

SOUTH CAROLINA WILDLIFE AND MARINE
RESOURCES DEPARTMENT

A Survey of the Ichthyofauna of the Surf Zone
in South Carolina

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ABSTRACT

Six stations in the surf zone of South Carolina were seined on a monthly basis for one year (1971). A total of 6,516 fish were captured representing 18 families, 29 genera, and 39 species. The eight most important species were Menidia menidia, Anchoa mitchilli, Trachinotus carolinus, Menticirrhus littoralis, Mugil cephalus, Membras martinica, Fundulus majalis, and Anchoa hepsetus. Spring was the most productive season in numbers of individuals, whereas summer was the most important season in terms of biomass. Seasonal occurrence is examined for the more important species and periods of recruitment are determined for several species.

INTRODUCTION

Fishes of the surf zone of South Carolina are important to the commercial and sport fisheries of the state. Species found in the surf during some stages of their life histories enter directly into these fisheries, serve as forage fish for species which do, or interact in some other manner with species of these fisheries. Several species, such as the pompanos (Trachinotus spp.) and Gulf kingfish (Menticirrhus littoralis), utilize these nearshore waters as nursery areas. Clearly, the surf zone is important in terms of recreational and economic benefits to the State of South Carolina and its people. In spite of this, limited amounts of data are available on the surf zone fishes and their habitat.

In an effort to determine the species composition, seasonal occurrence, and importance of various species of fish in the surf zone, a monthly seining survey was conducted in 1971 by personnel of the South Carolina Wildlife and Marine Resources Department.

MATERIALS AND METHODS

Six stations were selected on unprotected stretches of beach along the coast of South Carolina as representative of the surf zone (Figure 1). These stations were sampled on a monthly basis for a year (January through December 1971). A station at Debidue Beach was discontinued after March, because of access problems, and a station at Pawleys Island was added in its place. The stations at Pawleys Island, Debidue Beach, and Bulls Island were in close proximity to inlets, whereas the others were not. This may have increased the species diversity at these stations because recruitment from protected inland water areas probably occurred. The stations at Edisto Beach, Garden City Beach, and Bulls Island have bottoms with considerable shell and shell hash but the other stations have a sandy bottom.

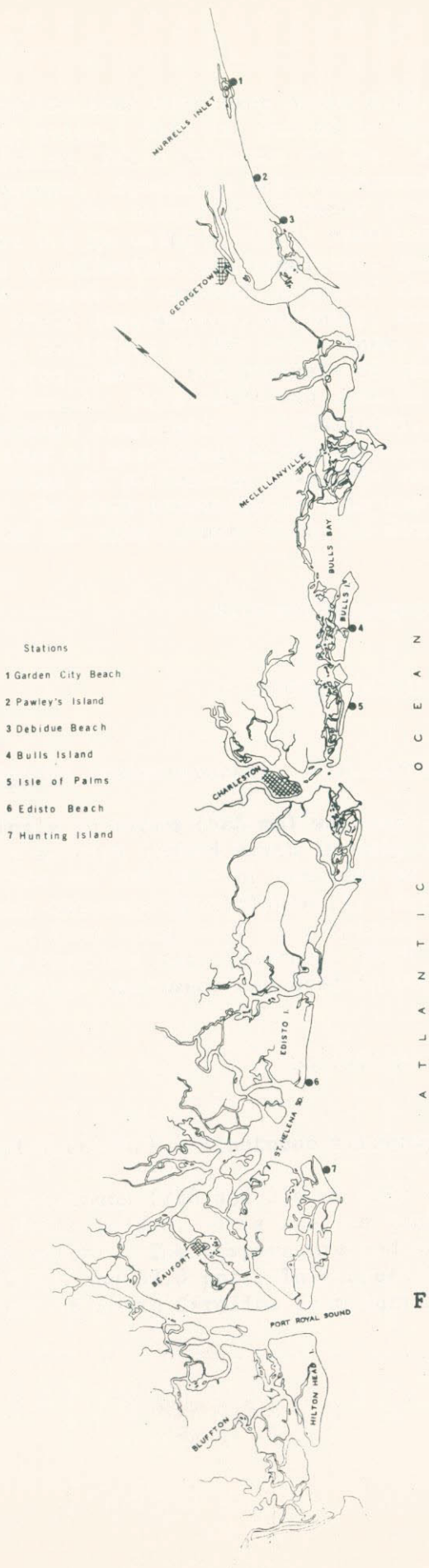


Figure 1. The coastline of South Carolina and the locations of the 1971 seining survey stations.

All collections were made using a 19.9m by 1.8m, 6.3mm stretch-mesh nylon bag seine. This was pulled in the breaker zone, parallel with the shoreline, for a distance of 75m. All tows were made with the long-shore current. Specimens were preserved in 10% formalin, identified, measured to the nearest millimeter (standard length), and weighed to the nearest 0.1 gm using a triple beam balance.

