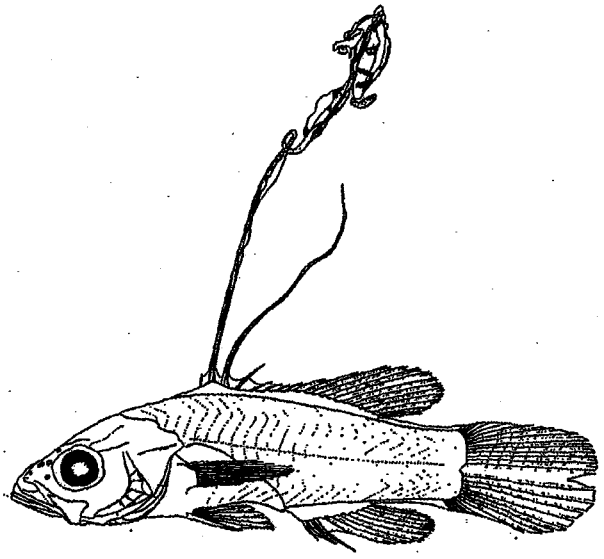
NOAA Technical Memorandum NMFS-SEFSC-419

# PRELIMINARY GUIDE TO THE IDENTIFICATION OF THE EARLY LIFE HISTORY STAGES OF SERRANID FISHES OF THE WESTERN CENTRAL ATLANTIC

BY

WILLIAM J. RICHARDS



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

February 1999

NOAA Technical Memorandum NMFS-SEFSC-419

# PRELIMINARY GUIDE TO THE IDENTIFICATION OF THE EARLY LIFE HISTORY STAGES OF SERRANID FISHES OF THE WESTERN CENTRAL ATLANTIC

BY

WILLIAM J. RICHARDS

U.S. DEPARTMENT OF COMMERCE
William M. Daley, Secretary

National Oceanic and Atmospheric Administration
D. James Baker, Under Secretary for Oceans and Atmosphere

National Marine Fisheries Service
Rolland A. Schmitten, Assistant Administrator for Fisheries

February 1999

NOTICE

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

This report should be cited as follows:
Richards, W. J.. 1999. Preliminary guide to the identification of the early life history stages of serranid fishes of the western central Atlantic. NOAA Technical Memorandum NMFS-SEFSC-419, 105 p.

This report was supported by NMFS MARFIN Grant No. NA47FF0013. The author thanks J. Javech, A. Powell, and W. A. Laroche for original illustrations; S. Kelley, S. Bolden, and B. Brandt for technical support; and Dr. L. Massey for editorial support.

This report will be posted on the SEFSC web site later in 1999 at URL: www.sefsc.noaa.gov

Copies may be obtained by writing:

The author at

NOAA Fisheries
75 Virginia Beach Drive
Miami, FL 33149

National Technical Information Center
5825 Port Royal Road
Springfield, VA 22161
(703) 487-4650, FAX (703) 336-4700
Rush Orders: (800) 336-4700

## FAMILY SERRANIDAE

by W. J. Richards

The Family Serranidae comprises some of the most valuable commercial and recreational marine fishes in the world. Most species are tropical, but several occur in temperate waters and a few enter freshwater, too. The most notable species are the groupers and the black sea basses. The family is very large with about 62 genera and 449 species worldwide (Nelson 1994). The family comprises several subfamilies and we follow Eschmeyer (1990) in dividing it into the following 5 subfamilies: Serraninae, Anthiinae, Epinephelinae, Liopropomatinae, and Grammistinae. These are convenient because the larvae are distinct for each subfamily. In the following pages each subfamily is introduced and separate accounts are given for each species along with ilustrations, if they are available. Meristic tables are also provided since meristic characters are very useful in identifying the larvae and juveniles. Eggs are poorly known and resemble the general percoid egg of tropical waters being about 1mm in diameter with a clear shell and very narrow periviteline space. Development is presumed to be very rapid thus making eggs especially difficult to identify. Larvae are rather distinct for each subfamily. The Serraninae larvae are typical basal percoid-like with slightly laterally compressed bodies with few spines on the head in the opercular region. Their heads are smooth lacking rugosity, and fin spines are not elongate. Pigmentation is variable but always found on the ventral midline. Epinepheline larvae are very unique with long dorsal and pelvic spines which often bear spinelets, moderately deep-bodied and compressed, giving a kite-like appearance. Anthininae larvae have large heads which are deep and wide and are usually rugose and spiny. A large interopercular spine lies medial to the preopercular spine giving a double spine appearance to the preopercle. The Liopropomatinae have laterally compressed larvae with a deep caudal peduncle and 1 or 2 long second and third dorsal spines which bear unusual appendages which resemble siphonophore tentacles. The Grammistinae are similar in body shape to the Liopropomatinae but they have only one elongate dorsal spine. Meristic characters for the family are given in Table SER-1.

**Key to the larvae and early juveniles**

1a. Head heavy, deep, and wide; long interopercular spine; myomeres 26 ..... Anthiinae
1b. Head compressed, not wide; interopercular spine not conspicuously long; myomeres <26 ..... 2
2a. Head compressed, elongate dorsal and pelvic spines bearing spinelets, kite-like body shape ..... Epinephelinae
2b. Head normal, elongate dorsal spines, if present, not bearing spinelets ..... 3
3a. No elongate dorsal or pelvic spines ..... Serraninae
3b. Elongate first dorsal spines ..... 4
4a. One elongate first dorsal spine ..... Grammistinae
4b. Two, rarely one elongate dorsal spines ..... Liopropomatinae

Table SER1. Meristic characters for the family Serranidae.

| Subfamily Serraninae: D. X,11-15 A.III,6-8 v. 10+14=24 | | | | | | | Lat. Line | |
|---|---|---|---|---|---|---|---|---|
| **Species** | **Dorsal** | **Anal** | **Pectoral** | **Gillrakers** | **Vert** | **Br** | **Scales** | **Source** |
| *Bullisichthys* | | | | | | | | |
| *caribbaeus* | X,13-14 | III,7 | 14-15 | 9-10+21-26=30-37 | 10+14 | 7 | 46-49 | Rivas 1971 |
| *Parasphyraenops* | | | | | | | | |
| *atrimanus* | X,10 | III,6 | 17 | 9+19+?=28 | 10+14 | 7 | ca. 49 | Johnson & Smith-Vaniz 1987 |
| *incisus* | X,10 | III,7 | 17 | 8-9+20-21=28 | 10+14 | 7 | | Johnson & Smith-Vaniz 1987 |
| *Centropristis* | | | | | | | | |
| *fuscula* | X,12 | III,7 | | 10+10=20 | 10+14=24 | | 48 | J & E 1896 |
| *ocyurus* | X,11 | III,7 | 17(16-18) | 19-21(17-22) | 10+14=24 | 7 | 47(46-48) | B & S 1991 |
| *philadelphica* | X,11 | III,7 | 18(15-20) | +11-12 | 10+14=24(22-23) | 7 | 47(46-49) | B & S1991 |
| *striata* | X,11 | III,7 | 16-19(14-20) | 10+18=22-23(20-29) | 10+14=24 | 7 | 47(46-49) | B & S 1991 |
| *Diplectrum* | | | | | | | | |
| *bivittatum* | X,12 | III,7(6-8) | 15-16(14) | 18-24(16-25) | 10+14 | 7 | 59-70(54-58) | Bortone 1971 |
| *formosum* | X,12(11-13) | III,7(6-8) | 16-17(18) | 18-24(17) | 10+14 | 7 | 66-70 | Bortone 1971 |
| *radiale* | X,12 | III,7 | 17(16-18) | 17-20(15-21) | 10+14 | 7 | 59-68(54-69) | Bortone 1971 |
| *Hypoplectrus* | | | | | | | | |
| *aberrans* | X.14-16 | III,7 | 14 | 6-8+11-15=18-19(17-20) | 10+14 | 7 | 48-53 | Randall 1968 |
| *chlorurus* | X,14-16 | III,7 | 14 | 6-8+11-15=18-19(17-20) | 10+14 | 7 | 48-53 | Randall 1968 |
| *gemma* | X,14-16 | III,7 | 14 | 6-8+11-15=18-19(17-20) | 10+14 | 7 | 48-53 | Randall 1968 |
| *guttavarius* | X,14-16 | III,7 | 14 | 6-8+11-15=18-19(17-20) | 10+14 | 7 | 48-53 | Randall 1968 |
| *indigo* | X,14-16 | III,7 | 14 | 6-8+11-15=18-19(17-20) | 10+14 | 7 | 48-53 | Randall 1968 |
| *nigricans* | X,14-16 | III,7 | 14 | 6-8+11-15=18-19(17-20) | 10+14 | 7 | 48-53 | Randall 1968 |
| *puella* | X,14-16 | III,7 | 14 | 6-8+11-15=18-19(17-20) | 10+14 | 7 | 48-53 | Randall 1968 |
| *unicolor* | X,14-16 | III,7 | 14 | 6-8+11-15=18-19(17-20) | 10+14 | 7 | 48-53 | Randall 1968 |
| *gummigutta* | X,14-16 | III,7 | 14 | 6-8+11-15=18-19(17-20) | 10+14 | 7 | 48-53 | Randall 1968 |
| *Schultzea* | | | | | | | | |
| *beta* | X,12(11-13) | III,7 | 15-17 | 9-11+20-26=29-39 | 24 | 6 | 48-56 | B & S 1991 |

Table SER-1. (continued)

| Subfamily Serraninae: D. X,11-15 A.III,6-8 v. 10+14=24 Species | Dorsal | Anal | Pectoral | Gillrakers | Vert | Br | Lat. Line Scales | Source |
|---|---|---|---|---|---|---|---|---|
| *Serraniculus* | | | | | | | | |
| *pumilio* | X(IX-X),11(10) | III,7(6) | 14-15 | 9-13 | 10+14 | 6 | 40-46 | B & S 1991 |
| *Serranus* | | | | | | | | |
| *annularis* | X,12(10-12) | III,7 | 13(14) | 15-18 | 10+14 | 7 | 43-50 | R & S 1961, B & S 1991 |
| *atrobranchus* | X,12(13) | III,7 | 16(15-17) | 15-20 | 10+14 | 7 | 44-47 | R & S 1961, B & S 1991 |
| *baldwini* | X,(IX-XI),12(11-13) | III,7 | 13-15 | 14-17 | 10+14 | 7 | 42-48 | Randall 1968 |
| *chionaraia* | X,11-12 | III,7 | 14(13) | 17-20 | 10+14 | 7 | 45-47 | R & S 1961 |
| *dewegeri* | X,14(15) | III,7 | | 10-14 | 10+14 | 7 | 55-63 | Randall 1968 |
| *flaviventris* | X,12(13) | III,7 | 16(17) | 5-6+12=17-18 | 10+14 | 7 | 39-44 | R & S 1961 |
| *luciopercanus* | X,12 | III,7 | 14 | 20-24 | 10+14 | 7 | 50-55 | R & S 1961 |
| *maytagi* | X,12 | III,7 | 15-16 | 19-23 | 10+14 | 7 | 45-50 | M & J |
| *notospilus* | X,12(11-13) | III,7(8) | 15-16(14-17) | 19(16-23) | 10+14 | 7 | 46-47(44-48) | R & S 1961, B & S 1991 |
| *phoebe* | X,12 | III,7(8) | 15-16(14-17) | 16-20 | 10+14 | 7 | 45-51 | R & S 1961 |
| *subligarius* | X,13(11-14) | III,7(6) | 16(14-17) | 16-17(15-19) | 10+14 | 7 | 42-46 | R & S 1961 |
| *tabacarius* | X,12(11) | III,7 | 15(14) | 21-25 | 10+14 | 7 | 52(50-51) | R & S 1961 |
| *tigrinus* | X,12 | III,7 | 14 | 15-19 | 10+14 | 7 | 48-51 | R & S 1961 |
| *tortugarum* | X,12(10) | III,7 | 14(15) | 26-31 | 10+14 | 7 | 48-49(46-50) | R & S 1961 |

| Subfamily Epinephelinae: v. 10+14 Species | Dorsal | Anal | Pectoral | Gillrakers | Vert | Br | Lat. Line Scales | Source |
|---|---|---|---|---|---|---|---|---|
| *Epinephelus* | | | | | 10+14=24 | | | |
| (*Alphestes*) | | | | | | | | |
| *afer* | XI,17-18(19) | III,9 | 16-17 | 6-8+16-17 | 10+14=24 | | 55-61 | Heemstra & Randall 1993 |
| (*Cephalopholis*) | | | | | | | | |
| *cruentatus* | IX,14(13-15) | III,8 | 16 | 10+9-11=18-25 | 10+14=24 | | 47-51 | Heemstra & Randall 1993 |
| *fulvus* | IX,15(14-16) | III,9 | 18(17-19) | 7-9+17(16-18)=23-27 | 10+14=24 | | 46-54 | Heemstra & Randall 1993 |
| (*Dermatolepis*) | | | | | | | | |
| *inermis* | XI,18-20 | III,9(8-10) | 18-19 | 7+14=19-22 | 10+14=24 | | Deeply embedded | Heemstra & Randall 1993 |

Table SER-1. (continued)

| Subfamily Epinephelinae: D. X,11-15 A.III,6-8 v. 10+14=24 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Species** | **Dorsal** | **Anal** | **Pectoral** | **Gillrakers** | **Vert** | **Br** | **Lat. Line Scales** | **Source** |
| (*Epinephelus*) | | | | | | | | |
| *adscensionis* | XI,16-18 | III,8 | 18-20 | 7-9+16-19=23-28 | 10+14=24 | | 48-53 | Heemstra & Randall 1993 |
| *drummondhayi* | XI,16(15-17) | III,9 | 18 | 9-10+17-18=26-28 | 10+14=24 | | 72-76 | Heemstra & Randall 1993 |
| *flavolimbatus* | XI,14(13-15) | III,9 | 18(17-18) | 8-9+15-17=23-25 | 10+14=24 | | ca. 65 | Heemstra & Randall 1993 |
| *guttatus* | XI,16(15-17) | III,8(7-9) | 17(16-18) | 8-9+16-18=24-26 | 10+14=24 | | 92-104 | Heemstra & Randall 1993 |
| *itajara* | XI,16(15) | III,8 | 18-19 | 8-9+13-15=21-24 | 10+14=24 | | 61-64 | Heemstra & Randall 1993 |
| *morio* | XI,15-17 | III,9(8-10) | 16-18 | 8-9+15-16=23-25 | 10+14=24 | | 60-68 | Heemstra & Randall 1993 |
| *mystacinus* | XI,15(14) | III,9(8) | 18-19 | 8-10+14-16=22-26 | 10+14=24 | | 58-69 | Heemstra & Randall 1993 |
| *nigritus* | X,14(13-15) | III,9 | 18-19 | 9-11+14-16=23-25 | 10+14=24 | | 62-71 | Heemstra & Randall 1993 |
| niveatus | X,14(13-15) | III,9 | 18(17-19) | 7-10+15-17=22-26 | 10+14=24 | | 64-73 | Heemstra & Randall 1993 |
| *striatus* | XI,16-18 | III,8 | 17-19 | 8-9+15-17=23-26 | 10+14=24 | | ca. 50 | Heemstra & Randall 1993, Powell and Tucker 1992 |
| *Mycteroperca* | | | | | | | | |
| *acutirostris* | XI,15-17 | III,10-12 | 15-17 | 16-20+32-36=48-55 | 10+14=24 | | 67-77 | Heemstra & Randall 1993 |
| *bonaci* | XI,15-17 | III,11-13 | 16-17 | 2-5+8-12 | 10+14=24 | | 78-83 | Heemstra & Randall 1993 |
| *cidi* | XI,15-17 | III,10-12 | 15-17 | 9-13+18-23 | 10+14=24 | | ca. 75 | Heemstra & Randall 1993 |
| *interstitialis* | XI,16-18 | III,10-12 | 16-17 | 4-6+11-15=23-27 | 10+14=24 | | 70-74 | Heemstra & Randall 1993 |
| *microlepis* | XI,16-18 | III,10-13 | 16-18 | 8-9+16 | 10+14=24 | | 88-96 | Heemstra & Randall 1993 |
| *phenax* | XI,16-18 | III,10-12 | 15-17 | 8-10+17-21=26-31 | 10+14=24 | | 76-82 | Heemstra & Randall 1993 |
| *tigris* | XI,15-17 | III,11 | 17 | 8+15-17=23-25 | 10+14=24 | | 82-83 | Heemstra & Randall 1993 |
| *venenosa* | XI,15-16 | III,10-12 | 16-18 | 8-10+17-18=24-27 | 10+14=24 | | 72-81 | Heemstra & Randall 1993 |
| *Paranthias* | | | | | | | | |
| *furcifer* | IX,17-18(19) | III,8-9(10) | 19-20 | 12-14+24-26=38 | 10+14=24 | | 69-77 | Heemstra & Randall 1993 |
| *Gonioplectrus* | | | | | | | | |
| *hispanus* | VIII,13 | III,7 | 16-17 | 5-7+14-16=20-22 | 10+14=24 | 7 | 47-49 | Heemstra & Randall 1993 |

Table SER-1. (continued)

| Subfamily Anthiinae: D.X,13-20 A.III,7-8 Pect.13-20 v.10+16 Species | Dorsal | Anal | Pectoral | Gillrakers | Vert | Br | Lat. Line Scales | Source |
|---|---|---|---|---|---|---|---|---|
| *Anthias* | | | | | | | | |
| *asperilinguis* | X,15 | III,7 | 18-19 | 11-13+26-28=38-40 | 10+16=26 | | 36-41 | Anderson & Heemstra 1980 |
| *nicholsi* | X,15(14) | III,7(6-8) | 19(18-21) | 12-13+27-31=39-44 | 10+16=26 | | 31-34 | Anderson & Heemstra 1980, B & S 1991 |
| *tenuis* | X,15(14) | III,8(7-9) | 20(19-21) | 9-11+24-28=34-39 | 10+16=26 | | 51-57 (interrupted) | Anderson & Heemstra 1980, B & S 1991 |
| *woodsi* | X,14(15) | III,7(8) | 18(16) | 11-12+26-28=38-40 | 10+16=26 | | 42-48 | Anderson & Heemstra 1980 |
| *Hemanthias* | | | | | | | | |
| leptus | X,14(13-15) | III,8 | 17-19 | 35-40 | 10+16=26 | | 54-64 | B & S 1991 |
| *vivanus* | (IX)X,13-14 | III,8-9 | 18-19 | 10+30=38-43 | 10+16=26 | | <53 | B & S 1991 |
| *Plectranthias* | | | | | | | | |
| *garrupellus* | X,15-16 | III,7(6-8) | 13(12) | 4-9+9-17 | 10+16=26 | 7 | 28-29(27-30) | B & S 1991 |
| *Pronotogrammus* | | | | | | | | |
| *aureorubens* | X,15 | III,8(9) | 16-17 | +28-29 | 10+16=26 | | 44-48 | B & S 1991 |
| *martinicensis* | X,15(13-16) | III,7 | 17(16-18) | 9-13+24-29=34-41 | 10+16=26 | | 35-41 | B & S 1991 |

| Subfamily Liopropominae: D.VII-VIII,12-15 A.III,7-8 v.10+14-15 Species | Dorsal | Anal | Pectoral | Gillrakers | Vert | Br | Lat. Line Scales | Source |
|---|---|---|---|---|---|---|---|---|
| *Pikea* | | | | | | | | |
| *mexicanus* | VIII,14(15) | III,8 | 14-15 | 6+12-13=18-23 | 10+14=24 | 7 | 45-47 | B & S 1991 |
| *Liopropoma* | VIII,12-13 | III,8 | | | | | | |
| *aberrans* | VI-I-I,12 | III,8 | 14 | 14(5r+9) | 10+14=24 | 7 | 44-50 | Robins 1967 |
| *carmabi* | VI-I-I,12-13 | III,8 | | | 10+14=24 | | 44-50 | Randall 1968 |
| *eukrines* | VIII,12 | III,8 | 13-14 | 15-17 | 10+14=24 | | 44-50 | Robins & Ray 1986 |
| *mowbrayi* | VI-I-I,12 | | | | 10+14=24 | | 44-50 | Randall 1968 |
| *rubre* | VI-I-I,12 | III,8 | 13 | | 10+14=24 | | | Randall 1968 |

Table SER-1. (continued)

| Subfamily Grammistinae: D.II-III or VII-VIII,9-29 A.0 or III,7-20 v.10+14-15 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Species** | **Dorsal** | **Anal** | **Pectoral** | **Gillrakers** | **Vert** | **Br** | **Lat. Line Scales** | **Source** |
| *Jeboehlkia* | | | | | | | | |
| *gladifer* | VIII,9 | III,7 | 15 | 9+1+16=26 | 9+15=24 | 7 | | Baldwin & Johnson 1991 |
| *Pseudogramma* | | | | | | | | |
| gregoryi | VII-VIII,15-24 | III,12-20 | 14-18 | | 10+14=24 | | | Kendall 1979 |
| *Rypticus* | II-IV,21-29 | 14-18 | 13-17 | | | | | |
| *bistrispinus* | II,25-26(24-27) | 15-16(17) | 13-15(16) | 7-10 | 10+15=25 | | | Courtenay 1967 |
| *bornoi* | II,26 | 16 | 13 | 2+6=8 | 10+14=24 | | | Courtenay 1967 |
| *brachyrhinus* | III,23-25 | 15(14-16) | 14-16 | 9(7-11) | 10+14=24 | | | Courtenay 1967 |
| *macrostigmus* | III,25-26 | 16-17 | 14 | 2+8=10 | 10+14=24 | | | Courtenay 1967 |
| *maculatus* | II(III),24-25(22-27) | 15-16(13-17) | 13-16 | 8-9(7-10) | 10+14=24 | | | Courtenay 1967 |
| *randalli* | III(II),23-24(25) | 15-16 | 15-16(17) | 9(8-11) | 10+14=24 | | | Courtenay 1967 |
| *saponaceus* | III,23-24(21-25) | 16-17(14-15) | 15-16(14-17) | 7-9(5-11) | 10+14=24 | | | Courtenay 1967 |
| *subbifrenatus* | III,21-23(24) | 14-15(13-16) | 14-15(16) | 8(7)+10 | 10+14=24 | 7 | | Courtenay 1967 |

## SUBFAMILY SERRANINAE

*By W.J. Richards*

This subfamily comprises 37 species in 8 genera. Almost all of these species are small synchronus hermaphrodites and several are poorly known. Only the genus *Centropristis* contains species which have commercial or recreational value, but some of the small species are used in the marine aquarium trade. The genus *Centropristis* comprises 4 species *C. striata, C. ocyurus, C.philadelphica,* and *C. fuscula* of which ELH stages are known only for *C. striata*. The *Centropristis* species all have similar meristics and have overlapping ranges thus ELH stages of *C.striata* may represent more than one species. *Bullisichthys caribbaeus* is a small pugnose species which is poorly known. There are two species of *Parashyraenops* with *P. atrimanus* known from 2 specimens from stomach contents from Bermuda and *P. incius* is known only from a few specimens collected from steep slopes in the Caribbean. ELH stages are unknown for both species. *Diplectrum* comprises 3 species of small, shallow water fishes generally found over sandy bottoms near reefs. *D. formosum* and the smaller *D. bivittatum* are common along U.S. coasts while *D.radiale* is found along the northern South American coasts. Two larval *Diplectrum* morphs are described from U. S. waters, but species assignement is not clear. *Schultzea beta* is a small, schooling planktivore whose ELH stages are unkown. *Serraniculus pumilio* is a small common serranid found over sand and shell bottoms near reefs and larvae and juveniles are known for it. *Serranus* is a speciose genus of small, colorful, reef fishes. One species has been reared (*tigrinus*), a few types have been encountered in ichthyoplankton studies, but the remaining 13 species have unknown ELH stages. The genus *Hypoplectrus* was recently shown to contain 11 species as previous workers had believed the species to be merely color morphs of one species (Domeier 1994). Reared series of 3 species of this genus have been made plus one hybrid and they are morphologically inseparable. Adults can only be separated by living coloration which is very distinct.

Based on the known species larvae of this subfamily are characterized by shared possession of basal percoid characters rather than unique specializations (Kendall 1984). The larvae are slightly laterally compressed with few spines on the head in the opercular region. The heads are smooth, lacking rugosity. Dorsal and pelvic fin spines are not elongated and are smooth. Pigmentation is variable but always found on the ventral midline. Pigmentation may occur in various locations on the head, trunk, and fins. These larvae would be most likely confused with gerriids or sparids rather than with other serranid subfamilies. Since only 5 genera and 8 species have been described, no key to the larvae is provided for this group.

Eggs, larvae, and juveniles have been well described for *Centropristis striata.* Eggs and yolksac larvae were described from rearing attempts and Kendall (1972) described larval stages. (He has excellent wash illustrations which cannot be clearly duplicated in this account so one must refer to the original). Kendall (1979) characterized the genus based on the one type of larvae which he refers to *C. striata* as follows: as for the subfamily but with almost all pigment associated with the ventral midline in larvae >5mmSL. Large spots (melanophores) on posterior margin of angular, cleithral symphysis, between pelvic fin bases, near anus, and near anal fin insertion; smaller spots at bases of anal fin rays, between larger caudal peduncle spots, and some caudal ray bases. The large spots on the caudal peduncle extend upward between myomeres. Pigment also occurs on the hindbrain and over the gut.

Larvae of *Diplectrum* sp. were described by Kendall (1979). Houde et al. (1979) considered these to be *D. formosum* as they followed the distribution pattern of the adults in the eastern Gulf of Mexico. *Diplectrum* larvae vary from the norm in that the first dorsal fin forms first simultaneously with the pelvic fin and their body shape is slender. Pigment is confined to the ventral midline and the spots are smaller than *Centropristis*.

*Serraniculus pumilio* larvae were described by Kendall (1979) and have the serranine ventral pigment plus additional pigment on the dorsum and lateral trunk making them the most heavily pigmented. This species has only 6 branchiostegals, a character shared with *Schultzea beta,* whose larvae are unknown.

*Serranus* contains 14 species and one, *S. tigrinus* has been reared by M. Domeier (pers. commun.). Kendall(1979) described a series of wild caught larvae, but could not assign it to a species. With similar meristics among all the species, identification can be solved with rearing. The known larvae have early forming pelvic fins which are heavily pigmented and elongate, and the body depth is deeper than other serranines except *Hypoplectrus*. The third dorsal spine is decidedly elongate and the pigment spots are very intense in several locations: angular, cleithral

symphysis, anus, above the anal fin, on the ventral caudal peduncle, and on the dorsum below the dorsal fins. Opercular region is ornately armed, nearly as much as *Diplectrum*.

*Hypoplectrus* until recently was considered to be one species with multiple color morphs, but Domeier (1994) has shown that the colormorphs are distinct species. He has reared three species (*H. guttavarius*, *H. unicolor,* and *H. gemma*) and a hybrid (*gemma* x *unicolor*). Illustrations of these are provided in the species accounts. Unfortunately of those 3 reared species neither I nor Domeier could find any morphological features which would distinguish the species. Kendall (1979) described one species from a series reared from unknown eggs which differs slightly in pigment pattern from the Domeier rearings. *Hypoplectrus* larvae are the deepest bodied of any of the serranines and have pigment spots at the angular, anus, above the anal fin base, on the caudal peduncle, and on the dorsum. The head and anterior trunk become heavily pigmented quite early. The second dorsal fin count is higher than the other serranines.

## MERISTICS

| | |
|---|---|
| Vertebrae | |
| Precaudal: | 10 |
| Caudal: | 14 |
| Total: | 24 |
| Number of Fin Spines and Rays: | |
| First Dorsal Fin: | X |
| Second Dorsal Fin: | 11 |
| Anal Fin: | III,7 |
| Pectoral Fin: | 16-19(14-20) |
| Gill Rakers: | 22-23(20-29) |
| Lateral Line Scales: | 47(46-49) |

## LIFE HISTORY

Range: ME to southeastern FL, and northeastern Gulf of Mexico
Habitat: Flat and gently rolling rocky bottoms from 1-30m.
ELH Pattern: Oviparous; pelagic eggs and larvae:
Spawning
Season: Fall to spring in eastern Gulf of Mexico
Mode: Protogynous hermaphrodites
Size/Age at First
Maturity: Females age 4 at 190mmSL
Males age 5-7 at >200mmSL
Longevity:

## LITERATURE

Hardy 1978
Bullock & Smith 1991
Kendall 1984

## EARLY LIFE HISTORY DESCRIPTION

**EGGS:**
Diameter: 0.9-1.0mm
No. of Oil Globules: 1
Oil Globule Diameter:
Yolk: transparent
Hatch Size: 2.01mmNL
Incubation: 38 hrs at 23 C
Pigment: few melanophores on embryo and oil globule
Diagnostic Characters: nothing distinctive

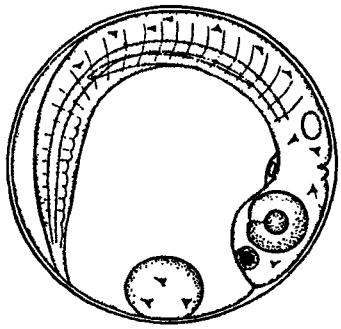
**LARVAE:**
Head Spination: first appear at 6.0mm on preopercle and postcleithrum, small not prominent
2nd dorsal spine: not elongated
Length at Flexion: 5.5-6.0mmSL
Sequence of Fin Development: C, both dorsas, anal, pelvic, pectoral
Pigmentation: angular, cleithral symphy- si, ventral midline and melanophores ex- tend up between myomeres, over gut, anus, hindbrain, rare on dorsal midline
Diagnostic Characters: pigment and meristics

**EARLY JUVENILES:**
Pigment: Prominent black stripe from op- percle to tail, Atlantic specimens with black spot on last dorsal spine, dark smudges on jaws.
Diagnostic Characters: meristics and pigmentation

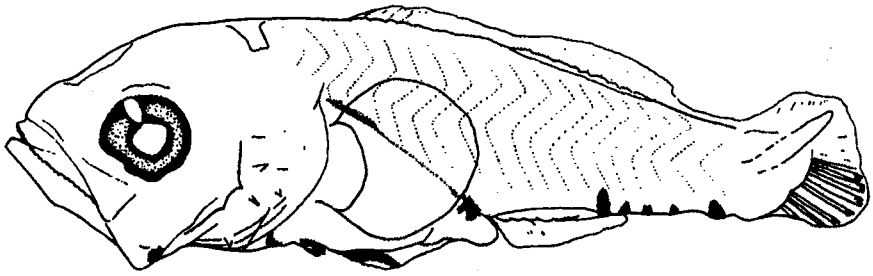
## ILLUSTRATIONS

Hardy 1978 (egg & juvenile)
Kendall 1979 (larvae)

A

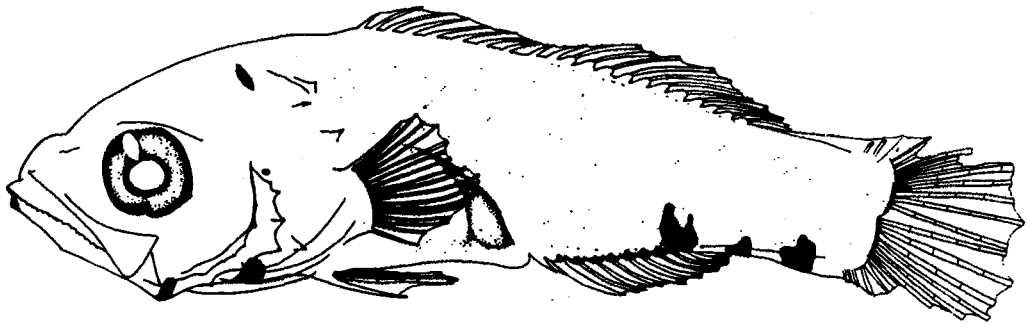


B



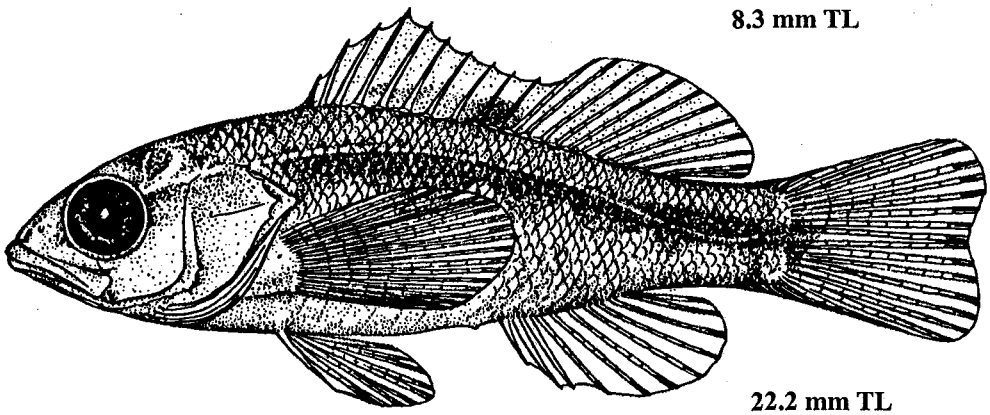
4.7 mm TL

C



8.3 mm TL

D



22.2 mm TL

## MERISTICS

| | |
|---|---|
| Vertebrae | |
| Precaudal: | 10 |
| Caudal: | 14 |
| Total: | 24 |
| Number of Fin Spines and Rays: | |
| First Dorsal Fin: | X |
| Second Dorsal Fin: | 12(11-13) |
| Anal Fin: | III,7(6-8) |
| Pectoral Fin: | 16-17(18) |
| Gill Rakers: | 18-24(17) |
| Lateral Line Scales: | 66-70 |

## LIFE HISTORY

Range: VA south throughout Gulf of Mexico along continental margin to Brazil, also Virgin Islands and Bahamas
Habitat: Coastal species over sandy bottoms from 1-80m.
ELH Pattern: Oviparous; pelagic eggs and larvae
Spawning
Season: Protracted winter to fall in the Gulf of Mexico
Area:
Mode: Synchronous hermaphrodites
Migration:
Size/Age at First
Maturity: Small species, largest 300mmSL
Longevity: To 6 years

## LITERATURE

Bortone 1977
Bullock & Smith 1991

## EARLY LIFE HISTORY DESCRIPTION

**EGGS:** Unknown

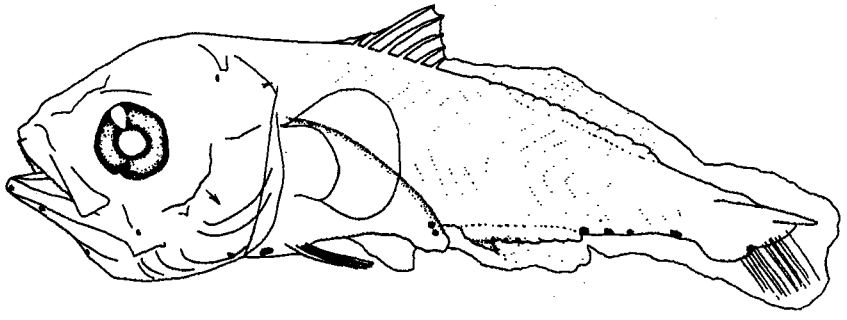
**LARVAE:**
Head Spination: Opercular flap and post-cleithra with small spines
2nd D Spine Length: Not elongated
Length at Flexion: ca. 5.5mmSL
Sequence of Fin Development: First dorsal and pelvic, second dorsal, anal, and pectoral
Pigmentation: Small spots on ventral midline along jaw, cleithral symphysis, anus, anal fin bases, caudal peduncle, few at caudal base. Spots of uniform size.
Diagnostic Characters: Meristics, pigmentation, slender body.

