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Food of crevalle jack (Caranx hippos)
from Florida, Louisiana, and Texas

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and

Steven P. Naughton

February 1984

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL MARINE FISHERIES SERVICE
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William G. Gordon, Assistant Administrator for
Fisheries

ABSTRACT

Stomachs of 3,643 crevalle jack were examined. Fish were caught by hook and line and seines from May 1980 through November 1981 from the continental shelf waters off east central Florida, south Florida, northwest Florida, Louisiana, and Texas. Differences in stomach contents by area, size of predator, season, and year were studied. About 40% of the stomachs were empty. The percent volume of fish, the dominant food category, ranged from 41.9% in Texas to 96.4% in northwest Florida, while the percent frequency of occurrence of fish ranged from 74.4% in Texas to 93.9% in northwest Florida. Twenty-eight families of fish and 50 species of fishes were represented in the diet, with Clupeidae, Carangidae, and Sparidae being the three dominant fish families. Different families of fish were dominant in different areas, with clupeids abundant in 3 or 4 areas depending on method of analysis, sparids in south Florida, and trichiurids in Texas. Penaeid shrimp and portunid crabs, depending on area were the second most important prey, with seagrasses and algae having at least 8% frequency of occurrence in northwest Florida and Texas. Invertebrates were most important in Texas and least important in northwest Florida based on percent volume. Large crevalle jack had a greater variety of food items, less digested fish remains, and a lower percentage of empty stomachs than small crevalle jack. Diet variations between seasons were more evident than between years. Comparisons of diet between areas, size of predator, seasons, and years were difficult due to disparities in sample size.

INTRODUCTION

Crevalle jack (Caranx hippos) is distributed in the western Atlantic from Nova Scotia to Uruguay. This species is most abundant off the northeast coast of the United States (Johnson 1978). Berry (1959) states that C. hippos is presently regarded as a circumtropical species.

Few studies on the food of C. hippos have been conducted. Knapp (1949) noted stomach contents of this species off the coast of Texas, while Kwei (1978) did likewise off the coast of Ghana. Kwei (1978) referenced work by Cadenat (1954) and Zai (1965). Hobson (1968) reported on feeding of C. hippos caninus off the California coast. We present the results of our studies on the food habits of C. hippos from five localities, three along the Florida coast, one along the Louisiana coast, and one along the Texas coast.

MATERIALS AND METHODS

Stomach samples were obtained from crevalle jack, which were caught by hook and line and by seine from May 1980 through November 1981, in five areas of the southeastern United States (Figure 1). The numbers of stomachs were: 361 from east central Florida; 194 from south Florida; 2,860 from northwest Florida; 72 from Louisiana; and 136 from Texas. The fork length (FL) in mm of each fish was measured prior to removing stomachs. The stomachs were wrapped in gauze and preserved in 10% Formalin.

In the laboratory, the stomachs were rinsed in water and cut longitudinally; stomach walls were scraped lightly with a spatula to remove fish scales, helminths, and small bones. The contents were placed in a glass dish and were sorted into taxonomic groups, identified, drained of water, and blotted dry. Volumes to the nearest 0.1 ml of each food item were determined by water displacement in a graduated cylinder. Volumetric food data were presented as a percentage of the total volume. Numbers of individuals of each taxon could not always be accurately determined due to digestion. Frequency of occurrence of each food type was obtained by counting every fish that contained the specific item. Relative frequency of occurrence (%) was calculated by dividing the number of fish that contained a specific food by the number of fish that had food in their stomachs and multiplying by 100. A summary of the number of stomach samples by area and fish length is given in Table 1.

The total number of stomachs examined in this study was 3,623. Of these 39.8% were empty (Table 1). Data obtained from food-containing stomachs were examined for variations associated with areas of capture, sizes of C. hippos, years, and seasons. Specific data on depths of water or distances from shore of the capture sites and on time of day of capture were unavailable.

COMPARISONS BETWEEN AREAS

The major food of C. hippos was fish. Percent volumes of fish ranged from 41.9% in Texas to 96.4% in northwest Florida. Percent frequencies

ranged from 74.4% in Texas to 93.9% in northwest Florida (Table 2). Of the 28 families of fishes, Clupeidae, Carangidae, Sparidae, and Trichiuridae were the most important components of the diet (Table 2). Based on volume, clupeids were dominant in east central Florida, northwest Florida, and Louisiana, sparids in south Florida, and trichiurids in Texas. Based on frequency of occurrence, clupeids were dominant in east central Florida, south Florida, northwest Florida, and Louisiana, while trichiurids were dominant in Texas. Species of importance varied by area. In east central Florida, based on percent frequency the important species were Harengula jaguana and Anchoa sp. The important species in south Florida were Sardinella aurita, Chloroscombrus chrysurus, Lagodon rhomboides, and Hemiramphus sp., in northwest Florida, Brevoortia patronus, Caranx hippos, and L. rhomboides, in Louisiana, B. patronus, and Decapterus punctatus, and in Texas, Trichiurus lepturus and C. chrysurus (Table 2).

Invertebrates, consisting of various species of crabs, shrimp, stomatopods, and mollusks, were of secondary importance in the diet. The percent volume and frequency of occurrence of invertebrates were highest in Texas and Louisiana and lowest in east central Florida, south Florida, and northwest Florida. Only shrimp in the family Penaeidae were consumed. Penaeids were especially important in south Florida and Texas. Portunid crabs were important in Louisiana and Texas, as were stomatopods. Mollusks, consisting mostly of squid, were important in south Florida, Louisiana, and Texas (Table 2). Results of Knapp (1949) in Texas were similar to ours in the high percent frequency of occurrence of invertebrates, but different in the composition of the invertebrates. Knapp (1949) had a frequency of occurrence of 61.5% for crabs and 7.7% for shrimp, while we found shrimp had a frequency of occurrence of 60.8% and crabs 40.8% (Table 2). Analysis of stomach contents of C. hippos from Ghana showed that they are primarily piscivorous, as 98.8% of the diet consisted of fish (Kwei 1978). The dominant fish species were Sardinella aurita, S. ega, Engraulis quineensis, and Brachydeuterus auritis.

Parasites, namely nematodes and trematodes, were present in C. hippos only from northwest Florida and had a frequency of occurrence of 0.2% (Table 2).

COMPARISONS BETWEEN FISH SIZES

Sufficient samples (>90) for comparisons of the stomach contents of C. hippos per size group (small: 100-399 mm FL; medium: 400-699 mm FL; and large: 700-999 mm FL) were available only from northwest Florida (Table 1). Crevalle jack that had food in their stomachs totaled 563 in the small size group, 93 in the medium, and 1,059 in the large. Fish was the dominant food in all three size groups, as the percent volume and percent frequency of occurrence of fish was at least 91.8% (Table 3). There were 27 fish families represented in the stomach contents; of these, Clupeidae, Carangidae, Sparidae, and Mugilidae were considered important for crevalle jack from northwest Florida. The dominant fish family was Clupeidae. The percent volume was about the same (37.2% to 40.5%) for each size group. The families Carangidae and Sparidae were consumed more by the small and large crevalle jack, while Mugilidae was preferred by the medium crevalle jack (Table 3).

Invertebrates were of minor volumetric importance, however, the large crevalle jack had a 15.2% frequency of occurrence of invertebrates. Portunid crabs made up the majority of this total. Invertebrates were absent from the medium group (Table 3). A surprising aspect was the fairly high frequency of occurrence of vegetation (8.8%) occurring in the stomachs of large crevalle jack. Thalassia testudinum was the major seagrass occurring in the stomachs.

COMPARISONS BETWEEN YEARS

Sufficient samples (>100) for between-year comparisons of the stomach contents of crevalle jack were available only from northwest Florida. Data for northwest Florida were obtained from 615 stomachs with food in 1980 and from 1,102 in 1981 (Table 4).

In northwest Florida the major annual differences in the diet of crevalle jack were apparent in the consumption of the clupeids, carangids, and sparids. In 1981 the percent frequency of occurrence and percent volume of clupeids increased about two fold over 1980, while the percent frequency of occurrence and percent volume of carangids and sparids decreased from 1980 to 1981 (Table 5). The number of fish families represented in 1980 was 16 compared to 26 in 1981; however, the sample size was almost twice as large in 1981 than in 1980.

Invertebrates had about a two fold increase from 1980 to 1981. The major invertebrates were the portunid crabs. The presence of vegetation in the diet was about the same for both years (Table 5).

