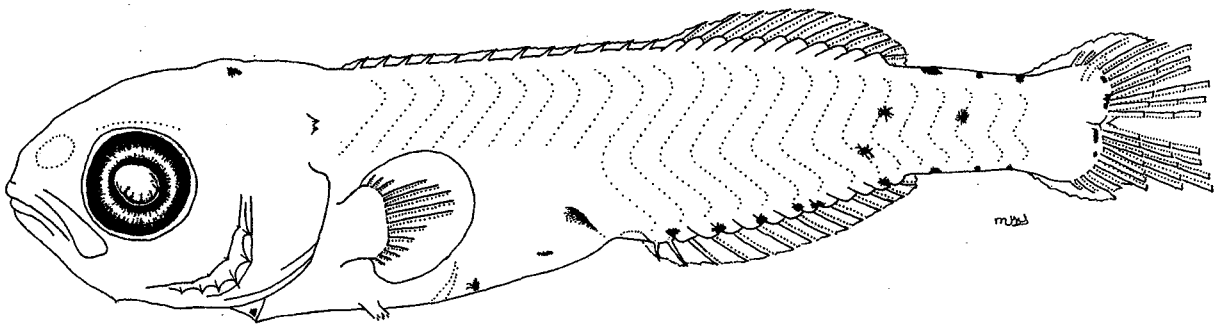




PRELIMINARY GUIDE TO THE IDENTIFICATION OF THE EARLY LIFE HISTORY STAGES OF SPARID
FISHES OF THE WESTERN CENTRAL NORTH ATLANTIC

BY

ALLYN B. POWELL & MICHAEL D. GREENE



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

May 2002



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

BY

ALLYN B. POWELL & MICHAEL D. GREENE

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

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

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

May 2002

This Technical Memorandum series is used for documentation and timely communication of preliminary results, interim reports, or similar special-purpose information. Although the memoranda are not subject to complete formal review, editorial control, or detailed editing, they are expected to reflect sound professional work.

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:

Powell, A. B. & M. D. Greene. 2002. Preliminary guide to the identification of the early life history stages of sparid fishes of the western central North Atlantic. NOAA Technical Memorandum NMFS-SEFSC-480, 20 p.

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

This report will be posted on the Bethune Cookman College NOAA Cooperative web site later in 2002 at URL: <http://www4.cookman.edu/NOAA/> and will also appear on the SEFSC web site at URL: <http://www.sefsc.noaa.gov/> It will be a chapter entitled Sparidae in the "Guide to the early life history stages of fishes of the western central North Atlantic".

Author's addresses:

Dr. A. B. Powell & M. D. Greene
NOAA National Ocean Service
Center for Coastal Fisheries & Habitat Research
101 Pivers Island Road
Beaufort, NC 28516-9722
E-mail: allyn.powell@noaa.gov
< michael.greene@noaa.gov >

Copies may be obtained by writing:

The authors

or

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

The family Sparidae contains six genera and 19 species that occur in the western central north Atlantic. The genus *Archosargus* and *Stenotomus* consists of two species; *Calamus* (the most speciose), 10 species; *Diplodus*, three species; *Lagodon* and *Pagrus*, one species. There is some debate as to the number of *Stenotomus* species in the western central north Atlantic. Some biologists¹ argue that three species might be valid, based on morphology. They suggest that *S. chrysops* occurs north of Cape Hatteras, North Carolina; *Stenotomus* sp. occurs from Cape Hatteras to Florida; and *S. caprinus* throughout the Gulf of Mexico. Here we treat *Stenotomus* sp. and *S. caprinus* as one species (i.e., *S. caprinus*).

Many adult sparids are important sport and food fishes (e.g., *Calamus* and *Pagrus*) and generally occur in warm-temperate and tropical waters. Sparids are deep-bodied, compressed, with a large eye and small mouth, and are generally silvery. They are commonly between 30-60 cm in length, but some may reach 91 cm (e.g., *Archosargus probatocephalus* and *Pagrus pagrus*). Most are common in bays and shallow coastal waters and banks where shellfishes are common; some prefer seagrass beds, and others occur around hard-bottom and coral reefs (Robins and Ray, 1986).

Larval sparids apparently spawn planktonic eggs that are ca. 0.8-1.2 mm diameter with an oil globule that is ca. 0.1-0.2 mm diameter. Recently hatched larvae are ca. 2 mm body length, with the oil globule positioned posteriorly in the yolk sac. The

coiled gut is < 50% of body length. Anal and dorsal rays have approximately equal number of rays. Head and pectoral girdle spination of western central north Atlantic sparids is weak, except for *Pagrus*. Larval pigmentation is variable. *Calamus* have distinct lateral body pigment that occurs at least as early as flexion (preflexion larvae have not been described); *Lagodon* and, apparently, *Stenotomus*, exhibit a series of ventral midline melanophores posterior to the anus; *Archosargus* and *Pagrus* are lightly pigmented and lack the series of ventral midline melanophores. Vertical bars commonly form by, or during, transformation to the juvenile stage (Fahay 1983; Watson and Sandknop, 1996; personal observations).

Larvae of the genus *Stenotomus* are rarely collected yet the two species (*S. chrysops* and *S. caprinus*) are common as adults (Wenner et al., 1979; Griswald and McKenney, 1984; Able and Fahay, 1998). Descriptions of *Stenotomus chrysops* are available, but are based on laboratory reared specimens derived from eggs that were stripped from females (Griswald and McKenney, 1984). Spawning of *Stenotomus caprinus* overlaps with *Lagodon rhomboides* (Caldwell, 1957; Geoghegan and Chittenden, 1982; Barans²), and based on dorsal fin ray counts, we are concerned that confusion could exist between these two species. Caldwell (1957) reported that of 485 *L. rhomboides*, 455 had counts of XII,11. Only two specimens had counts of XI,12, and none examined from the Atlantic seaboard had XII,12. We examined two collections of postlarval

¹ J. Hare & H. Walsh. Personal communications (June 2001). NOAA, Center for Coastal Fisheries and Habitat Research, 101 Pivers Island Road, Beaufort, NC 28528

² C. A. Barans, Personal communication (May 2001). Marine Resources Research Institute, South Carolina Wildlife and Marine Resources Department, Charleston, South Carolina 29412

specimens that were collected off North Carolina ($n = 29$); 76% had dorsal fin counts of XII,12, whereas 21% had XII,11. On the other hand, like *S. chrysops*, pelagic *S. caprinus* larvae might be rare, and dorsal fin counts of XI,12 might be valid for *L. rhomboides*. We examined numerous "*L. rhomboides*" larval pigmentation at all stages and were unable to detect two larval types, and conclude genetic studies will

be necessary to resolve this problem. Our illustrated *L. rhomboides* postflexion larvae has a dorsal fin count of XII, 11. We also included what we consider a postflexion "*L. rhomboides*" type with a dorsal fin count of XII,12 below as Figure 1. A series of *Calamus* sp. are shown in Figure 2.

Meristic data are given in Table 1 and distribution information in Table 2.

Figure 1. *Lagodon rhomboides*? with a dorsal-fin ray count of XII,12 (see text); Chapman, Cr. 93-02, leg 2, sta. 51; 9.2 mm SL.

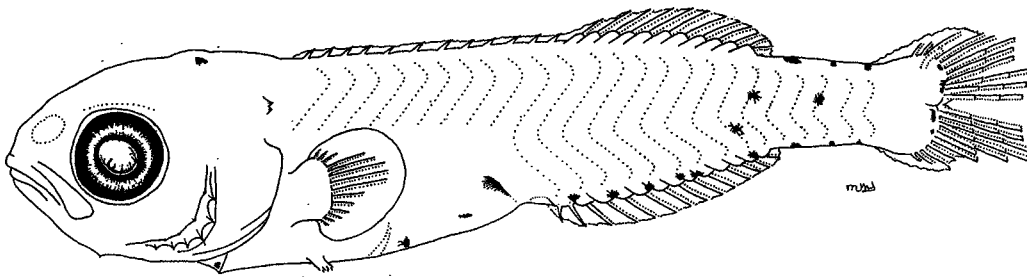


Figure 2. *Calamus* sp. A) 34°17.4'N, 076°47.9'W, 6.8 mm SL. B) 34°51.5'N, 075°52.3'W, 5.5 mm SL. C) 35°07.4'N, 075°15.9'W, 5.4 mm SL. D) 35°03.5'N, 075°24.6'W, 7.6 mm SL.

