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# MEMOIRS OF THE HOURGLASS CRUISES

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## SCIAENID FISHES (OSTEICHTHYES: PERCIFORMES) OF WESTERN PENINSULAR FLORIDA

By

JOHN E. DAROVEC, JR.[1]

## ABSTRACT

Keys and diagnoses are given for the genera and fourteen species of Sciaenidae from western peninsular Florida. Summaries of published information on their distribution, life history, feeding, and salinity and temperature tolerances are presented.

*Menticirrhus focaliger* Ginsburg and *Cynoscion arenarius* Ginsburg are considered synonyms under *M. saxatilis* (Bloch and Schneider) and *C. regalis* (Bloch and Schneider) respectively. *Pareques* Gill is treated at the generic level.

Length frequency and gonad analyses indicated *Equetus lanceolatus* (Linnaeus) spawns in late spring and summer. The smallest ripe females were 132 mm in standard length. Similar analyses for *Pareques umbrosus* (Jordan and Eigenmann) proved inconclusive. Gut contents showed that these reef species feed mainly on crustaceans.

Tribe level systematics, zoogeography, general life history, and position in the food web are discussed for the species captured and related species. These discussions present new hypotheses about intergeneric relationships, a demonstration of very different inshore and offshore sciaenid

[1] Florida Department of Natural Resources Marine Research Laboratory, 100 Eighth Avenue S.E., St. Petersburg, Florida 33701-5095.

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faunas in the study area, and descriptions of several examples of allometric growth exhibited by sciaenids of the west Florida shelf.

An appendix provides information on Florida sciaenids not found in the area covered.

## INTRODUCTION

Most sciaenids are shore fishes readily taken by commercial and sport fishing gear, and the few reef species are highly prized by aquarium enthusiasts. Many have been subjected to scientific study, and several have been helped in parts of their ranges by fishery management legislation.

Thirteen described and one new species, representing ten genera, occur off western peninsular Florida. This paper provides keys to identify those species and summarizes their life histories, ecology and systematics.

Since this paper is published by a government organization charged with managing natural resources, the goal of its species accounts is to briefly summarize what is known in a way that should be useful to resource managers as well as biologists. For the *Life history* section on each fish, for example, information on spawning, larval development, growth, movements, and maturity was reviewed. Hopefully, the accounts accurately present what is known of the variation in those categories of information. A similar concern with variation governed the presentations in other subsections for each species. All literature used is listed in the synonymies, and each listing is annotated to describe its major contributions.

## ACKNOWLEDGMENTS

I am grateful to my predecessors at the Florida Department of Natural Resources Marine Research Laboratory who collected and preserved the specimens used in this study.

Several of my colleagues contributed directly to this paper. Dr. Gregory B. Smith and Roy O. Williams provided information on reef species and on red drum and seatrout respectively. Gerard E. Bruger and David K. Camp advised on the processing of numbers, while Cynthia Huff, Judy Leiby, Helen Leavines and Alonzo Felder helped process the words. Manuscript revision benefited from comments by Kevin M. Peters, Gerard Bruger and Roy Williams, and from reviews by Drs. Howard W. Powles, George C. Miller, Labbish N. Chao, and Karen A. Steidinger.

I am pleased that this paper presents thirteen fish drawings by James H. Seagle.

## METHODS AND MATERIALS

Project Hourglass was a 28-month (August 1965 - November 1967) program during which the shelf fauna and flora of central west Florida were sampled (Figure 1, Table 1). Hydrographic data and descriptions of gear, stations, and collecting methods are given in Volume I, Part I of this series (Joyce and Williams, 1969). Most fishes were taken with a flat or a balloon trynet; some were taken with an otter trawl, dredge or poison. Eight species of Sciaenidae, mainly the reef fishes *Equetus lanceolatus* and *Pareques umbrosus*, were collected during the Hourglass program.

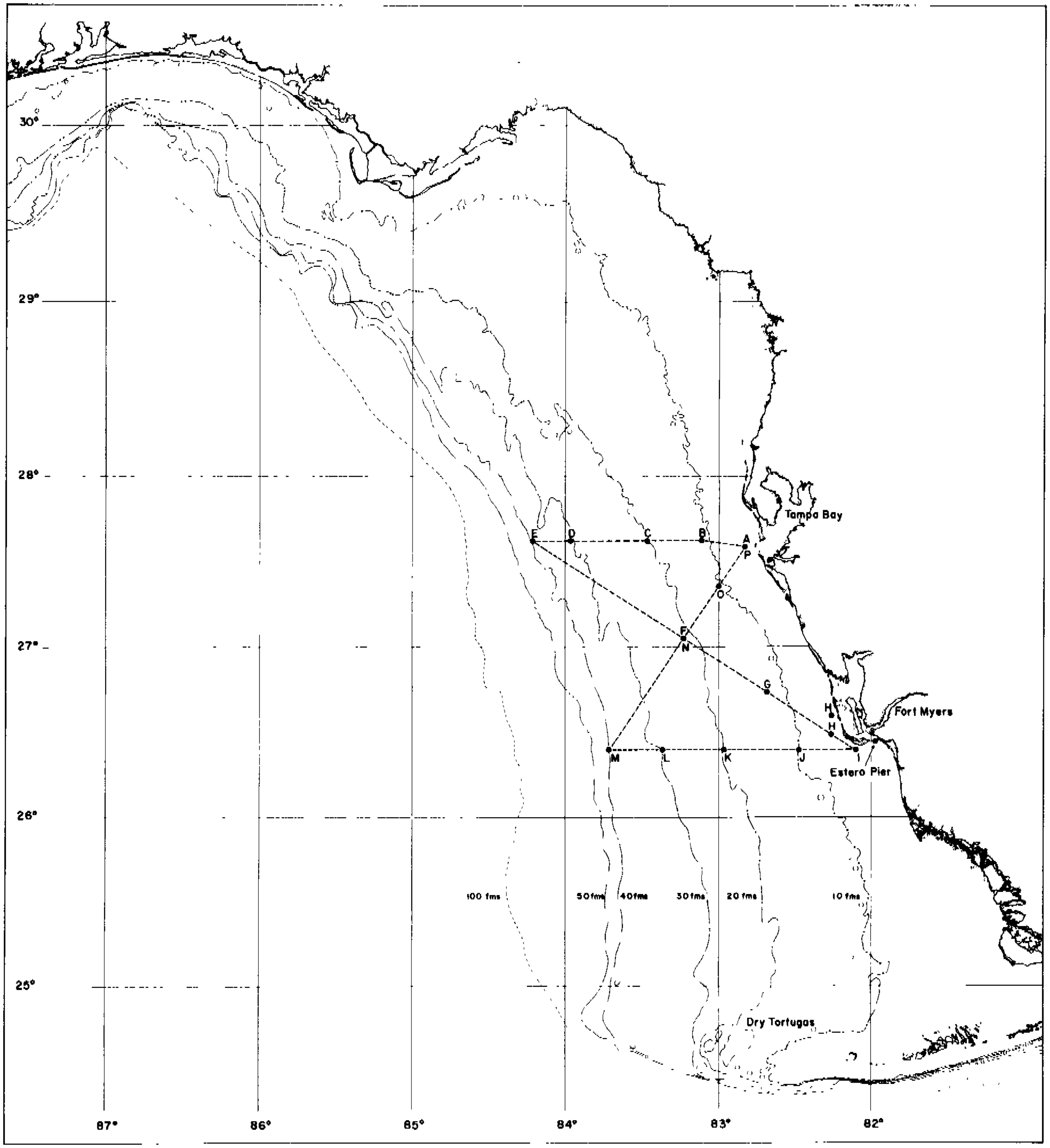



Figure 1. Hourglass cruise pattern and station locations. Isobaths are shown and labeled in fathoms.

TABLE 1: LOCATION AND DEPTH OF HOURGLASS STATIONS PRODUCING SCIAENIDAE.

| Station | Latitude* | Longitude* | Established Depth (meters) | Approximate Nautical Miles Offshore* |
|---|---|---|---|---|
| A | 27°35′N | 82°50′W | 6.1 | 4, due W of Egmont Key |
| B | 27°37′N | 83°07′W | 18.3 | 19, due W of Egmont Key |
| C | 27°37′N | 83°28′W | 36.6 | 38, due W of Egmont Key |
| D | 27°37′N | 83°58′W | 54.9 | 65, due W of Egmont Key |
| E | 27°37′N | 84°13′W | 73.2 | 78, due W of Egmont Key |
| I | 26°24′N | 82°06′W | 6.1 | 4, due W of Sanibel Island Light |
| J | 26°24′N | 82°28′W | 18.3 | 24, due W of Sanibel Island Light |
| K | 26°24′N | 82°58′W | 36.6 | 51, due W of Sanibel Island Light |
| L | 26°24′N | 83°22′W | 54.9 | 73, due W of Sanibel Island Light |
| M | 26°24′N | 83°43′W | 73.2 | 92, due W of Sanibel Island Light |

*U. S. Coast and Geodetic Chart No. 1003, dated June 1966.

Additional specimens from other Florida Department of Natural Resources Marine Research Laboratory collections supplemented Hourglass material thereby allowing coverage of western peninsular Florida (Dixie through Collier counties inclusive, Figure 2).

With the exception of two undescribed *Pareques* specimens, all material was taken within the 75 m depth contour.

More than 1,950 specimens were examined for the 14 species accounts presented. The key on page 8 shows how the accounts are arranged. In each entry of a *Material examined* section, numbers immediately following the first comma indicate standard length in mm. Numbers immediately following a location indicate water depth.

Each fish drawing is a composite of several specimens.

Synonymies are limited to the original description and literature used. Chao (1978) examined and synonymized many type specimens. His work provides the most recent clarifications of nomenclature.

Genera which are monotypic in the study area are treated at the species level.

Diagnoses were derived solely from material examined except for coloration which was described from live specimens, literature, and *in situ* observations by me and my colleagues. Counting, measuring, and the recording of meristic and morphometric data followed Hubbs and Lagler (1958). Location of the notch which separates the anterior and posterior sections of the dorsal fin is indicated by a "+."

For osteological examination, small specimens were cleared and stained (Taylor, 1967); large specimens were X-rayed.

Cluster analysis was used to show similarity of Hourglass stations using abundances of species as attributes and to show species associations using their abundances at Hourglass stations as attributes. Dendrograms showing these similarities were obtained using the ORDANA computer program made available by Bloom et al. (1977). To consider equal effort at all stations for all

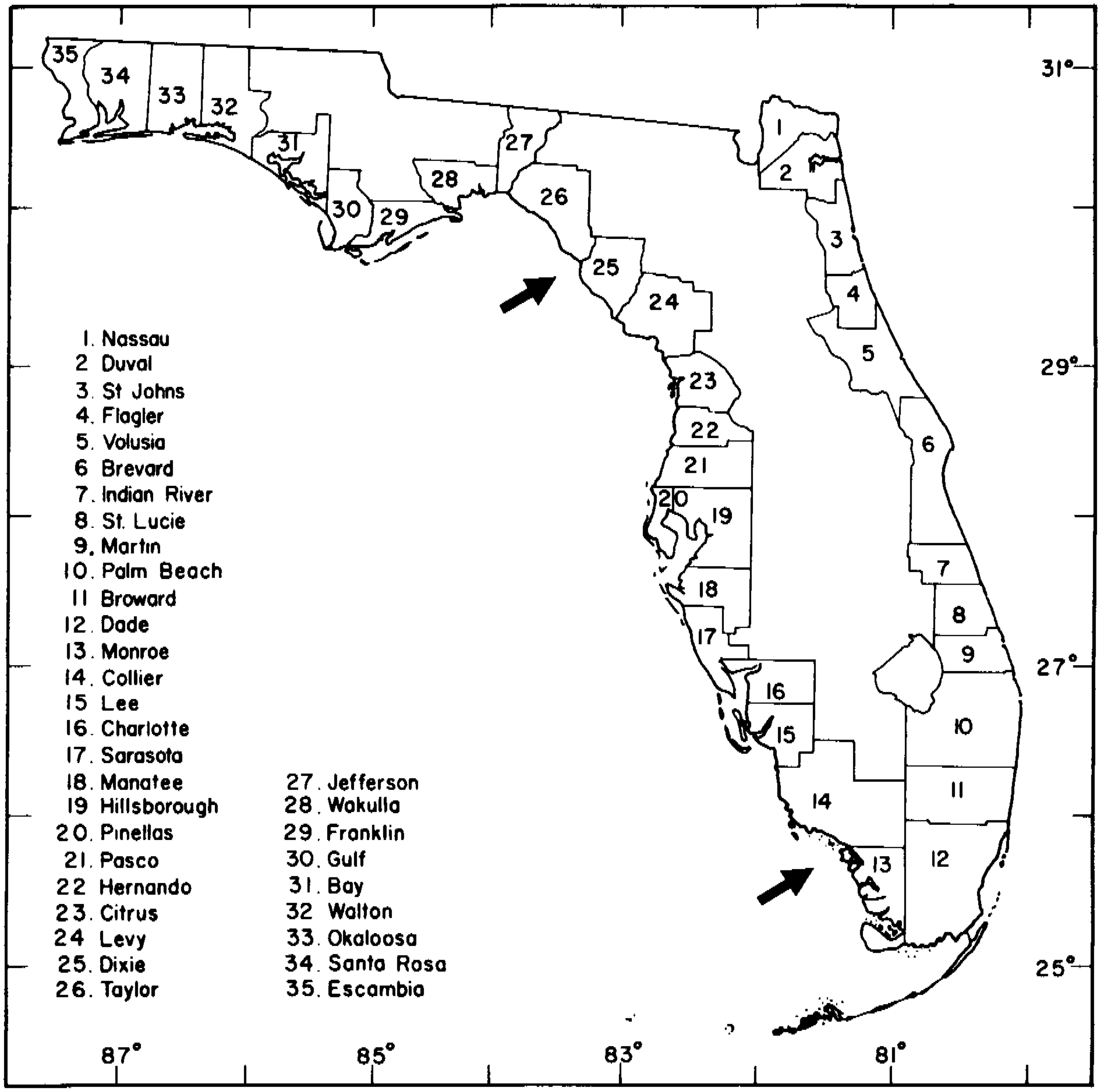



Figure 2. Florida's coastal counties. Arrows indicate limits of western penisular Florida as defined for this paper.

months, only data from the regular night cruises were used. Interentity similarity was calculated using the Czekanowski index. Data were quantitative but transformed, x set to $\ln(x+1)$, to minimize dominance by large collections, and the entities were clustered using a group average sorting strategy.

The following abbreviations are used in the text and figures:

A. — Anal fin meristics

BD — Body depth

Co. — County

D. — Dorsal fin meristics

descr. — Description

distrib. — Distribution

FSBC — Florida State Board of Conservation (now Florida Department of Natural Resources)

SL — Standard length or notochord length in pre-flexion larvae

syn. — Synonymy

TL — Total length

## SYSTEMATICS

### *FAMILY CHARACTERISTICS*

Drums, croakers, kingfishes, seatrouts, and spot constitute the family Sciaenidae. A combination of two external characters, a continuous lateral line extending to the caudal margin and an anal fin with no more than two spines, distinguish the sciaenids from all other percoid fishes.

Greenwood (1976) found that a continuous lateral line extending to or nearly to the caudal margin is characteristic of the Centropomidae as well as the Sciaenidae. An anteroposteriorly expanded neural spine on the second vertebra, the other character Greenwood used to diagnose centropomids, however, is not found in sciaenids.

Percoid families with less than three anal spines include: Grammistidae, Apogonidae, Percidae, Rachycentridae, Echeneidae, Coryphaenidae, Sciaenidae, Mullidae, Pomacentridae, Sphyraenidae, and some species of Gerreidae. Also, one western Atlantic carangid, *Elagatis bipinnulata* (Quoy and Gaimard, 1824) has only two spines (Miller and Jorgenson, 1973). Many relationships within this undoubtedly polyphyletic assemblage remain to be discovered.

Many sciaenids communicate by sound, and structures needed for this are highly developed. Bones of the skull are cavernous, accomodating well-developed laterosensory canals, and otoliths are very large. Sound is produced when special sonific muscles constrict the gas bladder, in some cases forcing gases into lateral diverticula (Chu et al., 1963). Swim bladder structure has considerable systematic significance within the family (see DISCUSSION) and is extremely complex in several genera (Chu et al., 1963; Trewavas, 1977; Chao, 1978).

Trewavas (1977) suggested the Pomadasyidae and Lutjanidae are the families most closely related to sciaenids. She found that all three families have similarly specialized sagittae. Moreover, she noted large, sciaenid-like lateral line pores on the chin and snout of pomadasyids. She also found similarities on the post-temporals of pomadasyids and sciaenids.

Teeth are limited to the premaxillae, dentaries, and pharyngeal arches. The chin usually has well-developed laterosensory pores and may have barbels. The dorsal fin is continuous but a deep notch divides it into an anterior spinous section and a posterior soft-rayed section which may be led by one or two spines. The caudal fin has a low aspect ratio (Nursall, 1958).

Surveys of individual character complexes have placed the Sciaenidae in what Greenwood

(1976: 4) called ". . . that taxonomic rag-bag, the 'lower percoid fishes' . . ." Freihofer (1963) argued that the pattern of the recurrent facial nerve found in sciaenids is primitive for percomorphs since the nerve exits through the parietal as it does in pre-percoid fishes. McAllister (1968) excluded the Sciaenidae from his group of percoids containing the most primitive families, but their branchiostegal count of seven (occasionally eight) would place them there. Unlike the Serranidae, Centrarchidae, Bathyclupeidae, and Branchiostegidae of that primitive group, however, sciaenids do not retain the Beryciform foramen in the ceratohyal. Gosline (1961) found the most generalized

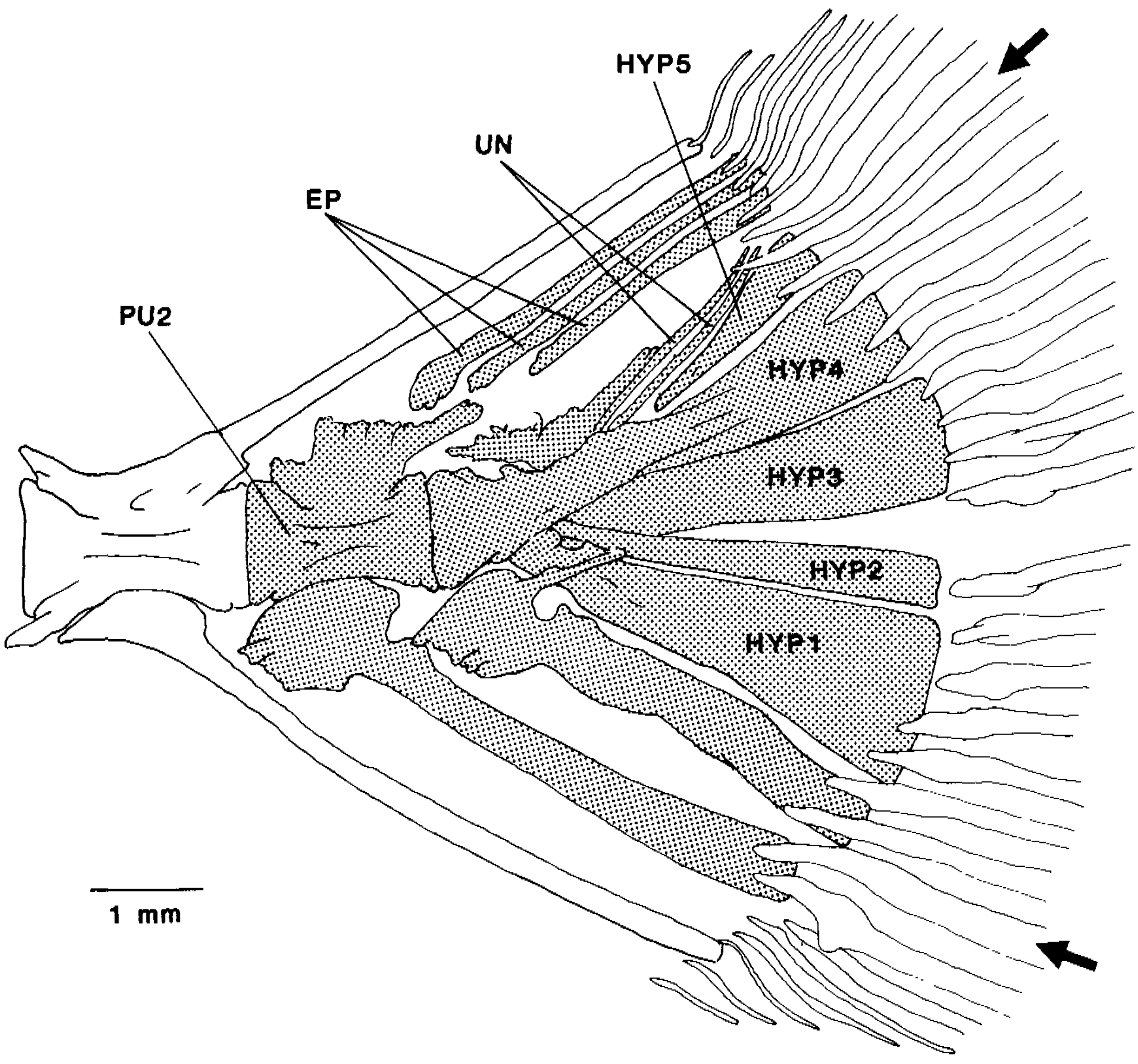



Figure 3. Sciaenid caudal skeleton, *Leiostomus xanthurus* Lacépède 1802, FSBC 8336, Long Bayou, Pinellas Co., Florida. Arrows indicate last principal rays. EP, epurals; HYP1-HYP5, hypurals; PU2, second preural centrum; UN, uroneurals.

perciform caudal skeleton has 17 principal rays, no neural spine on the second preural centrum, three epurals, two free uroneurals, no free ural centra, five autogenous hypurals, and autogenous hemal arches on the second and third preural centra. This is the caudal structure of the Sciaenidae (Figure 3) and several other primitive percoid families listed by Monod (1968) and Patterson (1968).

## KEY TO SCIAENID GENERA OF WESTERN PENINSULAR FLORIDA AND TABLE OF CONTENTS



### Genus *Menticirrhus* Gill, 1862

*Diagnosis*: Mouth inferior; a single, perforate, chin barbel present; body elongate, with flattened venter; swim bladder absent or vestigial (Trewavas, 1964); one anal spine present; ventral rays of caudal fin generally longer than dorsal rays.

### KEY TO *MENTICIRRHUS* SPECIES OF WESTERN PENINSULAR FLORIDA

1. Chest scales smaller than lateral scales, pectoral fins not reaching tips of pelvic fins, no bars on back and sides .......... *Menticirrhus littoralis* (Holbrook, 1855) (p. 9)
1. Chest and lateral scales about equal in size, pectoral fins reaching to or beyond tips of pelvic fins, coloration with bars on back and sides .......... 2
2. Third dorsal spine extending past one-third of soft dorsal fin, bars on back and sides narrow, forming distinct "V" below spinous dorsal .......... *Menticirrhus saxatilis* (Bloch and Schneider, 1801) (p. 11)
2. Third dorsal spine extending to origin of soft dorsal fin, bars on back and sides broad dusky and irregular .......... *Menticirrhus americanus* (Linnaeus, 1758) (p. 12)

*Remarks*: Irwin (1970) most recently revised this genus. He considers *M. focaliger*, the minkfish *sensu* Bailey et al. (1970), a synonym of *M. saxatilis* from the U.S.A. Atlantic coast. Ginsburg (1952) distinguished *M. focaliger* from *M. saxatilis* chiefly by counting vertical scale rows above the lateral line. His average counts were 81 for *M. focaliger* (from St. Joseph Bay, Florida) and 96 for *M. saxatilis* (from Massachusetts and North Carolina); there was no overlap. Irwin (1970), however, found that Ginsburg's data represent the extremes of a continuous clinal change in this character for *M. saxatilis*. The scale count decreases from Maine south to the tip of Florida, and then gradually increases around the Gulf coast to Yucatan. Robins et al. (1980) accepted the synonymy.

The limited life history and ecological information on the species of *Menticirrhus* tends to emphasize their similarity, and larvae cannot be identified to species with certainty (Powles and Stender, 1978). In addition, fisheries statistics fail to distinguish among species of "king whiting" and are of little value in assessing abundances. King whiting represented less than one percent by weight or dollars of commercial finfish landings on Florida's west coast in 1976 (Snell, 1978).

## *Menticirrhus littoralis* (Holbrook, 1855)

Gulf kingfish, Figure 4

*Umbrina littoralis* Holbrook, 1855, p. 142, pl. 20, fig. 1 [South Carolina].

*Menticirrhus littoralis*: Jordan and Eigenmann, 1889, pp. 90, 91 [America and Europe: syn., descr., distrib.]; Jordan and Evermann, 1898, p. 1477 [North America: descr., distrib., syn.]; Welsh and Breder, 1924, pp. 195, 196, figs. 56, 57 [eastern U.S.A.: distrib., descr.]; Hildebrand and Schroeder, 1928, pp. 294, 295, fig. 172 [Chesapeake Bay: syn., descr., food, distrib.]; Hildebrand and Cable, 1934, pp. 70-75, figs. 15-18 [eastern U.S.A.: distrib., spawning, descr. of young, growth]; Longley and Hildebrand, 1941, p. 143 [Tortugas, Florida: listing]; Gunter, 1945, p. 74 [Texas: spawning, movements, food, salinity, temperature]; Simmons, 1950, p. 4 [Texas: trapping]; Joseph and Yerger, 1965, p. 138 [Alligator Harbor, Florida: habitat]; Simmons, 1957, p. 186 [Laguna Madre, Texas: abundance, salinity]; Springer and Woodburn, 1960, pp. 59, 60, fig. 14 [Tampa Bay, Florida: habitat, spawning, growth, food, salinity, temperature]; Trewavas, 1964, p. 116 [swim bladder absent]; Beaumariage, 1969, pp. 28, 31 [eastern Florida: tagging, movement]; Irwin, 1970, pp. 58-62, 89, 90, 95, 96, 103, 108, 112, 116, figs. 56-61 [Americas: syn., descr., distrib., habitat, spawning, age and growth, food, salinity, temperature, parasites]; Gilbert and Kelso, 1971, p. 35 [Costa Rica: listing]; Wang and Raney, 1971, p. 37 [Charlotte Harbor, Florida: salinity, temperature]; Chao, 1978, pp. 6, 8, 9, 13, 15, 18, 20, 21, 23, 25-27, 30, 31, 45-48, 53 [ western Atlantic: syn., distrib., systematics]; Powles and Stender, 1978, pp. 36-41 [southeastern U.S.A.: distrib., spawning, descr. of larvae]; Johnson, 1978, pp. 216-219, figs. 128, 129 [Mid-Atlantic Bight: literature review].

*Material examined*: HOURGLASS STATION A: 1, 227; 1 December 1966; trynet; FSBC 4843.—OTHER MATERIAL: 1, 221; 27°43′N, 82°45′W, 5 m; 19 March 1963; trynet; FSBC 2601. —9, 14.6-36.5; Belle Vista Beach, Pinellas Co., 16-17 June 1958; seine; FSBC 601.—22, 25.0-138; Pass-a-Grille Beach, Pinellas Co., 2 m; 2 November 1957; seine; FSBC 163.—10, 43.5-61.1; Pass-a-Grille Beach, Pinellas Co., 1 m; 2 December 1957; seine; FSBC 234.—25, 20.7-136; Pass-a-Grille Beach, Pinellas Co., 1 m; 9 July 1958; seine; FSBC 670.—8, 51.3-145; Pass-a-Grille Beach, Pinellas Co., 1 m; 2 December 1958; seine; FSBC 1034.—2, 187, 236; 26°18′N, 81°55′W, 8 m; 13 April 1965; otter trawl; FSBC 3827.—1, 214; Naples, Collier Co., 12 m; 14 March 1966; herring net; FSBC 3869.

*Diagnosis*: See generic diagnosis; BD 16.4-26.9% SL; chest scales notably smaller than lateral scales; third dorsal spine extending to origin of soft dorsal; spine length 11.6-25.1% SL; pectoral fins not reaching tips of pelvic fins; color silvery gray above with no dark bars, bronze along sides, white on belly, gill cavity pale; D. X + I, 22-24 (rarely 21 or 25); A. I, 7.

*Distribution*: *Menticirrhus littoralis* occurs along the Atlantic and Gulf coasts from Chesapeake Bay to Brazil (Hildebrand and Schroeder, 1928; Chao, 1978).

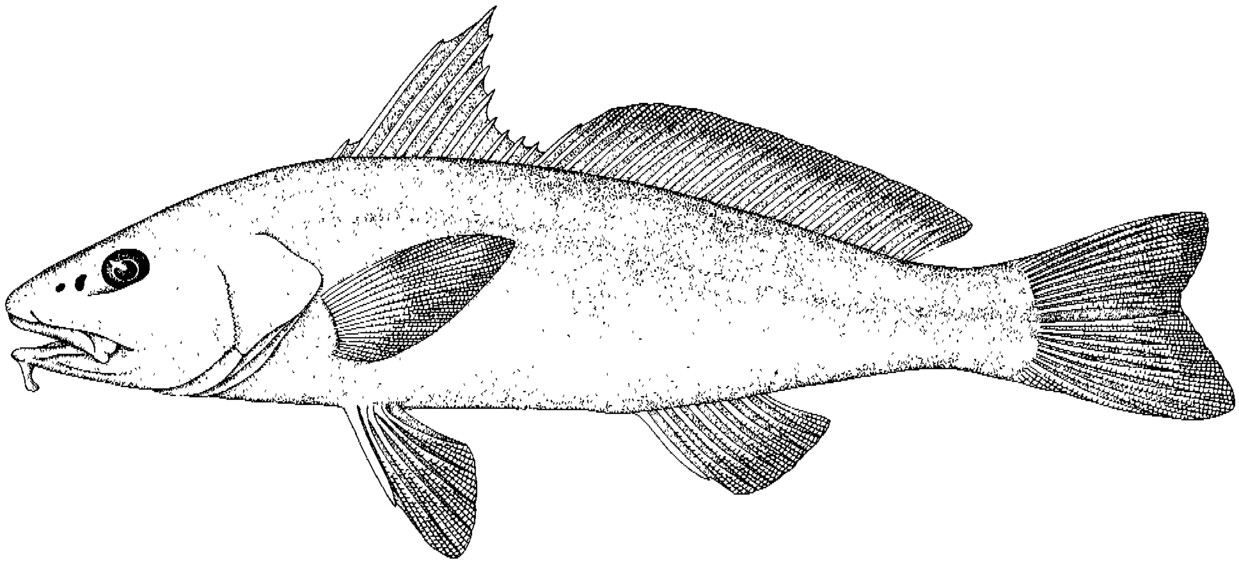


Figure 4. *Menticirrhus littoralis* (Holbrook, 1855).

*Life history*: Spawning seems to occur from May to August in open waters of the Atlantic and Gulf of Mexico. Tampa Bay data support the first half of that period (Springer and Woodburn, 1960).

The eggs have not been recognized, but Hildebrand and Cable (1934) described juvenile development (beginning at 10 mm TL).

Data available for the first months of life indicate rapid growth. Hildebrand and Cable (1934) collected age class 0 specimens 120 mm TL during September, and Springer and Woodburn (1960) collected 129-149 mm SL specimens during October.

When inshore, this species is found on open stretches of sandy beach; it rarely enters protected estuaries (Springer and Woodburn, 1960).

Data on size at sexual maturity is limited to Gunter's (1945) report of two ripe females, 210 and 310 mm TL.

*Food*: Hildebrand and Schroeder (1928) found only crustaceans in seven *M. littoralis* stomachs, but Gunter (1945) found razor clam shells in two ripe females. Stomachs of 15 specimens examined by Springer and Woodburn (1960) contained polychaetes, crustaceans (*Emerita*), and pelecypods (*Donax*). Adults will eat penaeid shrimps, while juveniles eat polychaetes and porcellanid crabs (Irwin, 1970). The Hourglass specimen had an empty gut.

*Salinity and temperature*: Gunter (1945) took 51 of 54 fish at salinities greater than 25 $^{0}/_{00}$. Salinities were 31.8-35.1 $^{0}/_{00}$ in collections made by Springer and Woodburn (1960). The Hourglass specimen was taken at a bottom salinity of 33.22 $^{0}/_{00}$.

Gulf kingfish have been found at temperatures of 13.8-30.6°C (Gunter, 1945), and Wang and Raney (1971) collected a single specimen from 31.6°C water off Gasparilla Pass, Florida. The Hourglass specimen was taken at a temperature of 18.0°C.

## *Menticirrhus saxatilis* (Bloch and Schneider, 1801)

Northern kingfish, Figure 5

*Johnius saxatilis* Bloch and Schneider, 1801, p. 75 [New York].

