

Scorpaeniformes

Selected meristic characters in species belonging to the order Scorpaeniformes, families Scorpaenidae, Triglidae and Dactylopteridae whose adults or larvae have been collected in the study area. Classification sequence follows Eschmeyer, 1990. Sources: Eschmeyer, 1965; Miller and Jorgenson, 1973; Ross, 1983; Uyeno *et al.*, 1983; Hureau and Litvinenko, 1986; Poss, 2003; Richards, 2006.

Family <i>Species</i>	Vertebrae	Dorsal Fin Rays	Anal Fin Rays	Pectoral Fin Rays	Pelvic Fin Rays
Scorpaenidae					
<i>Ectreposebastes imus</i>	26	XII, 9–10	III, 5–6	18–20	I, 5
<i>Helicolenus dactylopterus</i>	23–25	XII, 11–12	III, 5	17–20	I, 5
<i>Neomerinthe hemingwayi</i>	24	XII, 10	III, 5	16–17	I, 5
<i>Pontinus longispinis</i>	24	XII, 9	III, 5	17–18	I, 5
<i>Pontinus rathbuni</i>	24	XII, 9	III, 5	16–17	I, 5
<i>Pterois volitans</i>	24	XII–XIII, 9–12	III, 5–8	13–17	I, 5
<i>Scorpaena bergi</i>	24	XII, 9	III, 5	16–17	I, 5
<i>Scorpaena brasiliensis</i>	24	XII–XIII, 8–9	III, 5	16–20	I, 5
<i>Scorpaena calcarata</i>	24	XII, 7–10	III, 5	18–21	I, 5
<i>Scorpaena inermis</i>	24	XII, 7–8	III, 5	19–21	I, 5
<i>Scorpaena plumieri</i>	24	XII, 9	III, 5	18–21	I, 5
<i>Sebastes fasciatus</i>	29–32	XIV–XVI, 13–14	III, 6–8	17–20	I, 5
<i>Sebastes mentella</i>	(29) 30–31	XIV–XVI, 14–15	III, 8–10	18–20	I, 5
<i>Sebastes norvegicus</i>	30–31	XIV–XVI, 13–17	III, 7–10	18–21	I, 5
<i>Sebastes viviparus</i>	29–31	XIV–XVI, 12–15	III, 6–8	16–19	I, 5
<i>Setarches guentheri</i>	24	XII, 10	III, 4–6	20–25	I, 5
<i>Trachyscorpia cristulata</i>	25	XII, 8–9	III, 5	20–24	I, 5
Triglidae					
<i>Peristedion ecuadorensis</i> ¹	33–35	VIII, 16–19	17–19	10–13+2	I, 5
<i>Peristedion gracile</i>	35	VIII, 19–20	19–21	12+2	I, 5
<i>Peristedion greyae</i>	33–35	VIII, 18–20	18–21	11–13+2	I, 5
<i>Peristedion miniatum</i>	33	VII–VIII, 17–18	17–19	12–13+2	I, 5
<i>Peristedion thompsoni</i>		VII, 15	16	12+2	I, 5
<i>Peristedion truncatum</i>	33–34	VIII, 21	18	12+2	I, 5
<i>Prionotus carolinus</i>	26	X, 13–14	12	14+3	I, 5
<i>Prionotus evolans</i>	26	X, 13–14	11	13+3	I, 5
<i>Prionotus scitulus</i>	26	X, 12–14	11–13	12–14	I, 5
<i>Prionotus tribulus</i>	26	X, 11–12	10–12	12–14	I, 5
Dactylopteridae					
<i>Dactylopterus volitans</i>	22	VII, 8	6	6+26–30	I, 4
Cottidae					
<i>Artediellus atlanticus</i>	29–32	VIII, 12–16	9–13	19–24	I, 3
<i>Artediellus uncinatus</i>	28–31	VII–VIII, 10–14	10–12	19–24	I, 3
<i>Gymnocanthus tricuspis</i>	36–40	X–XII, 14–17	15–19	17–21	I, 3

¹ *Peristedion* is included in the family Peristediidae by some authors (e.g. Imamura, 1996)
(Cont.)

Scorpaeniformes

Selected meristic characters in species belonging to the order Scorpaeniformes, families Cottidae, Psychrolutidae, Agonidae, Cyclopteridae and Liparidae whose adults or larvae have been collected in the study area. Classification follows Eschmeyer, 1990; Chernova *et al.*, 2004; Mecklenburg and Sheiko, 2003; Sheiko and Mecklenburg, 2004. Sources: Kanayama, 1991; Eschmeyer, 1997; Scott and Scott, 1988.

Family <i>Species</i>	Vertebrae	Dorsal Fin Rays	Anal Fin Rays	Pectoral Fin Rays	Pelvic Fin Rays
Cottidae (Cont'd)					
<i>Hemitripterus americanus</i> ¹	38–39	XV–XVII, I, 12	13–14	18–19	I, 3
<i>Icelus bicornis</i>	40–43	VII–X, 17–23	12–17	15–19	I, 3
<i>Icelus spatula</i>	40–43	VIII–XI, 17–21	14–17	17–20	I, 3
<i>Myoxocephalus aenaeus</i>	30–34	VIII–XI, 13–14	10–11	14–17	I, 3
<i>Myoxocephalus octodecemspinosus</i>	34–44	VII–X, 15–17	12–15	16–19	I, 3
<i>Myoxocephalus quadricornis</i>	38–43	VI–X, 13–17	13–17	14–18	I, 3
<i>Myoxocephalus scorpioides</i>	35–38	VIII–X, 13–17	10–14	14–18	I, 3
<i>Myoxocephalus scorpius</i>	32–41	VII–XII, 12–20	9–16	14–19	I, 3
<i>Triglops murrayi</i>	44–47	IX–XII, 20–26	20–27	16–19	I, 3
<i>Triglops nybelini</i>	46–49	IX–XI, 24–28	24–28	20–22	I, 3
<i>Triglops pingeli</i>	45–51	X–XIII, 23–26	23–26	16–19	I, 3
Psychrolutidae					
<i>Cottunculus microps</i>	28–29	VI–VIII, 13–15	10	17–19	I, 3
<i>Cottunculus thompsoni</i>	–	VI–VIII, 17	13–14	23	I, 3
Agonidae					
<i>Aspidophoroides monopterygius</i>	48–52	5–6	5–6	10–11	I, 2
<i>Leptagonus decagonus</i>	44–49	V–VIII, 5–8	6–8	15–17	I, 2
<i>Ulcina olriki</i>	37–39	5–7	5–7	14–15	I, 2
Cyclopteridae					
<i>Cyclopterus lumpus</i>	28–29	VI–VIII, 9–11	9–10	19–20	11–12
<i>Eumicrotremus derjugini</i>	26–27	VII, 11–13	10–12	19–29 (fam)	–
<i>Eumicrotremus spinosus</i>	26–27	VI–VII, 10–12	10–12	19–29 (fam)	–
<i>Eumicrotremus terraenovae</i>		VII, 12	11	25	6+5=11
Liparidae²					
<i>Careproctus ranula</i>	53–62	46–58	42–51	24–32	8–12
<i>Careproctus reinhardti</i>	56–63	50–58	41–52	25–34	8–11
<i>Careproctus</i> sp.	64	56	50	26	9
<i>Liparis atlanticus</i>	38–42	31–35	25–29	27–31	5–6+5–6
<i>Liparis coheni</i>	42–46	36–41	30–35	32–40	5+5–6
<i>Liparis fabricii</i>	48–53	43–49	36–42	32–37	4–5+5–6
<i>Liparis gibbus</i>	44–50	38–46	32–37	37–45	4–5+5–6

¹ *Hemitripterus* is included in the family Hemitripteridae by some authors (e.g. Yabe, 1985)

² Cyclopteridae and Liparidae are combined in Cyclopteridae by some recent authors

Scorpaeniformes

Selected meristic characters in species belonging to the order Scorpaeniformes, family Liparidae, whose adults or larvae have been collected in the study area. Classification follows Chernova *et al.*, 2004; Sources: Burke, 1930; Able *et al.*, 1986; Chernova, 2001; 2004; Chernova *et al.*, 2004; Chernova and Stein, 2004.

Family <i>Species</i>	Vertebrae	Doral Fin Rays	Anal Fin Rays	Pectoral Fin Rays	Caudal Fin Rays
Liparidae (Cont'd)					
<i>Liparis inquilinus</i>	38–42	33–38	28–31	30–35	5+5–6
<i>Liparis tunicatus</i>	45–50	39–44	33–37	32–38	4–6+4–6
<i>Paraliparis bathybius</i>	–	59	51	19	6–8
<i>Paraliparis calidus</i>	–	58–63	54–58	20–22	6
<i>Paraliparis copei</i>	–	59–68	54–60	20–22	8–9
<i>Paraliparis garmani</i>	–	54–59	49–53	19–22	–
<i>Paraliparis liparina</i>	–	58–67	54–55	22–23	4
<i>Paraliparis vaillanti</i>	69	61	57	17+3+2	6+1
<i>Psednos barnardi</i> ¹	47	39–41	33–35	8+1+5	6
<i>Psednos christinae</i>	47	41	35	8–9+1+5–6	6
<i>Psednos delawarei</i>	42	36	31	14	6
<i>Psednos groenlandicus</i>	47	41	34–35	8+1–2+5–6	6
<i>Psednos harteli</i>	47	42	35	8+1+5	6
<i>Psednos melanocephalus</i>	43	38	31–33	13	6
<i>Psednos mirabilis</i>	41	34	29	8+0+5	6
<i>Psednos rossi</i>	46–47	42–44	33–35	15–16	6
<i>Rhodichthys regina</i> ²	62–69	56–60	54–57	16–17	10

¹ *Psednos* is considered a synonym of *Paraliparis* by some authors

² *Rhodichthys regina* is included in *Paraliparis* by some authors

Scorpaeniformes

Members of families within Scorpaeniformes all have a suborbital stay (formed by the elongation of the 3rd and 4th infraorbital bones, usually connected to the preopercle) that is the basis for the term "mail-cheeked fishes". Authorities are divided as to whether the scorpaeniforms are a monophyletic "pre-perciform" sister group of the Perciformes (e.g. Eschmeyer, 1990; Nelson, 1994) or are a suborder within the Perciformes (e.g. Johnson and Patterson, 1993). See Ambrose (1996m, 1996n, 1996o), Moser (1996g) and Richards (1996) for a more complete exposition of larval morphology in all the scorpaeniform families represented here, based on collections from the eastern Pacific Ocean.

Brief Synopses of Adult and Ontogenetic Characters in Scorpaeniform Families

Scorpaenidae

Usually have well-developed spines on cheeks and distinct ridges or spines on top of head; 1–2 spines on opercle, 3–5 spines on preopercle; single, usually notched, dorsal fin with 12–16 spines and 8–17 soft rays; anal fin with 3 spines and 4–10 soft rays (in species in the study area). Most are oviparous, many are viviparous, (but see *Helicolenus dactylopterus*). Larvae are characterized by well-developed head and preopercle spines and large, usually darkly pigmented pectoral fins. The larvae of relatively few species have been fully described, although unidentified larvae are readily recognized as scorpaenids because of their patterns of head spination and pectoral fin characters.

Triglidae

Most have elongate bodies with heads encased in bony plates and prominent spines. The snout is steep or flat with a projecting rostrum. The body of some is equipped with spinous scutes. Larvae have large, spiny heads with concave snout profiles. Pigmentation is light, although some have heavily pigmented pectoral fins and pigment over the gut. The lower few rays of the pectoral fin are thicker than, and distinct from, the upper rays. Two *Prionotus* species are common in estuarine and continental shelf waters of the study area, and deeper waters harbor members of *Peristedion*. Three species in the triglid genus *Bellator* may also produce early stages that could be collected in the study area. There are museum records of *Bellator egretta* and *B. militaris* in the extreme southern part of the study area. *Bellator brachyichir* occurs as far "north as North Carolina" but no museum records have been found north of 35°N latitude. Larvae in this genus are undescribed, but see Chapter 110: Triglidae, in Richards (2006) for comments on a 5.8 mmSL specimen.

Dactylopteridae

Elongate fishes with heads encased in bony shield; a long spine extends from angle of preopercle and a keeled spine extends posteriorly from nape. Distinctive larvae have well developed nuchal and preopercle spines and the first four vertebrae fuse together during early development. Relationships to other scorpaeniforms questioned by some authors (e.g. Imamura, 2000). May be more closely related to the percoid family Malacanthidae. (See comments on *Lopholatilus chamaeleonticeps* page.) The seven species in this family are also sometimes treated as a separate "pre-perciform" order, Dactylopteriformes (e.g. Johnson and Patterson, 1993).

Cottidae

Larvae from eastern Pacific Ocean have been organized into groups based on phenetic analysis; those from western North Atlantic all belong to "*Myoxocephalus* Group" (*sensu* Richardson, 1981; Washington *et al.*, 1984b; Ambrose, 1996m) except for *Hemitripterus americanus* (included in separate family by many recent authors) and two species in *Artediellus* whose larvae are undescribed. See *Icelus bicornis* figure page for a summary of larval characters.

Psychrolutidae

Larvae of two species reported from study area are undescribed. See Washington *et al.* (1984b) and Ambrose (1996m) for larval examples.

Agonidae

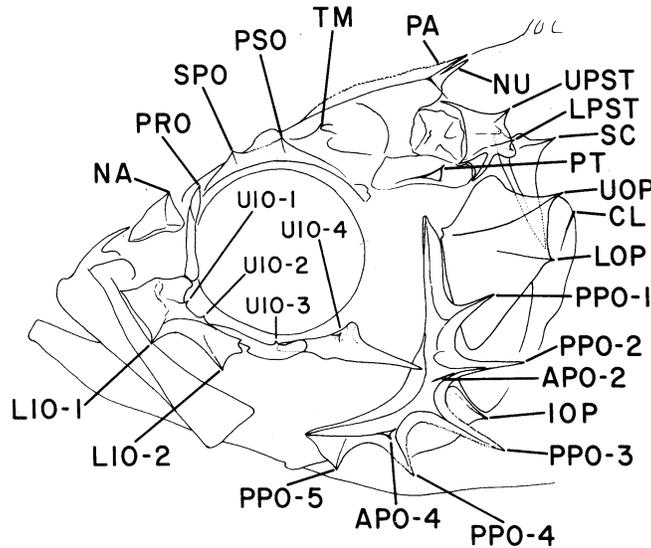
Larvae are elongate with early forming, large pectoral fins. Four rows of spines along bodies of larvae are precursors of plates (modified scales) in adults. Spiny ridges form on frontal and parietal bones and along edge of preopercle.

Cyclopteridae and Liparidae

See synopses of larval characters in these two families on *Liparis tunicatus* page.

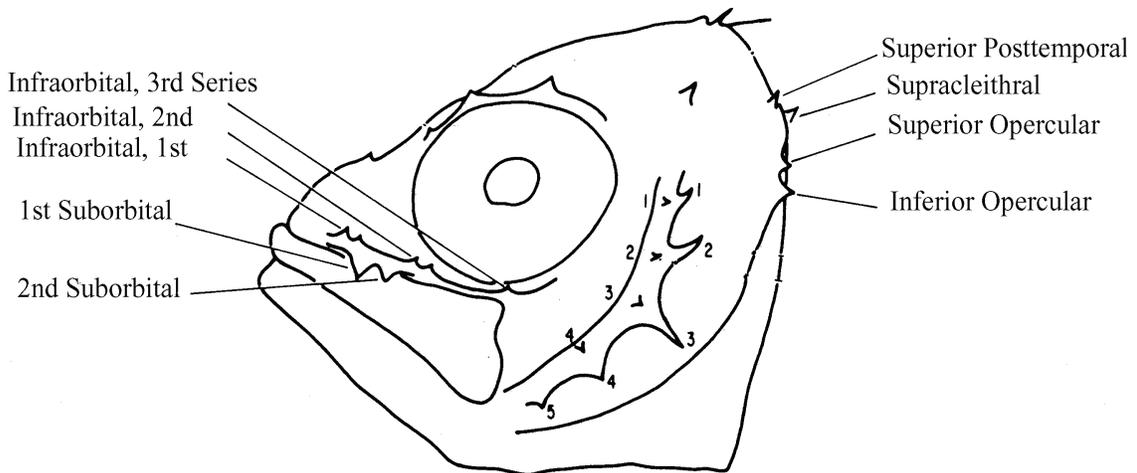
Scorpaeniformes

Head spine terminology in Scorpaeniformes (after Moser and Ahlstrom, 1978)



APO-2 thru 4: anterior preoperculars	NA: nasal	SC: supracleithral
CL: cleithral	NU: nuchal	SPO: supraocular
IOP: interopercular	PA: parietal	TM: tympanic
LIO-1 and 2: lower infraorbitals	PPO1 thru 5: posterior preoperculars	UIO-1 thru 4: upper infraorbitals
LOP: lower opercular	PRO: preocular	UOP: upper opercular
LPST: lower posttemporal	PSO: postocular	UPST: upper posttemporal
	PT: pterotic	

Head spine terminology in *Sebastes* (after Richardson and Laroche, 1979; Penney, 1987)



Terminology same as in top figure except: Infraorbital = upper infraorbitals; Suborbital = lower infraorbitals; Superior post-temporal = upper posttemporal; Supracleithral = cleithral; Superior Opercular = upper opercular; Inferior Opercular = lower opercular

Scorpaeniformes

Notes on *Sebastes* larvae in the western North Atlantic

Four species of *Sebastes* occur in the study area. The most commonly occurring species in the western North Atlantic are *Sebastes fasciatus* and *S. mentella*. *Sebastes fasciatus* is most common south and west of Grand Bank, *S. mentella* is most common north and east of Grand Bank. Where they overlap, *S. mentella* occurs in deeper water than *S. fasciatus*. Adults are definitively separable by extrinsic musculature of the air bladder (Hallacher, 1974; Litvinenko, 1980). *Sebastes norvegicus* and *S. viviparus* occur most commonly in the eastern North Atlantic, the former rarely occurring on or west of Flemish Cap, the latter barely reaching the southern tip of Greenland.

The following table of characters in adults (modified from Hureau and Litvinenko, 1986) and larvae (after Barsukov *et al.*, 1984; Penney, 1987) demonstrates the similarities of the four species:

Character	<i>Sebastes fasciatus</i>	<i>Sebastes mentella</i>	<i>Sebastes viviparus</i>	<i>Sebastes norvegicus</i>
Scale rows below lateral line	More than 55	More than 55	Fewer than 55	More than 55
Lower (5 th) preopercle spine orientation	Down, or slightly forward	Forward and down	Back, or down and back	Down and slightly back
Anal fin rays ¹	7 (6 or 8)	8–10 (7 or 11)	6–8	8–10 (7 or 11)
Dorsal fin rays ¹	(13) 14	14, 15 ³	13–14 (12–15)	15 (13–17)
Vertebrae ²	30 or fewer	31 or more	29–31	31–32
Parietal spines per side	2	1	1?	1
3 rd preopercle spine angle to longitudinal axis of body	< 50°	> 50°	–	> 40°
Lower, unbranched pectoral fin rays (far northern waters)	–	8 or fewer (9) ¹	–	9 or more (8) ¹
Larvae 10–15 mmTL:				
– Subcaudal melanophores	0–5 (usually 1+)	0–2 (usually 0)	1+ (usually 1)	0–2 (usually 0)
– Ventral row melanophores	over 16–20 myos ⁴	over 16–20 myos	–	–
– Dorsal row melanophores	over 6–21 myos	over 6–25 myos	–	–

¹ rare counts in parentheses

² not including rare counts

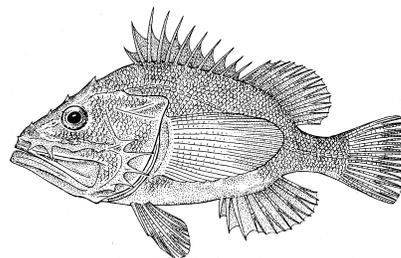
³ fifteen in most northern areas

⁴ myos = myomeres

Larvae of the four species are similar. They all have prominent parietal, supraocular and preopercle spines. The doubled spines illustrated in the parietal region by several authors may actually portray a parietal spine plus an adjacent nuchal spine, as is typical of many scorpaenid larvae (e.g. Moser, 1972; Moser and Ahlstrom 1978). Both spines originate from the parietal bone. Lesser spines occur in the posttemporal region. Pigment is typically distributed in five major areas:

- Melanophores in a series along the ventral edge of tail
- Melanophores along the dorsal edge of tail, beginning as a short series, expanding anteriorly
- Dense covering of pigment on dorsolateral surface of gut
- A prominent cluster of melanophores on top of head
- Usually distinct, subcaudal melanophores (1–5) at the base of the caudal fin rays (sometimes none)

The body and head proportions of all four species are also similar. Preflexion larvae are elongate, slender, with rounded heads and short preanus lengths. The head becomes relatively longer and more pointy with development. There is a trend for increasing number of fin rays, increasing size at extrusion and flexion, and delayed appearance of meristic and pigment characters from *S. fasciatus* → *S. norvegicus* → *S. mentella*. The larvae of *Sebastes fasciatus* also appear to form head spines earlier than larvae of congeners.