**EARLY JUVENILES:**
2nd D Spine Length: Not elongated

## ILLUSTRATIONS

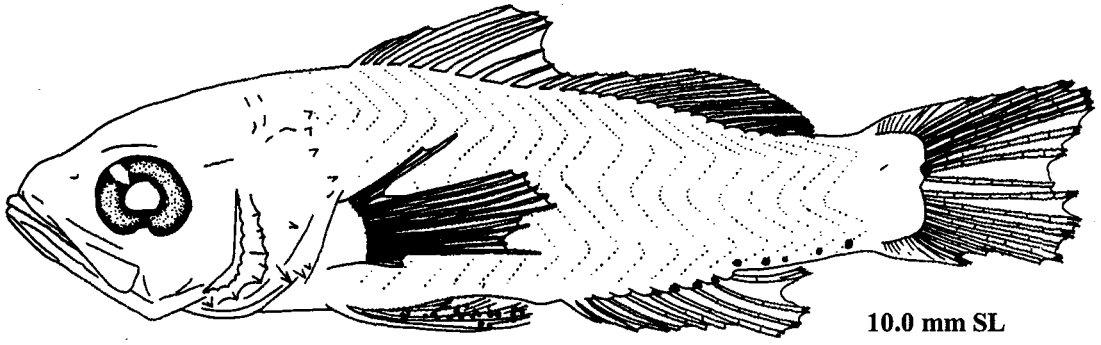
Kendall 1979 as *Diplectrum* sp.

**A**



**5.8 mm NL**

**B**



**10.0 mm SL**

## MERISTICS

| | |
|---|---|
| Vertebrae | |
| Precaudal: | 10 |
| Caudal: | 14 |
| Total: | 24 |
| Number of Fin Spines and Rays: | |
| First Dorsal Fin: | X |
| Second Dorsal Fin: | 14-16 |
| Anal Fin: | III,7 |
| Pectoral Fin: | 14(13-15) |
| Gill Rakers: | 6-8+11-15 |
| Lateral Line Scales: | 48-53 |

## LIFE HISTORY

Range: Endemic to Florida Keys.
Habitat: Coral reefs
ELH Pattern: Oviparous; pelagic eggs and larvae.
Spawning
Season:
Area:
Mode: Synchronous hermaphrodites
Migration:
Size/Age at First
Maturity:
Longevity

## LITERATURE

Domeier 1994

## EARLY LIFE HISTORY DESCRIPTION

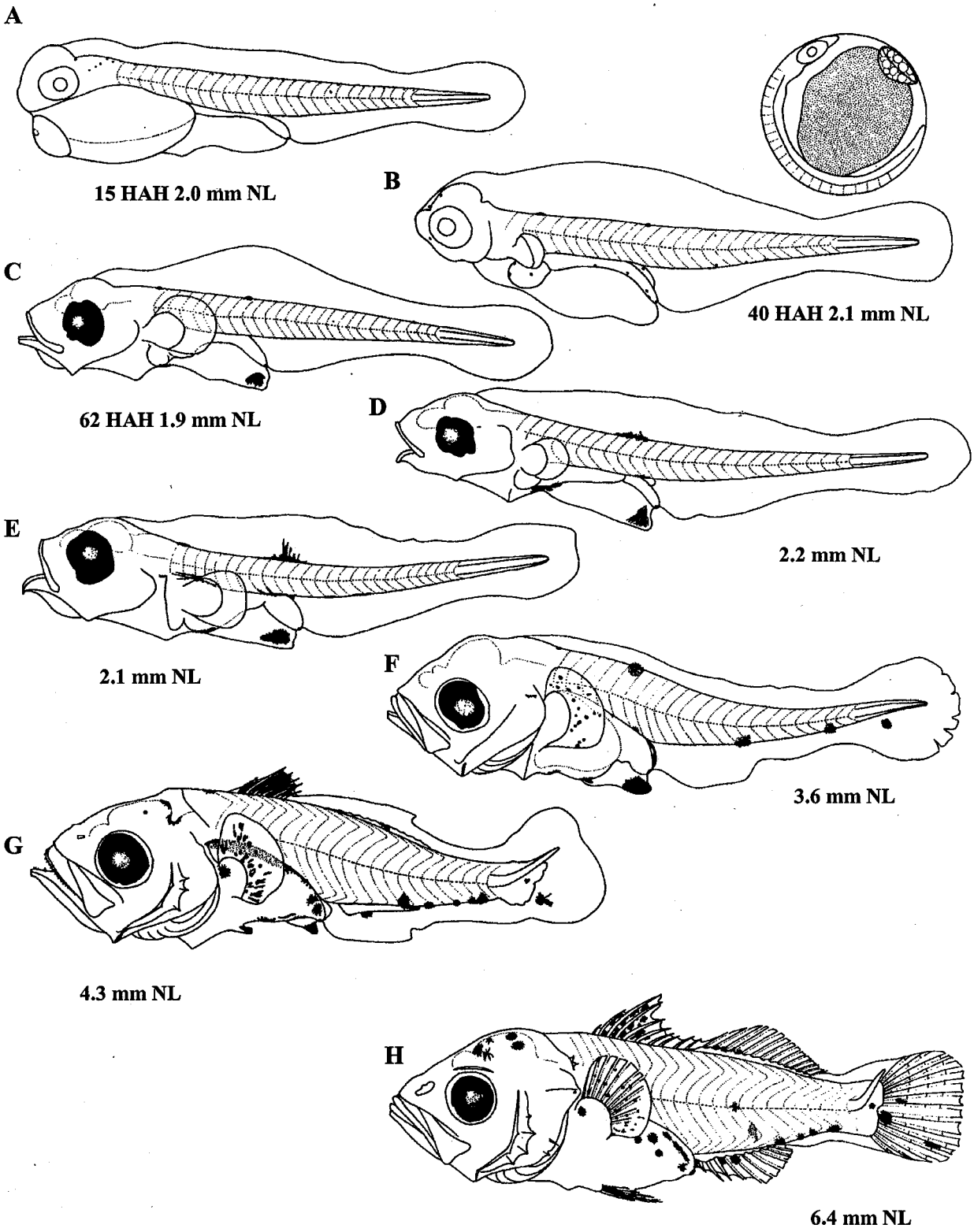
**EGGS:** Unknown

**LARVAE:**
Pigmentation:
Diagnostic Characters: All have a lot of pigment and are deep bodied.

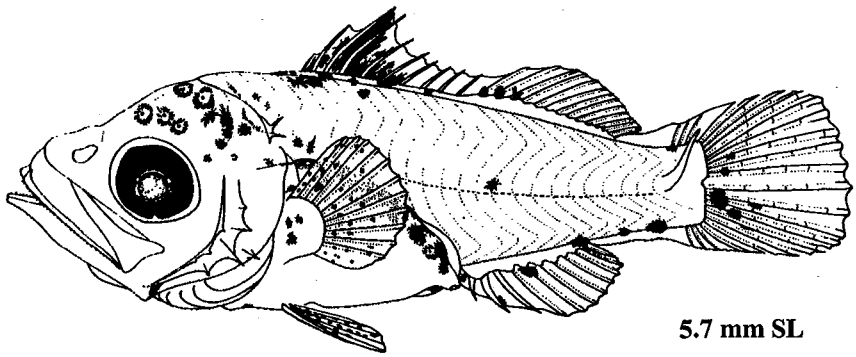
**EARLY JUVENILES:**
Diagnostic Characters: Color patterns

## ILLUSTRATIONS

Original, specimens from Domeier

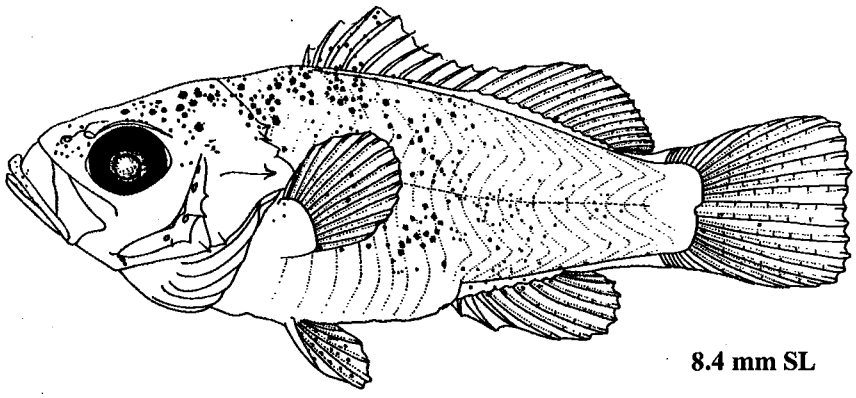

A
15 HAH 2.0 mm NL
B
40 HAH 2.1 mm NL
C
62 HAH 1.9 mm NL
D
2.2 mm NL
E
2.1 mm NL
F
3.6 mm NL
G
4.3 mm NL
H
6.4 mm NL

**A**



**5.7 mm SL**

**B**



**8.4 mm SL**

## MERISTICS

| | |
|---|---|
| Vertebrae | |
| Precaudal: | 10 |
| Caudal: | 14 |
| Total: | 24 |
| Number of Fin Spines and Rays: | |
| First Dorsal Fin: | X |
| Second Dorsal Fin: | 14-16 |
| Anal Fin: | III,7 |
| Pectoral Fin: | 14(13-15) |
| Gill Rakers: | 6-8+11-15 |
| Lateral Line Scales: | 48-53 |

## LIFE HISTORY

Range: FL Keys, Bahamas, Cuba, Hispaniola, Jamaica, Caymans, Puerto Rico, Virgin Islands, Lesser Antilles, and Honduras
Habitat: Coral reefs
ELH Pattern: Oviparous; pelagic eggs and larvae.
Spawning
Season:
Area:
Mode: Synchronous hermaphrodites
Migration:
Size/Age at First
Maturity:
Longevity

## LITERATURE

Domeier 1994
Randall 1968

## EARLY LIFE HISTORY DESCRIPTION

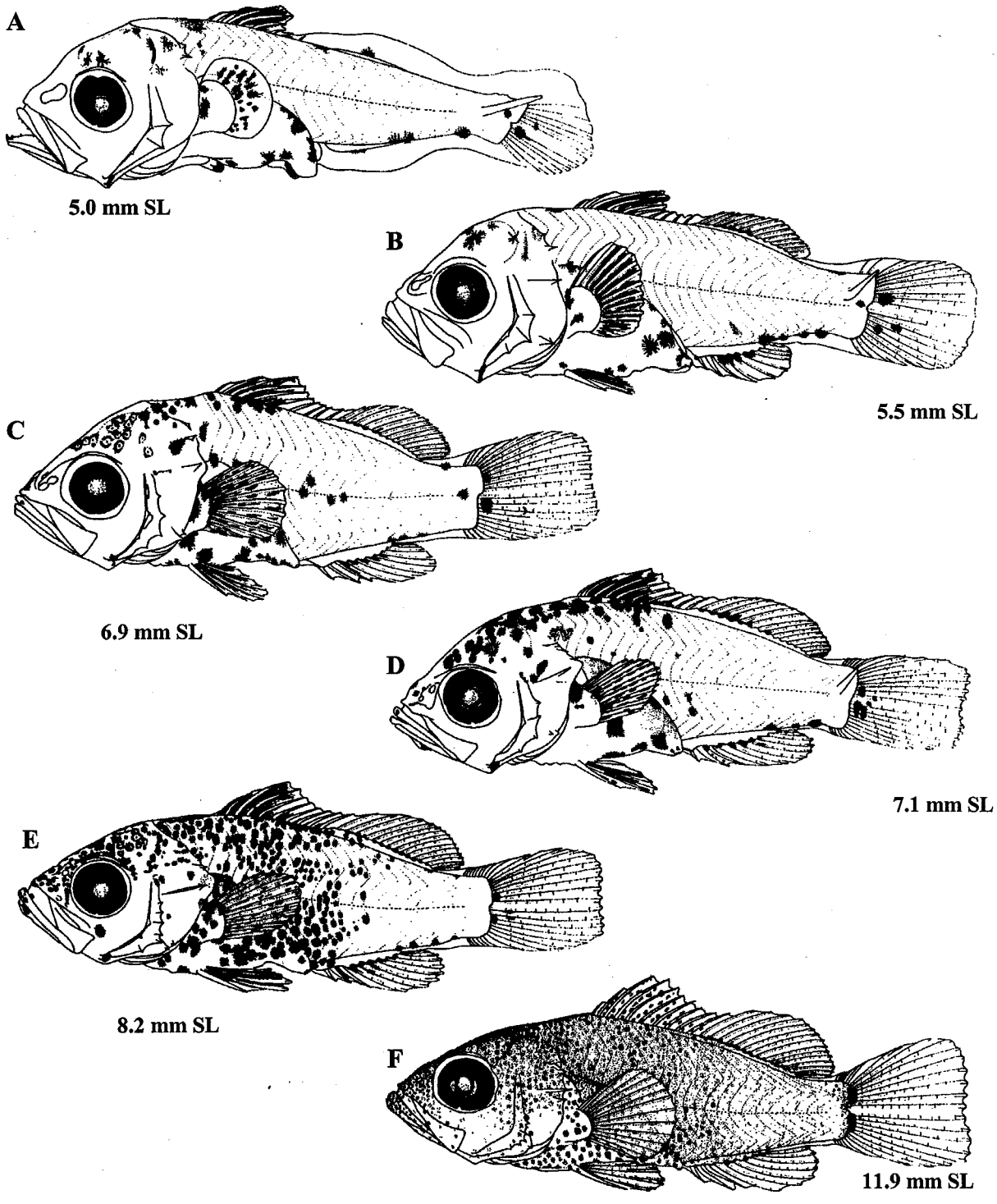
**EGGS:** Unknown

**LARVAE:**
Head Spination:
2nd D Spine Length:
Length at Flexion:
Sequence of Fin Development:
Length of Fin Development:
Pigmentation:
Diagnostic Characters: All have a lot of pigment and are deep bodied.

**EARLY JUVENILES:**
Diagnostic Characters: Color patterns

## ILLUSTRATIONS

Original, specimens from Domeier


A
5.0 mm SL
B
5.5 mm SL
C
6.9 mm SL
D
7.1 mm SL
E
8.2 mm SL
F
11.9 mm SL

## MERISTICS

| | |
|---|---|
| Vertebrae | |
| Precaudal: | 10 |
| Caudal: | 14 |
| Total: | 24 |
| Number of Fin Spines and Rays: | |
| First Dorsal Fin: | X |
| Second Dorsal Fin: | 14-16 |
| Anal Fin: | III,7 |
| Pectoral Fin: | 14(13-15) |
| Gill Rakers: | 6-8+11-15 |
| Lateral Line Scales: | 48-53 |

## LIFE HISTORY

Range: FL Keys, Bahamas, Yucatan, islands and continental margin f the Caribbean Sea.
Habitat: Coral reefs
ELH Pattern: Oviparous; pelagic eggs and larvae.
Spawning
Season:
Area:
Mode: Synchronous hermaphrodites
Migration:
Size/Age at First
Maturity:
Longevity

## LITERATURE

Domeier 1994
Randall 1968

## EARLY LIFE HISTORY DESCRIPTION

**EGGS:** Unknown

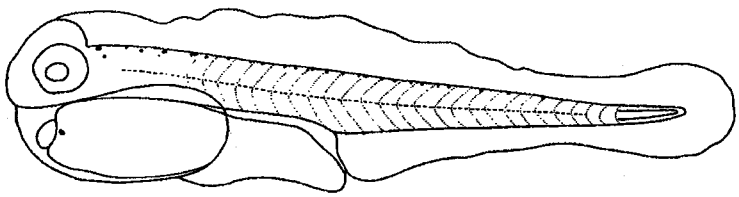
**LARVAE:**
Head Spination:
2nd D Spine Length:
Length at Flexion:
Sequence of Fin Development:
Length of Fin Development:
Pigmentation:
Diagnostic Characters: All have a lot of pigment and are deep bodied.

**EARLY JUVENILES:**
Diagnostic Characters: Color patterns

## ILLUSTRATIONS

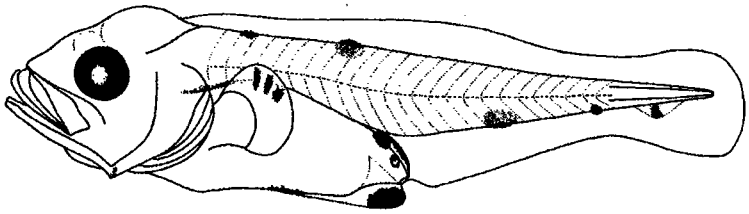
Original, specimens from Domeier

A



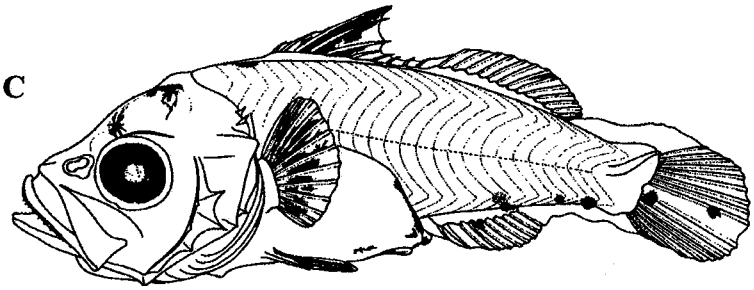
**1.9 mm NL**

B



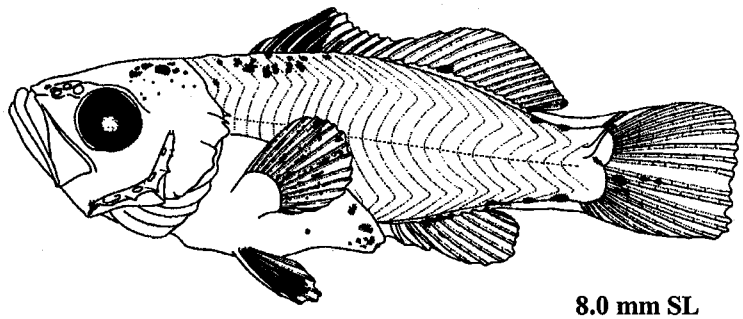
**3.7 mm NL**

C



**5.1 mm SL**

D



**8.0 mm SL**

## MERISTICS

| | |
|---|---|
| Vertebrae | |
| Precaudal | 10 |
| Caudal | 14 |
| Total | 24 |
| Number of Fin Spines and Rays: | |
| First Dorsal Fin | X |
| Second Dorsal Fin | 11(10) |
| Anal Fin | III,7(6) |
| Pectoral Fin | 14-15 |
| Gillrakers: | 9-13 |
| Lateral Line Scales: | 40-46 |
| Branchiostegals: | 6 (all other serranines with 7) |

## LIFE HISTORY

Range: NC to FL, Gulf of Mexico, south to Venezuela. Present in Puerto Rico, but absent from other West Indies islands.
Habitat: Sand and shell bottoms near coral reefs and grass flats in 1-165m.
ELH Pattern: Oviparous; pelagic eggs and larvae
Spawning:
Season: March - September in Gulf of Mexico.

## LITERATURE

Bullock and Smith 1991
Kendall 1979, 1984.

## EARLY LIFE HISTORY DESCRIPTION

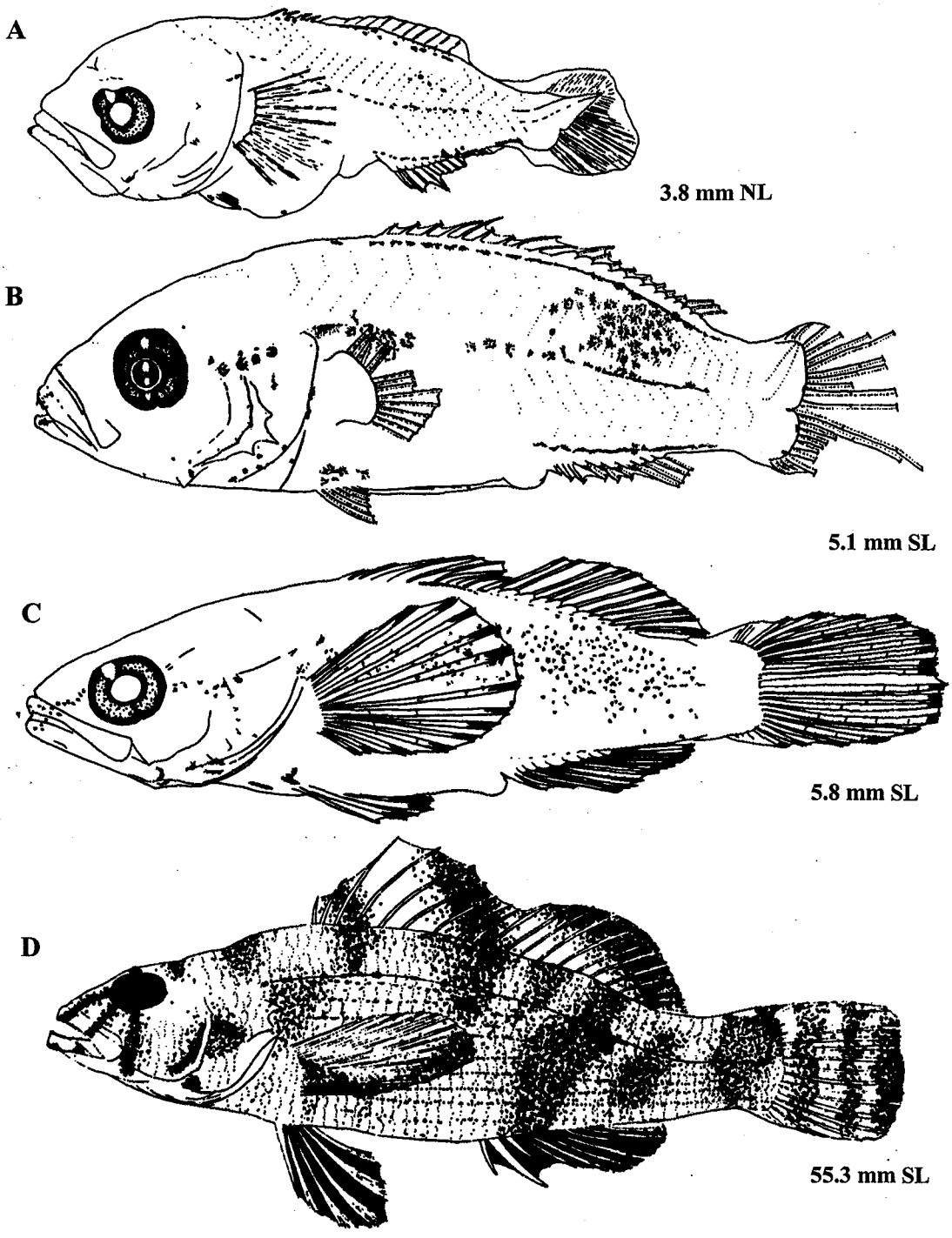
**EGGS:** Unknown

**LARVAE:**
Head Spination:
2nd Dorsal Spine Length:
Length at Flexion:
Sequence of Fin Development:
Length of Fin Development:
Pigmentation: Heavily pigmented with small melanophores making a pattern which changes with growth. 3 series of dashes along dorsum, lateral and ventral flanks, superficial small spots over much of trunk, ventral spots small and uniform in size.
Diagnostic Characters: Pigment pattern as illustrated, also meristics.
Dorsal spines and rays of equal size.
Body depth deeper than other serranines.

**EARLY JUVENILES:**
Diagnostic Characters: Color pattern and meristics.

## ILLUSTRATIONS

Kendall 1979.


A
3.8 mm NL
B
5.1 mm SL
C
5.8 mm SL
D
55.3 mm SL

## MERISTICS

| | |
|---|---|
| Vertebrae | |
| Precaudal: | 10 |
| Caudal: | 14 |
| Total: | 24 |
| Number of Fin Spines and Rays: | |
| First Dorsal Fin: | X |
| Second Dorsal Fin: | 12 |
| Anal Fin: | III,7 |
| Pectoral Fin: | 14 |
| Gill Rakers: | 15-19 |
| Lateral Line Scales: | 48-51 |

## LIFE HISTORY

Range: Bermuda, NC south to east and west FL, Bahamas, Yucatan, and Caribbean.
Habitat: Coral reefs and coral rubble in shallow depths to 37m. Usually solitary or in pairs
ELH Pattern: Oviparous; pelagic eggs and larvae.
Spawning
Season:
Area: Pairs in territorial areas
at sunset
Mode: Synchronous hermaphrodites
Migration:
Size/Age at First
Maturity:
Longevity

## LITERATURE

Robins & Starck 1961
Bullock & Smith 1991
Robins & Ray 1986

## EARLY LIFE HISTORY DESCRIPTION

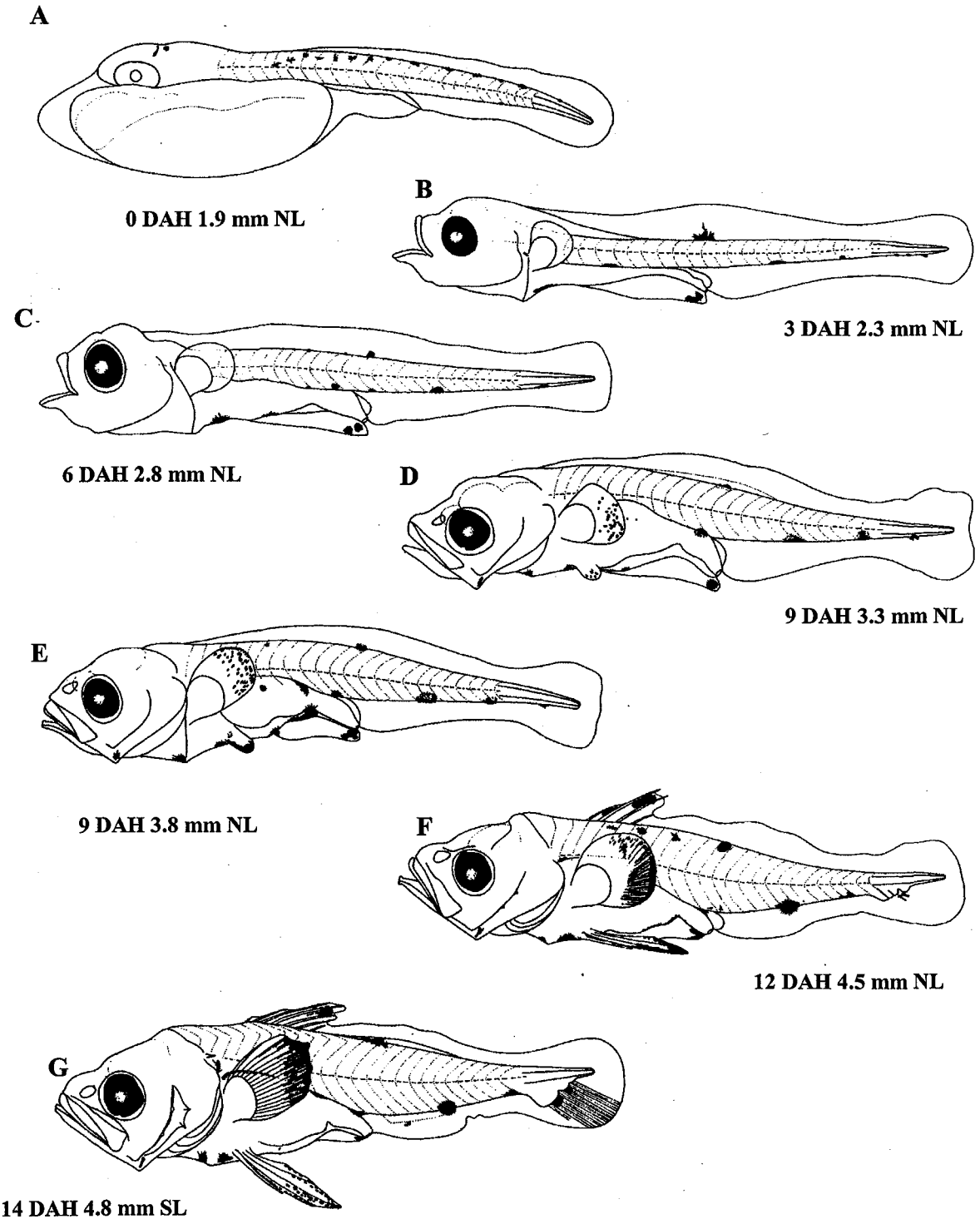
**EGGS:** Unknown

**LARVAE:**
Head Spination: Opercular flap ornately spined
3rd and 4th D Spine Length: Elongated
Length at Flexion: ca. 5mmSL
Sequence of Fin Development: Pelvic, 1st dorsal, caudal, 2nd dorsal, anal and pectoral
Pigmentation: Intense at angular, cleithral symphysis, anus, above anal fin, ventral caudal peduncle, and dorsum below fins.
Diagnostic Characters: Many species and only this species has been reared. Precocius pelvics, elongate 3rd dorsal spine, pigment pattern and meristics.

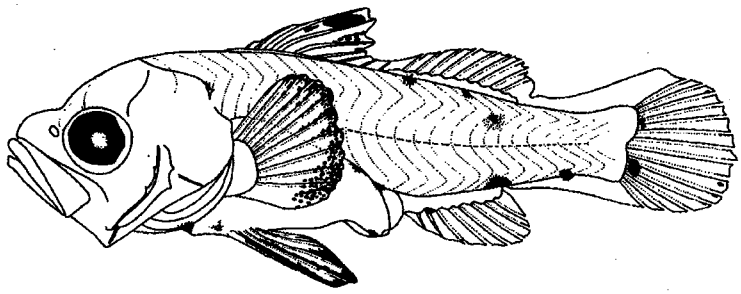
**EARLY JUVENILES:**
Diagnostic Characters: Color patterns

## ILLUSTRATIONS

Reared series, original
M. Domeier, pers. commun

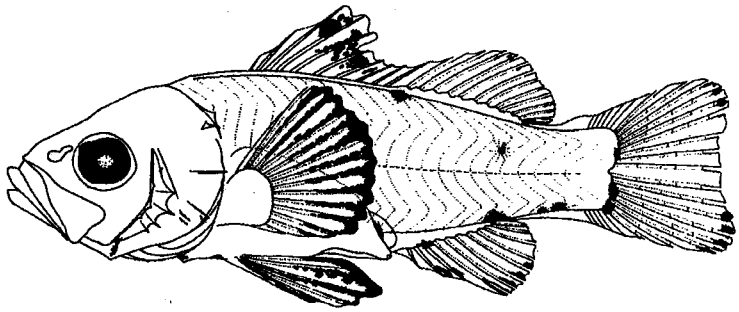

A
0 DAH 1.9 mm NL
B
3 DAH 2.3 mm NL
C
6 DAH 2.8 mm NL
D
9 DAH 3.3 mm NL
E
9 DAH 3.8 mm NL
F
12 DAH 4.5 mm NL
G
14 DAH 4.8 mm SL

H



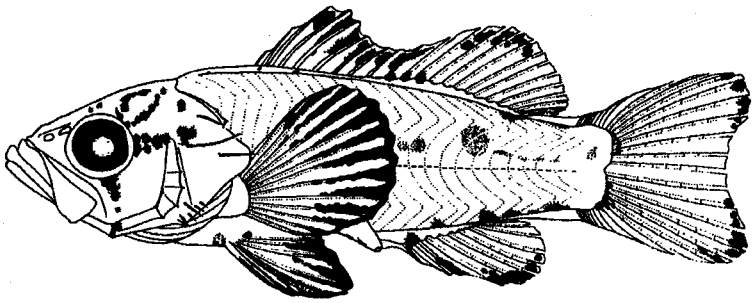
17 DAH 5.9 mm SL

I



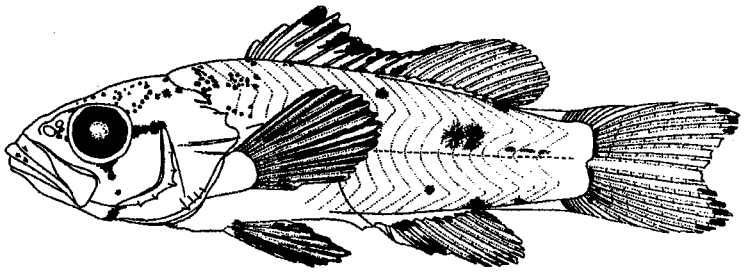
17 DAH 8.1 mm SL

J



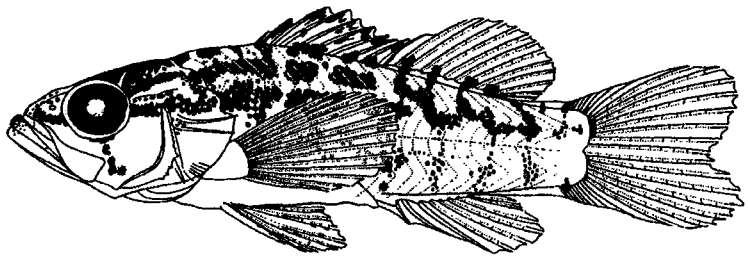
21 DAH 10.6 mm SL

K

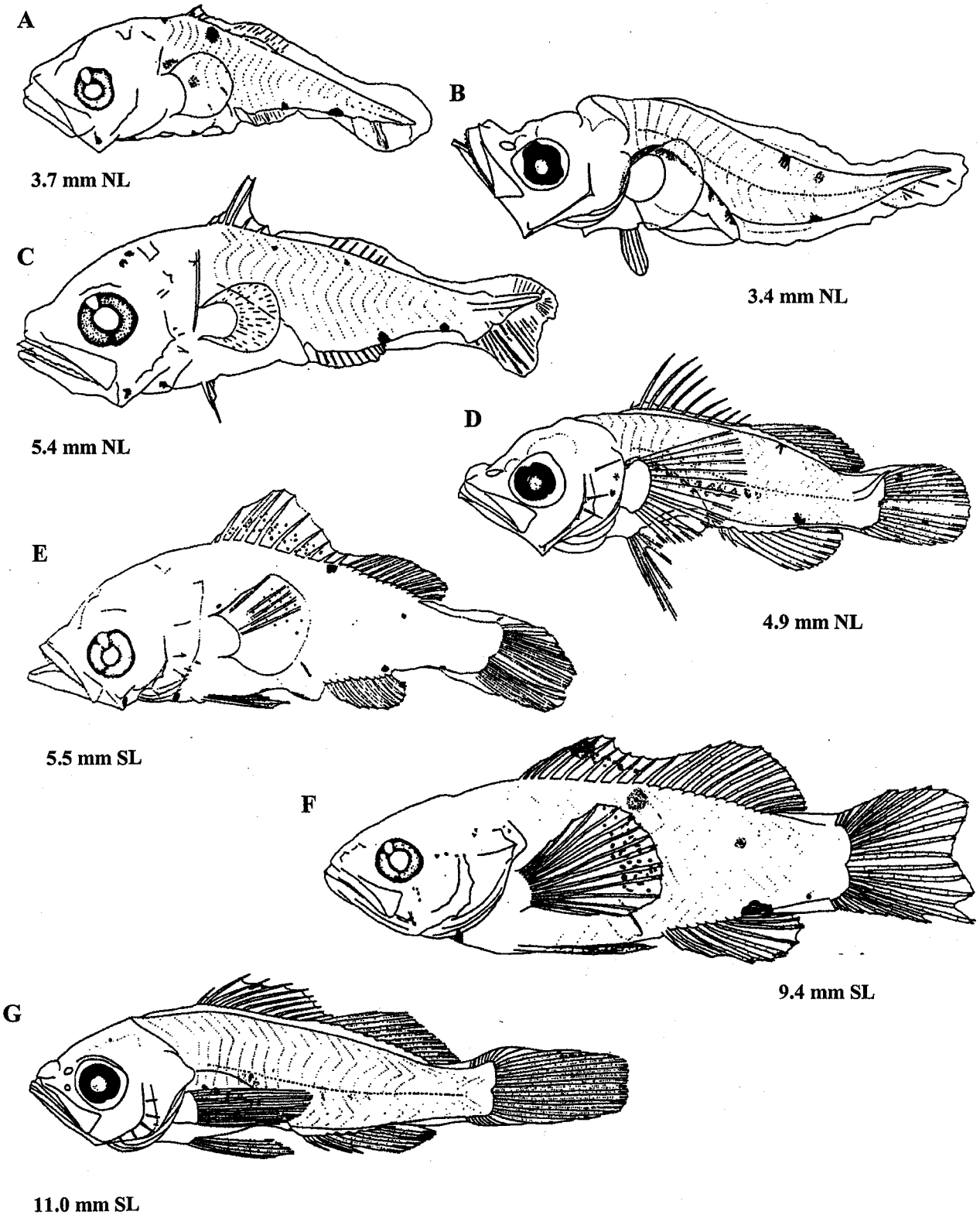


21 DAH 11.1 mm SL

L



26 DAH 14.0 mm SL


A
3.7 mm NL
B
3.4 mm NL
C
5.4 mm NL
D
4.9 mm NL
E
5.5 mm SL
F
9.4 mm SL
G
11.0 mm SL

## SUBFAMILY EPINEPHELINAE

**By W.J. Richards**

This subfamily comprises the most important commercially and recreationally fishes in the Family Serranidae. The adults of the world have been treated by Heemstra and Randall (1993). They list 24 species for our area in 7 genera. Many other papers on this group only consider them to have 4 genera with *Alphestes*, *Cephalopholis*, and *Dermatolepis* species groups within *Epinephelus*. To avoid confusion on this subjective question, I have listed these 3 as subgenera within *Epinephelus*. Adults present some identification problems due to color morphs, juveniles also present similar difficulties though not all are known or clearly described. Johnson and Keener (1984) did an excellent job in identifying the larvae, but were not successful in distinguishing all the species. A few individual accounts of eggs have appeared, but no treatment for identification exists and likely will not occur until eggs of all the species have been collected from known adults.

