SEAMAP-SA
ANNUAL REPORT

RESULTS OF TRAWLING EFFORTS IN THE COASTAL HABITAT OF THE SOUTH ATLANTIC BIGHT, FY - 2000

Prepared By

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INTRODUCTION

The Southeast Area Monitoring and Assessment Program - South Atlantic (SEAMAP-SA) Shallow Water Trawl Survey began in1986, funded by the National Marine Fisheries Service (NMFS) and conducted by the South Carolina Department of Natural Resources - Marine Resources Division (SCDNR-MRD). This survey provides long-term, fishery-independent data on seasonal abundance and biomass of all finfish, elasmobranchs, decapod and stomatopod crustaceans, and cephalopods that are accessible by high-rise trawls. Twenty-three finfish and four decapod species were selected as priority species by the SEAMAP-SA Shallow Water Trawl Committee. Additional data recorded for target species of fishes and decapod crustaceans include measurements of length or width for all priority species and reproductive information on commercially important penaeid shrimp and blue crabs.

Field data collected by the SEAMAP-SA Shallow Water Trawl Survey are available to users within a few weeks of collection. SEAMAP-SA trawl data collected from 1986 to the present are now available through the SEAMAP-SA Data Management Office at NMFS[1]. Management agencies and scientists currently have access to eleven years (1990-2000) of comparable trawl data from near-shore coastal areas of the South Atlantic Bight.

This report summarizes information on species composition, abundance, and biomass from SEAMAP-SA trawls made during the 2000 survey. Length-frequency distributions of nine commercially, recreationally, and ecologically important species, along with reproductive attributes of the commercially important penaeid species, are presented.

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[1]Data are available through the SEAMAP Data Manager (NMFS Mississippi Laboratory, P.O. Box 1207, Pascagoula, MS 39568-1207).

METHODS AND MATERIALS

Data Collection

Samples were taken by trawl from the coastal zone of the South Atlantic Bight (SAB) between Cape Hatteras, North Carolina, and Cape Canaveral, Florida (Figure 1). Multi-legged cruises were conducted in spring (April 17 - May 10), summer (July 18 - August 1), and fall (October 3- November 1).

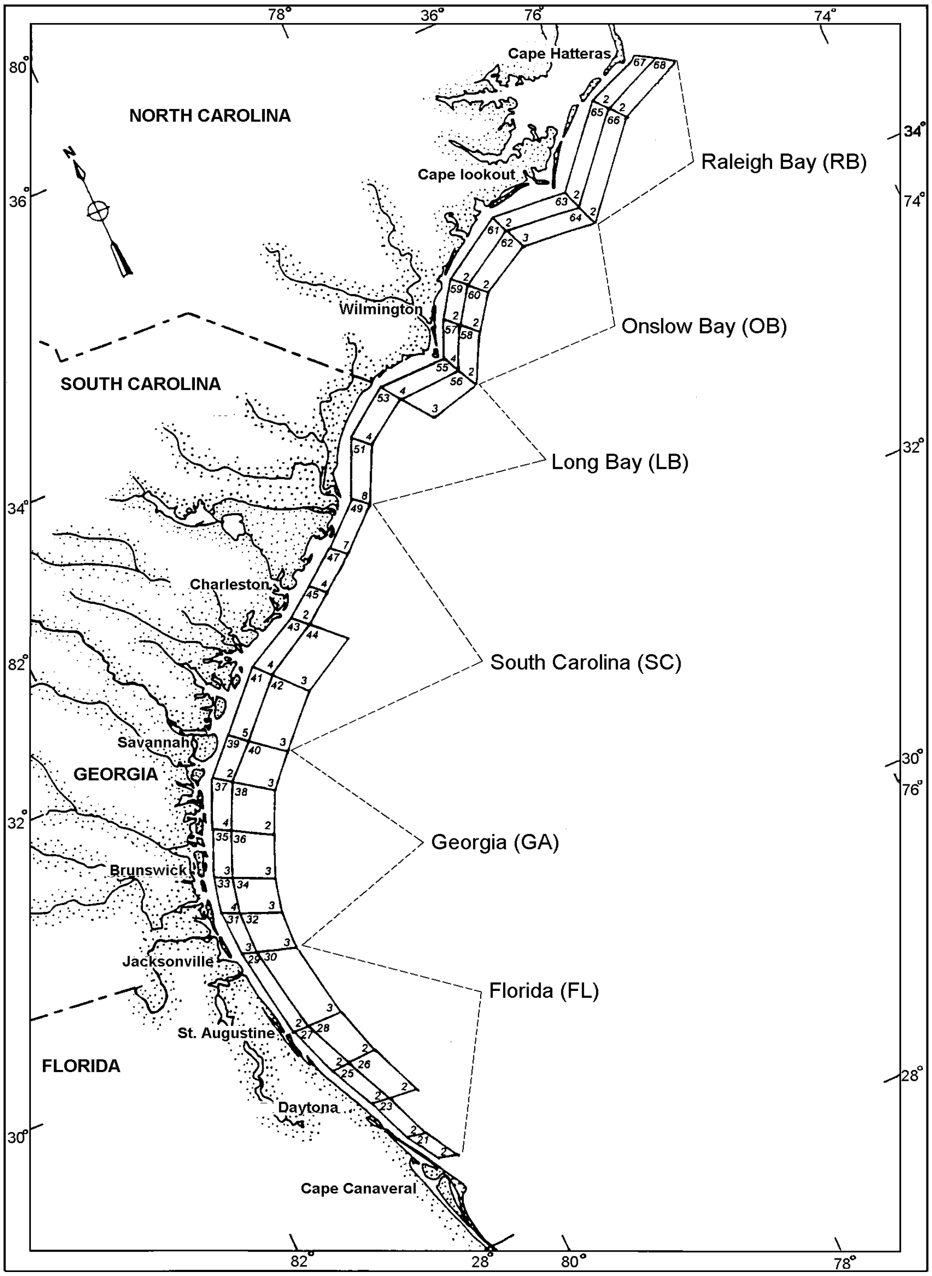

Figure 1. Strata sampled by the SEAMAP-SA Shallow Water Trawl Survey (2000). Stratum number is located in the upper left and number of trawl samples collected in the lower right of each stratum. Strata are not drawn to scale.

Stations were randomly selected from a pool of trawlable stations within each stratum. The number of stations in each stratum was proportionally allocated according to the total surface area of the stratum, with a minimum of 2 stations per stratum. A total of 78 stations were sampled each season within twenty-four inner strata. Inner or shallow strata were delineated by the 4 m depth contour inshore and the 10 m depth contour offshore. Additional stations were sampled in deeper strata with station depths ranging from 10 to 19 m. Twenty-seven stations located within ten outer strata in the southern half of the SAB were sampled only in spring to collect data on spawning of white shrimp. Sixteen stations in the seven outer strata off North Carolina were sampled in fall to gather data on the reproductive condition of brown shrimp. No stations in the outer strata were sampled in summer.

The R/V *Lady Lisa*, a 75-ft (23-m) wooden-hulled, double-rigged, St. Augustine shrimp trawler owned and operated by the South Carolina Department of Natural Resources (SCDNR), was used to tow paired 75-ft (22.9-m) mongoose-type Falcon trawl nets (manufactured by Beaufort Marine Supply; Beaufort, S.C.) without TED's. The body of the trawl was constructed of #15 twine with 1 ⅞-in (47.6-mm) stretch mesh. The cod end of the net was constructed of #30 twine with 1 ⅝-in (41.3-mm) stretch mesh and was protected by chafing gear of #84 twine with 4-in (10-cm) stretch "scallop" mesh. A 300-ft (91.4-m) three-lead bridle was attached to each of a pair of wooden chain doors which measured 10 ft x 40 in (3.0-m x 1.0-m), and to a tongue centered on the head-rope. The 86-ft (26.3-m) head-rope, excluding the tongue, had one large (60-cm) Norwegian float attached top center of the net between the end of the tongue and the tongue bridle cable and two 9-in (22.3-cm) PVC foam floats located one-quarter of the distance from each end of the net webbing. A 1-ft chain drop-back was used to attach the 89-ft foot-rope to the trawl door. A ¼-in (0.6-cm) tickler chain, which was 3.0-ft (0.9-m) shorter than the combined length of the foot-rope and drop-back, was connected to the door alongside the foot-rope.

Trawls were towed for twenty minutes, excluding wire-out and haul-back time, exclusively during daylight hours (1 hour after sunrise to 1 hour before sunset). Contents of each net were sorted separately to species, and total biomass and number of individuals were recorded for all species of finfish, elasmobranchs, decapod and stomatopod crustaceans, and cephalopods.

Only total biomass was recorded for all other miscellaneous invertebrates and algae, which were treated as two separate taxonomic groups. Marine turtles captured incidentally were measured, weighed, tagged, and released according to NMFS permitting guidelines. When large numbers of specimens of a species occurred in a collection, the entire catch was sorted and all individuals of that species were weighed, but only a randomly selected subsample was processed and total number was calculated. For trawl catches where visual estimation of weight of total catch per trawl exceeded 500 kg, the contents of each net were weighed prior to sorting and a randomly chosen subsample of the total catch was then sorted and processed.

In every collection, each of the twenty-seven target species was weighed collectively and individuals were measured to the nearest centimeter (Appendix 1). For large collections of the target species, a random subsample consisting of thirty to fifty individuals was weighed and measured. Depending on the species, measurements were recorded as total length, fork length, or carapace width. Additional data was collected on individual specimens of penaeid shrimp, blue crabs, and sharks. For the penaeid shrimp, *Litopenaeus setiferus*, *Farfantepenaeus aztecus*, and *F. duorarum,* formerly *Penaeus* (Perez-Farfante and Kensley, 1997), total length (mm), sex, female ovarian development, male spermatophore development, and occurrence of mated females were noted. Carapace width (mm), individual weight, sex, and presence and developmental stage of eggs were recorded for *Callinectes sapidus*. Individuals of all shark species were weighed, measured to the nearest centimeter (both total length and fork length), and sex was noted.

Hydrographic data collected at each station included surface and bottom temperature and salinity measurements taken with a CTD profiler, sampling depth, and an estimate of wave height. In addition, atmospheric data on air temperature, barometric pressure, precipitation, and wind speed and direction were also noted at each station.

Data Analysis

The SAB was separated into six regions for data analysis (Figure 1). Raleigh Bay (RB), Onslow Bay (OB) and Long Bay (LB) were each considered to be regions. South Carolina, excluding Long Bay (SC), Georgia (GA), and northern Florida (FL) were also treated as separate regions.

Data from the paired trawls were pooled for analysis to form a standard unit of effort (tow). Density estimates, expressed as number of individuals or kilograms per hectare (ha), were standardized by dividing the mean catch per tow by the mean area (ha) swept by the combined trawls. Mean area swept by a net was calculated by multiplying the width of the net opening (13.5 m) as determined by Stender and Barans (1994) by the distance (m) trawled, calculated from starting and ending coordinates, and dividing the product by 10000 m^2/ha. Only those data collected in the inner strata are included in general discussions.

Results for *Micropogonias undulatus*, *Leiostomus xanthurus*, *Menticirrhus americanus, Cynoscion regalis*, *Scomberomorus cavalla*, *S. maculatus*, *Litopenaeus setiferus*, *Farfantepenaeus aztecus*, and *F. duorarum* are presented and discussed individually in this report. Statistically significant differences in lengths of individuals among regions and seasons were determined using the non-parametric Kruskal-Wallis test, due to heterogeneity of variances (Sokal and Rohlf, 1981). Contingency tables using the G-statistic were used to determine if occurrence of ripe penaeid shrimp were independent of season and region.

RESULTS AND DISCUSSION

Hydrographic Measurements

Hydrographic patterns of temperature and salinity in the SAB are driven by four major influences which fluctuate seasonally: river run-off, the Gulf Stream, a southerly flowing coastal current, and atmospheric conditions. The warm, highly saline waters of the Gulf Stream, in close proximity to coastal waters off Florida and in Raleigh Bay, elevate temperatures and salinities in those areas (Pietrafesa et al., 1985). Most of the river run-off in the SAB occurs south of Cape Fear (Blanton and Atkinson, 1983; McClain et al., 1988). Water of lower salinity created by freshwater influx is pushed southward by the southerly flowing coastal current; however, this movement is impeded by the northerly flowing Gulf Stream off northern Florida (Blanton, 1981; Blanton and Atkinson, 1983). The result of this process is a concentration of lower salinity water off southern South Carolina and Georgia. Seasonal fluctuations in river run-off, atmospheric conditions, and migrations of the Gulf Stream dictate the magnitudes of these hydrographic patterns.

Typical seasonal and regional patterns of temperature and salinity were observed during the 2000 survey (Table 1), with temperatures and salinities being lower in spring and fall and higher in summer. Temperatures were lowest in the northernmost regions and highest off Georgia and Florida. Highest salinity occurred off Florida, as expected, and lowest occurred off South Carolina and Georgia.

Table 1. Seasonal mean bottom temperatures (°C) and salinities (‰) from each region for 2000. Regions are abbreviated as follows: Raleigh Bay (RB), Onslow Bay (OB), Long Bay (LB), South Carolina (SC), Georgia (GA), and Florida (FL).

	RB	OB	LB	SC	GA	FL	ALL REGIONS
SPRING							
0 Temperature	20.9	19.3	18.8	18.9	19.6	22.8	19.7
0 Salinity	35.7	34.8	33.7	33.5	32.7	35.7	33.9
SUMMER							
0 Temperature	25.9	27.4	28.2	29.1	28.2	24.0	27.7
0 Salinity	35.3	35.6	35.1	35.6	36.5	36.3	35.7
FALL							
0 Temperature	22.0	20.2	20.3	21.4	23.0	25.4	21.9
0 Salinity	33.3	35.1	34.9	34.8	34.5	35.1	34.8
ALL SEASONS							
0 Temperature	22.9	22.3	22.4	23.1	23.6	24.1	23.1
0 Salinity	34.8	35.2	34.6	34.6	34.6	35.7	34.8

Species Composition

The 2000 sampling effort resulted in the collection of 174 species (Appendix 2) from both inner and outer strata. Trawls in inner strata produced 171 species of which 115 species were finfish, 21 species were elasmobranchs, 30 species were decapod crustaceans, 2 species were stomatopod crustaceans, and 3 genera were cephalopods. Outer strata produced a total of 106 species, 74 of which were finfish, 9 were elasmobranchs, 18 were decapods, 2 were stomatopods, and 3 genera were cephalopods.

The number of species collected varied seasonally among inner strata (Table 2), with an increase in diversity from spring to fall. Regionally, the greatest number of species was found in Long Bay and Georgia.

Table 2. Summary of effort (number of trawl tows), diversity (number of species), abundance (number of individuals), biomass (kg), density of individuals (number/ha), and density of biomass (kg/ha), excluding miscellaneous invertebrates and algae, by region and season from inner strata.

	Effort	**Diversity**	**Abundance**		**Density**	
	(Tows)	**(Species)**	**Individuals**	**Biomass**	**Individuals**	**Biomass**
Region						
RALEIGH BAY	12	88	36886	2497.9	782.1	53.0
ONSLOW BAY	30	105	54179	3834.6	459.5	32.5
LONG BAY	48	124	39933	5581.5	211.7	29.6
S. CAROLINA	66	111	75652	3244.3	291.7	12.5
GEORGIA	48	120	65971	1626.3	349.7	8.6
FLORIDA	30	112	51477	3481.5	436.6	29.5
Season						
SPRING	78	112	103066	8081.4	336.2	26.4
SUMMER	78	131	126559	7729.9	412.9	25.2
FALL	78	144	94473	4454.8	308.2	14.5

Abundance, Biomass, and Density Estimates

Total catch for all inner and outer strata from the 2000 survey was 348,394 individuals with a biomass of 30,189 kg. Miscellaneous invertebrates and algae contributed an additional 7,847 kg of biomass. Inner strata yielded 324,098 specimens (1385 individuals/tow), weighing 20,266 kg (118.2 kg/tow), with an additional 7,385 kg of miscellaneous invertebrate and algae biomass. The overall density of individuals for inner strata (352 individuals/ha) was slightly higher than the estimate for the previous 10-year period (345 individuals/ha) (Figure 2).

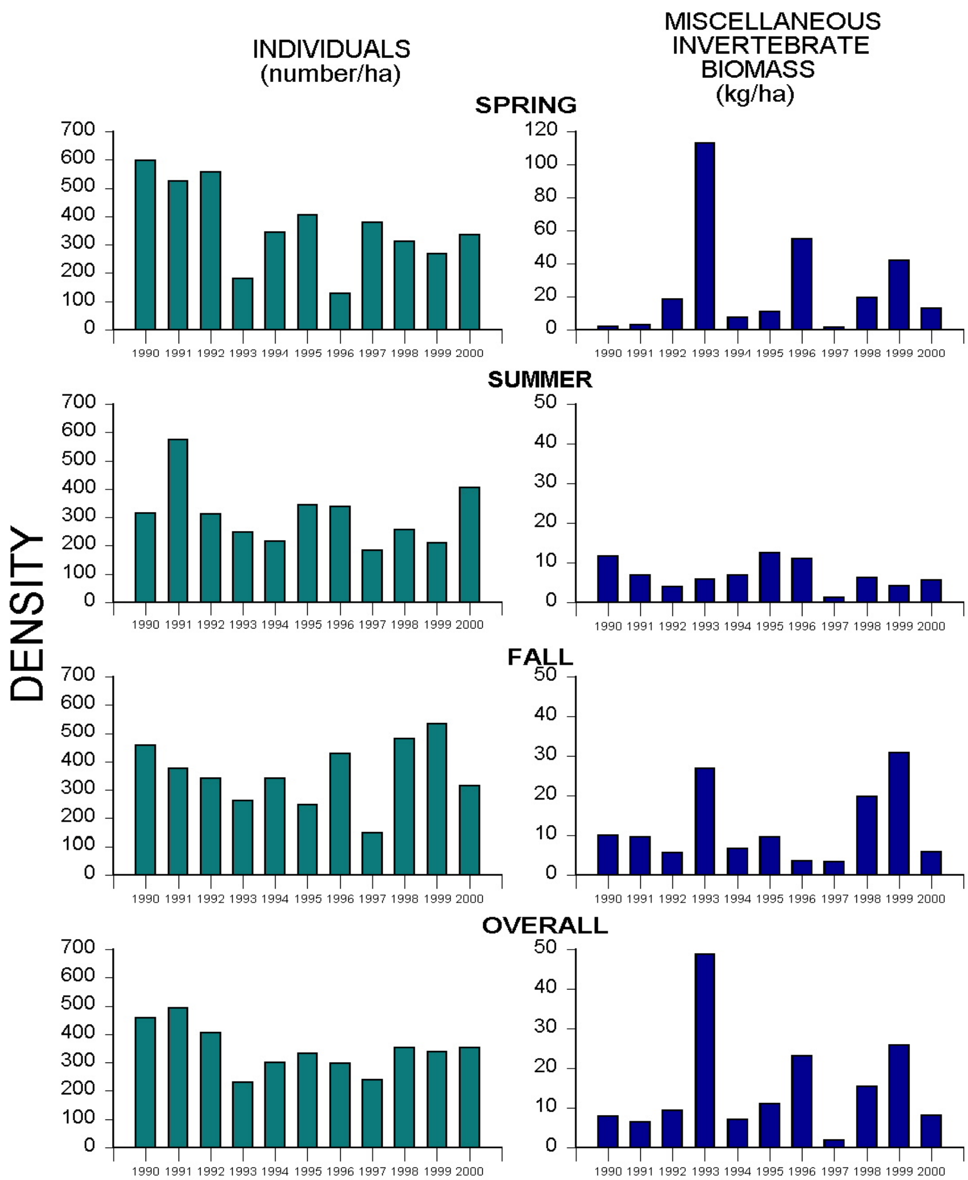

Figure 2. Annual densities from inner strata.

