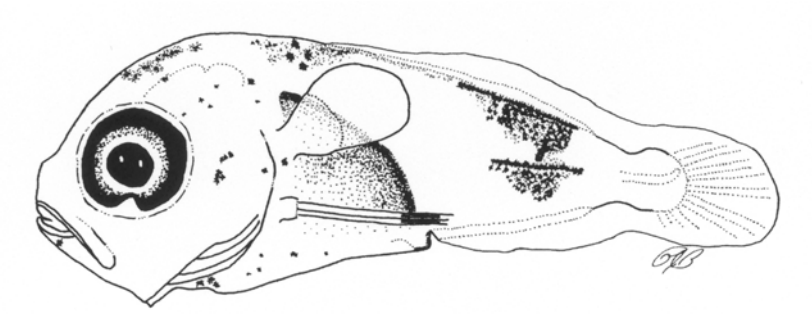
NOAA Technical Memorandum NMFS-SEFSC-489

# PRELIMINARY GUIDE TO THE IDENTIFICATION OF THE EARLY LIFE STAGES OF PHYCID FISHES OF THE WESTERN CENTRAL NORTH ATLANTIC

BY

B. H. COMYNS AND P. J. BOND



U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Southeast Fisheries Science Center
75 Virginia Beach Drive
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# PRELIMINARY GUIDE TO THE IDENTIFICATION OF THE EARLY LIFE HISTORY STAGES OF PHYCID FISHES OF THE WESTERN CENTRAL NORTH ATLANTIC

BY

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September 2002

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W. J. Richards, Editor. NOAA Fisheries, 75 Virginia Beach Drive, Miami, FL

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It will be a chapter entitled Phycidae in the "Guide to the early life history stages of fishes of the western central North Atlantic".

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## FAMILY PHYCIDAE: Phycid Hakes

By B. H. Comyns & P. J. Bond

The family Phycidae is comprised of 27 species in five genera (Nelson, 1994). This family was recognized at the subfamily level by Markle (1982), and later as a separate family by Cohen (1984) and Markle (1989). Phycids are benthic, mostly on soft bottom, and are found primarily in the Atlantic, but also occur off South Africa, New Zealand and Japan (Markle, 1982). Seven species of *Urophycis* (Gill), collectively referred to as 'hakes', and a single species of *Enchelyopus* (Bloch & Schneider), one of the rocklings, are found on the continental shelf and slope of the western central Atlantic Ocean (Svetovidov, 1948; Wenner, 1983; Cohen et al., 1990). These species are: *U. chesteri* (Goode and Bean), *U. chuss* (Walbaum), *U. cirrata* (Goode and Bean), *U. earlli* (Bean), *U. floridana* (Bean and Dresel), *U. regia* (Walbaum), *U. tenuis* (Mitchill), and *E. cimbrius* (Linnaeus). Hakes have two dorsal fins and one anal fin, each of which lack spines, and neither of which are connected to the caudal fin. The pelvic fin has two highly elongated rays (three rays in larvae), and barbels are present on the chin but not on the snout. Rocklings have 3 dorsal fins (first is a thickened unsegmented ray), 2-4 barbels on the snout, and a chin barbel (Cohen 1990). Phycids have small cycloid scales, and adults have highly specialized otoliths that are characterized by having a completely fused ostium and cauda (Nolf & Steurbaut, 1989).

Larvae of *E. cimbrius* are distinctive and have been well described (Fahay, 1983). However, taxonomic problems have persisted for other phycid larvae and have hindered the accumulation of ecological data on these significant components of offshore ichthyoplankton assemblages (Kendall & Naplin, 1981; Dunn & Matarese, 1984; Hermes, 1985). Methven (1985) presented a size dependent key to the identification of larval and pelagic juvenile *U. chuss*, *U. tenuis* and *U. chesteri* (then named *Phycis chesteri*) from the northwest Atlantic. Identifications were based on body depth, numbers of epibranchial gill rakers (Musick, 1973; Wenner, 1983), and numbers of caudal fin rays (Markle, 1982). Material for Methven's study came from the Scotian Shelf. He did not consider *U. cirrata*, *U. earlli*, *U. floridana*, and *U. regia* which occur further to the south and rarely, if ever, occur on the Scotian Shelf. Methven (1985) also examined several pigmentation characters but these were of limited use because of overlap between species. Methven's key is of limited use in the western central Atlantic Ocean where southern species of *Urophycis* occur.

Hildebrand & Cable (1938) described larval and pelagic juvenile *U. chuss*, *U. regia* and *U. floridana*. Larvae approximately 3-7 mm in length were identified on the basis of body depth and pelvic fin pigmentation, *U. chuss* having the most slender-bodied larvae and *U. regia* having the only larvae without dark pelvic-fin pigmentation. However, too much overlap exists with body depth measurements to afford confident identifications, and pelvic fin pigmentation is easily lost during the rigors of net capture. Hildebrand & Cable (1938) used additional meristic characters to identify pelagic juveniles. They noted that *U. chuss* has more second dorsal fin rays than *U. regia*, and can be separated from *U. regia* at sizes as small as 7 mm by numbers of second dorsal fin fulcra. Hildebrand and Cable also distinguished *U. chuss* from *U. regia* and *U. floridana* by numbers of anal fin rays, but meristic overlap precludes this separation. Newly hatched *U. chuss* and *U. regia* of known parentage were described by Hildebrand & Cable (1938), Miller & Marak (1959), Barans & Barans (1972), and Serebryakov (1978). Although these descriptions provide pigmentation differences between the two species, this information alone is not sufficient to identify field-caught larvae because newly hatched larvae of other species have not been described. Comyns & Grant (1993) identified hake larvae collected off the U. S. east coast. Species collected included *U.* chesteri, *U. chuss*, *U. cirrata*, *U. floridana*, *U. regia* and *U. tenuis*. Most specimens had attained the adult compliment of meristic elements, and identifications were based on numbers of epibranchial gill rakers, abdominal vertebrae, and fin rays (dorsal, caudal, pelvic), patterns of pterygiophore interdigitation, and morphometric characters including body depth at the vent and a ratio between height of the pelvic-fin base and length of the mandible. Unfortunately, Comyns & Grant (1993) found that faded pigmentation caused by specimen storage in formalin and subsequent clearing and staining prevented use and further description of larval pigmentation. Larvae of *U. cirrata* remain undescribed and consequently this species is not treated separately in this chapter. Five pelagic juveniles (20 to 42 mm) of *U. cirrata*, all cleared and stained prior to identification, were identified by Comyns and Grant (1993) based on numbers of epibranchial gill rakers, second dorsal fin rays, and anal-fin pterygiophores anterior to the first haemal spine. The identification of small hake larvae remains difficult, and more work is needed to recognize pigment patterns that are taxonomically useful.