The larvae are rare in recent collections possibly due to the depletion of many adult stocks from fishing. Larvae are very similar in appearance with elongated first dorsal (usually second and rarely third) fin spines and pelvic spines, moderately deep-bodied which is compressed (Kendall, 1979 said they were kite-shaped, but they are not as strikingly kite-shaped as the gempylid *Diplospinus*), and have 24 myomeres. The gut is small and triangular with variable pigment over it. The head is large with a large mouth and round eye. Preopercle and opercle bear spines with the former often large. There is little pigment on the head which is confined to the brain case. Trunk pigment is sparse but all have some pigment laterally on the caudal peduncle and one genus (*Mycteroperca*) and a few species of *Epinephelus* have a pigment spot on the cleithral symphysis. The second and third first dorsal fin spines and pelvic spine have consistent spinelet morphology which together with meristics of the dorsal, anal and pectoral fins have been used by Johnson and Keener (1984) to identify genera as small as 4-5mm and many of the species of *Epinephelus*. In preparing this account I noted some variation in meristics as reported by Johnson and Keener (1984), Heemstra and Randall (1993), and Rivas (1964) as shown in Table SER-2. The comprehensive table of serranid meristics (Table SER-1) are the counts used in the species accounts. The point to be taken is that these counts are very similar, great care must be taken in making counts together with careful examination of spine morphology. I have developed a provisional key to the larval stages which may help in the identification process. Characters used in the key are derived from Table SER-1 which contains dorsal, anal, and pectoral fin ray counts; spinelet features of the second spine of the first dorsal fin and pelvic spine; pigmentation, and cranial features. These characters are from Johnson and Keener (1984). Note that there is overlap in these characters which caused Johnson and Keener (1984) to note that these characters did not appear to confirm the phylogenetic relationships based on adult taxonomy. I cannot emphasize enough the great difficulty in identifying these larvae. One should carefully read the Johnson and Keener (1984) paper and examine each specimen for every character because there is so much overlap and similarity. I recommend that specimens be cleared and stained to insure acute accuracy with meristics and spinelet morphology. Specimens need not be bleached in this process so that the pigmentation may be retained. Pigmentation is so sparse that it will not interfere with observation of other characters.

Damaged specimens, wherein meristics and spinelet morphology are missing, present real problems as the long dorsal and pelvic spines are often broken as they are very fragile. It is rare to get a specimen with these spines clearly intact. In life these spines have fleshy tips which are heavily pigmented and are presumed to be defensive by giving an appearance of a large size to the small larvae (Colin and Koenig 1996). When they are intact, there is often distinct pigmented membranes at the spine tips.

**Provisional Key to the Genera and Species Groups of the Epinephelinae.**

1a. Dorsal fin VIII,13; anal fin III,7; dorsal and pelvic spines with furrowed appearance ..... *Gonioplectrus hispanus*
1b. Dorsal fin with more than 8 spines and 13 rays, anal fin with more than 7 rays, dorsal and pelvic spines with spinelets but lacking furrowed appearance ..... 2
2a. Dorsal fin IX,17-19; anal fin III,8-10; spinelets on second dorsal fin enlarged, narrow, and curved..... *Paranthias furcifer*
2b. Dorsal fin IX-XI,13-18; anal fin III,7-10; spinelets on second dorsal fin not enlarged, narrow or curved ..... 3
3a. Dorsal fin XI,14-18; anal fin III,8-13; enlarged recurved spinelets on second dorsal spine and primary ridge of pelvic spine; cleithral symphysis with one or more melanpohores ..... 4
3b. Dorsal fin XI,13-20; anal fin III,8-10; no enlarged recurved spinelets on second dorsal or pelvic spines; cleithral symphysis with no melanophores ..... 6
4a. Dorsal fin XI,15-18; anal fin III,10-13 ..... *Mycteroperca*
4b. Dorsal fin XI,14-16; anal fin III,8 ..... 5
5a. Spinelets enlarged and bifurcate near base of second dorsal spine and base of primary ridge of pelvic spine ..... *Epinephelus cruentatus*
5b. Spinelets not bifurcate near base of second dorsal spine and pelvic spine..... *Epinephelus itajara*
6a. Dorsal fin XI,18-20; anal fin III,9(8-10); dorsal spinelets enlarged, widely spaced, and straight..... *Epinephelus inermis*
6b. Dorsal fin IX-XI,13-19; anal fin III,8-10; dorsal spinelets not enlarged widely spaced and straight ..... 7
7a. Anal fin III,8; spinelets on second dorsal and pelvic spines small and straight *Epinephelus striatus* and *E. adscenensionis*
7b. Anal fin III,9..... 8
8a. Pectoral rays 17-18; dorsal fin XI,15-17; spinelets on second dorsal and pelvic spines small and straight ..... 9
8b. Pectoral fin rays 18; dorsal fin rays XI,14; spinelets on second dorsal spine and primary ridge of pelvic spine enlarged and recurved, small and straight on secondary pelvic ridge ..... *Epinephelus niveatus* and *E. flavolimbatus*
8c. Pectoral fin rays 17-18; dorsal fin XI,15; spinelets on second dorsal and primary and secondary ridges of pelvic spines enlarged and recurved..... *Epinephelus mystacinus* and *E. nigritus*
9a. Cranium rugose ..... *Epinephelus afer*
9b. Cranium smooth..... 10
10a. Pectoral fin rays 17..... *Epinephelus morio*, *E. guttatus*, and *E. drummondhayi*
10b. Pectoral fin rays 18..... *Epinephelus fulvus*

Table SER-2. Grouper mersitics comparison based on Rivas 1964, Johnson and Keener 1984, Heemstra and Randall

| Species | Source | D1 | D2 | A | P1 |
|---|---|---|---|---|---|
| *afer* | Rivas | | | | |
| | J and K | XI | 17-18 | III,9 | 17 |
| | H and R | XI | 17-19 | III,9 | 16-17 |
| *cruentatus* | | | | | |
| | Rivas | | | | |
| | J and K | IX | 14 | III,8 | 16 |
| | H and R | IX | 13-15 | III,8 | 16 |
| *fulvus* | | | | | |
| | Rivas | | | | |
| | J and K | IX | 15 | III,9 | 18 |
| | H and R | IX | 15(14-16) | III,9 | 17-19 |
| *inermis* | Rivas | | | | |
| | J and K | XI | 19-20 | III,9 | 18-19 |
| | H and R | XI | 18-20 | III,8-10 | 18-19 |
| *drummondhayi* | Rivas | XI | 16(15) | III,9 | 18 |
| | J and K | XI | 15-17 | III,9 | 18 |
| | H and R | XI | 15-16 | III,9 | 18 |
| *morio* | Rivas | XI | 16-17 | III,9(10) | 17(16-18) |
| | J and K | XI | 15-17 | III,9 | 17 |
| | H and R | XI | 16-17 | III,8-10 | 16-18 |
| *guttatus* | Rivas | XI | 16(15) | III,8(7) | 17(16) |
| | J and K | XI | 15-17 | III,9 | 17 |
| | H and R | XI | 15-16 | III,8 | 16-18 |
| *flavolimbatus* | Rivas | XI | 13-14(15) | III,9 | 18 |
| | J and K | XI | 14 | III,9 | 18 |
| | H and R | XI | 13-15 | III,9 | 17-18 |
| *niveatus* | Rivas | XI | 14(13) | III,9 | 18(19) |
| | J and K | XI | 14 | III,9 | 18 |
| | H and R | XI | 13-15 | III,9 | 17-19 |
| *striatus* | Rivas | XI | 17(16-18) | III,8 | 18(17) |
| | J and K | XI | 16-17 | III,8 | 18-19 |
| | H and R | XI | 16-18 | III,8 | 17-19 |
| *adscensionis* | Rivas | XI | 17(16) | III,8 | 19(18) |
| | J and K | XI | 16-17 | III,8 | 18-19 |
| | H and R | XI | 16-18 | III,8 | 18-20 |
| *mystacinus* | Rivas | XI | 15 | III,9 | 18-19 |
| | J and K | XI | 14-15 | III,9 | 18-19 |
| | H and R | XI | 14-15 | III,9(8) | 18-19 |
| *nigritus* | Rivas | X | 14(13-15) | III,9 | 18(19) |
| | J and K | X | 14-15 | III,9 | 18-19 |
| | H and R | X | 13-15 | III,9 | 18-19 |
| *itajara* | Rivas | XI | 16(15) | III,8 | 19 |
| | J and K | XI | 15-16 | III,8 | 18-19 |
| | H and R | XI | 15-16 | III,8 | 18-19 |
| *Myctoperca* | Rivas | | | | |
| | J and K | III,11(10-13) | | | |
| | H and R | XI | 15-18 | III,10-13 | 15-18 |
| *Paranthias* | Rivas | | | | |
| | J and K | IX | 18-19 | III,9 | 20 |
| | H and R | IX | 17-18(19) | III,8-9(10) | 19-20 |
| *Gonioplectrus* | Rivas | | | | |
| | J and K | VIII | 13 | III,7 | 16 |
| | H and R | VIII | 13 | III,7 | 16-17 |

## MERISTICS

| | |
|---|---|
| Vertebrae | |
| Precaudal | 10 |
| Caudal | 14 |
| Total | 24 |
| Number of Fin Spines and Rays: | |
| First Dorsal Fin | XI |
| Second Dorsal Fin | 16-18 |
| Anal Fin | III,8 |
| Pectoral Fin | 18-20 |
| Gillrakers: | 7-9+16-19=23-28 |
| Lateral Line Scales: | 48-53 |

## LIFE HISTORY

Range: MA to FL, Bermuda, Gulf of Mexico, Caribbean to southern Brazil
Habitat: Rocky reefs in depths of 2-100m.
ELH Pattern: Oviparous; pelagic eggs and larvae
Size/Age at First Maturity: Females at 25cmTL

## LITERATURE

Bullock and Smith 1991
Heemstra and Randall 1993
Johnson and Keener 1984

## EARLY LIFE HISTORY DESCRIPTION

**EGGS:**
Indistinguishable from *E. striatus*

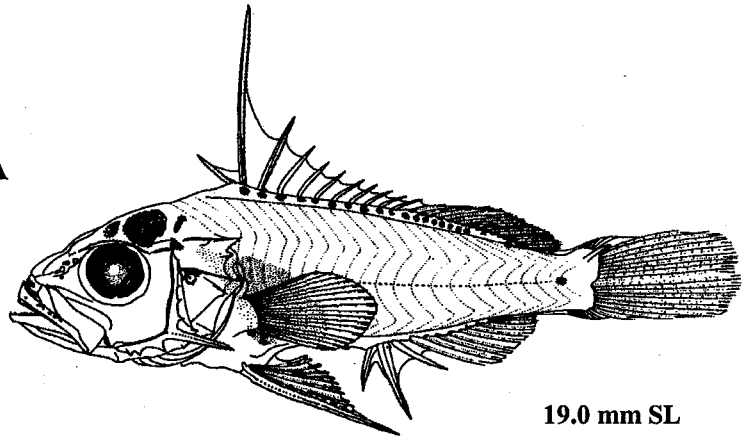
**LARVAE:**
2nd Dorsal Spine Length: 40%SL - one 10.5mmSL
Diagnostic Characters: Meristics identical to *E. striatus*. Both species with spinelets simple, straight, and quite small. Cannot be separated from *E. morio* group until anal fin complete.

**EARLY JUVENILES:**
Diagnostic Characters:
Color pattern like adult but with fewer and larger dark spots on head, body, and fins.

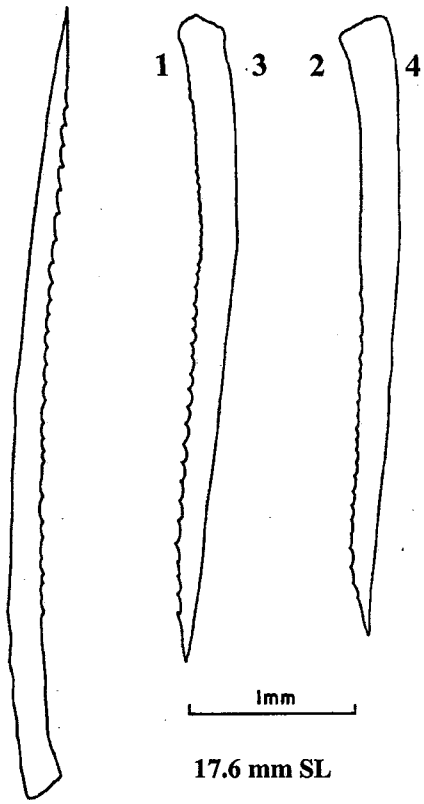
## ILLUSTRATIONS

Dorsal and pelvic spines from Johnson and Keener 1984

A



**19.0 mm SL**




**17.6 mm SL**

## MERISTICS

| | |
|---|---|
| Vertebrae | |
| Precaudal | 10 |
| Caudal | 14 |
| Total | 24 |
| Number of Fin Spines and Rays: | |
| First Dorsal Fin | XI |
| Second Dorsal Fin | 17-18(19) |
| Anal Fin | III,9 |
| Pectoral Fin | 16-17 |
| Gillrakers: | 6-8+16-17 |
| Lateral Line Scales: | 55-61 |

## LIFE HISTORY

Range: South Florida, Bermuda, south through Antilles to Brazil
Habitat: Shallow-water in seagrasses and crevices, cryptic and sedentary
ELH Pattern: Oviparous; pelagic eggs and larvae

## LITERATURE

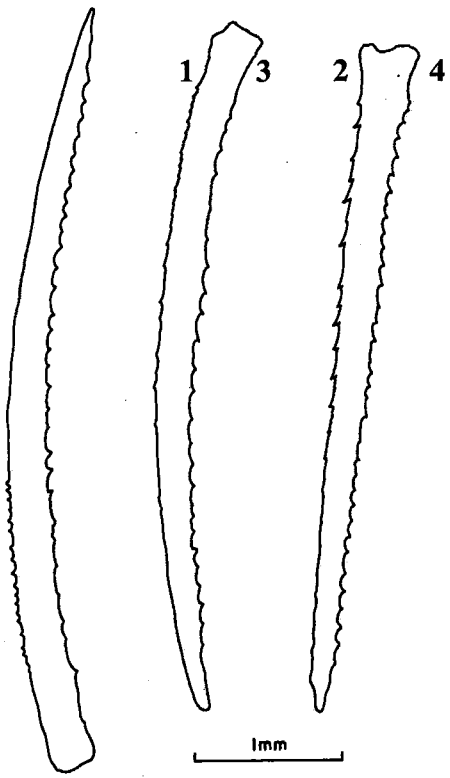
## EARLY LIFE HISTORY DESCRIPTION

**EGGS:**
Number of Oil Globules: single at anterior end of yolk-sac

**LARVAE:**
Head Spination: rugose at 13.5mm SL
2nd Dorsal Spine Length: short (25-59%SL)
Length at Flexion:
Sequence of Fin Development:
Length of Fin Development:
Pigmentation: 16-17(13-23) melanophores
Diagnostic Characters: Meristics along ventral tail midline shared with *E. morio* and E. guttatus and with enlarged melanophore spspines similar to *E. morio* and E. 3/4 distance to anal tip striatus species groups. Wing margin For genus plus pigmentation spinelets somewhat more widely spaced and curved toward spine tip.
Pelvic ridge spinelets small and ca. 15mm SL straight, those along proximal 1/2 of >5 green/brown lateral bands and 4th slightly enlarged and inclined transparent fins. At 22 mm SL toward tip. Most with 18 dorsal rays >5 thin yellow lateral stripes. 15-17 in *E. morio* group. Dorsolateral spot centered or dorsad lateral line, shifts dorsad and smaller with growth. Early Juveniles Similar to

## ILLUSTRATIONS

Dorsal and pelvic spines from Johnson and Keener 1984




**17.0 mm SL**

## MERISTICS

| | |
|---|---|
| Vertebrae: | |
| Precaudal | 10 |
| Caudal | 14 |
| Total | 24 |
| Number of Fin Spines and Rays: | |
| First Dorsal Fin | IX |
| Second Dorsal Fin | 14(13-15) |
| Anal Fin | III,8 |
| Pectoral Fin | 16-16 |
| Gillrakers: | 10+9-11=18-25 |
| Lateral Line Scales: | 47-51 |

## LIFE HISTORY

Range: NC, Bermuda, Bahamas, Gulf of Mexico and Caribbean
Habitat: Shallow seagrass beds and coral reefs to 170 m
ELH Pattern: Oviparous; pelagic eggs and larvae
Season: August-September
Area: Throughout range
Size/Age at First Maturity: Females at 16cmTL. Sex change at 20-23cm

## LITERATURE

Johnson and Keener 1984
Heemstra and Randall 1993

## EARLY LIFE HISTORY DESCRIPTION

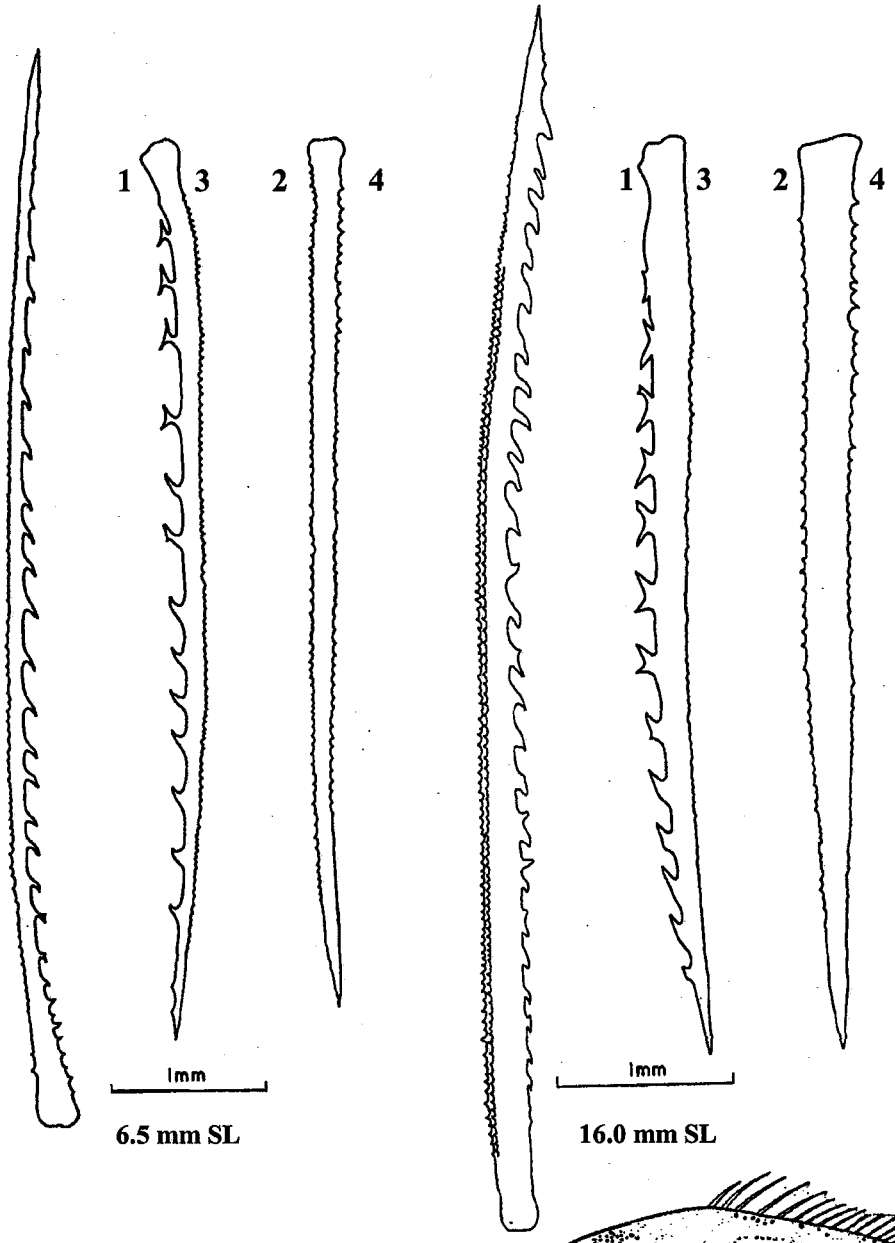
**EGGS:** Unknown

**LARVAE:**
2nd Dorsal Spine Length: long (80-105%SL)spec<10mm; 20-49%SL spec >17mm
Diagnostic Characters: Meristics and first pelvic fin ridge with several enlarged, widely spaced bifurcate spinelets proximally, followed by a series of recurved spinelets. Bifurcate spinelets occur occasionally in a few other species. Also small pigment spot on cleithral symphysis shared with E. itajara and Mycterpoerca

**EARLY JUVENILES:**

## ILLUSTRATIONS

Dorsal and pelvic spines from Johnson and Keener 1984
Juvenile from H and R 1993


1
3
2
4
1mm
6.5 mm SL
1
3
2
4
1mm
16.0 mm SL
A
21.0 mm SL

## MERISTICS

Vertebrae
- Precaudal : 10
- Caudal: 14
- Total: 24

Number of Fin Spines and Rays
- First Dorsal: XI
- Second Dorsal: 15-16
- Total Dorsal Elements
- Anal: III, 9(8)
- Anal Finlets:
- Total Anal Elements:
- Pectoral: 18
- Pelvic:
- Caudal:
- Dorsal Secondary:
- Principal:
- Ventral Secondary:
- Total:

Gillrakers on First Arch: 9-10+17-18=26-28
Lateral line scales: 72-76
Branchiostegals
First Closed Hemal Arch on Vertebrae:
Age at maturity:

## LIFE HISTORY

Range: Bermuda, NC to northern and eastern Gulf of Mexico. Reports from Cuba and Bahamas questionable.
Habitat: Rocky bottoms in 25-183m, most common in 60-120m.
ELH Pattern: oviparous, pelagic eggs 7 larvae
Spawning:
- Season: August in Gulf of Mexico
- Area:
- Mode:
- Migration:

Fecundity:
Age at First Maturity: Females at 45-60cmTL, age 4-5 years. Become males at ages 7-14.
Longevity: ca. 25 years

## LITERATURE

Bullock & Smith 1991
Heemstra & Randall 1993
Johnson & Keener 1984.

## EARLY LIFE HISTORY DESCRIPTION

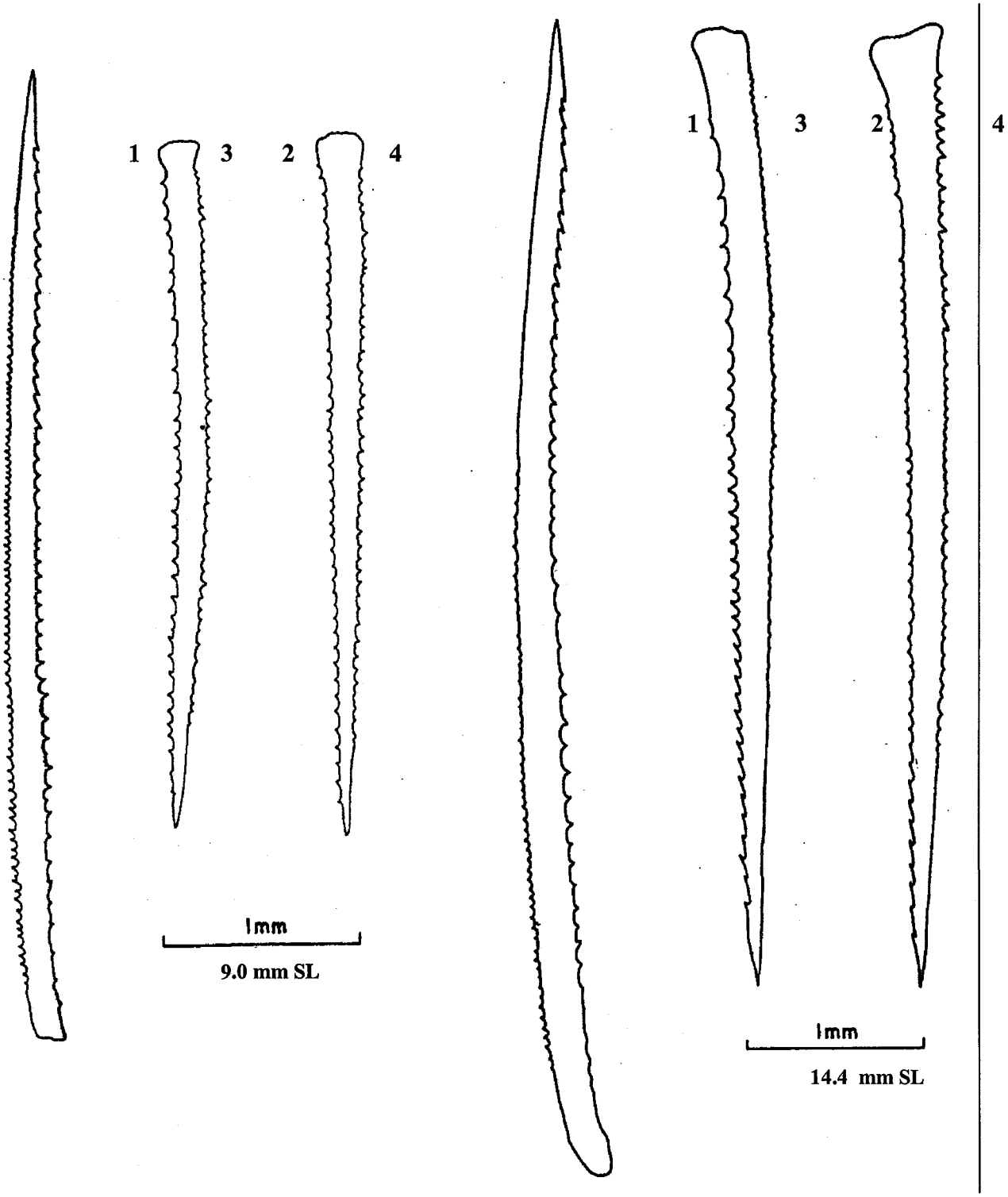
**EGGS:**
Diameter:
No. of Oil Globules:
Oil Globule Diameter:
Yolk:
Shell:
Hatch Size:
Incubation:
Pigmentation:
Diagnostic Characters:

**LARVAE:**
Length at Flexion:
Length at Transformation:
Sequence of Fin Development:
2nd D Spine Length: 46-67mmSL in 6-14mmSL
Pigmentation:
Diagnostic Characters:
Meristics identical to *E. guttatus* and *E. morio* except for more pectoral rays.
All spinelets simple, small, and straight.

**JUVENILES:**
Diagnostic Characters:
Pigment: Bright yellow covered with small bluish spots

## ILLUSTRATIONS

Dorsal and pelvic spines from Johnson & Keener 1984


1
3
2
4
1mm
9.0 mm SL
1
3
2
4
1mm
14.4 mm SL

## MERISTICS

| | |
|---|---|
| Vertebrae: | |
| Precaudal | 10 |
| Caudal | 14 |
| Total | 24 |
| Number of Fin Spines and Rays: | |
| First Dorsal Fin | XI |
| Second Dorsal Fin | 14(13-15) |
| Anal Fin | III,9 |
| Pectoral Fin | 18(17-19) |
| Gillrakers: | 8-9+15-17=23-25 |
| Lateral Line Scales: | ca. 65 |

## LIFE HISTORY

Range: NC to southern Brazil, include. Gulf of Mexico and Caribbean absent from Bermuda
Habitat: Rocky areas and sand/mud bottoms 64-275m.
ELH Pattern: Oviparous; pelagic eggs and larvae
Size/Age at First Maturity: Females at 52-60cmTL. Become males at 75cmTL
Longevity ca. 20 years

## LITERATURE

Bullock and Smith 1991
Heemstra and Randall 1993
Johnson and Keener 1984

## EARLY LIFE HISTORY DESCRIPTION

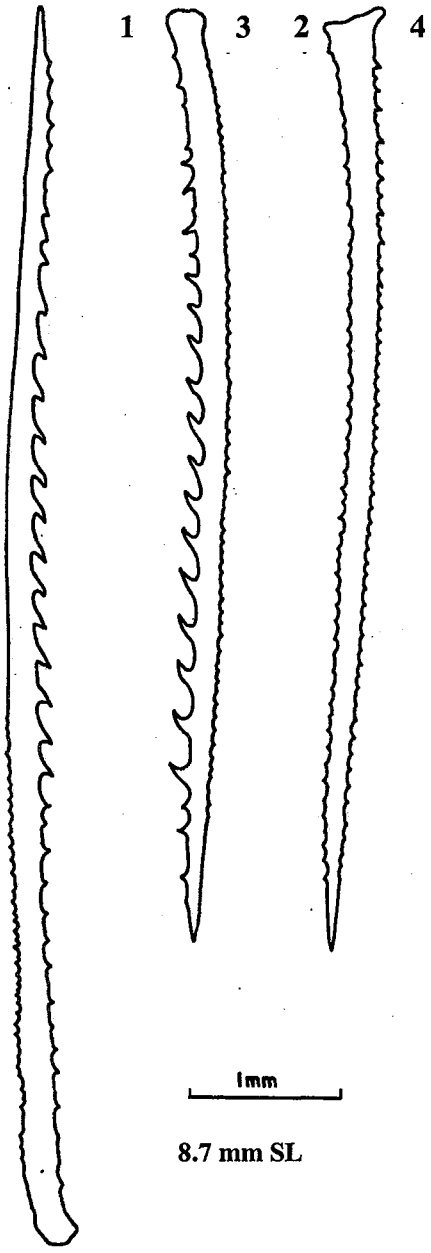
**EGGS:**
Diagnostic Characters: Indistinguishable from *E. niveatus*

**LARVAE:**
2nd Dorsal Spine Length: 65-86%SL in 4-19mmSL
Diagnostic Characters: Meristics identical to *E. niveatus*. Both species with spines like *Mycteroperca*. Large recurved spinelets with smaller spinelets proximally Pelvic primary ridge like second dorsal, remaining ridges with small straight spinelets, those near base of 4th slightly enlarged.

**EARLY JUVENILES:**
Diagnostic Characters: 5-10cm with pearly spots in 4 longitudinal rows and 7 vertical columns, dorsal fin with broad yellow margin, caudal fin white, anal and pelvics blackish; may have caudal peduncle black saddle.

