

Ophidiiformes

Selected meristic characters in species belonging to the order Ophidiiformes whose adults or larvae have been collected in the study area. Classification sequence follows Nielsen *et al.*, 1999; Fahay and Nielsen, 2003. Three subfamilies indicated under Ophidiidae. See Fahay and Hare, 2003 for sources. * = Early stages unknown.

| Family <i>Species</i> | Precaudal Vertebrae | Total Vertebrae | Dorsal Fin Rays | Anal Fin Rays | Caudal Rays | Pectoral Fin Rays |
|--------------------------------------|------------------------|--------------------|--------------------|--------------------|----------------|----------------------|
| Carapidae | | | | | | |
| <i>Carapus bermudensis</i> | 17–18 | 17–18(PC) | 36–45 ¹ | 53–62 ¹ | none | 17–20 |
| <i>Echiodon dawsoni</i> | 21–25 | 21–25(PC) | 28–35 ¹ | 39–43 ¹ | none | 17–21 |
| <i>Echiodon drummondi</i> | 26–29 | 26–29(PC) | 42–47 ¹ | 46–51 ¹ | none | 15–17 |
| Ophidiidae – Brotulotaeniinae | | | | | | |
| <i>Brotulotaenia brevicauda</i> | 13 | 63–66 | 79–84 | 58–64 | 9 | 21–24 |
| <i>Brotulotaenia crassa</i> | 13–15 | 88–96 | 119–134 | 98–108 | 9 | 22–26 |
| <i>Brotulotaenia nigra</i> | 13–14 | 89–90 | 113–115 | 91–94 | 5? | 20–25 |
| <i>Lamprogrammus brunswigi</i> | 13–14 | 68–71 | 108–125 | 92–108 | 8–9 | 19–22 |
| <i>Lamprogrammus niger</i> | 12–14 | 65–72 | 103–117 | 81–91 | 8 | 16–19 |
| <i>Lamprogrammus shcherbachevi</i> | – | 71–74 | 131–140 | 104–117 | – | 18–19 |
| Ophidiidae – Ophidiinae | | | | | | |
| <i>Lepophidium brevibarbe</i> * | 14–16 | 69–73 | 124–136 | 101–116 | 9 | 20–22 |
| <i>Lepophidium jeannae</i> | 14–15 | 73–75 | 131–140 | 112–117 | 9 | 20–21 |
| <i>Lepophidium profundorum</i> | 15–17 | 73–78 | 131–140 | 110–121 | 9 | 22–24 |
| <i>Ophidion josephi</i> | 15–16 | 67–68 | 128–150 | 105–122 | 9 | 21–22 |
| <i>Ophidion marginatum</i> | 15–16 | 67–70 | 138–162 | 116–129 | 9 | ~21 |
| <i>Ophidion robinsi</i> | 15–17 | 61–63 | 112–125 | 86–93 | 9 | 19–22 |
| <i>Ophidion selenops</i> | 15–16 | 77–81 | 132–140 | 123–129 | 9 | 15–16 |
| <i>Otophidium omostigma</i> | 14 | 56–58 | 99–108 | 80–87 | 9 | 16–18 |
| <i>Parophidion schmidti</i> | 15–16 | 66–67 | 115–126 | 98–106 | 9 | 17–19 |
| Ophidiidae – Neobythitinae | | | | | | |
| <i>Abyssobrotula galathea</i> | 17–19 | 67–75 | 97–116 | 76–96 | 8 | 10–11 |
| <i>Acanthonus armatus</i> | 9–10 | 60–65 | 98–108 | 88–100 | 8 | 16–19 |
| <i>Barathrites parri</i> | 19 | 67 | 112 | 82 | 8 | 22 |
| <i>Barathrodemus manatinus</i> * | 13 | 58 | 98–107 | 85–87 | 8 | 18–22 |
| <i>Bassogigas gilli</i> * | 15–16 | 61 | 83–106 | 67–84 | 6–8 | 27–31 |
| <i>Bassozetes compressus</i> | 11–15 | 67–72 | 123–129 | 102–109 | 8 | 24–27 |
| <i>Bassozetes normalis</i> | 13–15 | 67–71 | 121–132 | 99–108 | 8 | 22–28 |
| <i>Benthocometes robustus</i> | 11–12 | 49–50 | 95–111 | 79–98 | 11 | 27–33 |
| <i>Dicrolene intronigra</i> | 14 | 68 | 100–115 | 85–98 | 6–7 | 26 |
| <i>Dicrolene kanazawai</i> | – | 64 | 105–108 | 82–89 | 6–7 | 23–26 |
| <i>Luciobrotula corethromycter</i> * | 14–16 | 53–56 | 90–103 | 65–77 | 10–12 | 27–29 |
| <i>Monomitopus agassizi</i> * | 12–14 | 62 | 99–107 | 83–89 | 7–8 | 30–35 |
| <i>Neobythites marginatus</i> | 11–13 | 61–66 | 103–113 | 89–97 | 8 | 24–28 |
| <i>Penopus microphthalmus</i> * | 18–19 | 76–81 | 130–151 | 102–116 | 8 | 17–19 |
| <i>Porogadus miles</i> | 17–18 | 123–129 | 170–188 | 135–156 | 6–7 | 16–19 |
| <i>Spectrunculus grandis</i> | 18–25 | 71–79 | 121–148 | 90–113 | 8 | 22–23 |
| <i>Xyelacyba myersi</i> * | 11–12 | 49–52 | 87 | 71 | 9 | 19 |
| Bythitidae | | | | | | |
| <i>Diplacanthopoma brachysoma</i> * | 14–19 | – | 132 | 98 | 6? | – |
| <i>Thalassobathia pelagica</i> * | 12 | 48–49 | 72–79 | 58–65 | 10 | 22–27 |
| Aphyonidae | | | | | | |
| <i>Barathronus unicolor</i> * | 35–38 | 78–86 | 63–78 | 55–71 | 10 | 23–25 |

¹ Number of fin rays anterior to vertebra no. 31

Ophidiiformes

The order Ophidiiformes (*sensu* Cohen and Nielsen 1978; Nielsen *et al.*, 1999) contains the suborders Bythitoidei, viviparous forms with an external intromittent organ, and Ophidioidei, oviparous forms with pelvic fins at level of preopercle or farther anterior, and caudal fin confluent with dorsal and anal fins. Early stages of the Bythitoidei are rarely collected and are poorly known. In the Ophidioidei, larvae of Carapidae and the subfamily Ophidiinae are best known, probably because they occur rather commonly over continental shelf depths where most ichthyoplankton collecting has occurred. Neobythitine larvae are poorly described, thus general features are unknown.

General features

Ophidiiformes:

- Elongate larvae, preanus length generally short, caudal fin present or absent
- Myomeres, dorsal and anal fin ray counts high
- Unpaired fins long-based, confluent with caudal fin, if present; rays more numerous than adjacent vertebrae
- Pelvic fin rays positioned far forward, reduced to 1–2 rays, lacking in some species

Carapidae:

- Very elongate bodies, tapering to fine point (caudal filament often broken)
- Short, coiled gut (external and trailing in some)
- Elongate larval dorsal fin ray (the vexillum) anterior to 1st adult dorsal fin ray
- Anal fin rays longer than dorsal fin rays; dorsal fin rays are longer in ophidiids

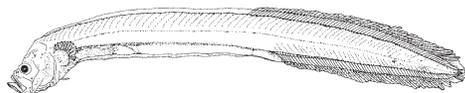
Brotulotaeniinae:

- Moderately to extremely trailing gut
- Pelvic fin rays originate well posterior to cleithra, lost at transformation
- Anterior dorsal fin pterygiophores modified (first 2 proximal and distal radials strongly fused, with tendency for entire apparatus to lean forward over neurocranium)

Ophidiinae:

- Body elongate, with relatively short preanus lengths
- Dorsal and anal fins long, confluent with caudal fin
- Characteristic, downward pointing jaw angle, contributing to a deep head
- Mid-section (or rarely the posterior end) of the gut tube forms a loop early in development
- Older larvae are laterally compressed
- Pelvic fin rays (two) arise from a thoracic position, and migrate forward when larvae settle to the bottom
- Pigment is generally light in most species, although some are prominently spotted

Larvae of Atlantic Ocean species of *Luciobrotula* (Brotulotaeniinae) and *Barathronus* (Aphyonidae) are undescribed. Larvae of congeners have been described from Pacific Ocean waters and are illustrated here because they are presumably similar.



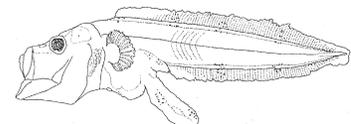
A. 41.8 mmSL

(Above): *Barathronus pacificus* **A.**
(Okiyama and Kato, 1997)

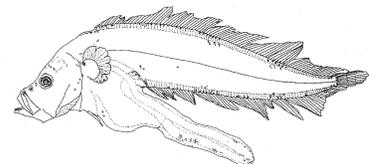
(Right): *Luciobrotula* sp. **B,D:** originally identified
as *Hoplobrotula armata* (Okiyama, 1988)

C: *Luciobrotula* sp. (Okiyama, pers. commun. 2002)

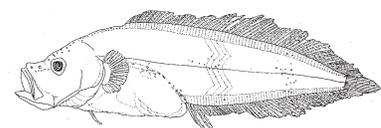
B.
10.1 mmSL



C.
16.0 mmSL



D.
20.7 mmSL



Ophidiiformes

Larvae of the subfamily Ophidiinae are most commonly collected in continental shelf waters and are often among the most common constituents of ichthyoplankton sampling studies. The larvae of 9 ophidiine species may be found in the study area. Important characters for distinguishing these larvae are contained in the table below. Also see counts of vertebrae and fin rays in the introductory meristic table. See Fahay and Hare (2003; 2006) for sources and additional species.

| <i>Species</i> | Gill Rakers | Ethmoid Spine ² | Dorsal Fin Origin ³ | Dorsal-Anal Fin Rays ⁴ |
|--------------------------------|-------------------|----------------------------|--------------------------------|-----------------------------------|
| <i>Lepophidium brevibarbe</i> | 3+6–8 | Long, pointed | | 23 |
| <i>Lepophidium jeannae</i> | 2+4 | Long, pointed | 1–2 (3) | 21–23 |
| <i>Lepophidium profundorum</i> | 9–12 ¹ | Long, pointed | 4–6 | 19–22 |
| <i>Ophidion josephi</i> | 2+4 | Short, pointed | 6–7 | 21–34 |
| <i>Ophidion marginatum</i> | 4–5 | Short, pointed | 6–8 | 24–33 |
| <i>Ophidion robinsi</i> | ?+4 | Short, blunt | 3–5 | 23–32 |
| <i>Ophidion selenops</i> | 2+5 | Long, pointed | 8–10 | 10–13 |
| <i>Otophidium omostigma</i> | 2–3+4 | Medium, pointed | 3 | 18–21 |
| <i>Parophidion schmidtii</i> | 2+4 | Low | 5–6 | 16–21 |

¹ 2–3 low rakers on upper limb + 5–7 well developed + 1–3 low rakers on lower limb. Also given as 3–4+7–8 (e.g. Uyeno, 1983)

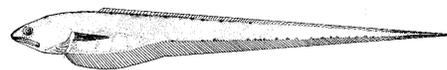
² Spine at tip of snout originating from ethmoid bone

³ Refers to interneural space into which the 1st interneural inserts

⁴ Refers to difference between total dorsal fin rays and total anal fin rays

Two species in the genus *Ophidion* differ in many respects from nominal congeners. Characters of *Ophidion selenops* and *O. nocomis* (a close relative from tropical waters) are compared to those of 10 *Ophidion* species in the table below:

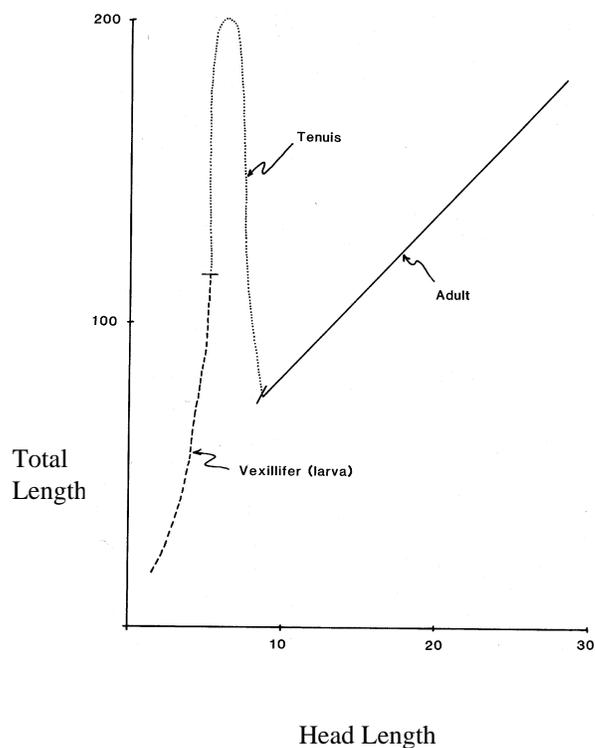
| Character | <i>Ophidion</i> spp. (n=10) | <i>Ophidion nocomis</i> / <i>Ophidion selenops</i> |
|--|-------------------------------------|---|
| Gut loop forms | At midsection of gut | At posterior end of gut |
| Vertebrae (range) | 61–70 (conservative within genera) | 84–87 or 77–81 |
| Dorsal fin origin | Vertebra 3–6 | Vertebra 6–9 |
| Antermost parapophyses | Vertebra 6 | Vertebra 8 |
| Number of pterygiophores per interneural space | Many species with 3 (patterns vary) | 2 (same as <i>Lepophidium</i>) |
| Ethmoid spine | Short, blunt or lacking | Prominent, long, sharp (same as <i>Lepophidium</i>) |
| Ventral gut pigment | Broad band of melanophores | Most on gut loop |
| Dorsal body pigment | Single median row, or paired rows | Very limited |
| Transformation | Gradual | Elongate pelagic stage, shrinkage at settlement |

Carapus bermudensis* (Jones, 1874)*Carapidae****Pearlfish****Meristic Characters**

| | |
|--------------------|-----------------|
| Myomeres: | many |
| Vertebrae: | 17–18 precaudal |
| Dorsal fin rays: | 36–45* |
| Anal fin rays: | 53–62* |
| Pectoral fin rays: | 17–20 |
| Pelvic fin rays: | none |
| Caudal fin rays: | 3–4 |

* anterior to vertebra #31

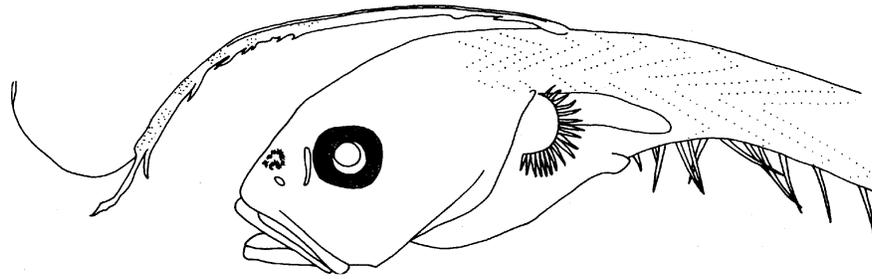
- Range:** Western North Atlantic Ocean from Bermuda, the Bahamas and south Florida through the Caribbean Sea to northern coast of South America
- Habitat:** Generally shallow waters near seagrass beds; occupies holothurian host during daylight, emerges at night
- Spawning:** Undescribed; free-swimming vexillifer larvae often collected in study area Feb–Nov, mostly late summer-early fall
- Eggs:** – Undescribed
- Larvae:**
- Body elongate, tapering to fragile, filamentous tip
 - Head relatively large, with prominent eye, nares well developed
 - Gut short, bulbous, in a flat coil; air bladder prominent
 - Dorsal and anal fin bases long
 - Pelvic fins lacking; pectoral fin bases lobate, not stalked
 - A vexillum, comprised of bilateral cartilaginous elements, arises from dorsal edge of body just behind head (and anterior to anal fin origin); ornamented with several fleshy tabs near tip
 - 1st dorsal fin ray origin over vertebra no. 10 or 11
 - 1st anal fin ray origin under vertebra no. 6
 - Pigmentation is sparse, limited to few spots on snout and on vexillum
- Note:** 1. Ontogeny includes a vexillifer stage, featuring an increase in length; a tenuis stage, where length is reduced; and an adult stage where growth resumes. See graph (after Arnold, 1956) and Figs. C–E (after Parmentier *et al.*, 2004)