Table Phycidae 1. A summary of key meristic, morphometric and pterygiophore interdigitation characters used to separate seven species of *Urophycis*. Given for each species: Body length (mm) at which characters are attained (upper), morphometric or meristic value (middle), and explanatory notes (**bold** letters in parentheses). Percentages indicate proportion of a species that possess a particular character. Specimens were cleared and stained. From Comyns & Grant 1993.

| | Epibranchial gill rakers | Caudal-fin rays | 2nd dorsal-fin rays | 1st dorsal-fin rays | Abdominal vertebrae | Anal-fin pterygiophores anterior to first haemal spine | Interdigitation of second dorsal-fin pterygiophore | Body depth at vent as %SL | Height of pelvic fin base as % mandible length | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 11-13mm | 10mm | 14mm | 15mm | 4mm | 8-9mm | | 12mm | 6-19mm | 20-34mm |
| *U. tenuis* | 2 (95%) | 35 (99%) | 53 (93%) | 12 | 15 | >6 (2%) | 9 (88%) | 19.0-21.1 | 24-42 | 26-37 |
| | **(A)** | | | | | <6 (60%) | **(J)** | | **(K)** | |
| | 11-13mm | 8-9mm | 14mm | 14mm | 4mm | 8-9mm | 12mm | 12mm | 6-19mm | 20-34mm |
| *U. chuss* | 3 (97%) | <35 | 53 | 12 | 15 (87%) | >6 (45%) | 9 (52%) | 17.6-19.7 | 20-39 | 15-22 |
| | | | **(E)** | | | <6 (5%) | | | | |
| | 11-13mm | 8-9mm | 14mm | 13mm | 4mm | 8-9mm | 12mm | 12mm | 6-19mm | 20-34mm |
| *U. regia* | 3 (97%) | <35 | 52 | <12 | 14 | >6 (57%) | <9 | 18.4-21.7 | 19-33 | 12-28 |
| | | | **(E)** | **(G)** | **(H)** | <6 (2%) | | | | |
| | | | | | | | | 12mm | 15-19mm | 20-34mm |
| *U. floridana* | 2 | <35 | 53 | 13 (33%) | 15 (98%) | >6 (74%) | .9 (73%) | 17.7-19.8 | 29-36 | 23-37 |
| | | | | | **(I)** | <6 (0%) | | | | |
| *U. earlli* | 2 | <35 | >53 | <12 | 14 (87%) | >6 (85%) | <9 | | | |
| | | **(C)** | | **(G)** | **(I)** | <6 (0%) | | | | |
| | | | | | | | | | | 20-34mm |
| *U. cirrata* | 3 | <35 | >53 | 12 | 15 | >6 (0%) | | | | 31-39 |
| | | | **(F)** | | **(I)** | <6 (82%) | | | | |
| | 16-18mm | | | | | | | 12mm | 6-19mm | 20-34mm |
| *U. chesteri* | 4-5 | <35 (77%) | 53 | 12 | 15 (88%) | >6 (0%) | 9 (38%) | 21.0-23.4 | 44-74 | 46-61 |
| | **(B)** | **(D)** | | | | | | | **(L)** | |

(**A**) *U. tenuis* occasionally possesed a third gill raker, however, only one specimen examined (n=167) possessed three gill rakers found on both left and right sides.
(**B**) Three epibranchial gill rakers had developed by 13 mm standard length (SL).
(**C**) *U. earlli* has never been recorded with more than 31 caudal fin rays while all other hake commonly have more than 31 rays.
(**D**) Although ranges in *U. tenuis* and *U. chesteri* overlapped, numbers of caudal fin rays separated over 40% of *U. chesteri* (<34 rays) from more than half of *U. tenuis* (>36 rays).
(**E**) Numbers of second dorsal fin pterygiophores separated *U. regia* from *U. chuss* at sizes as small as 6 mm SL (Comyns and Grant 1993).
(**F**) Although ranges overlap, almost 70% of *U. cirrata* had at least 64 second dorsal fin rays, while other *Urophycis* species (except *U. earlli*) had fewer than 64 rays.
(**G**) *U. regia* and *U. earlli* have never been found with more than l0 and 11 first dorsal rays, respectively, while over 80% of *U. floridana* (n=45) possessed more than 11 rays.
(**H**) Only eight specimens of *U. regia* from the Middle Atlantic Bight (n=698) had l5 abdominal vertebrae, and seven of these specimens had an anomalous 15th vertebra.
(**I**) *U. floridana* and *U. cirrata* commonly possessed l6 or 17 abdominal vertebrae, but *U. earlli* has never been recorded with this many.
(**J**) Numbers refer to the interneural space into which points the pterygiophore supporting the first ray of the second dorsal fin. The first interneural space was defined as the space anterior to the first haemal spine.
(**K**) Size ranges do not define size when character first became useful, but bracket the size range over which particular morphometric values were found.
(**L**) At sizes larger than 35 mm SL, *U. chesteri* was similar to other *Urophycis* species with respect to this character.

## MERISTICS[a]

| | |
|---|---|
| Vertebrae: | |
| Precaudal | 15-17 |
| Caudal | 38-39 |
| Total | 49-55 |
| Number of Fin Rays: | |
| First Dorsal Fin | 1, ~50 |
| Second Dorsal Fin | 45-54 |
| Anal Fin | 37-49 |
| Pectoral Fin | 15-19 |
| Pelvic Fin | 5-7 |
| Gill Rakers on first arch | 7-12 |

[a] Meristic characters pertain to specimens collected in the Gulf of Mexico and along the U.S. east coast from Florida to Virginia (Cohen and Russo, 1979).

## LIFE HISTORY

Range: Coastal waters of the North Atlantic. In the western Atlantic from the northern Gulf of Mexico to Newfoundland and West Greenland. In the eastern Atlantic around Iceland and the Faroes, along the coasts of Scandinavia, the British Isles and northern Europe. In addition, two specimens were collected in the eastern Atlantic as far south as Cape Blanc, Mauritania.
Habitat: Soft bottom habitat in depths from 1 to 650 m, but most commonly 20 to 50 m.
Size: Maximum known size is 410 mm TL. Common from 150 to 250 mm TL.
ELH Pattern: Oviparous. Pelagic eggs and larvae.
Spawning Season: Spring till early autumn.
Migration: Some indication of inshore movement during autumn and winter, and offshore movement during spring and summer.
Size/Age at First Maturity: 150 mm TL.

## LITERATURE

Bigelow & Schroeder 1953; Cohen et al. 1990; Cohen & Russo 1979; Colton & Marak 1969(MS); Fahay 1983; Fahay & Markle 1984; Markle 1982.