Ectreposebastes imus* Garman, 1899*Scorpaenidae****Midwater scorpionfish**

Range: Worldwide in warm waters; in the western North Atlantic from the Caribbean Sea and Gulf of Mexico to northern South America, with a few records as far north as Scotian Shelf

Habitat: Benthic- to mesopelagic in depths of 150–850 m (mostly 500–800 m)

Spawning: Undescribed

Eggs: – Undescribed

Larvae:

- Hatching occurs at <2.8 mm
- Body very deep with very large head and mouth
- Head length increases from 34% SL to 38% SL after flexion
- Body depth >40% SL; increases to >50% SL by transformation
- Flexion occurs at about 5.5 mmSL
- Preanus length ranges from about 50% SL in small larvae to about 75% SL at transformation
- Sequence of fin ray formation: P₁, C – D, A – P₂
- Transformation occurs at about 15–30 mm (larger than any other described scorpaenid)
- Pigment in small larvae includes a melanistic shield over air bladder and melanophores along ventral surface of gut; pigment also completely covers pectoral fin membrane and occurs in a series of 11–14 spots along ventral edge of tail; larger larvae develop an unpigmented area at base of pectoral fin; ventral gut pigment and series of spots along ventral edge of tail are lost during flexion; larvae near transformation have 2/3 of pectoral fin unpigmented but have added pigment spots to top of head and upper part of the body

Meristic Characters

Myomeres:	24–26
Vertebrae:	12 + 14 = 26
Dorsal fin rays:	XII, 9–10
Anal fin rays:	III, 5–6
Pectoral fin rays:	18–20
Pelvic fin rays:	I, 5
Caudal fin rays:	14

Head Spine Checklist:

Preopercle:	three well-developed spines; upper spine and spine at angle the longest
Supraocular:	ridge with single, stout spine
Parietal:	very long, simple spine
Nuchal:	small spine alongside base of parietal spine
Pterotic and posttemporal:	very small spines present in small larvae

Early Juvenile: Two live specimens, 15 and 16 mm, have been described as lacking melanophores, pectoral fins yellow with pinkish edge, body slightly pink and peritoneum silvery (Eschmeyer and Collette, 1966). The head spines were very well developed and the pectoral fin rays were undivided. The 3rd anal fin element had not yet changed from a soft ray to a spine, therefore the anal fin formula was II, 7.

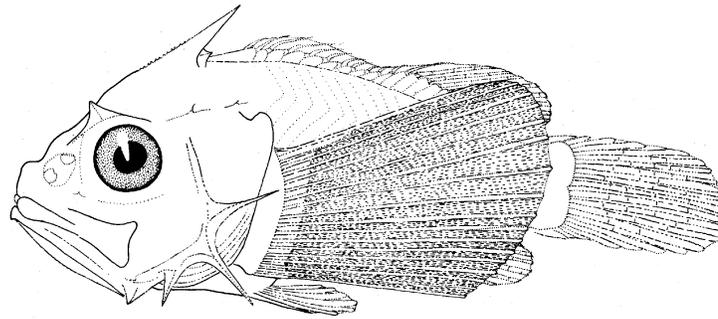
Note: The numbers of hypural elements and branched principal caudal fin rays vary between scorpaenid genera. These may be observed in developing larvae and juveniles by clearing and staining or radiography.

<i>Genus</i>	Upper Hypurals	Lower Hypurals	Branched Caudal Fin Rays
<i>Ectreposebastes</i>	3	3	6+6
<i>Pontinus</i>	3	2	6+5
<i>Helicolenus</i>	2	2	6+5
<i>Sebastes</i>	2	2	6+6

Figures: Adult: Poss, 2003; **A–B:** Moser *et al.*, 1977

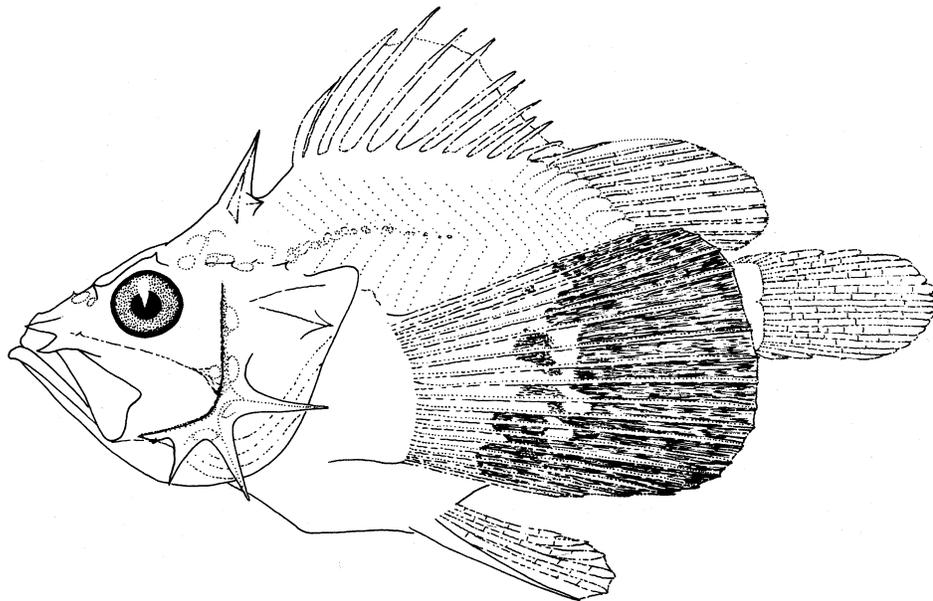
References: Eschmeyer and Collette, 1966; Moser *et al.*, 1977; Poss, 2003

Ectreposebastes imus



A. 6.7 mmSL

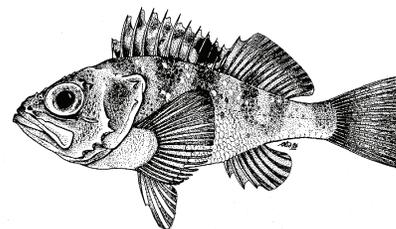
Dorsal and anal fin rays elongate



Note lower
infraorbital spines
projecting anteriorly

B. 23.0 mmSL

Pectoral fin rays very long, reaching base
of caudal fin or beyond; depth of pectoral
fin base 19-22% SL

Helicolenus dactylopterus* (Delaroche, 1809)*Scorpaenidae****Blackbelly rosefish**

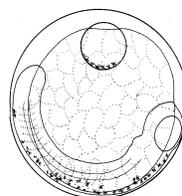
Range: Atlantic Ocean and Mediterranean Sea; in the western Atlantic from Scotian Shelf (La Have Bank) to Argentina, including Gulf of Mexico and Caribbean Sea

Habitat: Benthopelagic in depths of 124–682 m; usually on soft mud or sand substrates, sometimes mixed with rock or pebbles

Spawning: Winter to spring with peak Feb–Mar (off North Carolina); reproduction is *via* zygoparous oviparity; fertilization is internal, fertilized eggs are initially contained in gelatinous matrix, expelled into water soon after fertilization where matrix then dissolves

Eggs:

- Off-round, planktonic
- Diameter: 0.92–0.98 × 0.88–0.93 mm (long axis × short axis)
- Chorion: smooth
- Yolk: segmented
- Oil globule: single, about 0.2 mm
- Perivitelline space: narrow

**Meristic Characters**

Myomeres:	23–25
Vertebrae:	23–25
Dorsal fin rays:	XII, 11–12
Anal fin rays:	III, 5
Pectoral fin rays:	17–20
Pelvic fin rays:	I, 5
Caudal fin rays:	11+8+7+10–12

Larvae:

- Hatching occurs at about 2.8 mm (or about 3.5 mm measured alive), eyes unpigmented, mouth unformed; oil globule and dorsum of body pigmented, the latter disappearing before flexion begins
- Body moderately elongate with large head, short preanus length
- Preanus length increases from about 45% SL to <60% SL
- Flexion occurs at 6.0–8.0 mm
- Sequence of fin ray formation: C – D₂, A – P₂ – D₁ – P₁
- 3rd anal and 1st dorsal fin elements begin as soft rays, change into spines at transformation
- Transformation occurs between 19.0 and 35.0 mm
- Pigmentation in early larvae includes melanophores over gut, along venter of tail, behind eye, at tip of snout; later larvae have up to 3 distinct pigment accumulations along venter between anus and caudal fin; few spots occur on top of head, lower jaw and cleithral region.

Head Spine Checklist:

Preopercle: three to four stout spines along edge, with angle spine longest; few small spines on lateral ridge

Supraocular: ridge with small, simple spine

Parietal: well-developed spine with secondary serrations

Pterotic and posttemporal: small spines present

Note:

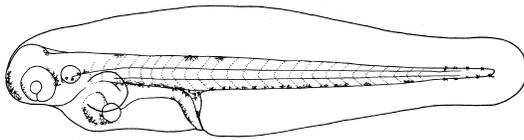
1. Mass of spongy tissue on body under base of 1st dorsal fin; present from 4.0 mm until transformation; not present in larvae of other scorpaeniform taxa
2. This is the most likely scorpaenid larva to be collected in the study area south of Long Island and inshore of the Gulf Stream; early stages of other scorpaenids may drift into study area *via* the Gulf Stream, but most are recognizable by large, early-forming, usually densely pigmented pectoral fins

Early Juvenile: Size at which planktonic larvae settle to benthic habitats undescribed; juvenile pigment includes a reddish body crossed by dark bands or saddles; a prominent dark blotch covers bases of posterior dorsal fin spines

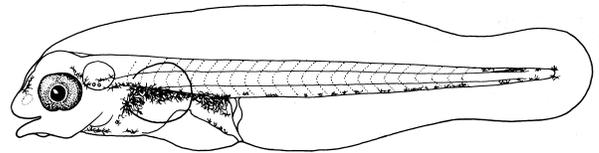
Figures: Adult: Poss, 2003; Egg: Brownell, 1979; **A–B:** Brownell, 1979; **C–F:** Tåning, 1961

References: Tåning, 1961; Barsukov, 1968; Moser *et al.*, 1977; Brownell, 1979; Klein-M^{ac}Phee and Collette, 2002a; Poss, 2003

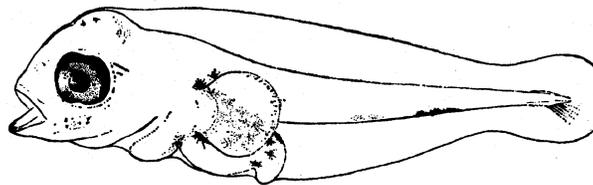
Helicolenus dactylopterus



A. 3.5 mmNL

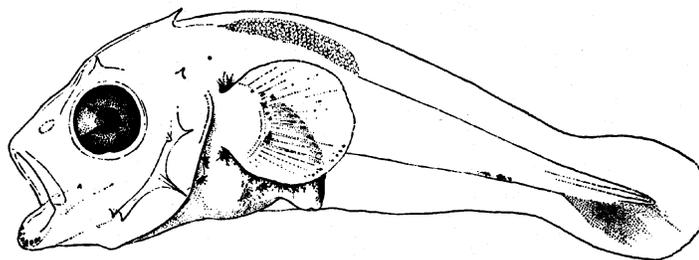


B. 3.8 mmNL



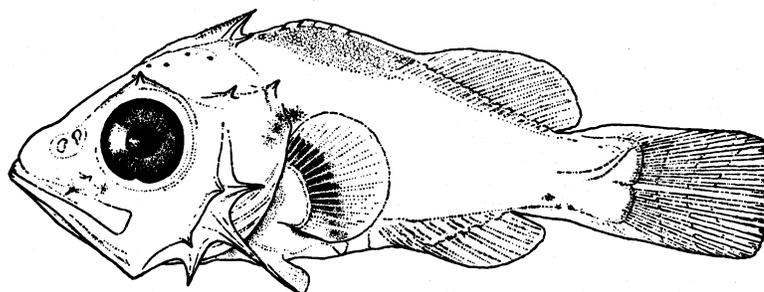
C. 3.6 mmSL

Dorsolateral gut pigment spreads ventrally with development



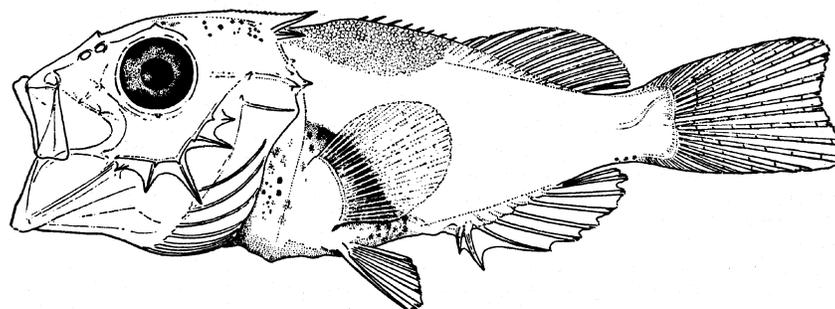
D. 5.6 mmSL

Ventral midline pigment reduced to few spots



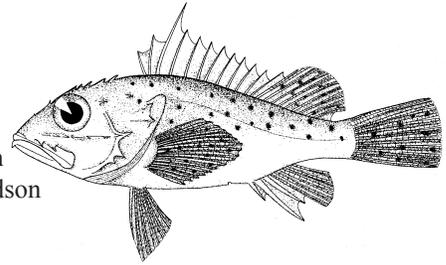
E. 10.0 mmSL

Pectoral fin well-developed, but not pigmented



F. 19.0 mmSL

***Pontinus longispinus* Goode and Bean, 1896**
Scorpaenidae
 Longspine scorpionfish



Range: Western North Atlantic from South Carolina to coast of northern South America, including Gulf of Mexico; also a record from vicinity of Hudson Canyon (AMNH 236162)

Habitat: Benthic over soft or semi-hard substrates in depths of 80–440 m

Spawning: Undescribed

Eggs: Undescribed

Larvae: Undescribed

Note: Two series of Pacific larvae (Moser *et al.*, 1977) are included here to illustrate larval characters of the genus.

Characters include:

- Lack of melanistic shield over dorsolateral surface of gut
- Presence of internal pigment over air bladder
- Well-developed head spines; see checklist below
- Pectoral fins aliform in shape (not fan-shaped as in other scorpaenid genera), with narrow bases
- Pectoral fin length ranges from 27% to 31% SL; pectoral fin pigment in intricate patterns
- The "Type A" series refers to an undescribed species; "Type B" larvae have been identified as those of *Pontinus sierra*, a Pacific species; (Moser, 1996g)

Meristic Characters

Myomeres:	24
Vertebrae:	24
Dorsal fin rays:	XII, 9
Anal fin rays:	III, 5
Pectoral fin rays:	17–18
Pelvic fin rays:	I, 5
Caudal fin rays:	6+5 (Br)

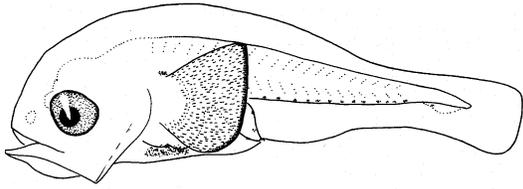
Head Spine Checklist:

Preopercle:	Three or more stout, simple spines along edge, angle spine longest; few small spines on lateral ridge
Supraocular:	ridge with very stout spine, directed anteriorly
Parietal:	very long, stout spine, with a few small serrations along leading edge
Nuchal:	tiny spine posterior to base of parietal spine
Pterotic:	small spine
Posttemporal:	small spine
Opercle:	two small spines at upper angle
Infraorbitals:	two or more small spines on both lower and upper infraorbitals

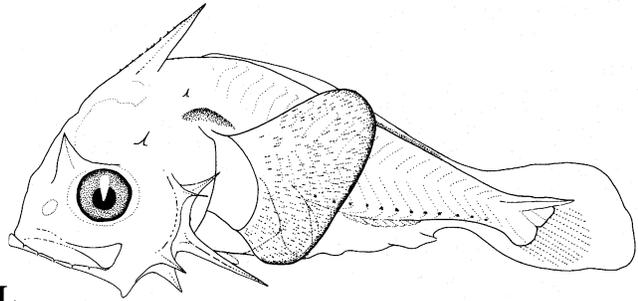
Figures: Adult: Poss, 2003; A–F: Moser *et al.*, 1977

References: Moser *et al.*, 1977; Poss, 2003; Hardy, 2006a

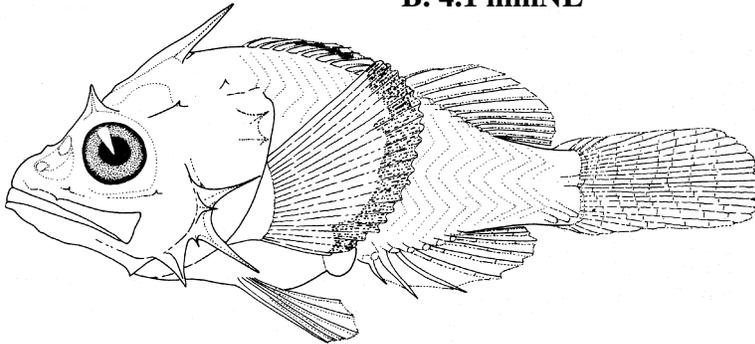
Pontinus "Type A" (Eastern Pacific Ocean)



A. 2.3 mmNL

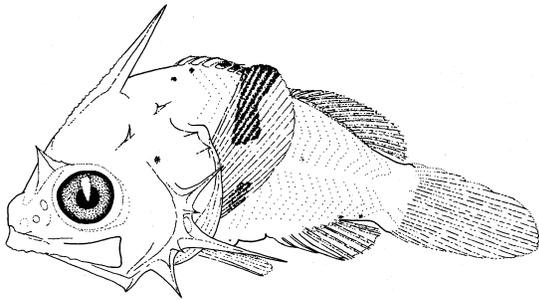


B. 4.1 mmNL

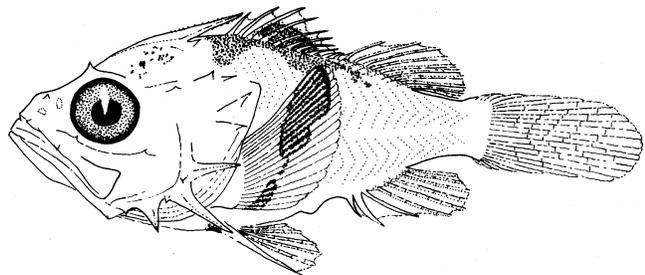


C. 8.0 mmSL

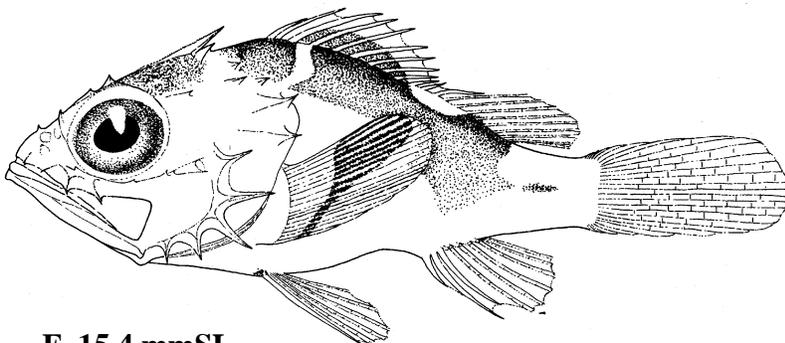
Pontinus "Type B" or *Pontinus sierra* (Pacific Ocean)