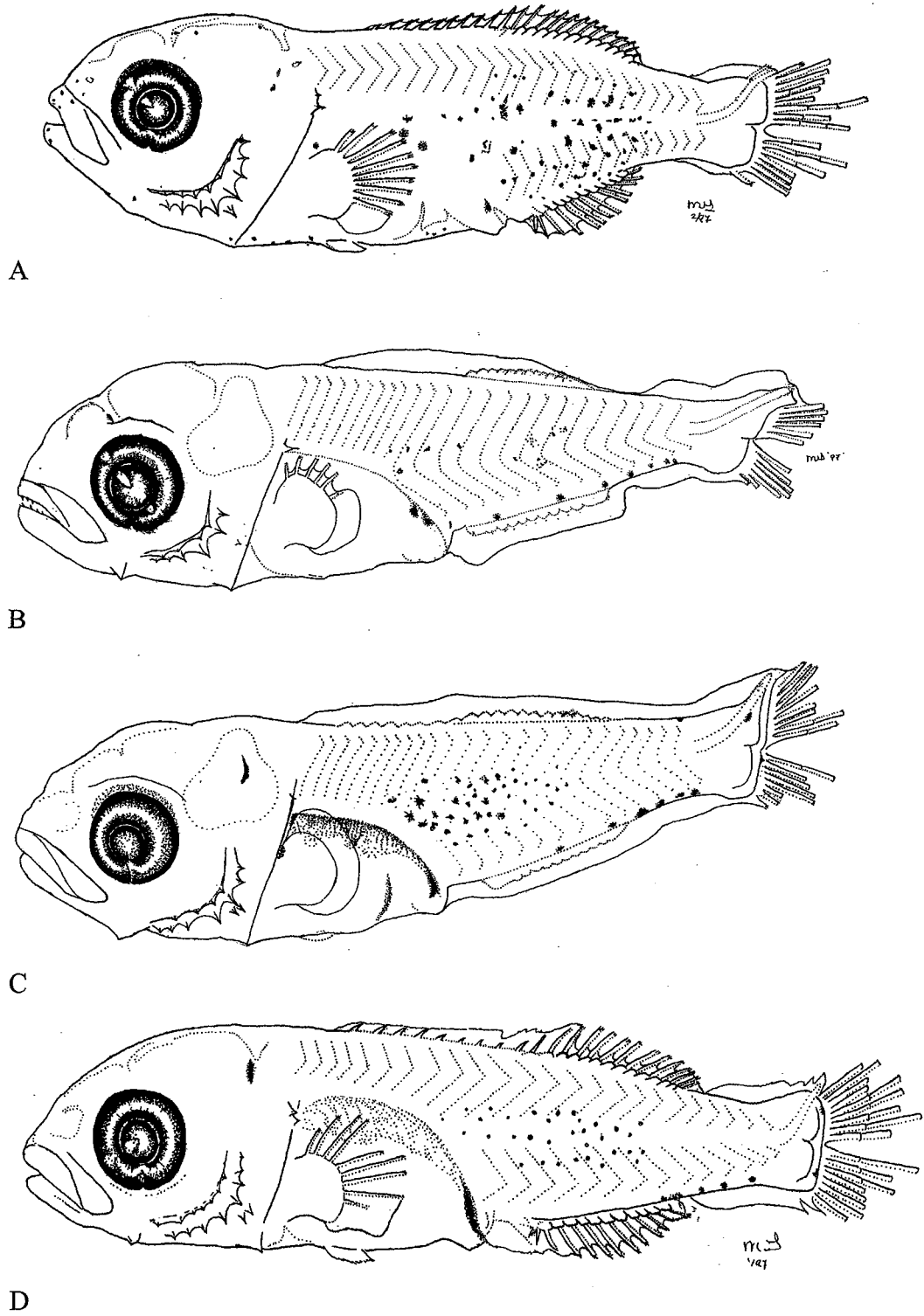


Table Sparidae 1. Meristic characters for the sparid species that occur in the western central north Atlantic. All species have I,5 pelvic rays ; 9 upper + 8 lower principal caudal rays; and 10 + 14 vertebrae, except *Diplodus holbrooki* (10-11 + 14). Values given are the usual counts and, in parenthesis, the range. Meristic character counts were obtained from Jordan and Evermann (1896); Hildebrand and Cable (1938); Caldwell (1957); Caldwell (1965a,b); Randall and Caldwell (1966); Fahay (1983); Houde & Potthoff (1976); Manooch et al. (1976); Johnson (1978); Randall and Vergara (1978); Griswold and McKenney (1984); Tucker and Alshuth (1997).

	Fin rays				Total Gill rakers
	Dorsal		Anal	Pectoral	
	First	Second			
<i>Archosargus</i>					
<i>probatocephalus</i>	XI-XII*	11-13(10)	III,10-11 (9-12)	15-17	6-9**
<i>rhomboidalis</i>	XIII(XII-XIV)	10-11	III,10 (10-11)	14 (14-15)	14-16
<i>Calamus</i>					
<i>arctifrons</i>	XII (XI-XIII)	12(11-13)	III,10 (10-11)	16 (15-16)	10 (10-12)
<i>bajonado</i>	XII	12 (11-12)	III,10 (10-11)	15 (14-16)	12-13 (11-14)
<i>calamus</i>	XII	12	III,11 (10-11)	14	11-13
<i>campechanus</i>	XII (XIII)	12(11)	III,10 (9-10)	15 (14-16)	12 (10-12)
<i>cervigoni</i>	XII	11	III,10 (10-11)	15 (14-15)	12 (12-13)
<i>leucosteus</i>	XII (XI-XIII)	12(11-13)	III,10 (9-11)	16 (15-17)	10-11 (10-12)
<i>nodosus</i>	XII(XII-XIII)	12(11-13)	II,11 (10-11)	14 (14-15)	11 (10-12)
<i>penna</i>	XII (XII-XIII)	12(11-13)	III,10 (9-10)	15 (14-16)	11-12 (10-13)
<i>pennatula</i>	XII	12 (11-13)	III,10 (9-11)	14 (13-15)	11-12 (9-13)
<i>proridens</i>	XII (XIII)	12(11)	III,10 (10-11)	14 (13-15)	11(11-13)
<i>Diplodus</i>					
<i>argenteus</i>					
<i>caudimacula</i>	XII	13-14	III,12-14		17-20
<i>holbrooki</i>	XII-XIII	13-16	III,13-15	15-17	17-21
<i>bermudensis</i>	XII(XI-XIII)	13-15(12-16)	III,13-14 (11-15)	16-17 (15-17)	17-18
<i>Lagodon</i>					
<i>rhomboides</i>	XII (XI-XIII)	11(10-12)	III,11 (IV,10-12)	16 (14-17)	19-20
<i>Pagrus</i>					
<i>pagrus</i>	XII-XIII	9-11	III,7-9	15-16	16 (13-17)
<i>Stenotomus</i>					
<i>caprinus</i>	XII	12	III,11		
<i>chrysops</i>	XII	12	III,11-12	16	16

*XII,11 & XI,12 most common counts for wild-caught specimens (Caldwell, 1965) vs.

XI,10-13 for laboratory reared specimens (Tucker and Alshuth (1997).

**Lower limb only

Table Sparidae 2. Distribution of sparid species that occur in the western central north Atlantic.

Distribution data were obtained from Randall and Vergara (1978); Robins and Ray (1986); Able and Fahay (1998).

