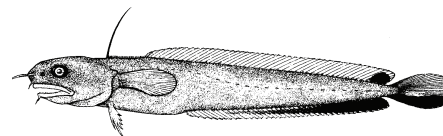


Enchelyopus cimbrius* (Linnaeus, 1776)*Phycidae****Fourbeard rockling**

Range: Coast of North America from Newfoundland to Gulf of Mexico; also southwest Greenland, Iceland and European coast from Bar-ents Sea to Bay of Biscay

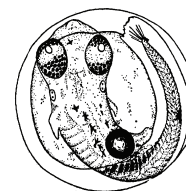
Habitat: Demersal on muddy sand, usually between harder substrates, or soft, silty areas on continental slope, in depths of 20–650 m (mostly 20–50 m) perhaps deeper

Spawning: Year-round with most in May–Sep and a strong peak in Jun; eggs rarely collected south of southern New England waters; most spawning in Gulf of Maine. (Illustrated specimens collected in Long Island Sound.)

Eggs:

- Pelagic, spherical, buoyant, transparent
- Diameter: 0.66–0.98 mm
- Chorion: smooth
- Yolk: homogeneous
- Oil globules: usually single, greenish yellow, diameter 0.13–0.27 mm; sometimes multiple, coalescing to 1
- Perivitelline space: narrow

Preserved eggs tend to float at surface of water



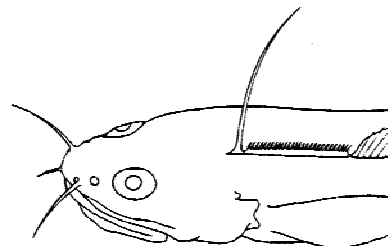
Larvae:

- Hatching occurs at 1.6–2.4 mm
- Late embryo has lightly pigmented eyes and characteristic larval pigment pattern
- Yolk absorbed at about 3.6 mm
- Body stubby anteriorly with long, tapering tail
- Anus opens laterally on finfold (not at margin) in early larvae
- Barbel forms on lower jaw at about 10 mm (3 barbels form on snout during juvenile stage)
- Sequence of fin ray formation: $P_2 - C, D_2, A - D_1, P_1$
- Pigmentation: melanophores on snout and crown; pigment on nape and peritoneal pigment sometimes merge into an oblique swath; band crosses mid-tail, most dense on dorsal and ventral margins; spot at notochord tip disappears when caudal fin rays form; entire pelvic fin pigmented black, persists until transformation when it is restricted to distal part of fin
- Transformation occurs at sizes greater than 20 mm, after development of 1st dorsal fin rays

Note:

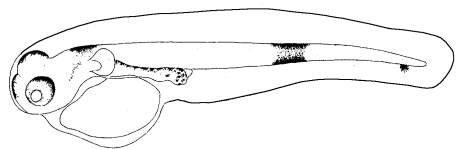
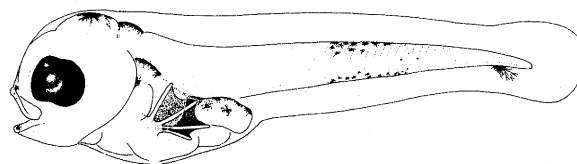
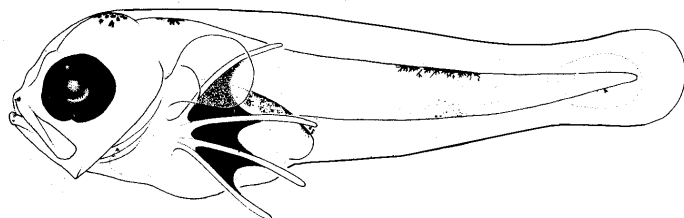
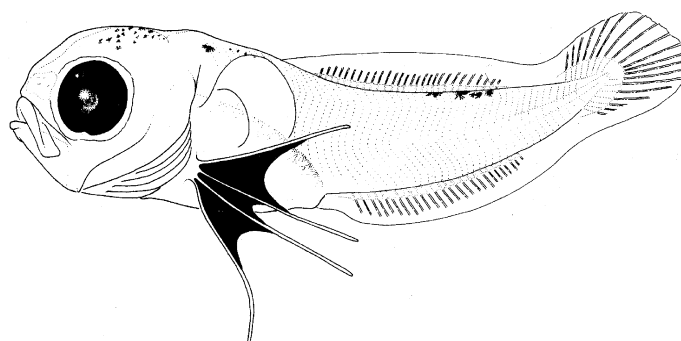
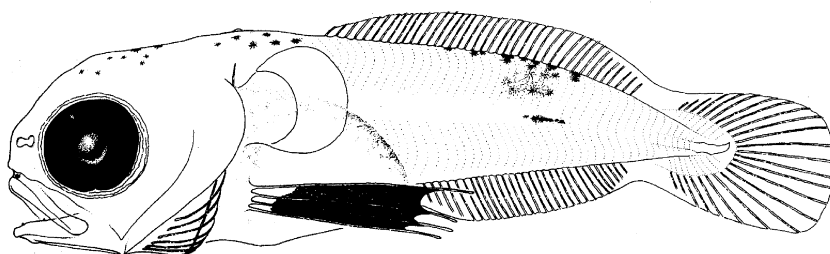
1. Larvae of *Gaidropsarus* are similar to those of *Enchelyopus*, but have prominent posttemporal spines
2. Some recent authors include *Enchelyopus*, *Gaidropsarus* and *Ciliata* in the family Gaidropsaridae, based largely on the structure of the dorsal fin (a single, long ray, followed by a series of short filaments in a groove, followed by a long fin of unspecialized fin rays) and the presence of barbels on the snout (Fig. G).
3. Early larvae of *Urophycis* lack notochord tip pigment and if pigment is present on pelvic fin, it is restricted to tip of fin; also compare structure of 1st dorsal fin and number of pelvic fin rays (4–7 in *Enchelyopus*; 2–3 in *Urophycis*)

G. Dorsal Fin Structure (Adult)

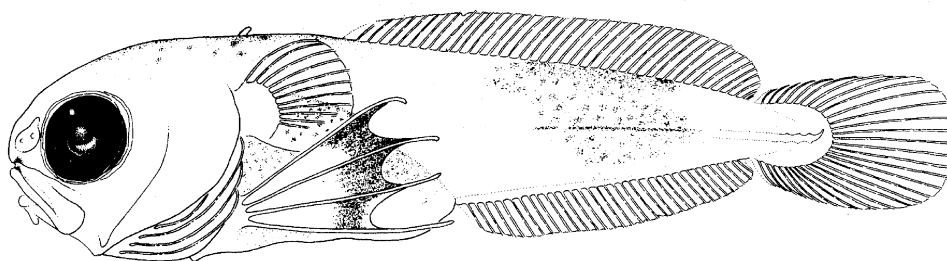


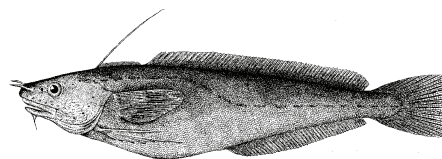
Figures: Adult and G: Cohen and Russo, 1979; Egg: Battle, 1929; A–F: Fahay, 1983

References: Cohen and Russo, 1979; Markle, 1982; Markle and Frost, 1985; Methven, 1985; Berrien and Sibunka, 1999; Iwamoto and Cohen, 2002b

Enchelyopus cimbrius**A. 2.6 mmNL****B. 2.9 mmNL****C. 3.8 mmNL****D. 6.0 mmNL****E. 7.2 mmNL**

Pelvic fin rays increase in number from 4 to 5-7 at transformation;
in the phycid genus *Urophycis*, 3 pelvic fin rays are reduced to 2 at
transformation

**F. 10.3 mmNL**

Gaidropsarus ensis* (Reinhardt, 1837)*Phycidae****Threebeard rockling**

Range: North Atlantic Ocean from Baffin Island and Greenland to Flemish Cap and Scotian Shelf, including deeper parts of Gulf of St. Lawrence; a few records off United States coast, as far south as 39°N

Habitat: Deep-abyssal, at least in southern part of range; occupies depths to 1,500 m, rarely <100 m

Spawning: Undescribed; larvae rarely collected in study area, most often near Newfoundland

Eggs: Undescribed

Larvae:

- Hatching occurs at unknown size; presumably <2.4 mmNL
- Body stubby, with rounded head and snout
- Anus opens laterally on finfold (not at margin) in early larvae
- Preanus length 40–46% NL, increasing to 50–57% SL
- Maximum body depth 26–32% NL decreasing to 20–24% SL
- Barbels form on lower jaw (1) and snout (2) after transformation to juvenile stage (size unknown)
- Pterotic spines form laterally on head in larvae as small as 2.7 mm; visible until 31.0 mm
- Sequence of fin ray formation: $P_2 - C - D_2, A - D_1 - P_1$
- Pelvic fin rays gradually increase in number: 4 at 4 mm; 6 at 8.7 mm; 8–9 at 21.7 mm
- Fin ray ossification in 2nd dorsal and anal fins begins in the middle of the fin
- Pigmentation: early larvae have saddle of pigment on nape, joined to scattered melanophores over gut, and a pronounced band midway along the tail; pigment near tip of pelvic fin begins at about 3.9 mm; at about 8–9 mm, the 2 major accumulations of pigment merge, yielding a dusky over-all appearance with an unpigmented section near the caudal peduncle; later larvae and juveniles have dusky over-all pigment with the caudal peduncle becoming pigmented last
- Transformation occurs at sizes greater than 20 mm, when all fin rays are formed

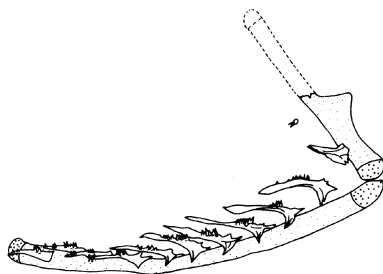
Note: 1. Distinguished from the more rare (and similar) *Gaidropsarus argentatus* (Reinhardt, 1838) by fewer, but less elongate, gill rakers (7–10 + 1 in *G. argentatus*) and one more total vertebra (16–17+35=51–52 in *G. argentatus*). *Gaidropsarus argentatus* occurs from Greenland to Grand Bank; also Iceland to the Faroes in the eastern Atlantic.

2. Some recent authors include *Enchelyopus*, *Gaidropsarus* and *Ciliata* in the family Gaidropsaridae, based largely on the structure of the dorsal fin (a single, long ray, followed by a series of short filaments in a groove, followed by a long fin of unspecialized fin rays) and the presence of barbels on the snout.

