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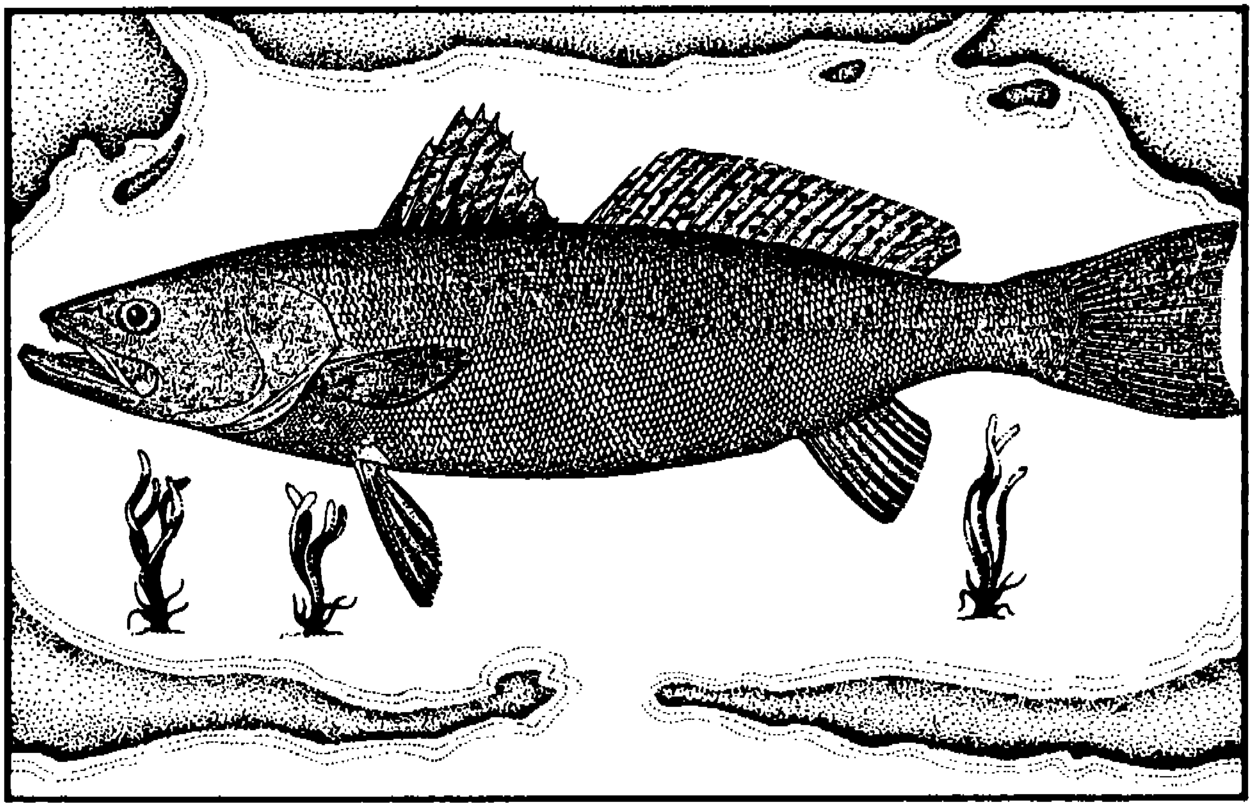
Species Profiles: Life Histories and Environmental Requirements (Gulf of Mexico)

