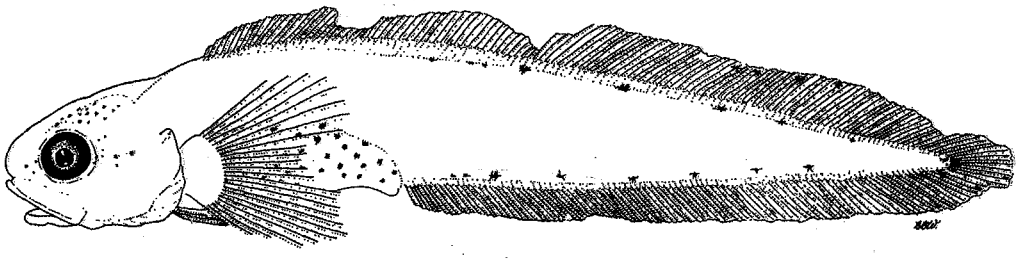
NOAA Technical Memorandum NMFS-SEFSC-520

PRELIMINARY GUIDE TO THE IDENTIFICATION OF THE EARLY LIFE HISTORY STAGES OF OPHIDIIFORM FISHES OF THE WESTERN CENTRAL NORTH ATLANTIC

BY

Michael P. Fahay & Jon A. Hare



U.S. DEPARTMENT OF COMMERCE
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National Marine Fisheries Service
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It will be chapters entitled Ophidiiformes and Ophidiidae in the "Guide to the early life history stages of fishes of the western central North Atlantic".

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ORDER OPHIDIIFORMES

By M. P. Fahay & J. A. Hare

The order Ophidiiformes (*sensu* Cohen & Nielsen 1978) contains the suborders Bythitoidei, including 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 (Table Ophidiformes 1). The monophyly of the order or its suborders has not been determined. Ophidiiform fishes, in general, are too poorly known anatomically to resolve questions of phylogenetic relationships (Cohen & Nielsen 1978), and details of ontogeny, including developmental osteology, have been described for too few genera to contribute to a resolution of these questions. Equally problematic are uncertainties concerning the composition of some genera (e.g. *Ophidion*, Robins & Böhlke, 1959), a situation that has become more apparent as eggs and larvae have become better known. The purpose of the present compilation is to marshal all available ontogenetic data based on published accounts and original descriptions of available ophidiiform material with origins in the western Atlantic Ocean. Species composition and selected meristic characters in ophidiiforms reported to occur in the western Central Atlantic are listed in Table Ophidiformes 2.

Bythitoidei includes the families Aphyonidae and Bythitidae. Early stages are rarely collected and are essentially undescribed in these families, although individuals or series have been described for a few species (Table Ophidiformes 3). Larval development information in the Aphyonidae is limited to *Barathronus pacificus* (Fig. Ophidiformes 1). A few larval series in the Bythitidae have been described. Because of their rarity, we reproduce here illustrations of Pacific or Eastern Atlantic representatives of genera that occur in the western central Atlantic study area (Figs. Ophidiformes 2-4). Ophidioidei contains the families Carapidae, with supramaxillary absent and anal fin rays longer than dorsal fin rays, and the Ophidiidae, with supramaxillary present and dorsal fin rays equal to or longer than opposing anal fin rays. Early stages of the diverse ophidiid subfamily Neobythitinae are also rarely collected and ill-described . We provide some information on a few recently collected specimens or series and also include a Pacific Ocean representative of *Neobythites* (Fig. Ophidiformes 5). The five species of *Brotula* (Brotulinae) are somewhat better known (Fig. Ophidiformes 6), although the western Central Atlantic species has not been described or illustrated heretofore. The Brotulotaeniinae, as presently understood, contains the single genus *Brotulotaenia* (with two species in the study area). However, largely based on larval morphology, it has recently been suggested also to include *Lamprogrammus* (Fahay & Nielsen 2003) and *Leptobrotula* (Okiyama & Yamaguchi, in press) both presently allocated to the Neobythitinae. A developmental series of *B. nielseni*, a Pacific Ocean species (Okiyama & Kato 2002) is reproduced here (Fig. Ophidiformes 7), and larvae known to occur in the western central North Atlantic (Fahay & Nielsen 2003) are included in the Species Treatments. In Ophidioidei, early stages are best known in the Carapidae and the ophidiid subfamily Ophidiinae, likely because these occur rather commonly over continental shelf depths where most

ichthyoplankton collecting has taken place. Larvae of the Carapidae have a prominent, elongate dorsal appendage arising from the dorsal edge of the body, and an elongate, tapering body (see Carapidae chapter). Larvae of the ophidiine cusk eels have short preanus lengths, an elongate, laterally flattened body, long dorsal and anal fins and relatively high numbers of meristic elements.

The following accounts include Tables Ophidiiformes 1-6, Figures Ophidiiformes 1-9, and species accounts for the families Bythitidae and most Ophidiidae. The subfamily Ophidiinae is treated in more detail followed by tables, figures and species accounts for that subfamily.

Acknowlegments.- Important series of specimens were provided by K. Hartel (MCZ), J. Lyons (Univ. Wisconsin), B. Saul, E. Böhlke, M. Littman (ANSP), K. Williams (FLDNR), L. Van Guelpen (ARC), C. Flores-Coto (UNAM), E. Maddox & J. Shenker (*Grammonus* specimen), R. Cowen, & A. Powell. B. Degan & E. Jugovich provided laboratory assistance. For discussions on various parts of the ms, we thank D. M. Cohen, J. Nielsen, M. Okiyama, J. E. Olney, A. B. Powell, & K. L. Tang. M. D. Greene illustrated several larvae and S. Kaiser illustrated juvenile *Ophidion marginatum*. The ms benefited from reviews by J. Govoni, F. Hertnandez, D. Johnson, A. Powell, & J. Sibunka.

Table Ophidiiformes 1. Classification of Ophidiiformes (after Cohen & Nielsen 1978, Nielsen et al. 1999) with numbers of each taxa occurring in the western central Atlantic

Order Suborder	Family	Subfamily	Genera	Species	Larval Descriptions[1]
Ophidiiformes					
Bythitoidei	Bythitidae	Bythitinae	8	14	1
		Brosmophycinae	4	23	1
	Aphyonidae	--	5	9	1
Ophidioidei	Carapidae	Carapinae	2	2	2
		Pyramodontinae	1	1	1
	Ophidiidae	Brotulinae	1	1	1
		Brotulotaeniinae	2[2]	6[2]	6
		Ophidiinae	4	24[3]	14
		Neobythitinae	22	42	10

[1] Some descriptions partial, from outside study area, or contained in the present study
[2] Modified after Fahay & Nielsen, 2003
[3] Plus several undescribed species

Table Ophidiiformes 2. List of ophidiiform species occurring in the western central Atlantic study area (Nielsen et al. 1999), with selected meristic characters. Classification follows Cohen & Nielsen (1978). See Table Ophidiiformes 4 for more complete meristic characters in the subfamily Ophidiinae. Species accounts follow this sequence. PC = precaudal vertebrae; Tot = total vertebrae; D = dorsal fin rays; C = caudal fin rays; A = anal fin rays; P_1 = Pectoral fin rays; * = species treated in more detail in the present report.

	Vertebrae					
Ophidiiformes	PC	Tot	D	C	A	P_1
Bythitoidei						
Aphyonidae						
Aphyonus gelatinosus	31-33	84	93-116	7-8	61-68	17-18
A. rassi	31	71	75	7	56	13-14
Barathronus bicolor	31-35	70-75	65-78	9-10	52-59	19-25
B. multidens	32-33	77-79	72-75	10	63-65	23-24
B. unicolor	35-38	78-86	63-78	10	55-71	23-25
Meteoria erythrops	39-41	68-70	48-50	8	34-40	13-15
Nybellina brevidorsalis	36	70	70	8	50	27
Sciadonus galathea	48	86	88-104	6	47-48	11-13
S. pedicellaris	43-44	81-83	90-93	6	46	12-14
Bythitidae						
Bythitinae						
Bythites gerdae	14-15	46-47	87-94	10-11	51-56	24-27
Calamopteryx goslinei	10-11[1]	38-46	63-70	10	51-57	13-17
C. robinsorum	10-11[1]	37-42	58-68	8	40-49	14-19
Cataetyx laticeps	13-18[1]	60-61	91-107	8-11	74-87	22-29
* *Cataetyx* sp.[9]	13[9]	42?	78	10?	57	
Diplacanthopoma sp.	14-19[1]		147-152	4(?)-8	110-120	25-27
D. brachysoma	14-19[1]		132	6?	98	
* *Grammonus claudei*	12	41-43	82-88	10	64-69	23-25
Saccogaster staigeri	13-14	51-53	87-88	12-13	54-55	18
S. parva[18]	16	54	91	12	64	14
S. rhamphidognatha[18]	20	58	77	12	49	12
S. melanomycter[18]	16	45	74	10	37	18
Stygnobrotula latebricola[15]	14		109	6	92	21-23
Thallassobathia pelagica	12	48-49	72-79	10	58-65	22-27
Brosmophycinae						
Dinematichthys iluocoeteoides	10	38-40	73-80	16	55-62	22-24
Gunterichthys longipenis	11-12	39-43	64-68	12-15	45-50	17-22
Lucifuga simile	11-13[1]		70-77		57-60	11-14
L. subterranea	11-13[1]	46-48	80-87	8	61-72	11-14
L. dentata	11-13[1]	46-48	83-95	8	69-78	15-17
L. spelaeotes	11-13[1]	52-53	92-98	10-11	71-72	18-20
L. teresinarum			78-80			10-11
* *Ogilbia cayorum*		38-44	58-79		47-62	
O. verrillii[11]						
Ogilbia spp (ca. 14 undescribed species)						

	Vertebrae					
	PC	Tot	D	C	A	P₁
Ophidioidei						
Carapidae						
Carapinae						
Echiodon dawsoni	21-25		28-35[2]		39-43[3]	17-20
Carapus bermudensis	17-18		36-45[3]		53-62[3]	17-20
Pyramodontinae						
Snyderidia canina	13-15		47-51[3] (173 total)	7	42-46[3] (169 total)	24-26
Ophidiidae						
Neobythitinae						
* *Abyssobrotula galatheae*	17-19	67-75	97-113	8	76-96	10-11
* *Acanthonus armatus*	9-10	60-65	98-108	8	88-100	16-19
Apagesoma edentatum	14	64	111-116	6	92-98	25-28
A. delosommatus	13	72-73	129-131	8	111	25-28
Barathrites iris	18	60-62	108-116	8-9	78-85	24-26
* *B. parri*	19	67	112	8	82	22
Barathrodemus manatinus	13	58	98-107	8	85-87	18-22
Bassogigas gillii	15-16	61	83-106	6-8	67-84	27-31
* *Bassozetus compressus*	11-15	67-72	123-129	8	102-109	24-27
B. levistomatus	14-16	64-68	117-126	8	93-103	27-29
B. normalis	13-15	67-71	121-132	8	99-108	22-28
B. oncerocephalus	16	70	129	8	105	27
B. robustus	13-15	65-68	114-130	8	96-103	27-28
B. taenia	12	69-73	122-128	8	100-110	26-27
Bathyonus pectoralis	17-19[1]		93	6	73	17
B. laticeps	17-19[1]		83?-94+?	6	62?-68+?	19
* *Benthocometes robustus*[14]	11-12	49-50	95-111	11	79-98	27-33
* *Dicrolene intronigra*	14	68	100-115	6-7	85-98	26[5]
D. kanazawai	13	64	105-108	6-7	82-89	23-26[6]
Eretmichthys spp.						25-29
Holcomycteronus profundissimus	18	67-71	103	8	80	10-16
H. squamosus	18-21[1]	69	110	6	89-92	18
Leucicorus atlanticus	13-14	58-62	82-98	8	68-80	22-24
Luciobrotula corethromycter	14-16	53-56	90-103	10-12	65-77	27-29
Monomitopus agassizii	12-14	62	99-107	7-8	83-89	30-35
M. magnus	15	61-65	104-108	8	85-92	30-35
Neobythites braziliensis	14	63-66	112-116	8	95-98	28-29
N. elongatus	12	60-63	101-105	7-8	86-90	23-26
N. gillii	11-13	52-56	88-98	7-9	73-81	23-29
* *N. marginatus*	11-13	61-66	103-113	8	89-97	26-27
N. monocellatus	12-13	54-58	93-99	8	78-83	24-27
N. multidigitatus	15	65	110	8	91	32
N. ocellatus	12-13	55-59	96-102	8	80-85	23-28
N. unicolor	12	57-59	96-101	8	80-86	26-30
Penopus microphthalmus[4]	18-19	76-81	130-151	8	102-116	17-19
Petrotyx sanguineus	12[8]	42-47[8]	86-91	9-10	68-72	25-27
Porogadus catena	15-18					15-16
* *P. miles*	17-18	123-129	170-188	6-7	135-156	16-19
P. silus	15-18					17-19

	Vertebrae					
	PC	Tot	D	C	A	P
Pycnocraspedum phyllosoma	12		97	10	71	26
* *Spectrunculus grandis* [10]	18-25	71-79	121-148	8	90-113	22-33
Xyelacyba myersi	11-12	49-52	87	9	71	19
Brotulinae						
* *Brotula barbata*	14-15[7]	54-57[7]	109-117	8-11	86-94	25-28
Brotulotaeniinae						
* *Brotulotaenia brevicauda*	13	63-66	79-84	9	58-64	21-24
* *B. crassa*	13-15	88-91(96)	119-134	9	98-108	22-26
* *B. nigra*	13-14	89-90	113-115	5	91-94	20-25
* *Lamprogrammus brunswigi*	13-14	68-71	108-125	8-9	92-108	19-22
* *L. niger*[12]	12-14	65-72	103-117	8	81-91	16-19
* *L. shcherbachevi*	11	71-74	131-140	8-9	104-117	18-19

Ophidiinae (See Table 4 for list of species and complete meristic characters)
Lepophidiini
Lepophidium 8 species + ca. 8 undescribed species
Ophidiini
Ophidion 12 species
Otophidium 3 species
Parophidion 1 species

Footnotes:

[1] Range in genus
[2] Number of dorsal fin rays anterior to vertebra no. 31
[3] Number of anal fin rays anterior to vertebra no. 31
[4] *P. macdonaldi* is junior synonym of *P. microphthalmus* (Seret 1988)
[5] Lower 6-9 rays free from rest of fin
[6] Lower 5-8 rays free from rest of fin
[7] Based on MCZ 61194; MCZ 76743; MCZ 76735; MCZ 76755; MCZ 70186; MCZ 88148; MCZ 76753 (n = 7)
[8] Based on ANSP 102958; ANSP 120464; ANSP 111943; ANSP 103438 (n = 10)
[9] Based on MCZ 63275 (n = 1)
[10] Counts include both Atlantic and Pacific ranges
[11] *O. verrilli* is junior synonym of *O. cayorum* (Smith-Vaniz et al. 1999)
[12] Counts include USNM099216 (n = 1); USNM210623 (n = 3)
[13] Three species of *Saccogaster* known from single specimens, thus ranges not known
[14] Also examined ARC Uncat.
[15] N = 1

Sources:

Anderson et al. 1985
Böhlke 1955; 1957
Böhlke & Cohen 1966
Carter & Cohen 1985
Cohen 1961; 1963; 1964a; 1964b; 1966; 1973; 1974a; 1974b; 1981a; 1981b; 1986; 1987
Cohen, D.M. pers. commun. Jan, 2001
Cohen et al. 1991
Cohen & Nielsen 1972; 1978
Cohen & Robins 1970
Cohen & Rohr 1993
Dawson 1966
Fahay & Nielsen 2003
Goode & Bean 1896
Günther 1887
Hoese & Moore 1977
Hubbs 1944
Machida & Amaoka 1990
Machida et al. 1997
Markle & Olney 1990
Nielsen 1966a; 1969; 1975a; 1975b; 1977; 1980; 1984b; 1986a; 1986b; 1999
Nielsen & Cohen 1973; 1986
Nielsen & Evseenko 1989
Nielsen & Merrett 2000
Nielsen & Retzer 1994
Nielsen et al. 1999
Nybelin 1957
Okiyama 1988
Okiyama & Kato 2002
Parr 1933
Sedor & Cohen 1987
Seret 1988
Shcherbachev 1976
Smith & Heemstra 1986
Staiger 1972
Suarez 1975
Uyeno et al. 1983

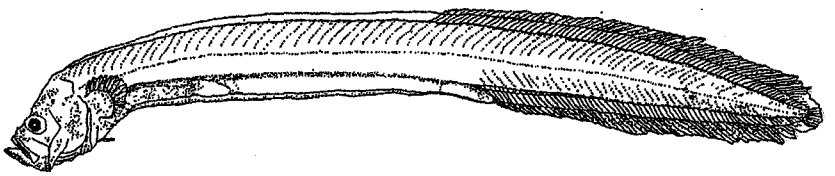
Table Ophidiformes 3. Descriptions of larval development (or single larvae) in the Ophidiiformes

Suborder Family Subfamily	Species	Geographic Area	Author(s)
Bythitoidei			
Aphyonidae	*Barathronus pacificus*	Pacific	Okiyama & Kato 1997
Bythitidae			
Bythitinae	Unidentified[1]	Atlantic	Gordon et al. 1984
	Cataetyx rubrirostris	Pacific	Ambrose 1996o
	Cataetyx sp.	W. Mediterranean	Sabates & Fortuño 1988
	Grammonus diagrammus (as *Oligopus diagrammus*)	Pacific	Ambrose 1996o
	Grammonus longhursti (as *Oligopus longhursti*)	E. Atlantic	Aboussouan 1972
Brosmophycinae	*Dinematichthys* sp.	Indo-Pacific	Leis & Rennis 1983
	Brosmophycis marginata	Pacific	Gordon et al. 1984 Ambrose 1996o
Ophidioidei			
Ophidiidae			
Brotulinae	*Brotula multibarbata*	Indo-Pacific	Leis & Rennis 1983 Okiyama 1988
	Brotula clarkae	E. Pacific	Ambrose 1996m
Brotulotaeniinae	"Rubaniform" larva	E. Atlantic	Fourmanoir 1976
	Brotulotaenia sp.[2]	Pacific	Aboussouan 1980
	Brotulotaenia nielseni	Pacific	Okiyama & Kato 2002
	Brotulotaenia brevicauda	Atlantic/Indian	Fahay & Nielsen 2003
	Brotulotaenia crassa	Atlantic/Indian	"
	Brotulotaenia nielseni	Pacific	"
	Brotulotaenia nigra	Atlantic	"
	"Exterilium" larvae	Tropical Atlantic & Pacific	Nielsen 1963[3] Fraser & Smith 1974[3] Moser 1981[4] Gordon et al. 1984[4] Okiyama 1988[3]
	Lamprogrammus niger	Indian/Celebes Sea	Fahay & Nielsen 2003

	Lamprogrammus shcherbachevi	Atlantic	Fahay & Nielsen 2003
Neobythitinae	*Spectrunculus grandis*	Pacific & Atlantic	Jordan & Thompson 1914 Aboussouan & Rasonarivo 1986 Matarese et al. 1989 Ambrose 1996m
	Benthocometes robustus	W. Mediterranean	Nielsen & Evseenko 1989
	Acanthonus armatus	Pacific	Okiyama 1988
	cf. *Hoplobrotula armata*	Pacific	Okiyama 1988 (Okiyama, pers. commun.)
	Sirembo imberbis	Pacific	Okiyama 1988
	Neobythites sivicola	Pacific	Okiyama 1988
Ophidiinae	*Cherublemma emmelas*	E. Pacific	Ambrose 1996m
	Chilara taylori	E. Pacific	Ambrose et al. 1983
	Genypterus capensis	South Africa	Brownell 1979 Olivar & Sabates 1989
	Genypterus blacodes	Australia	Furlani 1998
	Genypterus tigerinus	Australia	Furlani 1998
	Lepophidium jeannae	Gulf of Mexico	Gordon 1982
	Lepophidium negropinna	E. Pacific	Gordon et al. 1984 Ambrose 1996m
	Lepophidium profundorum	W. Atlantic	Fahay 1992
	Lepophidium staurophor	Gulf of Mexico	Gordon 1982
	Lepophidium stigmatistium	E. Pacific	Ambrose 1996m
	Ophidion barbatum	Mediterranean	Sparta 1929 Aboussouan 1972
	Ophidion marginatum	W. Atlantic	Fahay 1992
	Ophidion nocomis	W. Atlantic	Gordon et al. 1984
	Ophidion robinsi	W. Atlantic	Fahay 1992
	Ophidion scrippsae	E. Pacific	Ambrose et al. 1983
	Ophidion selenops	W. Atlantic	Gordon 1982
	Otophidium omostigma	W. Atlantic	Gordon 1982
	Parophidion vassali	Mediterranean	Sparta 1929

Carapinae	*Carapus acus*	Mediterranean	Padoa 1956 Markle & Olney 1990
	Carapus bermudensis	W. Atlantic	Dawson 1971 Olney & Markle 1979
	Echiodon coheni	Indo-Pacific	Markle & Olney 1990
	Echiodon cryomargarites	Southern Hemisphere, Atlantic & Pacific	Markle & Olney 1990
	Echiodon dawsoni	Tropical Atlantic	Olney & Markle 1979
	Echiodon dentatus	E. Atlantic Mediterranean	Sparta 1926 Padoa 1947
	Echiodon drummondi	E. No. Atlantic	Ehrenbaum 1905, 1909 Markle & Olney 1990
	Echiodon exsilium	E. Pacific	Trott 1970 Olney & Markle 1979
	Echiodon rendahli	S. Australia	Robertson 1975 Markle & Olney 1990
	Encheliophis vermicularis[5]	Pacific, Indian, Red Sea	Trott 1970
	Eurypleuron owasianum	Pacific & Indian	Markle & Olney 1990
	Onuxodon fowleri	Pacific & Indian	Markle & Olney 1990
	Onuxodon parvibrachium	Pacific & Indian	Markle & Olney 1990
	Pyramodon ventralis	Pacific & Indian	Markle & Olney 1980
	Snyderidia canina	Atlantic, Pacific & Indian	Strasburg 1965 Markle & Olney 1980

[1] Here referred to *Brotula barbata.*
[2] Referred to *Brotulotaenia crassa* (Fahay & Nielsen 2003). The Rubaniform larva described by Fourmanoir (1976) is also referable to this species.
[3] Referred to *Lamprogrammus shcherbachevi* (Fahay & Nielsen 2003).
[4] Referred to *Lamprogrammus brunswigi* (Fahay & Nielsen 2003).
[5] Originally described as *E. jordani.*



A. 41.8 mmSL

Figure Ophidiiformes 1. Representative larva of the Aphyonidae: A) *Barathronus pacificus*, 41.8 mm SL, Pacific (Okiyama & Kato 1997).

