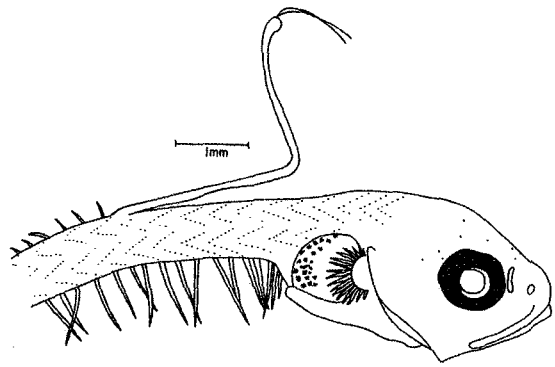
NOAA Technical Memorandum NMFS-SEFSC-514

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

BY

J. E. Olney



U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Southeast Fisheries Science Center
75 Virginia Beach Drive
Miami, FL 33149

December 2003

NOAA Technical Memorandum NMFS-SEFSC-514

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

BY

J. E. Olney

U.S. DEPARTMENT OF COMMERCE
Donald L. Evans, Secretary

National Oceanic and Atmospheric Administration
Conrad C. Lautenbacher, Jr., Under Secretary for Oceans and Atmosphere

National Marine Fisheries Service
William T. Hogarth, Assistant Administrator for Fisheries

December 2003

NOTICE

The National Marine Fisheries Service (NMFS) does not approve, recommend or endorse any proprietary product or material mentioned in this publication. No reference shall be made to NMFS or to this publication furnished by NMFS, in any advertising or sales promotion which would imply that NMFS approves, recommends, or endorses any proprietary product or proprietary material mentioned herein or which has as its purpose any intent to cause directly or indirectly the advertised product to be used or purchased because of this NMFS publication.

This report should be cited as follows:
Olney, J. E. 2003. Preliminary guide to the identification of the early life history stages of carapid fishes of the western central North Atlantic. NOAA Technical Memorandum NMFS-SEFSC-514, 10 p.

This report will be posted on the Bethune Cookman College NOAA Cooperative web site later in 2003 at URL: http://www4.cookman.edu/NOAA/ and will also appear on the SEFSC web site at URL: http://www.sefsc.noaa.gov/
It will be a chapter entitled Carapidae in the "Guide to the early life history stages of fishes of the western central North Atlantic".

Author's address:
School of Marine Science
College of William and Mary
Virginia Institute of Marine Science
Gloucester Point, VA 23062
<olney@vims.edu>

Copies may be obtained by writing:
The author or

National Technical Information Center
5825 Port Royal Road
Springfield, VA 22161
(800) 553-6847 or (703) 605-6000
http://www.ntis.gov/numbers.htm

CARAPIDAE: Pearlfishes **By J. E. Olney**

Three pearlfish species occur in the western central Atlantic region. Adults of these species are infrequently encountered but their larvae can be locally abundant. *Snyderidia canina* (subfamily Pyramondontinae) is a pelagic or epi-benthic species widely distributed in deep, oceanic waters. *Carapus bermudensis* (Carapinae, Carapini) is an obligate inquiline species that resides within the body cavity of sea cucumbers, usually in shallow, coral reef habitats. *Echiodon dawsoni* (Carapinae, Echiodontini) is an apparently free-living benthic species occupying inshore waters to depths of about 100 m on the continental shelf. Adults of *Carapus bermudensis* and *Ec. dawsoni* are distributed along the western shores of the Atlantic Ocean, Bermuda and the Caribbean Sea south to Brazil. Their larvae are long-lived and highly dispersal; thus, they occupy a larger range than the adults. Globally, the family Carapidae contains 31 species in seven genera that are widely distributed in tropical, subtropical and temperate seas. While some species are free living (all pyramodontines and all *Echiodon* spp.), the remaining species possess highly specialized behavioral associations with marine invertebrates such as starfish, seas cucumbers, bivalves and sea squirts. Some pearlfish species exit the host at night to feed while others never leave the host and prey on its internal organs. Markle and Olney (1990) present a phylogenetic treatment of the pearlfishes, including hypotheses of intra-relationships based on morphological analysis, descriptions of new taxa and descriptions of larvae. Gordon et al. (1984) review early life history including available information on egg and embryological development. Olney and Markle (1979), Markle and Olney (1980), Markle et al. (1983), Govoni et al. (1984), Ambrose (1996) and Olney et al. (2000) present larval descriptions and aspects of larval development. The early life history, population and recruitment dynamics, patterns of age and growth, spawning behavior, details of reproductive traits and general ecology of most pearlfish species are poorly known.