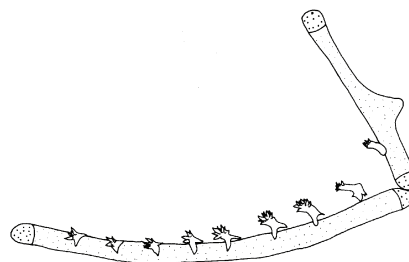
Meristic Characters

Myomeres:	about 52–53
Vertebrae:	16–17+35–36=52–53
Dorsal fin rays:	1, many, 52–64
Anal fin rays:	40–48
Pectoral fin rays:	22–27
Pelvic fin rays:	8–9
Caudal fin rays:	41–46
Gill rakers:	10–11+1–2 (Fig. D)

D: Gill rakers on first gill arch in 2 species of *Gaidropsarus*



Gaidropsarus ensis



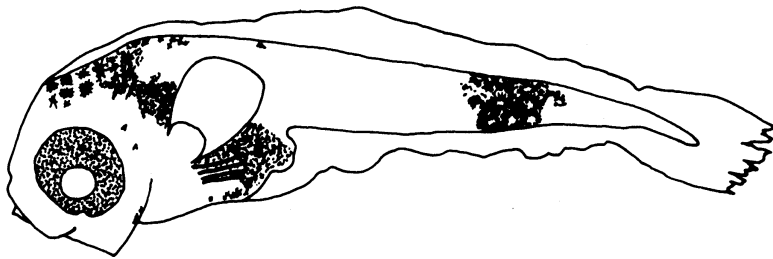
Gaidropsarus argentatus

Figures: Adult: D. R. Harriott (Scott and Scott, 1988); A–D: Markle, 1982

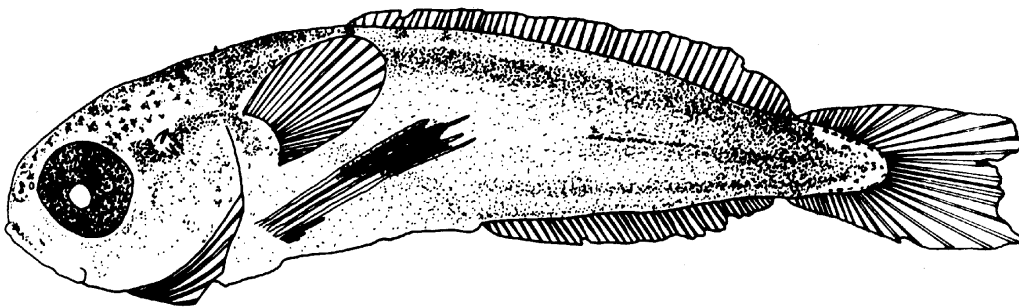
References: Grey, 1956; Markle, 1982; Methven, 1985; Iwamoto and Cohen, 2002b

Gaidropsarus ensis**A. 2.8 mmNL (*Gaidropsarus* sp.)**

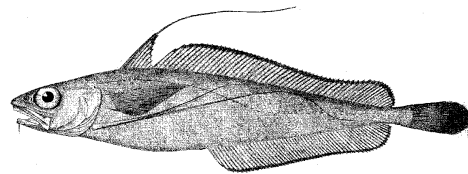
Larvae of *Urophycis* lack pigment on nape merging with pigment over gut

**B. 4.5 mmNL (*Gaidropsarus* sp.)**

Larvae of *Enchelyopus* have prominent melanophore at notochord tip

**C. 17.8 mmSL (*Gaidropsarus ensis*)**

Note: 2 small spines deriving from the pterotic bone are visible in the lateral head region in larvae as small as 2.7 mm and remain visible until about 31.0 mm; no other phycid (or any other gadiform) in present study area has these larval spines. They do, however, occur in eastern Atlantic *Phycis* larvae.

Urophycis chesteri* (Goode and Bean, 1878)*Phycidae****Longfin hake**

Range: Coast of North America from Labrador to Straits of Florida

Habitat: Edge of continental shelf and continental slope; found in depths of 90–1,400 m, mostly 400–800 m; also deep fjords nearshore

Spawning: Oct; larvae rarely collected in study area

Eggs

- (*Urophycis* sp.):**
- Pelagic, spherical
 - Chorion: smooth, clear, colorless
 - Diameter: 0.69–0.76 mm
 - Yolk: homogeneous
 - Oil globule: single, 0.17–0.23 mm in diameter
 - Perivitelline space: narrow

Larvae:

- Length at hatching unknown
- Body stubby, with rounded head and snout in early larvae
- Anus opens laterally on finfold (not at margin) in early larvae
- Preanus length 43–50% TL; body depth at dorsal fin origin 22–28% SL
- Barbel forms on lower jaw after transformation
- Sequence of fin ray formation: $P_2 - C - D_2, A - D_1, P_1$
- Pectoral fin base slightly pedunculate
- Pelvic fin base high on body
- Transformation occurs at sizes greater than 30 mm (pelagic-juvenile stage), when all fin rays are formed
- Pigmentation: early larvae have melanophores scattered over top of head and dorsum of body; few spots on side of head, tip of snout; pigment at tips of pelvic fin rays may form late in development; body liberally covered with melanophores by 11.0 mm

Meristic Characters

Myomeres:	45–52
Vertebrae:	13–16+31–37
Dorsal fin rays:	8–12+50–63
Anal fin rays:	43–54
Pectoral fin rays:	16–18
Pelvic fin rays:	2
Caudal fin rays:	28–36

Note: Eggs of the several species of *Urophycis* are not presently distinguishable. Characters here pertain to eggs collected throughout the year, with a peak in summer and fall

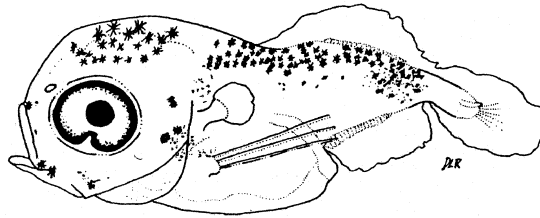
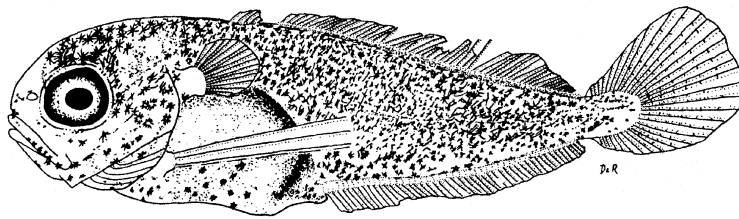
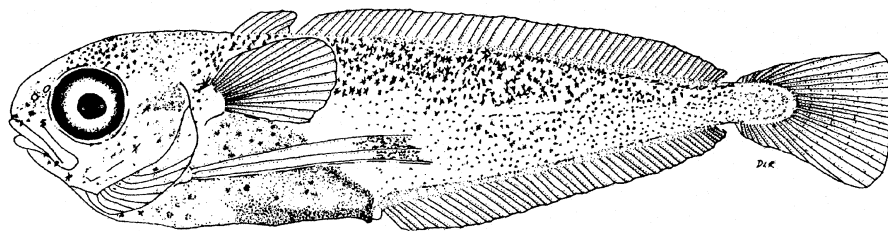
Note: 1. Distinguished from larvae of congeners by high location of pelvic fin base and by deep body (see table); epibranchial gill rakers (4–5) formed by 16–18 mm; (also see table on *Urophycis earlii* page)

Body depth in larvae of *Urophycis chesteri* and other *Urophycis* species:

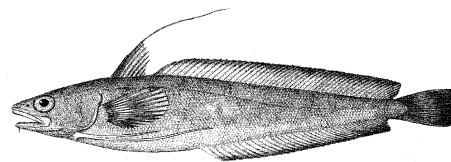
Measurement (% SL)	<i>Urophycis chesteri</i>	<i>Urophycis chuss</i>	<i>Urophycis regia</i>	<i>Urophycis tenuis</i>
Body depth at anus	19–25	15–18	19–25	16–20
Body depth at D_1 origin	22–29	17–23	about 26	19–25
Body depth at D_2 origin	21–30	16–24	25–29	16–24

Figures: Adult: H. L. Todd; A–C: David Ruple (Methven, 1985)

References: Markle, 1982; Wenner, 1983; Fahay and Markle, 1984; Methven, 1985; Methven and McKelvie, 1986; Comyns and Grant, 1993; Comyns and Bond, 2002a

Urophycis chesteri**A. 4.5 mm****B. 11.0 mm****C. 28.9 mm**

Note: This species is referred to the genus *Phycis* by many authors. Two ontogenetic characters, however, support its placement in *Urophycis*: 1) Larval pterotic spines are present in *Gaidropsarus* and eastern Atlantic *Phycis*, absent in all *Urophycis* (including this species); 2) initial pelvic fin ray number is 4 in *Gaidropsarus* and eastern Atlantic *Phycis*, 3 in all *Urophycis* (including this species). Other characters that may be relevant to this discussion include number of predorsal bones and otolith features. See discussions in Markle, 1982; Fahay and Markle, 1984; Methven, 1985; and several papers in Cohen (1989).

Urophycis chuss* (Walbaum, 1792)*Phycidae****Red hake**

Range: Coast of North America from Gulf of St. Lawrence to Cape Hatteras

Habitat: Usually found on muddy substrates, almost never on rock, gravel or shell; adults mostly in depths of 35–130 m (maximum 550 m); young stages in shallower waters

Spawning: Spring-summer into autumn

Eggs

- (*Urophycis* sp.):** – Pelagic, spherical
 – Chorion: smooth, clear, colorless
 – Diameter: 0.69–0.76 mm
 – Yolk: homogeneous
 – Oil globule: single, 0.17–0.23 mm in diameter
 – Perivitelline space: narrow



Yolk-sac Larva

- Larvae:**
- Hatching occurs at 1.8–2.0 mm; eyes unpigmented; body pigment scattered
 - Body stubby, with rounded head and snout
 - Anus opens laterally on finfold (not at margin) in early larvae
 - Preanus length <50% TL; body depth at pelvic fin origin about 25% SL
 - Barbel forms on lower jaw at about 15 mm
 - Sequence of fin ray formation: $P_2, C - A, D_2 - D_1 - P_1$
 - Pectoral fin base slightly pedunculate
 - Pigmentation: early larvae have scattered melanophores on forehead, between eyes, scattered on dorsal and ventral margins of body and on peritoneum; tips of pelvic fin rays pigmented by about 3.0 mm; pair of bars on tail equidistant in anterior-posterior extent; midline streak of pigment appears by about 5.0 mm, eventually spreads over much of body
 - Transformation occurs at sizes greater than about 20 mm (pelagic-juvenile stage), when all fin rays are formed

Note: 1. Distinguished from *U. regia* by pelvic fin pigment, 2nd dorsal fin rays, mean vertebral count; from *U. tenuis* by epibranchial gill raker count, caudal fin ray count, mean vertebral count; from *U. chesteri* by epibranchial gill raker count and location of pelvic fin origin (see table on *Urophycis earlii* page).