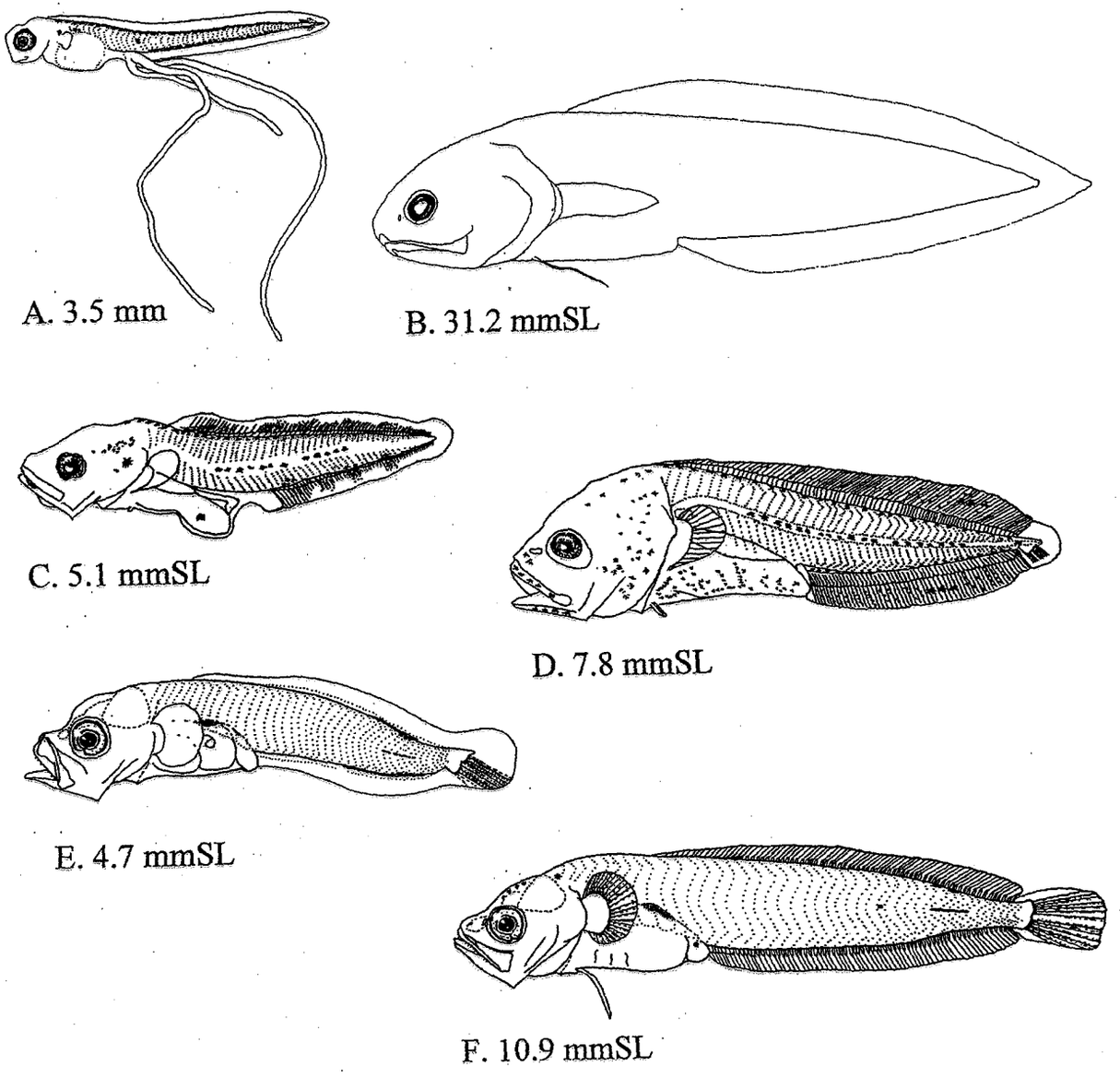
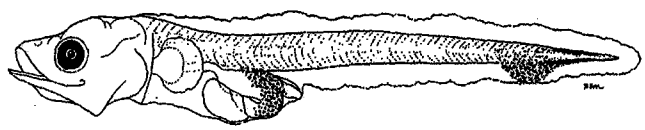
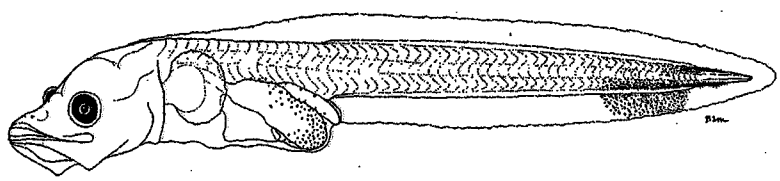


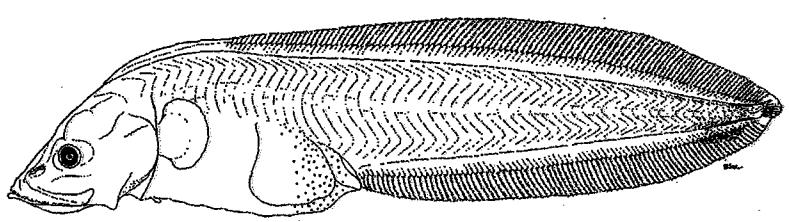
Figure Ophidiiformes 2. Representative larvae of the Bythitidae: A) *Grammonus diagrammus*, intraovarian embryo, 3.5 mm SL; B) *Grammonus diagrammus*, 31.2 mm SL; A,B: Pacific (Ambrose 1996o); C) *Grammonus longhursti*, 5.12 mm SL; D) *Grammonus longhursti*, 7.84 mm SL; C,D: Eastern Atlantic (Aboussouan 1972); E) *Dinematichthys* sp. 4.7 mm; F) *Dinematichthys* sp., 10.9 mm SL. E,F: Indo-Pacific (Leis & Rennis 1983).



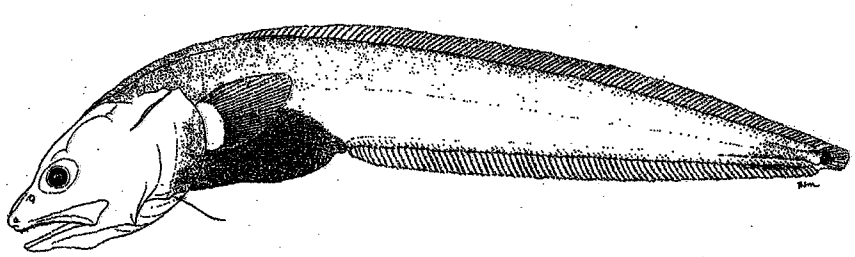
A. 7.3 mmSL



B. 12.5 mmSL

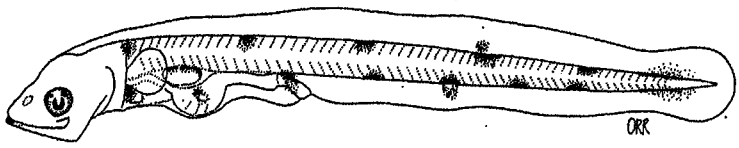


C. 23.8 mmSL

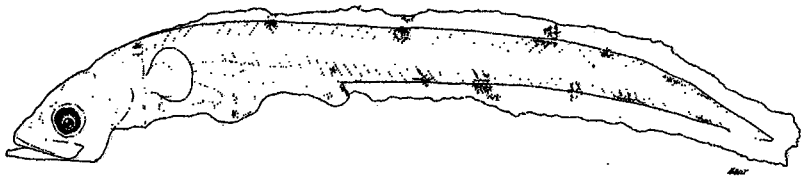


D. 29.0 mmSL

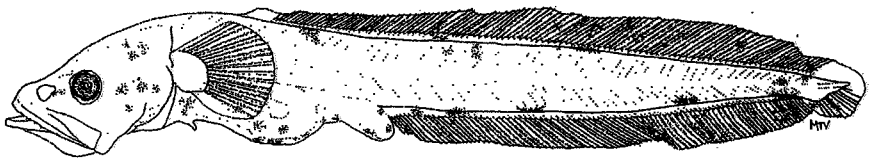
Figure Ophidiiformes 3. Representative larvae of the Bythitidae: *Cataetyx rubrirostris* A) 7.3 mm SL; B) 12.5 mm SL; C) 23.8 mm SL; D) 29.0 mm SL, Pacific (Ambrose 1996o).



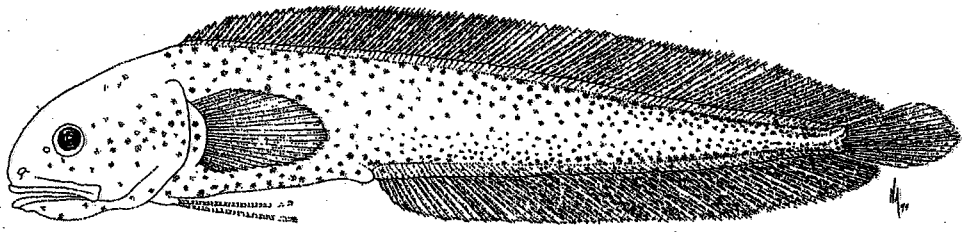
A. 9.8 mmNL



B. 12.5 mmNL



C. 17.2 mmSL



D. 37.5 mmSL

Figure Ophidiiformes 4. Representative larvae of the Bythitidae: *Brosmophycis marginata* A) 9.8 mm NL; B) 12.5 mm NL; C) 17.2 mm SL; D) 37.5 mm SL , Pacific. (A,C,D after Ambrose 1996o; B after Gordon et al. 1984.)

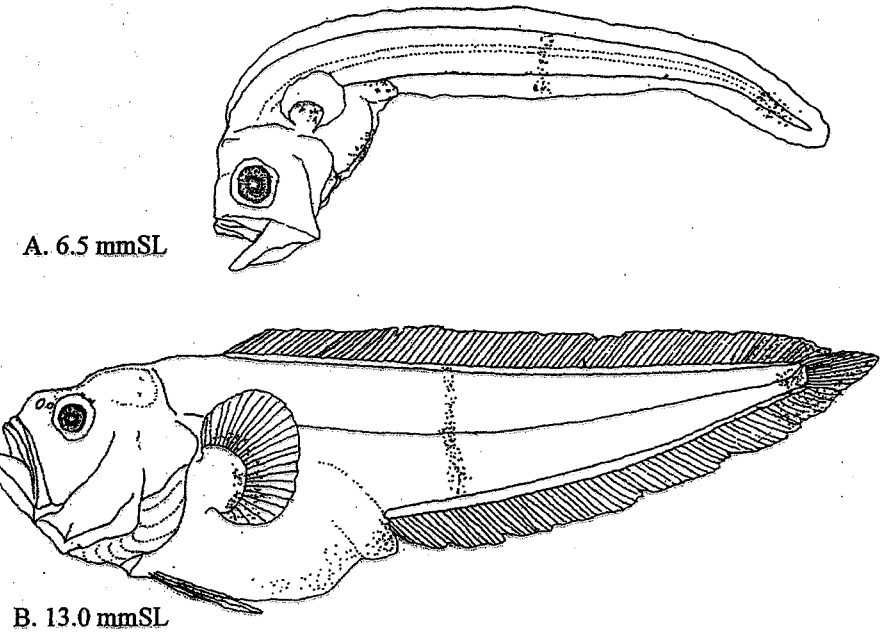
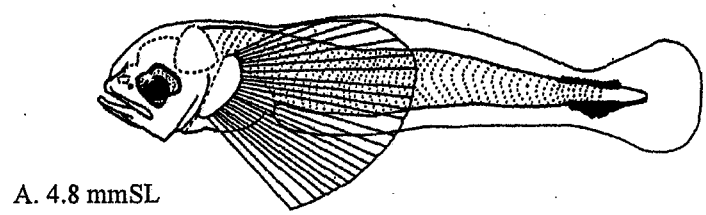
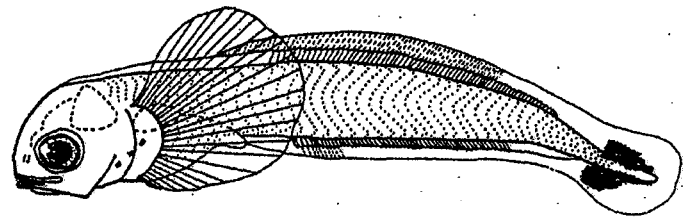


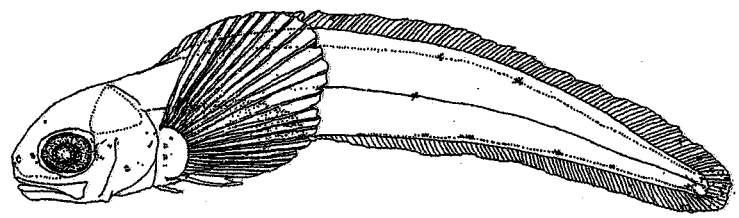
Figure Ophidiiformes 5. Representative larvae of the Neobythitinae: *Neobythites sivicola* A) 6.5 mm SL; B) 13.0 mm SL, Pacific, (Okiyama 1988).



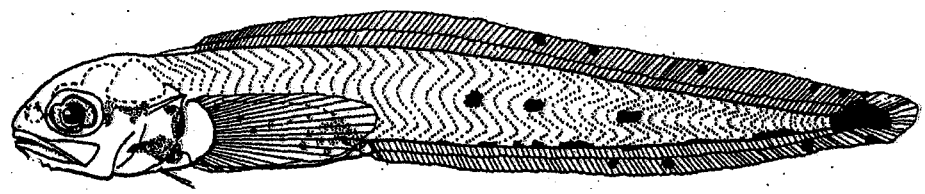
A. 4.8 mmSL



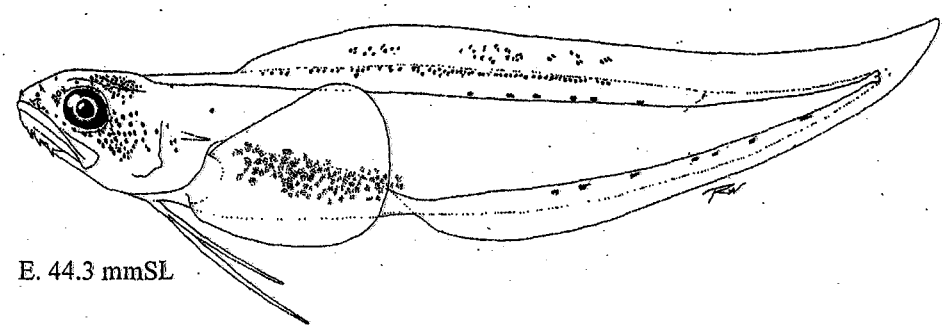
B. 7.9 mmSL



C. 12.0 mmSL

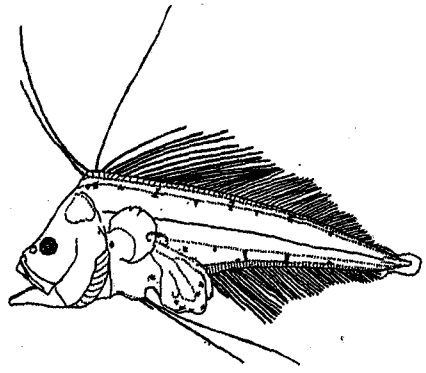


D. 17.7 mmSL

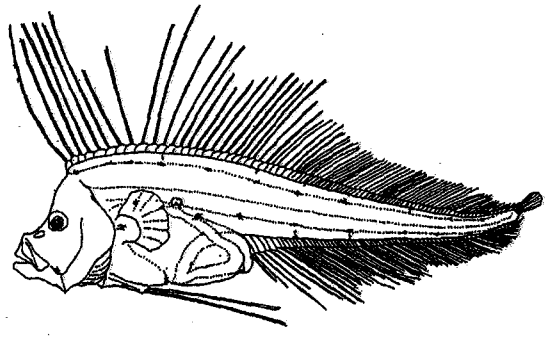


E. 44.3 mmSL

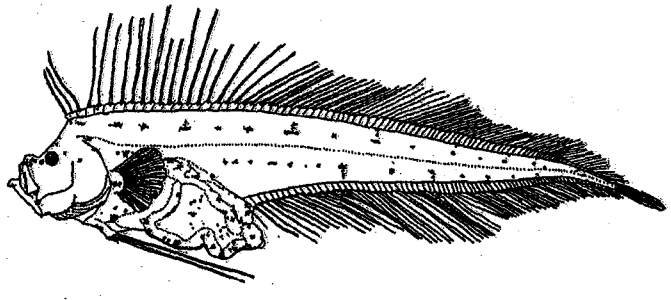
Figure Ophidiiformes 6. Representative larvae of the Brotulinae: A) *Brotula multibarbata* 4.8 mm SL; B) 7.9 mm SL; C)12.0 mm SL; D) 17.7 mm SL, Pacific, (A,B and D: Leis & Rennis, 1983; C: Okiyama 1988). E) *Brotula clarkae* postflexion larva, 44.3 mm SL, Pacific, (Ambrose 1996m).



A. 10.0 mm NL



B. 21.0 mm SL



C. 69.5 mm SL

Figure Ophidiiformes 7. Representative larvae of the Brotulotaeniinae: *Brotulotaenia nielseni*. A) 10.0 mm NL; B) 21.0 mm SL; C) 69.5 mm SL, Pacific, (Okiyama & Kato 2002).

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MERISTICS

Vertebrae:	
Precaudal	13
Caudal	~39
Total	~42
Number of Fin Rays:	
Total Dorsal Elements	78
Total Anal Elements	~57
Pectoral	?
Pelvic	1
Caudal	
Total	10?
Branchiostegals	7-9

LIFE HISTORY

Range: Temperate & subtropical waters of North Atlantic, Mediterranean & eastern South Atlantic.
Habitat: Benthopelagic to benthic in depths of 500-2,400 m.
ELH Pattern: Undescribed; larvae pelagic.
Spawning: Undescribed.
Mode: Viviparous.
Fecundity: Undescribed.
Age at First Maturity: Undescribed.
Longevity: Undescribed.

LITERATURE

Ambrose 1996 (*Cataetyx rubrirostris*, Pacific), Nielsen 1966b, Sabates & Fortuño 1988 (*Cataetyx* sp., Mediterranean).

EARLY LIFE HISTORY DESCRIPTION

EGGS: Undescribed.

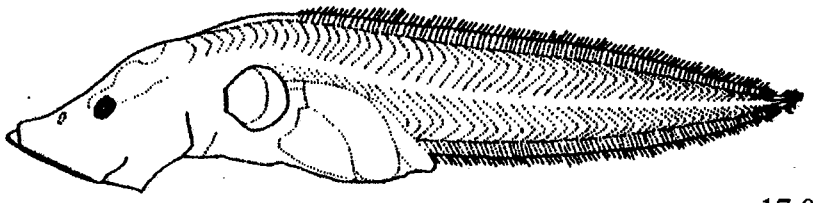
LARVAE:
Ethmoid spine: None.
Other spines: None.
Length at Flexion: Unknown.
Length at Transformation: Unknown.
Sequence of Fin Development: P_2 & P_1 late-forming; D rays slightly longer than A rays.
Pigmentation: Light; clusters of melanophores over terminus of gut, on top of head, & posterior body before caudal peduncle.
Diagnostic Characters: Stubby body with characteristic concave profile. Distinguish from other ophidiiform larvae by meristic characters, stubby body & concave profile.

JUVENILES:
Diagnostic Characters: Unknown.

ILLUSTRATIONS

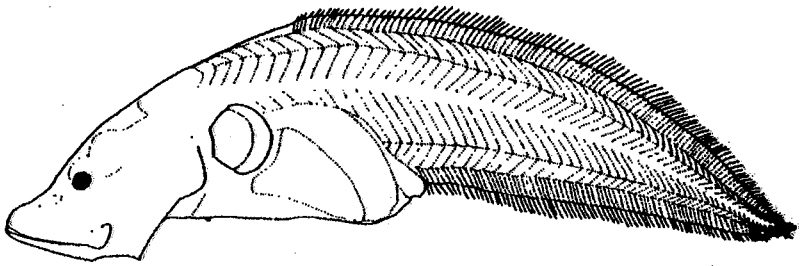
A) 17.0 mm TL; B) 19.8 mm TL. A-B after Sabates & Fortuño (1988) as *Cataetyx* sp. (Mediterranean Sea). C) 25.5 mm SL, MCZ 63275, 09° 06' N, 55° 09' W, 26 Sep. 1973 (Amazonian). Original. Specimen folded, damaged, maxilla & premaxilla disarticulated.

A



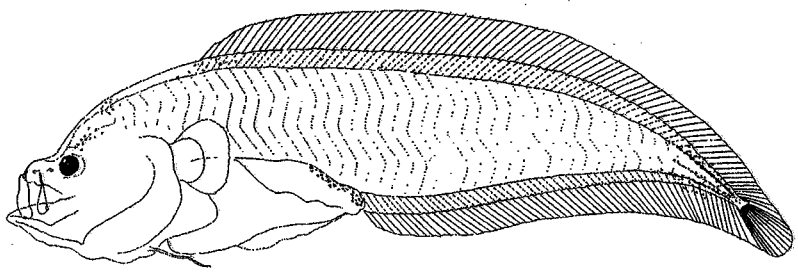
17.0 mm TL

B



19.8 mm TL

C



25.5 mm SL

Note: Meristic characters in 25.5-mm specimen are lower than in *Cataetyx laticeps* (see Introductory Table 2).

MERISTICS

Vertebrae:		
Precaudal	12	
Caudal	29-31	Total 41-43
Number of Fin Rays:		
Total Dorsal Elements	82-88	
Total Anal Elements	64-69	
Pectoral	23-25	
Pelvic	1	
Caudal Total	10	
Gillrakers on First Arch Total	2-3	
Branchiostegals	8	

LIFE HISTORY

Range: Tropical western North Atlantic.
Habitat: Benthic (reefs & marine caves) in depths of 6-70 m.
ELH Pattern: Larvae are pelagic.
Spawning: Undescribed.
Mode: Viviparous.
Fecundity: Undescribed (**check wourms...**)
Age at First Maturity: Unknown.
Longevity: Undescribed.

LITERATURE

Wourms & Cohen 1975 (Reproductive biology of *G. longhursti).*

EARLY LIFE HISTORY DESCRIPTION

EGGS: Undescribed.

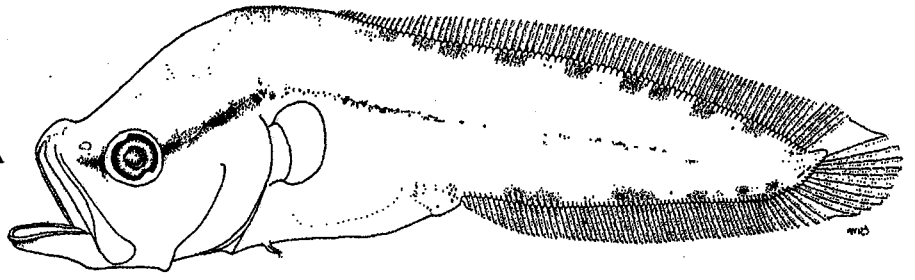
LARVAE:
Ethmoid spine: None.
Other spines: Single spine at upper angle of opercle.
Length at Flexion: ca. 7.0 mm SL.
Length at Transformation: Undescribed.
Sequence of Fin Development: P_1 rays last to form.
Pigmentation: Series of blotches form along dorsal & ventral edges of body; melanophores along midline of body continue anteriorly as a bar through upper opercle, orbit & snout; scattered spots on top of head, nape & under anterior D rays.
Diagnostic Characters: meristic characters, stubby body & pigmentation. Distinguish from other ophidiiforms by low numbers of meristic characters & pigment.

JUVENILES:
Diagnostic Characters: Meristic characters.

ILLUSTRATIONS

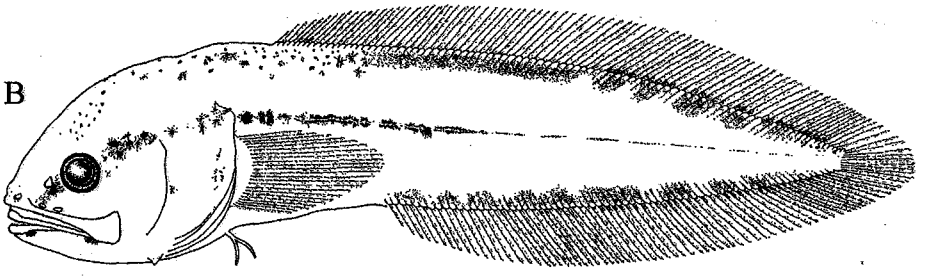
A) 7.0 mm SL, uncat., 17° 53'N, 65°48'W, southeast of Puerto Rico), 8 May, 1984. B) 12.5 mm SL, uncat. 23° 45'N, 6° 12'W, (Lee Stocking I., Bahamas),winter 1990/1991, both original, illustrated by Michael Greene. Identified based on meristic characters & collection location: *G. claudei* is the only *Grammonus* reported from the western North Atlantic.

A



7.0 mm SL

B



12.5 mm SL

MERISTICS

Vertebrae:	
Precaudal	11-12
Caudal	
Total	39-43
Number of Fin Rays:	
Total Dorsal Elements	64-68
Total Anal Elements	45-50
Pectoral	17-22
Caudal	
Total	12-15
Branchiostegals	8

LIFE HISTORY

Range: Northern Gulf of Mexico
Habitat: Burrows in mud-sand substrate
ELH Pattern:
Spawning: Undescribed
Season: Undescribed
Area:
Mode: Viviparous
Migration:
Fecundity:
Age at First Maturity:
Longevity: Unknown

LITERATURE

Dawson 1966.

EARLY LIFE HISTORY DESCRIPTION

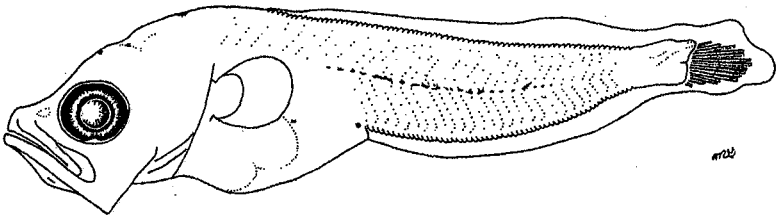
EGGS: Undescribed.

LARVAE:
Ethmoid spine: None.
Other spines: None.
Sequence of Fin Development: C first.
Pigmentation includes a series of melanophores along the midline of the body from over the gut to about ¾ the body length; few spots on top of head & a prominent melanophore near the anus.
Diagnostic Characters: meristic characters. Distinguish from other ophidiids by low meristic characters combined with C ray count.

JUVENILES:
Diagnostic Characters: Unknown.

ILLUSTRATIONS

A) 9.0 mm SL, Uncat., 17°53'N, 65°48'W, 8 May, 1984, SE of Puerto Rico. Illustrated by M. D. Greene.
Meristic characters of A: Myomeres: 37+,
D pterygiophores: 65, A pterygiophores: 48,
C rays: about 15.



A

9.0 mm SL

Based on observable, low, meristic characters, this larva probably belongs to the Bythitidae. Two species in the western central Atlantic (*Calamopteryx goslinei & Gunterichthys longipenis)* have ranges of dorsal & anal fin ray counts that encompass, or approach, the totals in this larva. The number of caudal fin rays (15) exceed the total in *C. goslinei*, but are within the range of counts in *G. longipenis*. Pending the acquisition of additional larval material, we are provisionally assigning this larva to *G. longipenis*

MERISTICS

Vertebrae:	
Total	38-44
Number of Fin Rays:	
Total Dorsal Elements	58-79
Total Anal Elements	47-62
Gillrakers on First Arch	
Lower	
Total	12-18
Branchiostegals	7

LIFE HISTORY

Range: Tropical western Atlantic, eastern Gulf of Mexico.
Habitat: Reefs.
ELH Pattern: Undescribed.
Spawning: Undescribed.
Mode: Viviparous
Fecundity: Brood sizes up to 14.
Age at First Maturity: Undescribed.
Size at First Maturity: 30 mm.

LITERATURE

Longley & Hildebrand 1941, Suarez 1975.

EARLY LIFE HISTORY DESCRIPTION

EGGS: Undescribed.
Hatch Size: 12-15 mm ('born').