D. 5.0 mmSL

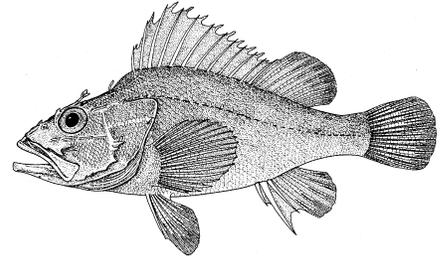


E. 8.7 mmSL



F. 15.4 mmSL

***Pontinus rathbuni* Goode and Bean, 1896**
Scorpaenidae
 Highfin scorpionfish



Range: Western North Atlantic Ocean from Virginia to southeastern Brazil, including northern Gulf of Mexico; also records from Hudson and Alvin canyons

Habitat: Benthic in depths of 73–366 m

Spawning: Undescribed; a single larva reportedly collected during austral winter off southeastern Brazil (June 9, 1966; 32°00'S, 50°00'W)

Eggs: – Undescribed

Larvae:

- Description based on a single 6.4-mm specimen
- Flexion complete at this size
- Body relatively deep, with large head; head length 39% SL
- Preanus length 60% SL
- Eye relatively small; eye diameter 29% HL
- Pectoral fins aliform shaped (narrow based)
- Head spines well-developed (see Fig. C and checklist below)
- Supraocular, parietal, nuchal and preopercular spines much larger than in comparably sized *Sebastes* larvae
- Supraocular and preopercular spines triangular in cross-section
- Preopercular spines limited to 3
- Pigmentation light, mostly concentrated on inter-ray surfaces of pectoral fin

Meristic Characters

Myomeres:	24
Vertebrae:	24
Dorsal fin rays:	XII, 9
Anal fin rays:	III, 5
Pectoral fin rays:	16-17
Pelvic fin rays:	I, 5
Caudal fin rays:	8+7 (PrC)

Head Spine Checklist:

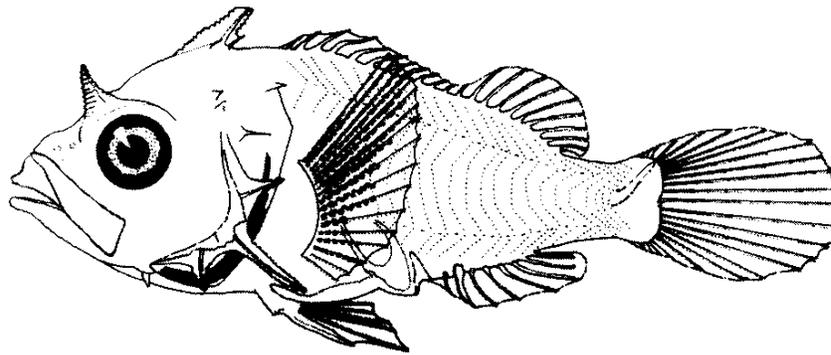
Preopercle: three stout spines along edge, angle spine longest, serrated
 Supraocular: stout, serrated spine, angled anteriorly
 Parietal: stout, serrated spine
 Nuchal: small spine at base of parietal spine
 Pterotic: small spine
 Posttemporal: small upper spine (UPST)
 Infraorbitals: two small spines on lower infraorbitals

Note: 1. Characters of this larva closely resemble those of *Pontinus* "Type A" (Sensu Moser *et al.*, 1977). See *Pontinus longispinus* figure page.

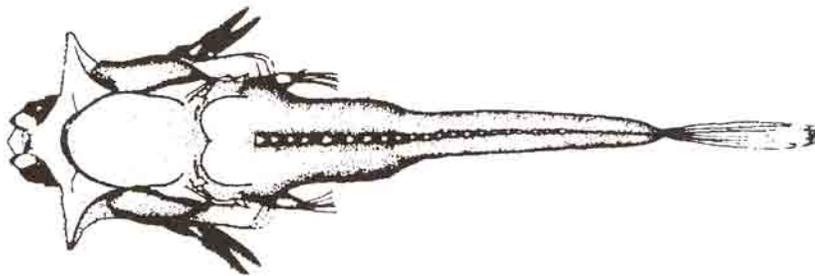
Figures: Adult: Poss, 2003; A–C: Sánchez and Acha, 1988 (B and C modified)

References: Moser *et al.*, 1977; Poss, 2003; Hardy, 2006a

Pontinus rathbuni



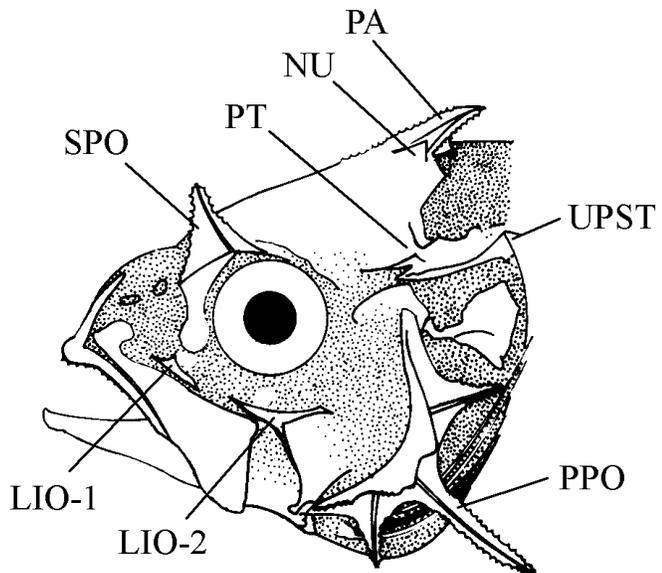
A. 6.4 mmSL

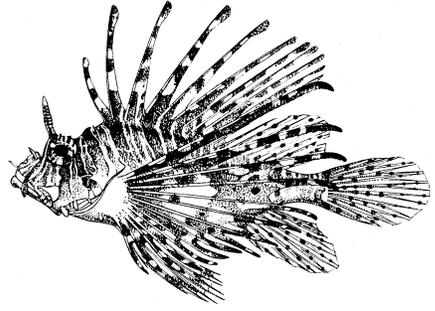


B. 6.4 mmSL (Dorsal View)

**C. 6.4 mmSL
(Head Spines)**

- LIO-1: Lower infraorbital
- LIO-2: Lower infraorbital
- NU: Nuchal
- PA: Parietal
- PPO: Preopercular
- PT: Pterotic
- SPO: Supraocular
- UPST: Posttemporal (upper)



Pterois volitans* (Linnaeus, 1758)*Scorpaenidae****Lionfish (red firefish)**

Range: Central and western Pacific Ocean; introduced into western North Atlantic off east coast of United States where it is apparently established between Long Island, New York and Bermuda to the Bahamas and Florida

Habitat: Benthic on reefs or rock, coral or sand substrates to depth of 50 m; usually solitary

Spawning: Reproduction has not been reported in study area, but may occur off the southeastern United States; groups of 3 to 8 individuals assemble during courtship; seasonality undescribed, but larvae present in eastern Indian Ocean Dec–Jan. (See Note 2, below)

Eggs:

- (Based on congeners):
- Pelagic, embedded in gelatinous matrix
- Diameter: 1.24 mm
- Chorion: smooth, spherical
- Yolk: segmented
- Oil globule: single, pigmented, 0.23 mm
- Perivitelline space: narrow

Meristic Characters

Myomeres:	24
Vertebrae:	24
Dorsal fin rays:	XII–XIII, 9–12
Anal fin rays:	III, 5–8
Pectoral fin rays:	13–17
Pelvic fin rays:	I, 5
Caudal fin rays:	8+7 (PrC)

Larvae:

- Early stages moderately deep-bodied, compressed, with moderately deep caudal peduncle
- Head, eye and mouth very large in early stages; snout slightly longer than eye diameter
- Head length decreases from about 40% SL in flexion stage to about 30% SL in postflexion stage
- Caudal peduncle depth increases from 9.6% SL to 12.0% SL
- Pectoral fin large, wide-based and early forming
- Sequence of fin ray formation: P₁, C – D₂, A – D₁, P₂; pectoral, dorsal, anal and pelvic fin rays complete by 9.5 mmSL
- Head spines well-developed; see checklist below
- Pigment occurs on pectoral fin rays and lower edge of caudal peduncle in flexion and postflexion stages; series of small spots along base of 2nd dorsal fin and over posterior part of anal fin base; melanophores added to mid-line of body, between posterior ends of dorsal and anal fins, in later stages

Head Spine Checklist:

Preopercle: spines along edge prominent in early larvae; size reduced in larger larvae
 Supraocular: ridge with single, simple spine; size reduced in larger larvae
 Parietal: single, stout spine; size reduced in larger larvae

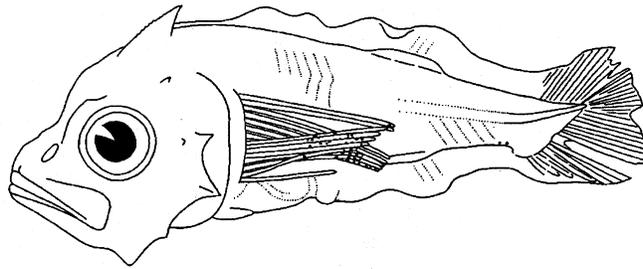
Note:

1. Description is based on the collection of 5 specimens (3.8 mmNL–11.0 mmSL) from northwestern Australia (eastern Indian Ocean). There may be minor ontogenetic differences between these larvae and those from other areas within the range of *P. volitans* but it is unknown whether these differences may pertain to larvae that might be found within the present study area.
2. Most individuals that have been collected in the present study area have been juveniles; those collected or observed south of Cape Hatteras have been adults; settlement to bottom habitats occurs at about 12 mmSL.
3. A congener, *P. miles*, is also suspected to have been introduced into waters off the Atlantic coast of the U.S., but there are no documented specimens and larvae are undescribed.

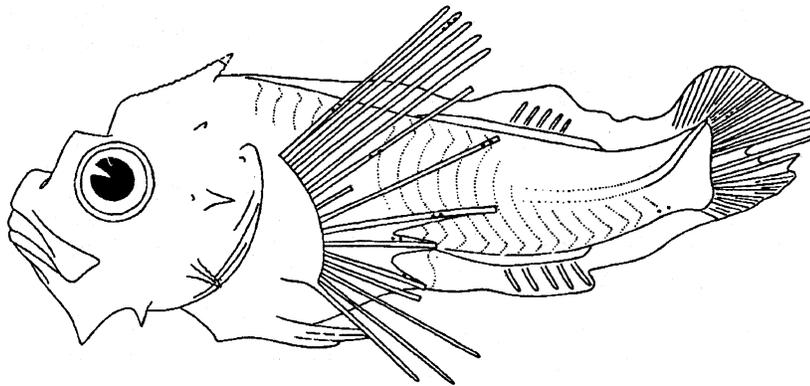
Figures: Adult: Wheeler, 1975; A–C: Imamura and Yabe, 1996

References: Breder and Rosen, 1966; Whitfield *et al.*, 2002; Hare and Whitfield, 2003; Kimball *et al.*, 2004

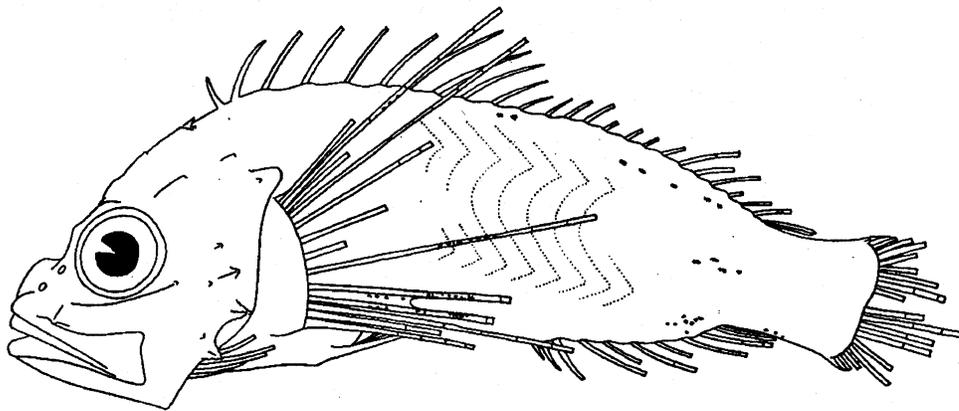
Pterois volitans



A. 3.8 mmSL

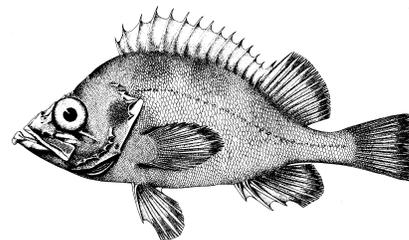


B. 4.5 mmSL



C. 10.7 mmSL

Late stage larvae add the following small head spines: 1st lower infraorbital; 4th upper infraorbital; nuchal; tympanic; 3rd and 4th anterior preopercle; 1st posterior preopercle

Sebastes fasciatus* Storer, 1856*Scorpaenidae****Acadian redfish**

Range: North Atlantic Ocean from Iceland and west Greenland to Long Island, New York and Virginia; most common south and west of Grand Bank; occurs in shallower water where it overlaps with *Sebastes mentella*

Habitat: Benthic, typically over banks, on rocky or muddy substrates, rarely sand, in depths of 70 to 500 m (to a maximum of 592 m)

Spawning: Ovoviviparous; females inseminated during Jun–Aug (rarely to Nov); oocytes fertilized Nov–Feb; larvae released Jun–Aug (rarely to Oct)

Eggs: – Incubate and hatch within the oviduct of female

Larvae:

- Hatching ("birth") occurs at \bar{x} 7.0 mmNL; (considerable geographic variation)
- Body slender, with round head, short gut
- Snout becomes more pointy with development
- Preanus length about 30% NL in preflexion stage, increases to 56% SL in postflexion stage
- Flexion occurs at 8.5–10.0 mm
- Body slightly deeper than that of *Sebastes norvegicus* during flexion and postflexion stages
- Head spines prominent after flexion; see checklist below
- Dorsal and anal fin rays last to form; 3rd anal fin spine and last dorsal fin spine begin as rays and change to spines in early juvenile stage
- Transformation size undescribed
- Pigmentation includes spots on top of head, dorsolateral surface of gut, embedded in nape, and on dorsal and ventral edges of tail; usually 1–2 spots at base of caudal fin rays (rarely 3–4); ventral series of 26–42 spots (\bar{x} = 31–40) extends from postanal myomere 1–4 to postanal myomere 19–23; dorsal series of 3–9 spots extends from postanal myomere 7–14 to postanal myomere 14–22, splitting into 2 lines in larger larvae; entire dorsum pigmented at about 10.8 mm

Meristic Characters

Myomeres:	29–32
Vertebrae:	29–32
Dorsal fin rays:	XIV–XVI, 13–14
Anal fin rays:	III, 6–8
Pectoral fin rays:	17–20
Pelvic fin rays:	I, 5
Caudal fin rays:	8+7 (PrC)

Head Spine Checklist:

Preopercle:	Four to five prominent spines along edge; angle spine slightly longer than upper spine; few smaller spines on lateral ridge
Supraocular:	ridge with small, simple spine
Parietal:	well-developed, simple spine
Nuchal:	very small spine posterior to base of parietal
Pterotic and posttemporal:	very small spines present

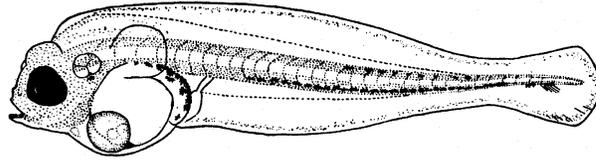
Note:

1. See notes on Scorpaeniformes introductory page summarizing characters for larvae of 4 *Sebastes* species
2. See *Scomber scombrus* page for comparative notes

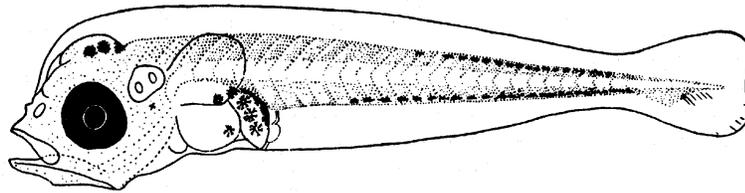
Figures: Adult: Hureau and Litvinenko, 1986; **A–D:** Bigelow and Welsh, 1925

References: Tåning, 1961; Moser *et al.*, 1977; Penney, 1985; 1987; Hureau and Litvinenko, 1986; Klein-M^{ac}Phee and Collette, 2002a

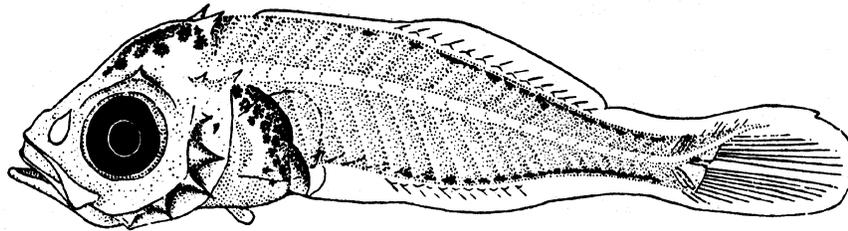
Sebastes fasciatus



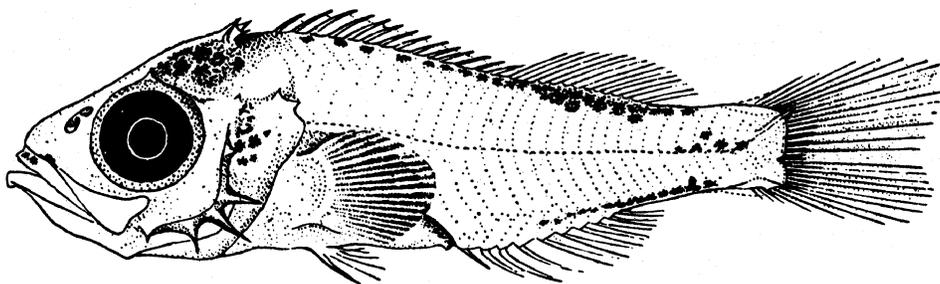
A. 6.0 mm



B. 9.0 mm

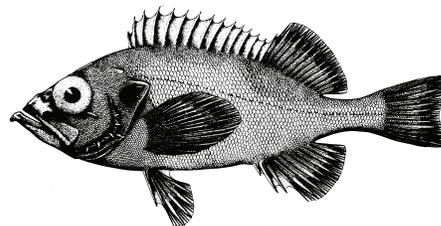


C. 12.0 mm



D. 20.0 mm

See notes on *Sebastes mentella* figure page

Sebastes mentella* Travin, 1951*Scorpaenidae****Deep-water redfish**

Range: North Atlantic Ocean from Barents Sea and Norwegian Sea to Iceland and coasts of Greenland; in the western North Atlantic from Baffin Island south to Long Island, New York

Habitat: Benthic in depths of 300–910 m

Spawning: Ovoviviparous; females inseminated during Sep–Dec (Iceland); oocytes fertilized Jan–Feb; larvae released Apr–Jun; (on Flemish Cap, 97% of larvae extruded before May 2 are *S. mentella*)

Eggs: – Incubate and hatch within the oviduct of female

Larvae:

