

SPOTTED SEATROUT IN COASTAL WATERS OF GEORGIA

by

ROBERT K. MAHOOD
Georgia Department of Natural Resources
Game and Fish Division
Coastal Fisheries Office
Post Office Box 1676
Brunswick, Georgia 31520

ABSTRACT

Various aspects of the life history of spotted seatrout in Georgia were studied. Females comprised 63.2 per cent and males 36.8 per cent of all fish examined. Spotted seatrout moved from the shallow waters of the estuaries to deeper waters in the creeks and rivers during periods of high and low water temperature. Spawning occurred in the shallow waters in all sectors of the estuaries including the beaches near inlets. Food items found in the stomachs of spotted seatrout consisted of 53.9 per cent fish, 44.9 per cent shrimp and 0.8 per cent squid.

INTRODUCTION

Spotted seatrout (*Cynoscion nebulosus*) range from Cape Cod to Mexico as far south as Carmen Island in the lower Gulf of Campeche (Welsh and Breder, 1924; Mather, 1952). They are found in varied estuarine environments along the Atlantic and Gulf coasts of the United States. In Texas they prefer clear bays and lagoons, and stretches of beach near passes (Pearson, 1929). Seatrout in Florida are found primarily in the brackish, non-tidal inner bays and lagoons of the estuary such as those formed by the Indian and Banana Rivers on Florida's east coast (Tabb, 1966). Hildebrand and Cable (1934) reported that spotted seatrout in North Carolina are taken throughout the year in the shallow waters of the estuaries and sounds. In Georgia they are found throughout the estuaries, from the upper tidal marshes to the beaches and outer bars. They seem to prefer the shallow waters along the banks of tidal creeks, rivers and sounds near oyster beds, and along the beaches near inlets.

Spotted seatrout are among the most sought after gamefish on the Georgia coast. They provide great sport on light tackle and can be readily taken fishing from the shore, bridges, piers and from small boats.

Commercial spotted seatrout landings depend primarily on the sport fish catch. Nearly all seatrout landed commercially are taken on hook and line by "sport" fishermen that possess a commercial license (there is no legal gill net fishery). The fish are sold to local wholesalers, fish markets and restaurants.

Georgia's commercial seatrout fishery is small compared to the other South Atlantic and Gulf states. From 1970 through 1973, seatrout represented only 1.2 per cent of the total pounds and 2.3 per cent of the total value of all commercial fish landings in Georgia (Georgia Landings—Annual Summaries, 1970-1973).

Data presented in this paper were collected from October 1970 through September 1973 in conjunction with a study entitled "Survey of the Fisheries Resources in Georgia's Estuarine and Inshore Ocean Waters" (Mahood, Harris, Music and Palmer, Parts I, II, III and IV, 1974). This study was conducted in cooperation with the U. S. Department of Commerce National Oceanic and Atmospheric Administration, National Marine Fisheries Service. During the study data were collected on the life history of the spotted seatrout in Georgia. Included in these data are information on length-frequencies, maturity, spawning, sex ratios, food habits, and distribution and seasonal abundance in the various sectors of the estuaries.

MATERIAL AND METHODS

Coastal waters were divided into three sections — southern, central and northern. A section consisted of two estuary systems, both of which were divided into four sectors — marsh and small creeks, large creeks and rivers, sounds, and close inshore ocean waters. The southern section consisted of St. Andrew Sound and St. Simons Sound estuary systems; the central section of Doboy Sound and Sapelo Sound estuary systems; and the northern section of Ossabaw Sound and Wassaw Sound estuary systems. Each section was studied for one year starting in the southern section in October 1970 and finishing in the northern section in September 1973 (Figure 1).