SPOTTED SEATROUT



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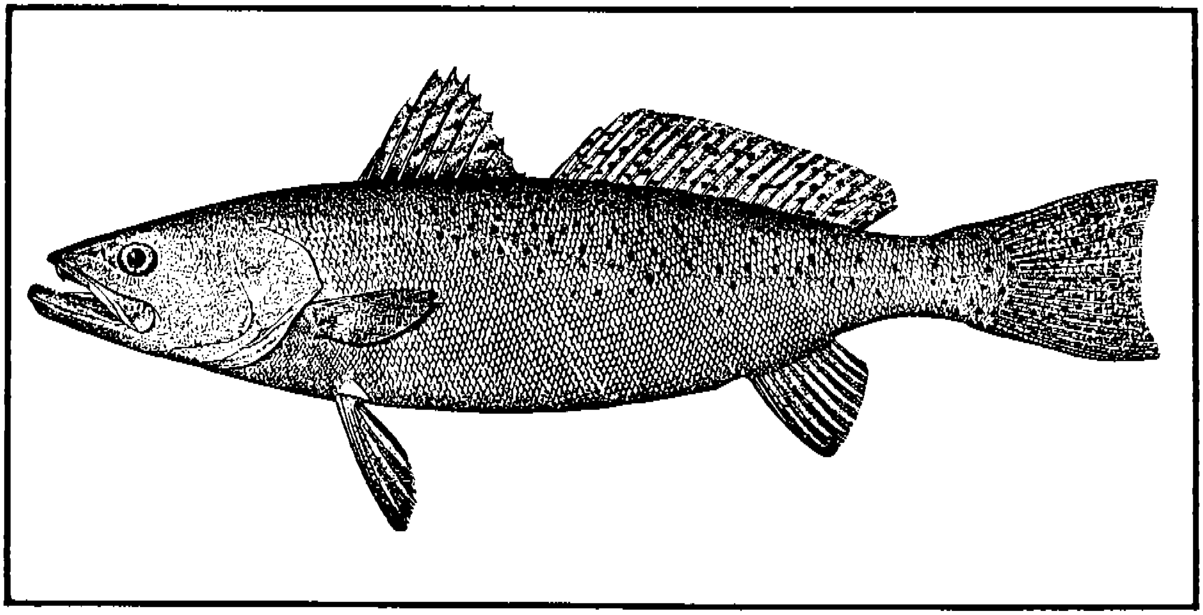

Figure 1. Spotted seatrout.

SPOTTED SEATROUT

NOMENCLATURE/TAXONOMY/RANGE

Scientific name. . .Cynoscion nebulosus (Cuvier)
Preferred common name . . . . . Spotted seatrout (Figure 1)
Other common names . . . . . . .Spotted weakfish, spotted squeteague, spotted trout, speckles, speckled trout, salmon trout, simon trout (Hildebrand and Schroeder 1972)
Class . . . . .Osteichthyes
Order . . . . Perciformes
Family. . . . . Sciaenidae

Geographic range: Coastal waters from Cape Cod, Massachusetts, to the Bay of Campeche, Mexico. Common along the entire Gulf of Mexico coast, but most abundant off eastern Louisiana, south Texas, Mississippi, and Alabama (Figure 2).

MORPHOLOGY/IDENTIFICATION AIDS[1]

D. X(rarely XI) + I, 24-26; A. II, 10-11; Sc. 90-102; Gr. 4 + 7-9; head 2.95-3.25; depth 3.4-4.35. Body elongate, somewhat compressed; back little elevated; head long and low; snout pointed, 3.75 to 4.2 in head; eye 4.45 to 5.35; interorbital 4.5 to 5.9; mouth

[1]Largely extracted from Pearson (1929), Hildebrand and Schroeder (1972), and Hoese and Moore (1977). See these references for explanations of abbreviations and measurements.