Species	Distribution
<i>Archosargus</i>	
<i>probatocephalus</i>	Nova Scotia to Florida and the northern Gulf of Mexico to Brazil; absent from West Indies and Bahamas. Late larvae and juveniles (ca. <50 mm) inhabit seagrass beds; larger juveniles and adults associated with rocks, pilings, wrecks and bulkheads.
<i>rhomboidalis</i>	New Jersey, eastern Gulf of Mexico along the Caribbean coast to Brazil; Antilles; rare north of Florida. Usually found associated with seagrasses in shallow waters.
<i>Calamus</i>	
<i>arctifrons</i>	Southern Florida to Louisiana. Common in seagrass beds.
<i>bajonado</i>	Rhode Island (rare), Gulf of Mexico (but absent from the western Gulf of Mexico) along the Caribbean coast to Brazil; Bahamas and Bermuda; most common in the Antilles, Florida Keys and Campeche Bank.
<i>calamus</i>	Reported from North Carolina, Gulf of Mexico (but absent in the western Gulf of Mexico) along the Caribbean coast, to Brazil; positively known only from the Florida Keys, Bermuda, West Indies, and Belize. Young associated with the seagrass <i>Thalassia</i> .
<i>campechanus</i>	Campeche Bank off the Mexican Yucatan Peninsula.
<i>cervigoni</i>	Eastern Venezuela.
<i>leucosteus</i>	North Carolina to southern Florida and entire Gulf of Mexico.
<i>nodosus</i>	North Carolina to Florida Keys; Gulf of Mexico from southern Florida to Pensacola, Florida, and from Port Aransas, Texas to the Campeche Bank off Yucatan.
<i>penna</i>	West coast of Florida; West Indies; Bahamas; southern Caribbean coast to Brazil.
<i>pennatula</i>	Bahamas; West Indies; southern Caribbean coast to Brazil.
<i>proridens</i>	East and west coast of Florida; Yucatan; Cuba and Hispaniola.
<i>Diplodus</i>	
<i>argenteus</i>	
<i>caudimacula</i>	South Florida; Bahamas; West Indies; southern Caribbean coast to Brazil.
<i>holbrookii</i>	Chesapeake Bay to northwest Gulf of Mexico.
<i>bermudensis</i>	Bermuda
<i>Lagodon</i>	
<i>rhomboides</i>	Cape Cod (rare) to Florida; throughout Gulf of Mexico; northern coast of Cuba; Bermuda
<i>Pagrus</i>	
<i>pagrus</i>	New York to Florida; throughout the Gulf of Mexico, southern Caribbean coast to Argentina.
<i>Stenotomus</i>	
<i>caprinus</i>	Cape Hatteras, North Carolina to Florida; entire Gulf of Mexico
<i>chrysops</i>	Nova Scotia To South Carolina; uncommon north of Cape Cod; rare south of North Carolina.

SPARIDAE

MERISTICS

Vertebrae:	
Precaudal	10
Caudal	14
Total	24
Number of Fin Spines and Rays:	
First Dorsal	XIII (XII-XIV)
Second Dorsal	10-11
Total Dorsal Elements	23-24
Anal	III, 10 (11)
Pectoral	14 (15)
Pelvic	I, 5
Caudal	
Dorsal Secondary	8-9(10)
Principal	9+8
Ventral Secondary	7-8(9)
Total	
Gillrakers on First Arch	
Upper	6-7
Lower	8-9
Total	14-16
Branchiostegals	6

LIFE HISTORY

Range: New Jersey, eastern Gulf of Mexico along the Caribbean coast to Brazil; rare north of Florida.

Habitat: Shallow seagrass beds.

ELH Pattern:

Spawning:

 Season: September to May in Biscayne Bay, FL; January to July in Terminos Lagoon, Mexico.

 Area: Inside waters.

 Mode: Oviparous, planktonic eggs & larvae.

 Migration: Unknown.

Fecundity: Unknown

Age at First Maturity: < 1 year.

Longevity: 2 years.

LITERATURE

Chavance et al. 1984, 1986; Houde & Potthoff 1976; Johnson 1984; Robins & Ray 1986; Tucker & Alsuth 1997

Archosargus rhomboidalis (Linnaeus)

EARLY LIFE HISTORY DESCRIPTION

EGGS:

Diameter: 0.80-0.94 mm

No. of Oil Globules: 1

Oil Globule Diameter: 0.21-0.26 mm

Yolk: Homogenous

Shell: Unpigmented and unsculptured

Hatch Size: 2.0-2.2 mm

Incubation: ~ 22 hr at 24°C

Pigmentation: Scattered melanophores on dorsal surface of head and trunk; anterior surface of oil globule.

LARVAE:

Length at Flexion: 4.2 mm

Length at Transformation: ~ 16 mm

Sequence of Fin Development: C₁, P₁ & D₂ & A, D₁, P₂ & C₂

Pigmentation: *Preflexion/Flexion*—postanal series along ventral midline; prominent melanophore anterior to anus; 1-3

melanophores in dorsal musculature posterior to hindbrain; dorsal surface of gut increasing with development; 1-4 melanophores near ventral tip of notochord; mid-lateral stripe from gut area to caudal region at >4.0 mm.

Postflexion—embedded melanophores anterior & posterior to eye forms stripe on head; increased pigmentation on head & trunk region, & myosepta; six indistinct vertical bars at ~ 12.0 mm.

Diagnostic Characters: D₁, XIII (≥ 8.2 mm); pigmentation

Distinguish from *Lagodon rhomboides* & *A. probatocephalus* on development of vertical bars, D₁ counts, & body depth.

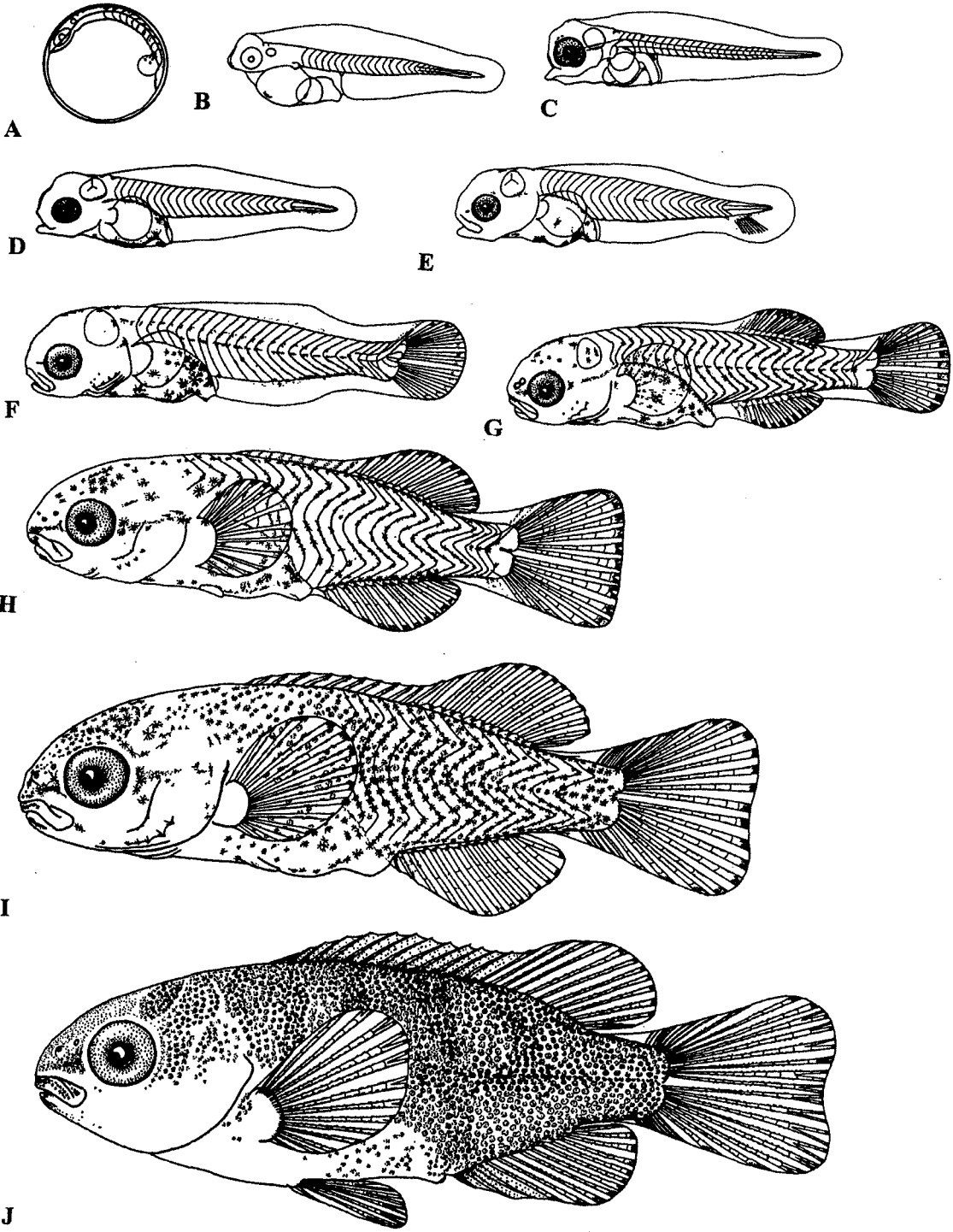
JUVENILES:

Diagnostic Characters: humeral spot below lateral line develops at ~20.0-20.5 mm.