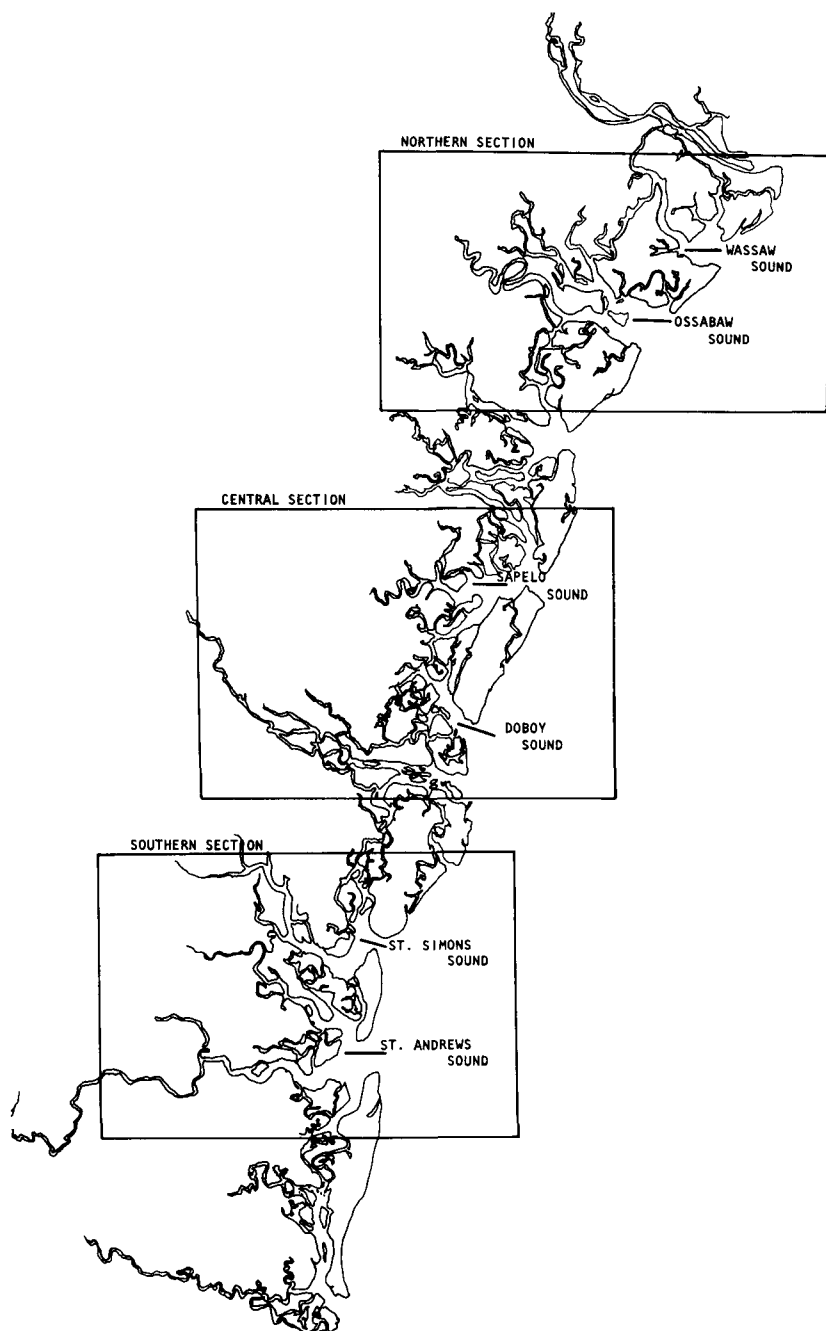


Figure 1. Map of Georgia coast showing the three sections studied.

Data were gathered from 184 seine, gill net and trawl stations located in the various sectors of the estuaries and sections of the state; data from all sections were combined. Due to the five to ten foot tides that occur twice daily on Georgia's coast, stations experienced fluctuating temperatures and salinities. Stations sampled during this project represented the various types of tidal habitats found in the estuaries along the coast.

Seine, gill net and trawl stations were sampled monthly for one year in each section of the state. Seining in the marshes and small creeks was accomplished using 12-foot nylon seines of 4-foot depth and 1/8-inch square mesh. Monofilament gill nets measuring 300 to 900-feet, with 2 1/8-inch stretched mesh were employed for gill netting in the creeks, rivers, sounds and close inshore ocean waters. A 40-foot standard flat shrimp trawl, with body and bag of 2-inch stretched mesh, was used for trawling in the larger creeks, rivers, sounds and outside waters.

Seine stations were located in small tidal pools and along the banks of small tidal creeks and rivers. Best results were obtained during low tide in areas that could be effectively blocked off with the seine. Catches were treated with 10% formalin solution in the field and returned to the laboratory where all juvenile seatrout were separated and measured.

A 20-foot gill net boat was used for all gill net operations. The gill net was usually set parallel to the bank or beach 10 to 50 yards from shore. Fish were driven into the net by striking the bottom with the oars. Largest catches were taken on slack tides fishing on or near oyster beds in the rivers and sounds, and near inlets and runouts along the beach. Data recorded for seatrout taken gill netting included: total number, total weight, number per pound, length, sex and maturity stage.

The 60-foot research vessel ANNA was used for all trawling operations. Trawl stations were located in the larger creeks, rivers, sounds and outside waters. Stations in the outside waters ranged from near the beach to 10 miles offshore. Largest catches were usually taken at or near low tide. Data recorded for seatrout taken in trawl catches were the same as for gill net catches.

Seatrout were measured as total length using the metric system. Weights were taken in pounds and ounces. At each seine, gill net and trawl station the following information was recorded: location, date, tidal stage, water and air temperatures in degrees centigrade and salinity in parts per thousand.

