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Food of bluefish (Pomatomus saltatrix) from the U.S. south Atlantic and Gulf of Mexico

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ABSTRACT

Stomachs of 4,841 bluefish were collected from five areas in the Gulf of Mexico and U.S. south Atlantic. Bluefish were primarily piscivorous with Sciaenidae, Clupeidae, Carangidae, and Mugilidae as important components among food fish. Bluefish most frequently consumed species that were normally schooling coastal pelagic fish and supplemented this diet with shrimp, squid, and crabs. Stomach contents varied by area, size of predator, and season of capture. Local abundance and availability of prey items seemed to be the controlling factor in prey selection.

INTRODUCTION

The bluefish (Pomatomus saltatrix) is a highly prized sportfish particularly along the Atlantic coast of the United States (U.S. Dept. Comm. 1980a). In addition to its status as a prime sportfish, bluefish is also sought and harvested by commercial fishermen. During 1977 through 1981, average landings of bluefish amounted to 6,207 metric tons and were valued at over three-million dollars (U.S. Dept. Comm. 1980b). While some bluefish life history research has been conducted in the northeast region (Hamer 1959, Lassiter 1962, Lund and Maltezos 1970, Olla, Katz, and Studholme 1970, Richards 1976, Wilk 1977, Kendall and Walford 1979), there is a paucity of information on food habits of bluefish from other areas along the coasts of the United States. The purpose of this report is to present the results of a study of the stomach contents of specimens collected in the Gulf of Mexico and the U.S. south Atlantic

MATERIALS AND METHODS

Bluefish were collected by hook and line from five areas (Fig. 1) during 1977-1981. Fork length was taken for each specimen and recorded to the nearest millimeter. Stomachs were removed, wrapped in gauze, labeled and preserved in 10% formalin.

Laboratory processing of stomachs for contents proceeded as follows: samples were rinsed in fresh water to remove formalin, each stomach was cut longitudinally and scraped lightly with a spatula to remove scales and bones. The contents were placed in a glass dish, sorted into taxonomic groups, identified and enumerated. After being drained of liquid, the volume of each food category was obtained by water displacement in a graduated cylinder.

Data were summarized by percentages of occurrence and volume. Frequency of occurrence for each food type was determined by counting every fish that contained that specific item. Relative frequency of occurrence (percent) was calculated by dividing the number of fish that contained a specific food by the total number of fish that had food in their stomachs and multiplied by 100.

Data were analyzed by area, size of bluefish, and season. Areas consisted of the Carolinas, southeast Florida, south Florida, northwest Florida and Louisiana (Fig. 1). Criteria for sizes of bluefish were: small (0-399 mm FL), medium (400-599 mm FL) and large (600-999 mm FL). Criteria for seasons were: spring (March, April, May), summer (June, July, August), autumn (September, October, November), and winter (December, January. February).

RESULTS

A total of 4,841 stomachs (68% of which were empty) was obtained from bluefish (Table 1). Fishes accounted for 96% of the volume and had

a 95% frequency of occurrence. Twenty-four families of fish were identified with five accounting for 86%, and ten accounting for 95%, of the total volume of identified fish (Table 2). Sciaenidae, Clupeidae, Carangidae, Mugilidae and Sparidae were the most prevalent fishes.

Invertebrates were of minor importance in the stomach contents with only 4% of the total volume and 7% frequency of occurrence. Percentage volume and frequency of occurrence for principal components of the invertebrate prey were as follows: crabs, 2.4% and 2.7%; shrimp, 0.3% and 1.1%; mollusks (squid and gastropods), 1.7% and 4%. Seagrasses were present, but were of rare occurrence (1.4%) and amounted to less than 0.1% of the volume.

Variation by Area

Five areas were sampled, but numbers of samples were not equal (Table 3). Rates of empty stomachs were high for each area, but were highest in southeast Florida (Table 1). Total number of stomachs with contents was highest in northwest Florida, which had more than twice as many as any other area, and represented 50% of the total (Table 3).

The food of bluefish varied by area (Appendix Table 1). Even considering the disparity in sample size, each area had fishes as the principal component of stomach contents. Samples from all areas except the Carolinas had more than 90% (volume) fish component.

Numbers of fish families differed for each area (Carolinas, 11; southeast Florida, 14; south Florida, 14; northwest Florida, 17; Louisiana, 5) (Appendix Table 1). The number of identified fish families may be related to the number of samples. Sciaenidae, Clupeidae, and Carangidae were the leading fish families in all areas, but the percentage volume of these three combined families increased generally from east to west with 39% volume in the Carolinas and 78% in Louisiana. No single species of fish was common to every area (Appendix Table 1).

Bluefish also ate crabs, shrimp, squid, gastropods and seagrass. Each area differed as to which invertebrate group was dominant. Crabs were consumed in all areas, but were most prevalent in the Carolina samples. Squid was totally absent in samples from the east coast of Florida and south Florida, but was well represented in northwest Florida and Louisiana. The occurrence of seagrass and gastropods in bluefish stomachs was noted for the Carolinas, south Florida, and northwest Florida. Bluefish collected in Louisiana contained no seagrass, but several were noted to have sand in their stomachs.

Subsequent comparisons (size and season) were made within areas, largely due to the disparity in sample size, but also because each area had a unique sample by size and season (Table 3).

Stomach Contents by Length of Predator

The food varied by the length of bluefish within and among areas (Appendix Table 2). In general, small bluefish fed more heavily on invertebrates (shrimp and squid), while large bluefish fed more heavily on fish. In all areas except Louisiana, small bluefish outnumbered medium and large bluefish. In Louisiana, medium bluefish were most prevalent (Table 3).

For the Carolinas, Sciaenidae, Clupeidae and Mugilidae comprised 56% of the volume among small bluefish and as size increased Mugilidae, Labridae and Atherinidae were the principal families. In this area, small and medium bluefish ate more fish than did large bluefish.

Southeast Florida specimens showed similar results with frequency of occurrence and volume of fishes. Mugilidae, Clupeidae and Sciaenidae remained the most important families of fish. Comparisons were made between small and medium bluefish as large ones contained only one specimen (Table 3).

South Florida bluefish had invertebrates in only the small-sized fish and consumed proportionately about the same amount of fishes with an increase in size. Again, large bluefish were represented by only one specimen. Seagrass and shrimp were apparent in small and medium bluefish. Clupeidae, Carangidae, Sciaenidae and Scombridae made up 58% of the volume among small bluefish, while Sciaenidae, Serranidae, Clupeidae and Haemulidae made up 73% of the volume in medium-sized bluefish from south Florida.

Northwest Florida bluefish ate proportionately more fish as they grew. Carangidae, Clupeidae, Sciaenidae and Sparidae made up 68% of the volume among small bluefish. Carangids were more important proportionally in volume with increasing size while clupeids were less.

Specimens of bluefish obtained in Louisiana showed marked variation of stomach contents by size (Appendix Table 2). However, this may have been the results of few samples in small and large sizes (Table 3); therefore, comparisons did not seem justified.

Stomach Contents by Season

Bluefish were not available in all seasons except in southeast Florida (Table 3). Winter samples were unobtainable in the three northernmost areas. In south Florida, samples were available only in winter and spring.

Stomach contents differed by seasons within areas (Appendix Table 3). Each area had families of fish prey or groups of invertebrate prey that dominated the overall diet, but these changed seasonally.

Bluefish collected in the Carolinas had stomach contents that increased in overall percent volume of fishes from spring through autumn. Each season however, was made up of a different proportion of families, namely, spring: Clupeidae (38% volume), Sciaenidae (10%); summer: Sciaenidae (43%), Carangidae (8%), Engraulidae (6%), Clupeidae (5%); autumn: Mugilidae (20%), Clupeidae (13%), Sciaenidae (6%). Invertebrates decreased in percent volume and frequency of occurrence from spring through autumn. Seagrass along with gastropods were present in bluefish stomachs from the Carolinas only in the summer.

