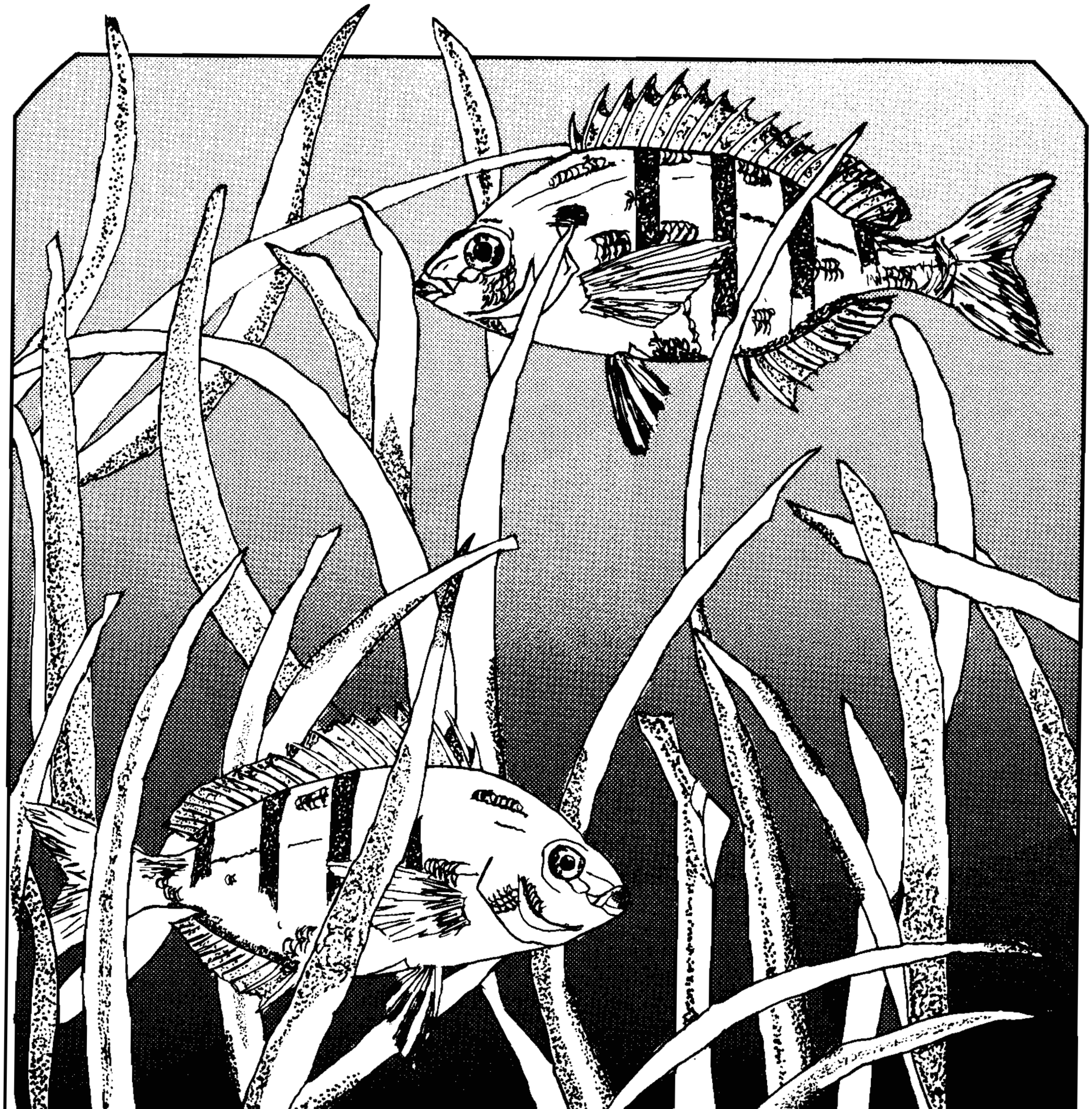
FWS/OBS-82/11.26
September 1984

TR EL-82-4

Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (Gulf of Mexico)

PINFISH



Fish and Wildlife Service

U.S. Department of the Interior

Coastal Ecology Group
Waterways Experiment Station

U.S. Army Corps of Engineers

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Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (Gulf of Mexico)

PINFISH

by

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PREFACE

This species profile is one of a series on coastal aquatic organisms, principally fish, of sport, commercial, or ecological importance. The profiles are designed to provide coastal managers, engineers, and biologists with a brief comprehensive sketch of the biological characteristics and environmental requirements of the species and to describe how populations of the species may be expected to react to environmental changes caused by coastal development. Each profile has sections on taxonomy, life history, ecological role, environmental requirements, and economic importance, if applicable. A three-ring binder is used for this series so that new profiles can be added as they are prepared. This project is jointly planned and financed by the U.S. Army Corps of Engineers and the U.S. Fish and Wildlife Service.

Suggestions or questions regarding this report should be directed to one of the following addresses.

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CONVERSION TABLE

Metric to U.S. Customary

Multiply	By	To Obtain
millimeters (mm)	0.03937	inches
centimeters (cm)	0.3937	inches
meters (m)	3.281	feet
kilometers (km)	0.6214	miles
square meters (m^2)	10.76	square feet
square kilometers (km^2)	0.3861	square miles
hectares (ha)	2.471	acres
liters (l)	0.2642	gallons
cubic meters (m^3)	35.31	cubic feet
cubic meters	0.0008110	acre-feet
milligrams (mg)	0.00003527	ounces
grams (g)	0.03527	ounces
kilograms (kg)	2.205	pounds
metric tons (t)	2205.0	pounds
metric tons	1.102	short tons
kilocalories (kcal)	3.968	British thermal units
Celsius degrees	1.8(C°) + 32	Fahrenheit degrees

U.S. Customary to Metric

Multiply	By	To Obtain
inches	25.40	millimeters
inches	2.54	centimeters
feet (ft)	0.3048	meters
fathoms	1.829	meters
miles (mi)	1.609	kilometers
nautical miles (nmi)	1.852	kilometers
square feet (ft^2)	0.0929	square meters
acres	0.4047	hectares
square miles (mi^2)	2.590	square kilometers
gallons (gal)	3.785	liters
cubic feet (ft^3)	0.02831	cubic meters
acre-feet	1233.0	cubic meters
ounces (oz)	28.35	grams
pounds (lb)	0.4536	kilograms
short tons (ton)	0.9072	metric tons
British thermal units (Btu)	0.2520	kilocalories
Fahrenheit degrees	0.5556(F° - 32)	Celsius degrees

ACKNOWLEDGMENTS

I am grateful for the reviews and suggestions by Dr. David S. Peters, National Marine Fisheries Service Southeast Fisheries Center, Beaufort, North Carolina, and Dr. Stephen T. Ross, Department of Biology, University of Southern Mississippi, Hattiesburg, Mississippi. The staff of the Mississippi Gulf Coast Research Laboratory Library in Ocean Springs provided valuable reference services and assistance.

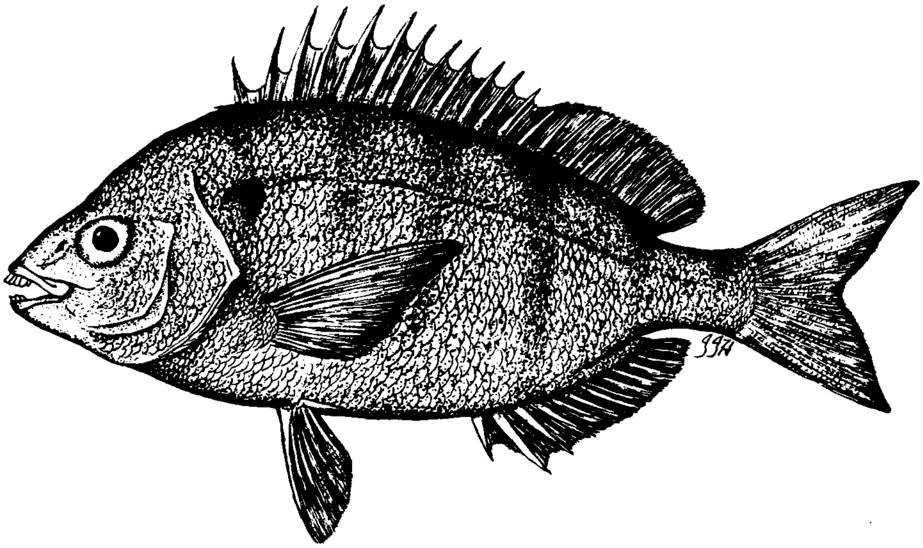

Figure 1. Pinfish.