Early Juvenile: Descent to bottom habitats occurs at about 35–40 mm, usually during late summer or fall (Fig. G). After descent, the body shape thickens, pigment more resembles adults, and the pelvic fin rays are reduced to 2, lose pigment at their tips and begin to be deployed in a forward orientation. Early settlers utilize shelter, especially scallops (*Placopecten magellanicus*) where they live within the mantles. They leave this inquiline association in late winter or early spring after reaching lengths of 90–116 mm.

Meristic Characters

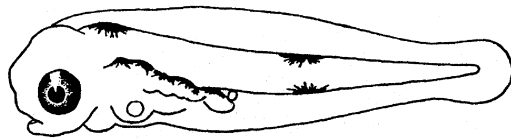
Myomeres:	45–51
Vertebrae:	14–17+33–36=45–51
Dorsal fin rays:	9–12+52–64
Anal fin rays:	45–57
Pectoral fin rays:	14–17
Pelvic fin rays:	2 (adults)
Caudal fin rays:	28–34

Note: Eggs of the several species of *Urophycis* are not presently distinguishable. Characters here pertain to eggs collected throughout the year, with a peak in summer and fall

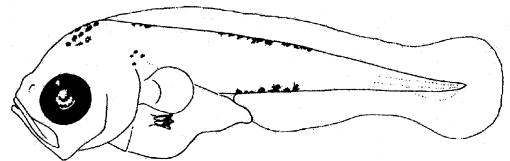
Figures: Adult: H. L. Todd; Yolk-sac larva and **A**: Miller and Marak, 1959 (redrawn); **B, C, E**: Hildebrand and Cable, 1938 (redrawn); **D, F**: David Ruple (Methven, 1985); **G**: Susan Kaiser (Able and Fahay, 1998)

References: Markle, 1982; Fahay and Markle, 1984; Methven, 1985; Comyns and Grant, 1993; Able and Fahay, 1998; Comyns and Bond, 2002a

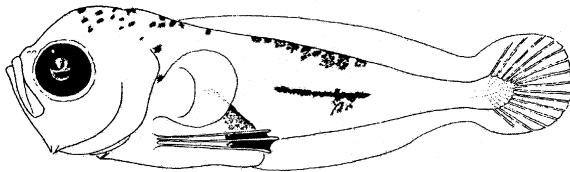
Urophycis chuss



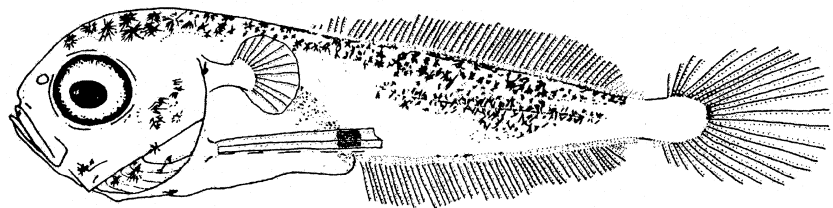
A. 2.2 mm



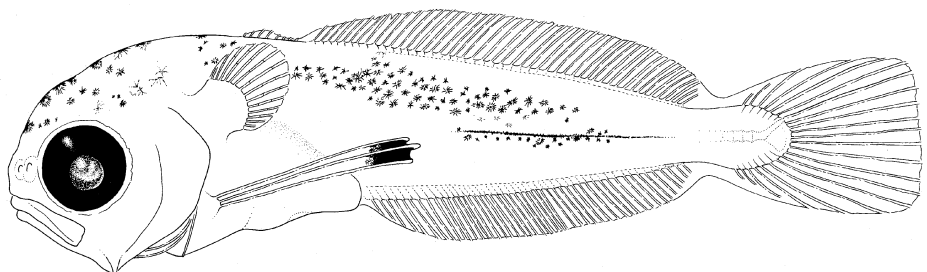
B. 2.75 mm



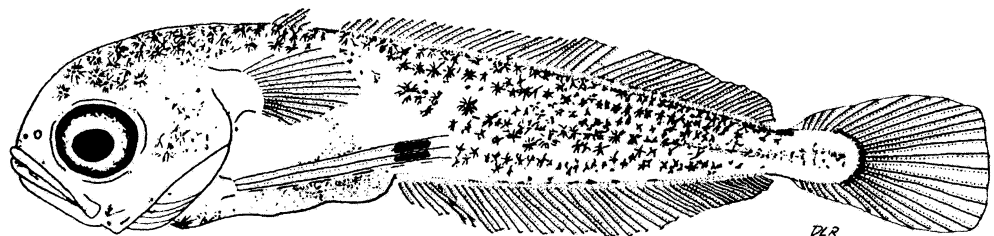
C. 5.0 mm



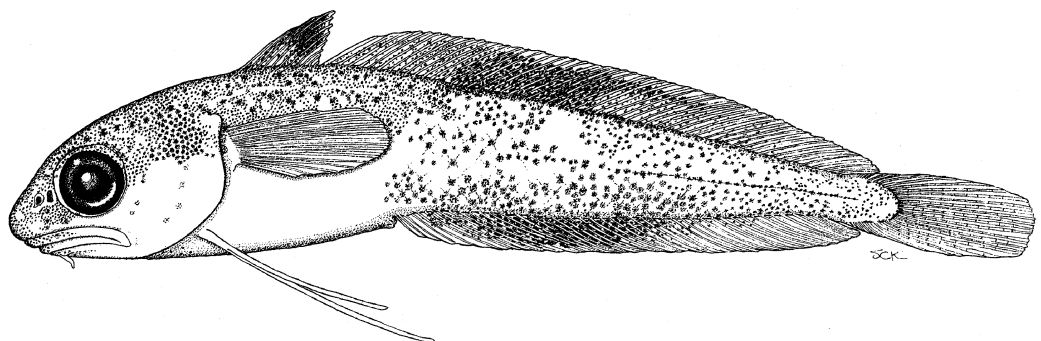
D. 7.1 mm



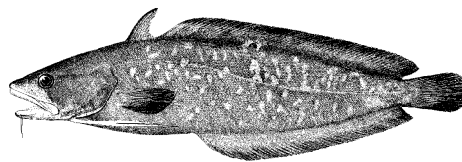
E. 9.5 mm



F. 10.7 mm



G. 35.0 mmSL
(Juvenile)

Urophycis earlii* (Bean, 1880)*Phycidae****Carolina hake**

Range: Coast of United States between Cape Hatteras and northeast Florida; also northeast Gulf of Mexico

Habitat: Hard substrates from nearshore to a depth of about 81 m

Spawning: Winter off North Carolina; possibly more prolonged; not well described

Eggs:

- (*Urophycis* sp.):**
- Pelagic, spherical
 - Chorion: smooth, clear, colorless
 - Diameter: 0.69–0.76 mm
 - Yolk: homogeneous
 - Oil globule: single, 0.17–0.23 mm in diameter
 - Perivitelline space: narrow

Larvae:

- Undescribed
- Pigmentation in juveniles is considerably darker than in comparably sized congeners; fins almost entirely black, with clear, unpigmented posterior corners; remnants of pigment on pelvic fins may indicate that earlier stages have pigmented pelvic fin ray tips

Note:

1. Distinguished from young stages of most congeners by epibranchial gill raker count (2); from *Urophycis tenuis* by total caudal fin ray count (also see table on opposite page)
2. Young stages have not been collected in study area, but winter collections in the Slope Sea or Gulf Stream might be expected to yield specimens of this species.

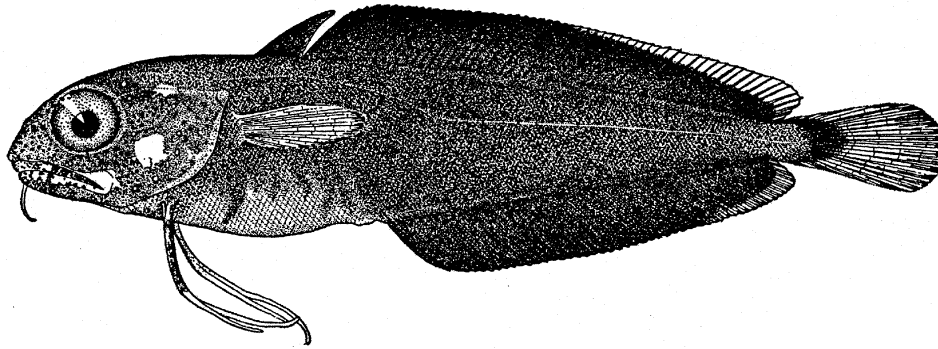
Meristic Characters

Myomeres:	45–48
Vertebrae:	14–15+31–34=45–48
Dorsal fin rays:	8–11+57–68
Anal fin rays:	49–60
Pectoral fin rays:	–
Pelvic fin rays:	2
Caudal fin rays:	27–31

Note: Eggs of the several species of *Urophycis* are not presently distinguishable. Characters here pertain to eggs collected throughout the year, with a peak in summer and fall

Figures: Adult: Jordan and Evermann, 1896–1900; A: Hildebrand and Cable, 1938

References: Comyns and Grant, 1993; Comyns and Bond, 2002a

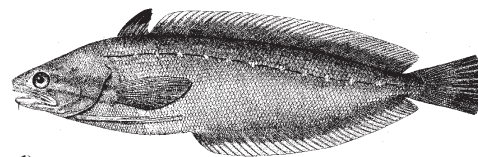
Urophycis earlii

**A. 37.0 mm
(Juvenile)**

Best characters for distinguishing the larvae of *Urophycis* spp. *Urophycis regia* larvae lack pigment on pelvic fin rays; other species acquire this pigment at some point in ontogeny (except nature of this character is unknown for larval *Urophycis cirrata*).

	Epibranchial Gill Rakers	Vertebrae (Mode)	Caudal Fin Rays	Dorsal Fin Rays	Anal Fin Rays
<i>U. chesteri</i>	4–5	13–16+34–36	28–35	8–12+50–63	43–54
<i>U. chuss</i>	3	14–17+32–36 (15+34)	28–34	9–12+52–64	45–57
<i>U. cirrata</i> ¹	3	15–17+32–37	<35	≤12+>53	46–58
<i>U. earlii</i>	2	14–15+31–34	27–31	8–11+57–68	49–60
<i>U. floridana</i> ¹	2	14–17+30–35	28–34	11–13+54–63	45–55
<i>U. regia</i>	3	13–14+31–35 (14+33)	30–33	8–10+43–52	41–50
<i>U. tenuis</i>	2	15–16+32–35 (16+34)	33–39	9–12+51–62	45–53

¹ The only published records of any life history stage of these species occurring in the study area concern pelagic-juveniles (Comyns and Grant, 1993). These authors reported collections near the edge of the continental shelf off New Jersey and Virginia, where *Urophycis cirrata* (n=5) were in the length range 20–42 mmSL, and *Urophycis floridana* (n=41) were 13–32 mmSL. All occurrences were during Feb and Mar and almost all specimens were collected in a neuston net. Early stages of *Urophycis cirrata* are undescribed. Larvae of *Urophycis floridana* are described and illustrated in Comyns and Bond (1996).