After a collection was completed, the following physical data were recorded: depth of capture, stage of the tide, bottom type, air temperature, water temperature, salinity, turbidity, wind velocity and direction, and condition of the sea. These parameters are interrelated to a large degree, making the analysis of the effects of a single one extremely difficult. No attempt was made to correlate any of the above parameters, except temperature and salinity, with occurrence.

The type of gear used during the survey is quite selective and is more efficient in collecting juveniles and slower swimming species. Consequently, the data presented in this report are not completely representative of the total ichthyofauna of South Carolina's surf zone.

Systematic Account

CARCHARHINIDAE

Aprionodon isodon (Valenciennes). Finetooth shark.

A single specimen (588 mm) was captured on 23 July at Hunting Island. This species ranked sixth in weight (4.3% of the total catch). The temperature and salinity at the time of collection were 27.0C and 32.3 parts per thousand (ppt) (Table 1). Prior to the collection of this specimen, only four records of this species existed for the State, three of which were from the surf (Bearden, 1965). Dahlberg and Heard (1969) reported on thirty specimens captured in Georgia waters.

DASYATIDAE

Dasyatis sayi (Lesueur). Bluntnose stingray.

Two specimens (228 and 236 mm disc width) were collected on 6 August at Bulls Island. This species ranked seventh in weight (4.0% of the total catch). The temperature and salinity at the time of capture were 27.2 C and 33.0 ppt. This species is commonly found in the inshore waters of South Carolina from April through November (Bearden, 1965).

Table 1 - Monthly size range (mm SL) and number collected (in parenthesis); overall size, temperature, and salinity ranges for each species collected during the 1971 seining survey.

Species	January	February	March	April	May	June	July	August	September	October	November	December	Total Number	Overall Size Range	Salinity Range (ppt)	Temperature Range (°C)
<i>Aloia acetiwalli</i>								101-110 (3)	56-68 (10)	57 (1)	41-58 (4)	106 (1)	3	101-110	33.4-33.9	27.2-27.5
<i>Anchoa hepsetus</i>				77 (1)		33-52 (189)	50-53 (5)	48-71 (43)	29-73 (5)	29-73 (5)	171-186 (4)	147 (1)	253	33-77	22.6-35.0	12.8-28.5
<i>Anchoa mitchilli</i>			36-51 (47)	42-61 (7)	52 (1)	42-61 (130)	23-54 (114)	26-59 (221)	20-52 (43)	38-61 (172)	14-15 (4)	41-61 (61)	2483	14-61	22.6-35.0	12.3-28.5
<i>Apilimodon fison</i>							598 (1)						1	598 *	32.3	27.0
<i>Astroscopus y-gracem</i>								63-99 (5)					5	63-99	22.6	28.5
<i>Bairdiella chrysura</i>													2	96-106	30.2-32.3	12.8-15.9
<i>Brevoortia tyrannus</i>													1	81	33.4	26.8
<i>Caranx hippos</i>							30 (1)	28-39 (4)	27-34 (5)	31-33 (2)	45-48 (2)		2	45-48	32.3-33.4	22.0-22.1
<i>Caranx latus</i>													1	21	32.9	27.5
<i>Chilomycterus schoepfli</i>						21 (1)							1	21	32.9	27.5
<i>Chlorocombus chrysurus</i>								18-36 (42)	29-73 (5)	36-39 (2)			49	18-73	22.6-33.4	22.0-28.5
<i>Cyprinodon variegatus</i>													2	35	31.2-32.3	10.3-15.9
<i>Desyatis sayi</i>								228-236 (2)					2	228-236 **	33.9	27.2
<i>Dorosoma cepedianum</i>			61 (1)										1	61	31.2	15.1
<i>Pandulus majalis</i>	40-51 (7)		41-64 (4)		39-61 (7)		24-102 (26)	37-54 (51)		46 (1)	39-44 (2)		98	24-102	31.2-35.0	7.6-28.2
<i>Kathostoma albigutta</i>		21 (1)											1	21	26.9	10.5
<i>Leiostomus xanthurus</i>								76 (1)	33-85 (7)		171-186 (4)	147 (1)	6	76-186	22.6-33.9	12.8-28.5
<i>Membra martinica</i>				65 (1)	72-79 (4)	69-87 (73)	54-88 (14)	50-77 (4)			80 (1)	68 (1)	105	33-88	22.6-33.9	12.3-28.5
<i>Menidia beryllina</i>	45 (1)	40 (1)	47-93 (847)	64-85 (28)	60-91 (64)	27-91 (112)	47-91 (45)	46-90 (459)	58-90 (37)	59-72 (15)	58-93 (131)	59-93 (537)	2530	27-94	22.6-35.0	7.1-28.5
<i>Menidia menidia</i>	59-94 (32)	51-93 (223)											2	24-51	32.9-33.9	27.2-27.5
<i>Menicichthys americanus</i>			69-112 (2)	54-109 (11)	66-88 (2)	22-111 (8)	25-115 (81)	19-89 (101)	21-85 (47)	27-102 (32)	50-70 (2)	33-62 (12)	298	19-115	22.6-35.0	12.8-28.5
<i>Menicichthys littoralis</i>						18-88 (11)		37 (1)					12	18-88	32.9-33.4	26.2-27.5
<i>Menicichthys saxatilis</i>						15-55 (31)					25-308 (6)	23 (1)	65	14-55	32.3-33.9	23.5-27.2
<i>Monacanthus tomentosus</i>					14-21 (34)	131-198 (3)	131 (1)	127-226 (9)	21-85 (47)	27-102 (32)	50-70 (2)	33-62 (12)	72	21-308	29.6-35.0	7.5-28.3
<i>Mugil cephalus</i>	23-119 (37)	21-26 (9)	25-134 (5)	23 (1)		131-198 (3)	131 (1)	127-226 (9)	21-85 (47)	27-102 (32)	50-70 (2)	33-62 (12)	45	24-95	32.9-35.0	25.4-28.3
<i>Mugil curema</i>						24-27 (17)	70-90 (9)	37-95 (19)					1	87	35.0	28.2
<i>Paralichthys dentatus</i>													1	87	35.0	28.2
<i>Paralichthys lethostigma</i>						422 (1)							1	422	33.4	26.8
<i>Paralichthys squamulentus</i>					56 (1)								2	56-97	33.4	23.2-26.8
<i>Pomatomus saltatrix</i>						61-111 (44)							44	61-111	32.9-33.9	26.2-28.3
<i>Pylamotus carolinus</i>													1	37	33.4	26.2
<i>Scleropterus ocellata</i>													1	242	22.6	28.5
<i>Selene vomer</i>						26 (1)		242 (1)					1	26	33.4	26.2
<i>Sphaeroides maculatus</i>					13 (1)								22	13-26	29.6-33.4	23.5-28.0
<i>Stromatolux marlina</i>						140-188 (8)	138-191 (2)						10	138-191	32.9-33.4	26.8-27.5
<i>Syngnathus fuscus</i>													1	97	33.4	12.7
<i>Trachinotus carolinus</i>	17-42 (6)					19-102 (127)	24-113 (28)	16-77 (112)	21-114 (13)	17-37 (15)	29 (1)	97 (1)	341	16-114	22.6-35.0	12.8-28.5
<i>Trachinotus falcatus</i>							18-60 (1)	18-60 (4)	17-104 (15)	15-30 (3)	37-65 (2)		26	16-104	22.6-33.9	12.8-28.5
<i>Trachinotus goodii</i>							72-127 (3)	72-127 (3)		87-125 (3)	52-147 (5)		11	52-147	22.6-33.9	12.1-29.5