PINFISH

NOMENCLATURE/TAXONOMY/RANGE

Scientific name..................*Lagodon rhomboides* (Linnaeus)
Preferred common name............Pinfish
Other common names....Bream, pin perch, sand perch, sailor's choice; Spanish name -- chopa espina or spined bream; Sargo saléma; French -- Sar saleme; Cajun -- poisson beurre or butterfish
Class......................Osteichthyes
Order......................Perciformes
Family........................Sparidae

Geographic range: Pinfish (Figure 1) inhabit coastal waters from Massachusetts southward to Florida and from Bermuda westward throughout the Gulf of Mexico (Hoese and Moore 1977) to the Yucatan Peninsula of Mexico (Burgess 1980) including northern Cuba (Randall et al. 1978) and Bermuda (Burgess 1980). Pinfish are rare north of Maryland. Collections of small juveniles in Delaware estuaries indicate that they migrate from more southern spawning grounds (Wang and Kernehan 1979). Pinfish are common from Virginia estuaries southward (Hildebrand and Cable 1938), and abundant along the south Atlantic and Gulf of Mexico coasts of the United States (Schimmel 1977). The distribution of the pinfish in the northern Gulf of Mexico is shown in Figure 2.

MORPHOLOGY/IDENTIFICATION AIDS

Dorsal spines XII, soft rays 11; anal spines III, rays 11; scales 65-70 in lateral line; 10 rows above and 17 rows below the lateral line (Hoese and Moore 1977). Randall et al. (1978) listed 12 dorsal rays and 53 to 68 scales in the lateral line. Body oval and compressed. Mouth comparatively small, 2.75 to 3.1 times in head length; maxilla reaches only to below the anterior margin of the eye. Both jaws have eight broad, deeply notched, incisorlike teeth anteriorly and have 2.5 rows of molarlike teeth laterally (Randall et al. 1978). A single small forward-directed spine precedes the 12 spines of the dorsal fin. The body is olivaceous above; the bluish-silver sides have yellow longitudinal stripes broader than the interspaces. A dark shoulder spot is near the origin of the lateral line. Six dark, diffused, vertical bars mark the body. Anal and forked caudal fins are yellow with broad light-blue margins (Randall et al. 1978). A monotypic genus.

REASONS FOR INCLUSION IN THE SERIES

The pinfish is an abundant estuarine dependent fish that usually inhabits vegetated marine bottoms, rocky reefs, jetties, and mangrove swamps (Schimmel 1977; Randall et al. 1978; Burgess 1980; Benson 1982). It is so abundant and predaceous that it is believed to alter the composition of estuarine epifaunal seagrass communities (Orth and Heck 1980; Coen et al. 1981; Stoner 1980, 1982).

Because of its small size, the pinfish lacks widespread appeal (Randall et al. 1978). If prepared while fresh, however, the fish is acceptably palatable. Commercial catch statistics include the pinfish in the unclassified or industrial fish category (Randall et al. 1978). Pinfish has a potential value as a baitfish (Breuer 1962; Migdalski and Fichter 1976) and is preyed upon by many species of commercial and sport fishes (Caldwell 1957; Breuer 1962; Randall et al. 1978; Schmidt 1979; Benson 1982). According to Randall et al. (1978), it is also a potential source of fish meal.

Pinfish have been used extensively as test fish in pesticide bioassays (Finucane 1969; Parrish et al. 1975) and physiological experiments (McCutcheon 1966; Kjelson and Johnson 1976; Burgess 1980).

LIFE HISTORY

Spawning

The time and location of spawning of the pinfish described here are inferred by the abundance and location of ripe females and newly hatched larvae taken by experimental gear near the surface in offshore waters. For example, in one area off the Mississippi coast, three large schools of more than 1,000 pinfish each were observed near the surface in waters about 38 m deep (Springer 1957). All females sampled with a cast net were ripe and may have been spawning. Spawning location is probably related more to depth and water temperature than to distance offshore (Johnson 1978). Small pinfish have been collected in January along the Texas coast near passes in the open gulf (Gunter 1945). Although spawning concentrations of pinfish were observed off the Mississippi coast in winter, Christmas and Waller (1973) indicated that spawning there peaked in the fall. Most studies in the gulf have indicated offshore spawning in the fall and early winter (Gunter 1945; Reid 1954; Caldwell 1957; Christmas and Waller 1973; Kjelson and Johnson 1976;

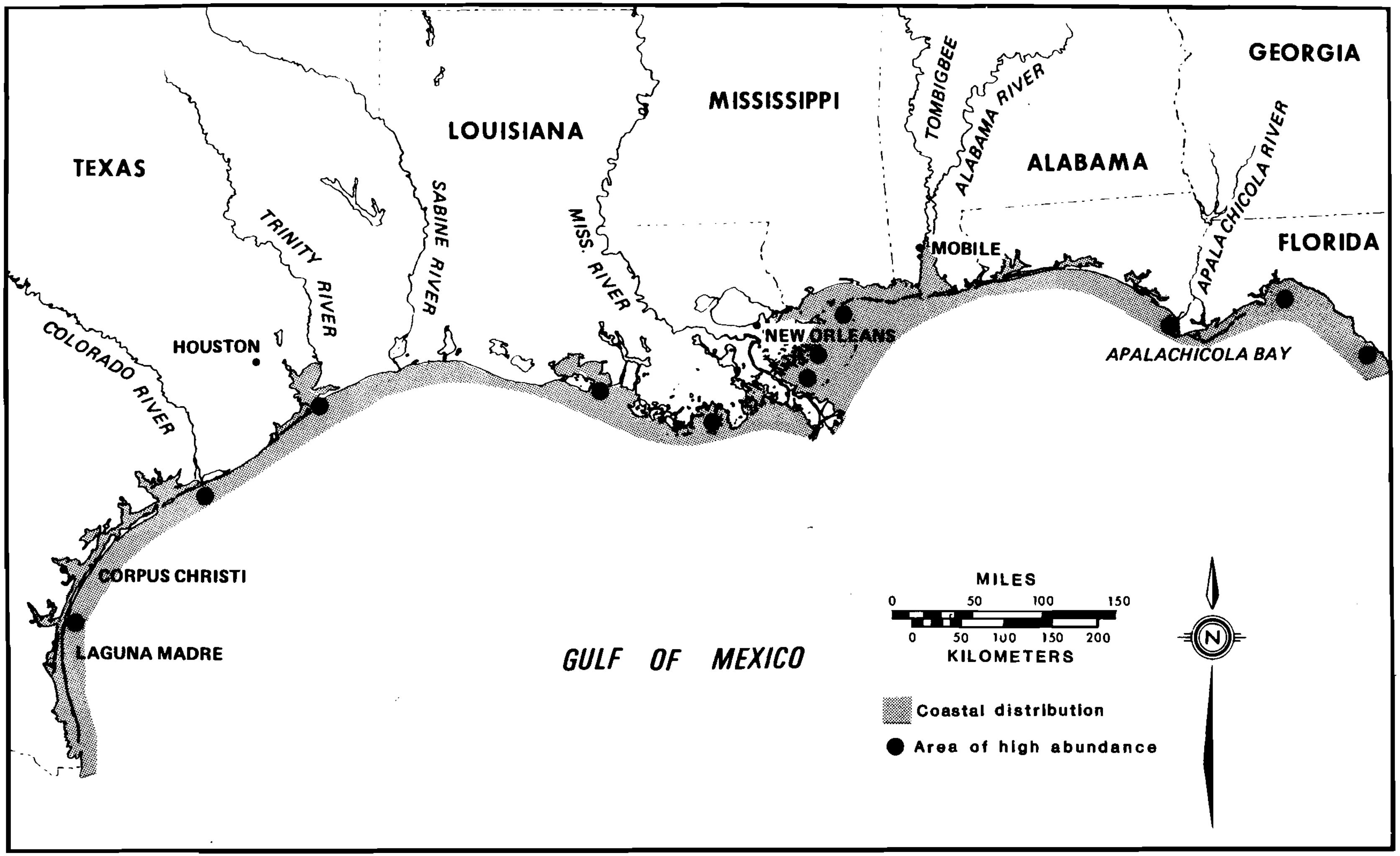

Figure 2. Distribution of the pinfish in the northern Gulf of Mexico.