Urophycis regia* (Walbaum, 1792)*Phycidae****Spotted hake**

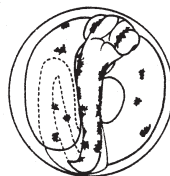
Range: Coastal United States from southern New England (Cape Cod) to Atlantic coast of Florida; also northeast Gulf of Mexico

Habitat: Demersal from nearshore to a depth of 420 m, mostly 110–185 m; often seen buried in sandy substrates; young stages enter estuaries

Spawning: Summer into winter; different size groups may spawn at different times of year, resulting in apparent bimodal pattern

Eggs:

- Pelagic, spherical
- Chorion: smooth, clear, colorless
- Diameter: 0.67–0.81 mm
- Yolk: homogeneous (pigmented)
- Oil globule: single, 0.14–0.22 mm in diameter (after 6–30 smaller oil globules coalesce)
- Perivitelline space: narrow

**Meristic Characters**

Myomeres: 44–48
 Vertebrae: 13–14+30–34=44–48
 Dorsal fin rays: 8–10+43–52
 Anal fin rays: 41–52
 Pectoral fin rays: 16
 Pelvic fin rays: 2
 Caudal fin rays: 30–33

Larvae:

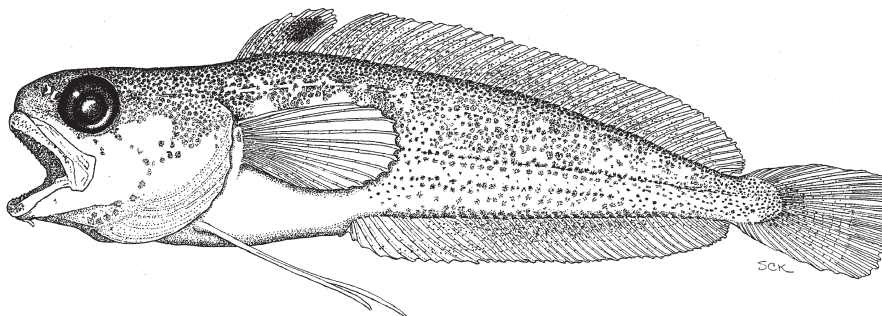
- Hatching occurs at 1.5–2.0 mm; eyes unpigmented
- Body stubby, with rounded head and snout
- Anus opens laterally on finfold (not at margin) in early larvae
- Preanus length 50–55% SL; body depth at pelvic fin origin about 30% SL
- Barbel forms on lower jaw at about 15 mmSL
- Sequence of fin ray formation: $P_2 - C, D_2, A - D_1, - P_1$
- Pectoral fin base slightly pedunculate
- Pigmentation: early larvae have pigment at tip of snout (compare to *Urophycis chuss*) plus top of head; peritoneal pigment dense; dorsal patch on body slightly anterior to ventral patch; pelvic fin pigment absent; midline streak forms at about 3.8 mm
- Transformation occurs at sizes greater than 20 mm (pelagic-juvenile stage), when all fin rays are formed

Note: Eggs of the several species of *Urophycis* are not presently distinguishable. Characters here pertain to eggs described by Barans and Barans (1972), based on *U. regia*

Note: 1. Distinguished from congeners by unpigmented pelvic fins (also see table on *U. earlii* page)

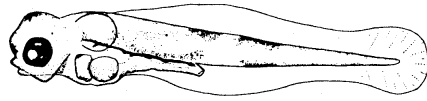
Early Juvenile: Descend to bottom habitats at 25–30 mm (rarely as large as 70 mm); some (not all) enter estuaries as early as Oct, others ingress Feb–Mar; penetrate low salinity areas and return to ocean in May, rarely remain as late as Jun

G. 39.0 mmSL

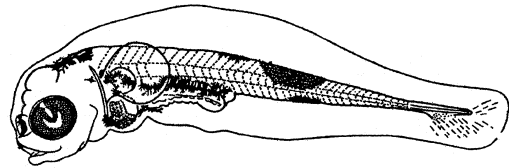
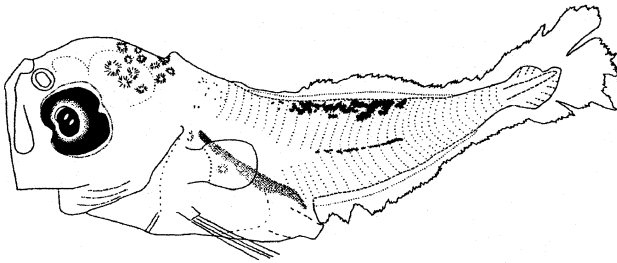
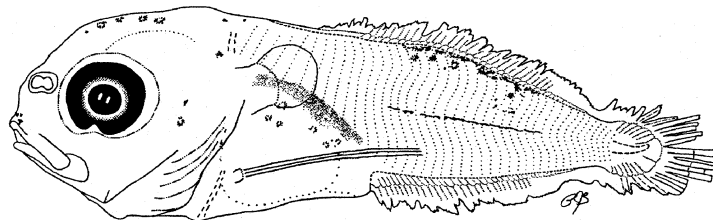
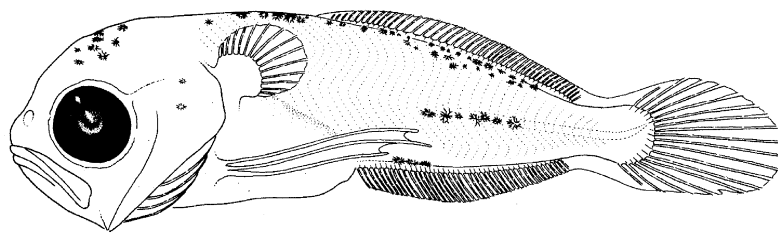


Figures: Adult: H. L. Todd; egg and **A**: Barans and Barans, 1972; **B**: Serebryakov, 1978; **C–D**: Comyns and Bond, 2002a; **E–F**: Hildebrand and Cable, 1938 (redrawn); **G**: Susan Kaiser (Able and Fahay, 1998)

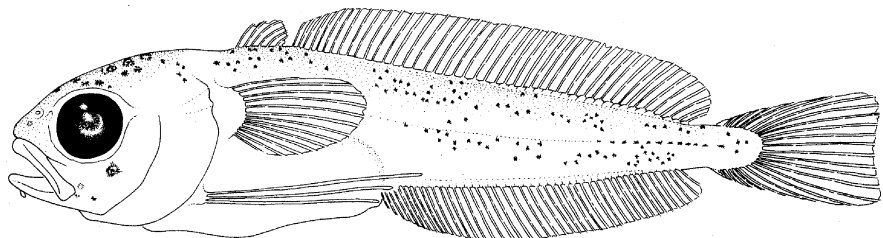
References: Barans and Barans, 1972; Fahay, 1987; Able and Fahay, 1998; Comyns and Bond, 2002a

Urophycis regia**A. 2.0 mm**

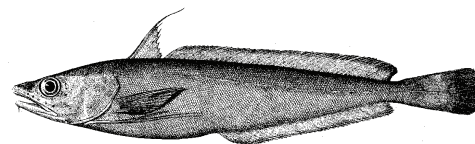
Note pair of dorsal pigment patches
and single ventral patch in early larvae

**B. 3.25 mm****C. 3.8 mm****D. 5.5 mm****E. 7.0 mm**

Dorsal and anal fin rays
longer than in comparably
sized *Urophycis chuss* larvae

**F. 15.0 mm**

Pigment in larger larvae includes large melanophores overlying a field of smaller spots

Urophycis tenuis* (Mitchill, 1814)*Phycidae****White hake**

Range: Coast of North America from southern Labrador and Grand Bank to Cape Hatteras, with isolated occurrences in deeper water off Florida

Habitat: Demersal on soft, muddy bottoms, mostly in depths of 27–110 m or more; juveniles somewhat shallower than adults; all move inshore during summer, offshore during winter

Spawning: Spring on continental slope off United States; summer-fall in Canadian populations

Eggs:

- Pelagic, spherical
- Chorion: smooth, clear, colorless
- Diameter: 0.70–0.79 mm
- Yolk: homogeneous
- Oil globule: single, 0.19–0.28 mm in diameter
- Perivitelline space: narrow

Larvae:

- Hatching size unknown
- Body stubby, with rounded head and snout
- Anus opens laterally on finfold (not at margin) in early larvae
- Preanus length 41–52% SL; body depth at pelvic fin origin 24–29% SL
- Barbel forms on lower jaw during pelagic-juvenile stage
- Sequence of fin ray formation probably similar to other *Urophycis*: $P_2 - D_2, A, C - D_1 - P_1$
- Pectoral fin base slightly pedunculate
- Pigmentation: prominent melanophores occur on top of head, along dorsum of much of the body, and in a heavy midline streak; pelvic fin ray tips densely pigmented
- Transformation occurs at sizes greater than 20 mm (pelagic-juvenile stage), when all fin rays are formed

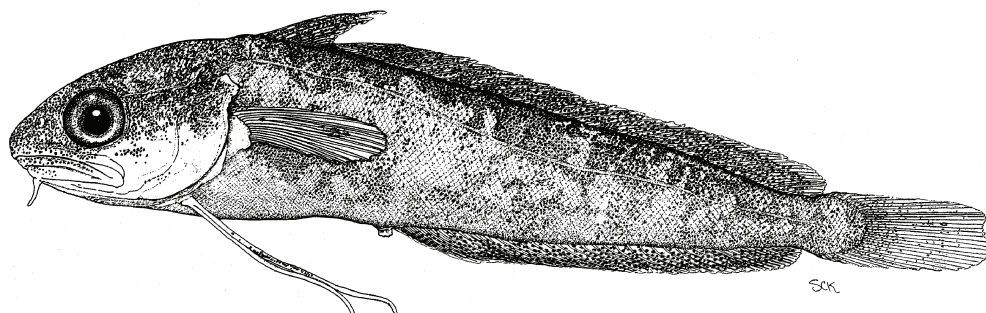
Note: 1. Distinguished from congeners by epibranchial gill raker count (2) and other meristic characters, especially total caudal fin ray counts (also see table on *Urophycis earlii* page)

Early Juvenile: After a pelagic-juvenile stage (sizes up to about 50 mmSL), young-of-the-year enter estuaries, usually in Jun–Jul, settle to the bottom, and remain until fall, when they return to the ocean.

Meristic Characters

Myomeres:	47–51
Vertebrae:	15–16+32–35=47–51
Dorsal fin rays:	9–12+51–62
Anal fin rays:	45–53
Pectoral fin rays:	16
Pelvic fin rays:	2
Caudal fin rays:	33–39

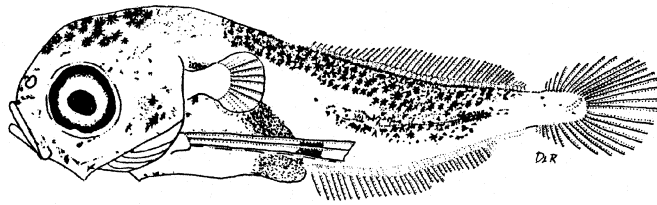
Note: Eggs of the several species of *Urophycis* are not presently distinguishable. Characters here are from Markle and Frost (1985), based on artificially fertilized eggs.

