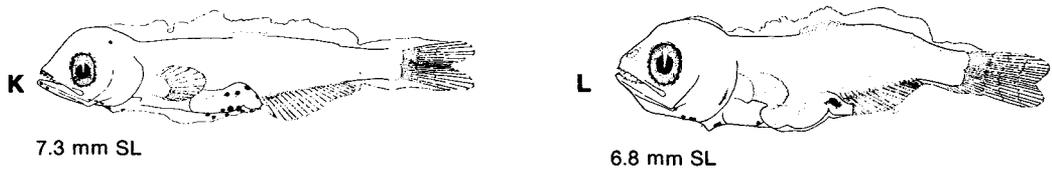
Hygophum reinhardtii

MYCTOPHIDAE



Hygophum macrochir

Hygophum taaningi



MYCTOPHIDAE *Myctophum punctatum* Rafinesque
Myctophinae

- | | | |
|---------------------|---|---|
| Morphology | <ul style="list-style-type: none"> — Body elongate. — Snout pointed, flat and broad. — Eyes narrow, stalked, with tapered choroid mass. — Large, broad pectoral fins on fan-shaped base. — Pelvic fin buds form at about 10 mm. — Flexion occurs at about 7.0 mm, and transformation at 21–22 mm. | Meristic features |
| | | <ul style="list-style-type: none"> Vert: 40 D : 13–14 A : 20–22 P : 13–14 |
| Photophores | <ul style="list-style-type: none"> — Only Br₂ forms during larval stage; others form at metamorphosis. | |
| Pigmentation | <ul style="list-style-type: none"> — Melanophores in caudal region are characteristic. — Preanal series of spots from anus to head. — Pigment often on posterior rays of dorsal, anal and adipose fins; spots at base of pectoral fin and a few along the rays. — Rows of spots on edges of upper and lower jaws, and spots on upper edge of opercle. | |
| Distribution | <ul style="list-style-type: none"> — Subpolar-temperate. | |
- Note:**
- (1) There is evidence that *M. punctatum* does not reproduce in the western Atlantic (Zurbrigg and Scott, 1972).
 - (2) *Myctophum affine* is similar to *M. punctatum* and *M. nitidulum* (p. 118), but larvae undescribed.



Fig. — A-B, D-F, Tåning 1918; C, Moser and Ahlstrom 1974.

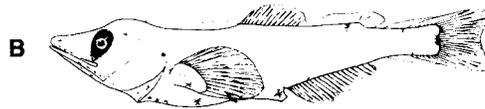
Myctophum punctatum

MYCTOPHIDAE



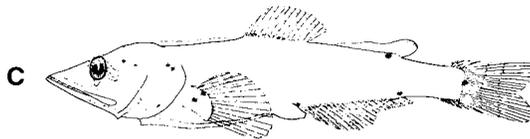
5.7 mm SL

Ventral spots disappear
in later stages

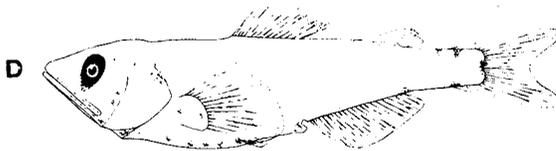


10.5 mm SL

Dorsal edge pigment
near adipose fin



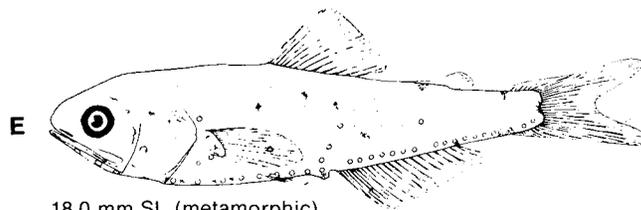
13.6 mm SL



16.0 mm SL

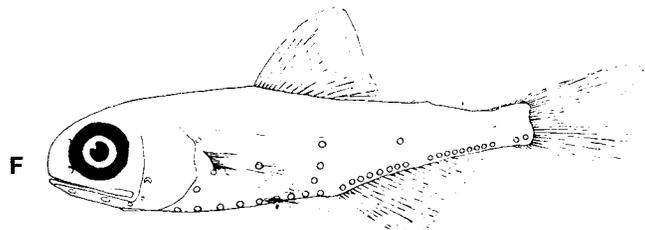
Prominent spot at mid-caudal base

Spots on dorsal and ventral
edge of peduncle



18.0 mm SL (metamorphic)

Eye round, but much larval pigment remains



Adult

MYCTOPHIDAE
Myctophinae

***Myctophum nitidulum* Garman**

- Morphology** — Body deeper than *M. punctatum*, but slimmer than other Atlantic *Myctophum* species.
 — Head massive and broad; eyes stalked with large cone of choroid tissue (53–56% of eye length).
 — Large, broad pectoral fin on fan-shaped base.
 — Anterior two-thirds of gut large and posterior one-third small; gut length 50% SL, increasing to 60–68% SL at flexion.
 — Flexion occurs at 6.5–7.0 mm, and transformation at 11.7–14.7 mm.

Meristic features

Vert: 37–39
 D : 13–14
 A : 19–20
 P : 13–14

- Ossification** — Sizes at beginning of ossification and completion of fin rays and vertebrae:

Pectoral rays	4.0 mm	5.0 mm
Primary caudal rays	5.0	6.0
Anal rays	6.9	8.2
Dorsal rays	6.9	11.3
Pelvic rays (buds at 6.0 mm)	8.4	11.3
Vertebrae	...	11.3

- Photophores** — Only Br₂ forms during larval stage (at about 7.0 mm).
Pigmentation — Spots on dentaries, branchiostegals, head, opercle, pectoral fins, tail, base of caudal fin, and ventral gut surface.
Distribution — Tropical-subtropical.

Comparison of Three Other *Myctophum* Species

Species	Body	Head	Eyes	Choroid mass	Photophore formation
<i>M. asperum</i> ^a Richardson	Rotund	Broad	Large, unstalked	Short	Dn at 4.6 mm PLO at 9.8
<i>M. obtusirostre</i> ^a Tåning	Rotund	Broad	Large, unstalked	Short	Dn at 4.0 mm PLO at 7.1 PO ₁ at 8.9
<i>M. selenops</i> ^b Tåning	Rotund	Longer and narrower	Slightly stalked	Narrower and more	Dn at 5.1 mm PLO at 6.2 PO ₁ at 7.5

^a Tropical

^b Tropical-subtropical

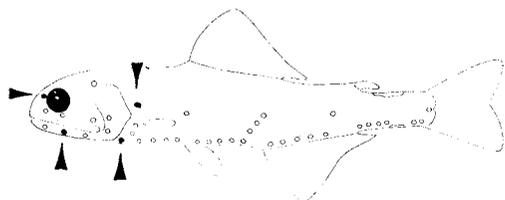
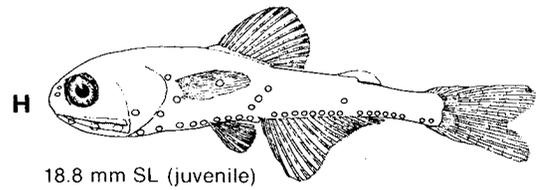
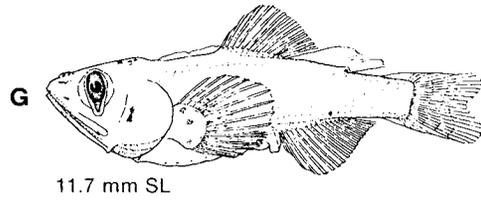
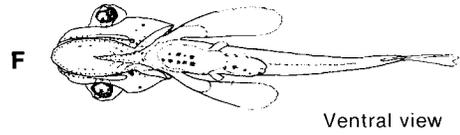
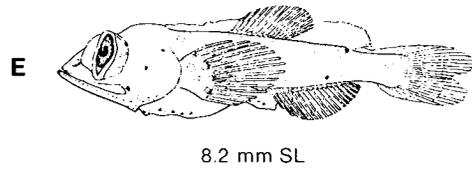
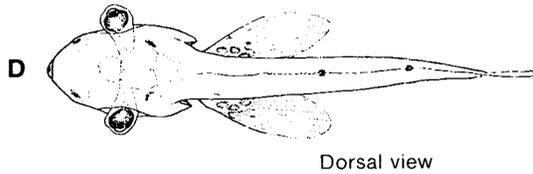
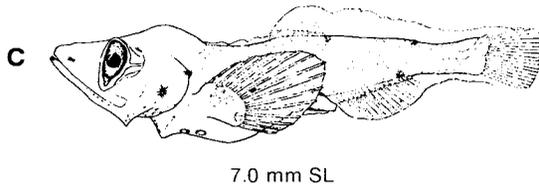
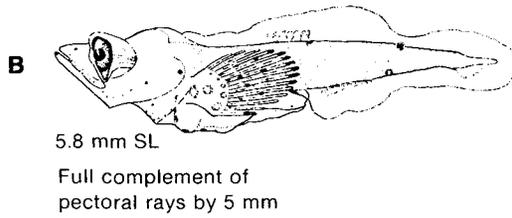
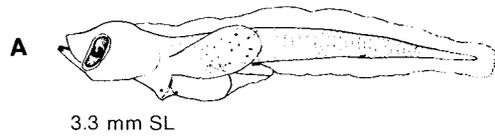


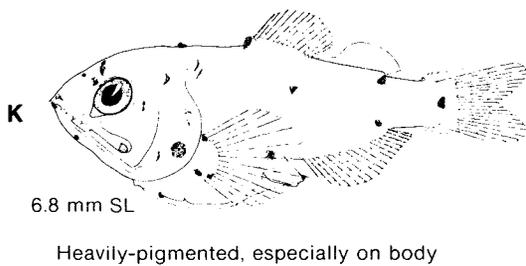
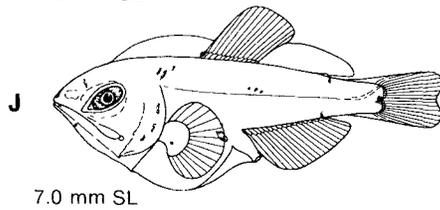
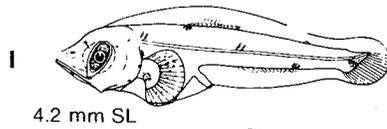
Fig. — A–H, Moser and Ahlstrom 1970; I–J, Pertseva-Ostroumova 1974; K–M, Moser and Ahlstrom 1974.

Myctophum nitidulum

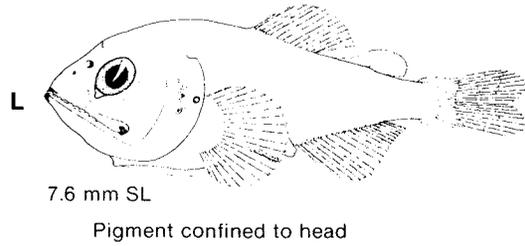
MYCTOPHIDAE



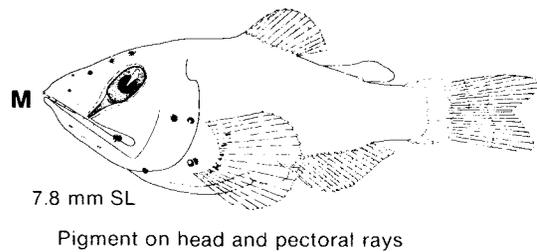
Myctophum asperum



Myctophum obtusirostre



Myctophum selenops



MYCTOPHIDAE ***Symbolophorus veranyi* (Moreau)**
Myctophinae

Morphology	<ul style="list-style-type: none"> — Moderately elongate body. — Narrow eyes on short stalks; small cone of choroid tissue. — Snout pointed; flat in small larvae. — Large pectoral fins with elongate bases; fins extend beyond anus. — Transforms at about 20 mm. 	Meristic features
		Vert : 39-40 D : 12-14 A : 21-23 P : 12-13
Ossification	— Dorsal rays not yet completely ossified at 17 mm.	
Photophores	— Only Br ₂ forms during larval stage (at about 12 mm).	
Pigmentation	<ul style="list-style-type: none"> — Few preanal ventral spots. — Large spot on posterior edge of opercle; spots on tip of snout and lower jaw. — Pigment on pectoral rays (heavier at bases). — Pigment decreases toward end of larval period. 	
Distribution	— Temperate.	

Note: *Symbolophorus rufinus* (Tåning), larvae undescribed, also occurs in the western North Atlantic. Larvae of the two species may differ in sequence of pelvic fin-ray formation.

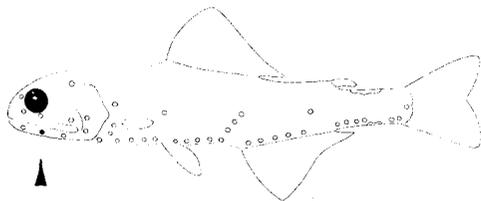
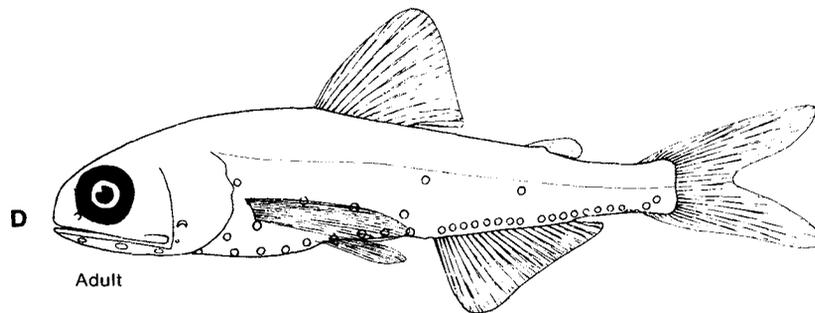
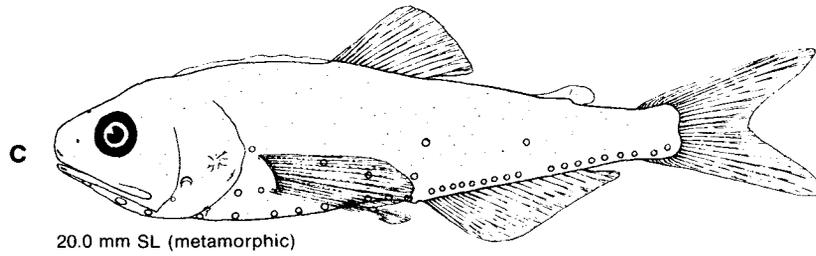
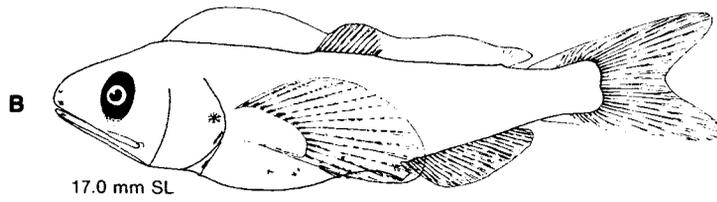
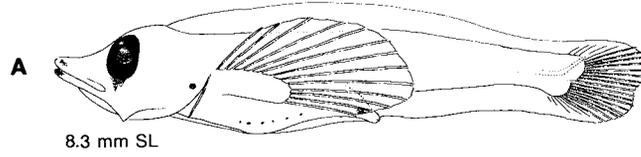


Fig. — A-D, Tåning 1918 (A, redrawn), described as *Myctophum humboldti*.

Symbolophorus veranyi

MYCTOPHIDAE



MYCTOPHIDAE *Diogenichthys atlanticus* (Tåning)
Myctophinae

- Morphology** — Body slender in small larvae: body depth increases from 11–13% SL during preflexion to 28% SL in late larvae.
- Eye slightly oval, with no opaque choroid mass.
- Head wedge-shaped; length increases from 21–22% SL at 3 mm to 33% SL at 8–9 mm, and then decreases to 28% SL at 14 mm.
- Gut uniform in diameter when small, conical in older larvae; length increases from 50% SL to 60% SL after flexion.
- Gap between anus and anal fin origin until about 9 mm.
- Barbel on lower jaw present from about 5 mm until transformation.
- Flexion occurs at 6–7 mm, and transformation at 14–15 mm.

