449

NOAA Technical Report NMFS Circular 449

Synopsis of Biological Data on the Pigfish, *Orthopristis chrysoptera* (Pisces: Haemulidae)

March 1983

FAO Fisheries
Synopsis No. 134

NMFS/S 134

SAST-*Orthopristis chrysoptera* 1,70(36), 032. 01

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service

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Malcolm Baldrige, Secretary
National Oceanic and Atmospheric Administration
John V. Byrne, Administrator
National Marine Fisheries Service
William G. Gordon, Assistant Administrator for Fisheries

CONTENTS

*No information available.

FOCUS

Synopsis of Biological Data on the Pigfish, *Orthopristis chrysoptera* (Pisces: Haemulidae)[1]

George H. Darcy[2]

ABSTRACT

Information on the biology and resources of the pigfish, *Orthopristis chrysoptera*, is compiled, reviewed, and analyzed in the FAO species synopsis style.

INTRODUCTION

The pigfish, *Orthopristis chrysoptera*, is a common, nearshore haemulid fish of the southeastern Atlantic and Gulf of Mexico coasts of the United States and Mexico. Although not a major commercial species, it is of some economic importance in areas such as Chesapeake Bay and the coasts of North Carolina and Florida and is a frequently caught recreational species; it is considered a good quality food fish and is used locally for bait. Because of its abundance, it is an important member of shallow-water eelgrass (*Zostera*) and turtlegrass (*Thalassia*) communities. The pigfish also occurs offshore in deeper water where it is caught as bycatch by shrimp trawlers. This is a summary of pertinent biological data concerning this species.

1 IDENTITY

1.1 Nomenclature

1.11 Valid name

Orthopristis chrysoptera (Linnaeus, 1766) (Fig. 1).

Pigfish, *Orthopristis chrysoptera* (Linnaeus, 1766:485) type locality: Charleston, South Carolina. The name comes from the Greek *orthos* (straight) and *pristes* (file or saw), referring to the evenly serrated preopercle (Jordan and Fesler 1893), and the Greek *chrysos* (gold) and *pter* (wing or fin), probably referring to the sometimes gold-tinged fins.

1.12 Objective synonymy

The following synonymy is based on the work of Jordan and Fesler (1893), Hildebrand and Schroeder (1928), and Konchina (1976):

Perca chrysoptera Linnaeus, 1766
Labrus fulvomaculatus Mitchill, 1814
Pristipoma fulvomaculatum. many authors
Pristipoma fasciatum Cuvier and Valenciennes, 1830
Orthopristis duplex Girard, 1859
Orthopristis fulvomaculatus. Uhler and Lugger, 1876
Pomadasys fulvomaculatus. Jordan and Gilbert, 1882
Orthopristis chrysopterus. Bean, 1891

1.2 Taxonomy

1.21 Affinities

Suprageneric

Phylum: Chordata
Class: Osteichthyes
Superorder: Acanthopterygii
Order: Perciformes
Suborder: Percoidei
Family: Haemulidae

Systematics and distribution of the family Haemulidae were reviewed by Konchina (1976), who listed several previously recognized families (Gaterinidae, Pomadasidae, Prisinpomidae, Plectorhinchidae, and Xenichthyidae) now included in Haemulidae. Although recent usage has favored the family name Pomadasyidae, Haemulidae is an earlier name which should be applied (Robins et al. 1980).

Generic

Members of the genus *Orthopristis* are probably most closely related to those of the genus *Pomadasys*, differing primarily in having a longer anal fin (III, 9–13 vs. III, 6–7), smaller scales, and less well developed dorsal fin spines (Jordan and Fesler 1893; Courtenay and Sahlman 1978).

The following description of the genus is derived from Courtenay and Sahlman (1978): "Chin with a central groove behind the symphysis of the lower jaw; . . . Preopercle rather finely serrate, none of the serrae directed forward; soft portions of dorsal and anal fins naked or with scales at their basal parts; body rather elongate, the head long; snout pointed; lips thin; anal fin long, with 3 spines and 9 to 13 soft rays."
Synonyms of *Orthopristis* include:

Microlepidotus Gill, 1862
Pristocantharus Gill, 1862
Isaciella Jordan and Fesler, 1893

[1]Contribution No. 83-07M of the Southeast Fisheries Center.
[2]Southeast Fisheries Center, National Marine Fisheries Service, NOAA, 75 Virginia Beach Drive, Miami, FL 33149.

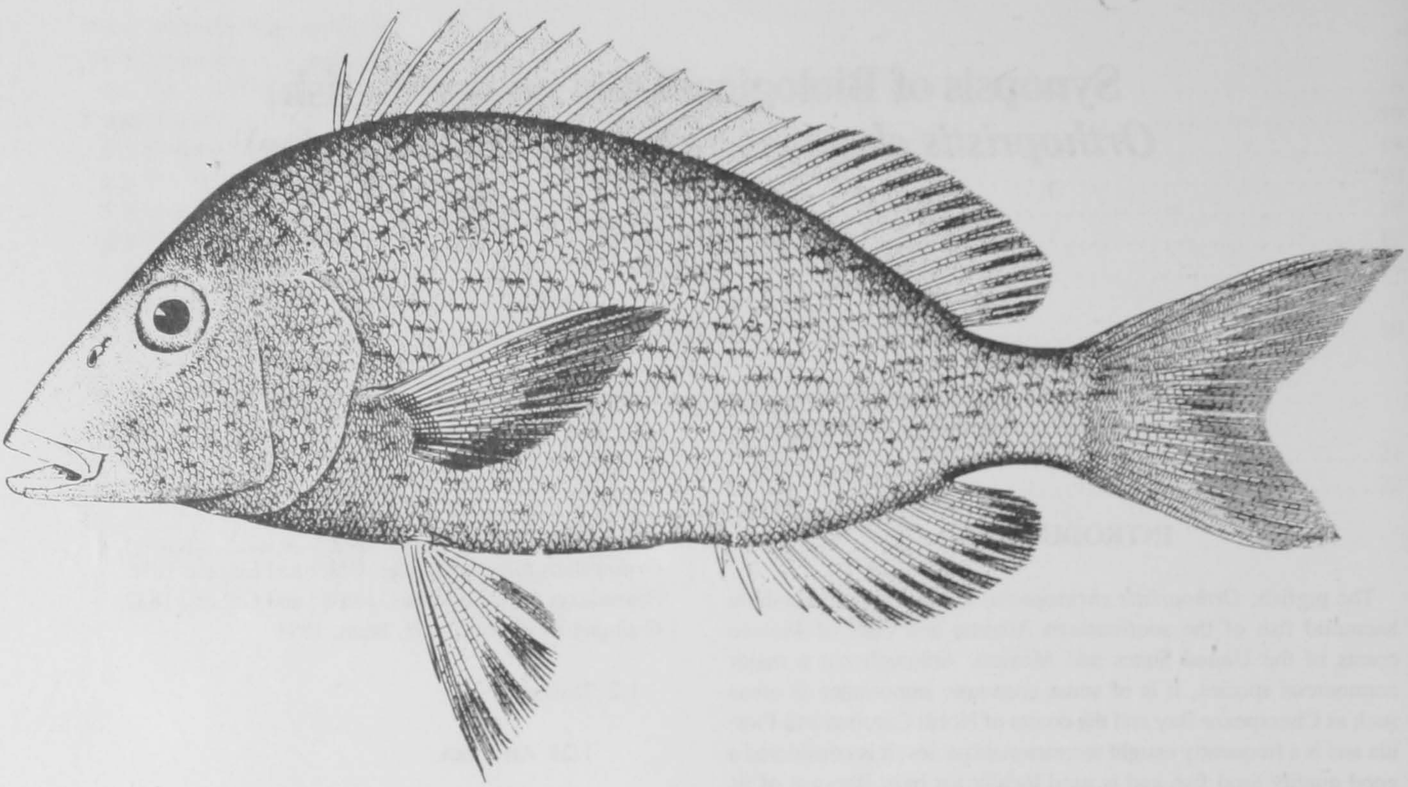

Figure 1.—Adult *Orthopristis chrysoptera*. (From Goode 1884, plate 146.)

Specific

The following species diagnosis is from Courtenay and Sahlman (1978): "Body ovate-elliptical, considerably compressed, *its depth contained 2.6 to 3.0 times in standard length* [SL] . . . *dorsal- and anal-fin spines enclosed in a deep scaly sheath, the soft rays naked. Pored lateral-line scales 55 to 58; 10 longitudinal rows of scales above, and 19 rows below the lateral line.*"

Orthopristis chrysoptera is distinguished from *O. poeyi*, which occurs only in Cuba, and *O. ruber*, which occurs from Honduras to Brazil, by the characters listed in Table 1.

Table 1.—Distinguishing characters of three species of *Orthopristis*. (From Courtenay and Sahlman 1978.)

Character	*O. chrysoptera*	*O. poeyi*	*O. ruber*
Standard length/ body depth	2.6–3.0	3.0–3.3	2.4–2.7
Pored lateral line scales	55–58	53–55	52–55
Longitudinal scale rows below lateral line	19	15	15
Anal fin rays	12–13	12–13	9–11
Gill rakers in lower limb of first arch	12	12	15

1.22 Taxonomic status

Orthopristis chrysoptera is generally considered a morphospecies, separated from the other two species of *Orthopristis* in the western Atlantic by the characters listed in Table 1. No electrophoretic data are available.

1.23 Subspecies

No subspecies are recognized.

1.24 Common and vernacular names

The generally accepted common name of *O. chrysoptera* in the United States is pigfish (Robins et al. 1980). Other common names appearing in the literature include: sailor's choice (Smith 1907; Beebe and Tee-Van 1933; Hoese and Moore 1977), hogfish (Hildebrand and Schroeder 1928), red-mouthed grunt (Jordan et al. 1930), piggy perch (Gunter 1945), and big perch (Hoese 1958). Standard FAO vernacular names are: English, pigfish; French, goret mule; Spanish, corocoro burro (Courtenay and Sahlman 1978).

1.3 Morphology

1.31 External morphology

Head 2.7–3.05 in SL; depth 2.3–2.65 in SL; dorsal fin rays XIII, 15–17; anal fin rays III, 12 or 13; scales 71–77; body elongate, compressed, back elevated; head moderate; snout long, tapering, 2.2–3 in head; eye 3.6–5 in head; interorbital 3.85–4.7 in head; mouth moderate, terminal, a little oblique; maxillary reaching vertical from first nostril, 3–3.4 in head; teeth in the jaws small, pointed, in broad bands; gill rakers short, 12 on lower limb of first arch; scales small, ctenoid, firm, in oblique rows above lateral line and horizontal rows below it, extending on base of caudal, pelvics, and pectorals, also forming a low sheath on base of anal and dorsals; dorsal fin continuous, low, spines rather slender, origin of fin over or slightly in advance of pectoral base; caudal fin deeply concave, upper lobe longest; anal fin with three rather strong, graduated spines; pelvic fins moderate, inserted a little behind base of pectorals; pectorals rather long, 1.2–1.55 in head (Hildebrand and Schroeder 1928).

Color is bluish with purplish reflections above, becoming paler to silvery below; sides of head and back with golden or brassy markings, variable, forming more or less distinct lines; dorsal fin clear with bronze spots; caudal and pectoral fins translucent; anal fin whitish to dusky, base and middle parts sometimes tinged with yellow; pelvics white to slightly dusky; stripes visible in juveniles (Hildebrand and Schroeder 1928).

See 1.21.

2 DISTRIBUTION

2.1 Total area

The pigfish is distributed from Massachusetts (Hoese and Moore 1977) and Bermuda to the southern tip of Florida, and throughout the Gulf of Mexico to the Yucatan Peninsula, Mexico (Briggs 1958; Courtenay and Sahlman 1978) (Fig. 2).

The pigfish is primarily an inhabitant of shallow water, often entering bays and estuaries (Smith 1907; Nichols and Breder 1927; Schwartz 1964; Richards and Castagna 1970; Perret et al. 1971; Dahlberg 1972; Shealy et al. 1974; Konchina 1977; Hoese and Moore 1977), and even canals (Roessler 1970), though avoiding extremely low salinity. A variety of habitats are accepted, including mud or sand bottom (Tabb and Manning 1961; Courtenay and Sahlman 1978), hard substrates such as rock jetties and reefs (Hastings 1972), and offshore platforms (Hastings et al. 1976). Pigfish also occur offshore in coastal and open-shelf habitats off the southeastern United States (Struhsaker 1969) and in the Gulf of Mexico (Springer and Woodburn 1960; Chittenden and Moore 1977). Hildebrand (1954) reported pigfish from shell banks off Campeche, Mexico, while Chittenden and McEachran (1976) reported them common on pink shrimp grounds and present on white shrimp grounds in the northwestern Gulf of Mexico, but absent from gulf brown shrimp grounds.

See 2.3, 3.32.