**D. 55.0 mmSL**

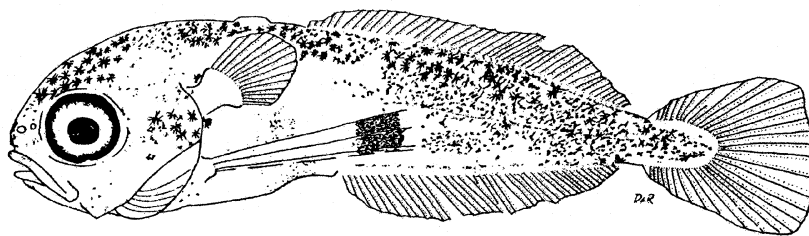
Figures: Adult: H. L. Todd; A–C: Dave Ruple (Methven, 1985); D: Susan Kaiser (Able and Fahay, 1998)

References: Methven, 1985; Markle and Frost, 1985; Fahay and Able, 1989; Able and Fahay, 1998

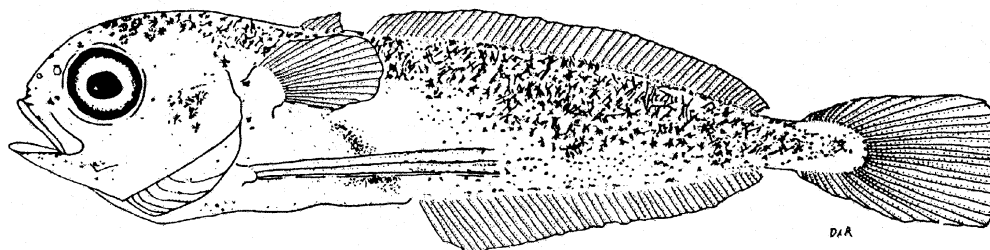
Urophycis tenuis



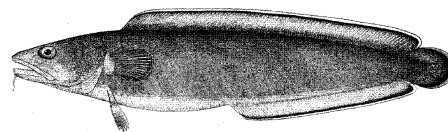
A. 6.7 mm



B. 10.3 mm



C. 14.9 mm

Brosme brosme* (Ascanius, 1772)*Lotidae****Tusk (or cusk)**

Range: Western North Atlantic Ocean from Strait of Belle Isle and Grand Bank to New Jersey; rarely southern tip of Greenland; also eastern Atlantic

Habitat: Usually on rock, gravel or pebbly bottoms, occasionally on mud, seldom on smooth sandy bottoms; at depths of 18–549 m; tolerates bottom temperatures of 0–10°C

Spawning: Mar–Nov (most abundant late spring to summer) in Gulf of Maine and Georges Bank; eggs rarely found south of Georges Bank, although a few occasionally occur near canyons at shelf edge

Eggs:

- Pelagic, spherical, coppery tint
- Diameter: 1.09–1.44 mm
- Chorion: enlarged pits visible with light microscopy (and 2 small pits within each large pit)
- Oil globule: single, 0.20–0.46 mm in diameter, brownish to pinkish
- Yolk: homogeneous
- Perivitelline space: narrow

Larvae:

- Hatching occurs at about 4.0 mm; oil globule posterior in yolk, little eye pigment, bold pigment pattern
- Yolk absorbed at about 5.0 mm
- Body elongate and tapered, with short, blunt, round snout
- Barbel forms on lower jaw at about 37.0 mm
- Sequence of fin ray formation: $P_2 - C, D, A - P_1$
- 3 pelvic fin rays form at about 6.0 mm, not connected by membrane, middle ray shortest; 2 additional rays sometimes visible medially
- Caudal, dorsal and anal fin rays begin formation at about 12.5 mm, complete by 28 mm
- Pigmentation includes melanophores on top of head, peritoneum, and body margin over gut; 2 prominent bands on tail, each paired or constricted at midline; prominent pigment at end of notochord on finfold or fin rays; pelvic fin rays densely pigmented on distal portion
- Transformation occurs at about 40 mm

Note: 1. Early eggs similar to those of *Scomber scombrus*, separable by enlarged chorion pits in *Brosme brosme* eggs; early larvae superficially similar to larvae of *Lophius americanus*

Meristic Characters

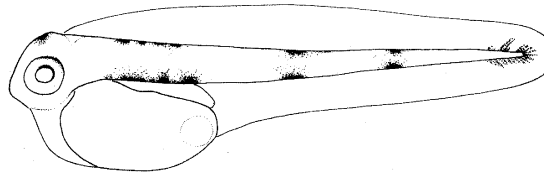
Myomeres:	64–66
Vertebrae:	64–66
Dorsal fin rays:	85–105
Anal fin rays:	71–76
Pectoral fin rays:	22–24
Pelvic fin rays:	4–5
Caudal fin rays:	45–48

Figures: Adult: H. L. Todd; **A–B; D–E:** Schmidt, 1905b (redrawn); **C:** Bev Vinter (Dunn and Matarese, 1984)

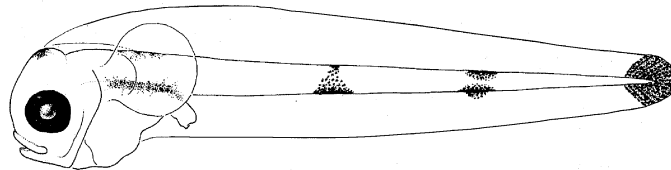
References: Fahay and Markle, 1984; Markle and Frost, 1985; Scott and Scott, 1988; Klein-MacPhee, 2002d

Brosme brosme

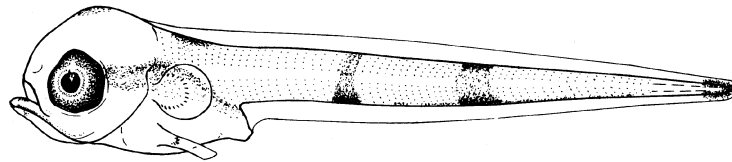
A. 4.0 mm



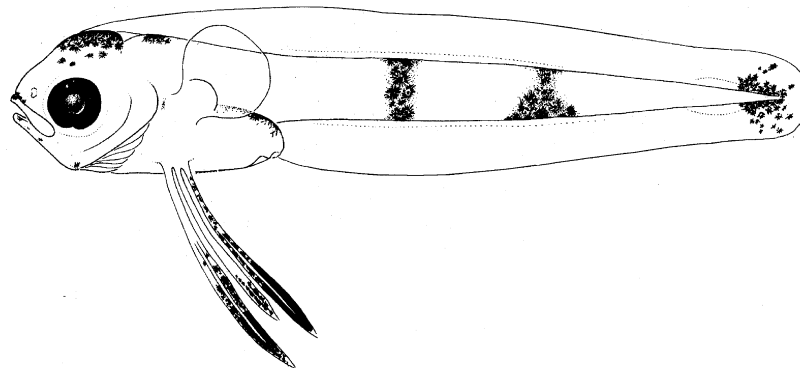
B. 5.0 mm



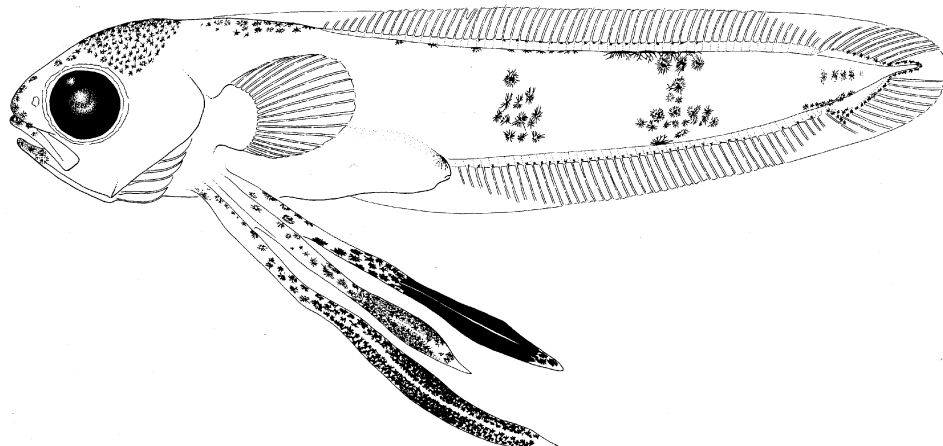
C. 5.9 mmSL

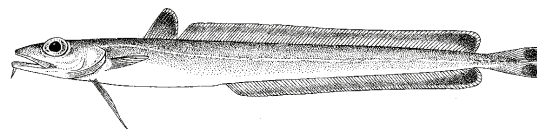


D. 11.0 mm



E. 14.0 mm



Molva dipterygia* (Pennant, 1784)*Lotidae****Blue ling**

Range: Primarily eastern Atlantic Ocean from Spitsbergen, Barents Sea and Iceland to Mediterranean Sea; also southeastern Greenland and off Newfoundland

Habitat: Muddy bottoms in depths of 150–1,000 m, mostly 350–500 m

Spawning: Apr–May

Eggs: – Undescribed

Larvae:

- Hatching occurs at unknown size
- Body elongate with large head, elongate pelvic fin rays
- Anus opens laterally on finfold (not at margin) in early larvae
- Preanus length 40–45% NL
- Body depth at pelvic fin origin <20% NL
- Barbel forms on lower jaw at 20–36 mm
- Sequence of fin ray formation: $P_2 - C - D_2, A - D_1 - P_1$
- Small larvae have 3 pelvic fin rays; more added during transformation
- Transformation occurs at sizes greater than 30 mm
- Pigmentation: early larvae have pigment clusters on top of head, on pelvic fin rays, and in 2 bars across tail; a third bar forms at base of caudal fin; later stages become heavily banded with pigment that extends onto dorsal and anal fins; pelvic fin rays pigmented

Meristic Characters

Myomeres: about 72–78

Vertebrae: 72–78

Dorsal fin rays: 11–15+69–83

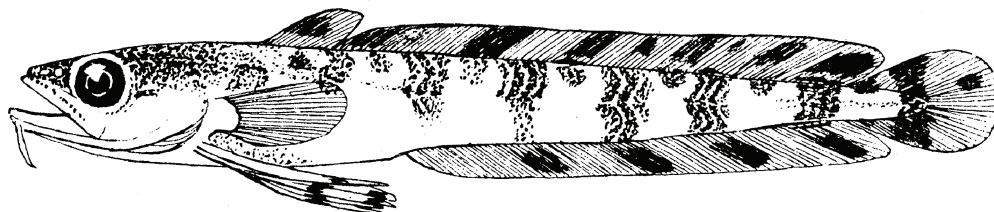
Anal fin rays: 62–75

Pectoral fin rays: 18–21

Pelvic fin rays: 6–7

Caudal fin rays: –

Note: 1. Distinguished from *Molva molva* by boldly barred appearance, more anal fin rays