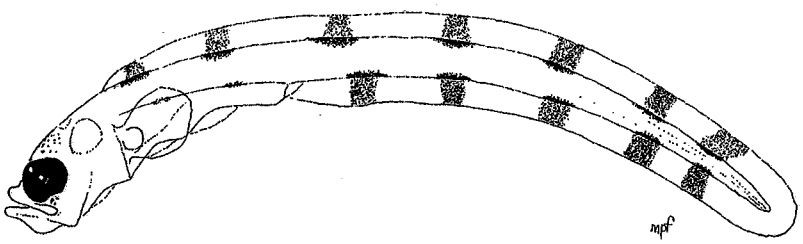
LARVAE:
Ethmoid spine: None.
Other spines: None.
Length at Flexion: Unknown.
Length at Transformation: Unknown.
Sequence of Fin Development: Unknown.
Pigmentation: Bands of pigment along edges of body & onto finfold; spots on crown; two internal patches on peritoneum.
Diagnostic Characters: Banded pigment pattern. Distinguish from other bythitoid larvae by pigment pattern & meristic characters.

JUVENILES:
Diagnostic Characters: Juveniles clear & colorless, except for broad, dusky stripe along the sides.

ILLUSTRATIONS

A) Laboratory reared. "Just born" 21 May, 1973; 6.0 mm preserved length. Original.
(There are about 14 undescribed species of *Ogilbia*).

A



6.0 mm TL

MERISTICS

Vertebrae:	
Precaudal	17-19
Caudal	49-56
Total	67-75
Number of Fin Rays:	
Total Dorsal Elements	97-113
Total Anal Elements	76-96
Pectoral	10-11
Pelvic	2
Caudal	
Principal	4+4
Total	8
Gillrakers on First Arch	
Upper	3-5
Lower	8-11
Branchiostegals	7-8
First Closed Hemal Arch on Vertebra	18-20
D_1 Insertion:	6-8

LIFE HISTORY

Range: Circumglobal, tropical, subtropical; in western North Atlantic from Puerto Rican Trench, Florida to south of Nantucket Island.

Habitat: Benthic at abyssal and hadal depths (3,111-8,370 m). This is the deepest living species of fish known.

ELH Pattern: Larvae pelagic, otherwise unknown.

Spawning: Undescribed.

Fecundity: Undescribed.

Age at First Maturity: Undescribed.

Longevity: Undescribed.

LITERATURE

Nielsen 1977.

EARLY LIFE HISTORY DESCRIPTION

EGGS: Undescribed.

LARVAE:

Ethmoid spine: None.

Other spines: None.

Length at Flexion: Unknown.

Length at Transformation: Unknown.

Sequence of Fin Development: Unknown.

Pigmentation: Dark peritoneum; dark upper angle of opercle; body covered with fine melanophores.

Diagnostic Characters: Body elongate with short gut; eyes small; weakly developed P_2 rays; long D & A fin bases; D rays slightly longer than A rays. Distinguish from other ophidiid larvae by elongate ural bones.

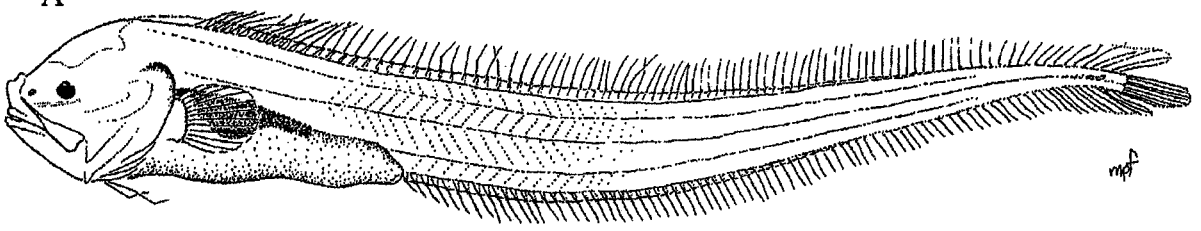
JUVENILES:

Diagnostic Characters: Elongate ural bones, low P_1 ray count, weak or no opercle spine, larger eyes (proportionately) than in adults. Distinguish from other ophidiids by small eyes, meristic characters.

ILLUSTRATIONS

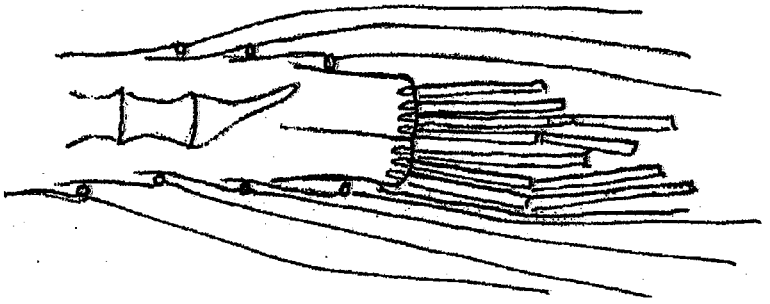
A-B) MCZ 76782. 36.0 mm SL.
37° 00.9'N, 071° 17.5'W. Original. C) After Nielsen (1977).
Myomeres/vertebrae: 67-68; D: 99; A: 83; P_1: 11; P_2: 2; C: 4+4. Collected in MOCNESS net fished between 0 & 1,004 m.

A



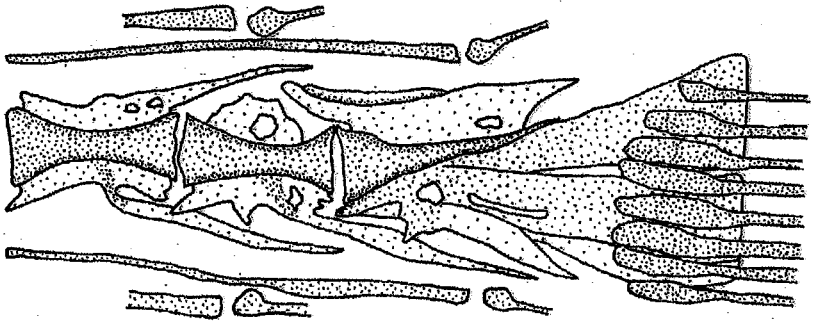
36.0 mm SL

B



36.0 mm SL Caudal

C



Adult Caudal

MERISTICS

Vertebrae:	
Precaudal	9-10
Caudal	
Total	60-65
Number of Fin Rays:	
Total Dorsal Elements	98-108
Total Anal Elements	88-100
Pectoral	16-19
Pelvic	2
Caudal	
Total	8
Gillrakers on First Arch	
Upper	4-5
Lower	16-20
Branchiostegals	8-9

LIFE HISTORY

Range: Worldwide in tropical & subtropical waters; in the western North Atlantic from Hudson Canyon to the Caribbean Sea.
Habitat: Benthopelagic in abyssal & bathyal depths; 1,500-4,415 m.
ELH Pattern: Unknown.
Spawning: Undescribed
Fecundity: Undescribed
Age at First Maturity: Undescribed
Longevity: Undescribed

LITERATURE

Nielsen et al. 1999, Okiyama 1988.

EARLY LIFE HISTORY DESCRIPTION

EGGS: Undescribed.

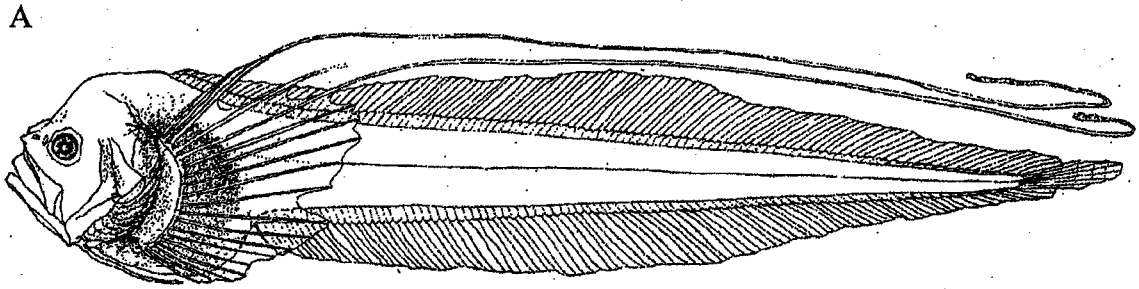
LARVAE:
Ethmoid spine: None.
Other spines: Adults typified by long, slender opercle angle spine, a spine at preopercle angle, & a bifid spine at tip of snout; all begin formation in larval stage.
Length at Flexion: Unknown.
Length at Transformation: Unknown.
Sequence of Fin Development: Unknown.
Pigmentation: Internal pigment on peritoneum & branchial chamber.
Diagnostic Characters: Body elongate with short, bulbous gut; head very short; weakly developed P_2 rays; several upper P_1 rays very elongate; D & A bases long; D rays slightly longer than A rays. Distinguish from other ophidiids by elongate P_1 rays, short, bulbous gut.

JUVENILES:
Diagnostic Characters: Trailing upper P_1 rays; blunt head; meristic characters; dark peritoneum & branchial chamber. Distinguish from other ophidiids by meristic characters & characters described above.

ILLUSTRATIONS

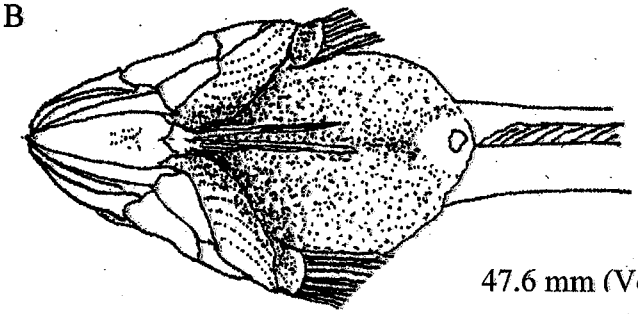
A-B) Pelagic juvenile, 47.6 mm (after Okiyama 1988).

A



47.6 mm

B



47.6 mm (Venter of head and gut)

MERISTICS

Vertebrae:	
Precaudal	19
Caudal	
Total	67
Number of Fin Rays:	
Total Dorsal Elements	112
Total Anal Elements	82
Pectoral	22
Pelvic	2
Caudal	
Principal	4+4
Total	8

LIFE HISTORY

Range: Western North Atlantic continental slope.
Habitat: Benthopelagic in depths of 1,270-3,000 m; can be abundant in some locations.
ELH Pattern: Larvae pelagic; otherwise unknown.
Spawning: Undescribed
Fecundity: Undescribed
Age at First Maturity: Undescribed
Longevity: Undescribed

LITERATURE

Nielsen et al. 1999, Nybelin 1957.

EARLY LIFE HISTORY DESCRIPTION

EGGS: Undescribed.

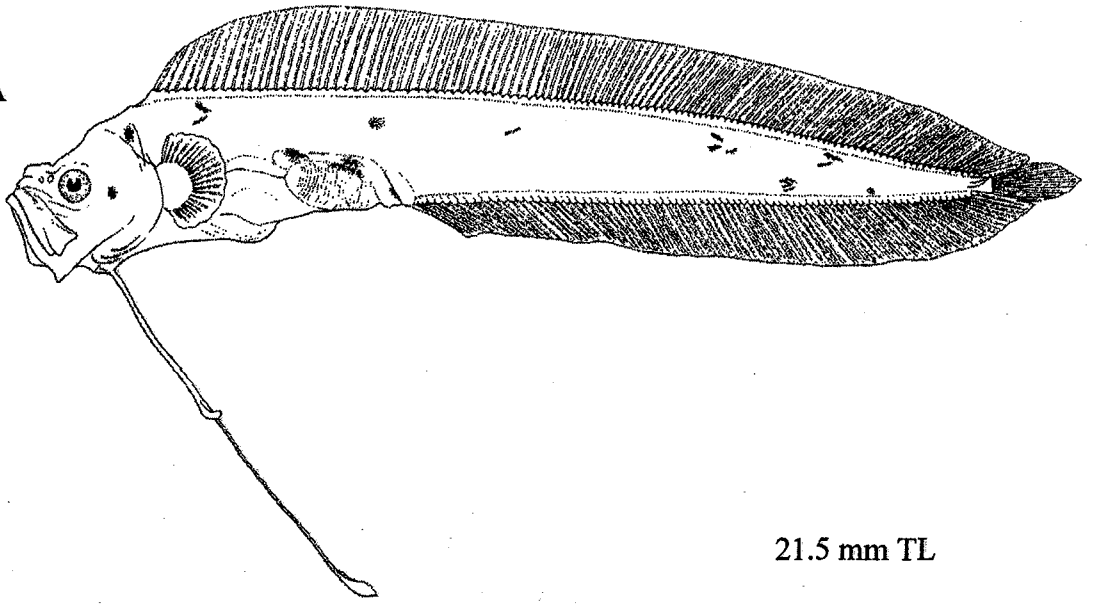
LARVAE:
Ethmoid spine: None.
Other spines: None.
Length at Flexion: Unknown.
Length at Transformation: Unknown.
Sequence of Fin Development: Unknown (P_1 late?).
Pigmentation: Widely spaced series of melanophores along length of body; prominent spots over gut & behind eye; air bladder pigmented.
Diagnostic Characters: Fleshy tabs on elongate, bifid P_2 rays; elongate body tapering to very narrow caudal peduncle; moderately short gut; D & A bases long; D rays longer than A rays. Distinguish from other ophidiid larvae by elongate, bifid P_2 rays & pigment pattern.

JUVENILES:
Diagnostic Characters: Unknown.

ILLUSTRATIONS

A) 21.5 mm TL (live length); Diver-collected; Chain Cruise 125, Sta. 408, 34° 56' N, 71° 13'W; 13 Aug., 1975, 1537 hrs. Illustrated by H. Orr. (Specimen & illustration loaned by H. G. Moser) Meristic characters: Myomeres: 69±2, D rays: 117, A rays: 84, P_1 rays: ~22, C rays: 4+4.

A



21.5 mm TL

MERISTICS

Vertebrae:	
Precaudal	11-15
Caudal	
Total	67-72
Number of Fin Rays:	
Total Dorsal Elements	123-129
Total Anal Elements	102-109
Pectoral	24-27
Pelvic	1
Caudal	
Principal	4+4
Total	8

LIFE HISTORY

Range: Eastern & western Atlantic; in the western Atlantic off SE United States, Gulf of Mexico, Caribbean Sea & West Indies to northern coast of South America; also off southern Brazil.
Habitat: Deep benthopelagic over mid-slope to abyssal depths; 3,180-5,456 m.
ELH Pattern: Larvae pelagic, otherwise unknown.
Spawning: Undescribed.
Fecundity: Ripe females 432-560 mm SL.
Age at First Maturity: Undescribed.
Longevity: Undescribed.

LITERATURE

Machida 1989, Nielsen & Merrett 2000.

EARLY LIFE HISTORY DESCRIPTION

EGGS: Undescribed.

LARVAE:
Ethmoid spine: None.
Other spines: None.
Length at Flexion: Unknown.
Length at Transformation: Unknown.
Sequence of Fin Development: Unknown.
Pigmentation: 5 prominent melanophores along body from level of anus to caudal peduncle; scattered pigment on head, opercle & P_1 base; pigment on mid-length of P_2 rays.
Diagnostic Characters: Body very elongate, tapering to narrow caudal peduncle; preanus length very short; D & A bases very long, separate from C fin; D rays longer than A rays. Distinguish from other ophidiids by elongate body, pigment pattern & meristic characters.

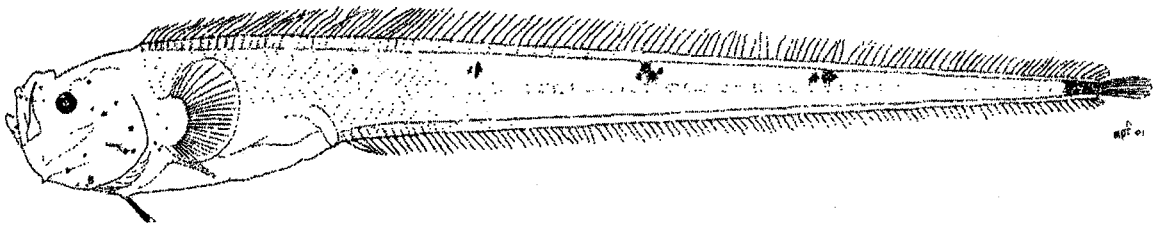
JUVENILES:
Diagnostic Characters: Unknown

ILLUSTRATIONS

A) MCZ 101089, 53 mm SL; 32° 38'N, 77° 18'W (No. Sargasso Sea); 29 July 1993. Original. Meristic characters: Myomeres: 74 (combination of myomeres & vertebrae), D rays: 125, A rays: 102, P_1 rays: 24, C rays: 4+4.

Note: counts similar to those of *B. taenia*, except latter has 26-27 P_1 rays.

A



53.0 mm SL

MERISTICS

Vertebrae:	
Precaudal	11-12
Caudal	37-39
Total	49-50
Number of Fin Rays:	
Total Dorsal Elements	95-111
Total Anal Elements	79-98
Pectoral	27-33
Pelvic	I, 2
Caudal	
Total	11
Gillrakers on First Arch	
Total	6-10 long rakers

LIFE HISTORY

Range: Tropical western Atlantic, northwest Africa, western Mediterranean Sea.
Habitat: Benthopelagic in depths of 500-1,000 m.
ELH Pattern: Long pelagic larval stage.
Spawning: Undescribed.
Season: Undescribed.
Fecundity: Undescribed.
Age at First Maturity: Undescribed.
Longevity: Undescribed.

LITERATURE

Nielsen & Evseenko 1989, Nielsen et al. 1999.

EARLY LIFE HISTORY DESCRIPTION

EGGS: Undescribed.

LARVAE:
Ethmoid spine: None, but protuberance above snout tip.
Other spines: 2 on opercle in late larvae.
Length at Flexion: Unknown.
Length at Transformation: Unknown.
Sequence of Fin Development: C & P_1 late. A rays & interhaemals longer than D rays & interneurals. Anterior D rays elongate.
Pigmentation: Several clusters of melanophores on posterior body, 3 along dorsum, 3 along midline, 2 along ventral margin; few spots behind eye; air bladder pigmented.
Diagnostic Characters: Meristic characters, elevated anterior D rays; pigment pattern. Distinguish from other ophidiids by meristic & pigment characters & anterior D rays.

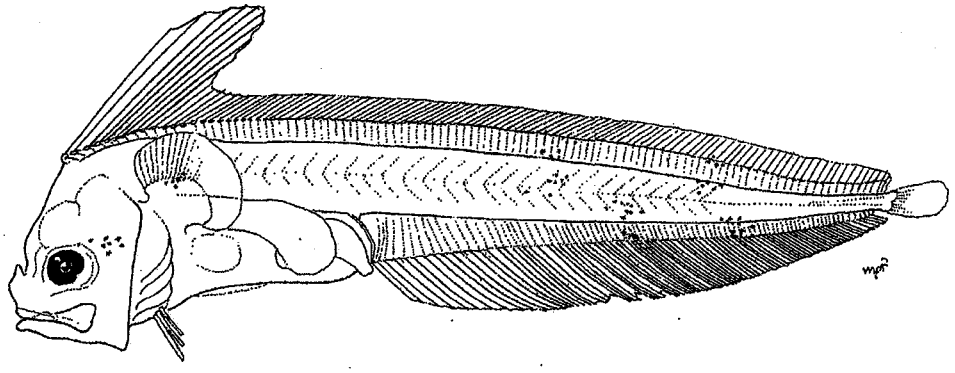
JUVENILES:
Diagnostic Characters: Meristic characters.

ILLUSTRATIONS

A) ARC 9010151, 14.5 mm TL; 40° 52' N; 66° 47' W; 19 May 1982. Original. B) 20.0 mm SL, ZMUC P77784, "Dana" st. 1124 III. C) 39.0 mm SL, ZMUC P77785, "Dana" st. 1132 II. (B & C after Nielsen and Evseenko 1989).

Meristic characters of A: Myomeres: 50-52, D rays: 109, A rays: 89, P_2 rays: I,2.

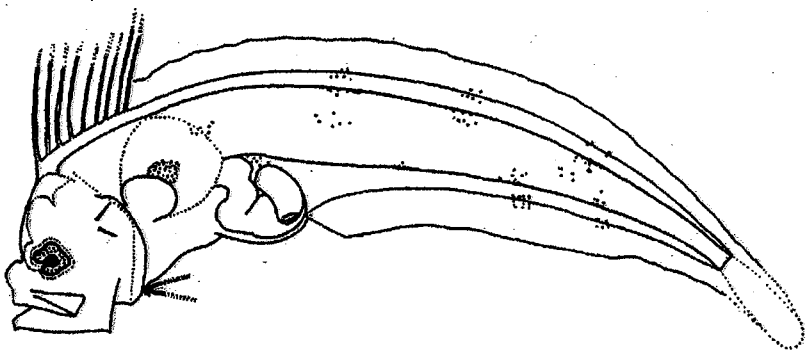
A



14.5 mm TL

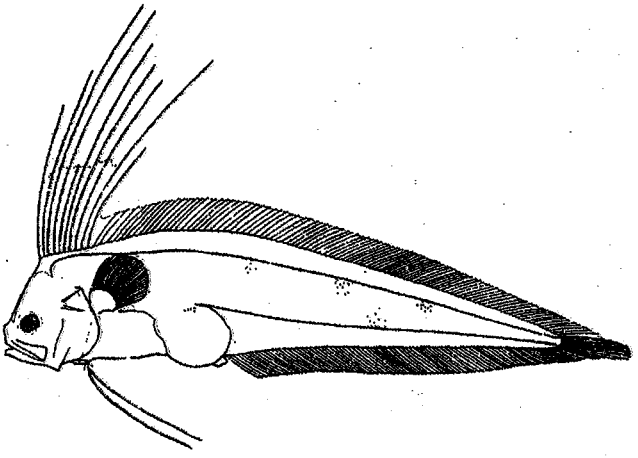
B

8-10 anterior, elongate dorsal fin rays are lost at transformation, leaving a series of predorsal pterygiophores (or supraneurals) in adults



20.0 mm SL

C



39.0 mm SL

MERISTICS

Vertebrae:	
Precaudal	13-14 (genus)
Caudal	
Total	64-68 (genus)
Number of Fin Rays:	
Total Dorsal Elements	100-115 (genus)
Total Anal Elements	82-98 (genus)
Pectoral	23-26 (genus)
Caudal	
Total	6-7 (genus)

LIFE HISTORY

Range: Eastern & western Atlantic (*D. intronigra*) or western Atlantic only (*D. kanazawai*).
Habitat: Benthopelagic in depths of 700-2,342 m.
ELH Pattern: Undescribed; larvae pelagic.
Spawning: Undescribed.
Fecundity: Undescribed.
Age at First Maturity: Undescribed.
Longevity: Undescribed.

LITERATURE

Nielsen et al. 1999.

EARLY LIFE HISTORY DESCRIPTION

EGGS: Undescribed.

LARVAE:
Ethmoid spine: None.
Other spines: None.
Length at Flexion: Unknown.
Length at Transformation: Unknown.
Sequence of Fin Development: Unknown; D rays longer than A rays.
Pigmentation: Head & body covered with fine melanophores except for an unpigmented area anterior to caudal peduncle; peritoneum & branchial chamber densely pigmented.
Diagnostic Characters: Elongate body, tapering to very narrow caudal peduncle. Distinguish from other ophidiid larvae by pigment pattern & free, lower P_1 rays.

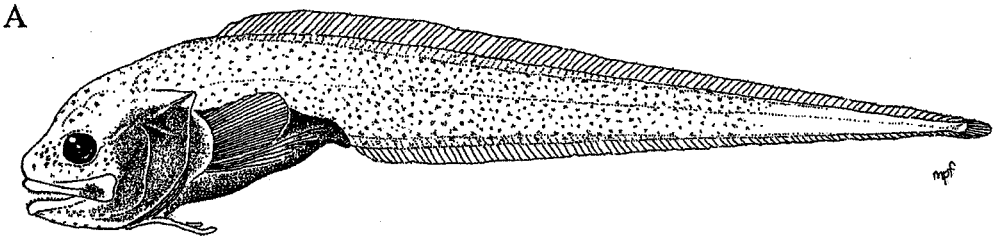
JUVENILES:
Diagnostic Characters: Lower 5-9 P_1 rays free from rest of fin.

ILLUSTRATIONS

A) 32.0 mm SL, MCZ 65823, 38° 54'36" N, 71° 36'48" W, Slope Water (Warm Core Ring), 23 April 1982. Original.

Meristic characters of A:
Vertebrae: 14 + ?, D rays: 105, A rays: 87, C rays: 6, P_1 rays: 24+5. (Also examined MCZ 76787, *D. intronigra*, 61 mm).

A



32.0 mm SL

MERISTICS

Vertebrae:	
Precaudal	11-13
Caudal	
Total	61-66
Number of Fin Rays:	
Total Dorsal Elements	103-113
Total Anal Elements	89-97
Pectoral	26-27
Pelvic	2
Caudal	
Total	8

LIFE HISTORY

Range: Western North Atlantic from North Carolina & the Bahamas through the Gulf of Mexico & Caribbean Sea to Trinidad.

Habitat: On or near bottom on outer continental shelf & upper slope in depths of 73-933 m.

ELH Pattern: Undescribed; larvae pelagic.

Spawning: Undescribed.

Fecundity: Undescribed.

Age at First Maturity: A single ripe female (153 mm SL) found with eggs (0.5-1.0 mm diameter).

Longevity: Undescribed.

LITERATURE

Nielsen 1999.

EARLY LIFE HISTORY DESCRIPTION

EGGS: Undescribed.

LARVAE:

Ethmoid spine: None.

Other spines: Upper angle of opercle.