RESULTS AND DISCUSSION

Movement in the Estuaries

Apparent movements of spotted seatrout in Georgia estuaries are based on the relative abundance and distribution taken in gill net and trawl catches each month. Spotted seatrout were taken in abundance gill netting in the shallow waters along the banks of tidal creeks, rivers, and sounds during the fall and early winter (Figure 2). As water temperatures dropped after December, the fish apparently began moving to deeper water in the estuaries, as evidenced by increased catches of spotted seatrout in trawl samples (Figure 3). Although part of this increase in abundance of seatrout in the trawl catch can be attributed to young fish leaving the shallow areas (Gunter, 1938 and 1945), many larger fish (300-414 mm.) were also taken.

Seatrout were taken along the beaches in fair numbers during the fall and early winter, but by January they had disappeared from gill net catches (Figure 4). We believe these fish moved to deep water in the estuaries during the winter, rather than moving offshore. Neither commercial fishermen nor sport fishermen have reported large numbers of spotted seatrout offshore. Knowlton (1972), in a study of fish caught incidental to commercial shrimp trawling off the Georgia coast, reported that very few spotted seatrout were taken during commercial operations. Anderson (1968) recorded no spotted seatrout taken while trawling off the Georgia coast.

Fish began moving back into shallow areas along tidal creeks, rivers, sounds and beaches as water temperatures warmed during March, and by May had reached their greatest abundance in these areas. As water temperatures continued to rise during June, July and August, catches of seatrout in shallow water areas decreased to lows comparable to those experienced during colder winter months (Figure 2). At the same time catches taken trawling in the deeper water of the estuaries increased (Figure 3). This indicates that spotted seatrout move to deep water to escape warmer water temperatures, as well as to escape colder water temperatures.

Gill net catches along the beaches declined during June, but remained high throughout the summer (Figure 4). We think this abundance of trout on the beaches during the summer indicates that some fish move from the creeks, rivers and sounds to the beaches during periods of warmer water. Salinities averaged 5 to 8 ppt higher on the beaches during the summer months and may be

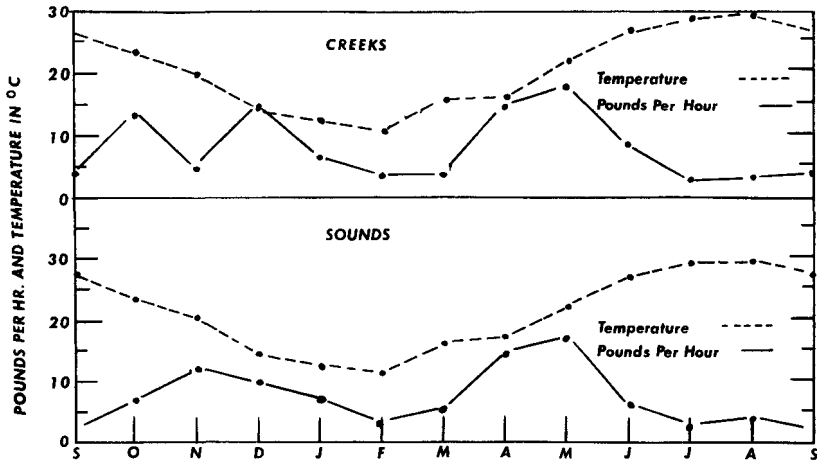


Figure 2. Pounds per hour of spotted seatrout taken gill netting in the creeks and sounds, in relation to water temperature fluctuations.

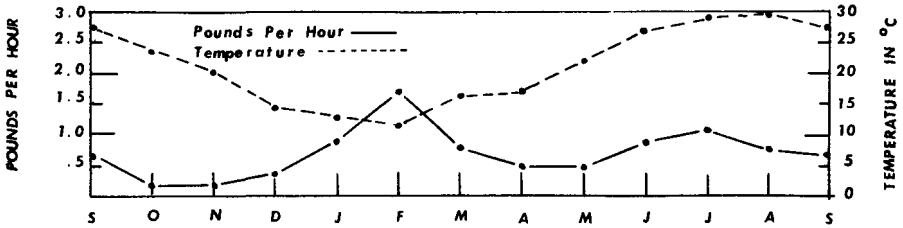


Figure 3. Pounds per hour of spotted seatrout taken trawling in the creeks and sounds, in relation to water temperature fluctuations.

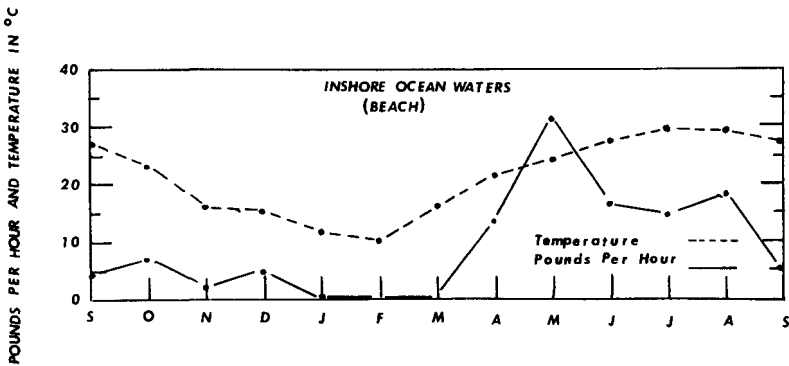


Figure 4. Pounds per hour of spotted seatrout taken gill netting along the beaches, in relation to water temperature fluctuations.

one of the factors that contributed to this apparent movement (Mahood, Harris, Music and Palmer, Part IV, table 17, 1974).