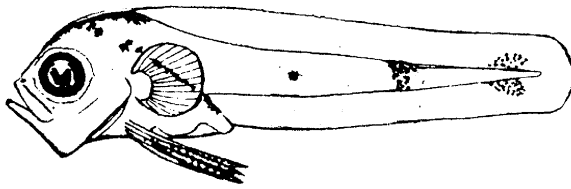
Early Juvenile:

G. 78.5 mm

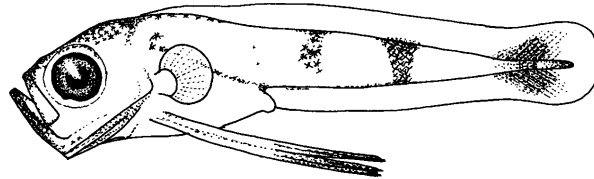
Figures: Adult: Cohen *et al.*, 1990; **A, C, E–G:** Schmidt, 1906b (redrawn in Ehrenbaum, 1909); **B, D:** Schmidt, 1906b (redrawn by Birgitte Rubæk in Munk and Nielsen, 2005)

References: Schmidt, 1906b; Russell, 1976; Scott and Scott, 1988; Fahay and Markle, 1984

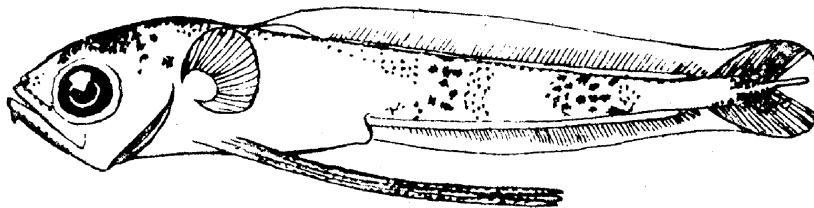
Molva dipterygia



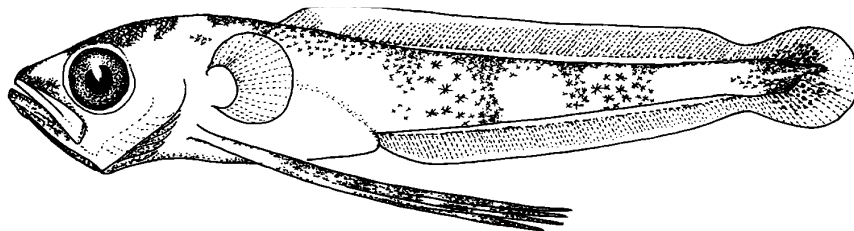
A. 6.0 mm



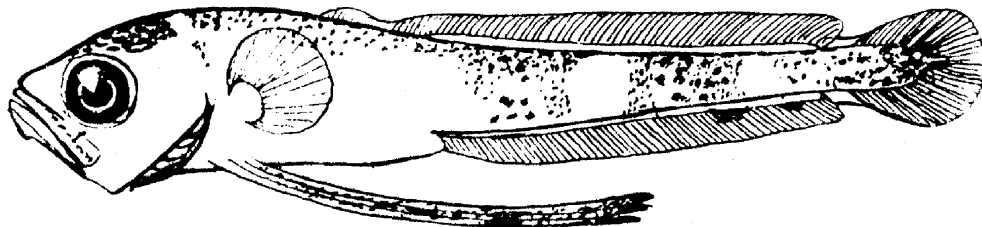
B. 8.5 mm



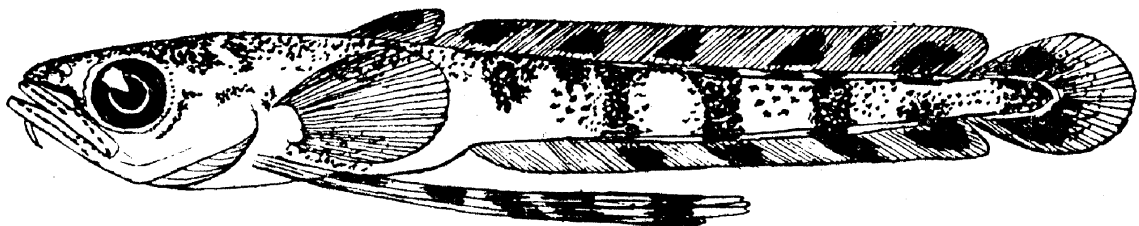
C. 16.0 mm



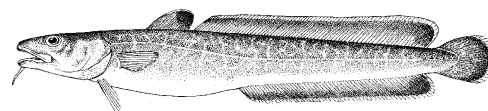
D. 18.5 mm



E. 19.8 mm



F. 36.5 mm

Molva molva* (Linnaeus, 1758)*Lotidae****Ling**

Range: Primarily eastern Atlantic Ocean from Barents Sea and Iceland to and including Mediterranean Sea; more rarely off southern Greenland and Newfoundland

Habitat: Demersal on rocky substrates; found in depths of 15–600 m, mostly 100–400m

Spawning: Mar–Jul

Eggs:

- Pelagic, spherical
- Diameter: 0.97–1.13 mm
- Yolk: homogeneous
- Oil globule: single, pigmented, 0.28–0.31 mm in diameter
- Perivitelline space: narrow

**Meristic Characters**

Myomeres:	about 62–67
Vertebrae:	62–67
Dorsal fin rays:	13–16+57–70
Anal fin rays:	55–67
Pectoral fin rays:	18–21
Pelvic fin rays:	6–7
Caudal fin rays:	22–23+5+3+25

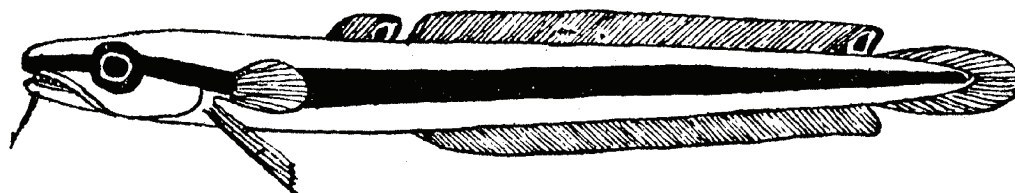


Larvae:

- Hatching occurs at 3.2 mm, eye unpigmented, mouth unformed
- Body elongate, head large, elongate pelvic fin rays
- Anus opens laterally on finfold (not at margin) in early larvae
- Preanus length 45% NL, increases to about 50% NL
- Body depth at pelvic fin origin about 20% NL
- Barbel forms on lower jaw after transformation to juvenile stage
- Sequence of fin ray formation: $P_2 - C - D_2, A - D_1 - P_1$
- Pelvic fin rays form early, 3 rays at about 5.0 mm, followed by an additional ray at about 11 mm, 14 mm, and 18.5 mm
- Transformation occurs at sizes greater than 20 mm (pelagic-juvenile stage), when all fin rays are formed
- Pigmentation: at hatching, a dorsal row of pigment entire length of body and a ventral row from anus to near end of body (these melanophores often expanded); 2 pairs of bars on tail in small larvae merge to form bands; midline pigment begins as few spots between each pair of bars at about 7.0 mm, spreading along much of flank at about 15 mm; pigment on top of head and on nape; pelvic fin membrane pigmented; a bar of pigment forms from snout through eye at about 18.0 mm

Note: 1. Distinguished from *Molva dipterygia* by less barred appearance, fewer anal fin rays; larger larvae and juveniles develop longitudinal stripe through snout, across opercle, and along body

Early Juvenile: Young fish usually found in shallow, coastal waters, 15–20 m

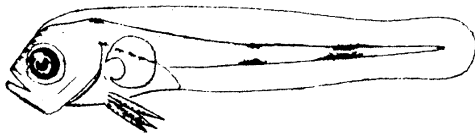


H. 79 mm

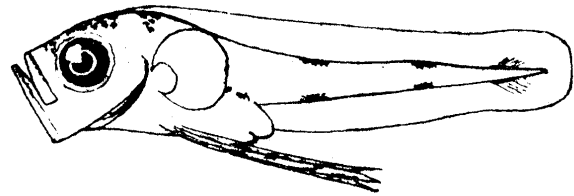
Figures: Adult: Cohen *et al.*, 1990; **A–B, D, F–G:** Schmidt, 1906b (redrawn in Ehrenbaum, 1909); **C:** Betsy Washington (Dunn and Matarese, 1984); **E:** Schmidt, 1906b (redrawn by Birgitte Rubæk in Munk and Nielsen, 2005); **H:** McIntosh and Masterman, 1897 (redrawn in Ehrenbaum, 1909)

References: Schmidt, 1906b; Russell, 1976; Dunn and Matarese, 1984; Fahay and Markle, 1984

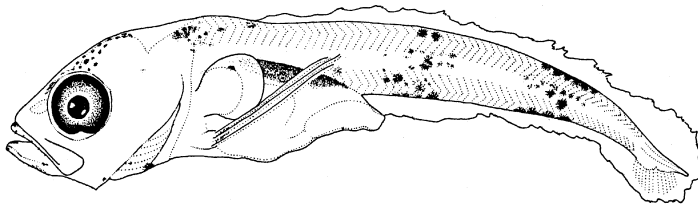
Molva molva



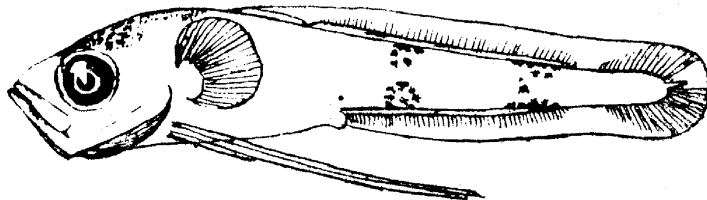
A. 5.0 mm



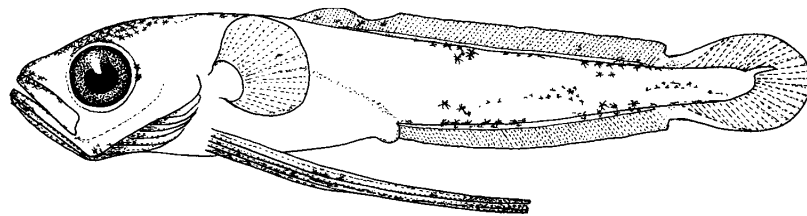
B. 6.0 mm



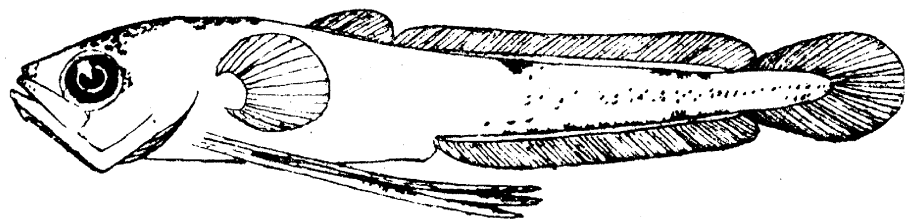
C. 8.2 mmSL



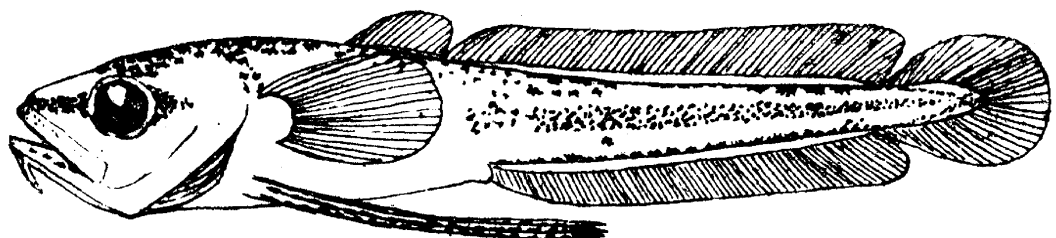
D. 10.8 mm



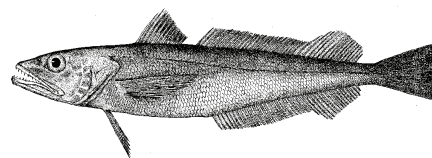
E. 14.0 mm



F. 15.5 mm



G. 22.0 mm

Merluccius albidus* (Mitchill, 1818)*Merlucciidae****Offshore hake**

Range: Western North Atlantic Ocean from edge of Scotian Shelf, along coast of United States, through Gulf of Mexico and Caribbean Sea to French Guiana.