Length at Flexion: Unknown.

Length at Transformation: Unknown.

Sequence of Fin Development: Unknown; D rays longer than A rays.

Pigmentation: Large, scattered clusters of melanophores on body, overlapping D & A fins; patch of spots behind eye & on venter of gut; fine spots on branchiostegal membranes.

Diagnostic Characters: Blunt head, elongate body, tapering to very narrow caudal peduncle; 2 median basibranchial tooth patches. Distinguish from other ophidiid larvae by head & body shape, pigmentation & meristic characters.

JUVENILES:

Diagnostic Characters: Meristic characters including basibranchial tooth patches.

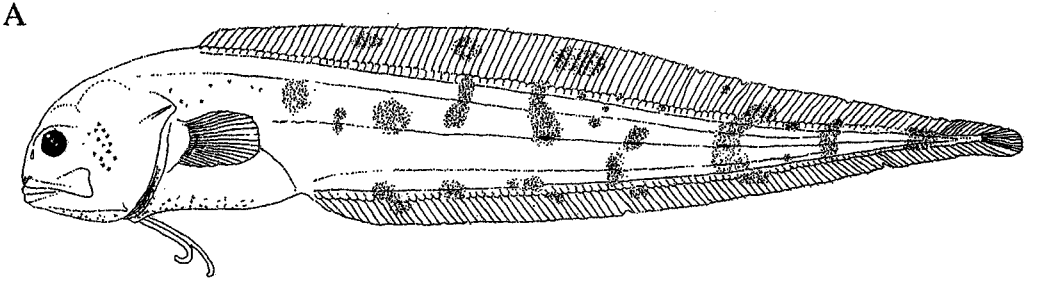
See Introductory Table Ophidiformes 3 for meristic characters in other species of *Neobythites*.

ILLUSTRATIONS

A) Late-larva/pelagic-juvenile, 38.0 mm SL, MCZ 76771, 37°0'54" N, 71°17'30" W, 20 Aug. 1982, (No. Sargasso Sea). Original.

Meristic characters of A: Vert: 12+52=64, D: 108, A: 95, P_1: 21-22, C: 8, Gill Rakers: 10.

A



38.0 mm SL

MERISTICS

Vertebrae:	
Precaudal	17-18
Caudal	
Total	123-129
Number of Fin Rays:	
Total Dorsal Elements	170-188
Total Anal Elements	135-156
Pectoral	16-19
Pelvic	2
Caudal	
Total	6-7
Gillrakers on First Arch	
Upper	iii-15-0

LIFE HISTORY

Range: Worldwide in tropical & temperate seas; in the western Atlantic from the Caribbean Sea & Gulf of Mexico to southern New England.
Habitat: Bathyal and abyssal in depths of 1,000-5,055 m.
ELH Pattern: Pelagic larvae.
Spawning: Undescribed.
Fecundity: Undescribed.
Age at First Maturity: Undescribed.
Longevity: Undescribed.

LITERATURE

Carter & Sulak 1984, Machida & Amaoka 1990, Nielsen& Cohen 1986, Nielsen et al. 1999.

EARLY LIFE HISTORY DESCRIPTION

EGGS: Undescribed

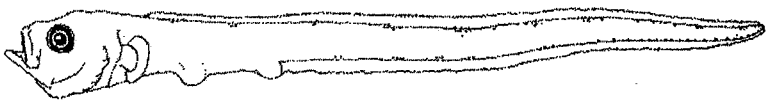
LARVAE:
Ethmoid spine: None.
Other spines: None.
Length at Flexion: Unknown.
Length at Transformation: Unknown.
Sequence of Fin Development: Unknown.
Pigmentation: Series of large, distinct melanophore clusters along posterior part of body.
Diagnostic Characters: Body very elongate, tapering to narrow caudal peduncle; gut coil near posterior part of intestine, preanus length short. Distinguish from other ophidiid larvae by very elongate body, meristic characters & pigmentation.

JUVENILES:
Diagnostic Characters: Unknown.

ILLUSTRATIONS

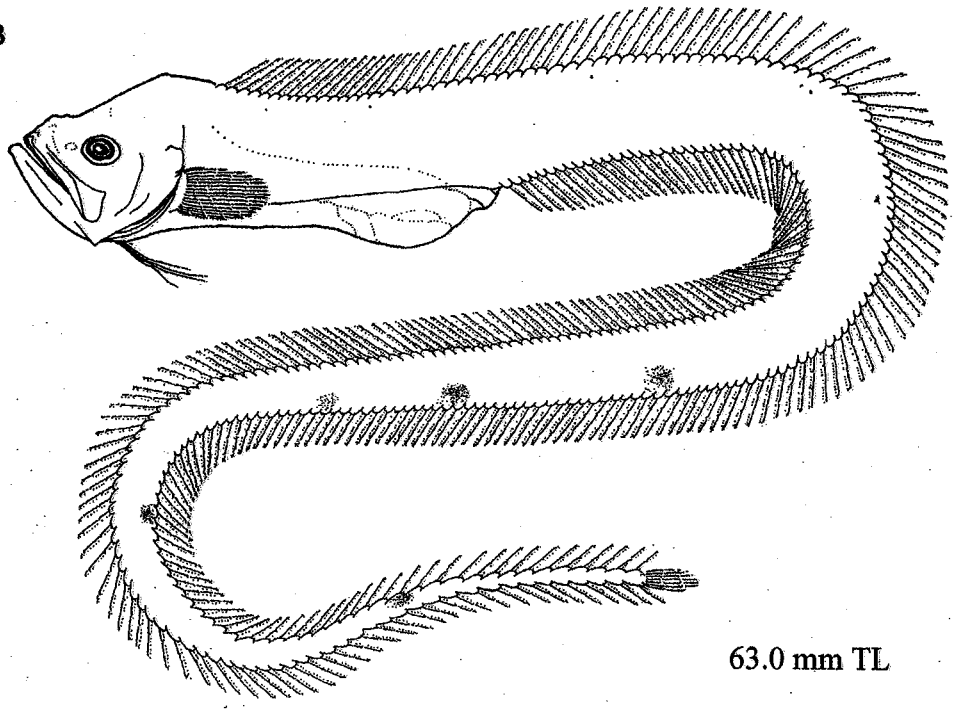
A) 12.0 mm SL, uncat., 38° 49.2'N, 72° 12'W, (Mid-Atlantic Bight slope), 17 July, 1988. B) 63 mm TL, MCZ 161214, 38° 30'N, 66° 30'W (northern Sargasso Sea), 30 July, 1976. Both original, illustrated by M. D. Greene. Identification based on collection location (thus excluding *P. silus*) and coincidence of high vertebral numbers. (Counts for *P. catena* unknown).

A



12.0 mm TL

B



63.0 mm TL

MERISTICS

Vertebrae:	
Precaudal	18-25
Caudal	
Total	71-79
Number of Fin Rays:	
Total Dorsal Elements	121-148
Total Anal Elements	90-113
Pectoral	22-23
Pelvic	2
Caudal	
Principal	4+4
Total	8
Gillrakers on First Arch	
Upper	3-4
Lower	8-9
Total	11-13
Branchiostegals	8

LIFE HISTORY

Range: Worldwide in tropical & temperate waters.
Habitat: Benthopelagic in bathyal & abyssal depths (800-4,255 m).
ELH Pattern: Pelagic larvae.
Spawning: Undescribed.
Mode: Oviparous.
Fecundity: Undescribed.
Age at First Maturity: Undescribed.
Longevity: Undescribed.

LITERATURE

Aboussouan & Rasonarivo 1986, Ambrose 1996m, Jordan & Thompson 1914, Matarese et al. 1989.

EARLY LIFE HISTORY DESCRIPTION

EGGS: Undescribed.

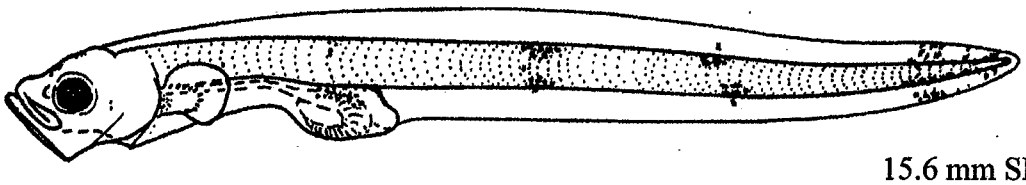
LARVAE:
Ethmoid spine: None.
Other spines: None.
Length at Flexion: >15.6 mm.
Length at Transformation: <52 mm.
Sequence of Fin Development: Unknown.
Pigmentation: Melanophores on crown, tip of lower jaw; 4 dorsal and 3 ventral clusters along body; scattering at tip of notochord.
Diagnostic Characters: Elongate body, becomes deep anteriorly, with short gut; gut loop forms early in posterior gut (<7 mm); meristic characters and paired pigment patches. Distinguish from other ophidiids by meristic characters & body shape.

JUVENILES:
Diagnostic Characters: Meristic characters & body shape.

ILLUSTRATIONS

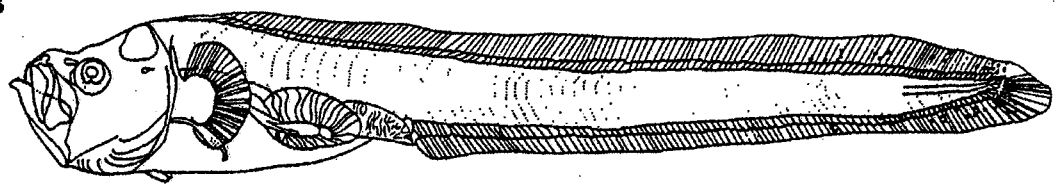
A) Preflexion 15.6 mm SL; B) Flexion, 20.7 mm SL; C) Postflexion, 29.8 mm SL; D) Pelagic-juvenile, 56.0 mm SL. A & C) after Matarese et al. 1989; B) from Aboussouan & Rasonarivo 1986; D) from Jordan & Thompson 1914.

A



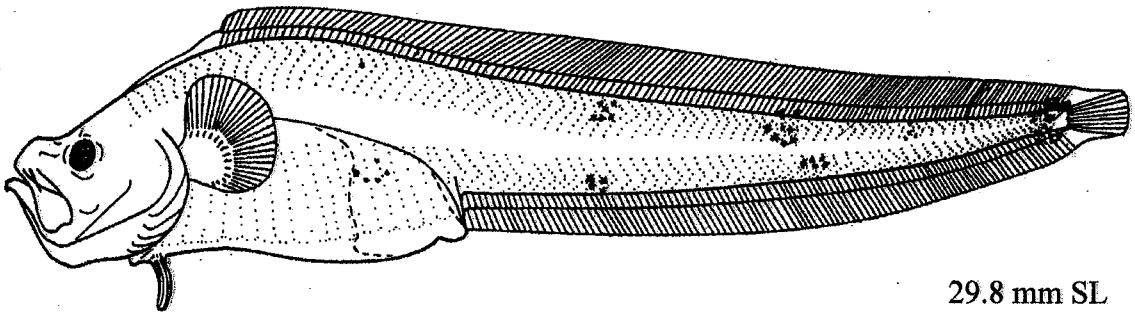
15.6 mm SL

B



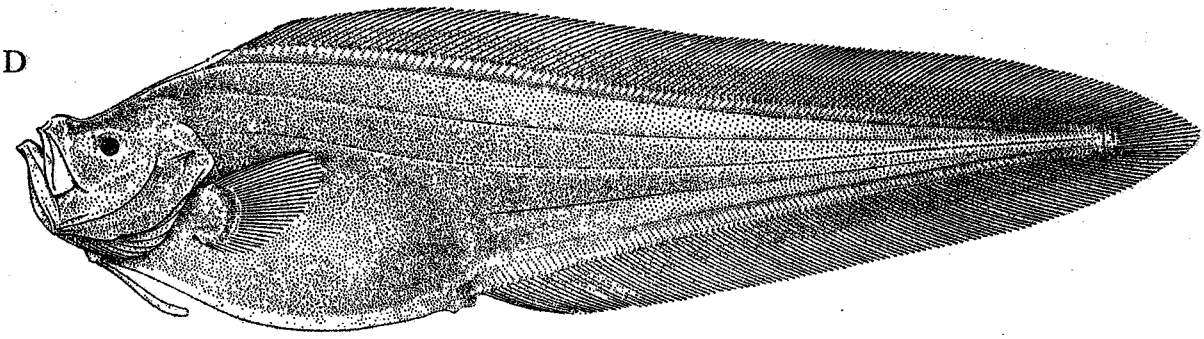
20.7 mm SL

C



29.8 mm SL

D



56.0 mm SL

MERISTICS

Vertebrae:	
Precaudal	14-15[1]
Caudal	40-42[1]
Total	54-57[1]
Number of Fin Rays:	
Total Dorsal Elements	109-117
Total Anal Elements	86-94
Pectoral	25-28
Pelvic	2
Caudal	
Total	8-11
Gillrakers on First Arch	
Upper	3 (low)
Lower	5 (low) + 3
Total	11
Branchiostegals	8
First Closed Hemal Arch on Vertebra	15-16
D1 Insertion:	3-4

[1] Based on MCZ 61194; MCZ 76743; MCZ 76735; MCZ 76755; MCZ 70186; MCZ 88148; MCZ 76753.

LIFE HISTORY

Range: Tropical & subtropical Atlantic; Bermuda to northern South America, including Caribbean and Gulf of Mexico.
Habitat: Benthopelagic from coastal waters to upper slope, in depths to 650 m.
ELH Pattern: Oviparous; pelagic larval stages.
Spawning:
Season: Unknown.
Mode: Oviparous.
Migration: Undescribed.
Fecundity: Undescribed.
Age at First Maturity: Undescribed.
Longevity: Undescribed.

LITERATURE

Gordon et al. 1984.

EARLY LIFE HISTORY DESCRIPTION

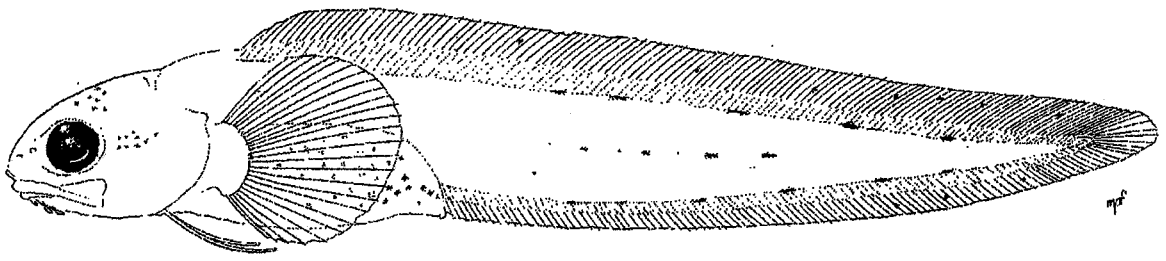
EGGS: Undescribed.

LARVAE:
Ethmoid spine: None.
Other spines: On upper opercle.
Length at Flexion: Unknown.
Length at Transformation: Unknown.
Sequence of Fin Development: Unknown; D rays longer than A rays; large, fan-shaped P_1.
Pigmentation: Series of spots along dorsal & ventral edges & a few along midline; scattered pigment on fin rays, over gut, on top of head & behind eye.
Diagnostic Characters: Barbels form on snout & tip of lower jaw. Distinguish from other ophidiids by barbels, pigment pattern & meristic characters.
JUVENILES:
Diagnostic Characters: Barbels on chin and snout tip; spine on opercle. Distinguish from ophidiines by above characters & characteristic crease in dorsal outline between head & D origin.

ILLUSTRATIONS

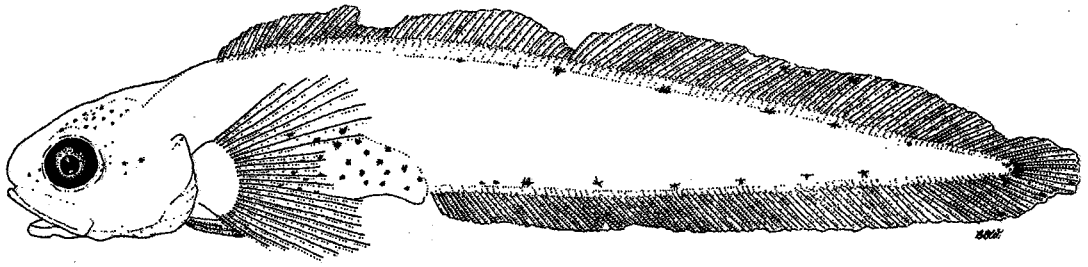
A) MCZ 76747, 24.0 mm SL; 19° 55'N, 70° 04'W; 16 Jun 1965. Original. B) 21.9 mm SL; Gordon et al., (1984). Meristic characters of A: D rays: 115, A rays: 90, P_1 rays: 26?, C rays: 10.

A



24.0 mm SL

B



21.9 mm SL

Note: The unidentified bythitid illustrated in Fig. B (described in Gordon et al., 1984; fig. 158B) shares the following characters with *Brotula barbata*: a notch in dorsal outline between head and dorsal fin origin; large, fan-shaped pectoral fin; pigment pattern on crown, body and over gut; a spine on opercle; similar (but slightly higher) numbers of meristic characters; and similar fin origin positions. However, it lacks barbels on the snout and lower jaw. It is presumably an example of *Brotula barbata*, and the absence of barbels should be considered an artifact of preservation or handling.

MERISTICS

Vertebrae:	(See Introductory Table 3)
Total	63-96 (genus)
Number of Fin Rays:	
Total Dorsal Elements	79-134 (genus)
Total Anal Elements	58-108 (genus)
Pectoral	20-26 (genus)
Pelvic	None (adult)
Caudal	
Total	(5?)9

LIFE HISTORY

Range: Worldwide in tropical & subtropical waters.
Habitat: Meso-, bathy- & possibly benthopelagic; collected in both midwater & bottom trawls.
ELH Pattern: Long, pelagic larval phase..
Spawning: Undescribed.
Fecundity: Undescribed.
Age at First Maturity: Undescribed.
Longevity: Undescribed.

LITERATURE

Aboussouan 1980, Cohen & Nielsen 1978, Fahay & Nielsen 2003, Fourmanoir 1976, Nielsen et al. 1999.

EARLY LIFE HISTORY DESCRIPTION

EGGS: Undescribed.

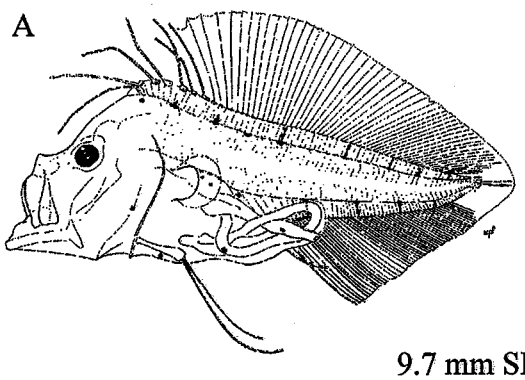
LARVAE:
Ethmoid spine: None.
Other spines: None.
Length at Flexion: 10-15 mm.
Length at Transformation: 62-78 mm.
Sequence of Fin Development: Precocious anterior D & P_2 rays; P_2 rays supported by cartilaginous structure, well posterior to cleithra, then lost at transformation.
Pigmentation: Series of melanophores along upper & lower myosepta angles.
Diagnostic Characters: Moderately exterilium gut, supported by very long descending process of coracoid. Distinguish from most ophidiid larvae by body & fin shape, bulging gut, 'lionesque' head; from *Lamprogrammus* larvae by a less exterilium gut.

JUVENILES:
Diagnostic Characters: Lack of P_2 rays.

ILLUSTRATIONS (note mix of species)

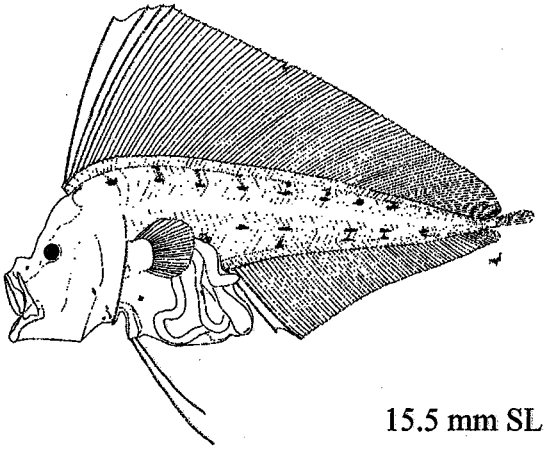
A) *B. brevicauda*, 9.7 mm SL. "Dana" St. 3543i. 12 Aug, 1928, 21 50'N, 50 12'W.
B) *B. nielseni**, 15.5 mm SL. "Dana" St. 3563v. 2 Sep, 1929, 07 45.5' S, 131 22'W.
C) *B. nigra*, 25.0 mm SL. "Dana" St. 1068ii. 11 Dec, 1913, 25 32'N 54 41'W.
D) *B. nigra*, 45.3 mm SL. "Dana" St. 866, 23 Jun, 1920, 28 32" N, 56 38'W.
E) *B. crassa*, 62.6 mm SL (after Aboussouan, 1980.

(A-D after Fahay & Nielsen 2003).
* Has not been reported from western central Atlantic.



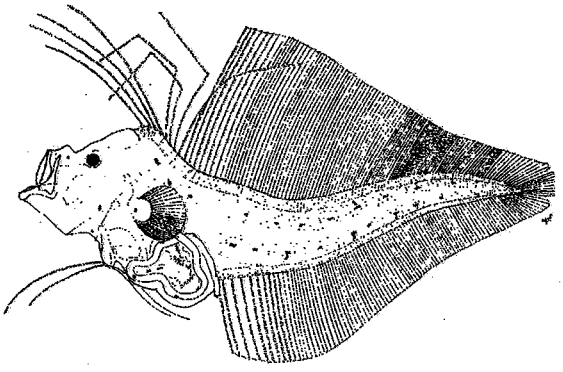
A

9.7 mm SL



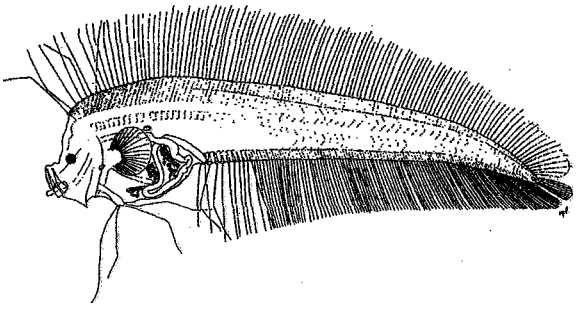
B

15.5 mm SL



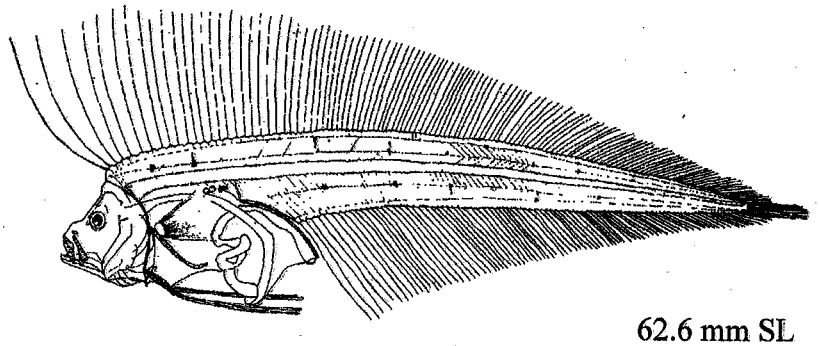
C

25.0 mm SL



D

45.3 mm SL



E

62.6 mm SL

MERISTICS

Vertebrae:	
Precaudal	13-14
Caudal	
Total	68-71
Number of Fin Rays:	
Total Dorsal Elements	108-125
Total Anal Elements	92-108
Pectoral	19-22
Pelvic	None (adult)
Caudal	
Total	8-9

LIFE HISTORY

Range: Worldwide, in tropical & subtropical waters, except for eastern Pacific.
Habitat: Bathypelagic in depths of 800-1,600 m; sometimes found floating at surface.
ELH Pattern: Undescribed, larvae pelagic.
Spawning: Undescribed.
Fecundity: Undescribed.
Age at First Maturity: Undescribed.
Longevity: Undescribed.

LITERATURE

Cohen et al. 1991, Fahay & Nielsen 2003, Nielsen et al. 1999.

EARLY LIFE HISTORY DESCRIPTION

EGGS: Undescribed.

LARVAE:
Ethmoid spine; None.
Other spines: None.
Length at Flexion: Unknown.
Length at Transformation: 74-108 mm.
Sequence of Fin Development: Anterior Dl & P_2 rays form early; D rays longer than A rays.
Pigmentation: Series of melanophores along body, scattered on gut & on fleshy tabs along gut.
Diagnostic Characters: Exterilium gut with fringes on exterior part; gut loops once & anus exits near body; frontal bones long, resulting in "lionesque" expression; P_2 rays lost at transformation. Distinguish from other ophidiid larvae by trailing gut and long D & A bases; distinguish species by meristic characters.