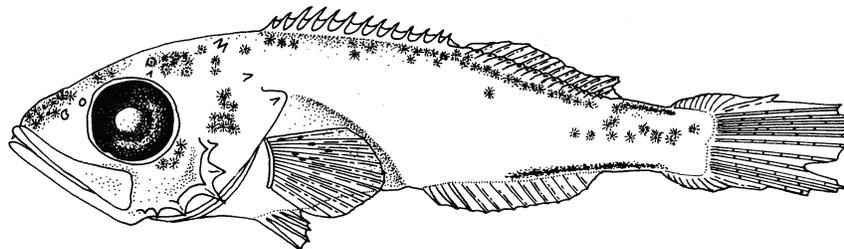
- Hatching ("birth") occurs at 6.0–8.9 mmTL (considerable geographic variation)
- Body slender with rounded head, short gut; head becomes more pointy with development
- Preanus length increases from 36% SL in preflexion stage to 54% SL in postflexion stage
- Head length increases from 20% SL in preflexion stage to 32% SL in postflexion stage
- Body depth through pectoral fin base increases from 18% SL to 24% SL through development
- Flexion occurs at 10.5–14.8 mm
- Head spines well-developed; see checklist below
- Sequence of fin ray formation: $C_1 - P_1 - C_2 - D_2, A, P_2 - D_1$; ossification of all fin spines and rays not complete until > 25 mm; 3rd anal fin spine and last dorsal fin spine begin as rays and change to spines in early juvenile stage
- Transformation occurs at about 25 mm
- Pigmentation includes melanophores on top of head, dorsolateral surface of gut and along dorsal and ventral edges of tail; latter 2 series increase in length during development, until dorsal pigment extends from nape to caudal fin base at about 15.0 mm; usually no spot ventral to tip of notochord; pigment on sides of caudal peduncle forms during flexion, spreads in later stages

Meristic Characters

Myomeres:	30–31
Vertebrae:	(29) 30–31
Dorsal fin rays:	XIV–XVI, 14–15
Anal fin rays:	III, 8–10
Pectoral fin rays:	18–20
Pelvic fin rays:	I, 5
Caudal fin rays:	8+7 (PrC)

Head Spine Checklist:

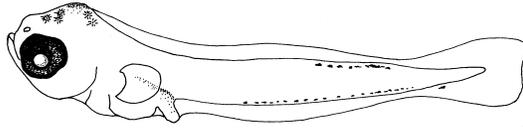
Preopercle:	strong spines along edge begin forming in preflexion stage; few small spines on lateral ridge
Supraocular:	very small spine
Parietal:	small, simple spine forms at about 15.0 mmSL
Nuchal:	small spine forms at about 11.0 mmSL; (nuchal and parietal spines fuse >20.0 mmSL)
Opercle:	small spine at upper angle
Pterotic and posttemporal:	small pterotic spine forms in preflexion, small posttemporal spine after flexion

Early Juvenile:**H. 24.2 mm** Pelagic juvenile stage

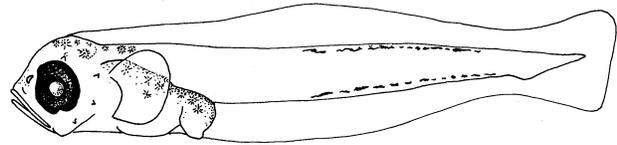
Figures: Adult: Hureau and Litvinenko, 1986; A–H: Stephan Stephan (Penney, 1987)

References: Templeman and Sandeman, 1959; Tåning, 1961; Barsukov, 1968; Barsukov and Zakharov, 1972; Litvinenko, 1974; Moser *et al.*, 1977; Templeman, 1980; Ni, 1981a, 1981b; Penney *et al.*, 1984; Penney, 1985; 1987; Hureau and Litvinenko, 1986; Klein-M^{ac}Phee and Collette, 2002a

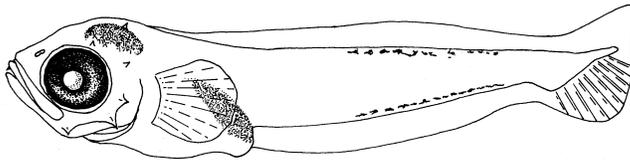
Sebastes mentella



A. 7.0 mm



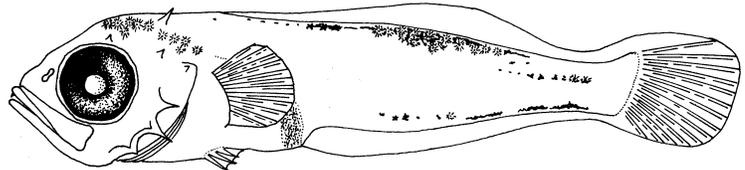
B. 9.9 mm



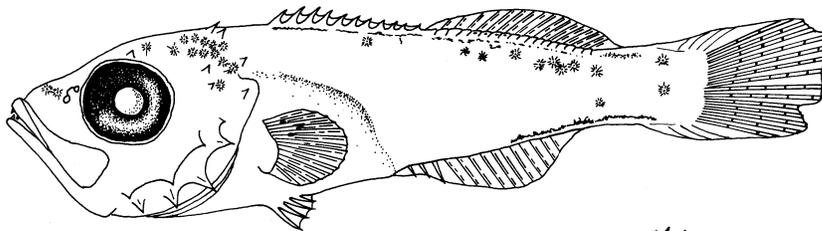
C. 11.6 mm

Discrete melanophores in nape region become embedded during flexion

Anal fin ray counts may separate *Sebastes mentella* from *S. fasciatus* in larvae >13.0 mmNL

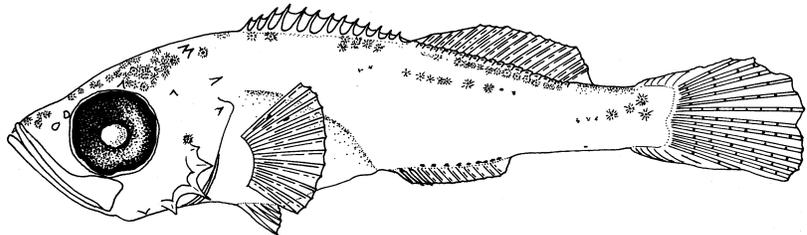


D. 15.0 mm

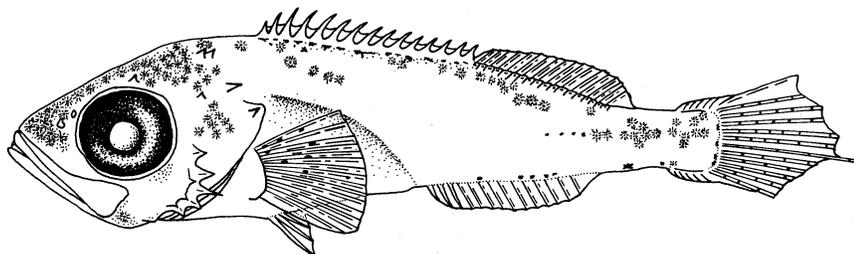


E. 18.5 mm

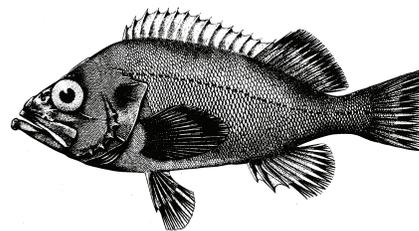
Some pigment occurs on rays and membrane of pectoral fin (not present in *S. fasciatus* or *S. norvegicus*)



F. 22.0 mm



G. 22.7 mm

Sebastes norvegicus* (Ascanius, 1772)*Scorpaenidae****Golden redfish**

Range: Eastern North Atlantic Ocean, rarely occurring west of Flemish Cap; occasional collections off Maine or Massachusetts

Habitat: Benthic in depths of 100–1,000 m; juveniles in shallower water in fjords, bays and coastal waters

Spawning: Ovoviviparous; females inseminated during Oct–Jan (Greenland and Iceland); larvae released Apr–Jun (as late as Aug)

Eggs: – Incubate and hatch within the oviduct of female

Larvae: – Hatching ("birth") occurs at 6.7–7.2 mm, eyes pigmented, mouth well-developed

– Body slender, with round head, short gut

– Preanus length increases from 35% SL during preflexion to 58% SL during postflexion

– Flexion occurs at 8.5–11.8 mm

– Dorsal and anal fin rays last to form; 3rd anal fin spine and last dorsal fin spine begin as rays and change to spines in early juvenile stage

– Head spines well-developed; see checklist below

– Transformation occurs at about 24.0 mm

– Pigmentation includes melanophores on top of head, embedded in nape, on dorsolateral surface of gut and on dorsal and ventral midlines of tail; spots at base of caudal fin rays missing in most specimens, rarely up to 3 present; ventral series of 9–24 spots (\bar{x} = 18) extends from postanal myomere 4–7 to postanal myomere 19–22; dorsal series of 8–21 spots (\bar{x} = 13) extends from postanal myomere 10–15 to postanal myomere 18–22

Meristic Characters

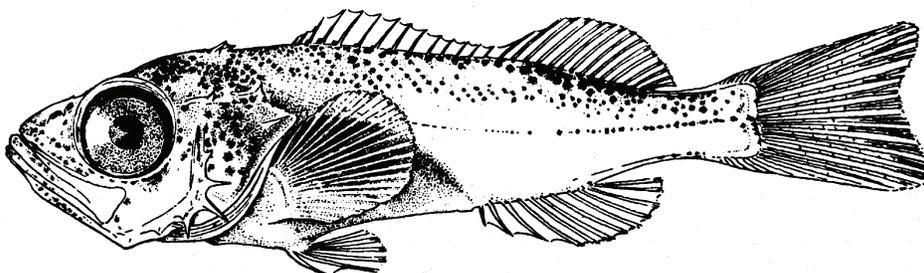
Myomeres:	30–31
Vertebrae:	30–31
Dorsal fin rays:	XIV–XVI, 13–17
Anal fin rays:	III, 7–10
Pectoral fin rays:	18–21
Pelvic fin rays:	I, 5
Caudal fin rays:	8+7 (PrC)

Head Spine Checklist:

Preopercle:	spines well-developed along edge; angle spine slightly longer than others; few small spines on lateral ridge
Supraocular:	single, tiny spine
Parietal:	strong spine forms after flexion
Nuchal:	tiny spine posterior to base of parietal spine
Pterotic and posttemporal:	small spines present after flexion
Opercle:	tiny spine at upper angle

Early Juvenile: Pelagic juvenile stage from 24.0–52.0 mm; note increase in dorsal pigment under 2nd dorsal fin

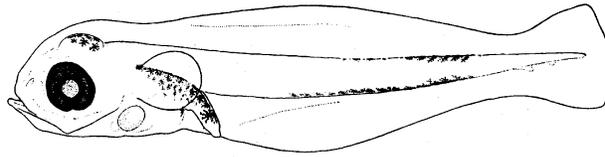
E. 27.0 mmSL



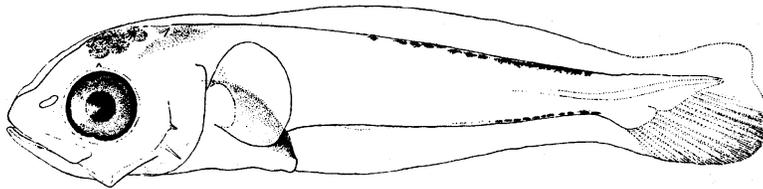
Figures: Adult: Hureau and Litvinenko, 1986; A–E: Tåning, 1961

References: Tåning, 1961; Moser *et al.*, 1977; Hureau and Litvinenko, 1986; Klein-M^{ac}Phee and Collette, 2002a

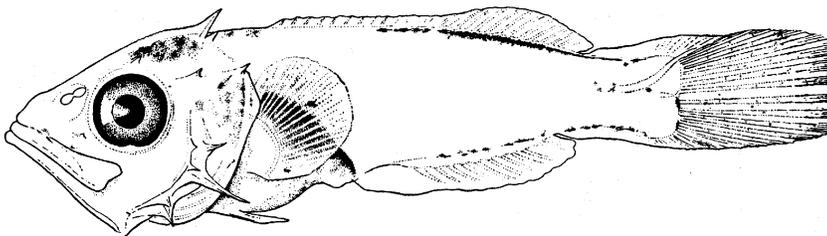
Sebastes norvegicus



A. 6.8 mmSL

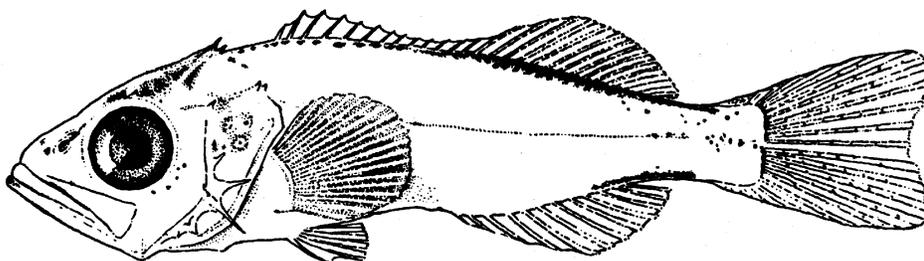


B. 10.5 mmSL



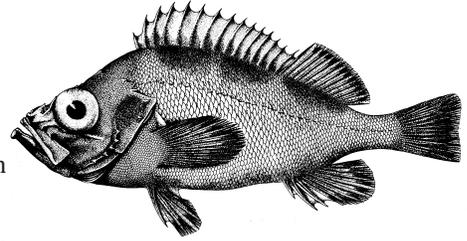
C. 15.7 mmSL

Tiny infraorbital spine may be present (illustrated, but not described)



D. 20.9 mmSL

See notes on Scorpaeniformes introductory page summarizing characters for larvae of four *Sebastes* species

Sebastes viviparus* Krøyer, 1845*Scorpaenidae****Small redfish**

Range: Eastern North Atlantic Ocean, rarely reaching as far west as southern Greenland

Habitat: Benthic over rocky bottoms, in depths of 10–150 m (rarely to 760 m); usually close to shore

Spawning: Ovoviviparous; season females inseminated unknown; larvae released May–Aug

Eggs: – Incubate and hatch within the oviduct of female

Larvae: – Hatching ("birth") occurs at 5.4 mm, eyes pigmented, mouth well-developed
– Body slender, with round head, short gut
– Preanus length increases from 30% SL to about 50% SL during larval stages

– Flexion occurs at 7.8–10.6 mm

– Head spines well-developed; see checklist below

– Dorsal and anal fin rays last to form; 3rd anal fin spine and last dorsal fin spine begin as rays and change to spines in early juvenile stage

– Transformation size undescribed

– Pigmentation includes melanophores on top of snout (usually absent in *Sebastes norvegicus* larvae); spots also on top of head, nape, dorsolateral (and ventral) surfaces of gut, and on dorsal and ventral edges of body; a single melanophore at mid-base of caudal fin; medial surface of pectoral fin base, and bases of pectoral fin rays, pigmented in larvae 6.0–10.6 mm; ventral series of 18–29 spots (\bar{x} = 25) (more numerous than in *Sebastes norvegicus*) extends from myomere 3 or 4 to myomere 19 or 21 (the latter numbers based on a small sample of larvae); dorsal series of spots begins in the 3rd quarter of body, extends anteriorly and posteriorly

Meristic Characters

Myomeres: 29–31

Vertebrae: 29–31

Dorsal fin rays: XIV–XVI, 12–15

Anal fin rays: III, 6–8

Pectoral fin rays: 16–19

Pelvic fin rays: I, 5

Caudal fin rays: 8+7 (PrC)

Head Spine Checklist:

Preopercle: well-developed spines along edge, angle spine longest; few small spines on lateral ridge

Supraocular: single moderate spine

Parietal: small but prominent spine

Nuchal: not described or illustrated but may be present posterior to base of parietal

Pterotic and posttemporal: small spines; pterotic forms during flexion

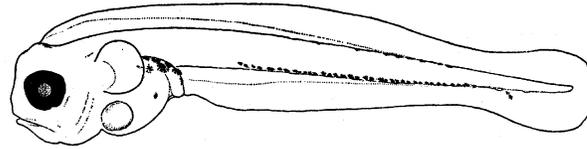
Opercle: small spine at upper angle

- Note:**
1. See notes on Scorpaeniformes introductory page summarizing characters for larvae of four *Sebastes* species
 2. "Birth" and flexion occur at smaller sizes than in *Sebastes norvegicus*; relative eye size, body depth and depth at pectoral fin base are greater than in comparably sized larvae of *Sebastes norvegicus*

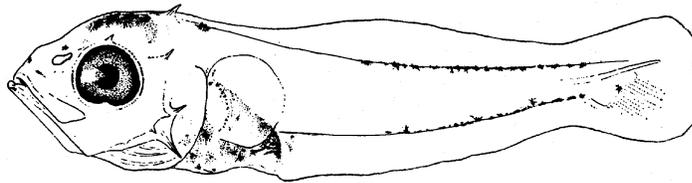
Figures: Adult: Hureau and Litvinenko, 1986; **A–D:** Tåning, 1961

References: Tåning, 1961; Moser *et al.*, 1977; Hureau and Litvinenko, 1986; Klein-M^{ac}Phee and Collette, 2002a

Sebastes viviparus



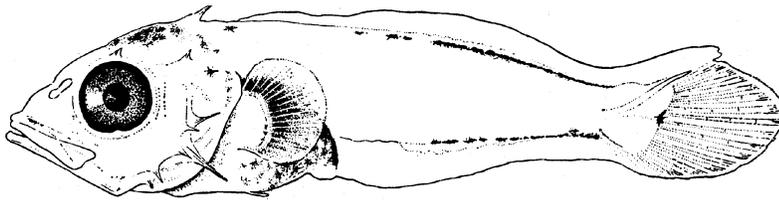
A. 5.8 mm



Note ventral surface of gut pigmented

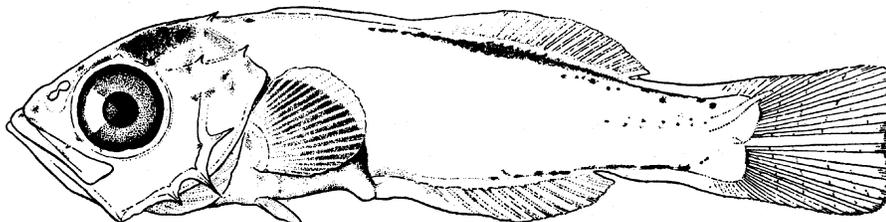
B. 8.9 mm

Preopercle spines more prominent than in *Sebastes norvegicus*



C. 10.1 mm

Pigment on pectoral fin base and rays (pigment may be present on pectoral fin rays and membranes in *S. mentella*)



D. 13.5 mm

See notes on *Sebastes mentella* figure page

***Peristedion* sp.**
Triglidae
 Armored searobin

Range: Several species in the genus *Peristedion* occur in the study area from the edges of the continental shelf and Georges Bank into tropical waters; *P. miniatum* occurs from Canadian Atlantic to Brazil

Habitat: Benthic, occurring in depths >100 m to nearly 1,000 m; typically collected from areas in or near submarine canyons

Spawning: Undescribed; larvae rarely collected in study area

Eggs: – Undescribed

Larvae:

- Very narrow, compressed, elongate body with prominently spiny l
- Head profile strongly concave
- Filamentous chin barbel may be present
- Upper fin rays of pectoral fin may be elongate and may include prominent pigment patches on fin membrane
- Head spines prominent; see checklist below
- Pigment typically consists of blotches on tail

Head Spine Checklist:

Preopercle: three stout spines along edge, oriented in different directions; lateral ridge spines also large

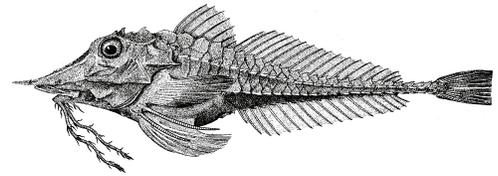
Supraocular: very well-developed, broad-based, serrated spine

Nuchal: described as very large, serrated, but description may refer to parietal, with very small nuchal spine posterior to its base

Infraorbital: series of spines on both upper and lower infraorbital bones

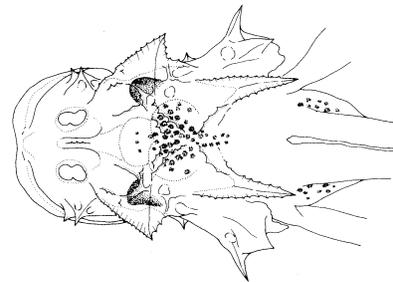
Note: 1. Species in *Peristedion* are divided into those with wide heads and those with narrow heads; see examples of both on figure page (Figs. **D** and **F**)

Early Juvenile:

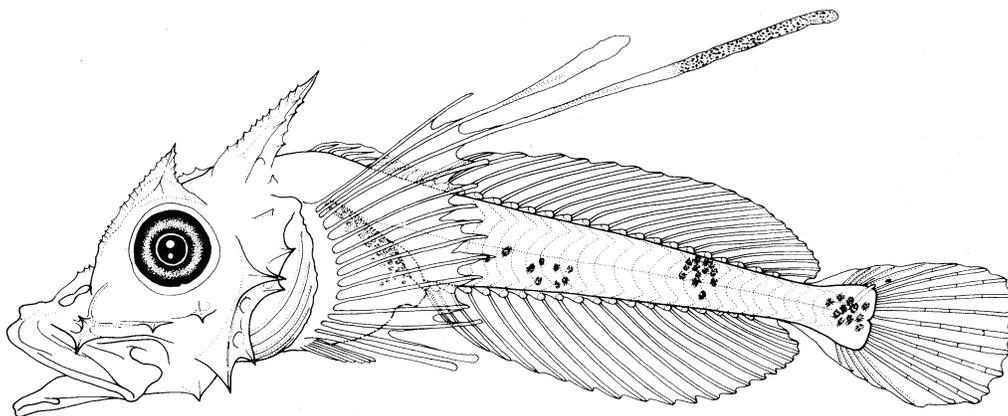


Meristic Characters

See Table in Scorpaeniformes
 Introductory pages for meristic
 characters in *Peristedion* species



G. 12.4 mmSL (Dorsal View of Head)

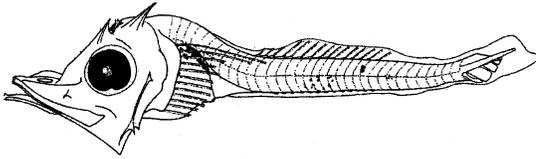


H. 12.4 mmSL (*Peristedion* sp. from Pacific Ocean)

Figures: Adult (*P. miniatum*): H. L. Todd (Bigelow and Schroeder, 1953); **A–F**: Richards, 2006a; **G–H**: Okiyama, 1988

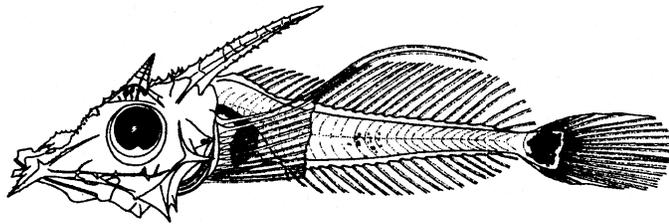
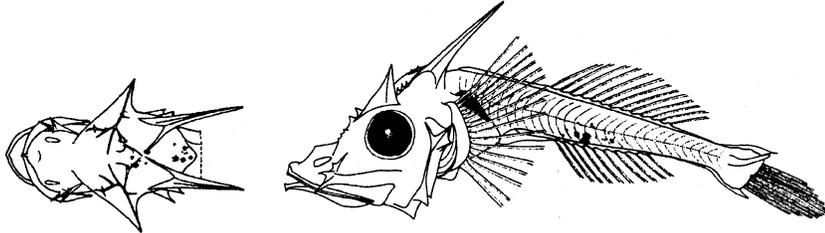
References: Okiyama, 1988; Richards, 2006a

Peristedion sp.