Habitat: On or near-bottom over outer continental shelf and upper continental slope, in depths of 80–1,170 m, mostly 160–640 m.

Spawning: Protracted and presumably year-round, with a strong peak Mar–Jul and another peak in Oct; most activity near continental shelf edge.

Eggs:

- Pelagic, spherical, transparent
- Diameter: 1.04–1.24 mm
- Chorion: smooth
- Yolk: homogeneous
- Oil globule single, 0.28–0.54 mm in diameter
- Perivitelline space: narrow

Larvae:

- Hatching occurs at 3.0–3.8 mm, eyes unpigmented, mouth unformed
- Body and head deep anteriorly, tapering posteriorly
- Anus opens laterally on finfold (not at margin) in early larvae
- Preanus length about 45–50% TL
- Body depth at cleithrum 25–30% NL (deeper than *M. bilinearis*)
- No barbel on lower jaw
- Sequence of fin ray formation: C – D₁ – P₂ – D₂, A – P₁
- Pelvic fin buds form at about 5.0 mm, and fin rays become moderately long
- Transformation occurs at about 20 mm
- Pigmentation: early larvae more heavily pigmented than those of *M. bilinearis*, with concentrations on head, yolk, oil globule, and 2 bands across tail, the posterior band most dense; no spot at notochord tip until about 10 mmNL; lateral series of expanded melanophores forms on flank, from pectoral fin to location of posterior band; pectoral and pelvic fins pigmented, usually heavily

Note:

1. Preserved eggs are often "sticky"; eggs tend to form clumps and float at surface of water in petri-dish
2. Distinguished from larvae of *M. bilinearis* by heavier pigment on flank, pigment on paired fins, and 9–11 gill rakers on first gill arch (in juveniles and adults)

Meristic Characters

Myomeres:	53–55
Vertebrae:	51–52
Dorsal fin rays:	11–13+37–40
Anal fin rays:	I, 37–41
Pectoral fin rays:	13–16
Pelvic fin rays:	7
Caudal fin rays:	16+6+3+18

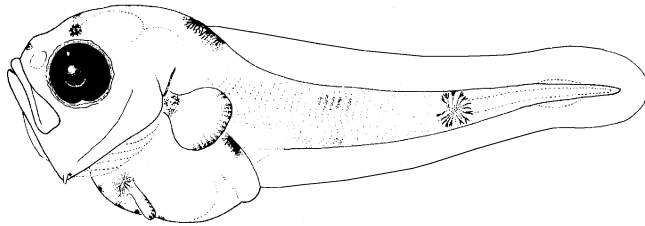


Yolk-sac larva

Figures: Adult: H. L. Todd; yolk-sac larva: Marak, 1967; **A–D:** Fahay, 1983

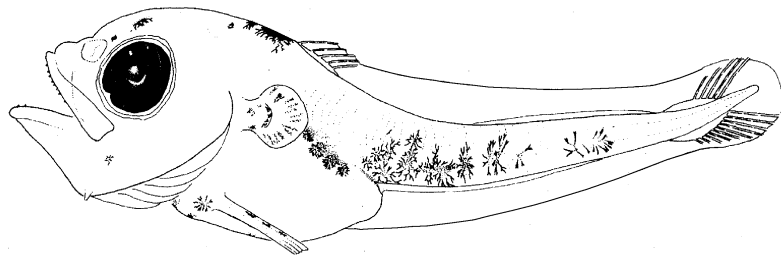
References: Fahay, 1983; Fahay and Markle, 1984; Markle and Frost, 1985; Berrien and Sibunka, 1999

Merluccius albidus

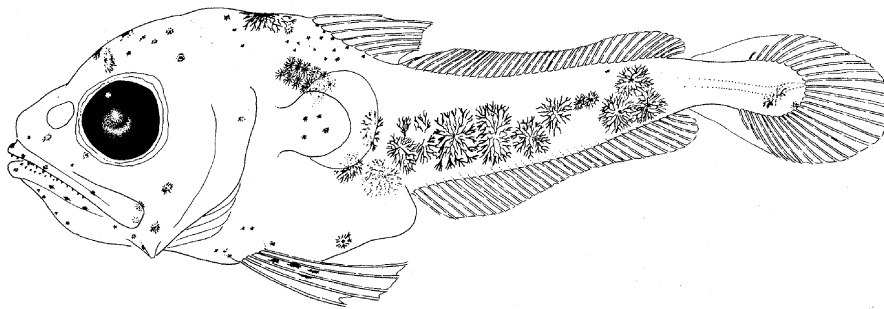


A. 5.5 mmNL

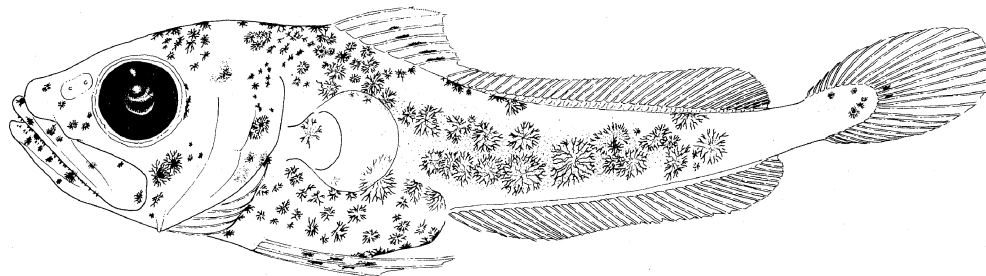
Note posterior of 2 bars on tail most intense until most of flank becomes pigmented



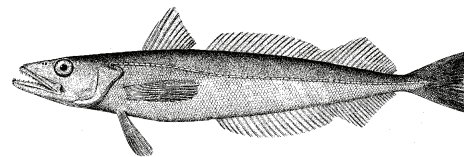
B. 8.5 mmNL Notochord tip unpigmented until later stages



C. 10.0 mmNL Note pigment on pectoral and pelvic fins



D. 14.0 mmNL

Merluccius bilinearis* (Mitchill, 1814)*Merlucciidae****Silver hake**

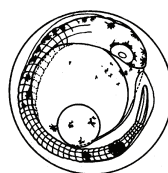
Range: Western North Atlantic Ocean; along coast of North America from southern Labrador to the Bahamas; most abundant between southern Newfoundland and South Carolina

Habitat: Outer continental shelf and upper slope, most commonly in depths of 125–325 m (spring) or 150–225 m (fall); usually over sandy substrates, but associated with a wide variety of bottom types; juveniles often occur in amphipod tube patches

Spawning: Some reproduction occurs year-round, with a peak between May and Oct; most spawning occurs on Georges Bank or edge of shelf

Eggs:

- Pelagic, spherical, transparent
- Diameter: 0.88–0.95 mm
- Chorion: smooth
- Yolk: homogeneous
- Oil globule single, 0.24–0.29 mm diameter
- Perivitelline space: narrow

**Meristic Characters**

Myomeres:	about 54–56
Vertebrae:	54–56
Dorsal fin rays:	11–14+36–42
Anal fin rays:	1, 37–42
Pectoral fin rays:	13–17
Pelvic fin rays:	7
Caudal fin rays:	13–15+6+2+15–17



Yolk-sac larva

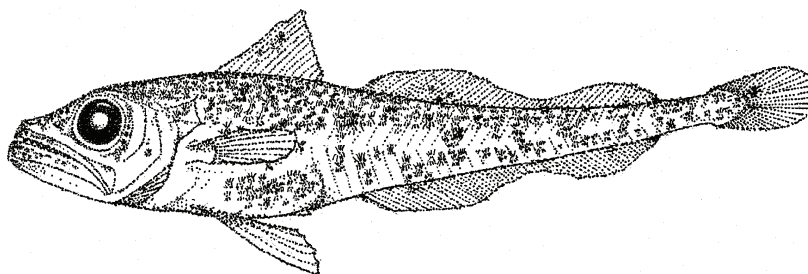
Larvae:

- Hatching occurs at 2.6–3.5 mm, eyes unpigmented, mouth unformed; pigment on yolk and oil globule
- Body slender and tapering, head length about 25% NL
- Anus opens laterally on finfold (not at margin) in early larvae
- Preanus length about 45% NL; body depth at cleithrum about 25% NL
- No barbel on lower jaw
- Sequence of fin ray formation: C – D₁ – P₂ – D₂, A – P₁
- Finfold between 1st and 2nd dorsal fins disappears by about 12 mmNL
- Pelvic fin rays moderately long; buds form at about 7 mm and fin rays reach level of anus at about 10 mmNL
- Transformation occurs at about 20 mm
- Pigmentation: 2 bands of melanophores, equal in intensity, form on tail; also scattered pigment on snout, crown, nape, and internally on peritoneum; few spots at notochord tip after yolk absorption; all fins unpigmented

Note: 1. Distinguished from larvae of *M. albidus* by lighter pigment on flank, unpigmented paired fins, and 15–22 gill rakers on first gill arch (in juveniles and adults)

Early Juvenile: Descent to bottom occurs at sizes 17–20 mm; settlement occurs over a wide range of continental shelf depths and bottom types (see Auster *et al.* (1997); Steves and Cowen, 2000; Sullivan *et al.*, 2000)