## EARLY LIFE HISTORY DESCRIPTION

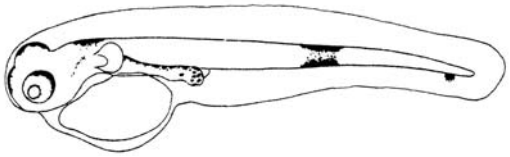
**EGGS:**
Diameter: 0.66-0.98 mm.
Oil Globules: initially many small droplets, most of which coalesce into one globule.
Oil Globule Diameter: after coalescense 0.13-0.25 mm.
Yolk: homogeneous.
Shell: smooth.
Hatch Size: 1.6-2.4 mm

**LARVAE:**
Length at Flexion:
Sequence of Fin Development: $P_2$, $D_2$ A, $D_1$ (first ray elongated), $P_1$.
Pigmentation: Pigment on snout, crown, nape, and midtail. Swath of pigment across midtail is most dense along dorsal and ventral margins. By 4 mm ventral & lateral pigment of swath is much reduced, leaving a patch of pigment on the dorsal surface of midtail. Pigmented pelvic fins develop at about 3 mm.
Diagnostic Characters: Early larvae distinguished from *Urophycis* by pigment near tip of notochord on ventral margin. By 3 mm four pelvic rays have developed, whereas *Urophycis* only develops three pelvic rays.

## ILLUSTRATIONS

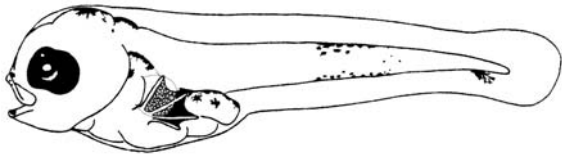
From Fahay 1983

**A**



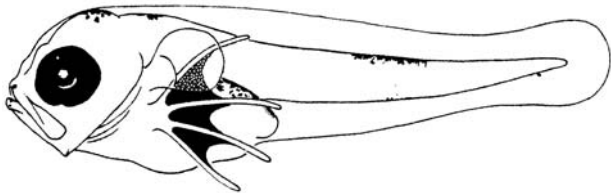
**2.6 mm**

**B**



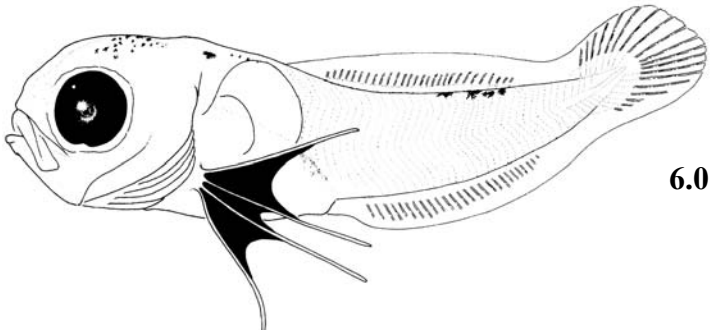
**2.9 mm**

**C**



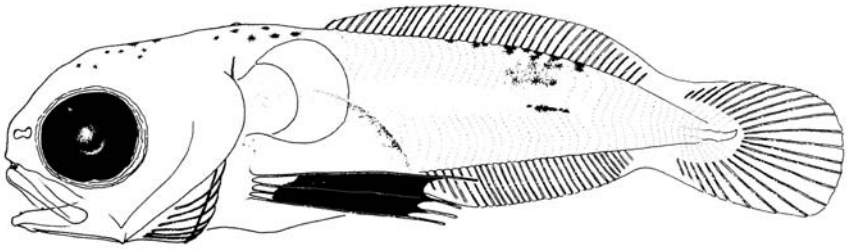
**3.8 mm**

**D**



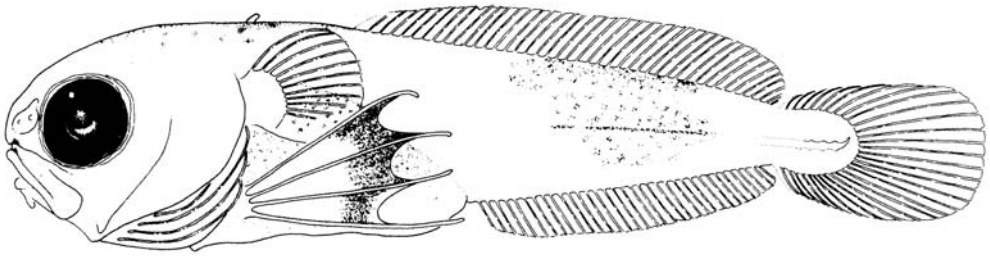
**6.0 mm**

**E**



**7.2 mm**

**F**



**10.3 mm**

## MERISTICS

| | |
|---|---|
| Vertebrae: | |
| Precaudal | 13-16 |
| Caudal | 31-37 |
| Total | 45-52 |
| Number of Fin Rays: | |
| First Dorsal Fin | 8-12 |
| Second Dorsal Fin | 50-63 |
| Anal Fin | 43-54 |
| Caudal Fin | 28-36 |
| Pelvic Fin[a] | 3 |
| Epibranchial Gill Rakers (1st gill arch) | 4-5 |

[a] Third pelvic-fin ray in adults is rudimentary.

## LIFE HISTORY

Range: Continental shelf edge and slope of western North Atlantic from at least 56°N off the coast of Labrador to the straits of Florida. Rare south of Cape Hatteras.
Habitat: Demersal, living at depths ranging from 90 to ca. 1,400 m, but most abundant between 400 and 800 m.
Size: Reaches ca. 400 mm TL.
ELH Pattern: Oviparous. Pelagic eggs and larvae
Spawning:
Season: Late September to April with a peak in December and January.
Area: Continental slope
Fecundity: Ca. 2,000 eggs/gram body weight

## LITERATURE

Cohen et al. 1990; Comyns & Grant 1993; Hildebrand & Cable 1938; Leim & Scott 1966; Methven 1985; Methven & McKelvie 1986; Scott & Scott 1988; Wenner 1983

## EARLY LIFE HISTORY DESCRIPTION

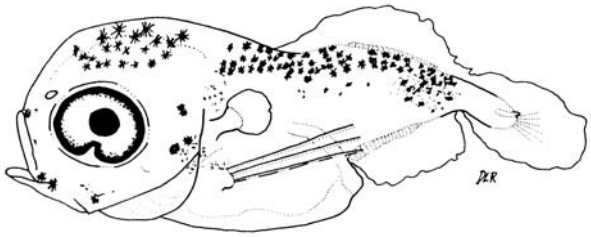
**EGGS:** Unknown. However, if similar to other *Urophycis* species, egss are likely to have a diameter of less than one mm, a smooth shell, initially many small oil droplets which coalesce into one globule, and a homogenous yolk.

