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TR EL-82-4

Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (South Atlantic)

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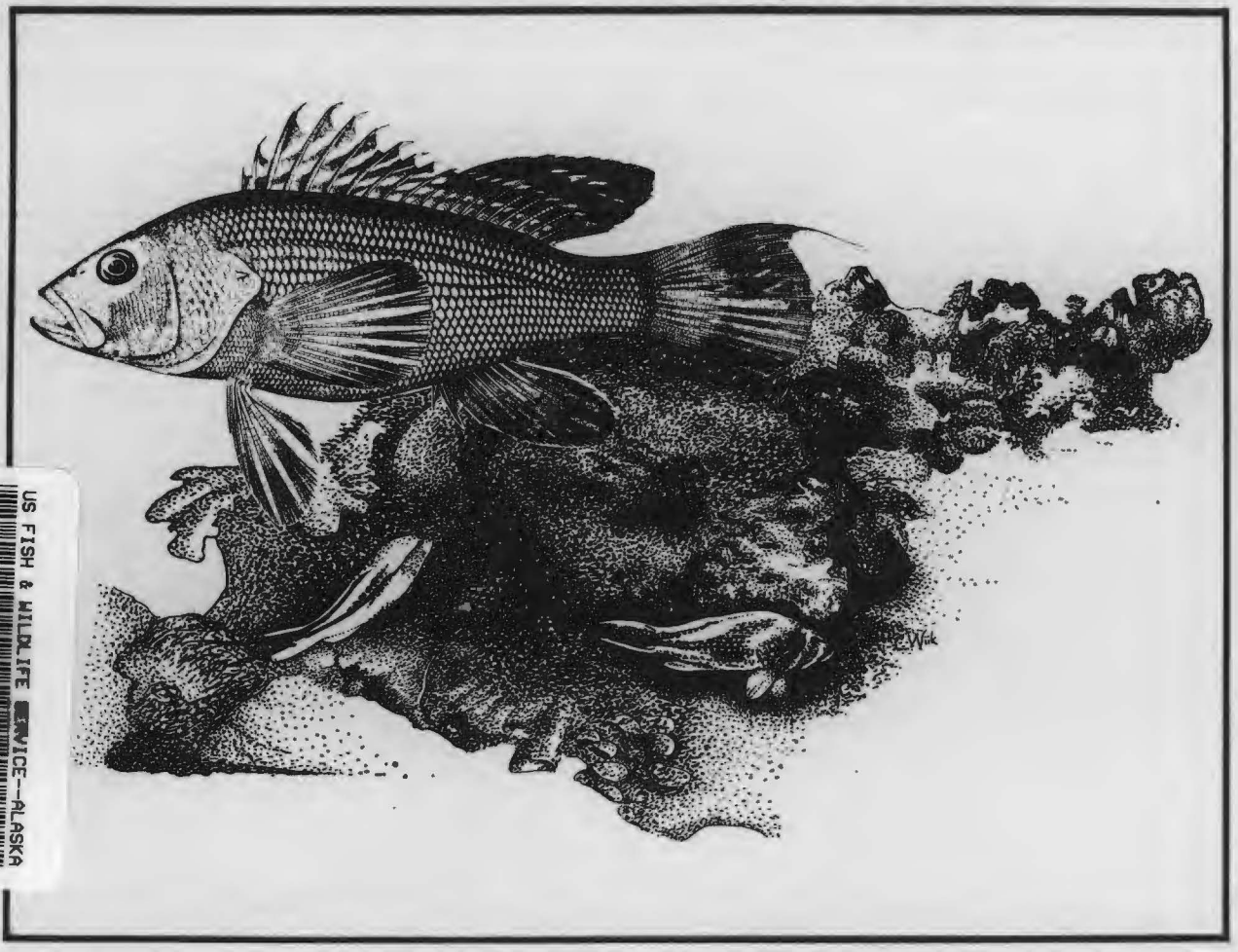

and Wildlife Service
Department of the Interior

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 (South Atlantic)

BLACK SEA BASS

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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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Attention: WESER-C
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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
meters (m)	0.5468	fathoms
kilometers (km)	0.6214	statute miles
kilometers (km)	0.5396	nautical 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 (m^3)	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 (t)	1.102	short tons
kilocalories (kcal)	3.968	British thermal units
Celsius degrees (°C)	1.8(°C) + 32	Fahrenheit degrees

U.S. Customary to Metric

inches	25.40	millimeters
inches	2.54	centimeters
feet (ft)	0.3048	meters
fathoms	1.829	meters
statute miles (mi)	1.609	kilometers
nautical miles (nmi)	1.852	kilometers
square feet (ft^2)	0.0929	square meters
square miles (mi^2)	2.590	square kilometers
acres	0.4047	hectares
gallons (gal)	3.785	liters
cubic feet (ft^3)	0.02831	cubic meters
acre-feet	1233.0	cubic meters
ounces (oz)	28350.0	milligrams
ounces (oz)	28.35	grams
pounds (lb)	0.4536	kilograms
pounds (lb)	0.00045	metric tons
short tons (ton)	0.9072	metric tons
British thermal units (Btu)	0.2520	kilocalories
Fahrenheit degrees (°F)	0.5556 (°F - 32)	Celsius degrees

CONTENTS

ACKNOWLEDGMENTS

I am grateful to Charles S. Manooch, III, Gene Huntsman, and R.O. Parker, Jr., of the National Marine Fisheries Service, Beaufort Laboratory, and C. Wayne Waltz of the South Carolina Wildlife and Marine Resources Department for reviewing the manuscript.