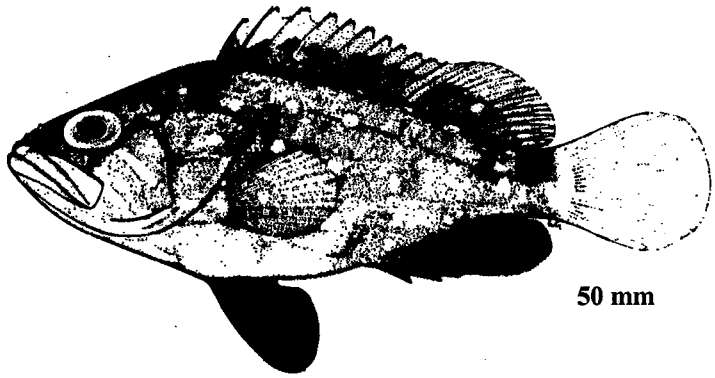
## ILLUSTRATIONS

Dorsal and pelvic spines from Johnson and Keener 1984
Juvenile from Heemstra and Randall 1993




8.7 mm SL

A



50 mm

## MERISTICS

| | |
|---|---|
| Vertebrae | |
| Precaudal: | 10 |
| Caudal: | 14 |
| Total: | 24 |
| First Dorsal Fin: | IX |
| Second Dorsal Fin: | 16(15-16) |
| Anal Fin: | III,8 |
| Pectoral Fin: | 18-19 |
| Gill Rakers: | 8-9+13-15=21-24 |
| Lateral Line Scales: | 61-64 |

## LIFE HISTORY

Range: SC, Bermuda, Bahamas, Gulf of Mexico and Caribbean to Brazil and Atol das Rocas
Habitat: Coral reefs and clear water to 45m, not in silty shallow reefs.
ELH Pattern: Oviparous; pelagic eggs and larvae
Spawning
Season: May to August in Bermuda
December-January in Bahamas
January-March in Jamaica
Area: Throughout range
Mode: Aggregations at sunset over several days
Migration:
Size/Age at First
Maturity: Females at 16cmTL
Sex change at 20cm
Longevity

## LITERATURE:

Johnson & Keener 1984
Heemstra & Randall 1993

## EARLY LIFE HISTORY DESCRIPTION

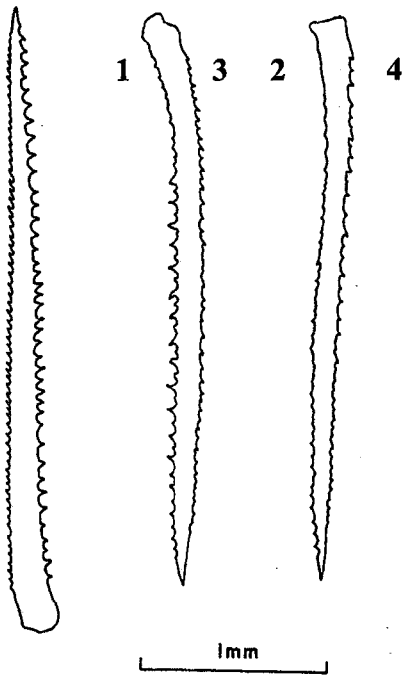
**EGGS:**
Diameter: 0.95mm
No. of Oil Globules: single
Oil Globule Diameter:
Yolk:
Hatch Size:
Incubation:
Pigment:
Diagnostic Characters:

**LARVAE**
Head Spination:
2nd D Spine Length: 48-55%SL spec 5.5-8.4mmSL; re-
sorption ca. 22-25mmSL.
Length at Flexion:
Sequence of Fin Development:
Length of Fin Development:
Pigmentation:
Diagnostic Characters: Meristics due to 9 dorsal spines.
Spines of generalized type with spinelets simple, straight and relatively small. Most spinelets on apex ridge curved toward tip.

**EARLY JUVENILES:**
Settlement Size :
Pigment:
2nd D Spine Length:
Diagnostic Characters:

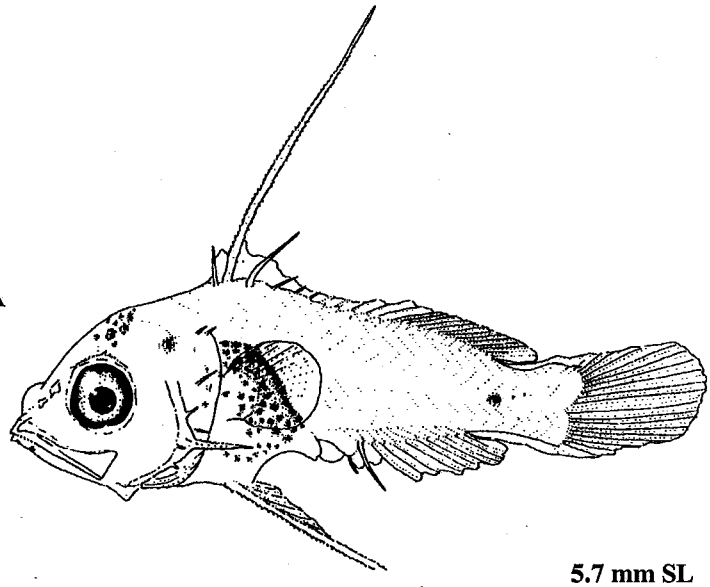
## ILLUSTRATIONS

Dorsal and pelvic spines from Johnson & Keener 1984
Larvae from Laroche (orig)
Juvenile from Laroche (orig)



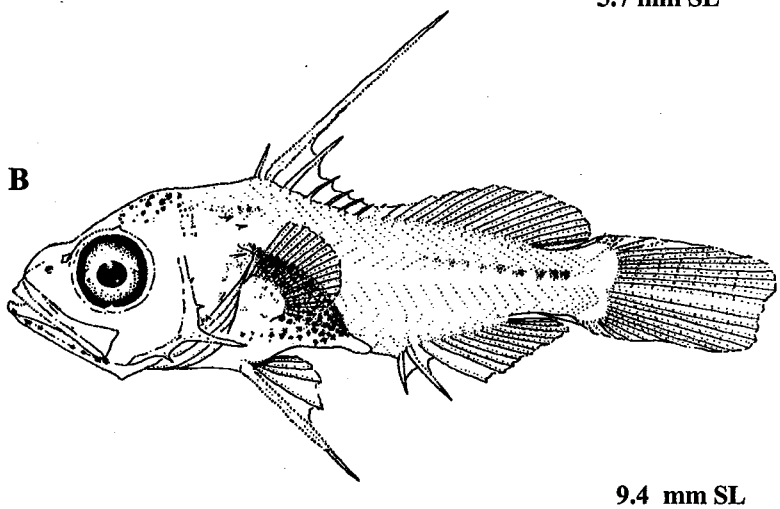

**8.0 mm SL**

**A**

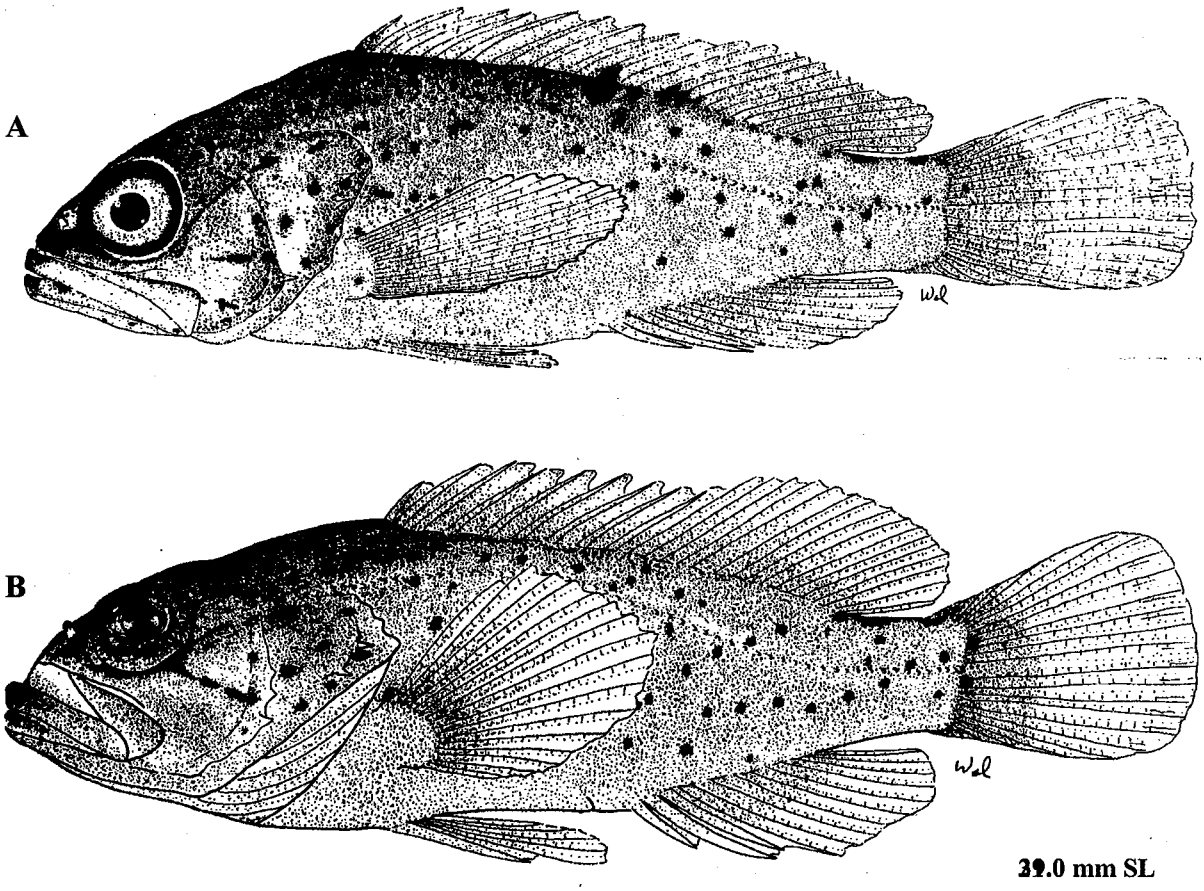


**5.7 mm SL**

**B**



**9.4 mm SL**


A
B
39.0 mm SL
C
33.0 mm SL

## MERISTICS

| | |
|---|---|
| Vertebrae | |
| Precaudal: | 10 |
| Caudal: | 14 |
| Total: | 24 |
| First Dorsal Fin: | XI |
| Second Dorsal Fin: | 16(15-17) |
| Anal Fin: | III,8(7-9) |
| Pectoral Fin: | 17(16-18) |
| Gill Rakers: | 8-9+16-18=24-26 |
| Lateral Line Scales: | 92-104 |

## LIFE HISTORY

Range: Bermuda, NC to Venezuela, Gulf of Mexico and Caribbean
Habitat: Shallow reefs and rocky bottoms in 2-100m.
ELH Pattern: Oviparous; pelagic eggs and larvae
Spawning
Season: January-February in during full moon
Area: Caribbean
Mode: Aggregations on outer top reefs in 20m
Migration:
Size/Age at First Maturity: Females at 22-24cmTL
Become males at 28-40cmTL.
Longevity ca. 22 years

## LITERATURE:

Colin et al. 1987
Heemstra & Randall 1993
Johnson & Keener 1984

## EARLY LIFE HISTORY DESCRIPTION

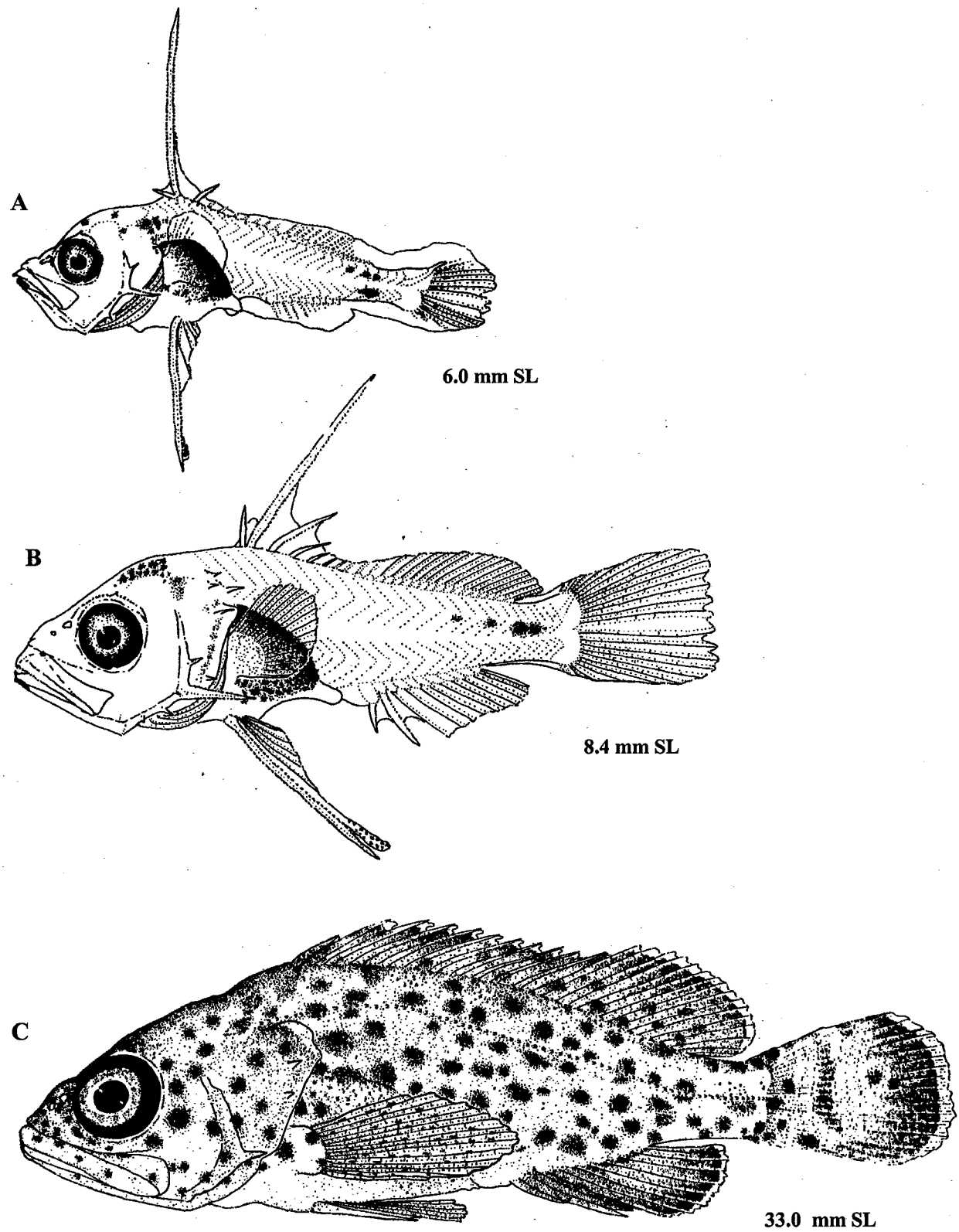
**EGGS:**
Diameter: 0.96-0.97mm
No. of Oil Globules: usually one, some with multiple smaller globules
Oil Globule Diameter: 0.22mm
Yolk: clear
Hatch Size:
Incubation: 27hr at 26.5 C.
Pigment: Pigment:
Diagnostic Characters:

**LARVAE**
Head Spination:
2nd D Spine Length: 46-67%SL in 6-14mmSL
Length at Flexion:
Sequence of Fin Development:
Length of Fin Development:
Pigmentation:
Diagnostic Characters: Meristics identical to E. morio and differs little in pectoral rays from E. drummondhayi. All spinelets simple, small, and straight.

**EARLY JUVENILES:**
Settlement Size :
Pigment:
2nd D Spine Length:
Diagnostic Characters:

## ILLUSTRATIONS

Larvae from Laroche
Juvenile from Heemstra & Randall 1993


A
6.0 mm SL
B
8.4 mm SL
C
33.0 mm SL

## MERISTICS

| | |
|---|---|
| Vertebrae | |
| Precaudal: | 10 |
| Caudal: | 14 |
| Total: | 24 |
| First Dorsal Fin: | XI |
| Second Dorsal Fin: | 18-20 |
| Anal Fin: | III,9(8-10) |
| Pectoral Fin: | 18-19 |
| Gill Rakers: | 7+14=19-20 |
| Lateral Line Scales: | 115-125 |

## LIFE HISTORY

Range: NC to Rio de Janiero, Brazil
incl. Gulf of Mexico
Habitat: Reef caves and crevices
21-213m
ELH Pattern: Oviparous; pelagic eggs and larvae
Spawning
Season:
Area:
Mode:
Migration:
Size/Age at First Maturity:
Longevity

## LITERATURE:

Johnson & Keener 1984

## EARLY LIFE HISTORY DESCRIPTION

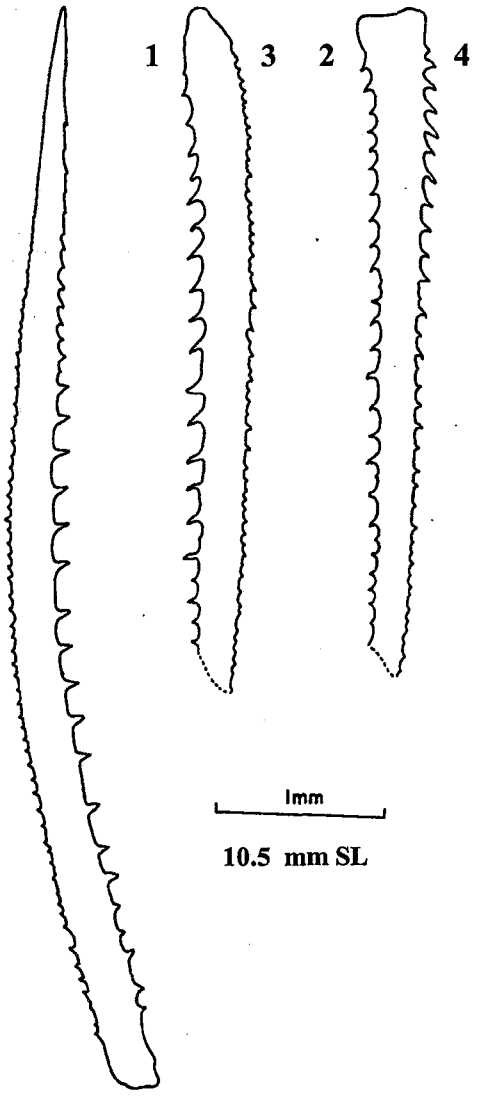
**EGGS:** Unknown

**LARVAE**
Head Spination: smooth
Preanal Length:
Length at Flexion:
Sequence of Fin Development:
Length of Fin Development:
Pigmentation:
Diagnostic Characters: Meristics unique and 2nd dorsal with widely spaced, straight spinelets about 3/4 length followed distally by smaller, slightly curved ones. Single apex ridge bears small straight spinelets. Pelvic primary ridge spine- lets fairly large, narrow, slightly curved toward spine tip. Ridges 2 and 4 bear smaller, narrow spinelets that curve slightly toward tip with 4th en- larged proximally. Ridge bears 3 small straight/slightly curved spinelets.

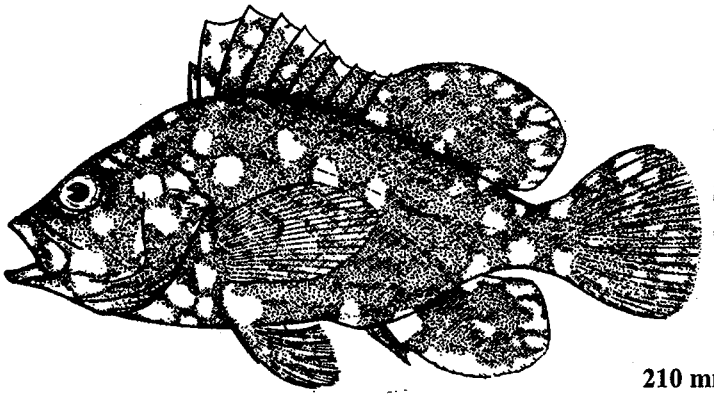
**EARLY JUVENILES:**
Settlement Size :
Pigment: Black or dark brown covered with white spots and blotches.
Diagnostic Characters: Meristics and pigmentation.

## ILLUSTRATIONS

Dorsal and pelvic spines from Johnson & Keener 1984
Juvenile from Heemstra and Randall 1993




**10.5 mm SL**



**210 mm SL**

## MERISTICS

| | |
|---|---|
| Vertebrae | |
| Precaudal | 10 |
| Caudal | 14 |
| Total | 24 |
| Number of Fin Spines and Rays: | |
| First Dorsal Fin | IX |
| Second Dorsal Fin | 16(15-16) |
| Anal Fin | III,8 |
| Pectoral Fin | 18-19 |
| Gillrakers: | 8-9+13-15=21-24 |
| Lateral Line Scales: | 61-64 |

## LIFE HISTORY

Range: SC, Bermuda, Bahamas, Gulf of Mexico and Caribbean to Brazil and Atol das Rocas
Habitat: Coral reefs and clear water to 45m, not in silty shallow reefs.
ELH Pattern: Oviparous; pelagic eggs and larvae
Spawning:
Season: May to August in Bermuda, December-January in Bahamas, January-March in Jamaica
Area: Throughout range
Mode: Aggregations at sunset over several days
Size/Age at First Maturity: Females at 16cmTL, Sex change at 20cm

## LITERATURE

Johnson and Keener 1984
Heemstra and Randall 1993

## EARLY LIFE HISTORY DESCRIPTION

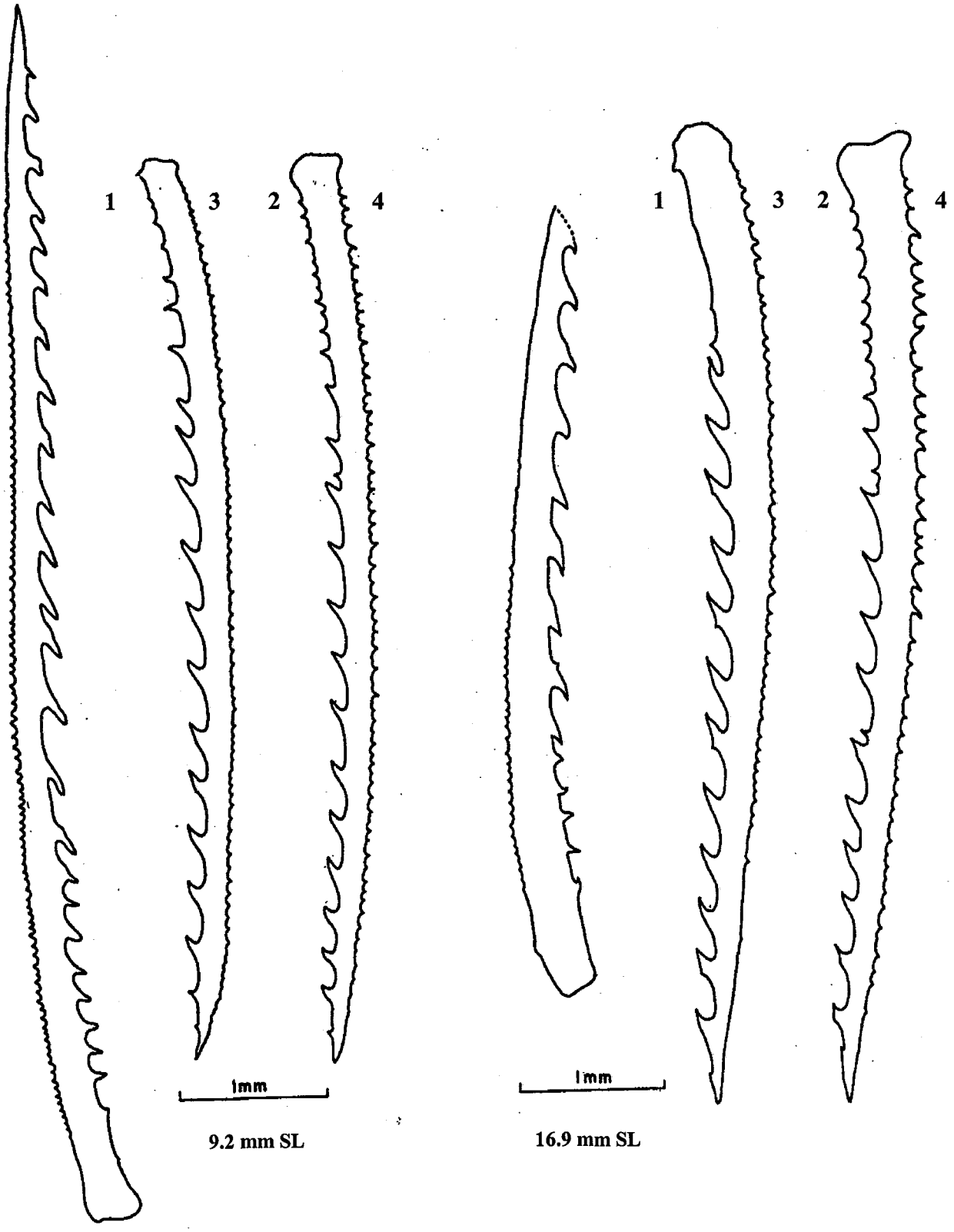
**EGGS:**
Diameter: 0.95mm
Number of Oil Globules: single

**LARVAE:**
2nd Dorsal Spine Length: 48-55%SL spec 5.5-8.4mmSL; resorption ca.
22-25mmSL
Diagnostic Characters: Meristics due to 9 dorsal spines. Spines of generalized type with spinelets simple, straight and relatively small. Most spinelets on apex ridge curved toward tip.

**EARLY JUVENILES:**

## ILLUSTRATIONS

Dorsal and pelvic spines from Johnson and Keener 1984


1
3
2
4
1mm
9.2 mm SL
1
3
2
4
1mm
16.9 mm SL

## MERISTICS

| | |
|---|---|
| Vertebrae | |
| Precaudal | 10 |
| Caudal | 14 |
| Total | 24 |
| Number of Fin Spines and Rays: | |
| First Dorsal Fin | XI |
| Second Dorsal Fin | 15-17 |
| Anal Fin | III,9(8-10) |
| Pectoral Fin | 17(16-18) |
| Gillrakers: | 8-9+15-16=23-25 |
| Lateral Line Scales: | 60-68 |

## LIFE HISTORY

Range: NC to southern Brazil, Gulf of Mexico and Caribbean present in Bermuda
Habitat: Rocky, sand or mud bottoms in 50-300m. Juviniles in shallow sea grass beds and inshore reefs, crevices and ledges.
ELH Pattern: Oviparous; pelagic eggs and larvae
Spawning:
Season: April-May in Gulf of Mexico
Size/Age at First Maturity: Females at 40-50cmTL, Become males at ages 7-14
Longevity ca. 25 years

## LITERATURE

Moe 1969
Heemstra and Randall 1993
Johnson and Keener 1984
Colin and Koenig 1996

## EARLY LIFE HISTORY DESCRIPTION

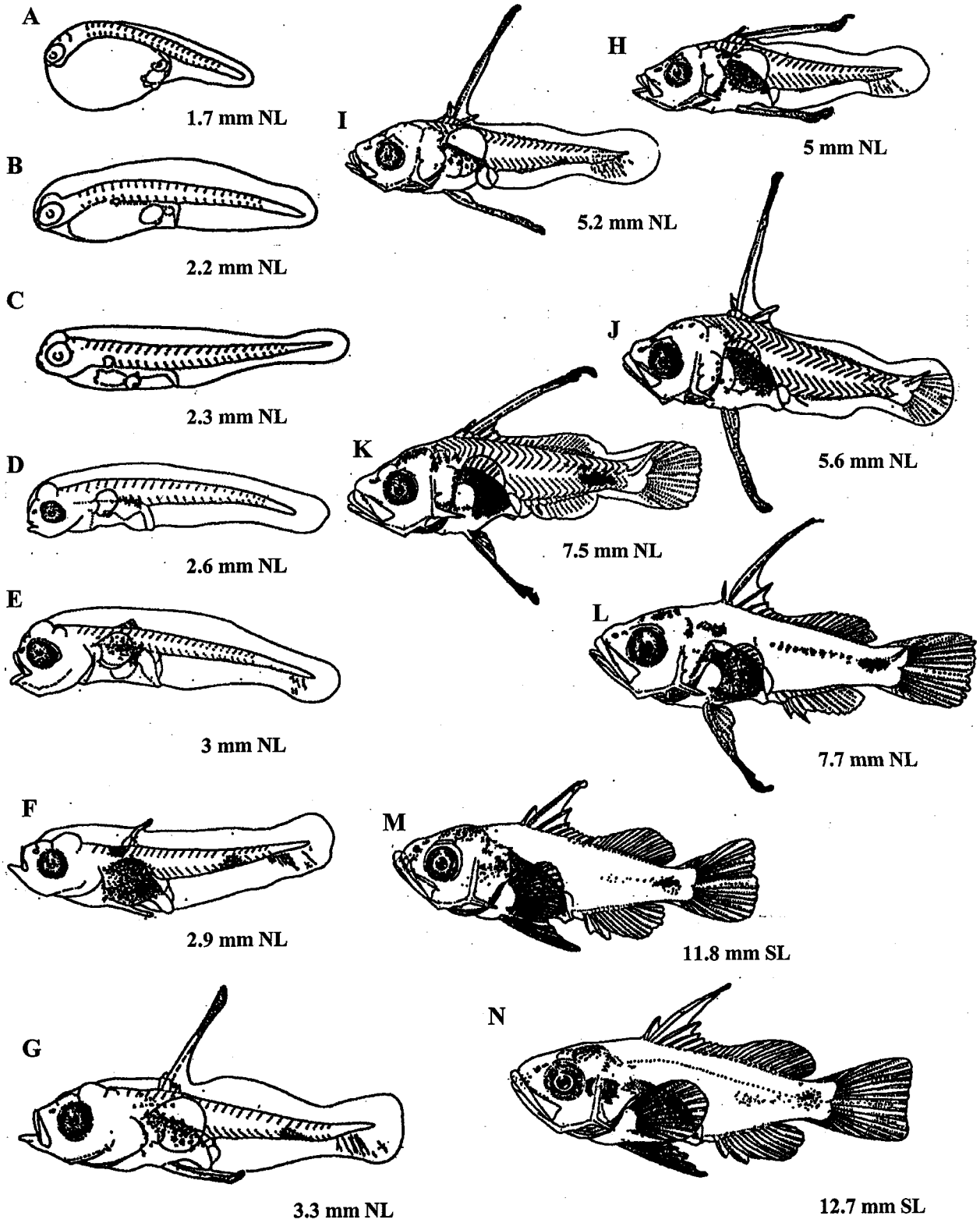
**EGGS:** Unknown

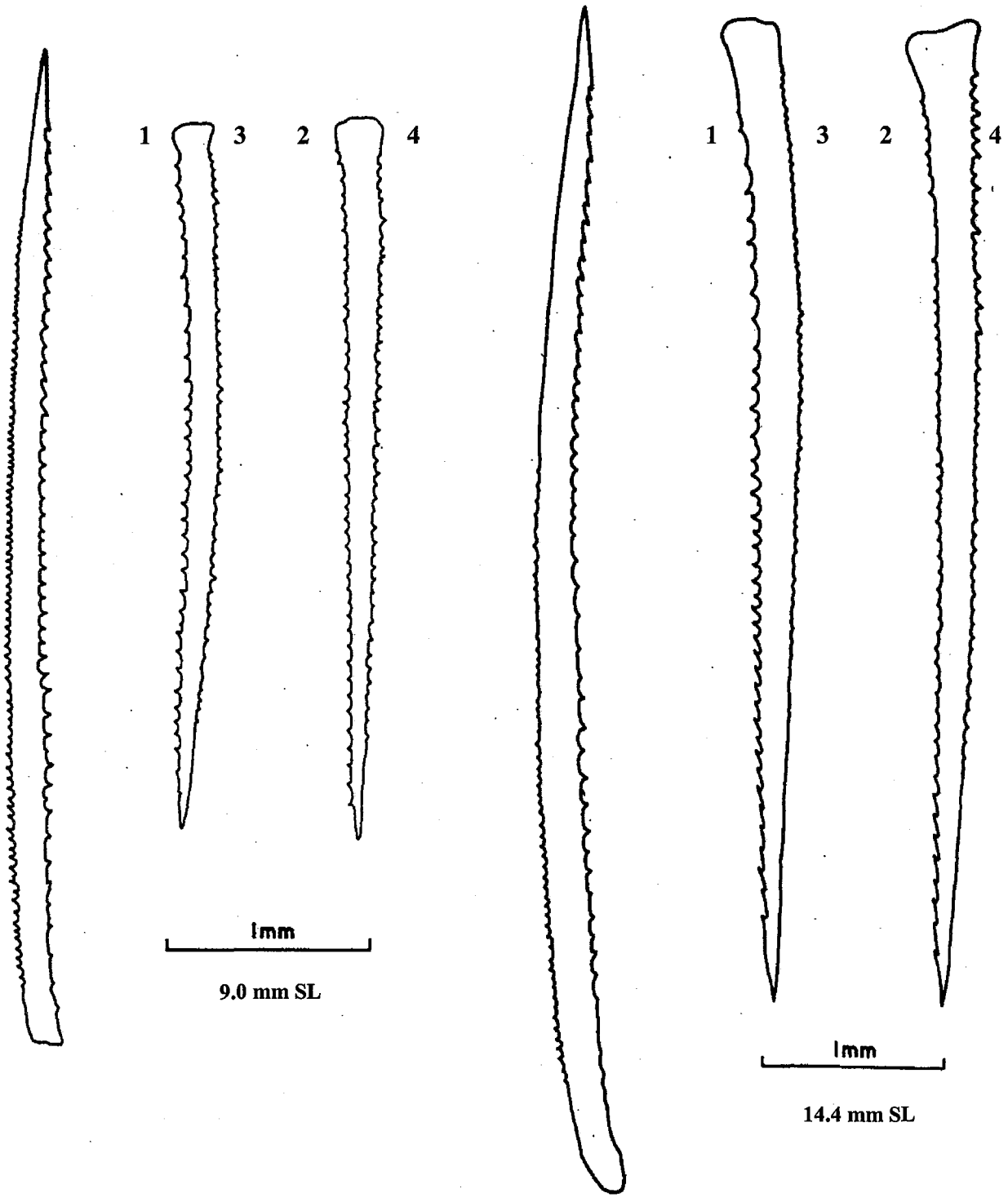
**LARVAE:**
2nd Dorsal Spine Length: 46-67%SL in 6-14mmSL
Diagnostic Characters: Meristics identical to E. guttatus and differs little in pectoral rays from E. drummondhayi. All spinelets simple, small, and straight.