*Menticirrhus focaliger* Ginsburg, 1952, pp. 97, 98 [St. Joseph Bay, Florida: descr., distrib.]; Hildebrand, 1954, p. 311 [western Gulf of Mexico: distrib., abundance]; Hildebrand, 1955, p. 213 [Gulf of Campeche: listing]; Joseph and Yerger, 1956, p. 138 [Alligator Harbor, Florida: listing of juveniles]; Boschung, 1957, pp. 440-442 [Alabama: syn., distrib., descr., temperature]; Springer and Woodburn, 1960, p. 60 [Tampa Bay, Florida: distrib., color, spawning, food, salinity, temperature]; Hastings, 1972, pp. 288, 289 [northeastern Gulf of Mexico: distrib., habitat, spawning].

*Menticirrhus saxatilis*: Jordan and Eigenmann, 1889, p. 431, fig. 9 [America: syn., distrib., descr.]; Jordan and Evermann, 1898, p. 1475 [North America: syn., descr., distrib.]; Welsh and Breder, 1924, pp. 190-195, figs. 46-55 [eastern U.S.A.: distrib., descr. of eggs through adult, spawning, growth, food]; Hildebrand and Schroeder, 1928, pp. 290, 291 [Chesapeake Bay: syn., descr., growth, food]; Hildebrand and Cable, 1934, pp. 64-70, figs. 11-14 [eastern U.S.A.: spawning, descr. of eggs and young, growth]; Schaefer, 1965, pp. 191-216, figs. 1-17 [New York: growth, mortality, maturity]; Irwin, 1970, pp. 22-29, 88, 89, 91, 92, 98, 102, 105-107, 110, 114, 115, figs. 11-19, 60 [Americas: syn., geographic variation, descr., distrib., spawning, growth, food, salinity, temperature, parasites]; Jannke, 1971, pp. 54-56, fig. 13 [Florida Everglades: spawning]; Scotton et al., 1973, pp. 82, 83, 7 figs. [Delaware Bay: literature review, descr. of eggs through adults]; Lippson and Moran, 1974, pp. 226-228, 12 figs. [Potomac River: literature review, descr. of eggs through adults]; Chao and Musick, 1977, pp. 692, 697, figs. 20-28 [York River, Virginia: feeding adaptations, food]; Chao, 1978, pp. 6, 8, 9, 13, 15, 18, 20, 21, 23, 25-27, 30, 31, 45-48, 53, figs. 4, 17, 22, 29, 30 [western Atlantic: syn., distrib., systematics]; Powles and Stender, 1978, pp. 36-41 [southeastern U.S.A.: spawning, descr. of larvae]; Johnson, 1978, pp. 220-226, figs. 130-133 [Mid-Atlantic Bight: literature review].

*Material examined*: HOURGLASS STATIONS: None collected. — OTHER MATERIAL: 1, 52.5; Pass-a-Grille Beach, Pinellas Co., 1.5 m; 2 November 1957; seine; FSBC 165. — 3, 30.7-62.1; Pass-a-Grille Beach, Pinellas Co., 1.5 m; 2 December 1957; seine; FSBC 234. — 2, 73.4, 90.8; Pass-a-Grille Beach, Pinellas Co., 1 m; 18 April 1958; seine; FSBC 503. — 22, 24.6-60.6; Pass-a-Grille Beach, Pinellas Co., 1.5 m; 15 May 1958; seine; FSBC 542. — 36, 35.0-107; Pass-a-Grille Beach, Pinellas Co., 1 m; 9 July 1958; seine; FSBC 669. — 7, 68.8-128; Mullet Key, Pinellas Co., 1.5 m; 2 August 1968; FSBC 9196. — 1, 25.5; Tampa Bay, St. Petersburg, Pinellas Co., 1 m; 26 November 1957; push net; FSBC 206. — 2, 12.6, 24.7; Tampa Bay, St. Petersburg, Pinellas Co.; 30 November 1957; push

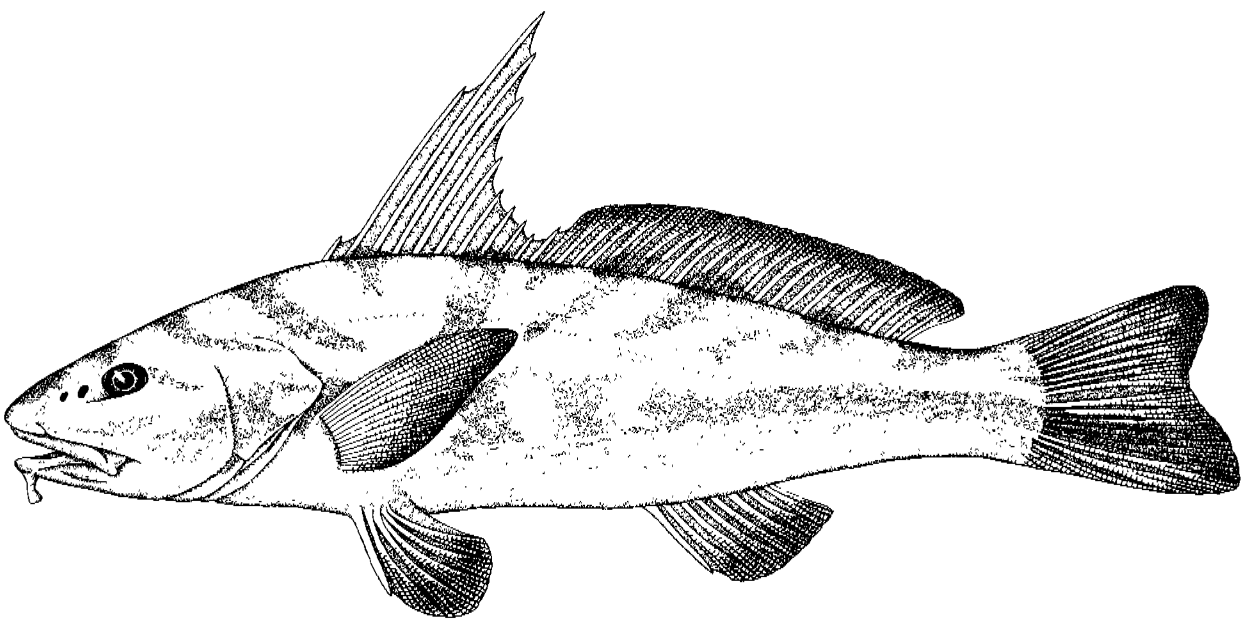


Figure 5. *Menticirrhus saxatilis* (Bloch and Schneider, 1801).

net; FSBC 229. — 2, 20.9, 27.6; Tampa Bay, Pinellas Co.; 15 January 1958; FSBC 313. — 1, 27.5; Tampa Bay, St. Petersburg, Pinellas Co., 1 m; 17 February 1958; push net; FSBC 399. — 1, 32.3; Tampa Bay, St. Petersburg, Pinellas Co., 1 m; 14 May 1958; seine; FSBC 536. — 1, 110; Tampa Bay, St. Petersburg, Pinellas Co., 1 m; 25 June 1958; seine; FSBC 636. — 1, 34.9; Tampa Bay, Pinellas Co.; 9 October 1964; seine; FSBC 3214. — 1, 94.6; Tampa Bay, Pinellas Co.; 8 June 1966; seine; FSBC 3882. — 1, 54.9; Punta Rassa Beach, Lee Co., 1 m; 6 May 1958; seine; FSBC 528. — 2, 73.0, 74.0; Estero Bay, Lee Co., 1 m; 11 February 1959; seine; FSBC 1130. — 5, 15.0-36.6; Gulf of Mexico, Lee Co.; 1 December 1959; FSBC 1604.

*Diagnosis*: See generic diagnosis; BD 21.7-33.3% SL; chest and lateral scales approximately equal in size; third dorsal spine extending past one-third of soft dorsal fin, spine 15.0-37.7% SL; pectorals reaching to or beyond tips of pelvics; color light yellow or gray, back and sides with black bars forming a "V" below spinous dorsal fin; D. X + I, 22-25; A. I, 7-8.

*Distribution and abundance*: *Menticirrhus saxatilis* occurs along the United States Atlantic and Gulf of Mexico coasts from Maine to Yucatan (Irwin, 1970; Chao, 1978). It is common around the southern tip of Florida, but not in the northern Gulf of Mexico (Irwin, 1970). It is caught on Gulf beaches along with *M. littoralis* and *M. americanus* (Joseph and Yerger, 1956; Springer and Woodburn, 1960).

*Life history*: Northern kingfish spawn during fall and winter in western peninsular Florida (Springer and Woodburn, 1960; Jannke, 1971). Spawning in the northern Gulf of Mexico, like that in the northern Atlantic states, occurs during spring and summer (Hastings, 1972; Jannke, 1971).

Eggs and larvae are described (Welsh and Breder, 1924; Hildebrand and Cable, 1934).

Springer and Woodburn (1960) reported a dark color phase in some specimens less than 22 mm SL. The entire fish, except for portions of the fins, was deeply and uniformly pigmented. Other individuals the same size had the adult color pattern.

Growth is rapid in the northeastern United States. Average total lengths may be 260 mm, 335 mm, and 375 mm, after one, two, and three years (Schaefer, 1965).

More than 50 percent of all *M. saxatilis* (either sex) reach maturity during their second year (Schaefer, 1965).

*Food*: Stomach contents were examined by Springer and Woodburn (1960). They found that fish under 30 mm SL ate copepods, mysids, crabs, and gammarids, while larger fish ate *Emerita*, gammarids, mysids, hermit crabs (without shells), polychaetes, and unidentifiable crustaceans. Nematodes, cestodes, *Limulus*, squid, bryozoa, and fishes are also found in gut contents (Irwin, 1970). Anatomical adaptions for feeding were described by Chao and Musick (1977).

*Salinity and temperature*: Springer and Woodburn (1960) took this species at salinities generally greater than 25 ‰ (21.0-35.1 ‰ and at temperatures of 13.5-30.7°C. Other workers have taken northern kingfish at salinities of 8.0-35.1 ‰ and temperatures of 7.8-35.8°C (Irwin, 1970).

## *Menticirrhus americanus* (Linnaeus, 1758)

Southern kingfish, Figure 6

*Cyprinus americanus* Linnaeus, 1758, p. 321 [Carolina].

*Menticirrhus americanus*: Jordan and Eigenmann, 1889, pp. 430, 431, fig. 8 [America: syn., distrib.]; Jordan and Evermann, 1898, pp. 1474, 1475, pl. CCXXV, fig. 572 [North America: descr., distrib., syn.]; Welsh and Breder, 1924, pp. 186-190, figs. 44, 45 [eastern U.S.A.: distrib., spawning, descr., food]; Hildebrand and Schroeder, 1928, pp. 291-294, figs. 169-171 [Chesapeake Bay: syn., descr., food, spawning, catch, growth, distrib.]; Hildebrand and Cable, 1934, pp. 52-64, figs. 1-10 [eastern U.S.A.: distrib., seasonal abundance, spawning, larval descr., distrib. of young, growth]; Gunter, 1938, pp. 324, 325, fig. 4 [Louisiana: seasonal abundance, preference for Gulf]; Pearson, 1941, p. 92 [Chesapeake Bay: distrib, and descr. of young]; Longley and Hildebrand, 1941, p. 143 [Tortugas: listing]; Gunter, 1945, pp. 73, 74 [Texas: seasonal abundance, spawning, food]; Miles, 1949, p. 156 [Texas: food]; Ginsburg, 1952, p. 98 [Cape San Blas, Florida: taken with congeners]; Reid, 1954, p. 51 [Cedar Key, Florida: spawning, food, seasonal movements]; Hildebrand, 1954, p. 311 [western Gulf of Mexico: migrations]; Hildebrand, 1955, p. 213 [Gulf of Campeche: abundance]; Joseph and Yerger, 1956, p. 138 [Alligator Harbor, Florida: record of young, juveniles and adults]; Springer and Woodburn, 1960, pp. 56-59, fig. 13 [Tampa Bay, Florida: spawning, growth, food, salinity]; Trewavas, 1964, p. 116 [vestigial gas bladder]; Beaumariage, 1969, p. 31 [east coast Florida: tag return]; Irwin, 1970, pp. 13-21, 88-91, 96, 97, 101, 104, 105, 109, 113, 114, figs. 4-10, 19 [Americas: syn., descr., distrib., spawning, growth, food, salinity, temperature, parasites]; Jannke, 1971, pp. 51-54, fig. 12 [Florida Everglades: spawning]; Gilbert and Kelso, 1971, p. 35 [Costa Rica: listing]; Wang and Raney, 1971, pp. 36, 37 [Charlotte Harbor, Florida: abundance, slainity, temperature]; Scotton et al., 1973, pp. 84-87, 7 figs. [Delaware Bay: literature review, descr. of larvae through adults]; Lippson and Moran, 1974, pp. 223-225, 7 figs. [Potomac River: literature review, descr. of larvae through adults]; Chao, 1978, pp. 6, 8, 9, 13, 15, 18, 20, 21, 23, 25-27, 30, 31, 45-48, 53, figs. 4, 17, 29, 30, 33 [western Atlantic: syn., distrib., systmatics]; Powles and Stender, 1978, pp. 36-41 [southeastern U.S.A.: distrib., spawning, descr. of larvae]; Johnson, 1978, pp. 209-215, figs. 124-127 [Mid-Atlantic Bight: literature review].

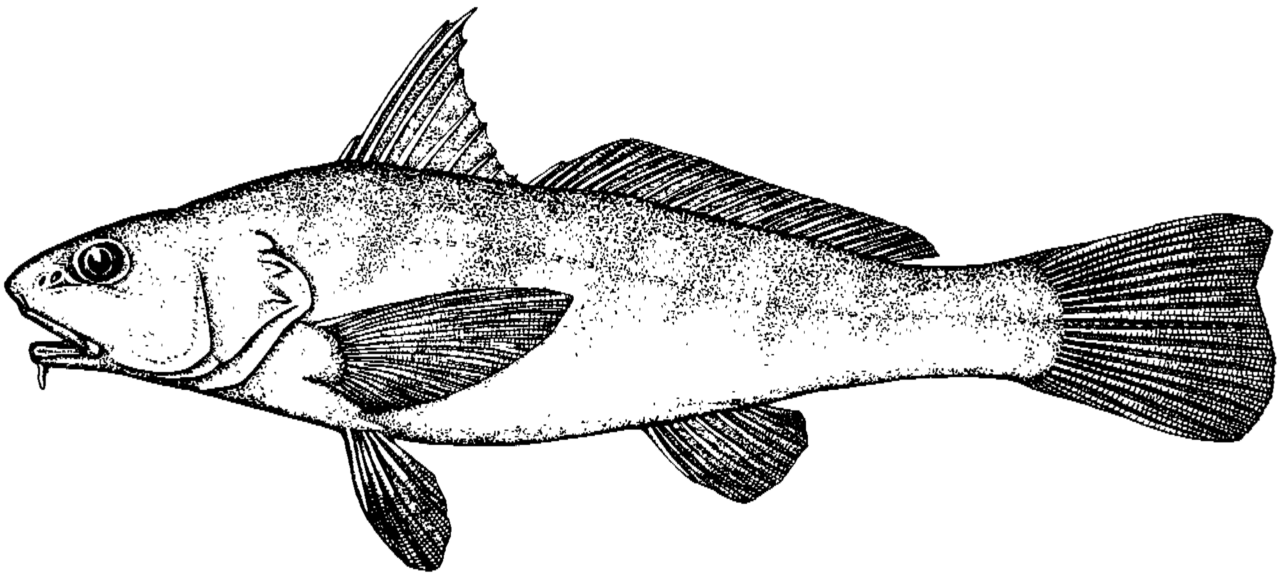


Figure 6. *Menticirrhus americanus* (Linnaeus, 1758).

*Material examined*: HOURGLASS STATION A: 1, 162; 4 October 1965; trynet; FSBC 4480. — HOURGLASS STATION I: 3, 199-245; 9 March 1966; trynet; FSBC 4799. — OTHER MATERIAL: 1, 229; 28°56′24″N, 82°48′30″W, 3 m; 16 July 1969; trawl; FSBC 6835. — 1, 129; Crystal River, Citrus Co.; 20 July 1971; trawl; FSBC 9253. — 1, 152; 27°58′N, 82°51′W, 6 m; 23 February 1963; trynet; FSBC 2570. — 1, 229; 27°58′N, 82°51′W, 6 m; trynet; FSBC 2592. — 3, 131-149; 27°58′N, 82°51′W, 6 m; trynet; FSBC 2618. — 2, 147, 154; 27°58′N, 82°51′W, 6 m; 7 June 1963; trynet; FSBC 2662. — 2, 183, 197; 27°43′N, 82°45′W, 5 m; 24 February 1963; trynet; FSBC 2573. — 1, 169; 27°43′N, 82°45′W, 5 m; 19 March 1963; trynet; FSBC 2596. — 4, 175-179; 27°43′N, 82°45′W, 5 m; 19 March 1963; trynet; FSBC 2600. — 2, 173, 174; 27°43′N, 82°45′W, 5 m; 18 April 1963; trynet; FSBC 2622. — 18, 25.4-49.4; Pass-a-Grille Beach, Pinellas Co., 1 m; 9 July 1958; seine; FSBC 668. — 20, 47.5-84.6; Pass-a-Grille Beach, Pinellas Co., 1 m; 8 August 1958; seine; FSBC 769. — 1, 193; Tampa Bay, Pinellas Co., 7 m; 18 May 1966; trawl; FSBC 3897. — 2, 174, 175; Hillsborough Bay, Hillsborough Co.; 12 February 1958; FSBC 388. — 1, 28.8; Gulf of Mexico, Lee Co.; 1 December 1959; FSBC 1603. — 2, 34.0, 41.0; Caloosahatchee River, Lee Co., 2 m; 5 December 1957; trawl; FSBC 239.

*Diagnosis*: See generic diagnosis; BD 21.8-28.5% SL; chest and lateral scales approximately equal in size; third dorsal spine extends to origin of soft dorsal, spine length 16.4-28.8% SL; pectorals reaching to or beyond tips of pelvics; color silvery gray with irregular dusky bars on the back and sides, gill cavity dusky; D. X (rarely IX to XI) + I, 22-25; A. I, 7 (rarely 6).

*Distribution and abundance*: *Menticirrhus americanus* occurs from New York to Costa Rica. It is the commercially important species of the genus from Chesapeake Bay southward (Hildebrand and Cable, 1934; Chao, 1978).

*Life history*: Most authors report the spawning season as April through September, but year-long spawning has been reported from the Everglades region of south Florida (Jannke, 1971). Spawning occurs largely or entirely offshore in 9-36 m (Irwin, 1970).

Springer and Woodburn (1960) presented monthly length frequency data indicating that fish of 25 mm SL in July could grow to 117 mm SL in October. That rate is roughly comparable to those of more northern populations (Welsh and Breder, 1924; Hildebrand and Cable, 1934).

Males mature by age two, 195 mm SL, while females mature at age two or three, 218-250 mm SL (Reid, 1954; Bearden, 1963; Irwin, 1970).

*Food*: Southern kingfish are generalized carnivores taking crustaceans, polychaetes, fishes and molluscs (Irwin, 1970). Their fish diet indicates they can feed on pelagic as well as benthic forms.

Young (17.6-49.8 mm SL) feed mainly on copepods, but other crustaceans, nematodes and polychaetes are also taken (Irwin, 1970).

*Salinity and temperature*: Springer and Woodburn (1960: 58) summarized the meager data on salinities at which southern kingfish have been taken and concluded the species ". . . prefers moderate to full strength sea water." Wang and Raney (1971), however, took this species at 8.9 $^{o}/_{oo}$ from the Peace River, Florida. Hourglass specimens were taken at a bottom salinity of 34.61 $^{o}/_{oo}$.

Absence of this fish from inshore waters during the winter is probably a temperature-related phenomenon (Gunter, 1938 and 1945; Hildebrand and Cable, 1934). The temperature range recorded by Springer and Woodburn (1960) was 12.5-31.0°C. Hourglass specimens were taken at temperatures of 17.9-27.8°C.

## Genus *Pogonias* Lacépède, 1802

### *Pogonias cromis* (Linnaeus, 1766)

Black drum, Figure 7

*Labrus cromis* Linnaeus, 1766, p. 479 [Carolina].

*Pogonias cromis*: Jordan and Eigenmann, 1889, pp. 435, 436, figs. 10, 11 [America: syn., distrib.]; Jordan and Evermann, 1898, pp. 1482, 1483, pl. CCXXV, fig. 573 [North America: descr., distrib., syn.]; Welsh and Breder, 1924, pp. 196, 197, figs. 58, 59 [eastern U.S.A.: distrib., descr., growth, migration, food]; Hildebrand and Schroeder, 1928, pp. 287-289, figs. 167, 168 [Chesapeake Bay: descr., growth, parasites, catch, distrib.]; Peason, 1929, pp. 157-178, figs. 13-23 [Texas: descr. of larvae and adults, spawning, age and growth, migration, food, catch, syn.]; Gunter, 1945, pp. 74, 75 [Texas: seasonal migration, food]; Gunter, 1950, p. 93 [Texas: abundance]; Miles, 1949, pp. 150, 151 [Aransas Bay, Texas: parasites, food]; Parker, 1951, pp. 2, 3, figs. 1-4 [Texas: parasites];

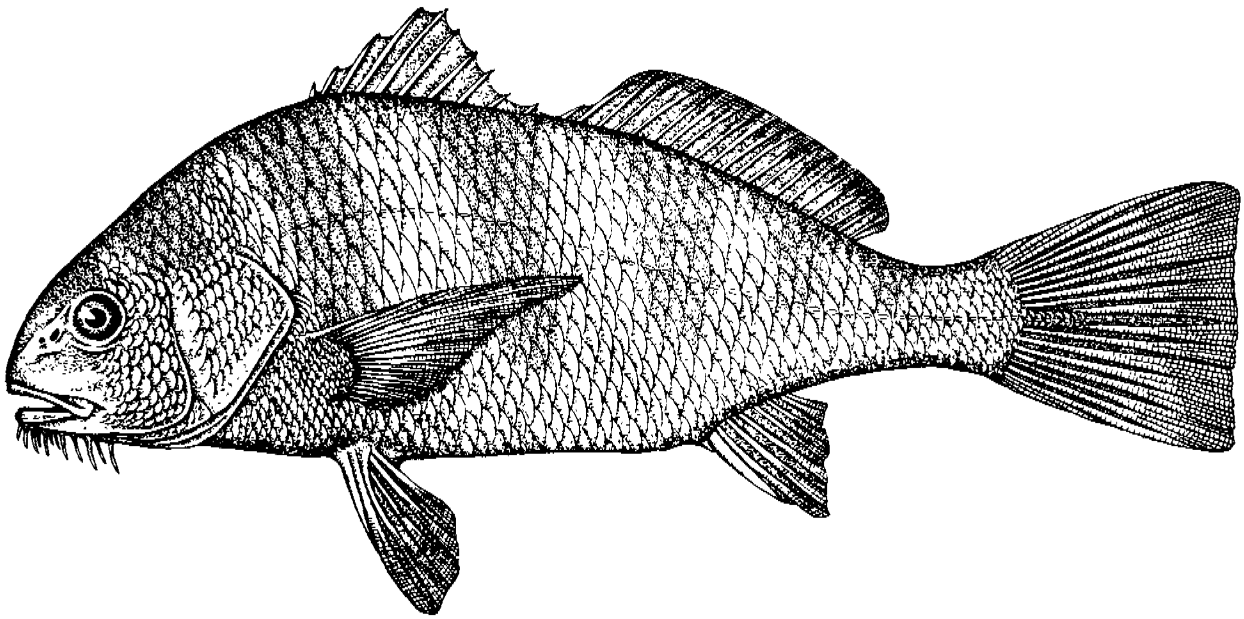


Figure 7. *Pogonias cromis* (Linnaeus, 1766).

Bigelow and Schroeder, 1953, pp. 425, 426, fig. 220 [Gulf of Maine: descr., distrib.]; Chandler, 1945, p. 351 [Gulf of Mexico: parasites]; Reid, 1954, pp. 51-52 [Cedar Key, Florida: spawning]; Kilby, 1955, p. 226 [Cedar Key, Florida: salinity, temperature]; Reid, 1955a, p. 330 [East Bay, Texas: abundance]; Reid, 1955b, p. 446 [East Bay, Texas: size range, food]; Joseph and Yerger, 1956, p. 139 [Alligator Harbor, Florida: abundance]; Gunter, 1956, p. 350 [North and Middle America: salinity]; Breuer, 1957, p. 146 [Baffin and Alazan Bays, Texas: abundance, movements, salinity, temperature]; Simmons, 1957, p. 186 [Laguna Madre, Texas: abundance, spawning, salinity]; Darnell, 1958, pp. 398-400 [Lake Pontchartrain, Louisiana: food]; Springer and Pirson, 1958, pp. 181, 182 [Port Aransas, Texas: abundance, spawning, migration]; Springer and Woodburn, 1960, p. 63 [Tampa Bay, Florida: spawning, salinity and temperature]; Frisbie, 1961, pp. 94-100 [Chesapeake and Delaware Bays: salinity, temperature, growth]; Tabb and Manning, 1961, p. 628 [northern Florida Bay: abundance, spawning]; Simmons and Breuer, 1962, pp. 193-211, figs. 6-12 [Texas: descr., distrib., life history, food, salinity, temperature, parasites, fishery]; Joseph et al., 1964, pp. 425-434, figs. 1-4 [Chesapeake Bay: descr. of eggs and larvae]; Leim and Scott, 1966, p. 261, 1 fig. [Nova Scotia: northernmost record]; Beaumariage, 1969, pp. 31, 34 [Florida: tagging, movement, growth]; Jannke, 1971, pp. 54-59 [Florida Everglades: spawning]; Wang and Raney, 1971, pp. 37, 38 [Charlotte Harbor, Florida: salinity, temperature]; Hastings, 1972, pp. 291, 292 [northeastern Gulf of Mexico: occurrence at jetties]; Liem, 1973, p. 435 [pharyngeal anatomy]; Miller and Jorgensen, 1973, p. 308 [western Atlantic: meristics]; Scotton et al., 1973, pp. 96-97 3 figs. [Delaware Bay: literature review, descr. of eggs through adults]; Lippson and Moran, 1974, pp. 232, 233, 9 figs. [Potomac River: literature review, descr. of eggs through adults]; Chao, 1978, pp. 6, 9, 13, 14, 20, 21, 24-27, 34, 44-46, 48 figs. 4, 10, 19, 29, 30, 40 [western Atlantic: syn., diagnosis, distrib., systematics]; Snell, 1978, p. 5 [Florida: commercial landings]; Powles and Stender, 1978, pp. 46-48 [southeastern U.S.A.: distrib., spawning, descr. of larvae, maturity]; Johnson, 1978, pp. 235-241, figs. 138-142 [Mid-Atlantic Bight: literature review]; Silverman, 1979, pp. 1-35, figs. 1-7 [literature review].

*Material examined*: HOURGLASS STATIONS: None collected. — OTHER MATERIAL: 1, 230; Crystal River, Citrus Co.; 25 September 1969; trap; FSBC 7864. — 1, 62.4; Long Bayou, Pinellas Co., 1 m; 10 June 1971; FSBC 8380. — 5, 36.8-83.9; Long Bayou, Pinellas Co., 1 m; 10 June 1971; FSBC 8381. — 1, 137; Cross Bayou Canal, Pinellas Co.; 14 November 1957; FSBC 198. — 4, 31.3-50.1; Salt Creek, Pinellas Co., 0.3-3.0 m; 18 June 1971; FSBC 8681. — 1, 230; Marco Island, Collier Co.; 15 December 1967; otter trawl; FSBC 6841.

*Diagnosis*: Mouth inferior; chin with 26 long (equal to pupil diameter) barbels; lower pharyngeal bones (fifth ceratobranchials) fused across mid-sagittal plane, bearing pavement (cobblestone-like) and some conical teeth; body deep, with elevated back, BD 32.0-36.6% SL; sonific muscles intrinsic to swim bladder; color silvery black, often with brassy luster, 4-7 broad, dark verticle bars in specimens examined (31.0-230 mm SL); fins dark or dusky; D. X + I, 21-22; A. II, 6.

*Distribution and abundance*: *Pogonias cromis* occurs from New England to Argentina, including the Gulf of Mexico (Chao, 1978). Leim and Scott (1966) list it from Nova Scotia.

Black drum represented less than one percent by weight or dollars of commercial finfish landings on Florida's west coast in 1976 (Snell, 1978).

*Life history*: Jannke (1971) summarized black drum spawning reports for the Gulf of Mexico. They suggest a winter to early spring season off western peninsular Florida. Spawning occurs in the Gulf near the mouths of bays (Pearson, 1929). Whether it also occurs within the bays is a matter of some debate (Frisbie, 1961; Joseph et al., 1964).

Joseph et al. (1964) described and illustrated black drum eggs and larvae from laboratory reared specimens and emphasized the uncertainty in identifying sciaenid eggs solely by morphology.

Soon after hatching, larvae enter inland bays (Pearson, 1929). Powles and Stender (1978) described larval development (3.9-4.6 mm SL) and Pearson (1929) illustrated juvenile stages.

Black drum reach standard lengths of 140-180 mm in one year, 290-330 mm and sexual maturity in two years, and 400-430 mm in three years (Pearson, 1929; Simmons and Breuer, 1962). These ranges allow for reported late spawning surges or split spawning seasons (Pearson, 1929; Breuer, 1957). Pearson (1929) presented a length-weight graph for drum to 900 mm TL. The record size fish reported by the International Game Fish Association (McCracken, 1979) weighed 51.28 kg (113 lb, 1 oz).

*Food*: Small black drum (80-200 mm SL) feed on marine annelids, fishes, and crustaceans; larger drum feed mainly on mollusks, crabs, shrimps, and fishes (Miles, 1949; Darnell, 1958). They take their food at or below the sediment surface, often damaging grass beds and raising silt in the process (Simmons and Breuer, 1962). Presumably, their numerous barbels aid in locating these benthic and infaunal foods.

The feeding mechanism of black drum is unique among species considered here. The pharyngeal jaws (illustrated by Simmons and Breuer, 1962) bear broad rounded teeth adapted for crushing shells. Furthermore, the fifth ceratobranchials are fused medially, thereby decreasing flexibility and increasing the efficiency of this crushing mechanism (Liem, 1973).

*Salinity and temperature*: Black drum inhabit areas and tolerate conditions that are inhospitable to many other estuarine species. Pearson (1929: 175) described their eurythermal and euryhaline nature as follows:

> In an environment where extremely turbid water prevails throughout the year; where the water temperature ranges from 80 to 90° F in summer and as low as 40° in winter; where during the summer salinity often is twice as great as that of ordinary sea water and during the rainy season a brackish condition exists; and where the average depth rarely is more than 4 feet, the black drum attains its greatest abundance along the coast of Texas.

Black drum populations can apparently recover in about one year from mass mortality caused by rapid temperature drop and sustained low temperatures (Simmons and Breuer, 1962).

*Parasites*: Ectoparasites include several species of copepods and two species of isopods, one of which embeds in the gill filaments (Miles, 1949; Simmons and Breuer, 1962). They are normally absent from fish in hypersaline waters.

Larvae of the tapeworm *Poecilancistrium robustum* (Chandler, 1935) or related species are responsible for the "wormy" reputation of large black drum (Parker, 1951; Chandler, 1954). They lie in the body musculature near the soft dorsal fin. Smaller fish are relatively free of this parasite which does not infect humans.

*Remarks*: A literature review of biological and fisheries data on the black drum was made by Silverman (1979). It should be consulted for further details.

## Genus *Micropogonias* Bonaparte, 1831

### *Micropogonias undulatus* (Linnaeus, 1766)

Atlantic croaker, Figure 8

*Perca undulata* Linnaeus, 1766, p. 483 [South Carolina].