Generally, when water temperatures dropped below 16°C or rose above 25°C most spotted seatrout left the shallow waters along the banks of tidal creeks, rivers and sounds.

As no tagging study has been conducted in Georgia, there is the possibility that some seatrout may migrate along the coast through interconnected tidal creeks and rivers or along the beaches. If these migrations do occur, they are probably over short distances from one estuary system to another. Tagging studies in Florida have shown spotted seatrout to be nonmigratory with fish seldom moving more than 30 miles from where they were tagged (Moffett, 1961; Iversen and Tabb, 1962).

Maturity and Spawning

Stages of maturity for 2,977 spotted seatrout were determined during the study. Females comprised 63.2 per cent and males 36.8 per cent of all fish examined. One of seven stages of maturity was assigned to each fish. These followed closely the stages of maturity listed by Tabb (1961): Stage I) Immature; II) Newly maturing or totally spent; III) Fat storage and first ripening stage; IV) Fat absorption and second ripening stage; V) Ripe fish; VI) Spent. During our study fish were designated as Stage V when the ovaries or testes filled the ventral cavity yet eggs and milt did not flow freely and Stage VI when eggs and milt did flow freely. Spents were designated Stage VII.

Table 1. Stages of maturity, by month, for male and female spotted seatrout in per cent of total at each maturity stage.

<i>Stages</i>	<i>I</i>	<i>II</i>	<i>III</i>	<i>IV</i>	<i>V</i>	<i>VI</i>	<i>VII</i>
Female	40.1	27.9					
October							
Male	29.5	2.3					
Female	37.3	24.3	0.6				
November							
Male	33.3	2.3					
Female	39.6	27.8					
December							
Male	30.8	1.8					
Female	43.6	13.7					
January							
Male	42.2	0.5					
Female	61.5	4.1					
February							
Male	33.5	0.7					
Female	38.6	19.6	2.5				
March							
Male	26.6	11.4	0.6	0.6			
Female	12.6	12.9	16.4	10.3	2.1	1.5	
April							
Male	5.3	6.2	20.2	11.4	1.2		
Female	1.1	1.1	8.6	25.4	16.4	2.2	0.2
May							
Male	1.8	5.1	15.9	13.2	8.8	0.2	
Female	4.8	6.8	17.3	22.8	16.3	0.3	0.3
June							
Male	5.1	13.6	7.1	5.4			
Female	6.5	6.0	20.5	25.6	8.8		
July							
Male	8.4	10.7	8.4	3.7	1.4		
Female	2.9	17.3	21.6	26.9	9.6		
August							
Male	4.3	5.8	7.7	2.9	1.0		
Female	39.7	19.8	4.3				5.2
September							
Male	15.5	13.8	1.7				

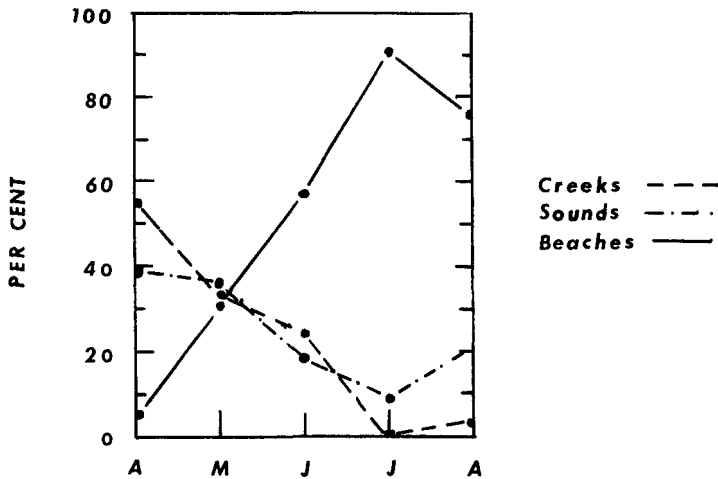


Figure 5. Per cent of ripe fish (stages 5 and 6) taken from the creeks, sounds and beaches from April through August.

Table 1 gives the stages of maturity for male and female spotted seatrout taken each month. Spawning in Georgia begins in April, reaches a peak in May and continues into August.

Ripe or spawning fish were taken in all sectors of the estuaries including the beaches. Seatrout found spawning on the beaches were always located near tidal inlets or the mouths of sounds. Ripe fish were usually taken in water three to ten feet deep, although some fish were taken in deeper water. Figure 5 shows that a greater percentage of ripe fish were taken in the creeks and sounds than in outside waters during April. As spawning reached its peak in May (Table 1), percentages of ripe fish were nearly equal in all three sectors. During the rest of the spawning season the greatest numbers of ripe fish were found on the beaches near inlets.