COMPARISONS BETWEEN SEASONS

Sufficient samples (>100) for seasonal comparisons of the stomach contents were available only from northwest Florida. Data for northwest Florida were obtained for spring, summer, and fall (228, 260, and 272 stomachs with food, respectively). The months representing the seasons were March, April, and May for spring; June, July, and August for summer; and September, October, and November for fall. Fish was the dominant food for all three seasons, with Clupeidae, Carangidae, and Sparidae being the major families. The percent frequency of occurrence and percent volume of clupeids increased from 5.7% and 3.4% respectively, in the spring to over 31% for summer and fall (Table 6). The percent frequency of occurrence and percent volume of carangids and sparids were highest in the fall and lowest during the summer or spring. One additional fish family was prominent in the diet of crevalle jack during the spring, as Stromateidae (Peprilus burti) accounted for 14.9% frequency of occurrence and 20.1% of the volume. Values of percent frequency of occurrence and percent volume for this family in the other two seasons were below 1.3% (Table 6).

Invertebrates represented 8.5 and 9.9% of the volume during the spring and summer respectively, but only had 0.1% of the volume in the fall. The

percent frequency of occurrence had a similar pattern with a 8.9 and 19.8% frequency of occurrence in the spring and summer, respectively, and only 1.8% frequency of occurrence during the fall. The percent frequency of occurrence of vegetation was highest in the summer and lowest in the spring (Table 6).

DISCUSSION

Data on the food habits of crevalle jack indicated that clupeids and carangids ranked high in 4 of the 5 areas, sparids in 3 of 5 areas and trichiurids in 1 of 5 areas. The frequency of occurrence of invertebrates was fairly high in all areas with Texas having the highest 77.6% (Table 2). The most important invertebrates were penaeid shrimps and portunid crabs. Seagrasses and algae also had a relatively high frequency of occurrence, at least 8.0% in northwest Florida and Texas. Comparisons of the variety of food in the stomachs of crevalle jack was complicated by the differences in sample sizes. Numbers of stomachs from northwest Florida were almost eight times the number from any other area. The diet of crevalle jack off Ghana was similar to that off the southeast coast of the United States and Gulf of Mexico, as Kwei (1978) noted Clupeidae, Carangidae, and Trichiuridae as dominant food items. In addition, three of his abundant prey species (S. aurita, C. chrysurus, and T. lepturus) were also abundant in this study.

The percent of empty stomachs averaged almost 40% for all five areas with Texas having the lowest percent (8.1%) of empty stomachs (Table 1). The percent of empty stomachs in Kwei's (1978) study was 42.2%. The percent of empty stomachs decreased as the size of crevalle jack increased (Table 1), indicating larger fish probably ate more frequently, consumed larger food items, and regurgitated less. Kwei (1978) also found a higher percent (70.6%) of empty stomachs in smaller crevalle jack. This may account for the low percentage of empty stomachs from Texas as small fish were absent in the Texas sample.

Small crevalle jack preyed mostly on a variety of clupeids, the medium crevalle jack ate mostly clupeids and sparids, while large crevalle jack consumed various clupeids, carangids, and sparids. Large crevalle jack appeared to be more opportunistic than the small crevalle jack. However, this may be related to sample size, as the number of large crevalle jack was almost twice that of small crevalle jack. The absence of invertebrates from the medium crevalle jack is probably related to sample size, as only 93 fish made up the sample. Invertebrates had a frequency of occurrence of over 15% in large crevalle jack with crabs (mostly portunids) comprising over 12% of the total.

Digested fish remains in the stomachs of crevalle jack declined as crevalle jack increased in size (Table 3). Large crevalle jack had more whole and larger fish, which made identification easier.

Differences in the occurrence and amount of the three dominant fish families (Clupeidae, Carangidae, and Sparidae) between years (1980 and 1981) in northwest Florida was evident. A greater variety in food items in 1981 was probably the result of the larger sample size in 1981.

Food availability seemed to be the major factor in the diet of crevalle jack as diet changed between sizes, seasons, areas, and years. Food availability as a diet factor was also mentioned by Kwei (1978) and he in turn referenced work by Cadenat (1954) and Zai (1965) which stated that crevalle jack are indiscriminate in feeding habits.

In conclusion, the stomach content data of crevalle jack clearly indicate that they are a major predator on small schooling fishes in the coastal zone of the Gulf of Mexico and the southern U.S. Atlantic coast. The dominance of clupeids, carangids, trichiurids, and sparids in the stomachs of crevalle jack supports this conclusion.

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LITERATURE CITED

- BERRY, F.H. 1959. Young jack crevalles (Caranx species) off the southeastern Atlantic coast of the United States. U.S. Fish Wildl. Serv. Fish. Bull. 152, vol 59:417-535.
- CADENAT, J.A. 1954. Note d'Ichthyologie Ouest-africaine VII Biologie, Regime alimentaire Carangidae, Bull. I.F.A.N., 16 (Series A) (21): 565-583. (Cited by Kwei, 1978.)
- HOBSON, E.S. 1968. Predatory behavior of some shore fishes in the Gulf of California. U.S. Fish Wildl. Serv. Res. Report 73, 92 p.
- JOHNSON, G.D. 1978. Development of fishes of the mid-Atlantic bight. An atlas of egg, larval, and juvenile stages. Carangidae through Ehippidae. U.S. Fish Wildl. Serv., Biol. Serv. Prog., Fish Wildl. Serv./OBS-78/12, vol. IV:314 p.
- KNAPP, F.T. 1949. Menhaden utilization in relation to the conservation of food and game fishes of the Texas gulf coast. Trans. Am. Fish. Soc. 79:137-144.
- KWEI, E.A. 1978. Food and spawning activity of Caranx hippos (L.) off the coast of Ghana. J. Nat. Hist. 12:194-215.
- ZAI, M. 1965. Biological investigation of fisheries resources. FAO, EPTA Report No. 2001, Ghana Government. (Cited by Kwei, 1978.)

Table 1. Numbers of crevalle jack stomachs by length group and area.

Length group mm FL	East Central Florida		South Florida		Northwest Florida		Louisiana		Texas		All areas		% empty
	With food	Total	With food	Total	With food	Total	With food	Total	With food	Total	With food	Total	
100-199	28	33	0	0	124	612	0	0	0	0	152	645	76
200-299	106	173	14	28	98	157	1	1	0	0	219	359	39
300-399	20	66	54	99	341	612	13	14	0	0	428	791	46
400-499	36	79	29	58	69	118	0	0	0	0	134	255	47
500-599	1	2	3	5	14	24	0	0	0	0	18	31	42
600-699	0	0	3	3	10	15	1	3	2	2	16	23	30
700-799	4	4	0	1	195	258	4	9	22	23	225	295	24
800-899	2	2	0	0	729	904	23	33	92	102	846	1,041	19
900-999	2	2	0	0	135	160	9	12	9	9	155	183	15
Total	199	361	103	194	1,715	2,860	51	72	125	136	2,193	3,643	39.8
% empty	44.9		46.9		40.0		29.2		8.1		39.8		

Table 2. Food of crevalle jack in five geographical areas. Percentages for categories above genus include contents not identified to lower taxa.

Food item	Percent frequency of occurrence					Percent volume				
	East central	South	Northwest			East central	South	Northwest		
	Florida	Florida	Florida	Louisiana	Texas	Florida	Florida	Florida	Louisiana	Texas
Vertebrates (fish)	93.0	84.5	93.9	82.4	74.4	89.8	91.7	96.4	77.9	41.9
<u>CLUPEIDAE</u>	20.6	17.5	29.8	41.2	2.4	49.1	25.3	40.2	44.2	0.5
<u>Brevoortia tyrannus</u>	3.5	0	0	0	0	36.2	0	0	0	0
<u>Brevoortia patronus</u>	0	0	11.8	7.8	0	0	0	27.3	13.9	0
<u>Brevoortia sp.</u>	0	0	2.8	0	0	0	0	2.7	0	0
<u>Dorosoma petenense</u>	0	0	0.1	0	0	0	0	20.1	0	0
<u>Harengula jaguana</u>	15.1	0	3.2	2.0	1.6	14.4	0	1.2	1.4	0.3
<u>Opisthonema oglinum</u>	1.5	1.0	0.7	0	0	3.6	6.6	0.8	0	0
<u>Sardinella aurita</u>	0	5.8	6.2	0	0.8	0	9.3	7.6	0	0.2
<u>CARANGIDAE</u>	0	7.8	12.5	5.9	8.8	0	5.4	27.4	4.1	3.5
<u>Caranx crysos</u>	0	0	0.2	0	0	0	0	0.4	0	0
<u>Caranx hippos</u>	0	0	8.8	0	0.8	0	0	15.6	0	0.1
<u>Chloroscombrus chrysurus</u>	0	7.8	2.5	0	7.2	0	5.4	2.8	0	3.2
<u>Decapterus punctatus</u>	0	0	0.6	5.9	0	0	0	0.2	4.1	0
<u>Oligoplites saurus</u>	0	0	0.1	0	0	0	0	<0.1	0	0
<u>Selar crumenophthalmus</u>	0	0	0	0	0.8	0	0	0	0	0.2
<u>Seriola sp.</u>	0	0	0.1	0	0	0	0	0.2	0	0
<u>Trachinotus carolinus</u>	0	0	0.1	0	0	0	0	<0.1	0	0