Southeast Florida bluefish stomachs had high fish volumes and frequencies of occurrence throughout the year. Mugilidae was dominant in spring, but steadily declined during subsequent seasons. Other families showed marked fluctuations in percent volumes and frequency of occurrence. Crabs and shrimp were the only two invertebrates represented and occurred only in spring and autumn.

South Florida collections consisted mostly of winter samples, as only four samples were contained in spring (too few to compare). Winter collections had 10 families of fish with Sciaenidae (26% volume), Carangidae (12%) and Clupeidae (12%) being most important. Invertebrates were of minor importance. Seagrasses were also present in winter collections.

Northwest Florida bluefish stomachs contained mostly fishes in the three seasons. In spring the important fish prey were Sciaenidae (26% volume), Clupeidae (20%), Sparidae (14%), Carangidae (12%); in summer the most important were Carangidae (36%), Clupeidae (19%), Sparidae (16%) and Sciaenidae (15%); in autumn, Clupeidae (24%), Sciaenidae (25%), Sparidae (11%) and Mugilidae (7%). Invertebrates (mostly shrimp and squid) were highest in spring. Seagrass was present in all seasons.

Louisiana samples were dominated seasonally by a relatively few number of fish families but also contained invertebrates. Spring samples had three principal families: Sciaenidae (37% volume), Carangidae (32%) and Clupeidae (6%). Summer collections contained Sciaenidae (39%), Clupeidae (23%) and Carangidae (16%). Autumn collections were too few for comparisons. Invertebrates were present in spring and summer with crabs, shrimp and stomatopods being principal components. Gastropods along with squid were present in summer collections, while shrimp were noted only in spring samples. Seagrass was not found in Louisiana bluefish. Fairly large amounts of sand were identified in several stomachs in the spring from this area.

Stomach Contents by Year

The only area that had sufficient numbers of samples yearly was northwest Florida. Three years (1977, 1978, 1980) of data were analyzed (Table 4). Even with a disparity in sample size, the overall percent volumes by category were similar from year to year. Fishes contributed 96% volume in 1977, over 99% in 1978, and 98% in 1980. The respective families of fish identified from year to year varied, however, with several notable exceptions: Clupeidae, Sciaenidae, Carangidae and Sparidae, which were well represented in all years. Invertebrates were relatively insignificant. Squid was present in all years at relatively the same frequency. Seagrass was also represented in all years. The relative proportions of all components of stomach contents from northwest Florida did not vary to the degree that radical shifts in diet were apparent.

DISCUSSION AND CONCLUSION

Bluefish are known to be predators primarily on teleost fishes (Lassiter 1962, Van Der Elst 1976, Wilk 1977). They appear to prey heavily on schooling prey, such as Sciaenidae, Clupeidae, Carangidae and Mugilidae. These families include such species as the Atlantic croaker (*Micropogonias undulatus*), striped mullet (*Mugil cephalus*), menhaden (*Brevoortia* sp.) Spanish sardine (*Sardinella aurita*), Atlantic bumper (*Chloroscombrus chrysurus*), and round scad (*Decapterus punctatus*), all of which are schooling fishes that were common in the stomachs analyzed in this study. Other authors (Breeder 1922, Lassiter 1962, Richards 1976, Van Der Elst 1976, Wilk 1977) have found similar prey items in studies of bluefish stomach contents along the Atlantic coast of the United States and elsewhere.

In our study we found juvenile bluefish (Pomatomus saltatrix) in the stomach contents of larger bluefish from Carolina waters. This same phenomenon has been previously reported by Lassiter (1962) and Richards (1976) who reported the stomach contents of bluefish from the North Carolina and Long Island Sound areas. Nowhere else in our study did we find this, suggesting that cannibalism may be peculiar to that region.

Bluefish also tend to consume proportionately fewer invertebrates with an increase in size as was mentioned for the majority of areas in our study (Appendix Table 2). Lassiter (1962) also observed this trend.

The presence of seagrass in stomachs of bluefish from North Carolina, south Florida and northwest Florida is important in that it suggests demersal feeding by bluefish. Louisiana bluefish, while having a relatively high proportion of invertebrates, contained no seagrass in their stomach contents. Lassiter (1962) has speculated that gravel is ingested incidentally by feeding bluefish in North Carolina. We found sand in stomachs of bluefish from Louisiana, but the occurrence of seagrass in some areas and the occurrence of sand in one area strongly suggests that bluefish are ingesting this material while on or near the bottom. Apparently the bluefish occasionally forage the demersal regions and are not strictly pelagic predators.

In conclusion, bluefish feed predominately on teleost fishes but on occasion utilize invertebrates in their diet. A preference for schooling coastal prey fishes is evident. Variations based on local abundance and seasonal availability of prey populations coupled with changes of food preference with size of predator is reflected in stomach contents. These findings agree with those previously reported for populations of bluefish along the Atlantic coast of the United States. On the other hand, Gulf of Mexico bluefish consume different families of fish and seem to be more general in their prey selection.

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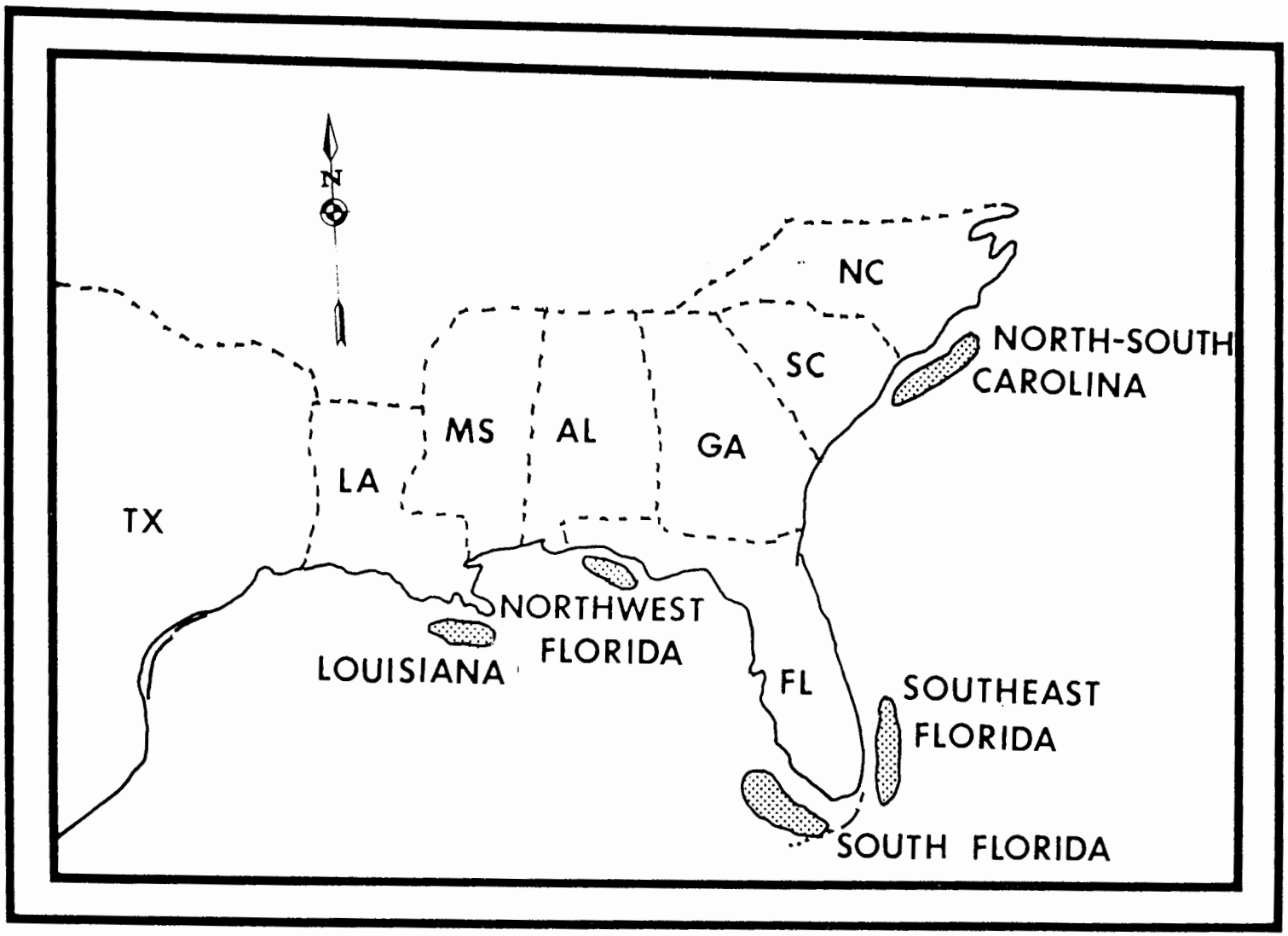

Figure 1. Five areas from which bluefish were collected in the Gulf of Mexico and U.S. south Atlantic, 1977-1981.