Johnson 1978; Wang and Kernehan 1979; Burgess 1980). In Florida coastal waters, most spawning is in February through March (Tabb and Manning 1961).

Eggs and Fecundity

Data reported on pinfish eggs were taken largely from eggs stripped from females injected with human chorionic gonadotropin and fertilized artifically with sperm (Schimmel 1977). The diameter of pinfish eggs in different samples ranged from 0.90 to 0.93 mm (Schimmel 1977) and 0.99 to 1.05 mm (Johnson 1978). The eggs usually have a single oil globule and a very narrow perivitelline space. In the laboratory immature and infertile eggs sank to the bottom of finger bowls (Schimmel 1977); whereas, fertile eggs were semibuoyant. Larvae that hatched after a 48-h incubation at 18°C were 2.3 mm long. Eggs with more than one oil droplet present did not hatch (Johnson 1978).

A 157-mm long female collected in Florida in late November contained an estimated 90,000 eggs (Caldwell 1957). Hansen (1970) estimated 7,700 to 39,200 (average 21,600) eggs in eight pinfish 111 to 152 mm standard length (SL). Developmental stages of eggs and embryos were illustrated by Schimmel (1977) and Wang and Kernehan (1979).

Larvae and Postlarvae

Early larval stages of pinfish 2.3 to 2.9 mm long, 96 h after emergence were described and illustrated by Schimmel (1977). The yolk sac was visible 24 h after hatching and was completely absorbed by the time the larvae were about 2.7 mm long. The mouth began to develop after 96 h, when the larvae were about 3 mm long. Various stages of larval development from 2.3 to 13 mm long were described by Hildebrand and Cable (1938), Johnson (1978), and Wang and Kernehan (1979).

Soft rays first appear when the larvae are 5 to 7 mm long and spines begin to differentiate when the larvae are 8 to 10 mm long. The caudal fin becomes rounded when the larvae are 8 to 10 mm, square-ended at 12 mm, and concave at 14 mm TL. Teeth are formed by the time the larvae are 10 mm long and scales first form when the larvae are 15 mm long (Johnson 1978).

In an early study (Hildebrand and Cable 1938), larval pinfish were collected from October through April near the surface offshore from Beaufort, North Carolina. Catches in another study (Thayer et al. 1983) were greater at the surface at night than during daylight. When the larvae are about 11 mm long, they begin moving into the estuaries (Johnson 1978; Wang and Kernehan 1979). Larvae 11 to 18 mm long were collected from December through March in plankton tows at Dog Keys Pass off Horn Island in the Mississippi Sound (Christmas and Waller 1973) and from late November through January near Cedar Key, Florida (Reid 1954).

Juveniles

Juveniles (15-100 mm long) migrate into estuaries in the spring and summer (Wang and Kernehan 1979). When the fish are 16 to 20 mm long, notched incisiform teeth appear outside a row of conical teeth and gradually replace the conical teeth (Johnson 1978). When the fish are 30 mm long, the color pattern is similar to that of the adult, and when they are about 44 mm long, the caudal fin becomes more deeply forked and the pectoral fin increases disproportionately in length. Most pinfish become sexually mature at lengths of 80 to 100 mm (Hansen 1970; Johnson 1978).

In the Mississippi Sound, first-year juveniles begin to migrate into the estuaries in March and increase in abundance there until May (Christmas and Waller 1973). Juvenile pinfish in northwest Florida marshes first appeared in estuaries in March and increased in numbers until June when all juveniles moved offshore (Zilberberg 1966). Juveniles first appeared in January in the inshore waters of Cedar Key, Florida (Reid 1954), and in January to March, juveniles had moved into Aransas Bay and Copano Bay, Texas (Gunter 1945).

Small juveniles (20-80 mm long) were most abundant in vegetated, shallow flats of estuaries (Reid 1954; Kilby 1955; Reid 1956; Zilberberg 1966; Clark 1970; Hansen 1970; Swingle 1971; Clark 1974; Johnson 1978). Juveniles occasionally have been collected in fresh waters (McClane 1964; Randall et al. 1978; Johnson 1978; Burgess 1980). Young pinfish rarely venture outside of seagrass-covered habitat into sand patches, except at night, when they inhabit open sandy bottoms (Stoner 1979).

Adults

Adult pinfish have been reported by Reid (1954) to be abundant in channels and vegetated flats, but Johnson (1978) reported that they prefer open water. In contrast, Odum et al. (1982) reported that adult pinfish prefer vegetated substrate. According to Clark (1974) trawl catches of pinfish in Whitewater Bay, Florida, were highest at night when tidal currents were low and where aquatic vegetation was abundant. Pinfish select cover or rest on the bottom at night under offshore platforms near Panama City, Florida (Hastings et al. 1976), but they are free-swimming during the day (Caldwell 1957).

According to Caldwell (1957) most pinfish in Florida mature in their second year of life (the smallest mature female was 128 mm long) and first spawn in their third year (age 2), but Hansen (1970) observed pinfish in northwest Florida that spawned late in their first and second year of life and all mature fish were 110 mm SL or longer. Most pinfish mature during the fall offshore spawning migration or at offshore spawning sites (Hansen 1970).

Catches of pinfish with experimental fishing gear give some idea of their size range. Those caught in gill nets near Panama City, Florida, ranged from 115 to 240 mm FL and averaged 160 mm (Pristas and Trent 1978). In trawl samples in shallow water, only about 1% were longer than 100 mm SL and none exceeded 128 mm SL (Reid 1954).

Migration

After hatching in offshore waters in fall and winter, larval pinfish migrate into the estuaries where they grow in the summer (Wang and Kernehan 1979). Larval pinfish exhibited higher relative abundance (70%) than diurnal abundance (30%) according to Thayer et al. (1983). Juveniles usually inhabit the shallow estuaries but when surface water temperatures exceed 32°C, most seek the deeper, cooler water of channels (Zilberberg 1966; Cameron 1969).

Pinfish migrate out of the estuaries in late fall (Weinstein et al. 1977, Wang and Kernehan 1979) to their spawning grounds where they congregate (Springer 1957; Randall et al. 1978) into size groups (Moe and Martin 1965; Hansen 1970; Benson 1982). In Texas, Gunter (1945) reported capturing pinfish from offshore waters only from November to January; Cameron (1969) reported that large pinfish left shallow flats when water temperatures dropped below 10°C, whereas some juveniles remained inshore. Adults were reported to be abundant in January and February (Zilberberg 1966) and in December through February in St. Andrew Bay, Florida (Pristas and Trent 1978).

GROWTH CHARACTERISTICS

Pinfish embryos develop rapidly in the egg. Yolksac larvae are 2.3 mm long 48 h after emergence (at 18°C) and

2.9 mm long when their yolk sac is absorbed (in about 96 h) (Schimmel 1977). The larvae begin to migrate shoreward when they are about 11 mm long (Johnson 1978) and grow from 18 mm in March to 52 mm by June in northwest Florida (Zilberberg 1966). In northwest Florida, the daily growth of age 0 pinfish was 0.32 mm in spring, 0.23 mm in summer, and 0.1 mm in fall (Hansen 1970). Daily growth of age 1 fish was 0.32 mm in the spring, 0.21 mm in the summer, 0.04 mm in the fall, and 0.02 mm in the winter. The annual daily growth rate was 0.12 mm. The growth increment was 65 to 110 mm at the end of their first year (age 0); 55 mm at the end of the second year (age 1), and 45 mm at the end of the third year (age 2). The annulus formed on scales in April of the second year of life (age 1). Age 1 pinfish in Texas were 103 to 143 mm long in May (Gunter 1945).

Maximum lengths of pinfish reported in the literature were 400 mm (Randall et al. 1978) and 343 mm (McClane 1964); 365 mm TL in Louisiana (Dunham 1972); 330 mm (Hildebrand and Cable 1938) and 245 mm (Schwartz and Tyler 1970) in North Carolina; 250 mm in Texas-Louisiana (Hoese and Moore 1977); and 240 mm FL in Florida (Pristas and Trent 1978). Conversion factors calculated by Hellier (1962) from 100 pinfish (44 to 101 mm SL) were standard length (SL) = 0.85 fork length, and 0.78 total length.