**EARLY JUVENILES:**

## ILLUSTRATIONS

Dorsal and pelvic spines from Johnson and Keener 1984
Larvae from Koenig (orig)


A
1.7 mm NL
B
2.2 mm NL
C
2.3 mm NL
D
2.6 mm NL
E
3 mm NL
F
2.9 mm NL
G
3.3 mm NL
I
5.2 mm NL
H
5 mm NL
J
5.6 mm NL
K
7.5 mm NL
L
7.7 mm NL
M
11.8 mm SL
N
12.7 mm SL


1
3
2
4
1mm
9.0 mm SL
1
3
2
4
1mm
14.4 mm SL

## MERISTICS

| | |
|---|---|
| Vertebrae | |
| Precaudal | 10 |
| Caudal | 14 |
| Total | 24 |
| Number of Fin Spines and Rays: | |
| First Dorsal Fin | XI |
| Second Dorsal Fin | 15(14-15) |
| Anal Fin | III,9(8) |
| Pectoral Fin | 18-19 |
| Gillrakers: | 8-10+14-16=22-26 |
| Lateral Line Scales: | 58-69 |

## LIFE HISTORY

Range: NC to FL, Bermuda, Gulf of Mexico, Yucatan, Greater and Leeward Antilles to Trinidad
Habitat: Deep-water species 100-400m juveniles to 30m.
ELH Pattern: Oviparous; pelagic eggs and larvae
Spawning Season: Summer?

## LITERATURE

Bullock and Smith 1991
Heemstra and Randall 1993
Johnson and Keener 1984

## EARLY LIFE HISTORY DESCRIPTION

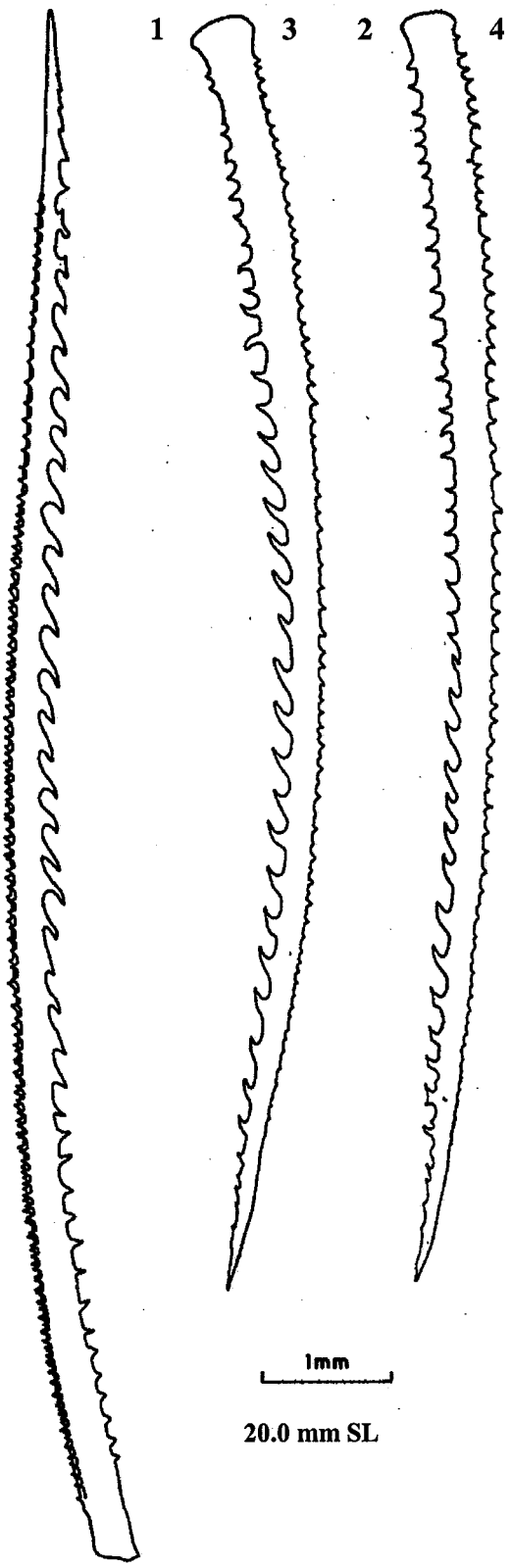
**EGGS:** Unknown

**LARVAE:**
2nd Dorsal Spine Length: 75%SL - one 20.1mmSL
Diagnostic Characters: Meristics close to *E. niveatus* and flavolimbatus. 2nd dorsal with large recurved spinelets on wing margins, 3 parallel rows of simple, straight spinelets at apex. Pelvic primary ridge with large recurved spinelets. 2nd ridge with large recurved spinelets on distal half, seen only in E. itajara and nigritus.

**EARLY JUVENILES:**
Diagnostic Characters: Color pattern with dark caudal peduncle saddle blotch.

## ILLUSTRATIONS

Dorsal and pelvic spines from Johnson and Keener 1984




**20.0 mm SL**

## MERISTICS

| | |
|---|---|
| Vertebrae | |
| Precaudal | 10 |
| Caudal | 14 |
| Total | 24 |
| Number of Fin Spines and Rays: | |
| First Dorsal Fin | X |
| Second Dorsal Fin | 14(13-15) |
| Anal Fin | III,9 |
| Pectoral Fin | 18-19 |
| Gillrakers: | 9-11+14-16=23-25 |
| Lateral Line Scales: | 62-71 |

## LIFE HISTORY

Range: MA to FL, northern Gulf of Mexico, Cuba, w. Hispaniola, Trinidad, and Rio de Janeiro
Habitat: Rough, rocky bottoms 55-525m juveniles near jetties, shallow reefs.
ELH Pattern: Oviparous; pelagic eggs and larvae
Spawning:
Season: Late summer? in the. Gulf
Migration: Limited home ranges
Size/Age at First Maturity:
Longevity >41 years

## LITERATURE

Bullock and Smith 1991
Heemstra and Randall 1993
Johnson and Keener 1984

## EARLY LIFE HISTORY DESCRIPTION

**EGGS:** Unknown

**LARVAE:**
Diagnostic Characters: Meristics, large recurved spinelets along primary ridge of pelvic and several similar on ridge 2, perhaps similar to *E. mystacinus*.

**EARLY JUVENILES:**
Diagnostic Characters: Meristics, Color pattern with yellow caudal fin, few scattered whitish spots on body; no dark caudal peduncle saddle blotch.

## ILLUSTRATIONS

## MERISTICS

| | |
|---|---|
| Vertebrae | |
| Precaudal | 10 |
| Caudal | 14 |
| Total 24 | |
| Number of Fin Spines and Rays: | |
| First Dorsal Fin | XI |
| Second Dorsal Fin | 14(13-15) |
| Anal Fin | III,9 |
| Pectoral Fin | 18(17-19) |
| Gillrakers: | 7-10+15-17=22-26 |
| Lateral Line Scales: | 64-73 |

## LIFE HISTORY

Range: MA to southern Brazil, include. Gulf of Mexico and Caribbean present in Bermuda
Habitat: Rocky bottoms in 30-525m, juveniles found inshore.
ELH Pattern: Oviparous; pelagic eggs and larvae
Spawning:
Season: April-July off FL Keys
Size/Age at First Maturity: Females at 40-50cmTL
Become males at 70cmTL
Longevity ca. 27 years

## LITERATURE

Moore and Labiskey 1984
Heemstra and Randall 1993
Johnson and Keener 1984

## EARLY LIFE HISTORY DESCRIPTION

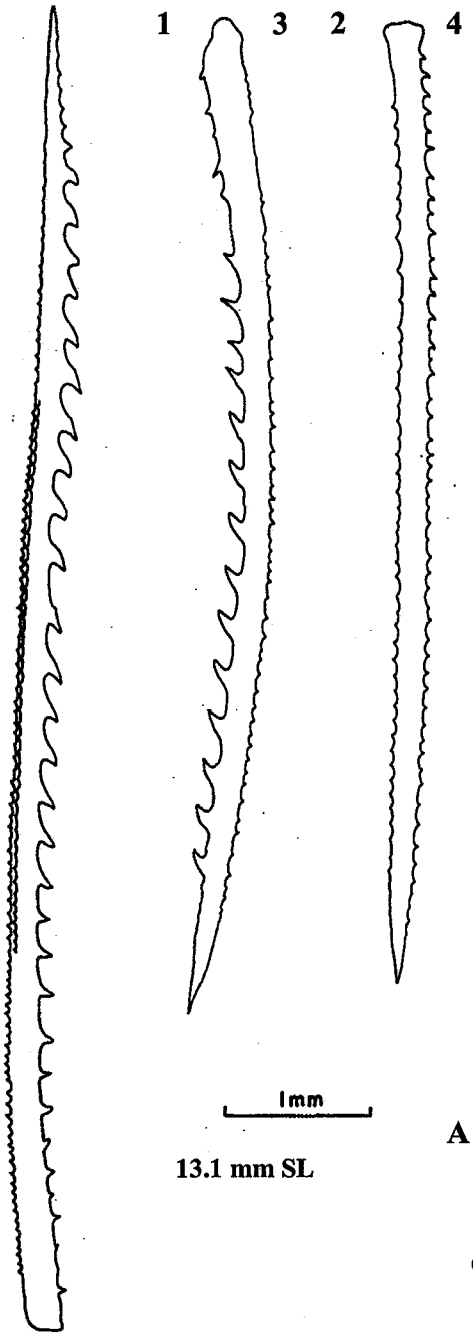
**EGGS:**
Diagnostic Characters: Indistinguishable from E. flavolimbatus

**LARVAE:**
2nd Dorsal Spine Length: 65-86%SL in 4-19mmSL
Diagnostic Characters: Meristics identical to E. flavolimbatus. Both species with spines like *Mycteroperca*. Large recurved spinelets with smaller spinelets proximally. Pelvic primary ridge like second dorsal, remaining ridges with small straight spinelets, those near base of 4th slightly enlarged.

**EARLY JUVENILES:**
Diagnostic Characters: dark brown with white spots in 5-6 longitudinal rows and 11 vertical columns, caudal and pectoral fins yellow, black saddle blotch on caudal peduncle reaching below lateral line.

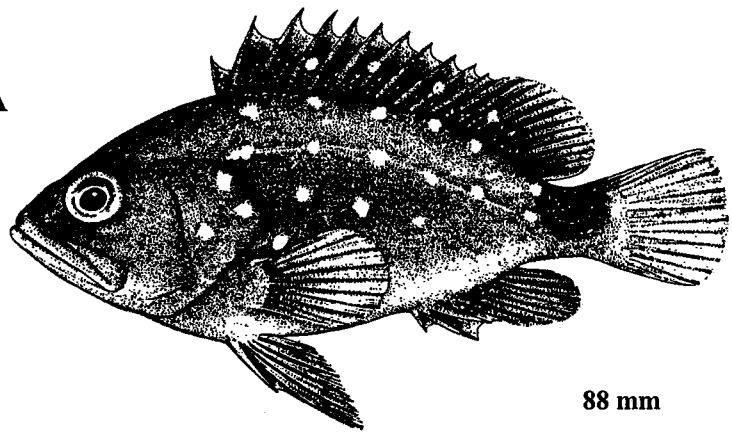
## ILLUSTRATIONS

Dorsal and pelvic spines from Johnson and Keener 1984
Juvenile from Heemstra and Randall 1993




**13.1 mm SL**

**A**



**88 mm**

## MERISTICS

| | |
|---|---|
| Vertebrae | |
| Precaudal | 10 |
| Caudal | 14 |
| Total | 24 |
| Number of Fin Spines and Rays: | |
| First Dorsal Fin | XI |
| Second Dorsal Fin | 16-18 |
| Anal Fin | III,8 |
| Pectoral Fin | 17-19 |
| Gillrakers: | 8-9+15-17=23-26 |
| Lateral Line Scales: | ca. 50 |

## LIFE HISTORY

Range: FL, Bermuda, Bahamas, Yucatan, Caribbean to southern Brazil
Habitat: Shallow coral reefs to 90m. Juveniles common in seagrass beds.
ELH Pattern: Oviparous; pelagic eggs and larvae
Spawning:
Season: December-February at full moon.
Area: Caribbean
Mode: Aggregations in 20-40m at specific locations
Size/Age at First Maturity: Females at 25cmTL

## LITERATURE

Bullock and Smith 1991
Heemstra and Randall 1993
Johnson and Keener 1984
Guitart M. and Fernandez 1966
Powell and Tucker 1992

## EARLY LIFE HISTORY DESCRIPTION

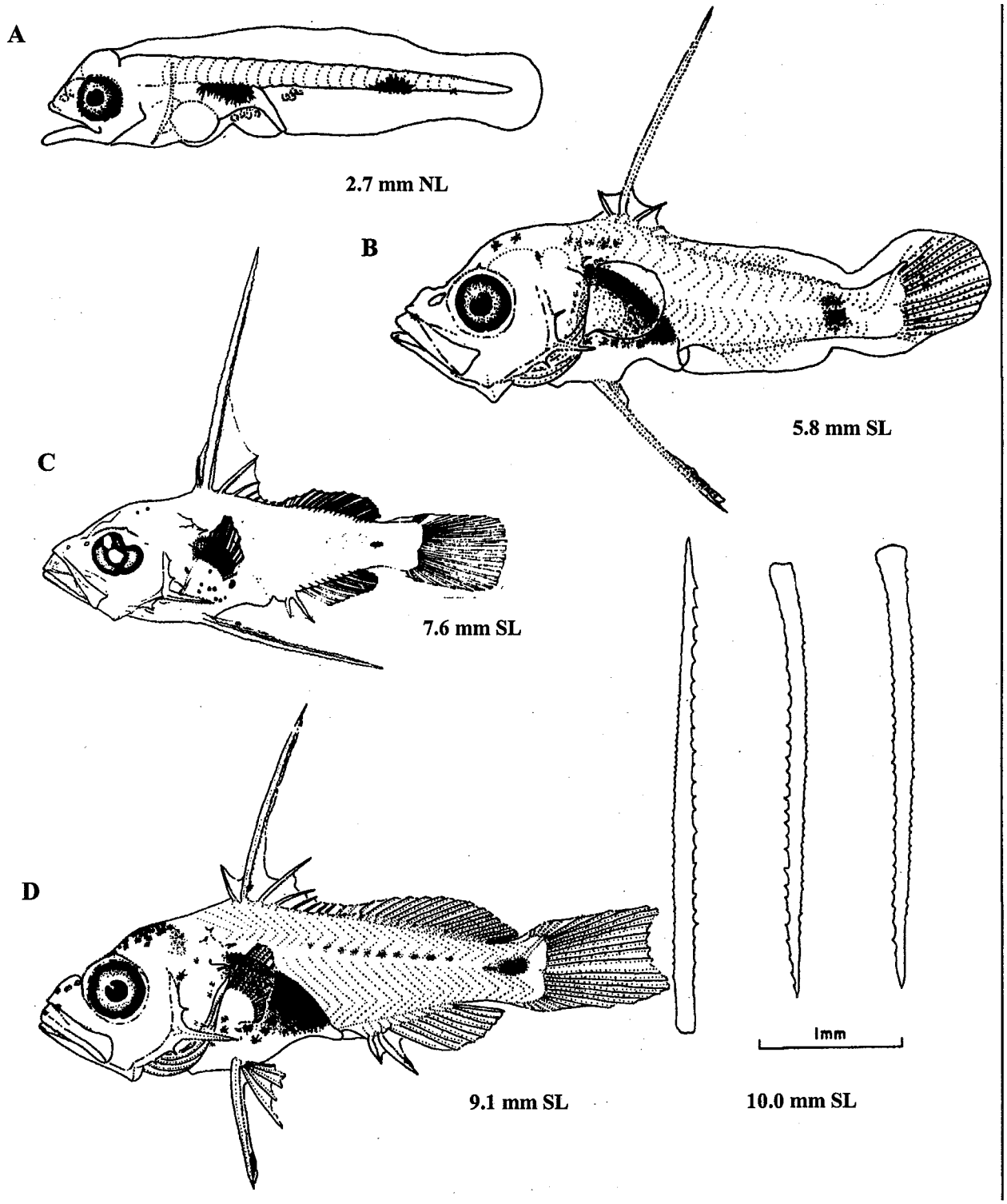
**EGGS:**
Diagnostic Characters: Indistinguishable from *E. adscensionis*

**LARVAE:**
2nd Dorsal Spine Length: 40%SL - one 10.5mmSL
Diagnostic Characters: Meristics identical to *E. adscensionis*. Both species with spinelets simple, straight, and quite small. Cannot be separated from *E. morio* group until anal fin complete.

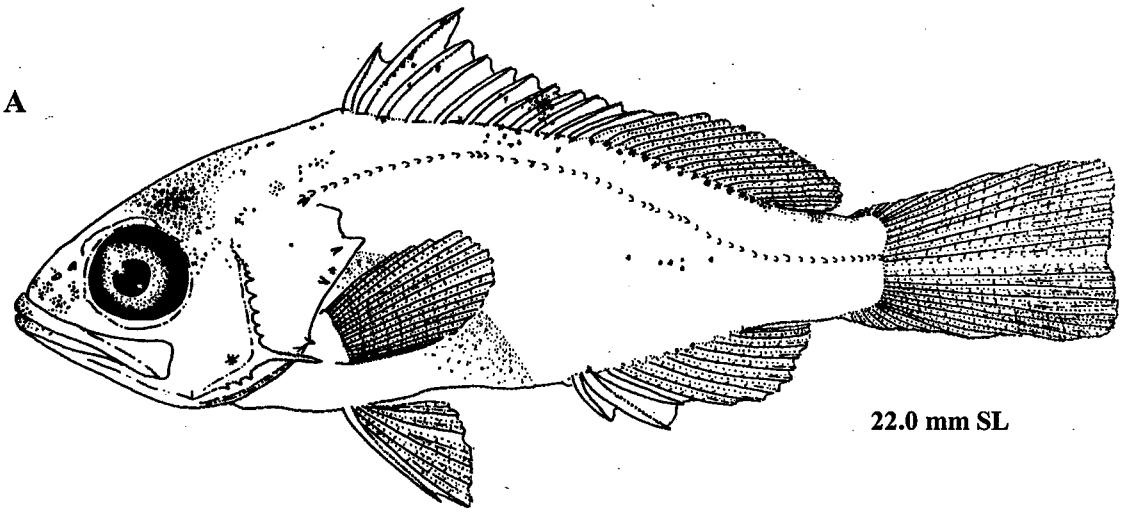
**EARLY JUVENILES:**

## ILLUSTRATIONS

Dorsal and pelvic spines from Johnson and Keener 1984
Larvae from Laroche (orig)
Juvenile from Laroche (orig)

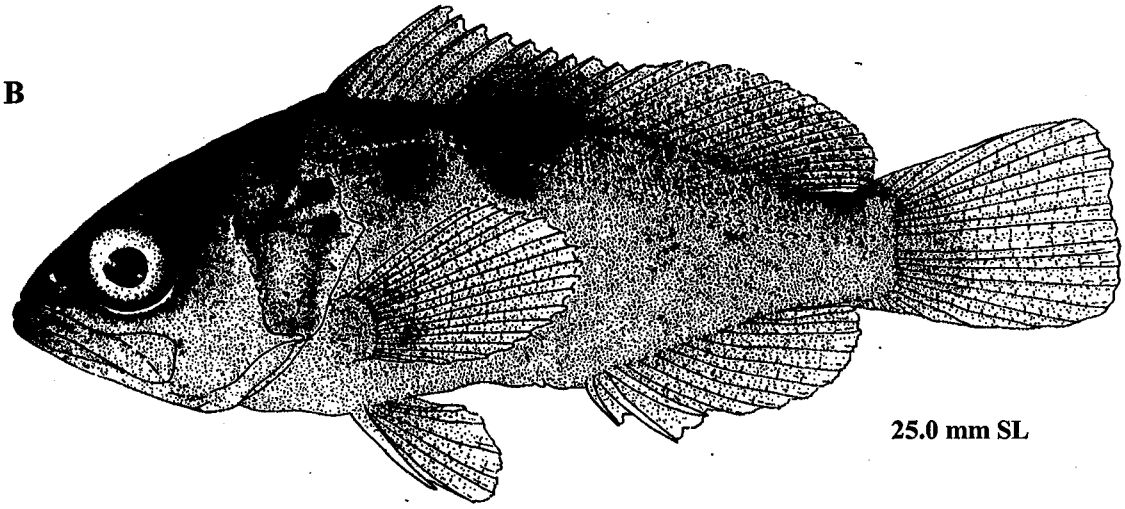

A
2.7 mm NL
B
5.8 mm SL
C
7.6 mm SL
D
9.1 mm SL
10.0 mm SL
1mm

A



22.0 mm SL

B



25.0 mm SL

## MERISTICS

| | |
|---|---|
| Vertebrae: | |
| Precaudal | 10 |
| Caudal | 14 |
| Total | 24 |
| Number of Fin Spines and Rays: | |
| First Dorsal Fin | VIII |
| Second Dorsal Fin | 13 |
| Anal Fin | III,7 |
| Pectoral Fin | 16-17 |
| Gillrakers: | 5-7+14-16=20-22 |
| Lateral Line Scales: | 47-49 |

## LIFE HISTORY

Range: NC to FL, Gulf of Mexico, Caribbean to Brazil
Habitat: Rocky bottoms in 60-365m
ELH Pattern: Oviparous; pelagic eggs and larvae
Spawning:
Season: Probably summer

## LITERATURE

Heemstra and Randall 1993
Johnson and Keener 1984
Kendall and Fahay 1979

## EARLY LIFE HISTORY DESCRIPTION

**EGGS:** Unknown

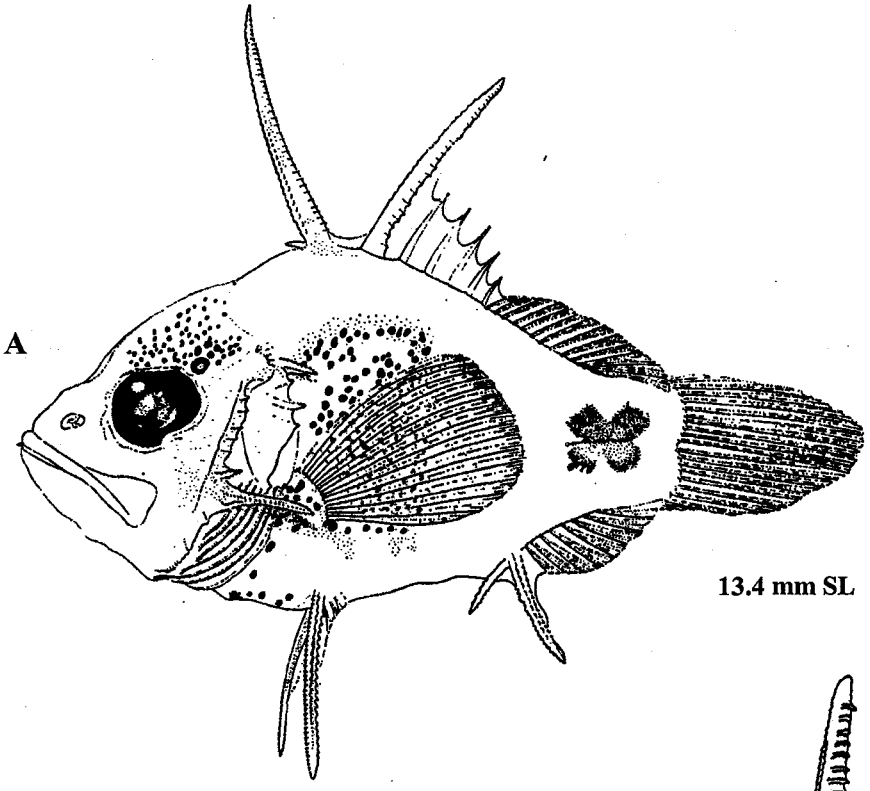
**LARVAE:**
2nd Dorsal Spine Length: 36-39%SL -13.4-14.0mmSL
Pigmentation: X-shaped spot on caudal peduncle
Diagnostic Characters: Meristics unique. Dorsal and pelvic spines unique with stout 2nd dorsal having small bump-like spinelets along primary apex ridge; and ridge with similar secondary spination along each side of apex. Small straight spinelets on lateral wings and bases of spinelets extend anteriorly as raised ridges beyond lateral wing margins, giving furrowed look. 3rd dorsal spine identical. Pelvics stout with ridges 1, 2, and 4 with small straight spinelets enlarges and slightly curved, ridge 3 with small, bump-like spinelets.

**EARLY JUVENILES:**

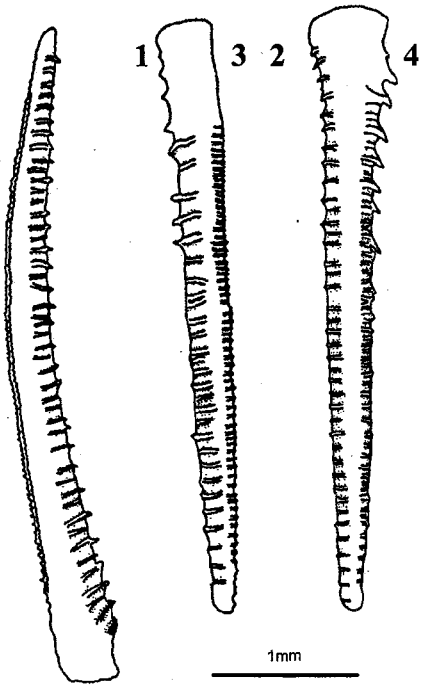
## ILLUSTRATIONS

Dorsal and pelvic spines from Johnson and Keener 1984
Larva from Kendall and Fahay 1979

A



13.4 mm SL




13.4 mm SL

## MERISTICS

| | |
|---|---|
| Vertebrae | |
| Precaudal | 10 |
| Caudal | 14 |
| Total | 24 |
| Number of Fin Spines and Rays: | |
| First Dorsal Fin | XI |
| Second Dorsal Fin | 15-17 |
| Anal Fin | III,10-12 |
| Pectoral Fin | 15-17 |
| Gillrakers: | 16-20+32-36=48-55 |
| Lateral Line Scales: | 67-77 |

## LIFE HISTORY

Range: Bermuda, northwestern Gulf of Mexico (rare); Antilles, southern coast of Caribbean, Brazil

Habitat: Rocky bottoms of high relief. Juveniles in turtle grass beds, mangroves, shallow coral reefs.

ELH Pattern: Oviparous; pelagic eggs and larvae

## LITERATURE

Heemstra and Randall 1993
Johnson and Keener 1984

## EARLY LIFE HISTORY DESCRIPTION

**EGGS:** Unknown

**LARVAE:**

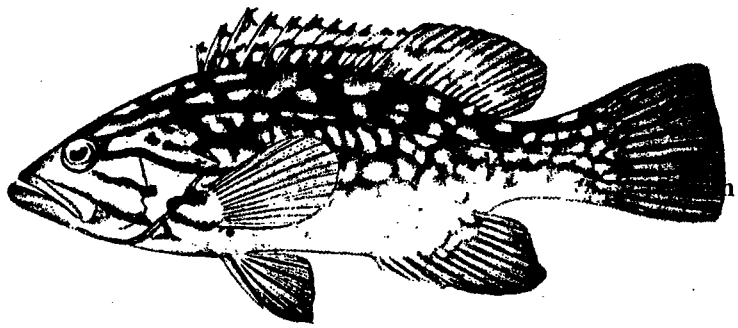
Diagnostic Characters: Meristics identical for all species. All with pigment spot at cleithral symphysis. Wing margins of 2nd dorsal and primary of pelvic spine bear large recurved spinelets along most of their length; bases of dorsal with small straight spinelets and pelvic with narrow curved spinelets Single apex ridge of dorsal and pelvic ridges 2, 3, and 4 bear small straight spinelets.

**EARLY JUVENILES:**

Diagnostic Characters: Juvenile <15cm with small black saddle on caudal peduncle.

## ILLUSTRATIONS

Juvenile from Heemstra and Randall 1993



## MERISTICS

| | |
|---|---|
| Vertebrae | |
| Precaudal | 10 |
| Caudal | 14 |
| Total | 24 |
| Number of Fin Spines and Rays: | |
| First Dorsal Fin | XI |
| Second Dorsal Fin | 15-17 |
| Anal Fin | III,11-13 |
| Pectoral Fin | 16-17 |
| Gillrakers: | 2-5+8-12 |
| Lateral Line Scales: | 78-83 |

## LIFE HISTORY

Range: Bermuda, FL south to southern Brazil. Juveniles north to MA
Habitat: Coral reefs and rocky bottoms in 10-30m or greater in the Gulf.
ELH Pattern: Oviparous; pelagic eggs and larvae
Size/Age at First Maturity: Females 50-100cmTL; males 96-116cmTL

## LITERATURE

Heemstra and Randall 1993
Johnson and Keener 1984
Bullock and Smith 1991

## EARLY LIFE HISTORY DESCRIPTION

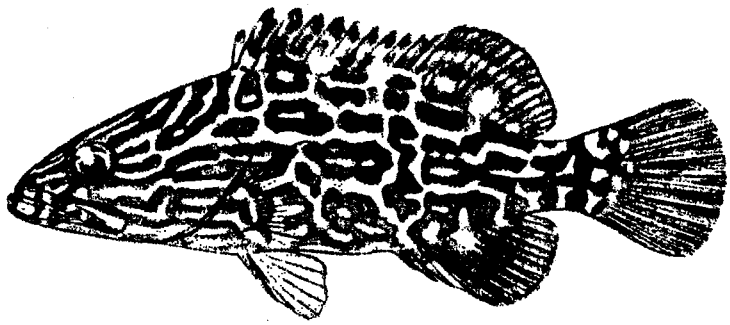
**EGGS:** Unknown

**LARVAE:**
Diagnostic Characters: Meristics identical for all species. All with pigment spot at cleithral symphysis. Wing margins of 2nd dorsal and primary of pelvic spine bear large recurved spinelets along most of their length; bases of dorsal with small straight spinelets and pelvic with narrow curved spinelets Single apex ridge of dorsal and pelvic ridges 2, 3, and 4 bear small straight spinelets.

**EARLY JUVENILES:**

## ILLUSTRATIONS

Juvenile from Heemstra and Randall 1993



**75 mm SL**

## MERISTICS

| | |
|---|---|
| Vertebrae | |
| Precaudal | 10 |
| Caudal | 14 |
| Total | 24 |
| Number of Fin Spines and Rays: | |
| First Dorsal Fin | XI |
| Second Dorsal Fin | 16-18 |
| Anal Fin | III,10-12 |
| Pectoral Fin | 16-17 |
| Gillrakers: | 4-6+11-15=23-27 |
| Lateral Line Scales: | 70-74 |

## LIFE HISTORY

Range: Gulf of Mexico, Bermuda, Caribbean (mainly insular) and southern Brazil
Habitat: Coral reefs and rocky bottom in 20-150m.
ELH Pattern: Oviparous; pelagic eggs and larvae
Spawning:
Season: June-August in Bermuda, April in Jamaica, August-September in FL

## LITERATURE

Heemstra and Randall 1993
Johnson and Keener 1984
Bullock and Smith 1991

## EARLY LIFE HISTORY DESCRIPTION

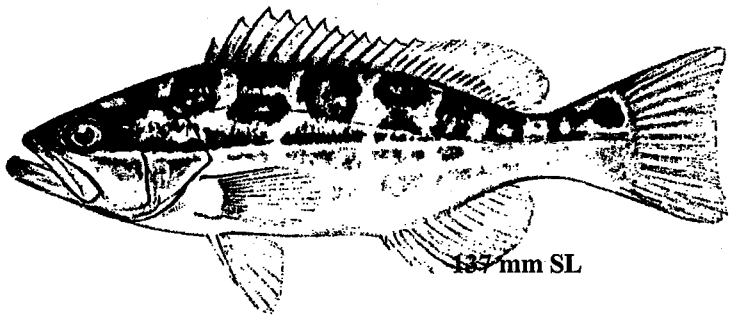
**EGGS:** Unknown

**LARVAE:**
Diagnostic Characters: Meristics identical for all species. All with pigment spot at cleithral symphysis. Wing margins of 2nd dorsal and primary of pelvic spine bear large recurved spinelets along most of their length; bases of dorsal with small straight spinelets and pelvic with narrow curved spinelets Single apex ridge of dorsal and pelvic ridges 2, 3, and 4 bear small straight spinelets.

**EARLY JUVENILES:**
Diagnostic Characters: Bicolored- head and body dark brown dorsally, and abruptly white below; white middorsal from tip of jaw along top of snout, head and base of dorsal fin.