Juvenile spotted seatrout began showing up in seine catches in May, reaching peak abundance in July and August, and continuing into December (Table 2). Juveniles were usually taken in tidal pools and small creeks at low tide when they could not hide in the grasses along the banks. Recruitment of seatrout under 20 mm. was not noticeable through August, however, by September most juvenile seatrout taken were larger than 20 mm. (Table 3).

Length-Frequency

The three types of gear employed during this study worked well for sampling all sizes of spotted seatrout. Seines were selective for juvenile fish due to the size used and the areas sampled. Fish taken by seining ranged from 9 to 183 mm., with over 91 per cent falling between 10 and 70 mm. Trawling was the least size-selective method of sampling. However, smaller juveniles and larger adults were not taken trawling. Trawl catches produced spotted seatrout ranging from 63 to 408 mm., with over 95 per cent falling between 113 and 323 mm. The gill nets used were very selective for larger fish and produced spotted seatrout ranging from 238 to 633 mm., with over 92 per cent falling between 303 and 428 mm. (Figure 6).

Using the age-length charts developed for spotted seatrout by Pearson (1929) and Miles, Simmons and Brewer (Guest and Gunter, 1958) as general guides, it was possible to determine the different age classes taken in the seine, trawl and gill net catches. Nearly all spotted seatrout taken seining were juveniles (0 year class). The majority of the fish taken trawling were year classes one and two, while those taken gill netting were year classes three and four. A few fish, possibly as old as year class eight, were taken gill netting.

Length frequencies for fish taken in seines, trawls and gill nets are listed in Tables 3, 4 and 5. Growth was slow during the fall, winter and spring, and rapid in the summer. Spotted seatrout were taken ranging from 9 to 633 mm. Largest fish were taken in April, May, August and September.

Table 2. Juvenile spotted seatrout taken seining each month, by total number and average size.

		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Spotted seatrout	Total Number	0	0	0	0	12	16	77	88	36	4	4	1
	Average Size (mm)					20	41	28	33	51	85	124	79

Table 3. Length-frequency distribution of juvenile spotted seatrout taken seining.

(mm)	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	(mm)	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1									1								2
2									2					1			
3									3					1	1		
4									4								
5									5		1				1		
6									6				1				
7									7						2		
8									8					2	1		
9			1						9					2		1	
10			1						60		1		1	1			
11			1						1				1				
12			3						2								
13			2						3						3		
14			2						4								
15			3	1					5								
16	2								6								
17	1		1	2					7								
18	2	1	5	2					8								
19	1		3	2					9				1				
20	5		3	4	1				70				2	1			
21	2		2	3					1								
22			7	10	1				2								
23		1	3	4					3								
24		1	2	5					4								
25	1	1	1	1					5								
26			1	2					6					1			
27		1	3	4					7			1					
28		1	2						8								
29			2	2					9								1
30			3	6					80		1						
31				1	1				1		1						
32		2	3						2								
33			1	3					3								
34		1	2	1					4		1						
35		2	2	2	1				5								
36			4	2	1				6								
37			1						7			1					
38		1							8								
39					1				9								
40			3	3	1				90		1						
41									1								
42				3	1				2							1	
43				2					3						1		
44				2	3				4								
45			2	1	1				5								
46									6								
47			2	1	2	1			7							1	
48		1		2	2				8					1			
49					1				9								
50					3				100								

Table 4. Length-frequency distribution of spotted seatrout taken trawling.

Midpoint mm	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
63						1						
68				2		1						
73				2		1						
78						3		1				
83				1		2						
88				1		1						
93				1	1	1						
98					3							
103					1	2	1					
108					3						2	
113			2	1	3		1					
118			1	3	7	1	2					
123		1	3	5	9	7			2		1	
128			5	9	11	5						
133		1	2	5	6	3	6	1				
138			2	5	12	6	6					
143			1	11	9	5	8	1				
148			6	13	11	3	9				2	1
153			5	12	9	5	9					1
158			6	8	14	3	8				1	
163			6	9	6	6	3					1
168			5	6	10	5	1	2				
173			4	9	14	2	2	1	2			
178		1	3	3	10	4	1					1
183			3	6	6	5		1	1			
188			2	6	5	5	3		1			2
193			3	2	8	1	1	1	2			1
198	1		3	1	3	1	1					1
203			2	2	5	3						1
208		2	4	4	13	2			2	1		2
213			2	2	4		2		2	2		
218	1	2	1	1	2	2			2	4		3
223			3	3	3	2		1	3	3		1
228	2	1	2	5	3	1	2	7	4	4		
233	1		3	4	4	1	1	7	5	5		1
238	1	1	2	4	9	1	2	5	7	7		1
243			1	3	3	1	1	2	11	2		
248			1	2	1	3		2	4	3		
253			2	2	3	3	3	1	1	4		5
258	2		2	2	4	4	2	7	11	3		1
263	1		1	3	3	1	1	1	7	3		
268	2		2	1	3	1	1	1	4	4		2
273	1	1	3	1	5			5	3	1		
278			1	2	3		1	1	2	4	2	3
283		4	1	2	7		1	1	1	2	2	1
288			2	3	1			2	1	2		
293	1		1	1	2		3		1	2		
298	1				1		2		2			3
303				1	3		2		1	1		
308	1				1		2		1	1	2	2
313							1		2	1	1	3
318				1	1	1	1		1		1	2
323		1	1								1	3
328											2	
333												
338									1		1	2
343												
348												
353								1				
358							1			1		
363												
368												1
373									1			
378												
383												
388												
393												
398											1	
403												
408												1