Hellier (1962) calculated a length-weight equation as $\text{Log Wt}_{(g)} = -4.3734 + 2.9136 \text{ Log L}_{(SL)}$ and Cameron (1969) calculated a length-weight relationship for 135 pinfish in Redfish Bay, Texas, as $\text{Log Wt}_{(g)} = -4.353 + 2.903 \text{ Log L}_{(SL)}$. Larval pinfish length-weight relationship was $\text{Wt}_{(g)} = 0.0089 \text{ TL}^{2.81}$ (Hoss 1974).

THE FISHERY

According to descriptions of the pinfish in the literature, the fish has little food value (Schwartz and Tyler 1970), is edible when cooked whole (Hoese and Moore 1977), or has a fine flavor (Zim and Schoemaker 1955). Anglers have condemned pinfish for stealing bait from their hooks (Chute 1964; Schwartz and Tyler 1970; Migdalski and Fichter 1976; Hoese and Moore 1977). Pinfish caught by anglers for food and bait along the Mississippi coast contributed less than 17% of the total catch in a July through December sportfishing survey in the Mississippi Sound (Jackson 1972). Most of the pinfish caught by headboat fishermen in Texas coastal bays and the Gulf of Mexico are included in the sport catch (McEachron and Matlock 1983).

Pinfish are not listed in commercial fishery statistics because they are combined with unclassified species or industrial fish (Roithmayr 1965; Dunham 1972). They are caught incidentally in gill nets (Pristas and Trent 1978), trammel nets, beach seines, traps, hook and line (Randall et al. 1978), and purse seines in the menhaden fishing off the Mississippi River (Christmas et al. 1960). Pinfish yield a high grade of oil but few, if any, are now used for that purpose (Hildebrand and Cable 1938). Gillnet selectivity for pinfish has been reported from St. Andrew Bay, Florida, by Trent and Pristas (1977).

ECOLOGICAL ROLE

Food Habits and Predation

Known predators on pinfish are ladyfish (Gunter 1945), porpoises (Springer 1957), spotted seatrout (Breuer 1962), alligator gar (Goodyear 1967), and gulf flounder (Ashton 1980). Larval pinfish feed mainly on calanoid copepods (Stoner 1979). Juvenile pinfish 20 to 80 mm long selectively feed on amphipods in Apalachee Bay, Florida (Stoner 1979, 1980, 1982). Pinfish, 15 to 19 mm long, in the Newport River estuary of North Carolina, fed more heavily near mid-day when tidal currents were low (Kjelson and Johnson 1976). In laboratory experiments, feeding intensity was greatest at a water temperature of 24°C. Feeding stopped at temperatures above 35° and below 6°C (Peters et al. 1973). Stomach evacuation time at 24°C was 28 to 37 h (Peters and Hoss 1974). The consumption rate was about 0.05 calorie per milligram of fish per day (Kjelson and Johnson 1976).

Pinfish change their diet as they increase in size and tooth structure changes. At 16 to 20 mm long, when notched incisiform teeth usually appear (Johnson 1978), juvenile pinfish fed on shrimp, mysids, and amphipods (Carr and Adams 1973). The selection of amphipods by pinfish 16 to 80 mm long (SL) appears to be a function of macrophyte density (Stoner 1979). The five major ontogenetic stages in pinfish diets appears to be primarily a function of mouth size and changes in incisiform teeth. Pinfish demonstrated planktivory, omnivory, strict carnivory, and strict herbivory at different times, locations, and stages of development (Stoner 1980). An increase in mouth width and height with an increase in pinfish body size enables pinfish to capture a larger size of prey (Stoner 1979, 1980).

The high abundance of pinfish in many inshore coastal waters and estuaries is certain to have broad ecological effects on the aquatic flora and fauna. Pinfish are numerically dominant among fish in seagrass habitat in shallow subtidal areas of Gulf of Mexico and the southeast Atlantic coast (Stoner 1980). The intensity of pinfish predation on amphipods in seagrass communities in spring and summer probably limit amphipod abundance there. The consumption of plant material and detritus by pinfish (Darnell 1961; Carr and Adams 1973; Adams 1976) contributes to the export of organic materials in estuaries, especially where eelgrass contributes up to 64% of the total primary production (Adams 1976). On the basis of routine metabolism, pinfish use 1.7% of the total yearly energy available to secondary consumers in the Newport River estuary in North Carolina (Hoss 1974). Pinfish are valuable forage for larger fishes in estuaries (Caldwell 1957; Breuer 1962; Schmidt 1979), and are useful as bait (Caldwell 1957; McClane 1964; Migdalski and Fichter 1976; Randall et al. 1978).

Abundance

Pinfish are reported to rank most abundant in collections at Cedar Key, Florida (Reid 1954), second at Marco Island, south of Naples, Florida (Weinstein et al. 1977), third in a coastal marsh in northwest Florida (Zilberberg 1966), and fourth among fish in St Andrew Bay, Florida (Pristas and Trent 1978). In the abundance of spiny-rayed fish, pinfish ranked first in Florida Bay, southwest Florida (Tabb and Manning 1961), and second in Whitewater Bay, Everglades National Park, Florida (Clark 1970). Juvenile pinfish are abundant in winter and early spring in the surf of Horn Island, 14 km off the Mississippi mainland (Modde and Ross 1981) and in Mississippi's estuaries in summer and fall (Christmas and Waller 1973). Pinfish were the 11th most abundant fish in marsh and bayou waters southeast of New Orleans, Louisiana (Rounsefell 1964); the most abundant fish in August through October along the Louisiana coast (Perret 1971); ranked second most abundant in Laguna Madre of Texas (Hellier 1962); abundant in Rollover Pass near Gilchrist, Texas (Reid 1956); and fifth most abundant in Aransas Bay, Texas (Moore 1978). They were considered a major fish species in the Colorado River (Texas) Estuary (Diener 1973). Pinfish larvae were reported to be scarce and restricted to inlets in Tamiahua Lagoon below Tampico, Mexico (Flores-Coto et al. 1983). Standing stock estimated by Naughton and Saloman (1978) placed the pinfish as the second most abundant species in central St. Andrew Bay, Florida, where it contributed 22% of the 37.5 kg of fish per hectare. The estimated biomass of pinfish in Laguna Madre, Texas, varied from a monthly high of 30 lb per acre in June to a low of 4 lb per acre in November to January (Hellier 1962). Production estimates varied from a 9 lb (4.1 kg) per acre high in June to a low of 0 in November. No more than 2% of the age 0 pinfish survived from hatching to reach age 1 in the following February (Hellier 1962).

ENVIRONMENTAL FACTORS

Pollutants

In bioassays, pinfish were highly sensitive to the pesticide Antimycin A at 7 ppb (Finucane 1969), as well as PCB's (Hansen et al. 1971) and mirex (Tagatz 1976). Petrochemical wastes from a Corpus Christi turning basin depressed respiratory rates of the pinfish and caused up to 10% mortality (Wohlschlag and Cameron 1967).

Diseases and Parasites

Streptococcus sp. is the major disease of pinfish along the Alabama and Florida coast (Plumb et al. 1974). Major parasites are the isopod *Lironeca ovalis* (Richardson 1905) and the haematozoan *Haemogreyarina bigemina* (Becker 1970).

Water Temperature

Pinfish in estuaries tolerate water temperatures of 10°C to 35°C (Table 1). The upper temperature tolerance of pinfish is about 33°C (Cameron 1969). In fall, pinfish migrate from estuaries to offshore spawning sites. Water temperature has been suggested as the major factor triggering emigration (Johnson 1978). Oxygen consumption of juvenile and adult pinfish in laboratory respirometers increases with an increase of water temperature from 5° to 30°C, especially above 20°C (Hoss 1974). Metabolism increases with water temperatures up to 33°C (Cameron 1969; Wohlschlag and Cech 1970; Hoss 1974). The swimming speed of juvenile pinfish (40 mm) increased up to 11 times their body length per second in relation to increased temperature (Hettler 1977). Food evacuation rates in pinfish decreased as water temperature declined from 30°C to 12°C (Peters et al. 1973); all feeding ceased at 6°C. Pinfish are relatively active at 7.6°C (Hellier 1962). Large numbers of pinfish (70 to 150 mm SL) were killed on the east coast of Florida when surface water temperatures dropped to 4°C (Snelson and Bradley 1979). Larger numbers of pinfish died during a severe cold spell in Copano Bay, Texas (Gunter 1941). Larval pinfish mortality is high at temperatures below 4°C in North Carolina (Lewis and Mann 1971). Pinfish stopped feeding when water temperatures reached 36°C and survived only one day at 37°C (Peters et al. 1973). Juvenile pinfish leave northwest Florida marshes before surface water temperatures reached 41°C in June (Zilberberg 1966). Pinfish larvae withstood 12°C temperature shocks at acclimation temperatures of 5°, 10°, 15°C, but 18°C was fatal (Hoss et al. 1974).