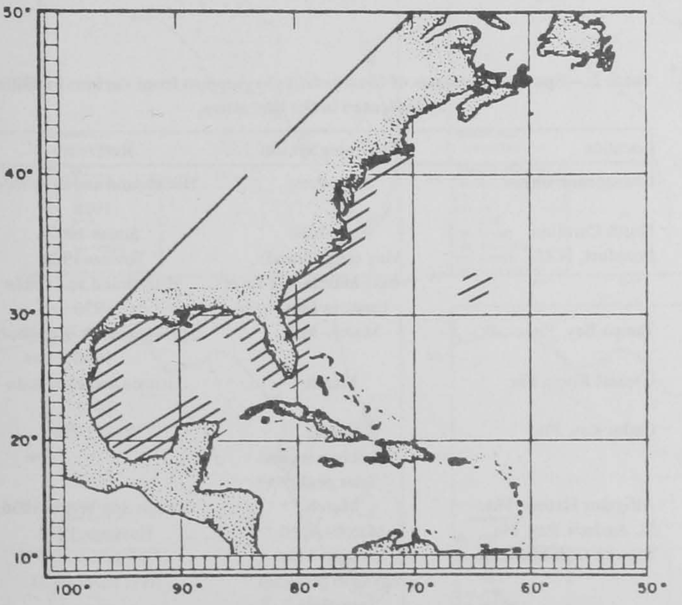

Figure 2.—Distribution of *Orthopristis chrysoptera*. (Based on Hoese and Moore 1977; Courtenay and Sahlman 1978.)

2.2 Differential distribution

2.21 Spawn, larvae, and juveniles

Pigfish eggs are buoyant and unattached (Hildebrand and Cable 1930) and probably planktonic. Larvae were commonly collected by Houde et al. (1979[3]) in the eastern Gulf of Mexico (Fig. 3), and were more abundant in the northern part of the survey area than in the southern part. No pigfish larvae were found at stations where depth exceeded 31 m, and 75% were collected at stations <20 m deep; largest catches occurred at stations <10 m deep. Pigfish larvae were most abundant in winter and spring in the survey area.

Small juveniles occur near the bottom in nearshore areas. Towers (1928) found 7 mm (SL) young common near inshore islands in the vicinity of Beaufort, N.C. Hildebrand and Cable (1930) speculated that 3 to 11 mm (type of length measurement unspecified) young lived in or very near sand bottom near Beaufort, since such individuals were found only in sand samples. Smallest specimens (12.5 mm SL) collected by Springer and Woodburn (1960) in Tampa Bay, Fla., appeared in April, as did the smallest (9.1 + mm SL) collected by Hastings (1972) near St. Andrew Bay, Fla., jetties. Smallest juveniles (12–15 mm, measurement unspecified) observed by Adams (1976a) at Beaufort appeared in eelgrass beds in May. Hildebrand and Schroeder (1928) reported young fish (10–15 cm, measurement unspecified) very common in lower Chesapeake Bay in fall. Gunter (1945) and Hildebrand (1954) found the smallest pigfish in shallow bays along the Texas coast.

Larger juveniles also appear to be most abundant in shallow nearshore habitats. Tabb and Manning (1961) collected juveniles from July to October in the Whitewater Bay area of southwestern Florida, Franks (1970) collected young in June at Horn Island, Miss., and Grimes and Mountain (1971) found that young-of-the-

[3]Houde, E. D., J. C. Leak, C. E. Dowd, S. A. Berkeley, and W. J. Richards. 1979. Ichthyoplankton abundance and diversity in the eastern Gulf of Mexico. Report to the Bureau of Land Management under Contract No. AA550–CT7–28, 546 p.

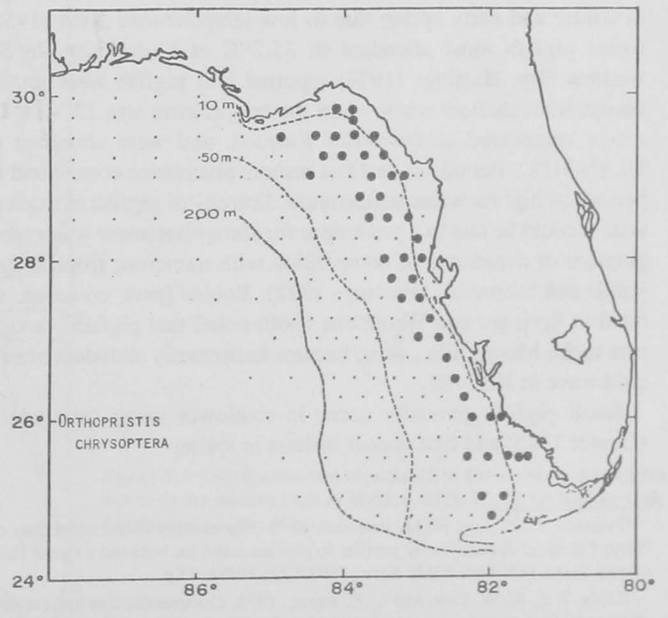

Figure 3.—Stations at which *Orthopristis chrysoptera* larvae occurred at least once during 17 cruises in the eastern Gulf of Mexico, 1971–74. (From Houde et al. text footnote 3, fig. 105.)

year (50 mm SL) pigfish appeared in June trawl samples at Crystal River, Fla. On intertidal flats in North Carolina, young are common in spring and summer, but scarce in winter (Peterson and Peterson 1979[4]).

Juveniles may occasionally associate with small individuals of other species. Wang and Raney (1971) collected young pigfish (16–25 mm SL) in mixed schools with small pinfish, *Lagodon rhomboides,* in Charlotte Harbor, Fla.

See 3.16.

2.22 Adults

Adult pigfish occur in nearshore areas throughout their range and may enter estuaries and other brackish areas (Smith 1907; Konchina 1977). Adults are common on intertidal flats in North Carolina in spring and summer (Peterson and Peterson footnote 4), and in shallow water in Florida Bay from September to March (Tabb and Manning 1961). Springer and Woodburn (1960) reported that pigfish were not as abundant in Tampa Bay as they were at Cedar Key, Fla., and along the northern gulf coast; abundance appeared to decrease from north to south along the gulf coast of Florida.

Pigfish also occur offshore, such as on shell banks off Campeche, Mexico (Hildebrand 1954), on white shrimp grounds off central Texas (Cody et al. 1978[5]), on offshore reefs and platforms in the northern Gulf of Mexico (Hastings 1972; Hastings et al. 1976), and in open-shelf habitats along the southeastern Atlantic coast of the United States (Anderson 1968; Struhsaker 1969).

See 3.51, 4.2.

2.3 Determinants of distribution changes

The primary factors affecting distribution of pigfish appear to be temperature and growth stage of the fish. Seasonality in distribution and abundance has been reported throughout the range.

Low water temperatures are apparently avoided by pigfish; pigfish migrate from shallow water to deeper water in winter (Hildebrand and Cable 1930; Gunter 1945; Reid 1954; Wang and Raney 1971; Grimes 1971; Hastings 1972; Ogren and Brusher 1977; Naughton and Saloman 1978) and are often absent in shallow water in winter and early spring due to low temperatures. Reid (1954) found pigfish most abundant at 25.2°C at Cedar Key. In St. Andrew Bay, Hastings (1972) reported that pigfish were totally absent from shallow water when the temperature was 12°–14°C; adults reappeared as the water warmed, and were abundant at 16.5°–31°C. Periods of greatest inshore abundance correspond to periods of highest water temperature. Scarcity of pigfish in tropical waters could be due to a preference for somewhat lower water temperature or avoidance of competition with numerous tropical lutjanids and haemulids (Hastings 1972). Robins (pers. commun. as cited in Springer and Woodburn 1960) noted that pigfish, though rare in the Miami, Fla., area, became temporarily abundant after a cold wave in 1957–58.

Small pigfish generally occur in shallower water than adults (Gunter 1945) and first appear inshore in spring.

Salinity may also have some influence on distribution; all pigfish <50 mm total length (TL) and all pigfish >200 mm TL collected on the Texas coast by Gunter (1945) were taken at salinities over 25.0°/oo. No specimens were collected at <10.0°/oo (Gunter 1945).

See 2.21, 2.22, 2.3, and 3.32.

3 BIONOMICS AND LIFE HISTORY

3.1 Reproduction

3.11 Sexuality

There is no evidence of sex reversals or hermaphroditism. Sexes are separate. No mention of external sexual dimorphism was found in the literature.

See 4.11.

3.12 Maturity

Pigfish probably mature in the second year of life (Taylor 1916); smallest mature specimens collected by Hildebrand and Cable (1930) were 200–215 mm TL.

3.14 Fertilization

Fertilization is probably external, as in other haemulids.

3.16 Spawning

Spawning in pigfish occurs primarily in spring (Table 2), though a limited amount may occur in winter and lasts for up to several months. Some workers (Reid 1954) have speculated that more than one spawning peak may occur in a year, but others (Grimes and Mountain 1971; Houde et al. footnote 3) have found only one peak (Figs. 4,5). Spawning may occur in open water just prior to inshore migration (Hastings 1972) or in quiet inshore waters, such as harbors, estuaries, and inshore banks (Hildebrand and Cable 1930), but may begin on outer shores first.

Table 2.—Spawning seasons of *Orthopristis chrysoptera* from various localities as indicated in the literature.

Location	Spawning season	Reference
Chesapeake Bay	May–June	Hildebrand and Schroeder 1928
North Carolina	May–June	Smith 1907
Beaufort, N.C.	May (eggs found)	Towers 1928
	mid-March–late June (peak in May)	Hildebrand and Cable 1930
Tampa Bay, Fla.	March–May	Springer and Woodburn 1960
Crystal River, Fla.	March	Grimes and Mountain 1971
Cedar Key, Fla.	Spring (possibly a second later peak)	Reid 1954
Alligator Harbor, Fla.	March	Joseph and Yerger 1956
St. Andrew Bay, Fla.	March–April	Hastings 1972
Eastern Gulf of Mexico	January–May (larvae in plankton samples)	Houde et al. (text footnote 3)
Horn Island, Miss.	Spring	Franks 1970
Port Aransas, Tex.	March–April	Gunter 1945

[4]Peterson, C. H., and N. M. Peterson. 1979. The ecology of intertidal flats of North Carolina: A community profile. Report prepared for National Coastal Ecosystem Team, U.S. Fish Wildl. Serv., FWS/OBS-79/39, 73 p.

[5]Cody, T. J., K. W. Rice, and C. E. Bryan. 1978. Commercial fish and penaeid shrimp studies, northwestern Gulf of Mexico. Pt. II. Abundance and distribution of fauna on the white shrimp, *Penaeus setiferus* (Linnaeus), grounds off the central Texas coast. Coastal Fish. Branch, Tex. Parks Wildl. Dep., P.L. 88–309. Proj. 2-276-R, 39 p.

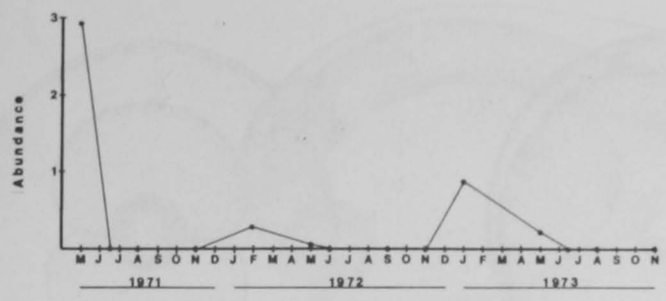

Figure 4.—Estimated mean abundance (number under 10 m² of sea surface) of *Orthopristis chrysoptera* larvae in the eastern Gulf of Mexico, 1971–74. (From Houde et al. text footnote 3, fig. 104.)

Pigfish spawn at dusk (1600–2000 h) exclusively (Towers 1928; Hildebrand and Cable 1930). In general, larger fish spawn first, with smaller ones spawning latest in the season (Hildebrand and Cable 1930). Eggs probably are not all shed at the same time; partially spent fish are common (Hildebrand and Cable 1930). Pigfish are noticeably thin during the spawning season, gaining weight progressively during summer and fall (Hildebrand and Schroeder 1928).

3.17 Spawn

Eggs are spherical, buoyant, and unattached, with a diameter of 0.7–0.8 mm. They are highly transparent, usually with one large (0.16 mm) oil globule and are similar in appearance to eggs of the silver perch, *Bairdiella chrysoura* (Hildebrand and Cable 1930). Eggs are presumed to be planktonic.

3.2 Preadult phase

3.21 Embryonic phase

Cleavage of the germinal disk of the egg is rapid (Fig. 6A), with the 2-cell stage being reached in 30 min (Fig. 6B, 6C), the 4-cell stage in 45 min (Fig. 6D), and the 8-cell stage in 90 min (Fig. 6E). After 1 d, the snout, eyes, and about 30 somites are visible on the embryo (Fig. 6G). At 36 h, the embryo has almost completely surrounded the yolk, and the heart and auditory vesicles are evident (Fig. 6H). Eggs hatch at about 48 h (Towers 1928).

3.22 Larvae and adolescent phase

The following descriptions of larval stages are from Towers (1928) and Hildebrand and Cable (1930).

The newly hatched larva is about 1.5 mm TL, with a large yolk (Fig. 7A). The larva floats on its back due to the large yolk and the contained oil globule, which lies at the anterior of the yolk, near the head. A few pigment spots are present.

The larva attains 2.5 mm TL within 1 d of hatching (Fig. 7B, 7C). The body is straight. Pigment spots on the anterior of the body become diffuse, but spots over the vent and at midcaudal length are very distinct and form more or less definite crossbars; some have spots persisting behind the auditory canals. The yolk is reduced to about one-quarter of its initial size and the larva is beginning to orient and swim on its side.

By day 3, the larva has attained about 2.8 mm TL, and the yolk is almost totally absorbed (Fig. 7D, 7E). Pectoral fins are present and the larva swims upright.

At 3.1 mm TL, the larva has a long, slender tail with the vent well in advance of midbody (Fig. 8A). The mouth is almost vertical. A pronounced dorsal hump occurs just behind the eyes. The intestine is attached loosely to the body and is free distally. The fin fold is continuous, with vertical fins undifferentiated. Pigment spots are absent in preserved specimens.