* Total length
** Disc width

CLUPEIDAE

Alosa aestivalis (Mitchill). Blueback herring.

Three specimens (101-110 mm SL) were collected during August in a temperature range of 27.2 to 27.5 C and a salinity range of 33.4 to 33.9 ppt.

Brevoortia tyrannus (Latrobe). Atlantic menhaden.

A single specimen (81 mm SL) was captured on 20 August, at Pawleys Island. The temperature and salinity at the time of collection were 26.8 C and 33.4 ppt.

This was the most numerous species taken by Tagatz and Dudley (1961) in North Carolina waters.

Dorosoma cepedianum (Lesueur). Gizzard shad.

A single specimen (61 mm SL) was taken at Debidue Beach on 23 March in water 15.1 C and 31.2 ppt. Several workers (Gunter, 1945; Perret, et al., 1971; Swingle, 1971) have reported that this species is usually found in salinities less than 15.0 ppt.

ENGRAULIDAE

Anchoa hepsetus (Linnaeus). Striped anchovy.

A total of 253 specimens (33-77 mm SL) was collected from April through November, with the majority being captured in the late spring and summer months. This species accounted for 3.9% of the total number of specimens (Table 2). It was captured over a temperature range of 12.8 to 28.5 C and a salinity range of 22.6 to 35.0 ppt.

Other workers (Gunter, 1945; Gunter and Hall, 1965) have noted the absence of this species in shallow marine waters during the winter and early spring months. This species ranked second in number collected in the surf zone of North Carolina (Tagatz and Dudley, 1961).

Anchoa mitchilli (Valenciennes). Bay anchovy.

There were 2,483 specimens (14-63 mm SL) collected during the survey. This species ranked second in both numbers and weight and accounted for 38.1% and 10.6% of the total catch respectively (Tables 2 and 3). Specimens were collected during each season, but the majority were captured in the period from June through October. Temperatures and salinities ranged from 12.3 to 28.5 C and 22.6 to 35.0 ppt.