Densities of individuals in the inner depth-zone were highest in summer (Figure 2). The summer density estimates were the second highest in the history of the survey. Densities of biomass peaked in spring and decreased in subsequent seasons (Table 2). The highest regional density of individuals and biomass occurred in Raleigh and Onslow Bays, reflecting relatively large catches of sciaenids. The third highest density occurred in waters off Florida. Long Bay and South Carolina had the lowest densities of individuals.

Patterns of abundance in the SAB generally reflect the abundance of two members of the sciaenid family, the spot, *Leiostomus xanthurus*, and the Atlantic croaker, *Micropogonias undulatus,* which have been consistent in their numerical dominance among years. These two species constituted more than 21% of the total catch during the 2000 survey. The Atlantic croaker, *Micropogonias undulatus* was the numerically dominant species, whereas the spot, *Leiostomus xanthurus*, ranked third in abundance, after the Atlantic thread herring, *Opithonema oglinum*. The white shrimp, *Litopenaeus setiferus,* ranked ninth overall and was the most abundant decapod crustacean collected, followed by the brown shrimp, *Farfantepenaeus aztecus*, and the portunid crab, *Callinectes similis*. Excluding miscellaneous invertebrates and algae, the bullnose ray, *Myliobatis freminvillei,* ranked first in biomass, followed by Atlantic croaker and spot (Table 3).

Table 3. Regional and seasonal estimates of density of abundance (individuals/ha) and biomass (kg/ha), excluding miscellaneous invertebrates and algae, for dominant species from inner strata in 2000.

	Inner	**Region**						**Season**		
	Strata	**RB**	**OB**	**LB**	**SC**	**GA**	**FL**	**SPR**	**SUM**	**FAL**
Abundance										
Micropogonias undulatus	43.6	203.5	65.6	37.5	57.3	1.7	11.8	18.0	96.2	15.1
Opisthonema oglinum	41.7	4.2	37.1	7.3	7.6	153.3	10.2	111.2	3.3	10.4
Leiostomus xanthurus	31.7	190.5	49.3	29.8	26.7	0.9	20.4	33.9	44.3	16.4
Anchoa hepsetus	22.0	60.8	47.0	28.9	4.8	12.2	24.9	13.8	13.8	39.6
Cynoscion nothus	19.1	0.7	8.6	3.0	7.1	4.2	109.6	17.6	36.3	2.8
Chloroscombrus chrysurus	18.9	0.09	3.2	1.6	9.5	51.8	36.4	15.6	14.7	27.1
Biomass										
Myliobatis freminvillei	4.3	4.8	4.0	16.1	0.6	0.4	0.2	12.2	0.004	0.7
Micropogonias undulatus	2.6	13.0	5.4	2.8	2.2	0.09	0.4	1.1	5.4	1.1
Leiostomus xanthurus	2.0	12.2	4.4	1.7	1.1	0.05	1.6	1.6	2.8	1.6
Cynoscion nothus	1.7	0.07	0.8	0.2	0.3	0.1	10.9	1.0	3.9	0.03
Menticirrhus americanus	0.9	0.9	0.5	0.2	1.2	0.7	2.1	0.5	1.4	0.8
Larimus fasciatus	0.7	1.6	0.8	1.8	0.3	0.04	2.3	0.3	1.6	0.2

Outer strata produced fewer specimens than those in the inner depth-zone, with a total of 24,296 individuals and 565 individuals/tow (spring/south: 10,130 individuals, 375 individuals/tow, 95 individuals/ha; fall/north: 14,166 individuals, 885 individuals/tow, 222 individuals/ha). Although spot and Atlantic croaker are sometimes numerically important in the outer depth-zones in both seasons, they play a less dominant role in the outer strata. In spring collections in the southern SAB, *Loligo* sp. was the most abundant taxon in outer strata, followed by *Anchoa hepsetus*, *Chloroscombrus chrysurus*, and *Opisthonema oglinum*. Spot ranked 26th, contributing less than 1% of the total, and Atlantic croaker were absent from collections made in spring in outer strata. *Stenotomus* sp. was most numerous in samples taken in outer strata in the northern SAB in fall, its abundance greater than the combined abundance of all other species sampled in those outer strata. Other species of importance in fall collections in outer strata included *Loligo* sp., *Haemulon aurolineatum,* and *Synodus foetens*. Spot and Atlantic croaker ranked 5th and 8th , respectively, and their combined total made up less than 8% of the individuals collected in fall.

In 2000, twenty-six sea turtles were taken in SEAMAP-SA trawls (Appendix 3). Twenty-four loggerhead sea turtles (*Caretta caretta*) and two Kemp's ridley turtles (*Lepidochelys kempi*) were removed from trawl catches alive. All turtles were measured, weighed, tagged with Inconel flipper tags supplied by NMFS, and released in good condition near the site of capture.

Distribution and Abundance of Priority Finfish Species

Micropogonias undulatus

The Atlantic croaker ranges from Argentina to the Gulf of Maine (Chao, 1978). This species is one of the most abundant finfish species in trawl catches in the SAB (Wenner and Sedberry, 1989) and is considered to be an excellent food fish. In addition to trawls, croaker are also caught with pound nets, gill-nets, trammel nets and seines, and also on hook-and-line by sports fishermen (Chao, 1978).

Micropogonias undulatus was the most abundant species collected in SEAMAP-SA samples in the 2000 survey (Appendix 2). The 40,092 individuals (2363 kg) made up 12% of the total number of specimens taken in inner strata. Density estimates for the inner strata over the entire SAB were 43.6 individuals/ha and 2.6 kg/ha. Density of individuals was lower than the estimate for the last two years (Figure 3).

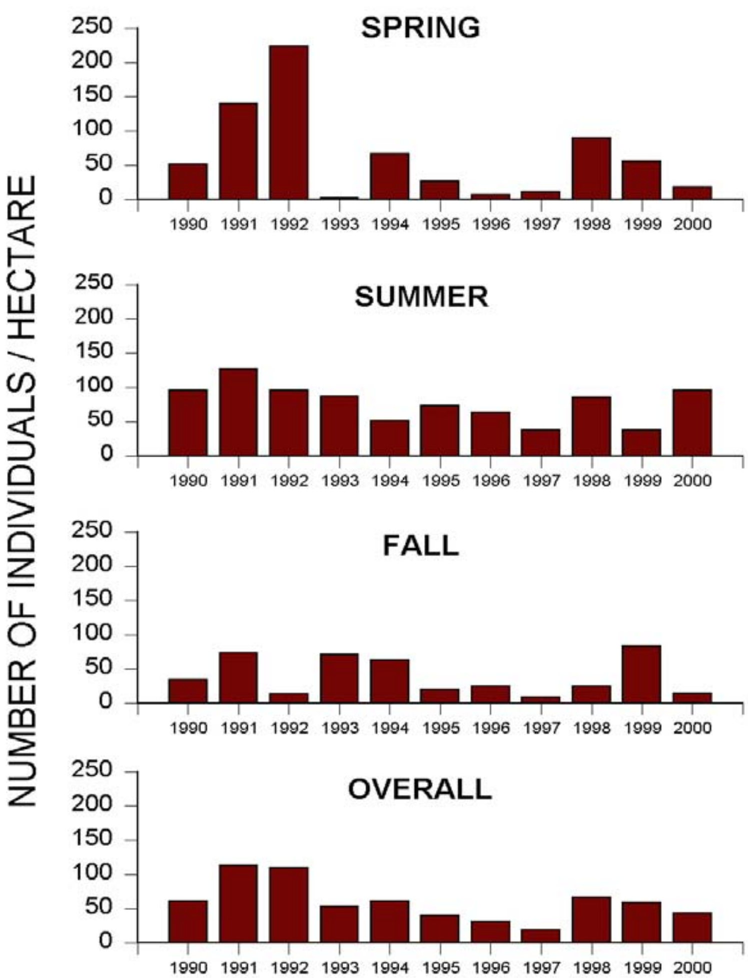

Figure 3. Annual densities of *Micropogonias undulatus* from inner strata

The highest regional and seasonal densities of individuals occurred in Raleigh Bay in spring and fall (Table 4). Highest overall regional density occurred in Raleigh Bay. Regional densities were greatest in spring in the northernmost strata (Raleigh and Onslow Bays) and in summer in Onslow Bay and South Carolina. Outer strata produced 363 specimens, all from fall collections in the northern SAB (fall/north: n = 363, 0/ha = 5.7).

Table 4. Estimates of density (number of individuals/hectare) for *Micropogonias undulatus* among inner strata 2000.

	Spring	Summer	Fall	Region
Raleigh Bay	423.1	68.2	176.5	203.5
Onslow Bay	9.6	159.4	24.9	65.6
Long Bay	0.2	109.3	2.6	37.5
South Carolina	0.07	163.1	5.3	57.3
Georgia	1.6	0.06	3.4	1.7
Florida	2.7	31.2	1.5	11.8
Season	18.0	96.2	15.0	43.6

Total lengths of Atlantic croaker from inner strata ranged from 4 to 26 cm (0 = 17.4 cm, n = 40,092). Lengths differed significantly among seasons ($X^2 = 280$, $p < 0.0001$). The mean length of Atlantic croaker was greatest in spring, dropped in summer due to the recruitment of YOY, and increased in fall as the result of juvenile growth (Figure 4). The spring length-frequency distribution appeared to comprise mostly Age I and a few Age II fish. The inclusion of smaller specimens in summer collections resulted in a length-frequency distribution representing mostly Age I fish that were spawned late and some YOY specimens. Fall collections consisted of mostly Age I, YOY, and a few Age II fish.

Based on length-at-age data, in all seasons the numerically dominant fish were probably Age 0 and Age I, with a few Age II fish present, primarily in spring. Length also varied significantly among regions ($X^2 = 16{,}011$, $p < 0.0001$), and mean lengths ranged from 15.0 cm off South Carolina to 19.5 cm in Onslow Bay (Figure 5). The length-frequency distribution in Raleigh Bay comprised primarily (87%) of fish caught in spring and fall. The length-frequency distributions from Long Bay, Onslow Bay, and South Carolina primarily represent fish caught in summer, when smaller specimens were taken. In waters off Georgia only 1% of the fish were collected in summer. The majority of specimens were taken in fall, when larger animals were collected in that region. Smaller specimens from waters off Georgia and Florida were taken in spring. The majority (88%) of the Atlantic croaker taken off Florida were caught during summer cruises; only 4% were collected in fall trawls.

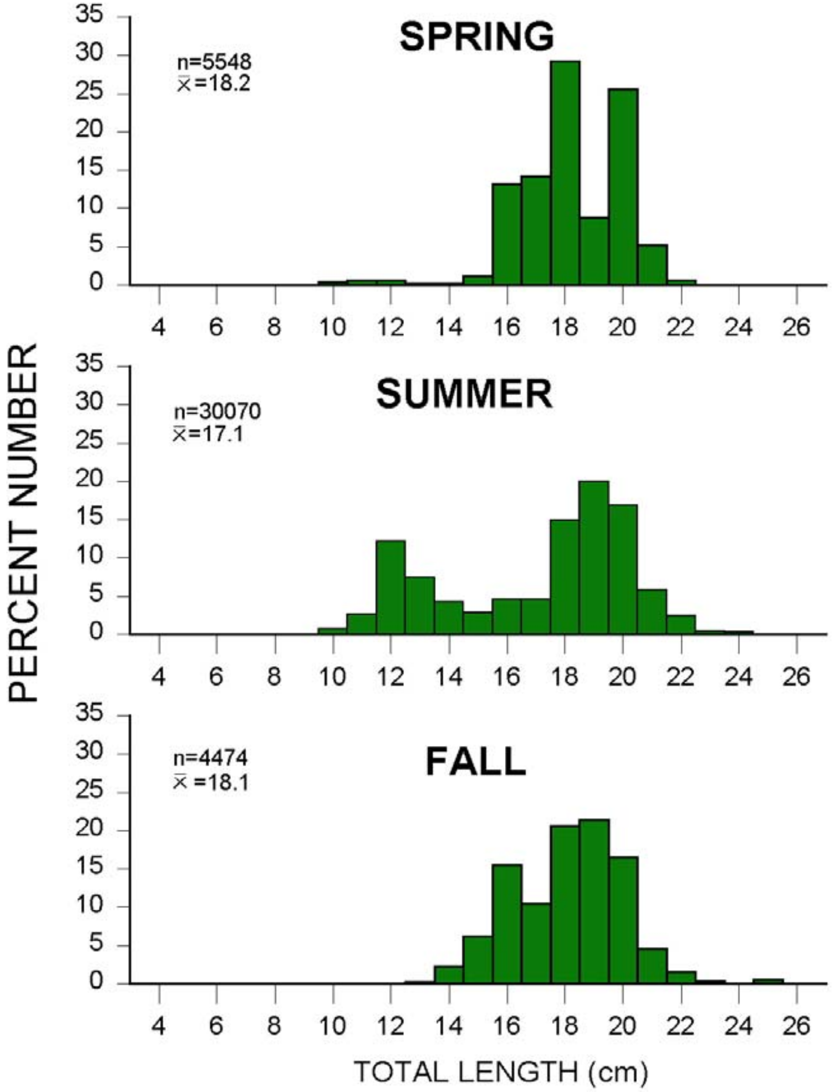

Figure 4. Seasonal length-frequencies of *Micropogonias undulatus* from inner strata in 2000.

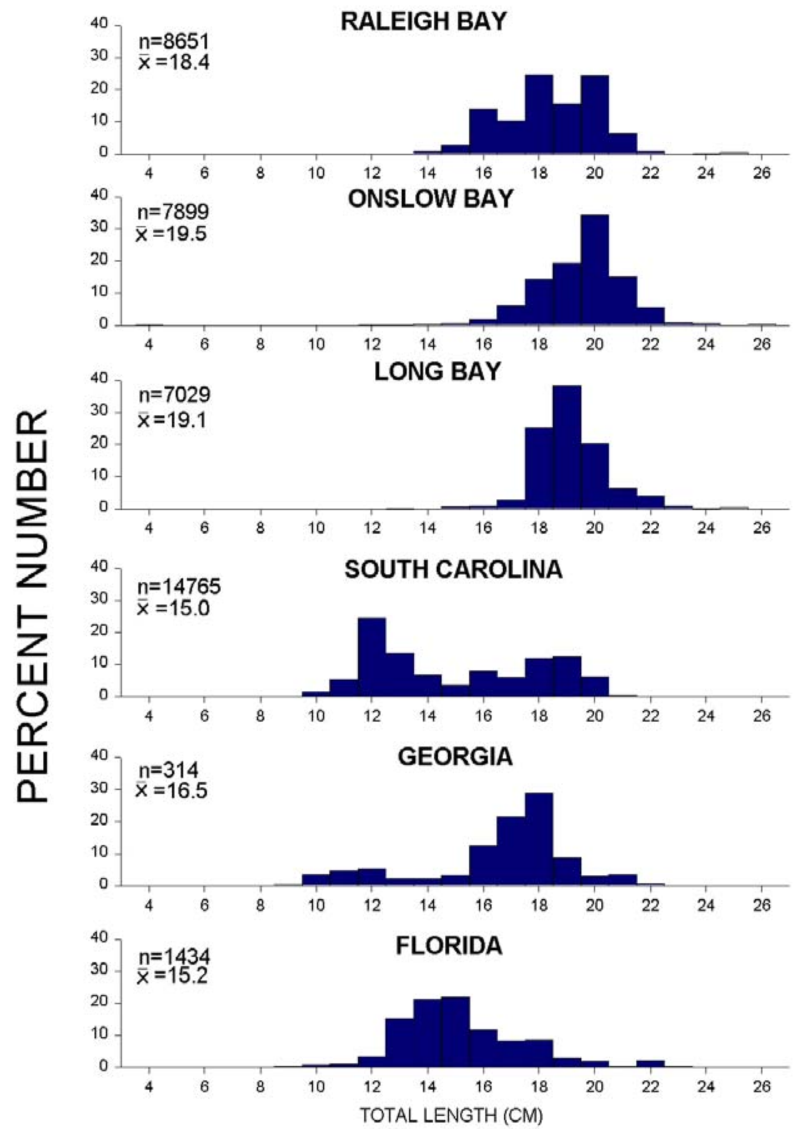

Figure 5. Regional length-frequencies of *Micropogonias undulatus* from inner strata in 2000.

Leiostomus xanthurus

The spot ranges from Massachusetts throughout the Gulf of Mexico to the mouth of the Rio Grande (Chao, 1978) and is one of the most widely occurring and abundant fishes in the coastal waters of the South Atlantic Bight (Wenner and Sedberry, 1989). Spot migrate offshore to spawn in early November through late January (Flores-Coto and Warlen, 1993) and are subjected to heavy commercial and recreational fishing pressure at that time. Historically, the largest spot fishery has been the commercial gill-net fishery, which has contributed to the great fluctuations in commercial landings over the last 60 years (Mercer, 1989). Furthermore, recreational landings have been estimated to exceed commercial landings for the last several years (Office of Fisheries Management, South Carolina Department of Natural Resources).

Leiostomus xanthurus was the third most abundant species collected by SEAMAP-SA from 2000 (Appendix 2). The 29,140 (31.7 individuals/ha) spot collected in the inner strata weighed 1867 kg (2.0 kg/ha) and constituted 9% of the total number of individuals taken in inner strata. Density of individuals increased slightly over the levels observed in 1998 and 1999, but was the third lowest density in the history of the survey (Figure 6).