The 4.9 mm TL larva has developed a deeper body, especially posteriorly (Fig. 8B). The caudal fin is partially differentiated, with rays forming ventral to the slightly upturned notochord.

At 6.7 mm TL, the body has further deepened posteriorly (Fig. 8C). The caudal fin is well developed, with a rounded margin. The notochord is strongly curved upward. Dorsal and anal fins are becoming differentiated.

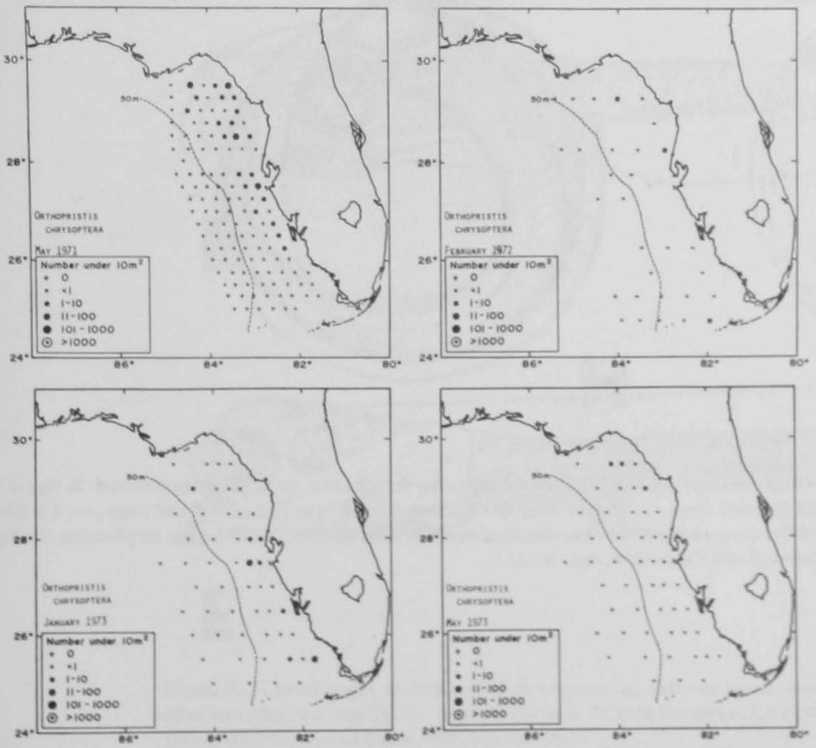

Figure 5.—Distribution and abundance of *Orthopristis chrysoptera* larvae in the eastern Gulf of Mexico, 1971–74. (From Houde et al. text footnote 3, fig. 106.)

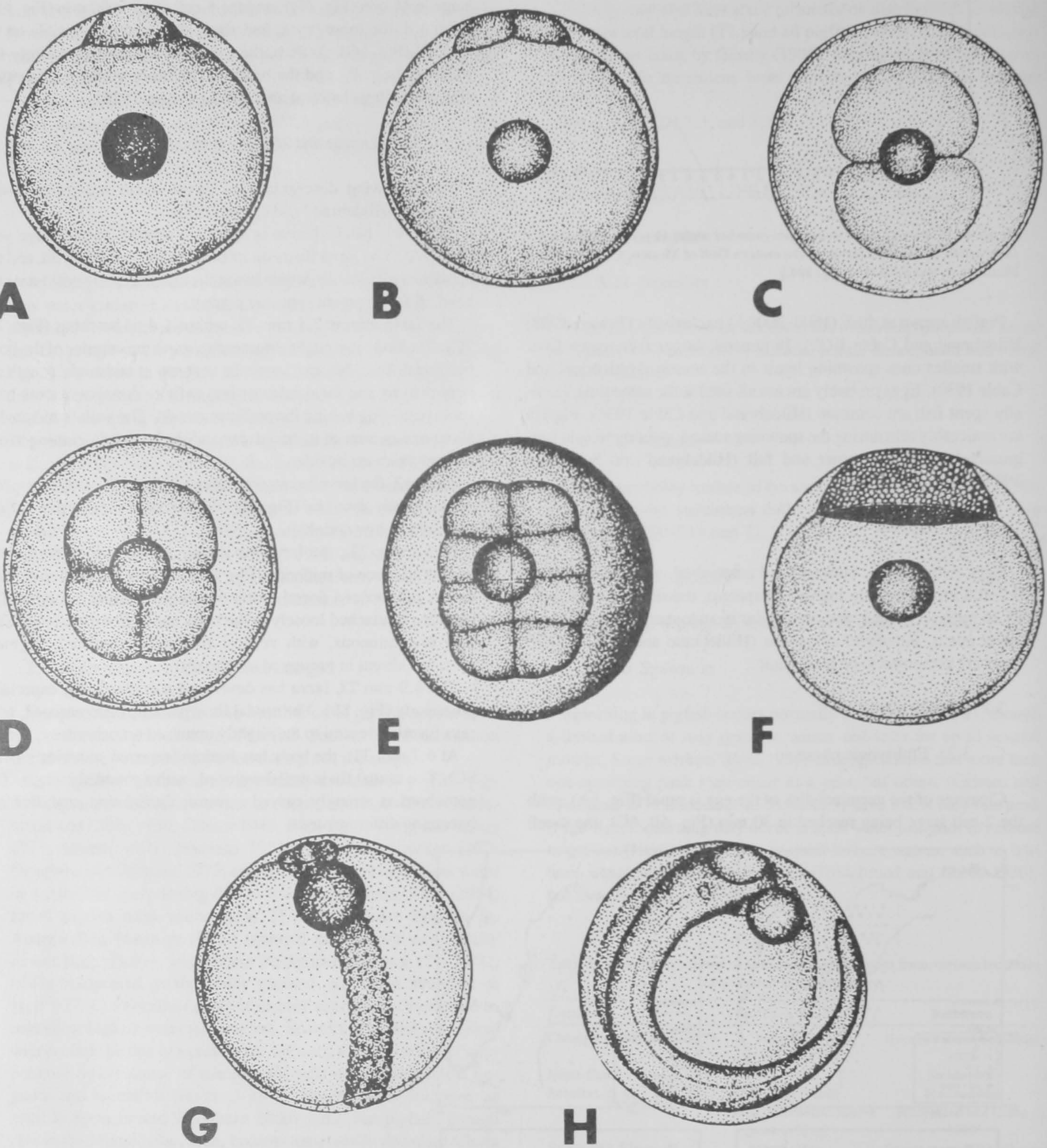

Figure 6.—Embryonic stages of *Orthopristis chrysoptera*. A. Egg with fully developed blastodisc, a few minutes after fertilization, ca. 0.75 mm in diameter. B. Egg in 2-cell stage, ca. 30 min after fertilization. C. Dorsal view of B. D. Egg in 4-cell stage, ca. 45 min after fertilization, dorsal view. E. Egg in 8-cell stage, ca. 1 h after fertilization, dorsal view. F. Egg in late cleavage stage. G. Egg with developing embryo, showing distribution of chromatophores, ca. 24 h after fertilization. H. Egg with well developed embryo, ca. 36 h after fertilization. (From Hildebrand and Cable 1930, figs. 16–23.)

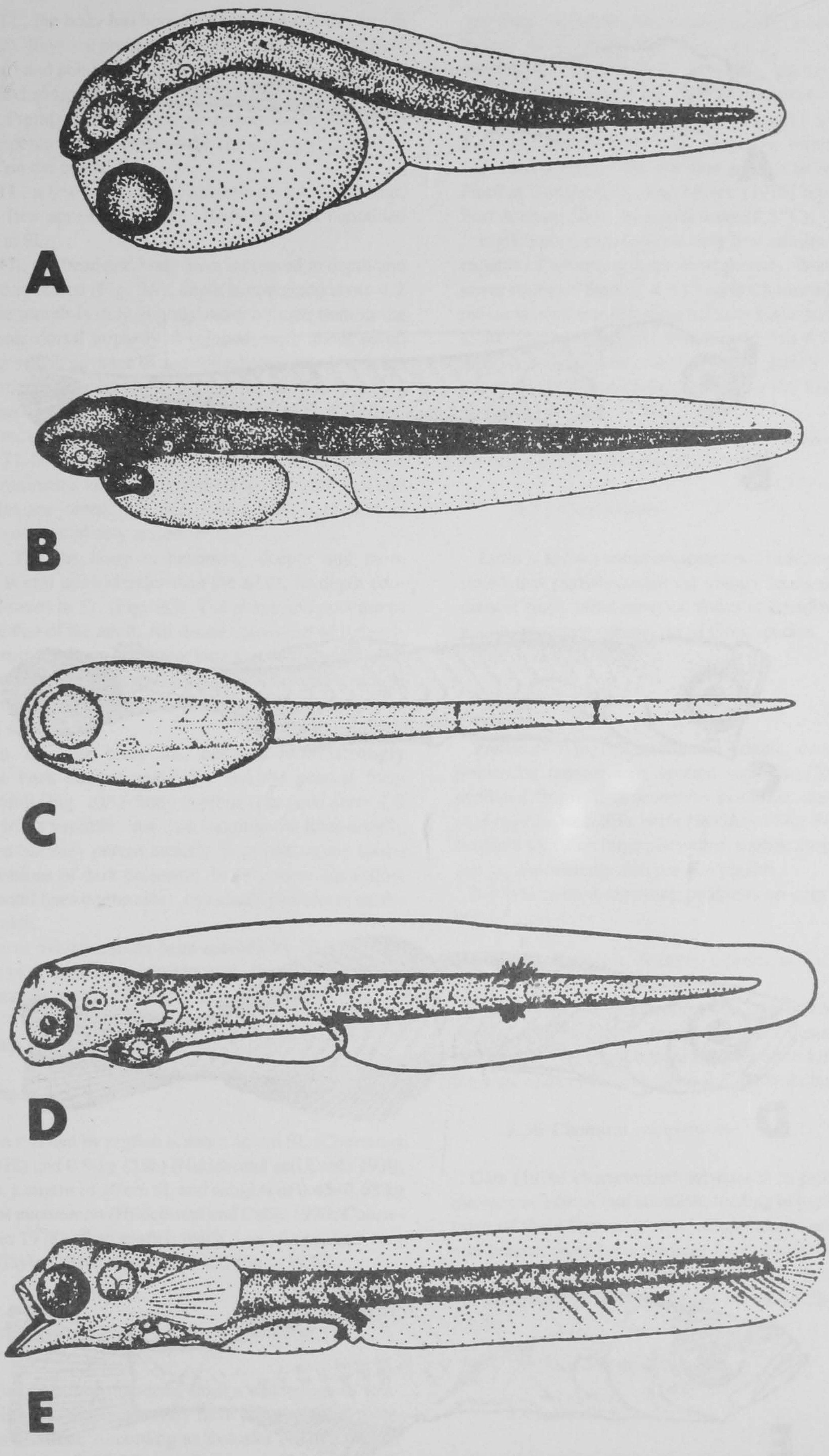

Figure 7.—Larval stages of *Orthopristis chrysoptera*. A. Yolk-sac larva, newly hatched, 1.5 mm TL. B. Yolk-sac larva, 1 d after hatching, 2.5 mm TL. C. Ventral view of B. D. Yolk-sac larva, 2.5 d after hatching, 3 mm TL. E. Larva, 2.8 mm TL. (From Hildebrand and Cable 1930, figs. 24–28.)

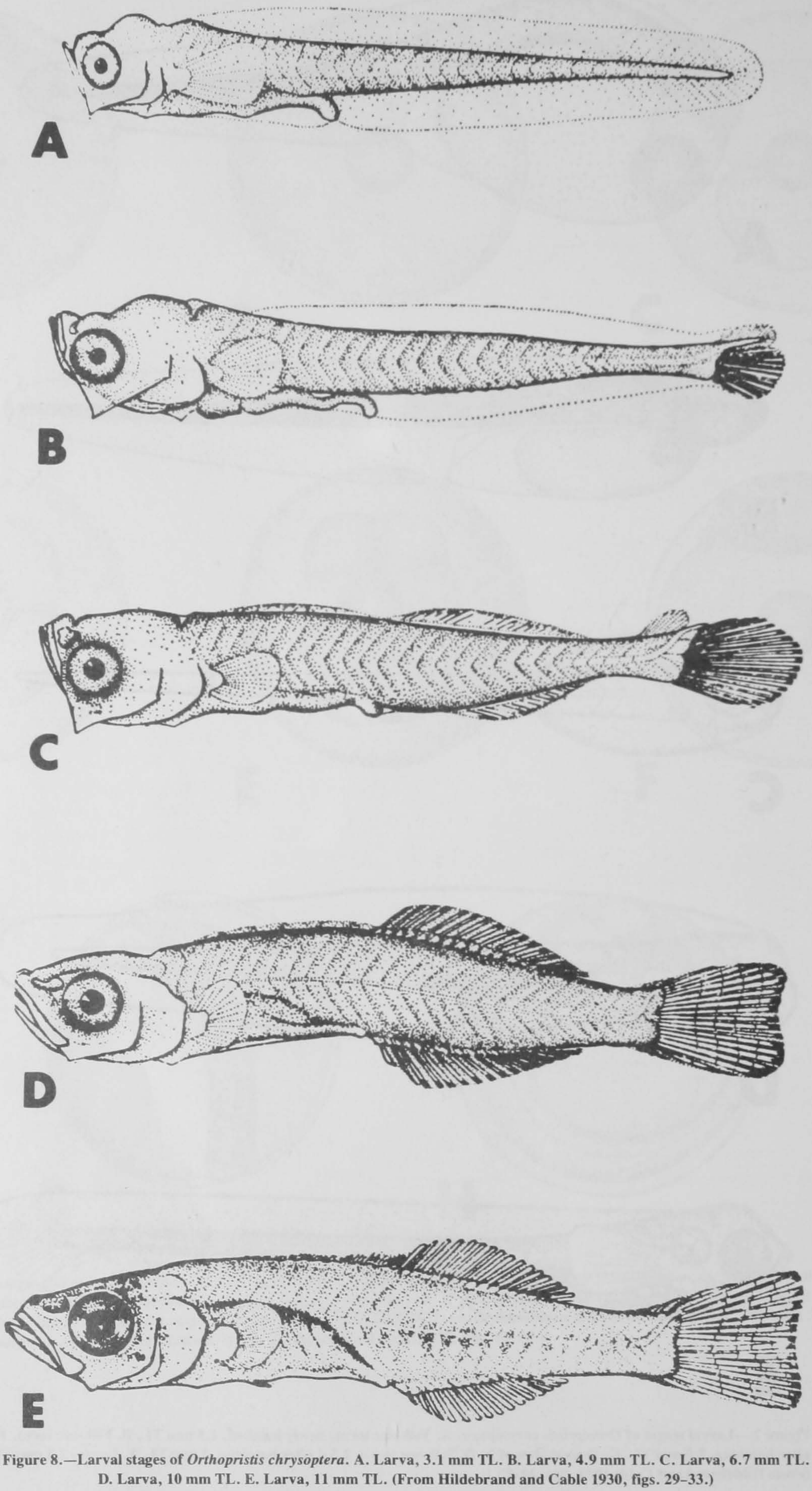

Figure 8.—Larval stages of *Orthopristis chrysoptera*. A. Larva, 3.1 mm TL. B. Larva, 4.9 mm TL. C. Larva, 6.7 mm TL. D. Larva, 10 mm TL. E. Larva, 11 mm TL. (From Hildebrand and Cable 1930, figs. 29–33.)