Table 1. Summary of data on stomach contents of bluefish (Pomatomus saltatrix) from the Gulf of Mexico and south Atlantic coasts of the United States. (FO = frequency of occurrence; Vol = volume)

Areas	Major prey groups								Number of stomachs	Number of stomachs with contents	Percent empty stomachs
	Fish		Squid		Crustaceans		Other				
	% FO	% Vol	% FO	% Vol	% FO	% Vol	% FO	% Vol			
Carolinas	86.6	81.4	5.3	3.8	14.1	14.7	1.1	0.1	729	283	61
Southeast Florida	98.5	98.9	--	--	1.9	1.1	--	--	1,019	260	74
South Florida	98.4	99.8	--	--	1.6	0.1	2.4	0.1	326	127	61
Northwest Florida	96.3	98.3	3.1	1.3	0.9	0.3	2.2	0.1	2,388	766	68
Louisiana	88.3	92.1	5.4	3.1	9.9	1.3	3.6	3.5	379	111	71
All areas	94.5	95.6	2.9	1.4	4.2	2.6	1.7	0.4	4,841	1,547	68

Table 2. Families of fish prey of bluefish from the U.S. Gulf of Mexico and south Atlantic coasts, 1977-1980.

Family	Percent frequency* of occurrence	Percent** volume
Sciaenidae	11.6	27.6
Clupeidae	18.2	23.0
Carangidae	5.9	14.7
Mugilidae	2.1	11.1
Sparidae	3.4	9.4
Serranidae	0.9	2.1
Haemulidae	0.5	2.0
Engraulidae	4.8	1.8
Labridae	0.5	1.6
Stromateidae	0.5	1.6
Ophichthidae	0.6	0.9
Ophidiidae	0.5	0.8
Scombridae	0.3	0.8
Elopidae	0.1	0.7
Pomatomidae	0.1	0.3
Bothidae	0.1	0.3
Atherinidae	0.1	0.3
Sphyraenidae	0.1	0.2
Lutjanidae	0.1	0.2
Synodontidae	0.1	0.1
Exocoetidae	0.1	0.1
Scaridae	0.1	0.1
Balistidae	0.1	0.1
Cynoglossidae	0.1	<0.1

* Percentage of total number of food-containing stomachs.
**Percentage of total fish prey volume.

Table 3. Number of stomachs with food by size and season for bluefish from the U.S. south Atlantic and Gulf of Mexico.

Areas	Size			Season				Total
	Small	Medium	Large	Winter	Spring	Summer	Autumn	
Carolinas	199	31	53	--	75	94	114	283
Southeast Florida	164	95	1	133	49	50	28	260
South Florida	85	41	1	123	4	--	--	127
Northwest Florida	601	97	68	--	151	204	411	766
Louisiana	9	94	8	--	26	79	6	111
All areas	1,058	358	131	256	305	427	559	1,547

Table 4. Stomach contents of bluefish (Pomatomus saltatrix) from northwest Florida by year.

Stomach contents	Percent frequency of occurrence			Percent volume		
	1977	1978	1980	1977	1978	1980
Fishes	97.9	97.4	95.5	96.2	99.6	97.7
Clupeidae	35.4	25.4	18.9	27.3	15.2	27.2
Sciaenidae	13.1	14.2	4.7	33.5	24.8	12.7
Carangidae	3.0	8.1	4.5	0.7	27.5	8.7
Sparidae	9.1	5.6	4.9	16.4	12.9	13.8
Serranidae	--	0.5	1.3	--	1.2	2.1
Mugilidae	--	0.5	0.4	--	6.2	2.6
Haemulidae	1.0	--	0.2	3.2	--	2.4
Engraulidae	--	1.5	2.6	--	0.1	1.9
Ophichthidae	1.0	1.5	0.9	0.6	0.8	0.8
Labridae	--	0.5	--	--	0.1	--
Lutjanidae	--	0.5	--	--	0.8	--
Elopidae	--	0.5	--	--	2.9	--
Pomatomatidae	--	--	0.2	--	--	0.7
Stromateidae	--	--	0.2	--	--	0.6
Ophidiidae	--	--	0.9	--	--	0.6
Cynoglossidae	--	--	0.2	--	--	0.1
Bothidae	--	--	0.2	--	--	<0.1
Fish remains	35.4	40.1	57.4	14.5	7.2	23.5
Invertebrates	3.0	2.5	5.1	3.6	0.2	2.1
Shrimp	--	--	1.1	--	--	0.4
Stomatopoda	--	--	0.4	--	--	0.3
Coral	--	--	0.2	--	--	<0.1
Squid	3.0	2.5	3.4	3.6	0.2	1.5
Seagrass	4.0	2.0	1.9	0.2	0.1	0.1
Number of stomachs with contents	99	197	470			

Appendix Table 1. Stomach contents of bluefish (Pomatomus saltatrix) from five areas of the U.S. Gulf of Mexico and south Atlantic coasts, 1977-1981 (dashes indicate no occurrence).

Contents	Percent frequency of occurrence					Percent volume				
	Carolinas	Southeast Florida	South Florida	Northwest Florida	Louisiana	Carolinas	Southeast Florida	South Florida	Northwest Florida	Louisiana
Fishes	86.6	98.5	98.4	96.3	88.3	81.4	98.9	00.0	98.3	92.1
Sciaenidae	13.4	11.5	15.0	8.2	26.1	20.5	13.7	24.9	21.2	40.6
Micropogonias undulatus	3.2	-	-	1.2	2.7	8.2	-	-	7.2	8.1
Leiostomus xanthurus	0.7	-	-	0.9	-	1.4	-	-	1.7	-
Cynoscion regalis	0.4	-	-	-	-	1.9	-	-	-	-
Bairdiella chrysoura	-	-	-	0.1	-	-	-	-	0.5	-
Clupeidae	11.7	10.4	15.7	22.7	13.5	15.7	13.9	11.2	22.2	19.3
Brevoortia sp.	4.6	0.4	-	1.6	o.8	8.4	0.3	-	2.8	1.5
Brevoortia patronus	-	-	-	2.3	6.3	-	-	-	4.0	15.9
Brevoortia tyrannus	1.4	1.2	0.8	-	-	2.4	3.1	1.0	-	-
Sardinella aurita	-	2.7	0.8	0.4	0.9	-	2.9	1.4	0.4	0.6
Opisthonema sp.	-	-	-	0.1	-	-	-	-	0,2	-
Opisthonema oglinum	-	0.8	0.8	0.1	-	-	0.8	0.5	0.1	-
Carangidae	1.4	3.8	8.7	5.2	18.0	2.9	6.7	11.7	15.2	18.2
Chloroscombrus chrysurus	0.4	1.9	-	1.8	0.9	0.9	1.0	-	11.1	0.7
Caranx crysos	0.4	-	1.6	0.1	0.9	1.5	-	3.0	0.2	1.3
Decapterus punctatus	0.7	-	-	1.4	17.1	-.7	-	-	1.8	16.2