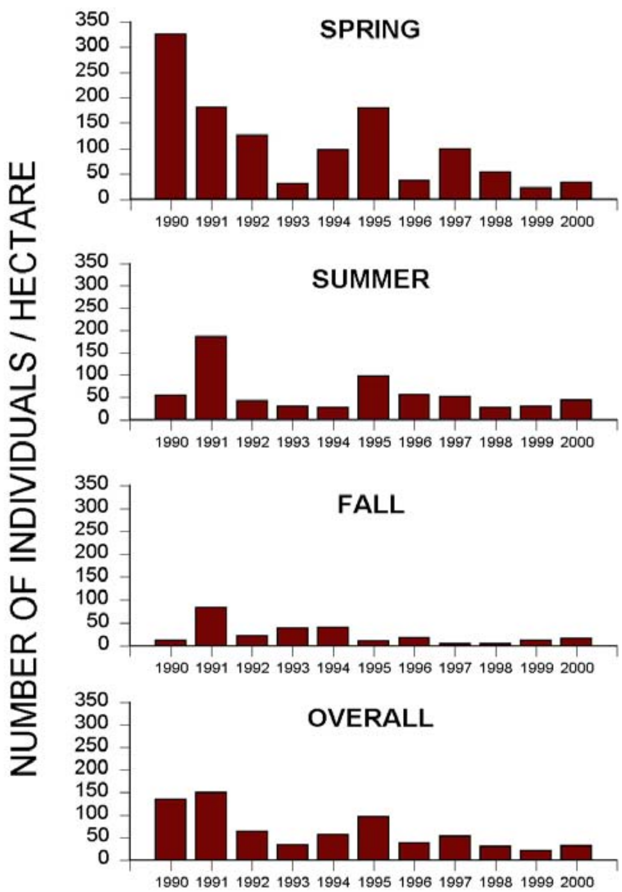

Figure 6. Annual densities of *Leiostomus xanthurus* from inner strata

The greatest seasonal density of abundance occurred in the northern portion of the SAB(Table 5). Density of abundance peaked in summer, then declined to the lowest point in fall. The lowest regional density was observed in waters off Georgia. In the outer strata, 734 spot were collected, the majority taken in the northern SAB in fall (spring/south: n = 17, 0/ha = 0.2; fall/north: n = 717, 0/ha = 11.3).

Table 5 . Estimates of density (number of individuals/hectare) for *Leiostomus xanthurus* among inner strata 2000.

	Spring	Summe	Fall	Region
Raleigh Bay	394.0	5.2	228.8	190.5
Onslow Bay	10.0	109.9	26.3	49.3
Long Bay	62.5	23.2	2.5	29.8
South Carolina	16.0	60.9	2.3	26.7
Georgia	0.4	2.0	0.2	0.9
Florida	2.1	57.4	1.6	20.4
Season	33.9	44.3	16.2	31.7

Total lengths of spot from the SEAMAP-SA survey (2000) ranged from 7 to 25 cm in inner strata, with a mean length of 15.6 cm (n = 29,140). Spot collected appeared to be fish of ages 0, I and II. Lengths varied significantly among seasons ($X^2 = 4518$, $p < 0.0001$). The mean length of spot increased from spring to fall (Figure 7).

Length also varied significantly among regions ($X^2 = 7975$, $p < 0.0001$). The length-frequency distribution of spot represents primarily specimens captured during spring and summer cruises. In all regions, with the exception of a few individuals, smaller specimens in the length-frequency distribution were collected during summer. Larger specimens were collected during fall. The mean length of spot was greatest in Florida and Onslow Bay (Figure 8).

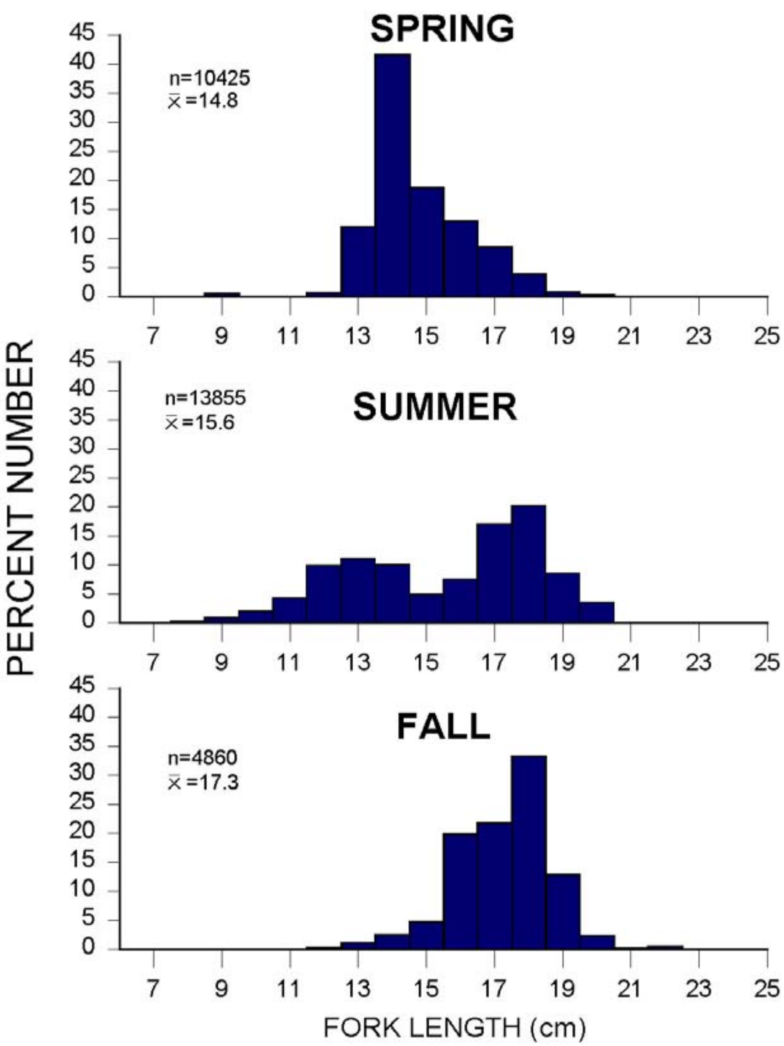

Figure 7. Seasonal length-frequencies of *Leiostomus xanthurus* from inner strata in 2000.

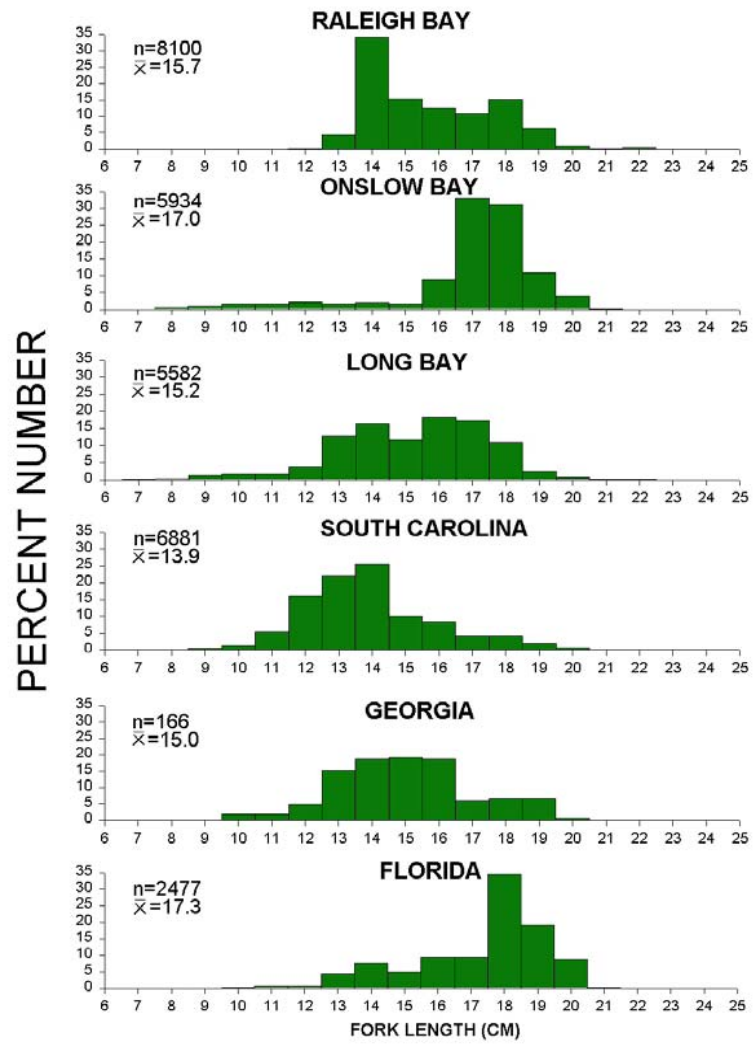

Figure 8. Regional length-frequencies of *Leiostomus xanthurus* from inner strata in 2000.

Menticirrhus americanus

The southern kingfish ranges from New England to Brazil (Chao 1978) and is the most abundant species in the genus occurring in the South Atlantic Bight. Southern kingfish attain the largest maximum body size of the three species of *Menticirrhus* and are important both commercially and recreationally.

The southern kingfish, *Menticirrhus americanus*, was the third most abundant target finfish, ranking 16th overall and in inner strata. Inner strata produced a total of 7,690 southern kingfish (8.4 individuals/ha) weighing 831 kg (0.9 kg/ha). Although the density of *Menticirrhus americanus* does not fluctuate a great deal annually, 2000 estimates represented a slight increase over levels observed for the last three years (Figure 9).

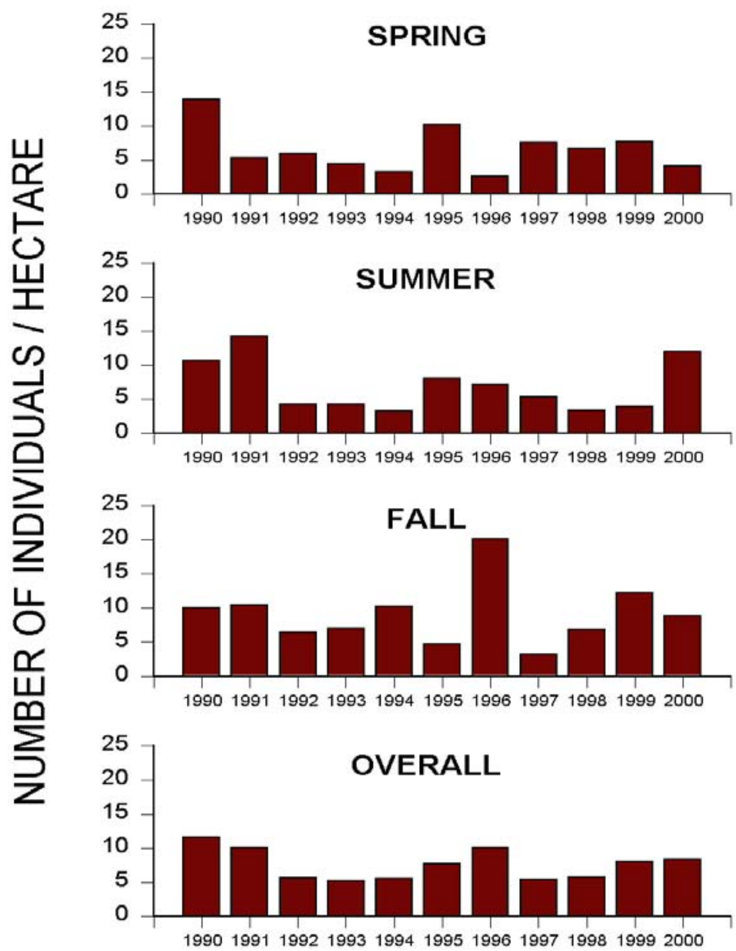

Figure 9. Annual densities of *Menticirrhus americanus* from inner strata

Density was greatest in summer and in waters off Florida (Table 6). The southern kingfish exhibited the highest percent occurrence of all priority species, being present in approximately 77% of all tows. Outer strata produced 192 specimens (spring/south: n = 132, 0/ha = 1.2; fall/north: n = 60, 0/ha = 0.9).

Table 6 . Estimates of density (number of individuals/hectare) for *Menticirrhus americanus* among inner strata 2000.

	Spring	Summer	Fall	Region
Raleigh Bay	14.7	1.4	14.3	9.6
Onslow Bay	1.2	1.6	6.0	2.8
Long Bay	1.7	1.5	1.1	1.4
South Carolina	3.8	22.3	7.2	11.2
Georgia	5.4	5.0	15.1	8.3
Florida	6.9	31.9	16.0	18.1
Season	4.2	12.0	8.9	8.4

Total lengths of *Menticirrhus americanus* ranged from 8 to 36 cm (0 = 21.3, n = 7690). Length was significantly different among seasons ($X^2 = 660$, $p < 0.0001$). Mean length decreased from summer to fall, representing the recruitment of YOY individuals (Figure 10). Length also varied significantly among regions ($X^2 = 510$, $p < 0.0001$), with larger fish occurring in the northern SAB and off Florida (Figure 11). The seasonal length-frequency distributions of southern kingfish were similar throughout the SAB, with most of the smaller fish collected in summer and fall collections. Regions in the southern SAB comprised approximately 87% of all southern kingfish taken from inner strata.

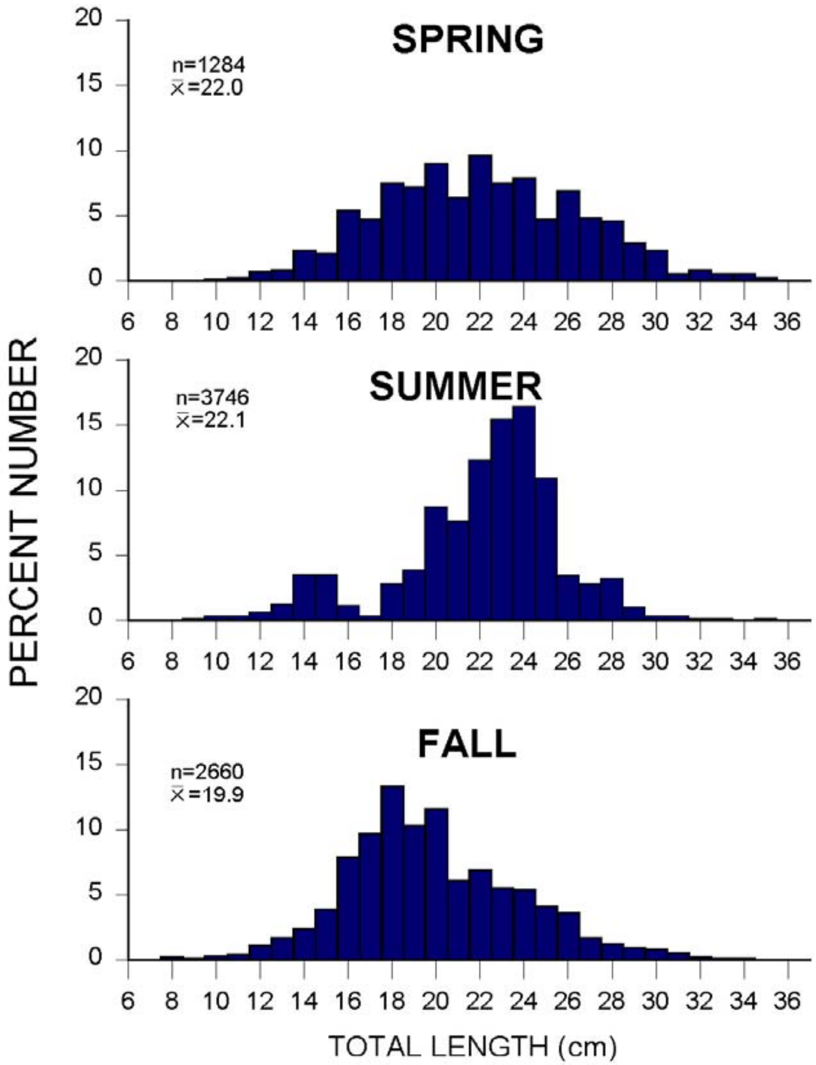

Figure 10. Seasonal length-frequencies of *Menticirrhus americanus* from inner strata in 2000.

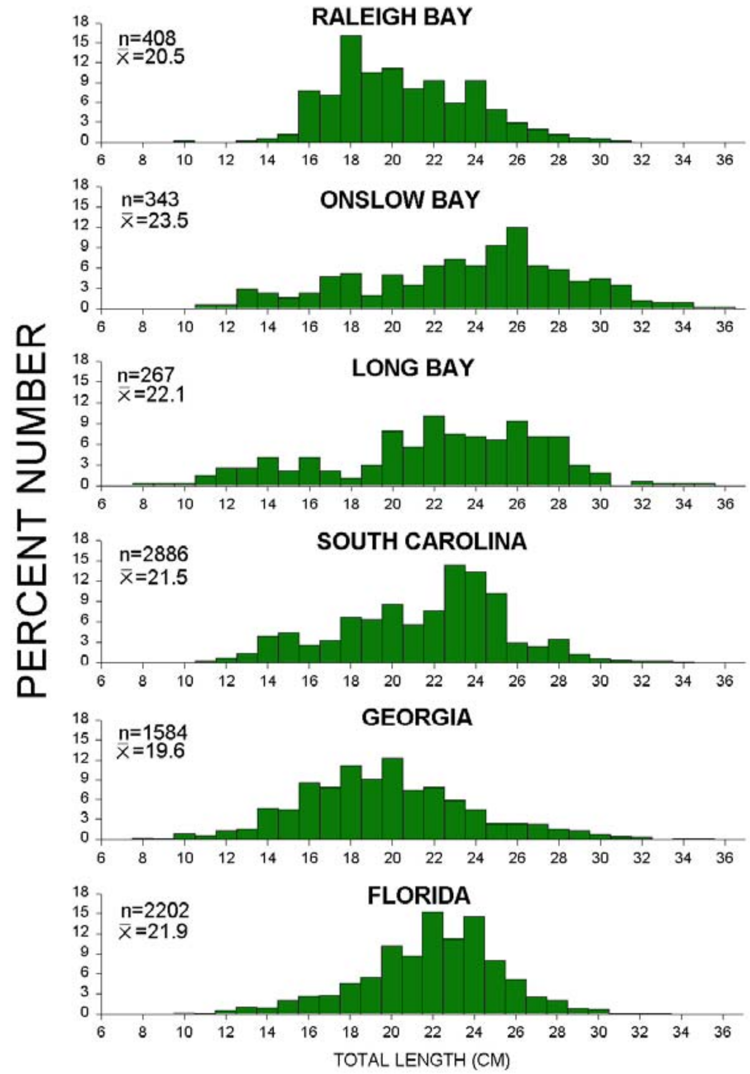

Figure 11. Regional length-frequencies of *Menticirrhus americanus* from inner strata in 2000.