By 10.0 mm TL, the body has become depressed and the mouth oblique (Fig. 8D). Rays are present in the soft dorsal and anal fins; the spinous dorsal and pelvic fins are undeveloped. The caudal fin is well formed and somewhat emarginate, and the notochord only slightly visible. Pigmentation appears as darkened margins of the opercle and preopercle, at the ends of the fin rays, and as broken black crosslines on the caudal fin.

At 11.0 mm TL, a few spines of the spinous dorsal are present, and pelvic fins first appear (Fig. 8E). Body depth is contained about 5.3 times in SL.

By 15.0 mm TL, the head and body have increased in depth and are noticeably compressed (Fig. 9A); depth is contained about 4.2 times in SL. The mouth is only slightly more oblique than in the adult. The spinous dorsal is partly developed, with about seven spines appearing well in advance of and entirely separated from the soft dorsal. A dark lateral band is developing, the lips and snout are dusky, small areas of dark chromatophores appear on the head and back, and scattered dusky spots occur along the base of the anal fin.

The 17.0 mm TL larva has about 10 dorsal spines well developed and other spine rudiments visible anteriorly (Fig. 9B); the first and second dorsal fins are joined. The dark lateral band is prominent and the body almost completely scaled.

At 25.0 mm TL, the body is becoming deeper and more compressed but is still more slender than the adult, its depth contained about 3.0 times in TL (Fig. 9C). The shape and position of the mouth is like that of the adult. All dorsal spines are well developed and the dorsal fin shape is approaching that of the adult. Pigmentation is general, with the lateral band prominent and a second one present extending from the nape to the base of the second dorsal fin. The body is scaled.

By 40.0 mm TL, the body has become more strongly compressed, the back narrow and high, and the general form resembling the adult (Fig. 10A); body depth is contained about 2.8 times in TL. Color is variable—the dark longitudinal lines usually have disappeared but may persist entirely or in part; some specimens have indications of dark crossbars. In life, there are yellow and green horizontal lines on the sides, especially prominent on the cheeks and opercles.

Adult body form has essentially been reached by 70.0 mm TL (Fig. 10B). The back is prominently elevated, the anterior ventral outline nearly straight, and the snout pointed.

3.3 Adult phase

3.31 Longevity

Maximum size reached by pigfish is about 46 cm SL (Courtenay and Sahlman 1978) and 0.9 kg (2 lb) (Hildebrand and Cable 1930; Konchina 1977). Lengths of 30 cm SL and weights of 0.45–0.68 kg (1–1.5 lb) are not uncommon (Hildebrand and Cable 1930; Courtenay and Sahlman 1978). Few pigfish reach 3 yr of age, and very few reach 4 yr (Taylor 1916; Hildebrand and Cable 1930).

3.32 Hardiness

Although pigfish have been reported from a wide range of temperatures and salinities, they apparently have only a limited tolerance to extremes of either. According to Roessler (1970), pigfish had been reported from 0–38.0°/oo salinity and 13.7°–36.0°C; Roessler (1970) collected pigfish in Buttonwood Canal, Fla., at 17.2–44.1°/oo and 19.5°–30.6°C. Springer and Woodburn (1960) stated that pigfish seemed to have a fairly narrow tolerance range in Tampa Bay (19.1–35.0°/oo, $\bar{x}=28.9$°/oo; 17.5°–32.5°C, $\bar{x}=27.6$°C). In Barataria Bay, La., pigfish were collected at 6.2–24.3°/oo and 17.3°–30.0°C (Dunham 1972) and in South Carolina estuaries at 27.6–34.2°/oo and 19.6°–24.4°C (Shealy et al. 1974). Pigfish apparently avoid low water temperatures; Moe and Martin (1965) did not find pigfish in water < 12.5°C off Pinellas County, Fla., and Moore (1976) reported them killed at Port Aransas, Tex., by a cold wave (4.5°C).

Pigfish also seem to avoid very low salinity, though they may be capable of tolerating it for short periods. Wang and Raney (1971) never collected them at < 15°/oo in Charlotte Harbor. Pigfish were the most common fish reported killed by a hurricane in September 1950, which lowered salinity from 23.5 to 9.7°/oo during 4 d near Way Key, on the west coast of Florida (Reid 1954). It is more likely the rapid drop in salinity, rather than the low salinity itself, that proved fatal.

Pigfish have been reported killed by red tides on the west coast of Florida (Springer and Woodburn 1960).

3.33 Competitors

Little is known about competitors. Hildebrand and Cable (1930) stated that pigfish consumed mainly foods not entering into the diets of many other common fishes at Beaufort, and was probably not an important competitor of those species.

See 3.41 and 3.42.

3.34 Predators

Predators of pigfish include the Atlantic sharpnose shark, *Rhizoprionodon terraenovae*; spotted seatrout, *Cynoscion nebulosus*; ocellated frogfish, *Antennarius ocellatus*; and weakfish, *Cynoscion regalis* (Radcliffe 1916; Hastings 1972; Peterson and Peterson footnote 4). Other large piscivores, such as snappers, groupers, and snook, undoubtedly also prey on pigfish.

No information regarding predators on eggs or larvae is available.

3.35 Parasites, diseases, injuries, and abnormalities

Pigfish off North Carolina are parasitized by *Pseudotagia cupida*, a monogenetic trematode that infests the gill filaments (Suydam 1971). Pigfish have been reported killed by red tides off the west coast of Florida (Springer and Woodburn 1960).

3.36 Chemical composition

Carr (1976) characterized substances in pink shrimp, *Penaeus duorarum*, extract that stimulate feeding in pigfish. Artificial mixtures of these low molecular weight amino-acid-like compounds and betaine stimulated feeding. Later experiments by Carr et al. (1977) isolated similar substances in crab, oyster, mullet, and sea urchin extracts, although the sea urchin compound did not elicit feeding.

3.4 Nutrition and growth

3.41 Feeding

Pigfish are primarily benthic feeders as adults, though young fish feed largely on plankton higher in the water column. Like most haemulids, pigfish may be nocturnal feeders, leaving shelter at

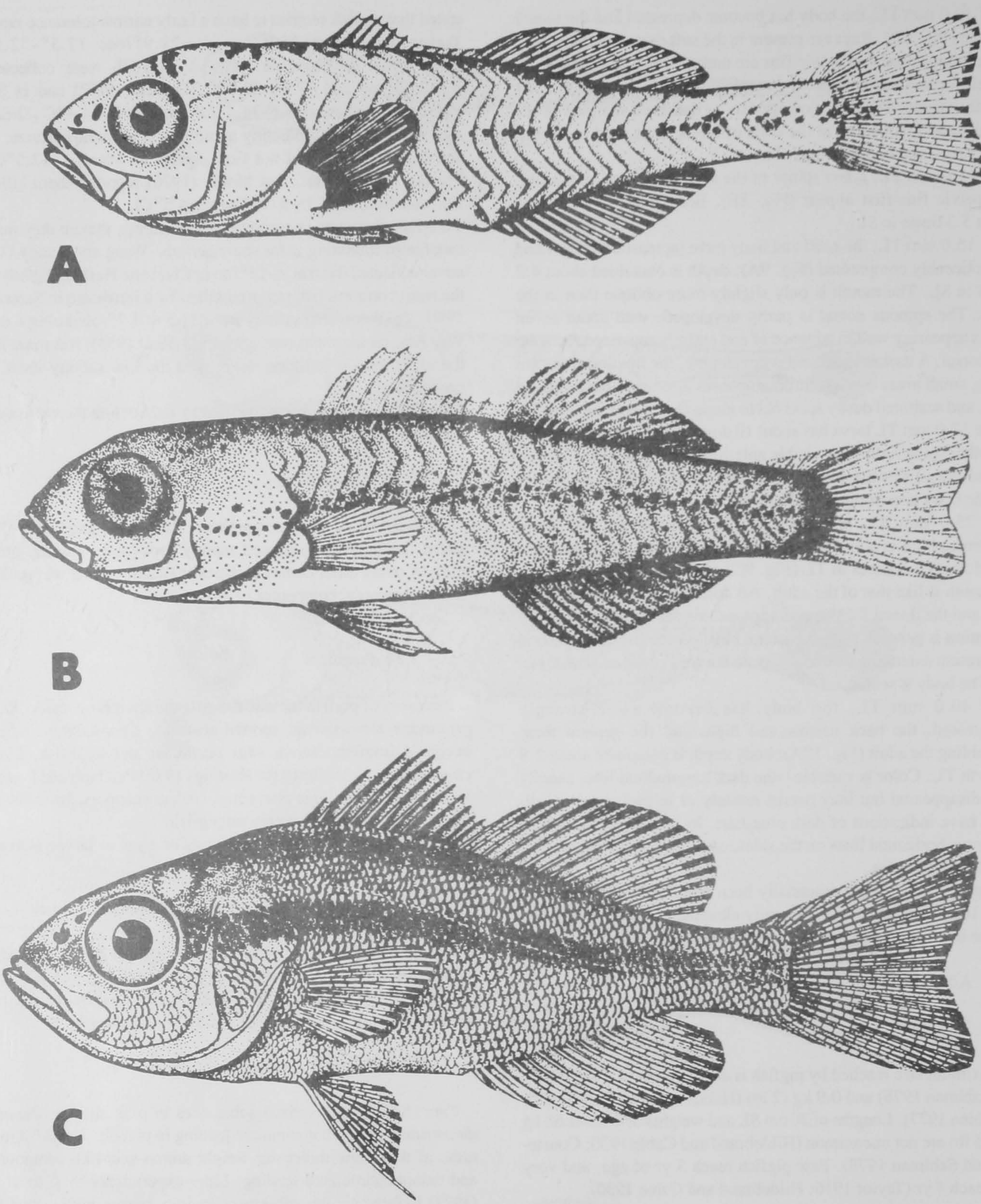

Figure 9.—Larval and juvenile stages of *Orthopristis chrysoptera*. A. Larva, 13.5 mm TL. B. Larva, 17 mm TL. C. Juvenile, 26 mm TL. (From Hildebrand and Cable 1930, figs. 34–36.)