Juvenile recruitment appears to occur from July through November in South Carolina waters (Table 1). Kuntz (1914) reported the spawning season of the bay anchovy as late April to early September in North Carolina waters.

BELONIDAE

Strongylura marina (Walbaum). Atlantic needlefish.

Ten specimens (138-191 mm SL) were collected during June and July. Temperatures ranged from 26.8 to 27.5 C and salinities from 32.9 to 33.4 ppt. The late spring and summer occurrence of this species has been recorded by Swingle (1971) and Perret, et al. (1971).

CYPRINODONTIDAE

Cyprinodon variegatus Lacepede. Sheepshead minnow.

Two specimens (each 35 mm SL) were collected, one in November and one in December, in temperature and salinity ranges of 10.3 to 15.9 C and 31.2 to 32.3 ppt.

Specimens were collected during the fall and winter in Louisiana waters with maximum abundance in January and March (Perret, et al., 1971). Gunter (1945) reported a similar seasonal abundance for collections made along the Texas coast.

Fundulus majalis (Walbaum). Striped killifish.

Ninety-eight specimens (24-102 mm SL) were collected in temperatures of 7.6 to 28.2 C and salinities of 31.2 to 35.0 ppt. This species ranked seventh in numbers and tenth in biomass, accounting for 1.5% and 2.4% of the total catch in these categories respectively. Specimens were collected during each season but the majority (78.7% of the individuals) were captured in the summer.

Tagatz and Dudley (1961) reported a similar occurrence and seasonal abundance for this species in North Carolina waters.

ATHERINIDAE

Membras martinica (Valenciennes). Rough silverside.

A total of 105 specimens (33-88 mm SL) was collected in temperatures of 12.3 to 28.5 C and salinities of 22.6 to 33.9 ppt. The majority (74.3% of the individuals) were taken in the spring. This species ranked sixth in numbers, accounting for 1.6% of the total catch. Specimens with ripening and running ripe gonads were collected in June. Hoese (1965) reported juvenile specimens (less than 27 mm SL)

in the period from May to October in the area of Port Aransas, Texas. This species ranked third in numbers in North Carolina (Tagatz and Dudley, 1961).

Menidia beryllina (Cope). Tidewater silverside.

Based on the number of anal fin rays, three specimens (40-45 mm SL) were identified as belonging to this species (Rubinoff and Shaw, 1960). Two were collected during the winter and one in the spring, in temperature and salinity ranges of 7.6 to 23.5 C and 32.9 to 33.4 ppt.

This species appears to occur more often at locations in South Carolina waters where lower salinities prevail. Tagatz and Dudley (1961) found a similar distribution in North Carolina and Perret, et al., (1971) found a preference for lower salinities by this species in Louisiana.

Menidia menidia (Linnaeus). Atlantic silverside.

A total of 2,530 specimens (27-94 mm SL) were collected at temperatures of 7.1 to 28.5 C and in salinities 22.6 to 35.0 ppt. Specimens were captured during every month, although the summer months produced the smallest numbers. The Atlantic silversides ranked first both in numbers and biomass collected, accounting for 38.8% and 37.7% of the total catch, respectively.

Specimens captured on 26 February appeared to be maturing and by 22 March all specimens were ripe, with sperm and eggs being extruded if slight pressure was applied to the abdominal area. Ripe individuals were caught through 7 June, but all specimens captured on and after 30 June had completed spawning. M. menidia appears to spawn for a three month period, beginning in early March and extending to early June, in South Carolina.

SYNGNATHIDAE

Syngnathus fuscus Storer. Northern pipefish.

A single specimen (97 mm SL) was collected on 22 December at Edisto Beach. The temperature and salinity were 12.7 C and 33.4 ppt. This species is believed to be non-migratory and is usually found in areas with aquatic vegetation (Bigelow and Schroeder, 1953).

POMATOMIDAE

Pomatomus saltatrix (Linnaeus). Bluefish.

A total of 44 specimens (61-111 mm SL) were collected in June in a temperature range of 26.2 to 28.3 C and a salinity range of 32.9 to 33.9 ppt. Smith (1907) reported juveniles to be abundant in Beaufort Harbor, North Carolina, during the summer.

CARANGIDAE

Caranx hippos (Linnaeus). Crevalle jack.

Twelve juvenile specimens (27-39 mm SL) were captured from July through October over a temperature range of 21.5 to 28.0 C and a salinity range of 31.2 to 33.9 ppt.

A similar seasonal occurrence was reported by Tagatz and Dudley (1961) for specimens in the surf zone in North Carolina. Juveniles are found in inshore areas along the Atlantic coast of the United States from April through November and then they disappear during the colder months, either migrating southward or to warmer offshore waters (Berry, 1959). Berry (1959) believes that spawning and early development occurs offshore with the spawning season beginning in early March and extending to early September.