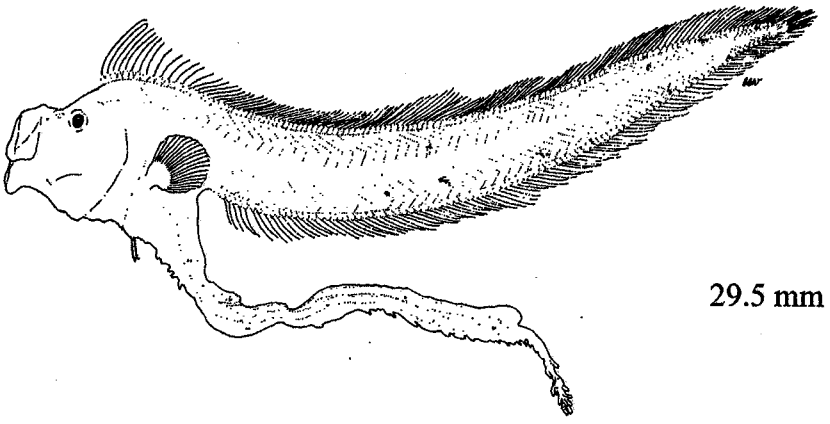
JUVENILES:
Diagnostic Characters: Lack of P_2 rays, meristic characters.

ILLUSTRATIONS

A) 29.5 mm SL; (Atlantic) Gordon et al. 1984,
B) 38.0 mm SL; (Pacific) Okiyama 1988,
C) 64.0 mm SL; (Pacific) Moser 1981.
(All referred to *L. brunswigi* by Fahay & Nielsen 2003)
Meristic characters of illustrated larvae:

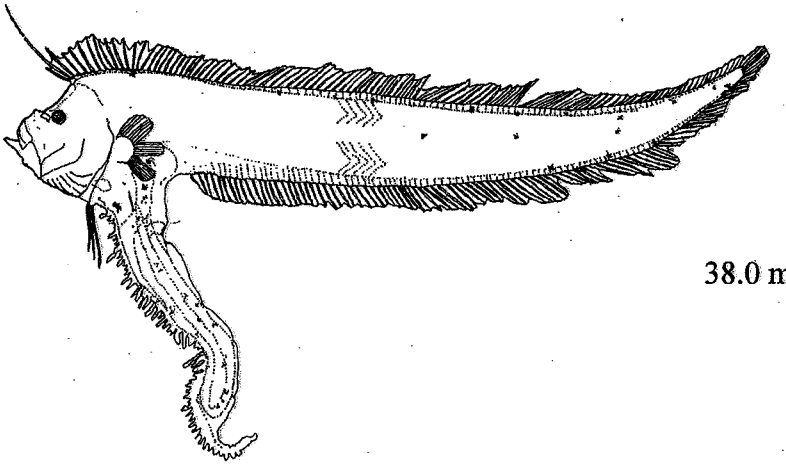
	Myomeres	D	A	P_1
A	~75	~129	~97	20
B	72	118	94	23
C	74	124	95	--

A



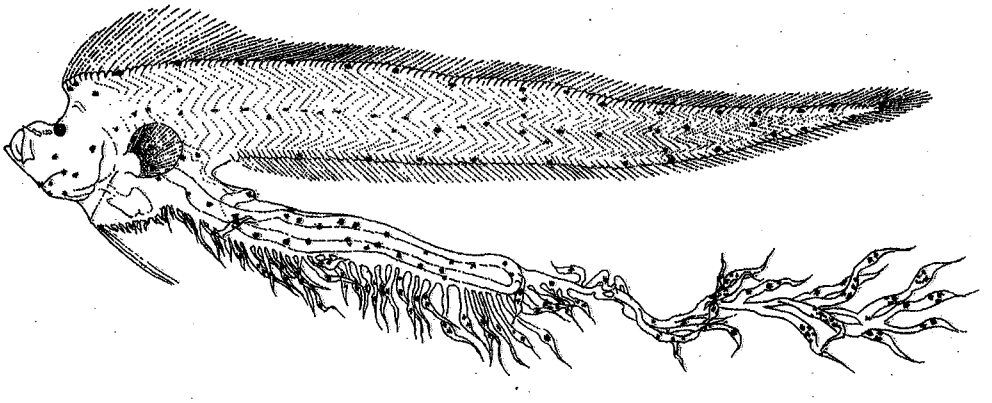
29.5 mm SL

B



38.0 mm SL

C



64.0 mm SL

MERISTICS

Vertebrae:	
Precaudal	12-14
Caudal	
Total	65-72
Number of Fin Rays:	
Total Dorsal Elements	103-117
Total Anal Elements	81-91
Pectoral	16-19
Pelvic	None (adult)
Caudal	
Total	8

LIFE HISTORY

Range: Worldwide in tropical & subtropical waters.
Habitat: Benthopelagic in depths to 1,500 m; small individuals sometimes mesopelagic.
ELH Pattern: Undescribed; larvae pelagic.
Spawning: Undescribed.
Fecundity: Undescribed.
Age at First Maturity: Undescribed.
Longevity: Undescribed.

LITERATURE

Cohen et al. 1991, Fahay & Nielsen 2003.

EARLY LIFE HISTORY DESCRIPTION

EGGS: Undescribed.

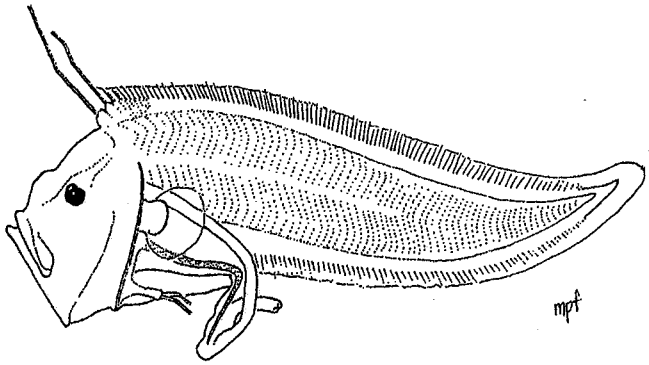
LARVAE:
Ethmoid spine: None.
Other spines: None.
Length at Flexion: 10-20 mm.
Length at Transformation: 74-108 mm.
Sequence of Fin Development: Anterior D & P_2 rays form early; D rays longer than A rays.
Pigmentation: Series of melanophores along body, trailing gut.
Diagnostic Characters: Exterilium gut with fringes on exterior part; gut loops twice & anus exits at distal tip of gut mass; frontal bones long, resulting in "lionesque" expression; P_2 rays lost at transformation. Distinguish from other ophidiid larvae by trailing gut & long D & A bases; from other *Lamprogrammus* by double-looping gut & meristic characters.

JUVENILES:
Diagnostic Characters: Lack of P_2 rays, meristic characters.

ILLUSTRATIONS

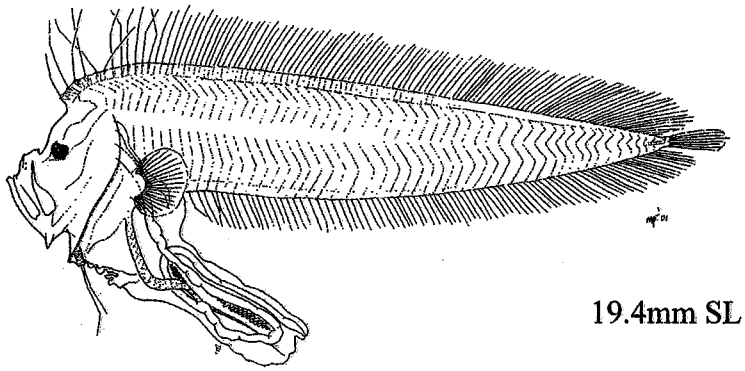
A-C) Fahay & Nielsen 2003.

A



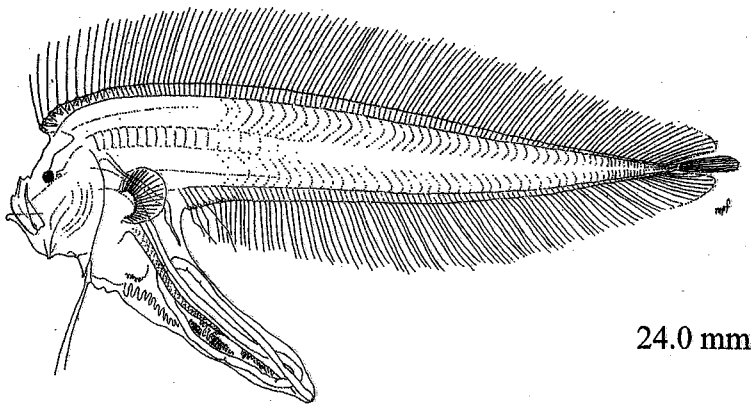
9.5mm SL

B



19.4mm SL

C



24.0 mm SL

MERISTICS

Vertebrae:	
Precaudal	11
Caudal	
Total	71-74
Number of Fin Spines and Rays:	
Total Dorsal Elements	131-140
Total Anal Elements	104-117
Pectoral	18-19
Pelvic	None (adult)
Caudal	
Total	8-9

LIFE HISTORY

Range: Tropical western Atlantic & a single record from the eastern North Atlantic.
Habitat: Bathypelagic in depths to 1,000 m.
ELH Pattern: Undescribed, larvae pelagic.
Spawning: Undescribed.
Fecundity: Undescribed.
Age at First Maturity: Undescribed.
Longevity: Undescribed.

LITERATURE

Cohen & Rohr 1993, Fahay & Nielsen 2003, Fraser & Smith 1974, Nielsen 1963, Nielsen & Schwarzhans 2000.

EARLY LIFE HISTORY DESCRIPTION

EGGS: Undescribed.

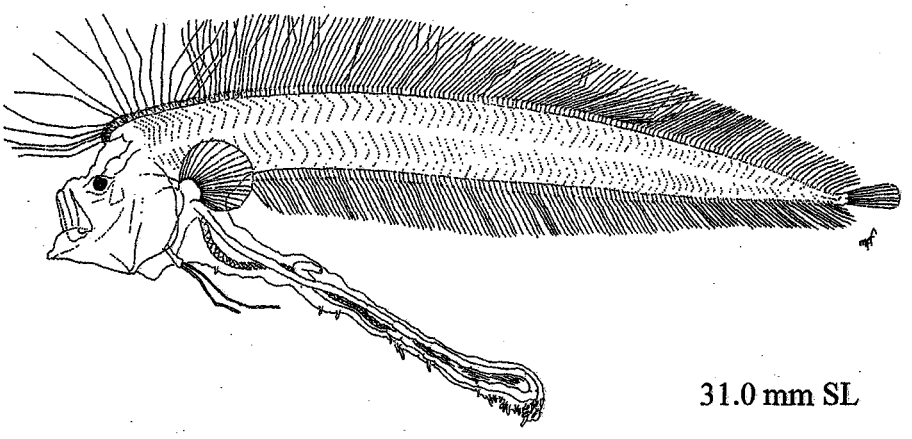
LARVAE:
Ethmoid spine: None.
Other spines: None.
Length at Flexion: Unknown.
Length at Transformation: 74-108 mm.
Sequence of Fin Development: Anterior Dl & P_2 rays are long; D rays longer than A rays.
Pigmentation: Unknown in present, faded specimen; in the Fraser & Smith (1974) specimen, a series of large blotches along body midline & another series along trailing gut.
Diagnostic Characters: Elongate, slim body; exterilium gut with fringes on exterior part; gut loops once & anus exits near body; frontal bones long, resulting in "lionesque" expression; P_2 rays lost at transformation. Distinguish from other ophidiid larvae by trailing gut & long Dl & A bases; from other *Lamprogrammus* by single-looping gut, meristic characters & slim body.

JUVENILES:
Diagnostic Characters: Lack of P_2 rays, meristic characters, slim body.

ILLUSTRATIONS

A) 31.0 mm SL, Fahay & Nielsen 2003.
Specimens described by Nielsen (1963) and Fraser & Smith (1974) were referred to this species by Fahay & Nielsen 2003.
Meristic characters of illustrated larvae: Vert: ~76, D: 150, A: 123, P_1: 23.

A



31.0 mm SL

Note: This larva was collected in the western central Atlantic, off the coast of French Guiana. A paratype of *L. shcherbachevi*, also collected off French Guiana, exhibits meristic characters that are very close to those of this larva. Characters of both specimens, however, are somewhat higher than conspecifics collected elsewhere. When all are considered, the ranges in meristic characters exceed the ranges in other ophidiiforms. Therefore, this specimen is provisionally assigned to *L. shcherbachevi*, although because of the wide range in meristic characters, it is possible that it is the larva of an undescribed species, or that *L. shcherbachevi*, as presently understood, comprises more than a single species (see Fahay & Nielsen 2003).

The subfamily Ophidiinae contains eight genera, four of which contain species occurring in the western central North Atlantic study area. Fishes in this subfamily lack barbels on the snout and chin, and have a covering of small, cycloid scales, arranged in regular rows (in *Genypterus, Cherublemma,* and *Lepophidium),* or at oblique angles to each other, (in *Ophidion, Otophidium, Parophidion, Chilara,* and *Raneya*). The pelvic fins (with two rays) are joined to an elongate, filamentous bone extending forward from the pectoral girdle, with the result that the fins originate at the level of the orbit after transformation. The swim bladder and anterior vertebral column are modified in many ophidiines, and some of these modifications are sexually dimorphic and associated with the production of sound (Rose, 1961; Courtenay, 1971). In all species examined, these specializations are similar on the first five vertebrae. Although 50-60 species have been described in the Ophidiinae (Cohen & Nielsen 1978; Nelson 1984), new species continue to be described and this total will almost certainly increase. The present treatment deals with 23 species, although we anticipate the descriptions of new species and taxonomic problems arising from synonymy.

Larvae of the Ophidiinae are abundant constituents of ichthyoplankton collections in tropical and temperate waters (e.g. Powles & Stender 1976; Houde et al. 1979; Ditty et al. 1988; Fahay 1992). Despite this abundance, early life history stages of most are undescribed. Egg descriptions are few. Eggs of *Genypterus capensis* were described by Brownell (1979), those of *Ophidion barbatum* by Sparta (1929) and reproductive behavior and egg masses of *Ophidion marginatum* by Fahay (1992). Few larvae have been described completely (Table Ophidiformes 3) and descriptions of larvae from the western Atlantic are limited. Larval series were described (some tentatively) for four species by Gordon (1982), and three species (one in *Lepophidium*, two in *Ophidion*) from north of Cape Hatteras, North Carolina by Fahay (1992). Partial descriptions of several species were also provided in Gordon (1982) and Gordon et al. (1984).

The purpose of the present chapter is to compile useful characters for identifying early stages of members of the subfamily Ophidiinae. These include meristic characters and pterygiophore interdigitation patterns, as well as pigment and morphological characters of larvae. In some cases our knowledge is incomplete, in which case we present only such figures as are available. Although our compilation is not yet complete, we have also attempted to characterize larvae at the genus level, and to discuss species-pairs.

Ophidiine species occurring in the western central North Atlantic study area are listed in Table Ophidiformes 4, along with their meristic characters. Most of these characters were collected from radiographs of specimens collected in the Cape Hatteras area (or off the coast of the northeastern U.S.), tempered by data available from the literature. Where specimens were lacking, meristic counts were taken from the sources cited. Geographic ranges and habitats occupied by western central North Atlantic ophidiines are listed in Table Ophidiformes 5.

Eggs of *Genypterus capensis* (S.E. Atlantic) are 1.18-1.30 mm, contain a single oil globule, 0.09-0.11 mm, and have a narrow perivitelline space, homogeneous yolk and smooth chorion (Brownell 1979). Eggs of *Ophidion barbatum* (Mediterranean Sea) and *O. marginatum* have been described as being encased in a gelatinous mass, and being released in small batches (Sparta 1929; Fahay 1992). Eggs of *O. marginatum* are slightly off-round, and measure 0.83-1.02 x 0.88-1.06 mm (short x long axis). They lack oil globules, and have a narrow perivitelline space, homogeneous yolk and smooth chorion (Fahay 1992).

Larvae of the Ophidiinae are elongate, with relatively short preanus lengths. They have a characteristic, downward pointing jaw angle, contributing to a deep head. The mid-section 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 do not migrate forward until larvae settle to the bottom. Pigment is generally light in most species, although some are prominently spotted. Larvae of *Ophidion nocomis* and *O. selenops* differ from

those of all other species examined. The gut loop forms at the posterior end of the gut, rather than the midsection, and the body and head regions are extremely slender. Meristic characters are useful in older larvae, when they are fully formed. Total vertebral (and myomere) counts are relatively stable within genera (Table Ophidiformes 4). In *Otophidium* they range from 56-65; in *Lepophidium* from 69-82 (except for *L. aporrhox* with lower counts); and in *Ophidion* from 61-70 (except in *O. nocomis* and *O. selenops* where they are much higher). The dorsal fin originates over vertebrae 2-4 in *Otophidium*; 1-5 in *Lepophidium*; 4-5 in *Parophidion*; 3-6 in most *Ophidion*, but 6-9 in *O. nocomis* and *O. selenops*. The anteriormost parapophyses develop on the sixth vertebra in all but *Ophidion nocomis* and *O. selenops*, where they are on the eighth vertebra. We have found interdigitation of the dorsal pterygiophores and interneural spaces to be valuable in discriminating species (Figs. Ophidiformes 8 & 9). These patterns (described in the caption to Fig. Ophidiformes 8) are visible in larvae as soon as ossification begins along the vertebrae and fin bases, but require x-ray or clearing and staining to quantify. For example, note the unique pattern in *Ophidion lagocheila*, where posterior to vertebra number 20, virtually every interneural space has two pterygiophores inserted, whereas several of the spaces between vertebrae numbers 7 and 19 have three pterygiophores inserted. In *O. nocomis* and *O. selenops*, there are two pterygiophores in nearly every interneural space, which coincides with the condition in *Lepophidium jeannae & L. profundorum*, but contrasts with the situation in *Ophidion* congeners where many spaces have three interneurals inserted. Based on available data, we suggest that this two-condition represents the plesiomorphic condition, whereas the presence of three in most interneural spaces represents the apomorphic condition.

Transformation to the juvenile, demersal stage is gradual in all species described except *O. nocomis* and *O. selenops* where the pelagic stage becomes quite elongate before reduction of intervertebral spaces causes shrinkage in total length immediately before larvae settle to benthic habitats (Gordon 1982). Settlement may be delayed in *Parophidion*, because pelagic collections contain numerous examples of post-transformation juveniles.

We have observed several species-pairs (or triplets) in *Ophidion*, based on similarities of ontogenetic characters. Whether these similarities reflect phylogenetic relationships remains to be determined, but in each pair, the adult morphology and coloration are also similar, at least in the expression of characters described to date. These pairs (and one triplet) are: *Ophidion marginatum-O. josephi; O. robinsi-O. grayi; O. antipholus-O. dromio* (with the possible inclusion of *O. holbrooki*); and the two unique species, *O. nocomis* and *O. selenops*, which share characters with each other but do not share many with their congeners. The relationships of *Ophidion lagocheila, O. puck,* and *O. guianense* with other species, or to each other, are not clear, although it has been suggested that *O. guianense* is a "southern disjunct sister species" of *O. antipholus* (Lea & Robins, 2003). Because we have not yet identified larvae of *O. guianense*, we can not comment on the ontogenetic evidence supporting or refuting this suggestion. We have also observed clinal differences in both larval and adult characters in the *Ophidion marginatum-Ophidion josephi* pair. The proportions of two or three pterygiophores per interneural space (Fig. Ophidiformes 9) would appear to separate these species, but there may be an area of intergradation in this character (and in other meristic characters) exhibited by fishes collected off Georgia. Larval pigment patterns (specifically the differences in length and time of onset of midline pigment and the number of melanophores on the venter of the gut) appear to separate larvae from the Gulf of Mexico from those collected off the east coast of the U.S., but there also appears to be an intergrade in these characters in larvae collected off the southeastern U.S. Based on these observations, we suggest that the validity of these two nominal species should be re-evaluated. In addition, the validity of the nominal species in other species pairs should be evaluated, and the inclusion of *Ophidion selenops* and *O. nocomis* in *Ophidion* should be

reconsidered based on their distinct larval and osteological morphology (Table Ophidiformes 6).

Ophidion larvae vary in pigment patterns, but all have a broad belt of melanophores on the venter of the gut (except *O. nocomis* and *O. selenops*). Dorsal pigment aligns itself into a single, median row, or paired rows (except in *O. nocomis* and *O. selenops* where there is none). Vertebrae ossify from both the anterior and posterior ends toward the middle. Pelvic fin rays form late in the larval period. The ethmoid spine is lacking, short or flat (except in *O. nocomis* and *O. selenops* where it is long and prominent) (Table Ophidiformes 4).

Lepophidium larvae are recognized at all sizes by the series of widely spaced melanophores along the ventral edge of the body. The most posterior of these has a corresponding melanophore situated on the dorsal edge. Pigment on the venter of the gut is light or absent. Dorsal pigment is usually absent in early larvae. Vertebrae ossify from anterior to posterior. Pelvic fin rays form early in the larval period. Late larvae and juveniles have a pungent, ethmoid spine.

Larvae and juveniles of *Otophidium* are most readily recognized by their low meristic counts. Dorsal pigment is absent, but a band of melanophores (or a few isolated melanophores) typically crosses the body about 2/3 of the way between the vent and caudal fin. Development of the pectoral fin rays is delayed, in contrast to the sequence in *Lepophidium* and *Ophidion*.

Parophidion larvae are slim-bodied and relatively lightly pigmented. The outline of their gut cavity is characteristically triangular, possibly because the gut-loop that typifies larvae of other genera, is not well-developed. When the two pelvic fin rays are developed, they are equal in length.

In the species accounts, the sequence of presentation is alphabetical, except in the *Ophidion* where descriptions are in pairs (see discussion above).

Table Ophidiformes 4. Species composition and meristic characters in the subfamily Ophidiinae from the western central North Atlantic study area. See data pages for details on synonymy, geographic range, and habitats. All ophidiines have 9 (4+5) caudal fin rays. LL = lower limb of first gill arch.

	Precaudal Vertebrae	Caudal Vertebrae	Total Vertebrae	Gill Rakers	Dorsal Fin Rays	Anal Fin Rays	Pectoral Fin Rays	Ethmoid Spine	D1@ [1]	D-A [2]	Source
Otophidium chickcharney	13	50-52	63-65	2+4	111-116	98-102	16-17	medium, flat	4-5	13-15	orig; BR59
Otophidium dormitator	14-15	49-51	64-65	2+4	111-117	94-99	15-16	short	3-4	15-21	orig; BR59
Otophidium omostigma	14	42-44	56-58 57-59	2-3+4	99-108	80-87 82-87	16-18	medium, pointed	3	18-21	orig; BR59
Ophidion antipholus	15-17	49-53	65-69	5-6 (LL)	111-133	94-103	18-21	short, blunt, stout	7-8	23-29	orig; G82; L&R03
Ophidion dromio	16-17	50-52	67-69	4 (LL)	116-129	92-102	19-21	short, blunt	6-7	25-26	L&R03; orig.
Ophidion grayi	16	48-50	64-66	2+4	131-146	99-113	20-23	short, blunt	4-5	27-40	orig; G82
Ophidion guianense	15-16	47-50	63-66	5-6 (LL)	109-122	91-96	19-20	stout, prominent	6	18-26	orig; L&R03
Ophidion holbrooki [3]	15-16	50-55	66-70	4 (LL)	117-132	97-109	19-21	no	6-7	21-27	orig
Ophidion josephi [4]	15-16	50-54	67-69	2+4	128-150	105-122	21-22	short, pointed	6-7	21-34	G82
Ophidion lagocheila	16-17	53-54	69-71	3+4-5	123-129	102-106	17-19	split, upturned	6-7	20-27	orig; BR59
Ophidion marginatum	15-16	52-54	67-70	4-5	138-164	116-131	ca. 21	short, pointed	6-8	24-33	orig; F92
Ophidion nocomis	17	67-70	84-87	2+5	144-153	132-139	14-17	long, pointed	7-9	10-15	orig; RB59
Ophidion puck	17-18	52-53	70	4 (LL)	129-130	100-101	21-22	short, blunt		28-29	L&R03

Ophidion robinsi	15-17	45-47	61-63	?+4	112-125	86-93	19-22	short, blunt	3-5	23-32	orig; F92
Ophidion selenops	15-16	62-65	77-81	2+5	132-140	123-129	15-16	long, pointed	8-10	10-13	orig, RB59
Parophidion schmidti	15-16	51-52	66-67	2+4	115-126	98-106	17-19	low	5-6	16-21	orig; BR59;Get84
Lepophidium aporrhox	13	52-53	65-66		109-114	96-99	21-23	long, pointed		14	R61
Lepophidium brevibarbe	14-16	55-57	69-73	3+6-8	124-136	101-116	20-22	long, pointed		23	G82; U83
Lepophidium jeannae	14-15	58-60	73-75 74-75	2+4	131-140 135-139	112-117 112-116	20-21	long, pointed	1-2 (3)	21-23	orig; G82; R58
Lepophidium kallion	15	59	72-74	10	130-135	108-115	23-24	long, pointed		25	R59
Lepophidium marmoratum	14-15	55-60	70-75		121-136	103-112	21-24	long, pointed		22	G82
Lepophidium pheromystax	14-15	54-57	69-72	2+7	125-132	104-110	20-22	long, pointed		21-22	R60; U83
Lepophidium profundorum	15-17	57-61	73-78	foot-note[3] 3-4+7-8	131-140 126-133	110-121 95-111	22-24 21-23	long, pointed	4-6	19-22	orig; F92; R86; U83
Lepophidium staurophor	15	65-67	80-82	4+8-11	140-147	122-127	22-23	long, pointed		21	R58

[1] Refers to interneural space where first neural spine inserts

[2] Refers to difference between total dorsal fin rays and total anal fin rays

[3] 2-3 low rakers on upper limb + 5-7 & 1-3 low rakers on lower limb; note counts differ in southern part of range; see data page

Sources: orig = original; BR59 = Böhlke & Robins 1959; R61 = Robins 1961; R59 = Robins 1959; R58 = Robins 1958; R86 = Robins 1986; RB59 = Robins & Böhlke 1959; U83 = Uyeno et al. 1983; G82 = Gordon 1982; Get84 = Gordon et al. 1984; F92 = Fahay 1992; L&R03 = Lea & Robins 2003

Table Ophidiiformes 5. Geographic and habitat ranges of ophidiine cusk eels in the western central North Atlantic. Larvae often occur outside reported ranges. Species listed alphabetically within genera. *Lepophidium* information tentative, pending future studies or revisions.