*Micropogon undulatus*: Jordan and Eigenmann, 1898, p. 418, fig. 7 [America: syn., distrib.]; Jordan and Evermann, 1898, pp. 1461, 1462, pl. CCXXIV, fig. 570 [North America: descr., distrib., syn.]; Welsh and Breder, 1924, pp. 180-184, figs. 39-41 [eastern U.S.A.: distrib., spawning, descr. of larvae, growth, food]; Hildebrand and Schroeder, 1928, pp. 283-287, figs. 164-166 [Chesapeake Bay: descr., syn., food, spawning, catch, growth, distrib.]; Pearson, 1929, pp. 194-203, figs. 33-38 [Texas: syn., descr. of larvae and adult, spawning, age and growth, migration, food, catch]; Hildebrand and Cable, 1930, pp. 430-445, figs. 51-58 [Beaufort, North Carolina: distrib., spawning, temperature, descr. of larvae, age and growth, food]; Gunter, 1938, pp. 322-324, fig. 2 [Louisiana: abundance, migrations, temperature]; Wallace, 1940, pp. 475-482, fig. 1 [Chesapeake Bay: sexual development, distrib. of young]; Pearson, 1941, pp. 91, 92 [Chesapeake Bay: descr. of larvae]; Gunter, 1945, pp. 71-73 [Texas: age and growth, food]; Gunter, 1950, p. 93 [Texas: abundance]; Simmons, 1951, pp. 1-15 [Texas: trapping]; Suttkus, 1954, pp. 1-7, figs. 1-3 [east Louisiana: migrations, age and growth]; Hildebrand, 1954, pp. 310, 311 [western Gulf of Mexico: abundance, food]; Roelofs, 1954, pp. 151-153 [North Carolina: food]; Hildebrand, 1955, p. 213 [Gulf of Campeche: distrib., food]; Reid, 1955b, p. 444 [East Bay, Texas: abundance, food]; Gunter, 1956, p. 350 [North and Middle America: salinity]; Simmons, 1957, p. 186 [Laguna Madre, Texas: salinity]; Breuer, 1957, p. 146 [Baffin and Alazan Bays, Texas: abundance]; Haven, 1957, pp. 88-97 [Chesapeake Bay: spawning, migrations, abundance, salinity, statistical analysis of methods]; Reid and Hoese, 1958, 225-231 [Texas: distrib. by size, salinity]; Darnell, 1958, pp. 392-398, figs. 12, 13 [Lake Pontchartrain, Louisiana: food]; Springer and Pirson, 1958, pp. 181-183, fig. 16 [Port Aransas,

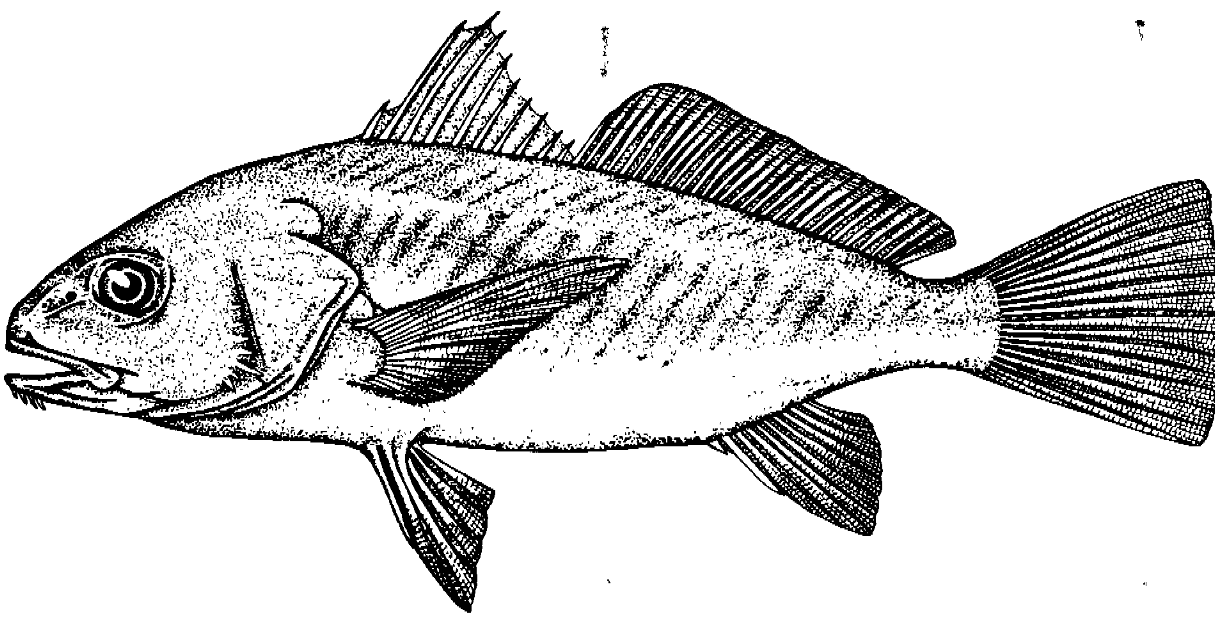


Figure 8. *Micropogonias undulatus* (Linnaeus, 1766).

Texas: abundance]; Haven, 1959, pp. 25-30, figs. 1-4 [Chesapeake Bay: tagging, migration]; Springer and Woodburn, 1960, pp. 60-62, fig. 15 [Tampa Bay, Florida: distrib., spawning, migration, age and growth, food, salinity, temperature]; Tabb and Manning, 1961, p. 628 [Florida Bay: abundance]; Dovel, 1968, pp. 313-319, figs. 1-3 [Chesapeake Bay: predation by striped bass]; Hansen, 1969, pp. 142-146, fig. 3 [Pensacola, Florida: abundance, spawning, migration, age and growth, food]; Nelson, 1969, pp. 25-50, figs. 1-9 [Mobile Bay, Alabama: abundance, spawning, age and growth, migration, salinity, temperature, depth]; Wang and Raney, 1971, p. 36 [Charlotte Harbor, Florida: abundance, salinity, temperature]; Parker, 1971, pp. 97-173, figs. 20-32 [Louisiana and Texas: abundance, spawning, growth, food, salinity, temperature]; Hastings, 1972, pp. 290-291 [northeast Gulf of Mexico: occurrence on jetties]; Miller and Jorgenson, 1973, p. 308 [western Atlantic: meristics]; Scotton et al., 1973, pp. 92-95, 4 figs. [Delaware Bay; literature review, descr. of larvae through adults]; Arnoldi et al., 1973, pp. 158-171, figs. 1-3 [Louisiana: tagging, growth rate]; Lippson and Moran, 1974, pp. 229-231, 8 figs. [Potomac River: literature review, descr. of larvae through adults]; Stickney et al., 1975, pp. 104-114, figs. 1-6 [southeastern U.S.A.: food]; Yakupzack et al., 1977, pp. 538-544, figs. 1-3 [Louisiana: migration]; Powles and Stender, 1978, pp. 41-46 [southeastern U.S.A.: distrib., spawning, descr. of larvae, maturity]; Fruge and Truesdale, 1978, pp. 643-648, figs. 1, 2 [northern Gulf of Mexico: descr. of larvae]; Bleil, 1978, pp. 1-25, figs. 1-6 [Chesapeake Bay: shoreward movement of larvae].

*Micropogonias undulatus*: Chao and Musick, 1977, pp. 657-702, figs. 1-5, 16-29 [York River, Virginia: life history, feeding adaptations, food]; White and Chittenden, 1977, pp. 109-123, figs. 1-9 [Texas: spawning, growth, age determination, latitudinal effects]; Chao, 1978, pp. 9, 13, 19-21, 24-26, 32, 33, 40, 46, 48, 53, figs. 4, 9, 17, 26, 29, 30, 33, 37 [western Atlantic: syn., distrib., systematics]; Snell, 1978, p. 5 [Florida: commercial landings]; Johnson, 1978, pp. 227-233, figs. 134-137 [Mid-Atlantic Bight: literature review].

*Material examined*: HOURGLASS STATION D: 16, 176-207; 20 November 1966; trynet; FSBC 5267.—OTHER MATERIAL: 1, 240; Crystal River, Citrus Co.; 29 January 1970; power plant intake screen; FSBC 7833.— 1, 13.2; Long Bayou, Pinellas Co., 1 m; 6 November 1970; plankton net; FSBC 8327. — 149, 55.0-99.8; Cross Bayou Canal, Pinellas Co., 1 m; 17 June 1958; seine; FSBC 620. — 1, 24.1; Cats Point Finger Fills, Pinellas Co., 3 m; 8 December 1970; trynet; FSBC 8328. — 3, 210-236; Tampa Bay, Pinellas Co.; spring, 1963; cast net; FSBC 2361. — 3, 41.0-66.9; Caloosahatchee River, Lee Co., 2-3 m; 10 February 1958; trynet; FSBC 384.

*Diagnosis*: Mouth inferior; chin with four short (about one-fourth pupil diameter) barbels along ventral edge of each dentary; body elongate and compressed, BD 27.1-32.8% SL; caudal biconcave; color silvery green or gray above, sides with 10-21 oblique, brassy or brown bars, silvery white below; D. X + I, 26-31; A. II, 8 (occassionally 7 or 9).

*Distribution and abundance*: Hoese and Moore (1977) gave the range of *Micropogonias undulatus* as Massachusetts to at least central Mexico. Recently, however, Chao and Musick (1977) extended the northern limit to the Gulf of Maine, and Chao (1978), based on color pattern methods for distinguishing *M. undulatus* from its southwestern Atlantic congener, *M. furnieri* (Desmarest, 1823), extended the southern limit to Argentina.

Springer and Woodburn (1960) collected 264 *M. undulatus* specimens in the Tampa Bay area but considered this species rare at that location. They suggested it might invade southern Florida only during exceptionally cold winters.

Croaker represented less than two percent by weight and one percent by dollar value of commercial finfish landings on Florida's west coast in 1976 (Snell, 1978).

*Life history*: Nelson (1969) provided a referenced table of croaker spawning times by locality. Hildebrand and Cable (1930) postulated a September through May spawning season based on collections of larvae from North Carolina, but most authors report a shorter season during the fall and winter. As expected for a cool weather spawner, onset of spawning is later at lower latitudes (Springer and Woodburn, 1960). Spawning occurs offshore in the ocean or Gulf (Powles and Stender, 1978). Larvae are carried shoreward by Ekman transport (Bleil, 1978) and into estuaries by intruding salt wedges. They settle near the bottom in deep channels (Wallace, 1940; Haven, 1957).

Eggs have not been recognized, but larvae were described by Pearson (1929), Hildebrand and Cable (1930) and Powles and Stender (1978). Hildebrand and Cable also presented a table for distinguishing larval croaker from larval spot (*Leiostomus xanthurus* Lacépède, 1802), and Fruge and Truesdale (1978) compared larval development in the two species.

Springer and Woodburn (1960) and Nelson (1969) summarized growth data for croakers in their first year. One year old fish are 100 to 150 mm TL in the reports they summarized. Parker (1971) averaged growth data from throughout the croaker's range, concluding that they grow 12 mm/month during the first year, 5.3 mm/month during the second year, and 3.6 mm/month during the third year. Arnoldi et al. (1973) suggested a somewhat higher growth rate. Hildebrand and Schroeder (1928) presented a length-weight conversion table. Parker (1971) provided length-weight and condition analyses.

In Gulf of Mexico populations, larger croaker in their first year migrate from the estuaries by their first summer (Yakupzack et al., 1977). Whether these fish return to the estuary and participate in the spawning migration of their year class as it approaches age two (165-220 mm TL) cannot be determined from published accounts (Pearson, 1929; Nelson, 1969).

Wallace (1940) stated that in Chesapeake Bay only 45 percent of males and no females were mature at age two. Maturity may be as late as age three or four in northern croaker (Welsh and Breder, 1924), or as early as age one in southern croaker (White and Chittenden, 1977). This information is not necessarily contradictory since individuals of the same species may mature at a later age in cooler climates (Hildebrand and Cable, 1930).

*Food*: Feeding adaptations in *M. undulatus* include an inferior mouth, villiform teeth, and, compared to other sciaenids, an intermediate number of gill rakers and a long intestine (Chao and Musick, 1977). Croaker change from feeding on plankton to feeding on epifauna at about 25 mm SL (Darnell, 1958). Juveniles feed on polychaetes and crustaceans (Chao and Musick, 1977). With growth, they become more generalized, opportunistic feeders (Parker, 1971; Stickney et al., 1975), and molluscs begin to replace polychaetes in the diet. Geographic and seasonal variation in diet is probably attributable to availability of prey species (Darnell, 1958; Chao and Musick, 1977).

Hourglass specimens had eaten crustaceans and fishes.

*Salinity and temperature*: Gunter (1945) found a positive correlation of size with salinity for estuarine croaker less than a year old, however, Reid and Hoese (1958) found that croaker distribution by size in East Bay, Texas, remained the same when the normal salinity pattern was reversed after the opening of Rollover Pass. Furthermore, Nelson (1969) showed there is a similar correlation with water depth. Parker (1971) concluded that factors other than salinity may determine croaker distribution. Salinity, however, is important during the spawning season when larvae may be carried into their nursery grounds by salt wedge intrusion.

Hourglass specimens were taken at a bottom salinity of 35.99 $^{o}/_{oo}$. Temperature is probably the most important single factor influencing croaker migration. Springer and Woodburn (1960) noted the later onset of spawning at lower latitudes. This correlates with the later onset of cold weather which probably triggers, either directly or indirectly, the spawning migration (Nelson, 1969).

Hildebrand and Cable (1930) observed that young croakers are less sensitive to low temperatures than older fish, thus explaining why the young are able to remain in the estuary during winter while older fish migrate to deeper, warmer water.

White and Chittenden (1977) felt temperature may affect age at maturity, spawning-associated somatic weight loss, and post-spawning mortality and thereby account for the shorter life cycle of croaker at lower latitudes.

Hourglass specimens were taken at a temperature of 25°C.

## Genus *Cynoscion* Gill, 1862

*Diagnosis*: Mouth terminal, large; lower jaw protruding; two fang-like teeth at tip of upper jaw; body elongate, fusiform; no more than two predorsal bones present.

### KEY TO *CYNOSCION* SPECIES OF WESTERN PENINSULAR FLORIDA

1. Body with round black spots, soft dorsal and anal fins not scaled ........................ ............................................*Cynoscion nebulosus* (Cuvier, 1830) (p. 22)
1. Body with no round black spots, soft dorsal and anal fin scaled ......................... ................................... *Cynoscion regalis* (Bloch and Schneider, 1801) (p. 25)

*Remarks*: Guest and Gunter (1958) were the latest workers to place *Cynoscion* in the Otolithidae, a group assembled by Jordan and Eigenmann (1889) and given family status by Jordan (1923). Vertebral counts were used to diagnose the two families. Otolithids supposedly had more abdominal than caudal vertebrae (14 + 10), while sciaenids had the opposite (10 + 14). Skogsberg (1939), however, did not recognize the Otolithidae as distinct from the Sciaenidae because he detected a gradual transition from sciaenids to otolithids and found that some of Jordan's otolithids (e.g., *Seriphus* and *Nebris*) had the vertebral formula characteristic of sciaenids.

Ginsburg (1930) distinguished *C. nothus* from *C. regalis* in the Atlantic and from *C. arenarius* in the Gulf on the basis of vertebral, dorsal, and anal meristics. Similarities in these characteristics were noted for *C. regalis* and *C. arenarius*, but the species were not synonymized. Weinstein and Yerger (1976a), however, have found electrophoretic and distributional evidence that *C. arenarius* is a subspecies of *C. regalis*, and that finding is accepted here in the synonymy for *C. regalis*.

Two internal features of the swim bladder, which may help elucidate relationships among the *Cynoscion* species of Florida, are found in the anterior two-thirds of the bladder. The first occurs exclusively in *C. nebulosus*. It consists of two parasagittal partitions (Figure 9) and was found in fish as small as 50.7 mm SL. It is present in both sexes. The second feature occurs in larger *C. regalis* and *C. nebulosus*. It consists of two pairs of parasagittal cords (Figure 9). It is present in fishes larger than about 150 mm SL and is found in both sexes. The largest *C. nothus* available was 179 mm SL. It had no parasagittal cords, but larger fish should be examined to verify absence of the cords.

Some of the material examined to make these comparisons is not listed elsewhere in this paper. It included five *C. nothus* from Jacksonville, Florida (FSBC 4370), one from St. Lucie Co., Florida (FSBC 10119) and six from Pensacola Bay, Florida (FSBC 10980). To my knowledge *C. nothus* has not been taken from the area and depths treated in this paper. A few of the *C. regalis* specimens examined came from the east coast of peninsular Florida including two from St. Augustine (FSBC 9891), four from St. Johns Co. (FSBC 4178) and one from Brevard Co. (FSBC 3729).

Hypothetical relationships based on six characters of Florida *Cynoscion* species are shown in Figure 10. The characters are listed and are designated symplesiomorphic (P), synapomorphic (S), or autapomorphic (A) (*sensu* Hennig, 1966) for the genus. Within limits imposed by available material,

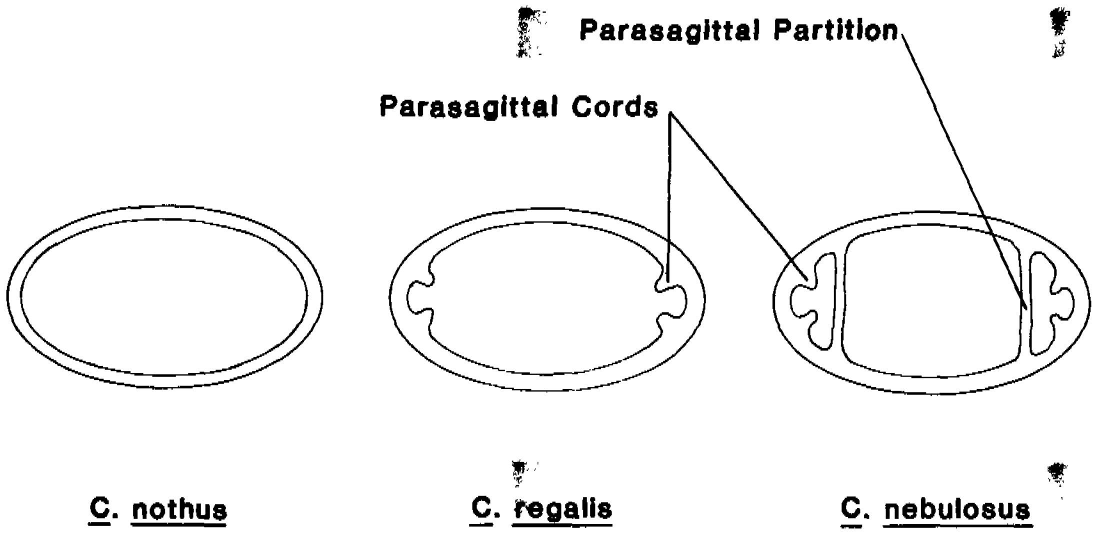



Figure 9. *Cynoscion* swim bladders, cross sections from anterior two-thirds exclusive of horns.

| *C. nothus* | *C. regalis* | *C. nebulosus* |
|---|---|---|
| (P) Scaled dorsal and anal fins | (P) Scaled dorsal and anal fins | (A) Scaleless dorsal and anal fins |
| (P) Not spotted | (P) Not spotted | (A) Spotted |
| (P) Swim bladder with no parasagittal cords | (S) Swim bladder with parasagittal cords | (S) Swim bladder with parasagittal cords |
| (P) Swim bladder with no parasagittal partitions | (P) Swim bladder with no parasagittal partitions | (A) Swim bladder with parasagittal partitions |
| (A) Vertebrae 27 | (P) Vertebrae 25 | (P) Vertebrae 25 |
| (A) A. = II, 9 | (P) A. = II, 11 or 12 | (P) A. = II, 10 or 11 |

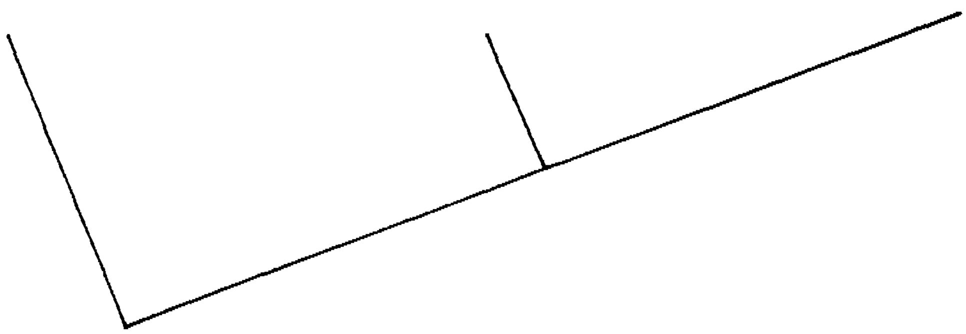


Figure 10. Characteristics and relationships of Florida seatrouts, genus *Cynoscion*. (A), autapomorphic; (P), symplesiomorphic; (S), synapomorphic.

I compared equivalent semaphoronts (*sensu* Hennig, 1966). The systematic significance of these characters, however, will be different if species from a greater geographic area are considered. For example, among Florida seatrouts the reduced anal count of II, 9 is unique autapomorphic, to *C. nothus*. Among western Atlantic seatrouts, however, it is also found (Miller and Jorgenson, 1973) in *C. jamaicensis* (Vaillant and Bocourt, 1915) and is therefore a synapomorphic character, evidence for close relationship of those two species.

## *Cynoscion nebulosus* (Cuvier, 1830)

Spotted seatrout, Figure 11

*Otolithus nebulosus* Cuvier *in* Cuvier and Valenciennes, 1830, p. 79 [Locality unknown].

*Cestreus nebulosus*: Jordan and Eigenmann, 1889, pp. 368, 369, fig. 2 [America: syn. distrib.].

*Cynoscion nebulosus*: Jordan and Evermann, 1898, p. 1409, pl. CCXXI, fig. 563 [North America: descr., distrib., syn.]; Welsh and Breder, 1924, pp. 164-169, figs. 15-20 [eastern U.S.A.: distrib., migration, abundance, spawning, growth]; Hildebrand and Schroeder, 1928, pp. 296-299, figs. 174, 175 [Chesapeake Bay: syn., distrib., descr., food, spawning, growth, catch, migration]; Pearson, 1929, pp. 178-194, figs. 24-32 [Texas: syn., descr., spawning, growth, migration, food, catch]; Ginsburg, 1930, pp. 71-85, figs. 1-7 [southeastern U.S.A.: descr., distrib., systematics]; Hildebrand and Cable, 1934, pp. 92-102, figs. 34-40 [eastern U.S.A.: descr. of larvae through adults, development compared with *C. regalis*, distrib., spawning, growth, temperature]; Gunter, 1938, pp. 30, 31, fig. 8 [Louisiana: seasonal abundance, salinity, temperature]; Gunter, 1945, pp. 76, 77 [Texas: seasonal abundance, spawning, food, salinity, temperature, catch]; Miles, 1949, pp. 145, 146 [Texas: spawning, food]; Herald and Strickland, 1949, p. 107 [Homosassa Springs, Florida: listing]; Moody, 1950, pp. 147-171, pls. 1-4, figs. 1-4 [Cedar Key, Florida: spawning, migraton, growth, food, salinity, temperature]; Gunter, 1950, p. 93 [Texas: abundance]; Simmons, 1950, pp. 1-7 [Texas: spawning, growth, movement, salinity, temperature]; Parker, 1951, pp. 2, 3, figs. 1-4 [Texas: parasites]; Chandler, 1954, p. 351 [Gulf of Mexico: parasites]; Reid, 1954, pp. 53, 54 [Cedar Key, Florida: spawning, salinity, temperature]; Kilby, 1955, pp. 224, 225 [Florida: salinity, temperature]; Reid, 1955b, p. 447 [Texas: spawning, size range]; Joseph and Yerger, 1956, p. 136 [Alligator Harbor, Florida: seasonality, spawning]; Gunter, 1956, p. 350 [North and Middle America: salinity]; Breuer, 1957, p. 350 [Texas: spawning, size, food, salinity]; Simmons, 1957, pp. 185, 186, fig. 10 [Texas: spawning, food, salinity, temperature]; Briggs, 1958, p. 280 [Florida: distrib.]; Darnell, 1958, pp. 384-389, figs. 8, 9 [Lake Pontchartrain, Louisiana: food]; Guest and Gunter, 1958, pp. 1-34, figs. 1-4 [Gulf of Mexico: descr., distrib., fecundity, spawning, gonad maturation, growth, development, migration, food, salinity, temperature, parasites]; Springer and Pirson, 1958, pp. 180, 181, fig. 14 [Texas: spawning, seasonality]; Klima and Tabb, 1959, pp. 5-25, figs. 1-5 [northwest Florida: spawning, growth, food, salinity, temperature]; Springer and Woodburn, 1960, pp. 52, 53 [Tampa Bay, Florida: spawning,

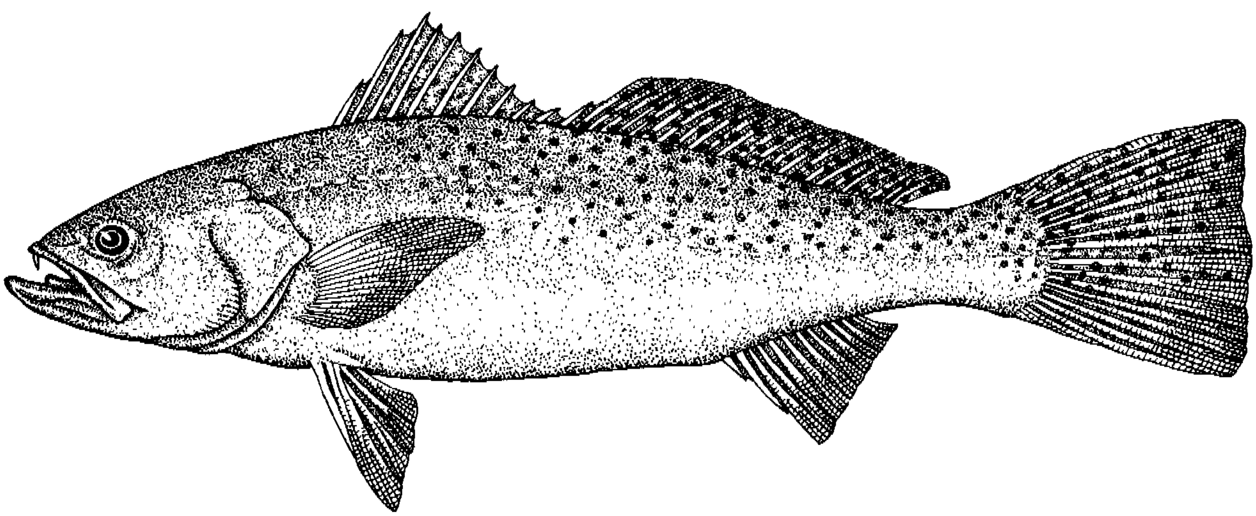


Figure 11. *Cynoscion nebulosus* (Cuvier, 1830).

growth, food, salinity, temperature]; Stewart, 1961, pp. 1-103, figs. 1-14 [Florida Everglades: spawning, growth, food]; Tabb, 1961, pp. 4-22, figs. 1-4 [east-central Florida: gonad maturation, growth, food]; Tabb and Manning, 1961, pp. 625-628 [Florida Bay: catch, spawning, growth, food, temperature, hurricane effects]; Moffett, 1961, pp. 5-33, figs. 1-17 [west Florida: movements, growth, spawning]; Iverson and Tabb, 1962, pp. 544-548, figs. 1, 2 [Florida: subpopulations, growth, movements]; Sundararaj and Suttkus, 1962, pp. 84-90, figs. 1-4 [Louisiana: fecundity]; Beaumariage, 1969, p. 28 [Florida: movements]; Seagle, 1969a, pp. 25-27, figs. 6, 10, 13, 14 [Texas: food]; Seagle, 1969b, 6 pp., figs. 1-6 [Texas: food]; Futch, 1970, pp. 1-11, 4 figs. [Florida: catch, distrib., descr., spawning, movements, growth, food, parasites]; Jannke, 1971, pp. 33-39, figs. 6, 7 [Florida Everglades: spawning]; Wang and Raney, 1971, p. 37 [Charlotte Harbor, Florida: seasonal abundance, salinity, temperature]; Hastings, 1972, pp. 277, 278 [northeastern Gulf of Mexico: record from jetties]; Odum and Heald, 1972, pp. 719, 720 [southeastern Florida: food]; Miller and Jorgenson, 1973, p. 308 [western Atlantic: meristics]; Lippson and Moran, 1974, pp. 214-216, 8 figs. [Potomac River: literature review, descr. of larvae through adults]; Weinstein and Yerger, 1976a, pp. 599-607, figs. 1-6 [Gulf of Mexico: electrophoresis, systematics]; Weinstein and Yerger, 1976b, pp. 97-102, figs. 1-4 [Florida: electrophoresis, populations]; Matlock et al., 1977, pp. 477-483, figs. 1, 2 [Texas: local abundance, effect of commercial netting]; Chao, 1978, pp. 10, 11, 13, 15, 20-22, 24-27, 34-37, 43, 45, 46, 49, 51, 52, figs. 4, 17, 22, 29, 30 [western Atlantic: syn., distrib., systematics]; Fable et al., 1978, pp. 65-71, figs. 1, 2 [Texas: descr. of eggs and larvae]; Snell, 1978, p. 5 [Florida: commercial landings]; Powles and Stender, 1978, pp. 11-16 [southeastern U.S.A.: distrib., spawning, descr. of larvae, maturity]; Johnson, 1978, pp. 180-186, figs. 106-109 [Mid-Atlantic Bight: literature review]; Harrington et al., 1979, 8 pp. [Texas: conversion of size measurements].

*Material examined*: HOURGLASS STATIONS: None collected. — OTHER MATERIAL: 5, 25.8-85.3; Crystal River, Citrus Co.; 15 July 1971; seine; FSBC 6869. — 1, 137; Crystal River, Citrus Co.; 28 July 1971; trynet; FSBC 6875. — 1, 225; Crystal River, Citrus Co.; 3 June 1969; trawl; FSBC 7825. — 4, 40.4-107; Crystal River, Citrus Co.; 24 August 1970; seine; FSBC 7839. — 7, 29.8-59.4; Crystal River, Citrus Co.; 25 August 1970; seine; FSBC 7840. — 2, 119, 131; Crystal River, Citrus Co.; 15 April 1969; trawl; FSBC 7862. — 88, 15.4-64.6; Boca Ciega Bay, Pinellas Co.; 14 October 1958; trawl; FSBC 897. — 1, 70.1; Cross Bayou Canal, Pinellas Co., 1.5 m; 22 January 1958; seine; FSBC 328. — 2, 84.4, 95.5; Old Tampa Bay, Pinellas Co., 1.5 m; 16 December 1957; trawl; FSBC 276. — 3, 38.0-88.1; Gandy Flats, Tampa Bay, Pinellas Co.; 21 September 1956; FSBC 36. — 8, 15.7-40.8; Tampa Bay, Pinellas Co., 1 m; 6 June 1958; push net; FSBC 579. — 1, 67.2; Tampa Bay, Pinellas Co., 6 m; 7 January 1965; trawl; FSBC 2776. — 3, 37.0-42.5; Tampa Bay, Pinellas Co.; 9 October 1964; seine; FSBC 3212. — 4, 34.4-128; Tampa Bay, Pinellas Co., 2.5 m; 31 August 1964; trawl; FSBC 3265. — 1, 56.4; Bunce's Pass, Pinellas Co.; 27 August 1969; seine; FSBC 5514. — 78, 37.2-127; Little Bacilla Island, Lee Co., 1 m; 13 August 1965; trawl; FSBC 3743. — 4, 39.9-57.8; York Island, Lee Co., 0.5 m; 10 August 1965; trawl; FSBC 3759. — 18, 31.9-153; Buzzard Bay, Lee Co.; 12 August 1965; FSBC 6314. — 10, 32.8-118; Smokehouse Key, Lee Co., 0.5 m; 11 August 1965; trawl; FSBC 6361.

*Diagnosis*: See generic diagnosis; BD 21.8-29.0% SL; soft dorsal and anal fins not scaled; 25 vertebrae; caudal fin 17.8-30.8% SL; color dark bluish gray above with round black spots dorsolaterally and on dorsal and caudal fins, pale silver below; D. X+I, 24-26; A. II, 10 or 11.

*Distribution and abundance*: *Cynoscion nebulosus* occurs from New York to Florida and along the Gulf coast to northern Mexico (Chao, 1978). Its center of abundance is along the coast of Florida and the Gulf states (Pearson, 1929). It represented 3.8% by weight and 5.7% by dollars of Florida's west coast commercial finfish landings in 1976 (Snell, 1978).

*Life history*: Length of the spotted seatrout spawning season increases at lower latitudes. Spawning is limited to May and June in Chesapeake Bay (Hildebrand and Schroeder, 1928), but may occur year-round in the Florida Everglades (Stewart, 1961; Jannke, 1971). At latitudes covered in this study, spawning occurs from March through October or November (Guest and Gunter, 1958; Tabb, 1961).

Spawning may take place in coastal or estuarine areas (Pearson, 1929; Tabb, 1961; Powles and Stender, 1978). Fable et al. (1978) described eggs and early larvae from rearing studies, while Powles and Stender (1978) described development of wild-caught specimens 4.9-32.2 mm SL. Larval and juvenile development often occurs in beds of submerged grasses.

Studies of spotted seatrout migration show they do not move far, generally less than 50 km (Moffett, 1961; Beaumariage, 1969). As a result, there is reduced gene flow between adjacent estuarine systems. The population of each system becomes locally adapted and takes on unique characteristics (Weinstein and Yerger, 1976b).