Cynoscion regalis

Weakfish occur along the Atlantic coast of the United States from Nova Scotia to southern Florida and occasionally to the Gulf coast of Florida (Chao, 1978). Weakfish in the SAB are reported to move south from waters off North Carolina to Florida during fall migrations (Mercer, 1985). The weakfish is an important commercial and recreational species, primarily caught by hook-and-line, gill-nets, and bottom trawls (Bigelow and Schroeder, 1953; Thomas, 1971; Chao, 1978; Mercer, 1985).

Inner strata yielded a total of 3,332 weakfish (3.6 individuals/ha) weighing 284 kg (0.3 kg/ha). In 2000, density of individuals dropped to a level near that of the lowest historical density observed in 1994 (Figure 12).

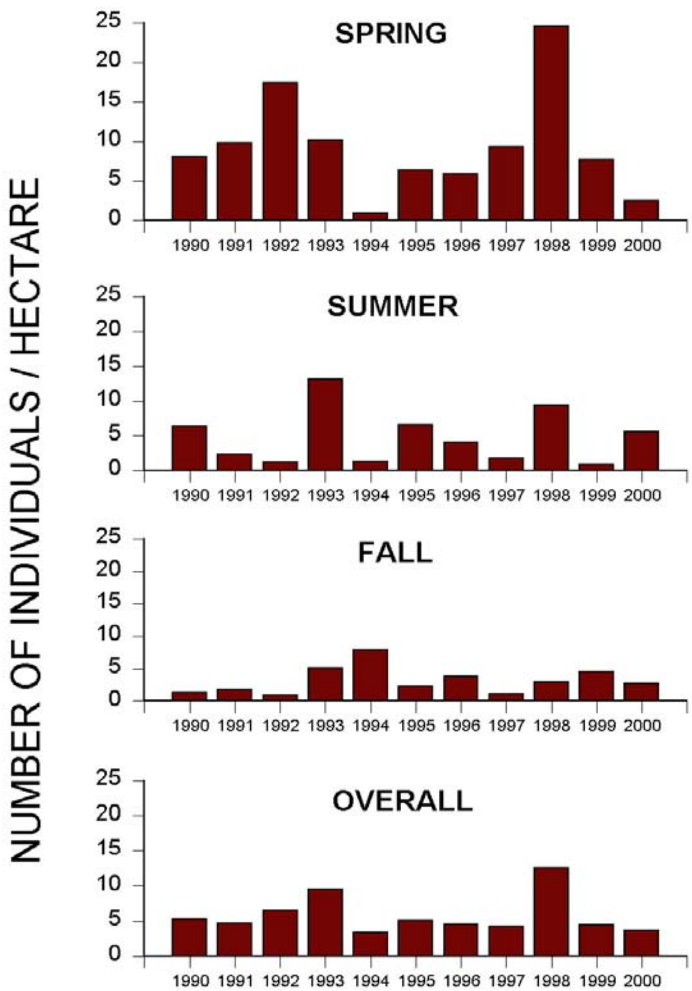

Figure 12. Annual densities of *Cynoscion regalis* from inner strata

Overall density was greatest in summer and the highest regional density occurred in Raleigh Bay (Table 7). Outer strata produced only 28 specimens (spring/south: n = 16, 0/ha = 0.2; fall/north: n = 12, 0/ha = 0.2)

Table 7 . Estimates of density (number of individuals/hectare) for *Cynoscion regalis* among inner strata 2000.

	Spring	Summer	Fall	Region
Raleigh Bay	27.1	34.6	27.3	30.0
Onslow Bay	0.8	8.7	0.1	3.3
Long Bay	1.1	3.0	0.5	1.5
South Carolina	1.7	7.3	2.0	3.7
Georgia	1.1	0.3	2.7	1.4
Florida	3.4	0.07	0.6	1.4
Season	2.5	5.6	2.7	3.6

Total lengths of *Cynoscion regalis* ranged from 8 to 37 cm (0 = 19.5, n = 3332). Length was significantly different among seasons ($X^2 = 50$, $p < 0.0001$). Mean length decreased from spring to summer, indicating the recruitment of YOY individuals, and increased in fall as the result of subsequent juvenile growth (Figure 13).

Mean length also varied significantly among regions ($X^2 = 1168$, $p < 0.0001$), with larger fish occurring in Onslow Bay and off Florida (Figure 14). The length-frequency distributions of weakfish in Raleigh Bay, Onslow Bay, Long Bay, and off South Carolina comprised primarily individuals taken in summer. The distributions from Georgia represent fish taken primarily from fall trawls, whereas the majority of specimens from Florida waters were taken in spring. Mean length of weakfish was greatest in collections from waters off Florida and in Onslow Bay.

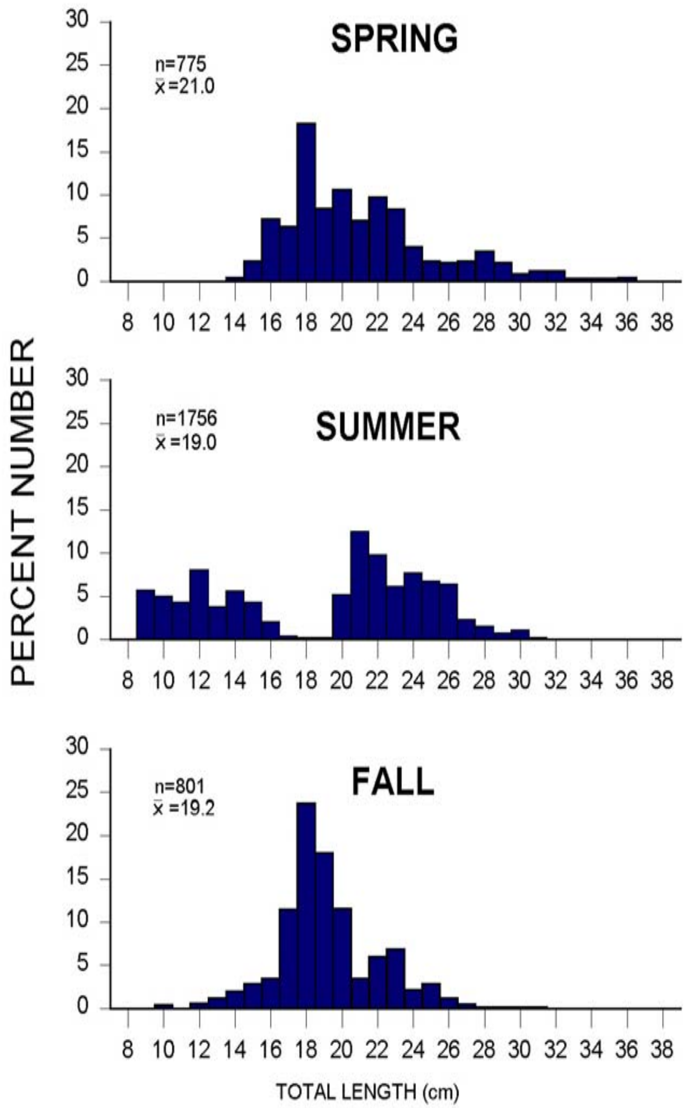

Figure 13. Seasonal length-frequencies of *Cynoscion regalis* from inner strata in 2000.

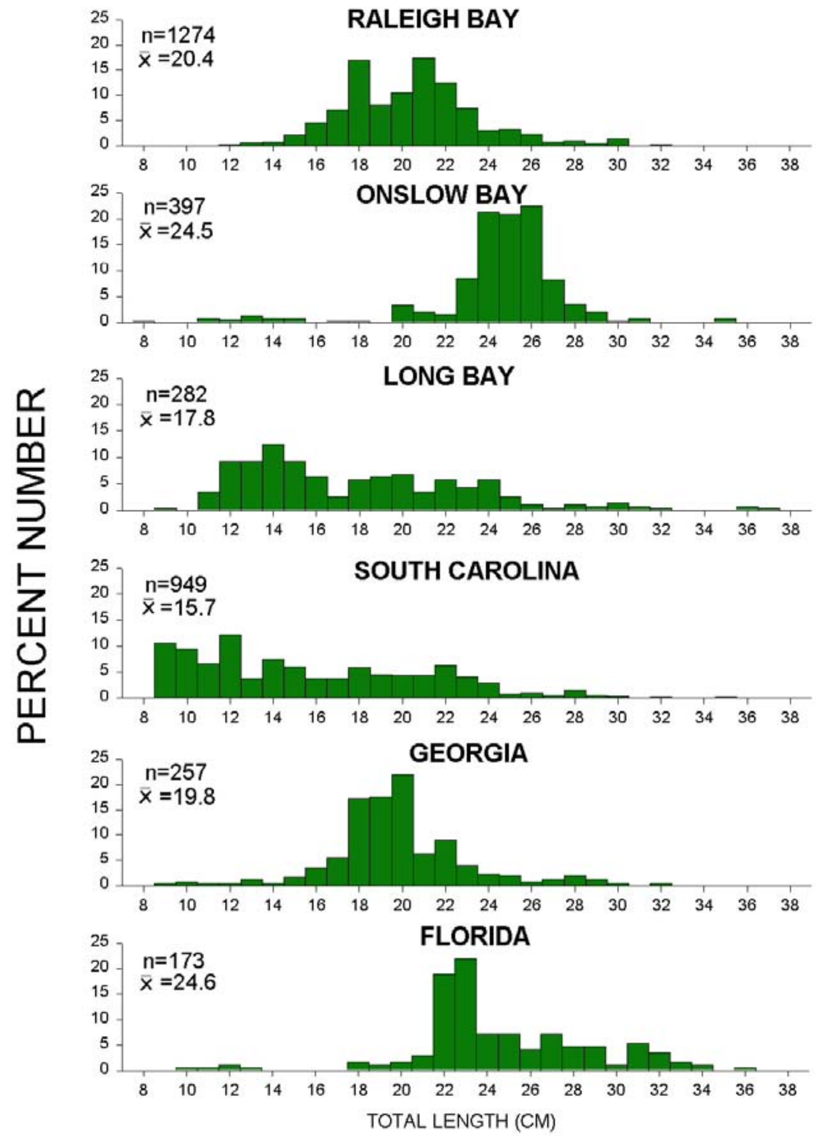

Figure 14. Regional length-frequencies of *Cynoscion regalis* from inner strata in 2000.

Scomberomorus maculatus

Spanish mackerel range from the Gulf of Maine to the Yucatan Peninsula, where they are replaced by *Scomberomorus brasiliensis* from Belize to Brazil (Collette and Russo, 1984). Generally occurring in coastal waters at depths of less than 72 m, S. *maculatus* are known to enter estuaries occasionally (Fritzsche, 1978). An excellent food fish, this species is the target of recreational anglers and supports a large purse-seine and gill-net fishery (Fritzsche, 1978).

Sampling in 2000 produced 1,718 Spanish mackerel that weighed a total of 200 kg (1.9 individuals/ha; 0.2 kg/ha). The density of individuals of Spanish mackerel in 2000 represents the highest estimate since the peak in density observed in 1991-1992 (Figure 15).

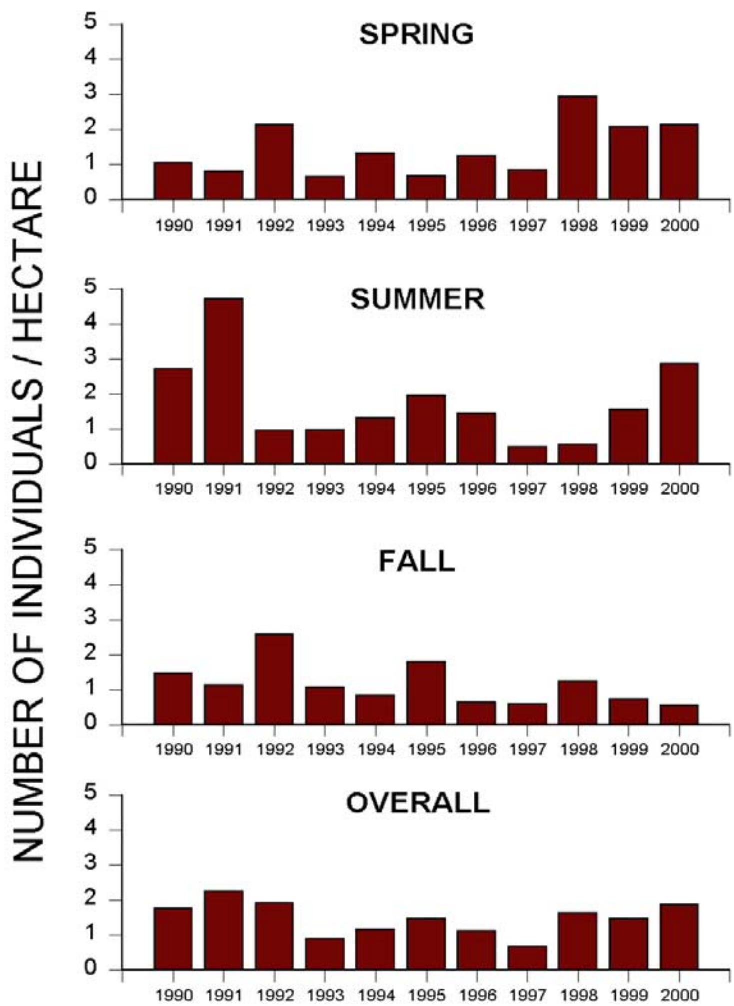

Figure 15. Annual densities of *Scomberomorus maculatus* from inner strata

The highest seasonal densities of Spanish mackerel were found in spring and summer and regional densities were greatest in the southern SAB, in waters off Georgia and Florida. (Table 8). Outer strata produced 80 Spanish mackerel, 82% of which were collected in spring in the southern SAB (spring: n = 76, 0/ha = 0.7; fall: n = 4, 0/ha = 0.06).

Table 8 . Estimates of density (number of individuals/hectare) for *Scomberomorus maculatus* among inner strata 2000.

	Spring	Summer	Fall	Region
Raleigh Bay	0.09	0.06	0.6	0.3
Onslow Bay	1.3	2.9	0.5	1.6
Long Bay	2.1	2.5	0.5	1.7
South Carolina	1.1	1.6	0.3	1.0
Georgia	2.9	5.3	1.0	3.1
Florida	4.6	3.5	0.5	2.9
Season	2.1	2.9	0.5	1.9

Fork lengths of Spanish mackerel ranged from 7 to 45 cm (0 = 22.4 cm, n = 1,717). Lengths differed significantly among seasons ($X^2 = 983$, $p < 0.0001$). Mean length decreased from spring to fall, indicating the recruitment of YOY individuals (Figure 16). By the end of their first year, Spanish mackerel reach lengths greater than 30 cm (Powell, 1975). Specimens collected in spring were generally fish ending their first year. Summer collections contained primarily newly recruited YOY with a few representatives of the previous year-class still present. Fall collections were made up of fish from two year-classes. Length also varied significantly among regions ($X^2 = 91$, $p < 0.0001$), and mean lengths ranged from a low of 20.6 cm in Onslow Bay to 24.2 cm off Florida (Figure 17).

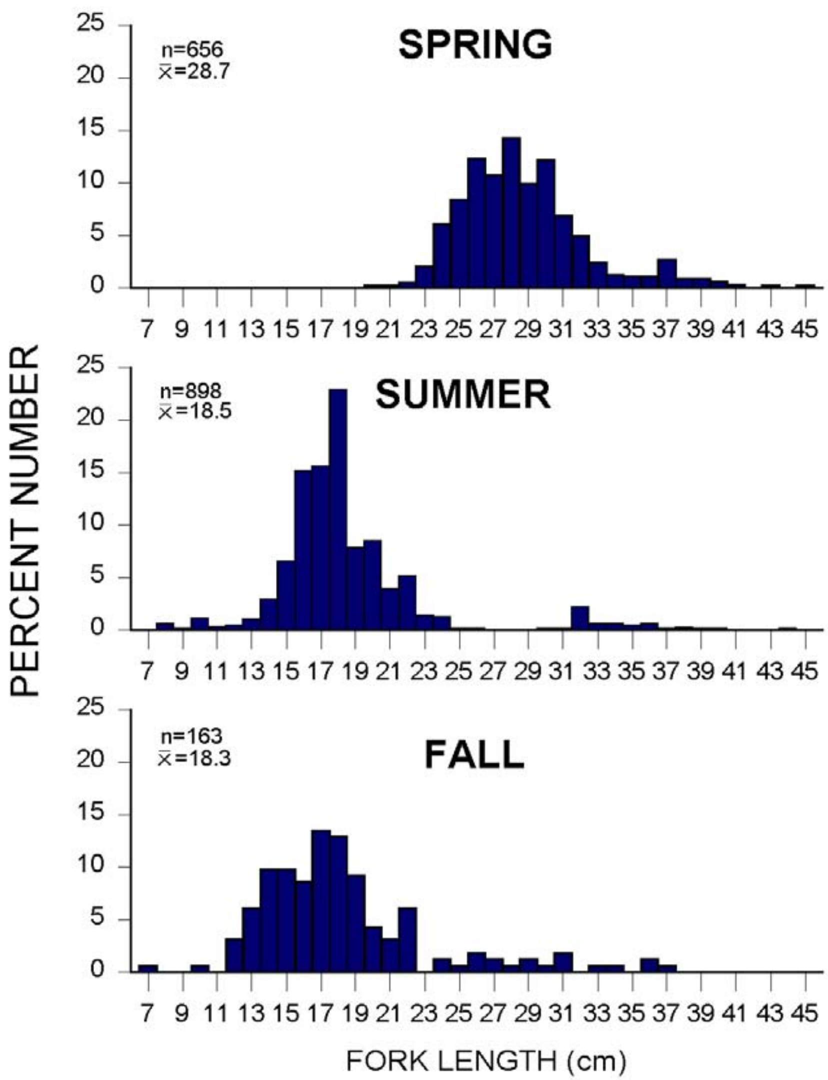

Figure 16. Seasonal length-frequencies of *Scomberomorus maculatus* from inner strata in 2000.