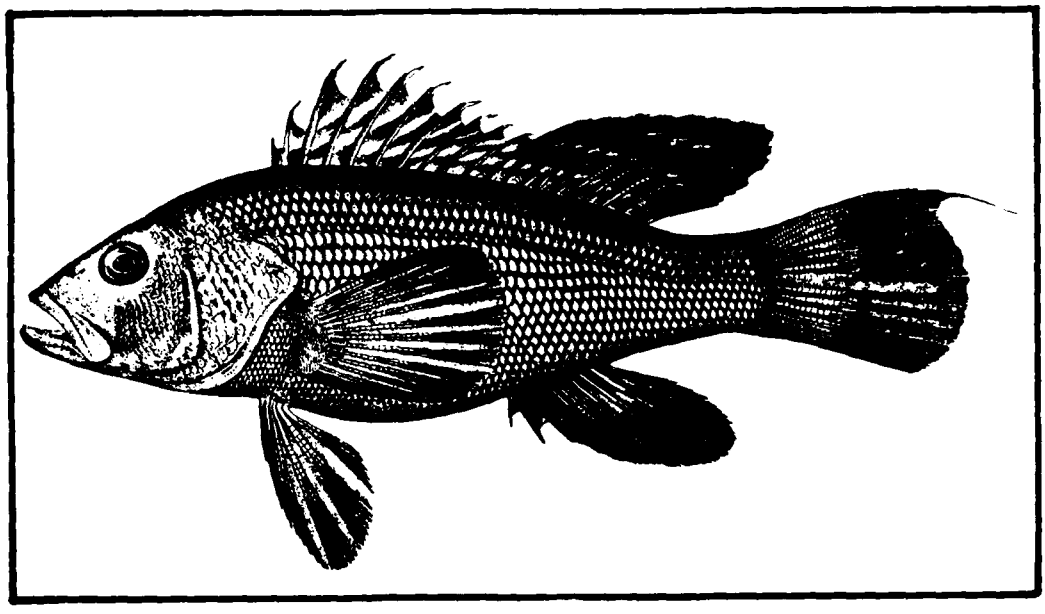

Figure 1. Black sea bass (from Goode 1884).

BLACK SEA BASS

NOMENCLATURE/TAXONOMY/RANGE

Scientific name.....*Centropristis striata* (Linnaeus) (Figure 1)
Preferred common name.....Black sea bass (Robins et al. 1980)
Other common names.....Blackfish, black bass, black will (Smith 1907)
Class.....Osteichthyes
Order .....Perciformes
Family.....Serranidae

Geographic range: The black sea bass, *Centropristis striata striata*, occurs along the Atlantic coast from Cape Cod, Massachusetts, to Cape Canaveral, Florida (Figure 2), and occasionally as far south as the Florida Keys (Fischer 1978). A subspecies, *C. s. melana*, occurs along the eastern and northern coastal areas of the Gulf of Mexico. Two populations of black sea bass may occur along the Atlantic coast, separated at Cape Hatteras, North Carolina (Mercer 1978).

MORPHOLOGY/IDENTIFICATION AIDS

The following description was given by Miller (1959): Dorsal X, 11; anal III, 7; total gill rakers plus tubercles usually 22-28 (20-29), lower limb usually 14 to 18 (14-19); scales large, lateral line scales 47 (46-49). Body robust, the back somewhat elevated anteriorly; head large; snout moderately pointed; mouth large, oblique. Spinous and soft dorsal fins continuous, males having the noticeably higher fins; caudal fin rounded in juveniles, trilobed and with one upper ray extended in adults.

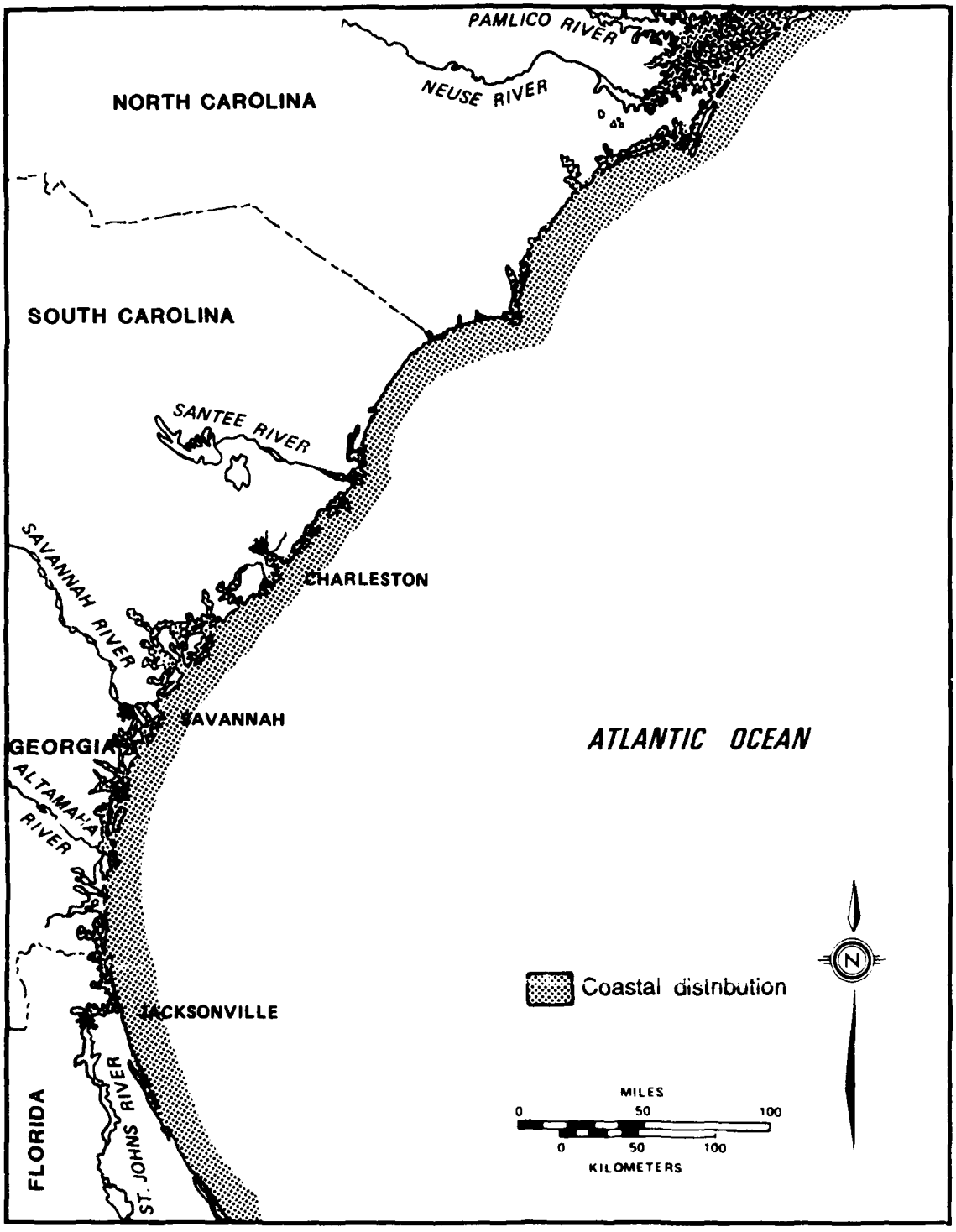

Figure 2. Distribution of black sea bass along the South Atlantic coast.

Breeding males develop an adipose hump on the nape.