Perret et al. (1980) summarized growth information on six Gulf populations of spotted seatrout. Growth rates vary among estuaries and with the year class for a given estuary, but female growth rates always exceed those of the males. Averaging data tabulated by Perret et al. (1980) shows that the standard lengths of fish from western peninsular Florida will be about 117, 203, 264, 316, 363, and 410 mm at ages one through six respectively. The record size spotted seatrout reported by the International Game Fish Association (McCracken, 1979) weighed 7.25 kg (16 lb).

Harrington et al. (1979) derived SL-TL and TL-weight relationships for spotted seatrout.

Tabb (1961) presented data showing an increasing percentage of females among older fish. Moffett (1961) found the oldest males were age six, and the oldest females were age eight.

Some males become sexually mature in their second year at about 180 mm SL while females require at least two to three years to reach maturity at 210 mm SL (Klima and Tabb, 1959). Tabb (1961) described six stages of gonadal maturation, and Sundararaj and Suttkus (1962) found fecundity increases with size to about 1.1 million.

*Food*: *Cynoscion nebulosus* seems to be an adventitious carnivore that feeds mainly in grassy areas (Tabb, 1961; Seagle, 1969a and 1969b). Its diet is determined chiefly by its size and by the seasonal abundance of food organisms (Pearson, 1929; Gunter, 1945). Moody (1950) found that 20-30 mm SL fish fed mainly on copepods, 40-150 mm SL fish fed on caridean shrimps, 150-300 mm SL fish ate penaeid shrimps, and larger fish ate mainly fishes. He also found that fish and crustacea were taken in equal volume during the spring and summer, but more fish than crustaceans were taken in fall and winter. Large spotted seatrout in Texas feed on mullet, which may be greater than half their size (Breuer, 1957; Simmons, 1957).

Darnell (1958) summarized the literature on spotted seatrout feeding and found temporal resource partitioning among *Cynoscion* species in Lake Pontchartrain. *Cynoscion nebulosus* feeds in the mid-morning, while *C. regalis* feeds early in the morning and again in the afternoon.

*Salinity and temperature*: Gunter (1956) includes *C. nebulosus* as a euryhaline fish. In Texas, he took them at salinities of 2.3 to 34.9 $^{o}/oo$, mainly below 20 $^{o}/oo$ (Gunter, 1945). Herald and Strickland (1949) recorded them from the fresh water of Homosassa Springs, Florida. Simmons (1957) took them in Texas at salinities from 25 $^{o}/oo$ to 75 $^{o}/oo$, but found they did not spawn in salinities over 45 $^{o}/oo$.

Although Reid (1954) considered this species eurythermal as well as euryhaline, temperature has been reported as a limiting factor causing trout to seek deeper water when temperature drops in the fall. Hildebrand and Cable (1934) record numbing of trout by cold weather, and major cold kills have occurred in Texas (Guest and Gunter, 1958).

*Parasites*: *Poecilancistrium robustrum* or closely related tapeworm larvae are internal parasites commonly found in larger *C. nebulosus*. The pleurocerci are found in the upper lateral musculature of the trout, and the adult is found in sharks. These "spaghetti worms" do not affect the taste of the trout and are not infectious to humans (Parker, 1951; Chandler, 1954).

The copepod *Lernanthropus gisleri* is the spotted seatrout's most common ectoparasite. It has been found on the gills of trout from Florida, Louisiana, Texas, and Mexico (Guest and Gunter, 1958).

*Remarks*: In a recent fishery profile, Perret et al. (1980) summarized biological information on this species. That paper should be consulted for further detail.

## *Cynoscion regalis* (Bloch and Schneider, 1801)

Weakfish, Figure 12

*Johnius regalis* Bloch and Schneider, 1801, p. 75.

*Cestreus regalis*: Jordan and Eigenmann, 1889, pp. 366-368, fig. 1 [America: syn., distrib., descr.].

*Cynoscion regalis*: Jordan and Evermann, 1898, p. 1407, pl. CCXX, fig. 562 [North America: syn., descr., distrib.]; Welsh and Breder, 1924, pp. 150-164, figs. 2-14 [eastern U.S.A.: spawning, descr. of eggs through adults, migrations, growth, maturity, food, salinity, temperature]; Hildebrand and Schroeder, 1928, pp. 300-305, figs. 176-182 [Chesapeake Bay: syn., descr., sexual dimorphism, spawning, growth, food, catch]; Hildebrand and Cable, 1934, pp. 102-110, fig. 41 [eastern U.S.A.: spawning, descr. of eggs and larvae, growth]; Bigelow and Schroeder, 1953, pp. 417-423, fig. 217 [Gulf of Maine: distrib., descr., spawning, growth]; Scotton et al., 1973, pp. 78-81, 5 figs. [Delaware Bay: literature review, descr. of eggs through adults]; Lippson and Moran, 1974, pp. 217-219, 7 figs. [Potomac River: literature review, descr. of eggs through adults]; Chao and Musick, 1977, pp. 657-702, figs. 1-5, 10-13, 20-29 [York River, Virginia: life history, feeding adaptions, food]; Powles and Stender, 1978, pp. 20-26 [southeastern U.S.A.: distrib., spawning, descr. of eggs and larvae]; Johnson, 1978, pp. 190-197, figs. 112-116 [Mid-Atlantic Bight: literature review]; Wilk, 1979, pp. 1-49, figs. 1-17 [eastern U.S.A.: biological and fisheries information, literature review]; Weinstein, 1981, pp. 125-138, figs. 1-3 [ western Atlantic: distrib., spawning, salinity, temperature, food].

*Cynoscion arenarius* Ginsburg, 1930, pp. 71-85, figs. 1-4, 6, 7; [U.S.A. Gulf and Atlantic coasts: systematics, meristics, morphometrics, descr.]; Ginsburg, 1931, p. 144 [Louisiana: depth, size]; Gunter, 1938, pp. 329, 330, fig. 7 [Louisiana: spawning, migration]; Gunter, 1945, pp. 75, 76 [Texas: spawning, growth, migration, salinity, temperature]; Reid, 1954, pp. 52, 53 [Cedar Key, Florida: seasonal abundance, food, salinity, temperature]; Hildebrand, 1954, p. 312 [western Gulf of Mexico: spawning, depth, migration, food]; Reid, 1955b, pp. 446, 447 [East Bay, Texas: spawning, food]; Hildebrand, 1955, p. 213 [Gulf of Campeche: abundance, depth]; Kilby, 1955, p. 225 [Florida Gulf coast: size, salinity, temperature]; Joseph and Yerger, 1956, p. 137 [Alligator Harbor, Florida: depth, food]; Reid et al., 1956, p. 102 [East Bay, Texas: food]; Simmons, 1957, p. 185 [Laguna Madre, Texas: abundance, salinity];

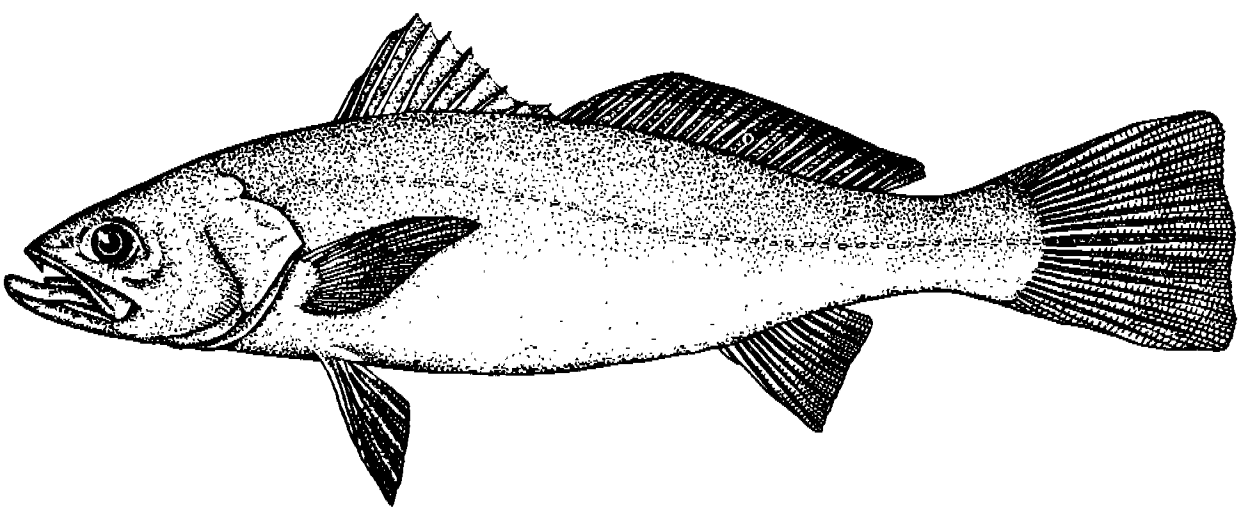


Figure 12. *Cynoscion regalis* (Bloch and Schneider, 1801).

Breuer, 1957, p. 146 [Baffin and Alazan Bays, Texas: abundance]; Darnell, 1958, pp. 383, 384, fig. 7 [Lake Pontchartrain, Louisiana: food]; Guest and Gunter, 1958, pp. 34-37 [Gulf of Mexico: size, spawning, migration, food, salinity, temperature]; Briggs, 1958, p. 280 [Florida: distrib.]; Springer and Woodburn, 1960, p. 53 [Tampa Bay, Florida: depth, spawning, food, salinity, temperature]; Jannke, 1971, pp. 44-47, fig. 10 [Florida Everglades: spawning]; Wang and Raney, 1971, p. 37 [Charlotte Harbor, Florida: salinity, temperature]; Hastings, 1972, pp. 276, 277 [northeastern Gulf of Mexico: depth, food, temperature]; Miller and Jorgenson, 1973, p. 308 [western North Atlantic: meristics]; Weinstein and Yerger, 1976a, pp. 599-607, figs. 1-6 [Gulf of Mexico: electrophoresis, systematics]; Hoese and Moore, 1977, p. 205 [Texas and Louisiana: descr., spawning, food]; Chao, 1978, pp. 10, 11, 13, 15, 20-22, 24-27, 34-37, 43, 45, 46, 49, 51, 52, figs. 4, 17, 29, 30 [western Atlantic: syn., distrib., systematics]; Snell, 1978, p. 5 [Florida: commercial landings].

*Material examined*: HOURGLASS STATION A: 9, 189-209; 4 October 1965; trynet; FSBC 4476. — HOURGLASS STATION I: 2, 212, 222; 3 September 1965; trynet; FSBC 4445. — OTHER MATERIAL: 1, 40.0; Crystal River, Citrus Co.; 28 July 1971; trawl; FSBC 9408. — 1, 203; Pass-a-Grille Beach, Pinellas Co., 6-8 m; 13 September 1962; trynet; FSBC 2258. — 2, 12.2, 16.2; Long Bayou, Pinellas Co., 1 m; 12 May 1971; FSBC 8368. — 1, 67.3; Long Bayou, Pinellas Co., 1 m; 29 September 1971; FSBC 8756. — 1, 70.9; Cross Bayou Canal, Pinellas Co.; FSBC 197. — 21, 31.1-67.3; Cross Bayou Canal, Pinellas Co., 1.5 m; 17 July 1958; seine; FSBC 688. — 26, 31.4-79.7; Cross Bayou Canal, Pinellas Co., 1 m; 13 October 1958; seine; FSBC 888.

*Diagnosis*: See generic diagnosis; BD 22.6-34.1% SL; soft dorsal and anal fins scaled; 25 vertebrae; caudal fin 17.9-36.9% SL; color pale, without well defined spots, yellowish above, silvery below; indistinct broad cross bars in young; D. X + I, 24-26 (occasionally 27); A. II, 10 or 11 (occasionally 12).

*Distribution and abundance*: *Cynoscion regalis* (including *C. arenarius*) occurs along the United States Atlantic coast and throughout the Gulf of Mexico (Briggs, 1958; Guest and Gunter, 1958).

Weakfish (reported as white seatrout) represented less than one percent by weight and dollars of commercial finfish landings from Florida's west coast in 1976 (Snell, 1978).

*Life history*: Weakfish spawn from May to September on the northeast United States coast (Welsh and Breder, 1924). Spawning extends from March to September in the Gulf and from mid-February through October in the Everglades of south Florida (Jannke, 1971).

Spawning occurs in or near the mouths of bays (Powles and Stender, 1978). While the spawning grounds of weakfish and spotted seatrout may overlap, spotted seatrout spawn mainly in shallow estuarine areas while weakfish spawn in the deeper sounds, passes, and nearshore areas (Weinstein, 1981). On 17 October 1979 I collected night surface samples of plankton entering Tampa Bay at flood tide. They contained weakfish larvae as small as 3.3 mm SL.

Egg and larval development have been described. Welsh and Breder (1924) gave the first descriptions from field notes of Lewis Radcliffe, and Powles and Stender (1978) provided the most recent information.

Wilk (1979) summarized age and growth information on weakfish. They average total lengths of 191, 264, 310, 375, 435 and 480 mm at ages one through six respectively.

In the northern Gulf of Mexico, weakfish spend much of their adult life at depths less than 22 m. They are replaced by *C. nothus* offshore (Ginsburg, 1931; Hoese and Moore, 1977). When in protected inshore waters, they prefer channels to grass flats (Springer and Woodburn, 1960).

Gunter (1945) reported a ripe male 157 mm long and Hildebrand (1954) found four ripe females

210-375 mm long. These Gulf of Mexico specimens confirm Wilk's (1979) estimate that sexual maturity in both males and females is reached during the second year.

*Food*: Reid et al. (1956) found that weakfish less than 60 mm in length feed on copepods and larval or metamorphosing shrimps and crabs. Fish 60-79 mm feed mainly on shrimps, and larger weakfish feed of such fishes as clupeids, engraulids, and sciaenids. Reid (1955b) found fish remains in the stomachs of 34mm SL weakfish.

Darnell (1958) found similar feeding habits and considered *C. regalis* a highly selective predator since it consumed few incidental items. He took the absence of sand and plant remains as an indication that seagrass beds are not primary feeding sites. If this is true, *C. regalis* does not compete with *C. nebulosus* for food when in protected inshore waters.

Chao and Musick (1977) described the weakfish's anatomical adaptations for feeding.

*Salinity and temperature*: Gunter (1945) noted a positive correlation between the size of fish and the salinity where they were caught. They have been taken at salinities from zero to greater than 45 $^{o}/oo$ (Simmons, 1957; Springer and Woodburn, 1960; Wang and Raney, 1971). Hourglass specimens were taken at salinities of 34.61-35.13 $^{o}/oo$.

Weakfish seem to seek warmer waters with the onset of cool weather. Gunter (1938, 1945) noted a fall migration from the bays to the Gulf and collected weakfish at temperatures ranging from 13.7-36.7°C. Springer and Woodburn (1960) reported cold-killed specimens from Tampa Bay at 13°C but also reported live specimens from Pensacola Bay at 10.2°C. Hourglass specimens were taken at temperatures of 27.8-29.6°C.

*Remarks*: Additional biological and fishery information on the weakfish is available in a summary by Wilk (1979). That paper should be consulted for further details.

## Genus *Equetus* Rafinesque, 1815

### *Equetus lanceolatus* (Linnaeus, 1758)

Jackknife-fish, Figure 13

*Chaetodon lanceolatus* Linnaeus, 1758, p. 277 [Caraibes Islands].

*Eques lanceolatus*: Jordan and Eigenmann, 1889, pp. 441, 442 [America: syn., distrib.]; Jordan and Evermann, 1898, pp. 1489, 1490, pl. CCXXVI, fig. 575 [North America: syn., descr., distrib.]; Welsh and Breder, 1924, p. 198, fig. 60 [eastern U.S.A.: distrib.]; Longley and Hildebrand, 1941, pp. 143, 144 [Tortugas, Florida: descr. of juveniles and adults]; Hildebrand, 1955, p. 213 [Gulf of Campeche: abundance].

*Equetus lanceolatus*: Jordan et al., 1930, p. 353 [North and Middle America: distrib., syn.]; Briggs, 1958, p. 280 [Florida: distrib.]; Springer and Woodburn, 1960, p. 54 [Tampa Bay, Florida: listing, depth, descr.]; Tabb and Manning, 1961, p. 628 [Florida Bay: listing]; McPhail, 1961, pp. 27, 28, fig. 1 [eastern Pacific: generic relationships]; Starck, 1968, p. 23 [Alligator Reef, Florida: abundance]; Böhlke and Chaplin, 1968, p. 401, 1 fig. [Bahamas: descr., distrib., habitat]; Randall, 1968, p. 152, fig. 174 [Caribbean: descr., distrib., depth]; Hastings, 1972, pp. 278-280 [northeastern Gulf of Mexico: distrib., depth and substrate preference, growth]; Miller and Jorgenson, 1973, p. 308 [western Atlantic: meristics]; Smith, 1973, pp. 132-135 [eastern Gulf of Mexico: abundance, ecology, distrib., spawning]; Smith et al., 1975, p. 8 [Florida Middle Ground: listing]; Smith, 1976, pp. 28, 29 [eastern Gulf of Mexico: distrib., abundance]; Gilmore, 1977, p. 139 [eastern peninsular Florida: distrib.]; Smith, 1978, pp. 209, 210 [mid-eastern Gulf of Mexico: depth and habitat preference, spawning]; Chao, 1978, pp. 8, 14, 24-27, 44, 50, 52, figs. 4, 30 [western Atlantic: syn., distrib., systematics].

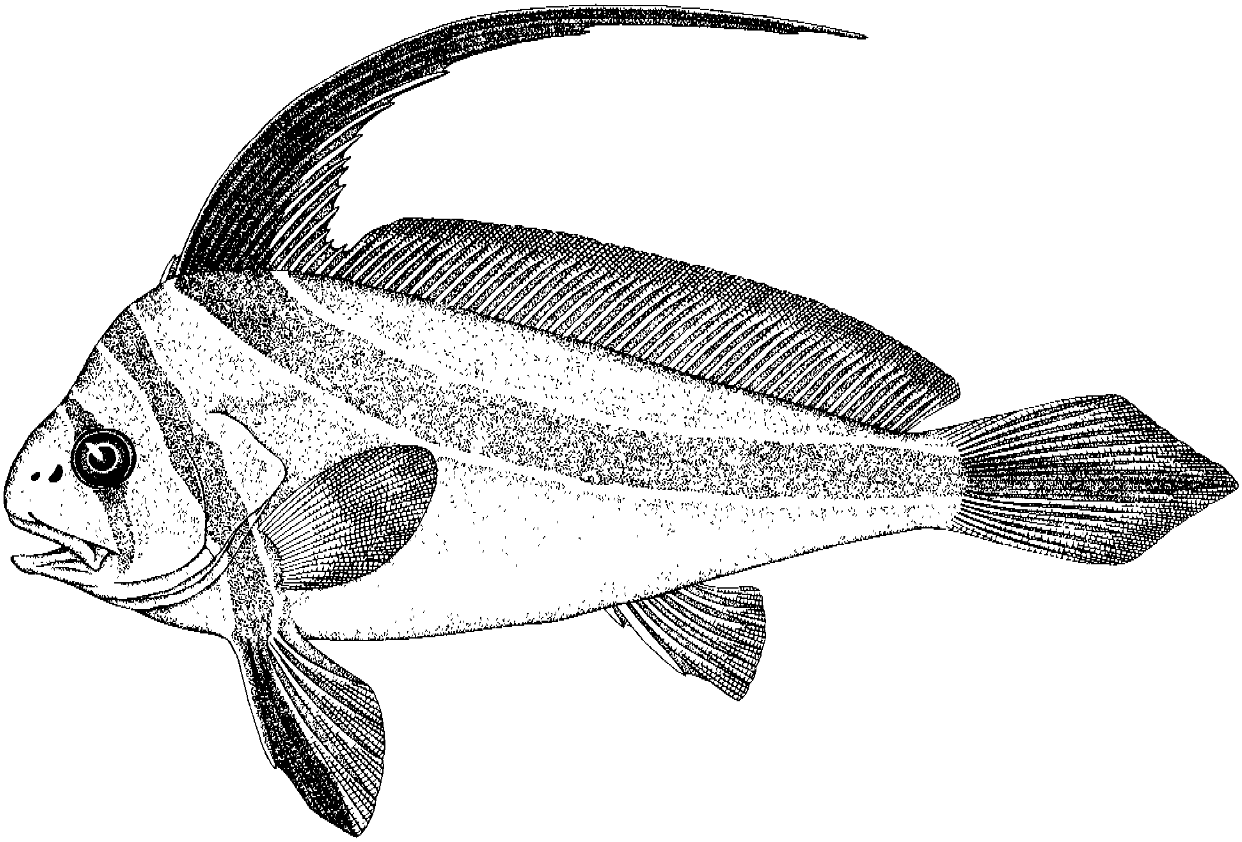


Figure 13. *Equetus lanceolatus* (Linnaeus, 1758).

*Material examined*: HOURGLASS STATION B: 1, 56.4; 3 August 1965; trynet; FSBC 4422.—7, 126-206; 20 October 1965; trynet; FSBC 4535.—2, 155, 158; 2 July 1966; trynet; FSBC 10419.—9, 128-205; 18 July 1966; trawl; FSBC 10422.—4, 101-133; 20 June 1967; trynet; FSBC 10416.—HOURGLASS STATION C: 1, 138; 8 November 1965; trynet; FSBC 10423.—3, 159-186; 3 January 1966; trynet; FSBC 4659.—1, 179; 20 February 1966; trynet FSBC 5008.—4, 146-177; 1 December 1966; trynet; FSBC 10410.—2, 128, 130; 2 June 1967; trynet; FSBC 10414.—2, 137, 158; 6 January 1967; trynet; FSBC 10418.—1, 173; 1 July 1967; trynet; FSBC 10413.—HOURGLASS STATION D: 1, 140; 20 November 1966; trynet; FSBC 5266.—1, 140; 26 January 1967; trawl; FSBC 10417.—HOURGLASS STATION J: 6, 115-147; 12 October 1965; trynet FSBC 4516.—5, 123-158; 12 November 1965; trynet; FSBC 10424.—1, 127; 13 January 1966; trynet; FSBC 10421.—13, 144-183; 9 March 1966; trynet; FSBC 4911.—47, 111-208; 21 July 1966; trawl; FSBC 4883.—11, 156-194; 30 January 1967; trawl; FSBC 10407.—16, 118-186; 5 July 1967; trynet; FSBC 10425.—5, 32.7-61.8; 6 August 1967; scuba; FSBC 5370.—9, 128-186; 11 October 1967; trynet; FSBC 10426.—HOURGLASS STATION K: 3, 141-149; 22 July 1966; trawl; FSBC 5251.—2, 138, 176; 5 August 1966; trynet; FSBC 4859.—1, 143; 12 January 1967; trynet; FSBC 10411.—29, 84.3-197; 30 January 1967; trawl; FSBC 5667.—HOURGLASS STATION L: 2, 154, 160; 13 October 1965; trynet; FSBC 4523.—1, 120; 8 April 1967; trynet; FSBC 10409.—OTHER MATERIAL: 1, 199; 28°21'N, 84°05'W, 30 m; 2 May 1965; trawl; FSBC 3471.—2, 163, 175; northwest of Egmont Key, Pinellas Co., 9 m; 5 December 1964; trawl; FSBC 2724.—2, 29.7, 151; west of Egmont Key, Pinellas Co., 22 m; 23 August 1962; trynet; FSBC 2249.—8, 91.0-156; west of Egmont Key, Pinellas Co., 28 m; 16 December 1964; trawl; FSBC 2539.—1, 101; west of Egmont Key, Pinellas Co., 24 m; 17 December 1964; trynet; FSBC 2939.—1, 162; 27°35'N, 83°07'W, 24 m;

18 April 1963; trynet; FSBC 2640. — 9, 149-190; west of Anna Maria Key, Manatee Co.; 10 February 1958; explosives; FSBC 385. — 1, 161; Gulf of Mexico, off Bradenton, Manatee Co.; 19 June 1962; dredge; FSBC 2185. — 3, 87.6-103; 27°24'N, 83°20'W, 34 m; 22 December 1964; trawl; FSBC 2875. — 4, 128-178; 27°06'N, 83°15'W, 38 m; 21 October 1965; trawl; FSBC 5472. — 3, 22.6-59.7; off Sarasota, Sarasota Co., 18 m; 30 August 1970; scuba; FSBC 7305. — 2, 59.0, 66.6; off Sarasota, Sarasota Co., 15 m; 31 October 1970; scuba; FSBC 7336. — 1, 65.1; off Sarasota, Sarasota Co., 15 m; 10 November 1970; scuba; FSBC 7351. — 1, 37.0; off Sarasota, Sarasota Co., 22 m; 23 September 1970; scuba; FSBC 7355. — 1, 69.8; off Sarasota, Sarasota Co., 22 m; 24 October 1970; scuba; FSBC 7373. — 4, 41.1-55.2; off Sarasota, Sarasota Co., 23 m; 12 September 1970; scuba; FSBC 7374. — 2, 102, 104; off Sarasota, Sarasota Co., 16 m; 24 March 1972; scuba; FSBC 7553.

*Diagnosis*: Mouth inferior; body compressed with elevated back sloping to narrow caudal peduncle; BD 34.6-41.9% SL; second dorsal spine elongate, 51.3-100.9% SL; predorsal bones absent; color light yellowish with three brown lateral stripes bordered by white, principle stripe extending up leading edge of dorsal fin; D. 13-16 spines and 44-55 soft-rays (The last spine may or may not be the first element of the soft dorsal.); A. II, 6 (some 5 or 7).

*Distribution and abundance*: Chao (1978: 52) gives the distribution of *E. lanceolatus* as "Bermudas, North Carolina to Florida, western Gulf of Mexico, Antilles, and Venezuela to Brazil." They also occur from Campeche Bank to southernmost Brazil (George C. Miller, personal communication) and in the South Atlantic Bight (Miller and Richards, 1980). In Florida, jackknife-fish have been recorded from the Keys (Starck, 1968), from the Tortugas (Longley and Hildebrand, 1941), from western peninsular Florida (Springer and Woodburn, 1960) and from the northeastern Gulf of Mexico (Hastings, 1972; Smith et al., 1975). Gilmore (1977) lists them as uncommon on offshore reefs in his study area of eastern peninsular Florida.

The numbers of *E. lanceolatus* specimens taken during Project Hourglass collections are presented in Table 2.

*Life history*: The smallest Hourglass jackknife-fish were taken mainly in summer and fall (Table 3). That is the time of year they are usually seen by researchers (Smith, 1973, 1978), scuba divers, and

TABLE 2. NUMBERS OF HOURGLASS *Equetus lanceolatus* BY STATION AND MONTH.

| *Equetus lanceolatus* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STA | 1965 | | | | | 1966 | | | | | | | | | | | | | 1967 | | | | | | | | | | | | TOT |
| | A | S | O | N | D | J | F | M | A | M | J | J | J sp | A | S | O | N | D | J | J sp | F | M | A | M | J | J | A | S | O | N | |
| A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| $B_1$ | 1 | 1 | | | 1 | | | | | | | 2 | 9 | | 6 | | 6 | 2 | | 1 | | | 7 | 1 | 1 | 1 | | | | | 39 |
| $B_2$ | | | 7 | 5 | | | | | | | 1 | | | | 10 | | 61 | | | | | | 1 | | 45 | | | | | | 130 |
| $C_1$ | | 1 | | 2 | 2 | 3 | | | 1 | | | | | 3 | | | | 6 | 2 | 13 | | | | | 2 | 1 | | | 1 | | 37 |
| $C_2$ | | | | | | | 1 | | 1 | | | | | | | | | | | | | | | | | | | | | | 2 |
| $D_1$ | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | 1 |
| $D_2$ | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | | | | 1 |
| E | | | | | | | | | | | | | | 1 | | | | | | | | | | | | | | | | | 1 |
| I | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| J | 9 | 2 | 6 | 5 | | 1 | 3 | 16 | | | 1 | | 47 | | | 1 | 5 | | | 13 | 10 | | | | | 19 | 5 | | 9 | 2 | 154 |
| K | | 1 | | | | | 1 | 1 | | 2 | | 1 | 3 | 2 | | 1 | | | 1 | 43 | 1 | | 2 | | | | | | | | 59 |
| L | | 1 | 2 | | | | | | | | | | | 1 | | 3 | | | | | | | 1 | | | | | | | | 8 |
| M | | | | | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | 1 |
| TOT | 10 | 6 | 15 | 12 | 3 | 4 | 5 | 17 | 3 | 2 | 2 | 3 | 59 | 7 | 16 | 5 | 73 | 8 | 3 | 71 | 11 | | 11 | 1 | 48 | 21 | 5 | | 10 | 2 | 433 |

Subscripts 1, 2 and sp designate regular, post and supplementary cruises *sensu* Joyce and Williams (1969).

TABLE 3. MONTHLY CATCH OF HOURGLASS *Equetus lanceolatus* BY SIZE CLASS.

TABLE 3.

| SL | 1965 | | | | | 1966 | | | | | | | | | | | | 1967 | | | | | | | | | | | TOT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | A | S | O | N | D | J | F | M | A | M | J | J | A | S | O | N | D | J | F | M | A | M | J | J | A | S | O | N | |
| 40 | | | | | | | | | | | | | | | | | | | | | | | | | 3 | | | | 3 |
| 50 | | | | | | | | | | | | | | 1 | | | | | | | | | | | 1 | | | | 2 |
| 60 | | 1 | | | | | | | | | | | | 3 | | | | 1 | | | | | | | | | | | 5 |
| 70 | | | | | 1 | | 1 | | | | | 1 | | 5 | | 3 | 1 | | | | | | | | 1 | | | 1 | 14 |
| 80 | | | | 1 | | | | | | | | | | 5 | | 10 | 1 | | | | | | | | | | | | 17 |
| 90 | | | | | 1 | | | | | 1 | | | | 1 | | 16 | | 1 | | | | 1 | | | | | | | 21 |
| 100 | | | | | | | | | | | | | | | | 10 | 1 | 2 | | | | | 2 | | | | | | 15 |
| 110 | | | | | | | | | | | | 1 | | | | 17 | | | 1 | | 1 | | 5 | | | | | | 25 |
| 120 | 1 | 1 | 1 | | | | | | 1 | | | 1 | 2 | 1 | 1 | 7 | | 2 | | | 2 | | 12 | 3 | | | | | 35 |
| 130 | | 1 | 1 | 1 | | 1 | | | | | | 7 | | | | 2 | | 2 | | | 2 | | 21 | 3 | | | 2 | | 43 |
| 140 | 2 | | 2 | 6 | | | 1 | 1 | | | | 10 | 1 | | | 1 | | 9 | | | 3 | | 7 | 4 | | | 1 | | 48 |
| 150 | 2 | 1 | 5 | 2 | | | 1 | 4 | 1 | | | 13 | | | 1 | 1 | 1 | 10 | 3 | | | | | 2 | | | | | 47 |
| 160 | 3 | 1 | 3 | 2 | | 1 | 1 | 6 | | | 1 | 8 | 3 | | 1 | 2 | | 10 | 1 | | 1 | | 1 | 1 | | | 2 | | 48 |
| 170 | 1 | | | | | | | 3 | | | | 8 | | | 2 | 1 | 2 | 13 | 2 | | 2 | | | 4 | | | 1 | | 39 |
| 180 | 1 | 1 | 1 | | | 1 | 1 | | 1 | 1 | | 5 | 1 | | | 1 | 2 | 16 | 1 | | | | | 3 | | | 2 | | 38 |
| 190 | | | 1 | | | 1 | | 2 | | | 1 | 4 | | | | 1 | | 4 | 3 | | | | | 1 | | | 2 | | 20 |
| 200 | | | | | | | | 1 | | | | 2 | | | | 1 | | 4 | | | | | | | | | | 1 | 9 |
| 210 | | | 1 | | 1 | | | | | | | 1 | | | | | | | | | | | | | | | | | 3 |
| 220 | | | | | | | | | | | | 1 | | | | | | | | | | | | | | | | | 1 |
| TOT | 10 | 6 | 15 | 12 | 3 | 4 | 5 | 17 | 3 | 2 | 2 | 62 | 7 | 16 | 5 | 73 | 8 | 74 | 11 | 0 | 11 | 1 | 48 | 21 | 5 | 0 | 10 | 2 | 433 |

tropical fish collectors. Furthermore, ova were mature (i.e., 1.0 mm in diameter and clear) in June and July (Table 4). A late spring and summer spawning season is indicated.

TABLE 4. EGG MATURITY IN *Equetus lanceolatus*.

| Month | Number of females examined | Egg diameters in mm |
|---|---|---|
| January | 17 | 0.04-0.50 |
| February | 2 | 0.06-0.10 |
| March | 5 | 0.05-0.09 |
| April | 1 | 0.05-0.06 |
| May | 1 | 0.10-0.50 |
| June | 7 | 0.40-1.00 |
| July | 11 | 0.05-1.00 |
| August | 1 | 0.30-0.05 |
| September | 0 | —— |
| October | 9 | 0.05-0.50 |
| November | 2 | 0.02-0.07 |
| December | 4 | 0.04-0.06 |

Eggs and larvae are undescribed. Fish hatched in 1966 grew to 125 mm SL in about a year (Table 3). Unfortunately, too few young were taken to determine whether the 1965 and 1967 year classes had that same growth rate.