**LARVAE:**
Length at Flexion: Ca. 4 mm
Sequence of Fin Development: $P_2$, $D_2$ &A, $D_1$ & $P_1$.
Pigmentation: At 4.5 mm melanophores scatted above midline of body and on dorsal surface of head. One or two melanophores at anterior tip of body between premaxilla and snout. By 11 mm body covered with melanophores. Fewer melanophores on snout. Melanophores at anterior tip of body between premaxilla & snout remain distinctive. Methven (1985) illustrated a 28.9 mm juvenile (Fig. C) with pigment located on distal portion of pelvic-fin membrane. Two smaller illustrated specimens (Figs. A, B) did not show this pigment, perhaps because this pigment may have been removed by the rigors of net capture.
Diagnostic Characters: Distinguished from larvae of other *Urophycis* species (ca. 4 to 34 mm) by height of pelvic-fin base expressed as percent of mandible length (Table 1). Values for cleared and stained *U. chesteri* (n=33) ranged from 44 to 74%, while values for larvae of other *Urophycis* (n=141) ranged from 12 to 42%. Based on illustrations of non cleared and stained specimens in Methven (1985), values for *U. chuss* and *U. tenuis* (n=6) ranged from 11 to 24%, while values for three specimens of *U. chesteri* (smallest specimen 4.5 mm) ranged from 32 to 42%. At sizes larger than 16-18 mm, *U. chesteri* has 4-5 epibranchial gill rakers whereas other *Urophycis* species have no more than three. Three epibranchial gill rakers have developed in *U. chesteri* by 13 mm, whereas *U. tenuis* and *U. floridana* have only two epibranchial gill rakers.

## ILLUSTRATIONS

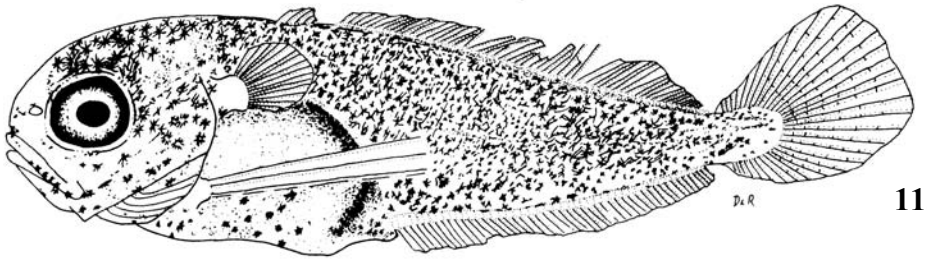
From Methven 1985

**A**



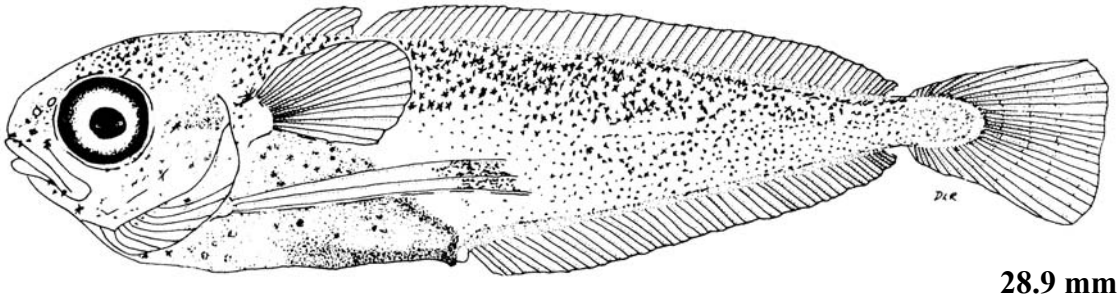
**4.5 mm**

**B**



**11.0 mm**

**C**



**28.9 mm**

## MERISTICS

| | |
|---|---|
| Vertebrae: | |
| Precaudal | 14-17 |
| Caudal | 33-36 |
| Total | 45-51 |
| Number of Fin Rays: | |
| First Dorsal Fin | 9-12 |
| Second Dorsal Fin | 52-64 |
| Anal Fin | 45-57 |
| Caudal | 28-34 |
| Pelvic Fin[a] | 3 |
| Epibranchial Gill Rakers (1st gill arch) | 3 |

[a] Third pelvic-fin ray in adults is rudimentary.

## LIFE HISTORY

Range: Western North Atlantic continental shelf from southern Nova Scotia and Newfoundland to Cape Hatteras, North Carolina.

Habitat: Soft mud or sand bottoms. Juveniles are most abundant in water shallower than 110 m (sometimes as shallow as 4-6 m), and many live in the mantle cavity of the sea scallop (*Placopecten magellanicus*). After young inquiline hake reach approximately 110 mm and have outgrown their bivalve host, they remain within the vicinity of scallop beds until their second year of life. Adults move to deeper water, typically 75-130 m, but depth may be as shallow as 35 m and occasionally deeper than 550 m.

Size: Maximum size is approximately 500 mm TL. Larger records are probably *U. tenuis*.

ELH Pattern: Oviparous. Pelagic eggs and larvae.

Spawning Season: Summer and early autumn.

Migration: Inshore migration of adults in spring and offshore migration in autumn.

Size/Age at First Maturity: ~300 mm/2-3 years.

## LITERATURE

Bigelow & Schroeder 1953; Cohen et al. 1990; Comyns & Grant 1993; Fahay 1983; Hildebrand & Cable 1938; Markle et al. 1982; Methven 1985; Musick 1973, 1974; Scott & Scott 1988; Svetovidov 1948.

## EARLY LIFE HISTORY DESCRIPTION

**EGGS:**

Diameter: 0.63-0.97 mm (most 0.7 to 0.8 mm).

Oil Globules: Initially many small droplets, which coalesce into one globule.

Oil Globule Diameter: After coalescense 0.17-0.20 mm.

Yolk: Homogeneous.

Shell: Smooth.

Hatch Size: 1.8-2.0 mm

**LARVAE:**

Length at Flexion: ca. 5 mm.

Sequence of Fin Development: $P_2$, $D_2$ & A, $D_1$ & $P_1$.

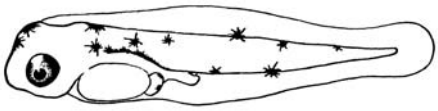
Pigmentation: Based on laboratory –reared larvae, at 2.1 mm (22 h after hatch) melanophores located between eyes, on forehead, and scattered on dorsal & ventral body margins. 2.1-2.2 mm larvae (38-86 h after hatch) had a single large melanophore on nape, & large dorso-ventral pair of melanophores at midtail. Peritoneum over gut heavily pigmented. By 2.75 mm tips of pelvic-fin membrane pigmented. By 5 mm (field-caught) midline stripe develops & ventral spot at midtail disappears.

Diagnostic Characters: Species of most concern are *U. regia*, *U. tenuis* and *U. chesteri*. Early larvae distinguished from *U. regia* by lack of pigment at tip of snout. In *U. regia* anterior edge of dorsal melanophore at midtail is several myomeres anterior to ventral melanophore, not directly above ventral melanophore as in *U. chuss*. Tips of pelvic fins pigmented, unlike *U. regia* which does not have pelvic fin pigment. Absence of this pigment may be caused by physical stress during net capture. Distinguished from *U. regia* by number of second dorsal-fin rays (at sizes as small as 6 mm). Distinguished from *U. tenuis* by number of epibranchial gill rakers, & from most *U. tenuis* by number of caudal fin rays. Distinguished from *U. chesteri* by number of epibranchial gill rakers, and at sizes as small as ca. 4 mm by height of pelvic-fin base expressed as percent of mandible length (see *U. chesteri* section).