Color in life: smoky gray, dusky brown, or blue-black above, slightly paler below; centers of scales pale blue or white, forming longitudinal stripes along back and sides; sides sometimes mottled or with dark and light vertical crossbars. Breeding males with vivid hues of fluorescent blue and green around eyes and nape; females are lighter and brownish or gray-blue instead of blue-black (Hardy 1978). Link (1980) described four juvenile color phases: an overall light grayish phase peppered with small dark spots; a dark phase with dull white spots; a striped phase with a single horizontal dark stripe; and a barred phase with six vertical bars.

The Atlantic subspecies of black sea bass differs from Gulf of Mexico subspecies in the following details: gill rakers and tubercles usually 25 to 26, instead of 22-24; pectoral rays 18 or 19, instead of 17 or 18; jaw usually 16% or 17% of standard length, instead of 18%-19%; black spot at base of last dorsal spines distinct in juveniles, rather than indistinct to almost absent; dark blotches on jaws usually absent in young. Bortone (1977), who compared the osteology of three species of Centropristis, found no obvious osteological differences between C. s. striata and C. s. melana.

Other species of Centropristis differ in being very pale to white, with seven diffuse to distinct dark vertical bars on side, fins pale, soft dorsal and caudal with dark to inky spots (Miller 1959).

REASON FOR INCLUSION IN THE SERIES

The black sea bass is a valuable commercial and recreational fish along the South Atlantic coast. Commercial landings increased sharply after 1960 due to the development of a fishery using baited wire crab traps (Rivers 1966). Black sea bass comprises the bulk of the North Carolina charter boat catch of reef fishes (Manooch et al. 1981) and is probably second in importance to red porgy (Pagrus pagrus) in the inshore catch by Carolina headboats (sport fishing boats having a passenger capacity of 30-75 anglers) (Huntsman 1976). Management regulations for black sea bass caught in the Fishery Conservation Zone (the area in which the United States asserts exclusive fishery management authority and which extends seaward from 3 to 200 nm) were established in the Fishery Management Plan for the snapper-grouper fishery of the South Atlantic Region (Anonymous 1983). A minimum size limit of 203 mm TL (8 inches) was adopted for black sea bass on the basis of a yield-per-recruit analysis that indicated the harvest is less than the maximum possible.

LIFE HISTORY

Spawning

Black sea bass are protogynous hermaphrodites. Most individuals function first as females, undergo sexual succession, and become functional males (Lavenda 1949). The process of sexual succession was described from histological studies of the gonads (Lavenda 1949; Reinboth 1965; Mercer 1978; Wenner et al. 1986). Bands of testicular precursor cells are found in various stages of development in the ovarian wall. Sexual transition begins in the posterior region of the ovary and the proliferation of testicular tissue proceeds forward.

Spawning of black sea bass extends from January to June offshore in the South Atlantic region, peaking from March to May (Cupka et al. 1973; Mercer 1978; Link 1980; Wenner et al. 1986). Minor spawning occurs in September and October. Spawning

occurs later in the northern part of the range. The frequency of occurence of transitional individuals increases after both spawning periods, indicating that sexual succession is primarily a post-spawning process (Mercer 1978; Wenner et al. 1986).

Black sea bass mature between age I and IV (Mercer 1978; Link 1980; Wenner et al. 1986). Wenner et al. (1986) reported that the percentages of females that were mature were 0 at age 0, 48.4 at age I, 90.3 at age II, 99.1 at age III, and 100 at all older ages. The smallest observed mature females and males were 90-110 mm and 100-110 mm SL, respectively (Mercer 1978; Wenner et al. 1986). Link (1980) reported that all females of ages I and II collected at depths <12 m were immature, whereas some females of ages I-III collected at depths >12 m were mature, and all age IV females were mature.

Sex ratios of black sea bass differ significantly from 1:1 in favor of females at the smaller sizes and younger ages (Mercer 1978; Waltz et al. 1979; Link 1980; Wenner et al. 1986). An increased frequency of males occurs between 200 and 240 mm SL and ages IV and V. Individuals undergoing sexual succession ranged in length from 118 to 327 mm SL and from ages I to VIII; modes were at 200 mm SL and age III.

Fecundity and Eggs

Fecundity relationships for South Atlantic black sea bass were determined by Cupka et al. (1973), Link (1980), and Wenner et al. (1986) and by Mercer (1978) for Middle Atlantic fish (Table 1). Estimates of fecundity ranged from 17,000 in a fish of 108 mm SL (age II) to 1,050,000 in a fish of 438 mm SL of undetermined age (Wenner et al. 1986). Fecundity was significantly related to length, weight, and age.

Black sea bass eggs are pelagic, are 0.9-1.0 mm in diameter and hatch in about 75 h at 16 °C (Wilson 1891; Smith 1907). Eggs from artificially

Table 1. Fecundity relationships for South Atlantic black sea bass, where n=sample size, F=fecundity, SL=standard length (mm), TL=total length (mm), W=weight (g), and A=age.

Reference	n	Fecundity relationship	r^2	Size range (mm SL)	No. of eggs
Cupka et al. (1973)	18	log F = 0.308 + 1.973 log SL	0.67	139-250	29,770-121,500
		log F = 3.349 + 0.629 log W	0.69		
		log F = 4.543 + 0.784 log A	0.70		
Link (1980)	18	log F = -2.10 + 3.03 log SL	0.94	137-335	26,938-370,443
Wenner et al. (1986)	115	log F = -0.309 + 2.318 log SL	0.65	108-438	17,000-1,050,000
		log F = -0.605 + 2.335 log TL	0.62		
		log F = 3.057 + 0.822 log W	0.65		
		log F = 4.529 + 0.913 log A	0.33		

spawned gulf black sea bass (C. s. melana) hatch in about 38 h after fertilization at 23 °C under an 11 h photoperiod (Hoff 1970).

Larvae

Little is known of the early life history of black sea bass. Larvae (2-13 mm) have been collected from June to November between Sandy Hook, New Jersey, and Cape Lookout, North Carolina (Kendall 1972). The larvae were collected in tows from the surface to a depth of 33 m, 4 to 82 km from shore where water depths ranged from 15 to 51 m. The pelagic existence of this fish is short. Larvae longer than 13 mm SL were not collected, presumably because they become demersal or estuarine near that size. It is not known what part of the population remains at sea, nor are the routes and mechanisms of larval transport known. Kendall (1972) described armature, body shape, development of meristic characters, and pigment patterns of larvae 2.1 to 13.0 mm SL.

Juveniles

Juvenile black sea bass occur in saline areas of estuaries along the coast from Florida to Massachusetts (Kendall 1977) and in offshore areas (Cupka et al. 1973). Link (1980) reported that young-of-the-year (30-50 mm SL) appeared on inshore jetties in late May and early June. Within estuaries, juveniles are found around jetties, piers, wrecks, and shell bottom such as oyster reefs.