Frightened juvenile *E. lanceolatus* may retreat into the protection of sea urchin (*Diadema antillarum* Philippi, 1845) spines (Smith, 1978). The fish orient with their lateral stripes parallel to the long *Diadema* spines thereby becoming both camouflaged and protected. The smallest females collected with mature ova were 132 mm SL.

*Food*: Cursory gut content analyses were made by other workers during early processing of Hourglass fish specimens (Table 5). Food was identified to the lowest taxonomic level possible, hence food group categories are somewhat redundant. Nevertheless, crustaceans are clearly the most important part of the diet.

*Salinity and temperature*: During Hourglass sampling *E. lanceolatus* was taken at bottom salinities of 33-36 $^{0}/_{00}$ and at bottom temperatures of 16-29°C.

TABLE 5. STOMACH CONTENTS OF HOURGLASS *Equetus lanceolatus*.

| Item | Number of Stomachs Containing Item |
|---|---|
| Shrimp | 55 |
| Crustacean remains | 27 |
| Worms | 8 |
| Clams | 7 |
| Bits of shell | 3 |
| Crab | 1 |
| Planktonic crustacean | 1 |
| Algae | 1 |
| Unidentifiable remains | 66 |
| Empty | 224 |

## Genus *Pareques* Gill, 1876

*Diagnosis*: Mouth inferior; body compressed with elevated back; 3 predorsal bones present; dorsal rays 37-42.

*Remarks*: In light of arguments given by McPhail (1961), Chao (1978) recognized three species of *Pareques* among western Atlantic sciaenid fishes. Two of the species, *P. umbrosus* and the undescribed *Pareques* sp. (Black Bar), occur off western peninsular Florida while the third, *P. acuminatus*, occurs farther south and up the east coast to Chesapeake Bay (Chao, 1978). Chao (1978) provided a key to these western Atlantic *Pareques*, but its meristic ranges overlap and it relies on coloration and dorsal spine length which change ontogenetically. As a result, the species of *Pareques* remain difficult to identify.

Identification and interrelationships of *Pareques* species will be treated in a revision now in progress (George C. Miller, personal communication). In the meantime, "*Pareques umbrosus*" refers here to the cubbyu (*Equetus umbrosus*, *sensu* Bailey et al., 1970), a species named for the dark color phase it exhibits when openly visible. All other *Pareques* off western peninsular Florida are here considered *Pareques* sp. (Black Bar) since they have the black peritoneum that George C. Miller (personal communication) says is diagnostic for that species.

Although juvenile *Equetus lanceolatus* and *P. umbrosus* frequently school together, the adults seek different bottom types. Adult *E. lanceolatus* are characteristic of low relief rock, coral and sponge areas while *P. umbrosus* adults are residents of reef ledges (Smith, 1973).

Adult *E. lanceolatus* are thought to remain farther offshore than *P. umbrosus* (Springer and Woodburn, 1960; Smith, 1973). Data presented in Table 6, however, suggest the opposite depth preference. To some extent this may be an artifact of Hourglass sampling. Hourglass trawls were worked in low relief areas (Joyce and Williams, 1969). Such areas are likely to yield more *E. lanceolatus* than *P. umbrosus*. While this consideration explains the results at the 18.3 m stations, it does not explain the results at the 36.6 m stations where *P. umbrosus* predominated.

Powles and Burgess (1978) described morphology and behavior of *Pareques* larvae. They were not able to identify their specimens, the largest of which was 7.6 mm SL, to species.

TABLE 6. NUMBERS BY DEPTH OF HOURGLASS SPECIMENS COLLECTED.

| Species | Depth (meters) 6.1 | 18.3 | 36.6 | 54.9 | 73.2 |
|---|---|---|---|---|---|
| *Menticirrhus littoralis* | 1 | — | — | — | — |
| *Menticirrhus americanus* | 7 | — | — | — | — |
| *Micropogonias undulatus* | — | — | — | 17 | — |
| *Cynoscion regalis* | 24 | — | — | — | — |
| *Equetus lanceolatus* | — | 323 | 98 | 10 | 2 |
| *Pareques umbrosus* | — | 98 | 200 | 78 | 14 |
| *Pareques* sp. (Black Bar) | — | — | — | — | 2 |
| *Leiostomus xanthurus* | 23 | 2 | — | 18 | — |
| *Bairdiella chrysoura* | 21 | — | — | — | — |

## *Pareques umbrosus* (Jordan and Eigenmann, 1889)

Cubbyu, Figure 14

*Eques acuminatus umbrosus* Jordan and Eigenmann, 1889, pp. 440, 441 [Charleston, South Carolina and Pensacola, Florida: descr., distrib., abundance]; Jordan and Evermann, 1898, pp. 1487, 1488 [North America: descr., distrib., syn.].

*Pareques umbrosus*: Jordan et al., 1930, p. 353 [North and Middle America: distrib., syn.]; Chao, 1978, pp. 8, 14, 24-28, 44, 50, 54, figs. 4, 18, 30 [western Atlantic: syn., distrib., systematics].

*Eques acuminatus*: Longley and Hildebrand, 1941 [in part], p. 144 [Tortugas: descr., behavior, distrib., variety *umbrosus* considered merely a color phase of *E. acuminatus* Bloch and Schneider, 1801].

*Pareques acuminatus umbrosus*: Kritzler, 1951, pp. 245, 246, fig. 1 [St. Augustine, Florida: descr., distinguished from *P. a. acuminatus*]; Reid, 1954, p. 52 [Cedar Key, Florida: listing].

*Pareques acuminatus*: Hildebrand, 1955 [in part?], p. 213 [Gulf of Campeche: listing]; McPhail, 1961, pp. 27, 28, fig. 1 [eastern Pacific: systematics].

*Equetus umbrosus*: Briggs, 1958, p. 280 [Florida: distrib.]; Starck, 1968, p. 23 [Alligator Reef, Florida: listing]; Hastings, 1972, pp. 280-283 [northeastern Gulf of Mexico: abundance, depth, substrate]; Miller and Jorgenson, 1973, p. 308 [western Atlantic: meristics]; Gilmore, 1977, p. 139 [eastern peninsular Florida: habitat, abundance]; Smith, 1973, pp. 135-140 [eastern Gulf of Mexico: abundance, distrib., descr., spawning]; Smith et al., 1975, p. 8 [Florida Middle Ground: listing]; Smith, 1976, pp. 28, 29 [eastern Gulf of Mexico: abundance, distrib., descr.]; Smith, 1978, pp. 210-212 [mideastern Gulf of Mexico: distrib., nomenclature, habitat, coloration].

*Equetus acuminatus*: Springer and Woodburn, 1960, p. 54 [Tampa Bay, Florida: abundance, behavior, descr.]; Böhlke and Chaplin, 1968 [in part?], p. 400, 1 fig. [Bahamas: descr., distrib., habitat]; Randall, 1968 [ in part?], p. 150, fig. 172 [Caribbean; descr., distrib.].

*Material examined*: HOURGLASS STATION B: 8, 65.5-145; 30 August 1965; trynet; FSBC 4423. — 1, 159; 1 December 1966; trynet; FSBC 10034. — 15, 29.3-55.0; 25 July 1967; scuba; FSBC 5384. — HOURGLASS STATION C: 2, 129-143; 8 November 1965; trynet; FSBC 10043. — 5, 126-

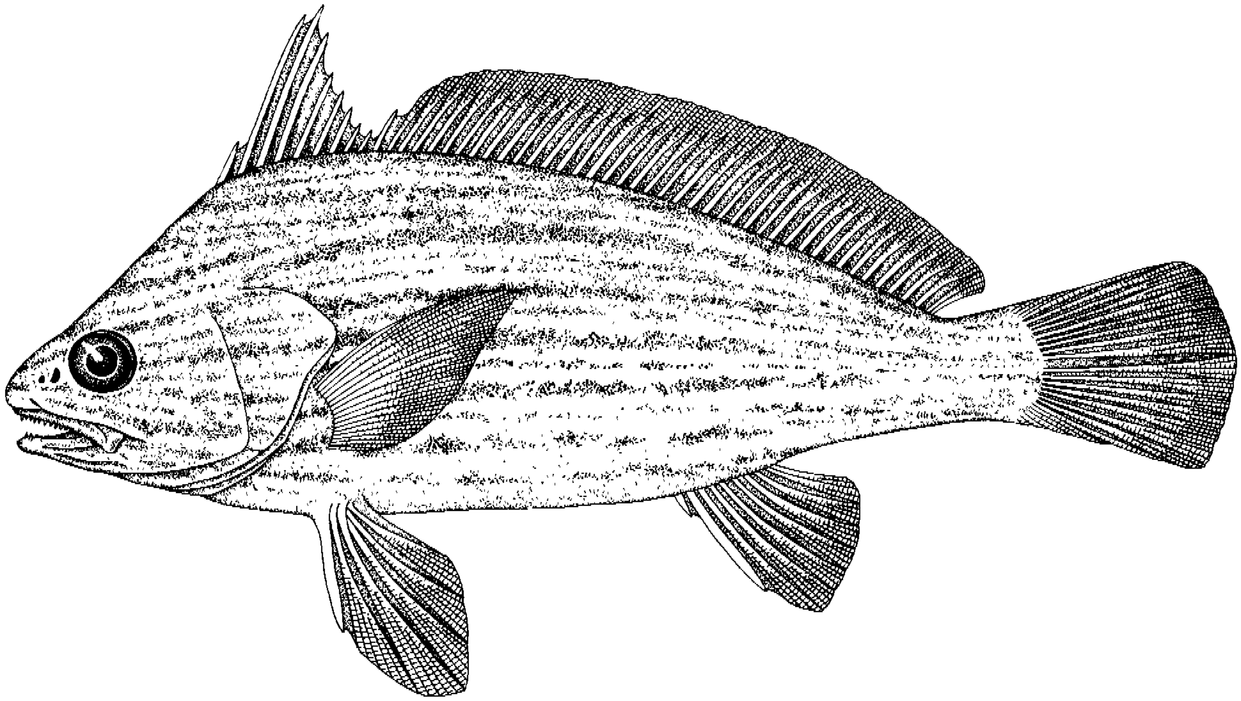


Figure 14. *Pareques umbrosus* (Jordan and Eigenmann, 1889).

168; 3 December 1965; trynet; FSBC 4613. — 6, 95.0-130; 12 July 1966; trynet; FSBC 10044. — 27, 107-161; 11 August 1966; trynet; FSBC 10046. — 1, 92.0; 1 December 1966; trynet; FSBC 10429. — 10, 75.7-151; 6 January 1967; trynet; FSBC 10045. — 1, 133; 2 June 1967; trynet; FSBC 10430. — 1, 103; 1 July 1967; trynet; FSBC 10428. — HOURGLASS STATION D: 18, 93.3-157; 27 March 1966; trynet; FSBC 4860. — 1, 126; 3 May 1966; trynet; FSBC 10035. — 34, 93.9-143; 11 August 1966; trynet; FSBC 10042. — 3, 113-126; 26 January 1967; trawl; FSBC 10038. — 1, 128; 3 November 1967; trynet; FSBC 10037. — HOURGLASS STATION E: 2, 139-143; 7 June 1966; trynet; FSBC 4938. — 2, 135, 148; 26 January 1967; trawl; FSBC 10036. — HOURGLASS STATION J: 6-135, 148; 26 January 1967; trawl; FSBC 4515. — 2, 102, 114; 12 November 1967; trynet; FSBC 10432. — 3, 103-140; 13 January 1966; trynet; FSBC 10040. — 2, 102, 137; 12 November 1966; trynet; FSBC 10039. — 1, 50.7; 6 August 1967; scuba; FSBC 5362. — HOURGLASS STATION K: 5, 101-143; 7 December 1965; trynet; FSBC 4632. — 2, 67.9, 115; 30 January 1967; trawl; FSBC 5154. — HOURGLASS STATION M: 3, 112-126; 12 April 1966; trynet; FSBC 5037. — OTHER MATERIAL: 1, 164; 29°32′N, 83°32′W, 7.5 m; 9 July 1964; trap; FSBC 3042. — 1, 153; 28°21′N, 84°05′W, 30 m; 2 May 1965; trawl; FSBC 3462. — 1, 148; Anclote Key, Pinellas Co., 2 m; October 1973; gill net; FSBC 8284. — 1, 44.4; 28°09′N, 84°21′W, 18 m; 4 August 1972; FSBC 7193. — 1, 50.5; 28°05′N, 83°16′W, 17 m; 20 July 1967; trap; FSBC 7372. — 1, 156; off Honeymoon Island, Pinellas Co., 14 m; 19 October 1972; FSBC 7589. — 1, 151; off Caladesi Island, Pinellas Co., 9 m; December 1972; FSBC 9205. — 1, 165; off Clearwater, Pinellas Co.; March 1973; FSBC 7659. — 1, 90.1; off Clearwater, Pinellas Co., 9 m; 16 September 1976; FSBC 9128. — 1, 107; between Indian Rocks Springs and Clearwater, Pinellas Co.; 14 February 1958; explosives; FSBC 396. — 5, 40.8-50.9; Gulf of Mexico, Pinellas Co., 18 m; 9 August 1958; FSBC 775. — 1, 58.8; Gulf of Mexico, Pinellas Co.; 16 August 1958; FSBC 789. — 19, 49.2-75.1; Gulf of Mexico, Pinellas Co., 18 m; 14 September 1958; rotenone; FSBC 835. — 11, 64.3-178; Gulf of Mexico, Pinellas Co.; 21 September 1958; FSBC 862. — 3, 64.1-100; Gulf of Mexico, Pinellas Co., 14 m; 9 November 1958; rotenone; FSBC 967. — 6, 74.1-97.3; Gulf of Mexico, Pinellas Co., 11 m; February 1959; rotenone; FSBC 1104. — 1, 168;

27°44′N, 84°10′W, 47 m; 21 October 1965; trap; FSBC 5452. — 3, 39.0-41.6; Tampa Bay, Pinellas Co.; 8 June 1958; FSBC 589. — 1, 76.9; Tampa Bay, Pinellas Co., 3 m; 3 August 1958; rotenone; FSBC 744. — 1, 176; Tampa Bay, Pinellas Co.; 3 July 1965; hook-and-line; FSBC 3637. — 1, 180; Tampa Bay, Pinellas Co., 6 m; 13 May 1967; hook-and-line; FSBC 9654. — 1, 95.3; Egmont Key, Pinellas Co., 28 m; 16 December 1964; trawl; FSBC 2543. — 1, 111; Egmont Key, Pinellas Co.; 16 December 1964; trynet; FSBC 2960. — 1, 153; 27°29′48″N, 82°53′39″W; 18 June 1958; FSBC 627. — 2, 38.9-47.4; Gulf of Mexico, off Bradenton, Manatee Co., 17 m; 11 July 1970; scuba; FSBC 7281. — 12, 35.8-77.6 Gulf of Mexico, off Bradenton, Sarasota Co., 17 m; 11 July 1970; scuba; FSBC 7356. — 6, 26.6-44.1; Gulf of Mexico, off Sarasota, Sarasota Co., 13 m; 21 June 1970; scuba; FSBC 7294. — 2, 59.1, 73.1; Gulf of Mexico, off Sarasota, Sarasota Co., 22 m; 12 September 1970; scuba; FSBC 7301. — 1, 129; Gulf of Mexico, off Sarasota, Sarasota Co., 19 m; 30 August 1970; scuba; FSBC 7302. — 27, 32.3-59.4; Gulf of Mexico, off Sarasota, Sarasota Co., 15 m; 19 July 1970; rotenone; FSBC 7308. — 8, 25.2-31.8; Gulf of Mexico, off Sarasota, Sarasota Co., 13 m; 13 June 1970; scuba; FSBC 7364. — 3, 26.2-40.7; Gulf of Mexico, off Sarasota, Sarasota Co.; June 1971; FSBC 7442. — 3, 30.5-38.9; Gulf of Mexico, off Sarasota, Sarasota Co., 24 m; 30 June 1971; FSBC 7455. — 2, 54.8, 60.7; Gulf of Mexico, off Sarasota, Sarasota Co., 23 m; 3 October 1970; scuba; FSBC 7456. — 8, 26.5-41.3; Gulf of Mexico, off Sarasota, Sarasota Co., 13 m; 21 June 1970; scuba; FSBC 7458. — 1, 133; Gulf of Mexico, off Sarasota, Sarasota Co., 16 m; 31 October 1970; scuba; FSBC 7487. — 7, 52.2-145; Gulf of Mexico, off Sarasota, Sarasota Co., 13 m; 13 June 1970; scuba; FSBC 7488. — 20, 54.1-130; Gulf of Mexico, off Sarasota, Sarasota Co., 19 m; 4 September 1970; scuba; FSBC 7498. — 10, 45.5-62.5; Gulf of Mexico, off Sarasota, Sarasota Co., 16 m; 24 March 1972; FSBC 7554. — 9, 111-161; 27°06′N, 83°15′W, 38 m; 21 October 1965; trawl; FSBC 5478. — 1, 169; 37°03′N, 83°14′W, 33 m; trap; FSBC 5427.

*Diagnosis*: See generic diagnosis; BD 29.2-39.2% SL; longest dorsal spine 12.2-48.6% SL; predorsals present; color light with 7-10 longitudinal stripes narrower than pupil; young with anteriorly directed, V-shaped dark bar connecting orbits across top of head (Chao, 1978); D. 8-10 spines and 37-42 soft-rays (The last spine may or may not be the first element of the soft dorsal.); A. II, 7 (some 6 or 8).

*Distribution and abundance*: Chao (1978) gives the distribution as "Chesapeake Bay to Florida and Gulf of Mexico coast." Reports also list it from the east coast of Florida and the Florida Keys (Hastings, 1973; Gilmore, 1977; Starck, 1968). Confusion in applying the names *P. umbrosus* and *P. acuminatus*, however, makes this distribution uncertain (Smith, 1976, 1978). Of the two species, only *P. umbrosus* is found above Florida Bay in the Gulf, and it seems to be a warm-temperate species while *P. acuminatus* is tropical (George C. Miller, personal communication).

The numbers of *P. umbrosus* specimens taken during Project Hourglass collections are presented in Table 7.

*Life history*: The smallest Hourglass cubbyu were taken in summer (Table 8). Smith (1978) found juveniles to be most abundant during late spring and fall but to be present throughout the year. Fish with maturing ova (those with diameters greater than 0.5 mm) can be found in most months of the year, but few clear, ripe, 1.0 mm ova indicating imminent spawning were seen (Table 9).

Eggs and larvae are undescribed, and data presented in Table 8 are insufficient to determine growth rate or size at sexual maturity.

Smith (1978) found that adults of this species assume an all black color phase when in open areas of the reef surface. They revert to the normal striped pattern when under cover or upon preservation.

TABLE 7. NUMBERS OF HOURGLASS *Pareques umbrosus* BY STATION AND MONTH.

| *Pareques umbrosus* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STA | 1965 | | | | | 1966 | | | | | | | | | | | | | 1967 | | | | | | | | | | | TOT |
| | A | S | O | N | D | J | F | M | A | M | J | J | J sp | A | S | O | N | D | J | J sp | F | M | A | M | J | J | A | S | O | N | |
| A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| $B_1$ | | 8 | 1 | 5 | 2 | | | | | 3 | | 2 | 10 | | | | | 4 | | 6 | 1 | | | 1 | | 15 | | | 1 | 2 | 61 |
| $B_2$ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| $C_1$ | | | 2 | 2 | 5 | 6 | 3 | 1 | 6 | | | 6 | | 4 | | | 2 | 14 | 10 | 24 | | | 7 | | 1 | 1 | | | 1 | | 95 |
| $C_2$ | | | | | | | | | | 9 | | | | 27 | | | | | | | | | | | | 1 | | | | 1 | 38 |
| $D_1$ | | | | 1 | 1 | | 3 | | | 1 | 1 | | | | | | | | 1 | 3 | 2 | | | | | | | 1 | 1 | 2 | 17 |
| $D_2$ | | | | | | | | 18 | | | | | | 40 | | | | | | | | | | | | | | | | | 58 |
| E | | | | | | | | | | | 2 | | | | | | | | | 2 | | | | | | | 1 | | | | 5 |
| I | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| J | | 2 | 6 | 2 | 1 | 3 | 1 | 1 | | | | | 7 | | | 3 | 2 | | | | | | | | | | 1 | | 7 | 1 | 37 |
| K | | | 1 | | 5 | 1 | 1 | 2 | 3 | 5 | | 2 | 24 | 4 | 1 | 2 | 6 | | | 2 | 6 | | 2 | | | | | | | | 67 |
| L | | | | | | | | | | | | | | | | | | 2 | | | 1 | | | | | | | | | | 3 |
| M | | | | | 1 | | | | 4 | | | | | | | | 3 | | 1 | | | | | | | | | | | | 9 |
| TOT | | 10 | 10 | 10 | 15 | 10 | 8 | 22 | 13 | 18 | 3 | 10 | 41 | 75 | 1 | 5 | 13 | 20 | 12 | 37 | 10 | | 9 | 1 | 1 | 17 | 2 | 1 | 10 | 6 | 390 |

Subscripts 1, 2 and sp designate regular, post and supplementary cruises *sensu* Joyce and Williams (1969).

TABLE 8. MONTHLY CATCH OF HOURGLASS *Pareques umbrosus* BY SIZE CLASS.

TABLE 8.

| SL | 1965 | | | | | 1966 | | | | | | | | | | | | 1967 | | | | | | | | | | | TOT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | A | S | O | N | D | J | F | M | A | M | J | J | A | S | O | N | D | J | F | M | A | M | J | J | A | S | O | N | |
| 30 | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | 1 |
| 40 | | | | | | | | | | | | | | | | | | | | | | | | 3 | | | | | 3 |
| 50 | | | | | | | | | | | | 1 | | | | | | | | | | | | 7 | | | | | 8 |
| 60 | | | | | | | | | | | | 1 | | | | | | | | | | | | 4 | 1 | | | 1 | 7 |
| 70 | | 1 | | 1 | | | | | | | | 3 | | | | | | 1 | | | | | | | | | 1 | | 7 |
| 80 | | 1 | | 1 | | | | | | 1 | | 2 | | | | | 7 | 2 | | | 1 | | | | | | 2 | 2 | 19 |
| 90 | | 2 | 1 | 1 | | 1 | | 2 | | 1 | | 1 | 2 | | | 1 | 2 | 7 | 2 | | | | | | | | 2 | | 25 |
| 100 | | 1 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 1 | | 3 | 9 | | | | | 5 | 2 | | 1 | 1 | | 1 | | | | | 36 |
| 110 | | 2 | | 1 | 1 | 1 | 1 | 2 | 1 | 1 | | 7 | 14 | | | 2 | 1 | 4 | 1 | | 1 | | | 1 | 1 | | 1 | 1 | 44 |
| 120 | | | 1 | 1 | 3 | | 2 | 1 | 1 | 4 | | 8 | 9 | 1 | | 3 | 2 | 9 | 3 | | 4 | | | | | 1 | | | 53 |
| 130 | | 1 | 2 | 1 | 4 | 2 | 2 | 8 | 4 | 2 | | 11 | 11 | | 4 | 1 | 3 | 8 | 1 | | | | | | | | 1 | 1 | 67 |
| 140 | | 1 | 2 | | | 2 | | 4 | 1 | 5 | 2 | 7 | 18 | | 1 | 5 | 3 | 6 | 1 | | 1 | | 1 | | | | 2 | 1 | 63 |
| 150 | | 1 | 1 | 1 | 3 | | 2 | 2 | 2 | 3 | 1 | 2 | 5 | | | 1 | | 3 | | | 1 | | | | | | 1 | | 29 |
| 160 | | | 1 | 1 | 1 | | | 1 | 2 | | | 3 | 4 | | | | 2 | 2 | | | | | | | | | | | 17 |
| 170 | | | | | 1 | 2 | | | | | | 2 | 2 | | | | | 1 | | | | | | | | | | | 8 |
| 180 | | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | 2 |
| 190 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 0 |
| 200 | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | 1 |
| TOT | 0 | 10 | 10 | 10 | 15 | 10 | 8 | 22 | 13 | 18 | 3 | 51 | 75 | 1 | 5 | 13 | 20 | 49 | 10 | 0 | 9 | 1 | 1 | 17 | 2 | 1 | 10 | 6 | 390 |

*Food*: Nearly all identifiable remains in gut contents of Hourglass specimens (Table 10) were crustacean.

*Salinity and temperature*: During Hourglass sampling *P. umbrosus* were taken at bottom salinities of 32-36 $^o/_{oo}$. Bottom temperatures were 16-31°C.

TABLE 9. EGG MATURITY IN *Pareques umbrosus.*

| Month | Number of females examined | Egg Diameters in mm |
|---|---|---|
| January | 9 | 0.04-0.60 |
| February | 0 | —— |
| March | 11 | 0.05-1.00 |
| April | 3 | 0.05-0.60 |
| May | 1 | 0.05-0.80 |
| June | 4 | 0.03-0.05 |
| July | 0 | —— |
| August | 24 | 0.05-0.80 |
| September | 2 | 0.05-0.50 |
| October | 0 | —— |
| November | 1 | 0.05-0.60 |
| December | 9 | 0.05-0.70 |

TABLE 10. STOMACH CONTENTS OF HOURGLASS *Pareques umbrosus.*

| Item | Number of Stomachs Containing Item |
|---|---|
| Shrimp | 67 |
| Crustacean remains | 18 |
| Crabs | 9 |
| Worms | 2 |
| Unidentifiable remains | 59 |
| Empty | 188 |

## *Pareques* sp. (Black Bar)

*Material examined*: HOURGLASS STATION E: 1, 122; 2 August 1966; trynet; FSBC 5085.— OTHER MATERIAL: 2, 73.5-80.2; 19 August 1960; 27°00'N, 35°21.5'W, 62 m; FSBC 1886.—1, 405; 21 September 1978; 26°10'N, 84°18'W, 186 m; hook-and-line; FSBC 11502.—1, 395; 14 December 1978; Gulf of Mexico, 26°N, in 128 m; hook-and-line; FSBC 11505.

*Remarks*: An undescribed species of *Pareques* (*sensu* McPhail, 1961) occurs in the Gulf of Mexico. Chao (1978) refers to it as the manuscript species of L. Woods and G. Miller.

Three small specimens (73.5-122 mm SL) are light in color with a broad, dark band between the base of the spinous dorsal and the pelvics. A narrow, dark midlateral stripe runs from this band to the tip of the caudal fin. A second, narrower band runs from the occiput through the eye. Meristics do not distinguish this species from *P. umbrosus* or *P. acuminatus*, and it has probably often been considered *Equetus lanceolatus* due to similarities in coloration. Although the three specimens examined came from 62 to 73 m, Gregory B. Smith (personal communication) has seen others off Tampa Bay in depths as shallow as 14 m.

Two large specimens (395, 405 mm SL), recovered recently from commercial fishing boats, are identifiable as *Pareques* (*sensu* McPhail, 1961), since they have three predorsal bones. Their coloration, however, differs from the small specimens. In life they were countershaded gray with a gold wash dorsally. They were taken in 128 and 186 m.

All five specimens had the black peritoneum that is diagnostic for this species.

## *Leiostomus xanthurus* Lacépède, 1802

Spot, Figure 15

*Leiostomus xanthurus* Lacépède, 1802, p. 439 [Carolina]; Jordan and Eigenmann, 1889, pp. 409, 410, fig. 6 [America: syn., distrib.]; Jordan and Evermann, 1898, pp. 1458, 1459, pl. CCXXIII, fig. 569 [North America: descr., distrib., syn.]; Welsh and Breder, 1924, pp. 177-180, figs. 37, 38 [eastern U.S.A.: distrib., spawning, growth, food]; Hildebrand and Schroeder, 1928, pp. 271-276, figs. 155, 156 [Chesapeake Bay: syn., descr., food, growth, spawning, fishery, movements, distrib.]; Pearson, 1929, pp. 204-210, figs. 39-42 [Texas: descr., spawning, growth, movements, maturity, fishery]; Hildebrand and Cable, 1930, pp. 416-430, figs. 41-49 [Beaufort, North Carolina: distrib., fishery, temperature, movements, spawning, development, growth, maturity, food]; Gunter, 1938, pp. 326-328, fig. 6 [Louisiana: movements, spawning, growth]; Gunter, 1945, pp. 70, 71 [Texas: spawning, fishery, growth, movements, food, salinity]; Simmons, 1950, p. 5 [Rockport, Texas: trapped]; Bigelow and Schroeder, 1953, p. 423, fig. 218 [Gulf of Maine: listing]; Roelofs, 1954, pp. 152, 153 [North Carolina: food]; Reid, 1954, pp. 49, 50 [Cedar Key, Florida: spawning, movements, food, salinity, temperature]; Hildebrand, 1954, pp. 309, 310 [Western Gulf of Mexico: movements]; Kilby, 1955, pp. 225, 226, fig. 9 [Gulf coast marsh: habitat, spawning, salinity]; Reid, 1955a, p. 328, figs. 3-5 [East Bay, Texas: abundance]; Reid, 1955b, pp. 443, 444 [East Bay, Texas: abundance, habitat, food]; Joseph and Yerger, 1956, pp. 137, 138 [Alligator Harbor, Florida: local distrib., abundance, movements, spawning, growth]; Gunter, 1956, p. 350 [North and Middle America: salinity]; Townsend, 1956, pp. 1-43, fig. 2 [Alligator Harbor, Florida: spawning, growth, migrations, food]; Breuer, 1957, p. 146 [Baffin and Alazan Bays, Texas: seasonal abundance]; Simmons, 1957, p. 186 [Laguna Madre, Texas: spawning, salinity]; Reid and Hoese, 1958, pp. 228-231, figs. 3, 4 [Texas: salinity]; Briggs, 1958, p. 281 [Florida: distrib.]; Dawson, 1958, pp. 1-48, figs. 1-7 [South Carolina: abundance, distrib., habitat, fecundity, spawning, growth, food, predation, fishery, salinity, temperature, parasites]; Darnell, 1958, pp. 389-392, figs. 10, 11 [Lake Pontchartrain, Louisiana: food]; Springer and Woodburn, 1960, pp. 54-56 [Tampa Bay, Florida: abundance, growth,

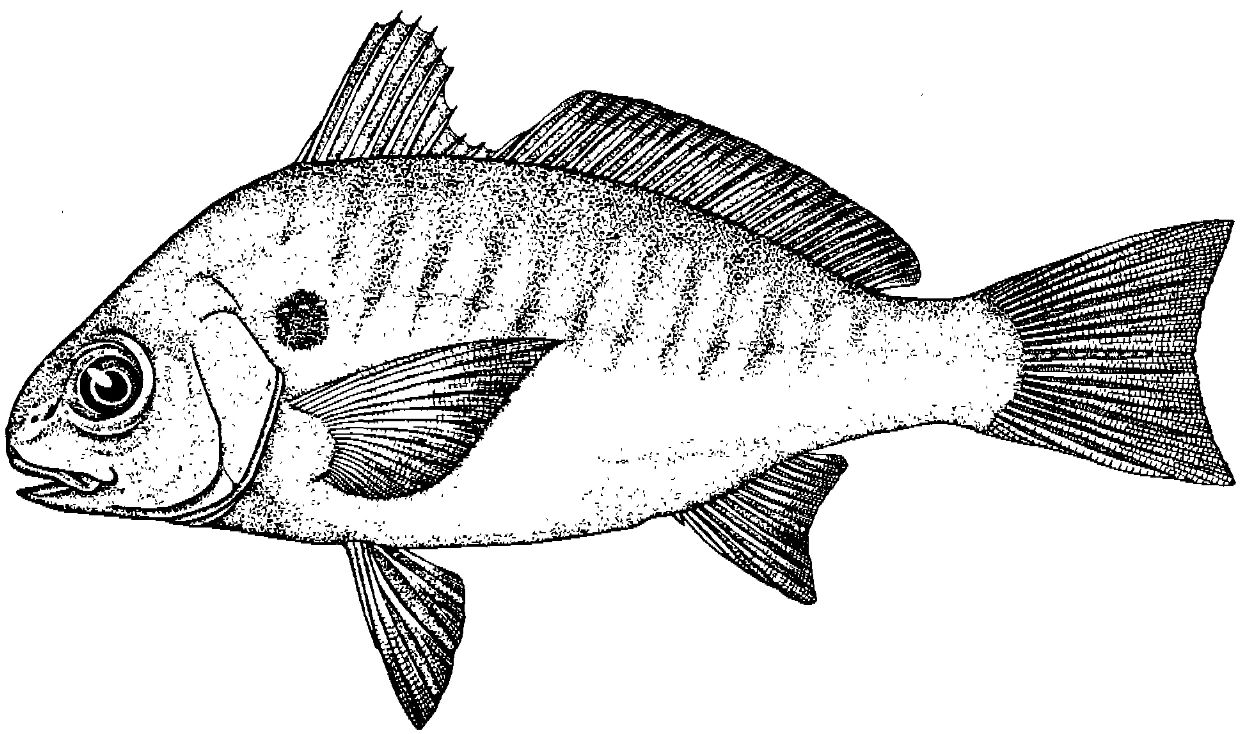


Figure 15. *Leiostomus xanthurus* Lacépède, 1802.

movements, salinity, temperature, food]; Tabb and Manning, 1961, p. 628 [northern Florida Bay: movements, spawning]; Pacheco, 1962a, pp. 18-28, figs. 1-8 [Chesapeake Bay: growth, juvenile abundance]; 1962b, pp. 256, 257 [Chesapeake Bay: movements]; Nelson, 1969, pp. 4-24, 57-92, figs. 10-13 [Mobile Bay, Alabama: spawning, growth, movements, habitat, salinity, temperature]; Parker, 1971, pp. 28-96, 162-173, figs. 8-19 [Louisiana and Texas: spawning, growth, abundance, food, salinity, temperature]; Jannke, 1971, pp. 47-50, fig. 11 [Florida Everglades: spawning, movements]; Wang and Raney, 1971, p. 36 [Charlotte Harbor, Florida: spawning, salinity, temperature]; Hastings, 1972, pp. 283-288 [northeast Gulf of Mexico: distrib., spawning, abundance, habitat, movements, food]; Miller and Jorgenson, 1973, p. 308 [western Atlantic: meristics]; Scotton et al., 1973, pp. 88-91, 5 figs. [Delaware Bay: literature review, descr. of larvae through adults]; Music, 1974, pp. 1-29, figs. 1-11 [Georgia: spawning, growth, salinity, temperature, fishery]; Lippson and Moran, 1974, pp. 220-222, 9 figs. [Potomac River: literature review, descr. of larvae through adults]; Chao and Musick, 1977, pp. 657-702, figs. 1-8, 20-29 [York River, Virginia: life history, feeding adaptations, food]; Chao, 1978, pp. 8, 14, 21, 24-27, 29, 32, 36, 39, 44, 49, figs. 4, 5, 18, 29, 30 [western Atlantic: syn., key, distrib., systematics]; Snell, 1978, p. 5 [Florida: commercial landings]; Powles and Stender, 1978, pp. 30-36 [southeastern U.S.A.: distrib., spawning, descr. of larvae, maturity]; Fruge and Truesdale, 1978, pp. 643-648, figs. 1, 2 [northern Gulf of Mexico: descr. of larvae]; Johnson, 1978, pp. 203-208, figs. 120-123 [Mid-Atlantic Bight: literature review]; Sheridan, 1979, pp. 1-14, fig. 1 [Apalachicaola Bay, Florida: food].