## ILLUSTRATIONS

A-B from Miller & Marak 1959; C-D from Fahay 1983; E-F from Methven 1985.

**A**

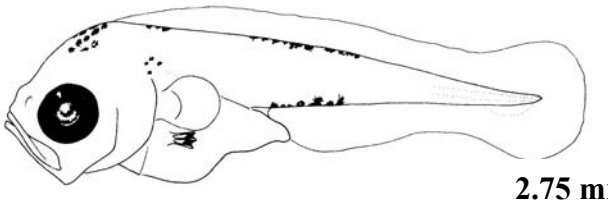


**2.1 mm**

**B**

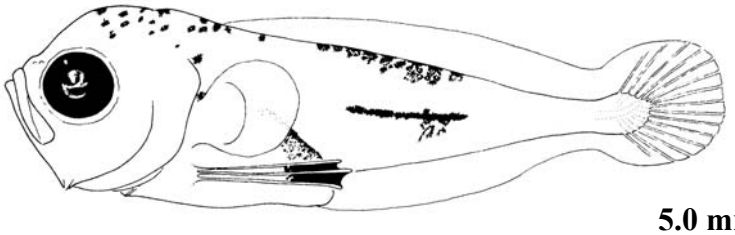
**2.2 mm**

**C**



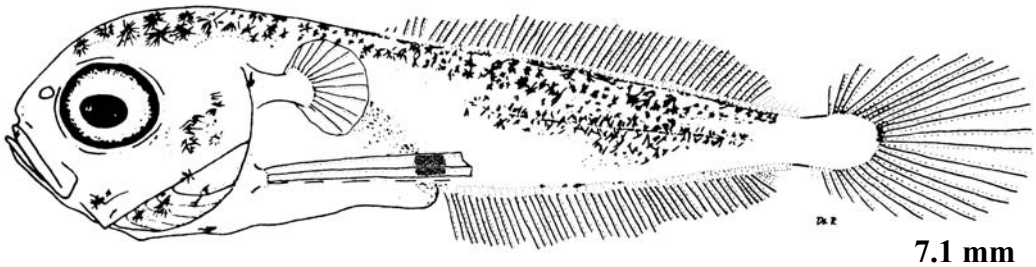
**2.75 mm**

**D**



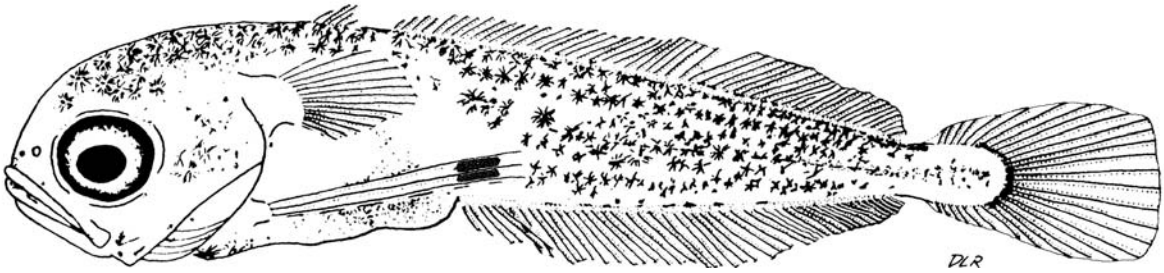
**5.0 mm**

**E**



**7.1 mm**

**F**



**10.7 mm**

## MERISTICS

| | |
|---|---|
| Vertebrae: | |
| Precaudal | 14-15 |
| Caudal | 31-34 |
| Total | 45-48 |
| Number of Fin Rays: | |
| First Dorsal Fin | 8-11 |
| Second Dorsal Fin | 57-68 |
| Anal Fin | 49-60 |
| Caudal Fin | 27-31 |
| Pelvic Fin[a] | 3 |
| Epibranchial Gill Rakers (1st gill arch) | 2 |

[a] Third pelvic-fin ray in adults is rudimentary.

## LIFE HISTORY

Range: Western North Atlantic from Cape Hatteras, North Carolina to the northeastern Gulf of Mexico.
Habitat: Nearshore in waters shallower than 100 m. Generally associated with hard bottoms.
Size: Reaches about 450 mm TL.
ELH Pattern: Oviparous. Pelagic eggs and larvae.
Spawning Season: At least during winter off North Carolina.

## LITERATURE

Boschung 1992; Cohen et al. 1990; Comyns & Grant 1993; Hildebrand & Cable 1938; McEachran & Fechhelm 1998; Svetovidov1948.

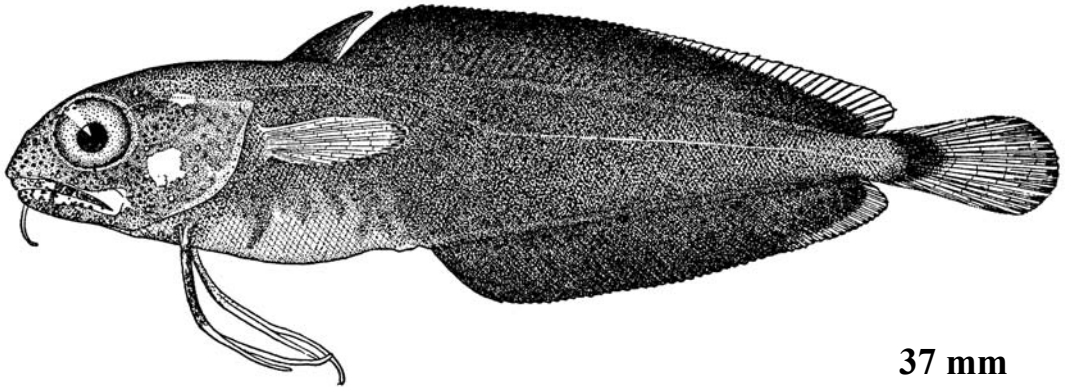
## EARLY LIFE HISTORY DESCRIPTION

**EGGS:** Unknown. However, if similar to other *Urophycis* species, egss are likely to have a diameter of less than one mm, a smooth shell, initially many small droplets which coalesce into one globule, and a homogenous yolk.

**LARVAE:**
Length at Flexion: Unknown, but likely 4 to 5 mm as with other *Urophycis* species.
Sequence of Fin Development: Unknown, but likely same as other *Urophycis* species. $P_2$, $D_2$ & A, $D_1$ & $P_1$.
Pigmentation: Unknown. Juvenile (37 mm) notably darker than other species with almost black fins.
Diagnostic Characters: Distinguished from *U. chesteri*, *U. cirrata*, *U. regia* and *U. chuss* by number of epibranchial gill rakers. Distinguished from *U. tenuis* by number of caudal fin-rays. Most specimens distinguished from *U. floridana* by number of first dorsal fin-rays, abdominal vertebrae, & the interneural space into which projects the pterygiophore supporting the first ray of the second dorsal-fin. Most *U. earlli* (84%, n=32) with <11 first dorsal fin-rays, whereas *U. floridana* (n=45) has ≥11. No *U. earlli* with >11 first dorsal fin-rays, whereas 82% of *U. floridana* has >11. Most *U. earlli* (87%, n=31) with 14 abdominal vertebrae, whereas *U. floridana* (n=48) has ≥15. No *U. earlli* with >15 abdominal vertebrae, whereas 85% of *U. floridana* with this many. In 56% (n=27) of *U. earlli* the pterygiophore that supports the first ray of the second dorsal-fin projects into the 7th interneural space, but in all *U. floridana* (n=42) this pterygiophore is more posterior. Most *U. floridana* (76%) with this pterygiophore posterior to 8th interneural space, but all *U. earlli* with this pterygiophore anterior to this position.