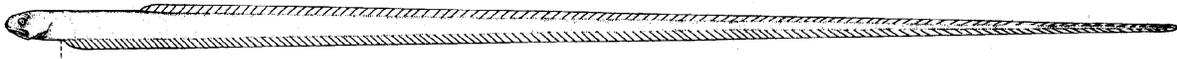
Figures: Adult: P. MacWhirter (Markle and Olney, 1990); A, F: Olney and Markle, 1979 (reversed); B: P. MacWhirter (Markle and Olney, 1990); C–E: Parmentier *et al.*, 2004

References: Arnold, 1956; Olney and Markle, 1979; Williams and Shipp, 1982; Govoni *et al.*, 1984; Parmentier *et al.*, 2004

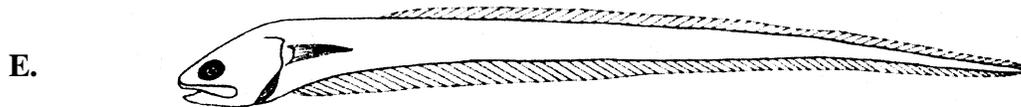
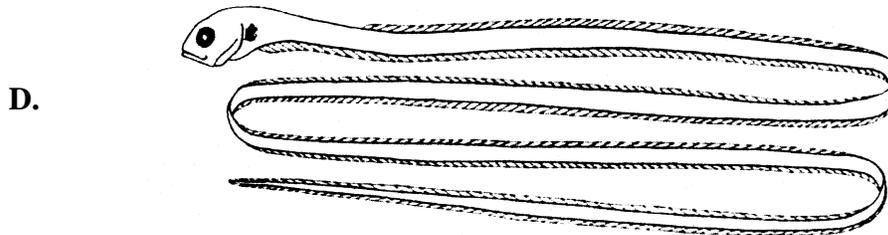
Carapus bermudensis



A. Vexillifer stage, 4.0 mm HL



B. Tenuis stage, 5.8 mm HL

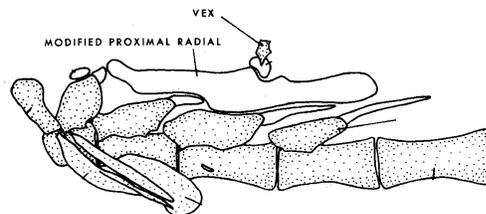


Growth stages in *Carapus homei* (South Pacific).

C: Vexillifer larva, 110 mmTL; D: Tenuis larva, 185 mmTL; E: Juvenile: 80 mmTL

F. Modified proximal radial

vex = base of vexillum



Echiodon dawsoni* Williams and Shipp, 1982*Carapidae****Chain pearlfish**

Range: Western North Atlantic Ocean from Cape Cod and Bermuda to southern Brazil, including Gulf of Mexico and Caribbean Sea

Habitat: Benthic, in depths of 75 to 175 m; free-living (not inquiline as many other species of carapids)

Spawning: Undescribed; larvae commonly collected in study area, May–Nov

Eggs: – Undescribed

Larvae:

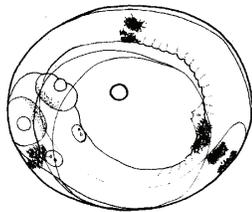
- Body elongate, tapering to fragile, filamentous tip
- Head relatively large, with prominent eye, nares well developed
- Gut short, bulbous, in a flat coil; air bladder prominent
- Dorsal and anal fin bases long
- Pelvic fins lacking; pectoral fin bases lobate, not stalked
- A vexillum, comprised of bilateral cartilaginous elements, arises from dorsal edge of body some distance behind head, immediately anterior to first dorsal fin ray (and posterior to anal fin origin)
- 1st dorsal fin ray origin over vertebrae no. 11–12
- 1st anal fin ray origin under vertebra no. 6
- Pigmentation is sparse, limited to peritoneal spots in some specimens

Note:

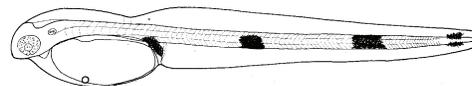
1. Ontogeny includes a vexillifer stage, featuring an increase in length; a tenuis stage, where length is reduced; and an adult stage where growth resumes. See graph on *Carapus bermudensis* page. This growth pattern is not as strongly expressed in *Echiodon dawsoni* as it is in *C. bermudensis*.
2. Development of egg and vexillum in an undescribed species of carapid (possibly *Echiodon*) from South Africa (Brownell, 1979) is shown below:

Meristic Characters

| | |
|-----------------------------|-----------------|
| Myomeres: | many |
| Vertebrae: | 21–25 precaudal |
| Dorsal fin rays: | 28–35* |
| Anal fin rays: | 39–43* |
| Pectoral fin rays: | 17–21 |
| Pelvic fin rays: | none |
| Caudal fin rays: | none |
| * anterior to vertebra # 31 | |



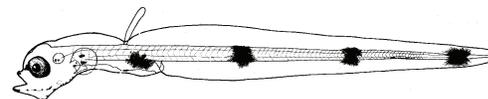
C. 1.14 x 0.99 mm
(Note oval egg)



D. 4.8 mm



E. 5.5 mm

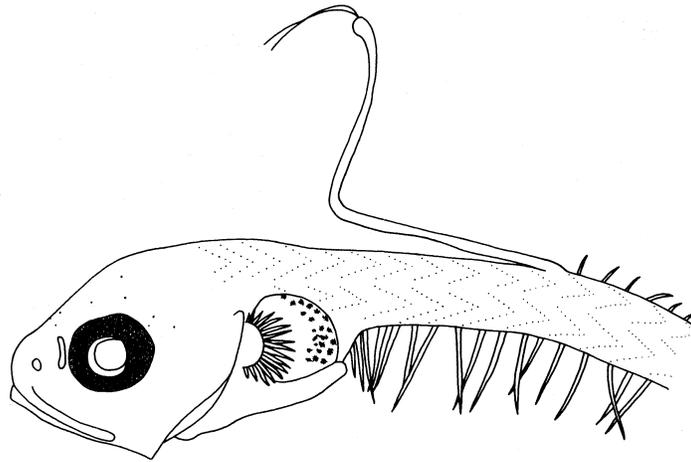


F. 5.8 mm

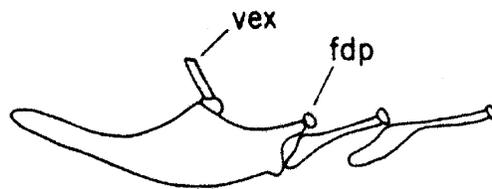
Figures: Adult: Esta Belcher (Williams and Shipp, 1982); A: Olney and Markle, 1979; B: Gordon *et al.*, 1984; C–F: Brownell, 1979

References: Olney and Markle, 1979; Williams and Shipp, 1982; Govoni *et al.*, 1984

Echiodon dawsoni



A. Vexillifer stage



B. Anterior 3 pterygiophores

vex = base of vexillum
fdp = distal radial of 1st dorsal fin ray

Echiodon drummondi* (Cuvier, 1829)*Carapidae**

No common name



- Range:** Temperate eastern North Atlantic Ocean
- Habitat:** Benthic, in depths to 200 m; free-living; common.
- Spawning:** Undescribed; remote chance of collecting larvae within study area (e.g. west of 40°W and north of 35°N)
- Eggs:** – Undescribed
- Larvae:**
- Body elongate, tapering to fragile, filamentous tip
 - Head relatively large, with prominent eye, nares well developed
 - Gut short, bulbous, in a flat coil; air bladder prominent
 - Dorsal and anal fin bases long
 - Pelvic fins lacking; pectoral fin bases lobate, not stalked
 - A vexillum, comprised of bilateral cartilaginous elements, arises from dorsal edge of body some distance behind head, immediately anterior to first dorsal fin ray (and at about same level as anal fin origin)
 - 1st dorsal fin ray origin over vertebra no. 9
 - 1st anal fin ray origin under vertebra no. 8
 - Pigmentation is sparse or absent

Meristic Characters

| | |
|--------------------|-----------------|
| Myomeres: | many |
| Vertebrae: | 26–29 precaudal |
| Dorsal fin rays: | 42–47* |
| Anal fin rays: | 46–51* |
| Pectoral fin rays: | 15–17 |
| Pelvic fin rays: | none |
| Caudal fin rays: | |

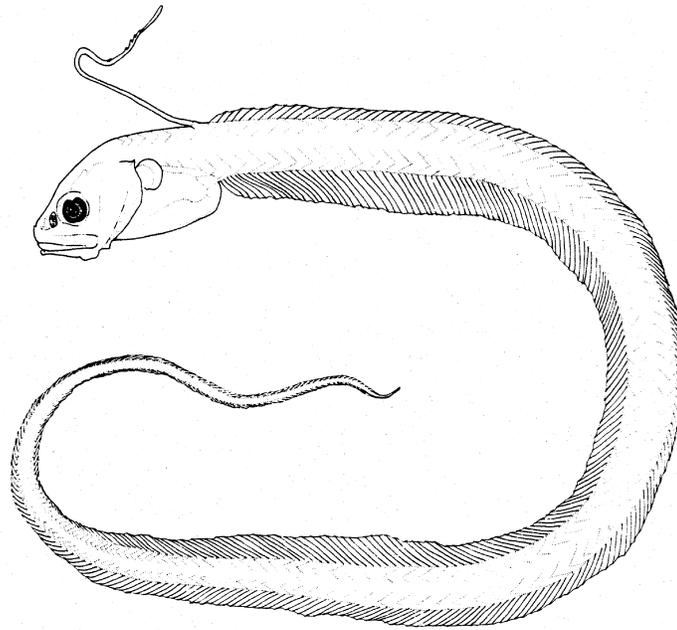
* anterior to vertebra # 31

- Note:**
1. Ontogeny includes a vexillifer stage, featuring an increase in length; a tenuis stage, where length is reduced, and an adult stage where growth resumes. See graph on *Carapus bermudensis* page. This growth pattern is not as strongly expressed in the present species.
 2. Although it is unlikely that larvae of this species will be encountered in the study area, it is most obviously discriminated from larvae of *E. dawsoni* by a combination of characters including fewer pectoral fin rays, more precaudal vertebrae, and fewer myomeres (or vertebrae) between the origins of dorsal and anal fins

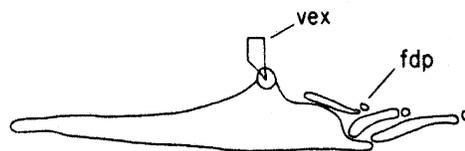
Figures: Adult: P. MacWhirter (Markle and Olney, 1990); **A:** Betsy Washington (Gordon *et al.*, 1984); **B:** Markle and Olney, 1990

References: Olney and Markle, 1979; Williams and Shipp, 1982; Govoni *et al.*, 1984

Echiodon drummondi



A. Vexillifer stage 3.8 mmHL



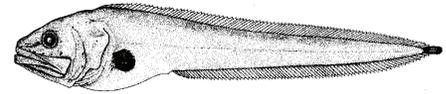
B. Anterior 3 pterygiophores

vex = base of vexillum

fdp = distal radial of 1st dorsal fin ray

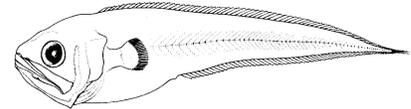
***Brotulotaenia* (3 species, see below)**
Ophidiidae (s.f. Brotulotaeniinae)
 No common name

- Range:** Worldwide (see table below)
- Habitat:** Meso-, bathy- and possibly benthopelagic; collected in both midwater and bottom trawls
- Spawning:** Undescribed
- Eggs:** – Undescribed
- Larvae:**
- Gut is moderately extirpated
 - Relative head length decreases through development
 - Developmental sequence is strongly anterior to posterior
 - Dorsal and anal fin bases long, rays long (dorsal longer than anal)
 - Pelvic fin rays elongate, originate posterior to cleithral symphysis, attach to flexible, cartilaginous rod, lost at transformation
 - Anterior dorsal fin rays more elongate than remainder
 - Caudal fin separate from dorsal and anal fins
 - Frontal bones elongate; "lionesque" expression
 - Series of melanophores form along upper and lower myosepta angles



Brotulotaenia nigra

Meristic Characters
 See table below

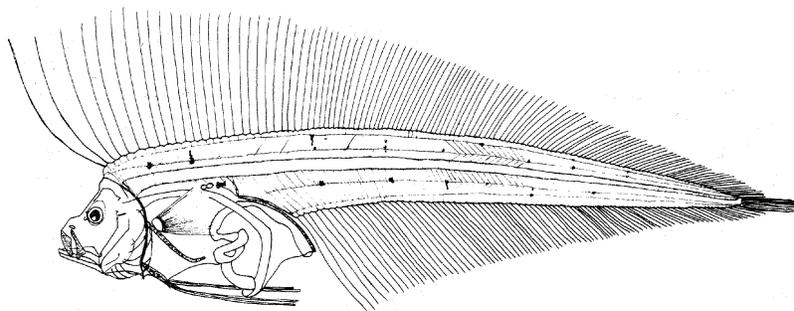


Brotulotaenia brevicauda



Brotulotaenia crassa

| | <i>B. brevicauda</i> Cohen, 1974 | <i>B. crassa</i> Parr, 1934 | <i>B. nigra</i> Parr, 1933 |
|----------------------|-------------------------------------|--------------------------------|-------------------------------|
| Distribution (Ocean) | Atlantic and Indian | Atlantic and Indian | Tropical Atlantic |
| Vertebrae | 63–66 | 88–96 | 89–90 |
| Dorsal fin rays | 79–84 | 119–134 | 113–115 |
| Anal fin rays | 58–64 | 98–108 | 91–94 |
| Pectoral fin rays | 21–24 | 22–26 | 20–25 |



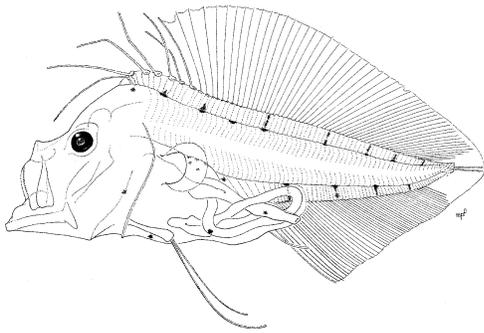
E. 62.6 mmSL *B. crassa*

Brotulotaenia nielseni has not yet been reported from the western Atlantic Ocean. The 15.5-mm larva is included here to complete a series of *Brotulotaenia* development. See Okiyama and Kato (2002) for complete description of Pacific larvae.