Distinguish from *Lagodon rhomboides* & *A. probatocephalus* by D₁ counts, & lack of short filament on 1st ray of P₂.

ILLUSTRATIONS

Houde and Potthoff (1976) Lab reared A) Egg 0.85 mm diameter; larvae lengths & days post hatch: B) 2.2 mm yolk-sac, 1 day; C) 2.5 mm, 3 days; D) 3.2 mm, 5 days; E) 4.1 mm, 7 days; F) 4.9 mm, 9 days; G) 5.8 mm, 11 days; H) 6.9 mm, 13 days; I) 8.0 mm, 15 days; J) 13.7 mm, 23 days.



MERISTICS

Vertebrae:	
Precaudal	10
Caudal	14
Total	24
Number of Fin Spines and Rays:	
First Dorsal	XI-XII
Second Dorsal	11-12 (10-13)
Total Dorsal Elements	23 (21-25)
Anal	III,10-11 (9-12)
Anal Finlets	
Total Anal Elements	13-14 (12-15)
Pectoral	15-17
Pelvic	I,5
Caudal	
Dorsal Secondary	9(8-9)
Principal	9+8
Ventral Secondary	7-8 (7-9)
Total	32-33
Gillrakers on First Arch	
Upper	
Lower	8-9 (6-9)
Total	
Branchiostegals	6
First Closed Hemal Arch on Vertebrae	
Age at maturity	Most at age 2

LIFE HISTORY

Range: Nova Scotia to Florida & the northern Gulf of Mexico to Brazil, but absent from the Caribbean and Bahamas

Habitat: Juveniles <50 mm in grass beds; adults prefer oyster beds, & other structure.

ELH Pattern:

Spawning:

 Season: February through April in east Florida & Louisiana; spring in North Carolina.

 Area: Offshore waters.

 Mode: Oviparous, planktonic eggs & larvae.

 Migration:

Fecundity:

Age at First Maturity: Most at age 2.

Longevity: Age 20 years

LITERATURE

Beckman et al. 1991; Hildebrand & Cable 1938; Johnson 1978; Mook 1977; Render & Wilson 1992; Robins & Ray 1986; Tucker & Alsuth 1997

EARLY LIFE HISTORY DESCRIPTION**EGGS:**

Diameter: 0.8-0.9 mm

No. of Oil Globules: one

Oil Globule Diameter: 0.2 mm

Yolk: Clear; homogenous & unpigmented

Shell: Transparent & smooth

Hatch Size: 1.6-1.7 mm

Incubation: 28 hours at 23° C

Pigmentation: Sparse pigmentation on snout & behind eye of embryo; several melanophores on oil globule.

Diagnostic Characters:

LARVAE:

Length at Flexion: 4.7-5.4 mm

Length at Transformation: 13.7 mm

Sequence of Fin Development: P₁, C₁, D₂, A, P₂, D₁

Pigmentation: *Preflexion*--variable postanus ventral midline not evenly spaced; ventral surface of gut.

Flexion--postanus ventral midline same as preflexion; ventral gut pigment consists of one anterior to cleithral symphysis, one below pectoral fin base, one anterior to anus; minute midbrain melanophore.

Postflexion--- ventral gut pigment similar to flexion larvae; two melanophores at base of anal fin, three streaks on ventral midline posterior to anal fin.

Diagnostic Characters: Unevenly spaced ventral midline pigment.

Distinguish from *Archosargus rhomboidalis*, *Lagodon rhomboides* and *Stenotomus chrysops* by unevenly spaced ventral midline pigment.

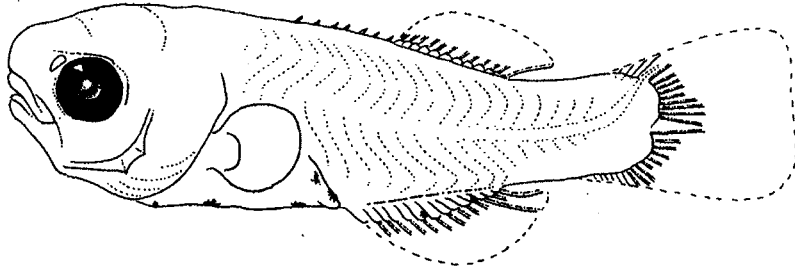
JUVENILES:

Diagnostic Characters: Prejuveniles (ca. 9 mm TL) with five--six distinct lateral bars on body.

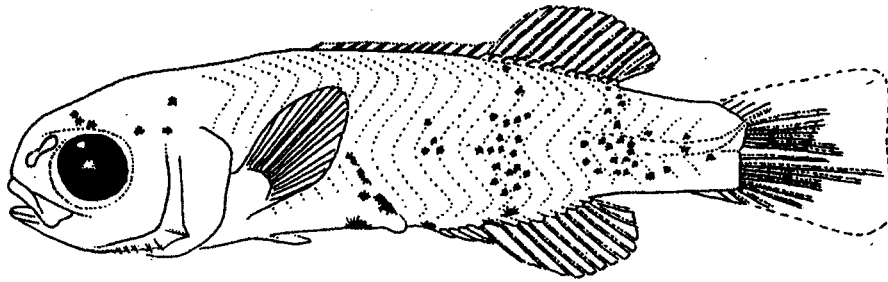
Distinguish from *A. rhomboidalis* and *L. rhomboides* by early attainment of lateral bars.

ILLUSTRATIONS

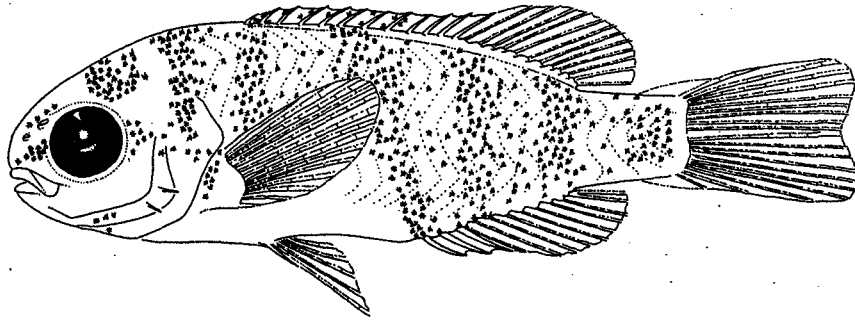
Illustrations from Fahay (1983): A) 6.0 mm TL, B) 7.5 mm TL; C) 12.0 mm TL.



A



B



C

SPARIDAE

MERISTICS

Vertebrae:	
Precaudal	10
Caudal	14
Total	24
Number of Fin Spines and Rays:	
First Dorsal	XII-XIII
Second Dorsal	13-16
Total Dorsal Elements	25-29
Anal	III,13-15
Total Anal Elements	16-18
Pectoral	15-17
Pelvic	I,5
Caudal	
Dorsal Secondary	8-9
Principal	9+8
Ventral Secondary	8
Total	33-34
Gillrakers on First Arch	
Upper	
Lower	14
Total	17-21
Branchiostegals	6

LIFE HISTORY

Range: Rare from Chesapeake Bay to North Carolina; common from North Carolina through Florida Keys to Dry Tortugas into Gulf of Mexico to Port Aransas, Texas (northwest Gulf of Mexico).

Habitat: Juveniles (Florida)-- <90 mm, shallow, inshore flats in spring and summer; deeper water in fall and winter. >91 mm, primarily offshore near reefs.