Black sea bass have been collected year round in North Carolina estuaries at salinities of 1 to 36 ppt and temperatures of 6 to 29 °C (Link 1980; Schwartz et al. 1981). In South Carolina estuaries juveniles (20-140 mm SL) were found at salinities of 8.8 to 37.8 ppt and temperatures of 5.6 to 30.4 °C, mainly from July to November (Cupka et al. 1973). Dahlberg (1972) collected young-of-the-year black sea bass throughout the the year in the lower reaches of a Georgia estuary, mostly over shell bottom. In the St. Johns River, Florida, Tagatz (1967) collected juveniles (28-71 mm FL) in June and July at 14.5 to 24.7 ppt and 26.6 to 27.4 °C. He collected larger individuals (91-176 mm FL) in February, March, and November at salinities of 7.7-13.1 ppt and 11.0-17.4 °C.

Adults

Adult black sea bass are found in offshore areas in depths of 10 to 120 m; however, most are at 20 to 60 m (Struhsaker 1969; Bearden and McKenzie 1971; Cupka et al. 1973; Grimes et al. 1982; Chester et al. 1984; Sedberry and Van Dolah 1984; Parker and Ross 1986).

Black sea bass are migratory in the northern part of their range, whereas south of Cape Hatteras, North Carolina, they are apparently residents in given areas year round. In the Middle Atlantic Bight black sea bass move inshore and northward in spring and offshore and south in fall, probably due to changes in temperature (Pearson 1932; Nesbit and Neville 1935; Musick and Mercer 1977). Off South Carolina the lowest bottom temperatures recorded in the depth range inhabited by adult sea bass are 10 °C or higher during all seasons (Walford and Wicklund 1968). Tagging studies off South Carolina and along the east coast of Florida have indicated that black sea bass there are essentially nonmigratory (Topp 1963; Beaumariage 1964, 1969; Beaumariage and Wittich 1966; Moe 1966; Cupka et al. 1973). Although no seasonal movements were observed in South Carolina waters, Cupka et al. (1973) noted that larger specimens were found in deep water, which suggests gradual offshore movements with increasing age; however, reduced fishing pressure offshore away from

ports may be a factor. Waltz et al. (1979) reported that average age increased with depth from 2.4 years at 18-26 m to 4.8 years at 37-46 m.

GROWTH CHARACTERISTICS

Age and growth of black sea bass have been determined from otoliths (Cupka et al. 1973; Mercer 1978; Waltz et al. 1979; Link 1980; Wenner et al. 1986). Analysis of marginal increments indicates that annulus formation occurs in April and May. Ten age groups were identified in the South Atlantic Bight (Table 2). Mean back-calculated lengths at age were similar in all studies except that of Cupka et al. (1973) and ages I and II of Waltz et al. (1979). The larger size at age found by Cupka et al. (1973) may reflect the condition of the population of black sea bass in the South Atlantic Bight before heavy exploitation began in 1969. Waltz et al.(1979) observed 37 black sea bass of 45 to 130 mm SL in which the first annulus had not yet formed; they concluded that the functionally derived correction factor used in their study underestimated the back-calculated length in the younger age groups. Males were larger than females at ages greater than one year.

Von Bertalanffy growth parameters are shown in Table 3. The low estimates of K (growth coefficient) indicate that black sea bass attains its maximum size slowly, as do other reef fishes (Huntsman and Manooch 1978). Link (1980), who used a logarithmic function to describe growth of black sea bass, obtained values that were intermediate to those of other studies.

Length-weight regressions for black sea bass were calculated by Cupka et al. (1973), Mercer (1978), Waltz et al. (1979), and Link (1980) (Table 4). No sexual differences in length-weight relationships were found in these studies. Slopes and intercepts were similar in all studies.

Table 2. Mean back-calculated lengths (mm SL) of black sea bass.

Reference	Sex	Age I	II	III	IV	V	VI	VII	VIII	IX	X
Cupka et al. (1973)	Combined	115	164	198	230	265	305	329			
Mercer (1978)	Female	93	143	176	199	218	208				
	Male	90	145	183	215	238	269	286	294		
	Combined	87	141	177	205	231	244				
Waltz et al. (1979)	Female	74	133	168	190	218	247	257	256	280	330
	Male	73	134	177	210	244	260	277	295	300	340
Link (1980)	Female	92	142	187	231	247	260				
	Male	99	155	202	244	272	277	293			
Wenner et al. (1986)	Combined	88	142	180	212	244	271	283	289	296	303

Table 3. Estimated von Bertalanffy parameters describing the growth of black seabass.[a]

Reference	t_o	K	L_∞
Mercer (1978)	-0.183	0.219	352
Cupka et al. (1973)	-1.330	0.088	625
Wenner et al. (1986)	-0.201	0.231	341

[a] t_o = theoretical age at which length is zero
K = rate at which length approaches the asymptote
L_∞ = asymptotic length at infinite age.

THE FISHERY

Commercial Harvest

The fisheries for black sea bass were reviewed by Rivers (1966), Cupka et al. (1973), Frame and Pearce (1973), and Mercer (1978). In the South Atlantic region black sea bass are mainly harvested by a trap fishery; small amounts are caught with trawls and hand lines. Smith (1907) reported that the fishery in the early 1900's was primarily a handline fishery. The trap fishery, which developed in 1960, operates year-round along the 18 m contour. Wire-mesh crab pots are used, baited with menhaden, herring, squid, mullet, spot, or croaker. Highest landings occur from early winter to spring due to increased participation in the fishery by shrimp and sport fishermen. Fifteen to 40 traps are set singly over patch reefs. Fishing time ranges from 20 to 45 minutes for each trap. This fishery differs considerably from the trap fishery north of Cape Hatteras, North Carolina, which operates from May to December, and in which 400 to 1,500 unbaited wooden slat traps are set out for the entire season in

Table 4. Weight-length regressions for black sea bass ($\log_{10}W = a + b\ [\log_{10}SL]$ where W = weight [g] and SL = standard length [mm]).

Reference	n	a	b	r^2
Mercer (1978)	628	-4.4592	2.9617	0.99
Link (1980)	912	-4.5243	3.0024	0.99
Cupka et al. (1973)	412	-4.5761	3.0237	0.99
Waltz et al. (1979)	1,771	-4.4833	2.9870	0.99
Wenner et al. (1986)	12,284	-4.328	2.978	0.98

strings of 10 or 20 traps per line, with about 200 traps fished daily. Trawl catches of black sea bass are primarily landed north of Cape Hatteras, North Carolina. Black sea bass are also caught in the handline fishery for snappers and groupers.

