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Short Papers and Notes

Eggs and Larvae of the Ophichthid Eel, *Pisodonophis cruentifer*, from the Chesapeake Bight, Western North Atlantic[1]

ABSTRACT: Eggs and early larvae (5.8–34.2 mm SL) of the snake eel, *Pisodonophis cruentifer* (Ophichthidae) are illustrated and described for the first time. The eggs are distinguished by their large size (>2 mm), large perivitelline space, segmented yolk, one to many oil globules, and pigmentation on late stage embryos. The larvae are distinguished most readily by myomere counts (145-153) and the number (8-9) and location of gut pigment patches. *Leptocephalus mucronatus* Eigenmann and Kennedy (1902) is synonymized with *P. cruentifer*.

Introduction

Occurrence of *Pisodonophis cruentifer*, the snake eel, has been reported from the Gulf of Maine to Cape Henry, Va. in depths to 448 m (Bigelow and Schroeder, 1953; Leim and Scott, 1966). It is the most northerly ranging ophichthid in the western Atlantic.

Little is known of its early life history. Late stage larvae (75–82 mm) of *P. cruentifer* were figured and described by Eigenmann and Kennedy (1902) as *Leptocephalus mucronatus* (Orton, pers. commun.). Eggs and early stage larvae identified as *P. cruentifer*, collected in the Chesapeake Bight, provide the first information on spawning and early development of this species.

I gratefully acknowledge Dr. E. B. Joseph for providing data on egg collections of *P. cruentifer*. I sincerely thank Mr. J. D. Hardy for providing notes, illustrations, and correspondence concerning 10.5 and 12.9 mm larvae of this species made by R. Mansueti, A. J. M. Lippson, and G. Orton based on specimens sent by W. H. Massmann from VIMS collections. I also thank Dr. G. C. Grant for use of fish larvae from his 1969 Norfolk Canyon plankton collections. I acknowledge Dr. E. H. Ahlstrom for information he has provided on ophichthid eggs and larvae.

Materials and Methods

All eggs and 8 larvae of *P. cruentifer* came from plankton collections made with the VIMS R/V PATHFINDER from 1961 to 1963 (Richardson and Joseph, 1973). Meter nets and Gulf III high-speed plankton samplers (Gehringer, 1962) were used. The area sampled ranged from 36° to 38° N lat. and from 18 to 148 km offshore. Nineteen larvae came from collections made with the NMFS ALBATROSS IV in Norfolk Canyon (37°04'N, 74°40'W) in August 1969. Miller nets and small mouth (0.2 m) bongos were used during a 24 hour station (Richardson and Joseph, 1973). All eggs and larvae were preserved in 5% buffered formalin. Lengths of larvae examined in this study refer to standard length.

Six adult specimens, 280–370 mm SL, from VIMS trawl collections (36°42'N, 74°34'W), were cleared and stained with Alizarin red S for vertebral counts, using the method described by Taylor (1967).

Results and Discussion

VERIFICATION OF IDENTIFICATION

The eggs, typical of ophichthid eggs (D'Ancona, 1931; Mito, 1961; Ahlstrom, pers. commun.) were identified as those of *P. cruentifer* primarily because of characteristics of late stage embryos. The largest embryos had myomere counts, gut lengths, and pigment patterns similar to the smallest larvae known to be *P. cruentifer*. Also, the time and location of collection of eggs corresponded to the time and location of collection of small larvae.

A series of 27 larval specimens ranging from 5.8 to 34.2 mm SL was linked together by pigment pattern and myomere counts. Identification of the larvae as *P. cruentifer* was based on known characteristics of ophichthid larvae and on species of ophichthids occurring in the area as adults. Larvae of ophichthids are distinguished by having round eyes and four or more intestinal loops with a pigment patch usually at the top of each loop (Schmidt, 1913; Castle, 1965; Ahlstrom, pers. commun.). *P. cruentifer* is the only common ophichthid in Virginia waters (Bigelow and Schroeder 1953) and is the only ophichthid represented in VIMS extensive trawl collections from these waters. Myomere counts of the larvae (Table 1) correspond to vertebral counts of six adult *P. cruentifer* (61 + 84 = 145; 61 + 85 = 146; 61 + 86 = 147; 62 + 86 = 148; 62 + 87 = 149; 62 + 90 = 152) taken from the same area as the larvae.

Identification of *Leptocephalus mucronatus* Eigenmann and Kennedy (1902) as *P. cruentifer* has not previously been reported. Synonymy of these two species is based on location of capture (38°25', 72°40'W), myomere counts (66 + 80), gut length, presence of nine gut loops and pigment patterns.