ELH Pattern: Oviparous, planktonic eggs and larvae.

Spawning:

Season: Late December, January, or February in Florida.

Area: Offshore.

Age at First Maturity: 1+

LITERATURE

Johnson 1978; Randall & Vergara 1978

Diplodus holbrooki (Bean)

EARLY LIFE HISTORY DESCRIPTION

EGGS: Unknown

LARVAE:

Pigmentation: *Postflexion*—melanophores on ventral & lateral surface of gut increase with development; numerous mid- & hindbrain pigment; melanophore anterior to cleithral symphysis; variable (~4-7) dashes on base of anal fin; ~2-4 post anal fin, ventral midline melanophores; bilateral melanophores on tissue adjacent to cleithrum (gill cover & gills need to be lifted to see melanophore); at ~12.0 mm vertical bar develops over gut.

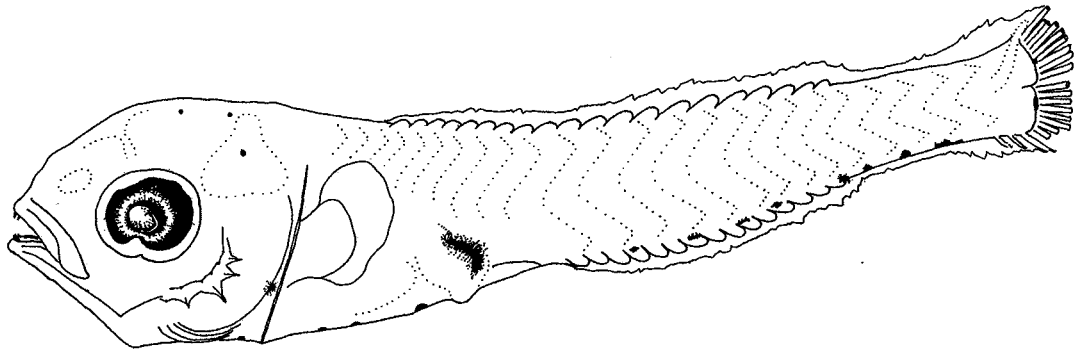
Diagnostic Characters: Anal & dorsal soft fin ray counts; melanophore adjacent to cleithrum.

JUVENILES:

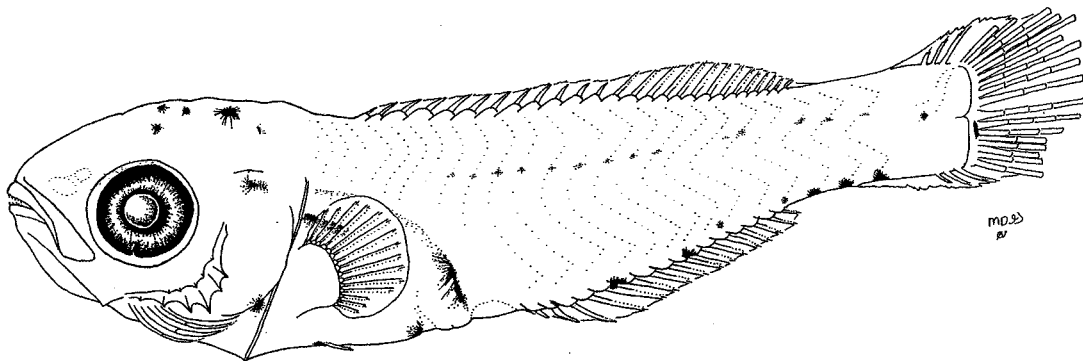
Diagnostic Characters: Anal & dorsal soft fin ray counts; five vertical stripes on back and sides.

ILLUSTRATIONS

A) 7.6 mm SL; B) 9.3 mm SL. Both original, Onslow Bay, NC [M. D. Greene].



A



B

SPARIDAE

MERISTICS

Vertebrae:	
Precaudal	10
Caudal	14
Total	24
Number of Fin Spines and Rays:	
First Dorsal	XII (IX- XIII)
Second Dorsal	11 (rarely 10 or 12)
Total Dorsal Elements	23 (21-24)
Anal	III, 11 (rarely 10 or 12)
Total Anal Elements	14 (13-15)
Pectoral	16 (14-17)
Pelvic	I, 5
Caudal:	
Dorsal Secondary	10-11
Principal	9+8
Ventral Secondary	7-10
Gillrakers on First Arch	
Upper	7 (6-9)
Lower	13 (10-15)
Total	19-20 commonly
Branchiostegals	6

LIFE HISTORY

Range: Cape Cod (rare) to Florida; throughout Gulf of Mexico; northern coast of Cuba; Bermuda.

Habitat: *Larvae*--pelagic, offshore; *juveniles*--abundant on shallow flats, moving to deeper water during ontogeny; *adults*--open water, associated with vegetation or structure.

ELH Pattern: oviparous, pelagic eggs & larvae.

Spawning:

 Season: Late fall and winter.

 Area: Offshore waters.

 Mode: Oviparous, planktonic eggs and larvae.

 Migration: Unknown

Fecundity: Unknown

Age at First Maturity: Most at age 1.

Longevity: Unknown

LITERATURE

Caldwell 1957; Johnson 1978, 1984;
Randall & Vergara 1978; Zieske 1989

Lagodon rhomboides (Linnaeus)

EARLY LIFE HISTORY DESCRIPTION

EGGS:

Diameter: 0.99-1.05

No. of Oil Globules: 1

Incubation: 48 hrs at ~18° C

LARVAE:

Length at Flexion: 5.0

Length at Transformation: 12.0

Sequence of Fin Development: P₁ & C₁, D₂ & A,
D₁, C₂, P₂

Pigmentation: *Preflexion*—melanophores on midbrain, one on nape; fairly evenly spaced ventral midline pigment; pigment at dorsal base of visceral mass & posterior surface of anus; ventral gut pigment consists of one anterior to cleithral symphysis (sometimes missing), one below pectoral fin base, one anterior to anus. *Flexion*—similar to *preflexion* but additionally at base of developing caudal rays; nape pigment becomes embedded; postdorsal fin midline pigment, & internal pigment over the notochord might be present.

Postflexion—head pigment becomes denser at 8.9 mm; slight dorso- and ventro-lateral pigment at 9.6 mm; vertical bars begin to form at 11.0-11.9 mm.

Diagnostic Characters: Series of ventral melanophores.

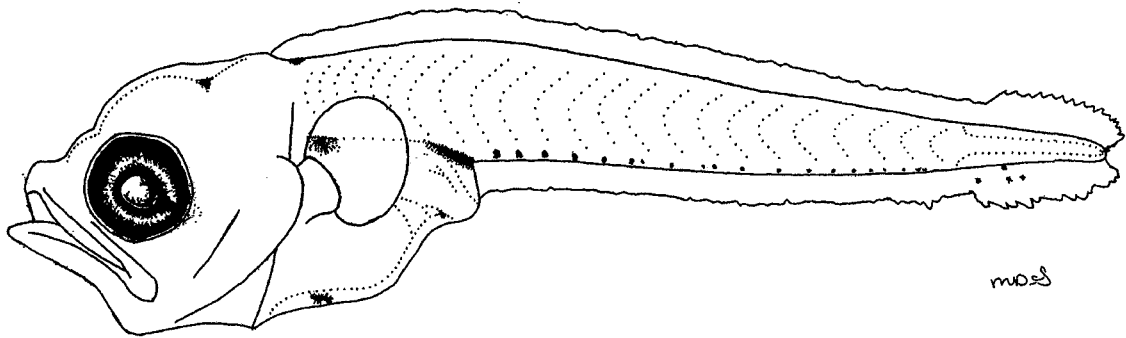
JUVENILES:

Diagnostic Characters: Dorsal secondary ray counts (~ >12.2 mm); seven vertical bars complete by 13.6 mm; 1-3 melanophores under outer edge of preoperculum; internal melanophores over notochord; one melanophore below otic capsule.