Appendix Table 1. Continued

Contents	Percent frequency of occurrence					Percent volume				
	Carolinas	Southeast Florida	South Florida	Northwest Florida	Louisiana	Carolinas	Southeast Florida	South Florida	Northwest Florida	Louisiana
Caranx sp.	-	-	0.8	-	-	-	-	1.1	-	-
Selene vomer	-	-	0.8	-	-	-	-	2.2	-	-
Mugilidae	3.2	1.2	0.8	0.8	-	13.7	25.1	0.4	3.7	-
Mugil cephalus	1.1	0.4	-	0.1	-	8.1	2.2	-	0.5	-
Mugil sp.	1.4	6.2	-	0.3	-	3.8	21.1	-	3.2	-
Sparidae	1.4	1.5	0.8	5.6	-	3.1	2.9	0.7	13.9	-
Lagodon rhomboides	0.7	0.8	0.8	5.4	-	2.5	1.5	0.7	13.4	-
Serranidae	-	-	3.9	0.9	1.8	-	-	8.1	1.4	1.8
Centropristis striata	-	-	0.8	-	-	-	-	1.5	-	-
Diplectrum sp.	-	-	0.8	-	-	-	-	0.4	-	-
Haemulidae	-	9.4	3.1	0.3	-	-	9.4	6.9	1.5	-
Haemulon sp.	-	-	1.6	-	-	-	-	3.1	-	-
Engraulidae	17.3	3.5	-	2.0	0.9	5.5	0.8	-	0.8	1.1
Anchoa sp.	13.1	2.7	-	1.6	0.9	5.0	0.4	-	0.8	1.1
Labridae	0.4	0.4	3.1	0.1	-	1.8	<0.1	9.2	<0.1	-
Stromateidae	-	2.3	-	0.1	-	-	5.6	-	0.2	-
Ariomma sp.	-	0.8	-	-	-	-	4.5	-	-	-
Peprilus burti	-	1.5	-	-	-	-	1.4	-	-	-

Appendix Table 1. Continued

Contents	Percent frequency of occurrence					Percent volume				
	Carolinas	Southeast Florida	South Florida	Northwest Florida	Louisiana	Carolinas	Southeast Florida	South Florida	Northwest Florida	Louisiana
Peprilus alepidotus	-	-	-	9.1	-	-	-	-	0.2	-
Ophichthidae	-	0.4	-	1.0	-	-	1.7	-	0.8	-
Myrophis punctatus	-	-	-	0.3	-	-	-	-	0.2	-
Ophidiidae	-	1.2	0.8	0.4	-	-	2.0	1.1	0.2	-
Scombridae	0.4	-	2.4	-	-	0.4	-	5.6	-	-
Scomber sp.	-	-	9.8	-	-	-	-	1.1	-	-
Scomberomorus sp.	-	-	-	-	0.4	-	-	-	-	0.4
Elopidae	-	-	-	0.1	-	-	-	-	1.2	-
Elops saurus	-	-	-	0.1	-	-	-	-	1.2	-
Pomatomidae	0.4	-	-	0.1	-	0.9	-	-	0.3	-
Pomatomus saltatrix	0.4	-	-	-	-	0.9	-	-	-	-
Bothidae	-	0.4	-	0.1	-	-	1.2	-	<0.1	-
Atherinidae	0.4	-	-	-	-	1.6	-	-	-	-
Menidia sp.	0.4	-	-	-	-	1.6	-	-	-	-
Sphyraenidae	-	0.8	-	-	-	-	0.9	-	-	-
Sphyraena guachancho	-	0.8	-	-	-	-	0.9	-	-	-
Lutjanidae	-	-	-	0.1	-	-	-	-	0.3	-

Appendix Table 1. Continued

Contents	Percent frequency of occurrence					Percent volume				
	Carolinas	Southeast Florida	South Florida	Northwest Florida	Louisiana	Carolinas	Southeast Florida	South Florida	Northwest Florida	Louisiana
Rhomboplites aurorubens	-	-	-	0.1	-	-	-	-	0.3	-
Synodontidae	-	-	0.8	-	-	-	-	1.1	-	-
Exocoetidae	0.4	-	0.8	-	-	0.3	-	0.4	-	-
Hemiramphus brasiliensis	-	-	0.8	-	-	-	-	0.4	-	-
Scaridae	-	0.8	-	-	-	-	0.4	-	-	-
Balistidae	-	-	0.8	-	-	-	-	0.6	-	-
Balistes sp.	-	-	0.8	-	-	-	-	0.6	-	-
Cynoglossidae	-	-	0.1	-.1	-	-	-	0.1	0.1	-
Symphurus sp.	-	-	-	0.1	-	-	-	-	0.1	-
Digested fish remains	38.5	47.7	41.7	50.1	28.8	15.0	23.6	17.3	15.2	11.1
Invertebrates	20.1	1.7	1.6	4.2	18.9	13.6	1.1	0.1	1.6	6.7
Crabs	14.1	1.2	-	-	6.3	13.7	1.0	-	-	0.8
Portunus sp.	3.2	-	-	-	5.4	1.3	-	-	-	0.7
Ovalipes guadulpensis	3.5	-	-	-	-	5.2	-	-	-	-
Ovalipes sp.	2.1	0.4	-	-	-	1.5	0.8	-	-	-
Ovalipes ocellatus	0.7	-	-	-	-	5.0	-	-	-	-
Callinectes sp.	-	-	-	-	0.9	-	-	-	-	<0.1
Emerita talpoida	-	0.4	-	-	-	-	0.2	-	-	-

Appendix Table 1. Continued

Contents	Carolinas	Southeast Florida	South Florida	Northwest Florida	Louisiana	Carolinas	Southeast Florida	South Florida	Northwest Florida	Louisiana
Shrimp	2.5	0.8	0.8	0.7	1.8	1.0	0.1	<0.1	0.1	0.2
Penaeus sp.	1.8	0.4	0.8	0.5	1.8	0.6	<0.1	<0.1	0.1	0.2
Trachypenaeus sp.	0.4	-	-	-	-	<0.1	-	-	-	-
Sicyonia sp.	-	0.4	-	-	-	-	0.1	-	-	-
Sicyonia brevirostris	0.4	-	-	0.1	-	0.3	-	-	<0.1	-
Isopoda	0.7	-	0.8	-	-	14.7	-	<0.1	-	-
Stomatopoda	-	-	-	0.3	1.8	-	-	-	0.1	0.4
Mollusks	6.0	-	-	3.1	7.2	3.9	-	-	1.3	5.4
Squid	5.3	-	-	3.1	5.4	3.8	-	-	1.3	3.1
Loligo pealeii	0.4	-	-	0.7	-	0.7	-	-	0.4	-
Lolliguncula brevis	-	-	-	0.4	-	-	-	-	0.5	-
Gastropoda	0.4	-	-	-	1.8	0.1	-	-	-	2.3
Littorina sp.	0.4	-	-	-	-	<0.1	-	-	-	-
Natica pusilla	-	-	-	-	0.9	-	-	-	-	0.1
Pelecypoda	0.4	-	-	-	-	0.1	-	-	-	-
Aplysiidae	-	-	-	-	0.9	-	-	-	-	2.2
Gorgonacea	-	-	-	0.1	-	-	-	-	<0.1	-

Appendix Table 1. Continued

Contents	Percent frequency of occurrence					Percent volume				
	Carolinas	Southeast Florida	South Florida	Northwest Florida	Louisiana	Carolinas	Southeast Florida	South Florida	Southwest Florida	Louisiana
Seagrasses	0.4	-	2.4	2.2	-	<0.1	-	0.1	0.2	-
Halodule wrightii	-	-	0.8	-	-	-	-	<0.1	-	-
Thallasia testudinum	0.4	-	0.8	1.8	-	<0.1	-	<0.1	0.1	-
Syringodium filiforme	-	-	0.8	0.4	-	-	-	<0.1	<0.1	-
Miscellaneous	-	-	-	-	0.9	-	-	-	-	1.0
Sand	-	-	-	-	0.9	-	-	-	-	1.0
Paper	-	-	-	-	0.9	-	-	-	-	0.2

Appendix Table 2. Stomach contents of bluefish from the U.S. Gulf of Mexico and south Atlantic coasts by size of predator. (Dashes indicate no occurrence.) Small bluefish, 0-399 mm FL; medium, 400-599 mm FL; large, 600-999 mm FL.