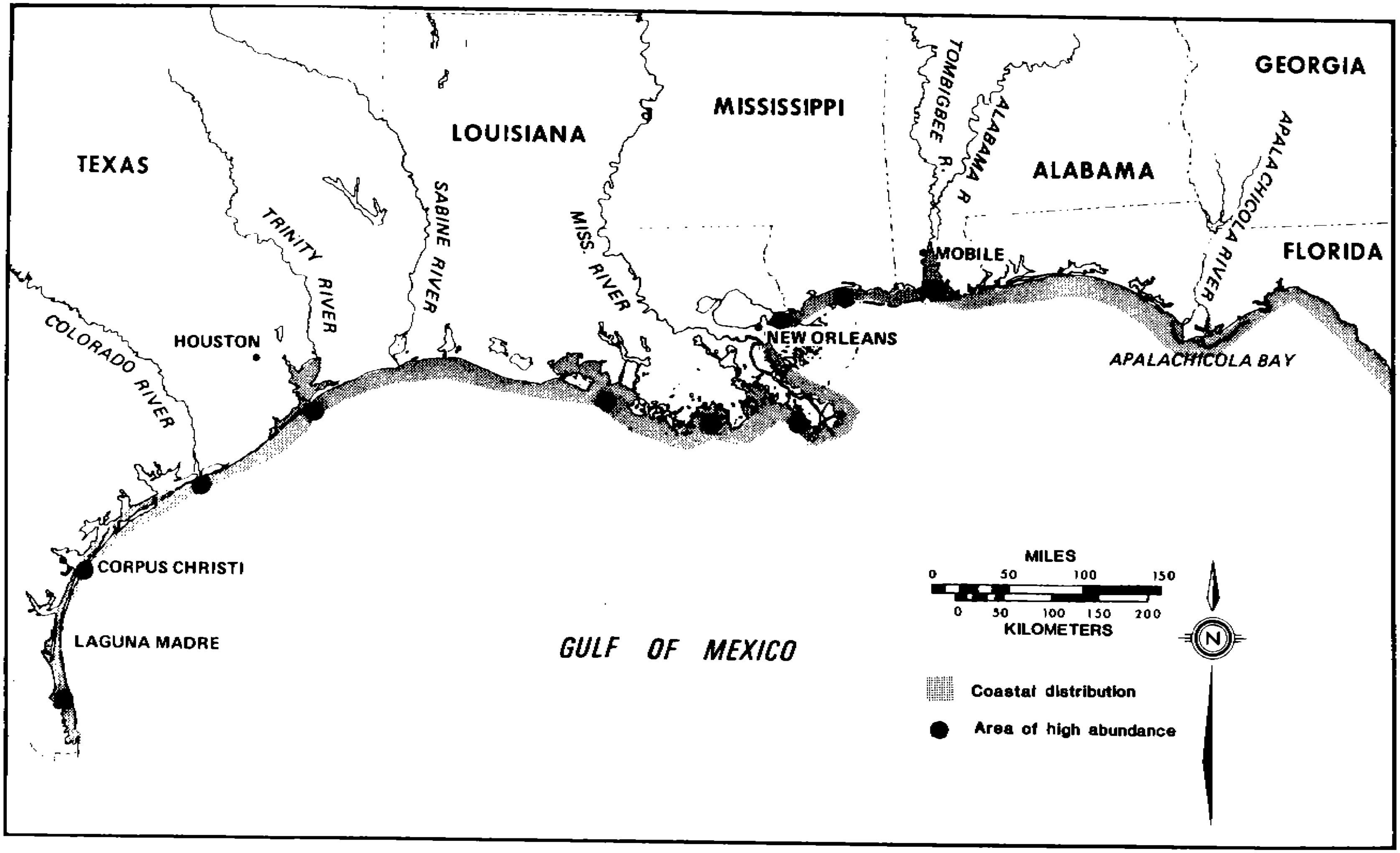

Figure 2. Distribution of spotted seatrout along the Gulf of Mexico coast.

to 5.35; interorbital 4.5 to 5.9; mouth large, oblique; lower jaw projecting; maxillary reaching nearly or quite opposite posterior margin of eye, 2.2 to 2.3 in head; teeth in jaws pointed, in two series anteriorly, becoming single posteriorly, at least in lower jaw, two enlarged, recurved teeth usually present in anterior part of upper jaw; gill rakers rather short and thick (longest about as long as width of pupil); scales small, thin, ctenoid, extending forward on head, cheeks, and opercles, not present on fins, 11 or 12 between origin of anal and lateral line; dorsal fins contiguous or separate, spines of the first weak, flexible, the longest spines scarcely longer than the longest soft rays; caudal fin lanceolate in very young, becoming truncate to somewhat concave in adults; anal fin small, the spines very weak, base of fin ending about an eye's diameter in advance of end of base of dorsal; ventral fins rather small, inserted a little behind base of pectorals, 1.85 to 2.25 in head.

Color in life: dark gray above with bluish to greenish reflections; silvery below; upper part of side with numerous round, black spots, which extend on to dorsal and caudal fins. Young above 80 mm total length (TL)[2] are similarly spotted. Larval and young stages are described by Pearson (1929), Hildebrand and Cable (1934), and Fable et al. (1978).

REASON FOR INCLUSION IN SERIES

Spotted seatrout support valuable commercial and sport fisheries throughout the coastal Gulf of Mexico. Estuaries are considered essential to the species as spotted seatrout depend upon the estuarine environment for feeding, spawning, and nursery grounds. Spotted seatrout have been identified as top carnivores and may play a significant role in the structure and function of estuarine communities.