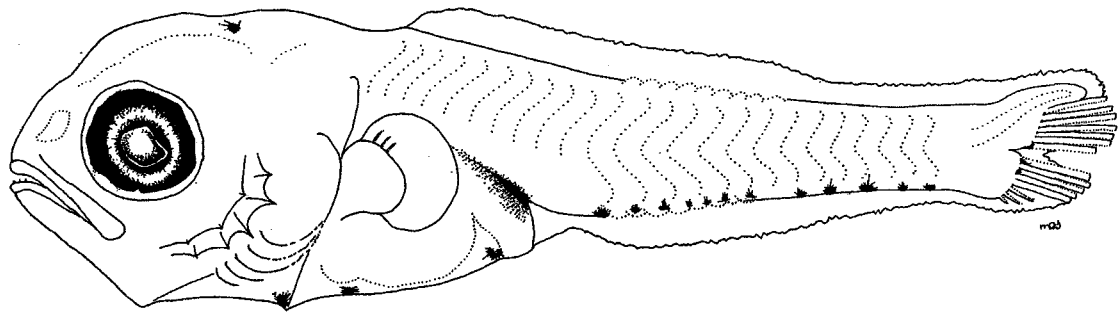
Note: See text for explanation of possible confusion with another sparid species.

ILLUSTRATIONS

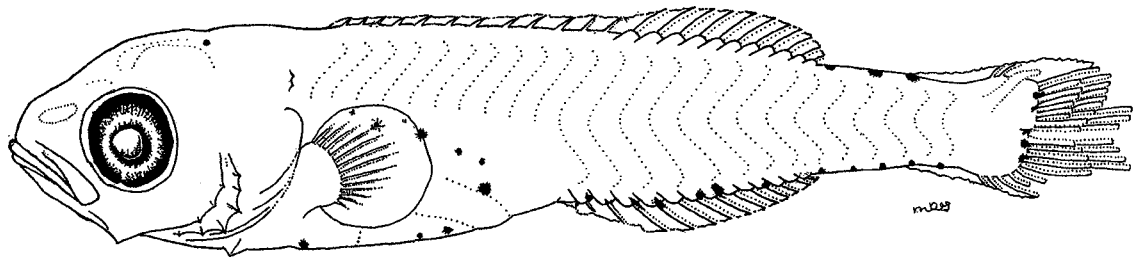
A-D, original [M. D. Greene]: A) 2.8 mm NL, OREGON II cruise 93-08, leg 5, station 4; B) 5.65 mm SL, Chapman cruise 93-02, station 36; C) 8.1 mm SL, Chapman cruise 93-02 station 51.



A



B



C

SPARIDAE

MERISTICS

Vertebrae:	
Precaudal	10
Caudal	14
Total	24
Number of Fin Spines and Rays:	
First Dorsal	XII-XIII
Second Dorsal	9-11
Anal	III,7-9
Total Anal Elements	10-12
Pectoral	15-16
Pelvic	I,5
Caudal	
Dorsal Secondary	
Principal	9+8
Ventral Secondary	
Total	
Gillrakers on First Arch	
Upper	6
Lower	10
Total	16 (13-17)
Branchiostegals	6

LIFE HISTORY

Range: New York to Florida; throughout the Gulf of Mexico, southern Caribbean coast to Argentina.

Habitat: hard bottom reefs.

ELH Pattern: oviparous, pelagic eggs & larvae.

Spawning:

 Season: January to April (Gulf of Mexico and North Carolina.

 Area: Offshore.

 Mode: Oviparous eggs & larvae.

 Migration:

Fecundity: unknown.

Age at First Maturity: Age 3 (most); age 4 (all).

Longevity: 17 years.

LITERATURE

Hood & Johnson 2000; Manooch 1976;
Manooch & Huntsman 1977; Manooch et al.
1976; Randall & Vergara 1978; Robins & Ray
1986

Pagrus pagrus (Linnaeus)

EARLY LIFE HISTORY DESCRIPTION

EGGS:

Diameter: 0.64-0.92 mm

No. of Oil Globules:

Oil Globule Diameter: 0.25

LARVAE:

Length at Flexion: 4.1

Length at Transformation:

Sequence of Fin Development: P₁ & C₁, D₂ & A,
D₁, C₂, P₂.

Pigmentation: *Preflexion*—upper & lower jaw pigment generally present; three to four distinct ventral midline melanophores; ventral gut pigment consists of one anterior to cleithral symphysis, one at pelvic fin insert, one anterior to anus; dorso-posterior gut pigment; *flexion*—similar to *preflexion* except two to four ventral midline melanophores; *postflexion*—similar to *flexion*, except two to three ventral midline melanophores.

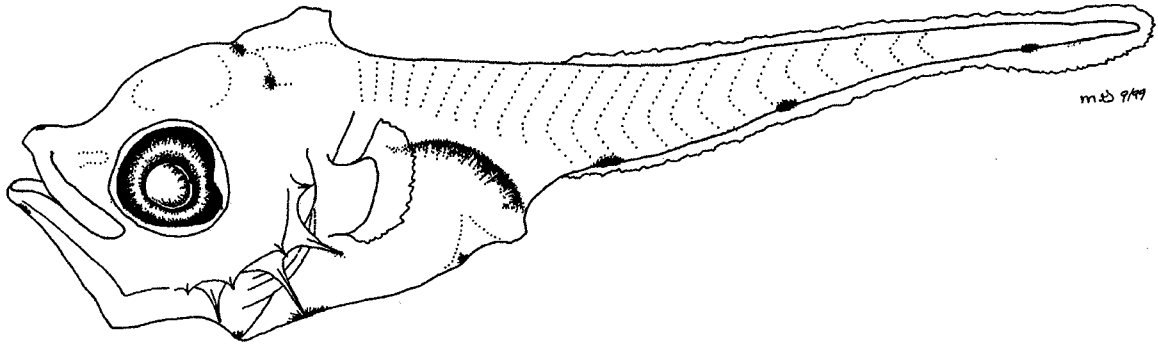
Diagnostic Characters: ventral midline pigment; heavy spination that includes (depending on larval stage of cleared & stained specimens) supraoccipital & supraocular crests; anterior & posterior preopercular, & interopercular spines; supracleithral, pterotic, tabular & posttemporal spines.

JUVENILES:

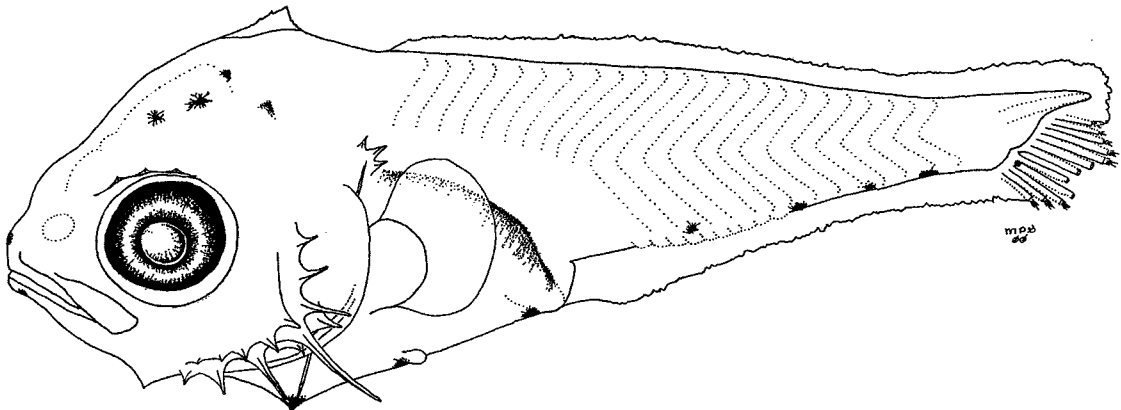
Diagnostic Characters: Minute spines along the dorsal & ventral midlines; 5-6 vertical pigment bands