Meristic features

Vert : 32–35
 D : 11–12
 A : 15–16
 P : 12–13

- Ossification** — Sizes at beginning of ossification and completion of fin rays:

Pectoral rays	6.0 mm	9.0 mm
Primary caudal rays	6.0	7.0
Anal rays	6.0	7.6
Dorsal rays	8.0	10.0
Pelvic rays (buds at about 7 mm)	8.0	12.0

- Photophores** — Size of larvae when formation begins and location:

Br ₂	~6.0	Postero-ventral margin of orbit
PO ₂	7.0	Under pectoral base.
PO ₅	8.5	Anterior to pelvic fins.
AO _{a1}	~11.0	Posterior to anus.
Br ₃ , PO ₁ , PO ₃	...	(May begin to form just before transformation)

- Pigmentation** — Spots on anal rays, at base of pectoral rays, and at base of caudal rays.
- Large spot on side of trunk over end of gut.
- Spots on ventral midline of tail and along anal fin base increase in number during larval development.
- Single spots form on dorsal midline, posterior to dorsal fin and posterior to adipose fin, at about 7 mm.

- Distribution** — Tropical-subtropical.

Note: Differences in developmental rates of 5 mm larvae (Fig. C, K and N) due to geographic variation.

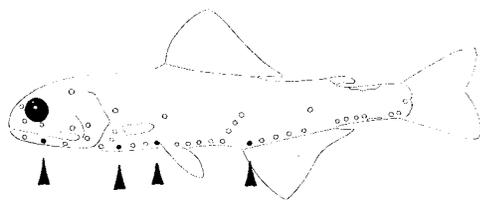
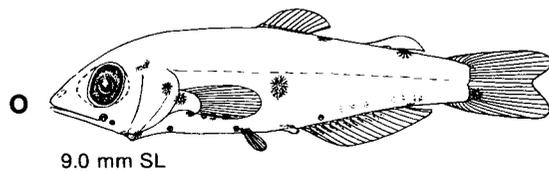
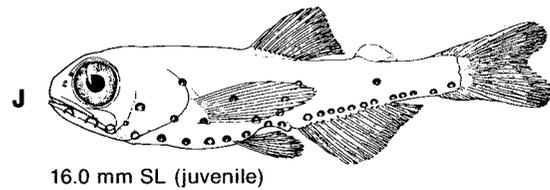
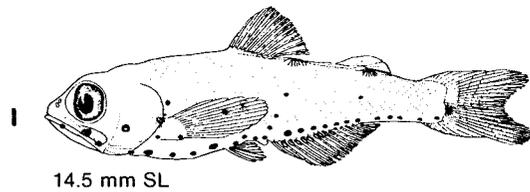
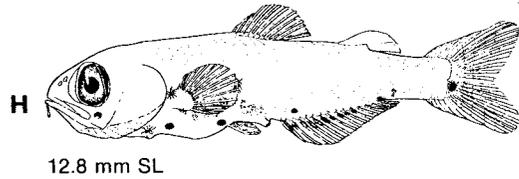
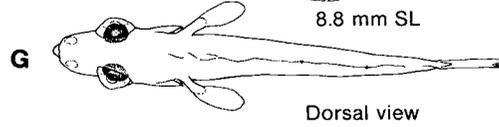
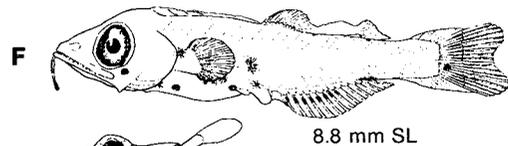
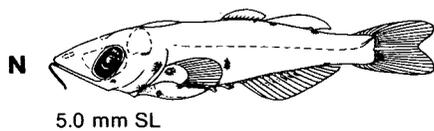
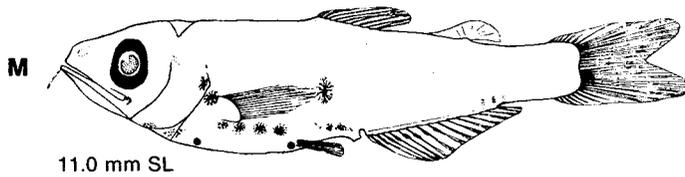
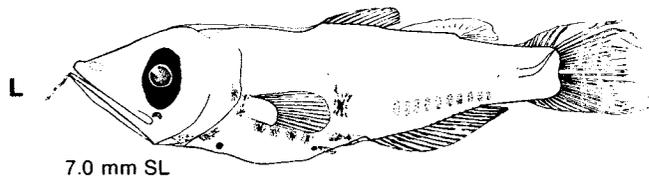
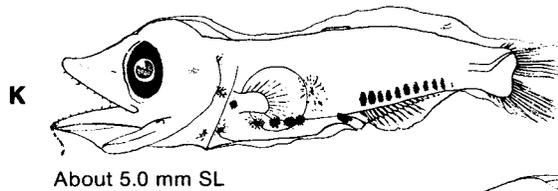
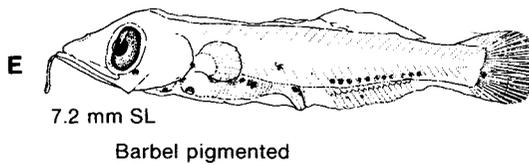
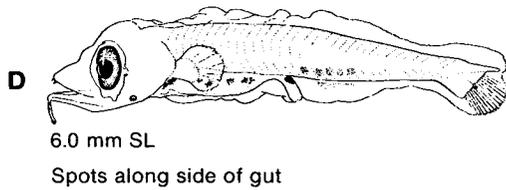
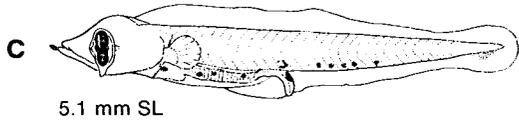
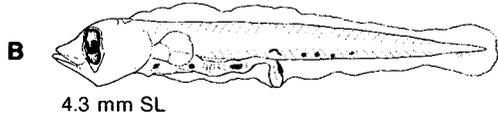
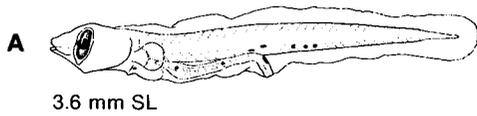


Fig. — A–J, Moser and Ahlstrom 1970; K–M, Tåning 1918; N–O, Pertseva-Ostroumova 1974.

Diogenichthys atlanticus

MYCTOPHIDAE



MYCTOPHIDAE ***Benthoosema glaciale* (Reinhardt)**
Myctophinae

- | | | |
|---------------------|---|---|
| Morphology | <ul style="list-style-type: none"> — Gap between anus and anal fin origin closes at about 8 mm. — Flexion occurs at 5–7 mm, and transformation at about 11 mm. | Meristic features |
| | | Vert : 34–36
D : 12–14
A : 17–19
P : 11–13 |
| Ossification | — Dorsal and anal fin rays complete at about 11 mm. | |
| Photophores | — In addition to Br ₂ , late larvae develop Br ₁ , OP ₂ and PO photophores; AO _a may develop before transformation. | |
| Pigmentation | <ul style="list-style-type: none"> — Spot at posterior edge of opercle; spots at tip of snout and lower jaw. — Three ventral spots from cleithral symphysis to anus. — Ventral spots on tail reduce to 1 faint spot over middle of anal fin at 11 mm; pectoral rays pigmented. — Spot near developing Br₂. | |
| Distribution | — Subpolar-temperate. | |

***Benthoosema suborbitale* (Gilbert)**

- | | | |
|---------------------|--|--|
| Morphology | <ul style="list-style-type: none"> — Anus-anal fin gap and size at transformation similar to <i>B. glaciale</i>. | Meristic features |
| | | Vert : 34
D : 11–14
A : 16–17
P : 12–14 |
| Photophores | — Sequence of development: Br ₂ , PO ₁ , PO ₂ , Br ₁ and Br ₃ . | |
| Pigmentation | <ul style="list-style-type: none"> — No ventral pigment. — See note on <i>Hygophum hygomii</i> (p. 112) regarding pigment on ventral surface of head, and illustration at right. | |
| Distribution | — Tropical-subtropical. | |



Badcock and Merrett 1976

Generic Characters

- Larvae**
- Some photophore development in larvae.
 - Oval eye with lunate choroid mass.
 - Gap between anus and anal fin origin.
 - Transformation occurs at relatively small size.

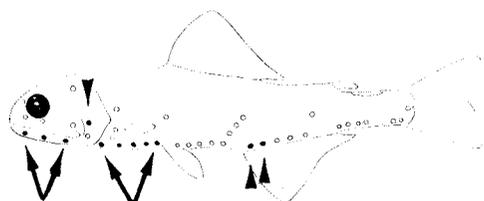
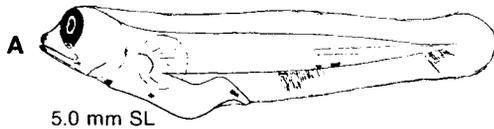


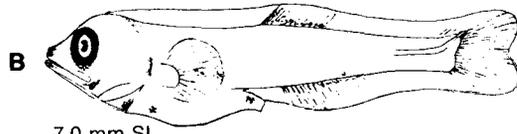
Fig. — A-B, D, F-G, Tåning 1918; C, E, K, Moser and Ahlstrom 1974; H-J, Pertseva-Ostroumova 1974 (redrawn).

Benthoosema glaciale

MYCTOPHIDAE



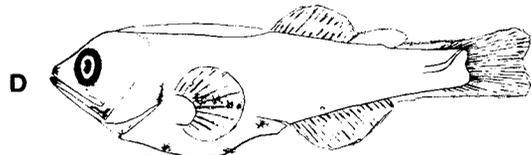
5.0 mm SL



7.0 mm SL



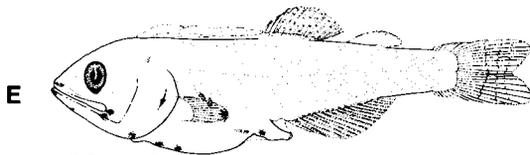
7.2 mm SL



9.0 mm SL

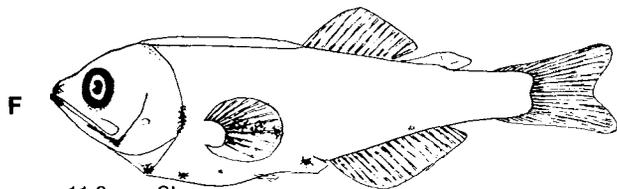
Pigmented pectoral rays

Spot at posterior edge of opercle



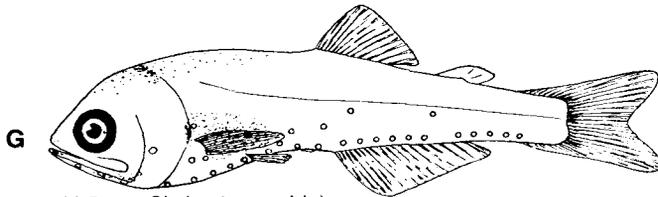
10.5 mm SL

Pigment at tips of snout
and lower jaw



11.0 mm SL

3 preanal spots, and faint
spot over mid-anal fin



11.5 mm SL (metamorphic)

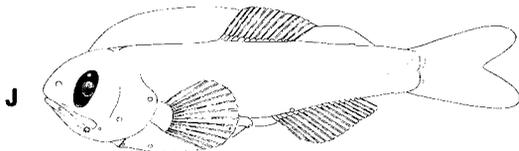
Benthoosema suborbitale



4.9 mm SL



6.4 mm SL



8.0 mm SL



9.2 mm SL

MYCTOPHIDAE
Myctophinae

***Loweina rara* (Lütken)**

- Morphology** — Large oval eyes, no opaque choroid mass.
— Posteriorly-placed median fins and large finfold.
— Elongate lower pectoral fin rays, with pigmented spatulate process on distal end.
— Long gut, increasing from 54–57% SL in small larvae to 70% SL at flexion and to 80% SL prior to transformation.
— Flexion occurs at 8–11 mm, and transformation at about 20 mm (large).
- Meristic features**
Vert: 37–39
D : 11–13
A : 15–16
P : 10–12
- Ossification** — Sizes at beginning of ossification and completion of fin rays:
- | | | |
|---------------------------------------|--------|--------|
| Pectoral rays (6 more than in adults) | 4.6 mm | 8.4 mm |
| Primary caudal rays | 7.5 | 8.8 |
| Anal rays | 8.8 | 11.0 |
| Dorsal rays | 9.3 | 11.0 |
| Pelvic rays (buds at 8.5 mm) | 15.7 | >20 |
- Photophores** — Br₂ forms at corner of jaw in 11 mm larvae; other photophores form after transformation.
- Pigmentation** — Transverse band across brain between eyes.
— Spot medial to pectoral base and one on mid-isthmus (2 spots may join in some larvae 7 to 12 mm).
- Distribution** — Tropical-subtropical.

***Gonichthys cocco* (Cocco)**

- Morphology** — Head and body deep and laterally-compressed.
— Small narrow eyes, with elongate choroid tissue.
— Snout flat at 5 mm (becomes rounded).
— Flexion occurs at 5.0–7.5 mm.
- Meristic features**
Vert: 40–41
D : 11–12
A : 20–23
P : 13–15
- Ossification** — All median fin rays formed by 7.5 mm.
- Photophores** — Only Br₂ forms during larval stage.
- Pigmentation** — Large spot at base of caudal fin, and some pigment on caudal rays and pectoral rays.
— Few small ventral spots anterior to anus.
— See illustrations for other pigment.
- Distribution** — Tropical-subtropical.

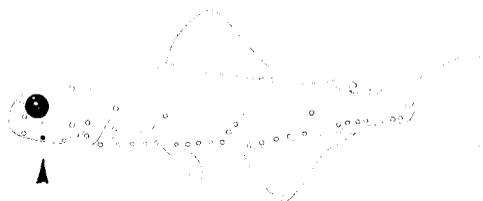


Fig. — A–H, Moser and Ahlstrom 1970; I–K, Tåning 1918.

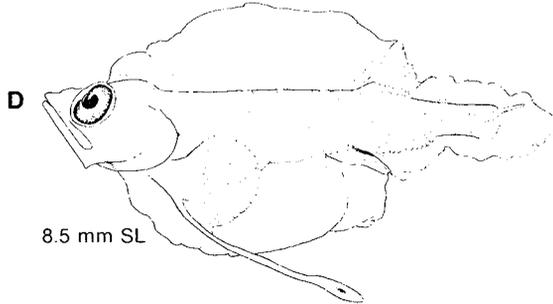
Loweina rara

MYCTOPHIDAE



4.8 mm SL

Gut ends in free, terminal section



8.5 mm SL

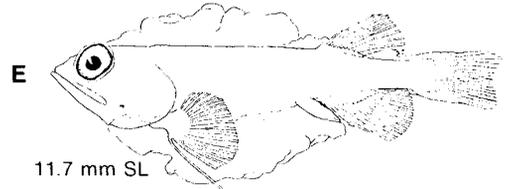


6.8 mm SL



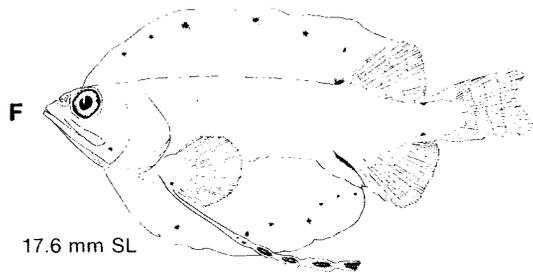
dorsal view

2 dorsal, 1 ventral blotch on tail

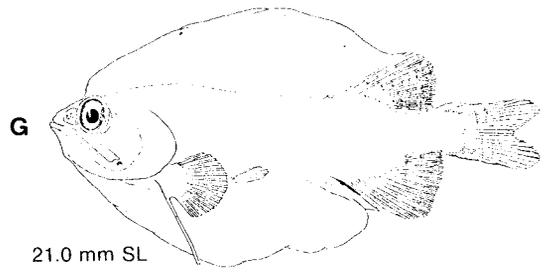


11.7 mm SL

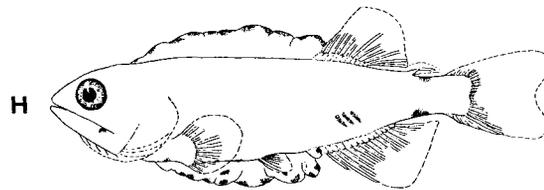
Finfold often pigmented and pigment on dorsal, terminal end of gut



17.6 mm SL

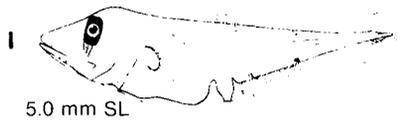


21.0 mm SL

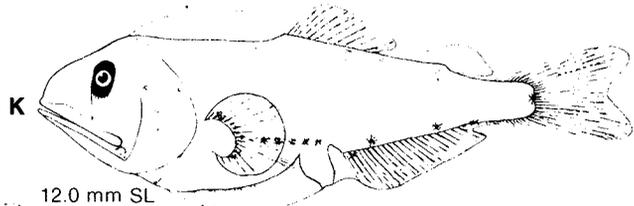


20.0 mm SL (metamorphic)

Gonichthys cocco

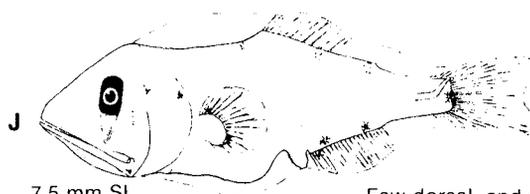


5.0 mm SL



12.0 mm SL

Diffuse internal abdominal pigment and row of external spots anterior to anus



7.5 mm SL

Small spot on anterior anal fin base

Few dorsal, and 2-3 ventral accumulations of pigment over anal fin

MYCTOPHIDAE *Lampadena urophaos atlantica* Maul
Lampanyctinae

- Morphology** — Body moderately slender.
Photophores — Develop early in the larval stage, with Br₂, PLO and PO₅ appearing first, followed by Vn and PO₁.
Pigmentation — Dorsal row of spots from dorsal fin origin to peduncle; ventral row of spots from anal fin origin to peduncle.
Distribution — Subtropical.