Caranx latus Agassiz. Horse-eye jack.

Two juvenile specimens (45 and 48 mm SL) were captured during October over temperatures of 22.0 to 22.1 C and salinities of 32.3 to 33.4 ppt.

According to Berry (1959) the horse-eye jack spawns and has its early development offshore. Juveniles migrate inshore when they attain a standard length of approximately 20 mm. As in the case of C. hippos, this inshore movement of juveniles may be attributed to a brackish water affinity. C. latus spawns from mid-March to mid-July (Berry, 1959).

Chloroscombrus chrysurus (Linnaeus). Atlantic bumper.

Forty-nine specimens (18-73 mm SL) were collected from August through October in temperatures of 22.0 to 28.5 C and salinities of 22.6 to 33.4 ppt. This species ranked tenth in terms of numbers collected.

A similar seasonal occurrence has been recorded for this species by Arnold, et al., (1960) in Texas waters. Reid (1945) collected seventeen specimens during October at Cedar Key, Florida.

Selene vomer (Linnaeus). Lookdown.

A single specimen (26 mm SL) was collected during June at the Isle of Palms in water of 26.2 C and 33.4 ppt. Perret, et al., (1971) believes that this species is found inshore only during the summer and fall.

Trachinotus carolinus (Linnaeus). Florida pompano.

Three hundred forty-one specimens (16-114 mm SL) were collected

from late spring to early fall over a temperature range of 12.8 to 28.5 C and a salinity range of 22.6 to 35.0 ppt. This species ranked third in numbers collected (5.2%) and fourth in biomass (7.6%).

Fincune (1969) also found T. carolinus to be seasonal in occurrence in Florida. The recruitment of juveniles over a period of six months in South Carolina waters is indicative of a prolonged spawning season (Table 1). Bellinger and Avault (1970) reported that recruitment occurs in a series of "waves" in the coastal waters of Louisiana. Fields (1962) reported a similar pattern of recruitment from late April through early December in Georgia waters.

Trachinotus falcatus (Linnaeus). Permit.

Twenty-six specimens (16-104 mm SL) were collected during the summer and early fall in temperatures of 12.8 to 38.5 C and salinities of 22.6 to 33.9 ppt.

A similar seasonal occurrence was noted for the permit in Florida waters (Finucane, 1969). The permit has a prolonged spawning season with recruitment occurring from July through November in South Carolina waters (Table 1). This species is believed to spawn offshore in the vicinity of the Gulf Stream (Fields, 1962).

Trachinotus goodei Jordan and Evermann. Palometa.

Eleven specimens (52-147 mm SL) were collected during the survey in the late summer and early fall in temperatures of 12.1 to 28.5 C and salinities of 22.6 to 33.9 ppt.

Fields (1962) reported an identical seasonal occurrence for T. goodei along Georgia beaches. Of the three species of Trachinotus occurring along the Atlantic coast of the United States, the palometa is the least abundant.

SCIAENIDAE

Bairdiella chrysura (Lacepede). Silver perch.

Two specimens (96 and 106 mm SL) were collected in November and December in temperatures of 12.8 and 15.9 C and salinities of 30.2 and 32.3 ppt.

This species is both euryhaline and eurythermal (Roessler, 1970) and is usually found in tidal creeks, sounds, and estuaries in South Carolina. The two specimens collected during the present study were probably recruited from a similar environment since both were captured at stations near a tidal inlet.

Leiostomus xanthurus Lacepede. Spot.

Six specimens (76-186 mm SL) were collected, five of which were

taken in the late fall when the fall "run" of spots along the beaches of South Carolina usually occurs, and the sixth in August. These specimens were collected in temperatures of 12.8 to 28.5 C and salinities of 22.6 to 33.9 ppt. This species ranked ninth in biomass and accounted for 2.9% of the total catch.

Menticirrhus americanus (Linnaeus). Southern kingfish.

Two specimens (24 and 51 mm SL) were collected, one in June and the other in August, in temperatures of 27.2 and 27.5 C and salinities of 32.9 and 33.9 ppt.

Tagatz and Dudley (1961) collected very few specimens of M. americanus during their survey in North Carolina as compared to the number of M. littoralis. The present survey indicates that M. americanus enters the surf zone only occasionally. Young specimens are normally found in tidal creeks and they are also found just offshore from the surf zone (Bearden, 1963).

Menticirrhus littoralis (Holbrook). Gulf kingfish.

This was the most common sciaenid taken during the survey with a total of 298 specimens (19-115 mm SL) being collected in temperatures of 12.8 to 28.5 C and salinities of 22.6 to 35.0 ppt. Specimens were collected during each season, but the majority (77%) were collected during the summer months. This species ranked fourth in numbers (4.6% of total catch) and eighth in terms of weight (3.5% of total catch).