Table 5. Length-frequency distribution of spotted seatrout taken gill netting.

Midpoint mm	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
238									1			
243								1	1	2		
248										1		
253								1				
258		1										
263	1		1						1			
268												
273	1							1				
278	1							1	1			
283			2									
288		1	1					2	1			
293		1	3					4				
298		1				1	1	5	2			
303	3	4	2	3	1		2	10	6			1
308	4	7	2	4		1	3	15	8	3	1	1
313	2	7	3	3		3	11	25	4	1	2	3
318	10	7	4	8		2	8	26	8	1	3	2
323	9	3	6	9	2		17	24	12	1	7	7
328	19	15	10	5	1	10	14	24	8	4	6	3
333	17	8	6	13	4	8	17	19	10	4	8	5
338	18	16	16	13	6	6	23	25	7	2	7	7
343	23	15	12	15	7	8	18	24	10	5	8	6
348	17	15	16	7	6	14	23	32	11	7	6	5
353	20	10	23	6	1	9	20	32	12	8	9	3
358	16	8	14	8	3	7	17	33	14	5	8	2
363	9	10	15	3	2	3	13	33	8	4	8	5
368	16	9	14	4	4	6	17	36	16	6	7	2
373	13	5	10	1		7	7	35	10	7	10	2
378	1	3	8	4	2	3	11	30	13	6	8	4
383	6	3	6	2	3	2	14	18	13	5	12	3
388	7	5	8	2	3	2	7	22	7	8	8	1
393	1	2	1	1			5	11	4	5	11	1
398	6	3	3	1			3	15	9	4	5	3
403	1	1		1	1	1	5	11	9	3	7	2
408	3	4	1				5	6		7	7	2
413	2			1			4	14	6	4	5	
418	4	2	1	2			5	5	7	1	7	2
423	3		2			1	6	8	2	1	2	2
428	4	2			2		3	3	3	2	2	
433		1				1	2	2	4	2	2	1
438	3	1	2		1		1	4		4		1
443		1		1		1	2	3	2		1	1
448							1	2	2		1	
453	1						3	1		1	1	
458	1						1	2		1		1
463			2				1	1			1	
468			2					5	1		1	
473		1					1	1	3			

Table 5. Continued

Midpoint mm	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
478		1					1	2		2		
483							1	1		1	1	
488		1					1	1	1		1	
493	1						1	1	2			
498	1	1					1	2				1
503										1		
508								1				
513							1	1				
518							2	2		1		
523		1					1					
528							1	1				
533												
538										1		
543								2		1		
548												
553											1	
558									1			
563											1	
568												
573								1				
578												
583												
588												
593												
598												
603												
608												
613												
618												
623												
628												
633											1	

Food Habits

Spotted seatrout are one of the major large carnivores in the coastal waters and in Georgia's productive estuaries have a wide range of food from which to choose. Stomachs of 108 spotted seatrout containing food were examined during the study. Ten of the stomachs contained more than one food item. Fish were found in 64 of the stomachs, representing 53.9 per cent of all food items and shrimp were found in 53 stomachs, representing 44.9 per cent of all food items. Squid (*Loligo* spp.), was the only other food item found and it represented only 0.8 per cent. (Table 6).

The most predominant species found in the stomachs of larger fish were: Menhaden, *Brevoortia* spp.; mullet, *Mugil* spp.; croaker, *Micropogon undulatus*; mummichog, *Fundulus heteroclitus* and white and brown shrimp, *Penaeus setiferus* and *P. aztecus*. Most common species found in smaller seatrout were: Anchovy, *Anchoa mitchilli* and *A. hepsetus*; silverside, *Menidia menidia*; seabob, *Xiphopeneus krøyeri* and grass shrimp, *Palaemonetes vulgaris*. Other species found in stomachs were: Star drum, *Stellifer lanceolatus*; spot, *Leiostomus xanthurus*; summer trout, *Cynoscion regalis*; sea catfish, *Galeichthys felis*; harvestfish, *Peprilus alepidotus*; black seabass, *Centropristes striatus*; mantis shrimp, *Squilla empusa* and snapping shrimp, *Crangon* spp.