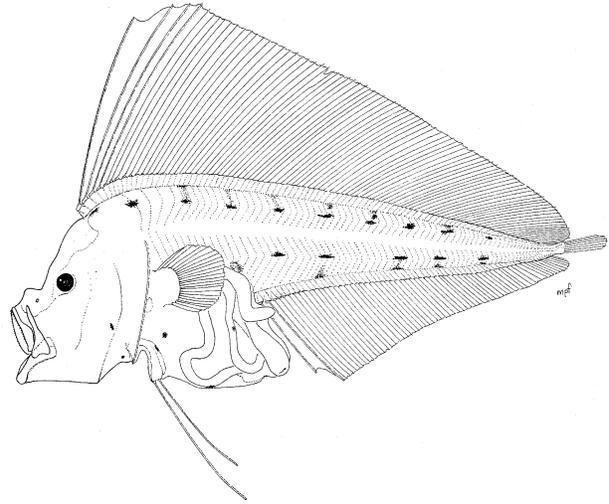
Figures: Adults: *B. nigra*: Nielsen *et al.*, 1999; *B. brevicauda*: Nielsen, 1986; *B. crassa*: Keiko Moore (Cohen, 1974); **A–D**: Fahay and Nielsen, 2003; **E**: Aboussouan, 1980

References: Cohen, 1974; Aboussouan, 1980; Bañón *et al.*, 1999; Okiyama and Kato, 2002; Fahay and Nielsen, 2003; Fahay and Hare, 2003; 2006

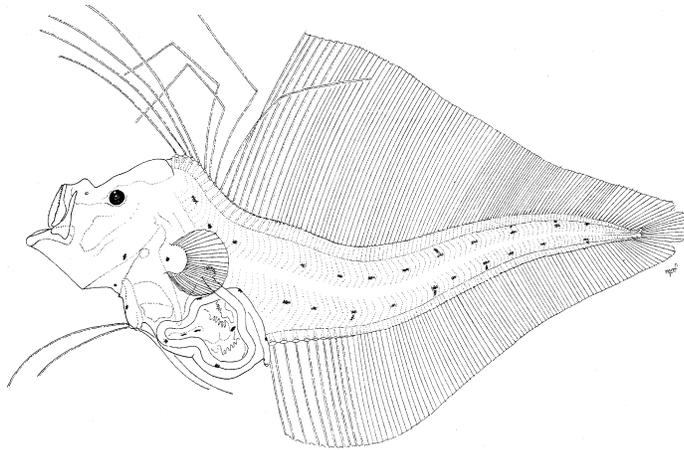
Brotulotaenia brevicauda, *B.nielseni* and *B. nigra*



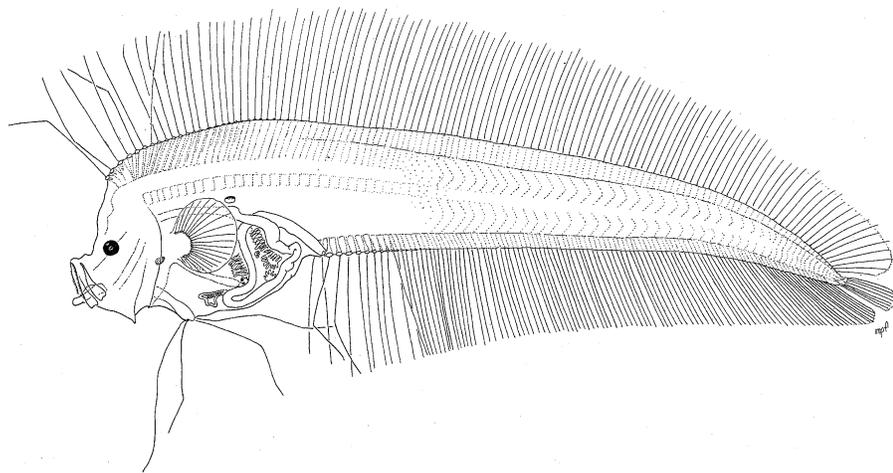
A. 9.7 mmSL
B. brevicauda



B. 15.5 mmSL
B. nielseni



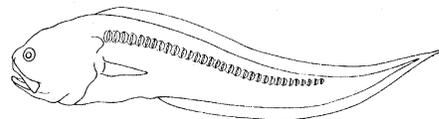
C. 25.0 mmSL
B. nigra



D. 45.3 mmSL
B. nigra

Lamprogrammus niger* Alcock, 1891*Ophidiidae (s.f. Brotulotaeniinae)**

No common name



Range: This species and *L. brunswigi*, both present in the study area, are circum-tropical

Habitat: Small individuals are meso- to bathypelagic; larger ones are usually taken by bottom trawls at bathyal depths

Spawning: Undescribed

Eggs: – Undescribed

Larvae:

- Gut extremely extirpated; trailing well outside gut cavity
- Intestine forms single or double loop, depending on species
- Relative head length decreases through development
- Developmental sequence is strongly anterior to posterior
- Dorsal and anal fin bases long, rays long (dorsal longer than anal)
- Pelvic fin rays elongate, originate posterior to cleithral symphysis, attach to flexible, cartilaginous rod, lost at transformation
- Anterior dorsal fin rays more elongate than remainder
- Caudal fin separate from dorsal and anal fins
- Frontal bones elongate; "lionesque" expression
- Pigmentation includes series of melanophores along body, gut and fleshy tabs on trailing gut

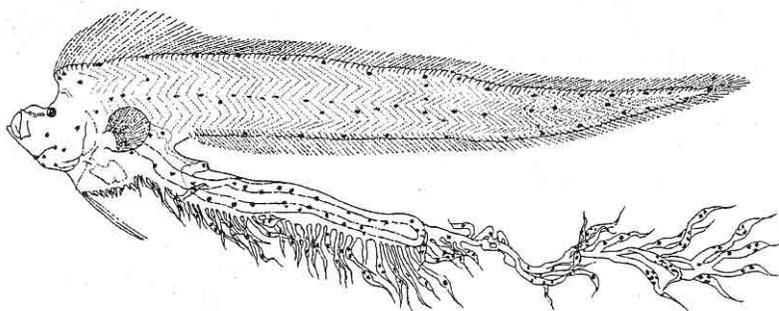
Note:

1. The circumglobal species *Lamprogrammus shcherbachevi* has only been found from tropical waters in the western Atlantic, although it has recently been found farther north in the eastern Atlantic (Nielsen and Schwarzhans, 2000). Both the adults and larvae are noticeably slimmer-bodied than congeners
2. The extirpated larva described by Moser (1981) (see Fig. E) has recently been referred to *Lamprogrammus brunswigi* (Fahay and Nielsen, 2003). Similar larvae (Gordon *et al.*, 1984; Okiyama, 1988) are also referable to *L. brunswigi*; two others (Nielsen, 1963; Fraser and Smith, 1974) are conspecific with *L. shcherbachevi*.

Meristic Characters

See table below

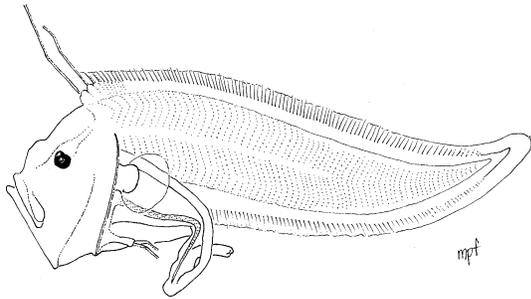
| | <i>L. brunswigi</i> (Brauer, 1906) | <i>L. niger</i> Alcock, 1891 | <i>L. shcherbachevi</i> Cohen and Rohr, 1986 |
|-------------------|---------------------------------------|---------------------------------|---|
| Vertebrae | 68–71 | 65–72 | 71–74 |
| Dorsal fin rays | 108–125 | 103–117 | 131–140 |
| Anal fin rays | 92–108 | 81–91 | 104–117 |
| Pectoral fin rays | 19–22 | 16–19 | 18–19 |

**E. 64 mmSL**

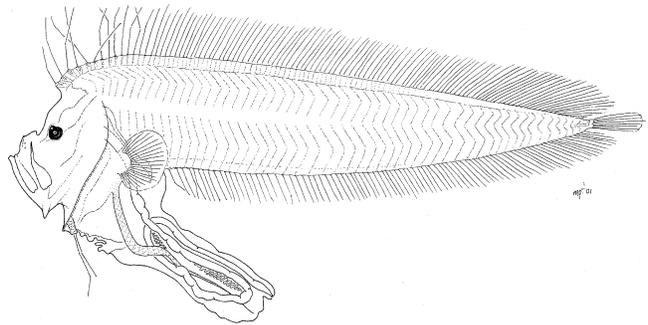
Figures: Adult: Nielsen and Cohen, 1986; **A–D:** Fahay and Nielsen, 2003; **E:** Moser, 1981

References: Cohen *et al.*, 1991; Cohen and Rohr, 1993; Fahay and Nielsen, 2003; Fahay and Hare, 2003; 2006

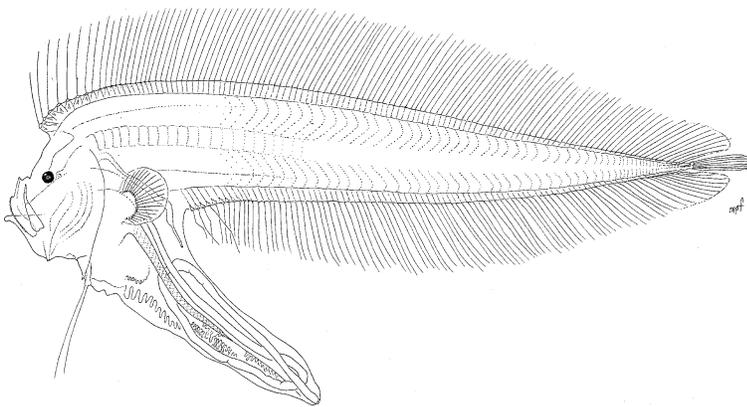
Lamprogrammus niger and *L. shcherbachevi*



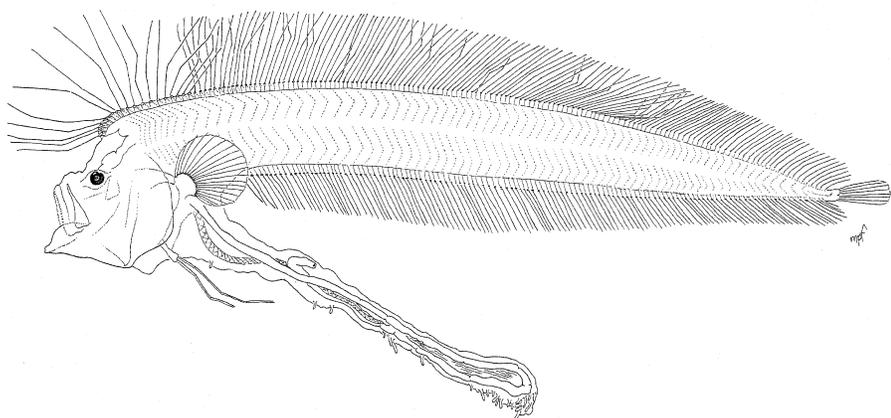
A. 9.5 mmSL
L. niger



B. 19.4 mmSL
L. niger



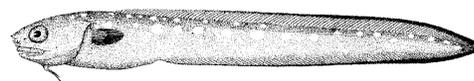
C. 35.7 mmSL
L. niger



D. 31.0 mmSL
L. shcherbachevi

Lepophidium profundorum* (Gill, 1863)*Ophidiidae (s.f. Ophidiinae)**

Fawn cusk-eel



Range: Western North Atlantic Ocean from Georges Bank to northern Florida and Gulf of Mexico

Habitat: Outer continental shelf in depths of 55–365 m, especially on silty or soft mud bottoms

Spawning: Summer-fall in the Middle Atlantic Bight; larvae are the most widely distributed ophidiid species in the study area, extending from just north of Cape Hatteras to Georges Bank, mostly over depths >40 m; larvae are especially abundant on the outer continental shelf south of southern New England and along the southern flank of Georges Bank

Eggs: – Undescribed

Larvae:

- Hatching occurs at a length of about 2.0 mm (based on smallest pelagic larvae collected)
- Body elongate with relatively short gut
- Preanus length decreases from 39–48%SL (preflexion) to 29–38%SL (postflexion)
- The gut forms a coil, midway along its length at about 3.5 mm
- Flexion begins at about 7.0 mm and is complete at about 13.0 mm
- Vertebrae ossify from anterior end to posterior end
- Dorsal, anal and caudal fin rays begin to form at about 9.0 mm
- Pectoral fin rays form early (about 8.5 mm)
- Pigment includes a characteristic series of prominent melanophores along ventral edge from anus to tail tip; these number 4 in smallest larvae (with minor pigment between the major spots), increase to 10–11 in the largest larvae; these prominent spots internalize at transformation
- Other pigmentation includes a single dorsal melanophore located opposite the posteriormost ventral spot; from mid-flexion onwards, a single spot covers each distal pterygiophore of the anal fin; branchiostegal membrane pigment is absent in preflexion larvae, faint in older larvae; pigment along venter of gut is absent in preflexion larvae, light in older larvae (and does not form a broad belt as in *Ophidion marginatum* and *O. robinsi*); flexion and older larvae have few spots along each dentary; except for the last melanophore, pigment along dorsum is absent
- A pungent, anteriorly directed ethmoid spine occurs on snout in large larvae, juveniles and adult
- Descent to the bottom occurs at about 42 mmSL, based on largest pelagic larva collected

Note:

1. The pelvic fin rays arise from a point near the cleithral symphysis in larvae; after settlement to the bottom, the pelvic fin basipterygium elongates and the rays appear to originate from near the lower jaw tip
2. Pigment in juveniles (or largest pelagic larva) includes subcutaneous spots along the ventral edge, with a remnant pair just before caudal peduncle, and broad swaths of fine spots along the dorsal and ventral thirds of the flank (middle third unpigmented)

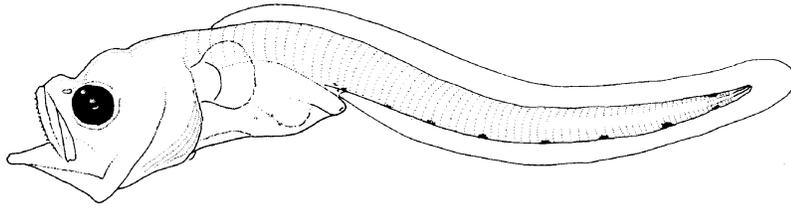
Meristic Characters

| | |
|--------------------|---------|
| Myomeres: | 73–78 |
| Vertebrae: | 73–78 |
| Dorsal fin rays: | 131–140 |
| Anal fin rays: | 110–121 |
| Pectoral fin rays: | 22–24 |
| Pelvic fin rays: | 2 |
| Caudal fin rays: | 4+5=9 |

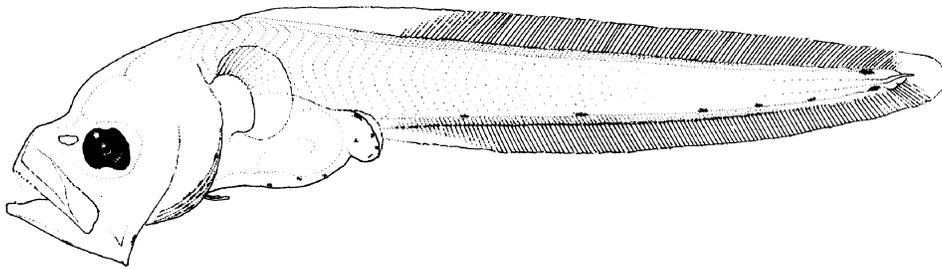
Figures: Adult: H.L. Todd; A–C: Fahay, 1992

References: Fahay, 1992; Nielsen *et al.*, 1999; Collette and M^{ac}Phee, 2002b; Fahay and Hare, 2003; 2006

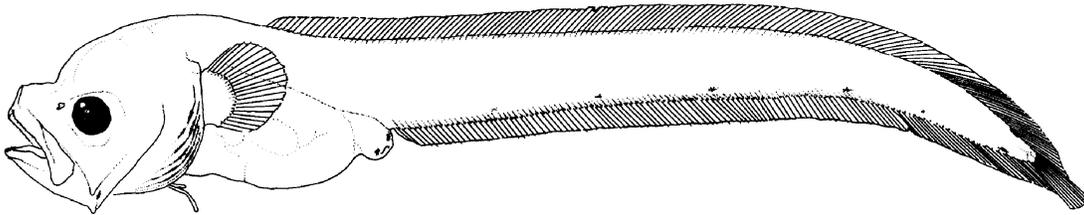
Lepophidium profundorum



A. 6.0 mmNL

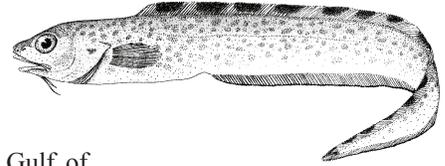


B. 9.2 mmNL



C. 16.7 mmNL

***Lepophidium jeannae* Fowler, 1941**
Ophidiidae (s.f. Ophidiinae)
 Mottled cusk-eel



Range: Coastal United States from North Carolina to Florida and northern Gulf of Mexico

Habitat: Benthic in depths of 18–280 m, (mostly between 64 and 73 m off Texas). Several "R/V *Eastward*" specimens, including early-settlement stages, have been collected from North Carolina locations north of 35°N (M. P. Fahay and J. A. Hare, pers. observ.)