A similar seasonal occurrence was recorded in North Carolina waters (Tagatz and Dudley, 1961). It appears that spawning begins in May and continues through September in South Carolina waters, judging from the recruitment of juveniles into the surf zone (Table 1). Hildebrand and Cable (1934) reported an identical spawning period for M. littoralis in North Carolina.

Menticirrhus saxatilis (Bloch and Schneider). Northern kingfish.

Twelve specimens (19-88 mm SL) were collected, eleven in June, in temperature and salinity ranges of 26.2 to 27.5 C and 32.9 to 33.4 ppt.

This species spawns from April through May in North Carolina waters (Hildebrand and Cable, 1934). A similar spawning period probably occurs in South Carolina waters and the smaller juveniles collected during this study represent individuals from the most recent spawning period.

Sciaenops ocellata (Linnaeus). Red drum.

A single specimen (242 mm SL) was captured during August in water of 28.5 C and 22.6 ppt. Juveniles are found well up in the estuaries and larger specimens are usually able to avoid the gear used in the present survey. Large individuals are frequently caught by surf fishermen from March through November along South Carolina's beaches.

MUGILIDAE

Mugil cephalus Linnaeus. Striped mullet.

Seventy-two specimens (21-308 mm SL) were collected during the survey in temperatures of 7.5 to 28.3 C and salinities of 29.6 to 35.0 ppt. Specimens were captured during each season but the majority (71%) were caught during the winter months. M. cephalus ranked eighth in terms of numbers and third in terms of biomass, accounting for 1.1% and 9.8% of the total catch respectively.

The young striped mullet, which are spawned at sea during late fall or winter, begin to move inshore and appear in the surf when they attain a standard length of approximately 18 mm (Anderson, 1958). In Georgia waters, juveniles appear in early November and recruitment continues through April until by May the majority of the population has entered the estuarine areas where development and growth continue (Anderson, 1958). An identical recruitment period is indicated by the present survey for South Carolina waters (Table 1). Large schools of adult striped mullet are found in the surf zone, especially in late summer and fall, but they are generally able to avoid the seine.

Mugil curema Valenciennes. White mullet.

Forty-five specimens (24-95 mm SL) were collected during the late spring and early summer months in temperatures of 25.4 to 28.3 C and salinities of 32.9 to 35.0 ppt.

The spring appearance of juvenile white mullet in the beach and estuarine areas of Georgia and North Carolina has been recorded by Anderson (1957). Juveniles, which were spawned in early spring, migrate from those areas in late fall and early winter (Anderson, 1957). A similar seasonal occurrence and period of recruitment is indicated for South Carolina waters (Table 1).

URANOSCOPIDAE

Astroscopus y-graecum (Cuvier). Southern stargazer.

Five specimens (63-99 mm SL) were collected during August at Edisto Beach in water of 28.5 C and 22.6 ppt. The southern stargazer is normally found in shallow inshore areas (Berry and Anderson, 1961).

Kathetostoma albigutta (Bean). Lancer stargazer.

A single specimen (21 mm SL) was collected during February at Hunting Island Beach in water of 10.5 C and 26.9 ppt. This record is interesting because this species has previously been unrecorded from shallow inshore waters (Cupka and Dias, in press).

TRIGLIDAE

Prionotus carolinus (Linnaeus). Northern searobin.

A single specimen (37 mm SL) was collected during June at the Isle of Palms in water of 26.2 C and 33.4 ppt. This species has also been captured in the surf in North Carolina (Tagatz and Dudley, 1961).

BOTHIDAE

Paralichthys dentatus (Linnaeus). Summer flounder.

A single specimen (87 mm SL) was captured at Bulls Island during July in water of 28.2 C and 35.0 ppt.

Young summer flounder, which are spawned offshore, migrate inshore and enter estuarine areas where they grow until reaching a standard length of approximately 125 mm, at which time they usually begin to move offshore to higher salinity water (Ginsburg, 1952).

Paralichthys lethostigma Jordan and Gilbert. Southern flounder.

A single specimen (422 mm SL) was collected during June at Pawleys Island in water of 26.8 C and 33.4 ppt.

The southern flounder prefers a mud bottom and is generally found in shallow water (Ginsburg, 1952). Swingle (1971) reported P. lethostigma to be most abundant in the Mobile Delta area of Alabama from May through July.

Paralichthys squamilentus Jordan and Gilbert. Broad flounder.

Two specimens (56 and 97 mm SL) were collected, one during May and the other in August, over a temperature range of 23.2 to 26.8 C and at a salinity of 33.4 ppt.

This species is represented by juveniles in the surf zone of South Carolina during the spring and summer months. Specimens have been collected in the coastal waters of South Carolina at localities with a sand bottom and at temperatures above 22.0 C and salinities greater than 29.0 ppt. (Bearden, 1971). Swingle (1971) recorded eleven specimens of similar size taken during June along the Gulf Beach area of Baldwin County, Alabama.