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Table 2. Continued

Food item	Percent frequency of occurrence					Percent volume				
	East central Florida	South Florida	Northwest Florida	Louisiana	Texas	East central Florida	South Florida	Northwest Florida	Louisiana	Texas
SPARIDAE	1.0	12.6	14.6	0	2.4	11.9	32.5	14.2	0	0.1
<u>Calanus nodosus</u>	0.5	0	0	0	0	6.9	0	0	0	0
<u>Calanus sp.</u>	0.5	0	0	0	0	5.1	0	0	0	0
<u>Lagodon rhomboides</u>	0	12.6	14.4	0	0.8	0	32.5	14.2	0	<0.1
<u>Stenotomus caprinus</u>	0	0	0	0	1.6	0	0	0	0	0.1
ELOPIDAE	0	0	0.1	0	0	0	0	0.1	0	0
<u>Elops saurus</u>	0	0	0.1	0	0	0	0	0.1	0	0
HAEMULIDAE	0	1.0	0.4	0	0	0	3.1	0.2	0	0
<u>Haemulon aurolineatum</u>	0	1.0	0	0	0	0	3.1	0	0	0
<u>Haemulon plumieri</u>	0	0	0.1	0	0	0	0	0.1	0	0
<u>Orthopristis chrysoptera</u>	0	0	0.1	0	0	0	0	0.1	0	0
ARIIDAE	0	0	3.2	2.0	0	0	0	2.4	1.4	0
<u>Arius felis</u>	0	0	2.3	0	0	0	0	2.0	0	0
SCIAENIDAE	3.5	0	3.0	7.8	2.4	3.2	0	2.0	10.7	1.2
<u>Cynoscion nebulosus</u>	0	0	0.1	0	0	0	0	<0.1	0	0
<u>Cynoscion sp.</u>	0	0	0.1	0	0	0	0	<0.1	0	0
<u>Equetus umbrosus</u>	0	0	0.1	0	0	0	0	<0.1	0	0
<u>Larimus fasciatus</u>	0.5	0	0	0	0	0.3	0	0	0	0

Table 2. Continued

Food item	Percent frequency of occurrence					Percent volume				
	East central	South	Northwest	Louisiana	Texas	East central	South	Northwest	Louisiana	Texas
	Florida	Florida	Florida			Florida	Florida	Florida		
<u>Leiostomus xanthurus</u>	1.0	0	2.2	3.9	0.8	1.6	0	1.5	4.7	0.3
<u>Menticirrhus</u> sp.	0	0	0.1	0	0	0	0	0.1	0	0
<u>Micropogonias undulatus</u>	0.5	0	0.1	3.9	1.6	0.5	0	<0.1	6.1	1.0
TRICHIURIDAE	0	0	0.1	2.0	47.2	0	0	<0.1	2.8	29.6
<u>Trichiurus lepturus</u>	0	0	0	2.0	47.2	0	0	0	2.8	29.6
TRIGLIDAE	0	0	0.8	0	0.8	0	0	0.4	0	<0.1
<u>Prionotus rubio</u>	0	0	0.1	0	0.8	0	0	<0.1	0	<0.1
BALISTIDAE	0	1.0	0.2	0	1.6	0	0.4	0.1	0	0.4
<u>Balistes capriscus</u>	0	1.0	0.1	0	1.6	0	0.4	<0.1	0	0.4
<u>Monacanthus hispidus</u>	0	0	0.1	0	0	0	0	<0.1	0	0
STROMATEIDAE	0	1.0	2.6	3.9	4.8	0	0.4	0.9	1.4	2.4
<u>Peprilus burti</u>	0	1.0	2.6	3.9	4.8	0	0.4	0.8	1.4	2.4
<u>Peprilus triacanthus</u>	0	0	0.1	0	0	0	0	0.1	0	0
SCOMBRIDAE	0	0	0.2	0	0	0	0	0.2	0	0
<u>Scomberomorus cavalla</u>	0	0	0.1	0	0	0	0	<0.1	0	0
<u>Euthynnus alletteratus</u>	0	0	0.1	0	0	0	0	0.1	0	0
SERRANIDAE	0	0	0.3	2.0	0	0	0	0.1	5.5	0
<u>Diplectrum formosum</u>	0	0	0.2	0	0	0	0	0.1	0	0

Table 2. Continued

Food item	Percent frequency of occurrence					Percent volume				
	East central Florida	South Florida	Northwest Florida	Louisiana	Texas	East central Florida	South Florida	Northwest Florida	Louisiana	Texas
<u>Mycteroperca</u> sp.	0	0	0.1	0	0	0	0	<0.1	0	0
SYNODONTIDAE	0	0	0.1	0	0.8	0	0	<0.1	0	0.1
<u>Synodus foetens</u>	0	0	0.1	0	0	0	0	<0.1	0	0
MUGILIDAE	0.5	0	2.2	0	0	0.2	0	1.6	0	0
<u>Mugil cephalus</u>	0	0	0.8	0	0	0	0	0.8	0	0
<u>Mugil</u> sp.	0	0	1.0	0	0	0	0	0.6	0	0
CYNOGLOSSIDAE	0.5	0	0.1	0	0	0.2	0	<0.1	0	0
ENGRAULIDAE	13.6	0	1.6	5.9	0	5.0	0	0.4	1.4	0
<u>Anchoa hepsetus</u>	0	0	0.2	3.9	0	0	0	0.1	0.8	0
<u>Anchoa mitchilli</u>	0	0	0.1	0	0	0	0	<0.1	0	0
<u>Anchoa nasuta</u>	0	0	0.1	0	0	0	0	<0.1	0	0
<u>Anchoa</u> sp.	13.6	0	1.2	2.0	0	5.0	0	0.2	0.7	0
ATHERINIDAE	0	0	0.4	0	0	0	0	<0.1	0	0
<u>Membras martinica</u>	0	0	0.2	0	0	0	0	<0.1	0	0
POMATOMIDAE	0	0	0.2	0	0	0	0	0.6	0	0
<u>Pomatomus saltatrix</u>	0	0	0.2	0	0	0	0	0.6	0	0
POMADASYIDAE	0	0	0.2	0	0	0	0	<0.1	0	0
POMACANTHIDAE	0	0	0	0	0.8	0	0	0	0	0.1

Table 2. Continued

Food item	Percent frequency of occurrence					Percent volume				
	East central Florida	South Florida	Northwest Florida	Louisiana	Texas	East central Florida	South Florida	Northwest Florida	Louisiana	Texas
<u>Pomacanthus paru</u>	0	0	0	0	0.8	0	0	0	0	0.1
SPHYRAENIDAE	0	0	0.1	0	0	0	0	0.3	0	0
<u>Sphyraena guachancho</u>	0	0	0.1	0	0	0	0	0.3	0	0
NETTASTOMATIDAE	0	0	0.1	0	0	0	0	<0.1	0	0
LABRIDAE	0	0	0.1	2.0	0	0	0	<0.1	0.6	
<u>Hemipteronotus novacula</u>	0	0	0.1	2.0	0	0	0	<0.1	0.6	0
BOTHIDAE	0	0	0.8	0	2.4	0	0	0.4	0	1.2
<u>Etropus crossotus</u>	0	0	0.1	0	0	0	0	<0.1	0	0
<u>Paralichthys albigutta</u>	0	0	0.1	0	0	0	0	<0.1	0	0
<u>Syacium gunteri</u>	0	0	0	0	0.8	0	0	0	0	0.5
GERREIDAE	0	0	0.1	0	0	0	0	<0.1	0	0
<u>Eucinostomus argenteus</u>	0	0	0.1	0	0	0	0	<0.1	0	0
EXOCOETIDAE	0	11.6	0.1	0	0	0	11.2	<0.1	0	0
<u>Hemiramphus brasiliensis</u>	0	0	0.1	0	0	0	0	<0.1	0	0
<u>Hemiramphus</u> sp.	0	10.7	0	0	0	0	10.3	0	0	0
OPHICHTHIDAE	0	1.0	0.3	5.9	0	0	0.9	0.1	1.5	0
Digested fish remains	42.2	35.9	41.5	25.5	24.8	5.7	12.6	4.8	4.2	2.7