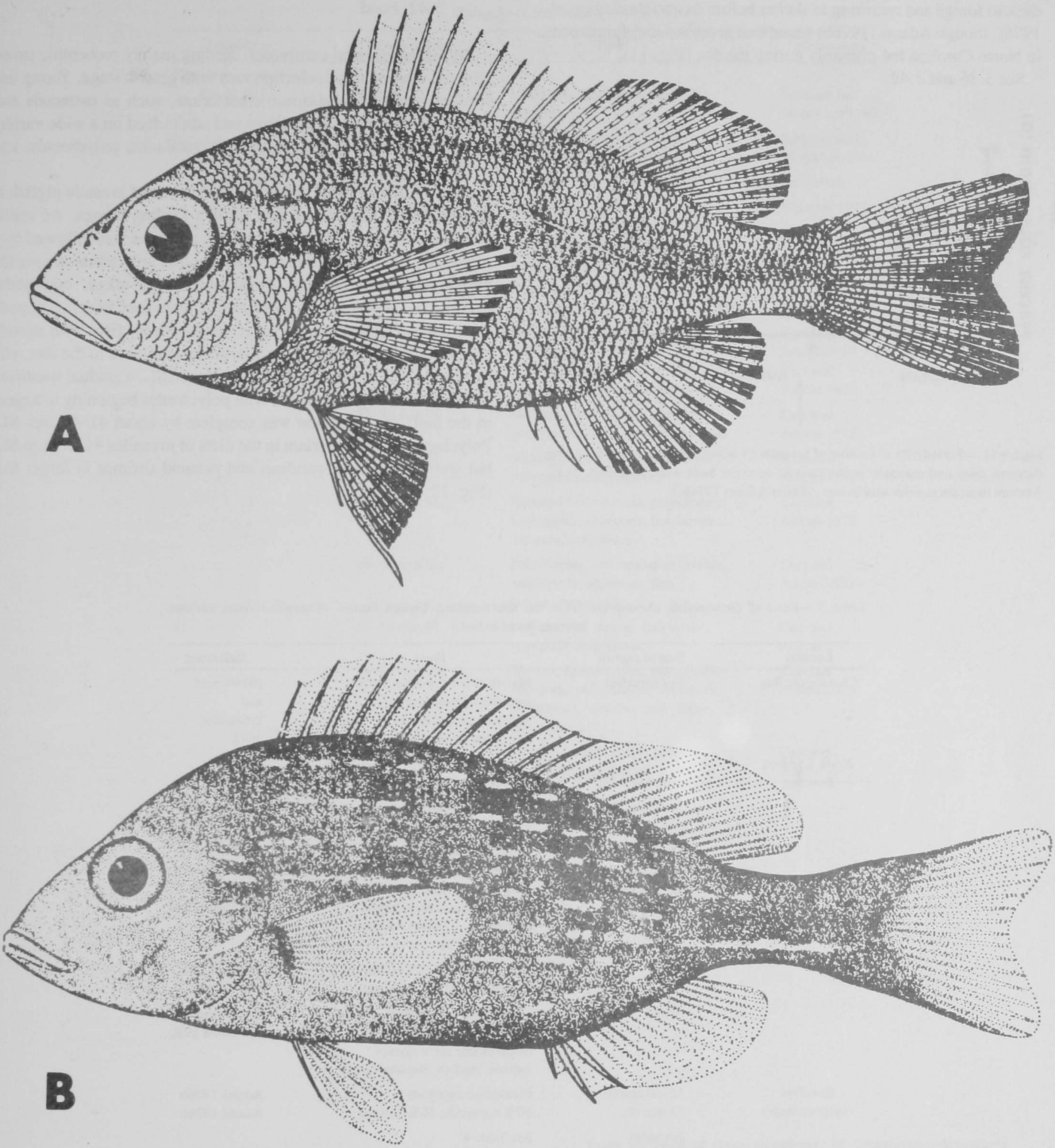

Figure 10.—Juvenile *Orthopristis chrysoptera*. A. Juvenile, 38 mm TL. B. Juvenile, 70 mm TL. (From Hildebrand and Cable 1930, figs. 37, 38.)

dusk to forage and returning to shelter before dawn (Hastings et al. 1976), though Adams (1976b) found that juveniles in eelgrass beds in North Carolina fed primarily during the day (Fig. 11).

See 3.36 and 3.42.

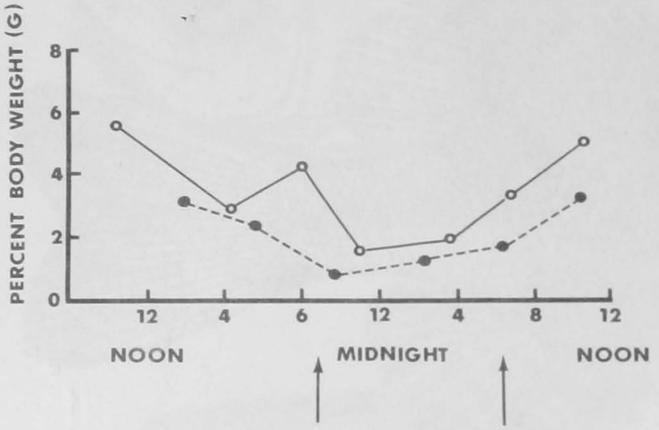

Figure 11.—Periodicity of feeding of juvenile *Orthopristis chrysoptera* in spring (broken line) and summer (solid line) in eelgrass beds near Beaufort, N.C. Arrows indicate sunrise and sunset. (From Adams 1976b.)

3.42 Food

Pigfish are general carnivores, feeding mainly on benthic invertebrates. Prey size and selection vary with growth stage. Young fish feed primarily on planktonic crustaceans, such as ostracods and copepods, while larger juveniles and adults feed on a wide variety of prey, including larger crustaceans, mollusks, polychaetes, and small fish (Tables 3–5).

Carr and Adams (1973), studying food habits of juvenile pigfish at Crystal River, Fla., found two distinct feeding phases. An initial planktivorous stage in 16 to 30 mm SL juveniles was followed by a two-phase carnivorous diet in which benthic invertebrates were the preferred foods. During the planktivorous stage, copepods, mysids, and postlarval shrimp were the main food items; copepods were most commonly eaten by 16 to 20 mm SL fish, with mysids and postlarval shrimp making a larger contribution to the diet with increasing size of the fish. At about 26 mm SL, a gradual transition to benthic feeding took place, with polychaetes beginning to appear in the diet; this transition was complete by about 41–45 mm SL. Polychaetes were important in the diets of juveniles 41–55 mm SL, but were replaced by caridean and penaeid shrimps in larger fish (Fig. 12).

Table 3.—Food of *Orthopristis chrysoptera* from the southeastern United States. (Compiled from various sources listed below.)

Locality	Size of pigfish	Food	Reference
Chesapeake Bay	Not specified	Mainly annelid worms; small amounts of crustaceans, mollusks, insect larvae, fish, plant debris	Hildebrand and Schroeder 1928
North Carolina			
Beaufort	10–11 mm SL	Very small copepods	Towers 1928
	12–25 mm TL	Mainly copepods, a few ostracods	Hildebrand and Cable 1930
	25–35 mm TL	Copepods, some ostracods, minute gastropods	Hildebrand and Cable 1930
	40–100 mm TL	Larger crustaceans (amphipods, small shrimp, crabs), larger gastropods, bivalves, worms, a few small fish	Hildebrand and Cable 1930
		In fish <60 mm SL: ostracods, *Gammarus*, *Mysis*, copepods	Towers 1928
	Adults	Crustaceans (amphipods, shrimp, crabs), mollusks (especially bivalves like razor clams), worms, starfish, *Balanoglossus*	Hildebrand and Cable 1930
Beaufort (eelgrass beds)	15–30 mm SL	Planktonic copepods	Adams 1976b
	35 mm SL	50% copepods, 50% detritus	Adams 1976b
	Juveniles	See Table 4	
Beaufort (intertidal flats)	Juveniles	Mainly detritus, zooplankton, and small shrimp; other small crustaceans (gammaridean amphipods, harpacticoid copepods, small crabs), small mollusks, annelid worms	Peterson and Peterson (text footnote 4)
	Adults	Mainly annelid worms (*Axiothella*, *Diopatra*, *Rhyncobolus*, *Arenicola*, *Pectinaria*), nemerteans (*Cerebratulus*), mollusks, crabs (including fiddler, horseshoe, hermit, blue), shrimp and other small crustaceans (amphipods, isopods), fishes, sea urchins	Peterson and Peterson (text footnote 4)

Table 3.—*Continued.*

Locality	Size of pigfish	Food	Reference
Florida			
Tampa Bay	60 mm TL	Copepods, ostracods, small bivalves	Springer and Woodburn 1960
	Adults	Bivalves, gastropods, crustaceans, polychaetes	Springer and Woodburn 1960
Cedar Key	25–170 mm TL	See Table 5	Reid 1954
East Pass (near Panama City)	Not specified	Amphipods, copepods, isopods, mysids, tanaids, shrimps, crabs, crab megalops, barnacles, polychaetes, bivalves, brittlestars	Hastings 1972
Crystal River	16–20 mm SL	Copepods, sergestids, tadpole larvae, veligers, cypris	Carr and Adams 1973
	21–25 mm SL	Shrimp and/or mysids, copepods, fish larvae	Carr and Adams 1973
	26–30 mm SL	Copepods, shrimp and/or mysids, fish larvae, amphipods, polychaetes	Carr and Adams 1973
	31–35 mm SL	Shrimp and/or mysids, copepods, polychaetes, fish larvae, amphipods	Carr and Adams 1973
	36–40 mm SL	Shrimp and/or mysids, copepods, polychaetes, amphipods	Carr and Adams 1973
	41–45 mm SL	Shrimp and/or mysids, polychaetes, amphipods, copepods, fish larvae, veligers, nematodes	Carr and Adams 1973
	46–50 mm SL	Polychaetes, shrimp and/or mysids, amphipods, copepods, fish larvae, nematodes	Carr and Adams 1973
	51–55 mm SL	Polychaetes, shrimp, fish larvae, copepods, amphipods	Carr and Adams 1973
	56–65 mm SL	Shrimp, xanthid crabs, gastropods, copepods, polychaetes, fish larvae, amphipods, detritus and algae, and veligers	Carr and Adams 1973
	66–80 mm SL	Shrimp, xanthid crabs, polychaetes, copepods, fish	Carr and Adams 1973

Table 4.—Food of juvenile *Orthopristis chrysoptera* from eelgrass beds near Beaufort, N.C. (From Adams 1976b.)

Food	Percentage by weight
Detritus	46.2
Copepods (calanoids)	35.2
Shrimp (*Palaeomonetes*)	12.5
Crabs	1.8
Copepods (harpacticoids)	1.5
Amphipods (gammarids)	1.2
Polychaetes	0.6
Shrimp (*Hippolyte*)	0.6
Bivalves	0.4
Total	100.0

Table 5.—Food of three size-classes of *Orthopristis chrysoptera* from Cedar Key, Fla. (From Reid 1954, table 3.)

	Percent frequency of occurrence		
Food item	25–50 mm SL ($N=6$)	51–150 mm SL ($N=39$)	151–170 mm SL ($N=10$)
Copepods	83.3	38.4	—
Ostracods	50.0	—	—
Amphipods	—	53.8	10.0
Shrimps	16.6	56.4	40.0
Crabs	—	5.1	20.0
Mollusks	—	—	20.0
Polychaetes	16.6	7.7	60.0
Fishes	—	5.1	—
Insects	—	—	10.0

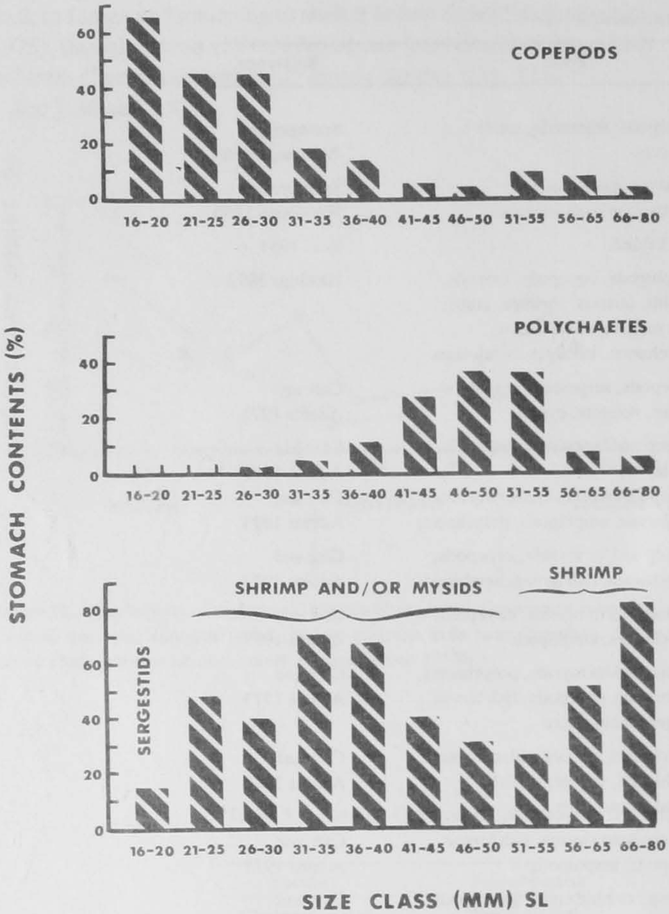

Figure 12.—Relative occurrence of copepods, polychaetes, shrimp, and mysids in the stomachs of 10 size-classes of juvenile pigfish collected at Crystal River, Fla. (Data from Carr and Adams 1973, fig. 8.)

3.43 Growth rate

Growth data on pigfish have been collected by several authors working in North Carolina and Florida (Tables 6, 7). Based on these data, growth rates of age 0 pigfish range from 10.0 mm SL/mo (Reid 1954 data, Cedar Key, Fla.) to 19.9 mm TL/mo (Hildebrand and Cable 1930 data, Beaufort, N.C.) during the spring and summer (April to August). Growth slows considerably at the end of the first summer; growth rates for age 0 pigfish over the period

Table 6.—Comparative monthly average size (mm) of the "0" year class of *Orthopristis chrysoptera*. (From Springer and Woodburn 1960, table 10.)

	Month				
	April	May	June	July	August
Springer and Woodburn[1] Tampa Bay Area, Fla.	17.5	28.7	40.0	47.5	62.1
Hildebrand and Cable[2] Beaufort, N.C.	6.2	5.6	18.6	57.4	85.9
Reid[3]					
Cedar Key, Fla. 1950	—	36			
1951			49	52	66

[1]Standard lengths.
[2]Total lengths (TL 60 = SL 48; TL 82 = SL 66; TL 91 = SL 71).
[3]Standard lengths, estimated from graph.

October to April ranged from 3.1 mm SL/mo (Grimes and Mountain 1971 data, Crystal River, thermally nonaffected stations) to 5.5 mm SL/mo (Reid 1954 data, Cedar Key). This slowing in growth was shown graphically by Hildebrand and Cable (1930) (Fig. 13).