BALISTIDAE

Monacanthus hispidus (Linnaeus). Planehead filefish.

Sixty-five specimens (14-55 mm SL) were collected during May

and June in temperatures of 23.5 to 27.2 C and salinities of 32.3 to 33.9 ppt. This species ranked ninth in numbers, accounting for 1.0% of the total catch. Reid (1954) recorded juvenile specimens of similar size from May through November at Cedar Key, Florida.

TETRAODONTIDAE

Sphoeroides maculatus (Bloch and Schneider). Northern puffer.

Twenty-two specimens (13-26 mm SL) were collected during the survey in water of 23.5 to 28.0 C and 29.6 to 33.4 ppt. The majority (95%) of the specimens were collected in late spring.

DIODONTIDAE

Chilomycterus schoepfi (Walbaum). Striped burrfish.

A single specimen (21 mm SL) was captured at Edisto Beach during June in water of 27.5 C and 32.9 ppt.

Reid (1954) recorded juvenile specimens from May through August at Cedar Key, Florida, where spawning is believed to occur during the spring. Perret, et al., (1971) collected specimens measuring less than 21 mm SL during June in Louisiana.

DISCUSSION

Collections made at six stations in the surf zone of South Carolina on a monthly basis resulted in the capture of 6,516 fish representing 39 species, 29 genera, and 18 families. These collections were made over a temperature range of 7.1 to 28.5 C and a salinity range of 22.6 to 35.0 ppt.

The five most important species collected, based on numbers, in order of decreasing importance were Menidia menidia, Anchoa mitchilli, Trachinotus carolinus, Menticirrhus littoralis, and Anchoa hepsetus (Table 2). These five species accounted for 90.6% of the total catch.

The four most important species collected, based on weight, in decreasing order of importance were Menidia menidia, Anchoa mitchilli, Mugil cephalus, and Trachinotus carolinus (Table 3). These four species accounted for 65.7% of the total catch.

Species diversity increased from a winter minimum of eight species to a summer maximum of twenty-six species (Table 4). In terms of numbers, spring was the most important season (39.8% of the total catch) whereas collections made in the fall produced the fewest number (15.8% of the total catch). In terms of biomass of fishes captured, summer was the most productive season (34.8%) while winter (18.7%) and fall (19.1%), which produced essentially, the same biomass, were the least productive seasons.

TABLE 2. The ten most important species captured during the 1971 seining survey, based on the number of specimens collected.

<u>SPECIES</u>	<u>NUMBER</u>	<u>PER CENT OF TOTAL CATCH</u>
<u>Menidia menidia</u>	2530	38.8
<u>Anchoa mitchilli</u>	2483	38.1
<u>Trachinotus carolinus</u>	341	5.2
<u>Menticirrhus littoralis</u>	298	4.6
<u>Anchoa hepsetus</u>	253	3.9
<u>Membras martinica</u>	105	1.6
<u>Fundulus majalis</u>	98	1.5
<u>Mugil cephalus</u>	72	1.1
<u>Monacanthus hispidus</u>	65	1.0
<u>Chloroscombrus chrysurus</u>	49	0.8
TOTAL	6294	96.6

TABLE 3. The ten most important species captured during the 1971 seining survey, based on biomass collected.

<u>SPECIES</u>	<u>TOTAL WEIGHT (gms)</u>	<u>PER CENT OF TOTAL CATCH</u>
<u>Menidia menidia</u>	8399.1	37.7
<u>Anchoa mitchilli</u>	2367.2	10.6
<u>Mugil cephalus</u>	2177.6	9.8
<u>Trachinotus carolinus</u>	1684.3	7.6
<u>Paralichthys lethostigma</u>	1362.0	6.1
<u>Aprionodon isodon</u>	965.0	4.3
<u>Dasyatis sayi</u>	882.0	4.0
<u>Menticirrhus littoralis</u>	776.0	3.5
<u>Leiostomus xanthurus</u>	653.2	2.9
<u>Fundulus majalis</u>	527.3	2.4
TOTAL	19793.7	88.9

TABLE 4. Number of species, total number and total weight of specimens captured during the 1971 seining survey by season.

<u>Season</u>	<u>No. of Species</u>	<u>Per Cent of Total</u>	<u>Number of Specimens</u>	<u>Per Cent of Total</u>	<u>Total Weight (gms)</u>	<u>Per Cent of Total</u>
Winter (Jan-Mar)	8	20.5	1217	18.7	4161.5	18.7
Spring (Apr-June)	21	53.8	2598	39.8	6103.7	27.4
Summer (July-Sept)	26	66.7	1673	25.7	7768.4	34.8
Fall (Oct-Dec)	17	43.6	1028	15.8	4272.3	19.1
TOTAL			6516		22305.9	