Table 2. Continued

Food item	Percent frequency of occurrence					Percent volume				
	East central Florida	South Florida	Northwest Florida	Louisiana	Texas	East central Florida	South Florida	Northwest Florida	Louisiana	Texas
Invertebrates	8.0	21.4	10.6	49.0	77.6	10.2	8.3	3.2	22.1	57.6
Shrimp	1.0	12.6	1.4	3.9	60.8	0.2	6.4	0.2	3.4	33.2
PENAEIDAE	0	0	0.2	0	0	0	0	<0.1	0	0
<u>Penaeus aztecus</u>	0	0	0	2.0	8.0	0	0	0	3.3	3.2
<u>Penaeus duorarum</u>	0	0	0	0	19.2	0	0	0	0	17.0
<u>Penaeus setiferus</u>	0	0	0.1	0	2.4	0	0	<0.1	0	2.2
<u>Penaeus sp.</u>	1.0	11.6	0.3	2.0	28.8	0.2	5.9	<0.1	0.1	6.2
<u>Sicyonia dorsalis</u>	0	0	0	0	0.8	0	0	0	0	<0.1
<u>Sicyonia brevirostris</u>	0	0	0.1	0	1.6	0	0	<0.1	0	0.8
<u>Sicyonia sp.</u>	0	1.0	0.7	0	0.8	0	0.2	0.1	0	<0.1
<u>Trachypeneus constrictus</u>	0	1.0	0.1	0	3.2	0	0.4	<0.1	0	2.9
<u>Trachypeneus sp.</u>	0	0	0	0	4.8	0	0	0	0	0.8
Crab	3.0	0	9.1	23.5	40.8	3.8	0	2.7	6.5	6.9
PORTUNIDAE	0	0	2.4	0	0	0	0	0.5	0	0
<u>Portunus sp.</u>	1.5	0	2.2	15.7	15.2	0.4	0	0.6	4.4	2.4
<u>Portunus gibbesii</u>	0	0	0.9	7.8	7.2	0	0	0.2	1.2	1.3
<u>Portunus sayi</u>	0	0	0.1	2.0	4.0	0	0	<0.1	0.3	0.6
<u>Portunus spinimanus</u>	0	0	0.5	0	0.8	0	0	0.2	0	0.1

Table 2. Continued

Food item	Percent frequency of occurrence					Percent volume				
	East central Florida	South Florida	Northwest Florida	Louisiana	Texas	East central Florida	South Florida	Northwest Florida	Louisiana	Texas
<u>Portunus megalops</u>	0	0	0.1	0	0	0	0	<0.1	0	0
<u>Callinectes</u> sp.	0	0	0	2.0	1.6	0	0	0	0.6	0.1
<u>Callinectes ornatus</u>	0.5	0	0	0	2.4	0.5	0	0	0	0.6
<u>Callinectes similis</u>	0.5	0	0	0	7.2	0.4	0	0	0	1.0
<u>Callinectes sapidus</u>	1.0	0	0	0	3.2	2.5	0	0	0	0.6
<u>Ovalipes</u> sp.	0	0	0.6	0	0	0	0	0.2	0	0
<u>Ovalipes ocellatus</u>	0	0	2.6	0	2.4	0	0	1.0	0	0.3
ALBUNEIDAE (<u>Albunea</u> sp.)	0	0	0.1	0	0	0	0	<0.1	0	0
Stomatopoda	0	0	1.3	19.6	28.4	0	0	0.2	8.8	14.8
SQUILLIDAE	0	0	0.1	3.9	0.8	0	0	<0.1	0.9	0.2
<u>Squilla</u> sp.	0	0	0	0	5.6	0	0	0	0	1.4
<u>Squilla empusa</u>	0	0	0.8	15.7	31.2	0	0	0.2	7.8	13.1
MOLLUSKS	5.4	7.8	1.4	15.7	12.0	6.2	1.7	0.1	3.5	2.7
Cephalopoda	4.5	6.8	1.0	11.8	12.0	6.2	1.7	0.1	3.3	2.7
<u>Loligo pealeii</u>	0	0	0.3	2.0	3.2	0	0	<0.1	1.0	1.2
<u>Pickfordiateuthis pulchella</u>	1.0	0	0	0	0	5.2	0	0	0	0
Pelecypoda	0	0	0.4	5.9	0	0	0	<0.1	0.2	0
<u>Barbartia</u> sp.	0	0	0.2	0	0	0	0	<0.1	0	0

Table 2. Continued

Food item	Percent frequency of occurrence					Percent volume				
	East central Florida	South Florida	Northwest Florida	Louisiana	Texas	East central Florida	South Florida	Northwest Florida	Louisiana	Texas
<u>Barbartis tenera</u>	0	0	0.1	0	0	0	0	<0.1	0	0
<u>Cantharus cancellarius</u>	0	0	0	2.0	0	0	0	0	<0.1	0
<u>Chione cancellata</u>	0	0	0.1	0	0	0	0	<0.1	0	0
<u>Ervilia concentrica</u>	0	0	0	2.0	0	0	0	0	0.1	0
<u>Tellina acquistriata</u>	0	0	0	2.0	0	0	0	0	<0.1	0
Unidentified arciids	0	0	0.1	0	0	0	0	<0.1	0	0
Gastropoda	0	0	0.1	0	0.8	0	0	<0.1	0	0.1
<u>Pisania tineta</u>	0	0	0.1	0	0	0	0	<0.1	0	0
<u>Marginella</u> sp.	0	1.0	0	0	0	0	0.1	0	0	0
Echinodermata (<u>Mellita</u> <u>quinquiesperforata</u>)	0	0	0.2	0	0	0	0	<0.1	0	0
Urochordata	0	0	0.1	0	0	0	0	<0.1	0	0
Anthozoa (hard coral)	0	1.0	0	0	0	0	0.2	0	0	0
Nematoda	0	0	0.2	0	0	0	0	<0.1	0	0
Trematoda	0	0	0.2	0	0	0	0	<0.1	0	0
Vegetation	0	1.0	8.2	0	8.0	0	<0.1	0.3	0	0.4
Seagrass	0	0	7.6	0	0	0	0	0.2	0	0
<u>Thalassia testudinum</u>	0	0	5.4	0	0	0	0	0.2	0	0
<u>Halodule wrightii</u>	0	0	0.8	0	0	0	0	<0.1	0	0

Table 2. Continued

Food item	Percent frequency of occurrence					Percent volume				
	East central Florida	South Florida	Northwest Florida	Louisiana	Texas	East central Florida	South Florida	Northwest Florida	Louisiana	Texas
<u>Syringodium filiforme</u>	0	0	1.5	0	0	0	0	<0.1	0	0
Algae	0	0	0.9	0	0	0	0	0.1	0	0
<u>Gracilaria sp.</u>	0	0	0.2	0	0	0	0	<0.1	0	0
<u>Gracilaria foliifera</u>	0	0	0.1	0	0	0	0	<0.1	0	0
<u>Grateloupia filicina</u>	0	0	0.1	0	0	0	0	<0.1	0	0
<u>Sargassum sp.</u>	0	1.0	0.3	0	8.0	0	<0.1	<0.1	0	0.4
<u>Sargassum filipendula</u>	0	0	0.1	0	0	0	0	<0.1	0	0
<u>Sargassum fluitans</u>	0	0	0.1	0	0	0	0	<0.1	0	0
Miscellaneous	0	0	0.9	0	0	0	0	0.1	0	0
Sand	0	0	0.8	0	0	0	0	0.1	0	0
Wood	0	0	0.1	2.0	0	0	0	<0.1	0.1	0

Table 3. Food of three sizes of crevalle jack in northwest Florida. Small = 100-399 mm FL; medium = 400-699 mm FL; large = 700-999 mm FL. Percentages for categories above genus include contents not identified to lower taxa.