Spawning: Ripe females found Feb–Jul off Texas

Eggs: – Undescribed

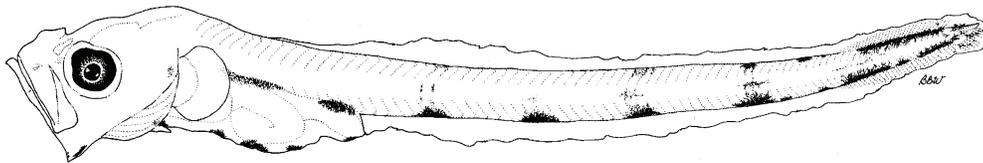
Larvae:

- Body elongate with short preanus length
- The gut forms a coil, midway along its length
- Pigment includes a characteristic series of prominent melanophores along ventral edge, with a corresponding melanophore on dorsal edge near tail tip
- Few spots on branchiostegal membrane
- Gut pigment is light; few spots near anus
- A pungent, anteriorly directed ethmoid spine occurs on snout in large larvae, juveniles and adult

Meristic Characters

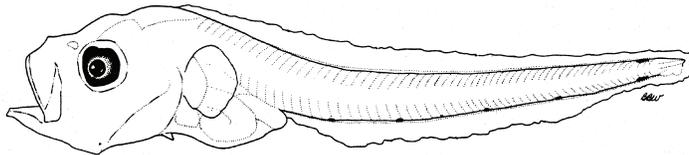
| | |
|--------------------|---------|
| Myomeres: | 73–75 |
| Vertebrae: | 73–75 |
| Dorsal fin rays: | 131–140 |
| Anal fin rays: | 112–117 |
| Pectoral fin rays: | 20–21 |
| Pelvic fin rays: | 2 |
| Caudal fin rays: | 4+5=9 |

Note: 1. The occurrence of as many as 8 undescribed species of *Lepophidium* in the western Atlantic (Nielsen *et al.*, 1999) precludes progress in understanding ontogenetic development in members of this genus. Examples of described larvae from outside the study area are included here to illustrate recurring characters:



E. 12.0 mmSL *Lepophidium staurophor* (Gulf of Mexico)

This species has been collected in depths of 208–248 m off North Carolina as far north as 33°10.3'N, 77°16.6'W (Quattrini *et al.*, 2004). Collections included a gravid female, therefore there is a potential for early stages to occur in the study area, most likely in Gulf Stream or Slope Sea waters.

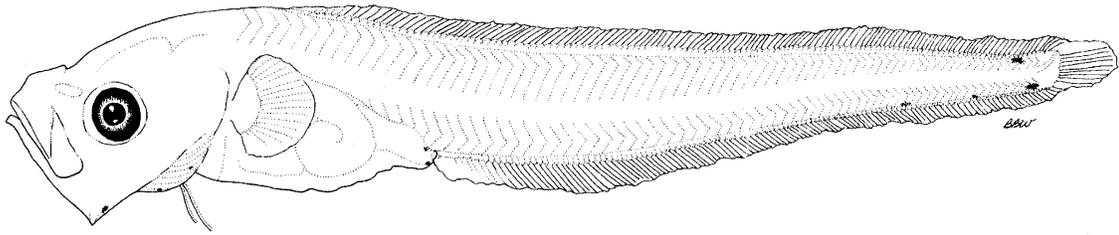


F. 7.8 mmNL *Lepophidium* sp. (Gulf of Mexico)

Figures: Adult: Janice Fechhelm (M^cEachran and Fechhelm, 1998); **A, C, E–F:** Betsy Washington (Gordon *et al.*, 1984); **B, D:** Nancy Arthur (Ambrose, 1996)

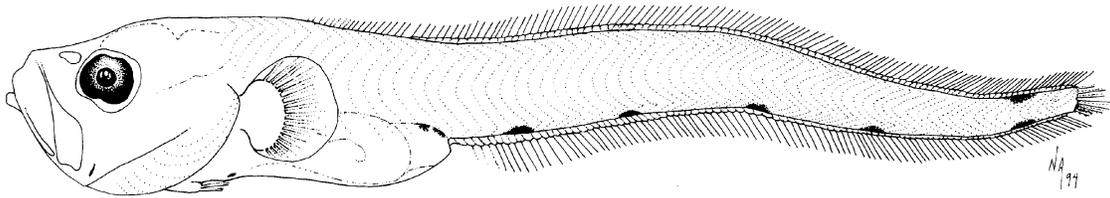
References: Gordon, 1982; Gordon *et al.*, 1984; Retzer, 1991; Ambrose, 1996; Fahay, 1992; Fahay and Hare, 2003; 2006

Lepophidium jeannae

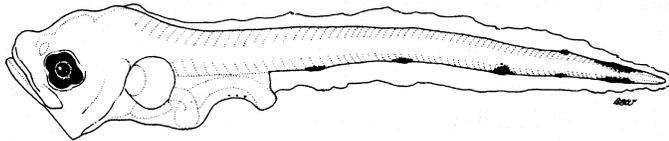


A. 11.0 mmSL

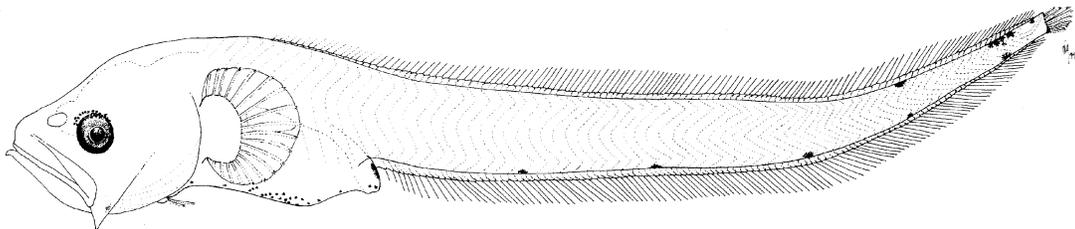
Examples of larval *Lepophidium* included to demonstrate similarities and range of characters in the genus



B. 11.2 mmSL *Lepophidium stigmatistium* (Pacific Ocean)



C. 5.1 mmSL *Lepophidium negropinna* (Pacific Ocean)



D. 13.3 mmSL *Lepophidium negropinna* (Pacific Ocean)

Ophidion josephi* Girard, 1859*Ophidiidae (s.f. Ophidiinae)**

Crested cusk-eel



Range: Atlantic coast of the United States from Georgia to northeast Florida and the northern Gulf of Mexico; isolated occurrences farther north along the east coast

Habitat: Shallow coastal waters in depths of 0–55 m.

Spawning: Oct–Nov off Texas coast; age at earliest maturity 8–9 months; transforming larvae have been collected as far north as New Jersey, usually in the fall

Eggs: – Undescribed

Larvae:

- Hatching occurs at a length of about 2.0 mm
- Body elongate with short gut length; preanus length decreases from 43–48%SL (preflexion) to 33–38%SL (postflexion)
- The gut forms a coil, midway along its length at about 4.0 mmNL
- Flexion begins at about 6.5 mmNL and is complete at about 16.0 mmSL
- Vertebrae ossify from both ends toward the middle
- Dorsal, anal and caudal fin rays begin to form at about 8.0 mmNL
- Pectoral fin rays form late
- Pigment includes a single, median line of separate spots along the anterior dorsal edge of body followed by a scattering of spots posteriorly in early larvae (Fig. A); later larvae lose the anterior mid-dorsal line but retain the posterior scattered spots
- Other pigmentation includes rows of distinct spots along both sides of the anal fin base, a median streak of spots along midline on posterior part of tail, a scattering of spots on the branchiostegal membrane, a midventral line of spots in the gular area (in larger larvae) and a broad belt of gut pigment along venter
- Descent to the bottom occurs at about 45 mmSL, based on largest pelagic larvae collected

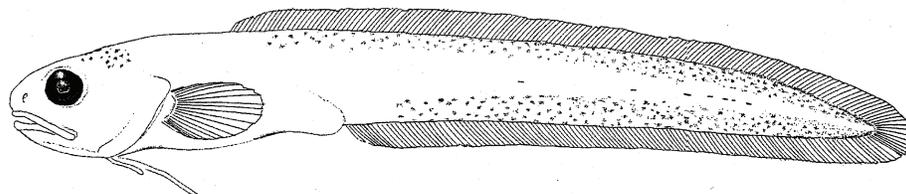
Meristic Characters

| | |
|--------------------|---------|
| Myomeres: | 67–68 |
| Vertebrae: | 67–68 |
| Dorsal fin rays: | 128–150 |
| Anal fin rays: | 105–122 |
| Pectoral fin rays: | 21–22 |
| Pelvic fin rays: | 2 |
| Caudal fin rays: | 4+5 = 9 |

- Note:**
1. Both larvae and adults are very similar to *Ophidion marginatum*; meristic characters are lower in *O. josephi*, but overlap broadly; larvae have a lateral stripe as in larvae of *O. marginatum*., but have different numbers of gut and venter melanophores; an area of overlap in the latter characters occurs off Georgia. Larvae and juveniles are best distinguished from *O. marginatum* by meristic characters and interdigitation pattern.
 2. The well-known and often-used name *Ophidion welshi* (Nichols and Breder, 1922) is a junior synonym of *Ophidion josephi* Girard, 1858 (Nielsen *et al.*, 1999).

Juvenile:

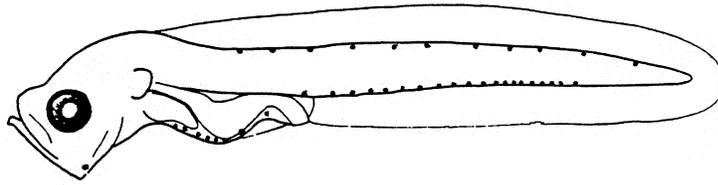
E. 45.0 mmSL



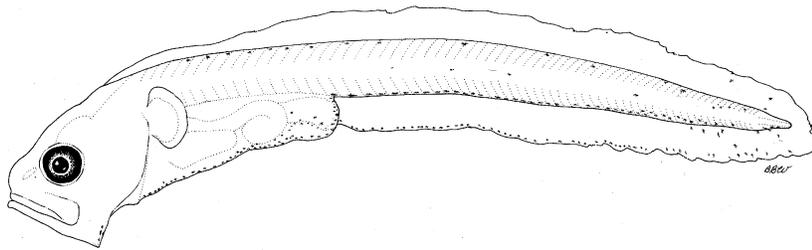
Figures: Adult: Nichols and Breder, 1922; **A, C–D:** Gordon, 1982 (as "Type 2"); **B:** Betsy Washington (Gordon *et al.*, 1984); **E:** original (collected 6 Jan, 1978 at 35°19.8'N, 75°12.6'W, R/V *Eastward*)

References: Gordon, 1982; Gordon *et al.*; 1984; Retzer, 1991; Fahay and Hare, 2003; 2006

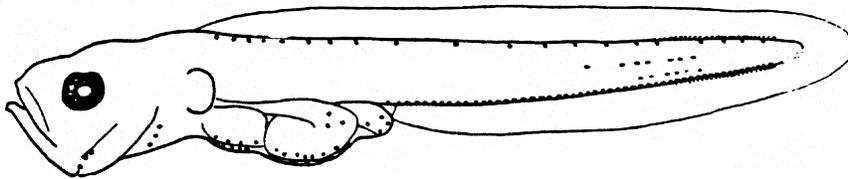
Ophidion josephi



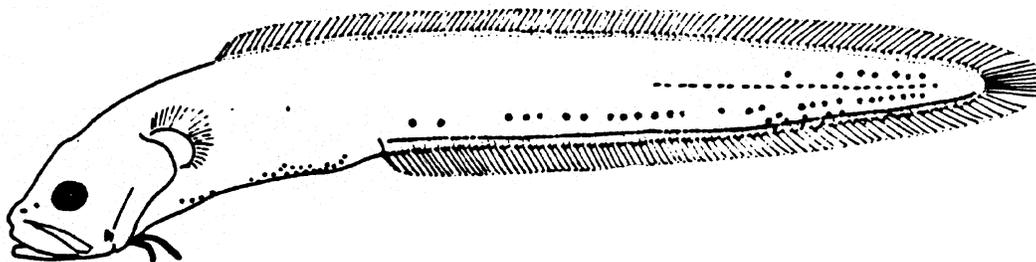
A. 4.5 mmNL



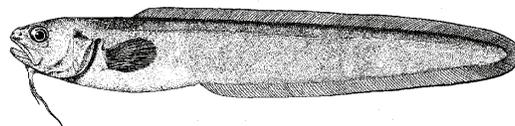
B. 7.0 mmNL



C. 8.5 mmNL



D. 17.0 mmSL

Ophidion marginatum* (DeKay, 1842)*Ophidiidae (s.f. Ophidiinae)****Striped cusk-eel**

Range: Western North Atlantic Ocean from New York to northern Florida; occurrences in Gulf of Mexico need confirmation

Habitat: Sandy bottoms on inner continental shelf and embayments; burrows in the substrate during day, emerges at night

Spawning: Jun–Nov in study area; more extended season south of 35°N; spawning presumably occurs at night and is associated with courtship and sound production; females may release small batch of eggs nightly for up to 2 months (in laboratory)

Eggs:

- Slightly off-round, encased in buoyant, gelatinous veil
- Diameter: 0.83–1.02 mm (short axis) × 0.88–1.06 mm (long axis)
- Chorion: smooth, emits iridescent colors with transmitted light
- Yolk: homogeneous
- Oil globules: lacking
- Perivitelline space: narrow
- Incubation occupies 36 hours at 24°–26°C

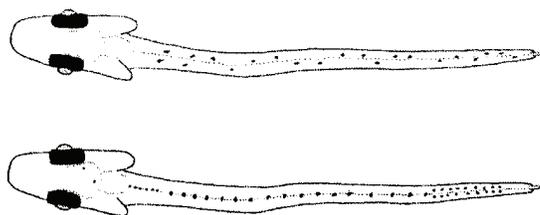
Larvae:

- Hatching occurs at a length of about 2.0 mm
- Body elongate with short gut length; preanus length decreases from 43–48%SL (preflexion) to 33–38%SL postflexion)
- The gut forms a coil, midway along its length at about 4.0 mm
- Flexion begins at about 6.5 mm and is complete at about 16.0 mm
- Vertebrae ossify from both ends toward the middle
- Dorsal, anal and caudal fin rays begin to form at about 8.0 mm
- Pectoral fin rays form late
- Pigment includes a single, median line of separate spots along the anterior dorsal edge of body followed by a scattering of spots posteriorly in early larvae (Fig. E); later larvae lose the anterior mid-dorsal line but retain the posterior scattered spots
- Other pigmentation includes rows of distinct spots along both sides of the anal fin base, a median streak of spots along midline on posterior part of tail, a scattering of spots on the branchiostegal membrane, a midventral line of spots in the gular area (in larger larvae) and a broad belt of gut pigment along venter
- Descent to the bottom occurs at about 22 mmSL, based on largest pelagic larvae collected

Note: 1. The pelvic fin rays arise from a point near the cleithral symphysis in larvae; after settlement to the bottom, the pelvic fin basipterygium elongates and the rays appear to originate from near the lower jaw tip

Meristic Characters

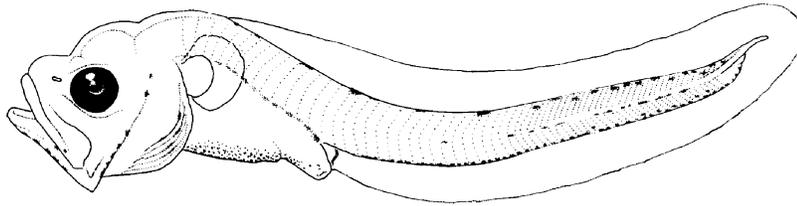
| | |
|--------------------|-----------|
| Myomeres: | 67–70 |
| Vertebrae: | 67–70 |
| Dorsal fin rays: | 138–162 |
| Anal fin rays: | 116–129 |
| Pectoral fin rays: | about 21 |
| Pelvic fin rays: | 2 |
| Caudal fin rays: | 4+5 (PrC) |

**E. Dorsal pigment in *Ophidion robinsi* (top) and *O. marginatum* (bottom)**

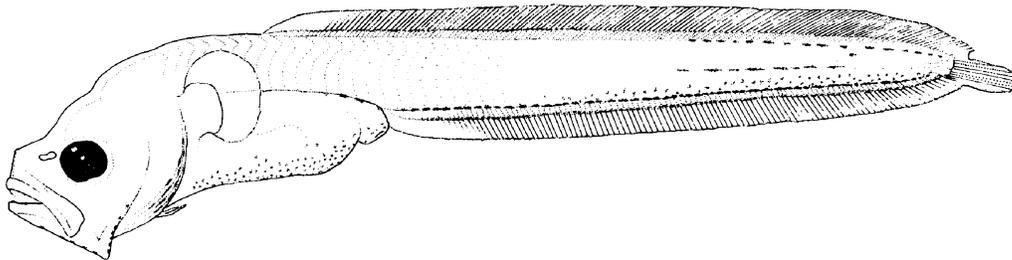
Figures: Adult: H. L. Todd; A–C: Fahay, 1992; D: Susan Kaiser (Able and Fahay, 1998); E: Jon Hare (Fahay and Hare, 2003)

References: Gordon *et al.*, 1984; Fahay, 1992; Able and Fahay, 1998; Collette and McPhee, 2002; Fahay and Hare, 2003; 2006

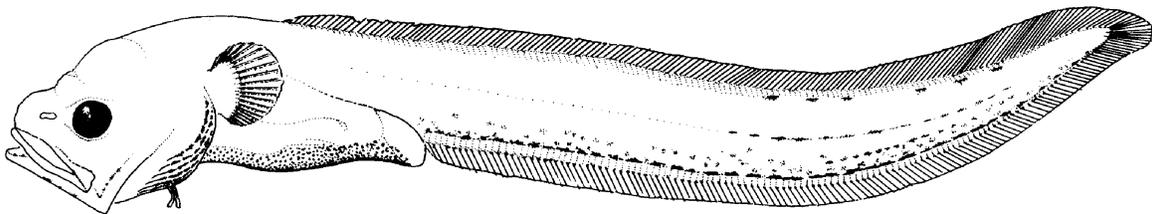
Ophidion marginatum



A. 6.7 mmNL

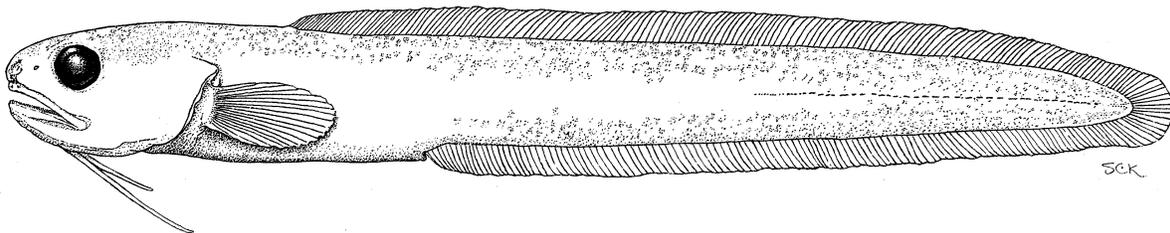


B. 9.8 mmNL



C. 17.5 mmNL

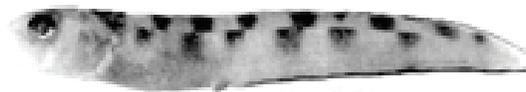
Note: Mid-lateral streak of pigment on posterior tail is present only in larvae of this species and those of *O. josephi*



**D. 41.8 mmSL
Juvenile**

Ophidion robinsi* Fahay, 1992*Ophidiidae (s.f. Ophidiinae)**

Checkered cusk-eel



Range: Western North Atlantic Ocean from off Delaware Bay, New Jersey to Charleston, South Carolina

Habitat: Sandy substrates on inner continental shelf, in depths of 12–45 m; a burrowing and cryptic species

Spawning: Begins in May near Cape Hatteras, increases through the summer as far north as New Jersey, ends during fall. Larvae distributed over mid-depths of continental shelf. Spawning patterns south of study area unknown

Eggs: – Undescribed

Larvae:

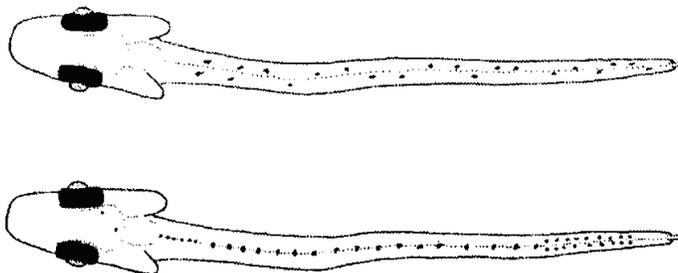
- Hatching occurs at a length of about 2.0 mm (based on smallest larvae collected)
- Body elongate with short gut length; preanus length decreases from 43–61%SL (preflexion) to 39–42%SL (postflexion); somewhat stubbier (and deeper bodied) than larvae of *Ophidion marginatum*
- The gut forms a coil, midway along its length at about 3.5 mm
- Flexion begins at about 7.0 mm and is complete at about 13.0 mm
- Vertebrae ossify from both ends toward the middle
- Dorsal, anal and caudal fin rays begin to form at about 7.5–8.0 mm
- Pectoral fin rays form late
- Dorsal pigment in early larvae consists of spots on both sides of the median line randomly distributed (Fig. E); dorsal pigment in the anterior region disappears during preflexion stage; scattered pigment retained in posterior region
- Other pigmentation includes rows of distinct spots along both sides of the anal fin base (more widely spaced than similar spots in *O. marginatum*), a scattering of spots on the branchiostegal membrane (most intense during flexion and postflexion), a broad belt of gut pigment along venter, and a broad belt of spots above, and blending with, the anal fin base rows (in later larvae)
- Descent to the bottom occurs at about 20 mmSL, based on largest pelagic larvae collected

Note:

1. The pelvic fin rays arise from a point near the cleithral symphysis in larvae; after settlement to the bottom, the pelvic fin basipterygium elongates and the rays appear to originate from near the lower jaw tip
2. Numbers of meristic characters are lower in this species than any other western North Atlantic ophidiid species except *Otophidium omostigma*; larvae and adults of the latter are separable by pigmentation characters

Meristic Characters

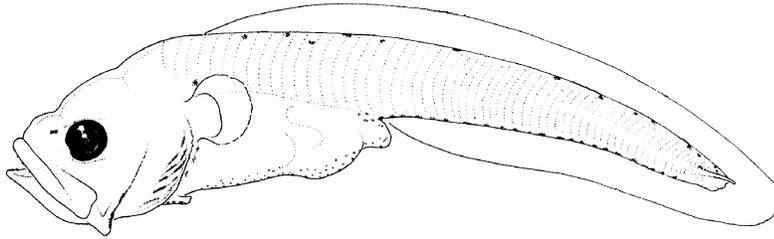
| | |
|--------------------|---------|
| Myomeres: | 60–63 |
| Vertebrae: | 61–63 |
| Dorsal fin rays: | 107–125 |
| Anal fin rays: | 85–93 |
| Pectoral fin rays: | 19–22 |
| Pelvic fin rays: | 2 |
| Caudal fin rays: | 4+5=9 |

**E. Dorsal pigment in *Ophidion robinsi* (top) and *O. marginatum* (bottom)**

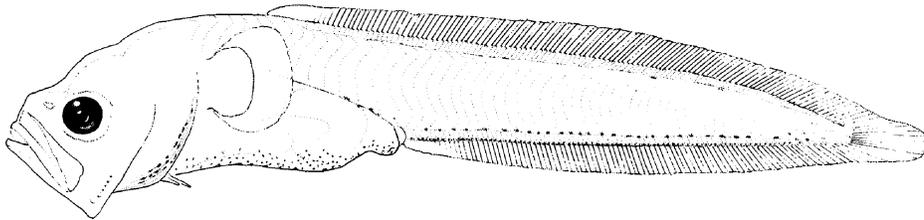
Figures: Adult: Fahay, 1992; A–C: Fahay, 1992; D: original (U. Wisconsin, Acc # 77-24) E: Jon Hare (Fahay and Hare, 2003)

References: Fahay, 1992; Nielsen *et al.*, 1999; Fahay and Hare, 2003; 2006

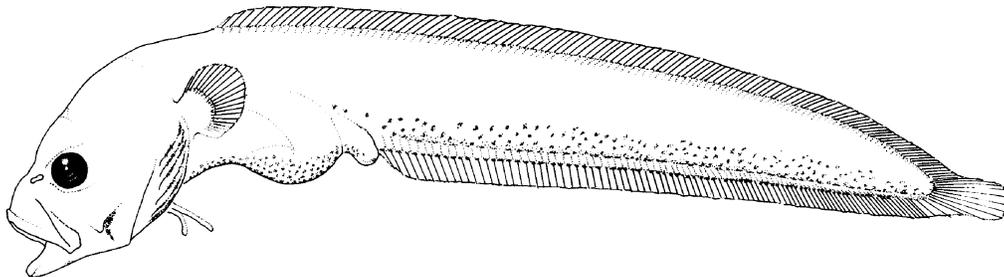
Ophidion robinsi



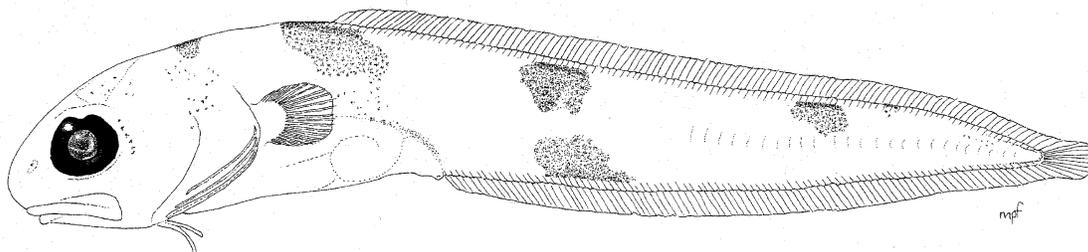
A. 5.9 mmNL



B. 8.8 mmNL



C. 17.0 mmNL



D. 23.6 mmSL

(R/V Eastward, E8-77, Sta. 6, Oct. 17, 1977)

Ophidion selenops* Robins and Böhlke, 1959*Ophidiidae (s.f. Ophidiinae)**

Mooneye cusk-eel

Adult figure unavailable

Range: Coastal United States from North Carolina to Florida Keys and southeastern Gulf of Mexico (larvae in Campeche Bay)

Habitat: Occurs in depths of 12–45 m; benthic, presumably burrowing in sand bottoms; common off North Carolina coast

Spawning: Spring-summer off North Carolina; larvae often drift great distances and are commonly collected as far north as Scotian Shelf

Eggs: – Undescribed

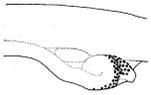
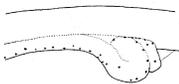
Larvae:

- Body and head regions extremely slender (much more so than in congeners)
- Concave ventral outline between head and gut loop typical
- Gut forms loop near anus (unusual location for *Ophidion*; congeners form loop in mid-gut)
- Venter of gut lacks broad belt of pigment (present in all congeners except *O. nocomis*); few spots present
- Pigment is lacking along dorsal edge (present in all congeners except *O. nocomis*)
- Light scattering of pigment on gut loop, near anus
- Faint cluster of spots forms weak band at mid-tail
- Dorsal and ventral series of spots occur near tail tip
- Meristic characters much higher than in congeners (except *O. nocomis*, where they are higher still)
- A pungent, ethmoid spine is easily felt at tip of snout (absent in all congeners except *O. nocomis*)
- Largest size of pelagic larvae: 48 mm

Note:

1. Pelagic stage becomes very elongate before reduction of intervertebral spaces causes decrease in length immediately before larvae settle to the bottom. In all congeners described to date (except *O. nocomis*), transformation is gradual, with no striking changes between larval and juvenile stages
2. Similar larvae of a close relative, *O. nocomis*, are also described, but occurrences are limited to waters south of the Bahamas. They have more myomeres (84–87) than *O. selenops* and differ in pigment pattern on the gut coil (see below):

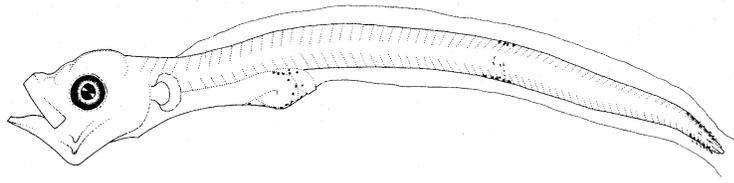
| Meristic Characters | |
|---------------------|---------|
| Myomeres: | 77–80 |
| Vertebrae: | 77–81 |
| Dorsal fin rays: | 132–140 |
| Anal fin rays: | 123–129 |
| Pectoral fin rays: | 15–16 |
| Pelvic fin rays: | 2 |
| Caudal fin rays: | 4+5=9 |

| Approximate size | <i>Ophidion selenops</i> | <i>Ophidion nocomis</i> |
|------------------|---|---|
| 5.0 mm |  |  |
| 8.0 mm |  |  |
| 19.0 mm |  |  |
| 40.0 mm |  |  |