Black sea bass landings (Table 5) increased sharply in the South Atlantic region after 1960 due to the development of the trap fishery. Cupka et al. (1973) reported that the numbers of vessels fishing for black sea bass in South Carolina increased from 8 in 1959 to 62 in 1971. Annual landings in North Carolina peaked at 904 t in 1967 and have fluctuated since then. South Carolina landings were highest in 1970, then declined, and increased in the early 1980's. Georgia and Florida contribute little to South Atlantic black sea bass landings.

Table 5. Commercial landings (metric tons) of black sea bass in the south Atlantic region, 1950-1984 (from Fishery Statistics of the U.S.).

	State				
Year	NC	SC	GA	FL	Total
1950	34	115	-	-	149
1951	43	84	-	-	127
1952	50	45	-	-	95
1953	37	35	1	-	73
1954	19	27	1	-	47
1955	9	8	-	6	23
1956	36	15	1	3	55
1957	16	2	*	19	38
1958	12	8	-	18	38
1959	19	17	*	21	57
1960	57	13	*	13	83
1961	288	147	*	10	446
1962	584	122	-	21	726
1963	335	120	1	29	485
1964	411	106	*	22	540
1965	494	38	2	22	556
1966	575	62	1	28	666
1967	904	30	1	35	971
1968	541	93	5	31	670
1969	475	327	4	32	838
1970	534	351	5	28	918
1971	339	233	20	42	634
1972	288	248	28	53	616
1973	310	130	12	31	484
1974	597	59	16	43	715
1975	521	67	7	45	640
1976	260	40	9	53	362
1977	664	8	4	32	708
1978	515	25	9	30	579
1979	624	100	4	28	756
1980	694	97	6	24	821
1981	543	283	8	22	856
1982	368	232	6	29	635
1983	242	106	*	25	373
1984	449	72	6	36	563

* = <1 metric ton.
\- = none reported.

Sport Fishing

The recreational catch of black sea bass has increased, partly due to the development of the headboat fishery in the mid-1960's (Huntsman 1976). The black sea bass is the most abundant species in the North Carolina charter boat bottom fishing catches of reef fishes, accounting for 75% of the catch by number and 64% of the catch by weight (Manooch et al. 1981). The estimated recreational catch of black sea bass in the South Atlantic ranged from 3.6 million fish and 1.9 million kg in 1980 to 9.7 million fish and 3.7 million kg in 1984 (Anonymous 1984, 1985a,b, 1986 (Table 6).

Management

Mortality rates for black sea bass captured off South Carolina and Georgia from 1978 to 1981 were presented by Low (1981) and Wenner et al. (1986). Catch curves for fish caught in traps at depths <40 m indicated that females were fully recruited to the fishery at age III, but the recruitment of males was not complete until age IV (Low 1981). The age at complete recruitment in deeper waters was about one year older. Low (1981) reported instantaneous rates of total mortality that ranged from 0.75 to 0.83 for fish caught in water

Table 6. Recreational landings of black sea bass for the South Atlantic region, 1980-1985 (Anonymous 1984, 1985a, b, 1986).

Year	Number (1000's)	Weight (kg) (1000's)
1980	3,617	1,944
1981	6,290	1,967
1982	6,061	2,269
1983	5,028	1,101
1984	9,703	3,676
1985	6,215	1,885

<40 m and from 0.60 to 0.61 for fish in deeper water. Wenner et al. (1986) reported that the instantaneous rate of total mortality of age IV and older black sea bass from catch curve analysis, ranged from 0.72 in 1978 to 1.32 in 1981 for commercial fish traps and from 0.73 in 1979 to 1.43 in 1981 for hook and line. From 1978 to 1981, mortality rates increased from 51.3% to 73.3% for trap-caught fish and from 51.6% to 76.1% for hook and line-caught fish older than age IV.

Wenner et al. (1986) used Petersen mark-recapture techniques to calculate population densities of 14 to 125 individuals per hectare on two shallow-water patch reefs. Abundance on both reefs declined from 1981 to 1983. Powles and Barans (1980) estimated black sea bass densities of 33 to 66 fish/ha and a biomass of 5.1 to 9.9 kg/ha from television transect data. Yield-per-recruit (YPR) models for black sea bass presented by Huntsman et al. (1983) indicated that at the lowest estimates of M (instantaneous natural mortality), black sea bass were subjected to sufficient fishing mortality on the headboat grounds to account for 80% to 98% of the maximal YPR. The South Atlantic Fishery Management Council concluded from YPR analysis that black sea bass are probably in the range of growth overfishing, i.e., excessive harvesting of small fish (Anonymous 1983). To control growth overfishing and prevent recruitment overfishing (excessive harvesting of spawners which decreases recruitment), a minimum size limit of 203 mm (8 inches) and restrictions on fish trap dimensions and trap fishing areas were adopted for black sea bass caught in the South Atlantic Fishery Conservation Zone (Federal waters south of Cape Hatteras). Minimum mesh size of traps is 1 by 2 inches (rectangular) or 1 1/2 inches (hexagonal).

ECOLOGICAL ROLE

Black sea bass are carnivorous bottom-feeders that eat crustaceans (primarily crabs and shrimp), fish, mollusks, and echinoderms (Smith 1907; Hildebrand and Schroeder 1928; Cupka et al. 1973; Link 1980; Steimle and Ogren 1982). Adults eat mainly crabs and fish, and the young eat shrimp, isopods, and amphipods. Link (1980) found that the diet of black sea bass, based on frequency of occurrence, was composed primarily of crustaceans (91%), mollusks (28%), and fishes (28%). Crabs occurred in about 51% of the stomachs and shrimp in about 13%. Cupka et al. (1973) noted that the presence of barnacles and other sessile organisms such as colonial tunicates were indicative of some grazing activity, particularly by adults. Results of feeding studies are affected by type of collection gear--trawl-caught black sea bass had minimal stomach eversion, but eversion was significant in fish caught with hook-and-line (Rogers et al. 1986).