LIFE HISTORY

Spawning

The only published account of an actual observation of spotted seatrout spawning found in the literature was that of Tabb (1966). He gave a brief account of spawning behavior and commented that spawning takes place at night "in deeper holes and scour-channels in the grass flats." This agrees with the findings of Pearson (1929) who reported capturing "many ripe and spending adults" along grassy shorelines. Pearson also believed that spawning actually occurred somewhat offshore of these areas in waters up to 3 to 4.6 m (10 to 15 ft) deep. Both authors reported that spawning often occurs well within the estuaries. Pearson, in fact, reported spawning as much as 81 to 97 km (50 to 60 mi) from the open gulf waters in the bayous and tidal streams entering Copano Bay, Texas. Spawning may also occur in lower regions of the estuary (Tabb 1966), near the passes between barrier islands (Tabb and Manning 1961; Etzold and Christmas 1979), or even entirely outside the estuaries (Jannke 1971; King 1971). Perret et al. (1980) suggested that the site of spawning "may be more related to salinity and temperature than to other physical parameters" (see Temperature and Salinity sections).

Spotted seatrout have a protracted spawning season throughout the Gulf of Mexico. Jannke (1971) reported spawning in southern Florida in all months with a first peak in May and a lesser peak in fall. Perret et al. (1980) suggested that the inception of spawning in the gulf is variable and may start as early as February, but that it has generally ceased by October. Peak spawning of the spotted seatrout in the Gulf of Mexico is usually cited as late as April to July (Pearson 1929; Tabb 1966) and has been suggested to be

[2] 25.4 mm = 1 inch.

closely linked with water temperature (see Temperature section). Both sexes have been reported to mature and spawn as early as the end of their first year of life (Sundararaj and Suttkus 1962), but most researchers suggest spawning at the end of the second or third year (Pearson 1929; Etzold and Christmas 1979). All are apparently mature and spawn by age IV (Klima and Tabb 1959). Several authors have reported that males mature at a lesser size and age than females (Moody 1950; Tabb 1961; Etzold and Christmas 1979). Sundararaj and Suttkus (1962) found that age III ("three winters") fish had the greatest "spawning power," contributing an estimated 40.6% of all eggs spawned.

Fecundity and Eggs

A fecundity estimate of 1.1 million eggs was reported by Pearson (1929), Tabb (1961), and Sundararaj and Suttkus (1962) for spotted seatrout of 534, 625, and 433 mm standard lengths (SL), respectively. It is uncertain whether the differences among these studies are real or are due to differences in estimation techniques. Pearson's estimate for a fish of 411 mm SL, however, was 427,819 eggs, or less than half that of the similarly sized specimen of Sundararaj and Suttkus mentioned above. Such disparate estimates suggest that the differences are real, but may indicate either wide individual variation or estuary-to-estuary (stock-to-stock) variation. Estimates of fecundity among smaller females include those of Tabb (1961) of 15,000 eggs for a 325-mm SL fish and Sundararai and Suttkus (1962) of 14,000 eggs for a 238-mm SL fish. No regression equation for fish size versus fecundity, or estimate of the variation about such a curve, was found in the literature.

The eggs of spotted seatrout are spherical and hatch as 1.30- to 1.35-mm SL larvae (Fable et al. 1978). Hatching occurs in 40 hours at 25°C or 77°F (Smith 1907, cited by Pearson 1929). Fable et al. (1978) also reported that eggs are pelagic, yet Taniguchi (pers. comm., cited by Perret et al. 1980) stated that eggs are buoyant at a salinity of 30 ppt, but sink at 25 ppt. At preferred spawning salinities (see Salinity section) in the estuary, therefore, eggs may either be buoyant or demersal, as suggested by Tabb (1966).

Larvae

Little is known about the distribution of larvae less than 10 mm long. Jannke (1971) and King (1971) reported finding larvae 5 to 6 mm long being transported on flood tides through passes connecting the Gulf of Mexico and inside waters. Pearson (1929) reported capturing a 7.8-mm larval spotted seatrout near Corpus Christi Bay at the edge of a deep channel. Taniguchi (pers. comm., cited by Perret et al. 1980) observed that upon hatching, larvae swam upward into the water column, but moved toward the bottom after 4 to 7 days.