In an effort to determine the most important species found in South Carolina's surf zone, an importance rank was calculated. This takes into account the rank in numbers, weight rank, and appearance rank for each species collected. The rank in numbers and weight rank were arrived at by arbitrarily assigning a rank of one to the species with the greatest number and weight collected. The second most important species, based on number and weight collected, were assigned a rank of two and so on until each species was ranked in terms of both number and weight. Species with the same number of specimens or the same weight were given equal ranking. The appearance rank was determined by ranking each species according to the number of months collected during the year, with the species appearing most frequently being arbitrarily assigned a rank of one and so on. Species occurring the same number of months were given equal ranking. The numerical rank, weight rank, and appearance rank were then summed up and an average was calculated upon which the importance rank was assigned (Table 5). The most important species found in the surf zone of South Carolina is Menidia menidia. The next seven most important species, in order of decreasing importance, are Anchoa mitchilli, Trachinotus carolinus, Menticirrhus littoralis, Mugil cephalus, Membras martinica, Fundulus majalis, and Anchoa hepsetus. These eight species accounted for 94.8% of the total catch in numbers and 74.6% of the total weight collected.

The species caught during the survey can be divided into three groups based on seasonality and occurrence: 1) resident species--these are species which have representatives present in the surf zone during each season as shown by their capture; 2) seasonal migrants--these are species having significant numbers present in the surf zone during some part of the year; 3) strays and occasionals--these are species which have been recruited from other environments or which are present in the surf zone only in small numbers.

TABLE 5. Numerical rank, weight rank, appearance rank, and importance rank of the sixteen most important species collected during the 1971 seining survey.

<u>SPECIES</u>	<u>NUMERI- CAL RANK</u>	<u>WEIGHT RANK</u>	<u>APPEAR- ANCE RANK</u>	<u>SUM OF RANKS</u>	<u>AVG.</u>	<u>IMPORT- ANCE RANK</u>
<u>Menidia menidia</u>	1	1	1	3	1.0	1
<u>Anchoa mitchilli</u>	2	2	2	6	2.0	2
<u>Trachinotus carolinus</u>	3	4	5	12	4.0	3
<u>Menticirrhus littoralis</u>	4	8	2	14	4.7	4
<u>Mugil cephalus</u>	8	3	3	14	4.7	4
<u>Membras martinica</u>	6	11	4	21	7.0	5
<u>Fundulus majalis</u>	7	10	5	22	7.3	6
<u>Anchoa hepsetus</u>	5	16	5	26	8.7	7
<u>Leiostomus xanthurus</u>	18	9	8	35	11.7	8
<u>Trachinotus falcatus</u>	13	17	6	36	12.0	9
<u>Paralichthys lethostigma</u>	22	5	10	37	12.3	10
<u>Aprionodon isodon</u>	22	6	10	38	12.7	11
<u>Dasyatis sayi</u>	21	7	10	38	12.7	11
<u>Chloroscombrus chrysurus</u>	10	23	8	41	13.7	12
<u>Monacanthus hispidus</u>	9	24	9	42	14.0	13
<u>Caranx hippos</u>	15	25	7	47	15.7	14

The following species are considered to be resident species: Menidia menidia, Anchoa mitchilli, Fundulus majalis, Menticirrhus littoralis, and Mugil cephalus.

Species considered to be seasonal migrants are: Anchoa hepsetus, Caranx hippos, Chloroscombrus chrysurus, Leiostomus xanthurus, Membras martinica, Menticirrhus saxatilis, Mugil curema, Monacanthus hispidus, Paralichthys squamilentus, Pomatomus saltatrix, Sciaenops ocellata, Sphoeroides maculatus, Strongylura marina, Trachinotus carolinus, Trachinotus falcatus, Trachinotus goodei, and Dasyatis sayi.

Species classified as strays and occasionals include: Alosa aestivalis, Aprionodon isodon, Astroscopus y-graecum, Bairdiella chrysurus, Brevoortia tyrannus, Caranx latus, Chilomycterus schoepfi, Cyprinodon variegatus, Dorosoma cepedianum, Kathetostoma albigutta, Menidia beryllina, Menticirrhus americanus, Paralichthys dentatus, Paralichthys lethostigma, Prionotus carolinus, Selene vomer, and Syngnathus fuscus.

Many of the species caught during the survey are important to both the commercial and sport fisheries. These include: Pomatomus saltatrix, Paralichthys dentatus, Paralichthys lethostigma, Menticirrhus americanus, Menticirrhus littoralis, Menticirrhus saxatilis, Mugil cephalus, Mugil curema, Trachinotus carolinus, Trachinotus falcatus, Trachinotus goodei, Leiostomus xanthurus, and Sciaenops ocellata.

Most of the species considered to be of primary importance and those present in the surf zone in the greatest numbers serve as a food source for many of the species entering the sport and commercial fisheries. These include: Menidia menidia, Anchoa mitchilli, Anchoa hepsetus, Membras martinica, and Fundulus majalis.

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