Species	Geographic Range	Habitat - Depth Range
Otophidium chickcharney	Bahamas	Benthic, nearshore to 15 m
Otophidium dormitator	Southern Florida & Bahamas to Yucatan, Mexico & Lesser Antilles	Benthic, nearshore to 15 m
Otophidium omostigma	North Carolina & northern Gulf of Mexico to Florida & Lesser Antilles	Benthic, 16-50 m
Ophidion antipholus	North Carolina & NW Gulf of Mexico to southern Florida & Yucatan, Mexico	Benthic on open sand & mud, 10-69 m
Ophidion dromio	North Carolina to southern Florida & Gulf of Mexico to northern coast of South America	Benthic on sand & mud, 50-183 m, most <100 m
Ophidion grayi	South Carolina to Florida & northern Gulf of Mexico to Mexico	Benthic in shallow, coastal waters, 10-60 m
Ophidion guianense	Eastern Caribbean Sea to Suriname	Benthic, 18-61 m
Ophidion holbrooki	North Carolina through Gulf of Mexico to Caribbean Sea & Brazil; not Bahamas	Benthic in coastal bays to 75 m
Ophidion josephi	Georgia & northeastern Florida through northern Gulf of Mexico	Benthic in shallow, coastal bays to 55 m
Ophidion lagocheila	Bermuda & Bahamas to Venezuela	Benthic in shallow, coastal waters
Ophidion marginatum	Massachusetts to northeastern Florida	Benthic on sand-mud bottoms, nearshore to mid-continental shelf
Ophidion nocomis	Bahamas, Puerto Rico, Barbados	Benthic on sand bottoms, 1-17 m
Ophidion puck	Bahamas & east coast of Yucatan, Mexico	Deep-benthic, 348-384 m
Ophidion robinsi	Delaware Bay, N.J. to South Carolina	Benthic on sand bottoms, 12-45 m
Ophidion selenops	North Carolina to Florida Keys & southeastern Gulf of Mexico	Benthic over outer continental shelf, 20-320 m
Parophidion schmidti	Bermuda, Bahamas, Florida to northern South America	Shallow coastal waters; often over sand bottoms & turtle grass beds
Lepophidium aporrhox	Honduras to Suriname	Benthic, 50-125 m
Lepophidium brevibarbe	Southeastern U.S. through northern Gulf of Mexico to southern Brazil	Benthic, nearshore to 75 m

Lepophidium jeannae	North Carolina to southern Florida & northern Gulf of Mexico	Benthic, 18-280 m, most 64-73 m
Lepophidium kallion	Bahamas & Greater Antilles to Barbados	Deep-benthic, 350-520 m
Lepophidium marmoratum	Bahamas, Cuba, Virgin Islands, Yucatan to Nicaragua	Benthic, 155-525 m
Lepophidium pheromystax	Puerto Rico & Colombia to northeastern Brazil	Benthic, 50-125 m
Lepophidium profundorum	Georges Bank to southeastern Gulf of Mexico	Benthic over silt or soft mud, outer continental shelf, 55-365 m

Table Ophidiformes 6. Comparison of ontogenetic characters in the ophidiine genus *Ophidion*. See table of meristic characters for listing of species examined. **Bold** characters indicate those most easily observed in larval & early juvenile stages.

Character	***Ophidion*** spp.	***Ophidion nocomis*** ***Ophidion selenops***
Gut loop forms	At posterior end of gut	At midsection of gut
Range of vertebrae	61-70 (conservative within genera)	84-87 77-81
Dorsal fin origin	Vertebra 3-6	Vertebra 6-9
Anteriormost parapophyses	6^{th} vertebra (same as spp in other genera)	8^{th} vertebra
Number of pterygiophores per interneural space	Many spaces have 3 (patterns vary)	2 (same as *Lepophidium*)
Ethmoid spine	Lacking, low or flat	Prominent (same as *Lepophidium*)
Ventral gut pigment	Broad band of melanophores	None
Dorsal body pigment	Single median row, or paired rows	None
Transformation	Gradual	Elongate pelagic stage, then shrinkage at settlement

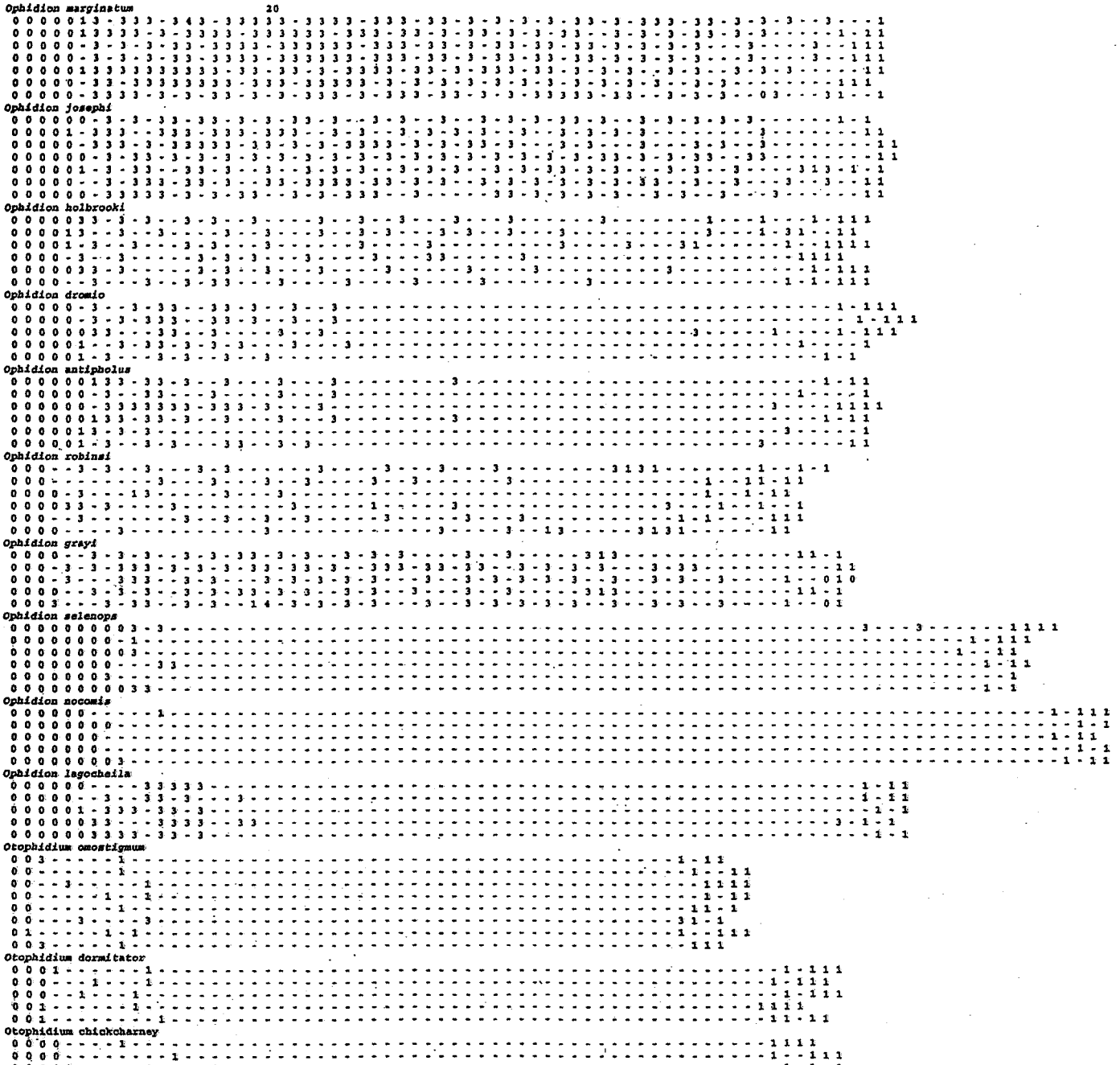


Figure Ophidiiformes 8. Patterns of interdigitation of dorsal fin pterygiophores in ophidiine larvae and juveniles. Each line represents a single specimen. Numbers indicate the number of pterygiophores extending into each interneural space, beginning with the most anterior and ending after the terminal neural spine. All 2s replaced with a dash (-) for clarity. The numeral 20 over the top line indicates the position of the 20th vertebra.

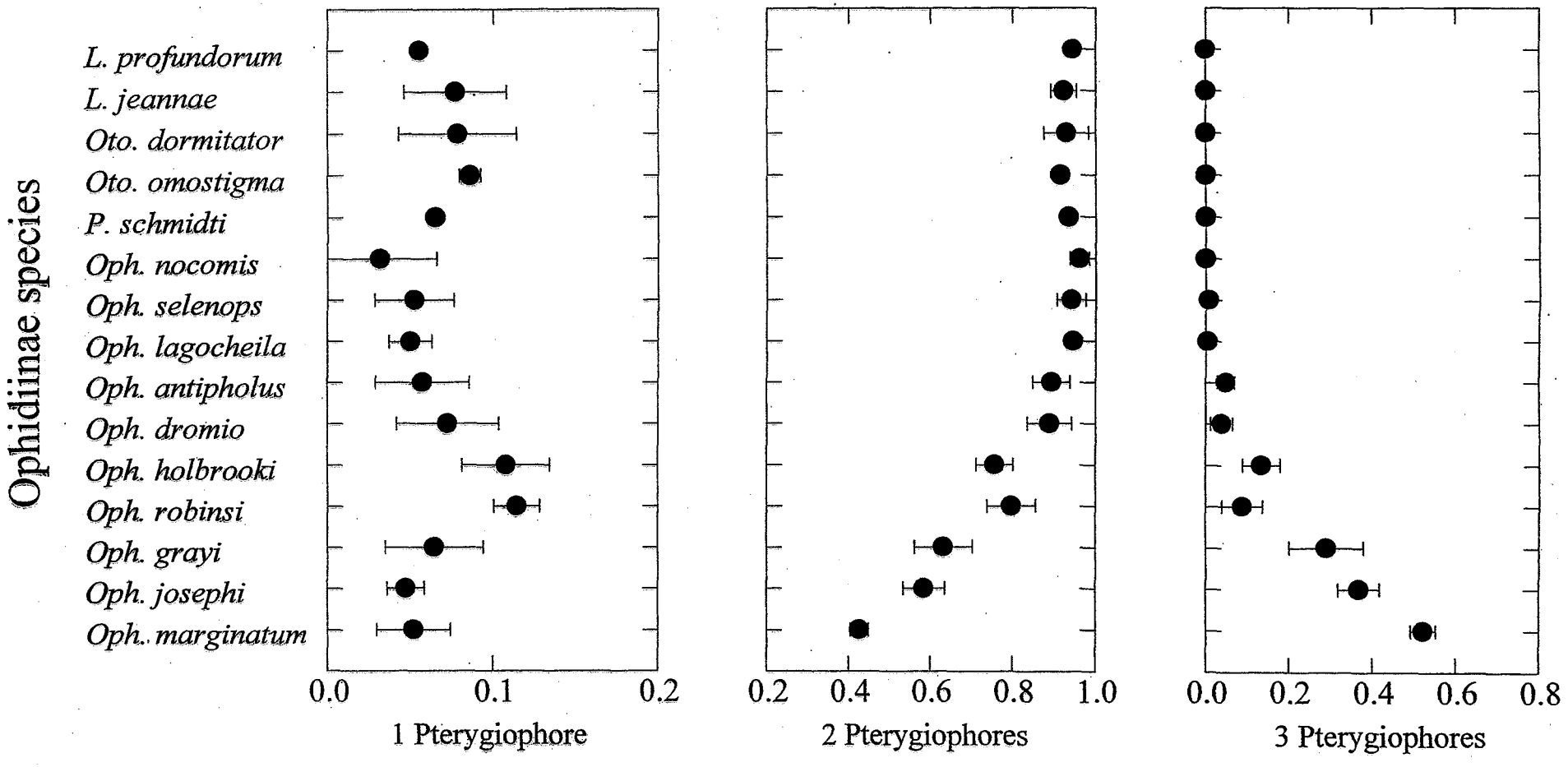


Figure Ophidiiformes 9. Frequency of dorsal fin ray pterygiophores per interneural space posterior to vertebra 20. Error bars are 1 standard deviation.

MERISTICS

Vertebrae:	
Precaudal	14-15
Caudal	58-60
Total	73-75
Number of Fin Rays:	
Total Dorsal Elements	131-140
Total Anal Elements	112-117
Pectoral	20-21
Pelvic	2
Caudal	
Principal	4+5
Total	9
Gillrakers on First Arch	
Upper	2
Lower	4
Total	6

First Closed Hemal Arch on Vertebra: 15-16
D1 Insertion: Interneural space 1-2 (3)

LIFE HISTORY

Range: North Carolina & northern Gulf of Mexico to southern Florida.
Habitat: 18-280 m (65-90 m off Texas, with most between 64 & 73 m).
ELH Pattern: Oviparous with pelagic larvae.
Spawning:
Season: Ripe Feb-Jul.
Area: No. Gulf of Mexico off Texas.
Mode: Undescribed.
Migration: Undescribed.
Fecundity: Undescribed.
Age at First Maturity: Undescribed.
Longevity: Undescribed.

LITERATURE

Gordon 1982, Gordon et al. 1984, Retzer 1991, Robins 1960, 1962.

EARLY LIFE HISTORY DESCRIPTION

EGGS: Undescribed.

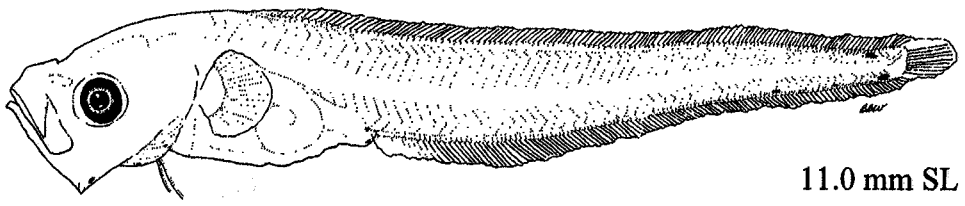
LARVAE:
Ethmoid spine: Yes.
Other spines: None.
Length at Flexion: Unknown.
Length at Transformation: Unknown.
Pigmentation: 3 melanophores along ventral edge of body posteriorly, the most posterior with a corresponding spot on the dorsal edge; few spots near anus & on branchiostegal membrane. Diagnostic Characters: Light pigment pattern, sharp ethmoid spine, meristic characters.

JUVENILES:
Diagnostic Characters: Unknown.

ILLUSTRATIONS

A) 11.0 mm SL, postflexion (Gordon et al. 1984); B) from D. Ambrose 1996m, C) from Gordon et al. 1984.

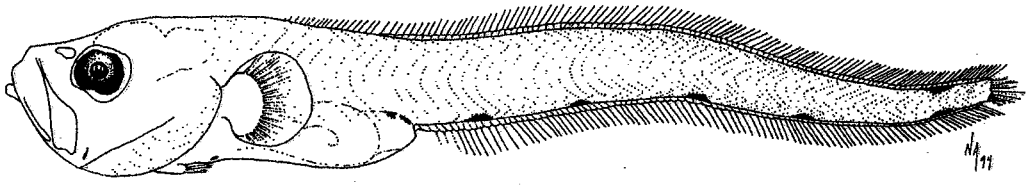
A



11.0 mm SL

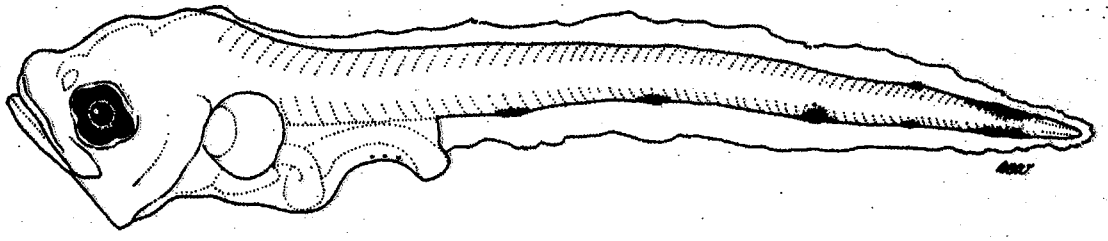
Examples of *Lepophidium* larvae from the eastern Pacific included to demonstrate similarities & ranges of characters in the genus.

B



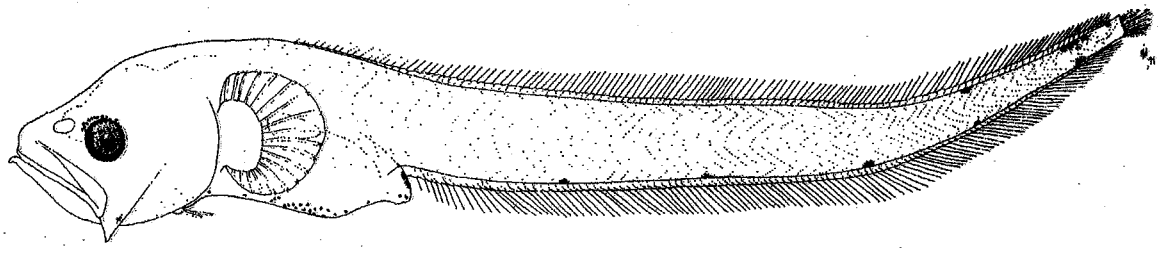
11.2 mm SL *Lepophidium stigmastistium* (Pacific)

C



5.1 mm SL *Lepophidium negropinna* (Pacific)

D



13.3 mm SL *Lepophidium negropinna* (Pacific)

MERISTICS

Vertebrae:		
Precaudal	15-17	
Caudal	57-61	Total 73-78
Number of Fin Rays:		
Total Dorsal Elements	131-140	
Total Anal Elements	110-121	
Pectoral	22-24	
Pelvic	2	
Caudal		
Principal	4+5	
Total	9	
Gillrakers on First Arch		
Upper	2-3 (low nubs)	
Lower	6 (devel.) + 1-3 (low nubs)	
Total	9-12	
First Closed Hemal Arch on Vertebrae:	16-18	
D_1 Insertion:	Interneural space 4-6	

LIFE HISTORY

Range: Georges Bank to southern Florida & southeastern Gulf of Mexico.
Habitat: Benthic on outer continental shelf in depths of 55-365 m; mostly on silty or soft mud bottoms.
ELH Pattern: Oviparous with pelagic larvae.
Spawning:
Season: Summer (July-November).
Area: Georges Bank to Cape Hatteras, most dense in southern New England waters <50 m; undescribed in southern part of range.
Mode: Undescribed.
Migration: Undescribed.
Fecundity: Undescribed.
Age at First Maturity: Undescribed.
Longevity: Undescribed.

LITERATURE

Collette & MacPhee 2002, Fahay 1992, Gordon 1982, Robins 1986.

EARLY LIFE HISTORY DESCRIPTION

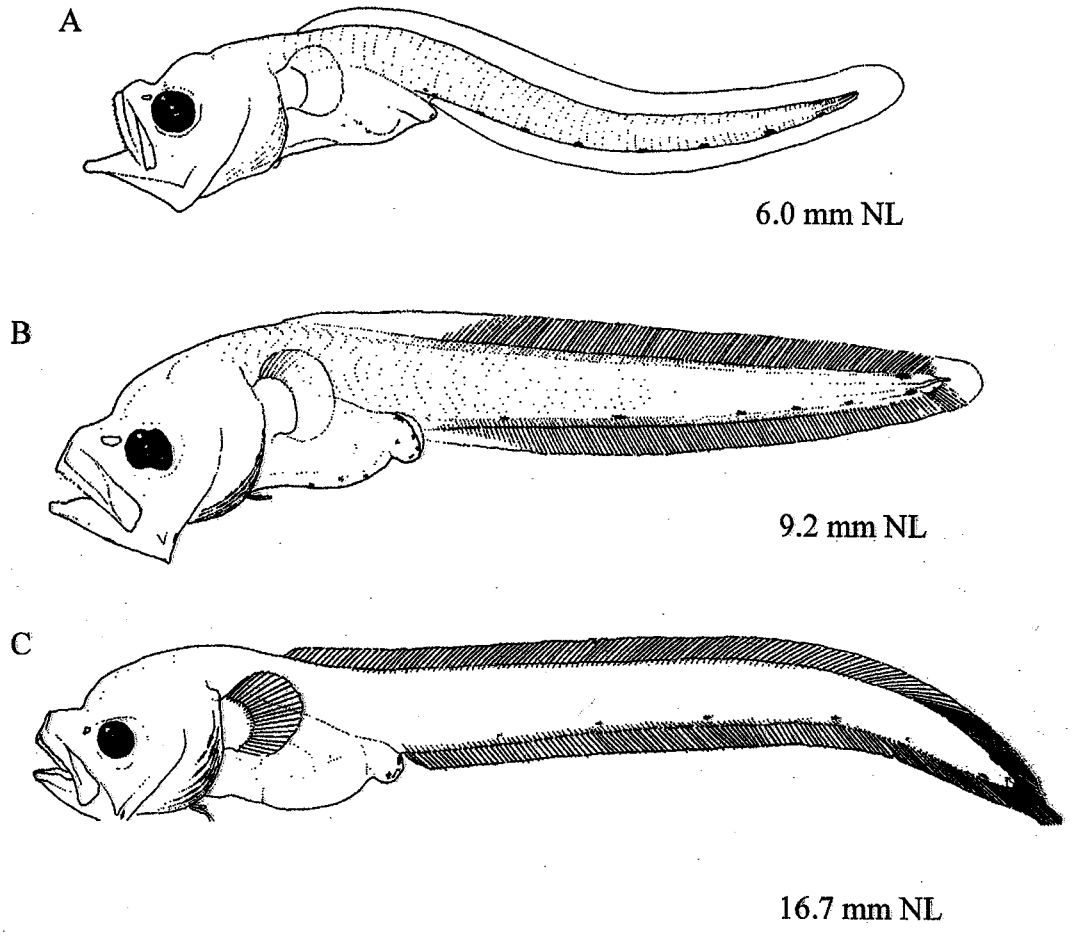
EGGS: Undescribed.

LARVAE:
Ethmoid spine: Yes (>30 mm).
Other spines: Opercle (1, >20 mm).
Preopercle (1, >20 mm).
Length at Flexion: 8-13 mm.
Length at Transformation: 42 mm (largest pelagic larva)
Sequence of Fin Development: C, P_1, P_2/D/A (early P_1 formation).
Pigmentation: Series of prominent spots along ventral edge of body with single dorsal spot above most posterior one; single spot at base of each A ray (in flexion & postflexion stages); branchiostegal pigment absent in preflexion & light in later stages; pigment on venter of gut light & scattered (absent in earliest stages).
Diagnostic Characters: Pigment pattern & meristic characters. Distinguish from *Ophidion* larvae by characteristic pigment pattern & presence of sharp, ethmoid spine; from other *Lepophidium* by meristic characters.

JUVENILES:
Pigment: Swaths of pigment extend along upper & lower thirds of body leaving middle third mostly pale.
Diagnostic Characters: Meristic characters. Distinguish from most other genera by presence of ethmoid spine.

ILLUSTRATIONS

A) 6.0 mm NL, preflexion; B) 9.2 mm NL, flexion; C) 16.7 mm NL, postflexion. All after Fahay 1992).


A
6.0 mm NL
B
9.2 mm NL
C
16.7 mm NL

MERISTICS

Vertebrae:	
Precaudal	15
Caudal	65-67
Total	80-82
Number of Fin Rays:	
Total Dorsal Elements	140-147
Total Anal Elements	122-127
Pectoral	22-23
Pelvic	2
Caudal	
Principal	4+5
Total	9
Gillrakers on First Arch	
Upper	4
Lower	8-11

First Closed Hemal Arch on Vertebrae: 16

LIFE HISTORY

Range: Southern Gulf of Mexico to western Caribbean Sea.
Habitat: Benthic in depths of 180-485 m.
ELH Pattern: Oviparous with pelagic larvae.
Spawning: Undescribed.
Fecundity: Undescribed.
Age at First Maturity: Undescribed.
Longevity: Undescribed.

LITERATURE

Gordon 1982 (fig. 13 as *L. staurophor*: 7.5 mm NL & 22.0 mm SL), Gordon et al., 1984.

EARLY LIFE HISTORY DESCRIPTION

EGGS: Undescribed.

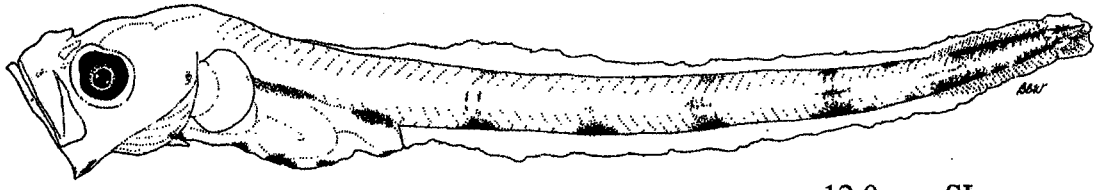
LARVAE:
Ethmoid spine: Yes.
Other spines: Unknown.
Length at Flexion: Unknown.
Length at Transformation: Unknown.
Sequence of Fin Development: Early P_1 ray formation.
Pigmentation: Series of 6 expanded melanophores along ventral edge of body, plus 2 peritoneal spots; 4 dorsal clusters along posterior edge of body; light pigment on midline posteriorly; venter of gut with 3-4 prominent blotches; angle of lower jaw with a single spot; larger larvae (22 mm) have scattered pigment on top & sides of head.
Diagnostic Characters: Pigment & meristic characters. Distinguish from larvae of other ophidiine genera by pigment pattern.