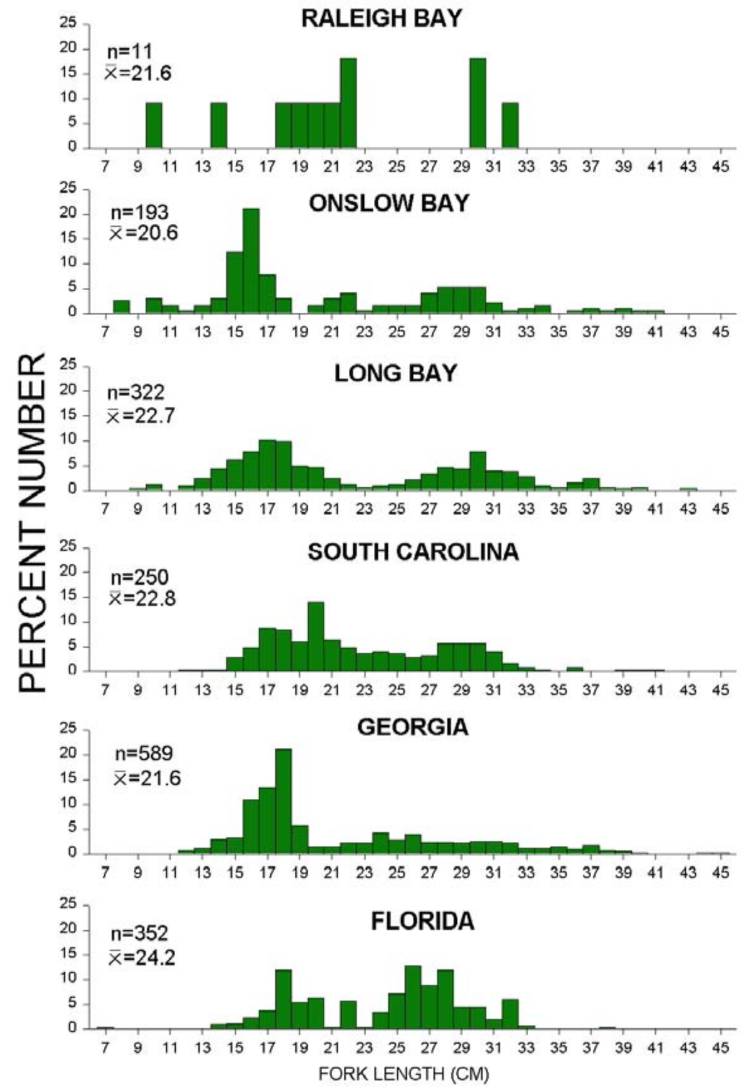

Figure 17. Regional length-frequencies of *Scomberomorus maculatus* from inner strata in 2000.

Scomberomorus cavalla

The king mackerel inhabits Atlantic coastal waters from Massachusetts south throughout the Gulf of Mexico and the Caribbean to Rio de Janeiro (Collette, 1978), possibly extending as far north as Maine (Fritzsche, 1978; Berrien and Finan, 1977). Atlantic stocks of king mackerel migrate northward from Florida during the warmer spring and summer months and return south as the waters get colder (Berrien and Finan, 1977), occurring singly or in small groups (Collette, 1978). Commercially, this species is the target of large purse-seine, gill-net, and hook-and-line fisheries (Collette, 1978). King mackerel spawn from May through September, with a peak in spawning activity in July (Finucane et al., 1986).

The 504 (0.5 individuals/ha) king mackerel collected from inner strata during the 2000 survey weighed 22 kg (0.02 kg/ha). In 2000, the density of king mackerel was greater than estimates calculated in 1999 (Figure 18).

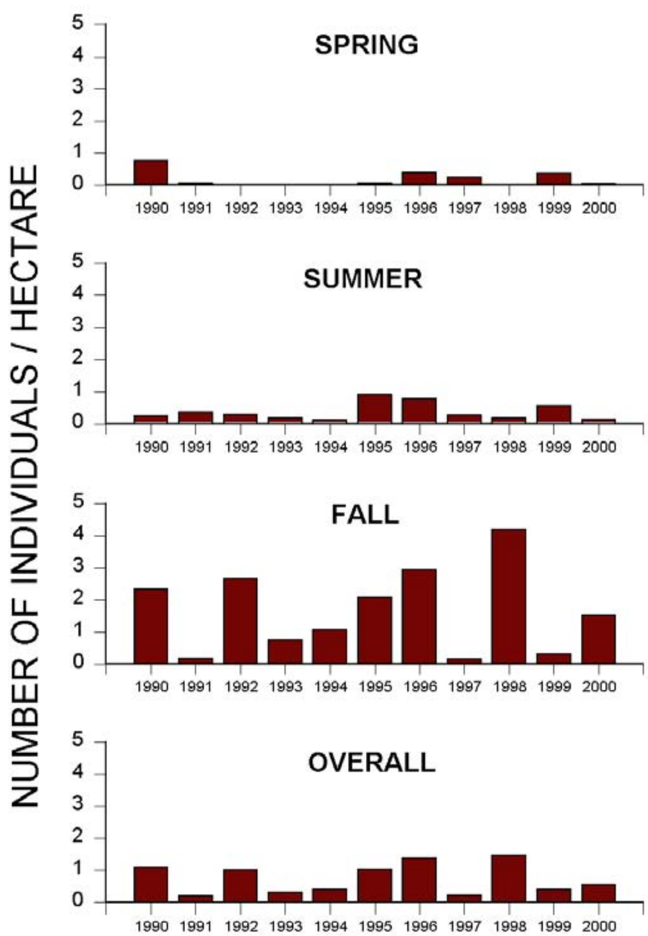

Figure 18. Annual densities of *Scomberomorus cavalla* from inner strata

Density was greatest in fall in the northern SAB (Table 9). No king mackerel were taken north of waters off South Carolina in spring and summer. Outer strata produced 17 king mackerel, all from the southern SAB in spring with the exception of one individual (spring/south: n = 16, O/ha = 0.15; fall/north: n = 1, O/ha = 0.015).

Table 9. Estimates of density (number of individuals/hectare) for *Scomberomorus cavalla* among inner strata 2000.

	Spring	Summer	Fall	Region
Raleigh Bay	0	0	2.5	0.9
Onslow Bay	0	0	3.3	1.0
Long Bay	0	0	1.9	0.6
South Carolina	0	0.01	1.3	0.4
Georgia	0.05	0.2	1.09	0.4
Florida	0.1	0.6	0.05	0.3
Season	0.03	0.1	1.5	0.5

Fork lengths of *Scomberomorus cavalla* ranged from 6 to 89 cm (O = 12.8 cm, n = 504) and represented two year-classes. Annual cohorts of king mackerel are spawned in spring and summer (Finucane et al., 1986) and reach mean lengths greater than 40 cm by the end of their first year (Collins et al., 1989). Lengths were significantly different among seasons ($X^2 = 111$, $p < 0.0001$) and mean length decreased from spring to fall (Figure 19). The fish less than 15 cm and greater than 34 cm in summer suggest that recruitment is beginning and that a few specimens from the Age II year class are still present. Lengths varied significantly among regions ($X^2 = 163$, $p < 0.0001$), with Florida waters producing the greatest mean length and mean size decreasing northward (Figure 20).

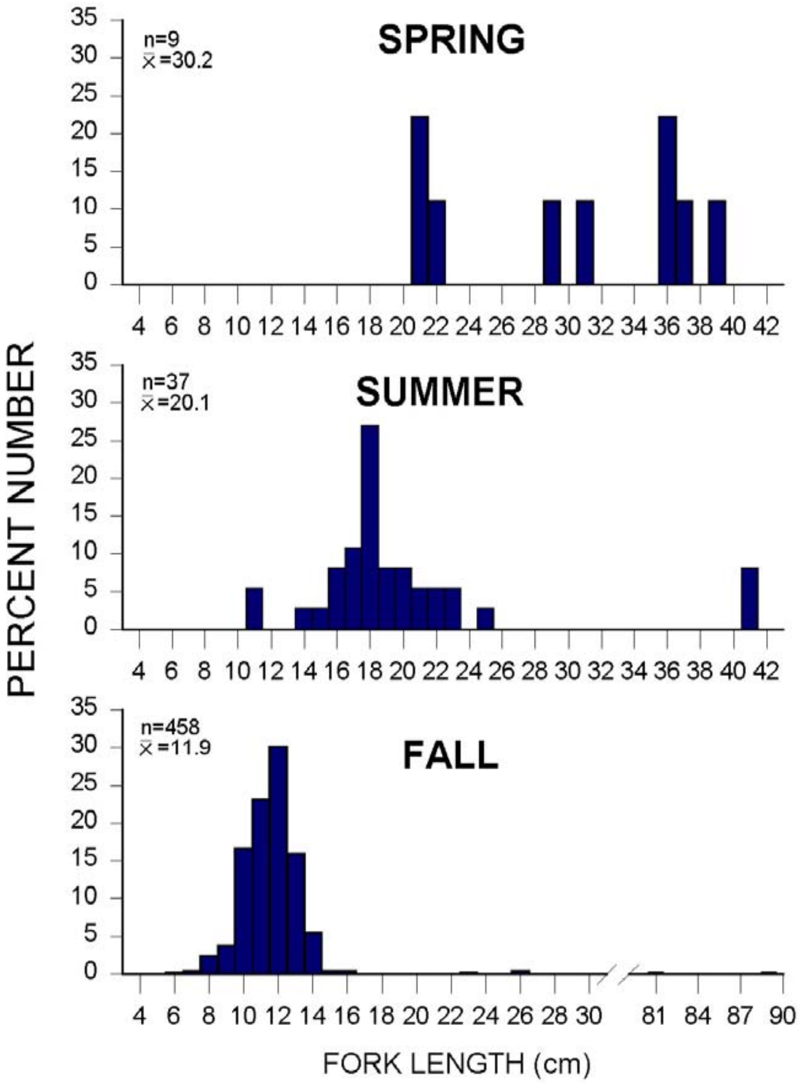

Figure 19. Seasonal length-frequencies of *Scomberomorus cavalla* from inner strata in 2000.

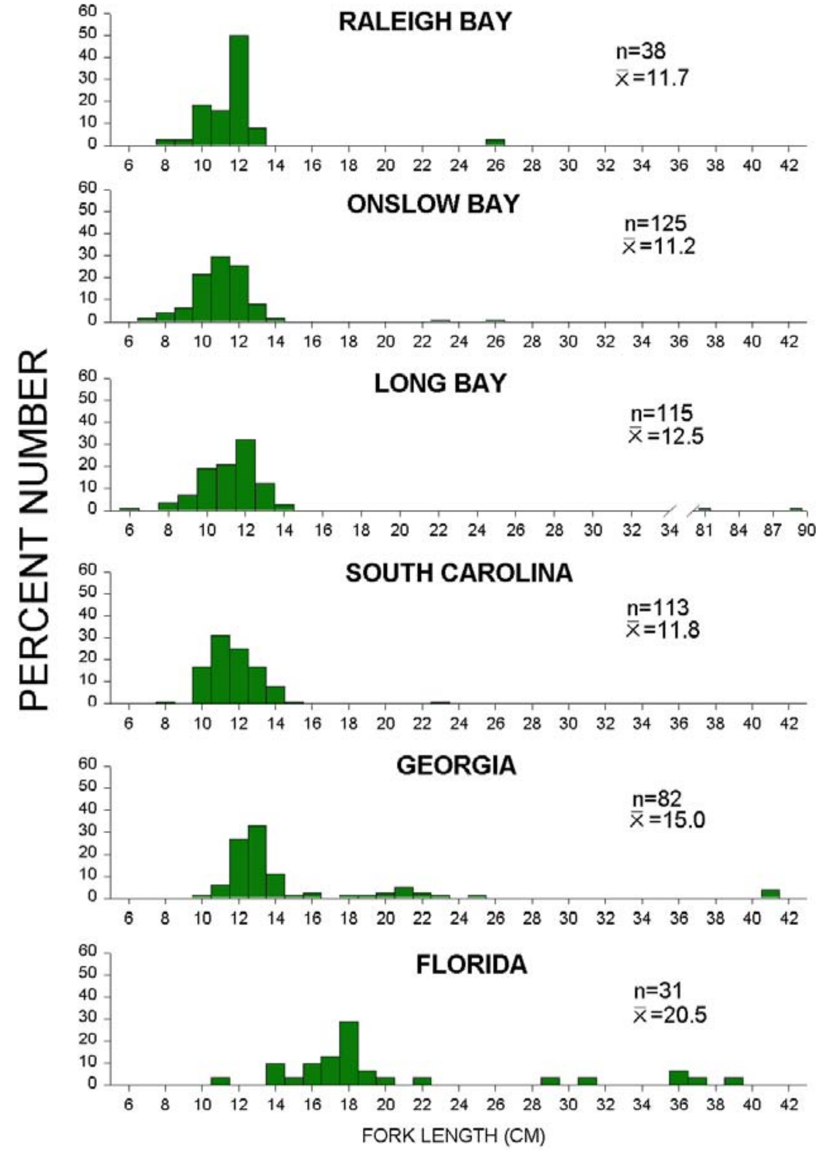

Figure 20. Regional length-frequencies of *Scomberomorus cavalla* from inner strata in 2000.

Distribution and Abundance of Priority Decapod Crustacean Species

Litopenaeus setiferus

The geographical range of white shrimp, formerly *Penaeus setiferus* (Perez-Farfante and Kensley, 1997), extends from New York to southern Florida and throughout the Gulf of Mexico (Perez-Farfante, 1978; Williams, 1984). White shrimp spawning in the SAB begins in May and continues into September (Lindner and Anderson, 1956; Williams, 1984). Centers of abundance along the Atlantic coast of the United States are found in waters off northeastern Florida, Georgia, and South Carolina (Perez-Farfante, 1978; Williams, 1984), where the species supports a large commercial fishery (South Atlantic Fishery Management Council, 1981).

White shrimp was the most abundant decapod crustacean species from inner strata in the SEAMAP-SA Trawl Survey, with 12,010 (13.1 individuals/ha) weighing 329 kg (0.4 kg/ha). The annual density of abundance of *L. setiferus* was considerably lower than the record 1999 estimates (Figure 21).

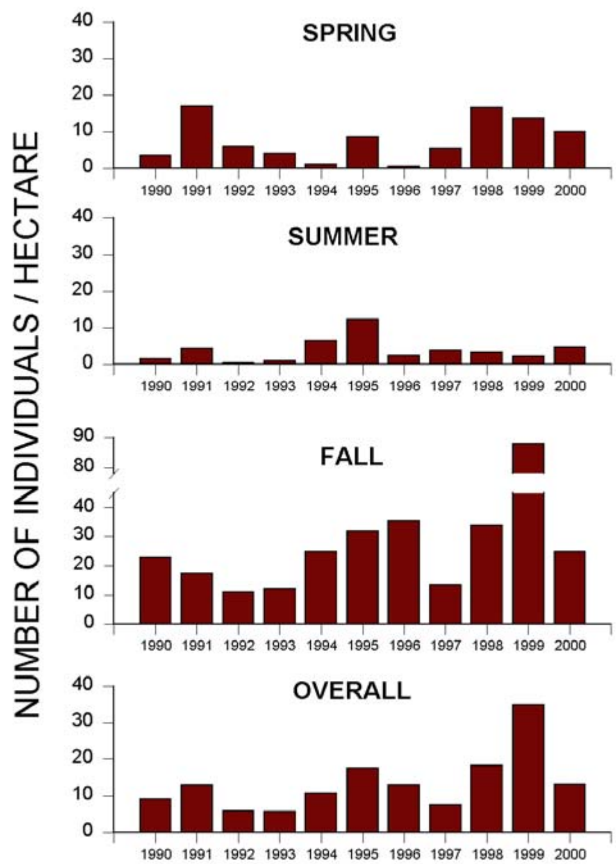

Figure 21. Annual densities of *Litopenaeus setiferus* from inner strata

Density was highest in fall collections (Table 10). Greatest regional densities of abundance were found off South Carolina and Georgia. Outer strata produced only 17 white shrimp, all of which were taken in spring collections in the southern SAB (spring: n = 17, O/ha = 0.16).

Table 10 . Estimates of density (number of individuals/hectare) for *Litopenaeus setiferus* among inner strata 2000.

	Spring	Summer	Fall	Region
Raleigh Bay	7.6	0.1	29.3	12.5
Onslow Bay	1.2	1.1	24.2	8.4
Long Bay	0.4	1.3	2.6	1.4
South Carolina	19.8	9.6	18.5	15.9
Georgia	9.5	0.4	65.4	24.3
Florida	15.2	12.0	9.5	12.3
Season	10.0	4.8	24.9	13.1

Total lengths of *L. setiferus* ranged from 6 to 21 cm, with a mean length of 15.0 cm (n = 12,006). There was a significant difference in mean length among seasons ($X^2 = 110$, $p < 0.0001$) (Figure 22), with mean length greatest in spring. Smaller YOY individuals began moving out of the estuaries in summer and continued to do so into the fall. *L. setiferus* inhabits estuaries until nearing maturity when they move offshore (Williams, 1984), where they are susceptible to capture by our gear. Regional mean lengths also differed significantly ($X^2 = 866$, $p < 0.0001$). Long Bay produced the smallest mean length (13.6 cm) and Raleigh Bay the greatest (16.0 cm) (Figure 23).