## ILLUSTRATION

From Hildebrand & Cable 1938



**37 mm**

## MERISTICS

Vertebrae:

| | |
|---|---|
| Precaudal | 14-17 |
| Caudal | 30-35 |
| Total | 44-51 |
| Number of Fin Rays: | |
| First Dorsal Fin | 11-13 |
| Second Dorsal Fin | 54-63 |
| Anal Fin | 45-55 |
| Caudal Fin | 28-34 |
| Pelvic Fin[a] | 3 |
| Epibranchial Gill Rakers (1st gill arch) | 2 |

[a] Third pelvic-fin ray in adults is rudimentary.

## LIFE HISTORY

Range: Western North Atlantic from Beaufort, North Carolina, to the northern and western Gulf of Mexico (to about 23° lat).
Habitat: Continental shelf at depths <400 m (most common <300 m). Juveniles utilize estuarine habitat.
Size: Common to 250 mm but reaches 350 mm TL.
ELH Pattern: Oviparous. Pelagic eggs and larvae

## LITERATURE

Boschung 1992; Cohen et al. 1990; Comyns & Grant 1993; Hildebrand & Cable 1938; McEachran & Fechhelm 1998; Svetovidov 1948.

## ILLUSTRATIONS

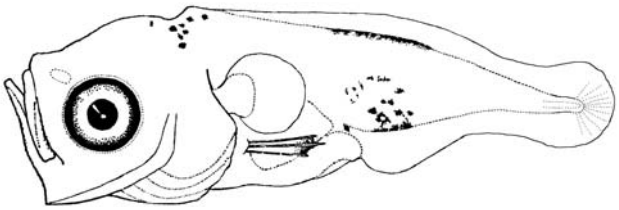
A-B from Hildebrand & Cable 1938 (redrawn)
C-D Original

## EARLY LIFE HISTORY DESCRIPTION

**EGGS:** Unknown. However, if similar to other *Urophycis* species, egss are likely to have a diameter of less than one mm, a smooth shell, initially many small droplets which coalesce into one globule, and a homogenous yolk.

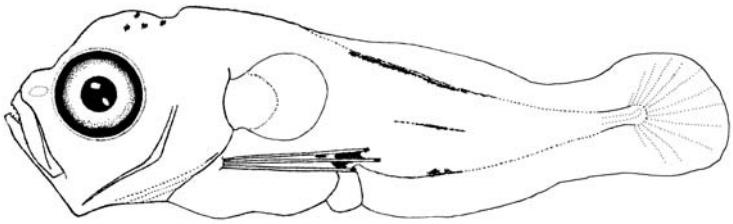
**LARVAE:**
Length at Flexion: Ca. 3.5 mm.
Sequence of Fin Development: $P_2$, $D_2$ & A, $D_1$& $P_1$.
Pigmentation: At 3 mm, melanophores on dorsal surface of head, & on dorsal & ventral body-margins at midbody. Scattered melanophores between pigment along ventral body-margin & the beginning of midline stripe. Distal portion of pelvic-fin membrane pigmented. At 4 mm midline stripe at midbody more distinct, & pigment along ventral body-margin reduced. At 4.3 mm melanophores no longer visible along ventral body-margin, & several melanophores now scattered over nape. Pigment extends ventrally from both midline stripe & dorsal body-margin. Peritoneum over gut heavily pigmented. By 12 mm, melanophores scattered over most of body except immediately posterior to gut, & midline stripe well developed.
Diagnostic Characters: Distinguished from *U. chesteri*, *U. cirrata*, *U. regia* and *U. chuss* by number of epibranchial gill rakers. Distinguished from *U. tenuis* by number of caudal fin-rays. Most specimens distinguished from *U. earlli* by number of first dorsal fin-rays, abdominal vertebrae, and the interneural space into which projects the pterygiophore supporting the first ray of the second dorsal-fin. Most *U. floridana* (82%, n=45) have >11 first dorsal fin-rays, whereas no *U. earlli* (n=32) have this many. *Urophycis floridana* does not have fewer than 11 first dorsal fin rays, whereas most *U. earlli* (84%, n=32) have this few. Most *U. floridana* (85%, n=48) with >15 abdominal vertebrae, whereas no *U. earlli* (n=31) have this many. Most *U. earlli* (87%, n=31) with 14 abdominal vertebrae, whereas *U. floridana* (n=48) has ≥15. In 76% (n=42) of *U. floridana*, the pterygiophore that supports the first ray of the second dorsal fin projects posterior to 8th interneural space, whereas with all *U. earlli* (n=27) this pterygiophore projects into or anterior to the 8th interneural space.

**A**



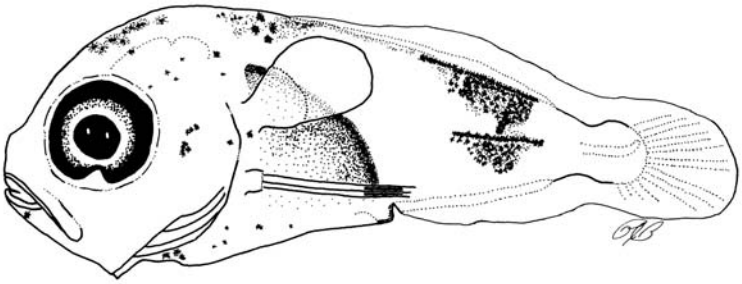
**3 mm**

**B**



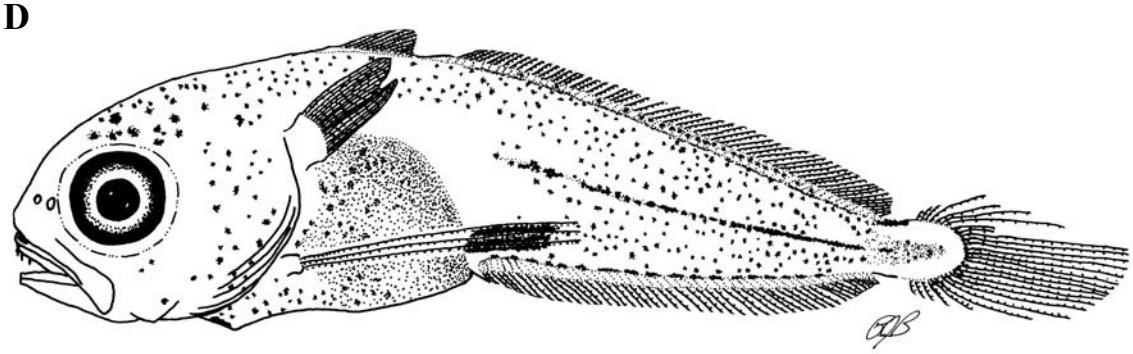
**4 mm**

**C**



**4.3 mm**

**D**



**12.1 mm**

## MERISTICS

| | |
|---|---|
| Vertebrae: | |
| Precaudal | 13-14 |
| Caudal | 30-34 |
| Total | 44-48 |
| Number of Fin Rays: | |
| First Dorsal Fin | 8-10 |
| Second Dorsal Fin | 43-52 |
| Anal Fin | 41-52 |
| Caudal Fin | 28-34 |
| Pelvic Fin[a] | 3 |
| Epibranchial Gill Rakers (1st gill arch) | 3 |