A wide variety of organisms were consumed by seatrout and it appears they had no definite preference, eating whatever was easiest to obtain at different times of the year.

ACKNOWLEDGEMENTS

I wish to express my appreciation to David H. G. Gould, Supervisor of Coastal Fisheries, for his support and guidance throughout the project and to fellow biologists Duane Harris, Jim Music and Bob Palmer for their able assistance. Special thanks are given to William W. Anderson, Chief, Coastal Fisheries Research and Development Program, for his many valuable ideas and suggestions and for his review of the paper.

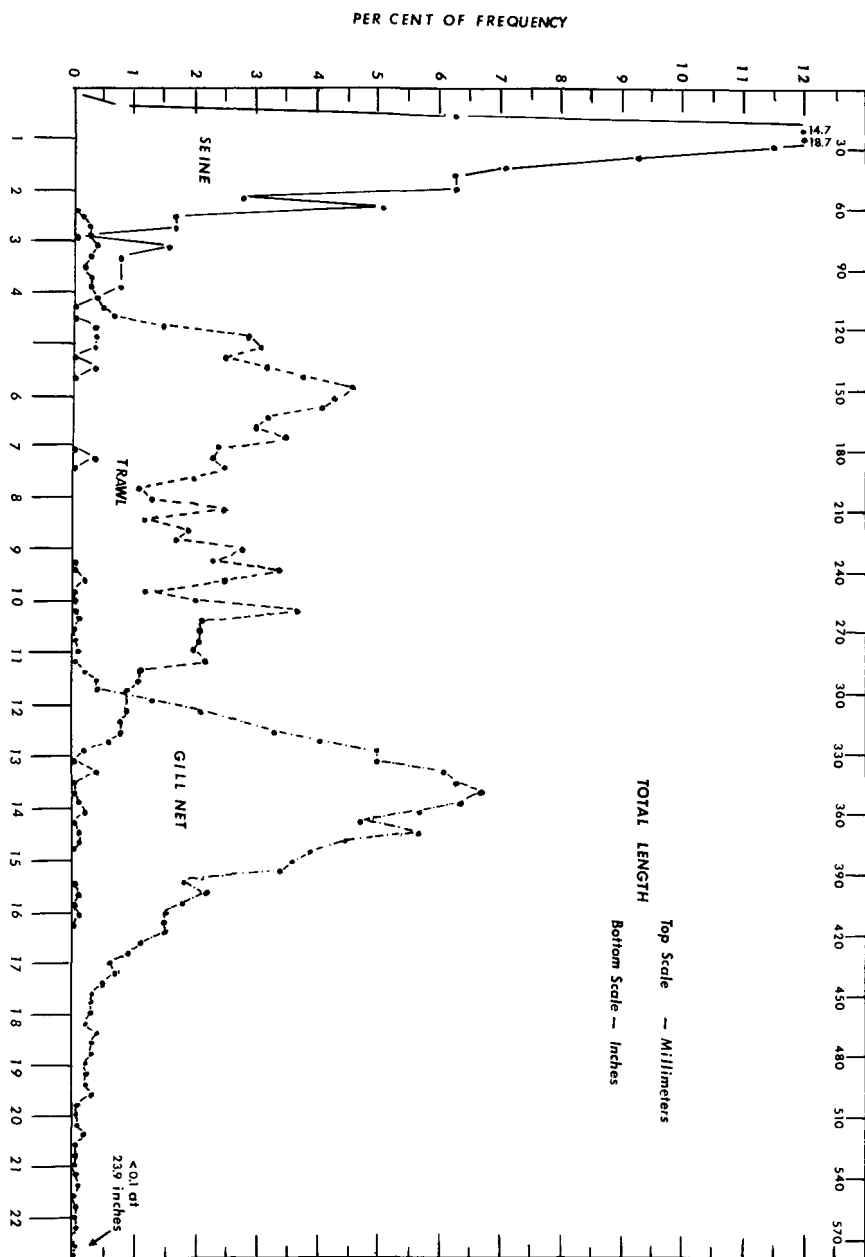


Figure 6. Per cent length-frequency distribution of spotted seatrout taken with seines, trawls and gill nets.

Table 6. Food organisms found in the stomachs of spotted seatrout by numbers and per cents.