JUVENILES:
Diagnostic Characters Unknown.

ILLUSTRATIONS

A-B) After Gordon et al., 1984.
The unidentified larva (B) is included to demonstrate the persistent *Lepophidium* pattern of discrete melanophores along the ventral edge of body, with a dorsal melanophore over the posteriormost spot. 28° 15'N, 84° 50'W.

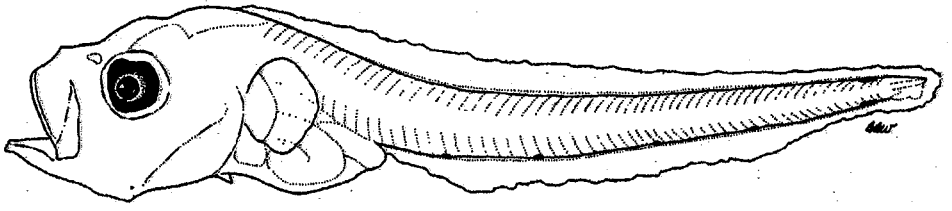
A



12.0 mm SL

Unidentified *Lepophidium* larva.

B



7.8 mm NL

MERISTICS

Vertebrae:	
Precaudal	15-16
Caudal	52-54
Total	67-70
Number of Fin Rays:	
Total Dorsal Elements	147-158
Total Anal Elements	118-124
Pectoral	ca. 21
Pelvic	2
Caudal	
Principal	4+5
Total	9
Gillrakers on First Arch	
Lower	4

First Closed Hemal Arch on Vertebra: 16-17
D_1 Insertion: Interneural space 6-8

LIFE HISTORY

Range: Massachusetts to NE Florida; occurrence in Gulf of Mexico needs confirmation.
Habitat: Sandy or muddy bottom, coastal to mid-continental shelf.
ELH Pattern: Oviparous, pelagic eggs & larvae.
Spawning:
- Season: Summer (July-November, north of Cape Hatteras).
- Area: Continental Shelf, Long Island to beyond Cape Hatteras
- Mode: Small batches of eggs spawned nightly
- Migration: Unknown

Fecundity: Unknown
Age at First Maturity: Unknown (age 1?)
Longevity: female 4 yrs; male 3 yrs

LITERATURE

Gordon 1982; Fahay 1992; Schwartz 1997

EARLY LIFE HISTORY DESCRIPTION

EGGS: (Slightly off-round).
Diameter: 0.83-1.02 x 0.88-1.06 mm.
No. of Oil Globules: None.
Oil Globule Diameter: N.A.
Yolk: Homogeneous.
Shell: Smooth.
Hatch Size: ca. 2.0 mm NL.
Incubation: 36 h @ 24°-26° C.
Pigmentation: Scattered, fine melanophores from head to tail tip.
Diagnostic Characters: Eggs slightly off-round, deposited in gelatinous masses.

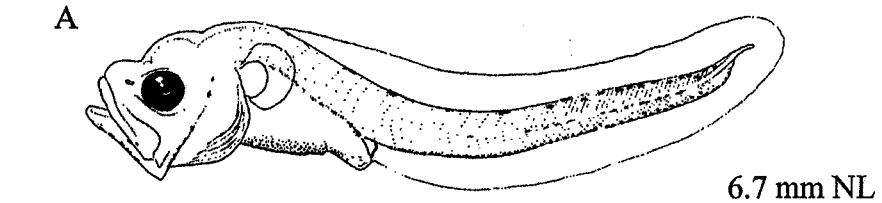
LARVAE:
Ethmoid spine: None.
Other spines: None.
Length at Flexion: 6.5-16.0 mm.
Length at Transformation: 20 mm (largest pelagic larva)
Sequence of Fin Development: C & D & A & P_2, P_1 (late P_1 formation).
Pigmentation:
1. Single, median, mid-dorsal line of spots on anterior 75% of body (disappears at flexion).
2. Lateral midline streak in caudal area.
3. Spots on branchiostegals and midventral line of gular area.
4. Double ventral rows along A base.
5. Broad belt of pigment on venter of gut.

Diagnostic Characters: Distinguish from most other *Ophidion* spp. by mid-dorsal line of spots (preflexion) & midline pigment streak in caudal area (later stages); from *O. josephi* larvae by meristic characters & interdigitation patterns.

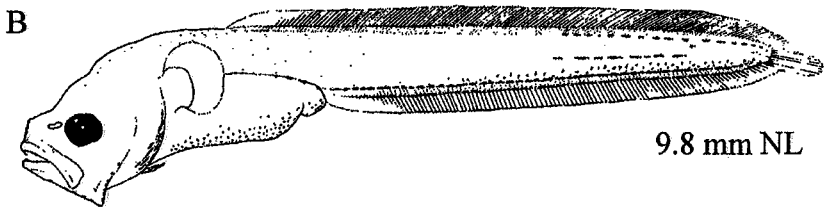
JUVENILES:
Diagnostic Characters: meristic characters, interdigitation pattern.

ILLUSTRATIONS

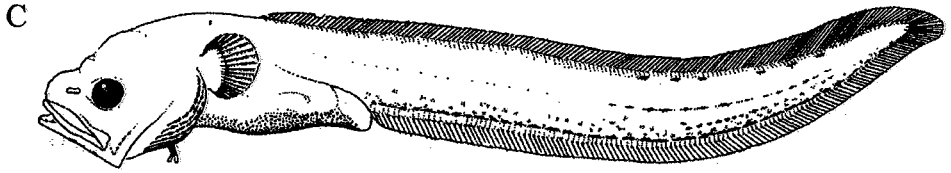
A) Early flexion, 6.7 mm NL; B) Late flexion, 9.8 mm NL; C) Postflexion, 17.5 mm NL. (After Fahay 1992): D) Juvenile, 41.8 mm SL (Able & Fahay 1998).



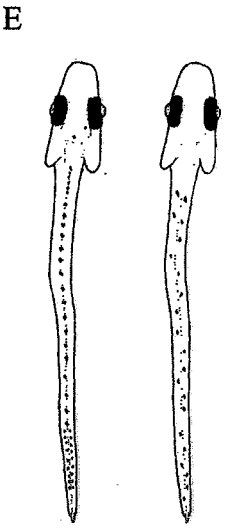
6.7 mm NL



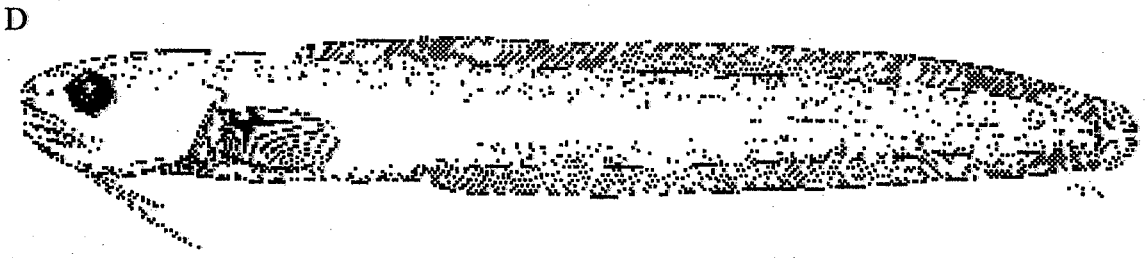
9.8 mm NL



17.5 mm NL



Compare dorsal pigment in *O. marginatum* (left) with *O. robinsi* (right). See description.



41.8 mm SL (juvenile)

MERISTICS

Vertebrae:	
Precaudal	15-16
Caudal	50-54
Total	67-69
Number of Fin Spines and Rays:	
Total Dorsal Elements	128-150
Total Anal Elements	105-122
Pectoral	21-22
Pelvic	2
Caudal	
Principal	4+5
Total	9
Gillrakers on First Arch	
Upper	2
Lower	4
Total	6
First Closed Hemal Arch on Vertebrae:	16-17
D_1 Insertion:	5-7

LIFE HISTORY

Range: Western Atlantic from Georgia to south Florida & Gulf of Mexico; strays as far north as New Jersey; distribution needs clarification.
Habitat: Benthic in shallow, coastal waters in depths to 55 m.
ELH Pattern: Oviparous with pelagic larvae.
Spawning:
Season: Oct-Nov.
Area: western Gulf of Mexico.
Migration: Undescribed.
Fecundity: Undescribed.
Age at First Maturity: 8-9 months.
Longevity: Undescribed.

LITERATURE

Gordon 1982, Retzer 1991.

EARLY LIFE HISTORY DESCRIPTION

EGGS: Undescribed

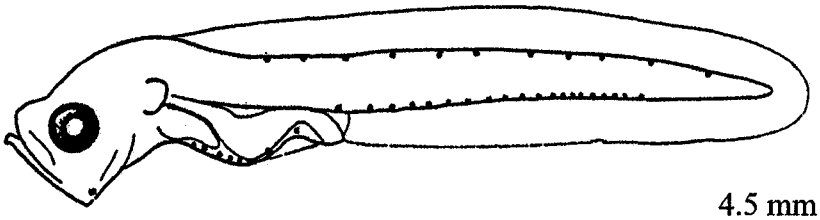
LARVAE:
Ethmoid spine: None.
Other spines: None.
Length at Flexion: ca. 10 mm.
Length at Transformation: Unknown.
Sequence of Fin Development: P_1 rays late-forming.
Pigmentation: Similar to pigment in *O. marginatum* larvae; note formation of streak of pigment on the midline anterior to caudal peduncle.
Diagnostic Characters: Pigment streak on body midline anterior to caudal peduncle. Distinguish from most other *Ophidion* by midline pigment streak; from *O. marginatum* by meristic characters & interdigitition pattern.

JUVENILES:
Diagnostic Characters: Meristic characters, interdigitation pattern.

ILLUSTRATIONS

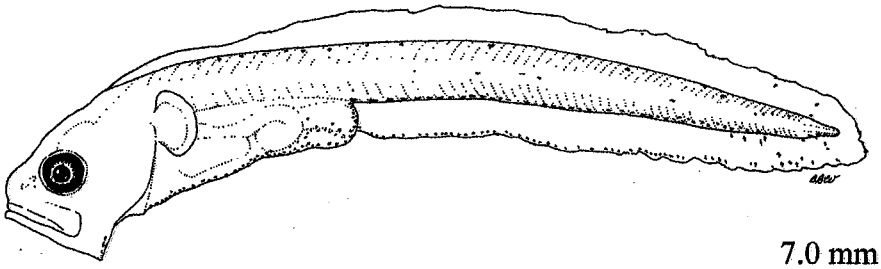
A) 4.5 mm NL; B) 7.0 mm NL (Gordon et al., 1984); C) 8.5 mm NL; D. 17.0 mm NL (Gordon, 1982 as "Type 2"); E) 45.0 mm NL; original.
Ophidion welshi (Nichols & Breder, 1922) is a junior synonym of *O. josephi* Girard, 1858 (Nielsen et al., 1999)

A



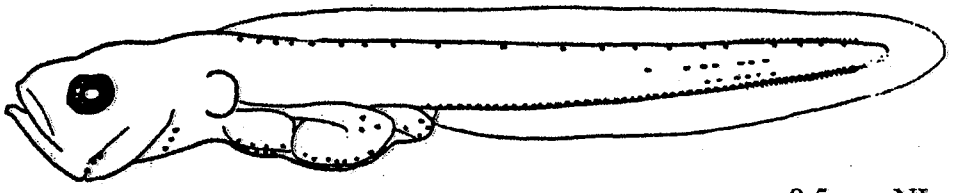
4.5 mm NL

B



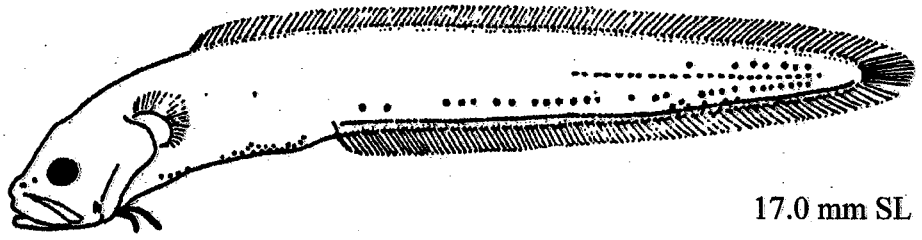
7.0 mm NL

C



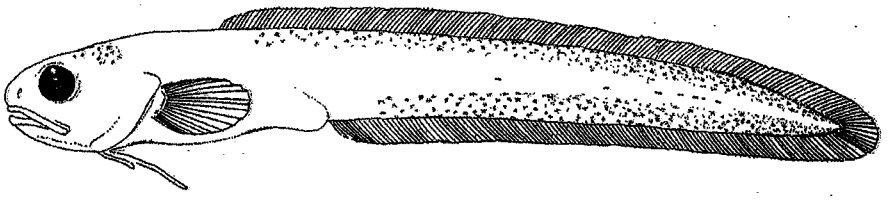
8.5 mm NL

D



17.0 mm SL

E



45.0 mm SL (juvenile)

MERISTICS

Vertebrae:	
Precaudal	15-17
Caudal	45-47
Total	61-63
Number of Fin Rays:	
Total Dorsal Elements	112-125
Total Anal Elements	86-93
Pectoral	19-22
Pelvic	2
Caudal	
Principal	4+5
Total	9
Gillrakers on First Arch	
Lower	4

First Closed Haemal Arch on Vertebra: 16-18
D_1 Insertion: Interneural space (3) 4 (5)

LIFE HISTORY

Range: Delaware Bay offings to Charleston, SC.
Habitat: Sand bottoms from 12 to 45 m.
ELH Pattern: Oviparous with pelagic larvae.
Spawning:
Season: Summer (May-November).
Area: New Jersey to North Carolina. Unknown to the south.
Mode: Unknown.
Migration: Unknown.
Fecundity: Unknown.
Age at First Maturity: Unknown.
Longevity: Unknown.

LITERATURE

Fahay 1992

EARLY LIFE HISTORY DESCRIPTION

EGGS: Undescribed.

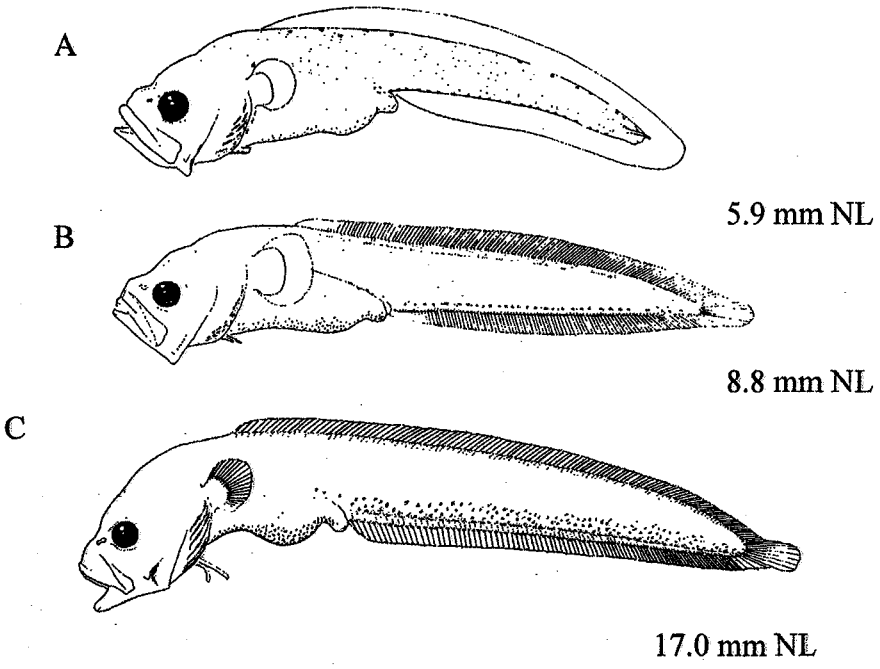
LARVAE:
Ethmoid spine: None.
Other spines: None.
Length at Flexion: 7.0-13.0 mm.
Length at Transformation: ca. 20 mm (largest pelagic larva).
Sequence of Fin Development: C & D & A & P_2, P_1 (late P_1 formation).
Pigmentation:
1. In early larvae, dorsal pigment consists of spots in random pattern on both sides of dorsal midline.
2. Single row of anal fin base spots becomes broad band of pigment.
3. Broad belt of pigment on venter of gut.

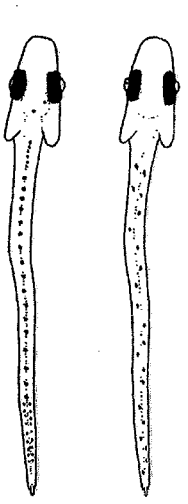
Diagnostic Characters: Low meristic character values; characteristic pigment. Distinguish from other *Ophidion* spp. by low meristic characters.

JUVENILES:
Diagnostic Characters: Low meristic characters, characteristic "checkerboard" pigment pattern. Distinguish from *Otophidium omostigma* by lack of dark spot on opercle.

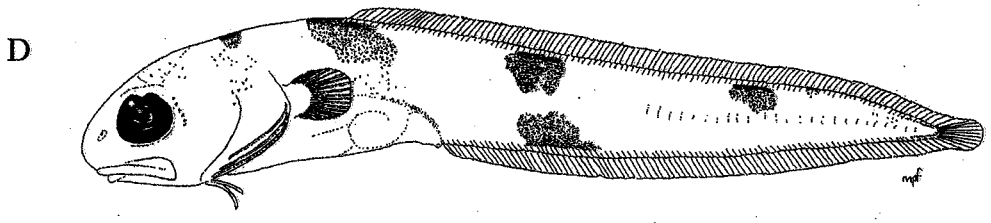
ILLUSTRATIONS

A) Preflexion, 5.9 mm NL; B) Late flexion, 8.8 mm NL; C) Postflexion, 17.0 mm NL. (After Fahay 1992). D) Early juvenile, recently settled, 23.6 mm SL. Original. Dorsal views: original.





Compare dorsal pigment in *O. marginatum* (left) with *O. robinsi* (right). See description.



MERISTICS

Vertebrae:	
Precaudal	16
Caudal	48-50
Total	64-66
Number of Fin Rays:	
Total Dorsal Elements	131-146
Total Anal Elements	99-113
Pectoral	20-23
Pelvic	2
Caudal	
Principal	4+5
Total	9
Gillrakers on First Arch	
Upper	2
Lower	4
Total	6
First Closed Hemal Arch on Vertebrae:	16-17
D_1 Insertion:	4-5

LIFE HISTORY

Range: South Carolina to Florida & northern Gulf of Mexico to Mexico.
Habitat: Benthic in shallow, coastal waters in depths of 10-60 m (13-22 m off Texas).
ELH Pattern: Oviparous with pelagic larvae.
Spawning:
Season: Oct-Nov.
Area: western Gulf of Mexico.
Mode: Oviparous.
Migration: Undescribed.
Fecundity: Undescribed.
Age at First Maturity: 8-9 months.
Longevity: Undescribed.

LITERATURE

Gordon 1982, Retzer 1991.

EARLY LIFE HISTORY DESCRIPTION

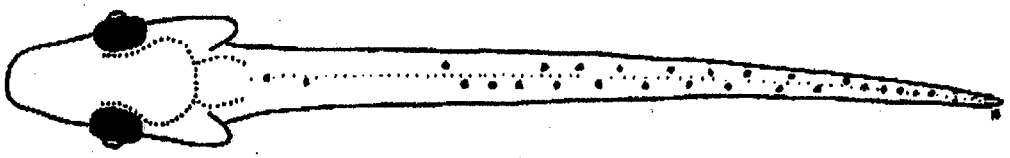
EGGS: Undescribed.

LARVAE:
Ethmoid spine: None.
Other spines: None.
Length at Flexion: Unknown.
Length at Transformation: Unknown.
Sequence of Fin Development: P_1 rays late-forming.
Pigmentation: Similar to pigmentation in *O. robinsi* larvae, except dorsal pigment consists of pairs of melanophores on both sides of midline, along almost entire length of dorsum beginning over the anus, becoming more centered on midline posteriorly.
Diagnostic Characters: Meristic characters & dorsal pigment. Distinguish from *O. robinsi* larvae by pigment pattern along dorsum & interdigitation pattern.
JUVENILES:
Diagnostic Characters: Meristic characters.

ILLUSTRATIONS

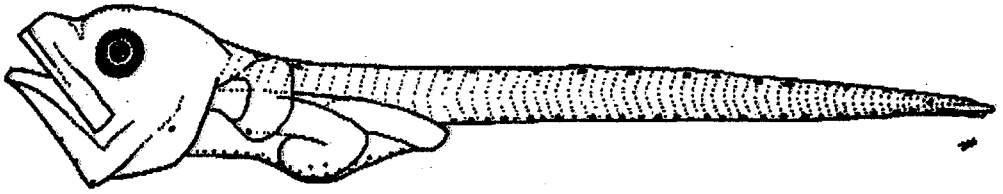
A, B) (Putative) 7.0 mm SL; uncat., 33° 17'N 77° 15'W, southeast of Cape Fear, North Carolina, 25 March, 1990. Original.
Gordon's (1982) "Type 2" larvae have meristic characters that overlap *O. grayi* & *O. josephi*. The range of A ray counts in these larvae indicate the contribution of more than one species. Pigment characters of illustrated specimens of "Type 2" larvae indicate they are *O. josephi*.

A



7.0 mm SL (dorsal)

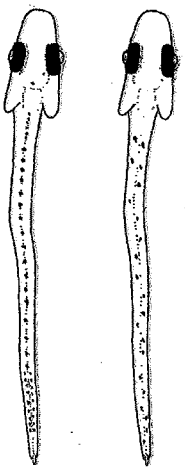
B



7.0 mm SL (lateral)

Note: Compare pigment patterns along the dorsum of the body in *O. grayi* & congeners. Dorsal midline melanophores are unpaired for most of the body length in *O. marginatum*, & are in two, staggered rows along most of body length in *O. robinsi*. Ventral pigment along the gut may be less dense in *O. grayi* larvae.

C



Dorsal pigment in *O. marginatum* (left) and *O. robinsi* (right).

MERISTICS

Vertebrae:	
Precaudal	15-17
Caudal	49-53
Total	65-69
Number of Fin Rays:	
Total Dorsal Elements	111-133
Total Anal Elements	94-103
Pectoral	18-21
Pelvic	2
Caudal	
Principal	4+5
Total	9
Gillrakers on First Arch	
Upper	2
Lower	5-6
Total	(6)7-8(9)
First Closed Hemal Arch on Vertebra:	16-18
D_1 Insertion:	Interneural space 7-8

LIFE HISTORY

Range: North Carolina & NW Gulf of Mexico to S. Florida; also off Yucatan Peninsula.
Habitat: Open sand & mud bottoms in depths of 10-69 m.
ELH Pattern: Oviparous with pelagic larvae.
Spawning: Undescribed.
Fecundity: Unknown.
Age at First Maturity: Unknown.
Longevity: Unknown.

LITERATURE

Gordon 1982, Lea & Robins 2003.

EARLY LIFE HISTORY DESCRIPTION

EGGS: Undescribed.

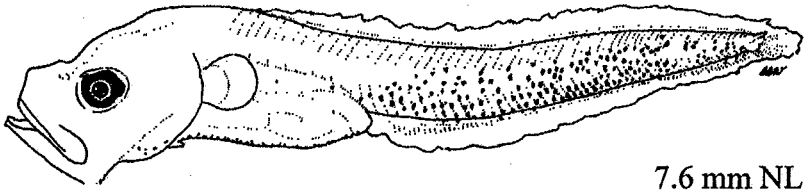
LARVAE:
Ethmoid spine: None.
Other spines: None.
Length at Flexion: Unknown.
Length at Transformation: Unknown.
Sequence of Fin Development: P_1 rays late-forming.
Pigmentation: Heavy pigment on flanks in the form of large, bold melanophores; broad swath of spots on venter of gut; branchiostegal membranes pigmented.
Diagnostic Characters: Bold pigment pattern; shares interdigitation pattern with *O. dromio*. Distinguish from other ophidiine larvae by pigment pattern.

JUVENILES:
Diagnostic Characters: Undescribed.

ILLUSTRATIONS

A) 7.6 mm NL (after Gordon et al., 1984);
Larvae (n=2): Vert 16 + 50-51, D: 115-127, A: 96-99, D_1: 7, D-A 19-28.

A



7.6 mm NL

The heavily spotted larval form illustrated above may include the larvae of two species: *O. antipholus & O. holbrooki.* Meristic & interdigitation characters in the larvae examined here all coincide with characters in *O. antipholus.* Gordon (1982) described 25 larvae (and illustrated three, 2.8 mm NL to 12.0 mm SL) as "Type 1" and suggested they were referable to *O. holbrooki* or a new species. The larvae in Gordon's series were similar to the larva illustrated above, although the flank pigment was somewhat more extensive in the smallest two larvae. Meristic characters in Gordon's "Type 1" larvae overlapped *O. antipholus & O. holbrooki,* but numbers of gill rakers & interdigitation patterns are unknown. See discussion of "Type 1" larvae in Gordon (1982).