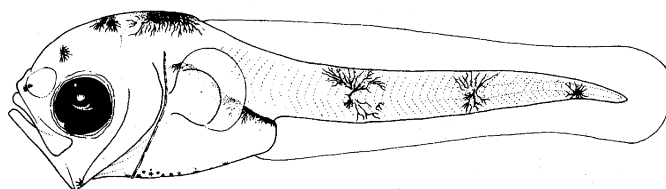
E. About 25 mmTL



Figures: Adult: H. L. Todd; egg: Sauskan and Serebryakov, 1968; yolk-sac larva: Colton and Marak, 1969; **A–D:** Fahay, 1983; **E:** Mark Sullivan (Sullivan *et al.*, 2000)

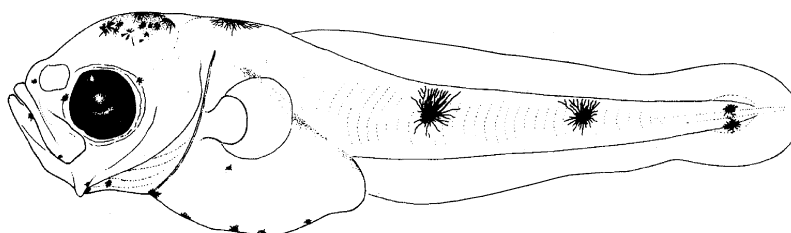
References: Sauskan and Serebryakov, 1968; Fahay, 1974; Auster *et al.*, 1997; Berrien and Sibunka, 1999; Steves and Cowen, 2000; Sullivan *et al.*, 2000

Merluccius bilinearis



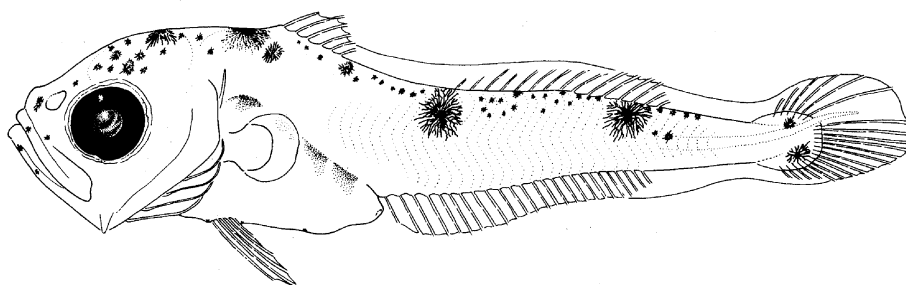
A. 4.1 mmNL

Note 2 pigment bars
on tail equally intense



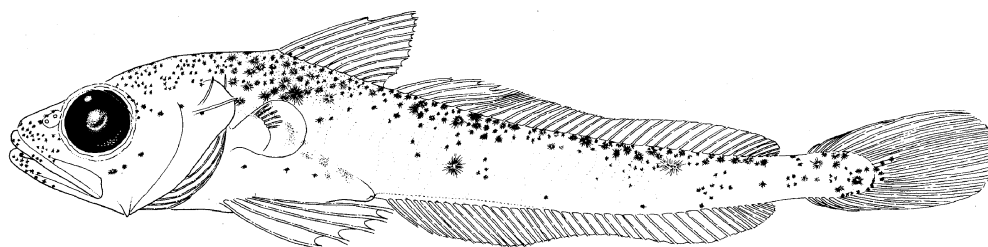
B. 5.7 mmNL

Note pigment at notochord tip

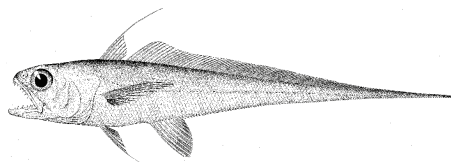


C. 9.0 mmNL

Fins unpigmented



D. 21.5 mmNL

Steindachneria argentea* Goode and Bean, 1896*Steindachneriidae****Luminous hake**

Range: Gulf of Mexico, Caribbean Sea, east coast of United States to 35°51'N, 74°51'W (MCZ 158593)

Habitat: Outer continental shelf and upper continental slope, usually over soft substrates

Spawning: Reproductive biology undescribed; larvae are pelagic

Eggs: – Undescribed

Larvae:

- Large head, large eye, and prominent mouth
- Body tapers to fine point
- Moderately narrowed pectoral fin bases
- Anus and urogenital openings initially close together; anus migrates forward with development
- Preanus length decreases from 34% SL to 19% SL through ontogeny
- Head length decreases from 22% SL to 17% SL through ontogeny
- Striated luminous organ begins forming in region of pelvic fin base and branchiostegal rays, then extends posteriorly on venter to region of mid-anal fin
- Sequence of fin ray formation: A – D – P₂ – P₁
- Fin ray formation begins with anterior anal fin
- Anterior portion of anal fin elevated in late larvae through adults
- Structure of first anal fin pterygiophore is unique among gadiform fishes
- Lightly pigmented: a single melanophore on the ventral edge of the tail, disappears early; posterior mid-brain and nape with small melanophores; scattered pigment on developing pectoral fin and near caudal tip

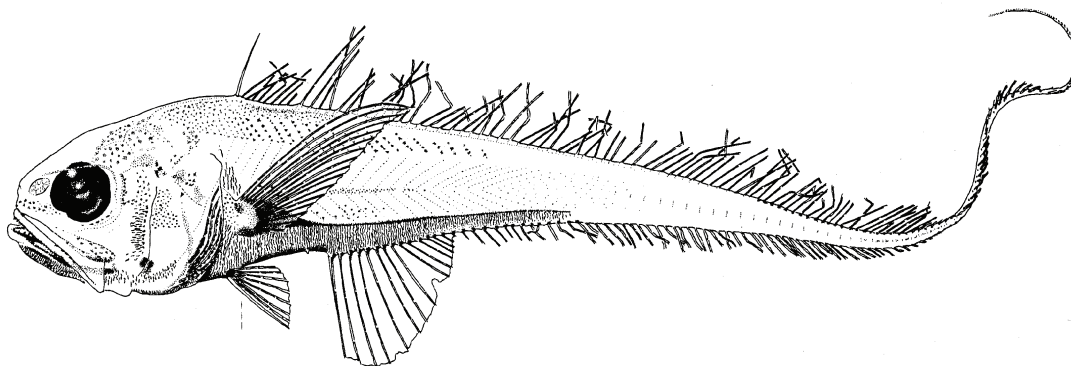
Meristic Characters

Myomeres:	numerous, taper to zero
Vertebrae:	13 precaudal + ?
Dorsal fin rays:	1, 7–9 + >123
Anal fin rays:	>123
Pectoral fin rays:	14–17
Pelvic fin rays:	8
Caudal fin rays:	very reduced

Note:

1. Certain macrourid larvae (e.g. *Hymenocephalus*) also have striated tissue on their ventral surfaces
2. Most macrourid larvae described to date have stalked (stylopterus) pectoral and pelvic fin bases

Early Juvenile: Development is gradual, with no striking changes at transformation to pelagic juvenile stage. Size at settlement to benthic habitats is unknown. Pelagic juvenile characterized by elevated anterior part of anal fin, long tapering body with tiny caudal fin, purplish, striated luminous tissue present on venter

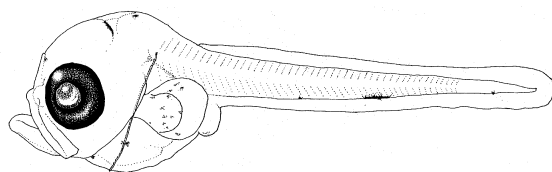


G. 55.0 mmSL

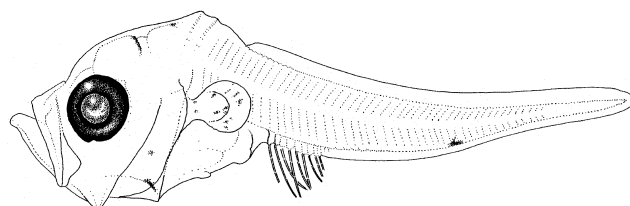
Figures: Adult: Goode and Bean, 1896; A–D, G: Fahay, 1989; E–F: Betsy Washington (Fahay and Markle, 1984)

References: Parr, 1946; Cohen 1964b; Fahay, 1989; Iwamoto and Cohen, 2002a

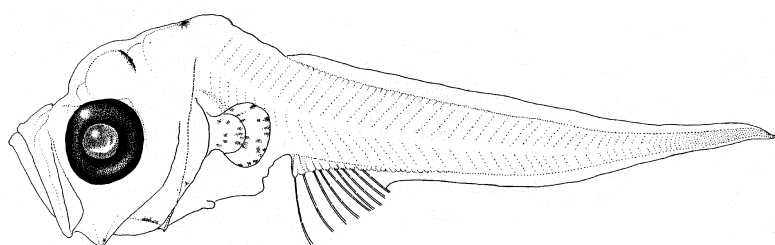
Steindachneria argentea



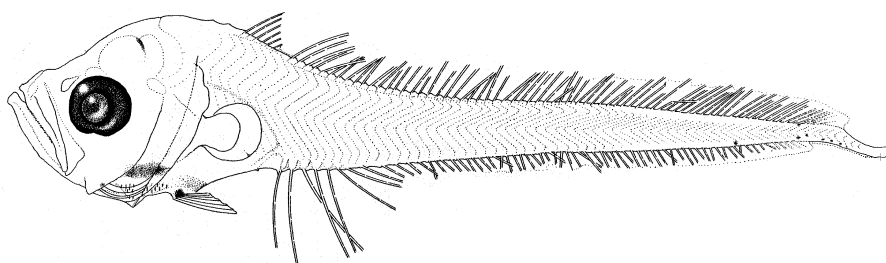
A. 2.3 mmSL



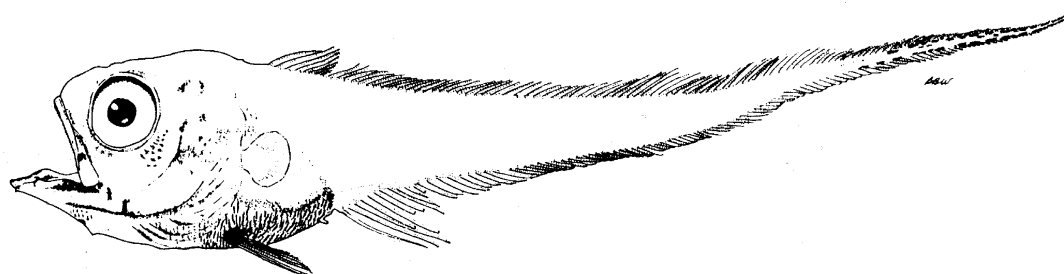
B. 4.6 mmSL



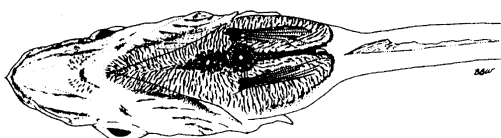
C. 5.8 mmSL



D. 11.5 mmSL



E. 24.0 mmSL



**F. 24.0 mmSL
(Ventral View)**