Adult pearlfish are elongate, eel-like ophidiiform fishes that lack pelvic fins (except the basal member *Pyramodon*) and scales. They possess moderate to light pigmentation, usually tan or cream colored with black spots concentrated on the top of the head and along the dorsal and ventral margins of the body. The species are cryptic and rarely observed. The anal-fin rays are longer that the opposing dorsal-fin rays. The anus and anal-fin origin is located far forward, usually under the pectoral-fin base. The teeth of the lower and upper jaws are usually either fang-like or small and heart-shaped (cardiform). There are usually one to several vomerine teeth. The anal- and dorsal-fin bases are long and extend to the tail tip. The caudal fin that is usually absent. Most adult carapids range in total length from 8 – 28 cm. The largest species, *Encheliophis boraborensis*, attains approximately 35 cm TL and resides in the body cavity of a large Pacific holothurian, *Thelenota*

ananas. The carapid head is large and the body tapers to a slender, hard tail tip. In most inquiline species, entry into the host is gained by tail-first penetration. Identification of adults is facilitated by counts of precaudal vertebrae (13-35), numbers of anal- (A_{30}, 36-63) and dorsal-fin rays (D_{30}, 19-53) anterior to the 31th vertebra, the number of anal-fin rays anterior to the first dorsal-fin ray (ARDO, 0-27 but not applicable in some species), the number of dorsal-fin rays anterior to the first anal-fin ray (DRAO, 0-18 but not applicable in some species) and counts of pectoral-fin rays (13-30), one species lacks the pectoral fin). In addition, internal features of adults distinguish genera. For example, in *Carapus*, the swimbladder possesses an internal constriction that delimits two sub-equal chambers. In *Echiodon*, there is a ventral patch of tunic ridges on the posterior swimbladder. In *S. canina*, the anal-fin radials are frail, slender and long, sometimes randomly positioned and often appearing to be broken and healed.

Carapids are oviparous. The eggs of most species, including those found in the western Atlantic, are undescribed. Eggs are known for several species of *Echiodon* and *Carapus acus* in the Mediterranean. The following features may be characteristic of the eggs of most pearlfish species: deposited in a mucilaginous raft; segmented yolk; oil globule present; chorion unornamented with an oval or ellipsoid shape; embryo pigmented.

Larval pearlfishes are conspicuous in plankton collections. They are unlike any other larval fish that is likely to be encountered in the western central Atlantic due their relatively long body (total length up to 20 cm for species of *Carapus*) and unique possession of an elongate dorsal ray, termed the vexillum. The vexillum is a movable dorsal-fin ray that is ornamented with large, pigmented, leaf-like tabs of fleshy tissue, deciduously lost at metamorphosis and enervated by a cranial nerve. The structure is erectile and the larva can control its length. The vexillum forms early in development and probably serves some sensory function. Its position relative to myomeres, vertebrae, and the first dorsal-fin ray, and the morphology of its supporting radial are useful characters for identification to genus. For example, in *Snyderidia canina* and *Echiodon dawsoni*, the vexillum position is adjacent to the first dorsal ray. The vexillar radial is simple (providing direct support to the vexillum and secondary support to the first dorsal ray) in *S. canina* and compound (providing direct support to both the vexillum and the first dorsal ray) in *Ec. dawsoni*. In *Carapus bermudensis*, the vexillum is well separated from the first dorsal ray and its supporting radial is simple. Counts, especially A_{30}, D_{30}, and ARDO, are also useful in identification but obtaining these counts requires that the specimen is cleared and stained or radiographed with high resolution.