## ILLUSTRATIONS

Juvenile from Heemstra and Randall 1993



## MERISTICS

| | |
|---|---|
| Vertebrae | |
| Precaudal | 10 |
| Caudal | 14 |
| Total | 24 |
| Number of Fin Spines and Rays: | |
| First Dorsal Fin | XI |
| Second Dorsal Fin | 15-17 |
| Anal Fin | III,10-13 |
| Pectoral Fin | 16-18 |
| Gillrakers: | 8-9+16 |
| Lateral Line Scales: | 88-96 |

## LIFE HISTORY

Range: NC to Yucatan, eastern Brazil rare in Bermuda, 1 Cuban record.
Habitat: Offshore rocky bottoms in 40-100m (rarely 152m). Juveniles in estuaries and seagrass beds.
ELH Pattern: Oviparous; pelagic eggs and larvae
Size/Age at First Maturity: Females at 67-75cmTL

## LITERATURE

Heemstra and Randall 1993
Johnson and Keener 1984

## EARLY LIFE HISTORY DESCRIPTION

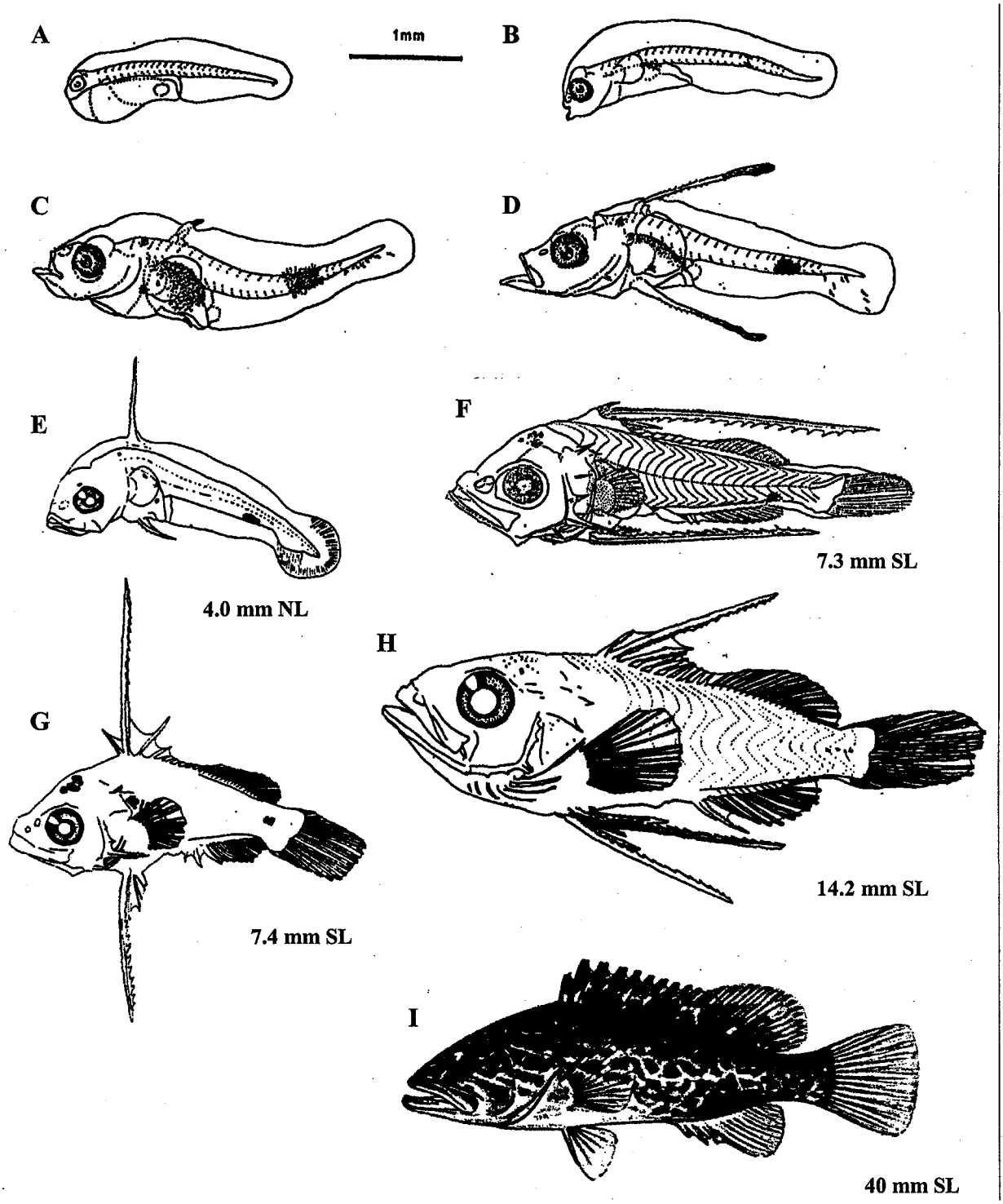
**EGGS:** Unknown

**LARVAE:**
Diagnostic Characters: Meristics identical for all species. All with pigment spot at cleithral symphysis. Wing margins of 2nd dorsal and primary of pelvic spine bear large recurved spinelets along most of their length; bases of dorsal with small straight spinelets and pelvic with narrow curved spinelets Single apex ridge of dorsal and pelvic ridges 2, 3, and 4 bear small straight spinelets.

**EARLY JUVENILES:**
Diagnostic Characters: Juveniles <40cmSL may not have developed distictive notch and rounded lobe at corner of preopercle and may be confused with *M. bonaci.*

## ILLUSTRATIONS

Larvae and juveniles from Koenig (orig)


A
1mm
B
C
D
E
F
7.3 mm SL
4.0 mm NL
G
H
14.2 mm SL
7.4 mm SL
I
40 mm SL

## MERISTICS

| | |
|---|---|
| Vertebrae | |
| Precaudal | 10 |
| Caudal | 14 |
| Total | 24 |
| Number of Fin Spines and Rays: | |
| First Dorsal Fin | XI |
| Second Dorsal Fin | 16-18 |
| Anal Fin | III,10-12 |
| Pectoral Fin | 15-17 |
| Gillrakers: | 8-10+17-21=26-31 |
| Lateral Line Scales: | 76-82 |

## LIFE HISTORY

Range: NC to Venezuela along contishore. Absent in Bermuda and Antilles.
Habitat: Topographic complex bottoms in 30-100m. Low relief off NC.
ELH Pattern: Oviparous; pelagic eggs and larvae
Spawning:
Season: April-August in Carolinas, March-May in eastern Gulf
Size/Age at First Maturity: Females at 35-40cmTL
Longevity: ca. 21 years

## LITERATURE

Heemstra and Randall 1993
Johnson and Keener 1984
Bullock and Smith 1991

## EARLY LIFE HISTORY DESCRIPTION

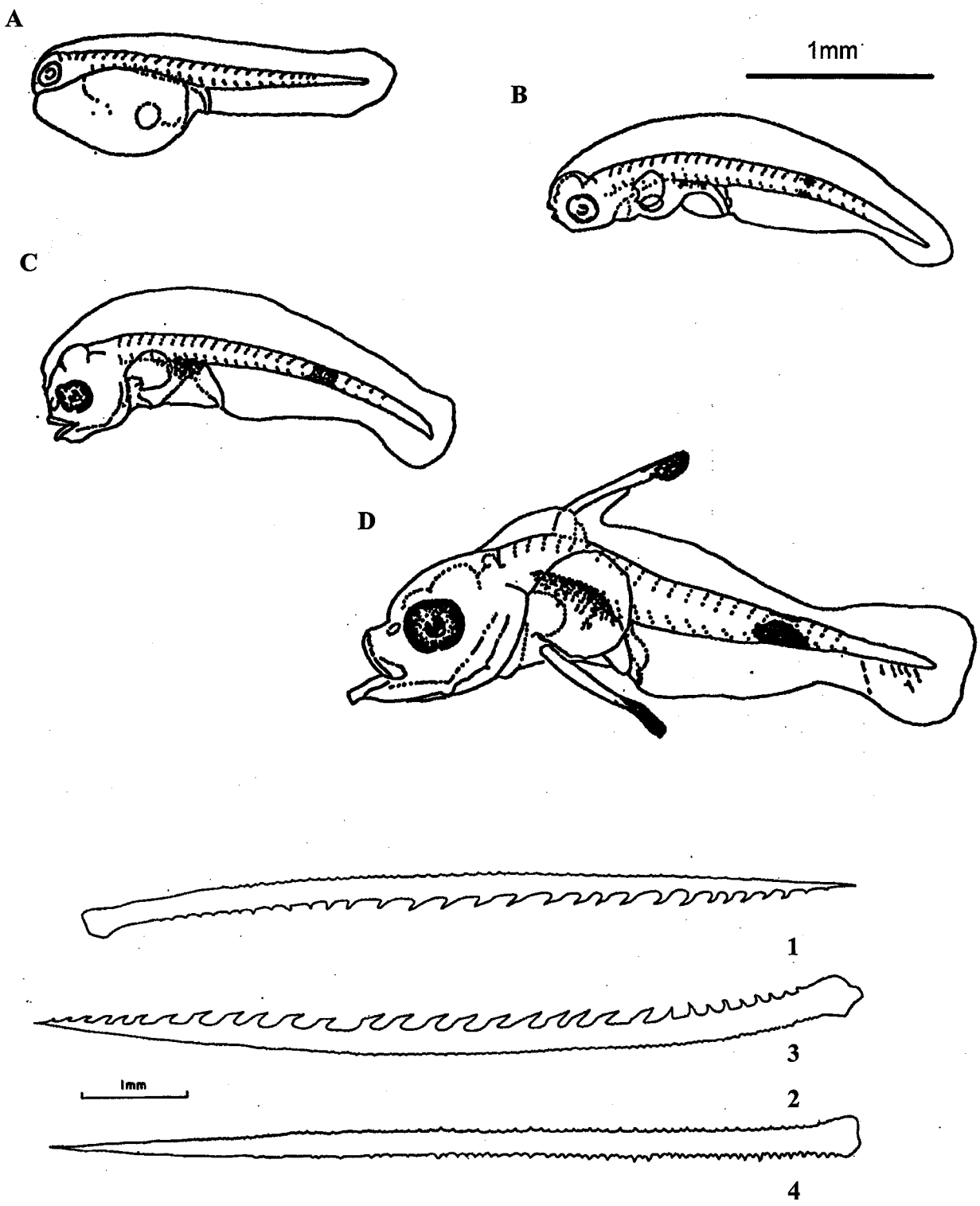
**EGGS:**
Diameter: 0.75-1.23mm
Number of Oil Globules: 1
Yolk: Clear

**LARVAE:**
Diagnostic Characters: Meristics identical for all species. All with pigment spot at cleithral symphysis. Wing margins of 2nd dorsal and primary of pelvic spine bear large recurved spinelets along most of their length; bases of dorsal with small straight spinelets and pelvic with narrow curved spinelets Single apex ridge of dorsal and pelvic ridges 2, 3, and 4 bear small straight spinelets.

**EARLY JUVENILES:**
Diagnostic Characters: Juveniles not bi-colored like *M. interstitialis*.

## ILLUSTRATIONS

Dorsal and pelvic spines from Johnson and Keener 1984
Larvae and juveniles from Koenig (ms)


A
1mm
B
C
D
1
3
1mm
2
4

## MERISTICS

| | |
|---|---|
| Vertebrae | |
| Precaudal | 10 |
| Caudal | 14 |
| Total | 24 |
| Number of Fin Spines and Rays: | |
| First Dorsal Fin | XI |
| Second Dorsal Fin | 15-17 |
| Anal Fin | III,11 |
| Pectoral Fin | 17 |
| Gillrakers: | 8+15-17=23-25 |
| Lateral Line Scales: | 82-83 |

## LIFE HISTORY

Range: Bermuda, south FL, TX south through Caribbean, Antilles to southern Brazil.
Habitat: Coral reefs and rocky bottom in 10-40m.
ELH Pattern: Oviparous; pelagic eggs and larvae
Size/Age at First Maturity: Females <37cmTL, males >45cmTL

## LITERATURE

Heemstra and Randall 1993
Johnson and Keener 1984

## EARLY LIFE HISTORY DESCRIPTION

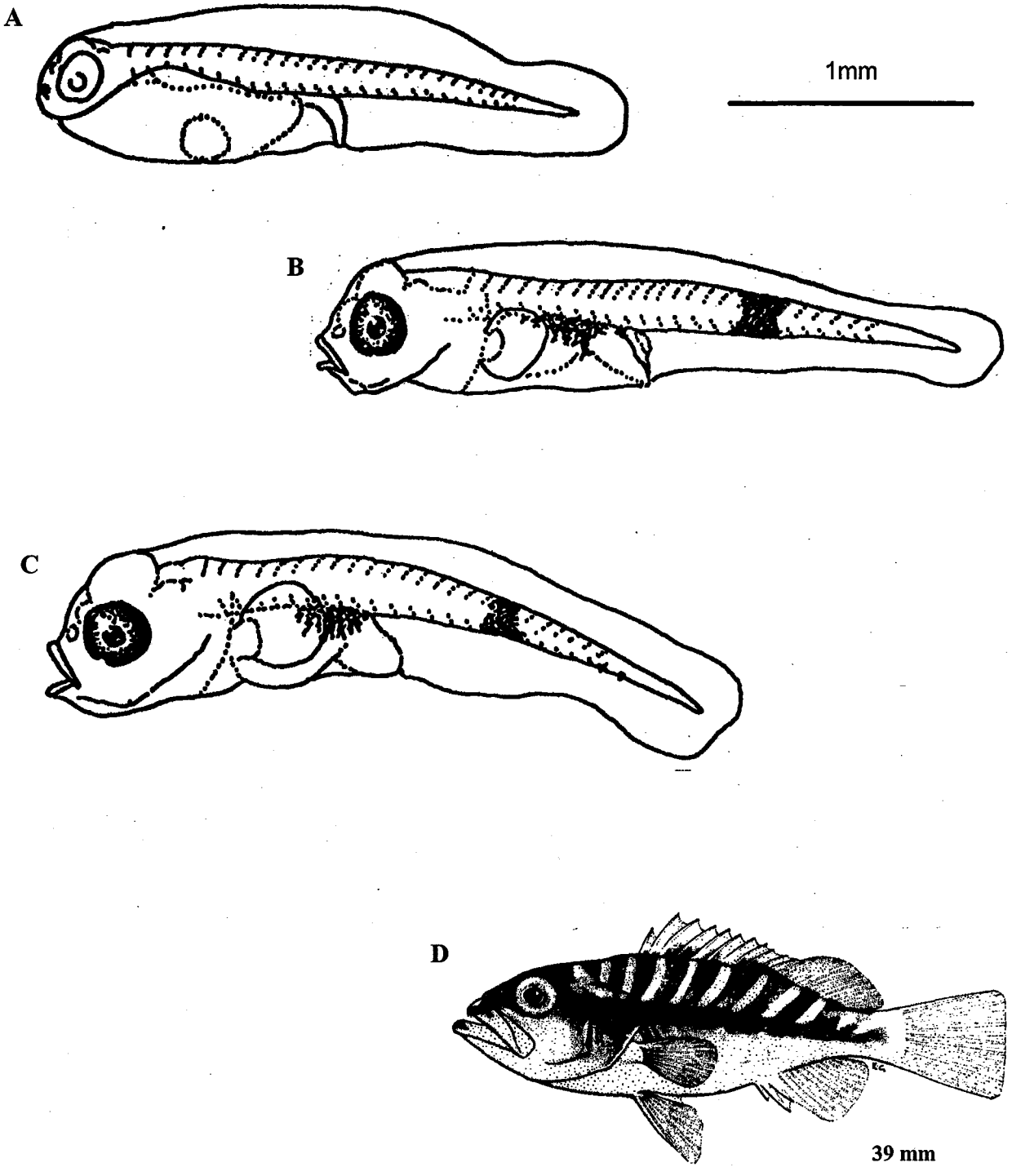
**EGGS:** Unknown

**LARVAE:**
Diagnostic Characters: Meristics identical for all species. All with pigment spot at cleithral symphysis. Wing margins of 2nd dorsal and primary of pelvic spine bear large recurved spinelets along most of their length; bases of dorsal with small straight spinelets and pelvic with narrow curved spinelets Single apex ridge of dorsal and pelvic ridges 2, 3, and 4 bear small straight spinelets.

**EARLY JUVENILES:**
Diagnostic Characters: 25-100mmSL yellow, with blackish brown midlateral stripe from tip of lower jaw, through eye along body almost to caudal.

## ILLUSTRATIONS

Larvae from Koenig (ms)
Juvenile from Heemstra and Randall 1993


A
1mm
B
C
D
39 mm

## MERISTICS

| | |
|---|---|
| Vertebrae | |
| Precaudal | 10 |
| Caudal | 14 |
| Total | 24 |
| Number of Fin Spines and Rays: | |
| First Dorsal Fin | IX |
| Second Dorsal Fin | 17-18(19) |
| Anal Fin | III,8-9(10) |
| Pectoral Fin | 19-20 |
| Gillrakers: | 12-14+24-26=38 |
| Lateral Line Scales: | 69-77 |

## LIFE HISTORY

Range: Bermuda, FL, Gulf of Mexico, Antilles, Caribbean to Brazil. Absent in northern Bahamas.
Habitat: Coral reefs and hard bottoms in 10-64m.
ELH Pattern: Oviparous; pelagic eggs and larvae
Spawning:
Season: April-October in FL, January-March in Jamaica, May in Bermuda
Size/Age at First Maturity: 223-292mmSL in females; 263-304mmSL in males

## LITERATURE

Heemstra and Randall 1993
Johnson and Keener 1984
Bullock and Smith 1991

## EARLY LIFE HISTORY DESCRIPTION

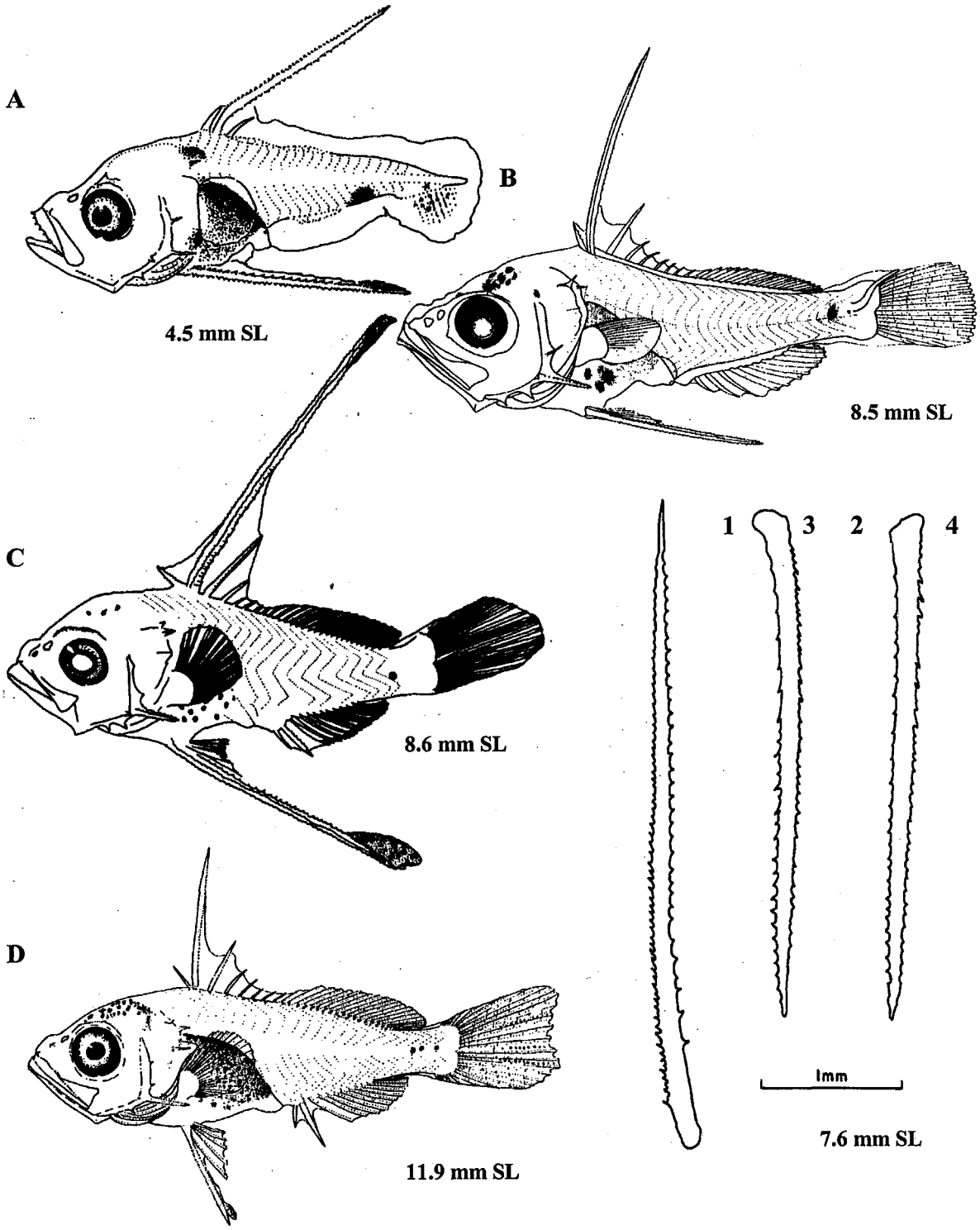
**EGGS:** Unknown

**LARVAE:**
2nd Dorsal Spine Length: 54-72%SL -7.2-7.6mmSL
Diagnostic Characters: Meristics unique.
Wing margins of 2nd dorsal and primary ridge of pelvic bear small, straight, widely-spaced spinelets.

**EARLY JUVENILES:**

## ILLUSTRATIONS

Dorsal and pelvic spines from Johnson and Keener 1984
Larvae from Kendall 1979 and Laroche (orig)

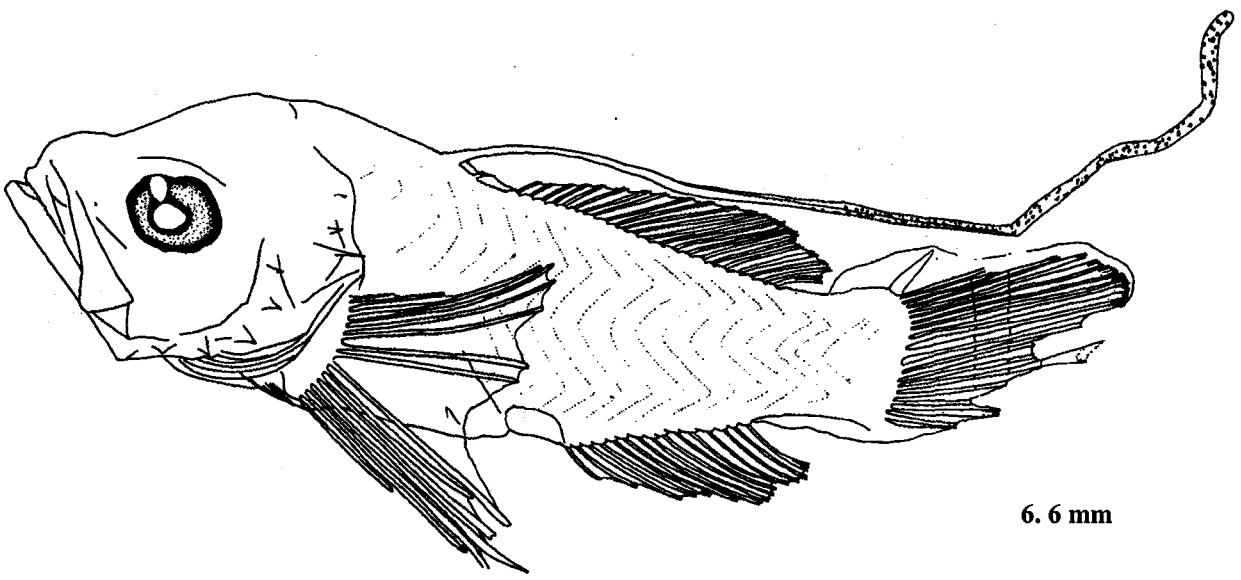

A
4.5 mm SL
B
8.5 mm SL
C
8.6 mm SL
D
11.9 mm SL
1
3
2
4
1mm
7.6 mm SL

## SUBFAMILY GRAMMISTINAE

**By W.J. Richards**

Eschmeyer (1991) considers this small group of genera as a subfamily whereas Johnson (1983) considers them a tribe within the Epinephelinae. I follow Eschmeyer (1991) because of the ease of distinguishing their larvae as I did with the Liopropomatinae, but this is not for any phyllogenetic reason. This subfamily is comprised of 2 genera in our area - the monotypic *Pseudogramma* and *Rypticus* with 8 species. As mentioned in the Liopropomatinae account, *Jeboehlkia gladifer*, could be assigned here because the larvae of this group share the single elongate dorsal spine rather than two as found in *Liopropoma*. *Pseudogramma gregoryi* larvae are quite common and resemble *Liopropoma* in body shape, but are easily separable because of the single elongate ray (either first or second), enlarged pectoral fins, and high anal fin ray count. *Rypticus* larvae share some of these features but have fewer dorsal spines and are moderately deep-bodied at the nape. Their elongated spine, when intact, is pigmented. Both genera lack pigment on the bodies and overlapping meristics do not allow speciefic identification in *Rypticus*.

Adult *P. gregoryi* are small fish (75mmSl) and are confined to areas of live coral. *Rypticus* species are much larger (15-20cmSL) and produce a toxic mucous (grammistin). Their larvae are uncommon.



**6. 6 mm**

## MERISTICS

Vertebrae
- Precaudal: 10
- Caudal: 14
- Total: 24

Number of Fin Spines and Rays:
- First Dorsal Fin: VII-VIII
- Second Dorsal Fin: 15-24
- Anal Fin: III,12-20
- Pectoral Fin: 14-18

Gill Rakers:
Lateral Line Scales:
Branchiostegals:

## LIFE HISTORY

Range: Bermuda, Bahamas, south FL, to northern South America
Habitat: Live coral areas
ELH Pattern: Oviparous; pelagic eggs and larvae
Spawning
Season:
Area:
Mode:
Migration:
Size/Age at First
Maturity: Small fishes
Longevity

## LITERATURE

Robins & Ray 1986
Kendall 1979, 1984

## EARLY LIFE HISTORY DESCRIPTION

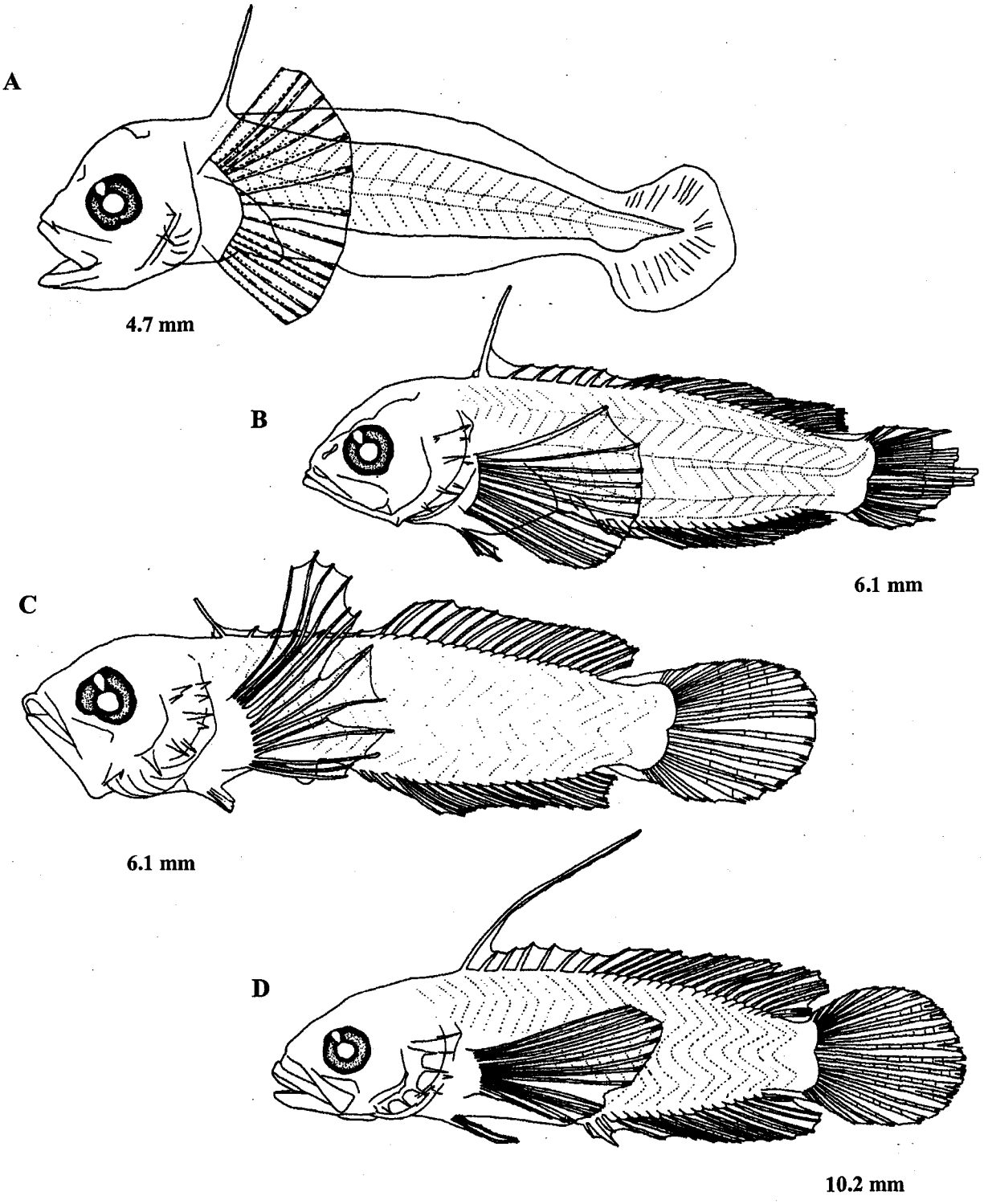
**EGGS:** Unknown

**LARVAE:**
Head Spination: few spines on opercular flap
2nd D Spine Length: 1st or 2nd greatly elongate
Length at Flexion: ca. 5mmSL
Sequence of Fin Development: elongate dorsal spine, pectoral, 1st dorsal, 2n dorsal, anal, caudal, pelvic
Pigmentation: eye and pectoral fin in small larvae
Diagnostic Characters: elongate dorsal spine, meristics

**EARLY JUNVENILES:**
Diagnostic Characters: coloration, note large, ocellated spot on opercle

## ILLUSTRATIONS

Kendall 1979


A
4.7 mm
B
6.1 mm
C
6.1 mm
D
10.2 mm

## MERISTICS

Vertebrae
  Precaudal: 10
  Caudal: 15
  Total: 25
Number of Fin Spines and Rays:
  First Dorsal Fin: II
  Second Dorsal Fin: 25-26(24-27)
  Anal Fin: 15-16(17)
  Pectoral Fin: 13-15(16)
Gill Rakers: 7-10

## LIFE HISTORY

Range: Bahamas, south FL, eastern Gulf of Mexico, West Indies to Brazil
Habitat: Shallow, clear waters but 37m or deeper in Gulf of Mexico
ELH Pattern: Oviparous; pelagic eggs and larvae.
Spawning
Season: Spring and summer in Gulf of Mexico
Area:
Mode:
Migration:
Size/Age at First Maturity:
Longevity

## LITERATURE

Robins & Ray 1986
Kendall 1979, 1984
Courtenay 1967
Bullock & Smith 1991

## EARLY LIFE HISTORY DESCRIPTION

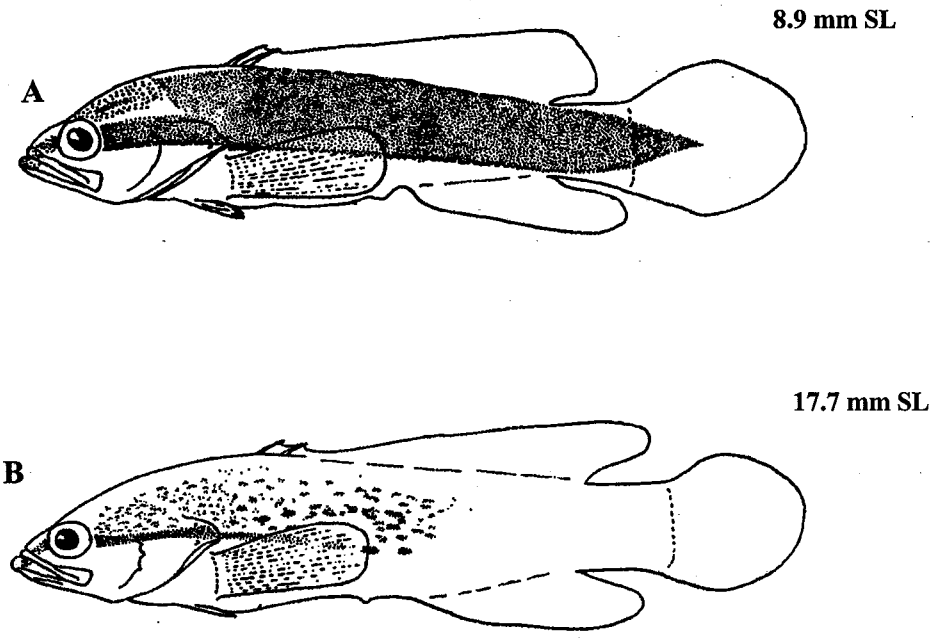
**EGGS:** Unknown

**LARVAE:**
Head Spination: few spines on opercular flap
2nd D Spine Length: 1st or 2nd greatly elongate
Length at Flexion: ca. 5mmSL
Sequence of Fin Development:
Pigmentation: eye and elongate spine
Diagnostic Characters: elongate dorsal spine, meristics. Species not separable.

**EARLY JUNVENILES:**
Diagnostic Characters: Below 10mmSL lack spots, but heavily pigmented dorsally extending as V-shape wedge on tail. >15mmSL dark area breaks up into spots.

## ILLUSTRATIONS

Courtenay 1967-juveniles
Fig. 11



## MERISTICS

Vertebrae
Precaudal: 10
Caudal: 14
Total: 24
Number of Fin Spines and Rays:
First Dorsal Fin: II
Second Dorsal Fin: 25-26
Anal Fin: 16-17
Pectoral Fin: 14
Gill Rakers: 2+8=10

## LIFE HISTORY

Range: Bahamas and Panama based on 2 specimens
Habitat:
ELH Pattern: Oviparous; pelagic eggs and **larvae.**
Spawning
Season:
Area:
Mode:
Migration:
Size/Age at First
Maturity:
Longevity

## LITERATURE

Courtenay 1967

## EARLY LIFE HISTORY DESCRIPTION

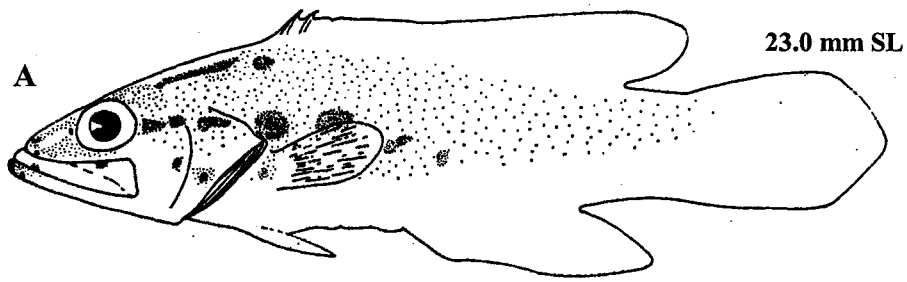
**EGGS:** Unknown

**LARVAE:**
Head Spination: few spines on opercular flap
2nd D Spine Length: 1st or 2nd greatly elongate
Length at Flexion: ca. 5mm SL
Sequence of Fin Development:
Pigmentation: eye and elongate spine
Diagnostic Characters: elongate dorsal spine, meristics. Species not separable.