*Material examined*: HOURGLASS STATION A: 4, 158-179; 4 October 1965; trynet; FSBC 4479. — HOURGLASS STATION B: 2, 147, 148; 1 December 1966; trynet; FSBC 4912. — HOURGLASS STATION I: 11, 148-191; 3 September 1965; trynet; FSBC 4439. — OTHER MATERIAL: 1, 91.4; 28°56′06″N, 82°45′18″W, 1.5 m; 17 July 1969; trawl; FSBC 6829. — 3, 166-178; Crystal River, Citrus Co.; 8 May 1969; trawl; FSBC 7824. — 25, 88.6-100; Crystal River, Citrus Co., 1.5 m; 12 May 1969; trawl; FSBC 7866. — 2, 62.6, 72.3; Crystal River, Citrus Co., 1 m; 18 January 1970; seine; FSBC 7881. — 4, 117-142; Crystal River, Citrus Co.; 20 July 1971; trawl; FSBC 9185. — 4, 137-156; Crystal River, Citrus Co.; 20 July 1971; trawl; FSBC 9256. — 1, 94.8; Crystal River, Citrus Co.; 17 July 1969; trawl; FSBC 9322. — 2, 56.1, 63.1; Crystal River, Citrus Co.; 15 July 1971; seine; FSBC 9352. — 5, 112-159; Crystal River, Citrus Co.; 20 July 1971; trawl; FSBC 9397. — 5, 19.1-28.4; Crystal River, Citrus Co.; 29 January 1971; seine; FSBC 9652. — 1, 93.0; Crystal River, Citrus Co., 1 m; 28 July 1971; trynet; FSBC 9675. — 1, 170; 28°17′N, 84°07′W, 44 m; 2 May 1965; trawl; FSBC 3401. — 4,131-144; 27°58′30″N, 82°51′W, 5 m; 7 June 1963; trynet; FSBC 2668. — 1, 145; Mullet Key, Pinellas Co.; 26 October 1956; FSBC 55. — 62, 40.0-60.6; Long Bayou, Pinellas Co., 1.5 m; 14 April 1971; FSBC 8336. — 4, 82.2-108; Long Bayou, Pinellas Co., 1 m; 19 October 1971; seine; FSBC 8757. — 18, 71.5-92.2; Cross Bayou Canal, Pinellas Co., 1.5 m; 14 November 1958; seine; FSBC 990. — 18, 21.2-34.3; Salt Creek, Pinellas Co., 1 m; 16 February 1971; trawl; FSBC 9005. — 2, 103, 117; Tampa Bay, Pinellas Co., 2 m; 15 December 1977; trawl; FSBC 10277. — 1, 143; Egmont Key, Pinellas Co., 28 m; 16 December 1964; trynet; FSBC 2537. — 2, 22.3, 29.2; Sarasota Bay, Sarasota Co.; 16 February 1967; seine; FSBC 9511. — 3, 19.8-49.1; Big Sarasota Pass, Sarasota Co., 1 m; 16 February 1967; FSBC 9344. — 2, 142, 154; off Boca Grande, Lee Co., 14 m; 30 November 1977; trawl; FSBC 10157. — 4, 58.9-87.6; San Carlos Bay, Lee Co.; 7 July 1960; seine; FSBC 3076.

*Diagnosis*: Mouth small, inferior, and horizontal; body short, deep, and laterally compressed, BD 28.2-39.1% SL; caudal forked; color bluish gray with golden reflections above, silvery below; 12-15 dusky, oblique bars laterally with black humeral spot; D. X + I, 28-32 (some 27); A. II, 12-13.

*Distribution and abundance*: Spot occur from the Gulf of Maine to the Bay of Campeche (Bigelow and Schroeder, 1953; Chao, 1978). They represented less than one percent by weight and dollars of commercial finfish landings on Florida's west coast in 1976 (Snell, 1978).

*Life history*: Most investigators have found that spot spawn offshore in the winter from December until late March. Dawson (1958), Jannke (1971), and Powles and Stender (1978) list the pertinent literature.

Eggs have not been described, but Hildebrand and Cable (1930) described a 1.5 mm TL larva with its yolk sac already absorbed and said the eggs must be small. They also described nine stages in spot development and differentiated young less than 10 mm TL from similar sized croaker. A more precise description was published by Fruge and Truesdale (1978). Powles and Stender (1978) described development of spot 4.0-39.0 mm SL.

In January, young found in bays have an average length of 20.5 mm SL (Springer and Woodburn, 1960). Later in their first year most migrate offshore and do not return to the bays (Springer and Woodburn, 1960; Nelson, 1969). While offshore, young remain in shallower water than older fish (Nelson, 1969).

Parker (1971) averaged and tabulated growth data from throughout the spot's range. He concluded that spot grow 11 mm/month during their first year, 5.5 mm/month during their second, and 3.0 mm/month during their third. Atlantic coast fish then grow an additional 18 months to reach 300 mm TL, but these older fish have not been found in Gulf coast populations.

Factors for converting among SL, TL and fork length are given in Dawson (1958). Dawson (1958) and Parker (1971) provided length-weight relationships and condition analyses.

Maturity is reached toward the end of the second year when the fish are about 200 mm TL (Dawson, 1958; Nelson, 1969).

*Food*: Darnell (1958) summarized information on spot food habits and concluded that spot change from sediment surface to infaunal feeders as their size increases. Young feed on amphipods, ostracods and copepods (especially harpacticoids); older spot feed on clams, chironomid larvae, and annelids. Spot apparently feed at twilight or night on muddy bottoms.

Spot in Tampa Bay are indiscriminate bottom feeders. They eat filamentous algae, desmids, forams, mysids, copepods, amphipods, ostracods, isopods, chaetognaths, insect larvae, bivalves, gastropods, and polychaetes (Springer and Woodburn, 1960).

In Apalachicola Bay, trophic resource partitioning between Atlantic croaker and spot was found to be based on particle size. In general, spot consumed smaller food items than did croaker (Sheridan, 1979).

Chao and Musick (1977) described the specializations in mouth position, dentition, gill raker morphology, digestive tract morphology, and snout morphology associated with spot feeding habits.

*Salinity and temperature*: Spot, generally considered euryhaline fishes (Gunter, 1956), have been taken from fresh water and salinities greater than 60 $^{o}/_{oo}$ (Dawson, 1958). Although smaller juvenile spot are taken at lower salinities (Dawson, 1958; Springer and Woodburn, 1960), size distribution is probably influenced more by bottom type or food (Dawson, 1958; Nelson, 1969; Parker, 1971). Hourglass specimens were taken at bottom salinities of 34.6-35.16 $^{o}/_{oo}$.

South Carolina spot have been taken at temperatures to 36.7° C (Dawson, 1958), and the lethal cold limit may be 5.0° C. or less for one year old or younger fish (Hildebrand and Cable, 1930). Hourglass specimens were taken at bottom temperatures of 20.0-29.6° C.

## *Sciaenops ocellatus* (Linnaeus, 1766)

Red drum, Figure 16

*Perca ocellata* Linnaeus, 1766, p. 483 [South Carolina].

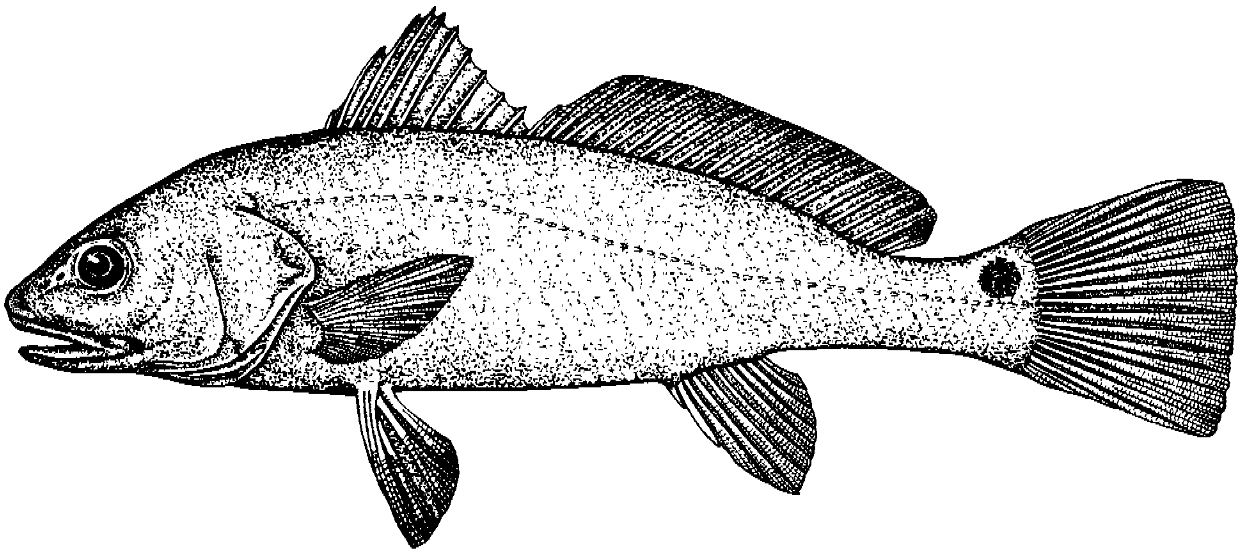


Figure 16. *Sciaenops ocellatus* (Linnaeus, 1766).

*Sciaenops ocellatus*: Jordan and Evermann, 1898, pp. 1453, 1454, pl. CCXXII, fig. 567 [North America: descr., distrib., syn.]; Welsh and Breder, 1924, pp. 184-186, figs. 42, 43 [eastern U.S.A.: distrib., spawning, migration, descr., growth]; Hildebrand and Schroeder, 1928, pp. 276-278, figs. 157, 158 [Chesapeake Bay: syn., descr., food, spawning, seasonal abundance, distrib.]; Pearson 1929, pp. 139-157 [Texas: syn., descr. of larvae and adults, spawning, fecundity, growth, migration, food]; Breuer, 1957, p. 146 [Baffin and Alazan Bays, Texas: seasonal abundance by size]; Wang and Raney, 1971, p. 38 [Charlotte Harbor, Florida: temperature]; Robins et al., 1980, p. 85 [nomenclature].

*Sciaenops ocellata*: Gunter, 1945, pp. 68-70 [Texas: seasonal abundance, spawning, food, salinity, temperature, catch]; Miles, 1949, pp. 147, 148 [Aransas Bay, Texas: food]; Simmons, 1950, pp. 5, 11-13 [Texas: trapping, tagging, age and growth]; Parker, 1951, pp. 2, 3, figs. 1-4 [Texas: parasites]; Chandler, 1954, p. 351 [Gulf of Mexico: parasites]; Reid, 1955b, p. 443 [East Bay, Texas: food]; Kilby, 1955, p. 226 [Florida: growth, salinity, food]; Gunter, 1956, p. 350 [North and Middle America: salinity]; Joseph and Yerger, 1956, p. 139 [Alligator Harbor, Florida: listing]; Simmons, 1957, p. 186 [Laguna Madre, Texas: seasonal abundance, food, salinity, temperature]; Briggs, 1958, p. 281 [Florida: distrib., salinity]; Darnell, 1958, p. 400 [Lake Pontchartrain, Louisiana: food]; Springer and Pirson, 1958, p. 183, fig. 17 [Port Aransas, Texas: abundance]; Springer and Woodburn, 1960, pp. 63, 64 [Tampa Bay, Florida: seasonal abundance, spawning, food, salinity, temperature]; Tabb and Manning, 1961, pp. 628, 629 [Florida Bay: salinity, temperature, sport catch]; Simmons and Breuer, 1962, pp. 184-193, figs. 1-5 [Texas: descr., distrib., spawning, growth, movements, food, salinity, temperature]; Yokel, 1966, pp. 1-160, figs. 1-14 [Atlantic and Gulf coasts: distrib., spawning, movements, food, salinity, temperature, parasites]; Starck, 1968, p. 23 [Alligator Reef, Florida: listing]; Topp and Cole, 1968, pp. 902-945, figs. 1-13 [eastern U.S.A.: osteology]; Beaumariage, 1969, p. 34 [Florida: tagging, movements, growth]; Jannke, 1971, pp. 39-44, figs. 8, 9 [Florida Everglades: spawning]; Hastings, 1972, pp. 292, 293 [northeastern Gulf of Mexico: listing]; Odum and Heald, 1972, pp. 718, 719 [southeast Florida: food]; Miller and Jorgenson, 1973, p. 308 [western Atlantic: meristics]; Lippson and Moran, 1974, pp. 234, 235, 5 figs. [Potomac River: literature review, descr. of larvae through adults]; Chao, 1978, pp. 9-11, 13, 14, 21, 24-27, 33, 34, 45, 46, 50, figs. 4, 11, 17, 20, 29, 30 [western Atlantic: syn., key, distrib., systematics]; Snell, 1978, p. 5 [Florida: commercial landings]; Powles and Stender, 1978, pp. 48-51 [southeastern U.S.A.: distrib., spawning, descr. of larvae, maturity]; Johnson, 1978, pp. 242-246, figs. 143-145 [Mid-Atlantic Bight: literature review].

*Material examined*: HOURGLASS STATIONS: None collected. — OTHER MATERIAL: 2, 26.7, 40.1; Crystal River, Citrus Co.; 17 November 1972; FSBC 7603. — 4, 18.3-21.7; Long Bayou Spillway, Pinellas Co., 1 m; 19 November 1971; seine; FSBC 9053. — 3, 43.5-66.0; Cross Bayou Canal, Pinellas Co., 1 m; 13 December 1957; seine; FSBC 268. — 10, 52.9-99.2; Cross Bayou Canal, Pinellas Co., 1 m; 24 February 1958; seine; FSBC 431. — 2, 122, 122; Cross Bayou Canal, Pinellas Co., 1 m; 23 April 1958; seine; FSBC 510. — 22, 19.8-41.3; Cross Bayou Canal, Pinellas Co., 1.5 m; 14 November 1958; seine; FSBC 989. — 30, 28.7-73.0; Cross Bayou Canal, Pinellas Co., 1.5 m; 4 December 1958; seine; FSBC 1042. — 4, 55.7-61.5; Salt Creek, Pinellas Co., 1 m; 18 March 1971; seine; FSBC 8332. — 1, 81.1; drainage canal, Pinellas Co., 1 m; 1 May 1970; seine; FSBC 9369. — 1, 19.9; Tampa Bay, Pinellas Co., 0.5 m; 22 November 1960; push net; FSBC 3201. —7, 11.4-26.2; Tampa Bay, Pinellas Co., 0.5 m; 23 November 1959; FSBC 3205. —3, 11.9-17.8; Sarasota Bay, Sarasota Co., 1 m; 23 October 1958; push net; FSBC 920. —7, 23.4-27.9; Caloosahatchee River, Lee Co.; 5 December 1957; rotenone; FSBC 240. —29, 47.9-98.0; Caloosahatchee River, Lee Co.; 10 February 1959; seine; FSBC 1118. —4, 51.5-245; Caloosahatchee River, Lee Co., 1 m; 10 February 1959; seine; FSBC 1119.

*Diagnosis*: Body elongate, with nearly straight ventral outline, back somewhat elevated, BD 22.2-31.1% SL; mouth inferior, large; caudal fin truncate; color silvery, often washed with coppery red, one or more spots or "ocelli" at base of upper caudal rays; D. X + I, 24-26; A. II, 8 (some 7).

*Distribution and abundance*: Red drum occur from Massachusetts to Tuxpan, Mexico (Simmons and Breuer, 1962). They represented 1.5% by weight and 1.3% by dollar value of Florida's west coast commercial finfish landings in 1976 (Snell, 1978).

*Life history*: Gulf populations of red drum spawn in the fall (Powles and Stender, 1978). Spawning in the Everglades continues longer than that of Gulf populations, and spawning in Mid-Atlantic states occurs during summer and early fall (Jannke, 1971).

Johnson et al. (1977) described reared eggs and early larvae. Pearson (1929) described specimens 4.5 mm TL and larger, emphasizing the diagnostic value of prominent melanophores at the posterior end of the anal fin base, while Powles and Stender (1978) favored pigmentation on the vertebral column for identification of larvae. Simmons and Breuer (1962) distinguished juvenile red drum from croaker by fin shape. The pectoral fin of red drum is more pointed than that of croaker, while the caudal fin of croaker is more pointed than that of red drum.

Spawning apparently occurs in the Gulf near passes (Pearson, 1929; Simmons and Breuer, 1962) after which the larvae are carried by bottom currents (Jannke, 1971) to inland waters where they seek quiet grassy coves (Pearson, 1929). During current research in the Tampa Bay estuarine system, larvae and young (5.0-75.0 mm SL) have been taken over sandy and muddy bottoms. The areas with muddy bottoms are in dredged canals or other pockets off tributary streams and may be the end points for the inward movement of the larvae.

Red drum spend their first winter in deeper inland waters and may move into the nearshore Gulf during their first spring. Except for their first winter, most move to deeper parts of bays or to the Gulf during cold weather. While this migration is gradual, the return to the bays in spring is pronounced and exploited by anglers (Pearson, 1929).

Simmons and Breuer (1962) summarized growth information which indicates red drum grow more than 300 mm their first year and about 200 mm a year during their second and third years. The record size fish reported by the International Game Fish Association (McCracken, 1979) weighed 40.82 kg (90 lb).

Perret et al. (1980) tabulated and graphed available SL - TL and length - weight relationships for *S. occelatus.*

Size and age at maturity varies considerably in published reports with males presumably maturing at a smaller size than females. Simmons and Breuer (1962) found that spawning normally occurs at the end of the third or fourth year when the fish are 700 - 800 mm long, but mature fish 305 - 381 mm long have been reported (Perret et al., 1980).

*Food*: Larvae feed on copepods until they reach about 10 mm SL when they begin to incorporate crab zoea and larval fishes into their diet (Odum and Heald, 1972). Darnell (1958) concluded that young red drum feed mainly on amphipods and schizopods, while larger individuals eat larger crustaceans and fishes. In inland waters the principal food of adult red drum is the blue crab [*Callinectes sapidus* Rathbun, 1895], and offshore, penaeid shrimps [*Paneaus aztecus* Ives, 1891 and *P. setiferus* (Linnaeus, 1767)] are of primary importance.

Fishes identified by Pearson (1929) and Darnell (1958) from red drum gut contents include the following bottom and free-swimming species: *Brevoortia* sp.; *Arius felis* (Linnaeus, 1766); *Anchoa mitchilli* (Valenciennes, 1848); *Cyprinodon variegatus* Lacépède, 1803; *Fundulus* sp.; *Lucania parva* (Baird, 1854); *Mugil cephalus* Linnaeus, 1758; *Menidia* sp.; *Syngnathus* sp.; *Leostomus xanthurus*; *Lagodon rhomboides* (Linnaeus, 1766); *Symphurus plagiusa* (Linnaeus, 1766); *Gobiosoma bosci* (Lacépède, 1798); and *Myrophis punctatus* Lutken, 1851.

Yokel (1966) described feeding behavior and noted the presence of special, apparently tactile, extensions of the first pelvic rays.

*Salinity and temperature*: Red drum, generally considered euryhaline fishes (Gunter, 1956), have been taken at salinities of 0 $^{0}/oo$ to 50 $^{0}/oo$ (Simmons and Breuer, 1962).

Red drum have been observed at temperatures of 2-33°C (Yokel, 1966), but they normally move to deeper water during periods of extreme cold. As in other sciaenids, temperature tolerance of young is greater than that of adults (Yokel, 1966). Cold kills have been documented (Simmons and Breuer, 1962).

*Parasites*: Like the black drum and spotted seatrout, red drum may host the pleurocercoid larvae of the tapeworm *Poecilancistrium robustum* or related species. These larvae do not affect the taste of the drum and do not infect humans (Parker, 1951; Chandler, 1954).

Yokel (1966) tabulated reports of parasitized red drum. Twenty-one parasite species have been found.

*Remarks*: In a recent fishery profile, Perret et al. (1980) summarized biological information on red drum. That paper should be consulted for further detail.

## *Odontoscion dentex* (Cuvier, 1830)

Reef croaker, Figure 17

*Corvina dentex* Cuvier *in* Cuvier and Valenciennes, 1830, p. 139 [Saint Dominique].

*Odontoscion dentex*: Jordan and Eigenmann, 1889, p. 377 [Havana, Cuba: syn., descr., distrib., abundance]; Jordan and Evermann, 1898, pp. 1425, 1426 [North America: descr., distrib., syn.]; Longley and Hildebrand, 1941, p. 143 [Tortugas, Florida: habitat, coloration, distrib.]; Briggs, 1958, p. 281 [Florida: distrib.]; Springer and Woodburn, 1960, pp. 62, 63 [Tampa Bay, Florida: range extension, habitat, depth]; Randall, 1968, p. 150, fig. 171 [Caribbean: descr., distrib., habitat, habits, food]; Starck, 1968, p. 23 [Alligator Reef, Florida: abundance]; Causey, 1969, p. 50 [northwestern Gulf of Mexico: listing]; Miller and Jorgenson, 1973, p. 308 [western Atlantic: meristics]; Smith, 1976, p. 29 [eastern Gulf of Mexico: listing, habits]; Gilmore, 1977, p. 139 [eastern peninsular Florida: abundance, habitat]; Chao, 1978, pp. 10, 13, 20, 21, 23, 24, 26, 38, 39, 45, 50, figs. 4, 15, 27, 30, 34 [western Atlantic: syn., key, distrib., systematics]; Smith, 1978, pp. 212, 213 [mid-eastern Gulf of Mexico: distrib., abundance, habitat, habits, coloration].

*Material examined*: HOURGLASS STATIONS: None collected.—OTHER MATERIAL: 1, 174;

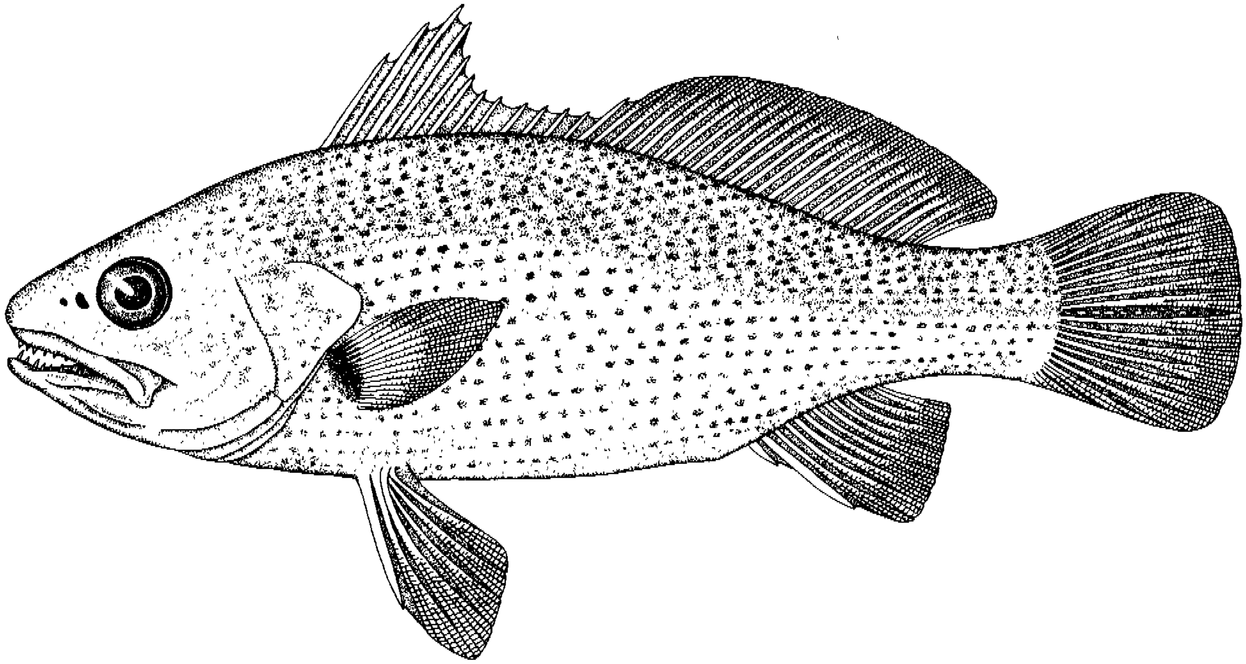


Figure 17. *Odontoscion dentex* (Cuvier, 1830).

off Clearwater, Pinellas Co., 9 m; 24 April 1973; hook-and-line; FSBC 7655. — 25, 39.7-82.9; off Clearwater, Pinellas Co., 9 m; 16 September 1976; rotenone; FSBC 9119. — 4, 49.1-129; off Clearwater, Pinellas Co., 9 m; 16 September 1976; rotenone; FSBC 9129. — 2, 73.1-101; off Johns Pass, Pinellas Co., 18 m; 14 September 1958; rotenone; FSBC 837. — 5, 62.3-86.8; off Johns Pass, Pinellas Co.; 21 September 1958; FSBC 861. — 1, 104; off Johns Pass, Pinellas Co., 17 m; 31 January 1959; rotenone; FSBC 1086. — 10, 60.5-143; off St. Petersburg Beach, Pinellas Co., 11 m; 8 February 1959; rotenone; FSBC 1105. — 1, 141; Pass-a-Grille Beach, Pinellas Co., 1 m; 2 December 1957; seine; FSBC 233. — 1, 72.2; off Sarasota, Sarasota Co., 16 m; 10 November 1970; scuba; FSBC 7332. — 1, 111; off Sarasota, Sarasota Co., 16 m; 21 May 1971; FSBC 7335. — 1, 123; Siesta Key, Sarasota Co., 3 m; 16 June 1968; poison; FSBC 9403.

*Diagnosis*: Mouth terminal, with well developed, uniserial, canine dentition on upper and lower jaws; body deep, BD 30.9-35.2% SL; color brownish silver, dark dots in preserved specimens form oblique stripes above the lateral line and horizontal stripes below the lateral line, a large black spot at the base of the pectoral fin; D. XII (some XI) + I (some II), 22-27; A. II, 10-11.

*Distribution*: The range of the reef croaker, listed by Briggs (1958) as Key Largo to Argentina, can be extended to include Florida's east coast (Gilmore, 1977) and the Gulf of Mexico (Springer and Woodburn, 1960; Causey, 1969).

*Life history*: Life history information is not available for this species, but scuba observations have uncovered many of its habits. It is a cryptic species which remains within reef crevices during the day and feeds nocturnally on small fishes, shrimps and their larvae (Randall, 1968; Smith, 1978).

Smith (1978) noted that in open reef areas reef croaker exhibit a dark color phase making them difficult to distinguish from adult *Pareques umbrosus*, with which they mingle. Smith considered this similarity a form of mimicry, giving the rarer *O. dentex* an advantage at the expense of the more abundant *P. umbrosus.*

## *Bairdiella chrysoura* (Lacépède, 1803)

Silver perch, Figure 18

*Dipterodon chyrsourus* Lacépède, 1803, p. 64 [South Carolina].

*Bairdiella chrysura*: Jordan and Eigenmann, 1889, pp. 386, 387, fig. 3 [America: syn., distrib., abundance, descr.]; Jordan and Evermann, 1898, pp. 1433, 1434, pl. CCXXII, fig. 566 [North America: descr., distrib., syn.]; Kuntz, 1915, pp. 3-13, figs. 1-24 [North Carolina: spawning, embryology, larval development]; Welsh and Breder, 1924, pp. 171-175, figs, 22-34 [eastern U.S.A.: distrib., spawning, embryology, growth, maturation, food]; Hildebrand and Schroeder, 1928, 279-282, figs. 159-163 [Chesapeake Bay: syn., descr., food, spawning, growth, abundance, distrib.]; Hildebrand and Cable, 1930, pp. 411-416, fig. 40 [North Carolina: distrib., spawning, development, growth, food]; Gunter, 1938, pp. 325, 326, fig. 5 [Louisiana: seasonal abundance, spawning]; 1945, p. 66 [Texas: spawning, movements, salinity]; Simmons, 1950, p. 5 [Texas: trapping]; Reid, 1954, pp. 48, 49, fig. 10 [Cedar Key, Florida: seasonal abundance, spawning, food]; Kilby, 1955, p. 224 [Gulf coast Florida: spawning]; Reid, 1955b, p. 442 [East Bay, Texas: listing, salinity]; Joseph and Yerger, 1956, p. 137 [Alligator Harbor, Florida: seasonal abundance, spawning, salinity]; Reid et al., 1956, p. 103 [East Bay, Texas: food]; Breuer, 1957, p. 146 [Baffin and Alazan Bays, Texas: abundance]; Simmons, 1957, p. 186 [Laguna Madre, Texas: salinity]; Darnell, 1958, pp. 381, 382 [Lake Pontchartrain, Louisiana: food]; Briggs, 1958, p. 280 [Florida: distrib.]; Springer and Woodburn, 1960, pp. 50-52, fig. 12 [Tampa Bay, Florida: spawning, growth, movements, salinity, temperature, food]; Tabb and Manning, 1961, pp. 624, 625 [Florida Bay: abundance spawning]; Jannke, 1971, pp. 25-33, figs. 4, 5 [Florida Everglades: spawning]; Wang and Raney, 1971, p. 35 [Charlotte Harbor, Florida: spawning, salinity, temperature]; Hastings, 1972, pp. 274-276 [northeastern Gulf of Mexico: seasonal abundance, spawning, food]; Odum and Heald, 1972, p. 720 [southwestern Florida: food]; Scotton et al., 1973, pp. 74-77, 5 figs. [Delaware Bay: literature review, descr. of eggs through adults, spawning, distrib.]; Miller and Jorgenson, 1973, p. 308 [western Atlantic: meristics]; Lippson and Moran, 1974, pp. 210-213, 11 figs. [Potomac River: literature review, descr. of eggs through adults, spawning]; Powles and Stender, 1978, pp. 7-11 [southeastern U.S.A.: distrib., spawning, descr. of larvae, maturity].