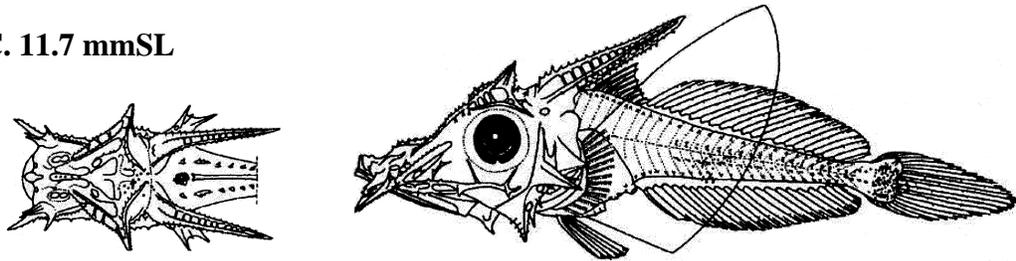


A. 6.2 mmNL

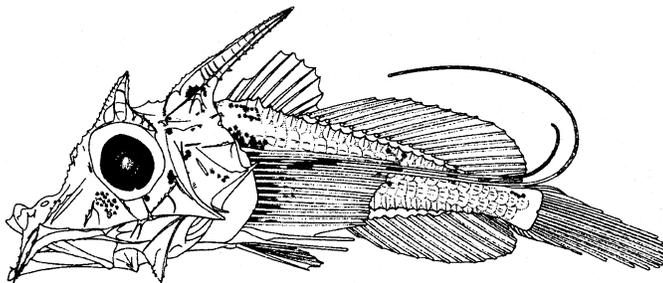
**B. 8.0 mmSL
(Dorsal Head and
Lateral View)**



C. 11.7 mmSL

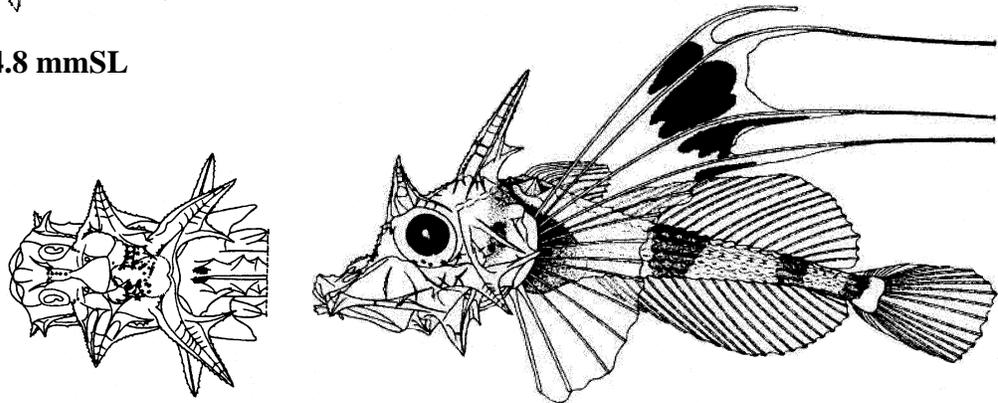


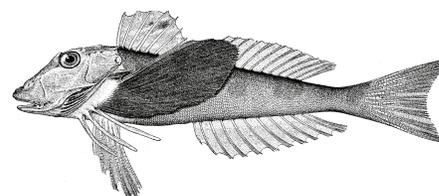
D. 12.5 mmSL (Dorsal Head and Lateral View)



E. 14.8 mmSL

**F. 19.8 mmSL
(Dorsal Head
and Lateral
View)**



Prionotus carolinus* (Linnaeus, 1771)*Triglidae****Northern searobin**

Range: Western North Atlantic Ocean from Bay of Fundy to Florida

Habitat: Benthic from estuaries to continental shelf edge; mostly on sand

Spawning: May–Oct with peak in Jul

Eggs: – See Table below

Larvae: – See Table below (and *P. evolans* page for characters in flexion-postflexion and juvenile stages)

Meristic Characters

Myomeres:	26
Vertebrae:	26
Dorsal fin rays:	X, 13–14
Anal fin rays:	12
Pectoral fin rays:	14+3
Pelvic fin rays:	I, 5
Caudal fin rays:	9–10+7+6+9–10

Character (Eggs)	<i>Prionotus carolinus</i>	<i>Prionotus evolans</i>
Diameter	0.86–0.97 mm (also reported 1.0–1.5 mm)	1.05–1.25 mm
Chorion	No pigment, light sculpting	Same
Oil globules	11–37 in 1 hemisphere	16–37 in 1 hemisphere
Perivitelline space	Very narrow	Same
Incubation	60 h @ 15–22°C	80–90 h @ 19–20°C
Size at Hatch	3.0 mmNL (± 0.09)	2.8 mmNL (± 1.77)

Character (Preflexion-Flexion)

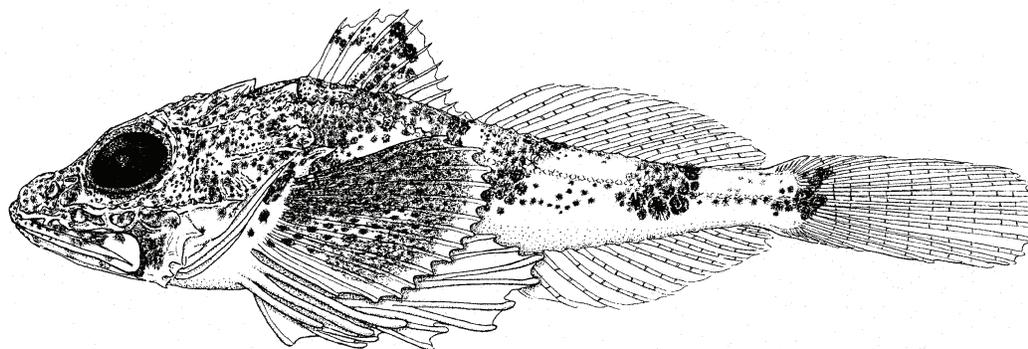
Nuchal spine	Forms early (4.0 mmSL) then double spines (at 6.5 mmSL)	Forms later (6.0 mmSL) then develops stout ridge (>6.5 mmSL) with supporting struts
Teeth formed	Early	Later
Depth at cleithrum	Deep	Very deep
Occiput shape	Concave	Strongly concave
Early pectoral fin rays	Long	Very elongate
Size at flexion	6.0–7.0 mm	6.0–7.0 mm

Early Juvenile:

Settle to bottom
at 7–12 mmSL

Occur in
estuaries
Apr–Jun

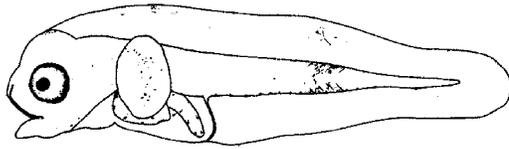
Modal size at
12 months: 75 mm

**F. 12.0 mmSL**

Figures: Adult: H. L. Todd); A–E: Susan C. Roberts (Fahay, 1983); F: Susan Kaiser (Able and Fahay, 1998)

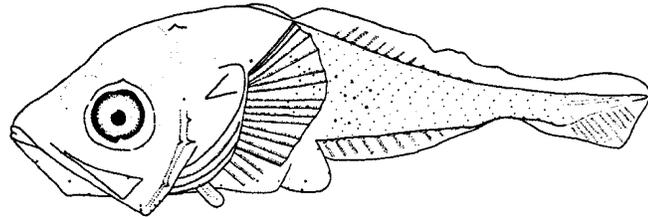
References: Yuschak and Lund, 1984; M^cBride and Able, 1994; Able and Fahay, 1998; Klein-M^{ac}Phee and M^cBride, 2002

Prionotus carolinus

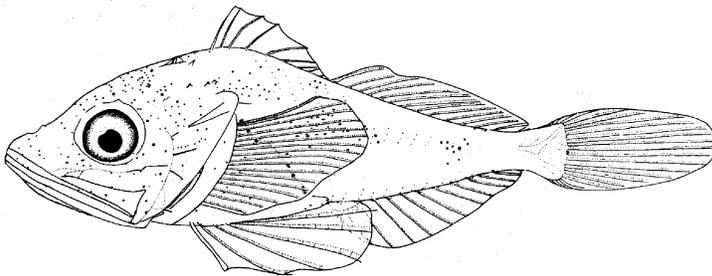


A. 2.8 mmNL

Pigment in early stages very light and fine

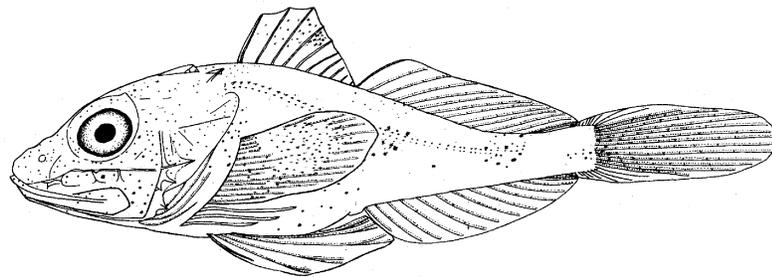


B. 5.2 mmNL

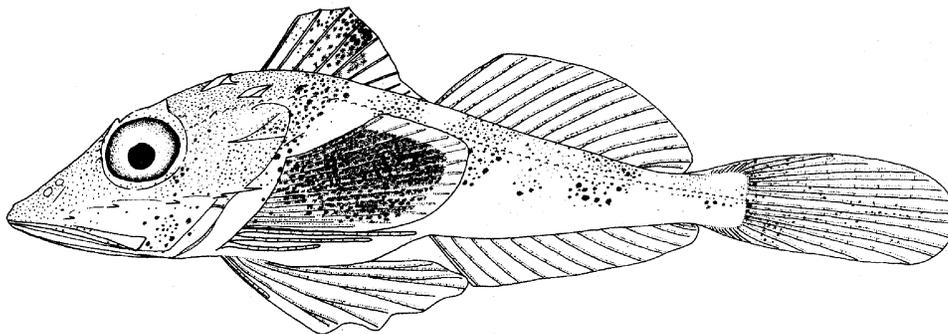


C. 8.6 mmSL

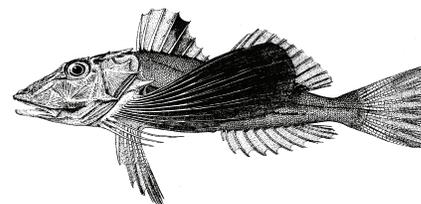
Note early forming, large, pectoral fins with characteristic pigment patterns; lowermost 3 fin rays eventually separate from rest of fin; strong head spines include bony ridge over eye with strengthening rods or "struts"; body cross-section triangular (widest ventrally)



D. 12.0 mmSL



E. 26.7 mmSL

Prionotus evolans* (Linnaeus, 1766)*Triglidae****Striped searobin**

Range: Western North Atlantic Ocean from Cape Cod (rarely Bay of Fundy) to South Carolina

Habitat: Benthic from estuaries to continental shelf edge; mostly on sand bottom; tends to occur in warmer, less oxygenated, more turbid habitats than *P. carolinus*

Spawning: May–Oct with peak in Jul–Aug

Eggs: – See Table on *P. carolinus* page

Larvae: – See Table below (and *P. carolinus* page for preflexion-flexion stages)
– Preflexion larvae often exhibit a row of fine, unevenly spaced spots along venter of tail, a short row of 3–4 spots midlaterally above anus, spots along edges of maxillae and a few spots on gular membrane (not illustrated)

Meristic Characters

Myomeres:	26
Vertebrae:	26
Dorsal fin rays:	X, 13–14
Anal fin rays:	11
Pectoral fin rays:	13+3
Pelvic fin rays:	I, 5
Caudal fin rays:	10–11+7+6+9–11

Character (Flexion-Postflexion)	<i>Prionotus carolinus</i>	<i>Prionotus evolans</i>
Flexion size	6.7–7.5 mmSL	5.4–6.8 mmSL
Pectoral fin rays (late stages)	Pigmented upper rays	Dark pigment over-all
Pectoral fin ray number	14+3	13+3
Anal fin ray number	12	11
Parietal spiny ridge	Absent	Present (anterior to nuchal spine)
Anterior teeth	Slightly expressed	Pronounced

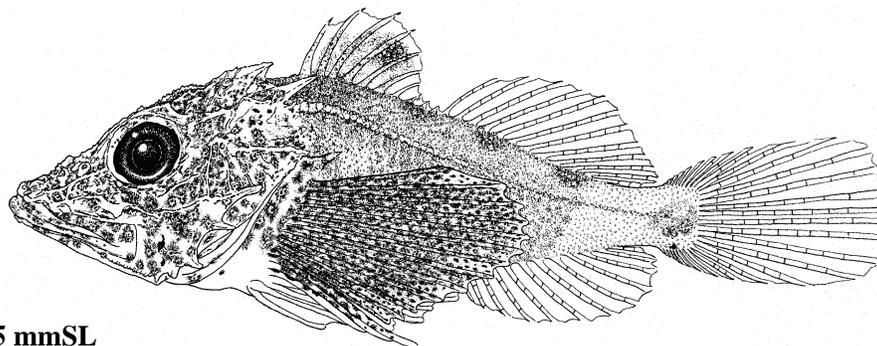
Character (Late postflexion-Juvenile)	<i>Prionotus carolinus</i>	<i>Prionotus evolans</i>
Pectoral fins	Extend to anal fin origin	Extend beyond anal fin origin
Head spines	Slightly developed	Well-developed
Body pigment	2 saddles dorso-laterally	Dark with lighter caudal peduncle
Subocular spine	Present (>7.0 mmSL)	Absent
Nasal spine	Absent	Present (>7.0 mmSL)
Spinous scales	Absent	Present over body, >10 mmSL

Early Juvenile:

Settle to bottom at 7–12 mmSL

Occur in estuaries Jul–Dec

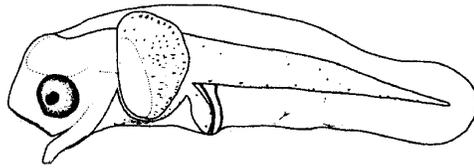
Modal size at 12 months: 90 mm

**H. 12.5 mmSL**

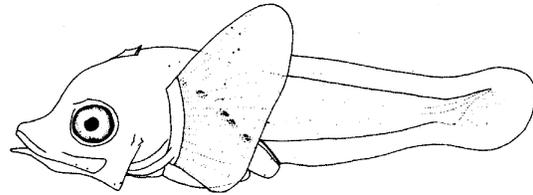
Figures: Adult: H. L. Todd (Klein-M^{ac}Phee and M^cBride, 2002); A–G: Susan C. Roberts (Fahay, 1983); H: Susan Kaiser (Able and Fahay, 1998)

References: Yuschak, 1985; M^cBride and Able, 1994; Able and Fahay, 1998; Klein-M^{ac}Phee and M^cBride, 2002

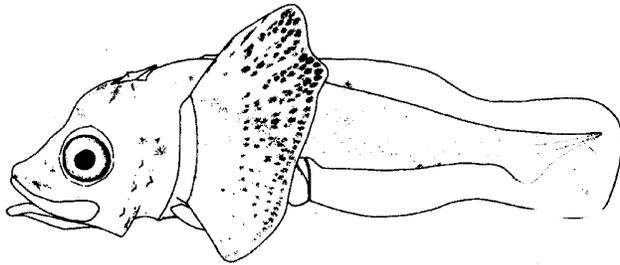
Prionotus evolans



A. 2.7 mmNL



B. 5.3 mmNL

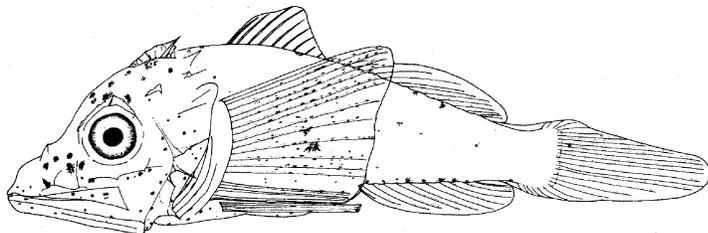
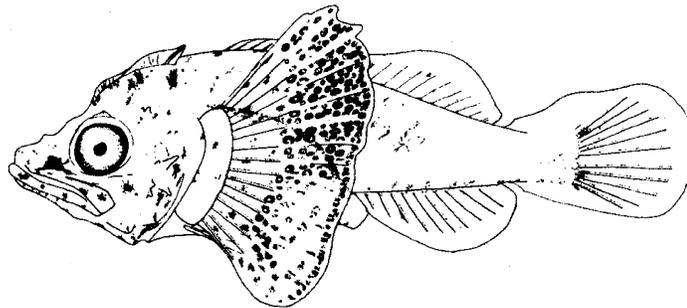


C. 6.3 mmNL

Note early forming, large, pectoral fins with characteristic pigment patterns; lowermost 3 fin rays eventually separate from rest of fin; strong head spines include bony ridge over eye with strengthening rods or "struts"; body cross-section triangular (widest ventrally)