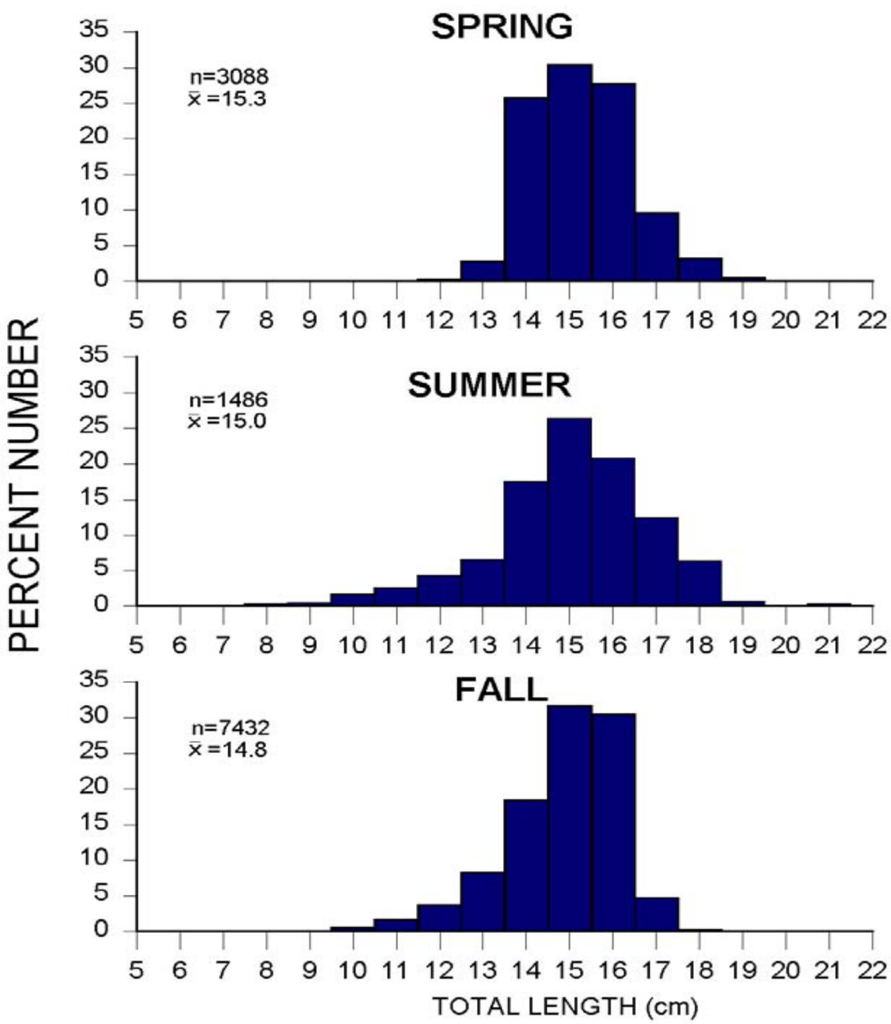

Figure 22. Seasonal length-frequencies of *Litopenaeus setiferus* from inner strata in 2000

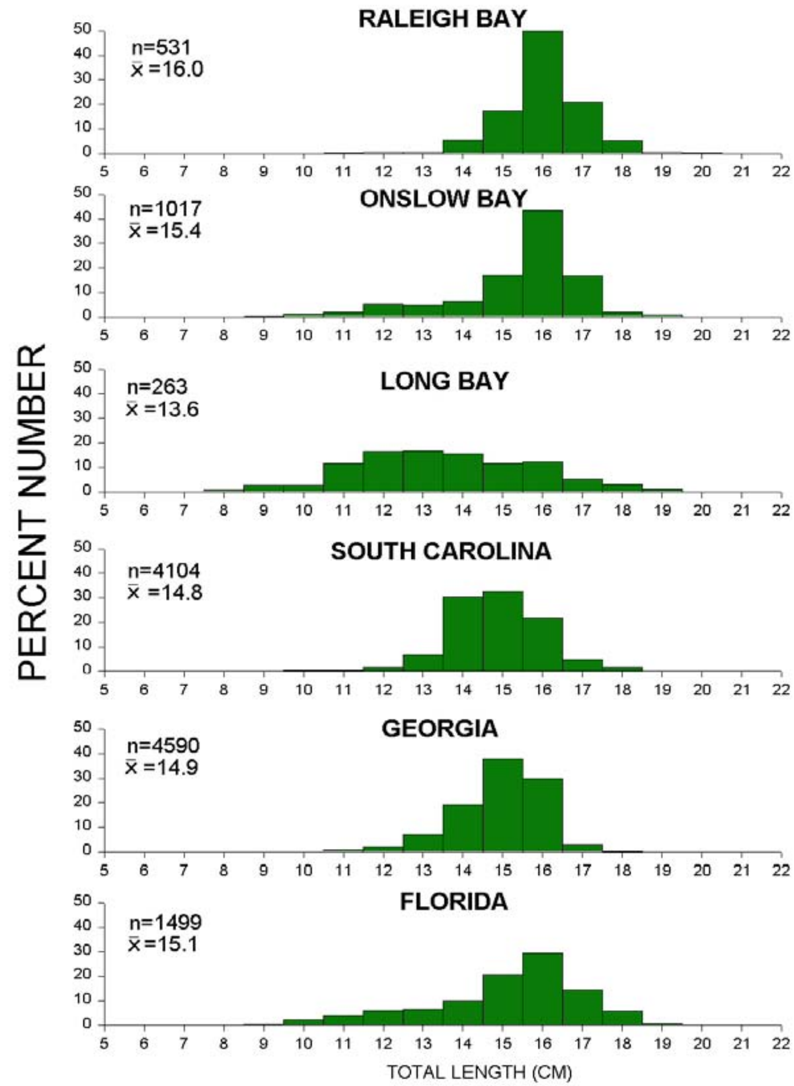

Figure 23. Regional length-frequencies of *Litopenaeus setiferus* from inner strata in 2000.

White shrimp are reported to spawn from May through September in the SAB (Lindner and Anderson, 1956; Williams, 1984). In SEAMAP samples (1990-2000) evidence of spawning was found as early as April, when approximately 42% (n=28) of all females with spent ovaries were taken. Only 6% of females collected in inner strata in 2000 had ripe ovaries. The percentage of ripe females peaked in summer (60% of all ripe females), the season with the lowest abundance of female white shrimp collected, whereas none were ripe in fall, when the greatest number (66%) of white females were taken. The ratio of ripe to nonripe females was not independent of season ($G = 7757$, $p < 0.001$) or region ($G = 1983$, $p < 0.001$). Less than 1% of the females taken in SEAMAP-SA trawls were mated. The percentage of males with fully developed spermatophores peaked in spring, decreasing to 2% in fall, when 46% of the males taken were collected (Figure 24). The ratio of males with fully developed spermatophores to those with spermatophores not yet fully developed was not independent of seasons ($G = 3277$, $p < 0.001$) or regions ($G = 1092$, $p < 0.001$). Outer strata in the southern half of the SAB, sampled only in spring for the purpose of collecting data on spawning of white shrimp, produced only 17 individuals.

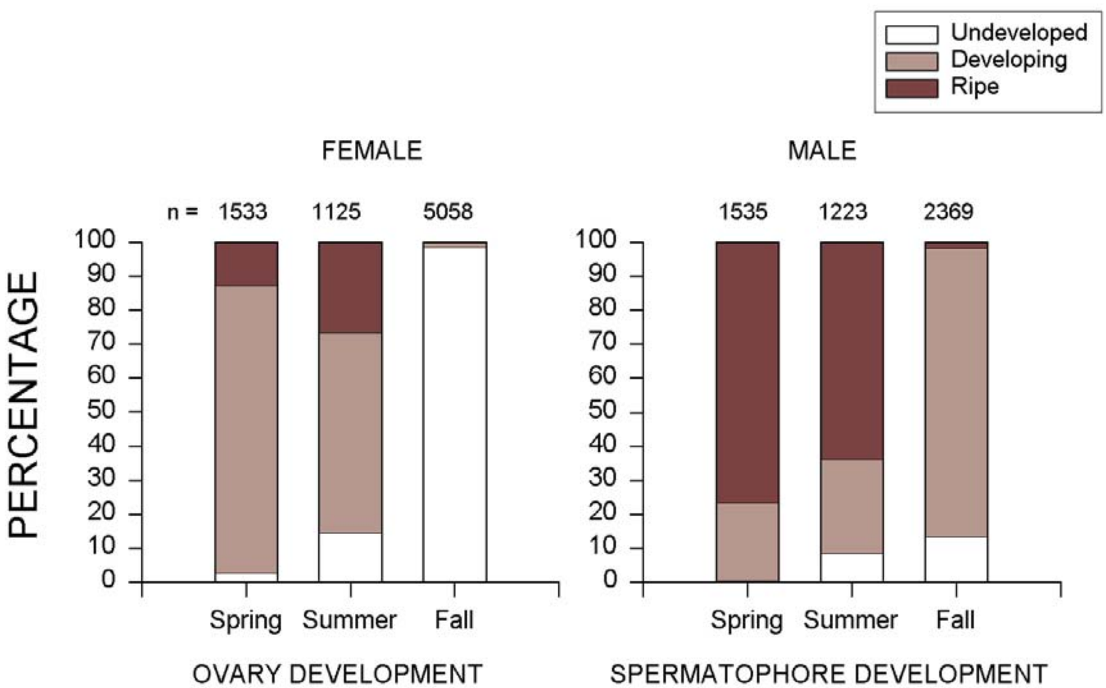

Figure 24. Gonadal development of *Litopenaeus setiferus* from inner strata.

Farfantepenaeus aztecus

Brown shrimp, formerly *Penaeus aztecus* (Perez-Farfante and Kensley, 1997), occur from Martha's Vineyard, Massachusetts, to the Florida Keys and around the Gulf of Mexico to northwestern Yucatan (Perez-Farfante, 1978; Williams, 1984). The spawning of brown shrimp is protracted and the time varies regionally, but generally occurs in fall and winter (Williams, 1984). The species supports a seasonal fishery along the mid-Atlantic states, but is most important commercially in the Gulf of Mexico off the coast of Texas (Perez-Farfante, 1978; South Atlantic Fishery Management Council, 1981; Renfro and Brusher, 1982).

The brown shrimp ranked second among decapod crustaceans in inner strata, with 7,078 specimens (7.7 individuals/ha) collected weighing 115 kg (0.1 kg/ha). The density of brown shrimp in 2000 was second only to the peak in abundance found in 1996 (Figure 25).

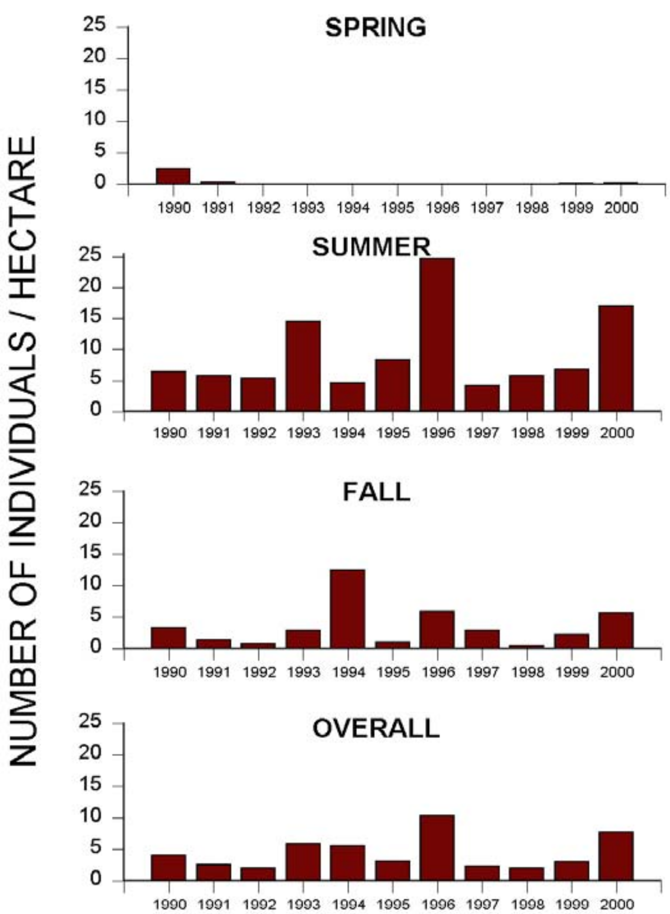

Figure 25. Annual densities of *Farfantepenaeus aztecus* from inner strata

Summer collections produced the highest seasonal density (Table 11). The greatest regional densities of brown shrimp occurred in Raleigh Bay and off South Carolina, although few brown shrimp were collected in those regions in spring. The overall seasonal pattern of abundance of brown shrimp includes small spring catches, followed by larger summer catches, and moderately-sized fall catches. Outer strata produced only three brown shrimp, all in fall in the northern SAB.

Table 11 . Estimates of density (number of individuals/hectare) for *Farfantepenaeus aztecus* among inner strata 2000.

	Spring	Summer	Fall	Region
Raleigh Bay	0	1.5	81.2	29.3
Onslow Bay	0	14.0	6.9	7.0
Long Bay	0	10.2	0.4	3.5
South Carolina	0.05	45.0	1.5	15.8
Georgia	0.02	2.1	0.7	0.9
Florida	1.1	0.8	0	0.6
Season	0.2	17.1	5.6	7.7

Total lengths of *F. aztecus* ranged from 7 to 19 cm with a mean length of 12.2 cm (n = 7,078). Total lengths differed significantly among seasons ($X^2 = 586$, $p < 0.0001$), with mean length increasing from summer to fall (Figure 26) Lengths were also significantly different among regions ($X^2 = 1214$, $p < 0.0001$). Mean lengths ranged from 11.3 cm in Long Bay to 13.4 cm in Raleigh Bay (Figure 27).

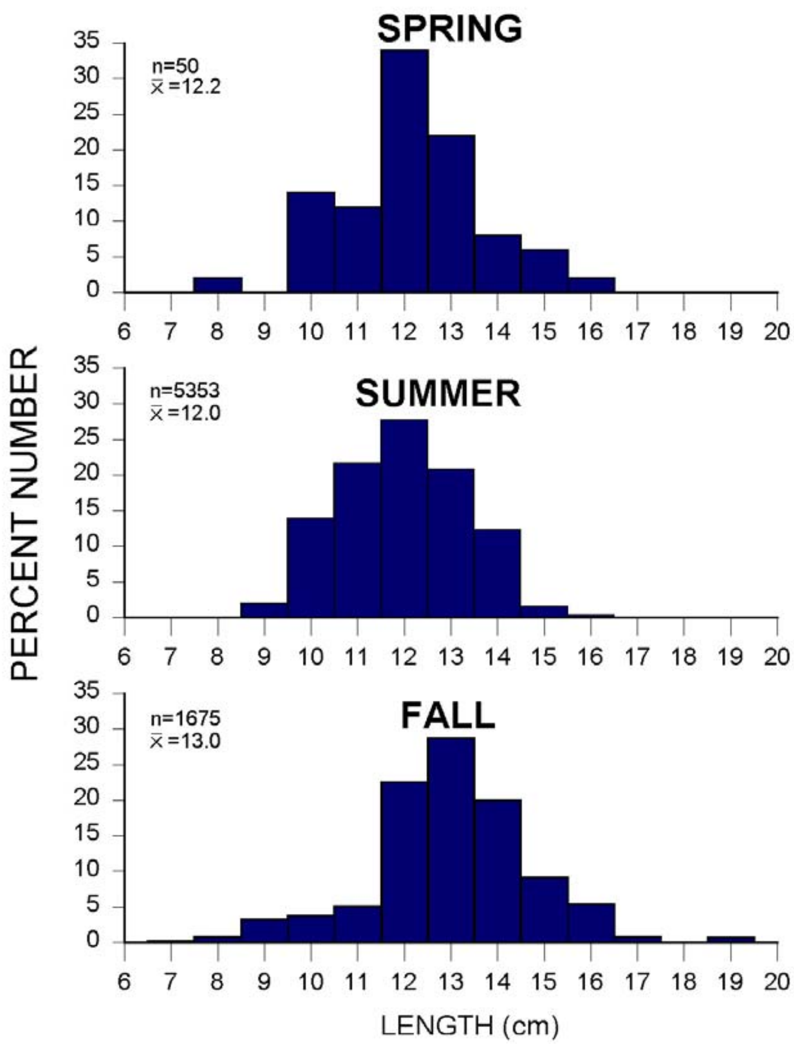

Figure 26. Seasonal length-frequencies of *Farfantepenaeus aztecus* from inner strata in 2000.

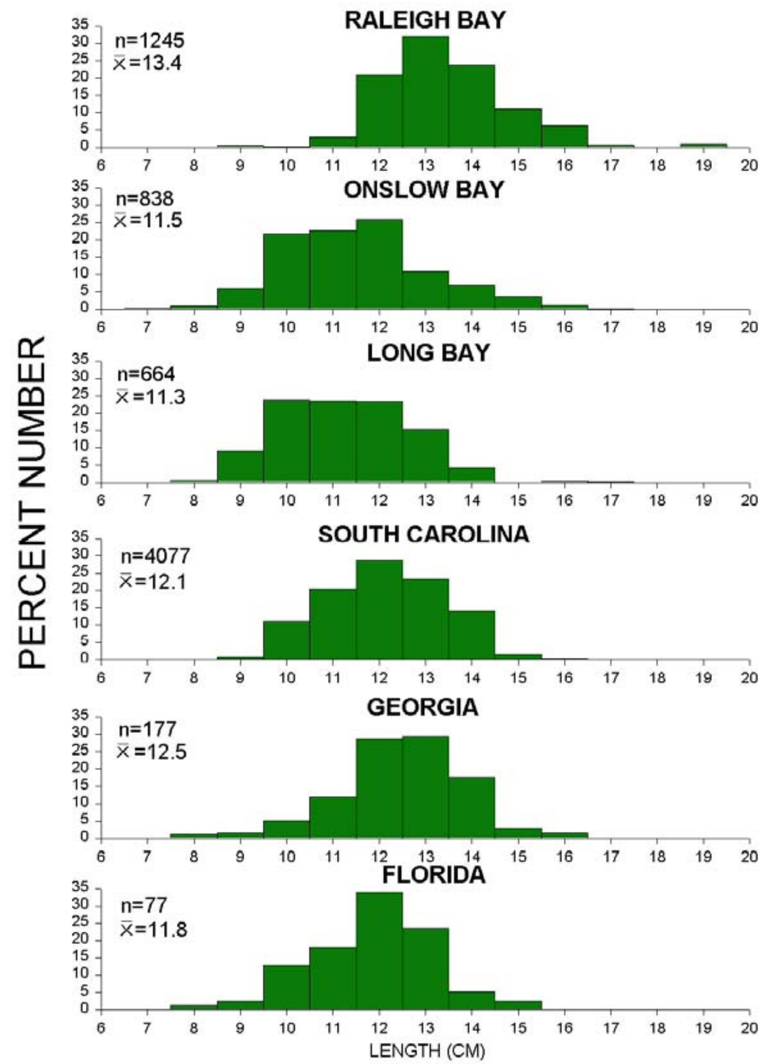

Figure 27. Regional length-frequencies of *Farfantepenaeus aztecus* from inner strata in 2000.

Less than 6% of the male brown shrimp had fully developed spermatophores (ripe), and less than 1% of the females had ripe ovaries (Figure 28). Spermatophore development was not independent of season (G = 277, $p < 0.001$) or region (G = 322, $p < 0.001$). The percentage of ripe males was greatest in fall. The ratio of ripe to nonripe females was not independent of season (G = 664, $p < 0.001$) or region (G = 617, $p < 0.001$); all of the females with ripe ovaries were collected in fall. Less than 1% of the female brown shrimp were found to be mated.

Outer strata off North Carolina were sampled in fall primarily for the purpose of gathering data on the reproductive condition of brown shrimp. Only three individuals were collected in outer strata. Neither of the two females taken in fall were mated.