**EARLY JUNVENILES:**

## ILLUSTRATIONS

Courtenay 1967
Fig. 19



## MERISTICS

Vertebrae
  Precaudal: 10
  Caudal: 14
  Total: 24
Number of Fin Spines and Rays:
  First Dorsal Fin: III
  Second Dorsal Fin: 23-24(21-25)
  Anal Fin: 16-17(14-15)
  Pectoral Fin: 15-16(14-17)
Gill Rakers: 7-9(5-11) more in specimens <15mmSL

## LIFE HISTORY

Range: Bermuda, Bahamas, Miami and FL Keys southward to Brazil, absent from Gulf of Mexico except for record of young (Houde 1982)
Habitat: Shallow silty waters to clear waters around reefs, in holes and burrows reefs, and oil platforms in n Gulf; cool deep waters over sand on east coast.
ELH Pattern: Oviparous; pelagic eggs and larvae.

## LITERATURE

Robins & Ray 1986
Kendall 1979, 1984
Courtenay 1967
Houde 1982

## EARLY LIFE HISTORY DESCRIPTION

**EGGS:** Unknown

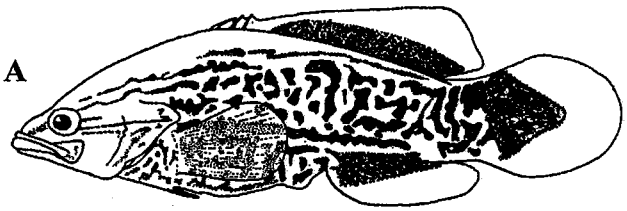
**LARVAE:**
Head Spination: few spines on opercular flap
2nd D Spine Length: 1st or 2nd greatly elongate
Length at Flexion: ca. 5mmSL
Sequence of Fin Development:
Pigmentation: eye and elongate spine
Diagnostic Characters: elongate dorsal spine, meristics. Species not separable.

**EARLY JUNVENILES:**
Diagnostic Characters: large young >65mm with distinct, single pores on lower jaw andposterior margin of preopercle; meristics

## ILLUSTRATIONS

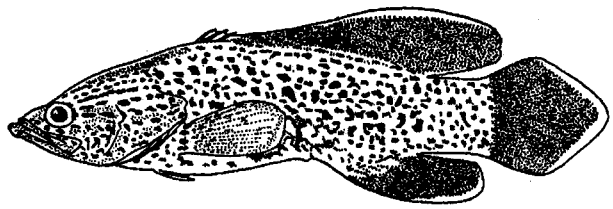
Courtenay 1967-juv fig. 5

A



**15.5 mm SL**

B



**23.7 mm SL**

## MERISTICS

Vertebrae
  Precaudal: 10
  Caudal: 14
  Total: 24
Number of Fin Spines and Rays:
  First Dorsal Fin: III-IV
  Second Dorsal Fin: 21-23(20-24)
  Anal Fin: 14-15(13-16)
  Pectoral Fin: 14-15(16)
Gill Rakers: 8-10(7)

## LIFE HISTORY

Range: Bahamas, south FL, & Caribbean
Habitat: Clear reef water, in deep holes and burrows
ELH Pattern: Oviparous; pelagic eggs and larvae.
Spawning
Season:
Area:
Mode:
Migration:
Size/Age at First
Maturity:
Longevity

## LITERATURE

Robins & Ray 1986
Kendall 1979, 1984
Courtenay 1967

## EARLY LIFE HISTORY DESCRIPTION

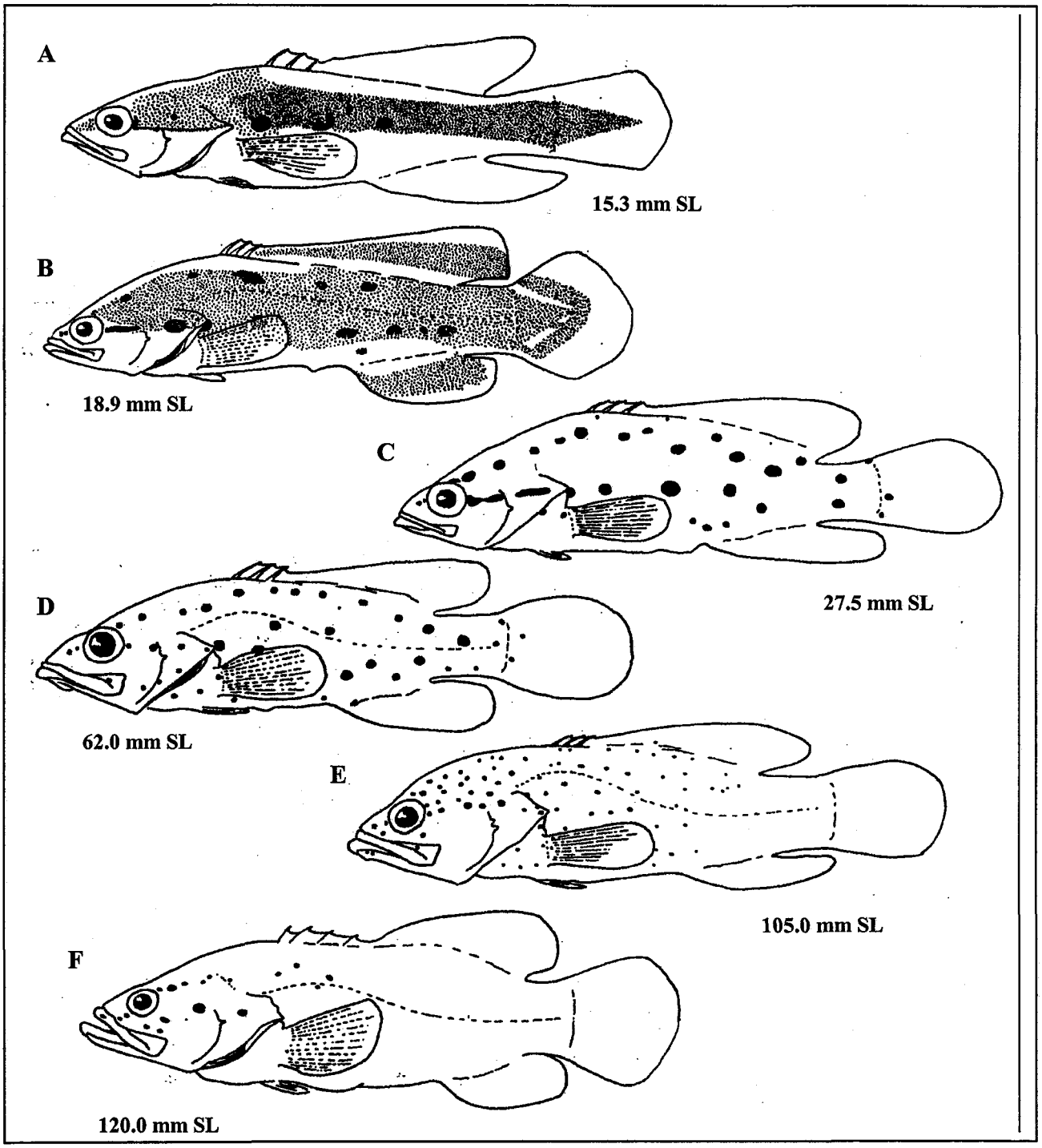
**EGGS:** Unknown

**LARVAE:**
Head Spination: few spines on opercular flap
2nd D Spine Length: 1st or 2nd greatly elongate
Length at Flexion: ca. 5mmSL
Sequence of Fin Development:
Pigmentation: eye and elongate spine
Diagnostic Characters: elongate dorsal spine, meristics. Species not separable.

**EARLY JUNVENILES:**
Diagnostic Characters: large young >65mm with distinct, single pores on lower jaw and posterior margin of preopercle; meristics

## ILLUSTRATIONS

Courtenay 1967-juv
Fig. 7-8

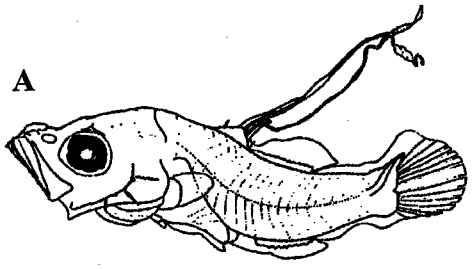

A
15.3 mm SL
B
18.9 mm SL
C
27.5 mm SL
D
62.0 mm SL
E
105.0 mm SL
F
120.0 mm SL

## SUBFAMILY LIOPROPOMATINAE

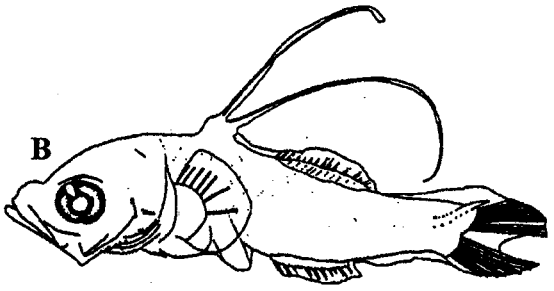
**By W.J. Richards**

Eschmeyer (1990) considers this group of genera as a subfamily whereas Johnson (1983) considers them as a tribe within the Epinephelinae. I follow Eschmeyer (1990) as the larvae are quite distinct from the epinephelines. The larvae are similar in shape to Serraninae but the gut is shorter and there is a space between the anus and anal fin. The caudal peduncle is deeper and resembles labrid and scarid larvae. The chief character is the one or two long second and third dorsalspines which bear unusual appendages which are often lost and broken during collection. These appendages are quite spectacular and have been thought to mimic siphophore tentacles ( and they occur in several diverse taxa (Govoni et al. 1984). Baldwin et al. (1991) shows a color photo of an in situ *Liopropoma*. Pigment is found only on the eye and on these dordsal spine appendages. The adults are small, brightly colored fishes and generally found in deep water most often associated with reefs.

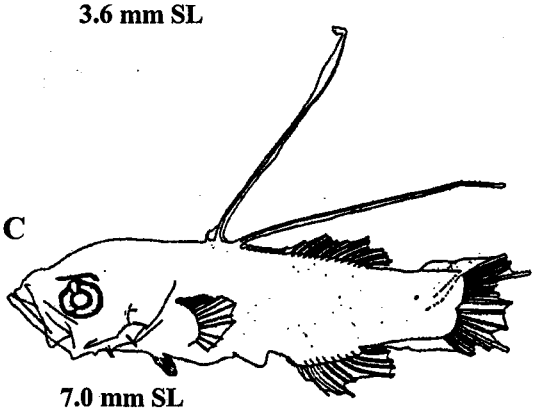
The larvae are known for *Liopropoma, Jeboehlkia,* and *Pikea*, often referred to as *Bathyanthias*, and which has also been synonimized with *Liopropoma*. *P.mexicanus* has been divided into two subspecies because of gill raker count differences. A related species, *P. rosea,* occurs just south of our area off Brazil. *Liopropoma* is represented by 5 species in our area, but no one has been able to assign the larvae to any species as meristic counts are similar and the larvae show no specific differences except possibly in the dorsal spine appendages. However, an intact specimen is rare thus no comparative study has been done. Jeboehlkia gladifer is monotypic and a species account isa given. Several illustrations are provided for *Liopropoma* sp and a species account for *P. mexicanus*.



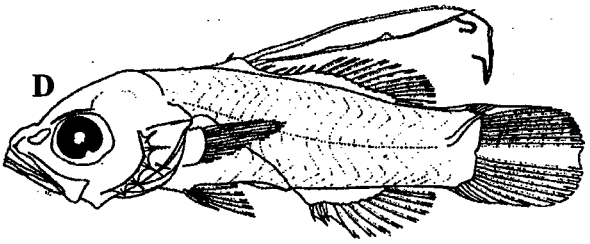

3.6 mm SL



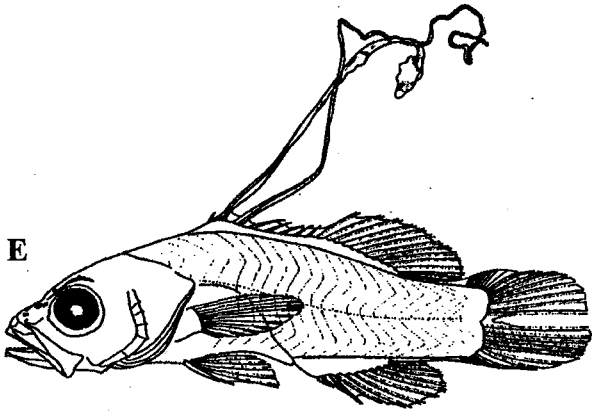

6.3 mm SL



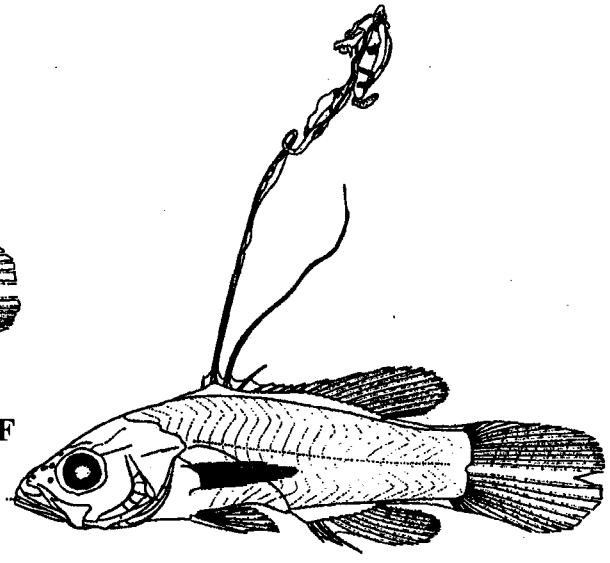

7.0 mm SL



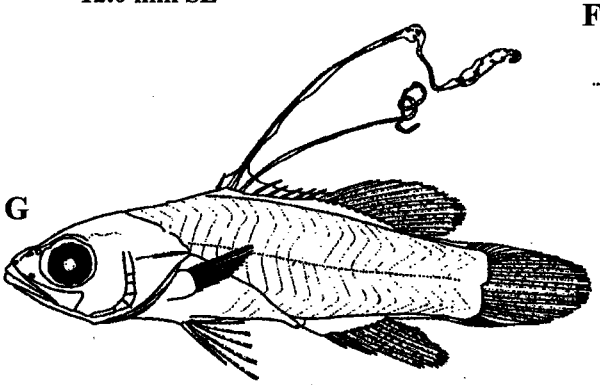

7.1 mm SL




12.0 mm SL




12.6 mm SL




14.9 mm SL

## MERISTICS

| | |
|---|---|
| Vertebrae | |
| Precaudal: | 9 |
| Caudal: | 15 |
| Total: | 24 |
| Number of Fin Spines and Rays: | |
| First Dorsal Fin: | VIII |
| Second Dorsal Fin: | 9 |
| Anal Fin: | III,7 |
| Pectoral Fin: | 15 |
| Gill Rakers: | 9+1+16=26 |
| Lateral Line Scales: | |
| Branchiostegal: | 7 |

## LIFE HISTORY

Range: Off Honduras and U. S. east coast off New York
Habitat: Deep waters ca. 165m
ELH Pattern: Oviparous; pelagic eggs and larvae
Spawning
Season:
Area:
Mode: Only adult a female with ovarian eggs
Migration:
Size/Age at First
Maturity: Small fishes
Longevity

## LITERATURE

Robins 1967
Baldwin & Johnson 1991

## EARLY LIFE HISTORY DESCRIPTION

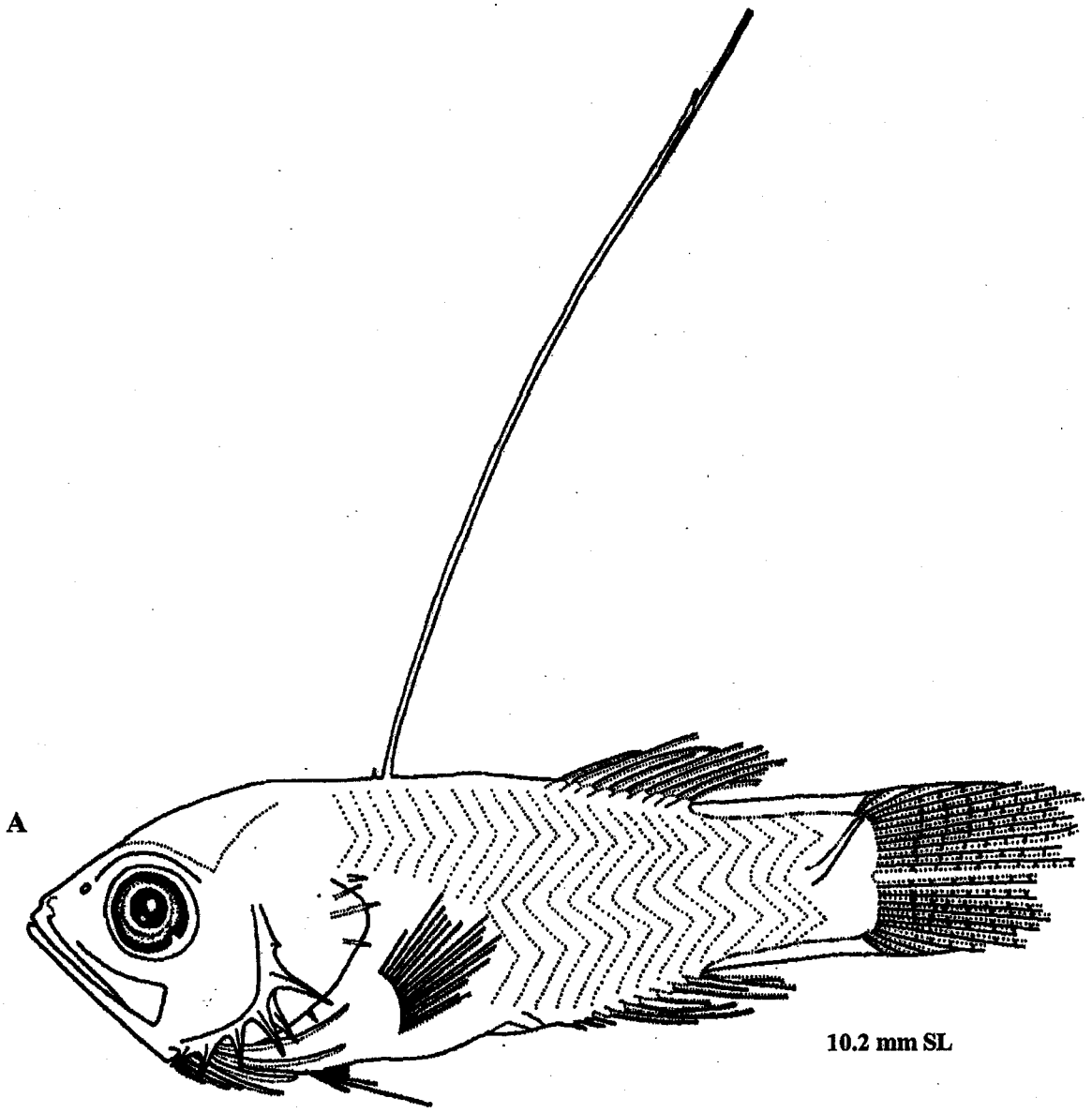
**EGGS:** Unknown

**LARVAE:**
Head Spination: Preopercular spines smooth and strong, 1st 3 antrose; subopercle, interopercle and supracleithrum, each with 1 spine; frontals with small pits.
2nd D Spine Length: elongate, > SL
Length at Flexion: unknown
Sequence of Fin Development: unknown
Pigmentation: None on larva
Diagnostic Characters:

**EARLY JUVENILES:**
Diagnostic Characters: Color patterns may be useful

## ILLUSTRATIONS

Baldwin & Johnson 1991



A

**10.2 mm SL**

## MERISTICS

| | |
|---|---|
| Vertebrae | |
| Precaudal: | 10 |
| Caudal: | 14 |
| Total: | 24 |
| First Dorsal Fin: | VIII |
| Second Dorsal Fin: | 14(15) |
| Anal Fin: | III,8 |
| Pectoral Fin: | 14-15 |
| Gill Rakers: | 6+12-13=18-23 |
| Lateral Line Scales: | 45-47 |
| Branchiostegals: | 7 |

## LIFE HISTORY

Range: FL east coast, FL Keys, north-eastern and northern Gulf of Mexico, Guianas, and Venezuela
Habitat: Deep-water in 70-274m
ELH Pattern: Oviparous; pelagic eggs and larvae
Spawning
Season: Summer
Area: Gulf of Mexico
Mode: Sequential hermaphrodite
Migration:
Size/Age at First
Maturity: Small fishes

## LITERATURE:

Bullock & Smith 1991
Robins & Ray 1986

## EARLY LIFE HISTORY DESCRIPTION

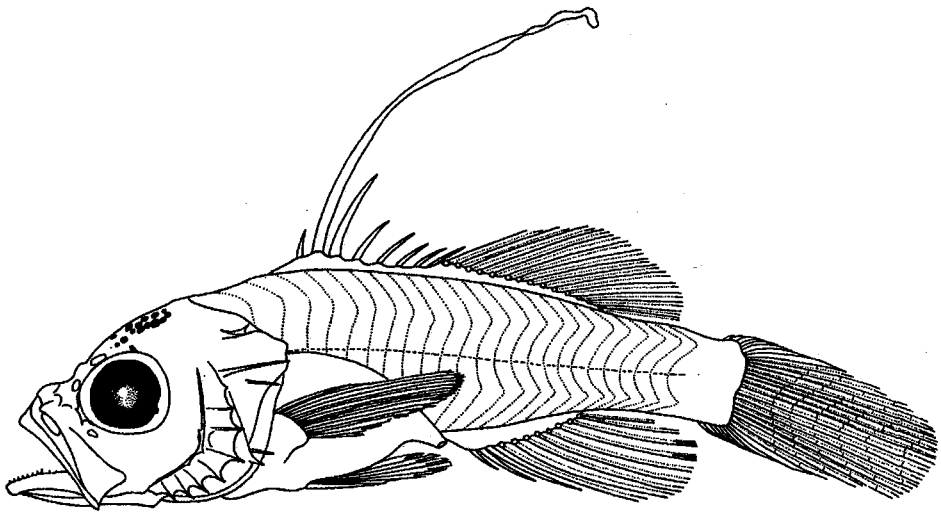
**EGGS:** Unknown

**LARVAE**
Head Spination: Preopercle and opercle
2nd D Spine Length: Elongate
Length at Flexion:
Sequence of Fin Development:
Length of Fin Development:
Pigmentation: Over brain
Diagnostic Characters: Meristics

**EARLY JUVENILES**

## ILLUSTRATIONS

Larva: Original



**12.8 mm SL**

## SUBFAMILY ANTHIINAE

**By W.J. Richards**

This subfamily comprises 9 species in our area allocated to 4 genera, but these generic allocations will change once revisionary work is completed (Baldwin 1994). The larval stages have been described for 8 species by Kendall (1979 and 1984). In his 1979 paper most were misidentified but these were corrected in his 1984 paper. These larvae are very distinct and easily identified to subfamily. They have very large heads which are deep and wide, usually very spinous, rugose, and rough in appearance. They have a large interopercular spine which lies medially to the large preopercular spine giving a double spine appearance to the preopercle. The trunk is deep and short and they have this appearance at very small sizes.

Baldwin (1994) treated 8 of the 9 species (only *Anthias asperilinguis* larvae remain undescribed) and divided them into 4 distinct groups as follows: Group 1 comprises *Hemanthias vivanus* and *Pronotogrammus aureorubens* characterized by a cockscomb-like supraoccipital crest, ornately spined heads with serrate ridges, larval scale type A, and serrate 1st dorsal (pigment in membranes) and pelvic spines ; Group 2 comprises *Anthias nicholsi, A. woodsi,* and *Pronotogrammus martinincensis* characterized by very large heads, supraoccipital crest smooth or small knob, frontal ridge smooth anteriorly and rough posteriorly, fin spines smooth with pigment in 1st dorsal membranes, larval scales absent or type B, and lacrimals and tabulars serrate; Group 3 comprises *Hemanthias leptus* and *A. tenuis* characterized by very large heads, frontal ridge rugose, small knob-like supraoccipital crest, no larval scales, internal trunk pigment, medial preopercular ridge strongly serrate, and no pigment in 1st dorsal fin membranes; and Group 4 comprises *Plectranthias garrupellus* characterized by no supraoccipital crest, head length equals body depth and lacks serrations, elongate non-serrate 3rd dorsal spine (also found in *A. nicholsi*), frontal ridge smooth to slightly rough (not rugose), and no pigment in 1st dorsal fin membrane.

All species are presumed to be protogynous hemaphrodites, but there is little information on their life history as they all occur in relatively deep water. Descriptions of eggs are lacking. Juveniles should be easily identified using adult meristics and descriptions. Meristics are given in Table SER-1.

Anthiinae larvae are quite unique and would likely be confused with larvae of the family Priacanthidae which have strong supraoccipital crests, large heads, and robust bodies. Priacanthids have long and pointed supraoccipital crests and different fin meristics. Priacanthids also lack the long interopercular spine.

**Key to the Larval Stages of the Anthiinae (excluding *Anthias asperilinguis*).**

1a. Supraoccipital crest well developed as a cockscomb ..... 2
1b. Supraoccipital crest absent or as a small knob-like structure ..... 3
2a. Frontal ridge joined, little pigment on 1st dorsal fin membrane, dorsal fin spines serrate (II-IV) ..... *Hemanthias vivanus*
2b. Frontal ridge joins ventral ridge, each 1st dorsal fin membrane pigmented, 3-6 dorsal fin spines serrate (I-III or I-VI) ..... *Pronotogrammus aureorubens*
3a. Supraoccipital crest knob-like ..... 4
3b. Supraoccipital crest absent ..... 6
4a. 1st dorsal fin membrane pigmented, frontal smooth anteriorly, but rugose posteriorly, lacrimal and tabular serrate ..... *Pronotogrammus martincenensis*
4b. 1st dorsal fin membranes lack pigment, frontals rugose, lacrimals and tabular smooth ..... 5
5a. Mid-lateral streak of internal pigment ..... *Hemanthias leptus*
5b. No mid-lateral streak of pigment but internal pigment present ..... *Anthias tenuis*
6a. 1st dorsal fin membranes pigmented, lacrimal and tabular serrate ..... 7
6b. 1st dorsal fin membrane lacks pigment, lacrimal and tabular smooth ..... *Plectranthias garrupellus*
7a. Mid-dorsal pigment blotch present, 3rd dorsal spine elongate ..... *Anthias nicholsi*
7b. No pigment on dorsal margin of trunk, no elongate dorsal spines ..... *Anthias woodsi*

## MERISTICS

| | |
|---|---|
| Vertebrae: | |
| Precaudal | 10 |
| Caudal | 16 |
| Total | 26 |
| Number of Fin Spines and Rays: | |
| First Dorsal Fin | X |
| Second Dorsal Fin | 15(14) |
| Anal Fin | III,7(6-8) |
| Pectoral Fin | 17-18 |
| Gillrakers: | 12-13+27-31=39-44 |
| Lateral Line Scales: | 31-34 |

## LIFE HISTORY

Range: Nova Scotia to FL, Gulf of Mexico, Guayana to Brazil
Habitat:
ELH Pattern: Eggs and larvae pelagic
Spawning: Protogynous
Season: February-April
Area: Gulf of Mexico
Size/Age at First Maturity: females 71-139mm, males 106-149mm

## LITERATURE

Bullock and Smith 1991
Baldwin 1994
Kendall 1979, 1984

## EARLY LIFE HISTORY DESCRIPTION

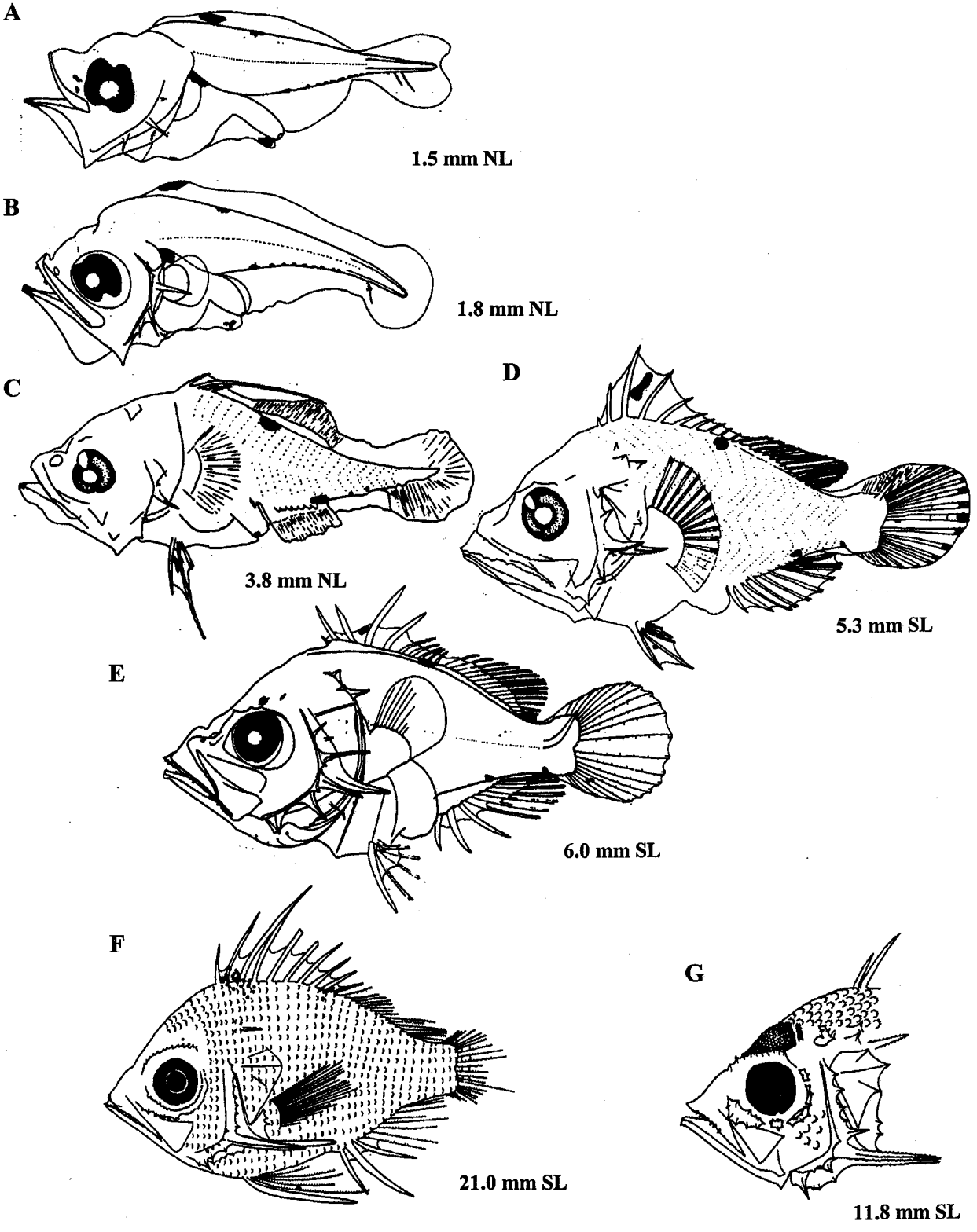
**EGGS:** Unknown

**LARVAE:**
Surpraoccipital crest: absent
Head Spination: smooth anteriorly, rugose posteriorly
Interopercle spine: long
Length at Flexion: ca. 4mmSL
Sequence of Fin Development:
Length of Fin Development:
HL vs. BD @ P1 base: >
Lachrymals: serrate
Tabulars: serrate
Pigmentation: dorsal trunk midline opposite anal origin, above anal fin, 1st dorsal fin membrane, anus, and pelvics
Diagnostic Characters: pigment on dorsal midline above anal origin, elongate 3rd dorsal spine

**EARLY JUVENILES:**
Diagnostic Characters: acquire scales at ca. 6.0mmSL

## ILLUSTRATIONS

Baldwin 1994
Kendall 1979
Original


A
1.5 mm NL
B
1.8 mm NL
C
3.8 mm NL
D
5.3 mm SL
E
6.0 mm SL
F
21.0 mm SL
G
11.8 mm SL

## MERISTICS

| | |
|---|---|
| Vertebrae: | |
| Precaudal | 10 |
| Caudal | 16 |
| Total | 26 |
| Number of Fin Spines and Rays: | |
| First Dorsal Fin | X |
| Second Dorsal Fin | 15(14) |
| Anal Fin | III,8(7-9) |
| Pectoral Fin | 20(19-21) |
| Gillrakers: | 34-39 |
| Lateral Line Scales: | 51-57(interrupted) |

## LIFE HISTORY

Range: NC to Venezuela including Gulf of Mexico, Bermuda, and Puerto Rico
Habitat:
ELH Pattern: Eggs and larvae pelagic
Spawning:Protogynous?

## LITERATURE

Baldwin 1994
Kendall 1979, 1984
Bullock and Smith 1991

## EARLY LIFE HISTORY DESCRIPTION

**EGGS:** Unknown

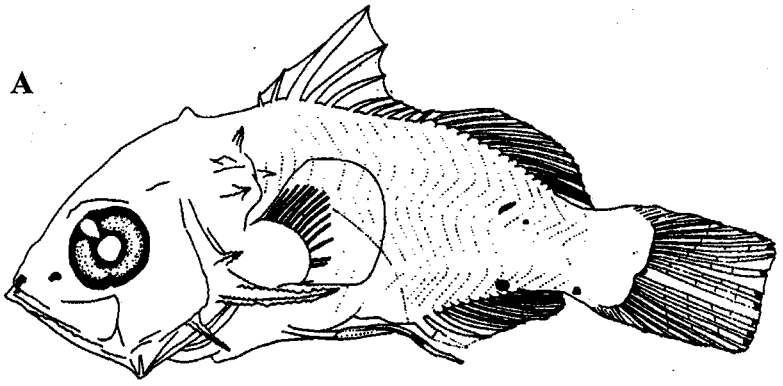
**LARVAE [BALDWIN 1990 GROUP 3]**
Surpraoccipital crest: small knob
Head Spination: serrate, frontal ridge rugose
Interopercle spine: long
Length at Flexion: ca. 4.5-5mmSL
Sequence of Fin Development:
Length of Fin Development:
HL vs. BD @ P1 base: >
Lachrymals: smooth
Tabulars: smooth
Pigmentation: no pigment on 1st dorsal fin, internal blotch of pigment below 2nd dorsal, little pigment on head, large melanophore below 2nd dorsal fin usually only on one side inlarger specimens Diagnostic Characters: internal pigment, 3 spines ventral to large inter-opercular vs. 1 in H. leptus no larval scales

**EARLY JUVENILES:**

## ILLUSTRATIONS

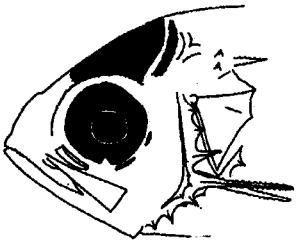
Kendall 1979
Baldwin 1994

A



**6.7 mm SL**

B



**10.4 mm SL**

## MERISTICS

| | |
|---|---|
| Vertebrae: | |
| Precaudal | 10 |
| Caudal | 16 |
| Total | 26 |
| Number of Fin Spines and Rays: | |
| First Dorsal Fin | X |
| Second Dorsal Fin | 14(15) |
| Anal Fin | III,7(8) |
| Pectoral Fin | 18(16) |
| Gillrakers: | 11-12+26-28=38-40 |
| Lateral Line Scales: | 42-48 |

## LIFE HISTORY

Range: SC to Dry Totugas, FL
Habitat: Deep 347-421m
ELH Pattern: Eggs and larvae pelagic
Spawning:Protogynous?