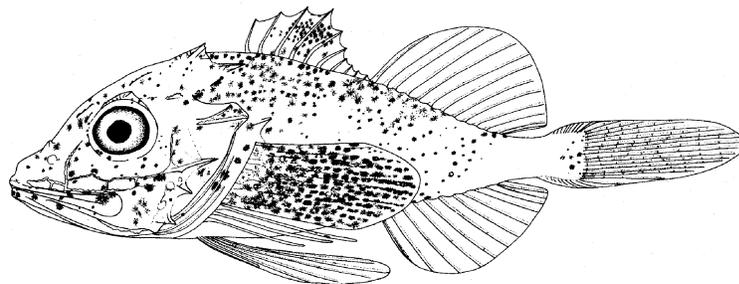
Pigment in early stages very light and fine

D. 7.2 mmSL

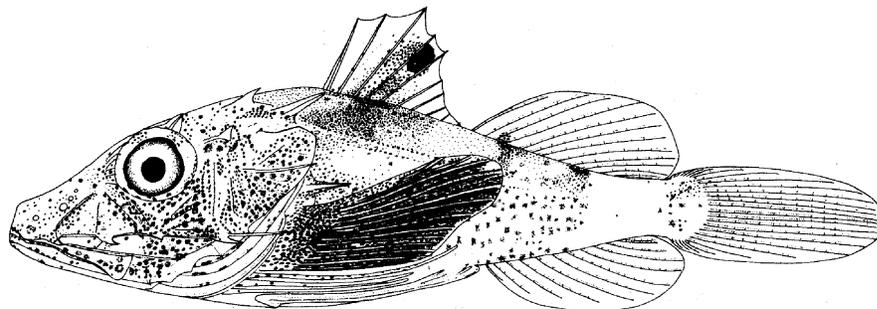


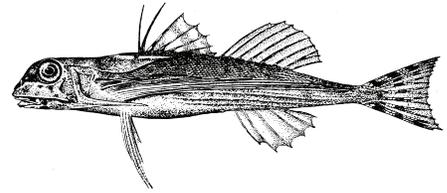
E. 8.7 mmSL

F. 12.5 mmSL



G. 24.8 mmSL



Dactylopterus volitans* (Linnaeus, 1758)*Dactylopteridae****Flying gurnard**

Range: Both sides of Atlantic Ocean; in the western Atlantic from Massachusetts and Bermuda to Argentina, including Gulf of Mexico and Caribbean Sea

Habitat: Benthic in coastal areas on sand or mud bottoms in depths <80 m

Spawning: Undescribed; (ripe females Jun–Jul in Mediterranean Sea)

Eggs:

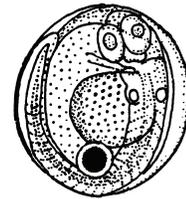
- Slightly off-round
- Diameter: 0.80 × 0.76 mm
- Oil globule: single, reddish, 0.14 mm in diameter
- Perivitelline space: very narrow

Larvae:

- Hatching occurs at sizes <2.0 mm; eye pigmented
- Body moderately elongate with rounded head; preanus length about 50% SL
- Body and head deepen early in development
- Head spines unique; see checklist below
- Rostral spine not present (as in holocentrids and istiophorids)
- Pigmentation includes a row of melanophores along ventral edge of tail; pigment concentrated around head and bases of elongate spines; later larvae densely pigmented over-all, except for clear area on caudal peduncle, which acquires pigment later

Meristic Characters

Myomeres:	22
Vertebrae:	22 (first 4 fused)
Dorsal fin rays:	VII, 8
Anal fin rays:	6
Pectoral fin rays:	6+26–30
Pelvic fin rays:	I, 4
Caudal fin rays:	6+5

**Head Spine Checklist:**

Preopercle: spine at angle greatly enlarged, develops secondary, hook-like spines near tip
 Supraocular: well-developed, broad-based spine in early larvae, becomes reduced in size
 Parietal: small spine at base of nuchal spine
 Nuchal: greatly enlarged spine with few serrations along edge

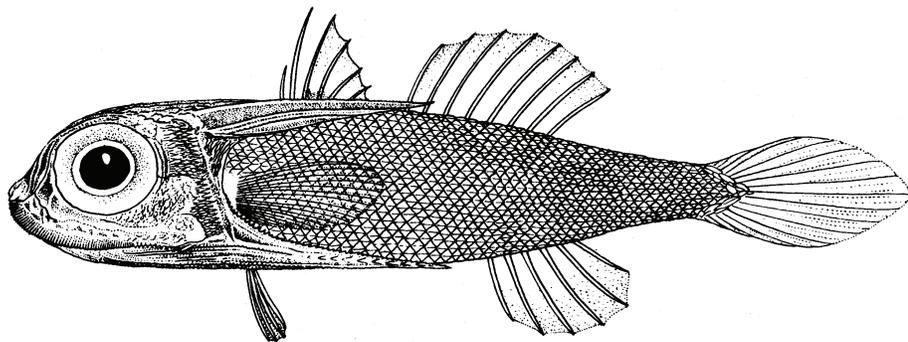
Note: 1. First 4 vertebrae become fused together during development; therefore, some accounts report fewer vertebrae

2. See *Lopholatilus chamaeleonticeps* page for comments on phylogenetic position of Dactylopteridae

Early Juvenile:

Older juveniles develop dark saddles on dorsum of body, silvery sides and very long pectoral fins; anterior 2 dorsal spines held upright

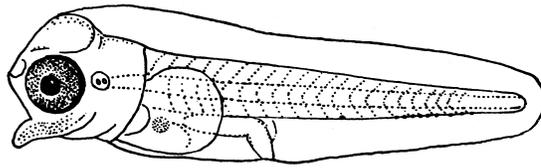
E. 25.0 mmSL



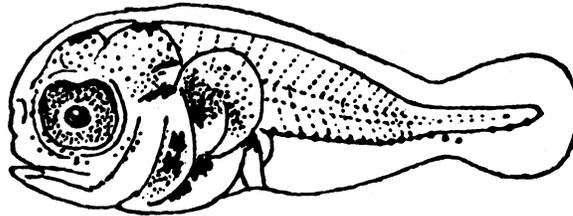
Figures: Adult: H. L. Todd (Smith-Vaniz, 2002a); egg and **B**: Padoa, 1956c; **A, C–D**: Sanzo, 1934 (**D** redrawn); **E**: Fowler, 1945

References: Sanzo, 1934; 1939; Padoa, 1956c; Imamura, 2000; Smith-Vaniz, 2002a

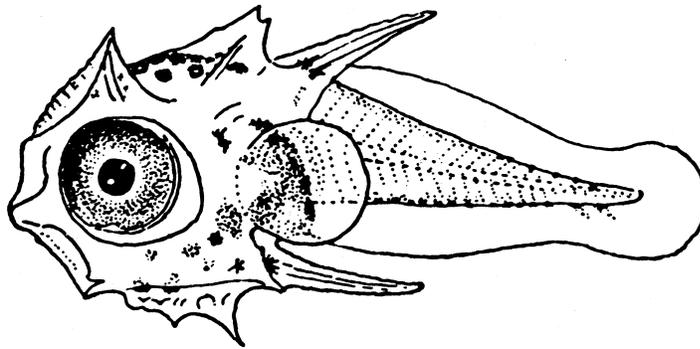
Dactylopterus volitans



A. 1.8 mmNL

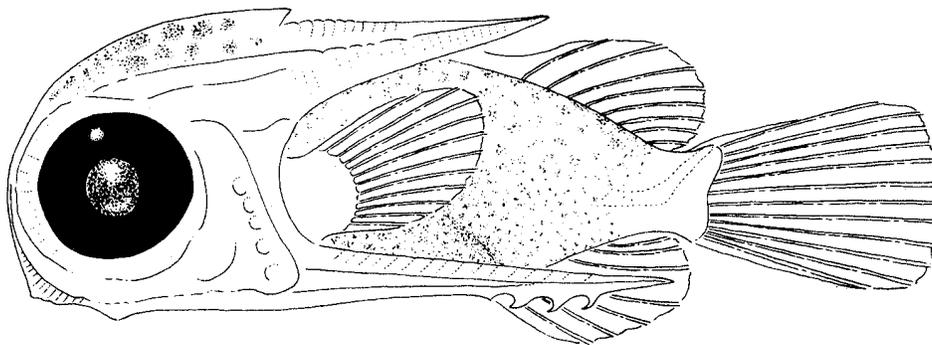


B. 1.9 mmNL

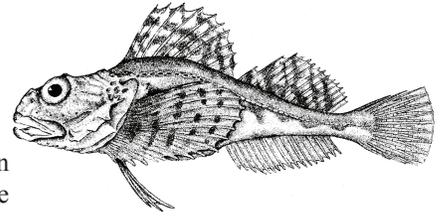


C. 2.4 mmNL

The greatly elongate nuchal spine has been interpreted as a posttemporal spine in the closely related, Indo-Pacific genus *Dactyloptena* (Leis and Rennis, 2004h)



D. 7.5 mmSL

Gymnocanthus tricuspis* (Reinhardt, 1832)*Cottidae****Arctic staghorn sculpin**

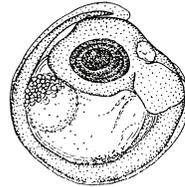
Range: Circumpolar; in the western North Atlantic from Hudson Bay and Baffin Island to Labrador and Newfoundland; rare in Bay of Fundy and a single record off Maine

Habitat: Benthic in cold waters (<5.0°C) on rocky or sandy substrates in depths of 18–174 m, rarely shallower

Spawning: Details not well known; gravid females collected during fall off Newfoundland; eggs deposited in clumps; incubation period is long (e.g. 80+ days at 1.2–1.6°C)

Eggs:

- Demersal, spherical
- Chorion: smooth, transparent
- Diameter: 1.8–1.9 mm
- Yolk: homogeneous
- Oil globule: single, straw colored, 0.41–0.52 mm
- Perivitelline space: narrow

**Meristic Characters**

Myomeres:	36–40
Vertebrae:	36–40
Dorsal fin rays:	X–XII, 14–17
Anal fin rays:	15–19
Pectoral fin rays:	17–21
Pelvic fin rays:	I, 3
Caudal fin rays:	6+6 (PrC)

Larvae:

- Hatching occurs at size of about 7.0 mm; eyes darkly pigmented; only other pigment on peritoneum
- Preflexion larvae have 8 preanal myomeres, 23–29 postanal myomeres
- Body moderately slender with rounded snout, becomes pointy in later stages
- Preanus length initially <33% SL; increases slightly to about 40% SL
- Dorsal fin rays form before spines; pelvic fin rays form last
- Finfolds between dorsal, anal and caudal fins persist to relatively large size
- Flexion occurs at about 12–13 mmSL
- Head spines moderate; see checklist below
- Heavy pigment in 'shield' over dorsolateral gut; a series of melanophores along ventral edge of tail; dorsal edge of body develops series of spots under dorsal fin base, extends posteriorly to include dorsum of caudal peduncle; other pigment includes scattering of prominent melanophores on top of head and nape, a cluster on base of pectoral fin (begins as single, bold melanophore in preflexion larvae), another cluster at base of caudal fin; few spots along midline of body in later larvae

Head Spine Checklist:

Preopercle: four spines situated along edge; upper spine of series curves upwards slightly, becomes branched and antler-like in adults

Supraocular: spine develops in late larvae

Parietal: spine develops in late larvae

Nuchal: spine develops in late larvae

Nasal: spine develops in late larvae

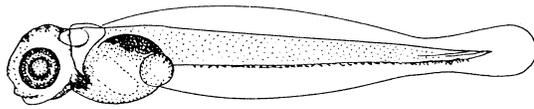
Note:

1. See note on *Icelus bicornis* figure page regarding characters of cottid larval groups
2. Spelled "*Gymnacanthus*" by some authors

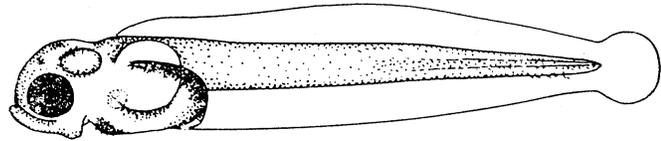
Figures: Adult: D. R. Harriott (Scott and Scott, 1988); A–E: Norvillo and Zhuravleva, 1989; F: Khan, 1972 (modified); G: Dunbar, 1947

References: Dunbar, 1947; Ennis, 1969; Khan, 1972; Scott and Scott, 1988; Norvillo and Zhuravleva, 1989

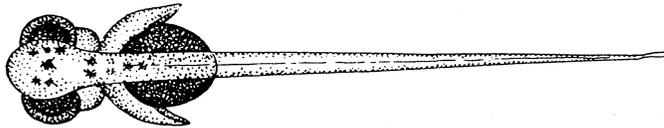
Gymnocanthus tricuspis



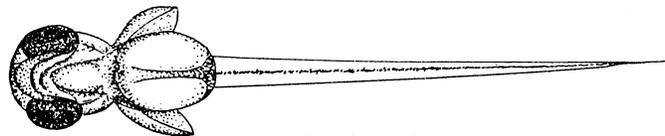
A. 7.2 mm



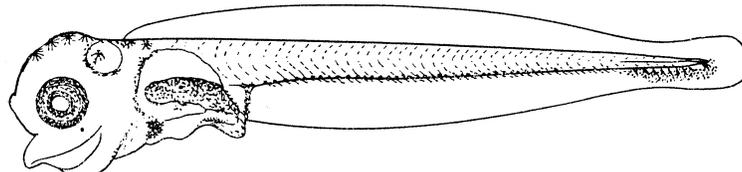
B. 8.2 mm



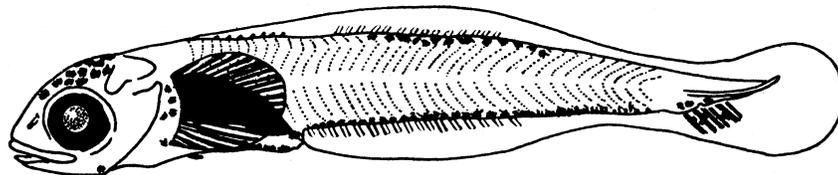
C. 8.2 mm (Dorsal View)



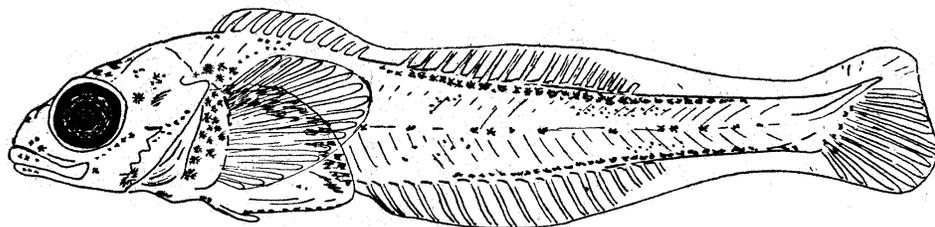
D. 8.2 mm (Ventral View)



E. 8.3 mm



F. 13.0 mm



G. 17.5 mmSL

Hemitripteris americanus* (Gmelin, 1789)*Cottidae****Sea raven**

Range: Atlantic coast of North America from Labrador to Chesapeake Bay; common off Nova Scotia, uncommon off Newfoundland

Habitat: Benthic on rocky or other hard substrates in depths of 2–91 m (one record at 192 m); preferred temperatures range from near freezing to 16°C

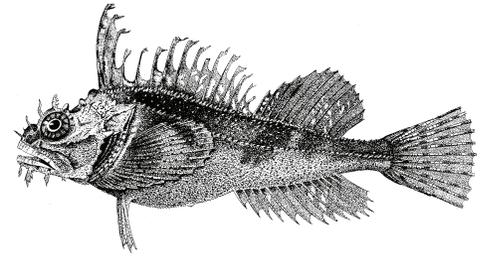
Spawning: Late fall to early winter (southern New England waters); eggs deposited in clumps, often on sponge (*Chalina* sp.)

Eggs:

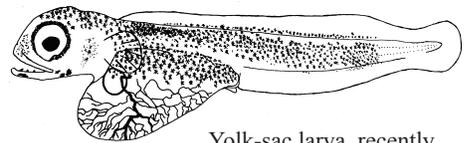
- Demersal, spherical, adhesive
- Diameter: 3.7–4.1 mm
- Chorion: thick, tough, pale yellow to light orange
- Oil globule: single, 0.8 mm
- Perivitelline space: narrow

Larvae:

- Hatching occurs at 10–14 mm, eyes well pigmented, mouth well developed
- Body initially slender, becomes relatively deep
- Head length 20–25% SL during preflexion, increases in later stages
- Snout initially rounded, becomes moderately pointy
- Preanus length >50% SL in later larvae (shorter during preflexion stage)
- Bulging gut pronounced
- Head spines moderate; see checklist below
- Caudal fin rays form first (shortly after hatching); all fin rays complete at 18–20 mmSL
- Sequence of fin ray formation: C – D₂, A – P₁ – D₁ – P₂
- Dorsal fin origin anterior to gill opening (compare to *Myoxocephalus scorpius*)
- Pigmentation includes heavy scattering of melanophores covering the flank (except for clear caudal peduncle), may extend onto finfolds in early preflexion larvae; top of head and peritoneum also heavily pigmented; spots develop on membranes of fins; spots on lower jaw and on isthmus; ventral midline of gut generally clear of pigment; embedded spots in ventral midline behind anal fin

**Meristic Characters**

Myomeres:	38–39
Vertebrae:	38–39
Dorsal fin rays:	XV–XVII, I, 12
Anal fin rays:	13–14
Pectoral fin rays:	18–19
Pelvic fin rays:	I, 3
Caudal fin rays:	6+6 (PrC)



Yolk-sac larva, recently hatched, 12.6 mmTL

Head Spine Checklist:

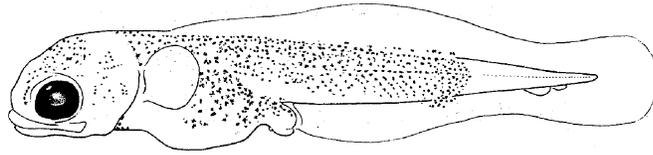
Preopercle: four rounded, unpronounced spines develop along edge
 Parietal: small spine
 Nuchal: small spine (adjacent to parietal spine)
 Supracleithral: two small spines (in posttemporal position)
 Opercle: two small spines form at upper angle in larger larvae and juveniles

- Note:**
1. Juvenile stage begins at about 19–20 mmTL
 2. This species considered to belong to a monotypic family Hemitripteridae according to several recent authors (e.g. Yabe, 1985). The larvae develop a spiny fronto-parietal ridge on top of head, and large, bony prickles over body, similar in structure to those found in larvae of the family Agonidae. These structures are absent in other cottids.
 3. See note on *Icelus bicornis* figure page regarding characters of cottid larval groups

Figures: Adult: D. R. Harriott (Scott and Scott, 1988); Yolk-sac larva: Fuiman, 1976; **A:** Warfel and Merriman, 1944; **B–D:** Khan, 1972 (**A–D** redrawn)

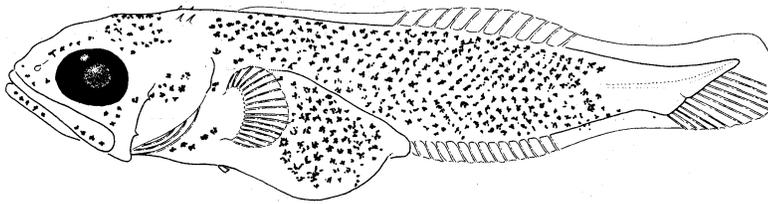
References: Bigelow and Schroeder, 1953; Fuiman, 1976; Okiyama and Sando, 1976; Fahay, 1983

Hemitripterus americanus

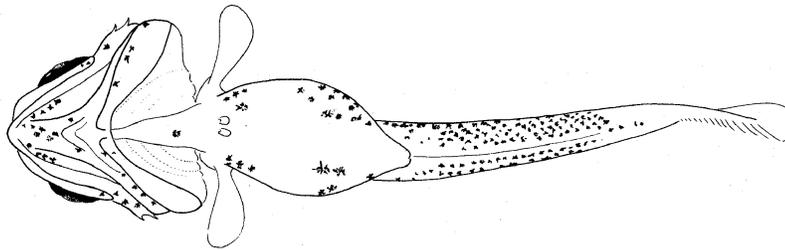


A. 12.0 mmTL

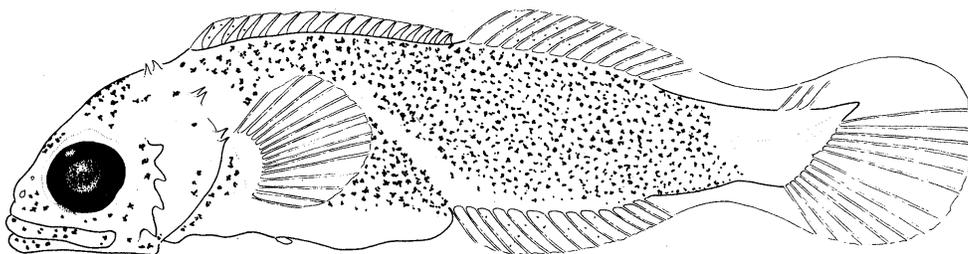
Hatches at larger size than
Myoxocephalus scorpius