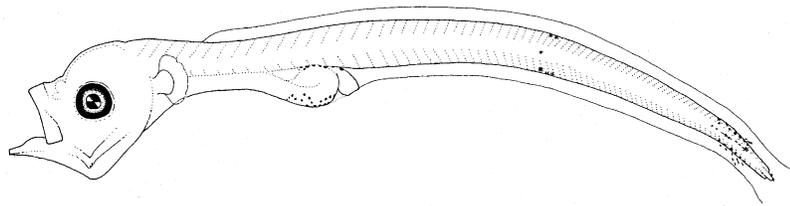
Figures: Gut pigment and A–C, E: Jon Hare (Fahay and Hare 2003); D: Betsy Washington (Gordon *et al.*, 1984)

References: Gordon, 1982; Fahay and Hare, 2003; 2006

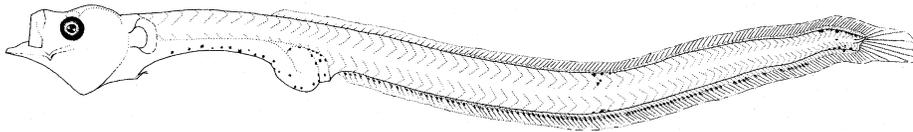
Ophidion selenops



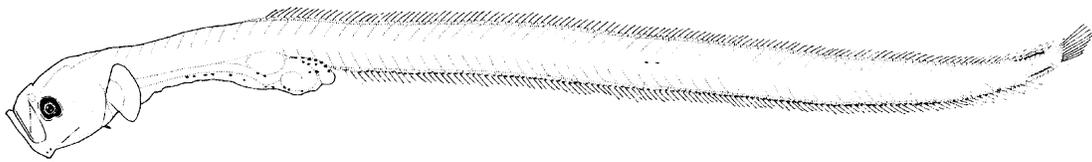
A. 5.6 mmTL



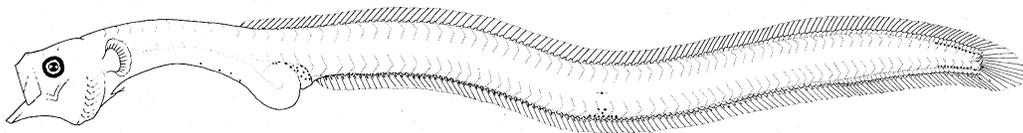
B. 7.9 mmTL



C. 19.1 mmTL

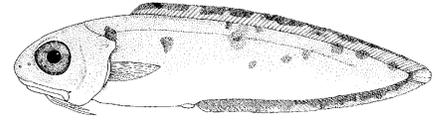


D. 24.0 mmSL



E. 38.2 mmSL

***Otophidium omostigma* (Jordan and Gilbert, 1882)**
Ophidiidae (s.f. Ophidiinae)
Polka-dot cusk-eel



Range: Western North Atlantic Ocean from North Carolina and northern Gulf of Mexico to Florida and Lesser Antilles

Habitat: Collected from depths of 16–50 m

Spawning: Undescribed; larvae infrequently collected in study area, usually from Gulf Stream or Slope Sea waters

Eggs: – Undescribed

Larvae:

- Body elongate with short gut; coil forms in mid-gut region
- Pectoral fin development delayed
- A flat and short ethmoid spine is present in larger larvae and juveniles
- Note low numbers of meristic characters
- Flexion occurs at 6–8 mm
- Light pigment present on finfolds before fin rays form
- Pigment includes a scattering of melanophores forming a band across tail, at about 2/3 of the tail length; this band gradually dissolves in larger larvae, when it is only visible as a few spots; a second, minor cluster of spots sometimes visible near caudal peduncle
- Venter of gut with light scattering of melanophores; melanophores also present on dorsal surface of gut
- Branchiostegal membranes with scattering of spots

Note: 1. The larvae of 2 other species of *Otophidium* have been collected in waters well south of 35°N, but have not yet been identified from the study area

Juvenile:

- Prominent spot situated on side above opercle tip
- Prominent spotted pattern over body

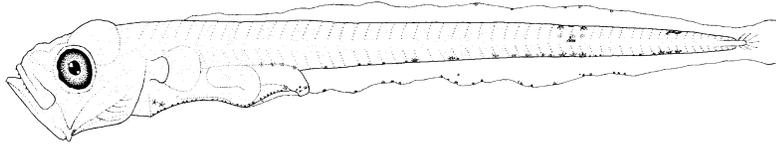
Meristic Characters

| | |
|--------------------|--------|
| Myomeres: | 56–58 |
| Vertebrae: | 56–58 |
| Dorsal fin rays: | 99–108 |
| Anal fin rays: | 84–87 |
| Pectoral fin rays: | 16–18 |
| Pelvic fin rays: | 2 |
| Caudal fin rays: | 4+5=9 |

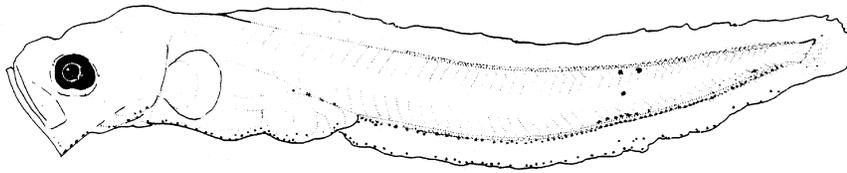
Figures: Adult: Nielsen *et al.*, 1999; **A, C:** Jon Hare (Fahay and Hare, 2003); **B:** Betsy Washington (Gordon *et al.*, 1984)

References: Gordon *et al.*, 1984; Hare *et al.*, 2001; Fahay and Hare, 2003; 2006

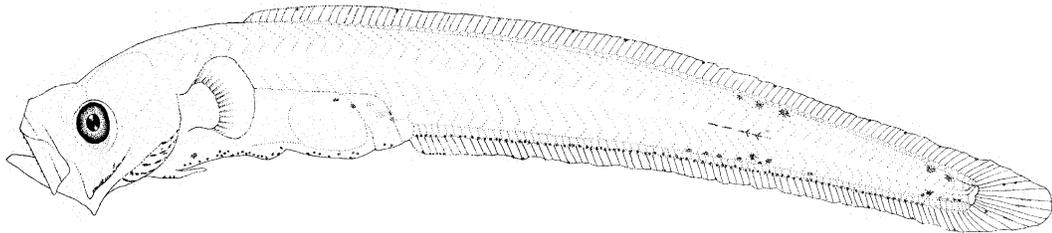
Otophidium omostigma



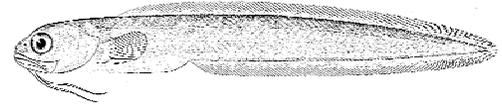
A. 6.6 mmSL



B. 8.3 mmNL



C. 13.8 mmSL

Parophidion schmidti* (Woods and Kanazawa, 1951)*Ophidiidae (s.f. Ophidiinae)****Dusky cusk-eel**

Range: Western North Atlantic Ocean from Bermuda, the Bahamas and southern Florida to northern South America

Habitat: Very shallow coastal waters, often associated with seagrass beds over sandy bottoms in protected or semi-protected bays

Spawning: Undescribed; larvae rarely collected in study area in Aug

Eggs: – Undescribed

Larvae:

- Body slim, elongate, with short gut; preanus length about 32% SL
- Gut cavity characteristically triangular in shape; gut coil not obvious
- When fully developed, the 2 pelvic fin rays are equal in length
- Ethmoid spine present, but reduced to low, rounded structure
- Pigment on body typically light; usually paired rows on dorsal and ventral edge of body near tail tip
- Head pigment includes a distinct scattering of spots on crown and spots on branchiostegal membrane
- A series of spots along base of anal fin

Note:

1. Settlement of larvae to bottom habitats may be delayed; pelagic collections contain many examples of post-transformation juveniles
2. Best distinguished from larvae of other ophidiines by slim body and triangular gut; distinguish from larvae of *Ophidion* by interdigitation pattern

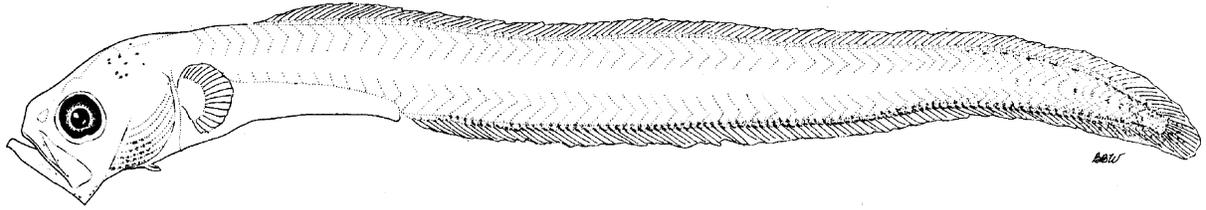
Meristic Characters

| | |
|--------------------|---------|
| Myomeres: | 66–67 |
| Vertebrae: | 66–67 |
| Dorsal fin rays: | 115–126 |
| Anal fin rays: | 98–106 |
| Pectoral fin rays: | 17–19 |
| Pelvic fin rays: | 2 |
| Caudal fin rays: | 4+5=9 |

Figures: Adult: Nielsen *et al.*, 1999; A: Betsy Washington (Gordon *et al.*, 1984)

References: Böhlke and Robins, 1959; Gordon *et al.*, 1984; Fahay, 1992; Fahay and Hare, 2003; 2006

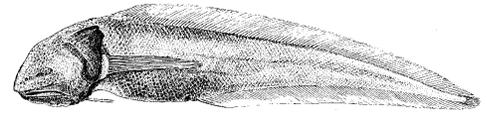
Parophidion schmidt



A. 17.0 mmSL

***Abyssobrotula galatheae* Nielsen, 1977**
Ophidiidae (s.f. Neobythitinae)

No common name



- Range:** Worldwide in tropical and subtropical seas; in the western North Atlantic from south of Nantucket Island to Puerto Rican Trench and off Florida
- Habitat:** Benthopelagic at abyssal and hadal depths (3,110–8,370 m). This is the world's deepest occurring fish species
- Spawning:** Undescribed; the postlarval specimen illustrated (MCZ 76782), was collected at 37°01'N, 71°18'W in Aug
- Eggs:** – Undescribed
- Larvae:**
- Body elongate with short gut; preanus length about 36% SL
 - Eyes small, but proportionately larger than in adults
 - Weakly developed pelvic fin rays
 - Long dorsal and anal fin bases
 - Dorsal fin rays slightly longer than anal fin rays
 - Light, scattered pigment on gut with darker peritoneal pigment
 - Upper corner of opercle with smudge of pigment
 - Other pigment lacking
- Note:** 1. In both the adults and young specimen illustrated, the caudal skeleton is characterized by elongate hypural bones (Fig. B and C) and a caudal fin formula of 4+3+1.

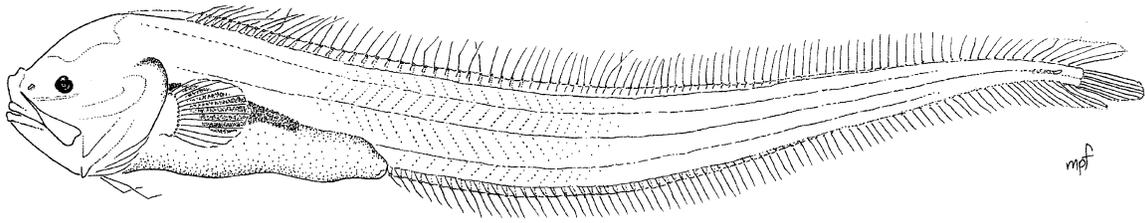
Meristic Characters

| | |
|--------------------|-------------|
| Myomeres: | 67–68 |
| Vertebrae: | 18–19+49–56 |
| Dorsal fin rays: | 97–116 |
| Anal fin rays: | 76–96 |
| Pectoral fin rays: | 10–11 |
| Pelvic fin rays: | 2 |
| Caudal fin rays: | 4+3+1 |

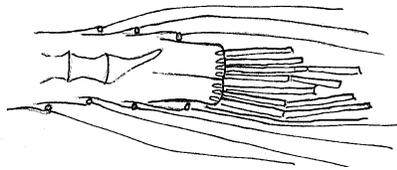
Figures: Adult: Nielsen, 1977; **A–B:** original; **C:** Nielsen, 1977 (modified)

References: Nielsen, 1977; Fahay and Hare, 2003; 2006

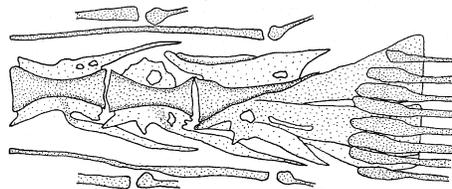
Abyssobrotula galathea



A. 36 mmSL



**B. 36 mmSL
(Caudal Fin Area)**



C. Adult Caudal Fin

***Acanthonus armatus* Günther, 1878**
Ophidiidae (s.f. Neobythitinae)

No common name



Range: Circumglobal in tropical and subtropical waters; in the western North Atlantic from Hudson Canyon to the Caribbean Sea

Habitat: Benthopelagic in abyssal and bathyal depths (1,500–4,415 m)

Spawning: Undescribed

Eggs: – Undescribed

Larvae:

- Elongate body with very short, somewhat bulbous, gut
- Head length very short
- Weakly developed pelvic fin rays
- Several upper pectoral fin rays greatly elongate
- Internal pigment on peritoneum and lining of branchial chamber

Note: 1. Adults are typified by long and slender opercle-angle spine and prominent, bifid spine at tip of snout; beginnings of both of these structures are visible in the larva illustrated, as is an early forming spine at the angle of the preopercle

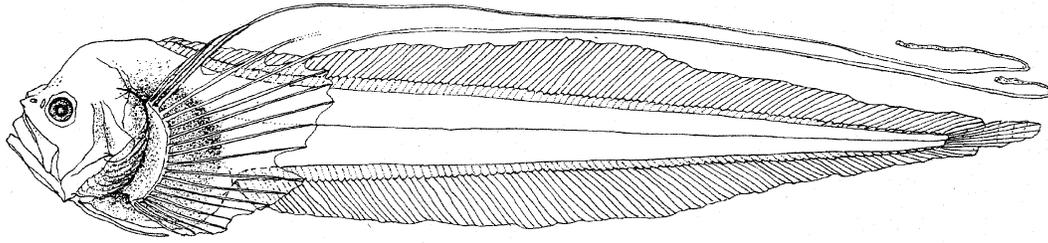
Meristic Characters

| | |
|--------------------|--------------|
| Myomeres: | 60–65 |
| Vertebrae: | 9–10 + 50–55 |
| Dorsal fin rays: | 98–108 |
| Anal fin rays: | 88–100 |
| Pectoral fin rays: | 16–19 |
| Pelvic fin rays: | 2 |
| Caudal fin rays: | 8 |

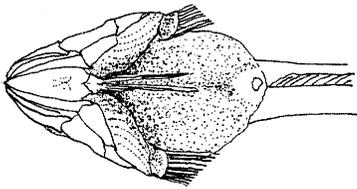
Figures: Adult: Nielsen *et al.*, 1999; **A–B:** Okiyama, 1988

References: Cohen and Pawson 1977; Nielsen *et al.*, 1999; Fahay and Hare, 2003; 2006

Acanthonus armatus



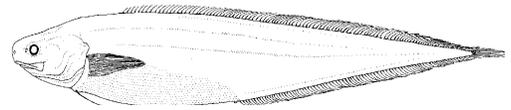
A. 47.6 mmSL



**B. 47.6 mmSL
(Venter of Head and Gut)**

***Barathrites parri* Nybelin, 1957**
Ophidiidae (s.f. Neobythitinae)

No common name



Range: Western North Atlantic Ocean over continental slopes; in study area south of southern New England

Habitat: Benthopelagic in depths of 1,270 to 3,000 m; can be abundant in some locations

Spawning: Undescribed

Eggs: – Undescribed

Larvae:

- Elongate body, tapering to very narrow caudal peduncle
- Moderately short gut
- Greatly elongate, bifid pelvic fin ray with fleshy tabs at end and mid-length
- Dorsal and anal fin bases long; dorsal rays longer than anal rays
- Widely spaced series of melanophores along length of body
- Gut with overlying prominent melanophores
- Prominent spot behind eye
- Pectoral fin rays presumably late-forming

Meristic Characters (n = 1)

| | |
|--------------------|--------|
| Myomeres: | 69 ± 2 |
| Vertebrae: | 67 |
| Dorsal fin rays: | 112 |
| Anal fin rays: | 82 |
| Pectoral fin rays: | 22 |
| Pelvic fin rays: | 2 |
| Caudal fin rays: | 8 |

Note: 1. The larva illustrated was hand-collected (dip-net) by diver (Harbison sta. 408 on "R/V *Chain*" cruise 125, Aug. 13, 1975) in an area just south of Cape Hatteras (34°56'N, 71°13'W).