Postlarvae through Adults

Numerous authors have cited an apparent preference of postlarval and juvenile spotted seatrout for shallow, vegetated estuarine areas (Pearson 1929; Miles 1950; Perret et al. 1980). Tabb (1966) reported schooling at 25 to 50 mm (6 to 8 weeks). Juveniles of 75- to 100-mm lengths have formed schools of 5 to 50 members (Perret et al. 1980) and continue this schooling behavior to age V or VI (Tabb 1966). By age VI, apparently most males have died and the remaining females "adopt a semi-solitary existence" (Tabb 1966). Juveniles remain in the estuarine nursery areas at least through the warmer months. Pearson (1929) suggested that the young seldom move into the gulf until mature, but that "many adults linger around the entrances to the passes at all times of the year." Fall emigration of spotted seatrout to the deeper, warmer waters of the bays or gulf is apparent, but less pronounced than in many other gulf fishes (Moffett 1961; Tabb 1966). Tagged fish have rarely been found to move more than 48 km (30 mi) from the site of tagging (Perret et al. 1980). Seasonal movement patterns are apparently in response to changes in water temperature and are more pronounced in northern waters (Pearson 1929; Tabb 1966). Movement back into the estuaries to feed and, for some, to spawn is usually completed by May (Pearson 1929).

GROWTH CHARACTERISTICS

Pearson (1929) discussed the use of scales in age and growth studies of spotted seatrout. He found that there "appeared to be little increment in size from November to March, but in early spring growth was resumed" and that annuli were thus formed. He preferred back-calculation of growth rate instead of length-frequency distribution because the latter was difficult to interpret due to overlap in lengths between age classes, a common problem among species with a protracted spawning season. This overlap is also mentioned by Perret et al. (1980), who summarized the results of several growth studies (Table 1). Females apparently have a higher growth rate than males (Pearson 1929; Etzold and Christmas 1979), but separate growth equations for a single population were not found in the literature. Data presented in Table 1 are representative of both sexes combined. Although there seems to be an indication from the data presented in Table 1 of estuary-to-estuary variation in growth rate, year-to-year variation cannot be ruled out as the primary source of these differences. Of the four studies reported in 1961, all except the clearly aberrant Indian River, Florida, population show similar results. Weinstein and Yerger (1976) have, however, presented evidence of electrophoretic differences between spotted seatrout stocks from different estuaries and of the divergent nature of the Indian River stock.

Several studies have reported a preponderance of males among younger year classes, a near 1:1 ratio at age II to III, and all or nearly all females by age V to VI or older (Klima and Tabb 1959; Moffett 1961; Tabb 1961). This pattern is similar to species that exhibit protandrous hermaphroditism, but this has not been suggested for the spotted seatrout. Instead, the shift in older fish is most often attributed to greater longevity in females. No mention of sexual differences in susceptibility to capture, distributional segregation among juveniles or of other than a 1:1 sex ratio at birth has been found in the literature. Evidence toward an acceptable explanation for the observed sex ratio in the earlier year classes therefore remains wanting.

Harrington et al. (1979, cited by Perret et al. 1980) reported the following length-weight relationships for spotted seatrout from the coast of Texas:

$$\log W(g) = -5.192 + 3.062 \log TL(mm) \quad \text{(44-902 mm TL range)}$$

$$TL(mm) = 11.804 + 1.138\, SL(mm) \quad \text{(36-744 mm SL range)}$$

$$W(g) = -33.338 + 1.151\, DW(g) \quad \text{(305-4595 g DW range)}$$

where: W = whole wet weight
TL = total length
SL = standard length
DW = dressed wet weight

Table 1. Lengths (mm SL) at age for several populations of spotted seatrout. Standard lengths for central Texas and Punta Gorda were converted from total lengths by the formula given in the text (Perret et al. 1980).

Age	Central Texas[a]	Apalachicola & Apalachee Bays[b]	Cedar Key[c]	Ft. Myers[d]	Punta Gorda[e]	Florida Bay[f]	Indian River[g]
1	119	116	130	130	91	133	165
2	200	190	211	208	192	224	248
3	257	255	268	264	262	275	317
4	299	312	323	320	306	339	384
5	338	369	382	368	341	397	457
6	376	422	434	430	367	434	533
7	418	437	-	431	-	451	561
8	445	-	-	438	-	-	624

[a]Pearson 1929. [b]Klima & Tabb 1959. [c]Moffett 1961. [d]Moffett 1961. [e]Welsh & Breder 1924. [f]Stewart 1961. [g]Tabb 1961.