Meristic features

Vert : 36-38
 D : 15-16
 A : 14
 P : 16-17

Lampadena luminosa (Garman)

- Morphology** — Body shape similar to *L. urophaos atlantica*.
Photophores — Development similar to *L. urophaos atlantica*.
Pigmentation — Dorsal and ventral pigment similar to *L. urophaos atlantica* but originates at posterior ends of dorsal and anal fins.
Distribution — Tropical-semisubtropical.

Meristic features

Vert : 36-37
 D : 14-15
 A : 13-15
 P : 15-17

Taaningichthys minimus (Tåning)

- Morphology** — Body more slender than *Lampadena*.
Photophores — No photophores in larvae until Br₂ forms just before transformation (about 18 mm); PO₅ forms at about 19.3 mm.
Pigmentation — Pigment similar to that in *Lampadena*; internal pigment above vertebral column in small larvae.
Distribution — Subtropical; larvae are neustonic.

Meristic features

Vert : 40-41
 D : 11-13
 A : 11-14
 P : 15-17

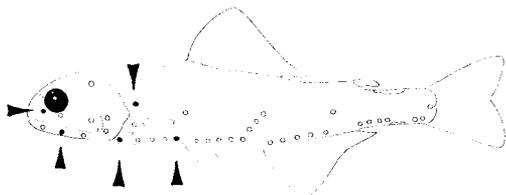
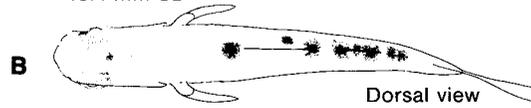


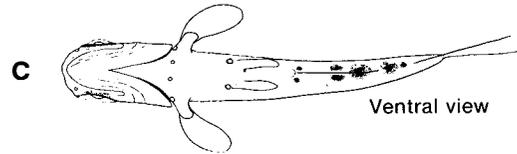
Fig. — A-D, F-H, Moser and Ahlstrom 1972; E, Moser and Ahlstrom 1974.

Lampadena urophaos atlantica**MYCTOPHIDAE**

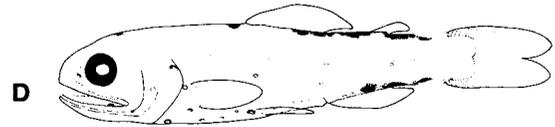
13.4 mm SL



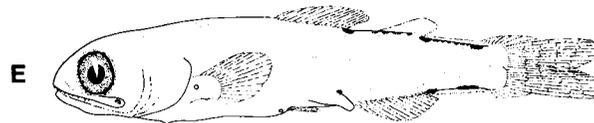
Dorsal view



Ventral view



19.6 mm SL (metamorphic)

Lampadena luminosa

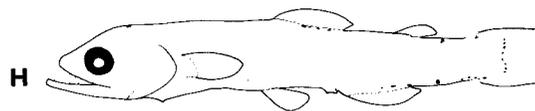
12.8 mm SL

Taaningichthys minimus

7.3 mm SL



Dorsal view



14.4 mm SL

MYCTOPHIDAE ***Bolinichthys supralateralis* (Parr)**
Lampanyctinae

Morphology	— Body rather stubby and deeper than <i>Lepidophanes</i> .	Meristic features
Photophores	— Very small; Br ₂ , Vn, PLO and PO ₅ form sequentially in some species of the genus whereas only Br ₂ forms in others.	Vert : ? D : 13-15 A : 13-15 P : 13-14
Pigmentation	— Sparse.	
Distribution	— Tropical-subtropical.	

***Lepidophanes guentheri* (Goode and Bean)**

Morphology	— Body elongate.	Meristic features
Photophores	— Br ₂ forms first, followed by Vn, PLO and PO ₅ which form about simultaneously; OP ₁ and OP ₂ form just before transformation.	Vert : ? D : 13-15 A : 14-15 P : 12-13
Distribution	— Tropical.	

***Lepidophanes gaussi* (Brauer)**

Morphology	— Body elongate.	Meristic features
Photophores	— Very small; Br ₂ forms first, followed by Vn, PLO and PO ₅ which form about simultaneously; OP ₁ and OP ₂ form just before transformation.	Vert : ? D : 13-14 A : 13-15 P : 12-13
Pigmentation	— Present on nape, on dorsal and ventral midlines of peduncle, and internally on posterior half of vertebral column.	
Distribution	— Subtropical.	

Note: *L. guentheri* and *L. gaussi* are superficially similar to *Ceratoscopelus maderensis* (p. 132), but they develop more quickly and transform at smaller size.

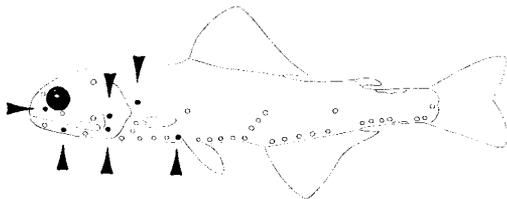
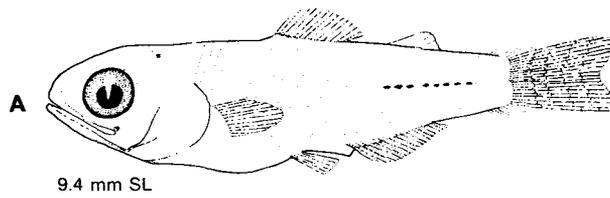


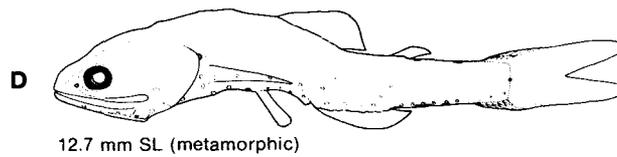
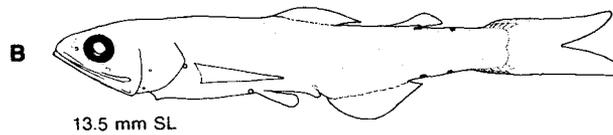
Fig. — **A, E**, Moser and Ahlstrom 1974; **B-D**, Moser and Ahlstrom 1972.

Bolinichthys supralateralis

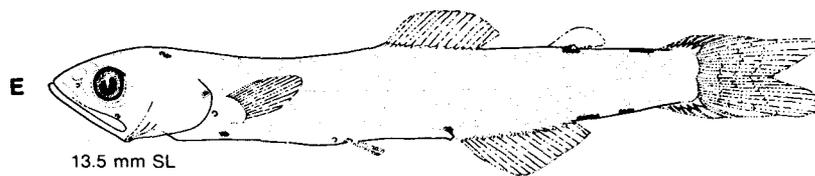
MYCTOPHIDAE



Lepidophanes guentheri



Lepidophanes gausi



MYCTOPHIDAE ***Ceratoscopelus maderensis* (Lowe)**
Lampanctinae

- | | | |
|---------------------|--|---|
| Morphology | <ul style="list-style-type: none"> — Body elongate. — Sliver of choroid tissue under eye. — Flexion occurs at about 6 mm, and transformation at about 16 mm. | Meristic features |
| | | <ul style="list-style-type: none"> Vert : 35-38 D : 13-14 A : 13-15 P : 13-14 |
| Ossification | — All fin rays formed by about 16.5 mm. | |
| Photophores | — Very small; Br ₂ , Vn, PLO and PO ₅ formed between 7 and 11 mm. | |
| Pigmentation | <ul style="list-style-type: none"> — At 5 mm, a series of small spots extends from anus to the larger spots on the ventral peduncle. — There are 3 or 4 larger spots on dorsal and ventral midlines of peduncle. — Few faint spots on occipital, abdomen and sides of anus. | |
| Distribution | — Temperate-semisubtropical. | |
| Note: | <i>Ceratoscopelus warmingi</i> (Lütken) is similar but lacks dorsal pigment on peduncle except a few spots possibly embedded near tip of notochord; distribution is tropical-subtropical. (See Fig. H opposite.) | |

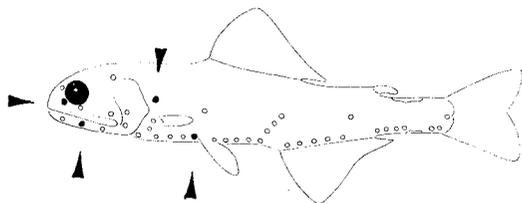
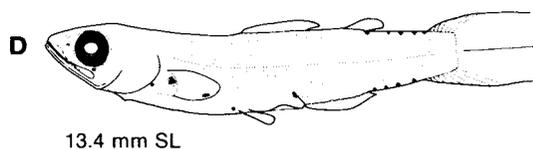
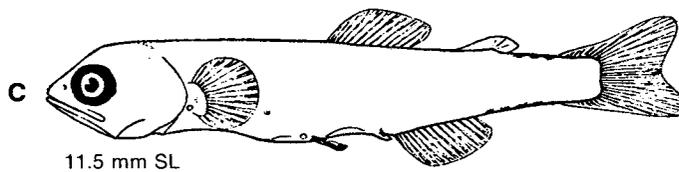
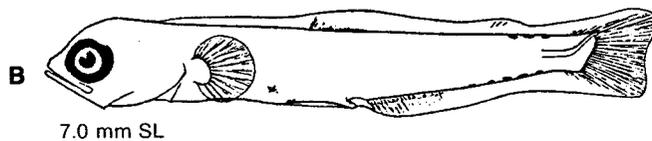
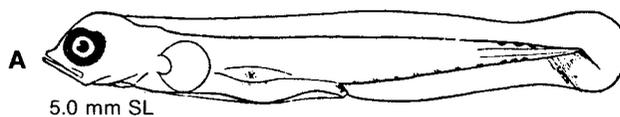


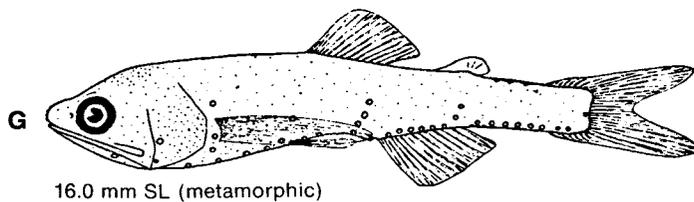
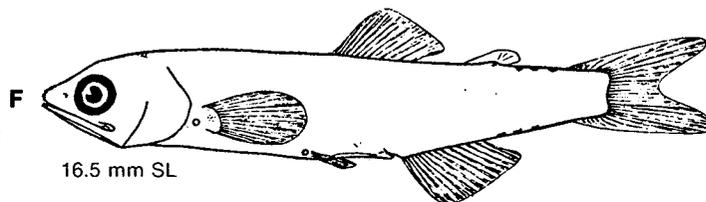
Fig. — A-C, F-G, Tåning 1918; D-E, Moser and Ahlstrom 1972; H, Miller *et al.* 1979.

Ceratoscopelus maderensis

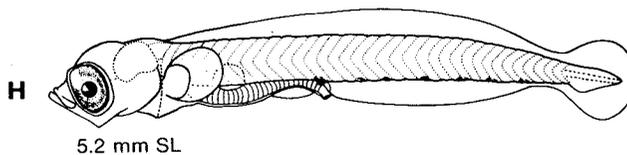
MYCTOPHIDAE



Snout lengthens throughout development



Ceratoscopelus warmingi



H (Pacific specimen)

MYCTOPHIDAE ***Lampanyctus pusillus* (Johnson)**
Lampanyctinae

Morphology	— Body short and stocky. — Eyes round, with no choroid tissue. — Transformation occurs at about 12 mm.	Meristic features Vert : 32-34 D : 12-13 A : 14-16 P : 13-15
Ossification	— All fin rays formed by 10 mm.	
Pigmentation	— Occipital spots (1 or 2) not distinct in figures. — Spots on gill cover, snout and lower jaw tip, and small spots (some internal) over abdomen. — Row of dorso-lateral spots and row of preanal spots develop.	
Distribution	— Temperate-semisubtropical.	

***Lampanyctus crocodilus* (Risso)**

Morphology	— Body more elongate than <i>L. pusillus</i> . — Eyes round, with no choroid tissue. — Transformation occurs at 19-22 mm.	Meristic features Vert : 36-37 D : 13-15 A : 17-18 P : 14-16
Ossification	— All fin rays formed by 19 mm.	
Pigmentation	— Pigment follows myosepta above pectoral base. — Spot on anus and occiput remain through larval development.	
Distribution	— Temperate-semisubtropical.	

Generic Characters

Morphology	— Deep-bodied with large head; jaws in some species elongate with prominent teeth. — Abrupt transformation from larvae to juveniles.
Photophores	— Br ₂ only photophore formed in the larval period.
Pigmentation	— Pigment in older larvae may develop in several locations: lower jaw tip, between eyes, back of head, side of head, adipose fin, pectoral fin, along myosepta, and in cleithral region (internal).

- Note:** (1) There are 13 species of *Lampanyctus* in the western North Atlantic.
(2) *L. pusillus* was described as *L. alatus* by Tåning (1918).

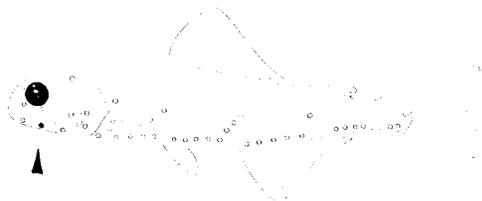
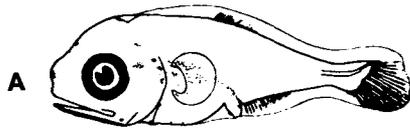


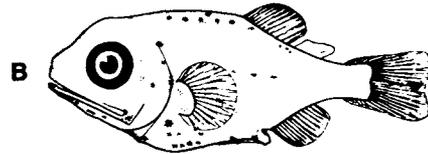
Fig. — A-K, Tåning 1918.