Taylor (1916), working at Beaufort, measured growth increments of 47.0 mm between age I and II, 35.0 mm between age II and III, and 4.2 mm between age III and IV (measurements unspecified) (Fig. 14). Growth rates calculated from scale annuli were somewhat higher than those measured. Taylor's (1916) data, when compared with the data of workers discussed above, indicate a slowing in growth after age 0, as expected, and a fairly constant growth rate after reaching age I.

See 4.13.

3.44 Metabolism

An oxygen consumption rate of pigfish was calculated by Adams (1976c) for specimens from eelgrass beds off Beaufort. The rate of oxygen consumption was related to body weight and temperature by a multiple regression equation:

$$\hat{Y}=0.29+0.77\,X_w+0.02\,X_T \qquad (r^2=0.95,\ N=31),$$

where $\hat{Y}$ is the expected log of oxygen consumed per hour in milligrams, X_w is log weight in grams, and X_T is temperature in °C; experiments were conducted over a temperature range of 18°–28°C. Body weight was found to be more important than temperature in describing oxygen consumption in pigfish.

See 4.6.

Table 7.—Comparative monthly mean standard lengths (mm) for age 0 *Orthopristis chrysoptera*; February and April figures probably actually represent age I individuals. (From Grimes and Mountain 1971.)

Study	Year collected	June	August	October	December	February	April
Springer and Woodburn 1960 (Tampa Bay)	1957	40.0	62.1				17.5
Reid 1954 (Cedar Key)[1]	1951	49.0	66.0	77.0		84.0	110.0
Grimes 1971[2]	1969						
Crystal River—Affected[3]		44.0	66.0	70.0	79.0		98.0
Crystal River—Nonaffected		51.0	75.0				111.0
Grimes and Mountain[2]	1970						
Crystal River—Affected			78.9	94.0	88.2		102.9
Crystal River—Nonaffected		50.0	68.9	87.2	90.8		105.8

[1]Lengths estimated from graph.
[2]Statistical comparison of annual growth (monthly mean standard length vs. time) of fish from thermally affected vs. nonaffected areas revealed no significant difference.
[3]Stations thermally affected by power plant effluent.

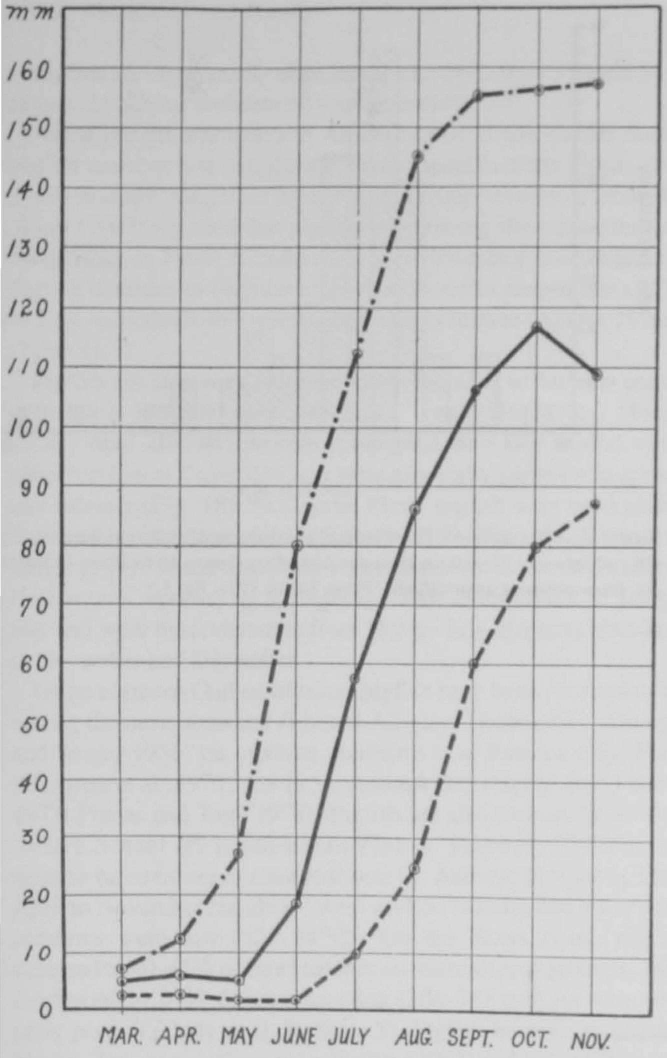

Figure 13.—Growth of *Orthopristis chrysoptera* during their first summer, near Beaufort, N.C. Solid line shows average size, dot-and-dash line shows maximum size, and dash line shows minimum size. (From Hildebrand and Cable 1930.)

3.5 Behavior

3.51 Migrations and local movements

Migrations of pigfish are seasonal and appear related to changes in water temperature; local nocturnal-diurnal foraging migrations also occur. Offshore migrations of pigfish occur in winter or late fall. Hildebrand and Cable (1930) reported offshore migrations in October and November at Beaufort, with largest fish the first to leave and the first to return in sprinig (March and April). Returning fish were not in very good condition, indicating that feeding or food supply on offshore grounds was not optimal. Pigfish have also been found to leave shallow waters in the Gulf of Mexico in winter (Moe and Martin 1965; Ogren and Brusher 1977). Low water temperatures are apparently avoided by pigfish.

Pigfish may also make short nocturnal foraging migrations, leaving shelter at dusk to feed, and returning before dawn (Hastings et al. 1976).

3.52 Schooling

Pigfish have an affinity for hard substrate and may school in areas near reefs or jetties (Hastings 1972). Wang and Raney (1971) reported young pigfish (16–25 mm SL) schooling heterotypically with *Lagodon rhomboides* juveniles in Charlotte Harbor.

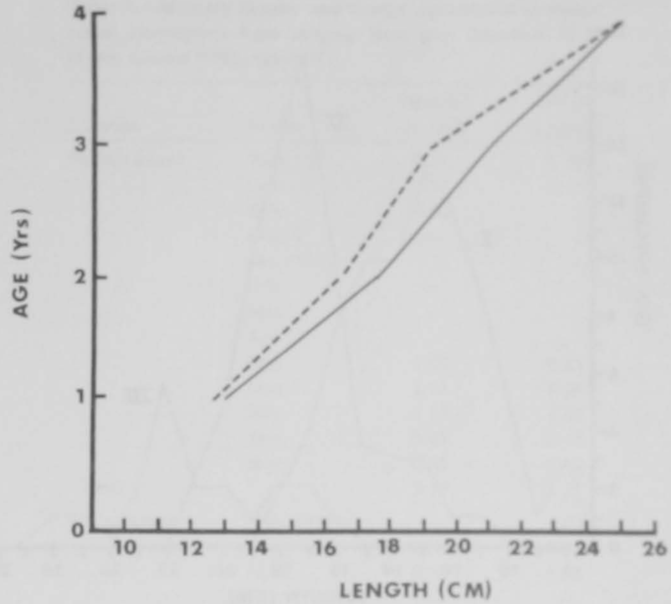

Figure 14.—Comparison of calculated (broken line) and measured (solid line) lengths of *Orthopristis chrysoptera* (measurements unspecified). (From Taylor 1916, fig. 8.)

4 POPULATION

4.1 Structure

4.11 Sex ratio

Pigfish sex ratio was reported to be approximately 1:1 in St. Andrew Bay, except in autumn samples when females predominated (Pristas and Trent 1978).

4.12 Age composition

A study of pigfish conducted by Taylor (1916) near Beaufort indicated a predominance of 1- and 2-yr-old fish in the population sampled (Fig. 15). Few 3-yr-olds and only one 4-yr-old were collected during the study.

4.13 Size composition

Length-frequency data on pigfish have been collected by several workers. Taylor (1916) found a modal length of about 17–18 cm (measurement unspecified) in specimens 1 yr old and over collected near Beaufort (Fig. 16).

Monthly collections made near Beaufort by Hildebrand and Cable (1930) indicated that small pigfish (0–20 mm TL) entered the sampling area in March through June, being the dominant length class until late fall (Fig. 17). A second year class (presumably age I) appeared in April and persisted through November, although without a distinct length mode. A similar pattern was found by Reid (1954) at Cedar Key; Springer and Woodburn (1960) in Tampa Bay; Moe and Martin (1965) off Pinellas County, Fla.; Wang and Raney (1971) in Charlotte Harbor estuary; and Grimes and Mountain (1971) at Crystal River.

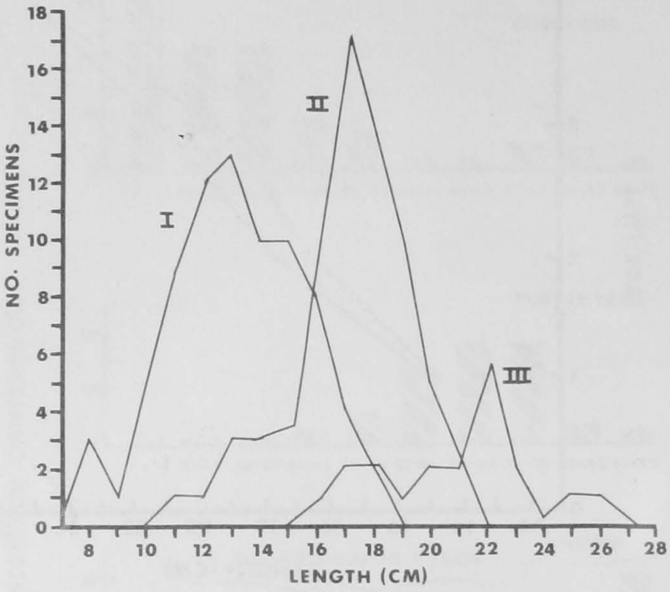

Figure 15.—Occurrence of *Orthopristis chrysoptera* of 1, 2, and 3 yr old. The 8 cm class consists of specimens 8 to 9 cm in length, etc. (From Taylor 1916, fig. 7.)

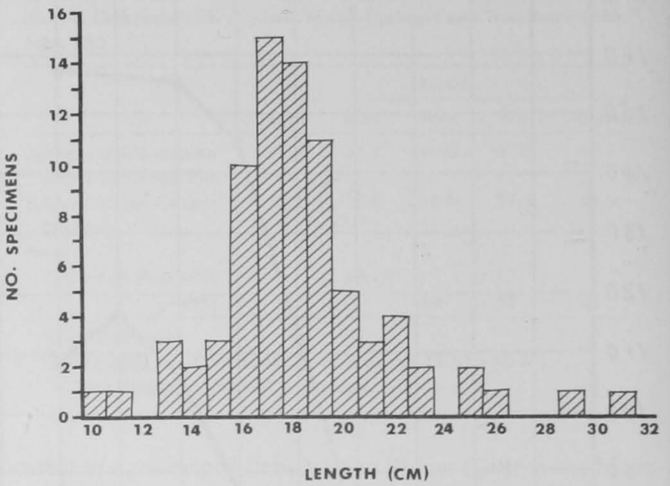

Figure 16.—Occurrence of *Orthopristis chrysoptera* of different lengths, 1 yr old and upward. The 10 cm class consists of specimens 10 to 11 cm in length, etc. (measurement unspecified). (From Taylor 1916, fig. 5.)

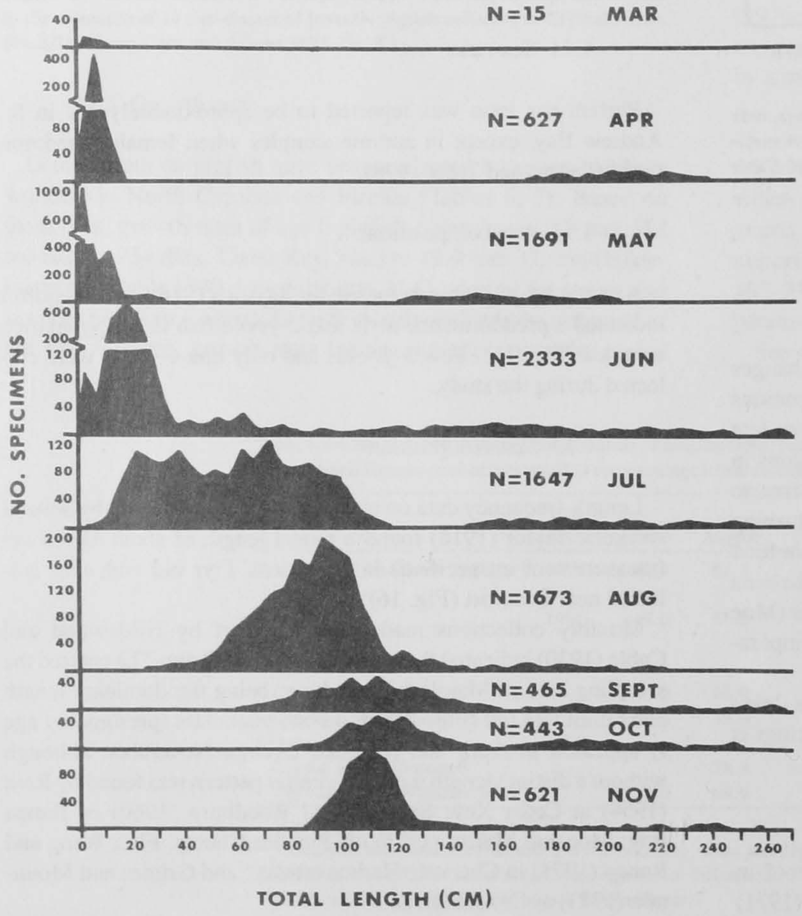

Figure 17.—Length frequencies of 9,512 *Orthopristis chrysoptera* collected near Beaufort, N.C. (From Hildebrand and Cable 1930, data from table 3.)