Food item	Percent frequency of occurrence			Percent volume		
	Small	Medium	Large	Small	Medium	Large
Vertebrates (fish)	98.2	100	91.8	97.3	100	96.3
<u>CLUPEIDAE</u>	22.7	40.9	32.6	37.2	40.4	40.5
<u>Brevoortia patronus</u>	0.2	35.5	15.9	2.1	38.0	27.9
<u>Brevoortia</u> sp.	0.4	1.1	4.3	0.9	0.3	2.8
<u>Dorosoma petenense</u>	0	0	0.1	0	0	<0.1
<u>Harengula jaguana</u>	3.0	0	3.5	5.0	0	1.1
<u>Opisthonema oglinum</u>	0.2	0	1.0	0.1	0	0.8
<u>Sardinella aurita</u>	6.6	2.2	6.4	15.4	1.8	7.6
<u>CARANGIDAE</u>	2.7	0	18.8	13.1	0	28.3
<u>Caranx crysos</u>	0	0	0.4	0	0	0.5
<u>Caranx hippos</u>	0.2	0	14.0	5.5	0	24.5
<u>Chloroscombrus chrysurus</u>	0.9	0	3.6	2.3	0	2.9
<u>Decapterus punctatus</u>	1.2	0	0.4	4.4	0	0.1
<u>Oligoplites saurus</u>	0	0	0.2	0	0	<0.1
<u>Seriola</u> sp.	0	0	0.1	0	0	0.3
<u>Trachinotus carolinus</u>	0	0	0.1	0	0	<0.1
<u>SPARIDAE</u>	5.2	15.0	19.6	11.2	5.8	14.7
<u>Lagodon rhomboides</u>	5.0	15.0	19.4	10.2	5.8	14.7

Table 3. Continued

Food item	Percent frequency of occurrence			Percent volume		
	Small	Medium	Large	Small	Medium	Large
ELOPIDAE	0.2	0	0.1	1.0	0	<0.1
<u>Elops saurus</u>	0.2	0	0.1	1.0	0	<0.1
HAEMULIDAE	0	0	0.4	0	0	0.2
<u>Haemulon plumieri</u>	0	0	0.2	0	0	0.1
<u>Orthopristis chrysoptera</u>	0	0	0.2	0	0	0.1
ARIIDAE	0	0	5.2	0	0	2.8
<u>Arius felis</u>	0	0	3.8	0	0	2.3
SCIAENIDAE	0.4	0	4.6	0.3	0	2.2
<u>Cynoscion nebulosus</u>	0	0	0.1	0	0	<0.1
<u>Cynoscion sp.</u>	0	0	0.1	0	0	<0.1
<u>Equetus umbrosus</u>	0	0	0.1	0	0	<0.1
<u>Leiostomus xanthurus</u>	0.2	0	3.4	0.1	0	1.6
<u>Menticirrhus sp.</u>	0	0	0.1	0	0	0.1
<u>Micropogonias undulatus</u>	0	0	0.2	0	0	<0.1
TRICHIURIDAE	0.2	0	0	0.2	0	0
TRIGLIDAE	0	0	1.2	0	0	0.4
<u>Prionotus rubio</u>	0	0	0.1	0	0	<0.1
BALISTIDAE	0	0	0.3	0	0	<0.1

Table 3. Continued

Food item	Percent frequency of occurrence			Percent volume		
	Small	Medium	Large	Small	Medium	Large
<u>Balistes caprisus</u>	0	0	0.1	0	0	< 0.1
<u>Monocanthus hispidus</u>	0	0	0.2	0	0	<0.1
STROMATEIDAE	0.7	1.1	3.8	0.9	0.3	0.9
<u>Peprilus burti</u>	0.7	1.1	3.7	0.9	0.3	0.8
<u>Peprilus triacanthus</u>	0	0	0.1	0	0	<0.1
SCOMBRIDAE	0	0	0.3	0	0	0.2
<u>Scomberomorus cavalla</u>	0	0	0.1	0	0	<0.1
<u>Euthynnus alletteratus</u>	0	0	0.1	0	0	0.1
SERRANIDAE	0	0	0.5	0	0	0.1
<u>Diplectrum formosum</u>	0	0	0.3	0	0	0.1
<u>Mycteroperca sp.</u>	0	0	0.1	0	0	<0.1
SYNODONTIDAE	0.4	0	0	0.3	0	0
<u>Synodus foetens</u>	0.2	0	0	0.2	0	0
MUGILIDAE	0.2	35.5	0.3	0.1	46.2	0.1
<u>Mugil cephalus</u>	0	15.0	0	0	23.4	0
<u>Mugil sp.</u>	0	17.2	0.2	0	18.3	0.1
CYNOGLOSSIDAE	0	0	0.2	0	0	<0.1
ENGRAULIDAE	2.3	0	1.3	4.0	0	0.3

Table 3. Continued

Food item	Percent frequency of occurrence			Percent volume		
	Small	Medium	Large	Small	Medium	Large
<u>Anchoa hepsetus</u>	0.4	0	0.2	1.1	0	0.1
<u>Anchoa mitchilli</u>	0.2	0	0.1	0.4	0	<0.1
<u>Anchoa nasuta</u>	0.2	0	0	0.6	0	0
<u>Anchoa sp.</u>	1.6	0	1.0	1.9	0	0.2
ATHERINIDAE	0	6.4	0	0	0.5	0
<u>Membras martinica</u>	0	3.2	0	0	0.2	0
POMATOMIDAE	0	0	0.3	0	0	0.6
<u>Pomatomus saltatrix</u>	0	0	0.3	0	0	0.6
POMADASYIDAE	0	0	0.3	0	0	<0.1
SPHYRAENIDAE	0	0	0.1	0	0	0.3
<u>Sphyraena guachancho</u>	0	0	0.1	0	0	0.3
NETTASTOMATIDAE	0	0	0.1	0	0	<0.1
LABRIDAE	0	0	0.2	0	0	<0.1
<u>Hemipteronotus novacula</u>	0	0	0.1	0	0	<0.1
BOTHIDAE	0	0	1.3	0	0	0.4
<u>Etropus crossotus</u>	0	0	0.1	0	0	<0.1
<u>Paralichthys albigutta</u>	0	0	0.2	0	0	<0.1
GERREIDAE	0	0	0.1	0	0	<0.1

Table 3. Continued

Food item	Percent frequency of occurrence			Percent volume		
	Small	Medium	Large	Small	Medium	Large
<u>Eucinostomus argenteus</u>	0	0	0.1	0	0	<0.1
EXOCOETIDAE	0	0	0.2	0	0	<0.1
<u>Hemiramphus brasiliensis</u>	0	0	0.2	0	0	<0.1
OPHICHTHIDAE	0	0	0.5	0	0	0.1
Digested fish remains	65.0	44.1	28.9	29.2	6.8	4.0
Invertebrates	3.2	0	15.2	1.9	0	3.3
Shrimp	0.5	0	1.7	0.3	0	0.2
PENAEIDAE	0	0	0.3	0	0	<0.1
<u>Penaeus</u> sp.	0.5	0	0.2	0.3	0	<0.1
<u>Penaeus setiferus</u>	0	0	0.1	0	0	<0.1
<u>Trachypeneus constrictus</u>	0	0	0.1	0	0	<0.1
<u>Sicyonia</u> sp.	0	0	1.0	0	0	0.1
<u>Sicyonia brevirostris</u>	0	0	0.2	0	0	<0.1
Crab	0.9	0	12.4	0.5	0	2.8
PORTUNIDAE	0.4	0	3.7	0.4	0	0.5
<u>Portunus</u> sp.	0.2	0	3.4	0.1	0	0.6
<u>Portunus megalops</u>	0.4	0	0	<0.1	0	0
<u>Portunus spinimanus</u>	0	0	0.8	0	0	0.2

Table 3. Continued

Food item	Percent frequency of occurrence			Percent volume		
	Small	Medium	Large	Small	Medium	Large
<u>Portunus gibbesii</u>	0	0	1.5	0	0	0.2
<u>Portunus sayi</u>	0	0	0.1	0	0	<0.1
<u>Ovalipes</u> sp.	0	0	1.0	0	0	0.3
<u>Ovalipes ocellatus</u>	0	0	4.2	0	0	1.1
ALBUNEIDAE (<u>Albunea</u> sp.)	0	0	0.1	0	0	<0.1
Stomatopoda	1.2	0	1.5	0.6	0	0.2
SQUILLIDAE	0.2	0	0	0.1	0	0
<u>Squilla empusa</u>	0.5	0	1.0	0.4	0	0.2
MOLLUSKS	1.4	0	1.3	0.5	0	0.1
Cephalopoda	1.2	0	0.9	0.5	0	0.1
<u>Loligo pealeii</u>	0.4	0	0.3	0.2	0	<0.1
Pelecypoda	0.2	0	0.5	<0.1	0	<0.1
<u>Barbartia</u> sp.	0	0	0.1	0	0	<0.1
<u>Barbartia tenera</u>	0.2	0	0	<0.1	0	<0.1
<u>Chione cancellata</u>	0	0	0.2	0	0	<0.1
Unidentified arciids	0	0	0.2	0	0	<0.1
Gastropoda	0	0	0.1	0	0	<0.1

Table 3. Continued

Food item	Percent frequency of occurrence			Percent volume		
	Small	Medium	Large	Small	Medium	Large
<u>Pisania tinctoria</u>	0	0	0.1	0	0	<0.1
Echinodermata (<u>Mellita quinquesperforata</u>)	0	0	0.3	0	0	<0.1
Urochordata	0	0	0.2	0	0	<0.1
Vegetation	3.4	1.1	8.8	0.8	<0.1	0.3
Seagrass	3.4	1.1	8.0	0.8	<0.1	0.2
<u>Thalassia testudinum</u>	3.2	1.1	6.9	0.8	<0.1	0.2
<u>Halodule wrightii</u>	0.2	0	1.1	<0.1	0	<0.1
<u>Syringodium filiforme</u>	0	0	2.4	0	0	<0.1
Algae	0	0	1.3	0	0	0.1
<u>Gracilaria</u> sp.	0	0	0.2	0	0	<0.1
<u>Gracilaria foliifera</u>	0	0	0.2	0	0	<0.1
<u>Grateloupia filicina</u>	0	0	0.1	0	0	<0.1
<u>Sargassum</u> sp.	0	0	0.5	0	0	<0.1
<u>Sargassum fluitans</u>	0	0	0.1	0	0	<0.1
<u>Sargassum filipendula</u>	0	0	0.1	0	0	<0.1
Miscellaneous	0	0	1.3	0	0	<0.1
Sand	0	0	1.2	0	0	0.1
Wood	0	0	0.1	0	0	0.1

Table 4. Numbers of crevalle jack stomachs with food by seasons and years.