Lampanyctus pusillus

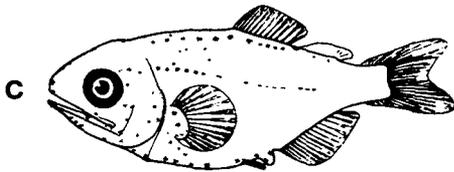
MYCTOPHIDAE



5.0 mm SL

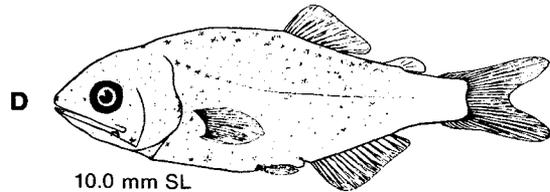


6.5 mm SL



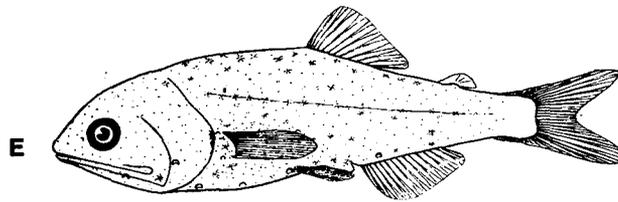
8.5 mm SL

Midlateral line of spots



10.0 mm SL

Usually a large spot between dorsal and adipose fins



12.0 mm SL (metamorphic)

Lampanyctus crocodilus



5.5 mm SL

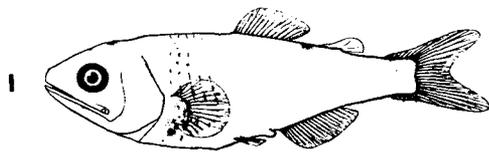


Dorsal view

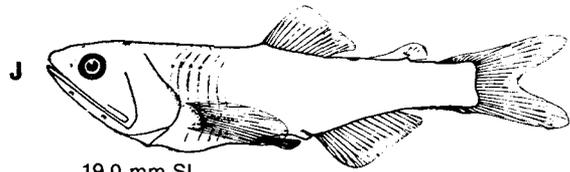


8.0 mm SL

Large spot between dorsal and adipose fins

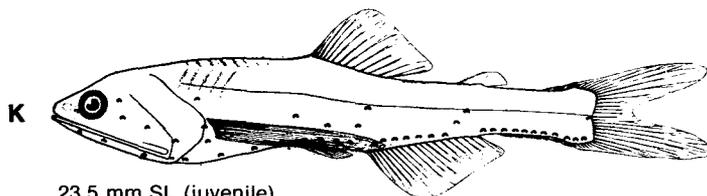


14.0 mm SL



19.0 mm SL

Several spots on pectoral base and rays



23.5 mm SL (juvenile)

MYCTOPHIDAE
Lampanyctinae

***Lobianchia dofleini* (Zugmayer)**

Morphology	— Body short and stocky; large pectoral fin. — Eyes small, slightly oval, with some choroid tissue. — Flexion occurs at about 5–6 mm, and transformation at 10–11.	Meristic feature
Ossification	— All fin rays complete by 11.5 mm; larvae have 17–19 pectoral fin rays, adults have 11–13.	Vert : 33–35 D : 15–17 A : 13–15 P : 11–13
Photophores	— PO ₁ may form at about 7 mm.	
Pigmentation	— Several scattered spots preanally and on anus. — Spots scattered below dorsal fin and above bases of pectoral and anal fins. — Several spots on pectoral fin base and along the rays.	
Distribution	— Temperate-semisubtropical.	

***Lobianchia gemellarii* (Cocco)**

Morphology	— Body short and stocky; long upper pectoral rays. — Eyes round. — Flexion occurs at about 5–6 mm, and transformation at about 14 mm.	Meristic features
Ossification	— All fin rays complete by 10 mm.	Vert : 36 D : 17–18 A : 13–15 P : 11–12
Photophores	— Br ₂ , PO ₁ , and PO ₅ are discernible at about 8 mm.	
Pigmentation	— Spot on anus and often at cleithral symphysis. — Spot at posterior anal fin base and two prominent spots at caudal base. — Spots at pectoral base, more prominent in smaller larvae.	
Distribution	— Tropical-subtropical.	

Generic Characters

Morphology	— Deep-bodied with large head. — Characteristic pectoral fin shape.
Pigmentation	— Heavily pigmented in pectoral fin area.
Photophores	— Br ₂ , PO ₁ and PO ₅ develop in the larval period.

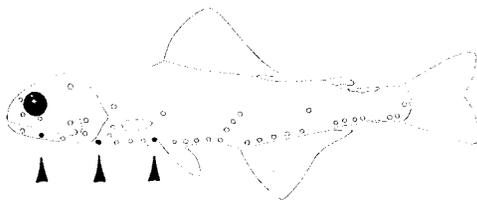
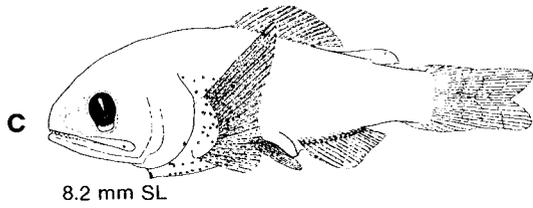
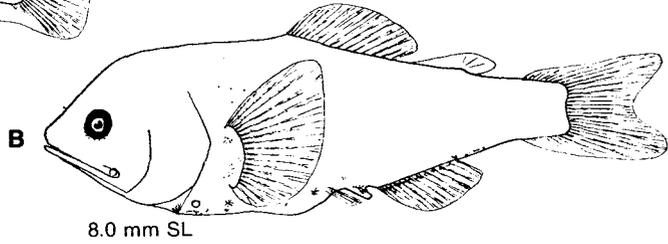
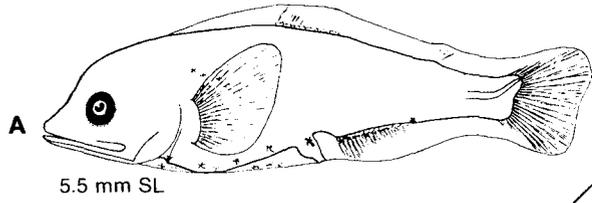


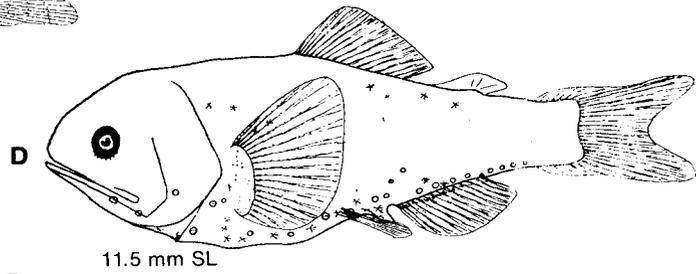
Fig. — A–B, D–G, I–J, Tåning 1918; C, H, Moser and Ahlstrom 1974.

Lobianchia dofleini

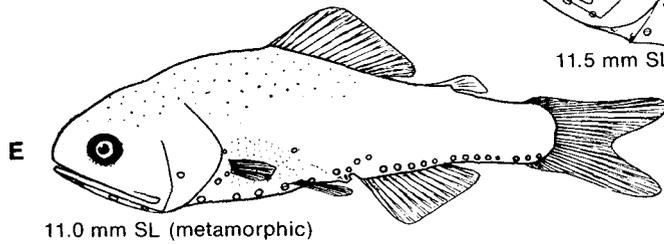
MYCTOPHIDAE



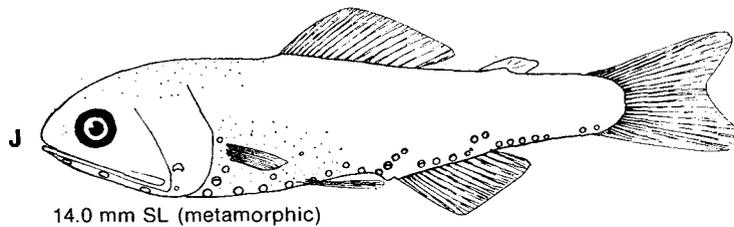
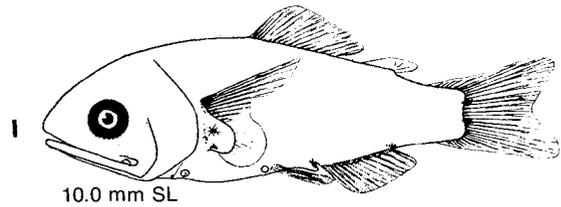
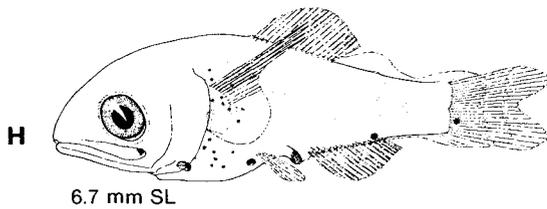
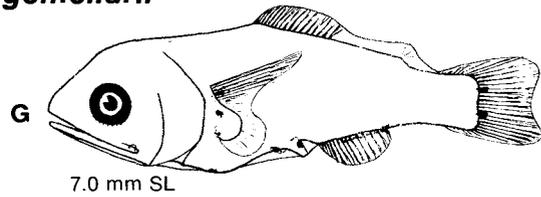
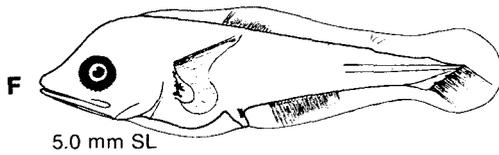
Reduction in pectoral fin size and ray number at metamorphosis



Spots at cleithral symphysis



Lobianchia gemellarii



MYCTOPHIDAE
Lampanyctinae

***Diaphus rafinesquii* (Cocco)**

- Morphology** — Body slender, with round eye.
— Flexion occurs at 4.5–6.0 mm, and transformation at about 10 mm.
- Ossification** — All fin rays complete by 9.5 mm.
- Photophores** — Br₂ and PO₅ visible at about 7 mm.
- Pigmentation** — Faint spot at anus; strong spot at posterior anal-fin base; two spots at caudal base.
- Distribution** — Temperate-semisubtropical.

Meristic features

Vert: 33–34
D : 13–14
A : 13–15
P : 10–11

***Diaphus holti* Tåning**

- Morphology** — Body slender, with round eye.
— Flexion occurs <5 mm, and transformation at 10–11 mm.
- Ossification** — All fin rays complete by 10 mm.
- Photophores** — Br₂, PO₁ and PO₅ begin formation at about 7 mm and are complete at 10 mm.
- Pigmentation** — Spot at anus and cleithral symphysis; row of spots along anal fin base and ventral midline of tail.
— Single, large spot on lower half of caudal fin base.
- Distribution** — Eastern Atlantic.

Meristic features

Vert: 32–34
D : 13–14
A : 12–14
P : 10–12

Generic Characters

- Morphology** — Two types: (1) slender body, small head, and series of melanophores on ventral midline of tail; (2) deeper body, bulbous head, and single persistent tail spot (or none).
- Photophores** — More photophores develop in larval period than in any other myctophid genus (i.e. Br₂, PO series, VO₁, VO₅, OP₂, VLO and PVO).
- Pigmentation** — Embedded spots common at base of caudal fin; pigment rarely on head and never between eyes.

Note: There are 23 species of *Diaphus* in western North Atlantic.

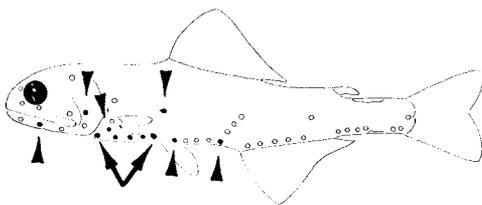
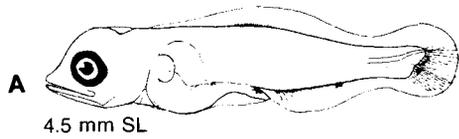


Fig. — A–H, Tåning 1918 (D, E and F redrawn).

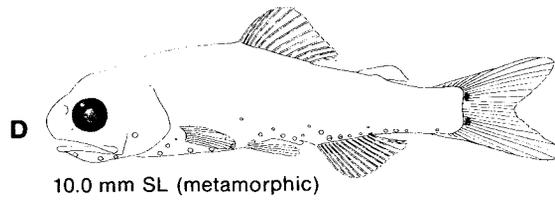
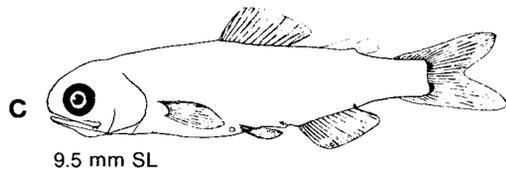
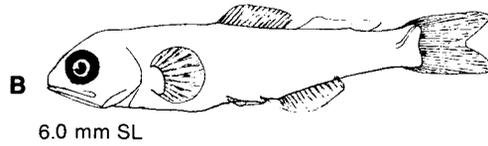
Ref. — Moser and Ahlstrom 1974.

Diaphus rafinesquii

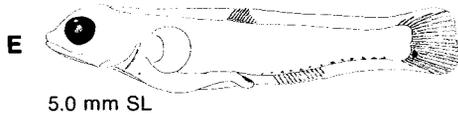
MYCTOPHIDAE



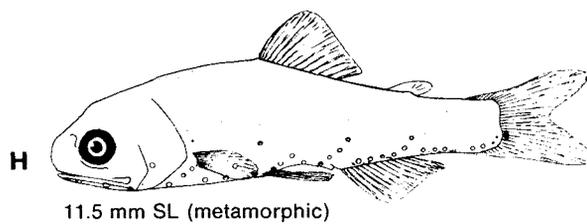
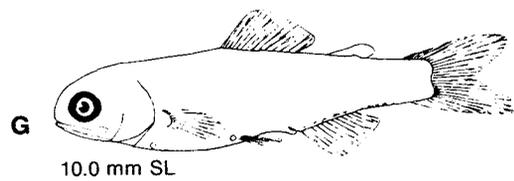
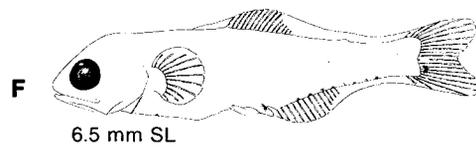
Pigment spots more prominent in smaller larvae



Diaphus holti



Pigment spots more prominent in smaller larvae



MYCTOPHIDAE *Notoscopelus resplendens* (Richardson)
Lampanyctinae

Morphology	<ul style="list-style-type: none"> — Body stout and tapering posteriorly; head blunt after flexion. — Dorsal fin base longer than anal fin base. — Flexion occurs at about 5 mm NL to 6 mm SL. 	Meristic features
		<ul style="list-style-type: none"> Vert: 36-37 D : 21-23 A : 18-20 P : 12-13
Ossification	<ul style="list-style-type: none"> — Dorsal and anal fin bases visible before flexion; 3-4 more dorsal rays than anal rays (equal number in most lampanyctines). — Pelvic rays begin forming at about 7 mm, and all fin rays complete at 9.8 mm SL. 	
Photophores	<ul style="list-style-type: none"> — Br₂ forms before flexion, PO₅ appears by 7 mm SL, Vn forms at about 9.8 mm SL, followed by PLO. 	
Pigmentation	<ul style="list-style-type: none"> — Formed before flexion (retained during larval development): spots on tips of lower jaw and snout; spot embedded on forehead, on anus, under opercle edge (near pectoral fin base), on posteroventral surface of brain; few spots on anterior lateral midline; peritoneum pigmented. — Formed during flexion: spots along dorsal fin base, and along anal fin base. — Formed after flexion: spots on head increase; vertical pigment at caudal fin base at about 11 mm SL; dorsal pigment may extend from nape to caudal peduncle. — Note difference in dorsal melanophores in larvae caught day and night (Fig. I and J). 	
Distribution	<ul style="list-style-type: none"> — Tropical-subtropical. 	

Note: Distribution of *Notoscopelus caudispinosus* (larvae undescribed) in the western North Atlantic is similar to that of *N. resplendens*.

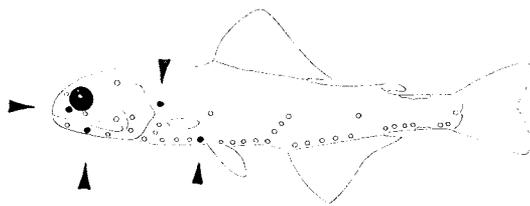
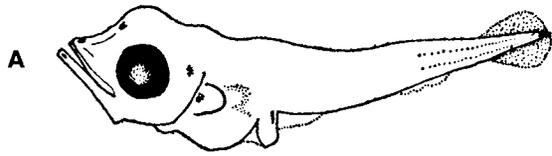


Fig. — **A-D, I-J**, Badcock and Merrett 1976; **E**, Moser and Ahlstrom 1974; **F-H**, Moser and Ahlstrom 1972.