EGGS

The eggs of *P. cruentifer* (Fig. 1) are pelagic. They are typical of ophichthid eggs in that they are large (usually >2 mm diameter), possess a smooth outer shell, large perivitelline space, segmented yolk, and

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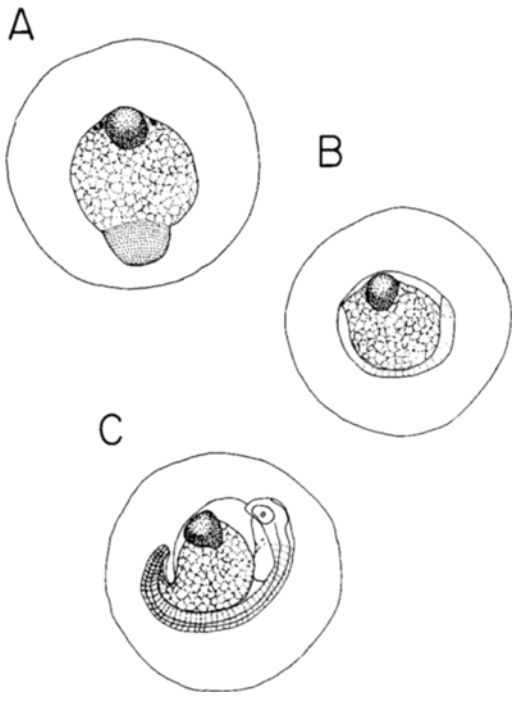

Fig. 1. A) Early, B) middle, and C) early late stage eggs of *Pisodonophis cruentifer*. (Illustrations by S. L. Richardson)

one to many oil globules. Measurements of egg and oil globule diameters of *P. cruentifer* collected in the Chesapeake Bight are in Table 1. Late stage eggs having well developed embryos are distinguished by myomere counts, gut length, and pigment patterns on the embryo which correspond to those of early stage larvae (Fig. 2A).

LARVAL DEVELOPMENT

The larvae of *P. cruentifer* probably hatch at a length of 5.5 mm SL ±0.5 mm. The smallest specimens examined, 5.8 mm, still possessed some yolk material. The jaws, which are not fully formed at hatching, become elongate with pronounced larval dentition (Fig. 2B) by 7 mm. The ratio of gut length to SL decreases during development from 76% SL at 5.8 mm to 63% SL at 34.2 mm (Table 2). The number of preanal myomeres (Table 2), however, remains consistent throughout the size range examined, thus providing a useful tool for identification of small larvae when total myomere counts are impossible to obtain. Dorsal and anal fins were not present on the 12.9 mm larva but were evident on all larvae over 19 mm. Metamorphosis takes place at about 80 mm, based on information given by Eigenmann and Kennedy (1902).

LARVAL PIGMENTATION

Head pigmention is minimal. The eyes become pigmented by 7 mm. The tip of the lower jaw develops pigment by 20 mm (Fig. 3B) and a patch of melanophores develops over the midbrain by 30 mm (Fig. 3C).

Dorsal gut pigmentation associated with intestinal loops is the most distinctive feature of these larvae. The location of the gut pigment patches with respect to myomere number (Table 3) is consistent throughout development and provides a useful diagnostic tool. Larvae <10 mm have 8 pigment patches. Larger larvae have an additional patch posterior to the rest. A pigment patch is also present on the dorsal surface of the esophagus in larvae >7 mm. Larvae >20 mm develop additional pigment ventral to the gut (Fig. 3B, C).

Other body pigment in larvae >10 mm consists of 1 to 5 patches located ventrally between the anus and tail tip and a line of melanophores located dorsally near the tail tip and a line of melanophores located dorsally near the tail tip (Fig. 2A, B). With development, the ventral pigment migrates to a lateral position just below the vertebral column (Fig. 3A). The dorsal pigment at the tail tip becomes positioned laterally just dorsal to the notochord (Fig. 3). Additional pigment develops irregularly along the body length lining the myosepta just ventral to the vertebral column (Fig. 3B, C).

As many as 8 pigment spots develop dorsally in the

TABLE 1. Diameters (mm) of eggs and oil globules (when only one is present) of *Pisodonophis cruentifer* from the Chesapeake Bight.