ILLUSTRATIONS

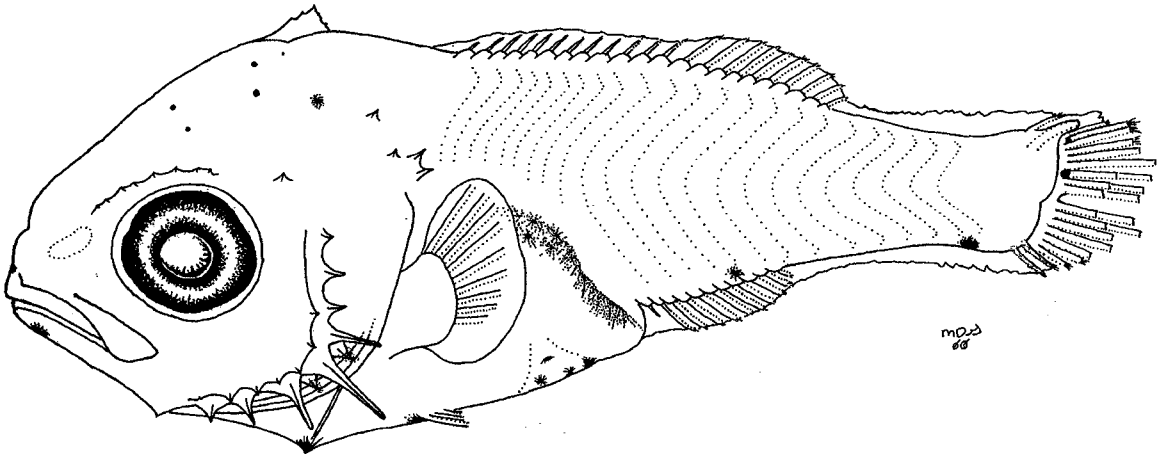
A) 3.64 mm NL, OREGON II cruise 93-08, Leg 2, station 16; B) 5.91 mm SL, OREGON II cruise 192, station 52600; C) 6.14 mm SL, OREGON II cruise 192, station 52600. All original by M. D. Greene.



A



B



C

SPARIDAE

Stenotomus chrysops (Linnaeus 1766)

MERISTICS

Vertebrae:	
Precaudal	10
Caudal	14
Total	24
Number of Fin Spines and Rays:	
First Dorsal	XII
Second Dorsal	12
Total Dorsal Elements	24
Anal	III, 11-12
Total Anal Elements	14-15
Pectoral	16
Pelvic	I, 5
Caudal	
Dorsal Secondary	7-8
Principal	9+8
Ventral Secondary	8-9
Total	
Gillrakers on First Arch	
Upper	
Lower	
Total	16
Branchiostegals	6

LIFE HISTORY

Range: Nova Scotia to South Carolina; uncommon north of Cape cod; rare south of North Carolina.

Habitat: Bays in summer; offshore in winter.

ELH Pattern: oviparous eggs & larvae.

Spawning:

 Season: May-August.

 Area: Sounds and coastal waters.

 Mode: Oviparous, planktonic eggs and larvae.

 Migration: Unknown.

Fecundity: Unknown.

Age at First Maturity: Age 2.

Longevity: 10 years.

LITERATURE

Able & Fahay 1998; Fahay 1983; Finkelstein 1969; Johnson 1978; Griswold & McKenney 1984

EARLY LIFE HISTORY DESCRIPTION

EGGS:

Diameter: 0.8-1.0 mm

No. of Oil Globules: one

Oil Globule Diameter: 0.17-0.21

Yolk: Unsegmented

Shell: Unsculptured

Hatch Size: 2.0 mm

Incubation: 70-75 h at 18° C, 44-54 h at 21° C

Pigmentation:

Diagnostic Characters:

LARVAE:

Length at Flexion: 4.8 mm

Length at Transformation:

Sequence of Fin Development: P₁, C₁, C₂, A & D₂, D₁, P₂.

Pigmentation: *Preflexion*— at 2.0-2.5 mm two dorsal rows of melanophores from head to myomere 20; at > 2.5 mm postanus series along ventral midline; pigment at dorsal surface of gut; prominent melanophore on hindgut anterior to anus; anterior and posterior ventral gut pigment. *Flexion/Postflexion*— several melanophores on midbrain & hindbrain; at 5.0 mm gradual increase in pigment on dorsal and dorsolateral head; few melanophores on snout & below eye; melanophore at lower jaw angle; melanophore anterior to cleithral symphysis; hindgut & ventral gut pigment similar to *preflexion* larvae; several melanophores on posterior dorsal pterygiophores; melanophores on most anal fin pterygiophores; at 9-10 mm numerous lateral body melanophores; with development, vertical bars of juveniles develop.

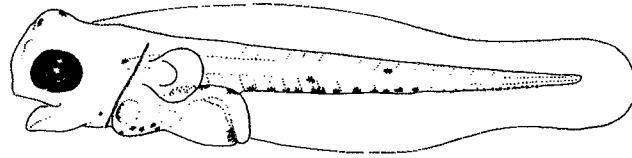
Diagnostic Characters: Lower jaw angle pigment; dorsal fin pterygiophore pigment.

JUVENILES:

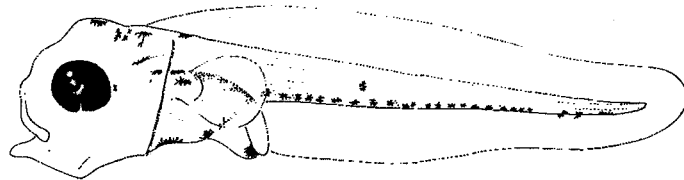
Diagnostic Characters: Vague vertical bars.

ILLUSTRATIONS

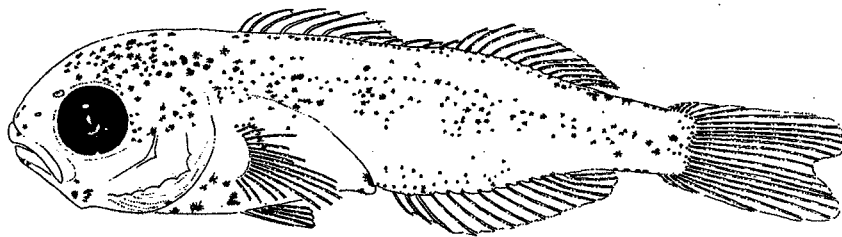
A-C from Fahay (1983); D from Able and Fahay (1998). A) 2.8 mm NL, B) 3.8 mm NL, C) 13.3 mm SL, D) 26.0 mm SL. Note: Descriptions of larvae & juveniles from Fahay (1983) based on laboratory-reared material Griswold and McKenney (1984) that generally has more intense pigment than wild-caught specimens as shown on page 16.