Notoscopelus resplendens

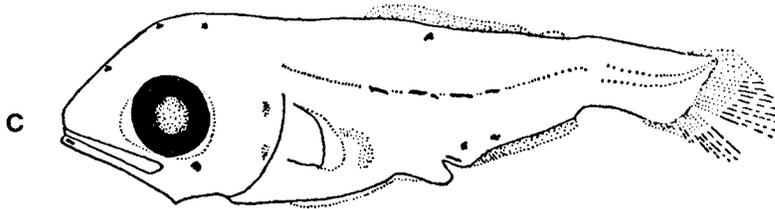
MYCTOPHIDAE



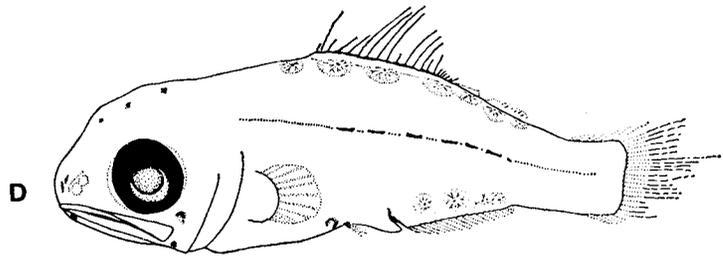
3.8 mm NL



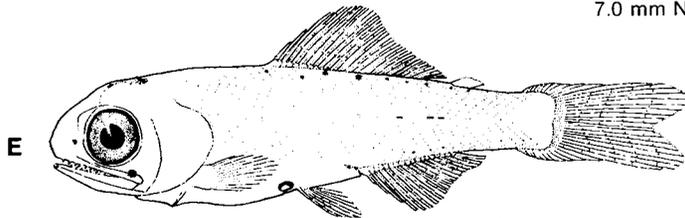
4.7 mm NL



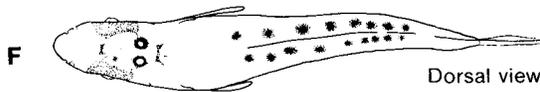
5.4 mm NL



7.0 mm NL



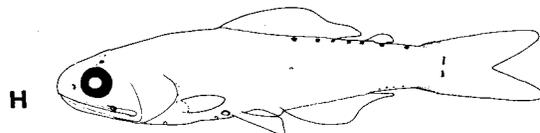
11.2 mm SL



Dorsal view



Ventral view



21.0 mm SL (metamorphic)



Day

I



Night

J

MYCTOPHIDAE
Lampanyctinae***Notolychnus valdiviae* (Brauer)**

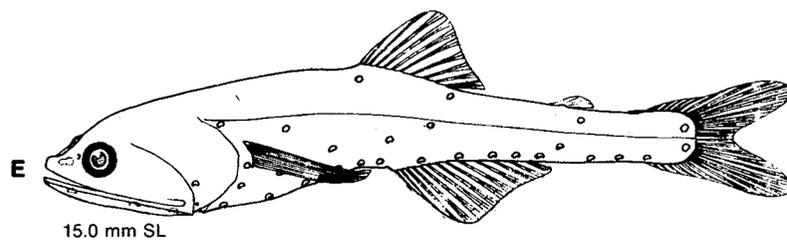
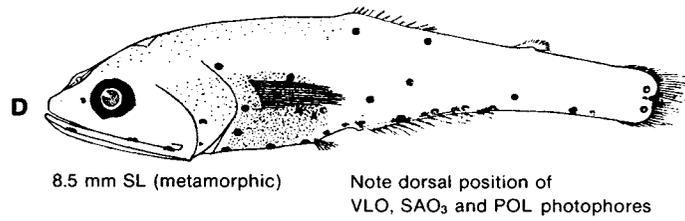
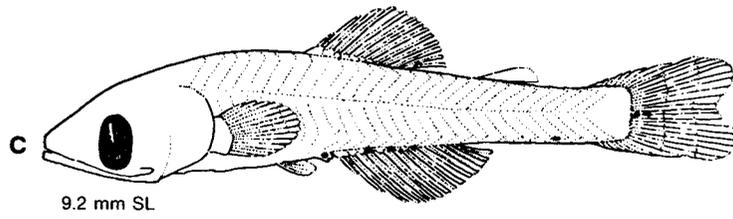
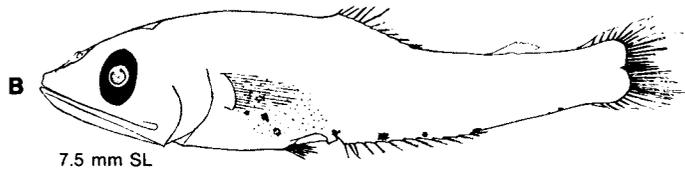
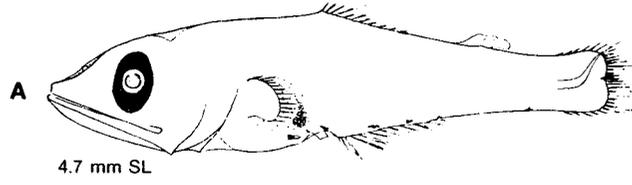
- Morphology** — Shapes of head, body and gut are unusual and distinctive.
— Eye shape varies among specimens, from narrow to nearly round.
— Larvae develop early and transform at small size (9–10 mm).
- Photophores** — All photophores formed after transformation.
- Distribution** — Tropical-subtropical.

Meristic features

Vert: 28–30
D : 10–12
A : 12–14
P : 12–13

Notolychnus valdiviae

MYCTOPHIDAE



PARALEPIDIDAE**General Characters**

Eleven genera and about 50 species of this myctophiform family occur worldwide. Nine genera and 15 species occur in the western North Atlantic. Tropical species are not included in this section.

Larval characters contrasted with other myctophiform families (Ege 1930; Rofen 1966).

Paralepididae	Other myctophiforms
Body compressed	Round and segmented in Chlorophthalmidae (p. 96) and Scopelosauridae (p. 100).
Head pointed; top of head not angular.	Top of head angular in Omosudidae (p. 160).
Snout and jaws not "duckbilled".	"Duckbilled" in Chlorophthalmidae (p. 96) and Scopelosauridae (p. 100).
Lower jaw slender (not deep).	Massive in Omosudidae (p. 160) and Alepisauridae (p. 162).
Toothless margin of upper jaw at symphysis.	
Both jaws relatively straight.	Strongly curved in some Scopelarchidae (p. 166).
No teeth on tongue.	Hooked teeth on tongue in some Scopelarchidae (p. 166).
Palatine teeth do not enter mouth profile when open.	Teeth do so in Evermannellidae (p. 164).
Distinct slender teeth in 1-2 rows.	
Eye large, lateral, round or slightly squared.	
Dorsal and pelvic fins posterior (about mid-trunk).	Anterior in Omosudidae (p. 160), Scopelarchidae (p. 166), and Evermannellidae (p. 164).
Dorsal fin small.	
Anal fin far posterior (usually most prominent fin).	
Anterior anal rays the longest.	
Gut lengthens gradually during larval development; gut pigment patches form sequentially on peritoneum.	In Scopelarchidae, gut lengthens suddenly at metamorphosis; 1 or 3 gut pigment patches form at one time (e.g. <i>Benthalbella</i> sp.).
Transformation occurs at large size.	

General Characters

PARALEPIDIDAE

Important specific characters

- Relative shape and length of head and body.
- Position of pelvic fin relative to dorsal fin.
- Nature of pigment on caudal fin and peduncle.
- Number of gut pigment patches and size at which they develop.
- Eggs and rate of growth are undescribed.

Distribution

Vertical distribution data for *Sudis* and *Stemonosudis* are scanty. Larvae of the other genera occur at depths of 20–200 m, with those of *Paralepis* and *Notolepis* generally deeper than 100 m. It is not uncommon for larvae of several species to occur in two or three distinct depth strata (i.e. *Paralepis coregonoides*, with peaks at 100 m and again at 200 m). Larger larvae are commonly found deeper than smaller larvae. (Ege 1930; Rofen 1966.)

Meristic characters of western North Atlantic paralepidids (Rofen 1966)

Species	Vertebrae		Fin rays		Max. No. gut pigment patches
	Total	Precaudal	Dorsal	Anal	
<i>Paralepis atlantica</i>	60–73	28–38	9–11	20–26	4*
<i>Paralepis elongata</i>	65–67	32–36	10–12	20–25	12
<i>Paralepis coregonoides</i>	68–74	32–37	9–11	22–26	10
<i>Notolepis rissoi</i>	80–85	38–41	8–11	31–34*	12
<i>Lestidium atlanticum</i>	75–87	35–41	9–11	26–32	8
<i>Lestidiops affinis</i>	75–85	30–35	8–10	27–30	11
<i>Lestidiops jayakari</i>	76–85	30–35	10	27–31	12
<i>Lestrolepis intermedia</i>	91–98*	28–30	9	41–44*	8
<i>Macroparalepis affine</i>	96–103*	57–62*	10–14	25–28	12
<i>Macroparalepis breve</i>	81–86	49–53	11–13	19–24	8
<i>Stemonosudis intermedia</i>	111–121*	49–56	9–10	41–47*	18*
<i>Sudis hyalina</i>	59–60*	33	12–16*	21–24	8
<i>Sudis atrox</i>	53–54*	28–30	12	21	6

* Diagnostic counts.

PARALEPIDIDAE**Diagnosis of western North Atlantic paralepidid postlarvae 10–40 mm (Rofen 1966)**

Taxon	Characters
<i>Sudis hyalina</i> , <i>S. atrox</i>	Pectoral fins elongate ; body short, head large, snout long, preopercle spines present.
<i>Pontosudis adventa</i> *	Pelvic fins elongate ; occurs in Gulf of Mexico and east of Florida.
<i>Paralepis</i>	Pectoral fins short ; body short, head large, snout long (except <i>P. elongata</i>).
<i>Macroparalepis</i>	Body elongate, head very small; intestine curved under head (<10 mm); caudal fin spotted with melanophores; 10 or fewer gut pigment patches (12 in W. Atlantic <i>M. affine</i>).
<i>Stemonosudis</i>	Body and head elongate; intestine behind head ; caudal fin unpigmented ; 10 or more gut pigment patches; highest vertebral and anal fin-ray counts.
<i>Paralepis coregonoides (borealis)</i> <i>Lestidiops affinis</i>	One or more lines of melanophores on side of body.
<i>Notolepis rissoi (krøyeri)</i> <i>Lestidiops jayakari (jayakari)</i> <i>Lestidium atlanticum</i>	Numerous oblique lines above and below vertebral column on caudal peduncle in larger larvae.
<i>Paralepis atlantica</i>	One vertical pigment band on body above anal fin.
<i>Lestidiops mirabilis</i> *	Two vertical pigment bands on body above anal fin; occurs in Carribean Sea.
<i>Lestrolepis intermedia</i>	Single curved line of melanophores on top of head; scattered spots on caudal region.
<i>Macroparalepis affine (americana)</i>	Numerous minute black spots on caudal fin.
<i>Macroparalepis breve</i>	Large black spots on caudal fin.

* Species not included in this guide.

PARALEPIDIDAE

Development of peritoneal pigment

Numbers (or range) of gut pigment patches observed in paralepidid larvae by species and size-class.

Species	Size of larvae (mm)															
	4	6	7	8	9	10	11	12	13	14	15	16	17	18	20	21
<i>Paralepis elongata</i>	3	8	6	...	...	6	...
<i>Paralepis coregonoides</i>	...	1	...	1	2	...	...	...	...	...	3	4	...	...	...	...
<i>Parelepis atlantica</i>	1	2	...	2	...	2	...	2	...	...	3	...	...	...
<i>Lestidium atlanticum</i>	...	0	...	...	...	4	...	...	...	...	...	...	8	...	...	...
<i>Notolepis rissoi</i>	1	...	...	...	...	...	...	...	...	...	2	...
<i>Lestidiops affinis</i>	0	...	...	2	...	...	...	...	3	...	9	...	8	10	...	...
<i>Sudis hyalina</i>	...	4	...	...	...	...	...	...	...	...	6	8	...	...	...	...
<i>Lestrolepis intermedia</i>	1	...	...	5	...	7	...	...	...	...	...	8	...
<i>Macroparalepis affine</i>	0	...	...	...	...	...	2	4*	6	...	9	...	10*
<i>Stemonosudis intermedia</i>	16	...	16	...
<i>Lestidiops jayakari</i>	2	...	...	...	4-5	5	...	7-9	10	...	9	10-12	...
<i>Macroparalepis breve</i>	0	...	...	0	...	4	...	7	8	...	7	...	...	8

Species	Size of larvae (mm)														
	22	23	24	25	26	27	28	29	30	34	37	38	42	43	45
<i>Paralepis elongata</i>	9	...	...	11-12	...	...	...	...	...	...	...	...	...	...	...
<i>Paralepis coregonoides</i>	...	6	...	...	...	...	...	...	9	...	...	...	...	...	...
<i>Parelepis atlantica</i>	3	...	...	...	3	...	...	...	...	...	...	...	...
<i>Lestidium atlanticum</i>	8	...	...	...	...	...	...	...	...	← faded, indistinct →					
<i>Notolepis rissoi</i>	...	3	...	...	...	...	4	...	5	...	8	...	...	12	...
<i>Lestidiops affinis</i>	11	10	...	...	...	...	12	...
<i>Sudis hyalina</i>	7	...	...	...	...	...	...	...	...	...	7	...
<i>Lestrolepis intermedia</i>	8	...	...	...	...	...	...	...	...	...	...
<i>Macroparalepis affine</i>	12*	...	11*	...	10	...	12*	...	...	...	...	...	...
<i>Stemonosudis intermedia</i>	18	...	...	...	...	...
<i>Lestidiops jayakari</i>	12	...	...	...	12	...	...	12	...	...	...	...
<i>Macroparalepis breve</i>	8	...	...	7	...	...	...	7	...	...

* Values refer to western Atlantic form of *M. affine*.

PARALEPIDIDAE ***Paralepis elongata* (Brauer)**

- Spawning:** Most intense in May; postlarvae present year-round.
- Morphology** — Snout relatively short, deep and conical.
 — Pelvic fin forms under dorsal fin at about mid-body.
 — Caudal and anal rays formed by 14.4 mm, dorsal rays by 15.6 mm, and pelvic rays by 22 mm.
- Pigmentation** — Total lack of pigment on posterior body in early stages (compare to *Notolepis* and other *Paralepis* species).
 — Characteristic pattern of stellate melanophores on occiput, nape and interorbital, develops at 12–14 mm and spreads posteriorly with development.
 — Five or 6 large gut patches located anterior to dorsal fin origin (2 in *P. atlantica*, p. 150; gut pigment patches (anterior much larger) develop as follows:

Gut patches	3	6	8	6	9	11–12
Larval size (mm)	14.4	16.7	15.6	20.0	22.0	25.0

Meristic features
 Vert: 65–67(32–36)
 D : 10–12
 A : 20–25
 () = precaudal vert.

***Paralepis coregonoides* Risso**

- Morphology** — Snout relatively long (compare to *P. elongata*).
 — Head smaller, snout shorter and gut pigment patches more than in *P. atlantica*.
 — Pelvic fin forms under dorsal fin at about mid-body.
 — Most caudal and anal rays formed by 15.5 mm; all rays formed by 30.5 mm.
- Pigmentation** — U-shaped line of pigment on interorbital (rounded side anterior) forms at 14–16 mm.
 — Gut pigment patches (1 to 9) develop as follows:

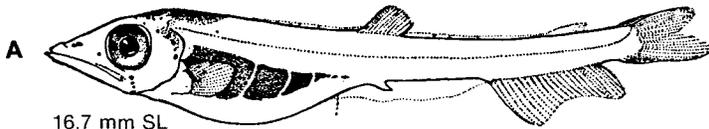
Gut patches	1	1	2	3	4	6+	9
Larval size (mm)	6.0	8.8	9.7	15.5	16.1	23.0	30.5

Meristic features
 Vert: 68–74(32–37)
 D : 9–11
 A : 22–26
 () = precaudal vert.

- Subspecies** — *P. coregonoides borealis*, with 73–77 myomeres (mode 74–75), occurs in eastern Atlantic and Greenland.
 — *P. coregonoides barracudina*, with 69–75 myomeres (mode 72–73), occurs in western Atlantic.