Pearlfish larvae in the western Atlantic have a moderately sized head (about 20% of the body length, however the posterior portion of the body is often missing or broken); a short, somewhat bulbous gut that is coiled; a short preanal distance (about 130% head length); large eyes (about 30% head length); and pigmentation confined to the snout (a small ring of melanophores in *C. bermudensis*), head region (a spot on the tip of the lower jaw in *S. canina* and

scattered on the top of the head in *Ec. dawsoni*) and the gut (on the peritoneum in *Ec. dawsoni*). Some pearlfish larvae have large exterilium guts but these species do not reside in the western Atlantic.

Some pearlfish larvae undergo multiple growth stages, easily depicted in plots of head length versus total length (see Markle and Olney 1990, their figure 93). In the pelagic vexillifer stage of *Carapus bermudensis*, the larva elongates to a maximum total length of about 18 cm prior to the deciduous loss of the vexillum. In the tenuis stage of *C. bermudensis*, the larva (lacking a vexillum) becomes demersal or transitory pelagic-demersal and the total length is reduced from about 16 cm to 7-8 cm. In the final growth stanza, the tenuis stage locates and inhabits a suitable invertebrate host, takes on the characteristic pigment patterns of the juvenile or sub-adult and grows in total length to maturity 7 cm to approximately 20 cm. The tenuis stage does not occur in *Snyderidia* and may be highly abbreviated in duration or absent in *Echiodon*.

The following descriptions are taken from Olney & Markle (1979) and Markle & Olney (1990). No new material was examined. Since the tail of adults and larvae are often missing or damaged, counts of caudal and total vertebrae, and counts of total anal anal and dorsal rays are not reported here. Additionally, information on the development of the caudal fin (if present) is lacking. In the descriptions of fin development, the abbreviation for the vexillum is 'Vex.'

Table Carapidae 1.

Counts useful in identification of larval pearlfish in the western Atlantic Ocean. Abbreviations are: VVO, number of vertebrae to the origin of the vexillum; VDO, number of vertebrae to the dorsal-fin origin; P, pectoral rays; A_{30}, number of anal-fin rays anterior to the 31st vertebra; D_{30}, number of dorsal-fin rays anterior to the 31st vertebra; ARDO, number of anal rays to the dorsal-fin origin; DRAO, number of dorsal rays to the anal-fin origin.

Species	VVO	VDO	P	A_{30}	D_{30}	ARDO	DRAO
Snyderidia canina	6	7	25	46	51	-----	6-9
Carapus bermudensis	4-5	10-11	19	53-58	39-42	13-18	-----
Echiodon dawsoni	11	11-12	18	38	29-30	10-11	-----

CARAPIDAE *Carapus bermudensis* (Jones)

Meristics

Vertebrae:	
Precaudal	17-18
Number of fin rays:	
Pectoral	17-20
A_{30}	53-62
D_{30}	36-45
ARDO	17-25
DRAO	------
Branchiostegals	7

LIFE HISTORY

Range: eastern US coast to Gulf of Mexico,Bermuda and Caribbean Sea
Habitat: inquiline in the body cavity of holothurians, especially *Actinopyga agassizi* and *Holothuria spp.*; generally shallow waters near coral reefs; at night, leaves the host to forage.
ELH Pattern: probably long-duration, planktonic larval stage, transitional planktonic-benthic tenuis stage.
Spawning: unknown but likely protracted.
Age-at-maturity: unknown.

LITERATURE

Olney & Markle 1979, Gordon et al. 1984, Markle & Olney 1990.

Early Life History Description

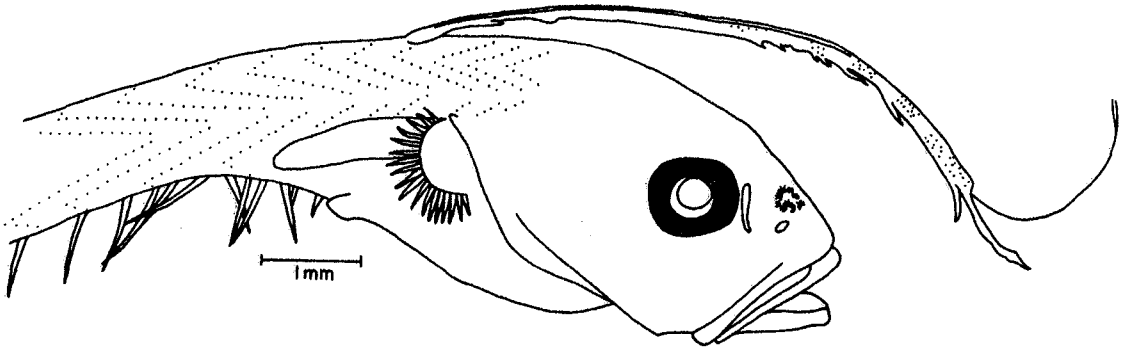
EGGS: unknown.