COMMERCIAL/SPORT FISHERY

A useful review of the harvest, economic and management history of the spotted seatrout fishery in the Gulf of Mexico is provided by Perret et al. (1980). Based on their report, the commercial catch (lb) was converted to metric tons (mt) and is presented in Table 2. Most who fish for spotted seatrout commercially also fish for red drum and a variety of other inshore species. Landings occur throughout the year along the gulf coast (Perret et al. 1980). Commercial catches of spotted seatrout from 1950 through 1977 fluctuated between 1,572 mt in 1954 and 3,374 mt in 1973, but no trends in abundance were discernable. Most of the commercial catch is sold fresh in local markets. The estimated sport catch of spotted seatrout for the gulf as a whole is substantially greater than the commercial catch (see footnote b, Table 2). Fish taken in the sport fishery average about 1.25 lb (0.6 kg) with the highest estimated catch per unit effort recorded from Louisiana during the summer (Perret et al. 1980).

No estimates of maximum and optimum sustainable yield were found and very little has been published relating to population or community dynamic modeling parameters. The only published quantitative comparison of the effects of fishing and natural mortality on spotted seatrout dynamics found in the literature was that of Iversen and Moffett (1962). For fish ranging from 280 to 700 mm TL, they estimated a coefficient of instantaneous fishing mortality of 1.4 and instantaneous natural mortality of 5.8. The resultant combined coefficient of instantaneous total mortality (Z) would, given common fishery assumptions (see Ricker 1975), equal 7.2, or an annual mortality rate (A) of over 99.9%. Estimation of Z by catch curve analysis of the age structure data presented by Etzold and Christmas (1979) yields a value of 0.3, or an A of 26%. The former estimate of Z seems exceedingly high, but the latter is perhaps too low. Oddly, Iversen and Moffett (1962) presented a graph of length-frequency distribution, but failed to use the data as a check on the mortality rate estimated by tagging studies. An approximation from their graph yielded a total annual mortality estimate of 49% for fish from about 370 to 500 mm TL. This is strikingly similar to the mean estimate of Tatum (1980) for spotted seatrout of ages III+ through VI+. Tatum used data collected from annual fishing tournaments in Alabama. For those years in which reliable data could be gathered (1966-68 and 1973-77), the value of A ranged from 36.2% to 58.1% with a mean of 49.0%. Additional experimental investigation or routine age-structure analysis of the catch should be carried out to provide more reliable estimates.

A review of fishing success in Everglades National Park for 1958 through 1978 indicated that the changes in age structure and abundance of spotted seatrout were attributable to environmental changes rather than to fishing mortality and that commercial fisheries had no effect on sport yield or catch rate (Davis 1980). The former conclusion of environmental control,

Table 2. The 1974 commercial catch (metric tons)[a] of spotted seatrout in the Gulf of Mexico by gear type and State (after Perret et al. 1980).[b]

Gear type	Fla.	Ala.	Miss.	La.	Tex.	Total	Percent
Runaround gill net	618.6	27.9	127.7	446.7	128.9	1349.8	42.3
Trammel net	186.7	131.6	3.4	414.1	302.3	1038.1	32.5
Long (trot) line	-	-	-	3.9	456.5	460.4	14.4
Hand line	110.9	3.1	2.5	67.1	2.4	186.0	5.8
Common haul seine	93.6	-	-	-	-	93.6	2.9
Stake gill net	-	-	-	30.6	9.1	39.7	1.3
Troll line	15.2	-	-	-	-	15.2	0.5
Shrimp otter trawl	-	2.4	-	1.5	6.3	10.2	0.3
Total	1025.0	165.0	133.6	963.9	905.5	3193.0	100.0

[a]Weight = round (live) weight.

[b]For comparison with sport catch, in 1979 the marine sport catch of spotted seatrout for the Gulf of Mexico was 4,010 mt, or about twice the 2,021 mt catch of the commercial fishery for that same year (National Marine Fisheries Service 1981).

while perhaps valid locally, does not seem consistent with the relatively stable history of the spotted seatrout catch throughout the Gulf of Mexico. The latter, regarding commercial and sport fisheries, is counter to the findings of Matlock et al. (1977), who found greater sport catch from areas where there was no commercial fishing. Matlock et al. (1977) concluded that "commercial netting reduced populations of spotted seatrout [and that] this effect was apparently localized." Localization of the effects is consistent with the findings of Iversen and Moffett (1962) and Weinstein and Yerger (1976), who suggested that the spotted seatrout populations of different estuaries constitute separate stocks and should be treated as such for fishery management purposes. The effects of shrimp by-catch on spotted seatrout abundance are unknown.