Based on available evidence, including the common occurrence of *O. holbrooki* along the Atlantic coast of the U.S. as far north as Cape Hatteras, N.C., heavily spotted larvae or juveniles should be regarded as either *O. antipholus* or *O. holbrooki,* and, if well-enough developed, can be identified based on gill raker counts & interdigitation patterns.

MERISTICS

Vertebrae:	
Precaudal	16-17
Caudal	50-52
Total	67-69
Number of Fin Rays:	
Total Dorsal Elements	116-129
Total Anal Elements	92-102
Pectoral	19-21
Pelvic	2
Caudal	
Principal	4+5
Total	9
Gillrakers on First Arch	
Upper	2
Lower	4
Total	6
First Closed Hemal Arch on Vertebra:	17-18
D_1 Insertion:	6-7

LIFE HISTORY

Range: North Carolina to southern Florida & Gulf of Mexico to northern coast of South America.
Habitat: Benthic on sand & mud bottoms in depths of 50-183 m, most commonly in <100 m.
ELH Pattern: Oviparous with pelagic larvae.
Spawning: Undescribed.
Migration: Undescribed.
Fecundity: Undescribed.
Age at First Maturity: Undescribed.
Longevity: Undescribed.

LITERATURE

Lea & Robins 2003, Robins & Ray 1986.

EARLY LIFE HISTORY DESCRIPTION

EGGS: Undescribed.

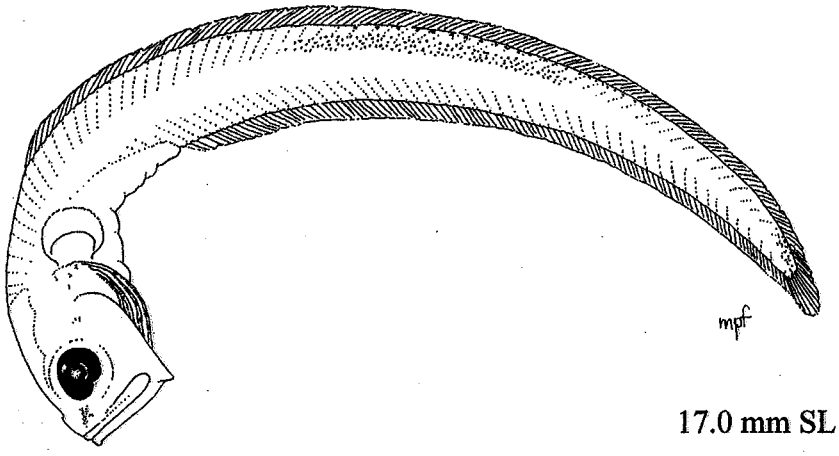
LARVAE:
Ethmoid spine: None.
Other spines: None.
Length at Flexion: Unknown.
Length at Transformation: Unknown.
Sequence of Fin Development: P_1 late-forming.
Pigmentation: Cluster of melanophores form elongate "thumbprint" on upper flank, mid-tail; scattering of spots on caudal peduncle; top of head pigmented; few internal spots on brain; branchiostegal membranes pigmented.
Diagnostic Characters: "Thumbprint" of melanophores; shares interdigitation pattern with *O. antipholus.* Distinguish from other ophidiine larvae by pigment pattern.

JUVENILES:
Diagnostic Characters: Interdigitation pattern.

ILLUSTRATIONS

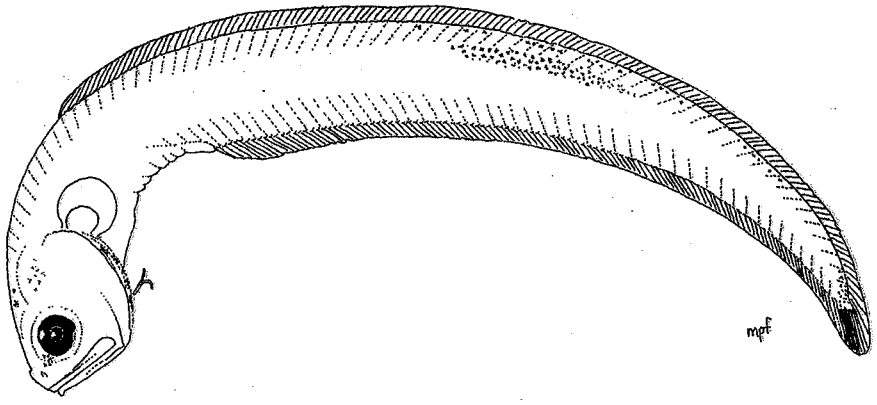
A-B) Based on MCZ 76793; 01°13' S, 34°35' W; 17 Feb, 1963; Amazonian Atlantic (n=6). Original.
This species has been referred to as "shorthead cusk-eel" based on its short head length (Robins & Ray, 1986). We have examined 3 adult individuals collected off North Carolina. In contrast to congeners, the head length approaches the head depth in these specimens, yielding a round image on radiographs. See Fig. Ophidiiformes 8 for interdigitation pattern.

A



17.0 mm SL

B



29.2 mm SL

MERISTICS

Vertebrae:	
Precaudal	17
Caudal	67-70
Total	84-87
Number of Fin Rays:	
Total Dorsal Elements	144-153
Total Anal Elements	132-139
Pectoral	14-17
Pelvic	2
Caudal	
Principal	4+5
Total	9
Gillrakers on First Arch	
Upper	2
Lower	5
Total	7

First Closed Hemal Arch on Vertebra: 18
D_1 Insertion: Interneural space 7-9

LIFE HISTORY

Range: Bahamas (Great Bahama Bank); also Puerto Rico & Barbados.
Habitat: Sand bottom in depths of 1-17.
ELH Pattern: Oviparous with pelagic larvae.
Spawning: Undescribed.
Fecundity: Undescribed.
Size at First Maturity: As small as 65 mm.
Longevity: Unknown.

LITERATURE

Robins & Böhlke 1959.

EARLY LIFE HISTORY DESCRIPTION

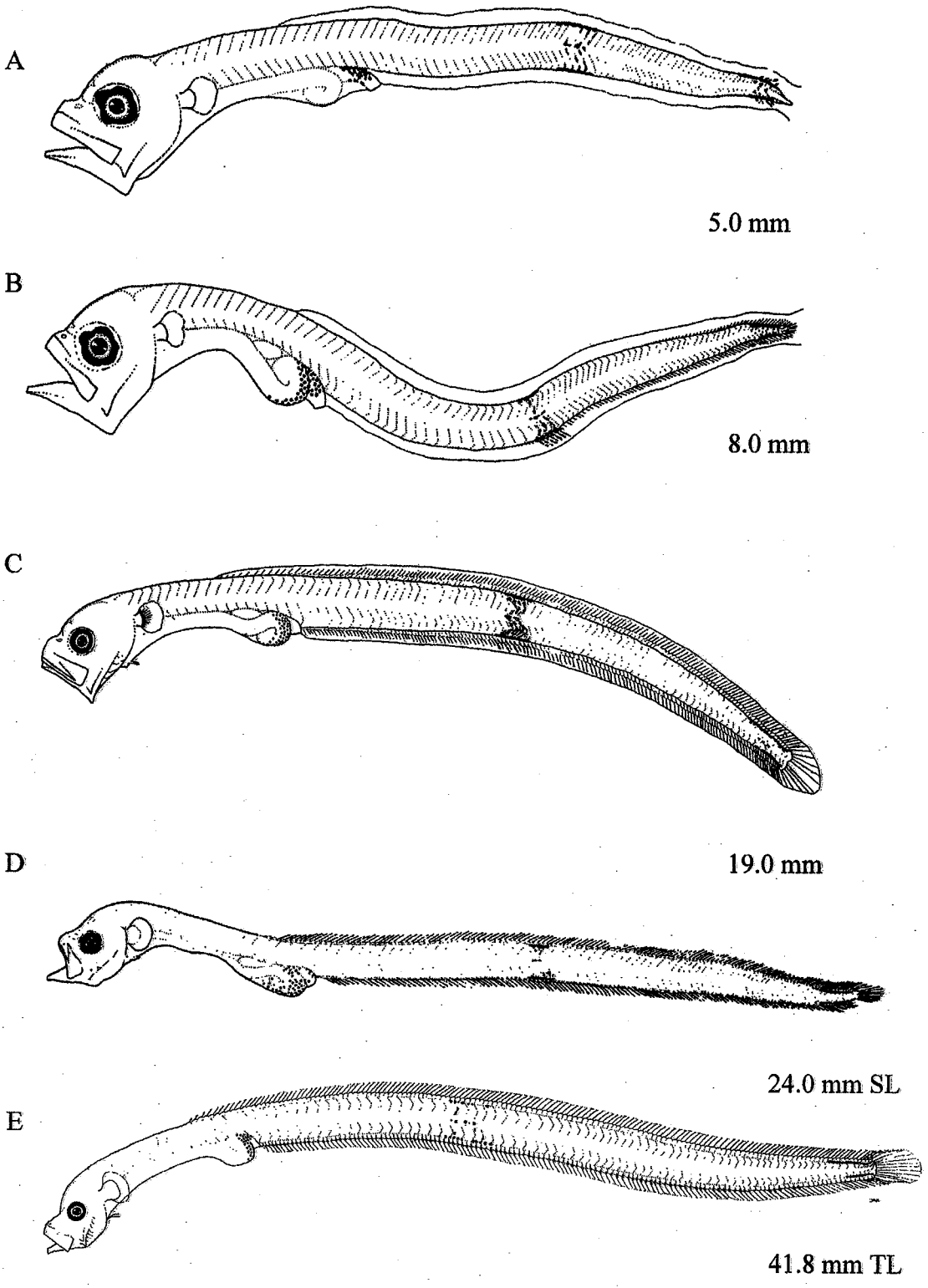
EGGS: Undescribed.

LARVAE:
Ethmoid spine: Yes.
Other spines: None.
Length at Flexion: 8-10 mm.
Length at Transformation: Unknown.
Sequence of Fin Development: P_1 rays late-forming
Pigmentation: Dense accumulation of spots on posterior part of gut loop near anus; cluster of spots forms well-defined band at mid-body; dorsal and ventral pair of bands on body near C, with few spots between these on midline; venter of gut lacks pigment.
Diagnostic Characters: Unusual gut morphology with loop near anus. Distinguish from *O. selenops* by pigment pattern near anus & on venter of gut; from all other ophidiids by gut morphology & elongate anterior region.

JUVENILES:
Diagnostic Characters: Small maximum size, high number of meristic characters & pungent ethmoid spine.

ILLUSTRATIONS

A) 5.0 mm TL, uncat., 13°20.6'N, 59°39.3'W, (Barbados), 1 May, 1990: B) 8.0 mm TL, uncat., 13°12.7'N, 59°51.3'W (Barbados), 2 May, 1990; C) 19.2 mm SL, uncat., 13°9.8'N, 59°23.8'W (Barbados), 10 May, 1990; D) 24.0 mm SL; E. 41.8 mm TL, uncat, 13°5.5'N, 59°25.5'W (Barbados), 10 May, 1990. A-C,E) original; D) Gordon et al., 1984.



See comparison of gut pigment in *O. selenops* & *O. nocomis* on *Parophidion schmidti* page.

MERISTICS

Vertebrae:	
Precaudal	15-16
Caudal	62-65
Total	77-81
Number of Fin Rays:	
Total Dorsal Elements	132-140
Total Anal Elements	123-129
Pectoral	15-16
Pelvic	2
Caudal	
Principal	4+5
Total	9
Gillrakers on First Arch	
Upper	2
Lower	5
Total	7

First Closed Hemal Arch on Vertebra: 16-17
D_1 Insertion: Interneural space 8-10

LIFE HISTORY

Range: North Carolina to Florida Keys & southeastern Gulf of Mexico; larvae in Campeche Bay.
Habitat: Benthic on outer continental shelf in depths of 20-320 m.
ELH Pattern: Oviparous with pelagic larvae.
Spawning:
Season: Spring, summer.
Area: Off North Carolina.
Mode: Unknown.
Migration: Unknown.
Fecundity: Undescribed.
Age at First Maturity: Undescribed.
Longevity: Undescribed.

LITERATURE

Gordon 1982 (Fig. 9 as *O. selenops*; 2.5 mm NL; 8.0 mm NL; 40.0 mm SL; 26.0 mm SL).

EARLY LIFE HISTORY DESCRIPTION

EGGS: Undescribed.

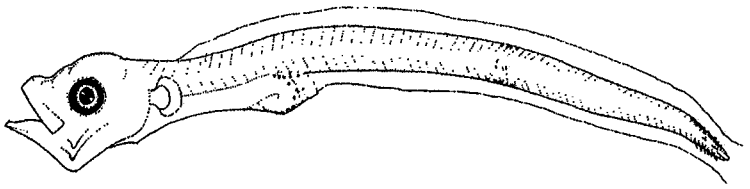
LARVAE:
Ethmoid spine: Yes.
Other spines: None.
Length at Flexion: 8-19 mm.
Length at Transformation: 48 mm (largest pelagic larva).
Sequence of Fin Development: P_1 rays late-forming.
Pigmentation: Light scattering of spots on gut loop near anus; faint cluster of spots forms band at mid-body; dorsal and ventral pair of bands on body near caudal fin; few spots on venter of gut.
Diagnostic Characters: Unusual gut morphology with loop near anus. Distinguish from *O. nocomis* by pigment pattern near anus & on venter of gut; from all other ophidiids by gut morphology & elongate anterior region.

JUVENILES:
Diagnostic Characters: Sharp ethmoid spine easily felt; pale pigmentation; high number of meristic characters; small maximum size. Distinguish from *O. nocomis* by meristic characters; from other *Ophidion* juveniles by ethmoid spine & meristic characters.

ILLUSTRATIONS

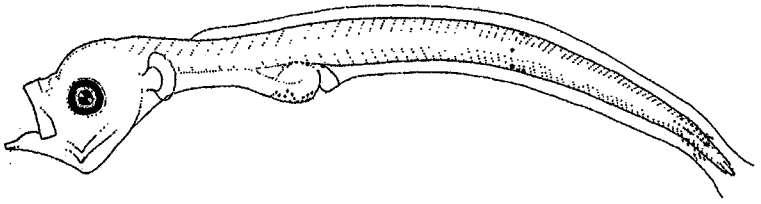
A) 5.6 mm TL, uncat., 34° 17.4'N, 76° 47.9'W, 27 April, 1989; B) 7.9 mm TL, uncat., 36° 47.6'N, 75° 13.5'W, 16 June, 1991; C) 19.1 mm TL, uncat., 35° 03.5'N, 75° 24.6 'W, 27 April, 1989; D) 24.0 mm SL (Gordon et al., 1984); E) 38.2 mm TL, uncat., 35° 03.5'N, 75° 24.6'W, 27 April, 1989. A-C, & E original.

A



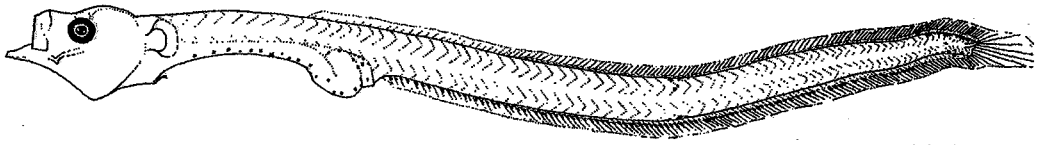
5.6 mm TL

B



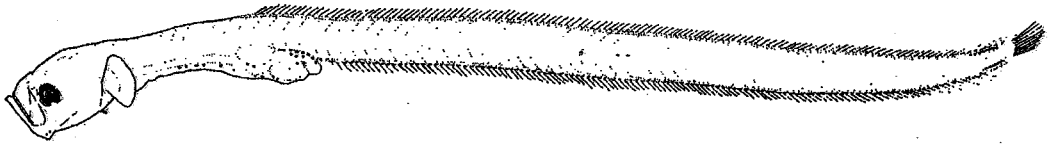
7.9 mm TL

C



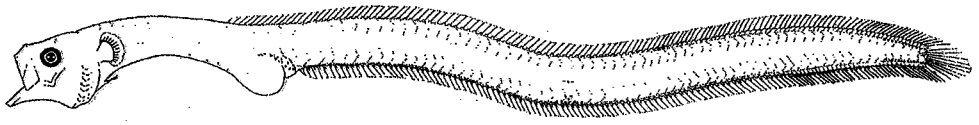
19.1 mm TL

D



24.0 mm SL

E



38.2 mm TL

See comparison of gut pigment in *O. selenops* & *O. nocomis* on *Parophidion schmidti* page.

MERISTICS

Vertebrae:	
Precaudal	14
Caudal	42-44
Total	56-59
Number of Fin Rays:	
Total Dorsal Elements	99-108
Total Anal Elements	80-87
Pectoral	16-18
Pelvic	2
Caudal	
Principal	4+5
Total	9
Gillrakers on First Arch	
Upper	2-3
Lower	4
Total	6-7

First Closed Hemal Arch on Vertebra: 15
D_1 Insertion: Interneural space 3

LIFE HISTORY

Range: North Carolina and northern Gulf of Mexico to Florida and Lesser Antilles.
Habitat: Benthic in depths of 16-50 m.
ELH Pattern: Oviparous with pelagic larvae.
Spawning:
Season: Unknown.
Area: Unknown.
Mode: Unknown.
Migration: Unknown.
Fecundity: Unknown.
Age at First Maturity: Unknown.
Longevity: Unknown

LITERATURE

Gordon 1982 (fig. 3 as *Oto. omostigmum*; 3.0 mm NL; 6.8 mm NL; 14.0 mm NL), Gordon et al. 1984

EARLY LIFE HISTORY DESCRIPTION

EGGS: Undescribed.

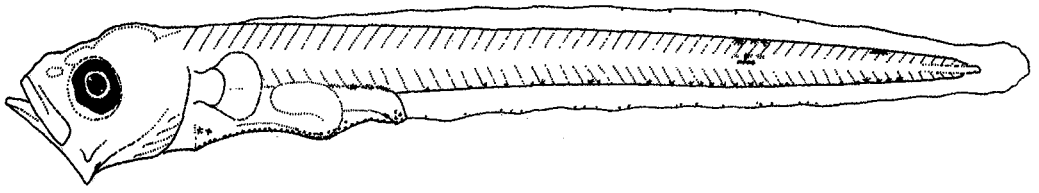
LARVAE:
Ethmoid spine: Present, flat & short.
Other spines: None.
Length at Flexion: 6-8 mm.
Length at Transformation: Unknown.
Sequence of Fin Development: Delayed P_1 ray development.
Pigmentation: A scattering of small spots forming a band across tail at ~2/3 of the tail length; this band gradually dissolves, or is reduced to a few spots, in larger larvae; a second, minor cluster of spots sometimes visible near caudal peduncle; venter of gut with light scattering of spots & a few spots on dorsal surface of gut & branchiostegals.
Diagnostic Characters: Very low numbers of meristic characters & pigment pattern. Distinguish from other ophidiine larvae by pigment pattern & low numbers of meristic characters.

JUVENILES:
Diagnostic Characters: Prominent spot on opercle, low numbers of meristic characters, prominently spotted pigment pattern. Distinguish from *Ophidion robinsi* by pigment spot on opercle.

ILLUSTRATIONS

A) 6.6 mmSL, uncat., 34° 56'N, 75° 55.4'W, 26 April, 1989. Original. B) 8.3 mm NL, (Gordon et al., 1984); C). 13.8 mm SL, uncat., 34° 46.8'N, 75° 49.1'W, 26 April, 1989. Original.

A

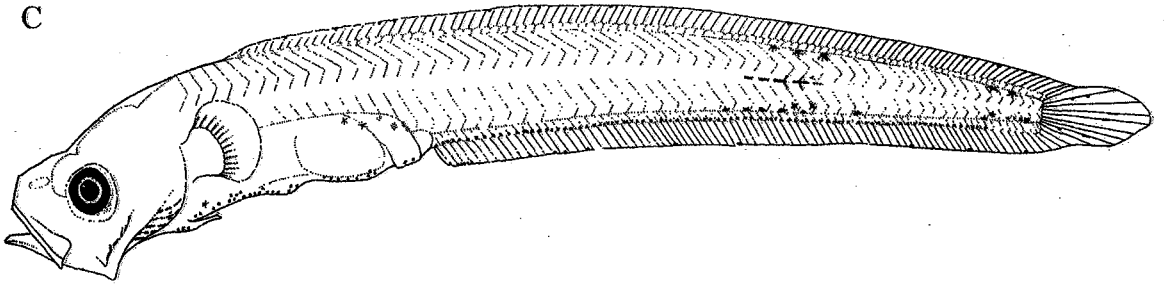


6.6 mm SL

B

8.3 mm NL

C



13.8 mm SL

MERISTICS

Vertebrae:	
Precaudal	15-16
Caudal	51-52
Total	66-67
Number of Fin Rays:	
Total Dorsal Elements	115-126
Total Anal Elements	98-106
Pectoral	17-19
Pelvic	2
Caudal	
Principal	4+5
Total	9
Gillrakers on First Arch	
Upper	2
Lower	4
Total	6

First Closed Hemal Arch on Vertebra: 16
D_1 Insertion: Interneural Space 5-6

LIFE HISTORY

Range: Bermuda, Florida, Bahamas to northern South America.
Habitat: Shallow coastal waters, often associated with turtle grass beds over sandy bottoms in protected bays.
ELH Pattern: Pelagic larvae.
Spawning: Undescribed.
Fecundity: Undescribed.
Age at First Maturity: Undescribed.
Longevity: Undescribed.

LITERATURE

Gordon et al. 1984, Böhlke & Robins 1959

EARLY LIFE HISTORY DESCRIPTION

EGGS: Undescribed.

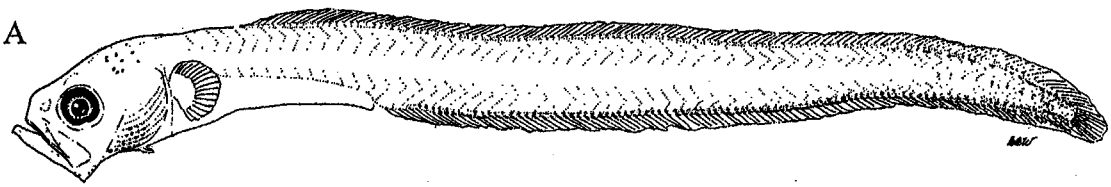
LARVAE:
Ethmoid spine: Low, rounded.
Other spines: None.
Length at Flexion: Unknown.
Length at Transformation: Unknown.
Sequence of Fin Development: Unknown.
Pigmentation: Characteristic pigment around tip of hind part of body; crown pigment distinct; pigment also on branchistegal membrane & a series along A base.
Diagnostic Characters: Slim body, with triangular shaped gut, probably due to unpronounced gut loop, light pigment. Distinguish from other ophidiine larvae by gut shape & body slimness.

JUVENILES:
Diagnostic Characters: P_2 rays (2) of equal length, slim body. Distinguish from *Ophidion* by unique pattern of interdigitation. From *O. nocomis* & *O. selenops* by meristics & gut pigment. From *Otophidium* by position of D origin. From *Lepophidium* by pigment pattern.
Settlement of larvae to bottom habitats may be delayed; pelagic collections contain many examples of post-transformation juveniles.

ILLUSTRATIONS

A) 17 mm SL, postflexion, (Gordon et al. 1984); Details of gut pigmentation in *O. nocomis & O. selenops*: original.

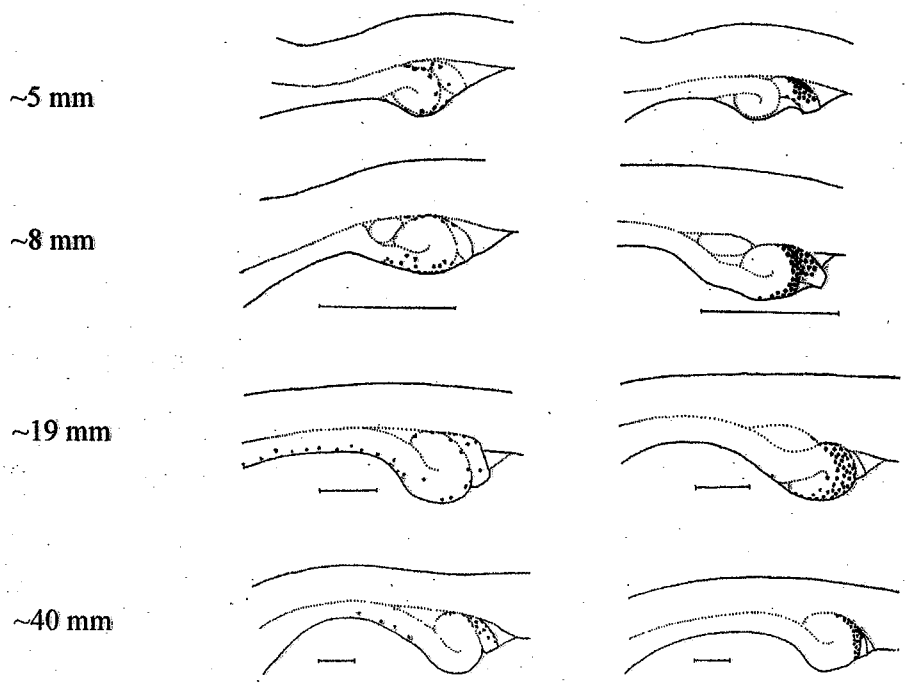
A



17.0 mm SL

Comparison of pigmentation on posterior gut in *Ophidion selenops & O. nocomis.*

B



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