[a] Third pelvic-fin ray in adults is rudimentary.

## LIFE HISTORY

Range: Northwestern Atlantic from New England to the northern Gulf of Mexico. Several rare records from southern Nova Scotia.
Habitat: Demersal, living fom onshore to ca. 420 m, but most abundant between 100 and 200 m. Juveniles utilize estuarine habitat.
Size: Common to 170 mm, but reaches 410 mm.
ELH Pattern: Oviparous. Pelagic eggs and larvae.
Spawning Season: In the Middle Atlantic Bight from late September through November and possibly to February.

## LITERATURE

Barans & Barans 1972; Bigelow & Schroeder 1953; Boschung 1992; Cohen et al. 1990; Fahay 1983; Hildebrand & Cable 1938; McEachran & Fechhelm 1998; Scott & Scott 1988; Serebryakov 1978; Svetovidov 1948.

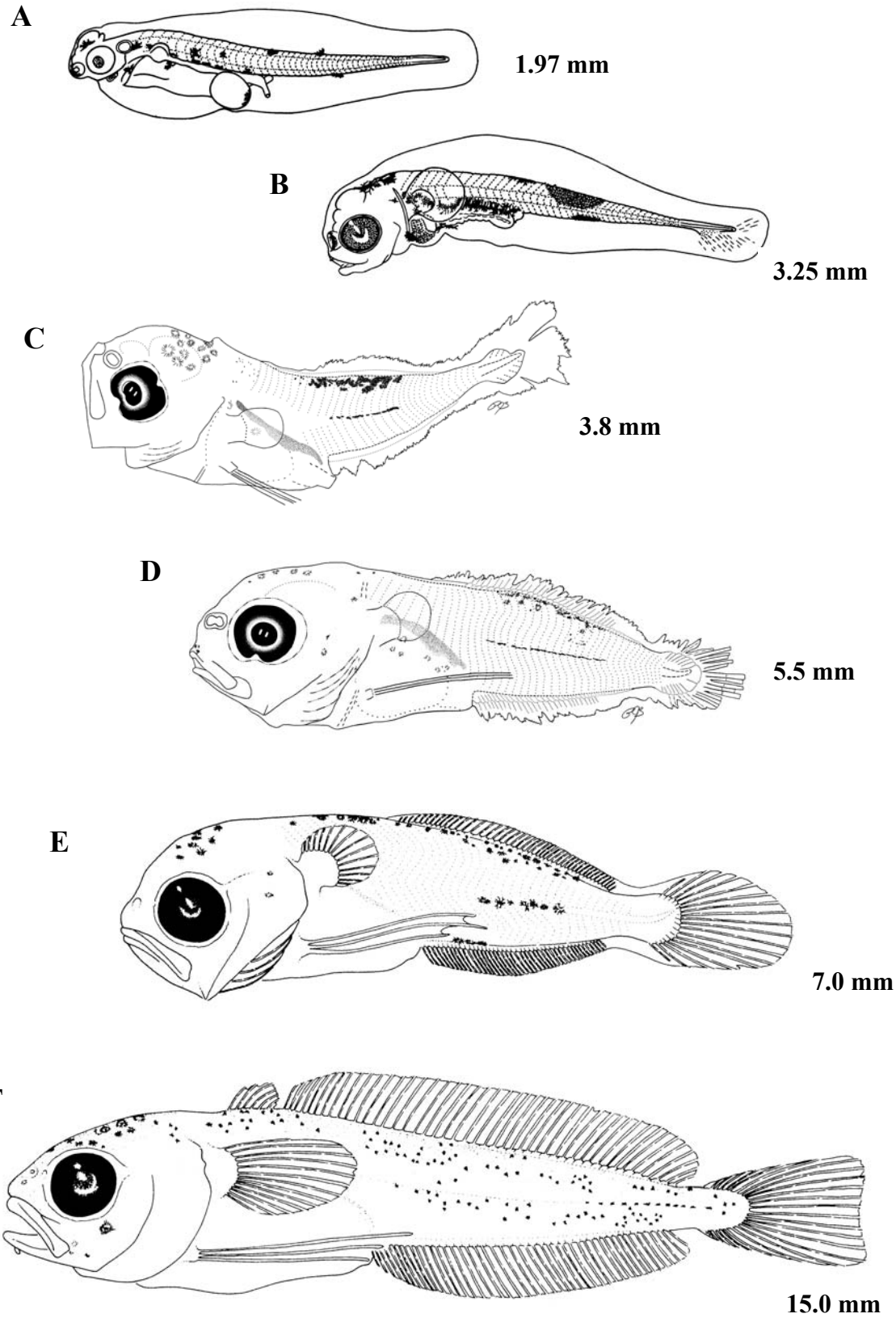
## ILLUSTRATIONS

A-B Serebryakov 1978; C-D Original;
E-F Hildebrand & Cable 1938 (redrawn in Fahay 1983).

## EARLY LIFE HISTORY DESCRIPTION

**EGGS:**
Diameter: 0.67-0.81 mm.
Oil Globules: Initially many small droplets, which coalesce into one globule.
Oil Globule Diameter: After coalescense 0.14-0.22 mm.
Yolk: Homogeneous.
Shell: Smooth.
Hatch Size: 1.5-2.0 mm.