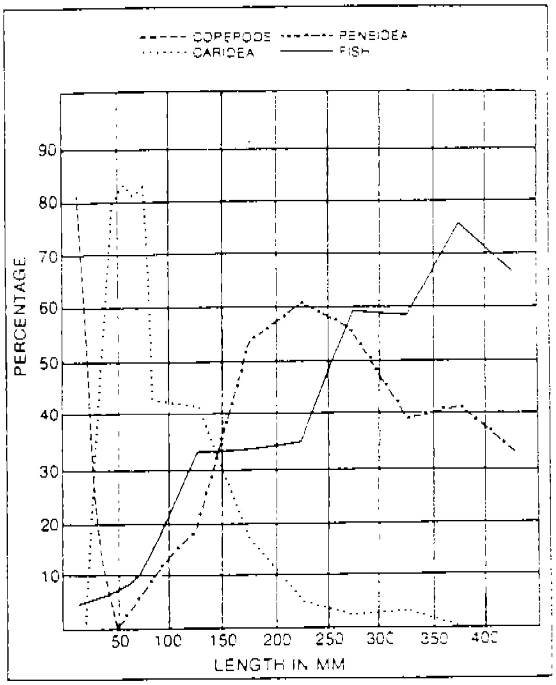

Figure 3. The percentage of occurrence of the four major food groups in the stomachs of spotted seatrout of various sizes (Moody 1950).

ECOLOGICAL ROLE

Perret et al. (1980) referred to the spotted seatrout as an "opportunistic carnivore whose food changes with size" (Figure 3). The illustrated pattern of change in diet is apparently typical of areas with abundant seagrass, e.g., Florida and Texas coasts, but may differ in areas of lower seagrass abundance, e.g., Lake Pontchartrain, Louisiana (Darnell 1958). Portions of Darnell's (1961) trophic studies of Lake Pontchartrain relating to spotted seatrout are given in Table 3. Feeding habits between stages may be reasonably distinct, but feeding within stages is apparently non-selective (Tabb 1961). Moody (1950) attributed the high percentage (54%) of empty guts found in his study to sporadic feeding, and Darnell (1958) suggested that feeding was heaviest during the early to mid-morning hours. No quantitative study of the role of spotted seatrout in estuarine trophic dynamics was found.

The longevity and growth rate of spotted seatrout may be affected by the structure of the surrounding community, e.g., the abundance of predators and competitors (Klima and Tabb 1959). Such differences may also be due to selective (genetic) differences between the various populations (Weinstein and Yerger 1976). No published experimental studies of competition or of other community level interactions were found.

ENVIRONMENTAL REQUIREMENTS

Temperature

Spotted seatrout are reportedly taken in Mississippi waters from 5° to

Table 3. Food (by percent of diet) of the spotted seatrout, Cynoscion nebulosus, from Lake Pontchartrain, Louisiana (Darnell 1961).[a]

Food category	Size (mmTL) 40-99	100-406
Zooplankton	20	-
Microinvertebrates	18	-
Detritus	8	8
Macroinvertebrates	6	13
Fish	48[b]	79

[a]Method for estimation of percent of diet was not given.

[b]Includes anchovies and larval fishes in juvenile (40-99 mm) guts.

34.9°C (41° to 95°F) (Etzold and Christmas 1979), but temperatures of 7° to 10°C (45° to 50°F) have been identified as "adverse" (Tabb 1966). Mass mortalities occur during cold snaps when water temperatures drop to 4° to 7°C (39° to 45°F) (Gunter 1941; Tabb 1958; Moore 1976). Loman (1978) reported highest catches from 25° to 30°C (77° to 86°F) while Tabb (1958) suggested 15° to 27°C (59° to 81°F) as a suitable temperature range for the spotted seatrout.