Higher water temperatures increase erythrocyte abundance and hematocrit in pinfish (Houston 1973). High temperatures increased hemoglobin concentration and red blood cell counts but decreased hematocrit and mean erythrocyte volume (Cameron 1970).

Salinity

Pinfish live in waters with salinities as low as 1 ppt and as high as 75 ppt (Hellier 1962) and, in Florida, some enter freshwater (Burgess 1980). In the northern Gulf of Mexico, pinfish tolerate salinities of 0 to 37.5 ppt (Table 1). No relation was found between salinity or temperatures and the arrival of juvenile pinfish in estuaries (Hansen 1970); but a positive relation between

Table 1. Numbers of pinfish captured by experimental gear in waters of different salinities and temperatures.

Salinities (ppt)	Water temperatures (°C)	No. fish	Method of capture[a]	State	Reference
10 - 15	18 - 23	1,501	S	FL	Zilberberg 1966
0.01 - 37.5	---	497	S-T	FL	Gunter and Hall 1965
2.0 - 20+	---	672	T-S-L	AL	Swingle 1971
5.0 - 35.5	10 - 35	601	T-S	MS	Christmas and Waller 1973
2.9 - 26.5	14 - 29	32	T	LA	Dunham 1972
0 - 30.0	10 - 35	193	T-S	LA	Perret 1971
2.1 - 11.9	26 - 33	22	T	LA	Perret and Caillouet 1974
0 - 4.9	15 - 35	16	S	LA	Tarver and Savoic 1976
1.4 - 25.5	15 - 30	9	T	LA	Barrett et al. 1978
3.2	14	2	T-S	LA	Juneau 1975
2.1 - 37.2	9 - 35	907	T-S-N	TX	Gunter 1945
8 - 37	7 - 31	---	T-S	TX	Cameron 1969
2.2. - 14.8	---	---	---	FL-GA	Swift et al. 1977
0 - 36.9	7 - 32	795	S	NC	Tagatz and Dudley 1961
14 - 35	2 - 31	---	T-P-L	NC	Hoss 1974

[a] Trawl (T), Seine (S), Larval net (L), Trammel net (N), and Traps (P).

recruitment of pinfish and salinity in north Florida salt marshes was reported by Subrahmanyam and Drake (1975). Roessler (1970) reported a negative relation between rainfall and catch of pinfish.

Juvenile pinfish are less able to withstand thermal shock if salinity also changes, i.e., they suffered from a temperature-salinity synergistic interaction effect. For example, at a salinity of 15 ppt, no mortality was reported for juveniles after being exposed 40 min to water temperature increased to 32°C, but a mortality of about 20% was observed when the water temperature was 12°C and the salinity increased from 20 to 30 ppt (Hoss et al. 1974).

Dissolved Oxygen

Respiration studies on pinfish weighing 0.013 to 240 g revealed lower rates of oxygen consumption in smaller fish and indicated that the relation between body size and respiration rate depended on the life history stage of the fish (Hoss and Peters 1976). The metabolism-weight regression (K) for fish of different weight was 0.99 for fish weighing less than 0.2 g, 0.15 for fish weighing 0 to 10 g, and 0.73 for fish above 10 g. Oxygen consumption rates were related also to temperatures and swimming velocities. Oxygen-carrying capacity of pinfish blood increases in response to lowered environmental oxygen, increased exercise, and increased salinity but does not compensate entirely for the increased respiratory demand caused by these changes (Cameron 1970).

Light

Diel distribution of pinfish in experimental cages in a thermal effluent channel was directly related to low ambient light conditions governed by the time of day and turbidity (Romanowsky and Strawn 1979). No nocturnal-diurnal differences in catches of larval pinfish in experimental gear were reported by Shenker and Dean (1979) but Thayer et al. (1983) caught 70% of the pinfish larvae at night. Juvenile pinfish approached sandy bottom substrate only at night (Stoner 1979), whereas large pinfish rested at night in cover and on the bottom at offshore platforms (Hastings et al. 1976). Pinfish fed during daylight (Wohlschlag and Cameron 1967; Peters and Kjelson 1975); juvenile pinfish fed most heavily at mid-day (Kjelson and Johnson 1976). Pinfish have been trained to react faster to visual stimuli than to auditory stimuli (Marcucella and Abramson 1978). Wohlschlag and Cameron (1967) reported that pinfish exhibited more excitability and nonlocomotor activity than most marine fishes used in laboratory studies.

Substrate

Pinfish prefer vegetated bottoms in Gulf of Mexico estuaries and along the southeast Atlantic coast (Reid 1954; Gunter and Hall 1965; Zilberberg 1966; Clark 1970; Hansen 1970; Coen et al. 1981). Most fin-clipped pinfish in mark-recapture studies inhabited grass flats until they migrated out of the estuary in late summer and fall (Hansen 1970). Pinfish are usually active foragers and make no attempt to conceal themselves, but can burrow into sand when startled (Coen et al. 1981).

The abundance and type of submerged vegetation in estuaries depends on bottom type, turbidity, salinity, water temperature, bottom slope, and tidal range (Etzold et al. 1983). Nearly 50% of the estuarine bottoms along the southern Florida gulf coast are covered by submerged vegetation which may account for the high abundance of pinfish fish there. The abundance of submerged vegetation decreases northward and covers only 5% of the bottom in coastal waters of the Florida panhandle and the northern gulf coast (Etzold et al. 1983). Of about 800,000 acres (32,300 ha) of submerged estuarine vegetation along northern

Gulf of Mexico coastline, 63% is in Florida and 31% in lower Texas (Lindall and Saloman 1977).

Pressure

Pinfish exhibit a yawn reaction within 0.5 to 2.0 minutes in response to a 0.5 cm^3 volume pressure increase (McCutcheon 1966); consequently, they can be expected to react to tidal changes to maintain buoyance drift. Pinfish adapted to gradient chambers established a base reference point to which they reacted within 0.1 s to pressure changes of less than 0.5 cm water pressure. In thermal effluents pinfish detected and avoided supersaturated (total gases) surface waters by seeking deeper waters (Romanowsky and Strawn 1979).

Sound

When held out of the water, pinfish make a scraping sound by sliding the upper and lower incisor teeth (Burkenroad 1931), but no evidence of underwater sounds attributable to pinfish were detected by Breder (1968) in Lemon Bay, Florida. Pinfish could be trained to meet avoidance criterion when trained with auditory stimuli (Marcucella and Abramson 1978). The critical masking ratio for auditory analysis falls within the band width measured for mammals, including man (Fay 1978).

LITERATURE CITED

Adams, S.M. 1976. Feeding ecology of eelgrass fish communities. Trans. Am. Fish. Soc. 105(4):514-519.

Ashton, C.E. 1980. The response of pinfish (Lagodon rhomboides) to cryptic and non-cryptic flounder (Paralichthys albigutta). M.S. Thesis, University of West Florida, Pensacola. 54 pp.

Barrett, B.B., J.L. Merrell, T.P. Morrison, M.C. Gillespie, E.J. Ralph, and J.F. Burdon. 1978. A study of Louisiana's major estuaries and adjacent offshore waters. La. Dep. Wildl. Fish. Tech. Bull. 27. 197 pp.

Becker, C.M. 1970. Haematozoa of fishes, with emphasis on North American records. Pages 82-100 in S.F. Snieszko, ed. A symposium on diseases of fishes and shellfishes. Am. Fish. Soc. Spec. Publ. 5. 526 pp.