List of contents	Frequency of occurrence			Percent volume		
	Small	Medium	Large	Small	Medium	Large
	Carolinas					
Fishes	9.30	96.8	56.6	91.4	93.3	62.4
Sciaenidae	16.6	9.7	1.9	29.6	31.3	0.9
Leiostomus xanthurus	1.0	-	-	2.7	-	-
Micropogonias undulatus	4.0	3.2	-	11.1	17.2	-
Cynoscion regalis	-	3.2	-	-	13.9	-
Clupeidae	10.1	41.9	1.9	15.8	51.5	2.0
Brevoortia sp.	1.0	35.5	-	4.4	44.7	-
Brevoortia tyrannus	2.0	-	-	4.5	-	-
Carangidae	2.0	-	-	5.6	-	-
Decapterus punctatus	1.0	-	-	1.1	-	-
Chloroscombrus chrysurus	0.5	-	-	1.7	-	-
Caranx crysos	0.5	-	-	2.8	-	-
Sparidae	1.5	-	1.9	4.3	-	2.4
Lagodon rhomboides	0.5	-	1.9	3.1	-	2.4
Engraulidae	21.6	-	13.2	6.3	-	8.0
Anchoa sp.	15.6	-	-	5.5	-	-
Mugilidae	3.0	-	5.7	10.5	-	24.4
Mugil cephalus	1.0	-	1.9	3.3	-	18.8
Mugil sp.	2.0	-	-	7.1	-	-
Scombridae	0.5	-	-	0.8	-	-
Scomberomorus sp.	0.5	-	-	0.8	-	-

Appendix Table 2. Continued

List of contents	Frequency of occurrence			Percent volume		
	Small	Medium	Large	Small	Medium	Large
Pomatomidae	0.5	-	-	1.7	-	-
Pomatomus saltatrix	0.5	-	-	1.7	-	-
Exocoetidae	-	-	1.9	-	-	1.9
Atherinidae	-	-	1.9	-	-	4.7
Labridae	-	-	1.9	-	-	5.2
Fish remains	39.2	45.2	32.1	16.9	10.5	13.8
Invertebrates	12.1	16.1	47.2	8.5	6.7	37.6
Crabs	2.0	9.7	43.4	1.7	6.3	34.1
Ovalipes ocellatus	-	-	3.8	-	-	14.8
Ovalipes sp.	0.5	-	7.5	0.1	-	2.8
Ovalipes guadulpensis	0.5	3.2	15.1	0.9	5.6	11.7
Portunus sp.	0.5	6.5	11.3	0.6	0.7	2.6
Shrimp	2.5	3.2	1.9	1.1	0.2	1.0
Sicyonia brevirostris	-	-	1.9	-	-	1.0
Penaeus sp.	2.0	-	-	1.1	-	-
Trachypenaeus sp.	0.5	-	-	<0.1	-	-
Isopoda	0.5	3.2	-	<0.1	0.2	-
Mollusks	7.0	-	5.7	5.7	-	2.5
Littorina sp.	-	-	1.9	-	-	<0.1
Unknown plecypod	-	-	1.9	-	-	0.3
Loligo pealeii	-	-	1.9	-	-	2.2
Seagrass	0.5	-	-	0.1	-	-
Thallasia testudinum	0.5	-	-	0.1	-	-
	Southeast Florida					
Fishes	98.2	98.9	-	97.4	99.9	-

Appendix Table 2. Continued

List of contents	Frequency of occurrence			Percent volume		
	Small	Medium	Large	Small	Medium	Large
Carangidae	6.1	5.3	-	6.2	7.1	-
Chloroscombrus chrysurus	3.0	-	-	2.4	-	-
Mugilidae	3.0	15.8	-	18.4	29.9	-
Mugil sp.	1.8	-	-	14.2	-	-
Mugil cephalus	-	1.1	-	-	3.8	-
Clupeidae	17.7	11.6	-	21.8	8.2	-
Sardinella aurita	4.3	-	-	7.0	-	-
Opisthonema oglinum	0.6	1.1	-	0.7	0.9	-
Brevoortia tyrannus	1.2	1.1	-	6.0	1.1	-
Brevoortia sp.	-	1.1	-	-	0.6	-
Scaridae	0.6	1.1	-	0.8	0.1	-
Ophidiidae	1.2	1.1	-	3.9	0.6	-
Sphyraenidae	1.2	-	-	2.2	-	-
Sphyraena guachancho	1.2	-	-	2.2	-	-
Engraulidae	4.9	1.1	-	1.6	0.1	-
Anchoa sp.	3.7	1.1	-	0.8	0.1	-
Sparidae	0.6	3.2	-	1.2	4.2	-
Lagodon rhomboides	-	1.1	-	-	1.8	-
Stromateidae	2.4	2.1	-	2.6	7.8	-
Sciaenidae	8.5	15.8	100.0	9.6	16.5	100.0
Ophichthidae	-	1.1	-	-	2.9	-
Bothidae	-	1.1	-	-	2.0	-
Haemulidae	-	1.1	-	-	0.9	-
Labridae	-	1.1	-	-	0.1	-
Fish remains	52.4	38.9	-	29.2	19.6	-

Appendix Table 2. Continued

List of contents	Frequency of occurrence			Percent volume		
	Small	Medium	Large	Small	Medium	Large
Invertebrates	2.4	1.1	-	2.6	0.1	-
Crabs	1.2	1.1	-	2.4	0.1	-
Ovalipes sp.	0.6	-	-	1.9	-	-
Emerita talpoida	0.6	-	-	0.5	-	-
Shrimp	1.2	-	-	0.2	-	-
Penaeus sp.	0.6	-	-	0.1	-	-
Sicyonia sp.	0.6	-	-	0.2	-	-
	South Florida					
Fishes	97.6	100.0	100.0	99.9	99.9	100.0
Clupeidae	15.3	17.1	-	11.3	12.8	-
Sardinella aurita	1.2	-	-	2.1	-	-
Brevoortia tyrannus	-	2.4	-	-	3.1	-
Opisthonema oglinum	-	2.4	-	-	1.6	-
Carangidae	10.6	4.9	-	14.4	6.2	-
Caranx sp.	1.2	-	-	1.7	-	-
Selene vomer	1.2	-	-	3.3	-	-
Caranx crysos	1.2	2.4	-	2.2	4.7	-
Haemulidae	2.4	4.9	-	4.0	13.0	-
Haemulon sp.	1.2	2.4	-	1.3	6.8	-
Sciaenidae	12.9	12.5	-	23.9	27.4	-
Labridae	4.7	-	-	13.8	-	-
Mugilidae	1.2	-	-	0.6	-	-
Scombridae	3.5	-	-	8.4	-	-
Scomber sp.	1.2	-	-	1.7	-	-
Ophidiidae	1.2	-	-	1.7	-	-