Spawning is reported to occur at temperatures of 21°C (70°F) or greater in Texas (Simmons 1951), 24°C (75°F) or greater in southwestern Florida (Jannke 1971), and 25.5° to 28.3°C (78° to 83°F) in east Florida (Tabb 1966). Taniguchi (1980) reported an optimum temperature of 28°C (82°F) for eggs and larvae, but predicted 100% survival between 23.1° and 32.7°C (74° and 91°F). Spotted seatrout move to deeper waters in conjunction with decreasing fall-winter temperatures. In North Carolina, Roelofs (1953) reported fall emmigration from the estuaries when water temperatures neared 10°C (50°F). Immigration into the estuaries the following spring occurred when water temperature reached 10° to 12°C (50° to 54°F) in North Carolina (Roelofs 1953), 17°C (63°F) in Georgia (Mahood 1974), and 21°C (70°F) in Texas (Simmons 1951). Migrations between offshore and estuary waters are less distinct in the Gulf of Mexico than along the Atlantic coast. Pearson (1929) and Tabb (1966) both reported concentrations of spotted seatrout in deep holes within estuaries during colder months. Tabb (1966) also mentioned that such holes, distant from deepwater routes to outside waters, became "death traps" during cold snaps and can be the site of mass mortalities.

Salinity

Spotted seatrout have been taken in waters with salinities ranging from 0.2 to 77 ppt (Simmons 1957). However, Tabb (1966) suggested that salinities below 5 ppt were "intolerable" and that larvae and juveniles unable to reach more saline waters during post-storm freshets may suffer mass mortalities. Simmons (1957) reported that no spawning occurred in the Laguna Madre

(Texas) at salinities greater than 45 ppt. Loman (1978) reported highest catches from waters of 20 to 35 ppt. Wohlschlag and Wakeman (1978) suggested that minimum salinity stress occurs at 20 ppt for spotted seatrout from south Texas tested at 28°C (82°F). They also suggested that "there may be no excess available energy beyond ecological maintenance requirements" at salinities below 10 ppt or above 45 ppt. Optimum salinity for eggs and larvae is reported as 28.1 ppt with 100% survival predicted from 18.6 to 37.5 ppt (Taniguchi 1980).

Habitat

The importance of estuaries to the spotted seatrout was emphasized by Etzold and Christmas (1979):

> "Since spotted seatrout may spawn in estuaries and are dependent upon them for food throughout their lives and since the evidence is very strong that each estuary maintains a distinct subpopulation [stock] of seatrout, it is clear that the estuarine environment is a particularly critical one for this species."

Most studies suggest that seagrass beds are the preferred habitat of postlarvae, juveniles, and adults (Pearson 1929; Moody 1950; Tabb 1966). Spotted seatrout may, however, occur abundantly near areas without extensive seagrass beds, e.g., shell reefs, marshes, and submerged or emergent islands (Lorio and Perret 1980). In a more general statement of habitat requirements for the species, Perret et al. (1980) seemed to tie distribution most strongly to food availability by stating that spotted seatrout "are probably found in any area offering suitable salinity and temperature regimes combined with sufficient primary productivity to support a food web suitable to their needs."

Tabb (1958) suggested that several ecological characteristics were important in determining the abundance of spotted seatrout in Indian River, Florida:

1. Large areas of shallow, quiet brackish water
2. Extensive grassy areas usually dominated by _Thalassia testudinum_ and _Halodule wrightii_ [Perret et al. (1980) would replace "grassy areas ..." with areas of primary productivity.]
3. Areas of 3 to 6 m [10 to 20 ft] depth adjacent to grass flats to be used for refuge from winter cold
4. An abundant food supply, viz., grazing crustaceans and suitable size fish
5. Absence of predators [not identified]
6. Absence of competitors [not identified]
7. Suitable temperature of 15° to 27°C [59° to 81°F] [see Temperature section]

Other Environmental Factors

Minimum metabolic oxygen demand for spotted seatrout tested at 28°C (82°F) was 210, 125, and 230 mg O_2/kg/hr at salinities of 10, 20, and 30 ppt, respectively (Vetter 1977). No reports relating dissolved oxygen to distribution or abundance were found, but Etzold and Christmas (1979) reported that spotted seatrout "have been found in oxygen depletion kills." Pearson (1929) suggested a preference by spotted seatrout for "less turbid" areas, and Tabb and Manning (1961) suggested that excessively turbid waters following Hurricane Donna caused mortality in spotted seatrout by packing the gill chambers with suspended solids. However, no quantitative study relating turbidity to spotted seatrout distribution or abundance was found. The reported parasites and diseases of spotted seatrout were reviewed briefly by Lorio and Perret (1980). Most are not known to be harmful to man, but several may alter growth pattern and cause scarring in the fish themselves (Pearson 1929).

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