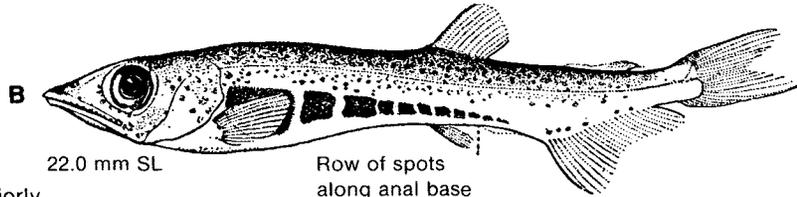
Paralepis elongata

PARALEPIDIDAE



16.7 mm SL
Snout unpigmented;
few spots at jaw angle

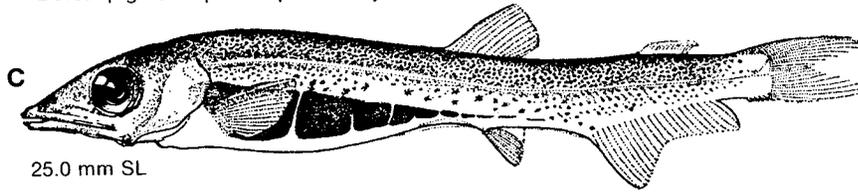
Few spots on pectoral fin;
other fins unpigmented



22.0 mm SL

Row of spots
along anal base

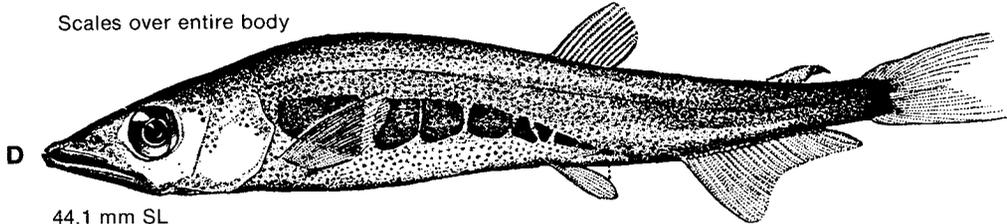
Dorsal pigment spreads posteriorly



25.0 mm SL

Anus located under
posterior dorsal rays

Scales over entire body



44.1 mm SL

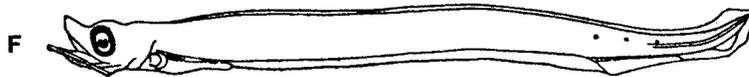
Paralepis coregonoides

1 deep spot above notochord



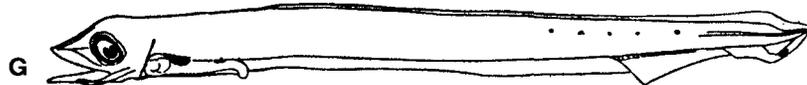
6.0 mm SL

1 gut pigment patch



11.8 mm SL

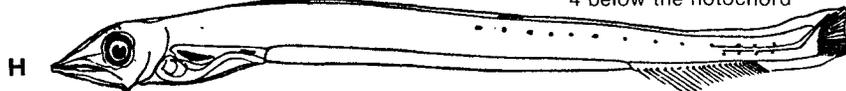
3 deep spots
above notochord



13.5 mm SL

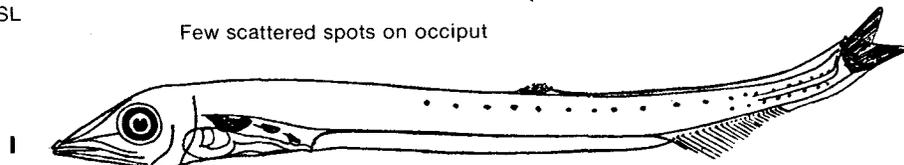
Top of head finely spotted >15 mm

3 deep spots above, and
4 below the notochord



18.0 mm SL

Few scattered spots on occiput



22.0 mm SL

Number of deep spots above and below
notochord increases with development

PARALEPIDIDAE***Paralepis atlantica* Krøyer**

- Spawning:** Mostly in Sargasso Sea and near Bermuda, mainly March–June; post-larvae present year-round. **Meristic features**
- Morphology** — Body shorter and head deeper than in *P. coregonoides*, with lower number of myomeres. Vert: 60–73(31–35)
 — Head and snout longer than in *P. elongata*. D : 9–11
 — Anus moves posteriorly early in development, reaching final position (67–72% SL) by 13–15 mm (compare with other species). A : 20–26
 — Pelvic fin forms under dorsal fin; all fin rays (except pelvic) formed by 14.6 mm. () = precaudal vert.
- Pigmentation** — Deep pigment between adipose and anal fins, begins as 2 spots above and below vertebral column at 10.5 mm.
 — Spots at origin of dorsal and anal fins form at 10.5 mm; spots present on lower principal caudal rays.
 — Gut pigment patches (maximum 3, but only 2 anterior to dorsal fin) develop as follows:

Gut patches	1	2	2	2	2	3	3	3
Larval size (mm)	5.8	8.2	10.5	12.2	14.6	17.2	24.7	28.0

***Lestidium atlanticum* Borodin**

- Spawning:** Mostly in Caribbean Sea, mainly November–April. **Meristic features**
- Morphology** — Head deep in early larvae; eye almost square, but becomes round at about 10.5 mm. Vert: 75–87(35–41)
 — Anus reaches final position (under posterior end of dorsal fin) at 17 mm. D : 9–11
 — Pelvic fin forms under or slightly anterior to first dorsal ray; dorsal, anal and pelvic rays formed by 22–23 mm. A : 26–32
 () = precaudal vert.
- Pigmentation** — Body lightly pigmented; single prominent spot above notochord near caudal fin present from smallest larvae to size of 31.5 mm.
 — Light gut pigment patches (0 to 8) develop as follows:

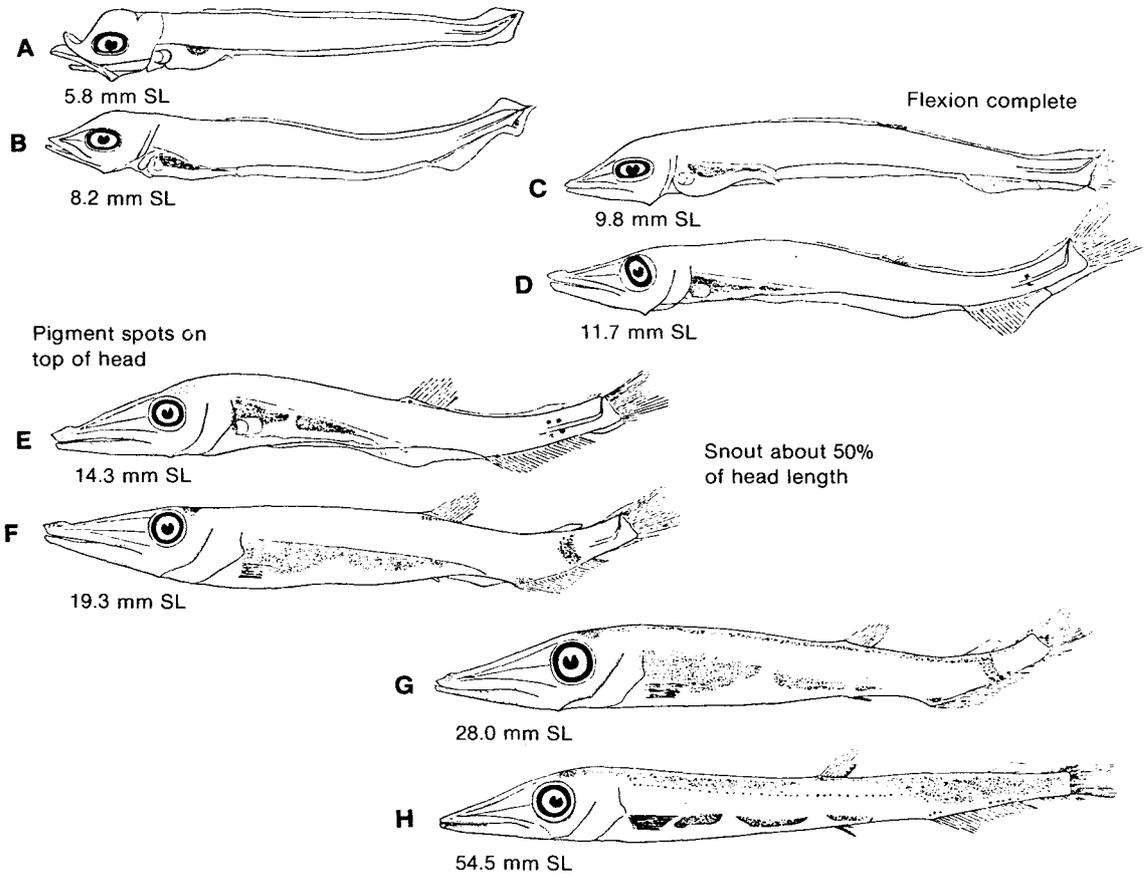
Gut patches	0	4	8	8 (indistinct)
Larval size (mm)	6.0	10.5	17.0	22.3 31.5 43.5

Fig. — A–N, Ege 1930.

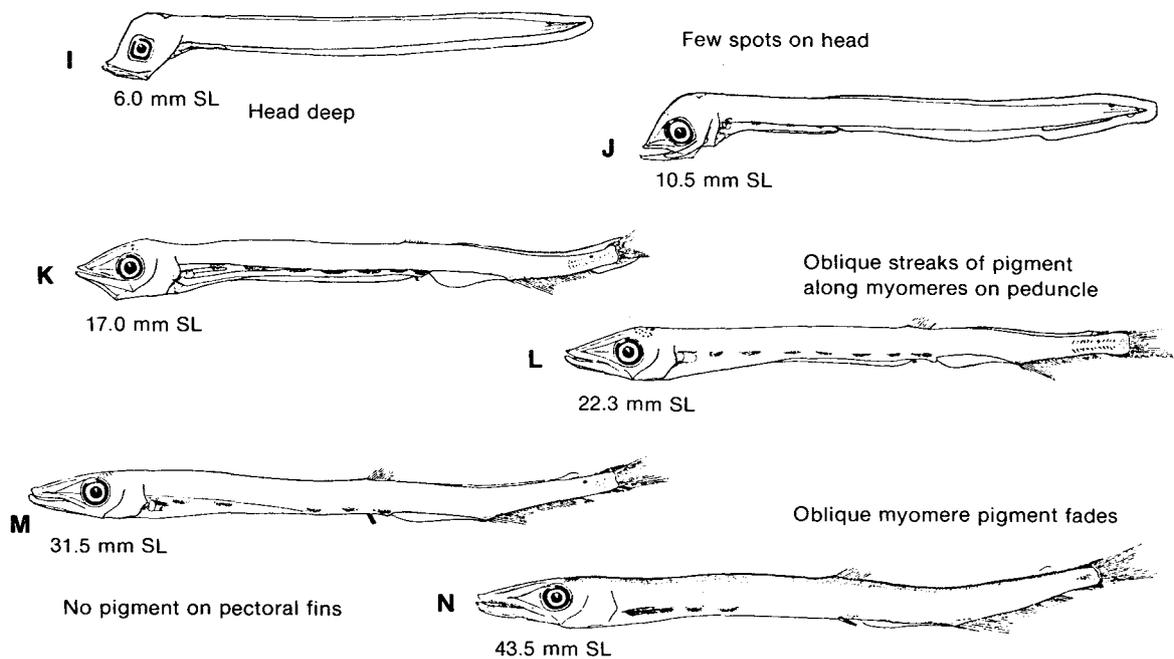
Ref. — Rofen 1966.

Paralepis atlantica

PARALEPIDIDAE



Lestidium atlanticum



PARALEPIDIDAE *Notolepis rissoi krøyeri* (Lütken)

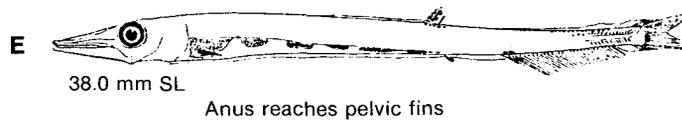
Spawning:	Mostly in May, but extends from January to September; postlarvae common to very abundant on Georges Bank, Scotian Shelf and over continental shelf.	Meristic features Vert: 80-85(38-41) D : 8-11 A : 31-34 () = precaudal vert.																
Morphology	<ul style="list-style-type: none"> — Body elongate; snout becomes more elongate with development. — Pelvic fin forms under dorsal fin at about 28 mm, and moves to a position behind dorsal fin at about 38 mm. — Caudal rays formed by 20.5 mm, dorsal rays by 30 mm, and anal rays by 28 mm. 																	
Pigmentation	<ul style="list-style-type: none"> — Five spots over posterior anal fin at 20.5 mm, increase to 2 lines of spots, one dorsal and one ventral to posterior end of notochord. — Four spots at anal fin origin at 23 mm, become more intense. — Large spots develop along base of dorsal fin, become more prominent at 38.8 mm. — Gut pigment patches (1 to 12) develop as follows: <table border="1" style="margin-left: 20px; border-collapse: collapse; width: 80%;"> <tr> <td style="text-align: left;">Gut patches</td> <td style="text-align: center;">1</td> <td style="text-align: center;">2</td> <td style="text-align: center;">3</td> <td style="text-align: center;">4</td> <td style="text-align: center;">5</td> <td style="text-align: center;">8</td> <td style="text-align: center;">12</td> </tr> <tr> <td style="text-align: left;">Larval size (mm)</td> <td style="text-align: center;">9.5</td> <td style="text-align: center;">20.5</td> <td style="text-align: center;">23.0</td> <td style="text-align: center;">28.0</td> <td style="text-align: center;">30.0</td> <td style="text-align: center;">38.0</td> <td style="text-align: center;">45.0</td> </tr> </table>	Gut patches	1	2	3	4	5	8	12	Larval size (mm)	9.5	20.5	23.0	28.0	30.0	38.0	45.0	
Gut patches	1	2	3	4	5	8	12											
Larval size (mm)	9.5	20.5	23.0	28.0	30.0	38.0	45.0											

***Stemonosudis intermedia* (Ege)**

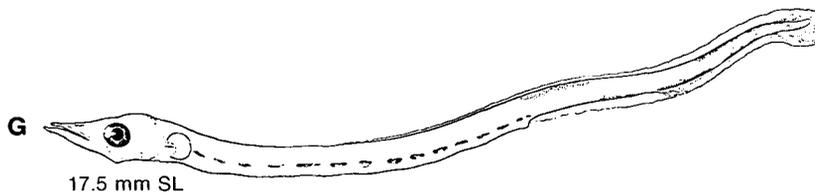
Morphology	<ul style="list-style-type: none"> — Body long and snout pointed. — Pelvic fin develops well anterior to dorsal fin; all fin rays formed by 34.3 mm. 	Meristic features Vert: 111-121(49-56) D : 9-10 A : 41-47 () = precaudal vert.								
Pigmentation:	<ul style="list-style-type: none"> — Spots on lower jaw tip; row of spots over brain. — Long patches (3-4) of spots both dorsally and ventrally, on tail posterior to dorsal fin. — Dense pigment develops on caudal fin at about 20 mm. — Gut pigment patches develop as follows: <table border="1" style="margin-left: 20px; border-collapse: collapse; width: 60%;"> <tr> <td style="text-align: left;">Gut patches</td> <td style="text-align: center;">16</td> <td style="text-align: center;">16</td> <td style="text-align: center;">18</td> </tr> <tr> <td style="text-align: left;">Larval size (mm)</td> <td style="text-align: center;">17.5</td> <td style="text-align: center;">20.2</td> <td style="text-align: center;">34.3</td> </tr> </table>	Gut patches	16	16	18	Larval size (mm)	17.5	20.2	34.3	
Gut patches	16	16	18							
Larval size (mm)	17.5	20.2	34.3							

Notolepis rissoi krøyeri

PARALEPIDIDAE



Stemonosudis intermedia

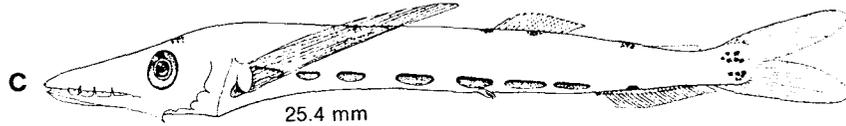
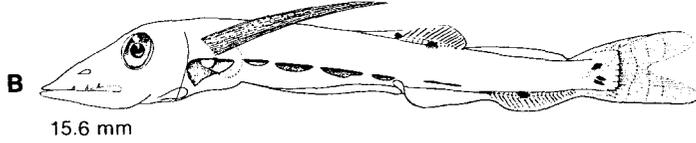


Lower jaw protrudes

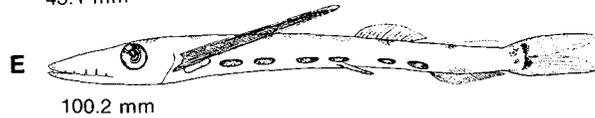


Sudis hyalina

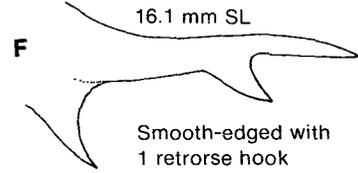
PARALEPIDIDAE



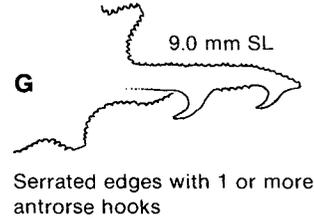
6 saddles of pigment develop dorsally



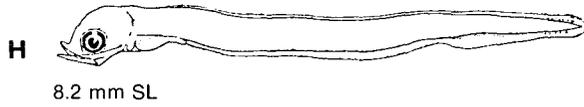
Preopercle-angle spine (*S. hyalina*)



Preopercle-angle spine (*S. atrox*)



Lestrolepis intermedia



In addition to finfold spots; 4 parallel rows of spots form near tip of notochord; upper and lower rows become indistinct, leaving a row above and a row below midline



Spots over anterior anal fin base

PARALEPIDIDAE

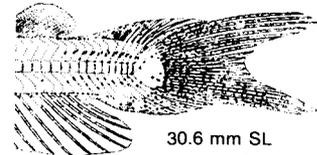
***Macroparalepis affine* Ege**

Note: Two subspecies in the North Atlantic; text refers to *M. affine americana* from western North Atlantic, and illustrations opposite are *M. affine affine* from eastern North Atlantic.