Appendix Table 2. Continued

List of contents	Frequency of occurrence			Percent volume		
	Small	Medium	Large	Small	Medium	Large
Serranidae	1.2	9.8	-	2.3	20.0	-
Centropristis striata	-	2.4	-	-	4.6	-
Diplectrum sp.	-	2.4	-	-	1.3	-
Sparidae	1.2	-	-	1.0	-	-
Lagodon rhomboides	1.2	-	-	1.0	-	-
Balistidae	-	2.4	-	-	2.0	-
Balistes sp.	-	2.4	-	-	2.0	-
Synodontidae	-	2.4	-	-	3.3	-
Hemiramphidae	-	-	100.0	-	-	100.0
Fish remains	43.5	39.0	-	18.5	15.2	-
Invertebrates	2.4	-	-	0.1	-	-
Shrimp	1.2	-	-	0.1	-	-
Penaeus sp.	1.2	-	-	0.1	-	-
Isopoda	1.2	-	-	<0.1	-	-
Seagrass	2.4	2.4	-	<0.1	0.1	-
Thallasia testudinum	1.2	-	-	<0.1	-	-
Syringodium filiforme	-	2.4	-	-	0.1	-
Halodule wrightii	1.2	-	-	<0.1	-	-
	Northwest Florida					
Fishes	95.7	97.9	100.0	97.6	97.6	100.0
Engraulidae	2.7	-	-	1.7	-	-
Anchoa sp.	2.2	-	-	1.6	-	-
Carangidae	4.0	0.9	20.6	7.3	0.2	40.1
Decapterus punctatus	1.3	-	4.4	2.1	-	2.3
Chloroscombrus chrysurus	0.3	0.9	16.2	0.8	0.2	37.8
Caranx crysos	0.2	-	-	0.4	-	-

Appendix Table 2. Continued

List of contents	Frequency of occurrence			Percent volume		
	Small	Medium	Large	Small	Medium	Large
Clupeidae	22.6	20.8	25.0	29.7	14.2	11.8
Brevoortia sp.	2.8	0.9	2.9	5.4	1.1	4.3
Brevoortia patronus	1.5	0.9	2.9	4.3	1.4	1.7
Sardinella aurita	0.5	-	-	0.8	-	-
Opisthonema oglinum	0.2	-	-	0.2	-	-
Opisthonema sp.	0.2	-	-	0.5	-	-
Sciaenidae	6.0	17.0	13.2	18.3	32.7	20.6
Micropogonias undulatus	1.0	0.9	2.9	4.6	3.1	14.8
Bairdiella chrysoura	0.2	-	-	1.0	-	-
Leiostomus xanthurus	0.8	-	1.5	2.8	-	0.7
Ophichthidae	1.2	0.9	-	1.3	0.4	-
Myrophis punctatus	0.3	-	-	0.4	-	-
Sparidae	4.2	14.2	4.4	12.2	26.3	8.9
Lagodon rhomboides	4.2	12.3	4.4	12.2	24.9	8.9
Lutjanidae	0.2	-	-	0.6	-	-
Rhomboplites aurorubens	0.2	-	-	0.6	-	-
Serranidae	1.0	0.9	-	1.6	2.6	-
Ophidiidae	0.3	0.9	-	0.3	0.1	-
Stromateidae	0.2	-	-	0.5	-	-
Peprilus alepidotus	0.2	-	-	0.5	-	-
Pomatomidae	0.2	-	-	0.5	-	-
Pomatomus saltatrix	0.2	-	-	0.5	-	-
Brotulidae	0.2	-	-	0.1	-	-
Cynoglossidae	0.2	-	-	0.1	-	-
Symphurus sp.	0.2	-	-	0.1	-	-

Appendix Table 2. Continued

List of contents	Frequency of occurrence			Percent volume		
	Small	Medium	Large	Small	Medium	Large
Bothidae	0.2	-	-	<0.1	-	-
Mugilidae	0.2	-	1.5	2.0	-	9.2
Mugil sp.	0.2	-	1.5	1.2	-	9.2
Mugil cephalus	0.2	-	-	0.9	-	-
Labridae	-	0.9	-	-	0.2	-
Haemulidae	-	1.9	-	-	8.0	-
Orthopristis chrysoptera	-	0.9	-	-	2.8	-
Elopidae	-	-	1.5	-	-	4.3
Elops saurus	-	-	1.5	-	-	4.3
Fish remains	53.7	32.1	38.2	21.3	13.0	5.1
Invertebrates	5.0	1.9	-	2.3	1.8	-
Shrimp	0.8	-	-	0.3	-	-
Sicyonia sp.	0.2	-	-	0.1	-	-
Penaeus sp.	0.7	-	-	0.2	-	-
Stomatopoda	0.3	-	-	0.2	-	-
Mollusks	3.7	1.9	-	1.8	1.8	-
Lolliguncula brevis	0.2	0.9	-	0.5	1.3	-
Squid remains	2.5	1.9	-	0.4	1.8	-
Loligo pealeii	0.8	-	-	0.8	-	-
Coral remains	0.2	-	-	<0.1	-	-
Seagrass	1.5	7.5	-	0.1	0.5	-
Thallasia testudinum	1.0	-	-	0.1	-	-
Syringodium filiforme	0.5	-	-	0.1	-	-

Appendix Table 2. Continued

List of contents	Frequency of occurrence			Percent volume		
	Small	Medium	Large	Small	Medium	Large
	Louisiana					
Fishes	88.9	88.3	87.5	95.1	91.6	97.3
Clupeidae	11.1	12.8	12.5	3.7	20.3	9.4
Sardinella aurita	-	1.1	-	-	0.6	-
Brevoortia sp.	-	2.1	-	-	1.6	-
Brevoortia patronus	-	5.3	-	-	16.7	-
Carangidae	11.1	21.3	-	65.9	18.4	-
Decapterus punctatus	-	20.2	-	-	17.7	-
Chloroscombrus chrysurus	-	1.1	-	-	0.8	-
Sciaenidae	-	27.7	37.5	-	39.3	72.3
Micropogonias undulatus	-	2.1	12.5	-	5.4	50.3
Serranidae	-	2.1	-	-	2.0	-
Engraulidae	-	1.1	-	-	1.2	-
Anchoa sp.	-	1.1	-	-	1.2	-
Fish remains	66.7	24.5	37.5	25.6	10.4	15.6
Invertebrates	11.1	19.1	12.5	4.9	7.0	2.7
Crab	-	8.5	-	-	0.9	-
Portunus sp.	-	7.4	-	-	0.8	-
Callinectes sp.	-	1.1	-	-	0.1	-
Shrimp	-	2.1	-	-	0.2	-
Penaeus sp.	-	2.1	-	-	0.2	-
Stomatopoda	0	1.1	12.5	-	0.2	2.7
Gastropoda	11.1	1.1	-	4.9	2.4	-
Aplysia sp.	-	1.1	-	-	2.4	-
Natica pusilla	11.1	-	-	4.9	-	-
Squid	-	6.4	-	-	3.4	-

Appendix Table 2. Continued

List of contents	Frequency of occurrence			Percent volume		
	Small	Medium	Large	Small	Medium	Large
Miscellaneous	-	2.1	-	-	1.3	-
Sand	-	1.1	-	-	1.1	-
Paper	-	1.1	-	-	0.2	-

Appendix Table 3. Stomach contents of bluefish from the U.S. Gulf of Mexico and south Atlantic coasts by season. Spring includes March, April, and May; summer includes June, July, and August; autumn includes September, October, and November; winter includes December, January, and February. Dashes indicate no occurrence.