Benson, N.G., ed. 1982. Pinfish. Pages 58-60 in Life history requirements of selected finfish and shellfish in Mississippi Sound and adjacent areas. U.S. Fish Wildl. Serv. Biol. Serv. Program FWS/OBS-81/51. 97 pp.

Breder, C.M., Jr. 1968. Seasonal and diurnal occurrences of fish sounds in a small Florida bay. Bull. Am. Mus. Nat. Hist. 138(6):325-378.

Breuer, J.P. 1962. An ecological survey of the lower Laguna Madre of Texas, 1953-1959. Publ. Inst. Mar. Sci. Univ. Tex. 8:153-183.

Burgess, G.H. 1980. Pinfish. Page 755 in D.S. Lee, ed. Atlas of North American freshwater fishes. Publ. No. 1980-12 N.C. Biol. Surv. 854 pp.

Burkenroad, M.D. 1931. Notes on the sound-producing marine fishes of Louisiana. Copeia 1931 (1):20-28.

Caldwell, D.K. 1957. The biology and systematics of the pinfish, Lagodon rhomboides (Linnaeus). Bull. Fla. State Mus. Biol. Sci. 2(6):77-173.

Cameron, J.N. 1969. Growth, respiratory metabolism and seasonal distribution of juvenile pinfish (Lagodon rhomboides Linnaeus) in Redfish Bay, Texas. Contrib. Mar. Sci. 14:19-36.

Cameron, J.N. 1970. The influence of environmental variables on the hematology of pinfish (Lagodon rhomboides) and striped mullet (Mugil cephalus). Comp. Biochem. Physiol. 32:175-192.

Carr, W.E.S., and C.A. Adams. 1973. Food habits of juvenile marine fishes occupying seagrass beds in estuarine zones near Crystal River, Florida. Trans. Am. Fish. Soc. 102(3):511-540.

Christmas, J.Y., G. Gunter, and E.C. Whatley. 1960. Fishes taken in the menhaden fishery of Alabama, Mississippi, and eastern Louisiana. U.S. Fish Wildl. Serv. Spec. Sci. Rep. Fish. 339:10 pp.

Christmas, J.Y., and R.S. Waller. 1973. Estuarine vertebrates, Mississippi. Pages 320-434 in J.Y. Christmas, ed. Cooperative Gulf of Mexico estuarine inventory and study, Mississippi. Gulf Coast Research Laboratory, Ocean Springs, Miss.

Chute, W.H. 1964. Guide to the John G. Shedd Aquarium. Shedd Aquarium, Chicago, Ill. 236 pp.

Clark, S.H. 1970. Factors affecting the distribution of fishes in Whitewater Bay, Everglades National Park, Florida. Ph.D. Dissertation, University of Miami, Fla. 125 pp.

Clark, S.H. 1974. A study of variation in trawl data collected in Everglades National Park, Florida. Trans. Am. Fish. Soc. 103(4):777-785.

Coen, L.D., K.L. Heck, Jr., and L.G. Abele. 1981. Experiments on competition and predation among shrimps of seagrass meadows. Ecology 62(6):1484-1493.

Darnell, R.M. 1961. Trophic spectrum of an estuarine community based on studies of Lake Pontchartrain, Louisiana. Ecology 42(3):553-568.

Diener, R.A. 1973. Observations on the hydrology and marine organisms of the tidal Colorado River and adjacent waters, Texas, February-June 1962. Contrib. Mar. Sci. 17:99-110.

Dunham, F. 1972. A study of commercially important estuarine-dependent industrial fishes. La. Wildl. Fish. Comm. Tech. Bull. 4. 63 pp.

Etzold, D.J., J.Y Christmas, and V. Blomo. 1983. Analysis of environmental and demand factors on shrimp production in the Gulf and South Atlantic United States. Pages 1-205 (Chapter I) in W.D. Chauvin, ed. Assessment of shrimp industry potentials and conflicts. Vol. I. Shrimp Notes Inc., New Orleans, La.

Fay, R.R. 1978. Sound detection and sensory coding by the auditory systems of fishes. Pages 197-236 in D.I. Mastofsky, ed. The behavior of fish and other aquatic animals. Academic Press, New York. 393 pp.

Finucane, J.H. 1969. Antimycin as a toxicant in a marine habitat. Trans. Am. Fish. Soc. 98(2):288-292.

Flores-Coto, C., F. Barba-Torres, and J. Sanches-Robles. 1983. Seasonal diversity, abundance, and distribution of ichthyoplankton in Tamiahua Lagoon, western Gulf of Mexico. Trans. Am. Fish. Soc. 112(2B):247-256.

Goodyear, C.P. 1967. Feeding habits of three species of gars, *Lepisosteus*, along the Mississippi Gulf coast. Trans. Am. Fish. Soc. 96(3):297-300.

Gunter, G. 1941. Relative numbers of shallow water fishes of the northern Gulf of Mexico, with some records of rare fishes from the Texas coast. Am. Midl. Nat. 26(1):144-200.

Gunter, G. 1945. Studies on marine fishes of Texas. Publ. Inst. Mar. Sci. Univ. Tex. 1(1):1-190.

Gunter, G., and G.E. Hall. 1965. A biological investigation of the Caloosahatchee estuary of Florida. Gulf Res. Rep. 2(1):1-71.

Hansen, D.J. 1970. Food, growth, migration, reproduction, and abundance of pinfish, *Lagodon rhomboides*, and Atlantic croaker, *Micropogon undulatus*, near

Pensacola, Florida 1953-1965. U.S. Fish Wildl. Serv. Fish. Bull. 68(1):35-146.

Hansen, D.J., J.I. Lowe, A.J. Wilson, Jr., and P.D. Wilson. 1971. Chronic toxicity, uptake and retention of Aroclor® 1254 in two estuarine fishes. Bull. Environ. Contam. Toxicol. 6(2):113-119.

Hastings, R.W., L.H. Ogren, and M.T. Mabry. 1976. Observations on the fish fauna associated with offshore platforms in the northeastern Gulf of Mexico. U.S. Natl. Mar. Fish. Serv. Fish. Bull. 74(2):389-401.

Hellier, T.R., Jr. 1962. Fish production and biomass studies in relation to photosynthesis in the Laguna Madre of Texas. Publ. Inst. Mar. Sci. Univ. Tex. 8:1-22.

Hettler, W.F. 1977. Swimming speeds of juvenile estuarine fish in a circular flume. Proc. Annu. Conf. Southeastern Assoc. Fish. Wildl. Agencies 31:392-398.

Hildebrand, S.F., and L.E. Cable. 1938. Further notes on the development and life history of some teleosts at Beaufort, N.C. U.S. Dep. Commer. Bull. Bur. Fish. 48:503.

Hoese, H.D., and R.H. Moore. 1977. Fishes of the Gulf of Mexico: Texas, Louisiana, and adjacent waters. Texas A&M University Press, College Station. 327 pp.

Hoss, D.E. 1974. Energy requirements of a population of pinfish Lagodon rhomboides (Linnaeus). Ecology 55:848-855.

Hoss, D.E., W.F. Hettler, Jr., and L.C. Coston. 1974. Effects of thermal shock on larval estuarine fish - ecological implications with respect to entrainment in power plant cooling systems. Pages 362-371 in J.H.S. Blaxter, ed. The early life history of fish. Springer-Verlag, New York. 765 pp.

Hoss, D.E., and D.S. Peters. 1976. Respiratory adaptation: fishes. Pages 336-346 in Estuarine processes, Vol I. Uses, stresses and adaptations to the estuary. Academic Press, New York.

Houston, A.H. 1973. Environmental temperature and the body fluid system of the teleost. Pages 87-160 in N. Chavin, ed. Responses of fish to environmental changes. Charles C. Thomas Publ., Springfield, Ill. 459 pp.

Jackson, G.A. 1972. A sport fishing survey of Biloxi Bay and the adjacent Mississippi Sound. M.S. Thesis. Mississippi State University, Mississippi State. 101 pp.

Johnson, G.D. 1978. Development of fishes in the mid-Atlantic Bight, an atlas of egg, larval, and juvenile stages. U.S. Fish Wildl. Serv. Biol. Serv. Program. FWS/OBS-72/12. Vol. 4. 311 pp.

Juneau, C.L. 1975. An inventory and study of the Vermilion Bay - Atchafalaya Bay complex. La. Wildl. Fish. Comm. Tech. Bull. 13. 153 pp.