*Bairdiella chrysoura*: Chao and Musick, 1977, pp. 657-702, figs. 1-5, 15, 20-29 [York River, Virginia: life history, feeding adaptations, food]; Chao, 1978, pp. 10, 13, 20, 23-26, 38-40, 50, figs. 2, 4, 15, 27, 30, 33 [western Atlantic: syn., key, distrib., systematics]; Johnson, 1978, pp. 172-179, figs. 100-105 [Mid-Atlantic Bight: literature review]; Powles, 1980, pp. 119-136, figs. 1, 2 [southeastern U.S.A.: descr. of larvae].

*Material examined*: HOURGLASS STATION A: 1, 115; 6 April 1966; trynet; FSBC 4845.—HOURGLASS STATION I: 1, 146; 9 March 1966; trynet; FSBC 4792.—OTHER MATERIAL: 1, 137; 28°58′54″N, 82°47′06″W, 1.5 m; trawl; FSBC 6821.—8, 100-135; 28°56′42″N, 82°46′48″W, 2 m; 6 June 1969; trawl; FSBC 7830.—21, 87.1-133; Crystal River, Citrus Co.; 9 June 1969; trawl; FSBC 7865.—3, 59.1-140; Crystal River, Citrus Co.; 8 September 1969; trawl; FSBC 9267.—10, 27.1-136; Crystal River, Citrus Co.; 20 July 1971; trawl; FSBC 9277.—1, 38.2; Crystal River, Citrus Co.; 26 June 1969; FSBC 9316.—3, 95.3-102; Crystal River, Citrus Co.; 17 July 1969; trawl; FSBC 9323.—2, 95.5-111; Crystal River, Citrus Co.; 9 June 1969; trawl; FSBC 9415.—1, 83.3; Crystal River, Citrus Co.; 27 March 1969; trawl; FSBC 9445.—3, 33.4-105; Crystal River, Citrus Co.; 28 July 1971; trawl; FSBC 9450.—1, 106; Crystal River, Citrus Co., 3 m; 3 June 1969; trawl; FSBC 9577.—9, 36.5-111; Crystal River, Citrus Co., 1 m; 28 July 1971; trynet; FSBC 9676.—4, 51.7-146; Crystal River, Citrus Co.; trynet; FSBC 9685.—3, 39.3-65.5; Crystal River, Citrus Co.; 20 July 1971; trynet; FSBC 9690.—1, 112; Port Richey, Pasco Co.; 3 June 1965; trawl; FSBC 3558.—1, 139; 27°58′30″N, 85°51′W, 5 m; 4 June 1963; trynet; FSBC 2660.—4, 123-134; 27°58′30″N, 82°51′W, 5 m; 7 June 1963; trynet; FSBC 2670.—1, 125; 27°43′N, 82°45′W; 6 June 1963; trynet; FSBC 2680.—2, 119-132; Pass-a-Grille Beach, Pinellas Co., 8 m; 13 September 1962; trynet; FSBC 2254.—9, 36.6-87.6; Sister Key, Pinellas Co., 1 m; 31 August 1964; seine; FSBC 3088.—2, 140-145; Bunces Pass, Pinellas Co., 8 m; 31 August 1964; trawl; FSBC 3047.—3, 55.7-69.2; Bunces Pass, Pinellas Co.; 27 August 1969; seine; FSBC 5513.—3, 39.1-65.4; Bunces Pass, Pinellas Co., 1 m; 30 November 1970; trawl; FSBC 8747.—1, 72.7; Bunces Pass, Pinellas Co., 1 m; 23 February 1971; trawl; FSBC 8748.—4, 21.9-55.8; Bunces Pass, Pinellas Co., 1 m; 26 July 1971; trawl; FSBC

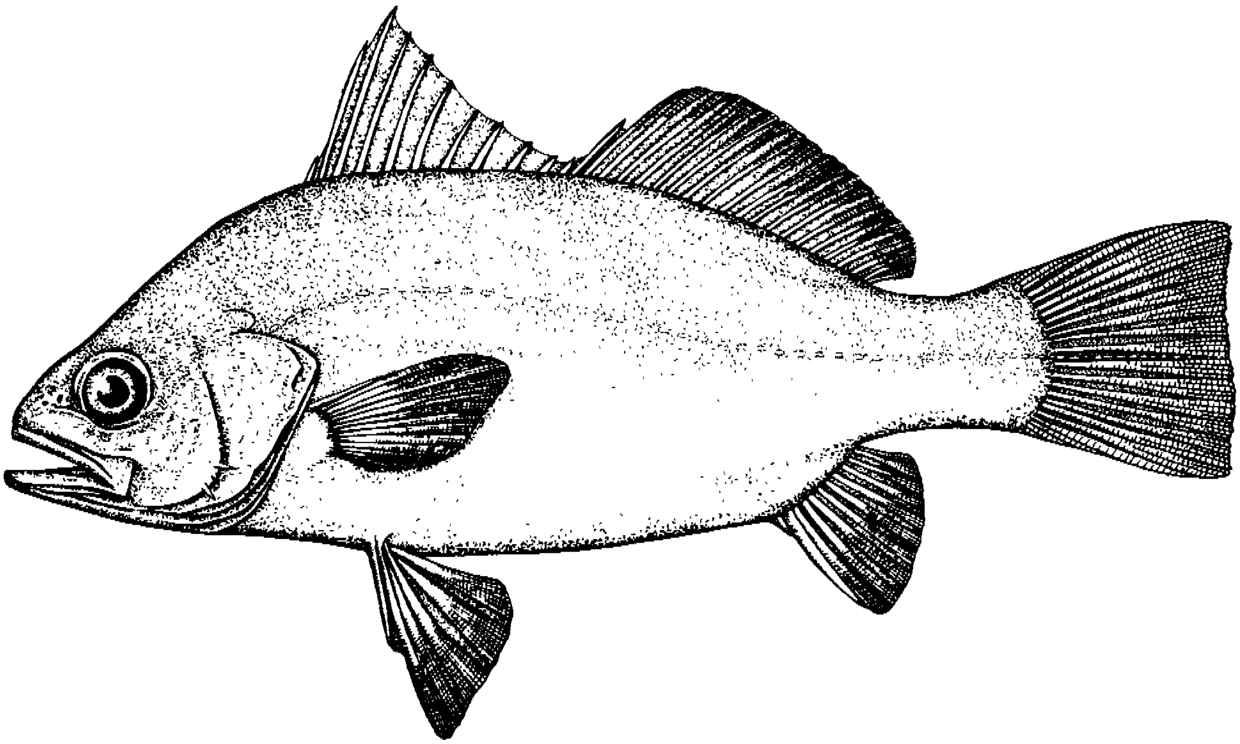


Figure 18. *Bairdiella chrysoura* (Lacépède, 1803).

8754.—5, 59.0-87.7; Bunces Pass, Pinellas Co.; 30 November 1971; trawl; FSBC 8759.—2, 75.2-100; Boca Ciega Bay, Pinellas Co., 1 m; 28 October 1971; trawl; FSBC 8760.—34, 21.9-77.4; Boca Ciega Bay, Pinellas Co., 1.5 m; 10 September 1958; pushnet; FSBC 821.—2, 93.8, 97.3; Long Bayou, Pinellas Co., 1 m; 19 November 1971; seine; FSBC 8761.—1, 17.3; Cross Bayou Canal, Pinellas Co.; 14 November 1957; FSBC 195.—2, 90.8-101; Bush Key, Pinellas Co., 1 m; 3 January 1965; trawl; FSBC 2769.—6, 44.3-92.3; Bay Vista Point, Pinellas Co., 1 m; 23 July 1964; seine; FSBC 3055.—22, 15.8-39.0; Big Bayou, Pinellas Co., 1 m; 13 June 1971; FSBC 9031.—1, 66.6; Bayboro Harbor, Pinellas Co., 3 m; 21 December 1971; trynet; FSBC 8762.—2, 26.7-84.4; Tampa Bay, Pinellas Co.; 21 September 1956; FSBC 35.—2, 114-123; Tampa Bay, Pinellas Co., 3 m; 7 January 1965; trawl; FSBC 2786.—1, 22.0; Tampa Bay, Pinellas Co.; 9 October 1964; seine; FSBC 3213.—10, 20.7-117; Tampa Bay, Pinellas Co., 3 m; 31 August 1964; trawl; FSBC 3266.—2, 84.3, 126; Tampa Bay, Pinellas Co., 2 m; 15 December 1977; trawl; FSBC 10276.—3, 55.0-58.6; Egmont Key, Pinellas Co., 3 m; July 1964; seine and trawl; FSBC 3008.—12, 23.4-37.2; Egmont Key, Pinellas Co., 1 m; 19 June 1964; seine; FSBC 3160.—5, 29.5-95.6; Sarasota Bay, Sarasota Co., 1 m; 23 October 1958; FSBC 919.—1, 72.1; Marco Island, Collier Co.; 15 December 1967; trawl; FSBC 7689.

*Diagnosis*: Mouth terminal, slightly oblique; teeth small, villiform; body compressed, back moderately elevated, BD 28.0-37.5% SL; color blue-grey above, silver below; fins mostly yellowish; D. XI (some XII) + I, 19-22; A. II, 8-10.

*Distribution*: *Bairdiella chrysoura* occurs from New York to southern Florida and around the Gulf of Mexico (Briggs, 1958; Chao, 1978).

*Life history*: Spawning of silver perch seems strongly related to springtime warming; occurring later at higher latitudes. It peaks near the end of February at the southern tip of Florida (Tabb and Manning, 1961; Jannke, 1971) but not until June in New Jersey (Welsh and Breder, 1924). Springer and Woodburn (1960) concluded that from Tampa, Florida, northwestward to Texas spawning occurs between April and June, but Tampa Bay sampling using nets of finer mesh than theirs produced larvae as small as 5.1 mm SL on 30 October 1979.

In North Carolina, Hildebrand and Cable (1930) found that spawning occurs in estuaries and offshore to 15 miles. In Louisiana, Gunter (1938) took ripe females from both Barataria Bay and the Gulf of Mexico. In Texas and in western peninsular Florida, however, they are thought to spawn in bays and lagoons (Gunter, 1945; Springer and Woodburn, 1960).

In North Carolina, Kuntz (1915) found *B. chrysoura* spawned in early evening. He described the eggs, embryology, and larval development. Eggs are 0.7-0.8 mm in diameter and slightly yellowish in color. Hatching occurs in about 18 hours at 27.5°C.

Hildebrand and Cable (1930) mentioned ways to distinguish silver perch embryos from those of *Orthopristis chrysoptera* (Linnaeus, 1766), with which they are easily confused. The distinctions are in oil globule coloration and position. Those authors also suggested that Kuntz's egg size range may include larger eggs from a second species. The size range they gave for *B. chrysoura* eggs is 0.66-0.72 mm.

Powles and Stender (1978) and Powles (1980) described development of specimens 3.1-8.8 mm SL. Silver perch grow to about 115 mm TL by November of their first year in Beaufort, North Carolina (Hildebrand and Cable, 1930). This represents a growth rate slightly greater than that for Chesapeake Bay (Hildebrand and Schroeder, 1928), but approximately the same as that for Tampa Bay (Springer and Woodburn, 1960). By the second winter season the fish have reached 120-200 mm TL (Welsh and Breder, 1924).

Maturity is reached after the second winter when the fish are 150-210 mm TL. After the first spawning, growth slows, and the fish seldom exceed a length of 240 mm TL (Welsh and Breder, 1924).

*Food*: Darnell (1958) summarized the literature on food habits of this species. Small silver perch feed on copepods, ostracods, cladocera, schizopods, amphipods, and annelids. Increased feeding on annelids, larger crustaceans and molluscs accompanies growth. Odum and Heald (1972) found that larvae feed on copepods and fish larvae, mainly *Menidia beryllina* (Cope, 1866), and Chao and Musick (1977) found that York River, Virginia, juveniles prey extensively on *Anchoa mitchilli* and other fishes.

Hildebrand and Cable (1930) concluded that this species is strictly carnivorous and usually feeds on the bottom. They stated it is not a serious predator of fishes or commercial crustaceans, but is frequently eaten by commercially valuable weakfishes and flounders.

Morphological adaptations for the silver perch's feeding were described by Chao and Musick (1977).

*Salinity and temperature*: Gunter (1945) described this species as euryhaline. In the Tampa Bay area, Springer and Woodburn (1960) took silver perch in salinities of 3.7-35.5 $^{0}/_{00}$, usually greater than 20.0 $^{0}/_{00}$. Wang and Raney (1971) took them from fresh water in the Myakka River, Florida. Hourglass specimens were taken at bottom salinities of 33.80 $^{0}/_{00}$.

Water temperatures for the collections made by Springer and Woodburn (1960) ranged from 10.0 to 32.5°C. Those authors also noted cold-killed specimens in 13.0°C water. Hourglass specimens were taken at bottom temperatures of 17.9 and 19.5°C.

## DISCUSSION

### *TRIBE LEVEL SYSTEMATICS*

Florida sciaenid genera (including those in APPENDIX) can be placed in six suprageneric groups or tribes based on swim bladder (Figure 19) and barbel structure.

The first group has a two-chambered swim bladder consisting of a yoke-shaped anterior chamber and a carrot-shaped posterior chamber. Barbels are absent. This group, which includes *Odontoscion*, *Bairdiella*, and *Stellifer*, (Chao, 1978) is here considered the tribe Stelliferini. Labbish Chao (personal communication) and John Wintersteen are preparing a manuscript to describe this tribe and revise the genus *Stellifer* Oken, 1817.

A second group is characterized by a simple swim bladder and a perforate chin barbel. *Merticirrhus* (in which the bladder atrophies) and *Umbrina* belong to this group. Following Trewavas (1962, 1964) this group is called the tribe Umbrinini. Trewavas (1977) discontinued her earlier use of this tribe without comment. It is retained here to emphasize the importance of the perforate chin barbel in linking *Umbrina* and *Menticirrhus*.

A third group with a simple swim bladder and no barbels includes *Equetus*, *Pareques*, *Larimus*, and *Leiostomus*. This group corresponds to the tribe Sciaenini of Trewavas (1962). Florida's *Larimus fasciatus* Holbrook, 1855, belongs in this group, but Trewavas (1962) illustrated a *Larimus breviceps* Cuvier, 1830, from Santos, Brazil, which might be placed more properly in the fifth group below.

The fourth group has a simple swim bladder with a pair of anterior, horn-shaped diverticula. Barbels are absent. *Cynoscion* is the sole Florida genus in this group, which corresponds to the tribe Cynoscionini of Trewavas (1962).

The fifth group has a swim bladder with a pair of diverticula that originate from the anterolateral corners, extend backwards, and may divide into numerous tubules. Barbels are absent. This group, corresponding to Trewavas' (1962) tribe Pseudotolithini, includes Florida's monotypic genus *Sciaenops*.

In the sixth group, swim bladders have one or more pairs of lateral diverticula. Numerous chin barbels are present. *Pogonias* and *Micropogonias* have these characteristics (Chao, 1978). Trewavas (1962) used this kind of swim bladder to define her tribe Otolithini. The barbel condition seems to be New World in origin. I chose Trewavas' 1962 rather than her 1977 terminology to emphasize that the fundamental bladder specialization in this group is the presence of diverticula which are lateral in position rather than anterolateral as in other tribes.

A possible phylogeny of these six tribes has been constructed (Figure 20). The tribes are essentially the same as groups in Chao's (1978: Figure 17) swim bladder grouping if *Lonchurus* is placed in the Cynoscionini and *Nebris* is placed in the Pseudotolithini. The phylogeny differs from Chao's swim bladder grouping primarily because greater importance has been attributed to the ontogeny of

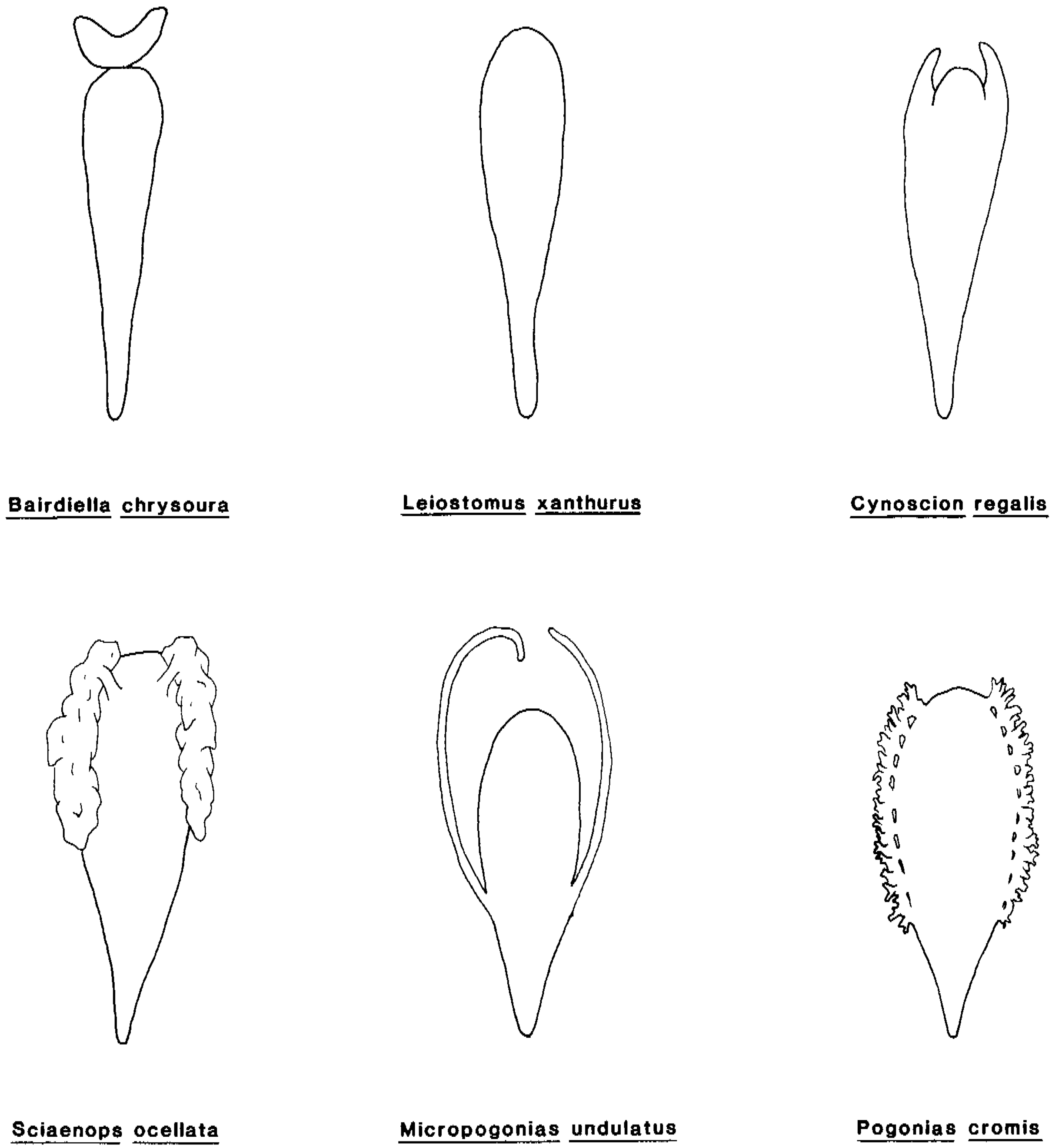
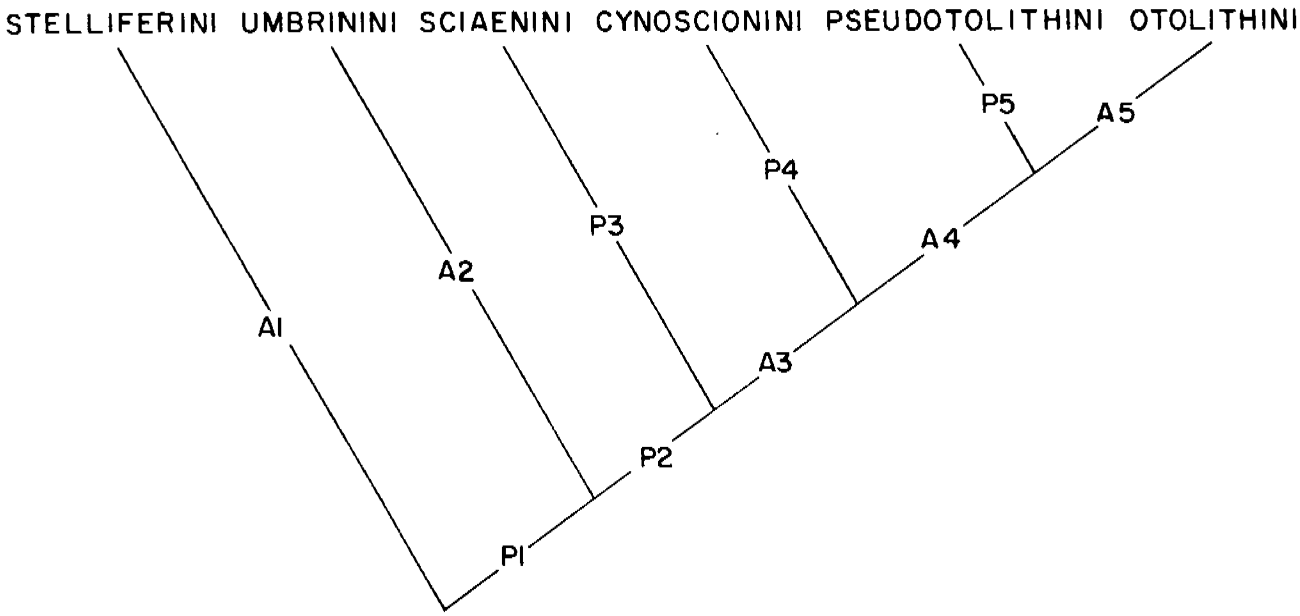



Figure 19. Representative sciaenid swim bladders. Modified from Chao (1978).

*Pogonias*. Chao (1978) found that the swim bladder of young *Pogonias* is simple, but that lateral diverticula develop, beginning anteriorly, as the fish grows. This otogenetic change suggests that elaboration of lateral diverticula is more recent than, and may be an extension of, the elaboration of anterolateral diverticula. The phylogeny presented here also considers presence and structure of barbels in addition to swim bladder structure.

Authorities on sciaenid systematics have generally studied otolith as well as swim bladder structure (Chu, Lo and Wu, 1963; Trewavas, 1962, 1964, 1977; Chao, 1978). Since sound




P

1. One-chambered swim bladder
2. No perforate chin barbel
3. No swim bladder diverticula
4. Simple diverticula
5. Anterolateral diverticula, no barbels

A

1. Two-chambered swim bladder
2. Perforate chin barbel
3. Swim bladder diverticula
4. Complex diverticula
5. Lateral diverticula,many barbels

Figure 20. Phylogeny of sciaenid tribes based on Florida genera. A, advanced; P, primitive.

communication is an important species recognition mechanism in this group (Trewavas, 1962; Chao, 1978), one might assume swim bladder and otolith structure are functionally related and selected for as a unit. Since Chao (1978; compare his Figures 17 and 29) found that otolith and swim bladder phylogenies are not congruent, either the functional relationship or Chao's interpretations must be questioned.

The fundamental dichotomy between the Stelliferini and other American sciaenids is well supported by otolith information since only that tribe has enlarged the lapillus as well as the sagitta (Chao and Miller, 1975; Chao, 1978), but the close relationship of *Cynoscion* to *Menticirrhus*, for example, based on sagitta structure alone (Chao, 1978: Figure 29) is difficult to accept against all other anatomical evidence.

## *HISTORICAL ZOOGEOGRAPHY*

The earliest known fossil sciaenid, *Eocilophyodus*, is from the upper Cretaceous of west Africa, and later fossils are mainly from North America and Europe (Romer, 1966). Considering the abundance of recent species in China (Chu, Lo and Wu, 1963), absence of fossils from that area may be a sampling artifact.

The fossil record suggests the sciaenid radiation occurred during late Mesozoic to early Cenozoic and was strong in the New World. The Tethys and Trans-American Seas were open at that time (Figure 21) allowing disperal of sciaenids into their present worldwide distribution, which is temperate to tropical.

Elevation of the Central American land bridge in the Pliocene to Pleistocene (Myers, 1966; Gilbert and Kelso, 1971) divided the ranges of several sciaenids. Florida genera occurring in the Pacific as well as in the Gulf of Mexico include *Bairdiella*, *Cynoscion*, *Larimus*, *Menticirrhus*, *Micropogonias*, *Odontoscion*, *Pareques*, *Stellifer*, and *Umbrina* (Jordan and Evermann, 1898; Meek and Hildebrand, 1925; McPhail, 1961; Bailey et al., 1970). *Pogonias* may also have trans-American affinities. Its pharyngeal dentition tends to relate it to *Aplodinotus* of the Mississippi drainage and to *Roncador* of the Pacific (Jordan and Evermann, 1898), and its swim bladder structure may relate it to the trans-American *Micropogonias*. Among Florida sciaenids, then, only *Leiostomus* and *Sciaenops*, both monotypic genera, are restricted to the Atlantic.

Pleistocene climatic changes affected the distributions of temperate water shore fishes in the Florida area (Hoese and Moore, 1977). During cold glacial periods they were able to extend their ranges around the southern tip of Florida to inhabit both Gulf and western Atlantic waters. Warm waters of interglacial periods then forced them northward from southern Florida along both sides of

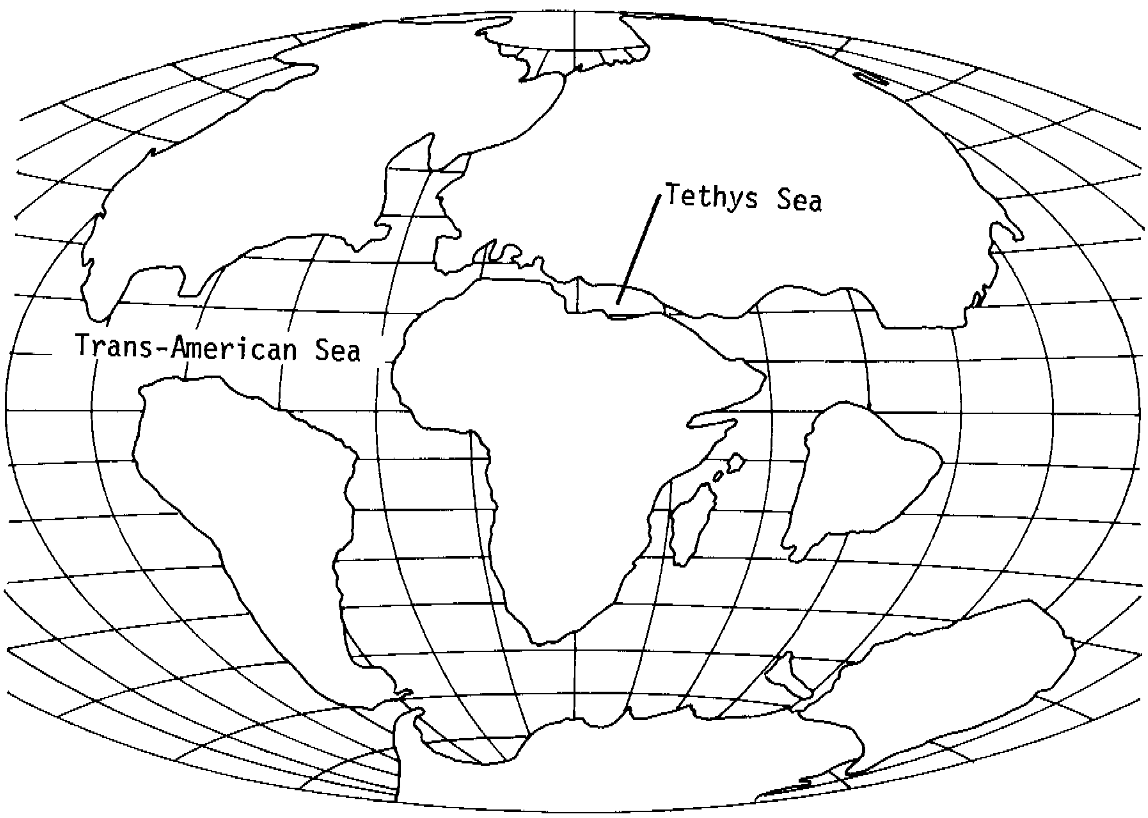



Figure 21. Positions of the continents at the end of the Cretaceous. Modified from Dietz and Holden (1970).

the peninsula thereby isolating the ends of their distributions. Each pair of isolates from a once continuous Atlantic to Gulf distribution then evolved distinctions that caused some authors to recognize them as separate species. Other authors feel speciation is incomplete and the isolates are synonymous. Species pairs involved are *Cynoscion regalis*/*C. arenarius* and *Menticirrhus saxatilis*/*M. focaliger*. Recent evidence favors synonymy in both cases (Weinstein and Yerger, 1976a, for *Cynoscion*; Irwin, 1970, for *Menticirrhus*).

## *STATION AND SPECIES ASSOCIATIONS*

Similarities of Hourglass stations based on abundances of sciaenid species are shown in Figure 22. The data are shown in Table 11.

As expected for sciaenids, there is a major difference between the inshore (6.1 m depth, Stations A and I) fauna and the fauna sampled farther offshore (18.3-73.2 m depth, Stations B-E and J-M). During regular night cruises, four species, *Menticirrhus littoralis*, *Menticirrhus americanus*, *Cynoscion regalis*, and *Bairdiella chrysoura*, were taken only at the inshore stations, and three species, *Equetus lanceolatus*, *Pareques umbrosus*, and *Pareques* sp. (Black Bar), were taken only offshore. *Leiostomus xanthurus* was taken mainly inshore (24 specimens), but two specimens were taken at Station B (18.3 m depth).

Using sciaenid data, the offshore stations showed no easily predictable subgroupings. They did not, for example, group by depth as they did when data on Hourglass Triglidae were used (Ross, 1982, figure 24). Both sciaenid and triglid data indicate, however, that the fundamental dichotomy is between the inshore and offshore stations.

Figure 23 shows species associations derived from the data in Table 11. The major dichotomy generally divides the five inshore species (including *L. xanthurus*) from the three offshore species described in the second paragraph of this section, but below that level some of the expected associations are weak. Only two specimens of *Pareques* sp. (Black Bar) were collected during Hourglass sampling. That species, therefore, shows poor association with the other two offshore sciaenids, which were well represented in Hourglass collections. Similarly, the two poorly represented *Menticirrhus* species show weak associations with the other three inshore species. *Pareques* sp. (Black Bar) probably occurs mainly offshore of, while *Menticirrhus* occurs mainly inshore of, the Hourglass study area.

## *GENERAL LIFE HISTORY*

Most Florida sciaenids (including those in APPENDIX) spawn inshore (depth less than about 10 m) in ocean or Gulf waters. Eggs are pelagic; larvae move into protected estuarine nursery areas; and juveniles return to and remain in inshore waters of the ocean or Gulf. Species following this general pattern include: *Cynoscion regalis*, *Menticirrhus americanus*, *M. saxatilis*, *Pogonias cromis*, *Sciaenops ocellatus* and *Stellifer lanceolatus*. See Hildebrand and Cable (1934) and Powles and Stender (1978) for those not covered in the text of this paper.