4.2 Abundance and density

Pigfish are often locally abundant in suitable habitats within their range; abundance and density vary seasonally.

Along the the southeastern Atlantic coast of the United States pigfish are common in open-shelf and coastal habitats (Struhsaker 1969) and are caught as bycatch by shrimp trawlers (Table 8). Smith (1907) reported that pigfish were among the most common food fishes in North Carolina and were abundant near Beaufort. Pigfish densities in eelgrass areas near Beaufort ranged from 0.02 to 2.92 individuals/m², with highest values in June (Adams 1976a) (Table 9).

Pigfish are also very common along the Gulf of Mexico coast, particularly in saltier bays and coastal waters (Hoese and Moore 1977). Reid (1954) reported that pigfish were the second most abundant fish at Cedar Key and were especially common in spring and summer (Fig. 18). At Crystal River, pigfish were most abundant in late summer and fall (Grimes 1971) (Fig. 19). Wang and Raney (1971) found that pigfish were more abundant in Charlotte Harbor than reported by Springer and Woodburn (1960) in Tampa Bay and were most abundant from May to July and least abundant in November and December.

In the northern Gulf of Mexico, pigfish have been reported to be among the most abundant fishes at Alligator Harbor, Fla., (Joseph and Yerger 1956) on offshore platforms near Panama City, Fla., (Hastings et al. 1976) and in St. Andrew Bay (Ogren and Brusher 1977; Pristas and Trent 1978). Pigfish are also commonly trawled on live bottom off northwestern Florida. Hastings (1972) found them to be common or abundant near St. Andrew Bay jetties from April to November but absent from shallow water when water temperatures were low (12°–14°C). On the Texas coast, pigfish occurred in 40–43% of trawl catches on white shrimp grounds, with catches of 14.2–37.6 fish/h trawling (366–741 g/h) for two sampling periods (Cody et al. footnote 5). Pigfish biomass in Laguna Madre, Tex., was estimated by Hellier (1962) and ranged from 0.0 kg/ha in January through April to 2.2 kg/ha (2.0 lb/acre) in September (Fig. 20). Pigfish are also abundant on shell banks off Campeche, Mexico (Hildebrand 1954).

See 2.21, 2.23, and 3.51.

Table 9.—Monthly density and energy equivalence of *Orthopristis chrysoptera* from eelgrass beds near Beaufort, N.C. (From Adams 1976a, table IV.)

Location	Month	Density (no./m²)	Energy (kcal/m²)
Phillips Island	Sept. 1971	0.11	2.59
	Oct.	—[1]	—
	Nov.	0.02	—
	Dec.	—	—
	Jan. 1972	—	—
	Feb.	—	—
	Mar.	—	—
	Apr.	—	—
	May	1.07	0.25
	June	2.92	1.06
	July	1.12	1.42
	Aug.	0.23	2.47
	Sept.	0.03	0.42
Total		5.50	8.21
Bogue Sound	Sept. 1971	—	1.03
	Oct.	0.02	0.66
	Nov.	0.06	4.85
	Dec.	—	—
	Jan. 1972	—	—
	Feb.	—	—
	Mar.	—	—
	Apr.	—	—
	May	0.33	0.70
	June	1.29	0.97
	July	0.24	0.68
	Aug.	0.04	0.35
	Sept.	—	—
Total		1.98	9.24

[1]No data.

Table 8.—Catches of *Orthopristis chrysoptera* as a bycatch of shrimp trawling off the southeastern Atlantic coast of the United States, 1931–35. (From Anderson 1968.)

Location		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
		Month												
South Carolina, Outside	no. fish/h trawling	5.8							0.8	1.0		0.4		0.7
	% total catch	0.2	—[1]	—	—	—	—	—	*[2]	*	—	*	—	*
	total no.	32							4	6		2		44
Georgia, Outside	no. fish/h trawling	1.0					0.1	0.5	0.3	8.8	1.1	1.2	*	1.1
	% total catch	0.1	—	—	—	—	*	0.1	*	0.3	0.1	0.1	*	0.1
	total no.	20					2	15	10	256	30	22	1	356
Georgia, Inside	no. fish/h trawling				*			3.3	0.6	0.5				0.4
	% total catch	—	—	—	*	—	—	0.2	*	*	—	—	—	*
	total no.				1			103	26	27				157
Florida, Outside	no. fish/h trawling	2.4	0.2	6.0	0.9	4.3	0.3	0.7	11.6	14.8	23.4	2.1	0.9	5.8
	% total catch	0.1	*	0.3	0.1	1.7	0.1	0.1	0.6	0.3	0.4	*	*	0.2
	total no.	20	2	36	6	13	1	10	128	148	164	16	8	552
All areas combined	no. fish/h trawling	1.3	*	0.5	0.1	0.2	*	1.5	1.8	4.4	2.7	0.9	0.2	1.2
	% total catch	0.1	*	0.1	*	*	*	0.1	0.1	0.2	0.1	*	*	0.1
	total no.	72	2	36	7	13	3	128	168	437	194	40	9	1,109

[1]No catch.

[2]Less than 0.1% of total catch.

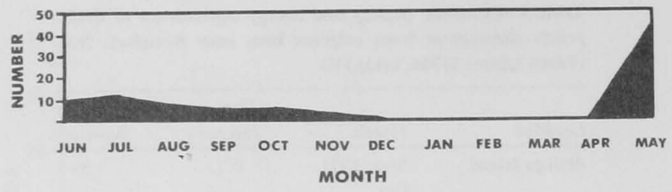

Figure 18.—Seasonal abundance of *Orthopristis chrysoptera* collected at Cedar Key, Fla. (From Reid 1954.)

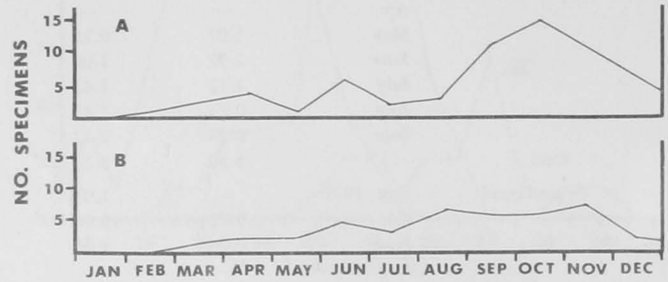

Figure 19.—Seasonal abundance of *Orthopristis chrysoptera* collected at shallow trawl stations near Crystal River, Fla. A. Thermally affected stations. B. Thermally nonaffected stations. (From Grimes 1971.)

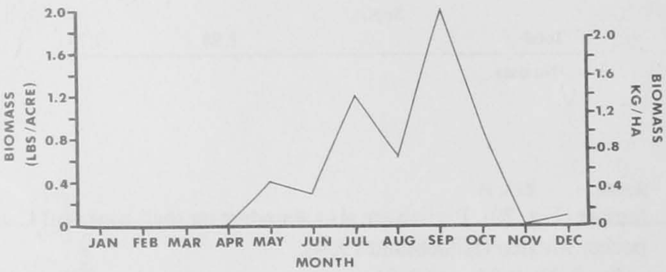

Figure 20.—Estimated seasonal biomass of *Orthopristis chrysoptera* in Laguna Madre, Tex. (From Hellier 1962 data.)

4.3 Natality and recruitment

4.32 Factors affecting reproduction

Spawning is seasonal, occurring primarily in spring, and is probably temperature related. Spawning seems to occur in open water just prior to inshore migration (Hastings 1972) or in quiet inshore waters (Hildebrand and Cable 1930). Since spawning areas are not well known, there is no information of environmental effects on reproduction.

See 3.16.

4.33 Recruitment

Length-frequency data indicate that youngest fish (approximately 10 mm SL) appear in shallow inshore waters from January to June, with the largest influx in April and May (Hildebrand and Cable 1930; Reid 1954; Springer and Woodburn 1960; Wang and Raney 1971). Smaller juveniles (3 + mm, measurement unspecified) may also be present in shallow water, but are not usually sampled because of their habit of burying in or lying on sand bottom (Hildebrand and Cable 1930).

See 2.21.

4.6 Population in the community and the ecosystem

Pigfish are important members of inshore grassbed communities during the warmer months of the year. Adams (1976b) calculated that pigfish contributed 8.0 and 9.3% of the total energy produced in eelgrass beds at Phillips Island and Bogue Sound, N.C., respectively. Pigfish made up 21 and 7%, respectively, of the total number of fish collected at each site. Standing crop of pigfish was high during spring, summer, and fall, and zero in winter when pigfish were absent from shallow water (Fig. 21). Caloric contents of pigfish studied by Adams (1976b) were:

Life stage	*SL* (*mm*)	*Caloric content* (*cal/mg ash-free dry weight*)
Adults	>86	5.85
Juveniles	38–82	5.52
Prejuveniles	16–38	5.48
Larvae	12–16	5.33

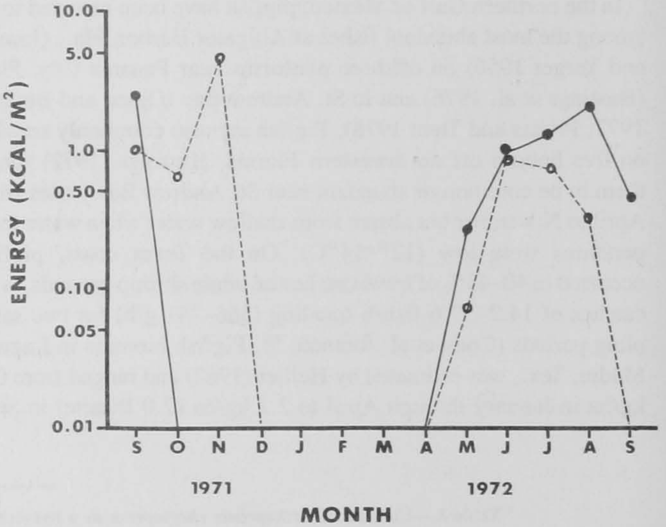

Figure 21.—Temporal distribution of the standing crop energy of *Orthopristis chrysoptera* in Bogue Sound (broken line) and Phillips Island (solid line) eelgrass beds, N.C. (From Adams 1976a.)

Pigfish production, respiration, and consumption were also calculated for the same two eelgrass beds (Adams 1976c) and conversion efficiencies estimated (Tables 10,11). Juveniles showed more efficient conversion of consumed energy to productivity (P/C ratio) (34%) than did adults (6–20%), whereas juveniles used less consumed energy for respiration (R/C ratio) (46%) than did adults (60–75%). Energy flow diagrams for the eelgrass fish communities studied by Adams (1976c) appear in Figure 22. Pigfish are thus significant consumers and producers of energy in such communities.

Offshore migrations of pigfish in late fall and winter may subject them to predation by offshore fish species, though little is known concerning predation. Assuming that such predation does occur, considerable amounts of energy may be transported from inshore to offshore communities by pigfish. The fact that pigfish returning to shallow water in spring were in poor condition (Hildebrand and Cable 1930) indicates that there is little feeding done while offshore; hence there is little energy transfer in the inshore direction.

Table 10.—Production and respiration of juvenile and adult *Orthopristis chrysoptera* in Bogue Sound and Phillips Island, N.C., eelgrass beds. (From Adams 1976c, table II.)

	Juveniles		Adults	
Month	Production (cal/m²)	Respiration (cal/m²)	Production (cal/m²)	Respiration (cal/m²)
	Phillips Island			
Sept. 1971	—[1]	—	—	2,815
October	—	—	—	—
November	—	—	—	405
December	—	—	—	—
Jan. 1972	—	—	—	—
February	—	—	—	—
March	—	—	—	—
April	—	—	—	—
May	284	743	—	—
June	1,035	1,424	—	—
July	1,652	1,427	333	204
August	558	748	—	1,040
September	—	232	—	—
Total	3,529	4,674	333	4,464
% of total community value	16.3	6.7	3.2	6.4

	Juveniles		Adults	
Month	Production (cal/m²)	Respiration (cal/m²)	Production (cal/m²)	Respiration (cal/m²)
	Bogue Sound			
Sept. 1971	—	—	383	408
October	—	—	252	274
November	—	—	—	1,046
December	—	—	—	—
Jan. 1972	—	—	—	—
February	—	—	—	—
March	—	—	—	—
April	—	—	—	—
May	329	85	—	—
June	518	1,000	54	65
July	459	425	—	265
August	—	267	—	—
September	—	—	—	—
Total	1,306	1,777	689	2,053
% of total community value	6.0	3.1	3.2	3.6

[1]No data.

Table 11.—Summary of the energy budget of juvenile and adult *Orthopristis chrysoptera* from eelgrass beds at Phillips Island and Bogue Sound, N.C. (From Adams 1976c, table V.)

	Productivity (P) (cal/m²per yr)	Respiration (R) (cal/m²per yr)	Consumption (C)[1] (Winberg) (cal/m²per yr)	Consumption (C)[1] (Bajkov) (cal/m²per yr)	P/C	R/C
Juveniles						
Phillips Island	3,529	4,674	10,255	10,566	0.34	0.46
Bogue Sound	1,306	1,777	3,853	4,366	0.34	0.46
Adults						
Phillips Island	333	4,464	5,986	4,385	0.06	0.75
Bogue Sound	689	2,058	3,434	6,907	0.20	0.60

[1]Calculated using two methods, one of Winberg, one of Bajkov.