Year	East central Florida					South Florida					Northwest Florida				Louisiana				Texas			
	Winter	Spring	Summer	Fall	Total	Winter	Spring	Summer	Fall	Total	Spring	Summer	Fall	Total	Spring	Summer	Fall	Total	Spring	Summer	Fall	Total
1980	113	0	0	0	113	2	1	37	13	53	1	338	276	615	13	35	3	51	30	86	9	125
1981	7	63	12	4	86	27	17	3	3	50	227	422	451	1,100	0	0	0	0	0	0	0	0
Total	120	63	12	4	199	29	18	40	16	103	228	760	727	1,715	13	35	3	51	30	86	9	125

Table 5. Food of crevalle jack during 1980 and 1981 in northwest Florida. Percentages for categories above genus include contents not identified to lower taxa.

Food item	Percent frequency of occurrence		Percent volume	
	1980	1981	1980	1981
Vertebrates (fish)	98.9	91.6	98.5	95.1
CLUPEIDAE	18.4	36.1	21.6	54.8
<u>Brevoortia patronus</u>	0.5	18.1	0.4	44.7
<u>Brevoortia</u> sp.	0.2	4.4	0.1	4.4
<u>Dorosoma petenense</u>	0	0.1	0	<0.1
<u>Harengula jaguana</u>	2.9	3.3	0.6	1.5
<u>Opisthonema oglinum</u>	0	1.1	0	1.3
<u>Sardinella aurita</u>	10.4	3.9	13.0	3.6
CARANGIDAE	16.3	10.4	38.0	19.4
<u>Caranx crysos</u>	0	0.3	0	0.6
<u>Caranx hippos</u>	8.5	9.0	30.5	18.2
<u>Chloroscombrus chrysurus</u>	5.7	0.7	6.2	0.3
<u>Decapterus punctatus</u>	1.6	0.1	0.5	0.1
<u>Oligoplites saurus</u>	0	0.2	0	0.1
<u>Seriola</u> sp.	0.2	0	0.6	0
<u>Trachinotus carolinus</u>	0	0.1	0	<0.1
SPARIDAE	19.2	12.0	24.3	6.9
<u>Lagodon rhomboides</u>	18.9	12.0	24.2	6.9
ELOPIDAE	0	0.2	0	0.1
<u>Elops saurus</u>	0	0.2	0	0.1
HAEMULIDAE	0.3	0.2	0.2	0.1
<u>Haemulon plumieri</u>	0	0.2	0	0.1
<u>Orthopristis chrysoptera</u>	0.3	0	0.2	0
ARIIDAE	4.6	2.4	3.9	1.4

Table 5. Continued

Food item	Percent frequency of occurrence		Percent volume	
	1980	1981	1980	1981
<u>Arius felis</u>	3.6	1.5	3.4	1.0
SCIAENIDAE	3.2	2.8	2.5	1.7
<u>Cynoscion nebulosus</u>	0	0.1	0	<0.1
<u>Cynoscion sp.</u>	0	0.1	0	<0.1
<u>Equetus umbrosus</u>	0.2	0	<0.1	0
<u>Leiostomus xanthurus</u>	2.4	2.0	1.7	1.2
<u>Menticirrhus sp.</u>	0	0.1	0	0.2
<u>Micropogonias undulatus</u>	0	0.2	0	<0.1
TRICHIURIDAE	0.2	0	<0.1	0
TRIGLIDAE	0.6	0.8	0.4	0.4
<u>Prionotus rubio</u>	0.2	0	<0.1	0
BALISTIDAE	0.2	0.2	0.1	<0.1
<u>Balistes capriscus</u>	0.2	0	0.1	0
<u>Monocanthus hispidus</u>	0	0.2	0	<0.1
STROMATEIDAE	0	4.1	0	1.4
<u>Peprilus burti</u>	0	4.0	0	1.3
<u>Peprilus triacanthus</u>	0	0.1	0	0.1
SCOMBRIDAE	0	0.3	0	0.3
<u>Scomberomorus cavalla</u>	0	0.1	0	0.1
<u>Euthynnus alletteratus</u>	0	0.1	0	0.2
SERRANIDAE	0.5	0.2	0.2	<0.1
<u>Diplectrum formosum</u>	0.3	0.1	0.2	<0.1
<u>Mycteroperca sp.</u>	0	0.1	0	<0.1
SYNODONTIDAE	0.2	0.1	<0.1	<0.1
<u>Synodus foetens</u>	0.2	0	<0.1	0

Table 5. Continued

Food item	Percent frequency of occurrence		Percent volume	
	1980	1981	1980	1981
MUGILIDAE	0.3	3.2	0.2	2.5
<u>Mugil cephalus</u>	0	1.3	0	1.2
<u>Mugil sp.</u>	0	1.6	0	1.0
CYNOGLOSSIDAE	0	0.2	0	<0.1
ENGRAULIDAE	3.1	0.7	0.5	0.2
<u>Anchoa hepsetus</u>	0.5	0.1	0.1	0.1
<u>Anchoa mitchilli</u>	0.2	0.1	<0.1	<0.1
<u>Anchoa nasuta</u>	0.2	0	<0.1	0
<u>Anchoa sp.</u>	2.3	0.5	0.4	0.1
ATHERINIDAE	0	0.5	0	0.1
<u>Membras martinica</u>	0	0.3	0	<0.1
POMATOMIDAE	0.2	0.2	0.8	0.4
<u>Pomatomus saltatrix</u>	0.2	0.2	0.8	0.4
POMADASYIDAE	0	0.3	0	0.1
SPHYRAENIDAE	0	0.1	0	0.5
<u>Sphyraena guachancho</u>	0	0.1	0	0.5
NETTASTOMATIDAE	0	0.1	0	<0.1
LABRIDAE	0	0.2	0	<0.1
<u>Hemipteronotus novacula</u>	0	0.1	0	<0.1
BOTHIDAE	0	1.3	0	0.6
<u>Etropus crossotus</u>	0	0.1	0	<0.1
<u>Paralichthys albigutta</u>	0	0.2	0	<0.1
GERREIDAE	0	0.1	0	<0.1
<u>Eucinostomus argenteus</u>	0	0.1	0	<0.1
EXOCOETIDAE	0.2	0.1	0.1	<0.1

Table 5. Continued

Food item	Percent frequency of occurrence		Percent volume	
	1980	1981	1980	1981
<u>Hemiramphus brasiliensis</u>	0.2	0.1	0.1	<0.1
OPHICHTHIDAE	0.3	0.3	0.1	0.1
Digested fish remains	53.7	34.8	5.7	4.0
Invertebrates	6.7	12.7	1.0	4.5
Shrimp	1.1	1.5	0.1	0.2
PENAEIDAE	0.3	0.1	<0.1	<0.1
<u>Penaeus</u> sp.	0.3	0.3	<0.1	<0.1
<u>Penaeus setiferus</u>	0.2	0	<0.1	0
<u>Trachypeneus constrictus</u>	0.2	0	<0.1	0
<u>Sicyonia</u> sp.	0.2	1.0	<0.1	0.2
<u>Sicyonia brevirostris</u>	0	0.2	0	<0.1
Crab	3.2	10.6	0.5	4.0
PORTUNIDAE	0.8	3.3	0.1	0.7
<u>Portunus</u> sp.	1.8	2.4	0.2	0.8
<u>Portunus megalops</u>	0	0.2	0	<0.1
<u>Portunus spinimanus</u>	0.2	0.7	0.2	0.2
<u>Portunus gibbesii</u>	0.2	1.4	<0.1	0.3
<u>Portunus sayi</u>	0	0.1	0	<0.1
<u>Ovalipes</u> sp.	0	1.0	0	0.4
<u>Ovalipes ocellatus</u>	0.3	3.8	0.1	1.6
ALBUNEIDAE (<u>Albunea</u> sp.)	0	0.1	0	<0.1
Stomatopoda	2.4	0.6	0.3	0.1
SQUILLIDAE	0.2	0	<0.1	0
<u>Squilla empusa</u>	1.5	0.4	0.2	0.1
MOLLUSKS	1.8	1.6	0.1	0.1