Fish assemblages associated with hard bottom or reef habitats in the South Atlantic Bight have been described in studies using submersibles, television and diver transects, trawls, and traps. Powles and Barans (1980) found that black sea bass, along with round scad (Decapterus punctatus) and southern porgy (Stenotomus aculeatus), dominated the fish assemblage of two inshore reef areas (16-32 m deep) off South Carolina. Television estimates of black sea bass and southern porgy density and biomass were greater than trawl estimates. Black sea bass occurred singly, swimming near bottom among attached organisms. Chester et al. (1984) identified seven groups of distributionally similar reef fish species on the continental shelf of North Carolina and South Carolina, based on analyses of headboat and research cruise catch records. Black sea bass was the dominant member of an inshore community on the inner shelf (<30 m) that was also characterized by the presence of whitebone porgy (Calamus leucosteus), spottail porgy (Diplodus holbrooki), sheepshead porgy (Calamus penna), longspine porgy (Stenotomus caprinus), tomtate (Haemulon aurolineatum), and pigfish (Orthopristis chrysoptera). Cluster analysis of summer and winter trawl collections in the South Atlantic Bight grouped black sea bass with pinfish (Lagodon rhomboides), pigfish, and cubbyu (Equetus umbrosus), in winter, and planehead filefish (Monacanthus hispidus), northern searobin (Prionotus carolinus), sand perch (Diplectrum formosum), inshore lizardfish (Synodus foetens), and scrawled cowfish (Lactophrys quadricornis), in summer (Sedberry and Van Dolah 1984). Wenner's (1983) cluster analysis of a late spring sponge-coral habitat trawl survey also grouped black sea bass with cubbyu, northern searobin, sand perch, and in addition, bank cusk-eel (Ophidion holbrooki), Atlantic midshipman (Porichthys Plectrodon), bank seabass (Centropristis ocyurus), whitebone porgy, twospot cardinalfish (Apogon pseudomaculatus), and jackknife-fish (Equetus lanceolatus).

ENVIRONMENTAL REQUIREMENTS

Temperature

Differences in temperature regime appear responsible for differences in seasonal distribution and migratory tendency of black sea bass between the South Atlantic and Mid-Atlantic Bights (Musick and Mercer 1977). North of Cape Hatteras, North Carolina, black sea bass move south and offshore in fall as inshore water temperatures decline. Black sea bass have been caught at temperatures as low as 6 °C in winter, but largest catches were taken at bottom temperatures of 8-10 °C and higher (Goode 1884; Nesbit and Neville 1935; Musick and Mercer 1977). Tagging studies off the South Atlantic coast revealed that adult black sea bass were year-round residents in given areas and, in contrast to Mid-Atlantic sea bass, did not undertake seasonal migrations. The lowest bottom temperatures off South Carolina in the depth range inhabited by adult black sea bass were 10 °C and higher during all seasons (Walford and Wicklund 1968). Grimes et al. (1982) reported that a decrease in temperature at live-bottom areas from 22 to 8 °C from November 1975 to February 1976 was accompanied by a marked change in faunal composition from a red porgy (Pagrus pagrus)-vermilion snapper (Rhomboplites aurorubens)-white grunt (Haemulon plumieri) assemblage to a fauna dominated by black sea bass, Atlantic spadefish (Chaetodipterus faber), and tautog (Tautoga onitis).

In North Carolina estuaries, black sea bass were collected at 6 to 29 °C (Link 1980; Schwartz et al. 1981). Cupka et al. (1973) reported that juvenile black sea bass were taken in estuaries at water tempera-

tures of 5.6 to 30.4 °C, but were most abundant in waters above 10 °C.

Salinity

Although the black sea bass is a marine species, juveniles and yearlings inhabit high salinity sections of estuaries as nursery grounds. In North Carolina estuaries, black sea bass were collected at salinities of 1.0 to 36.0 ppt but most often at >14.0 ppt (Link 1980; Schwartz et al. 1981). Cupka et al. (1973) reported that the most important sea bass nurseries were in high salinity (>30 ppt) reef areas, and Dahlberg (1972) found juvenile sea bass mostly in the lower reaches of a Georgia estuary.

Substrate

The black sea bass is a dominant species associated with the hard- or live-bottom sponge-coral habitat in the South Atlantic Bight (Struhsaker 1969; Powles and Barans 1980; Grimes et al. 1982; Wenner 1983; Chester et al. 1984; Sedberry and Van Dolah 1984; Parker and Ross 1986). This habitat, which is located on the open shelf from depths of 18 to 55 m, consists of low rock ridges, outcroppings, coral patches, and shipwrecks (Struhsaker 1969; Parker and Ross 1986). The black sea bass is also one of the most abundant species on artificial reefs along the South Atlantic coast (Buchanan 1973; Buchanan et al. 1974).

Depth

Black sea bass occur at depths as shallow as 1 m in estuarine waters (Link 1980) to depths of 73 to 165 m offshore in winter north of Cape Hatteras, North Carolina (Pearson 1932; Musick and Mercer 1977). Numerous studies of the South Atlantic Bight reef fish communities indicated that black sea bass were most abundant at depths of 16 to 38 m (Struhsaker 1969; Powles and Barans 1980; Grimes et al. 1982; Chester et al. 1984; Sedberry and Van Dolah 1984; Parker and Ross 1986). Black sea bass were caught as deep as 46-51 m off a rocky ledge on the Georgia coast in June 1986 (Wayne Waltz, S.C. Wildlife & Marine Resources Dep.; pers. comm.). Sedberry and Van Dolah (1984) reported that they were more abundant in summer than in winter at inner shelf stations (16-22 m), but seasonal differences in abundance were minor at middle shelf stations (25-38 m).

Contaminants

Stone et al. (1975) used tires to construct a simulated artificial tire reef to determine if pollutants would leach from the tires and affect black sea bass. No significant increase in concentrations of zinc, organochloride insecticides, or polychlorinated biphenyls (PCB's) was found. Hall et al. (1978) determined the concentrations of 15 trace elements in black sea bass muscle and liver tissue, but did not report information on acceptable or safe levels. Fair and Fortner (1987) found that the hydrocarbon benzo(a) pyrene (a compound found in petroleum) consumed by seabass increased muscle tissue concentrations of cadmium fed to the fish.

LITERATURE CITED

Anonymous. 1983. Fishery management plan, regulatory impact review, and final environmental impact statement for the snapper-grouper fishery of the South Atlantic region. South Atlantic Fishery Management Council in coop. with National Marine Fisheries Service. Charleston, S.C. 89 pp + Appendices.

Anonymous. 1984. Marine recreational fishery statistics survey, Atlantic and gulf coasts, 1979 (Revised)-1980. Natl. Mar. Fish. Serv. Curr. Fish. Stat. No. 8322. 239 pp.

Anonymous. 1985a. Marine recreational fishery statistics survey, Atlantic and gulf coasts, 1981-1982. Natl. Mar. Fish. Serv. Curr. Fish. Stat. No. 8324. 215 pp.