5 EXPLOITATION

5.1 Fishing equipment

Pigfish are caught by a variety of methods, mainly seines, traps, trawls, and handlines (Courtenay and Sahlman 1978). Most are marketed fresh. Hildebrand and Schroeder (1928) reported that in 1920, 50% of pigfish caught in Chesapeake Bay were caught by handlines, 28% by pound nets, 21% by haul seines, and 3% by gill nets. Many pigfish are caught on hook and line by recreational fishermen, mainly by stillfishing (Clark 1962), and others are caught as bycatch by shrimp trawlers. Pigfish for use as live bait are caught with small beam trawls, push nets, traps, and on hook and line (Anderson and Gehringer 1965).

5.2 Fishing areas

Pigfish are caught throughout their range, though they are not usually a targeted catch. Largest reported catches are from the Chesapeake Bay area, N.C., and both coasts of Florida (Hildebrand and Cable 1930). Hildebrand and Schroeder (1928) reported that pigfish were much esteemed as food fish in Chesapeake Bay, bringing a retail price of $0.44/kg ($0.20/lb) in 1921–22. Recreational catches of pigfish are considerable on the Middle Atlantic, South Atlantic, and Gulf of Mexico Coasts of the United States.

See 5.43.

5.3 Fishing seasons

Pigfish are caught primarily in the warmer months of the year when they are in shallow water. In Chesapeake Bay, the fishing season extends from April until October, with the most productive months being May, June, September, and October (Hildebrand and Schroeder 1928). Trawl catch rates reported from the Cape Canaveral, Fla., area were highest in September and October (Anderson and Gehringer 1965). Recreational catches were greatest in September and May (Anderson and Gehringer 1965).

See 2.3 and 5.43.

5.4 Fishing operations and results

5.41 Effort and intensity

See 5.43.

5.43 Catches

Reported commercial catches of pigfish for 1966–75 appear in Table 12. During that period the largest catch was 135,300 kg (298,000 lb) in 1971. North Carolina produced the largest catches. Chesapeake Bay catches were down considerably from the 1920 level, when pigfish ranked 18th among commercial catches there, with 14,403 kg (31,725 lb), valued at $2,348, landed (Hildebrand and Schroeder 1928).

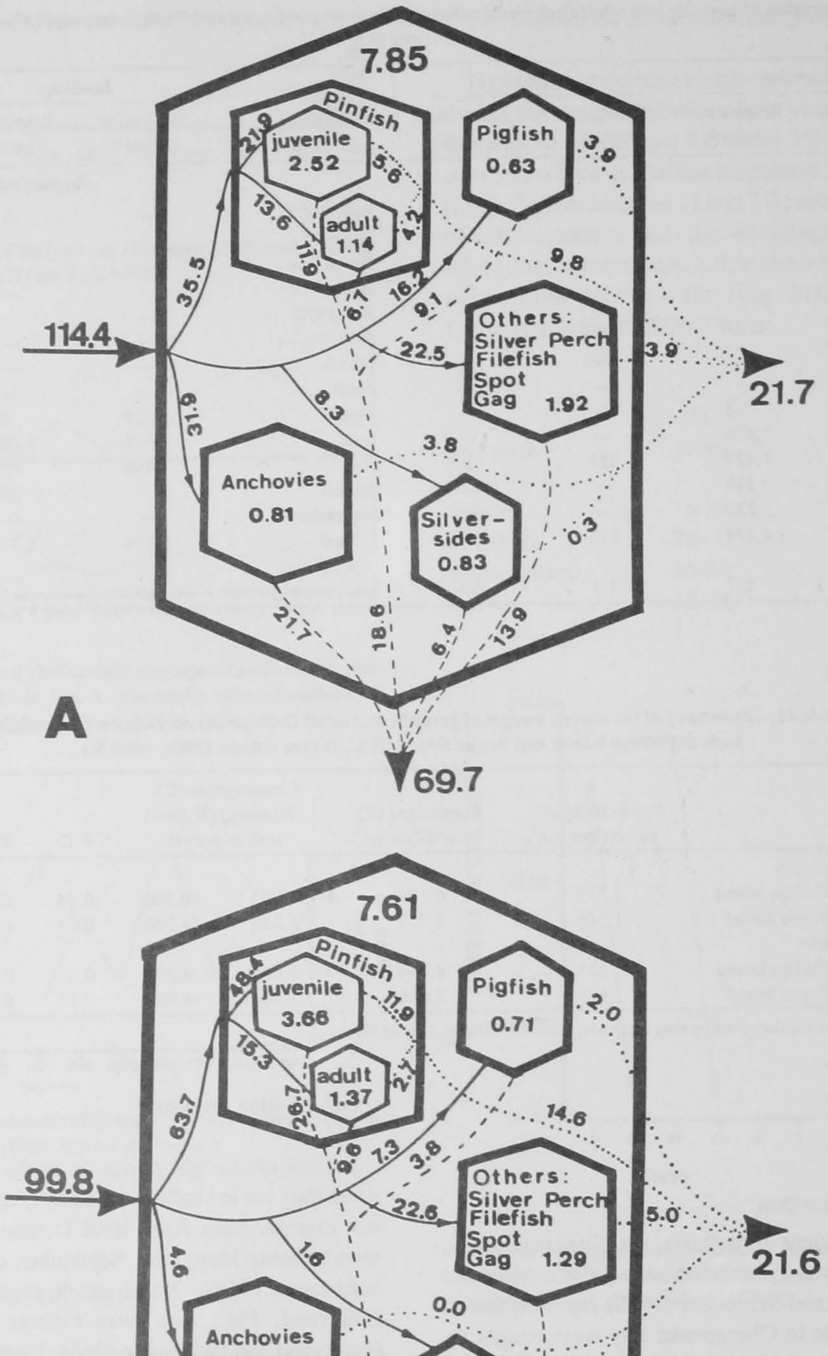

Figure 22.—Diagrams of the annual energy flows (kcal/m²) of the fish communities in A. Phillips Island, B. Bogue Sound, N.C., eelgrass beds. Large hexagons represent the total fish communities and small hexagons represent fish populations; numbers inside hexagons are average annual standing crop (kcal/m²). Solid flow lines are consumption, dashed lines oxygen consumption, and dotted lines production. (From Adams 1976c.)

Table 12.—Reported catches of *Orthopristis chrysoptera* along the United States coast, 1966–75. Figures are in thousands of pounds landed and thousands of dollars value. (Data from Fisheries of the United States, U.S. Department of Commerce, NOAA, NMFS Statistical Digests 60–69.)

Geographic area[1]		1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	10-Yr total
Chesapeake Bay	lb	8	4	3	7	22	10	1	2	—	—	57
	$	(1)[2]	(1)	(1)	1	2	(1)	(1)	(1)	—	—	
North Carolina	lb	86	133	123	181	181	256	172	127	136	144	1,539
	$	5	9	10	15	14	20	14	10	13	13	
Florida east coast	lb	26	20	15	21	14	18	10	11	15	5	155
	$	2	1	1	1	1	1	1	1	1	(1)	
Florida west coast	lb	20	30	69	38	34	14	21	15	13	4	258
	$	1	2	4	3	3	1	3	1	2	1	
Total	lb	140	187	210	247	251	298	204	155	164	153	2,009

[1]No *O. chrysoptera* catches were reported from South Carolina, Georgia, Alabama, Mississippi, Louisiana, or Texas.
[2]Parentheses refer to dollar amounts <1,000.

Table 13.—Catch per unit of effort of *Orthopristis chrysoptera* caught as bycatch of shrimp trawlers in the Cape Canaveral, Fla., area, 1933–35. Gear used was a 75-ft shrimp trawl towed at 2–3 kn. (Data from Anderson and Gehringer 1965.)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
No. fish/h trawling	3.3	0.3	9.0	0.9	6.5	0.5	1.0	8.0	22.8	37.0	4.0	1.5	7.6
% Total catch	0.1	—[1]	0.6	0.4	2.0	0.1	0.1	0.4	0.8	0.8	0.1	—	0.4
Total fish	20	2	36	6	13	1	6	44	148	148	16	8	448

[1]Less than 0.1% of total catch.

Table 14.—Recreational catch of *Orthorpristis chrysoptera* along the Atlantic coast of the United States in 1960. (Data from Clark 1962.)

	Middle Atlantic	South Atlantic
No. caught (thousands)	282	426
No. anglers (thousands)	18	3
Avg. catch (fish/angler)	15.7	142.0
Estimated weight (1,000 lb)	340	720
(1,000 kg)	154	327
Weight conversion (lb/fish)	1.2	1.7
(kg/fish)	0.5	0.8

Pigfish are frequently caught as bycatch by shrimp trawlers; Wolff (1972) reported pigfish ranked third (8.4% of total) among fish caught by shrimp trawlers in North Carolina. Pigfish landings by shrimpers in North Carolina averaged 4,257 fish during 1973–75 (Keiser 1977). Catch and effort and percent of total catch figures for commerical pigfish bycatch in the Cape Canaveral area were provided by Anderson and Gehringer (1965) (Table 13); catch rates were highest in September and October.

Recreational catches of pigfish on the Middle Atlantic and South Atlantic Coasts of the United States in 1960 were reported by Clark (1962) (Table 14). Total recreational pigfish catch was higher in the South Atlantic region than in the Middle Atlantic region, as was the average catch per angler and the average fish weight. Monthly recreational catches for the Cape Canaveral area appear in Table 15 (Anderson and Gehringer 1965). Largest numbers of pigfish were caught from bridges and causeways. Months with greatest reported landings were September and May.

According to the Marine Recreational Fishery Statistics Survey, Atlantic and Gulf Coasts, 1979 (U.S. Department of Commerce Current Fishery Statistics No. 8063), recreational anglers caught 15,000 pigfish in the Mid-Atlantic subarea, 456,000 in the South Atlantic subarea, and 1,521,000 in the Gulf subarea in 1979. Of these, 597,000 were caught in the ocean > 3 mi offshore, 501,000 were caught in the ocean < 3 mi offshore, 541,000 were caught in enclosed water, and 352,000 were from unknown localities. Most (1,226,000) were caught from private or rental boats, 585,000 were caught from manmade structures, and 181,000 from beaches or banks.

Pigfish flesh is considered good quality and is firm and rather dark, with good flavor (Hildebrand and Cable 1930). Mechanically separated pigfish flesh makes high quality fish patties (Webb and Thomas 1975).

Juvenile pigfish are popular live bait for sea trout in the Cape Canaveral area (Anderson and Gehringer 1965). Pigfish used as bait range from 6.25 to 10.0 cm TL (2.5–4.0 in) and average 10/lb. In 1963, 224,840 pigfish, weighing about 10,220 kg (22,484 lb) were caught in the Cape Canaveral area and brought a price of about $28,105 (Anderson and Gehringer 1965). Individual live pigfish were sold at 10 to 15 cents each or about $1.25/lb. Carr (1976) mentioned than at least one bait dealer in Oak Hill, Fla., was trapping pigfish to use as live bait at that time.

ACKNOWLEDGMENTS

I thank Donald M. Allen, Joan A. Browder, and Albert C. Jones of the Office of Fishery Management, Southeast Fisheries Center, National Marine Fisheries Service, and George C. Miller of the Southeast Fisheries Center Miami Laboratory for critically reviewing the manuscript, and Julie Josiek, Miami Laboratory, for her help in obtaining literature.

Table 15.—Estimated sport catch of *Orthopristis chrysoptera* in the Cape Canaveral, Fla., area in 1963. (Data from Anderson and Gehringer 1965.)

		Month								
		March	April	May	June	July	Aug.	Sept.	Oct.	Total
South Section,	no.	—[1]	1,324	7,563	263	119	1,379	4,392	1,148	16,188
bridges and causeways	lbs	—	331	1,891	66	30	345	1,098	287	4,048
	kg	—	150	859	30	14	157	498	130	1,838
South Section,	no.	—	—	—	—	—	50	—	—	50
ocean piers	lbs	—	—	—	—	—	12	—	—	12
	kg	—	—	—	—	—	5	—	—	5
South Section, Port	no.	—	—	—	—	809	42	313	—	1,164
Canaveral, inside	lbs	—	—	—	—	202	10	78	—	290
	kg	—	—	—	—	92	5	35	—	132
South Section, Port	no.	—	—	15	—	—	—	—	—	15
Canaveral, outside	lbs	—	—	4	—	—	—	—	—	4
	kg	—	—	2	—	—	—	—	—	2
South Section, boat	no.	—	—	—	112	—	—	—	—	112
fishery	lbs	—	—	—	28	—	—	—	—	28
	kg	—	—	—	13	—	—	—	—	13
North Section, bank	no.	—	—	—	—	1,326	1,407	258	—	2,991
fishery	lbs	—	—	—	—	336	348	69	—	753
	kg	—	—	—	—	153	158	31	—	342
North Section,	no.	272	1,248	1,720	232	1,352	2,664	5,408	3,776	16,672
bridges	lbs	64	312	432	56	336	664	1,352	944	4,160
	kg	29	142	196	25	153	301	614	429	1,889
North Section,	no.	—	—	—	—	—	—	102	154	256
surf	lbs	—	—	—	—	—	—	26	38	64
	kg	—	—	—	—	—	—	12	17	29
North Section,	no.	—	—	790	—	403	293	361	3,275	5,122
boat fishery	lbs	—	—	198	—	101	73	90	819	1,281
	kg	—	—	90	—	46	33	41	372	582
Total	no.	272	2,572	10,088	607	4,009	5,835	10,834	8,353	42,570
	lbs	64	643	2,525	150	1,005	1,452	2,713	2,088	10,640
	kg	29	292	1,147	68	458	659	1,231	948	4,832

[1]No data.

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