List of contents	Frequency of occurrence				Percent volume			
	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter
			Carolinas					
Fishes	73.3	84.0	97.4	-	67.3	74.7	95.4	-
Sciaenidae	6.7	28.7	4.4	-	10.1	42.9	6.3	-
Leiostomus xanthurus	-	2.1	-	-	-	4.0	-	-
Micropogonias undulatus	-	9.6	-	-	-	23.2	-	-
Cynoscion regalis	1.3	-	-	-	8.0	-	-	-
Clupeidae	21.3	4.3	12.3	-	38.2	5.0	12.6	-
Brevoortia sp.	16.0	1.1	-	-	33.8	1.1	-	-
Brevoortia tyrannus	-	1.1	2.6	-	-	2.5	3.7	-
Carangidae	-	3.2	0.9	-	-	7.6	0.6	-
Decapterus punctatus	-	1.1	0.9	-	-	0.9	0.6	-
Chloroscombrus chrysurus	-	1.1	-	-	-	2.6	-	-
Caranx crysos	-	1.1	-	-	-	4.2	-	-
Sparidae	-	2.1	1.8	-	-	1.8	6.1	-
Lagodon rhomboides	-	-	1.8	-	-	-	6.1	-
Engraulidae	18.6	10.6	21.9	-	5.0	6.3	4.9	-
Anchoa sp.	18.7	8.5	13.2	-	5.0	6.1	4.1	-

Appendix Table 3. Continued

List of contents	Frequency of occurrence				Percent volume			
	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter
Mugilidae	1.3	-	20.1	-	6.0	-	7.0	-
Mugil cephalus	-	-	2.6	-	-	-	19.8	-
Mugil sp.	-	-	3.5	-	-	-	9.2	-
Scombridae	-	1.1	-	-	-	1.1	-	-
Scomberomorus sp.	-	1.1	-	-	-	1.1	-	-
Pomatomidae	-	-	0.9	-	-	-	2.2	-
Pomatomus saltatrix	-	-	0.9	-	-	-	2.2	-
Exocoetidae	1.3	-	-	-	1.5	-	-	-
Atherinidae	-	-	0.9	-	-	-	3.8	-
Labridae	-	-	0.9	-	-	-	4.3	-
Fish remains	26.7	38.3	46.5	-	6.5	9.9	24.3	-
Invertebrates	36.0	25.5	5.3	-	32.7	25.2	4.6	-
Crabs	30.7	6.4	1.8	-	31.0	16.0	1.8	-
Ovalipes ocellatus	-	2.1	-	-	-	14.0	-	-
Ovalipes sp.	5.3	1.1	0.9	-	4.5	0.2	1.0	-
Ovalipes quadulpensis	12.0	1.1	-	-	19.8	1.3	-	-
Portunus sp.	9.3	1.1	0.9	-	3.5	0.4	0.8	-
Shrimp	2.7	2.1	2.6	-	1.6	0.4	1.1	-
Sicyonia brevirostris	1.3	-	-	-	1.5	-	-	-

Appendix Table 3. Continued

List of contents	Frequency of occurrence				Percent volume			
	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter
Penaeus sp.	1.3	1.1	2.6	-	0.1	0.3	1.1	-
Trachypenaeus sp.	-	1.1	-	-	-	<0.1	-	-
Isopoda	2.7	-	-	-	0.2	-	-	-
Mollusks	-	17.0	-	-	-	8.8	-	-
Littorina sp.	-	1.1	-	-	-	<0.1	-	-
Unknown plecypod	-	1.1	-	-	-	0.3	-	-
Loligo pealeii	-	14.9	0.9	-	-	8.5	1.8	-
Seagrass	-	1.1	-	-	-	0.1	-	-
Thallasia testudinum	-	1.1	-	-	-	0.1	-	-
	Southeast Florida							
Fishes	93.9	100.0	96.4	100.0	96.5	100.0	96.5	100.0
Carangidae	-	4.0	3.6	9.0	-	2.6	21.7	10.6
Chloroscombrus chrysurus	-	-	-	3.8	-	-	-	2.6
Mugilidae	18.4	18.0	3.6	0.8	57.3	29.1	19.2	3.5
Mugil sp.	14.3	16.0	3.6	-	46.3	28.9	19.2	-
Mugil cephalus	2.0	-	-	-	9.4	-	-	-
Clupeidae	12.2	36.0	7.1	12.0	5.5	2-.4	9.1	11.9
Sardinella aurita	-	12.0	-	-	-	8.6	-	-
Opisthonema oglinum	-	4.0	-	-	-	2.7	-	-

Appendix Table 3. Continued

List of contents	Frequency of occurrence				Percent volume			
	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter
Brevoortia tyrannus	-	4.0	3.6	-	-	8.5	7.5	-
Brevoortia sp.	-	-	-	0.8	-	-	-	0.9
Scaridae	2.0	2.0	-	-	1.4	0.2	-	-
Ophidiidae	2.0	2.0	-	0.8	1.5	1.9	-	2.8
Sphyraenidae	-	-	7.1	-	-	-	11.0	-
Sphyraena guachancho	-	-	7.1	-	-	-	11.0	-
Engraulidae	8.2	2.0	10.7	0.8	1.7	0.3	2.4	0.2
Anchoa sp.	4.1	2.0	10.7	0.8	0.3	0.3	2.4	0.2
Sparidae	2.0	2.0	-	1.5	2.6	2.6	-	4.0
Lagodon rhomboides	-	-	-	1.5	-	-	-	4.0
Stromateidae	-	4.0	-	3.0	-	15.4	-	2.8
Sciaenidae	14.3	8.0	7.1	12.8	18.4	9.3	6.7	15.6
Ophichthidae	-	-	-	0.8	-	-	-	4.4
Bothidae	-	-	-	0.8	-	-	-	3.0
Haemulidae	-	-	-	0.8	-	-	-	1.4
Labridae	2.0	-	-	-	0.1	-	-	-
Fish remains	32.7	26.0	57.1	57.0	7.9	10.3	26.5	39.8
Invertebrates	6.1	-	7.1	-	3.5	-	3.5	-
Crabs	4.1	-	3.6	-	3.5	-	2.7	-

Appendix Table 3. Continued

List of contents	Frequency of occurrence				Percent volume			
	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter
Ovalipes sp.	2.0	-	-	-	3.3	-	-	-
Emerita talpoida	-	-	3.6	-	-	-	2.7	-
Shrimp	2.0	-	3.6	-	9.1	-	0.8	-
Penaeus sp.	2.0	-	-	-	0.1	-	-	-
Sicyonia sp.	-	-	3.6	-	-	-	0.8	-
			South Florida					
Fishes	100.0	-	-	98.4	100.0	-	-	99.9
Clupeidae	25.0	-	-	15.4	19.5	-	-	11.5
Sardinella aurita	-	-	-	0.8	-	-	-	1.4
Brevoortia tyrannus	-	-	-	0.8	-	-	-	1.0
Opisthonema oglinum	-	-	-	0.8	-	-	-	0.5
Carangidae	-	-	-	8.9	-	-	-	12.0
Caranx sp.	-	-	-	0.8	-	-	-	1.2
Selene vomer	-	-	-	0.8	-	-	-	2.3
Caranx crysos	-	-	-	1.6	-	-	-	3.1
Haemulidae	-	-	-	3.3	-	-	-	7.1
Haemulon sp.	-	-	-	1.6	-	-	-	3.2
Sciaenidae	-	-	-	15.4	-	-	-	25.6

Appendix Table 3. Continued

List of contents	Frequency of occurrence				Percent volume			
	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter
Labridae	-	-	-	3.3	-	-	-	9.5
Mugilidae	-	-	-	0.8	-	-	-	0.4
Scombridae	-	-	-	2.4	-	-	-	5.8
Scomber sp.	-	-	-	0.8	-	-	-	1.1
Ophidiidae	-	-	-	0.8	-	-	-	1.2
Serranidae	-	-	-	4.1	-	-	-	8.3
Centropristis striata	-	-	-	0.8	-	-	-	1.5
Diplectrum sp.	-	-	-	0.8	-	-	-	0.4
Sparidae	-	-	-	0.8	-	-	-	0.7
Lagodon rhomboides	-	-	-	0.8	-	-	-	0.7
Balistidae	25.0	-	-	-	24.4	-	-	-
Balistes sp.	25.0	-	-	-	24.4	-	-	-
Synodontidae	25.0	-	-	-	40.7	-	-	-
Hemiramphidae	25.0	-	-	-	15.4	-	-	-
Fish remains	-	-	-	43.1	-	-	-	17.8
Invertebrates	-	-	-	1.6	-	-	-	0.1
Shrimp	-	-	-	0.8	-	-	-	<0.1
Penaeus sp.	-	-	-	0.8	-	-	-	<0.1
Isopoda	-	-	-	0.8	-	-	-	<0.1