Other Florida sciaenids show variations of this pattern. *Bairdiella chrysoura* and *Cynoscion nebulosus* probably spawn in protected estuaries. *Bairdiella batabana* spends most of its life associated with grass beds (Robins and Tabb, 1965). *Menticirrhus littoralis* rarely enters protected

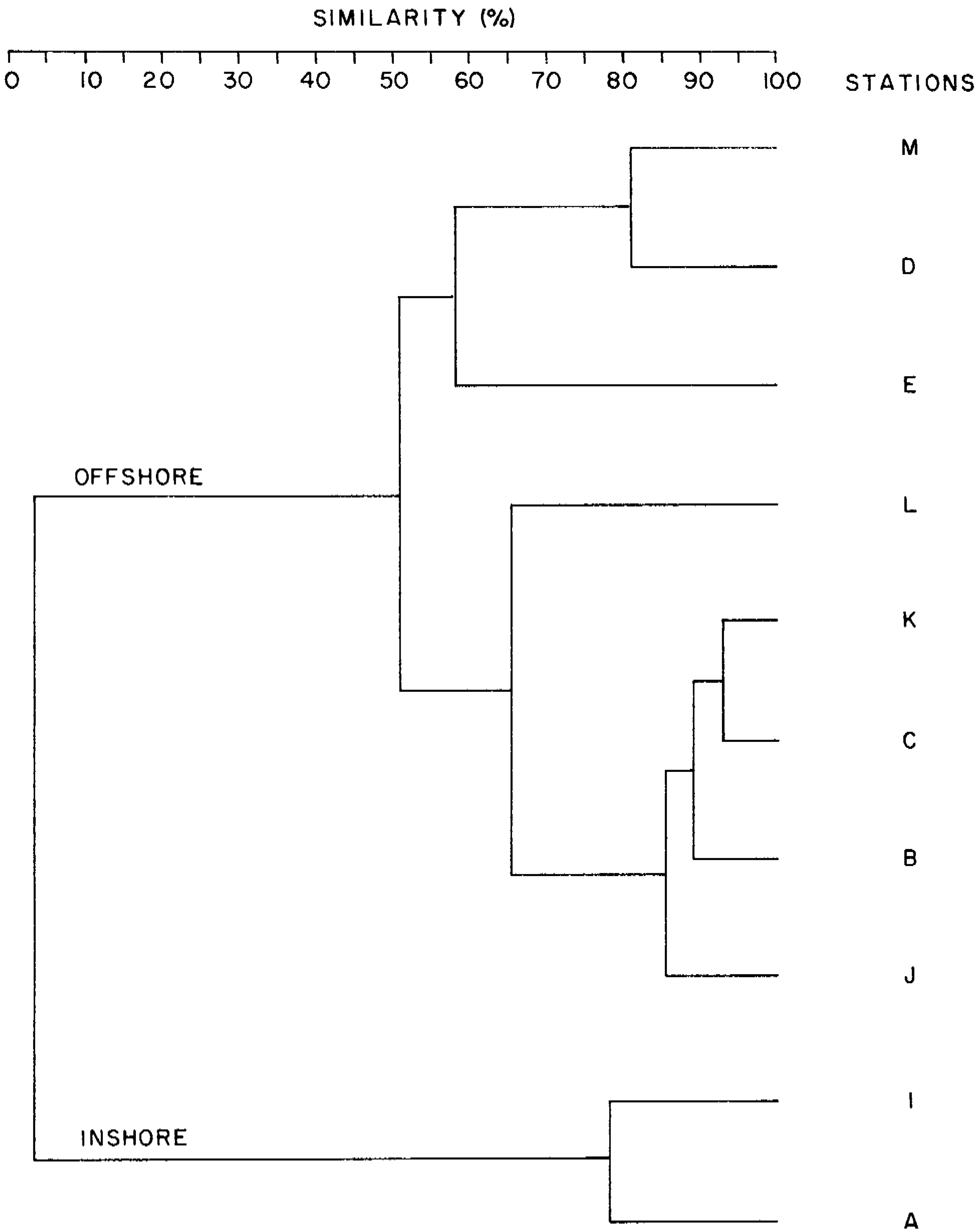



Figure 22. Similarities of Hourglass stations as indicated by abundances of sciaenid species.

TABLE 11. NUMBERS OF SCIAENIDS TAKEN DURING REGULAR NIGHT HOURGLASS CRUISES.

| Species | Hourglass Stations | | | | | | | | | | TOT |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | North Transect | | | | | South Transect | | | | | |
| | A | B | C | D | E | I | J | K | L | M | |
| *Menticirrhus littoralis* | 1 | — | — | — | — | — | — | — | — | — | 1 |
| *Menticirrhus americanus* | 4 | — | — | — | — | — | — | — | — | — | 4 |
| *Cynoscion regalis* | 18 | — | — | — | — | 6 | — | — | — | — | 24 |
| *Bairdiella chrysoura* | 8 | — | — | — | — | 13 | — | — | — | — | 21 |
| *Leiostomus xanthurus* | 11 | 2 | — | — | — | 13 | — | — | — | — | 26 |
| *Equetus lanceolatus* | — | 29 | 24 | — | 1 | — | 94 | 13 | 8 | 1 | 170 |
| *Pareques umbrosus* | — | 45 | 71 | 14 | 3 | — | 30 | 41 | 3 | 9 | 216 |
| *Pareques* sp. (Black Bar) | — | — | — | — | 2 | — | — | — | — | — | 2 |
| TOTALS | 42 | 76 | 95 | 14 | 6 | 32 | 124 | 54 | 11 | 10 | 464 |

estuaries, and *Umbrina coroides* is described as a littoral species, but its spawning area is not known (Gilbert, 1966). Larval *Cynoscion nothus, Larimus fasciatus, Leiostomus xanthurus*, and *Micropogonias undulatus* probably remain offshore with the adults (Hildebrand and Cable, 1934; Powles and Stender, 1978).

On November 20, 1966, Hourglass Post-Cruise No. 33 collected 18 spot and 17 Atlantic croaker at Station D in the same trynet tow. The spot (FSBC 5275, 130-205 mm SL) were inadvertently overlooked during the specimen examinations leading to the diagnoses and allometric analyses in this paper, so they are not in the *Material examined* section for that species.

All specimens of both species were apparently sexually mature and active. Since they were taken only during the daytime cruise, one might tentatively conclude that both species spawn near the surface at night and move down in the water column during the day where they become available to capture by trynet.

Though both of these species are known to spawn offshore, their possible spawning in close proximity has not been previously reported, and Hourglass Station D is about 40 km farther offshore than other reported spawning locations.

Reef forms, including *Bairdiella sanctaeluciae, Odontoscion dentex, Equetus* and *Pareques* presumably undergo little migration for spawning. Young and adult *Equetus lanceolatus* and *Pareques umbrosus* were taken simultaneously at Hourglass stations.

Life history information on some sciaenids supports the generalization that fish of a given inshore species grow and mature more rapidly at lower latitudes [see, for example, White and Chittenden (1977) on *Micropogonias undulatus*]. In addition, the spawning season of a given species is more protracted at lower latitudes. Jannke (1971) found this generally true for eight sciaenids.

Available specimens from western peninsular Florida allowed presentation of growth information for only *Equetus lanceolatus* and *Pareques umbrosus* (Tables 3 and 8). However, they did allow analyses of various kinds of allometric growth. Most of these allometries have been alluded to in the literature. To provide a more precise visual representation, they are presented here as regressions of component size on standard length. Ranges for size of the components as a percentage of standard length are given in the species accounts (*Diagnoses*).

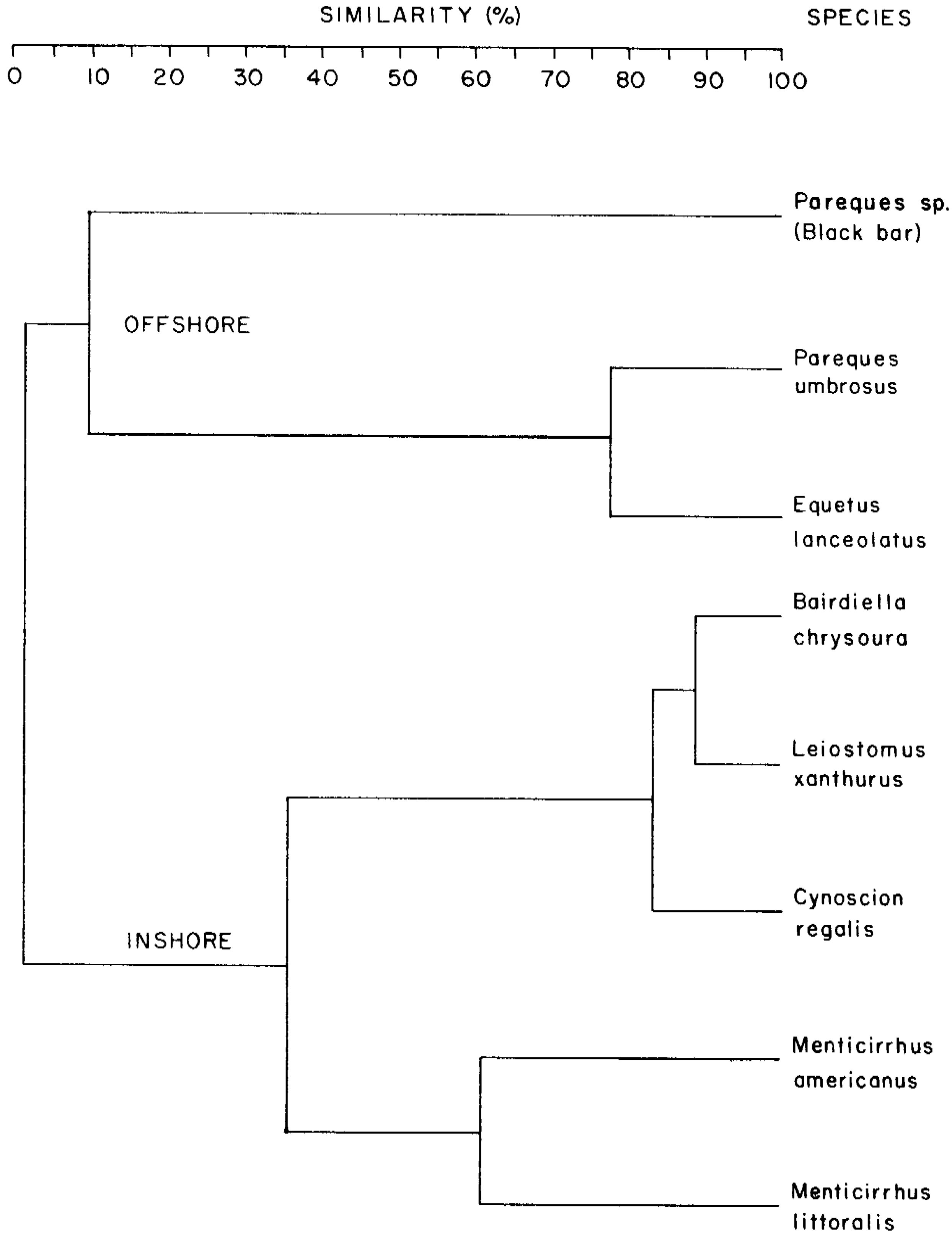



Figure 23. Associations of sciaenid species based on their abundances at Hourglass stations.

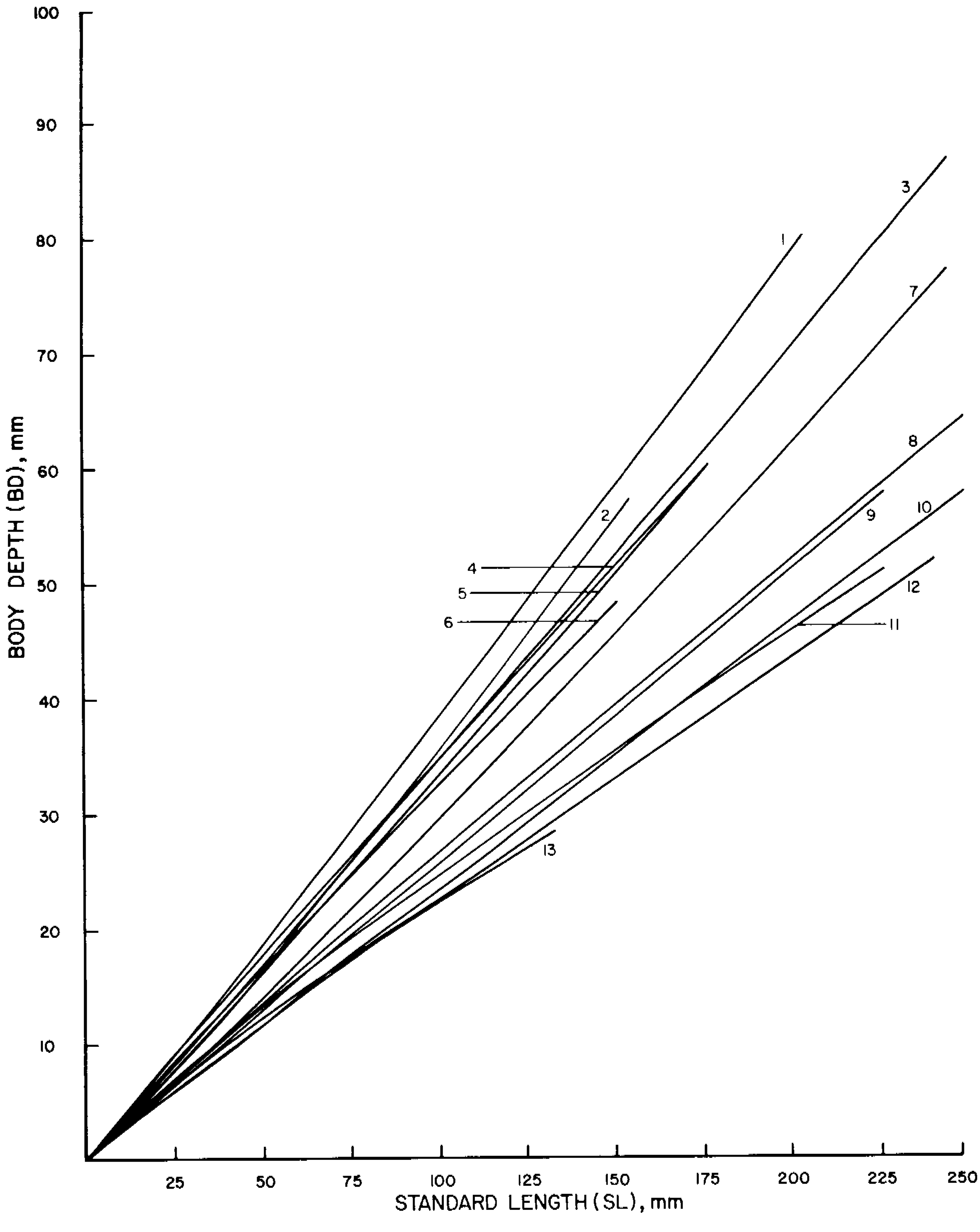



Figure 24. Regressions of BD on SL for western peninsular Florida Sciaenidae. See Table 12 for description of lines.

The relationship of body depth to standard length is nearly linear for most of the sciaenids considered. As standard length increases, *Leiostomus xanthurus* shows the greatest increase and *Menticirrhus saxatilis* shows the greatest decreased in relative body depth (Figure 24, Table 12).

TABLE 12. DESCRIPTION OF REGRESSIONS IN FIGURE 24. ALL LINES ARE BD = $a(SL)^b$.

| Plot | Species | a | b | $\underline{r}^2$ | S(Y/X) | F |
|---|---|---|---|---|---|---|
| 1 | *Equetus lanceolatus* | 0.320 | 1.036 | 0.991 | 0.037 | 26483.335 |
| 2 | *Leiostomus xanthurus* | 0.215 | 1.110 | 0.997 | 0.038 | 58054.150 |
| 3 | *Pogonias cromis* | 0.303 | 1.033 | 0.996 | 0.033 | 4520.995 |
| 4 | *Pareques umbrosus* | 0.378 | 0.981 | 0.990 | 0.050 | 35642.266 |
| 5 | *Odontoscion dentex* | 0.280 | 1.035 | 0.994 | 0.028 | 8881.371 |
| 6 | *Bairdiella chrysoura* | 0.374 | 0.971 | 0.996 | 0.035 | 58002.609 |
| 7 | *Micropogonias undulatus* | 0.205 | 1.080 | 0.992 | 0.038 | 20990.671 |
| 8 | *Sciaenops ocellatus* | 0.294 | 0.979 | 0.995 | 0.041 | 23649.978 |
| 9 | *Cynoscion nebulosus* | 0.277 | 0.987 | 0.991 | 0.044 | 25268.156 |
| 10 | *Menticirrhus americanus* | 0.224 | 0.994 | 0.996 | 0.045 | 16021.127 |
| 11 | *Cynoscion regalis* | 0.393 | 0.901 | 0.994 | 0.047 | 10034.251 |
| 12 | *Menticirrhus littoralis* | 0.270 | 0.961 | 0.992 | 0.062 | 9617.372 |
| 13 | *Menticirrhus saxatilis* | 0.442 | 0.855 | 0.995 | 0.037 | 16057.947 |

Length of the longest dorsal spine is useful in distinguishing *Menticirrhus saxatilis* from its congeners. With growth, *M. saxatilis* shows a greater increase in spine length relative to standard length (Figure 25, Table 13).

TABLE 13. DESCRIPTION OF REGRESSIONS IN FIGURE 25. ALL LINES ARE SPINE LENGTH = $a(SL)^b$.

| Plot | Species | a | b | $\underline{r}^2$ | S(Y/X) | F |
|---|---|---|---|---|---|---|
| 1 | *M. saxatilis* | 0.050 | 1.397 | 0.980 | 0.111 | 3588.975 |
| 2 | *M. littoralis* | 0.086 | 1.190 | 0.993 | 0.074 | 9724.680 |
| 3 | *M. americanus* | 0.161 | 1.059 | 0.986 | 0.092 | 4414.552 |

Hildebrand and Cable (1934) described the decrease in relative length of the caudal fin in *Cynoscion* development. This change was seen in the *C. nebulosus* and *C. regalis* specimens examined here (Figure 26, Table 14).

Length of the longest dorsal spine versus standard length for *Equetus lanceolatus* and *Pareques umbrosus* are shown in Figure 27 and Table 15. There is a great difference in relative spine growth between the two species.

## *POSITION IN FOOD WEB*

Sciaenids feed mainly on crustaceans, fishes, and marine worms. *Pogonias* is exceptional is that its molariform pharyngeal teeth allow it to feed on molluscs.

Welsh and Breder (1924) studied food resource partitioning among sciaenids. They found that feeding level in the water column (determined from gut contents) correlated with physical characters such as mouth position. Chao and Musick (1977) identified further feeding specializations in

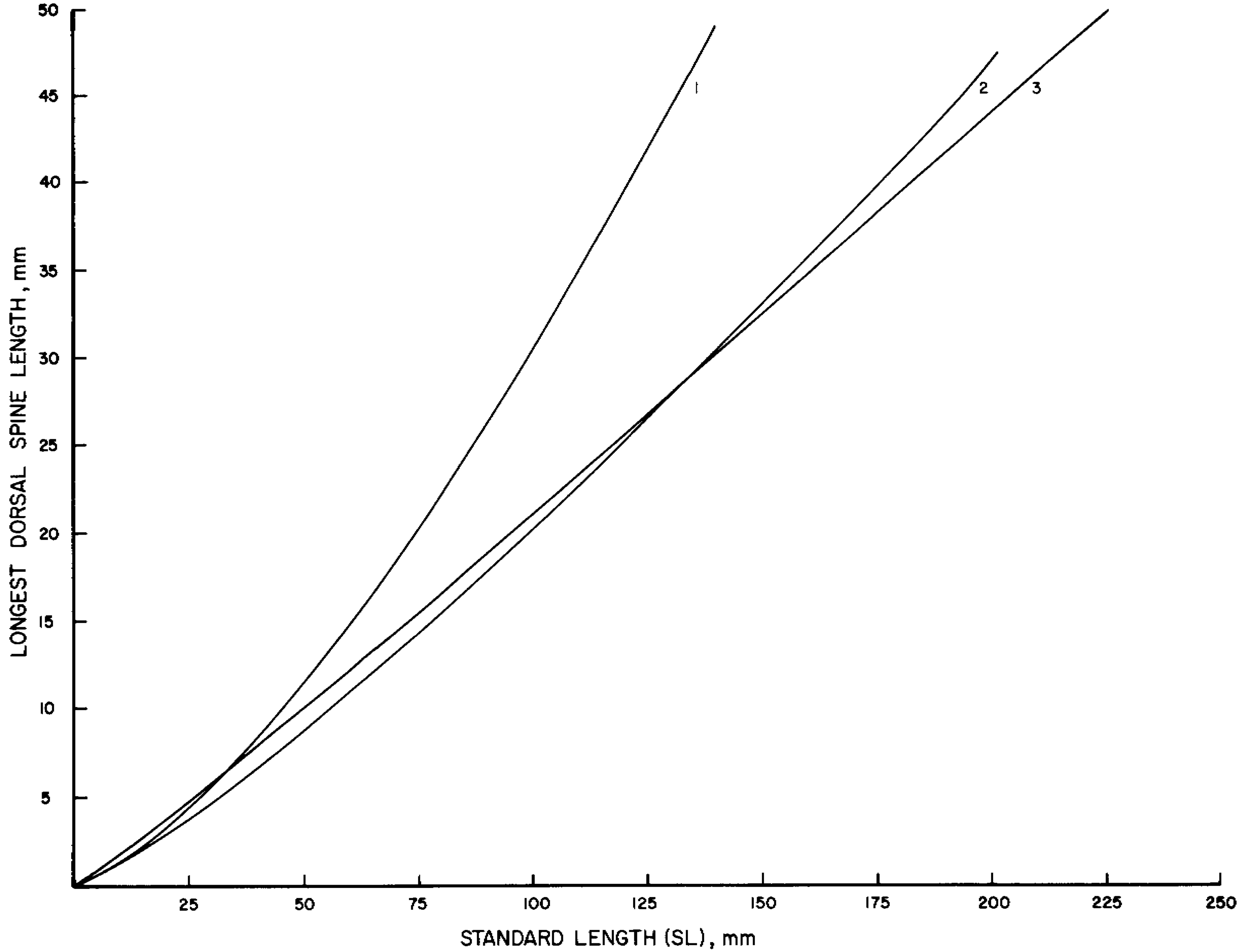



Figure 25. Regressions of longest dorsal spine length on SL for *Menticirrhus*. See Table 13 for description of lines.

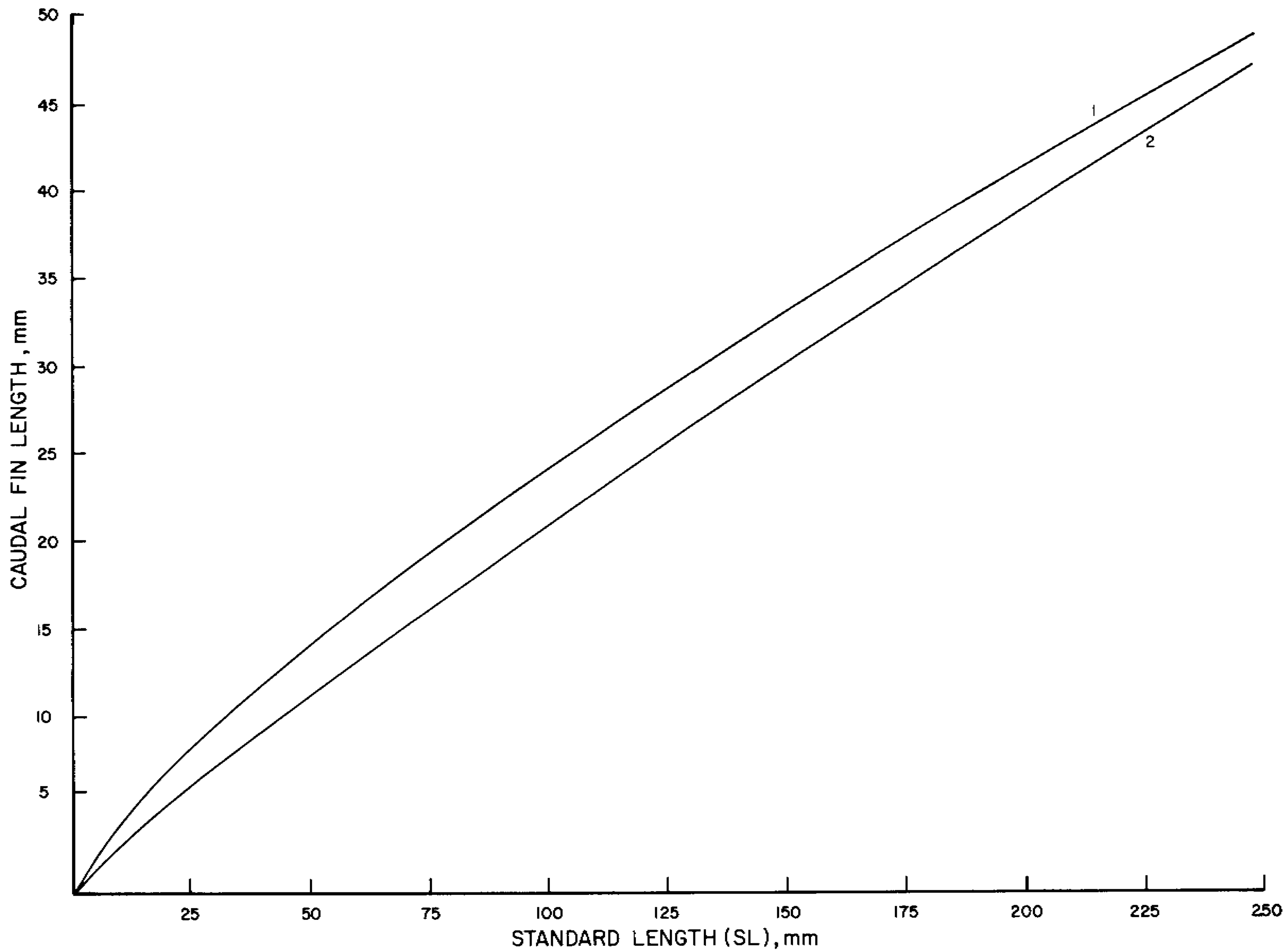



Figure 26. Regressions of caudal fin length on SL for *Cynoscion*. See Table 14 for description of lines.

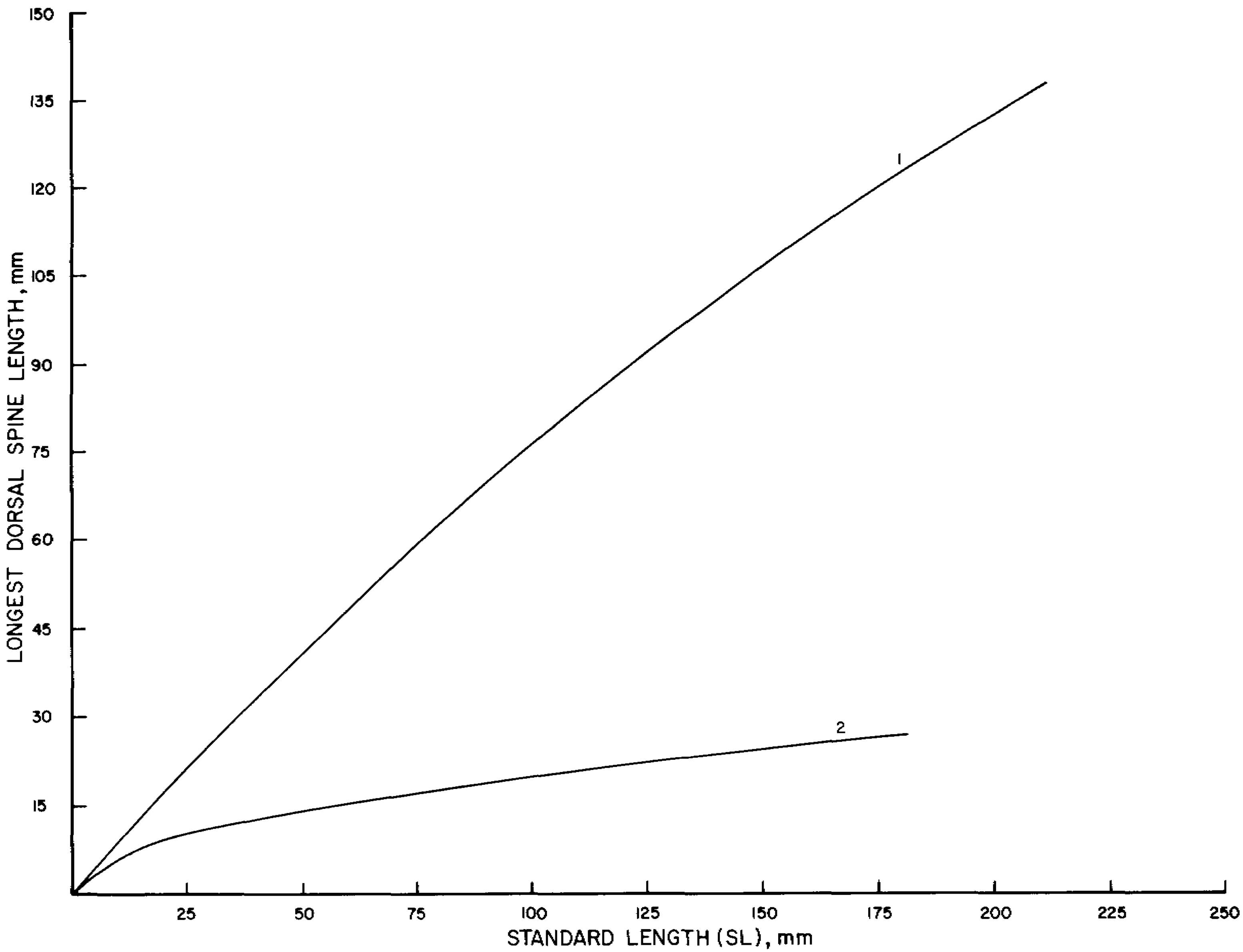



Figure 27. Regressions of longest dorsal spine length on SL for *Equetus* and *Pareques*. See Table 15 for description of lines.

TABLE 14. DESCRIPTION OF REGRESSIONS IN FIGURE 26. ALL LINES ARE CAUDAL LENGTH = $a(SL)^b$.

| Plot | Species | a | b | $r^2$ | S(Y/X) | F |
|---|---|---|---|---|---|---|
| 1 | *C. regalis* | 0.696 | 0.771 | 0.961 | 0.105 | 1509.050 |
| 2 | *C. nebulosus* | 0.348 | 0.891 | 0.926 | 0.116 | 2908.077 |

TABLE 15. DESCRIPTION OF REGRESSIONS IN FIGURE 27. SPINE LENGTH = $1/(a + b/SL)$ IN PLOT 1; SPINE LENGTH = $a(SL)^b$ IN PLOT 2.

| Plot | Species | a | b | $r^2$ | S(Y/X) | F |
|---|---|---|---|---|---|---|
| 1 | *Equetus lanceolatus* | 0.002 | 1.112 | 0.955 | 0.001 | 4094.583 |
| 2 | *Pareques umbrosus* | 2.180 | 0.483 | 0.858 | 0.101 | 1987.363 |

dentition, gill rakers, digestive tract, laterosensory pores, barbels, nares, and general body shape. Within general limitations imposed by their anatomies and swimming habits, however, sciaenids apparently feed opportunistically on whatever prey species is abundant (Seagle, 1969a, 1969b; Parker, 1971; Chao and Musick, 1977).

Various marine and estuarine animals feed on sciaenids. Striped bass and silky shark are predators of spot (Dawson, 1958). *Cynoscion regalis* is piscivorous at 34 mm SL and will feed on sciaenids (Reid, 1955b). *Cynoscion nebulosus* stomachs have been found to contain *C. nebulosus* as well as *B. chrysoura* (Moody, 1950), and *S. ocellatus* will take *L. xanthurus* (Gunter, 1945). Seagle (1969a, 1969b) recorded predator-prey relationships (Table 16) which indicate that sciaenids are a food source for common inshore and estuarine fishes.

TABLE 16. PREDATION ON THREE SCIAENIDS RECORDED BY SEAGLE (1969a, 1969b).

| | | Prey | |
|---|---|---|---|
| Predators | *B. chrysoura* | *L. xanthurus* | *S. ocellatus* |
| Sea Catfish (*Arius felis*) | + | + | + |
| Gafftopsail catfish (*Bagre marinus*) | + | + | |
| Spotted seatrout (*Cynoscion nebulosus*) | + | | |
| Atlantic croaker (*Micropogonias undulatus*) | | + | + |
| Red drum (*Sciaenops ocellatus*) | + | | |
| Southern flounder (*Paralichthys lethostigma*) | + | + | + |

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# APPENDIX

## *FLORIDA SCIAENIDS FROM OUTSIDE THE AREA COVERED*

In addition to the 14 sciaenid species occurring off western peninsular Florida, eight species are found elsewhere off the Florida coast. They are grouped here geographically, and recent references are provided.

### Northeastern and Northwestern Florida

Three species occur on the Atlantic coast from about Chesapeake Bay into northeastern Florida. They are absent from southern peninsular Florida, but are found in the northern Gulf of Mexico including the western Florida panhandle.

*Cynoscion nothus* (Holbrook, 1955), silver seatrout, Weinstein and Yerger (1976a)
*Larimus fasciatus* Holbrook, 1855, banded drum, Chao and Music (1977), Futch and Dwinell (1977)
*Stellifer lanceolatus* (Holbrook, 1855), star drum, Chao (1978), Futch and Dwinell (1977)

### Eastern Florida

*Umbrina coroides* Cuvier, 1830, the sand drum, occurs from "Brazil to Atlantic coast of Florida and occasionally farther north (one recorded from Chesapeake Bay); absent from all but extreme western Gulf of Mexico" (Gilbert, 1966: 235).

### Southeastern Florida

*Bairdiella sanctaeluciae* (Jordan, 1889), the striped croaker, a Caribbean species, is apparently common on Florida's Atlantic reefs at latitudes of 27-28°N (Gilbert and Kelso, 1971; Futch and Dwinell, 1977; Gilmore, 1977).

### Florida Keys

Three tropical sciaenids have the Florida Keys as part of their range. Warm Gulf Stream water allows them to also inhabit part of the east coast.

*Bairdiella batabana* (Poey, 1860), blue croaker, Robins and Tabb (1965)
*Equetus punctatus* (Bloch and Schneider, 1801), spotted drum, Chao (1978)
*Pareques acuminatus* (Bloch and Schneider, 1801), high hat, Chao (1978)