B. 14.5 mmTL



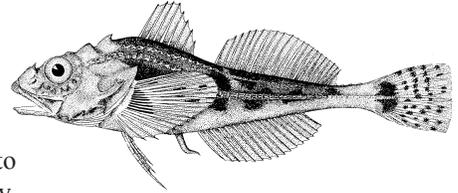
C. 14.5 mmTL (Ventral View)



D. 18.8 mmTL

Note: first 3 dorsal spines
thicker than others

Narrow, unpigmented strip posterior to dorsal gut
(Compare to pigment in *Myoxocephalus scorpius*)

Icelus bicornis* (Reinhardt, 1841)*Cottidae****Twohorn sculpin**

Range: Nearly circumpolar; in the western North Atlantic from Greenland to southern Scotian Shelf, including Ungava Bay, eastern Hudson Bay, Labrador and northeastern Newfoundland; most common in northern parts of range

Habitat: Benthic in cold waters (-1.8° to 8.8°C) in depths of 40–180 m (rarely to 560 m)

Spawning: Not well understood; may occur Aug–Sep (Kara Sea); number of eggs per female estimated to range from 147 to 340 in females 6.0 and 8.9 cm, respectively

Eggs: – Undescribed

Larvae:

- Hatching size undescribed
- Full series of larvae, including preflexion and flexion stages, not available
- Body moderately slender; snout pointy in larger larvae
- Preanus length about 45% SL in larger larvae
- Dorsal fin rays form before spines; pelvic fin rays form last
- Finfolds between dorsal, anal and caudal fins persist to relatively large size
- Size at flexion undescribed
- Head spines undescribed in early larvae; see checklist below
- Transformation to juvenile stage occurs at sizes larger than 25 mm; maximum size of adults only 90 mm
- Pigment in late larvae includes a series of melanophores along the base of anal fin and venter of caudal peduncle; dorsolateral surface of gut heavily pigmented; few spots on top of head and on lower parts of cheek

Meristic Characters

Myomeres:	40–43
Vertebrae:	40–43
Dorsal fin rays:	VII–X, 17–23
Anal fin rays:	12–17
Pectoral fin rays:	15–19
Pelvic fin rays:	I, 3
Caudal fin rays:	6+6 (PrC)

Head Spine Checklist:

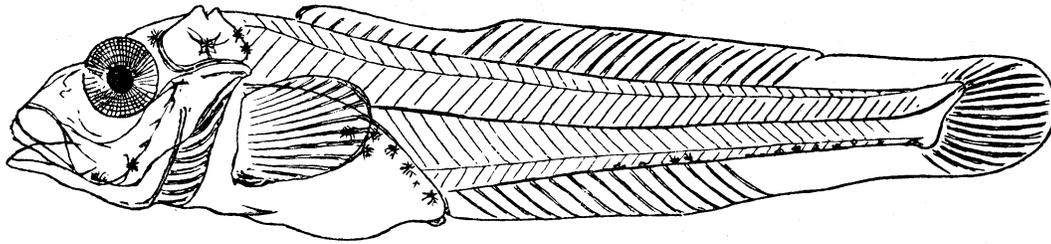
Preopercle:	four spines situated along edge; the uppermost becomes upturned and forked in juveniles and adults
Supraocular:	may form in late larvae (if present, relative size unknown)
Parietal:	forms in late larvae
Nuchal:	forms in late larvae (may be similar to parietal in size)
Nasal:	small spine forms in late larvae

Note:

1. Larva (Fig. A) described as *Centridermichthys hamatus* (Ehrenbaum, 1905)
2. See note box regarding characters of cottid larval groups

Figures: Adult: D. R. Harriott (Scott and Scott, 1988); A: Ehrenbaum, 1905

References: Ehrenbaum, 1905; Andriashev, 1954; Richardson, 1981; Richardson and Washington, 1980; Washington *et al.*, 1984b

Icelus bicornis

A. 25.0 mm

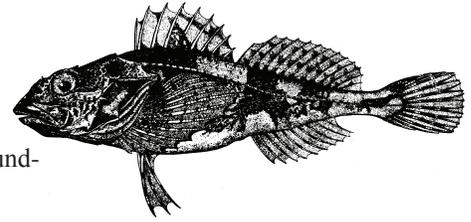
Larvae of most genera of Cottidae that occur in the western North Atlantic Ocean belong to the “*Myoxocephalus* Group” as determined after phenetic analyses by Richardson (1981), Richardson and Washington (1980), Washington *et al.* (1984b) and Ambrose (1996m), primarily based on eastern Pacific Ocean material. Genera in this group include *Myoxocephalus*, *Gymnocanthus*, *Icelus* and *Triglops*.

This is the least defined, most diverse group of the several groups of cottid larvae that have been defined. General characters of larvae in the “*Myoxocephalus* Group” include:

- Slender body with pointy snout
- Heavy pigment on dorsolateral gut
- Melanophores in series along ventral edge
- Development of 4 spines along edge of preopercle
- Development of other spines including parietal, nuchal, supraocular and nasal (Head spines in larvae have been widely reported as “paired parietal spines”; in the present treatment, this pair is considered to consist of a parietal and a nuchal spine, usually positioned very close to each other)

Arteidiellus spp. larvae are undescribed, therefore it is not known to which group their larvae may belong.

Hemitripterus larvae differ in several ways and some authors include them in the monotypic family Hemitriptoridae, separate from the Cottidae (e.g. Yabe, 1985). See *Hemitripterus americanus* for typical larval characters.

Myoxocephalus aeneus* (Mitchill, 1815)*Cottidae****Grubby**

Range: Western North Atlantic Ocean from Gulf of St. Lawrence and Newfoundland to New Jersey

Habitat: Benthic in coastal waters from low-tide mark to depth of about 27 m (rarely to 130 m) on sand, mud or gravel substrates; early stages occur over continental shelf as well as in estuaries

Spawning: Begins in winter in coastal waters, ends late spring in offshore waters; off United States, spawning extends from coast of New Jersey to northeast peak of Georges Bank; also reported from Newfoundland and several other Canadian locations; eggs deposited in clumps, adhere to algae, kelp holdfasts, or other objects

Eggs:

- Demersal, spherical, transparent and adhesive; color ranges from yellow, green and red to clear
- Diameter: 1.5–1.7 mm
- Oil globules: 2 large and several smaller (may coalesce to single oil globule, 0.2 mm)
- Perivitelline space: narrow

Larvae:

- Hatching occurs at mean size of 5.4 mmTL after incubation of 40–57 days
- Relatively slender body with short preanus length, bulky head and pectoral region
- Flexion occurs at about 6–8 mm
- D, A, P₁ and C fin rays begin at 6–8 mm, complete by 8–10 mm; D₁ spines and P₂ fin rays form later
- Pigmentation includes series of melanophores along ventral edge of tail; dorsolateral surface of gut densely pigmented; series of spots along ventral midline between isthmus and anus; spots on pectoral fin base; internal pigment along base of dorsal fin

Meristic Characters

Myomeres:	30–34
Vertebrae:	30–34
Dorsal fin rays:	VIII–XI, 13–14
Anal fin rays:	10–11
Pectoral fin rays:	14–17
Pelvic fin rays:	I, 3
Caudal fin rays:	6+6 (PrC)

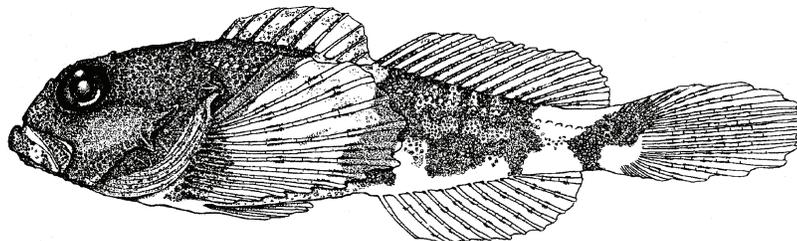
Head Spine Checklist:

Preopercle:	four to six low spines form along edge at sizes of 5–8 mm
Supraocular:	low spine forms in larger larvae
Parietal:	low spine forms in larger larvae
Nuchal:	low spine forms in larger larvae
Supracleithral:	small spine forms in larger larvae

- Note:**
1. Hatching, flexion and relative development occur at smaller sizes than in *Myoxocephalus octodecemspinosus*
 2. Juvenile pigment, including diagonal bands across body, begins forming <12 mm
 3. See note on *Icelus bicornis* figure page regarding characters of cottid larval groups

Early Juvenile:

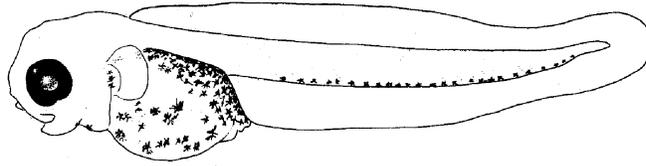
Size at settlement to bottom habitats occurs at 10–15 mm

E. 19.4 mmSL

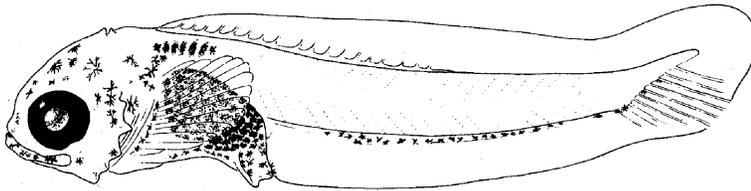
Figures: Adult: H. L. Todd; A–C: Lund and Marcy, 1975; D: Khan, 1972 (A–D redrawn); E: Susan Kaiser (Able and Fahay, 1998)

References: Khan, 1972; Lund and Marcy, 1975; Lazzari *et al.*, 1989; Able and Fahay, 1998; Klein-MacPhee, 2002h

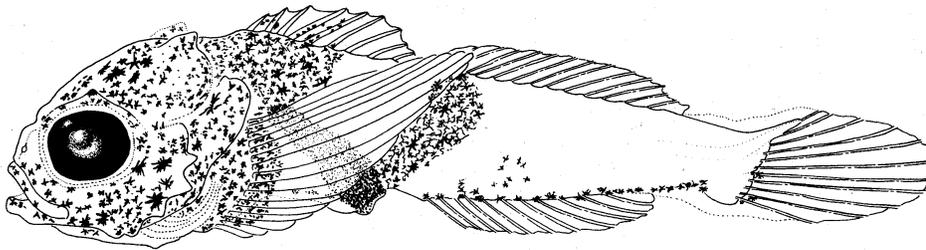
Myoxocephalus aenaeus



A. 5.4 mmTL

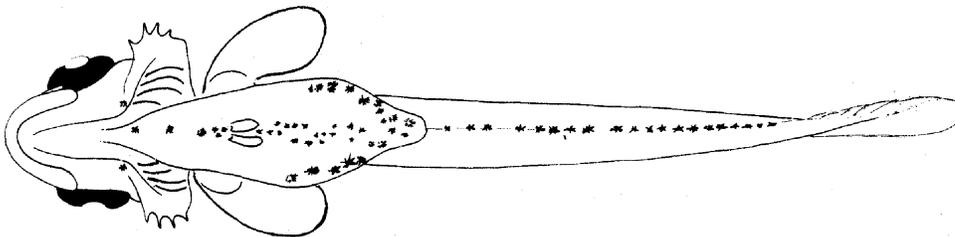


B. 6.8 mmTL



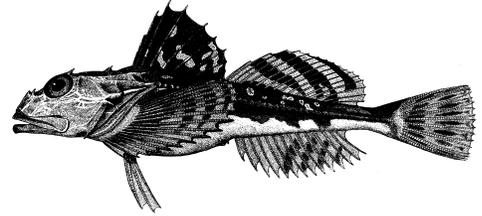
C. 9.2 mmTL

larger larvae have densely pigmented head and nape, with saddle on body at level of anal fin origin



D. 9.7 mmTL
(Ventral View)

Important series of small melanophores along venter between isthmus and anus (usually not present in *M. octodecemspinosus*)

Myoxocephalus octodecemspinosus* (Mitchill, 1815)*Cottidae****Longhorn sculpin**

Range: Western North Atlantic Ocean from Strait of Belle Isle, Newfoundland and northern Gulf of St. Lawrence to Virginia

Habitat: Benthic in coastal waters, ranging from estuaries and bays to depths of 90 m (rarely to 192 m); found in a wide range of temperatures (-0.5° to 19°C)

Spawning: Winter (peak Dec–Jan), usually in coastal waters; eggs deposited in clumps, often on sponge (*Chalina* sp.)

Eggs:

- Demersal, spherical, adhesive
- Diameter: 1.9–2.3 mm
- Chorion: thick; green, red, brown or orange
- Oil globules: 1 or more, diameters vary

Larvae:

- Hatching occurs at sizes of 6.3–7.3 mm, after incubation period of 36–65 days
- Relatively slender body with rounded head, becoming more pointy in larger larvae
- Flexion occurs at 9–11 mm
- Sequence of fin ray formation: $P_1 - C, A, D_2 - D_1 - P_2$
- Pigmentation includes series of melanophores along ventral edge of tail; dorsolateral surface of gut densely pigmented; ventral midline between isthmus and anus generally without pigment, but 3–5 large spots may occur on isthmus in small larvae; a group of very small melanophores, just anterior to anus, disappears in larger larvae; early larvae lack pigment on head (appearing in larger larvae), but large spots present on nape

Meristic Characters

Myomeres:	34–44
Vertebrae:	34–44
Dorsal fin rays:	VII–X, 15–17
Anal fin rays:	12–15
Pectoral fin rays:	16–19
Pelvic fin rays:	I, 3
Caudal fin rays:	6+6 (PrC)

Head Spine Checklist:

Preopercle: four to six spines form along edge at sizes between 7.5 and 8.5 mm; upper spine longest
 Supraocular: low, blunt spine forms in larger larvae
 Parietal: forms in larger larvae
 Nuchal: forms in larger larvae
 Supracleithral: forms in larger larvae

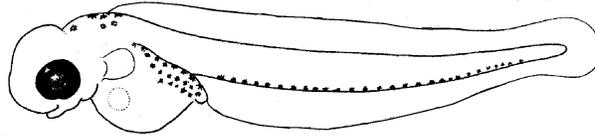
Note:

1. Hatching, flexion and relative development occurs at larger sizes than in *Myoxocephalus aeneus*
2. Juvenile pigment, including several saddle-shaped patches crossing body, begins to form at about 14 mm
3. Resemble *Triglops murrayi* larvae, which see for distinguishing characters
4. See note on *Icelus bicornis* figure page regarding characters of cottid larval groups

Figures: Adult: H. L. Todd (Klein-M^{ac}Phee, 2002h); **A, B, E:** Colton and Marak, 1969 (redrawn); **C–D:** Khan, 1972 (redrawn)

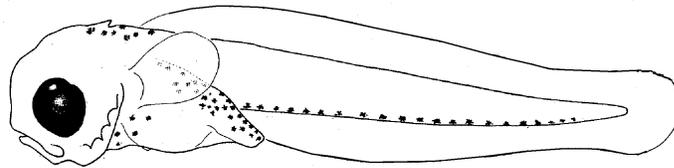
References: Morrow, 1951; Wheeler and Miller, 1960; Ennis, 1969; Cowan, 1971; Walsh and Lund, 1983

Myoxocephalus octodecemspinosus



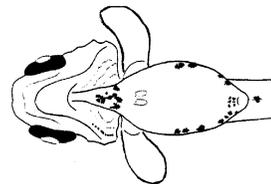
Row of melanophores along ventral edge spaced apart anteriorly, close together posteriorly

A. 6.8 mmTL

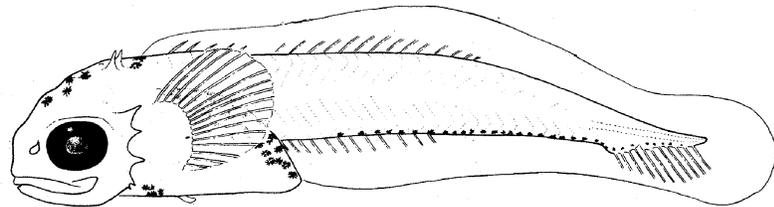


B. 8.5 mmTL

Venter between isthmus and anus usually without pigment, except few spots possible just anterior to anus



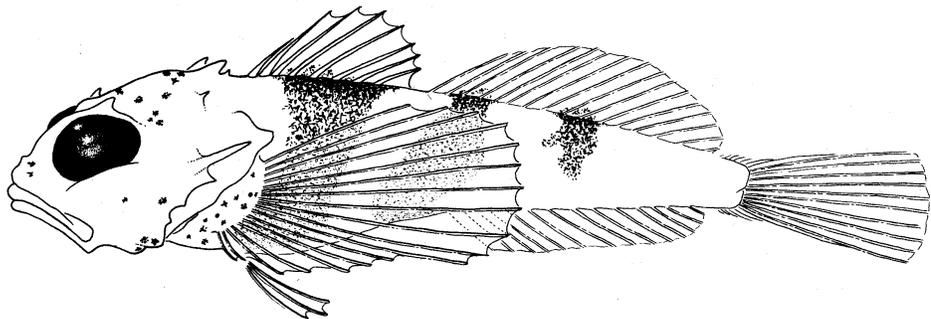
C. 9.5 mmTL (Ventral View)



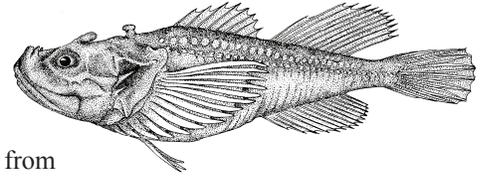
D. 10.7 mmTL

1st dorsal fin becomes high at about 15 mm

Upper preopercle spine becomes very long by about 15 mm



E. 15.2 mmTL

Myoxocephalus quadricornis* (Linnaeus, 1758)*Cottidae****Fourhorn sculpin**

Range: Circumpolar in arctic waters; in the western North Atlantic from Canadian Arctic and Hudson Bay south along the coasts of Greenland and Labrador to Nova Scotia; a freshwater form occurs in deep, cold lakes in northern North America

Habitat: Primarily estuarine and coastal waters, rarely in depths >20 m; sometimes ascends rivers

Spawning: Dec–Jan (may extend to Mar); hatch May–Jun after long incubation; males dig nest and protect the eggs during incubation

Eggs:

- Demersal, adhesive, deposited in clumps in prepared nests; green, brown or reddish
- Diameter: 2.4–2.9 mm (Baltic)
- Incubation lasts up to 74 days (at 2.0°C), 97 days (at 1.5°C)

Larvae:

- Hatching occurs at about 8.0 mmTL
- Of the 4 species of *Myoxocephalus* considered here, this species has shortest head, shortest preanus length, and slimmest body
- Flexion occurs at 13 to 16 mm
- Fin rays in second dorsal fin form before spines in first dorsal fin; pelvic fin rays form late
- Sequence of fin ray formation: P₁ – C, A – D₂ – D₁ – P₂
- Head spines moderately developed; see checklist below
- Pigment in small larvae includes dense peritoneal shield, distinct, prominent melanophores on top of the head, a row of spots along ventral edge of body and tail and a few spots on pectoral fin base; in later larvae, a series of melanophores forms along the midline of body between the dorsal and anal fins; this series eventually extends from level of pectoral fin to caudal peduncle; a barred pattern begins to form in larger larvae, with spots under dorsal fin base and on top of caudal peduncle