Kilby, J.D. 1955. The fishes of two Gulf Coast marsh areas of Florida. Tulane Stud. Zool. 2(8):175-247.

Kjelson, M.A., and G.N. Johnson. 1976. Further observations of the feeding ecology of postlarval pinfish, Lagodon rhomboides and spot, Leiostomus xanthurus. U.S. Natl. Mar. Fish. Serv. Fish. Bull. 74(2):423-432.

Lewis, R.M., and W.C. Mann. 1971. Occurrence and abundance of larval Atlantic menhaden, Brevoortia tryannus, at two North Carolina inlets with notes on associated species. Trans. Am. Fish Soc. 100(2):296-301.

Lindall, W.N., and C.H. Saloman. 1977. Alteration and destruction of estuaries affecting fishery resources of the Gulf of Mexico. Mar. Fish. Rev. 39:1-7.

Marcucella, H., and C.I. Abramson. 1978. Behavior toxicology and teleost fish. Pages 33-77 (Chapter 2) in D.I. Mostafsky, ed. The behavior of fish and other aquatic animals. Academic Press, New York. 393 pp.

McClane, A.J., ed. 1964. Pinfish, Lagodon rhomboides. Page 681 in McClane's standard fishing encyclopedia. Holt, Rinehart and Winston, New York. 1057 pp.

McCutcheon, F.H. 1966. Pressure sensitivity, reflexes, and buoyancy responses in teleosts. Anim. Behav. 14:204-217.

McEachron, L.W., and G.C. Matlock. 1983. An estimate of harvest by the Texas charter boat fishery. Mar. Fish. Res. 45(1):11-17.

Migdalski, E.C., and G.S. Fichter. 1976. The fresh and saltwater fishes of the world. Alfred A. Knopf, Inc., New York. 316 pp.

Modde, T., and S.T. Ross. 1981. Seasonality of fishes occupying a surf zone habitat in the northern Gulf of Mexico. U.S. Natl. Mar. Fish. Serv. Fish. Bull. 78(4):911-922.

Moe, M.A., Jr., and G.T. Martin. 1965. Fishes taken in trawl samples offshore of Pinellas County, Florida, with new additions to the fish fauna of the Tampa Bay area. Tulane Stud. Zool. 12(4):129-151.

Moore, R.H. 1978. Variations in the diversity of summer estuarine fish populations in Aransas Bay, Texas, 1966-1973. Estuarine Coastal Mar. Sci. 6:495-501.

Naughton, S.P., and C.H. Saloman. 1978. Fishes of the nearshore zone of St. Andrew Bay, Florida, and adjacent coast. Northeast Gulf Sci. 2(1):43-55.

Odum, W.E., C.C. McIvor, and T.J. Smith III. 1982. The ecology of the mangroves of south Florida: a community profile. U.S. Fish Wildl. Serv. Biol. Serv. Program FWS/OBS-81/24. 144 pp.

Orth, R.J., and K.L. Heck, Jr. 1980. Structural components of eelgrass (Zostera marina) meadows in the lower Chesapeake Bay - Fishes. Estuaries 3(4):278-288.

Parrish, P.R., G.H. Cook, and J.M. Patrick, Jr. 1975. Hexachlorobenzene: effects on several estuarine animals. Proc. Annu. Conf. Southeast. Assoc. Game Fish Comm. 28:179-187.

Perret, W.S. 1971. Cooperative Gulf of Mexico estuarine inventory and study, Louisiana. Pages 31-69 in Phase IV, Biology. La. Wildl. Fish. Comm. 171 pp.

Perret, W.S., and C.W. Caillouet, Jr. 1974. Abundance and size of fishes taken by trawling in Vermilion Bay, Louisiana. Bull. Mar. Sci. Gulf Caribb. 24(10):52-74.

Peters, D.S., and D.E. Hoss. 1974. A radioisotopic method of measuring food evacuation time in fish. Trans. Am. Fish. Soc. 103(3):626-629.

Peters, D.S., and M.A. Kjelson. 1975. Consumption and utilization of food by various postlarval and juvenile fishes of North Carolina estuaries. Estuarine research, Vol. 1:447-472. Academic Press, New York.

Peters, D.S., M.A. Kjelson, and M.T. Boyd. 1973. The effect of temperature on food evacuation rate in the pinfish (*Lagodon rhomboides*), spot (*Leiostomus xanthurus*) and silverside (*Menidia menidia*). Proc. Annu. Conf. Southeast. Assoc. Game Fish Comm. 26:637-643.

Plumb, J.A., J.H. Schachte, and J.L. Gaines. 1974. *Streptococcus* sp. from marine fishes along the Alabama and northwest Florida coast of the Gulf of Mexico. Trans. Am. Fish. Soc. 103(2):358-361.

Pristas, P.J., and L. Trent. 1978. Seasonal abundance, size, and sex ratio of fishes caught in gill nets in St. Andrew Bay, Florida. Bull. Mar. Sci. 28(3):581-589.

Randall, J.E., B. Bishop, and R. Vergara. 1978. SPARID Lago 1, 2 p. in Fischer, ed. FAO species identification sheets for fishery purposes. Western central Atlantic (fishing area 31). Vol. 5. Food and Agricultural Organization of the United Nations, Rome, Italy.

Reid, G.K., Jr. 1954. An ecological study of the Gulf of Mexico fishes, in the vicinity of Cedar Key, Florida. Bull. Mar. Sci. Gulf Carrib. 4(1):43-91.

Reid, G.K. 1956. Ecological investigations in a disturbed Texas coastal estuary. Tex. J. Sci. 8:296-327.

Richardson, H. 1905. A monograph on the isopods of North America. U.S. Natl. Mus. Bull. 54. 727 pp.

Roessler, M.A. 1970. Checklist of fishes in Buttonwood Canal, Everglades National Park, Florida, and observations on the seasonal occurrence and life histories of selected species. Bull. Mar. Sci. 20(4):860-893.

Roithmayr, C.M. 1965. Industrial bottomfish fishery on the northern Gulf of Mexico, 1959-63. U.S. Fish Wildl. Serv. Spec. Sci. Rep. Fish. 518:22 pp.

Romanowsky, P., and K. Strawn. 1979. Vertical distribution of caged estuarine fish in thermal effluent subject to gas supersaturation. Proc. Annu. Conf. Southeast. Assoc. Fish Game Agencies. 33:465-483.

Rounsefell, G.A. 1964. Preconstruction study of the fisheries of the estuarine area traversed by the Mississippi River - Gulf Outlet. U.S. Fish Wildl. Serv. Fish. Bull. 63(2):373-393.

Schimmel, S.C. 1977. Notes on the embryonic period of the pinfish *Lagodon rhomboides* (Linnaeus). Fla. Sci. 40(1):3-6.

Schmidt, T.W. 1979. Seasonal biomass estimates of marine and estuarine fishes within the western Florida Bay portion of Everglades National Park, May 1973 to July 1974. U.S. Dept. Int. Natl. Parks Serv. Trans. Proc. Ser. 5:665-672.

Schwartz, F.J., and J. Tyler. 1970. Marine fishes common to North Carolina. N.C. Dep. Conserv. and Devel. Div. Comm. Sports Fish. 32 pp.

Shenker, J.M., and J.M. Dean. 1979. The utilization of an intertidal salt marsh creek by larval and juvenile fishes: abundance, diversity and temporal variation. Estuaries 2(3):154-163.

Snelson, F.F., and W.K. Bradley, Jr. 1979. Mortality of fishes due to cold on the east coast of Florida, January 1979. Fla. Sci. 41(1):1-12.

Springer, S. 1957. Some observations on the behavior of schools of fishes in the Gulf of Mexico and adjacent waters. Ecology 38:166-171.

Stoner, A.W. 1979. Species-specific predation on amphipod crustacea by the pinfish Lagodon rhomboides: mediation by macrophyte standing crop. Mar. Biol. 55:201-207.

Stoner, A.W. 1980. The feeding ecology of Lagodon rhomboides (Pisces:Sparidae): variation and functional responses. U.S. Natl. Mar. Fish. Serv. Fish. Bull. 78:337-352.

Stoner, A.W. 1982. The influence of benthic macrophytes on the foraging behavior of pinfish, Lagodon rhomboides (Linnaeus). J. Exp. Mar. Biol. Ecol. 58:271-284.