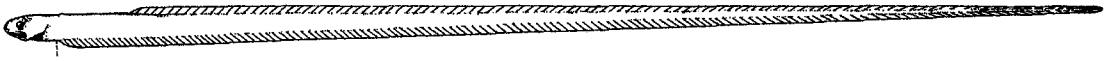
LARVAE:
Sequence of fin development: Vex & P, D & A
Pigmentation: a ring of melanophores located anterior-dorsal to the nasal rosettes is prominent in fresh material
Diagnostic characters: vexillifer larvae lacking enlarged teeth on the upper and lower jaws; possessing cardiform teeth; extremely elongate body; a vexillum placed well anterior to the dorsal-fin origin; anal-fin origin well anterior to the dorsal-fin origin; ARDO 13-18
Similar larvae: in both *Ec. dawsoni* and *S. canina*, the vexillum is adjacent to the first dorsal-fin ray.

JUVENILES:
A tenuis stage is present. Juveniles and pre-adults resemble adults.

ILLUSTRATIONS

A) Head of vexillifer larva: from Olney & Markle 1979, Fig. 1 (bottom); B) Tenuis larva: from Markle & Olney 1990, Fig. 100 (bottom).


1mm



CARAPIDAE — ***Echiodon dawsoni* Williams & Shipp**

Meristics

Vertebrae:

Precaudal	21-25
Number of fin rays:	
Pectoral	17-21
A_{30}	39-43
D_{30}	28-35
ARDO	11-12
DRAO	------
Branchiostegals	7

LIFE HISTORY

Range: adults: eastern US coast to Gulf of Mexico and southern Brazil; may be two allopatric species groups; larvae: widely distributed throughout the western and central North Atlantic, Gulf of Mexico, Caribbean Sea to West Africa.
Habitat: shallow muddy bottom to 100 m; free-living.
ELH Pattern: probably long-duration, planktonic larval stage.
Spawning: unknown but likely protracted.
Age-at-maturity: unknown.

LITERATURE

Olney & Markle 1979, Gordon et al. 1984, Markle & Olney 1990.

Early Life History

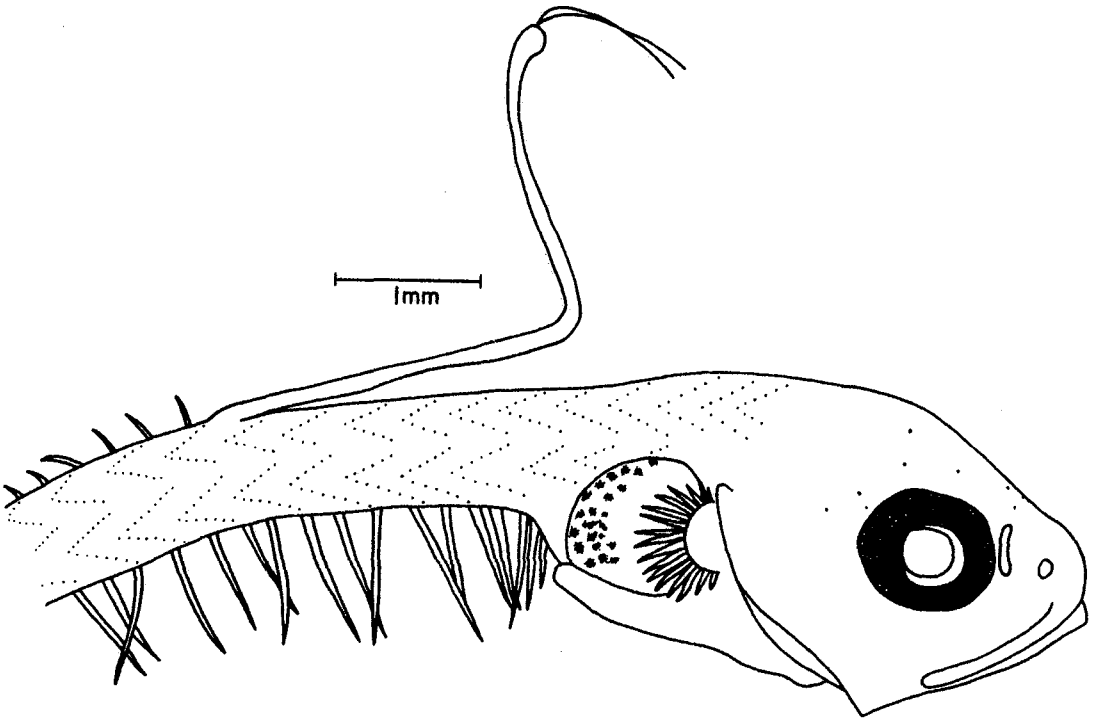
EGGS: unknown; hatch size, unknown.