Anonymous. 1985b. Marine recreational fishery statistics survey, Atlantic and gulf coasts, 1983-1984. Natl. Mar. Fish. Serv. Curr. Fish. Stat. No. 8326. 222 pp.

Anonymous. 1986. Marine recreational fishery statistics survey, Atlantic and gulf coasts, 1985. Natl. Mar. Fish. Serv. Curr. Fish. Stat. No. 8327. 130 pp.

Bearden, D.M., and M.D. McKenzie. 1971. An investigation of the offshore demersal fish resources of South Carolina. S.C. Wildl. Resour. Dep. Tech. Rep. 2. 19 pp.

Beaumariage, D.S. 1964. Results from the 1963 Schlitz tagging program. Fla. Board Conserv. Mar. Res. Lab. Tech. Ser. 43. 34 pp.

Beaumariage, D.S. 1969. Returns from the 1965 Schlitz tagging program. Fla. Board Conserv. Mar. Res. Lab. Tech. Ser. 59. 38 pp.

Beaumariage, D.S., and A.C. Wittich. 1966. Returns from the 1964 Schlitz tagging program. Fla. Board Conserv. Mar. Res. Lab. Tech. Ser. 47. 50 pp.

Bortone, S.A. 1977. Osteological notes on the genus Centropristis (Pisces: Serranidae). Northeast Gulf Sci. 1(1):23-33.

Buchanan, C.C. 1973. Effects of an artificial habitat on the marine sport fishery and economy of Murrells Inlet, South Carolina. U.S. Natl. Mar. Fish. Serv. Mar. Fish. Rev. 35 (9):15-22.

Buchanan, C.C., R.B. Stone, and R.O. Parker, Jr. 1974. Effects of artificial reefs on a marine sport fishery off South Carolina. U.S. Natl. Mar. Fish. Serv. Mar. Fish. Rev. 36(11):32-38.

Chester, A.J., G.R. Huntsman, P.A. Tester, and C. S. Manooch III. 1984. South Atlantic Bight reef fish communities as represented in hook-and-line catches. Bull. Mar. Sci. 34 (2):267-279.

Cupka, D.M., R.K. Dias, and J. Tucker. 1973. Biology of the black sea bass, Centropristis striata (Pisces: Serranidae), from South Carolina waters. S.C. Wildl. Mar. Resour. Dep. Unpubl. MS. 93 pp.

Dahlberg, M.D. 1972. An ecological study of Georgia coastal fishes. U.S. Natl. Mar. Fish. Serv. Fish. Bull. 70(2):323-353.

Fair, P.H., and A.R. Fortner. 1987. Effect of ingested benzo(a) pyrene and cadmium on tissue accumulation, hydroxylase activity, and intestinal morphology of the black sea bass, Centropristis striata. Environ. Res. 42:185-195.

Fischer, W., ed. 1978. FAO species identification sheets for fishery purposes. Western Central Atlantic. FAO, Rome, Vol. 4.

Frame, D.W., and S.A. Pearce. 1973. A survey of the sea bass fishery. U.S. Natl. Mar. Fish. Serv. Mar. Fish. Rev. 35(1-2):19-26.

Goode, G.B. 1884. The fisheries and fishery industries of the United States. Sect. I. Natural history of useful aquatic animals. 895 pp.

Grimes, C.B., C.S. Manooch, and G.R. Huntsman. 1982. Reef and rock outcropping fishes of the outer continental shelf of North Carolina and South Carolina, and ecological notes on the red porgy and vermilion snapper. Bull. Mar. Sci. 32(1):227-289.

Hall, R.A., E.G. Zook, and G.M. Meaburn. 1978. National Marine Fisheries Service survey of trace elements in the fishery resource. U.S. Natl. Mar. Fish. Serv. Spec. Sci. Rep. Fish. 721. 313 pp.

Hardy, H.D., Jr. 1978. Serranidae-sea basses. Pages 35-68 in Development of fishes of the Mid-Atlantic Bight. An atlas of egg, larval and juvenile stages. Vol. 3. Aphredoderidae through Rachycentridae. U.S. Fish Wildl. Serv. Biol. Serv. Program FWS/OBS-78/12. 394 pp.

Hildebrand, S.F., and W.C. Schroeder. 1928. Fishes of Chesapeake Bay. U.S. Bur. Fish. Bull. 43. 366 pp.

Hoff, F.H., Jr. 1970. Artificial spawning of black sea bass, Centropristes striatus melanus Ginsburg, aided by chorionic gonadotrophic hormones. Fla. Dep. Nat. Resour. Mar. Res. Lab. Spec. Sci. Rep. No. 25. 17 pp.

Huntsman, G.R. 1976. Offshore headboat fishing in North and South Carolina. U.S. Natl. Mar. Fish Serv. Mar. Fish. Rev. 38(3):13-23.

Huntsman, G.R., and C.S. Manooch III. 1978. Coastal pelagic and reef fishes in the South Atlantic Bight. Pages 97-106 in R.H. Stroud, ed. Marine recreational fisheries 3. Sport Fishing Institute., Washington, D.C. 176 pp.

Huntsman, G.R., C.S. Manooch III, and C.B. Grimes. 1983. Yield per recruit models of some reef fishes of the U.S. South Atlantic Bight. U.S. Natl. Mar. Fish. Serv. Fish. Bull. 81(4):679-695.

Kendall, A.W., Jr. 1972. Description of black sea bass, Centropristis striata (Linnaeus), larvae and their occurrences north of Cape Lookout, North Carolina, in 1966. U.S. Natl. Mar. Fish. Serv. Fish. Bull. 70(4): 1243-1260.

Kendall, A.W., Jr. 1977. Biological and fisheries data on black sea bass, Centropristis striata (Linnaeus). Natl. Mar. Fish. Serv., NEFC Sandy Hook Lab., Tech. Ser. Rep. No. 7. 29 pp.

Lavenda, N. 1949. Sexual differences and normal protogynous hermaphroditism in the Atlantic sea bass, Centropristes striata. Copeia 1949 (3)185-194.

Link, G.W., Jr. 1980. Age, growth, reproduction, feeding and ecological observations on the three species of Centropristis (Pisces: Serranidae) in North Carolina waters. Ph.D. Thesis. University of North Carolina, Chapel Hill. 277 pp.

Low, R.A., Jr. 1981. Mortality rates and management strategies for black sea bass off the southeast coast of the United States. N. Am. J. Fish. Manage. 1(2):93-103.

Manooch, C.S., III, L.E. Abbas, and J.L. Ross. 1981. A biological and economic analysis of the North Carolina charter boat fishery. U.S. Natl. Mar. Fish. Serv. Mar. Fish. Rev. 43(8):1-11.