	N	Range	$\bar{X}$	S
Eggs (1961)	23	1.78–2.74	2.24	±0.275
Oil Globules (1961)	5	0.36–0.40	0.38	±0.017
Eggs (1962)	44	2.44–2.89	2.63	±0.100
Oil Globules (1962)	34	0.33–0.44	0.37	±0.025

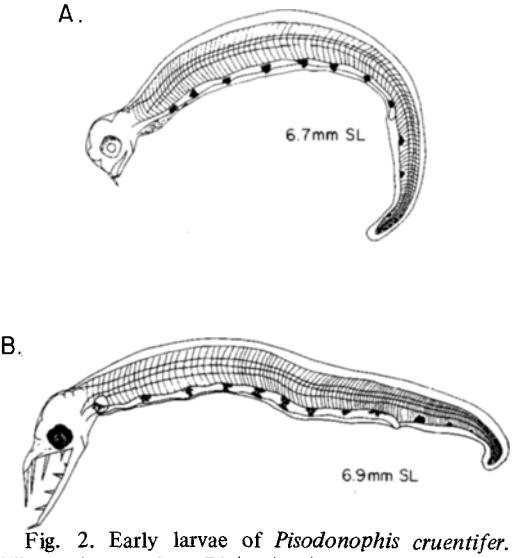

Fig. 2. Early larvae of *Pisodonophis cruentifer*. (Illustrations by S. L. Richardson)

TABLE 2. Morphometrics and meristics of larvae of *Pisodonophis cruentifer.* Data on the 10.5 and 12.9 mm larvae came from notes provided by J. D. Hardy.

Measurements (mm)									Myomeres		
SL	TL	Pre-anal length	Post-anal length	Head length	Snout length	Eye diam-eter	Post-cranial depth	Depth at anus	Pre-anal	Post-anal	Total
5.8	6.3	4.4	1.4	0.5	0.1	0.3	0.6	0.3	68	?	?
5.8	6.8	4.4	1.4	0.6	0.3	0.3	0.6	0.5	69	>50	>119
5.9	6.8	4.5	1.4	0.6	0.3	0.2	0.5	0.5	69	?	?
6.1	7.0	4.7	1.4	0.8	0.3	0.3	0.6	0.5	72	>50	>122
6.2	7.0	4.8	1.4	0.8	0.3	0.3	0.5	0.5	70	>50	>120
6.5	6.6	4.9	1.6	0.5	0.1	0.3	0.6	0.3	67	?	?
6.6	7.3	5.0	1.6	0.8	0.3	0.3	0.6	0.5	71	>50	>121
6.7	6.8	5.1	1.6	0.5	0.2	0.3	0.6	0.3	69	?	?
6.7	6.8	5.1	1.6	0.5	0.1	0.3	0.6	0.5	70	?	?
6.9	7.5	5.1	1.8	1.0	0.3	0.3	0.8	0.6	71	>50	>121
6.9	7.5	5.1	1.8	1.0	0.3	0.3	0.8	0.6	72	>50	>122
6.9	7.5	5.1	1.8	0.8	0.3	0.3	0.6	0.5	69	>50	>119
7.4	7.7	5.6	1.8	0.8	0.2	0.3	0.6	0.3	72	>50	>112
7.4	8.4	5.6	1.8	0.8	0.3	0.3	0.6	0.5	68	>50	>118
7.4	8.4	5.6	1.8	–	–	–	–	0.5	67	>50	>117
7.7	8.7	–	–	–	–	–	–	–	–	–	–
7.7	8.7	5.8	1.9	1.1	0.5	0.3	0.6	0.5	70	>65	>135
7.8	8.8	6.4	1.4	1.1	0.5	0.3	0.8	0.5	72	>50	>122
8.2	9.0	6.4	1.8	1.3	0.5	0.3	0.8	0.5	71	75	146
10.5	10.6	8.1	2.4	1.4	0.7	0.3	0.8	–	67	>56	>141
12.9	13.0	9.5	3.4	1.6	1.0	0.4	1.0	–	69	78–84	147–153
19.2	20.9	12.9	6.3	2.1	0.8	0.4	1.1	2.1	72	>72	>144
22.9	24.4	15.6	7.3	1.7	0.8	0.3	1.3	2.1	72	76	148
23.8	24.7	16.4	7.4	2.1	1.0	0.4	1.1	2.2	74	78	152
30.5	32.4	20.0	10.5	2.8	1.1	0.4	1.3	3.0	70	76	146
32.1	33.4	20.3	11.8	2.9	1.3	0.4	1.3	2.9	71	77–78	148–149
34.2	35.7	21.5	12.7	3.0	1.3	0.4	1.5	3.2	69	79–82	148–151