Morphology — Body elongate, snout relatively short, and eye square in early larvae.
 — Intestine begins under head in early larvae.
 — Pelvic fin forms anterior to dorsal fin.

Pigmentation — Uniform pigment on caudal fin in *M. affine americana* (right) (compare to *M. breve* below and *Lestidiops affinis*, p. 158).
 — Series of spots on ventral edge behind anus decrease in number with development.
 — Single spot under eye in W. Atlantic form at 14.8 mm, becomes 2 spots at about 26 mm.
 — Spots in arc on top of head begin in W. Atlantic form at 17.7 mm, increase in number.
 — Gut pigment patches (maximum 12 in western and 10 in eastern North Atlantic) develop as follows:

Meristic features
 Vert: 96–103(57–62)
 D : 10–14
 A : 25–28
 () = precaudal vert.



30.6 mm SL
M. a. americana
 (Rofen 1966)

Gut patches	0	2	4*	6	9	10*	12*	11*	10	12*
Larval size (mm)	8.0	14.0	14.8	15.5	18.5	21.4	24.0	26.1	28.0	30.6

* Western North Atlantic.

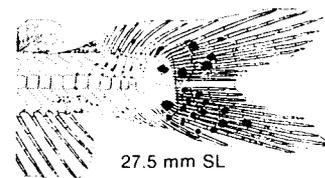
***Macroparalepis breve* Ege**

Spawning: Year-round in Sargasso Sea, but mainly during February–June.

Morphology — Body and snout relatively shorter than in *M. affine*.
 — Eye almost square in early larvae.
 — Intestine begins under head in early larvae.
 — Dorsal and anal fin rays complete at 27.5 mm.

Pigmentation — Series of spots along ventral edge from anus to anterior one-third of anal fin; number decreases with growth.
 — Spots develop over posterior end of anal fin at about 12 mm.
 — Conspicuous spotting on caudal fin (right) present from earliest larvae.
 — Gut pigment patches (maximum 7–8, in contrast to 11–12 in *M. affine*) develop as follows:

Meristic features
 Vert: 81–86(49–53)
 D : 11–13
 A : 19–24
 () = precaudal vert.



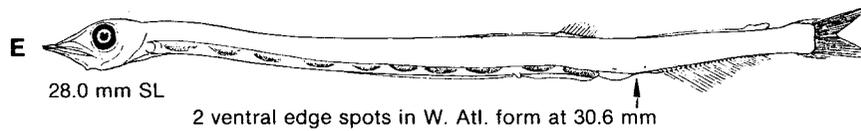
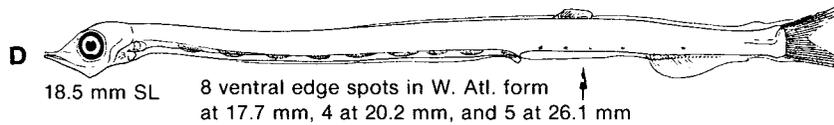
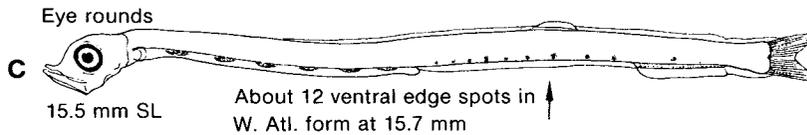
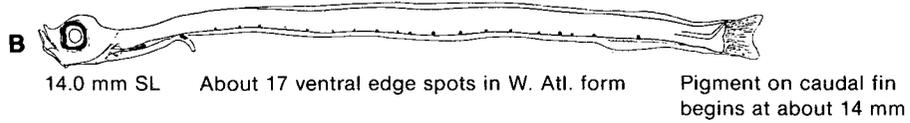
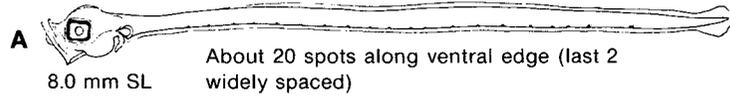
27.5 mm SL
 (Rofen 1966)

Gut patches	0	0	4	7	8	7	8	8	7	7
Larval size (mm)	7.5	10.0	12.0	14.5	15.5	17.0	21.5	27.5	30.5	30.7

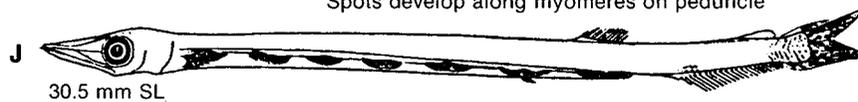
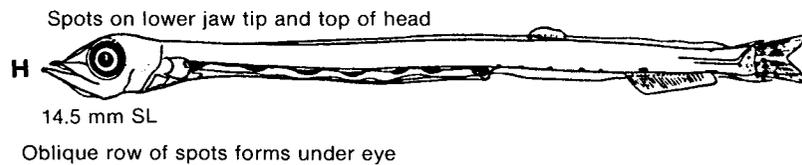
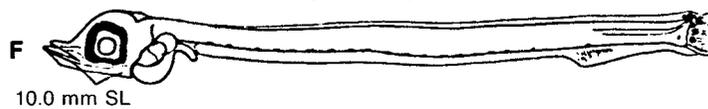
Fig. — A–K, Ege 1957.

Macroparalepis affine

PARALEPIDIDAE



Macroparalepis breve



PARALEPIDIDAE ***Lestidiops jayakari* (Boulenger)**

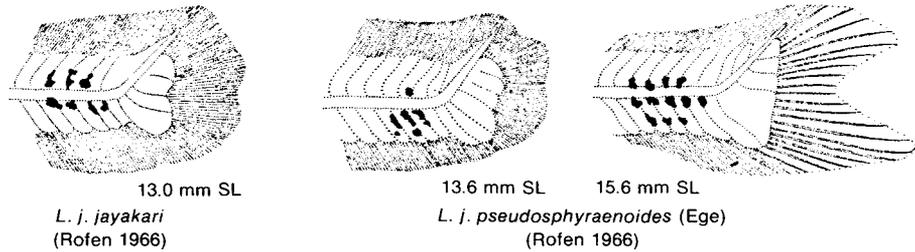
Note: Two subspecies in western North Atlantic, *L. jayakari jayakari* and *L. jayakari pseudosphyraenoides*; postlarvae are similar, but differ in peduncle pigment.

Spawning: Mainly during May–August in the Sargasso Sea–Bermuda area.

Morphology — Head short and deep in early larvae.
 — Anus reaches final position under dorsal fin origin at about 20 mm.
 — Pelvic fin forms well anterior to dorsal fin and is complete at about 25 mm.
 — Anal fin rays complete at about 20 mm, and dorsal rays at about 25 mm.

Pigmentation — See peduncle pigment below and note illustrations on opposite page.

Meristic features
 Vert: 76–85(30–35)
 D : 10
 A : 27–31
 () = precaudal vert.



— Gut pigment patches (2 to 12) develop as follows:

Gut patches	2	4	5	5	7	9	10	9	10	12	12
Larval size (mm)	8.0	12.0	12.2	13.0	15.0	15.6	16.5	18.0	20.6	25	37

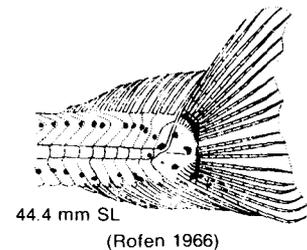
***Lestidiops affinis* Ege**

Spawning: Mainly April–June in Sargasso Sea, but some spawning during May–October in western North Atlantic.

Morphology — Head short and deep, with blunt snout; nostrils at mid-length of upper jaw.
 — Pelvic fin well anterior to dorsal fin.
 — Anus and pelvic fin farther anterior (relative to dorsal) than in *L. jayakari* and *Macroparalepis affine* (p. 156).
 — Most anal fin rays formed at about 30 mm, caudal rays at 30 mm, and all fin rays by 43 mm.

Pigmentation — Two widely-separated mid-ventral spots at 8.5 mm become doubled at 10–15 mm.
 — Mid-ventral row and 2 lines of spots develop on side of peduncle at 15–80 mm.
 — Internal pigment develops between vertebrae over anal fin origin at 36.5 mm.
 — Gut pigment patches (0 to 12) develop as follows:

Meristic features
 Vert: 75–85 (30–35)
 D : 8–10
 A : 27–30
 () = precaudal vert.



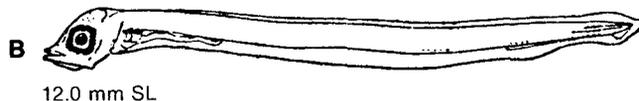
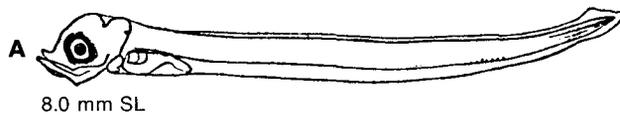
Gut patches	0	2	3	9	8	10	11	10	12
Larval size (mm)	4.3	8.5	13.5	15.3	17.5	18.1	29.0	29.8	43

Fig. — A–L, Ege 1930.

Lestidiops jayakari

PARALEPIDIDAE

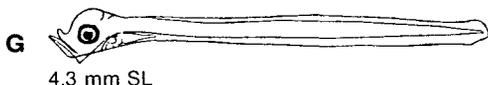
Note: 3 diagnostic groups of pigment spots: 1) ventral row between anus and anal fin origin, 2) ventral row over anterior anal fin, 3) midlateral on peduncle



Maximum gut pigment patches 12



Lestidiops affinis



No pigment except in eye



Spots at caudal base but not on peduncle in larvae <18 mm



Few spots on top of head



7 spots anus to anal fin and 3 over anterior anal fin, the latter 3 disappearing at 30 mm



Similar to postlarval *Macroparalepis affine* (p. 156)

OMOSUDIDAE***Omosudis lowei* Günther**

Spawning: Probably year-round; postlarvae occur across north central Atlantic and are abundant around Bermuda.

Eggs — Undescribed.

Larvae — Head and mouth larger and teeth (at about 6 mm) more prominent than in *Alepisaurus* (p. 162).
 — Snout to top of head almost straight (compare to *Alepisaurus*).
 — Single large canine tooth on lower jaw (compare to *Alepisaurus*), and large palatine canines.
 — Adipose fin present.
 — Anus well posterior to tips of pectoral fins which are much smaller than in *Alepisaurus*.
 — Small dorsal fin situated slightly behind mid-body; pelvic fin origin under middle of dorsal fin.
 — Dorsal, anal and caudal rays formed by 11.8 mm SL; caudal rays develop first and pectoral rays last.
 — Transformation gradual.
 — Pigmentation: no pigment on pectoral fins (compare to *Alepisaurus*); 3 or 4 gut pigment patches on peritoneum develop at about 6 mm and disappear at about 30 mm; 4 or 5 ventral spots posterior to anus in smaller larvae; very few spots in region of caudal peduncle.

Meristic features

Myomeres: 39-41
 Vert : 39-41(17-18)
 D : 9-11
 A : 13-14

() = precaudal vert.

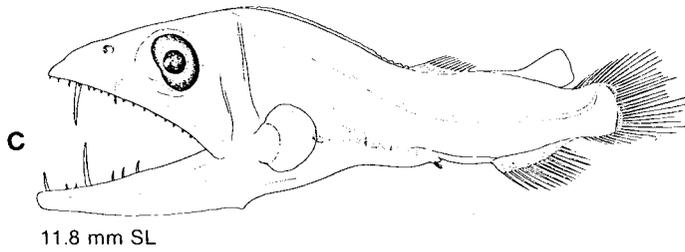
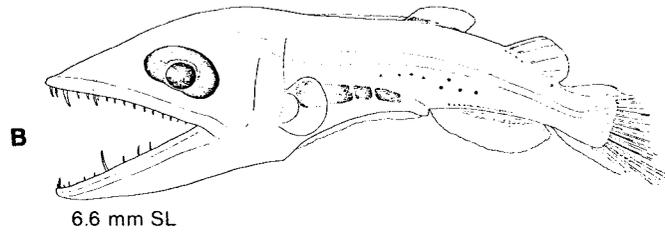
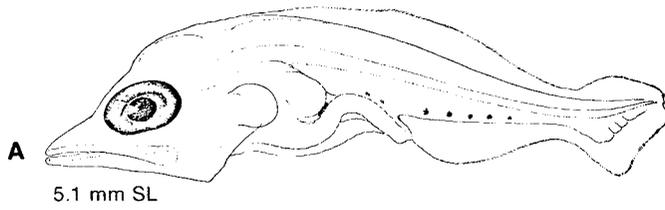
- Note:** (1) A 22.5 mm SL specimen, collected in the western Pacific differs as follows: pigment is dense, as in 75.2 mm SL specimen illustrated by Ege (1958) (Fig. F); distinct head spination present along edge of preopercle and along dorsum of head, culminating in a parietal spine (Okiyama 1981, pers. comm.).
- (2) Larvae superficially similar to scombrids (p. 306-323), but note presence of adipose fin and lack of fin spines.

Fig. — A-F, Ege 1958.

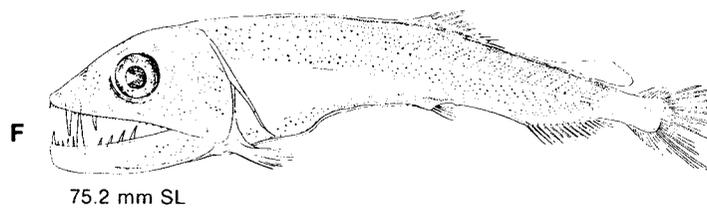
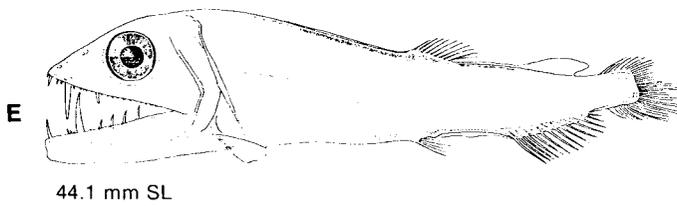
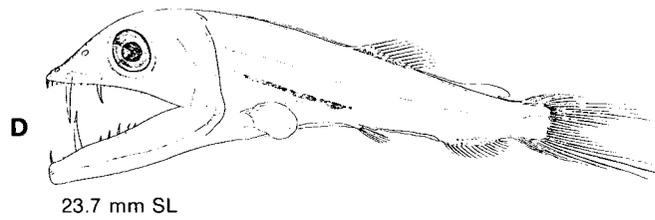
Ref. — Rofen 1966.

Omosudis lowei

OMOSUDIDAE



Dorsal fin base short



A-E (western and central North Atlantic); F (South China Sea.)

ALEPISAUROIDAE***Alepisaurus* sp.**

Eggs — Undescribed.

Larvae — Head and mouth large.
 — Snout to top of head curved (compare to *Omosudis*, p. 160).
 — Teeth small in early larvae; large depressed canines form along lower jaw (compare to *Omosudis*).
 — Adipose fin present.
 — Pectoral fin rays develop early; fin is large, on a long base (pedicel), and tip extends posterior to anus at sizes >20 mm.
 — Dorsal fin origin over edge of opercle and fin base long (compare to *Omosudis*).
 — Anal fin forms later than caudal and dorsal fins; pelvic fin forms late.
 — Transformation gradual.
 — Pigmentation: 2 very distinct gut pigment patches on peritoneum overlain by external pigment on abdomen; saddle of pigment under adipose fin; no pigment on peduncle or lower body posterior to anus; in early larvae, pigment restricted mainly to eye and pectoral rays (compare to *Omosudis*); in larger postlarvae, spots on upper jaw edge, top of head, nape, and along dorsum to adipose fin patch.

Meristic features

Myomeres: ~50
 Vert : 50 (24)
 D : 36-48
 A : 13-18
 () = precaudal vert.

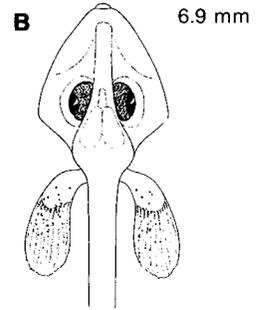
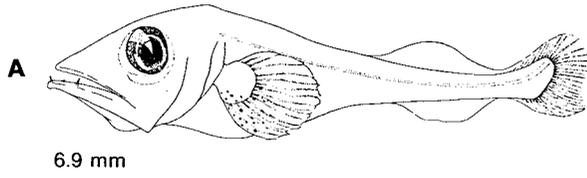
- Note:** (1) Size of larva illustrated in Fig. E may be an error; it should probably be 21.8 mm.
 (2) Larvae superficially similar to scombrids (p. 306-323), but note presence of adipose fin and lack of fin spines.