Mercer, L.P. 1978. The reproductive biology and population dynamics of black sea bass, Centropristis striata. Ph.D. Thesis. The College of William and Mary, Williamsburg, Va. 196 pp.

Miller, R.J. 1959. A review of the sea basses of the genus Centropristes (Serranidae). Tulane Stud. Zool. 7(2):35-68.

Moe, M.A., Jr. 1966. Tagging fishes in Florida offshore waters. Fla. Board Conserv. Mar. Lab. Tech. Ser. No. 49. 40 pp.

Musick, J.A., and L.P. Mercer. 1977. Seasonal distribution of black sea bass, Centropristis striata, in the Mid-Atlantic Bight with comments on the ecology and fisheries of the species. Trans. Am. Fish. Soc. 106 (1):12-25.

Nesbit, R.A., and W.C. Neville. 1935. Conditions affecting the southern winter trawl fishery. Bull. U.S. Bur. Fish. Fish. Circ. No. 18. 12 pp.

Parker, R.O., Jr., and S.W. Ross. 1986. Observing reef fishes from submersibles off North Carolina. Northeast Gulf Sci. 8(1):31-49.

Pearson, J.C. 1932. Winter trawl fishery off the Virginia and North Carolina coasts. U.S. Bur. Fish. Invest. Rep. No. 10. 31 pp.

Powles, H., and C.A. Barans. 1980. Groundfish monitoring in sponge-coral areas off the Southeastern United States. U.S. Natl. Mar. Fish. Serv. Mar. Fish. Rev. 42(5): 21-35.

Reinboth, R. 1965. Sex reversal in the black sea bass Centropristes striatus. Anat. Rec. 151:403 (Abstr.).

Rivers, J.B. 1966. Gear and technique of the sea bass trap fishery in the Carolinas. Commer. Fish. Rev. 28(4):15-20.

Robins, C.R., R.M. Bailey, C.E. Bond, J.R. Brooker, E.A. Lachner, R.N. Lea, and W.B. Scott. 1980. A list of common and scientific names of fishes from the United States and Canada. Am. Fish. Soc. Spec. Sci. Publ. No 12. 174 pp.

Rogers, S.G., H.T. Langston, and T.E. Targett. 1986. Anatomical trauma to sponge-coral reef fishes captured by trawling and angling. U.S. Natl. Mar. Fish. Serv. Fish. Bull. 84:697-704.

Schwartz, F.J., W.T. Hogarth, and M.P. Weinstein. 1981. Marine and freshwater fishes of the Cape Fear Estuary, North Carolina, and their distribution in relation to environmental factors. Brimleyana 7:17-37.

Sedberry, G.R., and R.F. Van Dolah. 1984. Demersal fish assemblages associated with hard bottom habitat in the South Atlantic Bight of the U.S.A. Environ. Biol. Fish. 11(4): 241-258.

Smith, H.M. 1907. The fishes of North Carolina. N.C. Geol. Econ. Surv. II. 423 pp.

Steimle, F.W., Jr., and L. Ogren. 1982. Food of fish collected on artificial reefs in the New York Bight and off Charleston, South Carolina. U.S. Natl. Mar. Fish. Serv. Mar. Fish. Rev. 44(6-7):49-52.

Stone, R.B., L.C. Coston, D.E. Hoss, and F.A. Cross. 1975. Experiments on some possible effects of tire reefs on pinfish (Lagodon rhomboides) and black sea bass (Centropristis striata). U.S. Natl. Mar. Fish. Serv. Mar. Fish. Rev. 37(3): 18-20.

Struhsaker, P. 1969. Demersal fish resources: composition, distribution, and commercial potential of the continental shelf stocks off Southeastern United States. U.S. Fish Wildl. Serv. Fish. Ind. Res. 4(7):261-300.

Tagatz, M.E. 1967. Fishes of the St. Johns River, Florida. Q. J. Fla. Acad. Sci. 30(1):25-59.

Topp, R. 1963. The tagging of fishes in Florida, 1962 program. Fla. Board Conserv. Mar. Res. Lab. Prof. Pap. Ser. No. 5. 76 pp.

Walford, L.A., and R.I. Wicklund. 1968. Monthly sea temperature structure from the Florida Keys to Cape Cod. Serial Atlas of the Marine Environment. Folio 15. American Geographical Society, N.Y.

Waltz, W., W.A. Roumillat, and P.K. Ashe. 1979. Distribution, age structure, and sex composition of the black sea bass, Centropristis striata, sampled along the southeastern coast of the United States. S.C. Mar. Resour. Cent. Tech. Rep. No. 43. 18 pp.

Wenner, C.A. 1983. Species associations and day-night variability of trawl-caught fishes from the inshore sponge-coral habitat, South Atlantic Bight. U.S. Natl. Mar. Fish. Serv. Fish. Bull. 81(3):537-552.

Wenner, C.A., W.A. Roumillat, and C.W. Waltz. 1986. Contributions to the life history of black sea bass, Centropristis striata, off the Southeastern United States. U.S. Natl. Mar. Fish. Serv. Fish. Bull. 84(3):723-741.

Wilson, H.V. 1891. The embryology of the sea bass (Serranus atrarius). U.S. Fish Comm. Bull. for 1889, 9:209-277.

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16. Abstract (Limit: 200 words)
Species profiles are literature summaries on the taxonomy, morphology, range, life history, and environmental requirements of coastal aquatic species. They are designed to assist in environmental impact assessment. The black sea bass, Centropristis striata, is an abundant species associated with the inshore sponge-coral habitat in the South Atlantic Bight (Cape Hatteras to Cape Canaveral). It is a protogynous hermaphrodite (each individual is first a female and then a male) that spawns from January to June on the Continental Shelf. Juveniles utilize estuaries, as well as offshore areas, for nurseries. It is a slow growing species with a life span of about 10 years. Juveniles and adults are bottom-feeding carnivores. Adults have been collected at temperatures as low as 6 °C but are most abundant at temperatures of 8 to 10 °C and above. Juveniles tolerate lower temperatures and greater salinity ranges than adults. Black sea bass are primarily harvested by the recreational hook and line fishery and the commercial trap fishery. Yield-per-recruit analyses indicate that the harvest of black sea bass is less than the maximum possible due to a combination of high fishing pressure and harvest of small fish.

17. Document Analysis a. Descriptors

Estuaries	Temperature
Fishes	Sediments
Fisheries	Feeding habits
Salinity	Life cycles
Growth	Contaminants

b. Identifiers/Open-Ended Terms

Black sea bass	Environmental requirements
Centropristis striata	

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