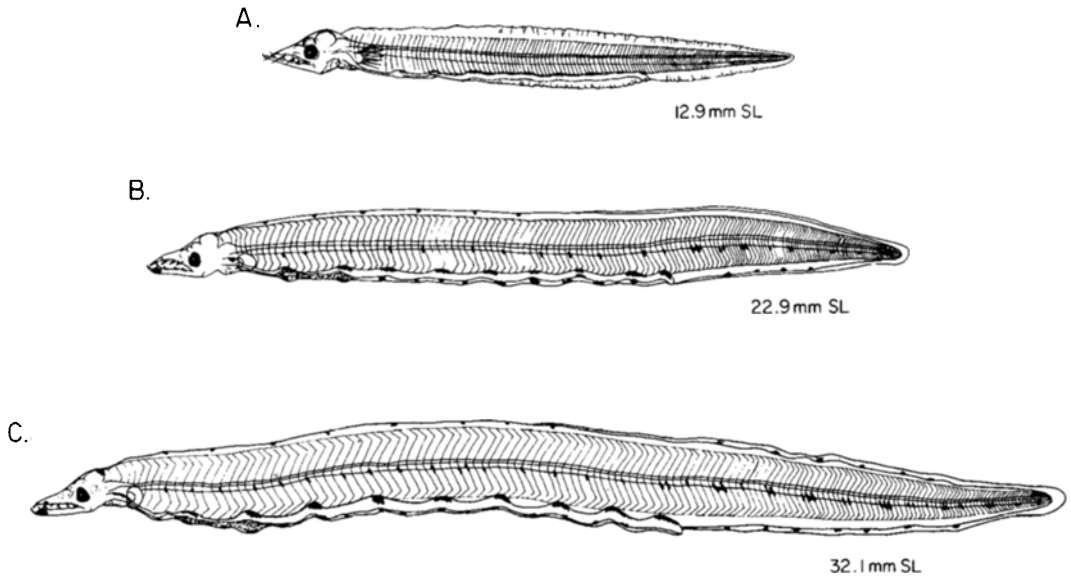

Fig. 3. Larvae of *Pisodonophis cruentifer.* (Illustration A by A.J.M. Lippson, B and C by S. L. Richardson)

TABLE 3. Location of gut pigment patches with respect to myomere number in larvae of *Pisodonophis cruentifer*. (The pigment patch on the dorsal surface of the esophagus is not included.)

Pigment patch no. (anterior to posterior)	Myomere no. (anterior to posterior) under which gut pigment patch is located	
	Range	Median
1	9–11	10
2	16–19	17
3	22–27	24
4	28–34	31
5	36–41	39
6	43–49	45
7	50–58	53
8	59–65	62
9	66–72	68

anterior portion of the body fold of larvae >20 mm. Additional pigment appears as a series of patches in the ventral body fold between the anus and tail tip (Fig. 3B). This pigment migrates onto the ventral fin (Fig. 3C). Similar pigment develops along the dorsal fin (Fig. 3C).

OCCURRENCE

From 11 July to 12 September 1961, 28 eggs of *P. cruentifer* were collected at 4 stations (in 6 samples) between 37°00′ and 37°20′N lat, 74°21′ and 75°10′W long. All but 3 eggs were taken at the surface. Surface temperatures were 23–27 C and salinities 29–32 o/oo. From 4–8 July 1962, 414 eggs were collected at 11 stations between 36°00′ and 38°00′N lat, 73°55′ and 75°10′W long. All but 9 were taken in surface tows. Surface temperatures were 20–23 C and salinities were 31–35 o/oo. All eggs were taken from 74 to 148 km off the Virginia coast, in waters over the Continental Slope. The greatest numbers of eggs per tow (>100) were taken in 1962 at stations nearest Norfolk Canyon.

All larvae <10 mm came from the Norfolk Canyon collections made in August 1969. Most of these 19 larvae were taken in surface tows. Larger larvae were collected in the summers of 1961 and 1963 at stations located 74 to 111 km off the mouth of Chesapeake Bay.

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Additional Records of the Least Brook Lamprey, *Okkelbergia aepyptera* (Abbott), from the Delmarva Peninsula

The least brook lamprey, *Okkelbergia aepyptera*, a nonparasitic freshwater species, is known on the Delmarva Peninsula from only 14 specimens from 3 localities: Chambers Lake, Caroline County, Maryland (Mansueti, 1951); below Urieville Pond, Kent County, Maryland (Schwartz, 1961); and Nassawadox Creek, Northampton County, Virginia (Musick, 1972). We present data on these specimens and on 170 additional *O. aepyptera* recently collected at 7 other localities on this peninsula, including the first records for the state of Delaware. The generic name *Okkelbergia* follows use recommended by Hubbs and Potter (1971). The only other lamprey recorded from Delmarva is the sea lamprey, *Petromyzon marinus* Linnaeus, a parasitic anadromous species.

In the immediate region of Delmarva, *O. aepyptera*