Fig. — A-E, Rofen 1966.

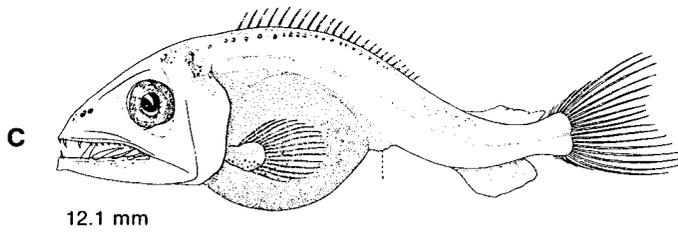
Ref. — Haedrich 1964; Gibbs and Wilimovsky 1966.

Alepisaurus sp.

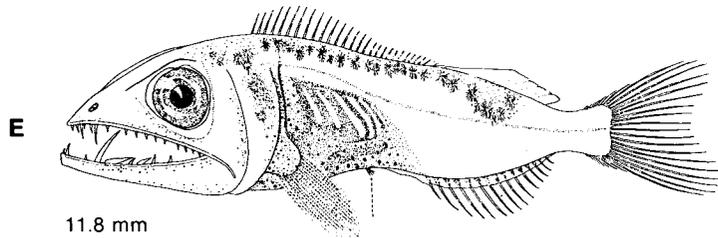
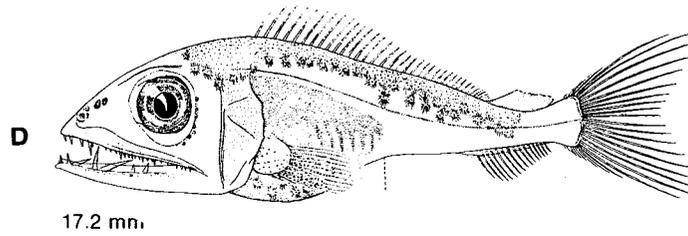
ALEPISAUROIDAE



Dorsum of head



Abdomen large and round



EVERMANNELLIDAE Three Genera

Genera: *Odontostomops*, *Evermannella*, *Coccorella*.

Meristic features*

Spawning: Spring through autumn, possibly year-round; species occur in open ocean and are rarely caught.

Myomeres: 49-53

Vert : 49-53

D : 11-13

A : 25-36

Piv : 8-10

P : 11-13

Eggs — Undescribed.

Larvae — Specimens <10 mm SL are unidentifiable to species or identifiable only on the basis of capture location.

— Myomeres covered by mid-lateral trunk musculature and are difficult to count.

— Pelvic fin origin under dorsal fin; pectoral fin low and not divided as in Bathypteroidae (p. 98); adipose fin present.

— Stomach is a heavily-muscularized blind sac, expanding posteriorly with growth, reaching full extension (just behind pelvic fin base) in larvae 20-25 mm SL.

— Transformation gradual; adult characters acquired one-by-one until about 30 mm SL.

— Peritoneal pigment sections never paired as in Scopelarchidae (p. 166); begin as dorsolateral canopy over gut and spread ventrally until closed pigment tube forms at 35-45 mm SL.

* Range for family

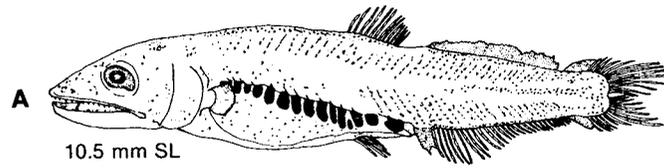
Generic identification:

1. Number of peritoneal pigment sections: 12 or more (typically 13-15) in *Odontostomops*, 3 in *Evermannella*, and 3 in *Coccorella*.
2. Gut morphology: in *Coccorella*, a pyloric caecum extends anteriorly and enters head in larger larvae, juveniles and adults (visible initially as a short bud-like sac on anteroventral margin of intestine).
3. Pigmentation (two phases):
 - a) In larvae less than 12-15 mm SL, pigment bands occur along myosepta in groups, with myosepta between unpigmented (barred appearance). (Also see Schmidt 1918, fig. 21-23).
 - b) In larger larvae, the juvenile to adult pattern begins:
 - Odontostomops* — Fine spots cover head and body.
 - Evermannella* — Three rows of very large spots, each row associated with one of the main divisions of trunk musculature.
 - Coccorella* — Size of spots intermediate between those of other two genera, and spots not in rows.
4. Transformation begins with gradual onset of juvenile pigmentation, 30 mm SL being an arbitrary division between larvae and juveniles; peritoneal pigment bands fuse into one tube at about 35 mm SL in *Evermannella* and *Coccorella* and about 45 mm SL in *Odontostomops*.

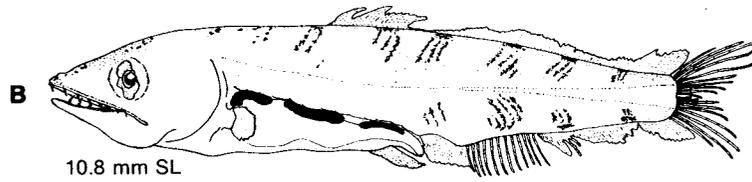
Fig. — A-E, Johnson 1982.

Ref. — Schmidt 1918; Rofen 1966.

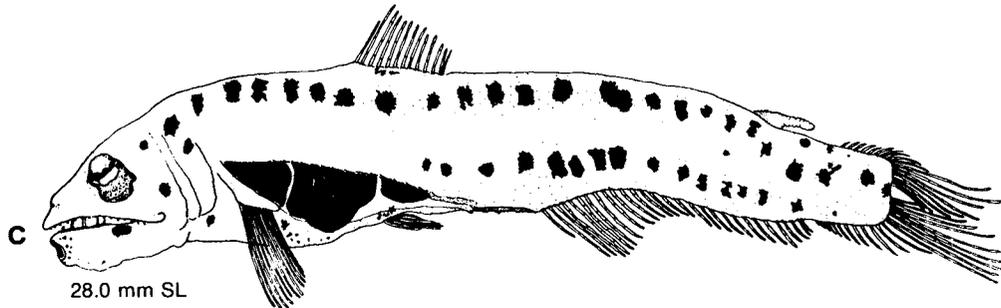
***Odontostomops normalops* EVERMANNELLIDAE**



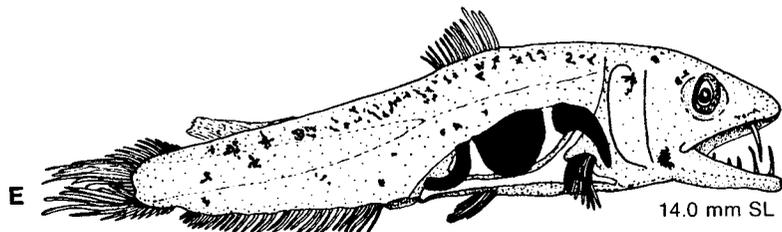
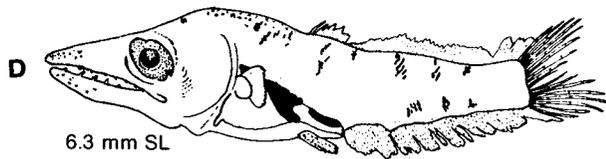
Evermannella balbo



Evermannella indica



Coccorella atlantica



Note anteriorly directed pyloric caecum

SCOPELARCHIDAE *Scopelarchus* (3 species)

Generic characters

- Eggs** — Undescribed.
- Larvae** — Body moderately elongate, deep anteriorly and tapers to peduncle.
- Snout elongate, with curved jaws and hooked teeth on tongue.
- Dorsal and pelvic fin origins anterior, with pelvic origin under dorsal and dorsal base short; anal fin origin at about 50% SL, and base long; adipose fin present.
- Fin formation sequence: caudal, dorsal and anal form first, followed by upper-pectoral, pelvic, and lower-pectoral.
- Pigmentation: one anterior and a pair of posterior peritoneal pigment patches fuse at transformation; mid-lateral pigment stripes form posterior to dorsal fin.

Meristic features*

Myomeres: 40–50

* See table below

Comparative features for three species

Character	<i>S. guentheri</i> Alcock	<i>S. analis</i> (Brauer)	<i>S. michaelsarsi</i> Koefoed
Vertebrae	46–50	44–49	40–44
Dorsal rays	7–8	7–9	7–9
Anal rays	24–29	21–26	18–21
Pelvic rays	9	9	9
Pectoral rays	18–19(21)	18–22	18–21
Transformation complete	50–55 mm	45–55 mm	32–35 mm
HL at 14–30 mm	<20% SL	>20% SL	>25% SL
Pectoral pigment	None	Some >22 mm all >30 mm	>18 mm
Choroid pigment at <20 mm size	Produced above lens	Not produced above lens	Not produced above lens
Mid-lateral pigment	See figures	See figures	See figures
Peritoneal pigment	Posterior 2 form first	Anterior 1 forms first (at ~16 mm)	All 3 formed at 9.5 mm

Other possible species in western North Atlantic

- *Scopelarchoides danae* Johnson: distinct spots on dorsal peduncle, ventral midline of peduncle, gut near anus, and base of caudal fin.
- *Benthalbella infans* Zugmayer: no pigment (except eyes) before transformation; pelvic fin origin well anterior to dorsal fin origin; transformation abrupt >50.0 mm.

Early larvae (Rofen 1966)

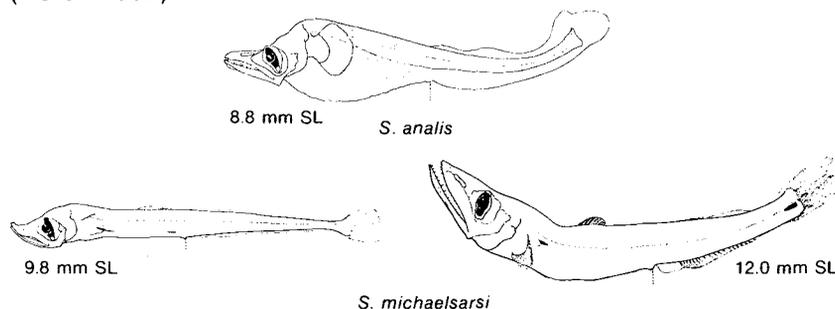
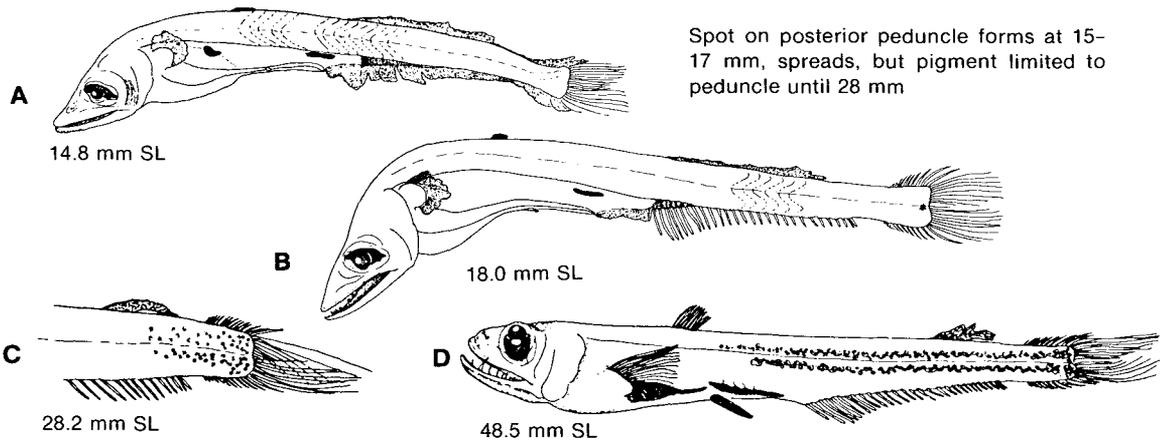


Fig. — A–G, I–J, Johnson 1974; H, Rofen 1966.

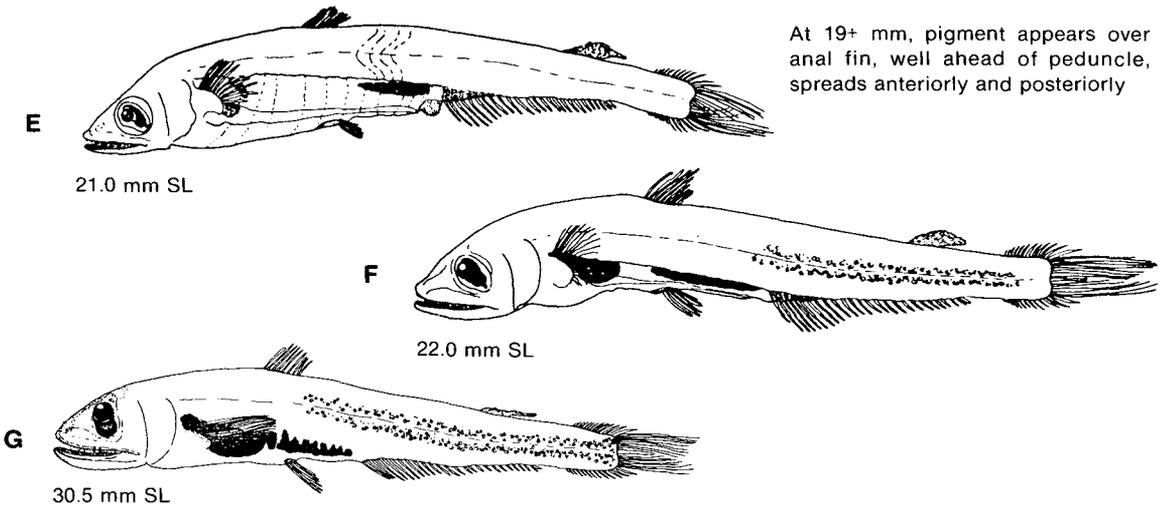
Scopelarchus guentheri

SCOPELARCHIDAE



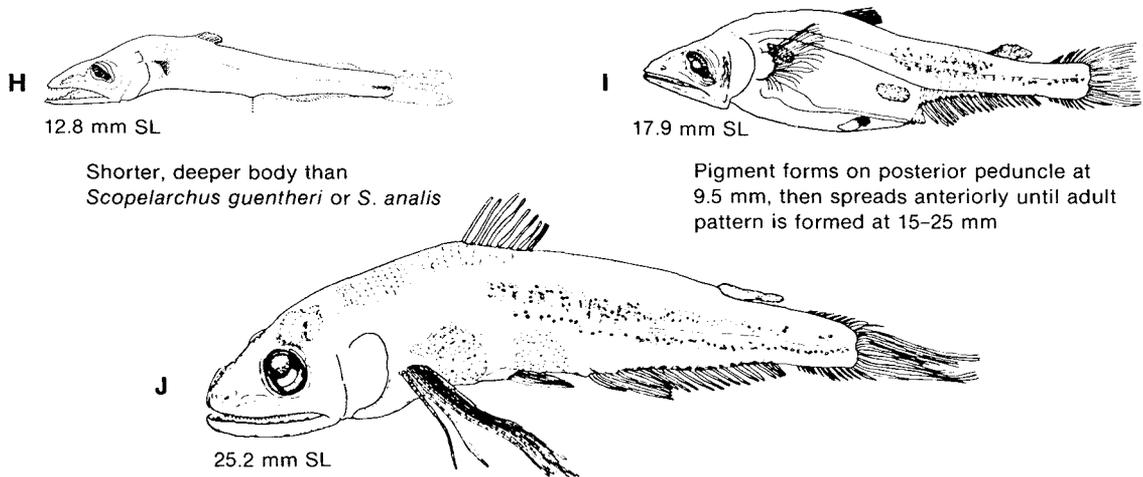
Spot on posterior peduncle forms at 15-17 mm, spreads, but pigment limited to peduncle until 28 mm

Scopelarchus analis



At 19+ mm, pigment appears over anal fin, well ahead of peduncle, spreads anteriorly and posteriorly

Scopelarchus michaelisarsi



Shorter, deeper body than *Scopelarchus guentheri* or *S. analis*

Pigment forms on posterior peduncle at 9.5 mm, then spreads anteriorly until adult pattern is formed at 15-25 mm