Table 5. Continued

Food item	Percent frequency of occurrence		Percent volume	
	1980	1981	1980	1981
Cephalopoda	1.6	0.6	0.1	0.1
<u>Loligo pealeii</u>	0.5	0.2	<0.1	<0.1
Pelecypoda	0.2	0.4	<0.1	<0.1
<u>Barbartia</u> sp.	0	0.1	0	<0.1
<u>Barbartia tenera</u>	0.2	0	<0.1	0
<u>Chione cancellata</u>	0	0.2	0	<0.1
Unidentified arciids	0	0.2	0	<0.1
Gastropoda	0	0.1	0	<0.1
<u>Pisania tinctoria</u>	0	0.1	0	<0.1
Echinodermata (<u>Mellita</u> <u>quinquiesperforata</u>)	0	0.3	0	<0.1
Urochordata	0	0.2	0	<0.1
Vegetation	7.0	6.5	0.3	0.3
Seagrass	6.7	6.2	0.3	0.2
<u>Halassia testudinum</u>	5.4	5.4	0.2	0.2
<u>Halodule wrightii</u>	0.6	0.3	<0.1	<0.1
<u>Syringodium filiforme</u>	1.3	1.5	0.1	<0.1
Algae	0.3	0.9	<0.1	0.1
<u>Gracilaria</u> sp.	0	0.3	0	<0.1
<u>Gracilaria foliifera</u>	0	0.2	0	<0.1
<u>Grateloupia folicina</u>	0	0.1	0	<0.1
<u>Sargassum</u> sp.	0	0.4	0	<0.1
<u>Sargassum fluitans</u>	0	0.1	0	<0.1
<u>Sargassum filipendula</u>	0	0.1	0	<0.1
Miscellaneous	0.8	0.9	0.2	<0.1
Sand	0.6	0.9	0.1	<0.1
Wood	0.2	0	0.1	0

Table 6. Food of crevalle jack during spring, summer, and fall in northwest Florida. Percentages for categories above genus include contents not identified to lower taxa.

Food item	Percent frequency of occurrence			Percent volume		
	Spring	Summer	Fall	Spring	Summer	Fall
Vertebrates (fish)	93.4	89.2	98.5	91.4	89.4	99.6
CLUPEIDAE	5.7	21.6	35.4	3.4	49.0	39.2
<u>Brevoortia patronus</u>	0	11.0	16.2	0	17.5	33.5
<u>Brevoortia</u> sp.	0	2.8	3.8	0	1.6	3.3
<u>Dorosoma petenense</u>	0	0	0.1	0	0	<0.1
<u>Harengula jaguana</u>	0	3.2	4.1	0	1.6	1.1
<u>Opisthonema oglinum</u>	0.4	1.4	0	0.1	2.8	0
<u>Sardinella aurita</u>	1.8	11.0	2.6	0.8	24.7	0.8
CARANGIDAE	9.2	5.0	21.3	21.1	9.6	36.1
<u>Caranx crysos</u>	0	0.3	0.1	0	1.1	0.1
<u>Caranx hippos</u>	9.2	0.3	17.6	21.1	1.6	33.9
<u>Chloroscombrus chrysurus</u>	0	3.4	2.3	0	5.4	1.9
<u>Decapterus punctatus</u>	0	0.8	0.7	0	0.6	0.2
<u>Oligoplites saurus</u>	0	0	0.3	0	0	0.1
<u>Seriola</u> sp.	0	0.1	0	0	0.9	0
<u>Trachinotus carolinus</u>	0	0	0.1	0	0	<0.1
SPARIDAE	13.2	6.7	23.2	12.4	13.4	15.1
<u>Lagodon rhomboides</u>	13.2	6.4	23.2	12.4	13.1	15.1
ELOPIDAE	0	0.1	0.1	0	0.1	<0.1
<u>Elops saurus</u>	0	0.1	0.1	0	0.1	<0.1
HAEMULIDAE	0	0	0.6	0	0	0.2
<u>Haemulon plumieri</u>	0	0	0.3	0	0	0.1
<u>Orthopristis chrysoptera</u>	0	0	0.3	0	0	0.1
ARIIDAE	0.9	3.0	4.0	0.6	2.5	2.6

Table 6. Continued

Food item	Percent frequency of occurrence			Percent volume		
	Spring	Summer	Fall	Spring	Summer	Fall
<u>Arius felis</u>	0.9	1.8	3.2	0.6	1.8	2.2
SCIAENIDAE	0	1.4	5.5	0	1.6	2.4
<u>Cynoscion nebulosus</u>	0	0	0.1	0	0	<0.1
<u>Cynoscion sp.</u>	0	0	0.1	0	0	<0.1
<u>Equetus umbrosus</u>	0	0.1	0	0	<0.1	0
<u>Leiostomus xanthurus</u>	0	0.5	4.5	0	0.6	2.0
<u>Menticirrhus sp.</u>	0	0.1	0	0	0.4	0
<u>Micropogonias undulatus</u>	0	0.1	0.1	0	<0.1	<0.1
TRICHIURIDAE	0	0.1	0	0	<0.1	0
TRIGLIDAE	0.4	1.0	0.6	0.4	0.6	0.3
<u>Prionotus rubio</u>	0	0.1	0	0	<0.1	0
BALISTIDAE	0	0	0.4	0	0	0.1
<u>Balistes capriscus</u>	0	0	0.1	0	0	0.1
<u>Monacanthus hispidus</u>	0	0	0.3	0	0	<0.1
STROMATEIDAE	14.9	1.3	0.1	20.1	0.8	0.1
<u>Peprilus burti</u>	14.9	1.2	0.1	20.1	0.6	0.1
<u>Peprilus triacanthus</u>	0	0.1	0	0	0.2	0
SCOMBRIDAE	0	0.1	0.3	0	0.5	0.1
<u>Scomberomorus cavalla</u>	0	0	0.1	0	0	0.1
<u>Euthynnus alletteratus</u>	0	0.1	0	0	0.5	0
SERRANIDAE	0.4	0.4	0.1	2.9	0.1	<0.1
<u>Diplectrum formosum</u>	0.4	0.3	0	2.9	0.1	0
<u>Mycteroperca sp.</u>	0	0	0.1	0	0	<0.1
SYNODONTIDAE	0	0.3	0	0	<0.1	0
<u>Synodus foetens</u>	0	0.1	0	0	<0.1	0

Table 6. Continued

Food item	Percent frequency of occurrence			Percent volume		
	Spring	Summer	Fall	Spring	Summer	Fall
MUGILIDAE	0	4.6	0.1	0	5.4	<0.1
<u>Mugil cephalus</u>	0	1.8	0	0	2.6	0
<u>Mugil sp.</u>	0	2.4	0	0	2.2	0
CYNOGLOSSIDAE	0	0.3	0	0	<0.1	0
ENGRAULIDAE	0.4	3.3	0.1	<0.1	1.2	<0.1
<u>Anchoa hepsetus</u>	0	0.5	0	0	0.3	0
<u>Anchoa mitchilli</u>	0	0.3	0	0	0.1	0
<u>Anchoa nasuta</u>	0	0.1	0	0	0.1	0
<u>Anchoa sp.</u>	0.4	2.4	0.1	<0.1	0.8	<0.1
ATHERINIDAE	0	0.8	0	0	0.1	0
<u>Membras martinica</u>	0	0.4	0	0	<0.1	0
POMATOMIDAE	0	0.3	0.1	0	0.9	0.5
<u>Pomatomus saltatrix</u>	0	0.3	0.1	0	0.9	0.5
POMADASYIDAE	0	0	0.4	0	0	0.1
SPHYRAENIDAE	0	0.1	0	0	1.1	0
<u>Sphyraena guachancho</u>	0	0.1	0	0	1.1	0
NETTASTOMATIDAE	0	0.1	0	0	<0.1	0
LABRIDAE	0	0.3	0	0	<0.1	0
<u>Hemipteronotus novacula</u>	0	0.1	0	0	<0.1	0
BOTHIDAE	1.8	1.3	0	5.8	0.7	0
<u>Etropus crossotus</u>	0	0.1	0	0	<0.1	0
<u>Paralichthys albigutta</u>	0	0.3	0	0	<0.1	0
GERREIDAE	0	0.1	0	0	<0.1	0
<u>Eucinostomus argenteus</u>	0	0.1	0	0	<0.1	0
EXOCOETIDAE	0	0.1	0.1	0	0.1	<0.1