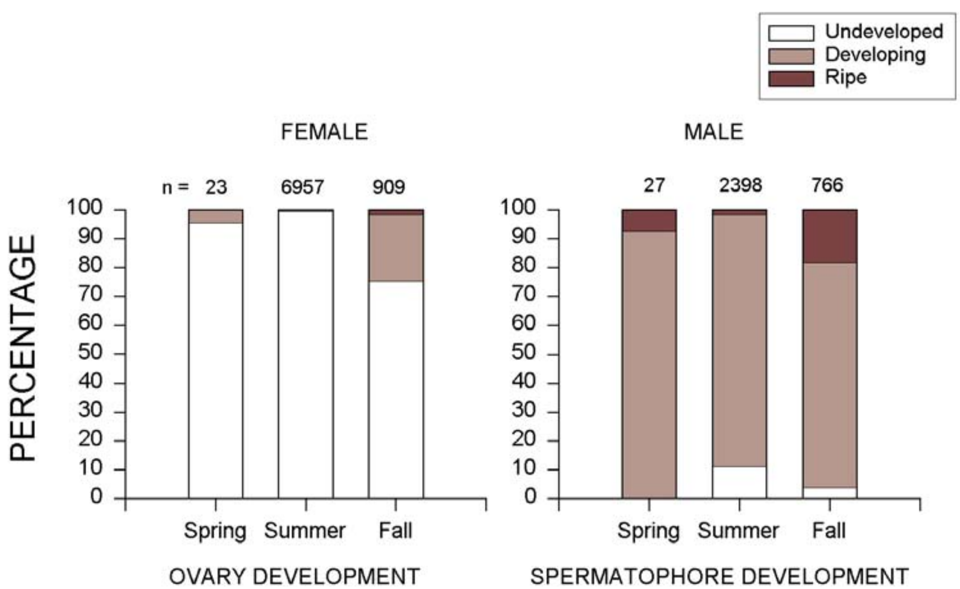

Figure 28. Gonadal development of *Farfantepenaeus aztecus* from inner strata.

Farfantepenaeus duorarum

Pink shrimp, formerly *Penaeus duorarum* (Perez-Farfante and Kensley, 1997), are found from Chesapeake Bay to the Florida keys and throughout the Gulf of Mexico to the Yucatan peninsula (Perez-Farfante, 1978; Williams, 1984). They are most abundant in waters off the Gulf coast of Florida, in the Bay of Campeche, and in waters off North Carolina (Perez-Farfante, 1978; Williams, 1984).

The pink shrimp was the least abundant commercially important penaeid shrimp species collected during 2000. The 194 specimens (0.2 individuals/ha) taken from inner strata weighed 3.2 (0.004 kg/ha). In 2000 density of individuals fell to the lowest level observed in the history of the survey (Figure 29).

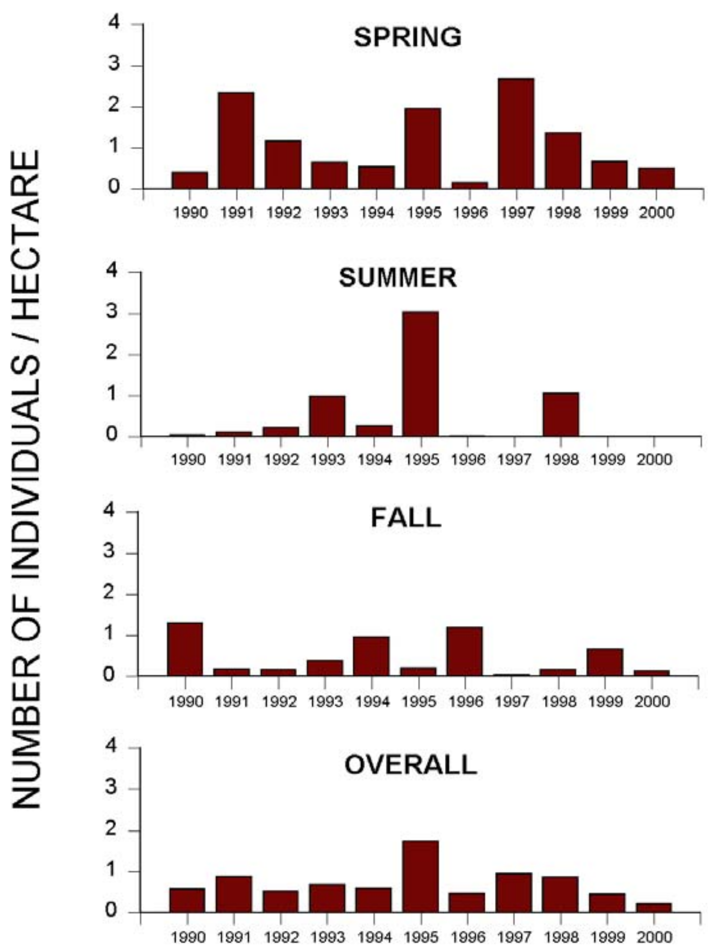

Figure 29. Annual densities of *Farfantepenaeus duorarum* from inner strata

Abundance was greatest in spring; however, pink shrimp were not collected in summer trawls (Table 12). Regional densities were observed to decrease from Onslow Bay southward. Not a single specimen of *F. duorarum* was taken in outer strata.

Table 12 . Estimates of density (number of individuals/hectare) for *Farfantepenaeus duorarum* among inner strata 2000.

	Spring	Summer	Fall	Region
Raleigh Bay	0.2	0	1.1	0.4
Onslow Bay	2.5	0	0.4	1.0
Long Bay	0.4	0	0.05	0.2
South Carolina	0.2	0	0.01	0.1
Georgia	0.1	0	0.07	0.1
Florida	0.02	0	0	0.01
Season	0.5	0	0.1	0.2

Total length of pink shrimp ranged from 8 to 16 cm (0 = 11.9 cm, n = 194). Total lengths varied significantly among seasons ($X^2 = 14$, $p < 0.0002$). Mean lengths decreased from 12.1 cm in spring to 11.0 cm in fall (Figure 30). Total length did not differ significantly among regions ($X^2 = 9$, $p > 0.1$). Regionally, mean lengths ranged from 10.0 cm off Florida to 12.6 cm off South Carolina (Figure 31).

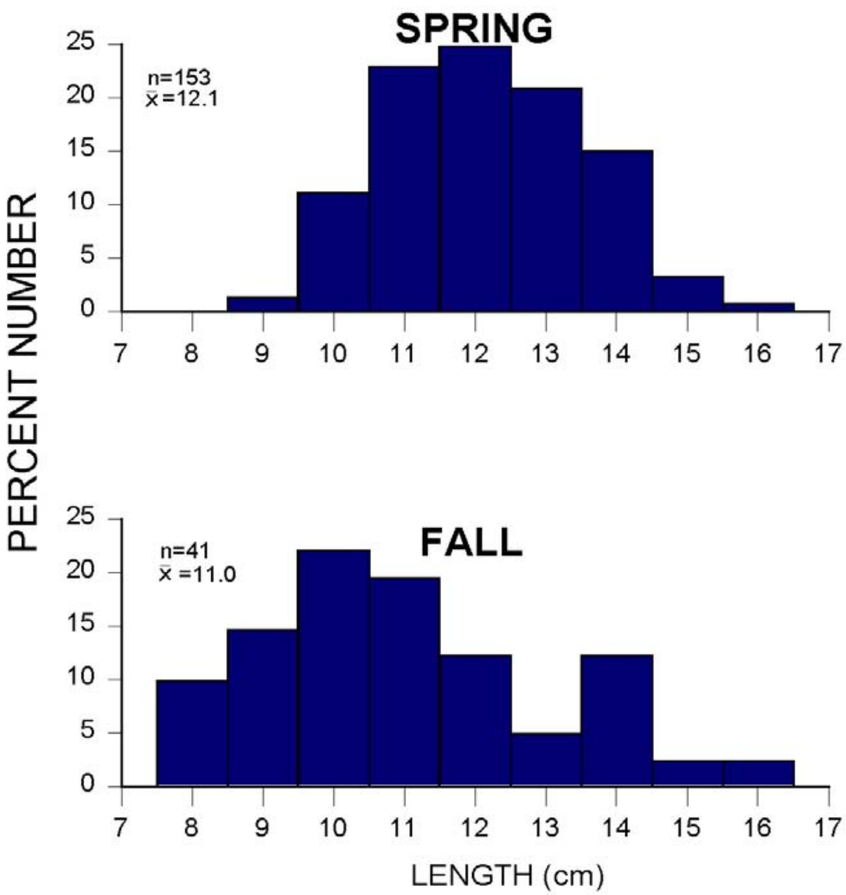

Figure 30. Seasonal length-frequencies of *Farfantepenaeus duorarum* from inner strata in 2000.

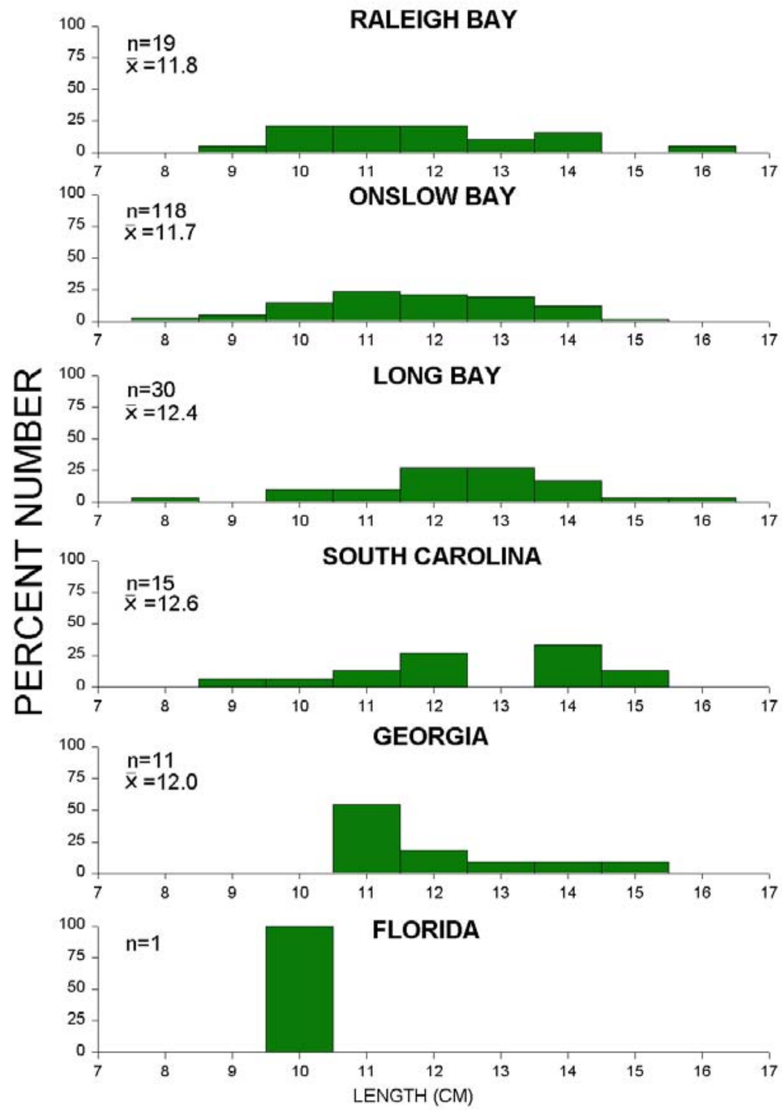

Figure 31. Regional length-frequencies of *Farfantepenaeus duorarum* from inner strata in 2000.

In inner strata approximately 40% of male pink shrimp sampled, all in spring collections, had fully developed spermatophores (Figure 32). Spermatorphore development was not independent of season (G = 27, p < 0.001), but was independent of region (G = 9 , p > 0.5). Burukovskii and Bulanenkov (1971) reported that spawning activity of pink shrimp in North Carolina waters peaked in spring. The ratio of ripe to nonripe females was not independent of season (G = 27, p < 0.001) or region (G = 18, p < 0.05). Only one female (1%), collected in spring, had fully developed ovaries and six females (6%) were mated. Like brown shrimp, copulation in pink shrimp may occur regardless of developmental stage of the ovaries (Perez-Farfante, 1969).

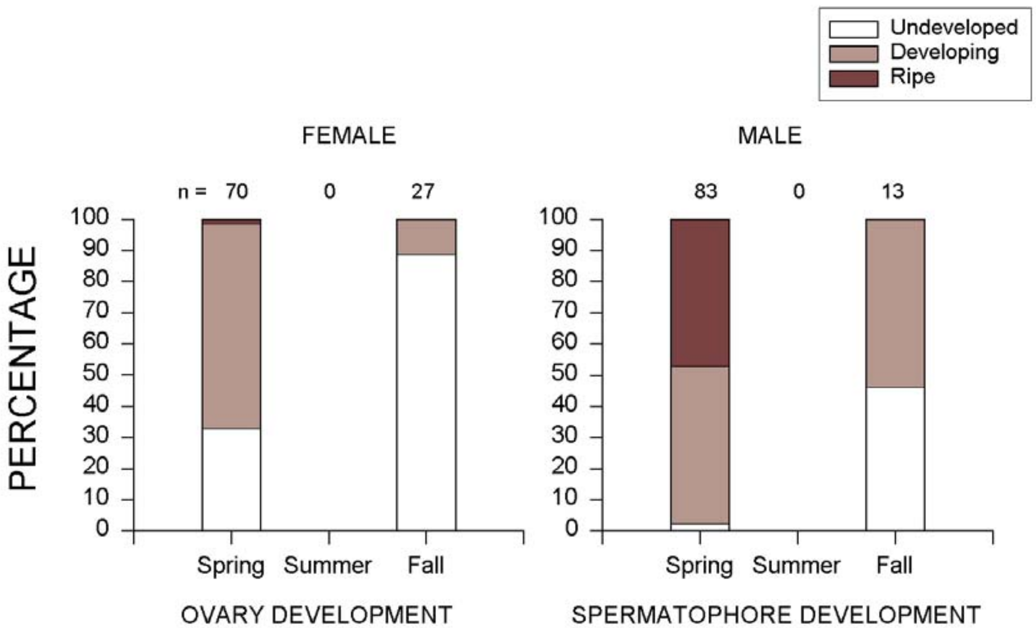

Figure 32. Gonadal development of *Farfantepenaeus duorarum* from inner strata.

ACKNOWLEDGMENTS

We appreciate the administrative assistance of David Whitaker, Dale Theiling, David Cupka, and Wayne Waltz and the recommendations of the SEAMAP-SA Committee and the Shallow Water Trawl Workgroup. Mike Schwarz and Jeff Jacobs were instrumental in the successful completion of SEAMAP-SA cruises through their able operation of the R/V *Lady Lisa*. Todd Beser, Joshua Dubick, Aubrey Tillman, and Jamie Williams assisted with field efforts.

APPLICATIONS OF SEAMAP SPECIMENS AND DATA

Cooperative Study:

As part of a cooperative Saltonstall-Kennedy Program (S/K) funded project entitled "Sampling and Evaluation of white spot and IGGN virus in commercially important South Atlantic Penaeid shrimp stocks" samples of hemolymph, gill, and head tissue from brown, pink, and white shrimp were preserved for viral testing and DNA analysis.

Stock Assessment/VPA:
- *Brevoortia tyrannus*
- *Cynoscion regalis*
- *Micropogonias undulatus*
- *Paralichthys lethostigma*

Life History (Age/Growth, Reproduction):
- *Cynoscion regalis*
- *Leiostomus xanthurus*
- *Lutjanus campechanus*
- *Menticirrhus americanus*
- *Micropogonias undulatus*

Genetics / Stock Identification Studies:
- *Limulus polyphemus*

Disease Studies:
- Penaeid shrimp viral testing

Toxicology (Heavy metals analysis):
- *Scomberomorus cavalla*
- *Scomberomorus maculatus*

Forensics (Gut content analysis):
- *Farfantepenaeus aztecus*
- *Litopenaeus setiferus*

Summary data requested by state agencies:

White shrimp gonadal development (2000) - SCDNR-Crustacean Management Section
Sea turtle data (1989-2000) - South Carolina DNR / Office of Environmental Management
2000 data - NC Division of Marine Fisheries
2000 data - GADNR
Sea turtle data (1989-2000) - GADNR
2000 data - Florida Fish and Wildlife Conservation Commission
Sea turtle data (1989-2000) - FFWCC - Endangered Species Division

Summary data requested by other agencies:

Sea turtle data (2000) - NMFS Marine Turtle tagging database
Sea turtle data (2000) - Sea Turtle Expert Working Group
Shark data (2000) - NMFS, Narrangansett Lab
Shark data (2000) - NMFS, Highly Migratory Species, Silver Spring, MD

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Appendix 1. Size statistics of target species from all SEAMAP-SA collections (2000).

FINFISH	MEAN LENGTH (CM)	SIZE EXTREMES (CM)
Archosargus probatocephalus	37.8	22 - 54
Brevoortia smithi	19.5	16 - 24
Brevoortia tyrannus	16.1	11 - 20
Centropristis striata	17.8	7 - 30
Chaetodipterus faber	9.2	4 - 29
Cynoscion nebulosus	*	N/A
Cynoscion regalis	19.5	8 - 37
Leiostomus xanthurus	15.6	7 - 25
Menticirrhus americanus	21.4	8 - 36
Menticirrhus littoralis	22.0	16 - 36
Menticirrhus saxatilis	24.8	14 - 32
Micropogonias undulatus	17.4	4 - 26
Mycteroperca microlepis	*	N/A
Paralichthys albigutta	28.3	20 - 34
Paralichthys dentatus	24.6	15 - 46
Paralichthys lethostigma	31.5	18 - 41
Peprilus alepidotus	11.5	3 - 20
Peprilus triacanthus	10.4	3 - 18
Pogonias cromis	**	23
Pomatomus saltatrix	20.2	10 - 32
Sciaenops ocellatus	*	N/A
Scomberomorus cavalla	13.4	6 - 89
Scomberomorus maculatus	22.7	7 - 45

DECAPOD CRUSTACEANS		
Farfantepenaeus aztecus	12.2	7 - 19
Farfantepenaeus duorarum	11.9	8 - 16
Litopenaeus setiferus	15.0	6 - 21
Callinectes sapidus	13.5	7 - 17

* No specimens of *Cynoscion nebulosus, Mycteroperca microlepis,* or *Sciaenops ocellatus* were collected.

** Only one specimen of *Pogonias cromis* was taken.

Appendix 2. Number of individuals and biomass (kg) for all species collected (2000). Abundance and biomass for inner strata only are indicated in parentheses.