	<i>Spotted Seatrout</i>	
	<i>No.</i>	<i>%</i>
Total stomachs containing food	108	
Stomachs containing more than one species	10	
Frequency of occurrence	118	
White and brown shrimp	40	33.9
Mantis shrimp	2	1.7
Sea bob	8	6.8
Snapping shrimp	1	0.8
Grass shrimp	2	1.7
Total shrimp	53	44.9
Anchovy	7	5.9
Menhaden	12	10.2
Silverside	9	7.6
Star drum	3	2.5
Croaker	5	4.2
Mummichog	6	5.1
Mullet	7	5.9
Spot	1	0.8
Catfish	1	0.8
Harvestfish	1	0.8
Seabass	1	0.8
Summer trout	1	0.8
Fish (unidentified)	10	8.5
Total fish	64	53.9
Total squid	1	0.8

LITERATURE CITED

- Anderson, W. W. 1968. Fishes taken during shrimp trawling along the South Atlantic coast of the United States, 1931-35. U. S. Fish and Wildl. Serv., Bur. Commer. Fish., Spec. Sci. Rep.—Fish. 570:1-60.
- Georgia Landings, Annual Summaries, 1970-73. U. S. Dept. Commerce, NOAA, Natl. Mar. Fish. Serv.
- Guest, W. C., and G. Gunter. 1958. The seatrout or weakfishes (genus *Cynoscion*) of the Gulf of Mexico. Gulf States Mar. Fish. Comm., Tech. Summary No. 1:1-40.
- Gunter, G. 1938. Seasonal variations in abundance of certain estuarine and marine fishes in Louisiana, with particular reference to life histories. Ecol. Monogr. Vol. 8:313-346.
- _____. 1945. Studies on marine fishes of Texas. Publ. Inst. Mar. Sci., Univ. Texas, Vol. 1(1):1-190.
- Hildebrand, S. F., and L. E. Cable. 1934. Reproduction and development of whittings or kingfishes, drums, spot, croaker, and weakfishes or seatrouts, family Sciaenidae, of the Atlantic coast of the United States. Bull. U. S. Bur. Fish. Vol. 48:41-117.
- _____, and W. C. Schroeder. 1928. Fishes of Chesapeake Bay. Bull. U. S. Bur. Fish. Vol. 43:1-366.
- Iverson, E. S., and D. C. Tabb. 1962. Subpopulations based on growth and tagging studies of spotted seatrout, *Cynoscion nebulosus*, in Florida. Copeia 1962(3):544-548.
- Knowlton, C. J. 1972. Fishes taken during commercial shrimp fishing in Georgia's close inshore ocean waters. Ga. Dept. Nat. Res., Game and Fish Div., Coastal Fish. Office. Contribution Series No. 21:1-42.
- Mahood, R. K., C. D. Harris, J. L. Music, and B. A. Palmer. 1974. Survey of the fisheries resources in Georgia's estuarine and inshore ocean waters, Part I. Ga. Dept. Nat. Res., Game and Fish Div., Coastal Fish. Office. Contribution Series No. 22:1-104.
- _____, _____, _____, and _____. 1974. Survey of the fisheries resources in Georgia's estuarine and inshore ocean waters, Part II. Ga. Dept. Nat. Res., Game and Fish Div., Coastal Fish. Office. Contribution Series No. 23:1-199.
- _____, _____, _____, and _____. 1974. Survey of the fisheries resources in Georgia's estuarine and inshore ocean waters, Part III. Ga. Dept. Nat. Res., Game and Fish Div., Coastal Fish. Office. Contribution Series No. 24:1-100.
- _____, _____, _____, and _____. 1974. Survey of the fisheries resources in Georgia's estuarine and inshore ocean waters, Part IV. Ga. Dept. Nat. Res., Game and Fish Div., Coastal Fish. Office. Contribution Series No. 25:1-201.
- Mather, F. J., III. 1952. Sport fishes of the vicinity of the Gulf of Honduras, certain Caribbean islands, and Carmen, Mexico. Proc. Gulf and Carib. Fish. Inst., 4th Ann. Sess., Miami Beach, Nov., 1951, p. 118-129.
- Moffett, A. W. 1961. Movements and growth of spotted seatrout, *Cynoscion nebulosus* (Cuvier), in West Florida. Fla. St. Bd. Conserv., Univ. Miami Mar. Lab. Tech. Ser. No. 36:1-35.
- Pearson, J. C. 1929. Natural history and conservation of redfish and other commercial sciaenids on the Texas coast. Bull. U. S. Fish. Vol. 44:129-214.
- _____. 1932. Winter trawl fishery off the Virginia and North Carolina coasts. U. S. Bur. Fish. Investigational Report No. 10:1-31.
- Tabb, D. C. 1961. A contribution to the biology of the spotted seatrout, *Cynoscion nebulosus* (Cuvier), of east-central Florida. Fla. St. Bd. Conserv., Univ. Miami Mar. Lab. Tech. Ser. No. 35:1-23.
- _____. 1966. The estuary as a habitat for spotted seatrout, *Cynoscion nebulosus*. Am. Fish. Soc., Spec. Publ. No. 3:59-67.
- Welsh, W. W., and C. M. Breder. 1924. Contributions to the life histories of Sciaenidae of the eastern United States. Bull. U. S. Bur. Fish. Vol. 39:141-201.