Appendix Table 3. Continued

List of contents	Frequency of occurrence				Percent volume			
	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter
Seagrass	-	-	-	2.4	-	-	-	0.1
Thallasia testudinum	-	-	-	0.8	-	-	-	<0.1
Syringodium filiforme	-	-	-	0.8	-	-	-	<0.1
Halodule wrightii	-	-	-	0.8	-	-	-	<0.1
	Northwest Florida							
Fishes	94.0	99.5	97.8	-	96.8	99.1	98.3	-
Engraulidae	2.0	1.0	2.7	-	0.8	0.2	1.4	-
Anchoa sp.	2.0	1.0	1.9	-	0.8	0.2	1.3	-
Carangidae	7.9	9.8	1.7	-	11.8	36.3	3.8	-
Decapterus punctatus	4.0	2.5	-	-	8.1	0.8	-	-
Chloroscombrus chrysurus	0.7	4.9	0.7	-	2.3	32.8	1.4	-
Caranx crysos	-	-	0.2	-	-	-	0.4	-
Clupeidae	19.9	23.0	23.1	-	19.7	18.6	24.1	-
Brevoortia sp.	2.0	1.5	2.9	-	6.5	1.6	4.0	-
Brevoortia patronus	-	2.0	1.9	-	-	2.9	4.2	-
Sardinella aurita	-	1.0	0.2	-	-	1.2	0.1	-
Opisthonema oglinum	-	-	0.2	-	-	-	0.2	-
Opisthonema sp.	-	-	0.2	-	-	-	0.5	-
Sciaenidae	6.6	8.3	8.8	-	25.5	14.6	24.5	-

Appendix Table 3. Continued

List of contents	Frequency of occurrence				Percent volume			
	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter
Micropogonias undulatus	1.4	0.5	1.4	-	16.9	1.6	7.0	-
Bairdiella chrysoura	-	-	0.2	-	-	-	1.0	-
Leiostomus xanthurus	1.3	2.0	-	-	3.5	3.3	-	-
Ophichthidae	1.3	2.5	0.2	-	0.7	1.4	0.4	-
Myrophis punctatus	-	2.5	-	-	-	0.7	-	-
Sparidae	7.9	6.4	4.4	-	13.5	15.5	11.2	-
Lagodon rhomboides	7.9	-	3.9	-	13.5	-	10.4	-
Lutjanidae	-	-	0.2	-	-	-	0.6	-
Rhomboplites aurorubens	-	-	0.2	-	-	-	0.6	-
Serranidae	1.3	1.0	0.7	-	0.8	0.8	1.9	-
Ophidiidae	0.7	1.0	-	-	0.1	0.6	-	-
Stromateidae	-	0.5	-	-	-	0.8	-	-
Peprilus alepidotus	-	0.5	-	-	-	0.8	-	-
Pomatomidae	-	0.5	-	-	-	0.9	-	-
Pomatomus saltatrix	-	0.5	-	-	-	0.9	-	-
Brotulidae	-	0.5	-	-	-	0.2	-	-
Cynoglossidae	-	0.5	-	-	-	0.2	-	-
Symphurus sp.	-	0.5	-	-	-	0.2	-	-
Bothidae	-	0.5	-	-	-	<0.1	-	-

Appendix Table 3. Continued

List of contents	Frequency of occurrence				Percent volume			
	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter
Mugilidae	-	-	0.7	-	-	-	7.2	-
Mugil sp.	-	-	0.5	-	-	-	6.3	-
Mugil cephalus	-	-	0.2	-	-	-	0.9	-
Labridae	-	-	0.2	-	-	-	0.1	-
Haemulidae	0.7	-	0.2	-	5.3	-	1.1	-
Orthopristis chrysoptera	-	-	0.2	-	-	-	1.1	-
Elopidae	-	-	0.2	-	-	-	2.4	-
Elops saurus	-	-	0.2	-	-	-	2.4	-
Fish remains	47.7	44.1	54.5	-	13.3	8.9	19.7	-
Invertebrates	7.9	4.9	2.4	-	3.1	0.8	1.5	-
Shrimp	2.6	-	0.2	-	0.8	-	<0.1	-
Sicyonia sp.	0.7	-	-	-	0.2	-	-	-
Penaeus sp.	2.0	-	0.2	-	0.6	-	<0.1	-
Stomatopoda	-	0.5	0.2	-	-	0.1	<0.2	-
Mollusks	5.3	3.9	1.9	-	2.3	0.7	1.3	-
Lolliguncula brevis	-	0.5	0.5	-	-	0.1	1.0	-
Loligo pealeii	1.3	0.5	0.2	-	1.9	0.2	<0.1	-
Coral remains	-	0.5	-	-	-	<0.1	-	-
Seagrass	2.6	2.0	2.2	-	0.1	0.1	0.2	-

Appendix Table 3. Continued

List of contents	Frequency of occurrence				Percent volume			
	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter
Thallasia testudinum	2.0	1.5	1.9	-	<0.1	0.1	0.2	-
Syringodium filiforme	0.7	0.5	0.2	-	<0.1	<0.1	<0.1	-
			Louisiana					
Fishes	84.6	88.6	100.0	-	91.2	91.8	100.0	-
Clupeidae	15.4	12.7	-	-	6.3	23.4	-	-
Sardinella aurita	-	1.3	-	-	-	0.7	-	-
Brevoortia sp.	-	2.5	-	-	-	1.9	-	-
Brevoortia patronus	3.8	6.3	-	-	3.2	19.7	-	-
Carangidae	15.4	21.5	-	-	31.9	16.1	-	-
Decapterus punctatus	15.4	19.0	-	-	31.9	13.5	-	-
Chloroscombrus chrysurus	-	1.3	-	-	-	0.9	-	-
Caranx crysos	-	1.3	-	-	-	1.7	-	-
Sciaenidae	11.5	30.4	33.3	-	37.1	39.0	82.2	-
Micropogonias undulatus	3.8	1.3	16.7	-	14.1	4.0	55.1	-
Serranidae	-	2.5	-	-	-	2.4	-	-
Engraulidae	-	1.3	-	-	-	1.4	-	-
Anchoa sp.	-	1.3	-	-	-	1.4	-	-
Fish remains	43.3	21.5	66.7	-	15.8	9.6	17.8	-
Invertebrates	19.2	17.7	-	-	3.2	7.9	-	-

Appendix Table 3. Continued

List of contents	Frequency of occurrence				Percent volume			
	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter
Crab	11.5	6.3	-	-	1.0	0.8	-	-
Portunus sp.	7.7	6.3	-	-	0.7	0.8	-	-
Callinectes sp.	3.8	-	-	-	0.2	-	-	-
Shrimp	7.7	-	-	-	1.1	-	-	-
Penaeus sp.	7.7	-	-	-	1.1	-	-	-
Stomatopoda	3.8	1.3	-	-	1.1	0.2	-	-
Gastropoda	-	2.5	-	-	-	2.9	-	-
Aplysia sp.	-	1.3	-	-	-	2.8	-	-
Natica pusilla	-	1.3	-	-	-	0.1	-	-
Squid	-	7.6	-	-	-	4.0	-	-
Miscellaneous	3.8	1.3	-	-	5.7	0.3	-	-
Sand	3.8	-	-	-	5.7	-	-	-
Paper	-	1.3	-	-	-	0.3	-	-

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