**LARVAE:**
Length at Flexion: Ca. 5 mm.
Sequence of Fin Development: $P_2$, $D_2$ & A, $D_1$ & $P_1$.
Pigmentation: Based on laboratory –reared larvae, at 2.0 mm (10 h after hatch) large melanophore at tip of snout, two melanophores above & between eyes, a dorsal melanophore above the anus, & a dorso- ventral pair of melanophores at midtail. No pigment on nape. By 3.2 mm (4 d after hatch) melanophores previously located above & between eyes have migrated to dorsal surface at rear of head above medulla oblongata. Large dorso-ventral pair of melanophores at midtail with dorsal melanophore extending several myomeres anterior to ventral melanophore. Peritoneum over gut heavily pigmented. By 3.8 mm (field-caught) midline stripe has developed and pigment on dorsal surface above midline and on dorsal surface of head. Ventral melanophore at midline no longer present, & pelvic fins not pigmented. Pigment similar in 7 mm specimen, except pigment now extends along dorsal surface onto nape.
Diagnostic Characters: Early larvae distinguished from *U. chuss* by melanophore at tip of snout. In *U. chuss* dorsal melanophore at midtail is directly above ventral melanophore, whereas in *U. regia* anterior edge of dorsal melanophore at midtail is several myomeres anterior to ventral melanophore. *Urophycis regia* has no dark pelvic-fin pigment, which is present in *U. chuss*, *U. chesteri*, *U. floridana* and *U. tenuis*. Absence of this pigment may be caused by physical stress during net capture. Distinguished from other *Urophycis* species by number of second dorsal-fin rays. Distinguished from *U. chesteri*, *U.earlli*, *U. floridana* and *U. tenuis* by number of epibranchial gill rakers. Distinguished from *U. chesteri* at sizes as small as ca. 4 mm by height of pelvic-fin base expressed as percent of mandible length (see *U. chesteri* section).


A
1.97 mm
B
3.25 mm
C
3.8 mm
D
5.5 mm
E
7.0 mm
F
15.0 mm

## MERISTICS

| | |
|---|---|
| Vertebrae: | |
| Precaudal | [a]13-17 |
| Caudal | 32-35 |
| Total | 47-51 |
| Number of Fin Rays: | |
| First Dorsal Fin | 9-12 |
| Second Dorsal Fin | 50-62 |
| Anal Fin | 41-53 |
| Caudal Fin | 33-40 |
| Pelvic Fin[b] | 3 |
| Epibranchial Gill Rakers (1st gill arch) | 2 |

[a] In material examined from the Middle Atlantic Bight (*n*=205) *U. tenuis* never possessed <15 abdominal vertebrae.

[b] Third pelvic-fin ray in adults is rudimentary.

## LIFE HISTORY

Range: North Atlantic from Iceland, Labrador and the Grand Banks of Newfoundland to North Carolina, straying as far south as Florida in deep water.

Habitat: A demersal species found primarily on the continental shelf and slope. Found over mud bottom most commonly at a depth of approximately 180 m, but extending down to 1000 m. In northern Gulf of Maine adults migrate inshore during summer & move offshore in winter.

Size: Common to 70 cm but reaches approximately 120 cm TL.

Spawning: July to September in shallow water.

ELH Pattern: Oviparous. Pelagic eggs & larvae.

## LITERATURE

Beacham 1983; Bigelow & Schroeder 1953; Cohen et al. 1990; Comyns & Grant 1993; Fahay & Able 1989; Markle et al. 1982; Methven 1985; Musick 1973, 1974; Scott & Scott 1988; Svetovidov1948.

## EARLY LIFE HISTORY DESCRIPTION

**EGGS:** Unknown. However, if similar to other *Urophycis* species, egss are likely to have a diameter of less than one mm, a smooth shell, initially many small oil droplets which coalesce into one globule, and a homogenous yolk.

**LARVAE:**

Length at Flexion: Unknown, but likely 4 to 5 mm as with other *Urophycis* species.

Sequence of Fin Development: Unknown, but likely same as other *Urophycis* species. $P_2$, $D_2$ & A, $D_1$ & $P_1$.

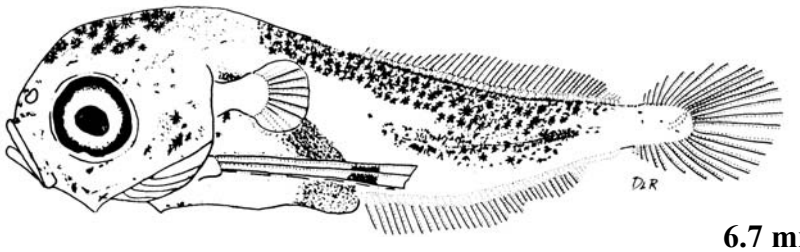
Pigmentation: At 6.7 mm midline stripe is prominent, pigment on dorsal surface of body extends from nape to caudal peduncle, & large melanophores are scattered on dorsal surface of head. Distal portion of pelvic-fin membrane pigmented. By 10.3 mm pigment on lateral surface of body extends below midline, & midline stripe is no longer prominent. Pigment extends onto caudal peduncle. Few melanophores on lateral & ventral surface of gut.

Diagnostic Characters: Species of most concern are *U. chesteri*, *U. chuss* and *U. regia*. Distinguished from *U. chesteri* by number of epibranchial gill rakers, & at sizes as small as 6 mm (and likely smaller) by height of pelvic-fin base expressed as percent of mandible length (see *U. chesteri* section). Distinguished from *U. regia* at sizes as small as ca 4 mm by number of abdominal vertebrae, & at larger sizes by number of caudal & second dorsal fin rays, & number of epibranchial gill rakers. Also distinguished from *U. regia* by presence of pigment on membrane of pelvic fins, but absence of this pigment may be caused by physical stress during net capture. Distinguished from *U. chuss* by number of caudal fin rays & epibranchial gill rakers.

## ILLUSTRATIONS

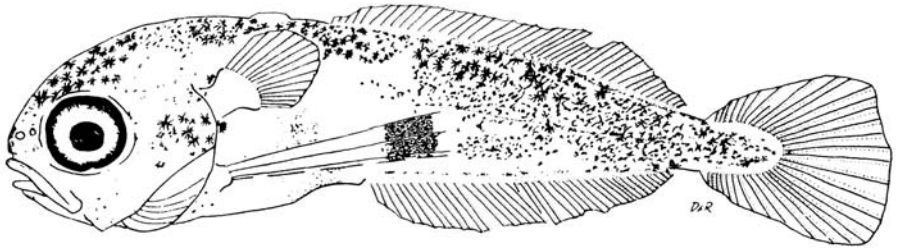
From Methven 1985

**A**



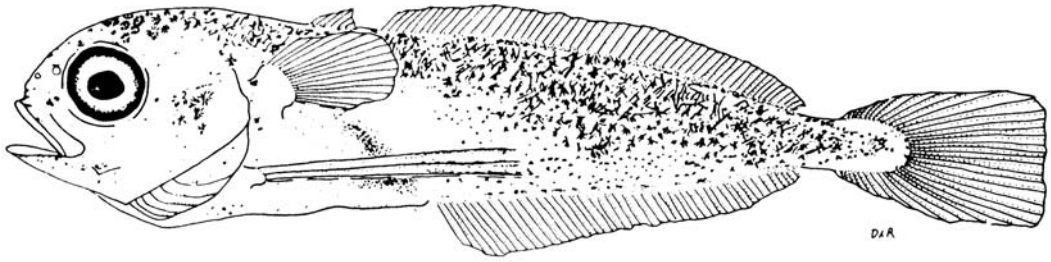
**6.7 mm**

**B**



**10.3 mm**

**C**



**14.9 mm**

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