Table 6. Continued

Food item	Percent frequency of occurrence			Percent volume		
	Spring	Summer	Fall	Spring	Summer	Fall
<u>Hemiramphus brasiliensis</u>	0	0	0.1	0	0.1	<0.1
OPHICHTHIDAE	0	0.7	0	0	0.3	0
Digested fish remains	50.9	45.1	34.8	24.7	7.4	2.0
Invertebrates	8.9	19.8	1.8	8.5	9.9	0.1
Shrimp	0	2.8	0.4	0	0.5	0.1
PENAEIDAE	0	0.4	0	0	0.1	0
<u>Penaeus</u> sp.	0	1.3	0	0	0.1	0
<u>Penaeus setiferus</u>	0	0.1	0	0	<0.1	0
<u>Trachypeneus constrictus</u>	0	0.1	0	0	<0.1	0
<u>Sicyonia</u> sp.	0	1.2	0.4	0	0.3	0.1
<u>Sicyonia brevirostris</u>	0	0.3	4	0	0.1	0
Crab	7.0	15.9	0.4	7.7	8.5	<0.1
PORTUNIDAE	3.5	3.9	0.4	2.2	1.3	<0.1
<u>Portunus</u> sp.	3.1	3.9	0	4.9	1.5	0
<u>Portunus megalops</u>	0	0.3	0	0	<0.1	0
<u>Portunus spinimanus</u>	0	1.2	0	0	0.6	0
<u>Portunus gibbesii</u>	0.9	1.8	0	0.6	0.6	0
<u>Portunus sayi</u>	0	0.1	0	0	0.1	0
<u>Ovalipes</u> sp.	0	1.4	0	0	0.8	0
<u>Ovalipes ocellatus</u>	0	5.8	0	0	3.5	0
ALBUNEIDAE (<u>Albunea</u> sp.)	0	0.1	0	0	<0.1	0
Stomatopoda	0.4	2.4	0.4	0.6	0.5	<0.1
SQUILLIDAE	0	0	0.1	0	0	<0.1
<u>Squilla empusa</u>	0.4	1.4	0.1	0.6	0.4	<0.1
MOLLUSKS	0.4	2.5	0.6	0.1	0.3	<0.1

Table 6. Continued

Food item	Percent frequency of occurrence			Percent volume		
	Spring	Summer	Fall	Spring	Summer	Fall
Cephalopoda	0	2.0	0.3	0	0.3	<0.1
<u>Loligo pealeii</u>	0	0.4	0.3	0	<0.1	<0.1
Pelecypoda	0	0.5	0.3	0	<0.1	<0.1
<u>Barbartia</u> sp.	0	0.1	0	0	<0.1	0
<u>Barbartia tenera</u>	0	0	0.1	0	0	<0.1
<u>Chione cancellata</u>	0	0.1	0.1	0	<0.1	<0.1
Unidentified arciids	0	0.3	0	0	<0.1	0
Gastropoda	0.4	0	0	0.1	0	0
<u>Pisania tincta</u>	0.4	0	0	0.1	0	0
Echinodermata (<u>Mellita quinquiesperforata</u>)	0.4	0.3	0	<0.1	<0.1	0
Urochordata	0	0.3	0	0	0.1	0
Vegetation	3.1	8.0	6.6	0.2	0.5	0.2
Seagrass	2.6	7.9	5.6	0.2	0.5	0.1
<u>Thalassia testudinum</u>	2.6	7.0	4.5	0.2	0.4	0.1
<u>Halodule wrightii</u>	0	1.6	0.1	0	<0.1	<0.1
<u>Syringodium filiforme</u>	0	2.1	1.2	0	<0.1	<0.1
Algae	0.4	0.4	1.6	<0.1	<0.1	<0.1
<u>Gracilaria</u> sp.	0	0	0.4	0	0	<0.1
<u>Gracilaria foliifera</u>	0	0	0.3	0	0	0.1
<u>Grateloupia folicina</u>	0	0	0.1	0	0	<0.1
<u>Sargassum</u> sp.	0.4	0.3	0.3	<0.1	<0.1	<0.1
<u>Sargassum fluitans</u>	0	0	0.1	0	0	<0.1
<u>Sargassum filipendula</u>	0	0	0.1	0	0	<0.1
Miscellaneous	0	1.4	0.6	0	0.2	0.1
Sand	0	1.4	0.4	0	0.2	<0.1
Wood	0	0	0.1	0	0	0.1

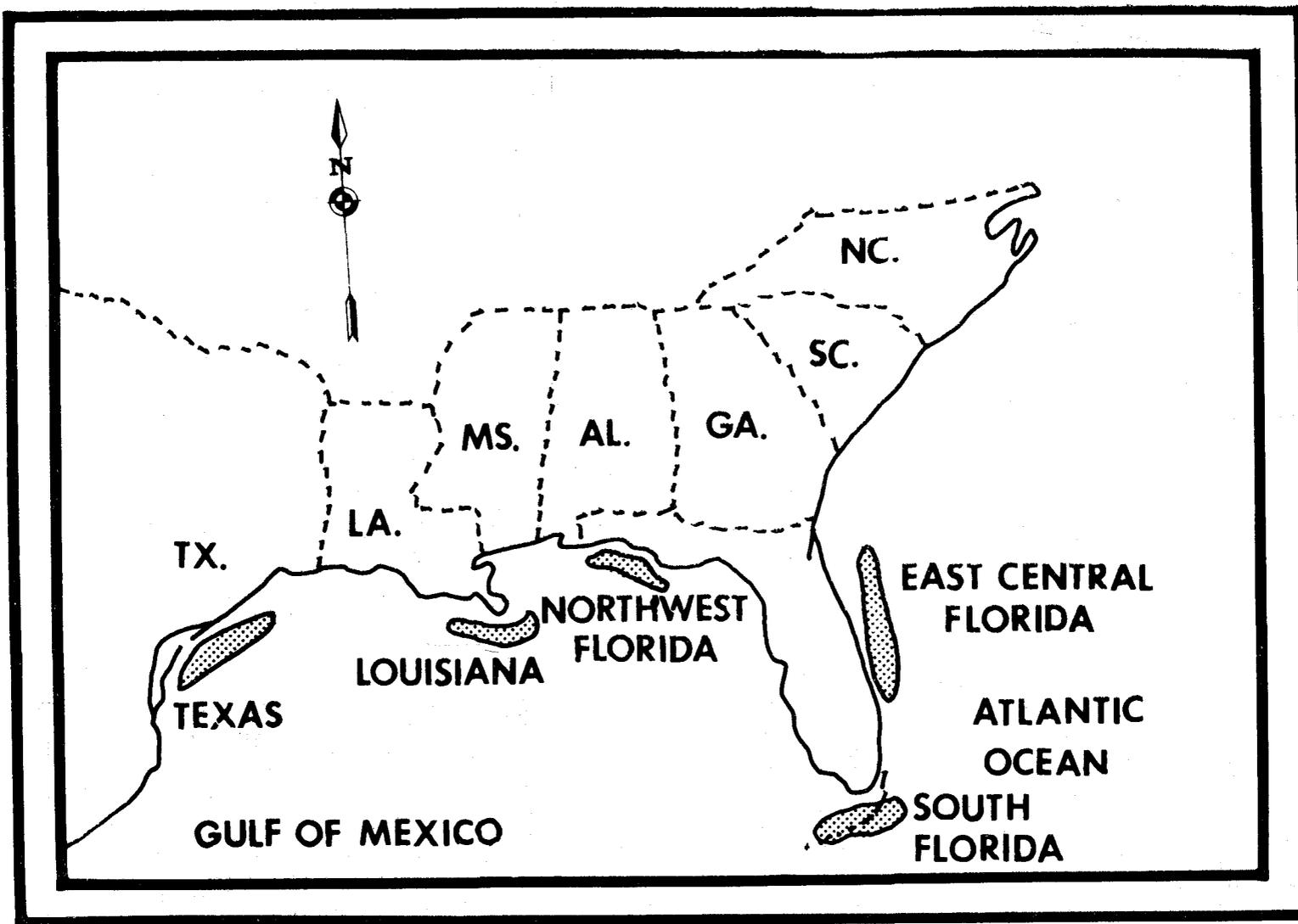


Figure 1. Sampling areas for crevalle jack food study.