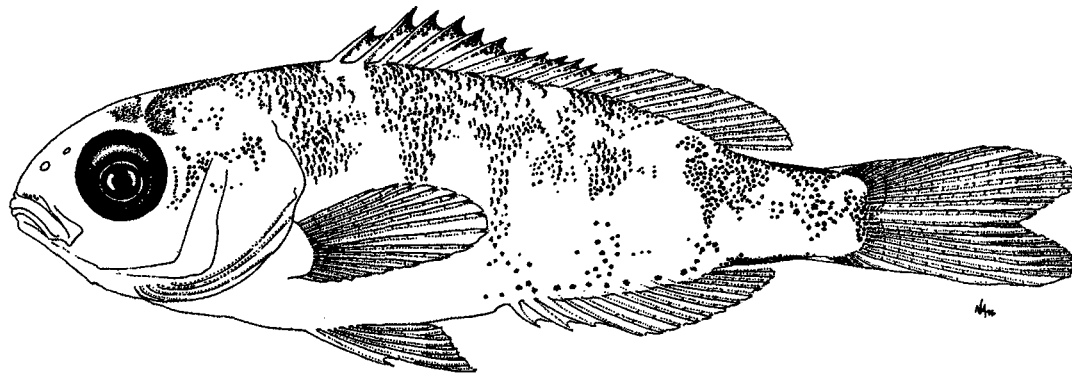
A



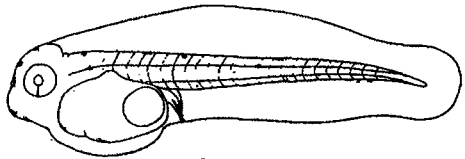
B



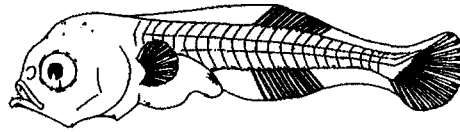
C



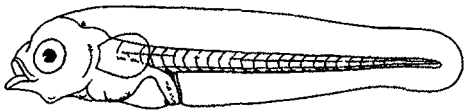
D



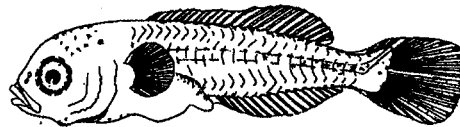
A DAY 1 2.0



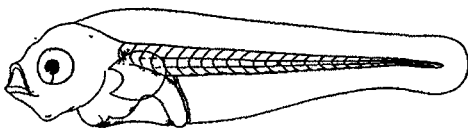
F DAY 13 5.7



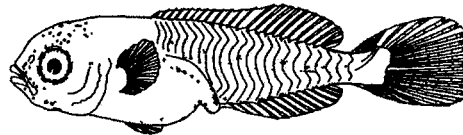
B DAY 4 2.8



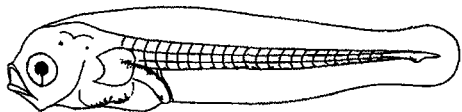
G DAY 15 7.3



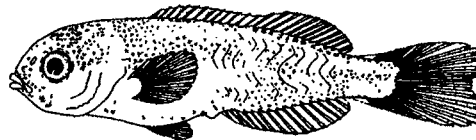
C DAY 5 3.0



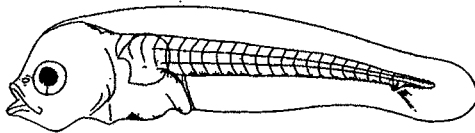
H DAY 17 9.4



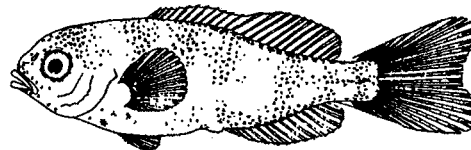
D DAY 6 3.4



I DAY 21 14.9



E DAY 9 4.2



J DAY 24 18.7

Literature Cited

- Able, K. W. & M. P. Fahay. 1998. The first year in the life of estuarine fishes in the Middle Atlantic Bight. Rutgers University Press, New Brunswick, New Jersey. 342 p.
- Beckman, D. W., A. L. Stanley, J. H. Render & C. A. Wilson. 1991. Age and growth-rate estimation of sheepshead *Archosargus probatocephalus* in Louisiana waters using otoliths. Fish. Bull. U. S. 89: 1-8.
- Caldwell, D. K. 1957. The biology and systematics of the pinfish, *Lagodon rhomboides* (Linnaeus). Bull. Fla. State Mus. 2: 78-173.
- 1965a. A new sparid fish of the genus *Diplodus* from Bermuda. Fieldiana:Zool. 44: 217-225.
- 1965b. Systematics and variation in the sparid fish *Archosargus probatocephalus*. Bull. Southern Calif. Acad. Sci. 64: 89-100.
- Chavance, P., C. Flores-Coto & A. Sanchez-Iturbe. 1984. Early life history and adult biomass of sea bream in the Terminos Lagoon, southern Gulf of Mexico. Trans. Amer. Fish. Soc. 113: 166-177.
- , A. Yanez-Arancibia & D. Flores-Hernandez. 1986. Ecology, biology and population dynamics of *Archosargus rhomboidalis* (Pisces: Sparidae) in a tropical coastal lagoon system, southern Gulf of Mexico. An. Inst. Cienc. Mar Limnol., U. N. A. Mex. 13: 11-30.
- Fahay, M. P. 1983. Guide to the early stages of marine fishes occurring in the north Atlantic Ocean, Cape Hatteras to the southern Scotian Shelf. J. Northwest Atl. Fish..Sci. 4: 1-423.
- Finkelstein, S. L. 1969. Age and growth of scup in the waters of eastern Long Island. N. Y. Fish Game J. 16: 84-110.
- Geoghegan, P. & M. E. Chittenden, Jr. 1982. Reproduction, movements, and population dynamics of the longspine porgy, *Stenotomus caprinus*. Fish. Bull. U. S. 80: 523-540.
- Griswold, C. A. & T. W. McKenney. 1984. Larval development of the scup, *Stenotomus chrysops* (Pisces:Sparidae). Fish. Bull. U. S. 82: 77-84.
- Hildebrand, S. F. & L. E. Cable. 1938. Further notes on the development and life history of some teleosts at Beaufort, N. C. Bull. of Bur. Fish. 48: 505-642.
- Hood, P. B. & A. K. Johnson. 2000. Age, growth, mortality, and reproduction of red porgy, *Pagrus pagrus*, from the eastern Gulf of Mexico. Fish. Bull. U. S. 98: 723-735.
- Houde, E. D. & T. Potthoff. 1976. Egg and larval development of the sea bream *Archosargus rhomboidalis* (Linnaeus): Pisces, Sparidae. Bull. Mar. Sci. 26: 506-529.
- Johnson, G. D. 1978. Sparidae. Pages 263-280 in Development of fishes of the Mid-Atlantic Bight. An Atlas of egg, larval and juvenile stages. Vol. IV. Carangidae through

- Ephippidae. U. S. Fish Wildl. Serv. Biol. Serv. Progr. FWS/OBS-78/12. 314 p.
- 1984. Percoidei: development and relationships. Pages 464-498 in H. G. Moser et al. (eds.), Ontogeny and systematics of fishes. Amer. Soc. Ichthyol. Herpetol. Spec. Publ. (1): 760 p.
- Jordan, D. S. & B. W. Evermann. 1896. The fishes of North and Middle America. U. S. Natl. Mus. Bull. 47.
- Manooch, C. S., III. 1976. Reproductive cycle, fecundity, and sex ratios of the red porgy, *Pagrus pagrus* (Pisces: Sparidae) in North America. Fish. Bull. U. S. 74: 775-781.
- & G. R. Huntsman. 1977. Age, growth, and mortality of the red porgy, *Pagrus pagrus*. Trans. Amer. Fish. Soc. 106: 26-33.
- , G. R. Huntsman B. Sullivan & J. Elliott. Conspecific status of the sparid fishes *Pagrus sedicim* Ginsburg and *Pagrus pagrus* Linnaeus. Copeia 1976: 678-683.
- Mook, D. 1977. Larval and osteological development of the sheeshead, *Archosargus probatocephalus* (Pisces:Sparidae). Copeia 1977: 126-133.
- Randall, J. E. & D. K. Caldwell. 1966. A review of the sparid fish genus *Calamus* with descriptions of four new species. Bull. Los Ang. Cty. Mus. Nat. Hist. Sci. (2): 47 p.
- & R. Vergara. 1978. Sparidae. Volume 5 in W. Fischer (ed), FAO Species Identification Sheets for Fishery Purposes. Western Central Atlantic (fishing area 31). Volumes 1-7: unpaginated.
- Render, J. H. & C. A. Wilson. 1992. Reproductive biology of sheepshead in the northern Gulf of Mexico. Trans. Amer. Fish. Soc. 121: 757-746.
- Robins, C. R. & G. C. Ray, 1986. A field guide to Atlantic coast fishes of North America. Houghton Mifflin Co., Boston. 354 p.
- Tucker, J. W. & S. R. Alshuth. 1997. Development of laboratory-reared sheepshead, *Archosargus probatocephalus* (Pisces:Sparidae). Fish. Bull. U. S. 95: 394-401.
- Watson, W. & E. M. Sandknop. 1996i. Sparidae: porgies. Pages 1013-1015 in H. G. Moser (ed.), The early stages of fishes in the California Current region. Calif. Coop. Oceanic Fish. Invest., Atlas (33): 1505 p.
- Wenner, C. A., C. A. Barans, B. W. Stender, & F. H. Berry. 1979. Results of MARMAP otter trawl investigations in the South Atlantic Bight. III. Summer 1974. Mar. Res. Res. Inst., South Carolina Wildl. Mar. Res. Dept., Charleston, SC. Tech. Rep. (41): 62 p.
- Zieske, G. G. 1989. Redescription of larvae of the pinfish, *Lagodon rhomboides* (Linnaeus) (Pisces, Sparidae). Contrib. Mar. Sci. 31: 51-59.