Subrahmanyam, C.B., and S.H. Drake. 1975. Studies on the animal communities in two north Florida salt marshes. Bull. Mar. Sci. 25(4):445-465.

Swift, C., R.W. Yerger, and P.R. Parrish. 1977. Distribution and natural history of the fresh and brackish water fishes of the Ochlockonee River, Florida and Georgia. Tall Timbers Res. Stn. Bull. 20. 111 pp.

Swingle, H.A. 1971. Biology of Alabama's estuarine area - Cooperative Gulf of Mexico estuarine inventory. Ala. Mar. Resour. Bull. 5:1-123.

Tabb, D.C., and R.B. Manning. 1961. A checklist of the flora and fauna of northern Florida Bay and adjacent brackish waters of the Florida mainland collected during the period July 1957 through September 1960. Bull. Mar. Sci. Gulf Caribb. 1(4):552-649.

Tagatz, M.E. 1976. Effect of mirex on predator-prey interaction in an experimental estuarine ecosystem. Trans. Am. Fish. Soc. 105(4): 546-549.

Tagatz, M.E., and D.L. Dudley. 1961. Seasonal occurrence of marine fishes in four shore habitats near Beaufort, North Carolina, 1957-1960. U.S. Fish Wildl. Serv. Spec. Sci. Rep. Fish. 390. 19 pp.

Tarver, J.W., and L.B. Savoic. 1976. An inventory and study of the Lake Pontchartrain - Lake Maurepas estuarine complex. La. Wildl. Fish. Comm. Tech. Bull. 19:7-99.

Thayer, G.W., D.R. Colby, M.A. Kjelson, and M.P. Weinstein. 1983. Estimates of larval-fish abundance: diurnal variation and influences of sampling gear and towing speed. Trans. Am. Fish. Soc. 112(2B):272-279.

Trent, L., and P.J. Pristas. 1977. Selectivity of gill nets on estuarine and coastal fishes from St. Andrew Bay, Florida. U.S. Natl. Mar. Fish. Serv. Fish. Bull. 75(1):185-196.

Wang, J.C.S., and R.J. Kernehan. 1979. Sparidae-porgies. Pages 227-229 (Chapter 33) in Fishes of the Delaware estuaries a guide to the early life histories. EA Communications, Towson, Md. 410 pp.

Weinstein, M.P., C.M. Courtney, and J.C. Kinch. 1977. The Marco Island estuary: a summary of physicochemical and biological parameters. Fla. Sci. 40(2): 97-124.

Wohlschlag, D.E., and J.N. Cameron. 1967. Assessment of a low level stress on the respiratory metabolism of the pinfish (Lagodon rhomboides). Contrib. Mar. Sci. 12:160-171.

Wohlschlag, D.E., and J.J. Cech, Jr. 1970. Size of pinfish in relation to thermal stress response. Contrib. Mar. Sci. 15:20-29.

Zilberberg, M.H. 1966. Seasonal occurrence of fishes in a coastal marsh of northwest Florida. Publ. Inst. Mar. Sci. Univ. Tex. 11:126-134.

Zim, H.S., and H.H. Schoemaker. 1955. Fishes. A guide to familiar American species. Golden nature guides. Golden Press, New York. 60 pp.

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16. Abstract (Limit: 200 words)

Species profiles are literature summaries of the taxonomy, morphology, life history, and environmental requirements of coastal aquatic species. They are prepared to assist in environmental impact assessment. The pinfish (Lagodon rhomboides) is an abundant and important marine fish which can alter estuarine epifaunal seagrass communities as well as serve as forage for commercial and sport fishes. Pinfish have been extensively used in pesticide bioassays, physiological experiments, and ecological studies. Adults and most large juveniles move offshore in late fall. They spawn offshore during fall and winter. Semibuoyant eggs hatch after 48 hours at 18°C. Larval pinfish (11 mm TL) move into estuarine nursery grounds soon after hatching, where they feed on calanoid copepods. Juvenile pinfish are most abundant in seagrass-covered habitats where they feed on amphipods. Pinfish change their diet as body size and tooth structure changes. Growth increments were 65 to 110 mm, 55 mm, and 45 mm long at the end of their first through third years of life, respectively. Pinfish are used for food and bait by anglers and are combined with unclassified species or industrial fish in commercial fisheries statistics. Pinfish inhabit inshore waters when temperatures are above 10°C and below 35°C. They are abundant in a broad range of salinities.

17. Document Analysis a. Descriptors
Estuaries
Fishes
Growth
Feeding

b. Identifiers/Open-Ended Terms
Pinfish
Lagodon rhomboides
Salinity requirements
Temperature requirements
Life history
Spawning

c. COSATI Field/Group

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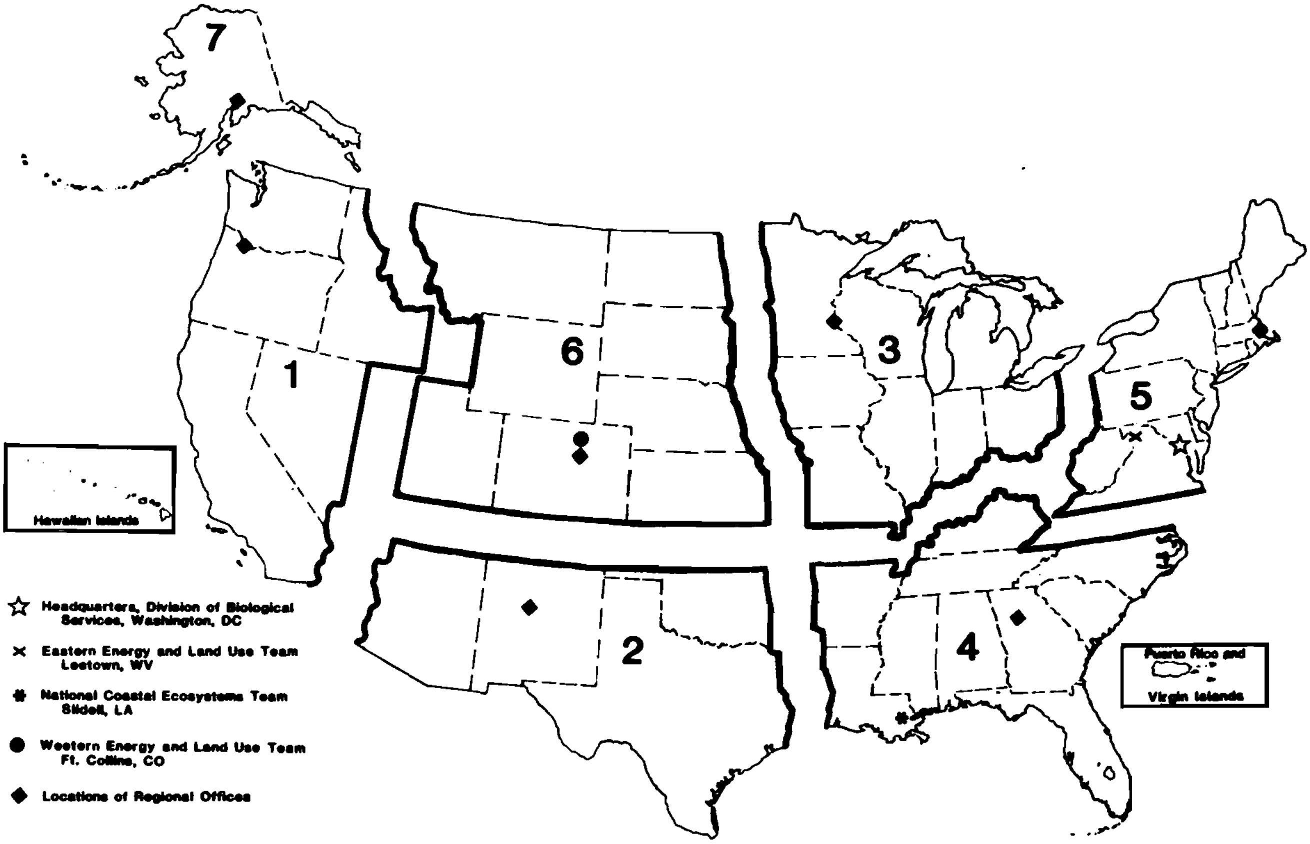

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