LARVAE:
Sequence of fin development: Vex & P, D & A.
Pigmentation: a few melanophores scattered on the cranium; internal pigment on the peritoneum above the gut.
Diagnostic characters: vexillum adjacent to the first dorsal-fin ray & anal-fin origin well anterior of the dorsal-fin origin; large fang-like teeth on the upper and lower jaws; ARDO 10-11.
Similar larvae: the vexillum of *S. canina* is placed anterior to the anal origin.

JUVENILES:
The tenuis stage may be highly abbreviated in duration or absent. Juveniles and pre-adults resemble adults.

ILLUSTRATIONS

A) Head of vexillifer larva: From Olney & Markle 1979, Fig. 1 (top)


1mm

Meristics

Vertebrae:	
Precaudal	13-15
Number of fin rays:	
Pectoral	24-27
A_{30}	42-46
D_{30}	47-50
ARDO	------
DRAO	6-11
Branchiostegals	7

LIFE HISTORY

Range: circumglobal, oceanic; widely distributed in western Atlantic, Gulf of Mexico, Caribbean Sea and South Atlantic.
Habitat: meso-pelagic to epi-benthic, free-living.
ELH Pattern: probably long-duration, planktonic larval stage.
Spawning: unknown.
Age-at-maturity: unknown.

LITERATURE

Gordon et al. 1984, Markle & Olney 1980, 1990.

Early Life History Description

EGGS: unknown.

LARVAE:
Sequence of fin development: Vex & P, D & A.
Pigmentation: in fresh material, a prominent concentration of melanophores at the symphysis of the lower jaw; scattered melanophores on the cranium.
Diagnostic characters: vexillifer larvae lacking pelvic-fin rays and cardiform teeth; body not extremely elongate; a large head and deep body; vexillum placement adjacent to first dorsal-fin ray and anterior to a vertical through the first anal-fin ray; DRAO 6-9.
Similar larvae in the region: the vexillum of *C. bermudensis* is not adjacent to the first dorsal-fin ray; the vexillum of *Ec. dawsoni* is well posterior to the anal origin

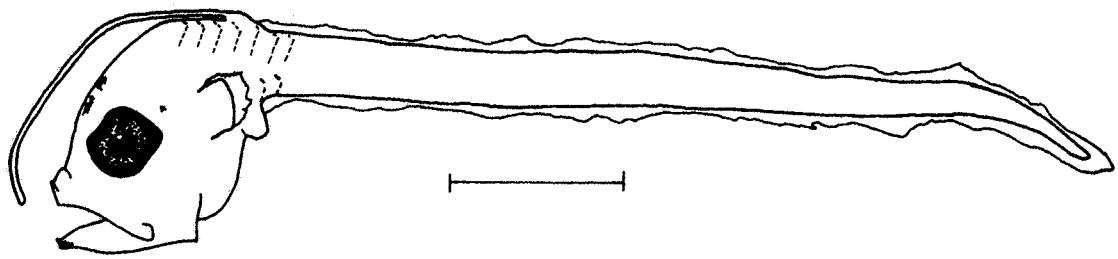
JUVENILES:
There is no tenuis stage. Juveniles and pre-adults resemble adults.