2. Meristic characters of illustrated specimen:

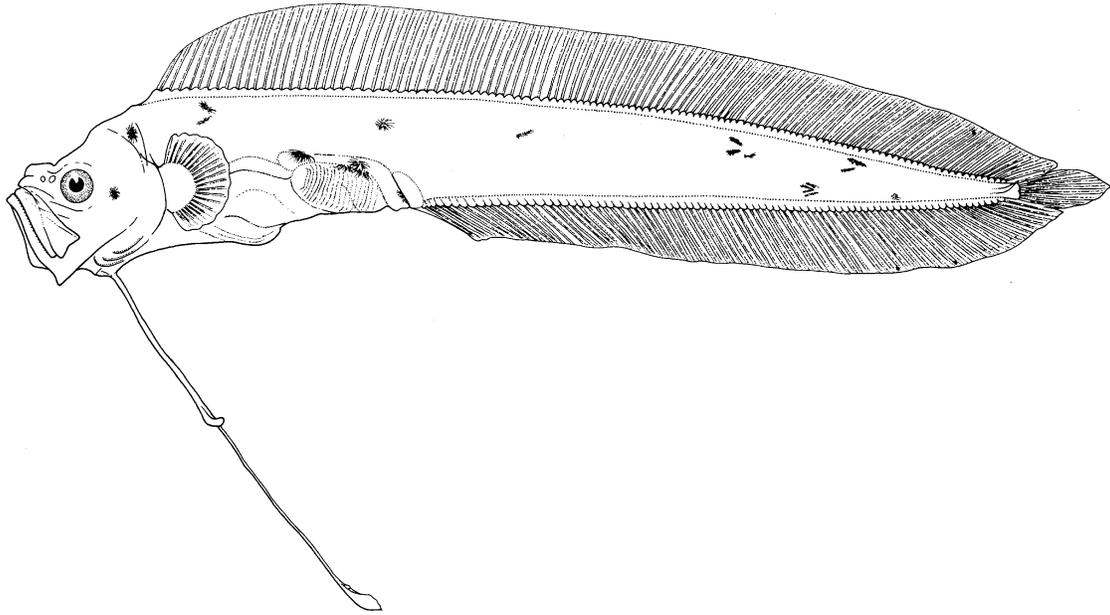
| | |
|--------------------|----------|
| Myomeres: | 69 ± 2 |
| Dorsal fin rays: | 117 |
| Anal fin rays: | 84 |
| Pectoral fin rays: | about 22 |
| Caudal fin rays: | 4+4 |

3. This larva has been tentatively assigned to *B. parri* because of the close agreement of meristic characters with those of adults.

Figures: Adult: Nielsen *et al.*, 1999; A: Henry Orr (specimen and illustration loaned by G. Moser)

References: Nybelin, 1957; Nielsen *et al.*, 1999; Fahay and Hare, 2003; 2006

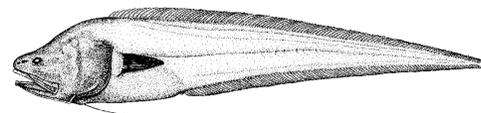
Barathrites parri



A. 21.5 mmSL

Bassozetus compressus* (Günther, 1878)*Ophidiidae (s.f. Neobythitinae)**

No common name



Range: Eastern and western Atlantic Ocean; in the western Atlantic known from collections in northern Sargasso Sea, off the southeastern United States, Gulf of Mexico, Caribbean Sea and West Indies to northern coast of South America; also off southern Brazil

Habitat: Deep benthopelagic over mid-slope to abyssal depths; collections range from 3,180 to 5,456 m

Spawning: Undescribed; ripe females reported from 432–560 mmSL

Eggs: – Undescribed

Larvae:

- Body very elongate, tapering to narrow caudal peduncle
- Preanus length very short
- Dorsal and anal fins very long based, separate from caudal fin
- Dorsal fin rays longer than anal fin rays
- 5 prominent melanophores (or clusters of a few spots) along upper side of body, the 1st at level of anus, the 5th on caudal peduncle
- Several distinct melanophores on head, opercle and pectoral fin base
- Pigment at mid-length of developing pelvic fin rays

Note: 1. Larva illustrated (MCZ 101089) collected from 32°38'N, 77°18'W (northern Sargasso Sea) Jul 29, 1993:

| | |
|-----------------------|-----|
| Myomeres + vertebrae: | 74 |
| Dorsal fin rays: | 125 |
| Anal fin rays: | 102 |
| Pectoral fin rays: | 24 |
| Caudal fin rays: | 4+4 |

Meristic Characters

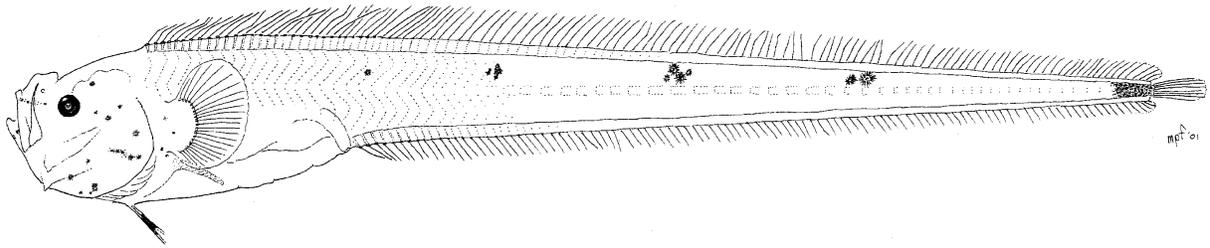
| | |
|--------------------|-----------|
| Myomeres: | 67–72 |
| Vertebrae: | 67–72 |
| Dorsal fin rays: | 123–129 |
| Anal fin rays: | 102–109 |
| Pectoral fin rays: | 24–27 |
| Pelvic fin rays: | 1 |
| Caudal fin rays: | 4 + 4 = 8 |

These meristic characters are also coincident with those of *B. taenia*, except for pectoral fin ray counts (26–27 in the latter).

Figures: Adult: M. Anderson (Nielsen and Merrett, 2000); A: original

References: Nielsen *et al.*, 1999; Nielsen and Merrett, 2000; Fahay and Hare, 2003; 2006

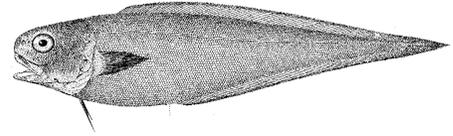
Bassozetus compressus



A. 53 mmSL

***Benthocometes robustus* (Goode and Bean, 1886)**
Ophidiidae (s.f. Neobythitinae)

No common name



Range: Tropical western Atlantic Ocean, also eastern Atlantic off northwest Africa and Mediterranean Sea

Habitat: Benthopelagic in depths of 500–1,000 m

Spawning: Undescribed; a long pelagic larval stage is suggested by disjunct distribution (e.g. both sides of the Atlantic Ocean)

Eggs: – Undescribed

Larvae:

- Body moderately elongate and compressed with short, coiled gut
- Dorsal and anal fins long-based, confluent with caudal fin
- Air bladder situated over anterior gut
- 2 spines on upper angle of opercle in larger larvae
- Pelvic fin composed of 1 spine and 2 rays in larvae; the spine is lost at transformation
- Anal fin rays and interhaemals longer than dorsal fin rays and interneurals (unusual for ophidiids); the opposite condition pertains in adults
- Several (9–10) anterior dorsal fin rays elongate; these will be lost at transformation, leaving 9–10 predorsal pterygiophores not supporting fin rays (= supraneurals)
- Caudal and pectoral fin rays form late
- Several clusters of melanophores staggered on posterior part of body; 3 along dorsal margin, 3 along mid-flank; 2 along ventral margin
- Several pigment spots on air bladder
- Smaller larvae have cluster of spots behind eye

Meristic Characters

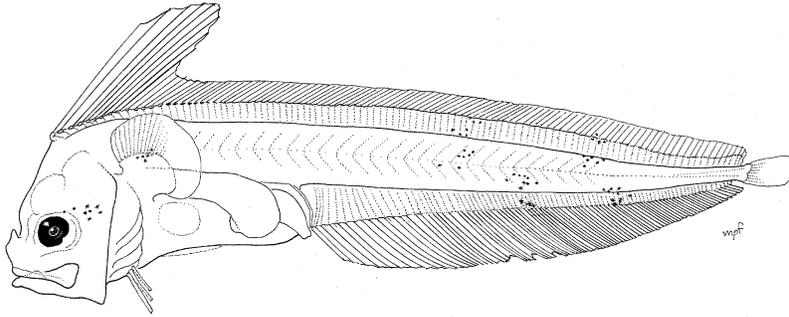
| | |
|--------------------|-------------------|
| Myomeres: | 49–50 |
| Vertebrae: | 11–12+37–39=49–50 |
| Dorsal fin rays: | 95–111 |
| Anal fin rays: | 79–98 |
| Pectoral fin rays: | 27–33 |
| Pelvic fin rays: | 2 |
| Caudal fin rays: | 11 |

Note: 1. The 14.5 mm specimen illustrated (ARC 9010151) was collected from 40°52'N, 66°47'W (southern flank of Georges Bank), May 19, 1982. The larger 2 larvae were collected from the western Mediterranean Sea.

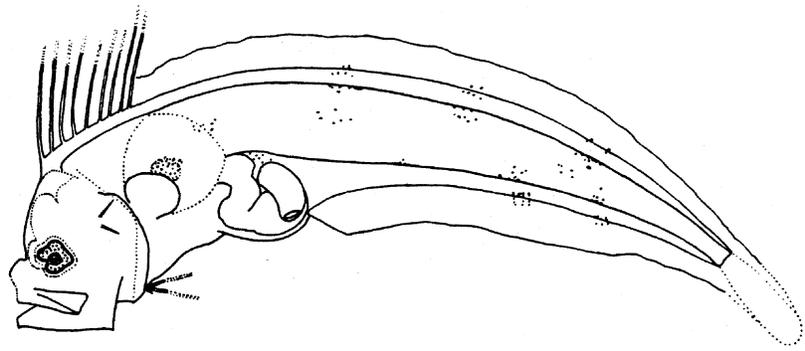
Figures: Adult: Goode and Bean, 1896; **A:** original; **B–C:** Nielsen and Evseenko, 1989

References: Nielsen and Evseenko, 1989; Nielsen *et al.*, 1999; Fahay and Hare, 2003; 2006

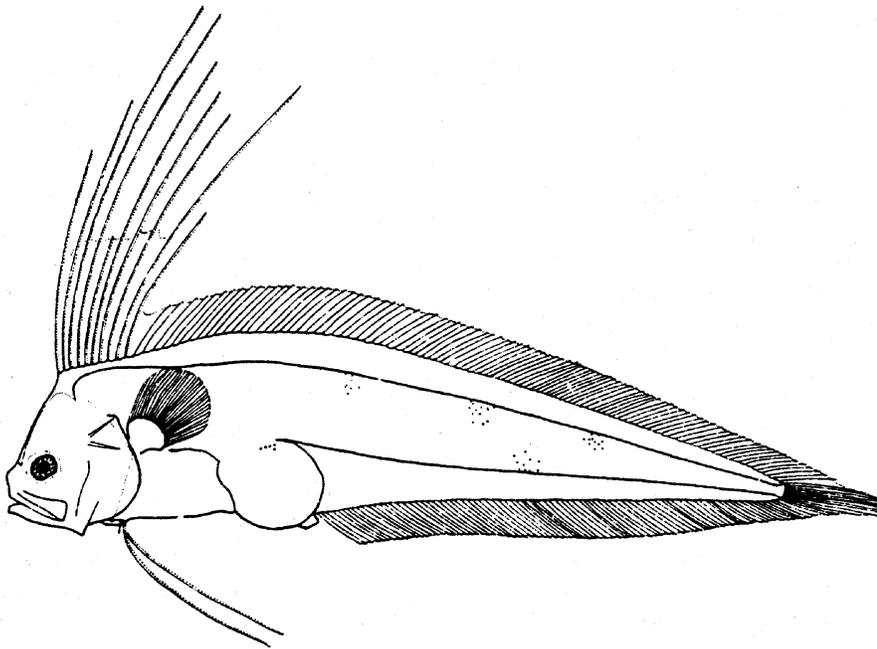
Benthocometes robustus



A. 14.5 mmSL

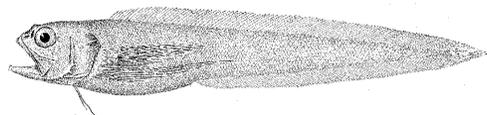


B. 20.0 mmSL



C. 39.0 mmSL

***Dicrolene* sp.**
Ophidiidae (s.f. Neobythitinae)
 No common names



Dicrolene intronigra

Range: 2 species occur in study area (see table):

| | <i>Dicrolene intronigra</i> Goode and Bean, 1883 | <i>Dicrolene kanazawai</i> Grey, 1958 |
|-------------------|--|---------------------------------------|
| Range | Eastern and western Atlantic | Western Atlantic |
| Habitat | Benthopelagic, 700–1,785 m | Benthopelagic, 1,375–2,342 m |
| Total vertebrae | 68 | 64 |
| Dorsal fin rays | 100–115 | 105–108 |
| Anal fin rays | 85–98 | 82–89 |
| Pectoral fin rays | 26 (lower 6–9 free) | 23–26 (lower 5–8 free) |

Spawning: Undescribed

Eggs: – Undescribed

Larvae:

- Elongate body, tapering to very narrow caudal peduncle
- Dorsal fin rays longer than anal fin rays
- Head and body covered with fine melanophores, except for an unpigmented region anterior to caudal peduncle
- Peritoneal cavity and branchial chamber densely pigmented
- Lower 5 pectoral fin rays disconnected and free from rest of fin

Note: 1. The larva illustrated (MCZ 65823) was collected from 38°54'36"N, 71°36'48"W, Apr 23, 1982, in a warm-core ring in continental slope waters

2. Meristic characters in the illustrated specimen:

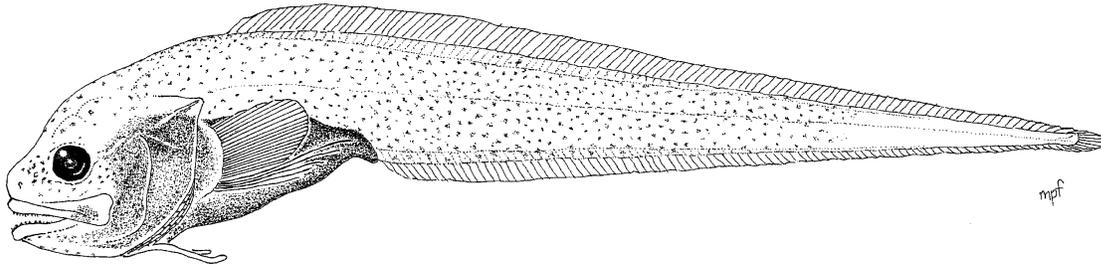
| | |
|--------------------|--------------------------------|
| Vertebrae: | 14+? |
| Dorsal fin rays: | 105 |
| Anal fin rays: | 87 |
| Caudal fin rays: | 6 |
| Pectoral fin rays: | 24 + 5 disconnected lower rays |

(Another pelagic, larval specimen, MCZ 76787, 61 mm, has been identified as *Dicrolene intronigra*)

Figures: Adult: Goode and Bean, 1896; A: original

References: Nielsen *et al.*, 1999; Fahay and Hare, 2003; 2006

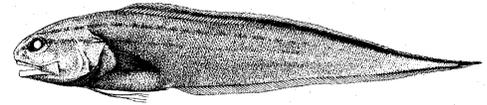
Dicrolene sp.