## LITERATURE

Anderson and Heemstra 1980
Baldwin 1994
Kendall 1979, 1984

## EARLY LIFE HISTORY DESCRIPTION

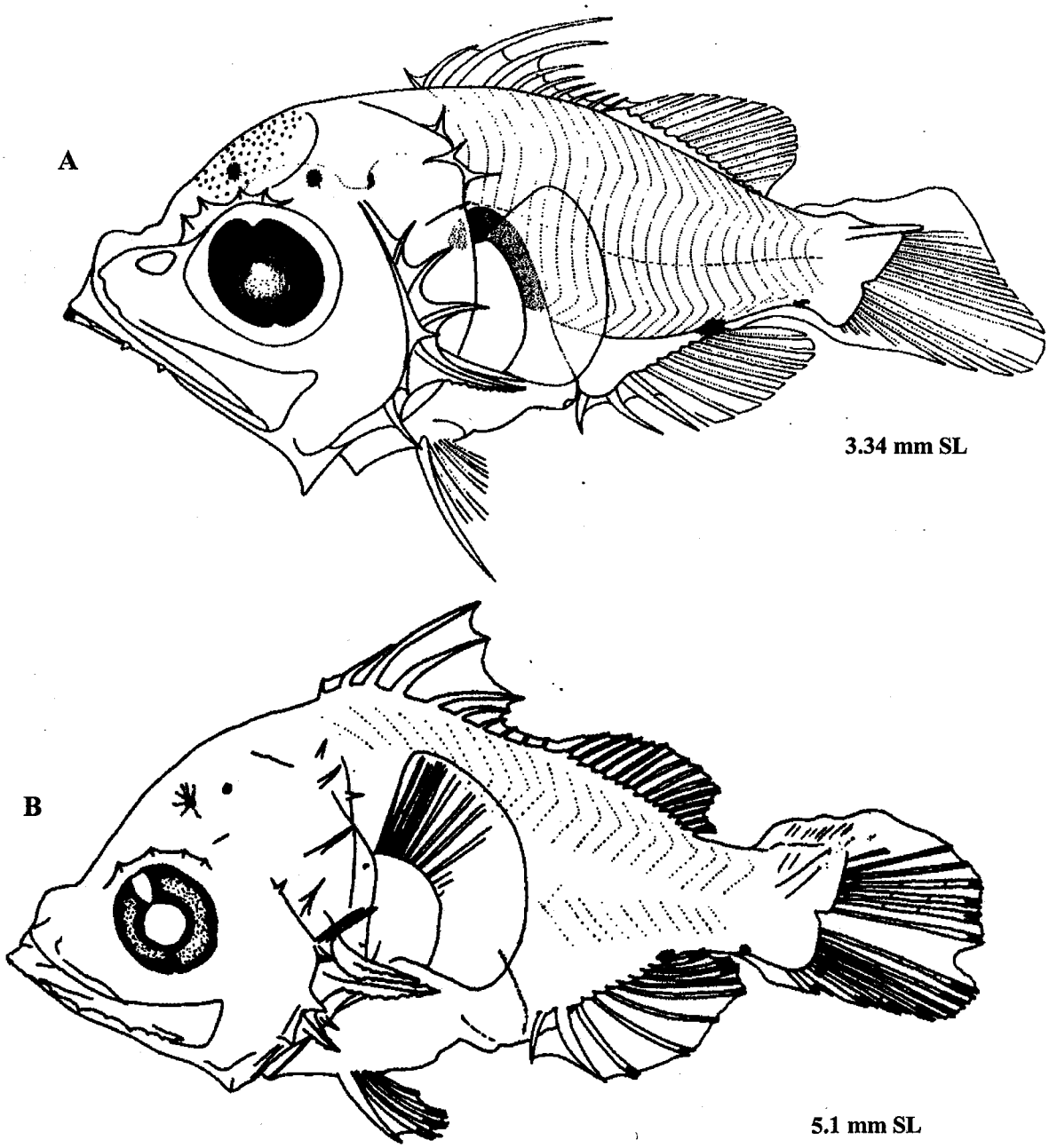
**EGGS:** Unknown

**LARVAE [BALDWIN 1990 GROUP 2]**
Surpraoccipital crest: absent
Head Spination: smooth anteriorly, rugose posteriorly
Interopercle spine: long
Length at Flexion: ca. 4mmSL
Sequence of Fin Development:
Length of Fin Development:
HL vs. BD @ P1 base: >
Lachrymals: serrate
Tabulars: serrate
Pigmentation: no dorsal trunk midline, above end of anal fin, spec. 2.8-4.8mm lack dorsal fin membrane and pelvic pigment, some on head Diagnostic Characters: no pigment on dorsal midline above anal origin

**EARLY JUVENILES:**

## ILLUSTRATIONS

Kendall 1979


A
3.34 mm SL
B
5.1 mm SL

## MERISTICS

| | |
|---|---|
| Vertebrae | |
| Precaudal | 10 |
| Caudal | 16 |
| Total | 26 |
| Number of Fin Spines and Rays: | |
| First Dorsal Fin | X |
| Second Dorsal Fin | 14(13-15) |
| Anal Fin | III,8 |
| Pectoral Fin | 17-19 |
| Gillrakers: | 35-40 |
| Lateral Line Scales: | 54-64 |

## LIFE HISTORY

Range: SC to Venezuela including Gulf of Mexico
Habitat: Deep 91-216m
ELH Pattern: Eggs and larvae pelagic
Spawning:Protogynous/diandric
Season: Variable
Size/Age at First Maturity: Females 48-216mm, males 43-456 mm

## LITERATURE

Baldwin 1994
Kendall 1979, 1984
Bullock and Smith 1991

## EARLY LIFE HISTORY DESCRIPTION

**EGGS:** Unknown

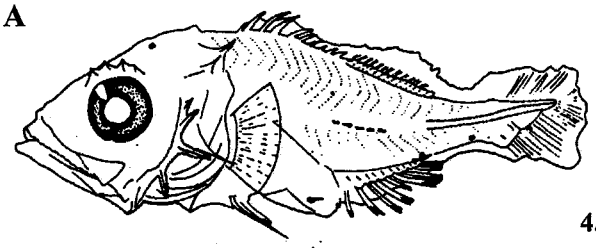
**LARVAE: [Baldwin 1990 Group 3]**
Surpraoccipital crest: small knob
Head Spination: serrate, frontal ridge rugose
Interopercle spine: long
Length at Flexion: ca. 4.5-5mmSL
Sequence of Fin Development:
Length of Fin Development:
HL vs. BD @ P1 base: >
Lachrymals: smooth
Tabulars: smooth
Pigmentation: no pigment on 1st dorsal fin, unique midlateral dashes of pigment internally, heavy pigment on head.
Diagnostic Characters: midlateral pigment, 1 spine ventral to large interopercular vs. 3 in A. tenuis no larval scales

**EARLY JUVENILES:**

## ILLUSTRATIONS

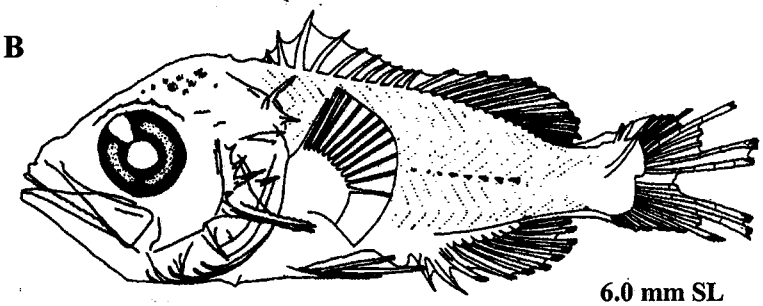
Kendall 1979
Baldwin 1994

A



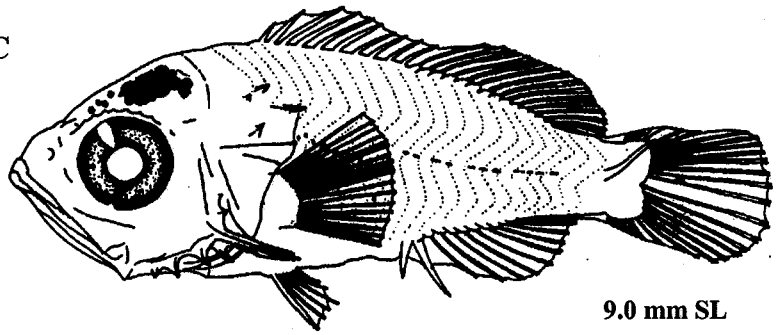
4.6 mm NL

B



6.0 mm SL

C



9.0 mm SL

D

9.1 mm SL

## MERISTICS

| | |
|---|---|
| Vertebrae | |
| Precaudal | 10 |
| Caudal | 16 |
| Total | 26 |
| Number of Fin Spines and Rays: | |
| First Dorsal Fin | X(IX) |
| Second Dorsal Fin | 13-14 |
| Anal Fin | III,8-9 |
| Pectoral Fin | 18-19 |
| Gillrakers: | 10+30=38-43 |
| Lateral Line Scales: | <53 |

## LIFE HISTORY

Range: NC to Gulf of Mexico
Habitat: Deep 73-427m
Off shelf edge
ELH Pattern: Eggs and larvae pelagic
Spawning:Protogynous
Season: Winter - spring in eastern Gulf of Mexico
Size/Age at First Maturity: Females 49-77mm, transition 95-106mm, males 113-117

## LITERATURE

Baldwin 1994
Kendall 1979, 1984
Bullock and Smith 1991

## EARLY LIFE HISTORY DESCRIPTION

**EGGS:** Unknown

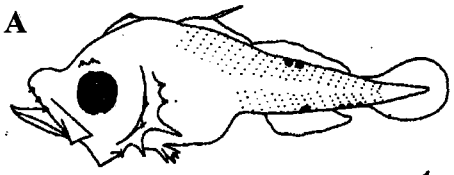
**LARVAE [BALDWIN 1990 GROUP 1]**
Surpraoccipital crest: large cockscomb
Head Spination: serrate
Interopercle spine: long
Length at Flexion: ca. 4.5-5mmSL
Sequence of Fin Development:
Length of Fin Development:
HL vs. BD @ P1 base:= or >
Lachrymals: smooth
Tabulars: smooth
Pigmentation: little if any pigment on 1st dorsal fin, below 2nd dorsal and above anal, lower caudal peduncle and head (frontal and supraorbital)
Diagnostic Characters: cockscomb, serrate dorsal and pelvic spines, frontal ridge not joined

**EARLY JUVENILES:**
Diagnostic Characters: Larval scale type A

## ILLUSTRATIONS

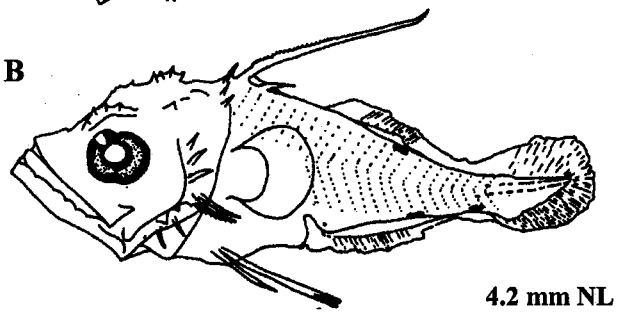
Kendall 1979
Baldwin 1994

A



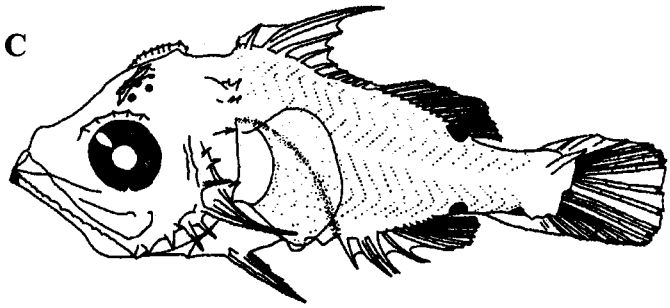
3.0 mm NL

B



4.2 mm NL

C



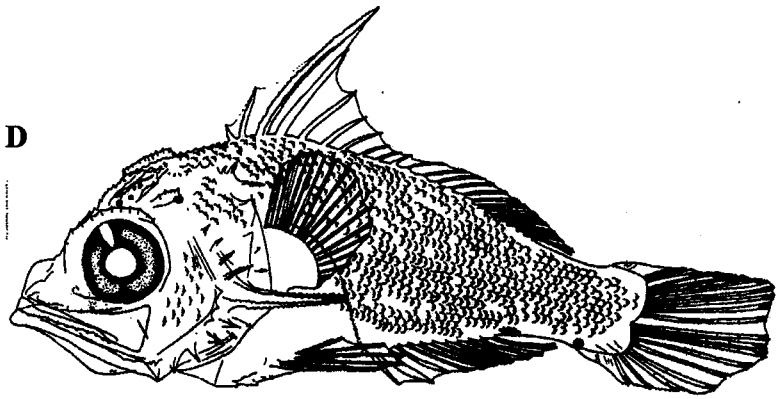
5.3 mm SL

4.3 mm

5.8 mm

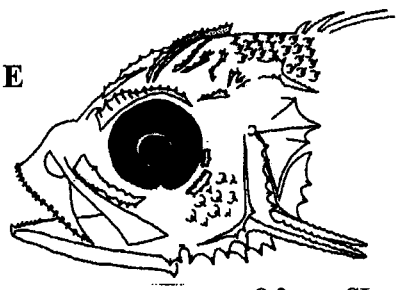
6.6 mm

D



6.8 mm SL

E



8.0 mm SL

## MERISTICS

| | |
|---|---|
| Vertebrae | |
| Precaudal | 10 |
| Caudal | 16 |
| Total | 26 |
| Number of Fin Spines and Rays: | |
| First Dorsal Fin | X |
| Second Dorsal Fin | 15-16 |
| Anal Fin | III,7(6-8) |
| Pectoral Fin | 13(12) |
| Gillrakers: | 4-9+9-17 |
| Lateral Line Scales: | 28-29(27-30) |

## LIFE HISTORY

Range: Both coasts of FL, Cuba and Bahamas
Habitat: 55-210m
ELH Pattern: Eggs and larvae pelagic
Spawning:
Season: August-November

## LITERATURE

Bullock and Smith 1991
Baldwin 1994
Kendall 1979, 1984

## EARLY LIFE HISTORY DESCRIPTION

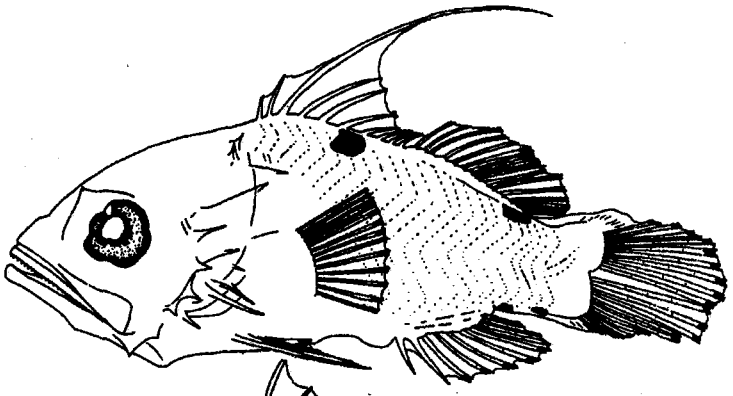
**EGGS:** Unknown

**LARVAE: [Baldwin 1990 Group 4]**
Surpraoccipital crest: absent
Head Spination: smooth to slightly rough, not rugose
Interopercle spine: long
Length at Flexion:
Sequence of Fin Development:
Length of Fin Development:
HL vs. BD @ P1 base: =
Lachrymals:
Tabulars: smooth
Pigmentation: dorsal trunk below both dorsal fins, on lower caudal peduncle, none on dorsal fin membrane, head, and pelvics
Diagnostic characters: pigment below both dorsal fins, preopercular spine smooth or slightly serrate, supraorbital with 1 spine, no larval scales

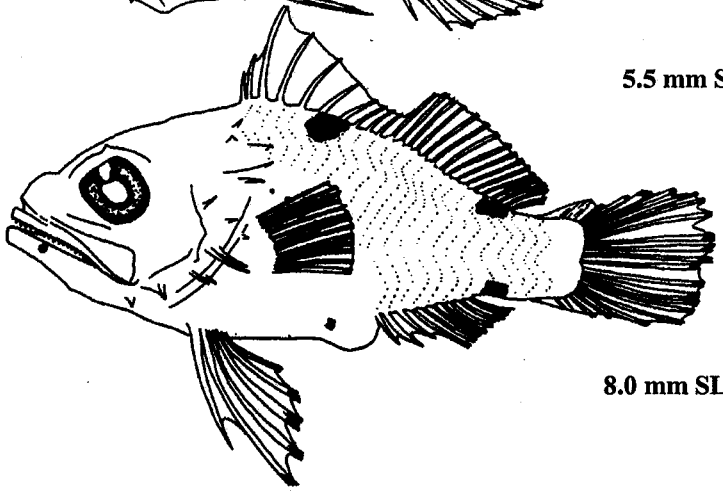
**EARLY JUVENILES:**
Diagnostic Characters: acquire scales at ca. 6.0mmSL

## ILLUSTRATIONS

Kendall 1979
Baldwin 1994



**5.5 mm SL**



**8.0 mm SL**

**8.2 mm SL**

## MERISTICS

| | |
|---|---|
| Vertebrae: | |
| Precaudal | 10 |
| Caudal | 16 |
| Total | 26 |
| Number of Fin Spines and Rays: | |
| First Dorsal Fin | X |
| Second Dorsal Fin | 15 |
| Anal Fin | III,8(9) |
| Pectoral Fin | 16-17 |
| Gillrakers: | +28-29 |
| Lateral Line Scales: | 44-48 |

## LIFE HISTORY

Range: Northeastern Gulf of Mexico, FL south to Dry Tortugas, Venezuela to Suriname
Habitat: Deep 91-457m
ELH Pattern: Eggs and larvae pelagic
Spawning:Protogynous
Season: May off FL
Size/Age at First Maturity: Females 49-77mm, transition 95-106mm, males 113-117

## LITERATURE

Baldwin 1994
Kendall 1979, 1984
Bullock and Smith 1991

## EARLY LIFE HISTORY DESCRIPTION

**EGGS:** Unknown

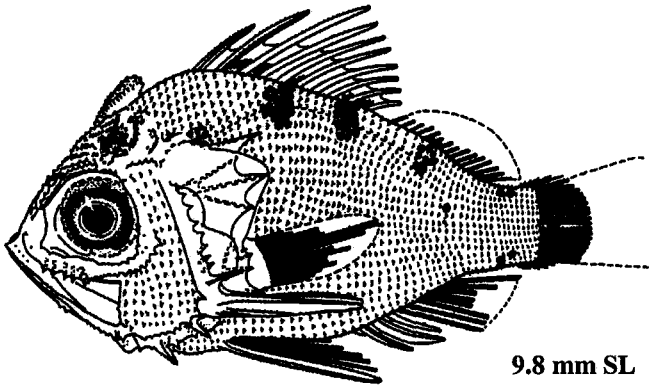
**LARVAE: [Baldwin 1990 Group 1]**
Surpraoccipital crest: large cockscomb
Head Spination: serrate
Interopercle spine: long
Length at Flexion:
Sequence of Fin Development:
Length of Fin Development:
HL vs. BD @ P1 base:= or >
Lachrymals: smooth
Tabulars: smooth
Pigmentation: unknown but early juveniles with 3-5 dorsal blotches and 1st dorsal membranes pigmented
Diagnostic Characters: cockscomb, serrate dorsal and pelvic spines, frontal ridge joined, very deep body.

**EARLY JUVENILES:**
Diagnostic Characters: Larval scale type A

## ILLUSTRATIONS

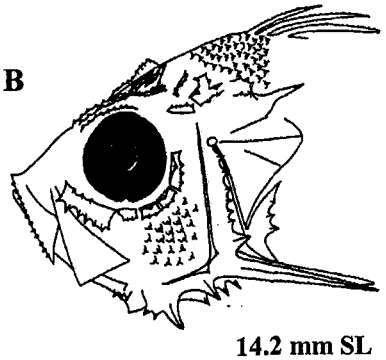
Kendall 1984
Baldwin 1994

A



**9.8 mm SL**

B



**14.2 mm SL**

## MERISTICS

| | |
|---|---|
| Vertebrae: | |
| Precaudal | 10 |
| Caudal | 16 |
| Total | 26 |
| Number of Fin Spines and Rays: | |
| First Dorsal Fin | X |
| Second Dorsal Fin | 15(13-16) |
| Anal Fin | III,7(8) |
| Pectoral Fin | 17(16-18) |
| Gillrakers: | 9-13+24-29=34-41 |
| Lateral Line Scales: | 35-41 |

## LIFE HISTORY

Range: NC to southern Brazil, Bermuda Gulf of Mexico and Caribbean
Habitat: Benthic 65-230m, drowned reefs, rocky outcrops
ELH Pattern: Eggs and larvae pelagic
Spawning:Protogynous
Season: February - July in eastern Gulf of Mexico
Size/Age at First Maturity: Females 47-112mm, transition 73-94mm, males 66-132

## LITERATURE

Anderson and Heemstra 1980
Baldwin 1994
Kendall 1979, 1984
Bullock and Smith 1991

## EARLY LIFE HISTORY DESCRIPTION

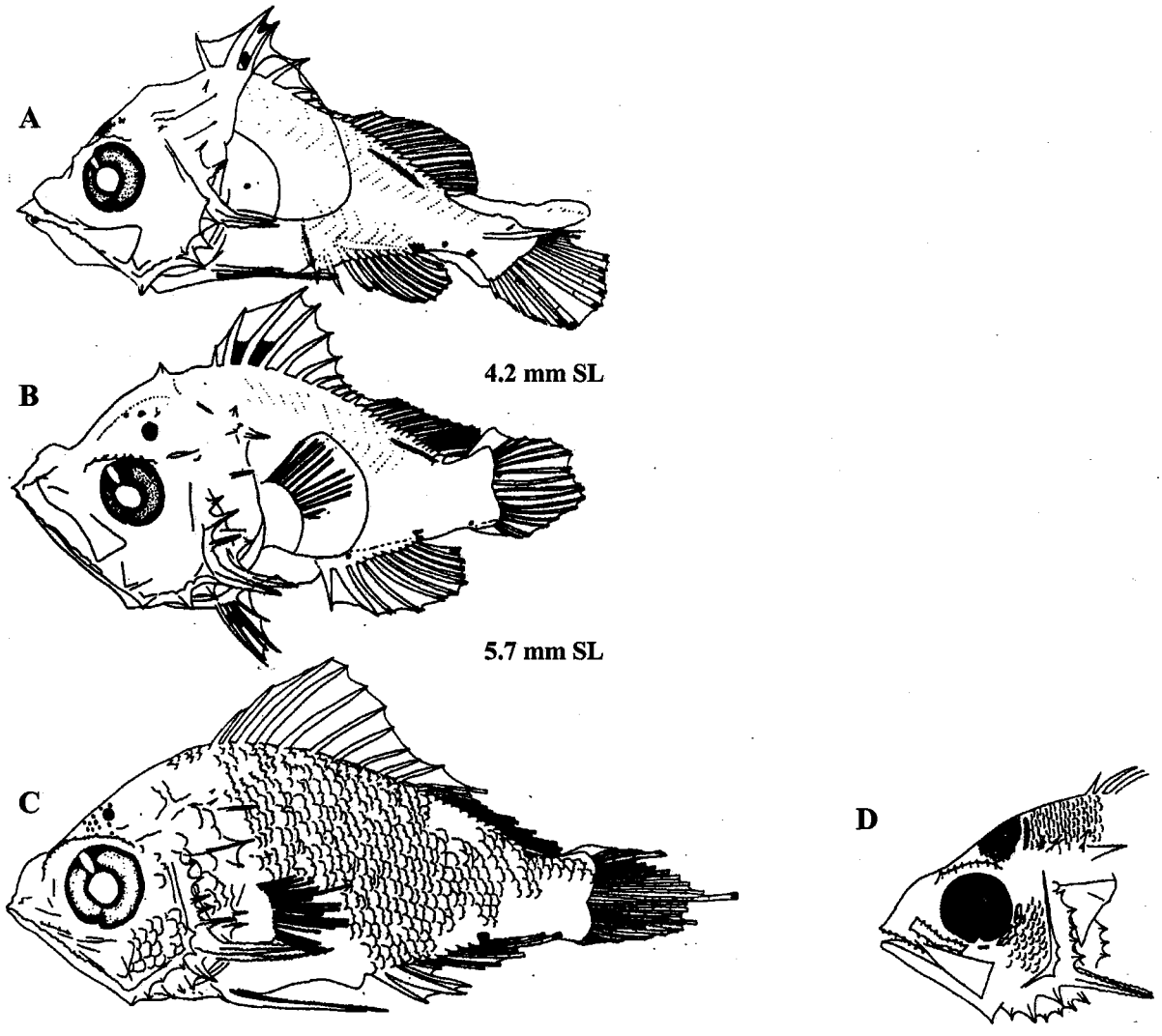
**EGGS:** Unknown

**LARVAE:[Baldwin 1990 Group 2]**
Surpraoccipital crest: small
Head Spination: smooth anteriorly, rugose posteriorly
Interopercle spine: long
Length at Flexion: ca. 4mmSL
Sequence of Fin Development:
Length of Fin Development:
HL vs. BD @ P1 base: >
Lachrymals: serrate
Tabulars: serrate
Pigmentation: unique streak on dorsal trunk midline below 2nd dorsal fin, dorsal fin membrane and pelvic pigmented, some on head, posteriorly above anal fin and on caudal peduncle.
Diagnostic Characters: unique streak below 2nd dorsal fin.

**EARLY JUVENILES:**
Diagnostic Characters: Larval scale type B

## ILLUSTRATIONS

Kendall 1979
Baldwin 1994


A
4.2 mm SL
B
5.7 mm SL
C
8.4 mm SL
D
8.7 mm SL

## LITERATURE CITED


Andreson, W. D., Jr. & P. C. Heemstra. 1980. Two species of western Atlantic *Anthias* (Pisces:Serranidae), with redescription of *A. asperlinguis* and review of *Holanthias martinicensis*. Copeia 1980:72-87.

Baldwin, C. C. 1990. Morphology of the larvae of American Anthiinae (Teleostei: Serranidae), with comments on relationships within the subfamily. Copeia 1990:913-955.

_____ & D. G. Johnson. 1991. A larva of the poorly known serranid fish *Jeboehlkia gladifer* (Teleostei: Serranidae: Epinephelinae). Fish. Bull. U. S. 89: 535-537.

_____, _____, & P. L. Colin. 1991. Larvae of *Diplorion bifasciatum*, *Belonoperca chabanaudi* and *Grammistes sexlineatus* (Serranidae: Epinephelinae) with comparison of known larvae of other epinephelines. Bull. Mar. Sci. 48: 67-93.

Böhlke, J. E. & C. C. G. Chaplin. 1968. Fishes of the Bahamas and adjacent tropical waters. Academy of Natural Sciences, Philadelphia, Pa. 771 p.

_____ & _____. 1993. Fishes of the Bahamas and adjacent tropical waters. 2nd Ed. University of Texas Press, Austin, Texas. 771 p.

Bortone, S. A. 1977. Revision of sea basses of the genus *Diplectrum* (Pisces: Serranidae). NOAA Tech. Rep. NMFS Circ. (404): 49 p.

Bullock, L. H. & G. B. Smith. 1991. Seabasses (Pisces: Serranidae) Mem. Hourglass Cruises 8(2): 243 p.

Colin, P. L. 1978. *Serranus incisus*, new species from the Caribbean Sea (Pisces, Serranidae). Proc. Biol. Soc. Wash. 91(1): 191-196.

_____ & C. C. Koenig. 1996. Spines in larval red grouper, *Epinephelus morio*: development and function. Proc. Gulf. Carib. Fish. Inst. 44: 31-38.

_____, D. Y. Shapiro, & D. Weiler. 1987. Aspects of the reproduction of two groupers, *Epinephelus guttatus* and *E. striatus* in the West Indies. Bull. Mar. Sci. 40: 220-230.

Courtenay, W. R., Jr. 1967. Atlantic fishes of the genus *Rypticus* (Grammistidae). Proc. Acad. Nat. Sci. Phila. 119(6): 241-293.

Domeier, M. L. 1994. Speciation in the serranid fish *Hypoplectrus*. Bull. Mar. Sci. 54: 103-141.

Eschmeyer, W. N. 1990. Catalog of the genera of recent fishes. California Academy of Sciences, San Francisco, Calif. 697 p.

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

Guitart Manday, D. & M. J. Fernandez. 1966. Desarollo embrionario y primeros esadios larvales de la cherna Crioll, *Epinephelus striatus* (Bloch) (Perciformes: Serranidae). Acad. Cien, Cuba, Estud. Inst. Oceanol. 1: 35-45.

Hardy, J. D., Jr. 1978. Development of fishes of the mid-Atlantic Bight, an atlas of egg, larval, and juveniles. Vol. III. Aphredoderidae through Rachycentridae. U. S. Fish Wildl. Serv. Biol. Serv. Prog. FWS/OBS-78/12.

Heemstra, P. C. & J. E. Randall. 1993. Groupers of the World. FAO Fish. Syn. (125), 16: 382 p. + 31 pls.

Houde, E. D. 1982. Kinds, distributions and abundances of sea bass larvae (Pisces: Serranidae) from the eastern Gulf of Mexico. Bull. Mar. Sci. 32: 511-522.

_____, J. C. Leak, C. E. Dowd, S. A. Berkely, & W. J. Richards. 1979. Ichthyoplankton abundance and diversity in the eastern Gulf of Mexico. Rep. Bur. Land Mangt. under contract AA550-CT7-28. NTIS PB-299 839. 546 p.

Johnson, G. D. 1983. Niphon spinosus: a primitive epinepheline serranid, with comments on the monophyly and intrarelationships of the Serranidae. Copeia 1983: 777-787.

_____ & P. Keener. 1984. Aid to identification of American grouper larvae. Bull. Mar. Sci. 34: 106-134.

_____ & W. F. Smith-Vaniz. 1987. Redescritption and relationships of *Parasphyraenops atrimanus* Bean (Pisces: Serranidae), with discussion of other Bermudan fishes known only from stomach contents. Bull. Mar. Sci. 40: 48-58.

Jordan, D. S. & B. W. Evermann. 1896. Fishes of North and Middle America. Bull. U. S. Natl. Mus. (47)(Pt.1): 1240 p.

Kendall, A. W., Jr. 1972. Description of balck sea bass, *Centropristis striata* (Linnaeus), larvae and their occurrences north of Cape Lookout, North Carolina, in 1966. Fish. Bull. U. S. 70: 1243-1260.

_____. 1979. Morphological comparisons of North American sea bass larvae (Pisces: Serranidae). NOAA Tech. Rep. NMFS Circ. (428): 50 p.

_____. 1984. Serranidae: development and relationships. Pages 499-510 *in* Ontogeny and systematics of fishes. H. G. Moser et al. (eds.). Amer. Soc. Ichthyol. Herpetol. Spec. Publ. (1): 760 p.

_____ & M. P. Fahay. 1979. Larva of the serranid fish *Gonioplectrus hispanus* with comments on its relationships. Bull. Mar. Sci. 29: 117-121.

Meek, S. E. & S. F. Hildebrand. 1925. The marine fishes of panama. Field Mus. Nat. Hist. Publ. (226). Zool. Ser. 15(2): 331-707.

Miller, R, J. 1959. A review of the sea basses of the genus *Centropristes* (Serranidae). Tulane stud. Zool. 7(2): 35-68.

Moe, M. A., Jr. 1969. Biology of the red grouper, *Epinephelus morio* (Valenciennes) from the eastern Gulf of Mexico. Fla. Dep. Nat. Res. Mar. Fish. Res. Lab., Prof. Pap. (10): 95 p.

Moore, C. M. & R. F. Labiskey. 1984. Population parameters of a relatively unexploited stock of snowy grouper in the lower Florida Keys. Trans. Amer. Fish. Soc. 113: 322-329.

Powell, A. B. & J. W. Tucker, Jr. 1992. Egg and larval development of laboratory-reared Nassau grouper *Epinephelus striatus* (Pisces, Serranidae). Bull. Mar. Sci. 50: 171-185.

Nelson, J. S. 1994. Fishes of the World. John Wiley & Sons, Inc. New York. 3rd Ed. 600 p.

Randall, J. E. 1968. Caribbean reef fishes. T. H. F. Publications, Jersey City, New Jersey. 318 p.

Rivas, L. R. 1964. Western Atlantic serranid fishes (groupers) of the genus Epinephelus. Q. J. Fla. Acad. Sci. 27(1): 17-30.

_____. 1971. A new genus and species of western Atlantic serranoid fishes with anterior vent. Copeia 1971: 718-721.

Robins, C. R. 1967. The status of the serranid fish *Liopropoma abberrans*, with the description of a new, apparently related genus. Copeia 1967: 591-595.

_____ & W. A. Starck. 1961. Materials for a revision of *Serranus* and related fish genera. Proc. Acad. Sci. Phila. 113(11): 259-314.

Watson, W. 1996. Serranidae: sea basses. Pages 876-899 *in* The early stages of fishes in the California Current region. H. G. Moser (Ed.). Calif. Coop. Ocean. Fish. Invest. Atlas (33): 1505 p.