ILLUSTRATIONS

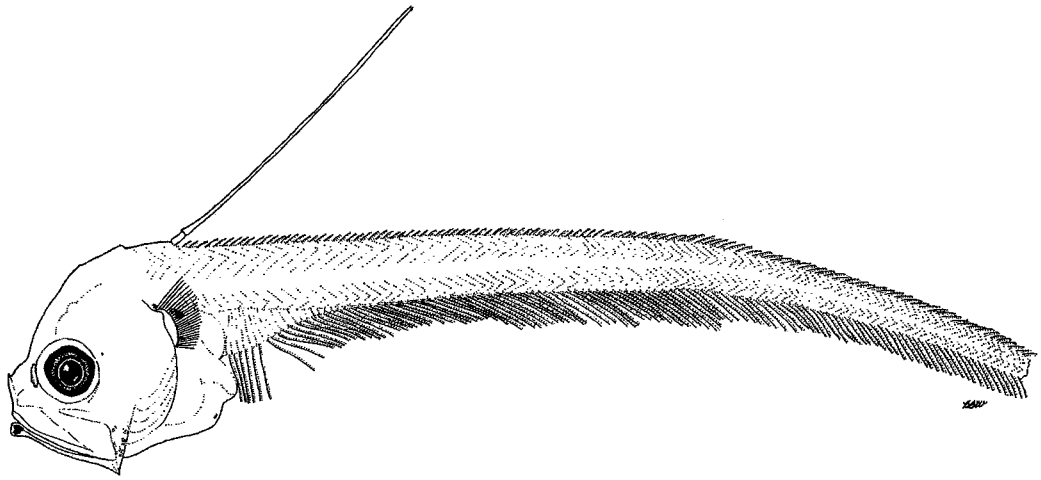
A) From Markle & Olney 1990, Fig. 50 (top); B) From Gordon et al. 1984, Fig. 163 (bottom).

CARAPIDAE ***Snyderidia canina* Gilbert**

A



B



Literature Cited

Ambrose, D. A. 1996n. Carapidae. Pages 532-537 *in* The early stages of fishes in the California Current Region, H. G. Moser (ed.). CalCOFI Atlas 33: 1505 p.

Gordon, D. J., D. F. Markle, & J. E. Olney. 1984. Ophidiiformes: development and relationships. Pages 308-319 *in* Ontogeny and systematics of fishes. H. G. Moser et al. (eds.), Amer. Soc. Ichthyol. Herpetol. Spec. Publ. (1): 760 p.

Govoni, J. J., J. E. Olney, D. F. Markle, & W. R. Curtsinger. 1984. Observations on structure and evaluation of possible functions of the vexillum in larval Carapidae (Ophidiiformes). Bull. Mar. Sci. 34: 60-70.

Markle, D. F. & J. E. Olney. 1980. A description of the vexillifer larvae of *Pyramodon ventralis* and *Snyderidia canina* (Pisces, Carapidae) with comments on classification. Pacif. Sci. 34: 173-180.

Markle, D. F. & J. E. Olney. 1990. Systematics of the pearlfishes (Pisces: Carapidae). Bull. Mar. Sci. 47: 269-410.

Markle, D. F., J. T. Williams, & J. E. Olney. 1983. Description of a new species of *Echiodon* (Teleostei: Carapidae) from the Antarctic and adjacent seas. Proc. Biol. Soc. Wash. 96: 645-657.

Olney, J. E. & D. F. Markle. 1979. Description and occurrence of vexillifer larvae of *Echiodon* (Pisces: Carapidae) in the western North Atlantic and notes on other carapid vexillifers. Bull. Mar. Sci. 29: 365-379.

Olney, J. E., J. M. Leis, & D. S Rennis. 2000. Carapidae (Pearlfishes). Pages 104-107 *in* The larvae of Indo-Pacific coastal fishes: An identification guide to marine fish larvae. Leis, J. M. & B. M. Carson-Ewart (eds.). Fauna Malesiana Handbook 2. Brill, Leiden. 850 p.