A. 32.0 mmSL

***Neobythites marginatus* Goode and Bean, 1886**
Ophidiidae (s.f. Neobythitinae)

No common name



Range: Western North Atlantic Ocean from North Carolina to Trinidad, including the Bahamas, Gulf of Mexico and Caribbean Sea

Habitat: On or near bottom on outer continental shelf and upper continental slope; collected from depths of 73–933 m

Spawning: Undescribed; a single ripe female (153 mmSL) found with eggs (0.5–1.0 mm diameter)

Eggs: – Undescribed

Larvae:

- Elongate body tapering to very narrow caudal peduncle
- Head blunt, with well-rounded profile
- Dorsal and anal fins long-based, confluent with caudal fin
- Dorsal fin rays longer than anal fin rays
- Pigmentation includes large, scattered clusters of melanophores on body, extending onto dorsal and anal fins
- Patch of spots on head, behind eye
- Venter of gut has a scattering of small melanophores
- Fine spots occur on branchiostegal membrane

Note: 1. The pelagic-larva illustrated (MCZ 76771) was collected from 37°0.54'N, 71°17.30'W (northern Sargasso Sea), Aug 20, 1982

2. Meristic characters in the illustrated specimen:

| | |
|-----------------------------|------------|
| Vertebrae: | 12+52=64 |
| Dorsal fin rays: | 108 |
| Anal fin rays: | 95 |
| Pectoral fin rays: | 21–22 |
| Basibranchial tooth patches | 2 (median) |

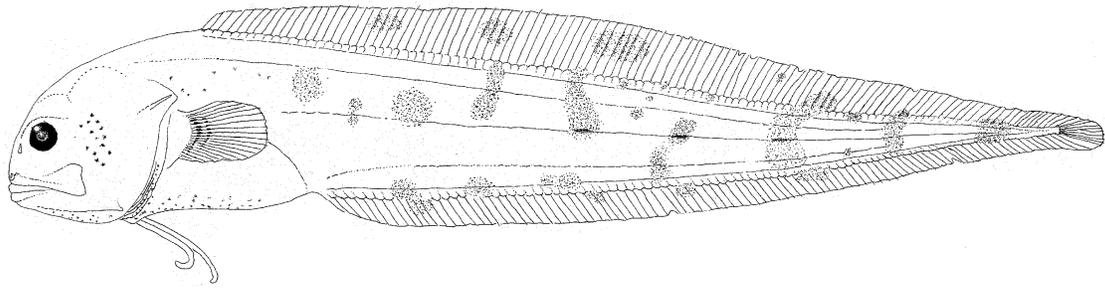
Meristic Characters

| | |
|--------------------|---------|
| Myomeres: | 61–66 |
| Vertebrae: | 61–66 |
| Dorsal fin rays: | 103–113 |
| Anal fin rays: | 89–97 |
| Pectoral fin rays: | 24–28 |
| Pelvic fin rays: | 2 |
| Caudal fin rays: | 8 |

Figures: Adult: R. Nielsen (Nielsen, 1999); A: original

References: Nielsen, 1999; Nielsen *et al.*, 1999; Fahay and Hare, 2003; 2006

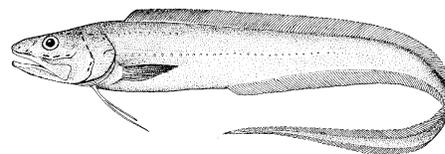
Neobythites marginatus



A. 38.0 mmSL

***Porogadus miles* Goode and Bean, 1886**
Ophidiidae (s.f. Neobythitinae)

No common name



Range: Worldwide in tropical and temperate waters; in the western North Atlantic from southern New England (e.g. between Hudson and Veatch canyons) to the Gulf of Mexico and Caribbean Sea

Habitat: Bathyal and abyssal; collected from depths of 1,000–5,055 m

Spawning: Undescribed

Eggs: – Undescribed

Larvae:

- Body extremely elongate, tapering to narrow caudal peduncle
- Gut coiled near posterior part of intestine; preanus length short
- Head small, scarcely deeper than body depth
- Mouth terminal, large, extending to posterior edge of eye
- Sequence of fin ray formation unknown
- Clusters of melanophores distributed in a series along dorsum of body; anterior-most clusters become light in larger larvae
- Early larvae have clusters of fine melanophores in a series along venter of tail

Meristic Characters

| | |
|--------------------|---------|
| Myomeres: | 123–129 |
| Vertebrae: | 123–129 |
| Dorsal fin rays: | 170–188 |
| Anal fin rays: | 135–156 |
| Pectoral fin rays: | 16–19 |
| Pelvic fin rays: | 2 |
| Caudal fin rays: | 6–7 |

- Note:**
1. Identification of the illustrated specimens based on capture location and coincidence of high vertebral numbers
 2. Collection details of illustrated specimens:
 - A: Uncatalogued, July 17, 1988, 38°49.2'N, 72°12'W (continental slope of study area)
 - B: Uncatalogued, (cleared and stained). Designated #250. Venter damaged, gut uncoiled
 - C: MCZ 161214, July 30, 1976, 38°30'N, 66°30'W (northern Sargasso Sea)
 3. Most meristic characters are unreported for *Porogadus catena* (Goode and Bean, 1886). This species is uncommon in western Atlantic and Gulf of Panama in depths of 1,180–3,500 m; see comparison of available characters in table below:

| Character | <i>Porogadus miles</i> | <i>Porogadus catena</i> |
|---|------------------------|-------------------------|
| Spines on top and sides of head | Well developed | Poorly developed |
| Lateral lines | 3, prominent | Absent |
| Scales along position of middle lateral line anterior to anus | 40 or more | 28–36 |

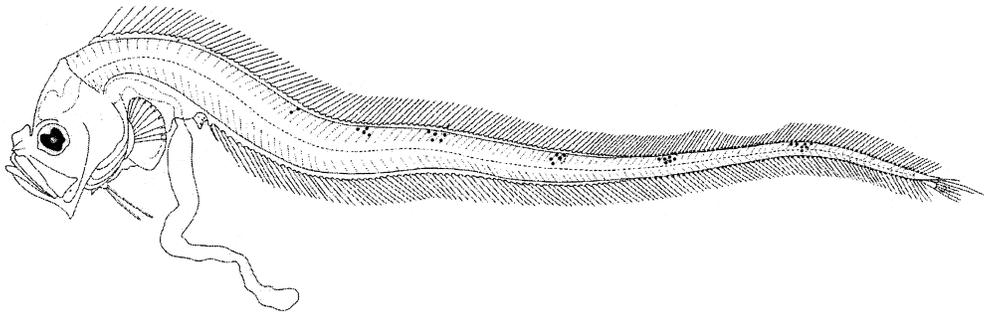
Figures: Adult: Nielsen *et al.*, 1999; **A, C:** Michael Green (original); **B:** Jack Javech (Bill Richards, pers. comm. 10 Dec. 2003)

References: Carter and Sulak, 1984; Nielsen *et al.*, 1999; Moore *et al.*, 2003; Fahay and Hare, 2003; 2006

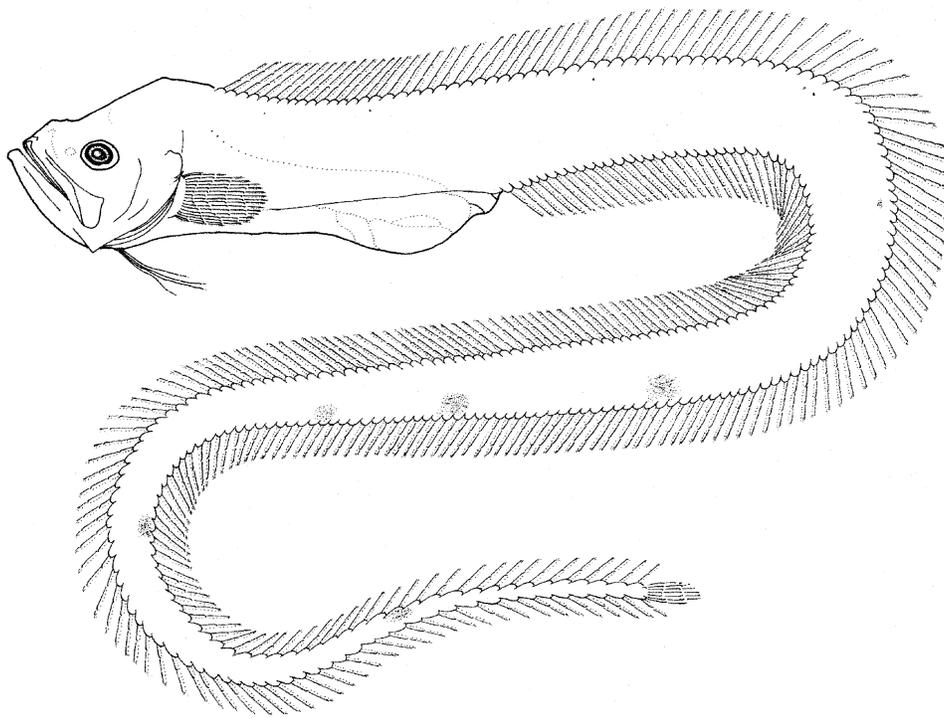
Porogadus miles



A. 12.0 mmTL



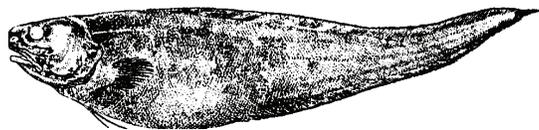
B. 23.9 mmSL



C. 63.0 mmTL

Spectrunculus grandis* (Günther, 1877)*Ophidiidae (s.f. Neobythitinae)**

No common name



Range: Worldwide in tropical and temperate waters; in study area, has been collected from south of Georges Bank and from waters near Hudson, Block and Alvin canyons

Habitat: Benthopelagic in bathyal and abyssal depths (800–4,255 m)

Spawning: Undescribed; only known to be oviparous with planktonic larvae

Eggs: – Undescribed

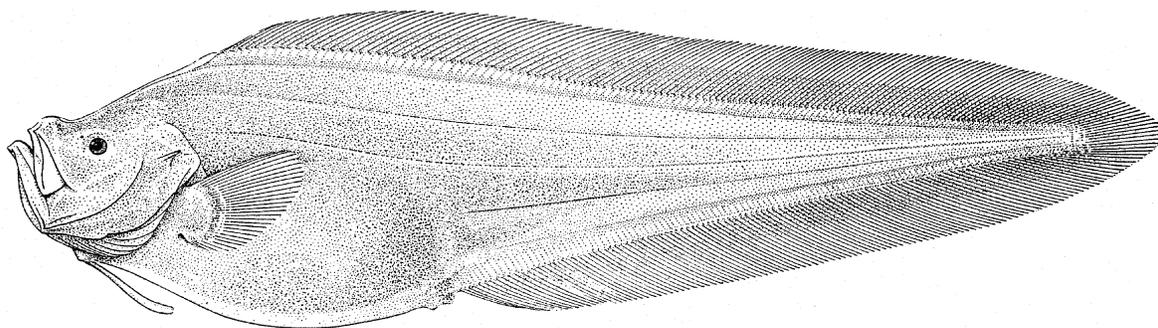
Larvae:

- Body very elongate, with short gut
- Gut forms a loop in posterior part of intestine during preflexion stage
- Dorsal fin rays longer than anal fin rays
- Flexion occurs at >15 mm
- Pigmentation includes melanophores on crown in early larvae, tip of lower jaw, and a series of 4 dorsal clusters of melanophores from level of gut to tail tip; 3 clusters of pigment along venter of tail, located opposite the dorsal clusters
- Pigment disappears in older stages
- Transformation occurs at >52 mm

Note: 1. Compare to preflexion larvae of the pleuronectid, *Glyptocephalus cynoglossus*; preanus length is relatively shorter, and total myomeres fewer, in the latter

Meristic Characters

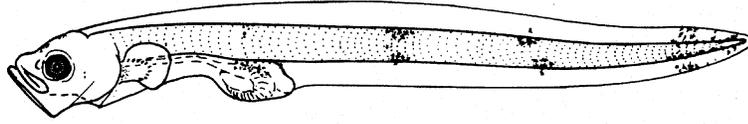
| | |
|--------------------|---------|
| Myomeres: | >75 |
| Vertebrae: | 71–79 |
| Dorsal fin rays: | 121–148 |
| Anal fin rays: | 90–113 |
| Pectoral fin rays: | 22–23 |
| Pelvic fin rays: | 2 |
| Caudal fin rays: | 8 |

Early Juvenile:**D. 56.0 mmSL**

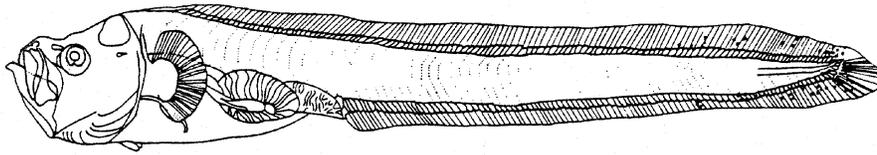
Figures: Adult: Nielsen and Hureau, 1980; **A, C:** Bev Vinter (Matarese *et al.*, 1989; **B:** Aboussouan and Rasonarivo, 1986; **D:** Jordan and Thompson, 1914

References: Nielsen and Hureau, 1980; Aboussouan and Rasonarivo, 1986; Nielsen *et al.*, 1999; Fahay and Hare, 2003; 2006

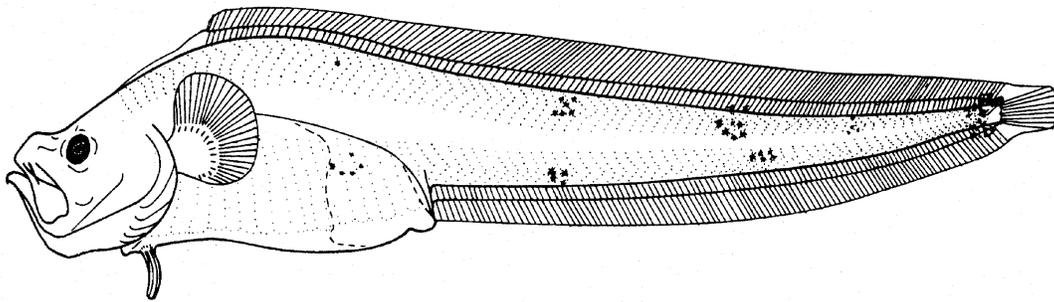
Spectrunculus grandis



A. 15.6 mmSL



B. 20.7 mmSL



C. 29.8 mmSL