Meristic Characters

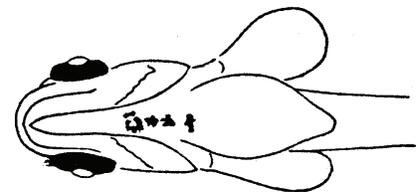
Myomeres:	38–43
Vertebrae:	38–43
Dorsal fin rays:	VI–X, 13–17
Anal fin rays:	13–17
Pectoral fin rays:	14–18
Pelvic fin rays:	I, 3
Caudal fin rays:	6+6 (PrC)

Head Spine Checklist:

Preopercle:	four spines along edge form early
Parietal:	small, simple spine
Nuchal:	small, simple spine
Frontal and nasal:	small spines form late

- Note:**
1. See note on figure page regarding larvae of the freshwater form
 2. Juvenile pigmentation begins at about 17 mm
 3. See note on *Icelus bicornis* figure page regarding characters of cottid larval groups

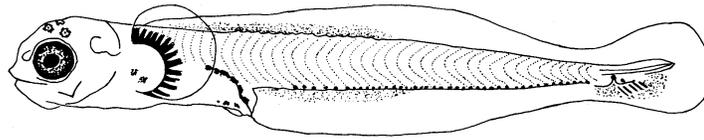
Some larvae have a few spots on the isthmus (Fig. E); most larvae have no pigment on venter of head and gut except for a few small spots immediately anterior to anus in early larvae (Fig. A)

E. 14.5 mmTL (Ventral View)

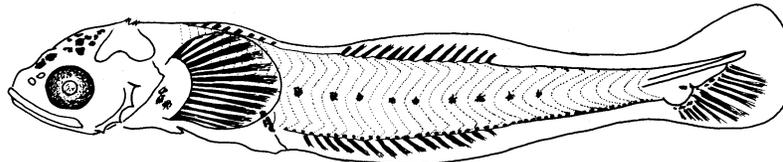
Figures: Adult: D.R. Harriott (Scott and Scott, 1988); A–D: Khan and Faber, 1974; E: Khan, 1972 (redrawn)

References: Zviagina, 1963; Westin, 1969; Khan, 1972; Khan and Faber, 1974; Scott and Scott, 1988

Myoxocephalus quadricornis

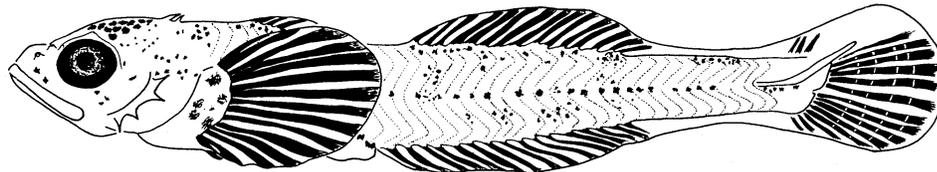


A. 12.8 mmTL

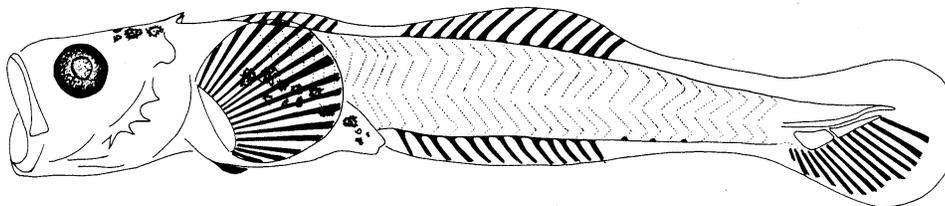


B. 14.4 mmTL

Supraocular and supracleithral spines
absent (compare to *M. scorpius*)

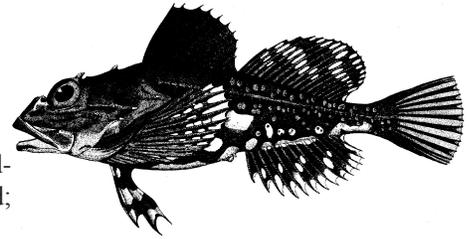


C. 17.0 mmTL



D. 17.1 mmTL (Lake Michigan)

Larvae of the freshwater form of this species develop at approximately the same rate as those of marine representatives, but differ in pigmentation. Note lack of midline melanophores and presence of short series of spots along the venter of the tail. Head pigment is less dense.

Myoxocephalus scorpius* (Linnaeus, 1758)*Cottidae****Shorthorn sculpin**

Range: Nearly circumpolar; in the western North Atlantic Ocean from Hudson Bay, Baffin Island and west Greenland to southern New England; rarely to New Jersey

Habitat: Bays and coastal ledges on sand, mud, pebbly, weedy or bare substrates, usually in depths <36 m, rarely as deep as 110 m; found in near-freezing temperatures to a maximum 16°C

Spawning: Nov–Feb, peak in Dec; eggs deposited in adhesive clumps on bare sand bottoms or in objects; males may build nest and provide protection while eggs incubate

Eggs:

- Demersal, spherical, adhesive
- Diameter: 2.0–2.5 mm
- Chorion: thick, reddish yellow to pinkish
- Oil globule: single, 0.4–0.5 mm

Larvae:

- Hatching occurs at 7.4–8.6 mm after 4–12 weeks incubation
- Preflexion larval body slender with rounded head, short gut; head becomes pointy in later stages
- Preanus length 45% SL through much of larval stage, increases slightly (to 50% SL) at transformation
- Sequence of fin ray development: C – P₁ – A, D₂ – D₁, P₂
- Finfolds persist between dorsal, anal and caudal fins
- Flexion occurs at 9–15 mm
- Head spines well-developed; see checklist below
- Pigment includes a series of melanophores along ventral edge of tail, beginning at about myomere 16; a mid-lateral blotch of several melanophores begins as a few, scattered spots which then spread; prominent pigment occurs on top of head and nape and on dorsolateral surface of gut; a series of spots on base of pectoral fin and several melanophores on cheek region

Meristic Characters

Myomeres:	32–41
Vertebrae:	32–41
Dorsal fin rays:	VII–XII, 12–20
Anal fin rays:	9–16
Pectoral fin rays:	14–19
Pelvic fin rays:	I, 3
Caudal fin rays:	6+6 (PrC)

Head Spine Checklist:

Preopercle: four spines situated along edge beginning at about 10 mm
 Supraocular: small, simple spine forms in larger larvae
 Parietal: large, simple spine forms in larger larvae
 Nuchal: tiny spine forms posterior to parietal spine in larger larvae
 Nasal: small, hook-like spine forms in larger larvae
 Supracleithral: small spine forms in larger larvae

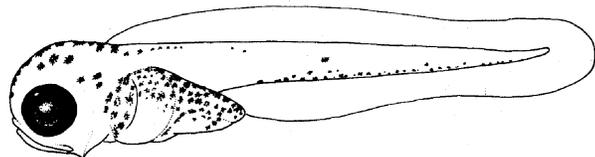
Note:

1. Preanus length shorter than in comparably sized *Hemitripteris americanus*, and pigment is lighter overall
2. Hatching, flexion and formation of head spines occurs at smaller sizes than in *Myoxocephalus quadricornis*
3. Juvenile pigmentation begins at about 17 mm
4. See note on *Icelus bicornis* figure page regarding characters of cottid larval groups

Figures: Adult: H. L. Todd (Klein-M^{ac}Phee, 2002h); A, E: Rass, 1949 (redrawn); B, C, F: Khan, 1972 (redrawn); D: Joanne Lyczkowski-Shultz (unpubl.); G: Ehrenbaum, 1905

References: Khan, 1972; Russell, 1976; Scott and Scott, 1988; Klein-M^{ac}Phee, 2002h

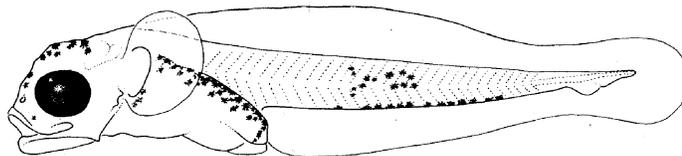
Myoxocephalus scorpius



A. 7.9 mmTL

Line of pigment forms early under anterior dorsal fin

Note absence of pigment between isthmus and anus except for few tiny spots just anterior to anus

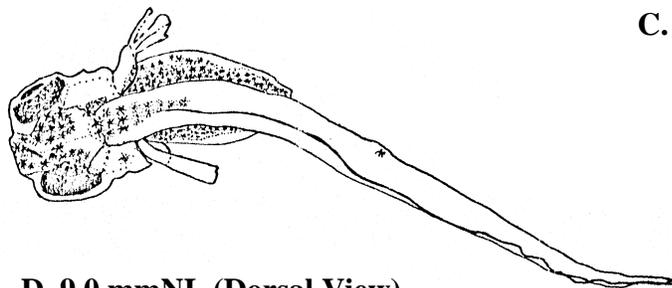


B. 8.5 mmTL

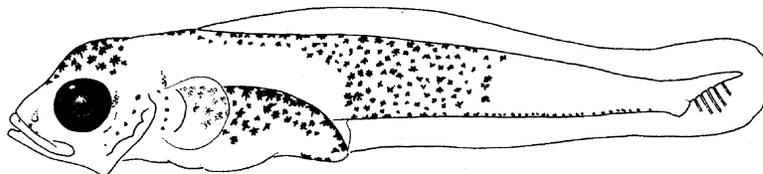


C. 8.5 mmTL (Ventral View)

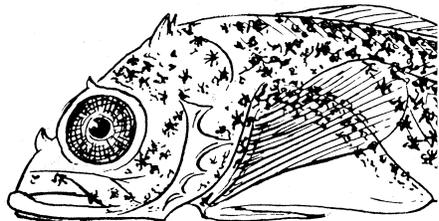
Note prominent pigment on top of head and nape, beginning in early stages (compare to *M. aeneus* and *M. octodecemspinus*)



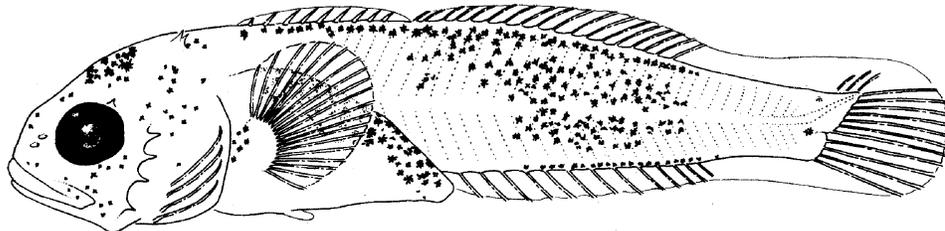
D. 9.0 mmNL (Dorsal View)



E. 9.5 mmTL

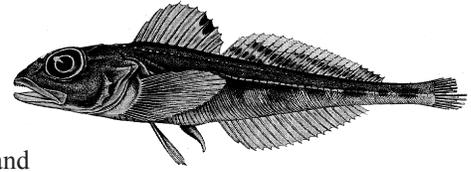


G. 18.0 mm (Head Detail)



F. 17.4 mmTL

***Triglops murrayi* Günther, 1888**
Cottidae
 Moustache sculpin



Range: North Atlantic portions of Arctic Ocean, Hudson Bay and Baffin Island to Cape Cod; also eastern Atlantic as far south as White Sea

Habitat: Benthic in depths of 18–110 m (rarely as deep as 320 m)

Spawning: Fall, possibly into winter; ripe females observed during Oct in Bay of Fundy and Gulf of Maine; Jul in Canadian waters

Eggs: – Undescribed; ovarian eggs 2.0–2.2 mm diameter, pinkish, with 3–15 amber-colored oil globules

Larvae: – Hatching occurs at 7–8 mm
 – Preanus length about 35% SL initially, increases to about 45% SL in larger larvae
 – Head deep, with downward projecting preopercle angle
 – Sequence of fin ray formation: P₁, C – A, D₂ – D₁ – P₂
 – Flexion occurs at about 12 mm or larger
 – Head spines well-developed; see checklist below
 – Pigment includes row of melanophores along ventral edge of tail, beginning farther posteriorly than in comparable *Myoxocephalus* spp. larvae and becoming embedded at about 16–18 mm; few spots on base of pectoral fin; isthmus and venter of gut lacks pigment; pigment absent on flanks until juvenile stage begins; melanophores present on top of head, but not extending onto nape

Meristic Characters

Myomeres:	44–47
Vertebrae:	44–47
Dorsal fin rays:	IX–XII, 20–26
Anal fin rays:	20–27
Pectoral fin rays:	16–19
Pelvic fin rays:	I, 3
Caudal fin rays:	6+6 (PrC)

Head Spine Checklist:

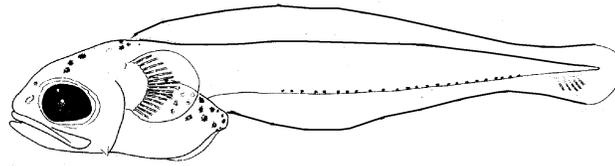
Preopercle: four spines form along edge; not as prominent as in *Myoxocephalus* spp. larvae
 Supraocular: two small spines form at 12–14 mm (*Myoxocephalus* spp. larvae have a single spine)
 Parietal: small spine
 Nuchal: small spine
 Supracleithral: small spine

Note: 1. Note high counts of myomeres/vertebrae (compare to *Myoxocephalus* spp. larvae)
 2. Hatching, flexion and formation of head spines occurs at relatively large size
 3. See note on *Icelus bicornis* figure page regarding characters of cottid larval groups

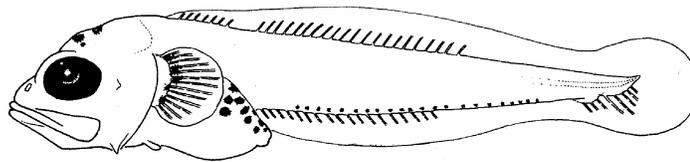
Figures: Adult: K. Ito (Klein-MacPhee, 2002h); **A–B, E:** Khan, 1972 (redrawn); **C–D:** Joanne Lyczkowski-Shultz (unpubl.)

References: Khan, 1972; Pietsch, 1993; Klein-MacPhee, 2002h

Triglops murrayi

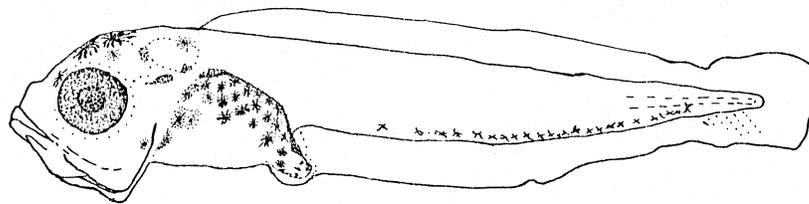


A. 8.4 mmTL



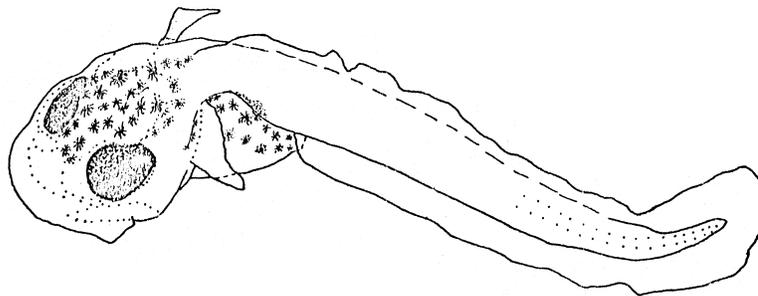
B. 11.6 mmTL

No lateral pigment
on tail

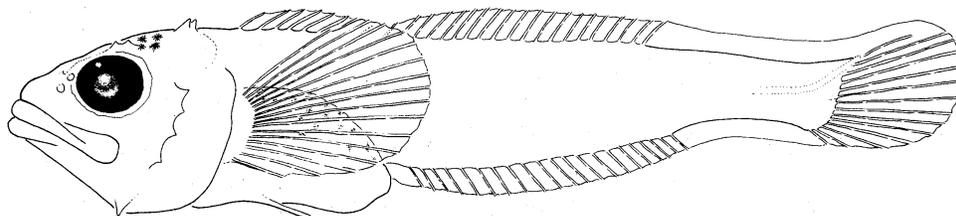


(Pectoral fin
not drawn)

C. 12.0 mmNL Nape pigment absent (compare to *Myoxocephalus scorpius*)

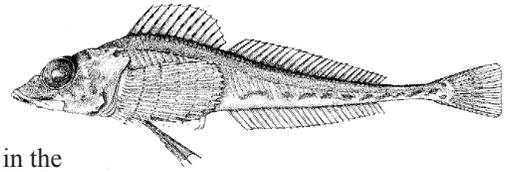


D. 12.0 mmNL (Dorsal Oblique View)



E. 18.9 mmTL

***Triglops pingeli* Reinhardt, 1832**
Cottidae
 Ribbed sculpin



- Range:** North Atlantic and North Pacific oceans, mostly in arctic waters; in the western North Atlantic from Hudson Bay and Ungava Bay south along coasts of Labrador and Greenland
- Habitat:** Benthic in depths of 10–285 m, a rare record at 930 m; can survive in temperatures below 0°C and very low salinities
- Spawning:** Not well understood; almost mature females have been collected Sep–Oct
- Eggs:** – Undescribed; ovarian eggs described as 3.0 mm
- Larvae:** – Full series of larvae undescribed; characters based on late flexion specimens below
 – Body moderately elongate with pointy snout
 – Preanus length described as 50% SL at 18.0 mm, 40% SL at 28.0 mm
 – Sequence of fin ray formation undescribed; pelvic fin rays form late
 – Flexion occurs at large sizes; not complete by 28.0 mm
 – Head spines present; see checklist below
 – Pigment includes series of melanophores along ventral edge of tail; dorsolateral surface of gut densely pigmented; pigment absent on venter of gut; pigment patterns in early larvae undescribed

Meristic Characters

Myomeres:	45–51
Vertebrae:	45–51
Dorsal fin rays:	X–XIII, 23–26
Anal fin rays:	23–26
Pectoral fin rays:	16–19
Pelvic fin rays:	I, 3
Caudal fin rays:	6+6 (PrC)

Head Spine Checklist:

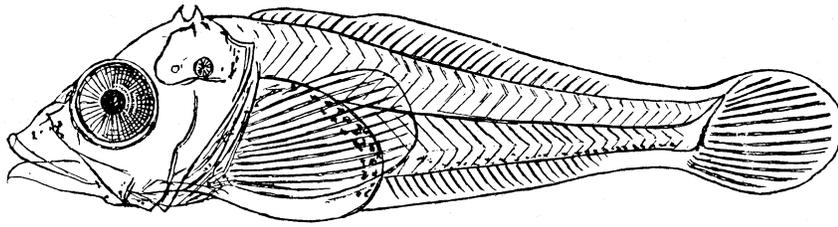
Preopercle:	four spines situated along edge
Supraocular:	small spine
Parietal:	small spine
Nuchal:	small spine
Nasal:	small spine

- Note:**
1. High counts of myomeres/vertebrae (compare to *Myoxocephalus* spp. larvae)
 2. Barred pattern of juveniles beginning in 28.0 mm specimen; also note large melanophores on pectoral fin base
 3. See note on *Icelus bicornis* figure page regarding characters of cottid larval groups

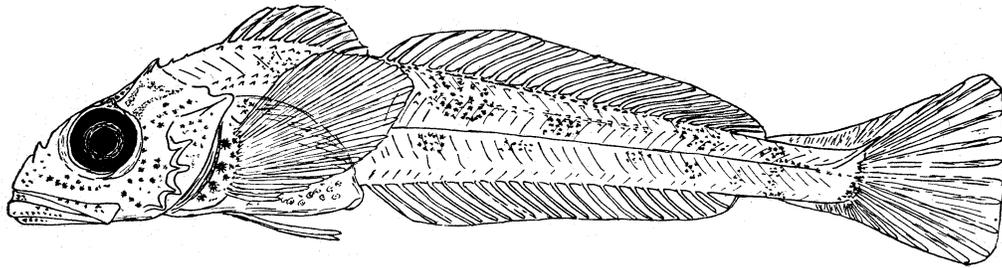
Figures: Adult: D. R. Harriott (Scott and Scott, 1988); **A:** Ehrenbaum, 1905; **B:** Dunbar, 1947

References: Ehrenbaum, 1905; Dunbar, 1947; Andriashev, 1954; Scott and Scott, 1988

Triglops pingeli



A. 18.0 mmSL



B. 28.0 mmSL