Rank	Species Name	Total Number		Total Weight	
1	MICROPOGONIAS UNDULATUS	40455	(40092)	2394.332	(2363.450)
2	OPISTHONEMA OGLINUM	39133	(38344)	439.910	(423.643)
3	LEIOSTOMUS XANTHURUS	29874	(29140)	1929.011	(1866.567)
4	ANCHOA HEPSETUS	22356	(20262)	176.863	(164.746)
5	STENOTOMUS SP.	19537	(11630)	883.752	(571.418)
6	CHLOROSCOMBRUS CHRYSURUS	18843	(17408)	503.942	(444.734)
7	CYNOSCION NOTHUS	17649	(17575)	1562.438	(1552.395)
8	LOLIGO SP.	16822	(12158)	185.878	(132.405)
9	TRICHIURUS LEPTURUS	12656	(12649)	492.399	(492.340)
10	LITOPENAEUS SETIFERUS	12027	(12010)	329.177	(328.641)
11	SELENE SETAPINNIS	11334	(11186)	149.160	(143.369)
12	STELLIFER LANCEOLATUS	9216	(9216)	155.488	(155.488)
13	LARIMUS FASCIATUS	8980	(8945)	677.069	(673.415)
14	LOLLIGUNCULA BREVIS	8431	(8194)	81.745	(78.995)
15	LAGODON RHOMBOIDES	8410	(8364)	561.105	(557.649)
16	MENTICIRRHUS AMERICANUS	7882	(7690)	863.336	(831.314)
17	FARFANTEPENAEUS AZTECUS	7081	(7078)	114.755	(114.716)
18	ANCHOA MITCHILLI	6136	(5925)	7.432	(7.147)
19	PEPRILUS TRIACANTHUS	5555	(4656)	156.901	(139.096)
20	PEPRILUS PARU	4495	(4495)	285.571	(285.571)
21	SYNODUS FOETENS	4483	(3066)	367.174	(226.474)
22	CYNOSCION REGALIS	3360	(3332)	287.892	(284.277)
23	CALLINECTES SIMILIS	2774	(2770)	35.091	(35.008)
24	ORTHOPRISTIS CHRYSOPTERA	1978	(1741)	130.251	(123.697)
25	SCOMBEROMORUS MACULATUS	1798	(1718)	214.267	(199.627)
26	BAIRDIELLA CHRYSOURA	1786	(1786)	68.658	(68.658)
27	LIBINIA DUBIA	1571	(1562)	11.822	(11.700)
28	ANCHOA LYOLEPIS	1546	(1488)	1.854	(1.785)
29	PRIONOTUS CAROLINUS	1363	(1203)	27.236	(23.983)
30	CHAETODIPTERUS FABER	1151	(1120)	41.597	(39.952)
31	OVALIPES STEPHENSONI	1144	(974)	11.153	(9.091)
32	ARENAEUS CRIBRARIUS	1135	(1131)	14.913	(14.799)
33	HAEMULON AUROLINEATUM	1024	(14)	89.304	(1.031)
34	DECAPTERUS PUNCTATUS	930	(907)	40.755	(39.682)
35	PORTUNUS GIBBESII	925	(889)	6.643	(6.254)

36	RHIZOPRIONODON TERRAENOVAE	859	(828)	722.141	(610.315)
37	POMATOMUS SALTATRIX	843	(837)	94.158	(93.168)
38	MYLIOBATIS FREMINVILLEI	746	(743)	3978.388	(3962.148)
39	PRIONOTUS SCITULUS	693	(631)	13.551	(11.709)
40	SPHYRAENA GUACHANCHO	664	(305)	90.265	(34.151)
41	ETROPUS CROSSOTUS	570	(555)	8.834	(8.240)
42	SCOMBEROMORUS CAVALLA	521	(504)	25.706	(21.693)
43	TRINECTES MACULATUS	510	(503)	16.093	(15.850)
44	EUCINOSTOMUS SP.	486	(476)	7.182	(6.999)
45	CITHARICHTHYS MACROPS	483	(450)	8.459	(7.828)
46	BREVOORTIA TYRANNUS	480	(478)	32.226	(32.060)
47	SELENE VOMER	476	(476)	16.366	(16.366)
48	SQUILLA EMPUSA	465	(464)	7.371	(7.345)
49	MENTICIRRHUS LITTORALIS	443	(439)	50.368	(49.567)
50	UROPHYCIS REGIUS	425	(422)	14.485	(14.369)
51	SYMPHURUS PLAGIUSA	397	(393)	14.278	(14.124)
52	ANCYLOPSETTA QUADROCELLATA	354	(285)	21.314	(16.678)
53	DASYATIS SAYI	282	(273)	447.930	(443.368)
54	SCOPHTHALMUS AQUOSUS	265	(264)	9.030	(8.944)
55	SPHYRNA TIBURO	259	(233)	521.378	(462.667)
56	GYMNURA MICRURA	234	(230)	182.702	(178.432)
57	OVALIPES OCELLATUS	221	(218)	4.032	(3.997)
58	SQUILLA NEGLECTA	195	(193)	3.098	(3.075)
59	ETRUMEUS TERES	194	(193)	0.350	(0.345)
60	FARFANTEPENAEUS DUORARUM	194	(194)	3.203	(3.203)
61	PORTUNUS SPINIMANUS	179	(177)	3.240	(3.212)
62	PARALICHTHYS DENTATUS	163	(159)	29.965	(28.077)
63	SARDINELLA AURITA	154	(79)	0.914	(0.381)
64	PRIONOTUS EVOLANS	144	(140)	8.069	(7.534)
65	CARANX CRYSOS	133	(88)	12.774	(8.405)
66	CENTROPRISTIS PHILADELPHICA	122	(117)	5.581	(5.363)
67	SPHOEROIDES MACULATUS	110	(103)	12.671	(11.953)
68	ARIOPSIS FELIS	100	(99)	3.325	(3.040)
69	RAJA EGLANTERIA	98	(85)	79.632	(69.868)
70	ETROPUS CYCLOSQUAMUS	97	(42)	1.163	(0.513)
71	HEPATUS EPHELITICUS	95	(85)	1.426	(1.325)
72	PRIONOTUS SALMONICOLOR	88	(78)	2.297	(1.871)
73	RHINOPTERA BONASUS	87	(52)	986.670	(236.920)
74	RIMAPENAEUS CONSTRICTUS	85	(84)	0.199	(0.190)

75	DIPLECTRUM FORMOSUM	84	(12)	4.176	(0.509)
76	BAGRE MARINUS	79	(79)	7.516	(7.516)
77	CALLINECTES SAPIDUS	79	(78)	11.463	(11.240)
78	CHILOMYCTERUS SCHOEPFI	76	(70)	12.947	(10.700)
79	SICYONIA BREVIROSTRIS	76	(67)	0.397	(0.343)
80	HARENGULA JAGUANA	75	(68)	2.108	(1.955)
81	STEPHANOLEPIS HISPIDUS	74	(72)	0.779	(0.765)
82	PRIONOTUS TRIBULUS	68	(66)	2.612	(2.196)
83	SYACIUM PAPILLOSUM	63	(26)	5.326	(1.875)
84	CENTROPRISTIS STRIATA	62	(52)	6.468	(5.032)
85	LIBINIA EMARGINATA	60	(53)	1.603	(1.460)
86	PERSEPHONA MEDITERRANEA	53	(49)	0.550	(0.518)
87	TRACHINOTUS CAROLINUS	49	(49)	8.145	(8.145)
88	CALLINECTES ORNATUS	44	(44)	0.497	(0.497)
89	XIPHOPENAEUS KROYERI	42	(42)	0.265	(0.265)
90	ECHENEIS NAUCRATES	41	(37)	5.688	(5.197)
91	PAGURUS POLLICARIS	37	(36)	0.882	(0.876)
92	MENTICIRRHUS SAXATILIS	34	(25)	5.903	(4.288)
93	CITHARICHTHYS SPILOPTERUS	34	(33)	0.638	(0.619)
94	TRACHURUS LATHAMI	33	(20)	0.387	(0.221)
95	GYMNURA ALTAVELA	30	(29)	396.408	(394.428)
96	PARALICHTHYS LETHOSTIGMA	26	(25)	9.165	(8.627)
97	PARALICHTHYS ALBIGUTTA	24	(14)	6.260	(3.238)
98	DASYATIS SABINA	22	(22)	4.705	(4.705)
99	DASYATIS AMERICANA	20	(20)	68.350	(68.350)
100	ARCHOSARGUS PROBATOCEPHALUS	19	(19)	31.451	(31.451)
101	MOBULA HYPOSTOMA	18	(18)	218.210	(218.210)
102	SPHYRNA LEWINI	16	(16)	13.519	(13.519)
103	HIPPOCAMPUS ERECTUS	14	(9)	0.130	(0.058)
104	ALECTIS CILIARIUS	14	(13)	0.469	(0.366)
105	CARCHARHINUS ACRONOTUS	13	(13)	62.398	(62.398)
106	CARANX HIPPOS	13	(13)	0.934	(0.934)
107	HYPLEUROCHILUS GEMINATUS	12	(12)	0.042	(0.042)
108	UROPHYCIS FLORIDANUS	10	(9)	0.616	(0.548)
109	SERIOLA DUMERILI	10	(10)	2.689	(2.689)
110	LUTJANUS SYNAGRIS	10	(10)	0.155	(0.155)
111	MUSTELUS CANIS	9	(9)	13.767	(13.767)
112	UPENEUS PARVUS	9	(2)	0.297	(0.065)
113	PORTUNUS SAYI	9	(9)	0.087	(0.087)

114	MENIPPE MERCENARIA	9	(9)	0.857	(0.857)
115	DASYATIS CENTROURA	8	(6)	406.600	(274.600)
116	AETOBATUS NARINARI	7	(7)	178.110	(178.110)
117	RACHYCENTRON CANADUM	7	(2)	1.993	(0.790)
118	PILUMNUS SAYI	7	(7)	0.060	(0.060)
119	BREVOORTIA SMITHI	6	(6)	0.746	(0.746)
120	ALUTERUS SCHOEPFI	6	(6)	0.151	(0.151)
121	LAGOCEPHALUS LAEVIGATUS	6	(5)	0.444	(0.419)
122	CANCER IRRORATUS	6	(6)	0.033	(0.033)
123	DIPLODUS HOLBROOKI	5	(5)	0.092	(0.092)
124	GYMNACHIRUS MELAS	5	(5)	0.108	(0.108)
125	BOTHUS ROBINSI	5	(4)	0.114	(0.102)
126	LYSMATA WURDEMANNI	5	(5)	0.005	(0.005)
127	ALBUNEA PARETII	5	(5)	0.037	(0.037)
128	SYNGNATHUS LOUISIANAE	4	(4)	0.049	(0.049)
129	CALAMUS LEUCOSTEUS	4	(1)	0.361	(0.033)
130	HEMIPTERONOTUS NOVACULA	4	0	0.109	0.000
131	ASTROSCOPUS Y-GRAECUM	4	(4)	0.153	(0.153)
132	ACANTHOSTRACION QUADRICORNIS	4	(3)	1.644	(1.364)
133	CARCHARHINUS PLUMBEUS	3	(3)	26.080	(26.080)
134	ELOPS SAURUS	3	(3)	0.435	(0.435)
135	OPHICHTHUS GOMESI	3	(2)	0.533	(0.406)
136	OLIGOPLITES SAURUS	3	(3)	0.369	(0.369)
137	UMBRINA COROIDES	3	(3)	0.072	(0.072)
138	CHAETODON OCELLATUS	3	(3)	0.065	(0.065)
139	PARALICHTHYS SQUAMILENTUS	3	(3)	0.104	(0.104)
140	PETROLISTHES GALATHINUS	3	(3)	0.030	(0.030)
141	CALAPPA FLAMMEA	3	(2)	0.580	(0.520)
142	EUGOMPHODUS TAURUS	2	(2)	57.460	(57.460)
143	GALEOCERDO CUVIERI	2	(2)	3.300	(3.300)
144	OPHICHTHUS OCELLATUS	2	(2)	0.470	(0.470)
145	OPSANUS TAU	2	(2)	0.081	(0.081)
146	UROPHYCIS EARLLI	2	(2)	0.088	(0.088)
147	CARANX BARTHOLOMAEI	2	(2)	0.019	(0.019)
148	LUTJANUS CAMPECHANUS	2	(1)	0.050	(0.045)
149	LUTJANUS GRISEUS	2	(2)	0.171	(0.171)
150	PAREQUES UMBROSUS	2	(2)	0.031	(0.031)
151	CARCHARHINUS BREVIPINNA	2	(2)	10.470	(10.470)
152	SICYONIA LAEVIGATA	2	(1)	0.008	(0.002)

153	OCTOPUS VULGARIS	2	(1)	0.297	(0.007)
154	RHINOBATOS LENTIGINOSUS	1	(1)	1.220	(1.220)
155	OGCOCEPHALUS ROSTELLUM	1	(1)	0.008	(0.008)
156	ALOSA AESTIVALIS	1	(1)	0.102	(0.102)
157	TRACHINOCEPHALUS MYOPS	1	0	0.014	0.000
158	PORICHTHYS PLECTRODON	1	(1)	0.038	(0.038)
159	OGCOCEPHALUS VESPERTILIO	1	(1)	0.012	(0.012)
160	RISSOLA MARGINATA	1	(1)	0.032	(0.032)
161	MEMBRAS MARTINICA	1	(1)	0.004	(0.004)
162	FISTULARIA TABACARIA	1	(1)	0.008	(0.008)
163	SYNGNATHUS FLORIDAE	1	(1)	0.004	(0.004)
164	PRIACANTHUS ARENATUS	1	(1)	0.008	(0.008)
165	POGONIAS CROMIS	1	(1)	0.180	(0.180)
166	HYPSOBLENNIUS HENTZI	1	(1)	0.002	(0.002)
167	SCOMBEROMORUS REGALIS	1	0	0.166	0.000
168	ARIOMMA REGULUS	1	(1)	0.010	(0.010)
169	SCORPAENA CALCARATA	1	(1)	0.012	(0.012)
170	PRIONOTUS OPHRYAS	1	(1)	0.032	(0.032)
171	ALUTERUS HEUDELOTI	1	(1)	0.010	(0.010)
172	HYPORHAMPUS MEEKI	1	(1)	0.011	(0.011)
173	PETROCHIRUS DIOGENES	1	(1)	0.200	(0.200)
174	HYPOCONCHA ARCUATA	1	(1)	0.011	(0.011)

Appendix 3. Summary of incidental catch data of sea turtles in 2000.

Date	Collection number	Species	Tag Numbers	Curved Length (cm)	Curved Width (cm)	Straight Length (cm)	Straight Width (cm)	Sex	Weight (kg)	Latitude/ Longitude	Strata/ Region
					Spring 2000						
04/17/00	000004	L. kempi	SSR951 SSR952	53.0	56.5	50.5	50.0	U	18.29	32° 34.30N 80° 01.27N	43M6 SC
04/19/00	000035	C. caretta	SSR953 SSR954	71.0	70.0	67.0	55.0	U	41.00	30° 53.08N 81° 18.97N	33M3 GA
04/26/00	000090	C. caretta	SSR955 SSR956	68.0	65.0	63.5	52.5	U	36.15	33° 08.23N 79° 09.33N	49M3 SC
04/28/00	000120	C. caretta	SSR957 SSR957	62.0	59.5	56.0	46.0	U	27.60	32° 50.76N 79° 35.77N	47M6 SC
05/09/00	000196	C. caretta	SSR959 SSR960	57.0	56.0	52.5	43.5	U	22.20	34° 25.25N 77° 32.49N	61M4 OB
					Summer 2000						
07/20/00	000244	C. caretta	SSR961 SSR962	64.0	61.0	59.0	50.0	U	34.32	29° 50.23N 81° 15.20N	27M4 FL
07/20/00	000253	C. caretta	SSR963 SSR964	74.5	72.0	70.0	58.5	U	47.57	30° 46.90N 81° 19.29N	31M5 GA
07/20/00	000256	C. caretta	SSR965 SSR966	65.0	65.0	59.0	50.0	U	37.57	30° 51.47N 81° 22.24N	33M6 GA
07/20/00	000257	C. caretta	SSR967 SSR968	69.0	66.0	64.0	51.5	U	38.61	30° 53.94N 81° 19.08N	33M3 GA
07/21/00	000259	L. kempi	SSR969 SSR970	58.0	62.0	55.0	56.5	U	26.25	31° 51.19N 80° 53.22N	39M2 GA
07/21/00	000261	C. caretta	SSR971 SSR972	60.5	58.0	56.5	47.0	U	18.06	31° 57.49N 80° 47.18N	39M3 GA
07/21/00	000263	C. caretta	SSR973 SSR974	77.0	74.0	72.5	57.5	U	59.40	32° 03.80N 80° 46.19N	41M5 SC
07/21/00	000264	C. caretta	SSR975 SSR976	85.0	79.0	77.0	60.0	U	67.90	32° 03.80N 80° 46.19N	41M5 SC
07/21/00	000266	C. caretta	SSR977 SSR978	73.0	69.0	67.5	56.5	U	51.40	32° 04.37N 80° 39.67N	41M7 SC
07/21/00	000266	C. caretta	SSR979 SSR980	65.0	62.0	60.5	49.0	U	34.34	32° 04.37N 80° 39.67N	41M7 SC
					Fall 2000						
10/03/00	000372	C. caretta	SSR981 SSR982	73.0	71.0	68.0	53.0	U	40.90	29° 57.57N 81° 17.79N	29M2 FL
10/06/00	000405	C. caretta	SSR983 SSR984	87.0	83.0	80.0	62.0	M	76.50	32° 03.83N 80° 46.15N	41M5 SC
10/11/00	000419	C. caretta	SSR985 SSR986	87.0	80.0	81.0	61.5	U	80.05	33° 47.69N 78° 41.46N	53M3 LB
10/13/00	000449	C. caretta	SSR987 SSR988	62.0	63.0	59.0	49.0	U	32.20	33° 02.93N 79° 16.70N	49M9 SC
10/13/00	000451	C. caretta	SSR989 SSR990	99.0	93.0	94.5	73.0	M	110.00	32° 59.14N 79° 16.36N	49M1 SC
10/13/00	000456	C. caretta	SSR991 SSR992	66.0	61.0	61.0	49.0	U	36.36	32° 55.18N 79° 28.11N	47M1 SC
10/19/00	000492	C. caretta	SSR993 SSR994	67.0	63.0	63.5	51.0	U	34.59	34° 32.95N 76° 38.18N	64M1 OB
10/26/00	000515	C. caretta	SSR995 SSR996	72.0	67.0	66.0	54.0	U	38.98	33° 27.53N 79° 03.72N	51M1 LB
10/26/00	000523	C. caretta	SSR997 SSR998	72.0	69.0	66.0	54.0	U	39.19	33° 17.61N 79° 07.80N	51M6 LB
10/31/00	000541	C. caretta	XXL077 XXL078	73.5	72.5	68.0	55.0	U	52.20	31° 23.22N 81° 09.07N	35M1 GA
10/31/00	000553	C. caretta	SSR999 SSR000	65.0	64.0	59.5	51.0	U	33.89	31° 58.25N 80° 45.13N	39M1 GA