STOMACH CONTENTS OF JUVENILES OF KING MACKEREL (*Scomberomorus cavalla*) AND SPANISH MACKEREL (*S. maculatus*)[1]

Several authors have noted that the diets of scombrids change with size within a species (Magnuson and Heitz, 1971; Dragovich and Potthoff, 1972). These studies have dealt with the relative proportions of crustaceans and other invertebrates to fish in scombrid diets. Changes in the fish component have been linked to seasonal abundance and availability of prey items (DeVane, 1978), size of prey items versus degree of satiation in the predator (Nakamura, 1962), and size of gill raker gap and maximum distensibility of mouth and esophagus in the predator versus size of prey (Magnuson and Heitz, 1971).

We had the opportunity to examine some trawl-caught king and Spanish mackerel that ranged from 100 to 400 mm fork length. These small mackerel are not commonly collected in the hook-and-line and gill-net fisheries for king and Spanish mackerel. We therefore were eager to see if the stomach contents of these fish were notably different from larger (over 400 mm fork length) specimens that we have examined and from those reported by other authors (Earll, 1883; Goode, 1887; Carson, 1944; Knapp, 1949; Miles and Simmons, 1951; Klima, 1959; Menezes, 1969; Beardsley and Richards, 1970; Menezes, 1970; Beaumariage, 1973; DeVane, 1978).

Both king and Spanish mackerel were obtained in shrimp trawls, 139 king mackerel (103 to 309 mm fork length) from Port Canaveral Navigation Channel, Cape Canaveral, Florida, from October 1978 through October 1979 and 344 Spanish mackerel (117 to 432 mm fork length) from Cape Canaveral and Galveston Bay, Texas, from August 1978 through June 1979. Beaumariage (1973) described the average size at maturity for king mackerel as 819 mm for females and 718 mm for males. Klima (1959) stated that Spanish mackerel reached sexual maturity at 250 mm for females and 280 mm for males. Thus, the majority of the fish reported on in this study were Juvenile or early adult. Methods and the use of the Index of Relative Importance were the same as those of Pinkas, Oliphant, and Iverson (1971).

About equal numbers of king mackerel (139; 39% empty) and Spanish mackerel (130; 45% empty) were obtained from Cape Canaveral. From Galveston, 214 (41% empty) Spanish mackerel stomachs were obtained.

The diets of Spanish mackerel were different between areas (Fig. 1, Table 1). Spanish mackerel collected in Galveston waters had lower percentages of unidentified fish and clupeids and more engraulids. Squid was more abundant in Spanish mackerel stomachs collected from Cape Canaveral. Fishes occurred in 95% of the Spanish mackerel stomachs that contained food and represented 97% of the total volume of the stomach contents. Relative frequencies of occurrence and percent volumes, respectively, by taxon were: Engraulidae (*Anchoa* sp.), 32 and 47; Clupeidae, 3 and 16; Sciaenidae, 2 and 2; unidentified fish, 59 and 33. Invertebrates (squid) had a frequency of occurrence of 6% with a 2% volume (Fig. 1).

The stomach contents of king mackerel from Cape Canaveral consisted primarily of fish (Fig. 2, Table 2). Fish occurred in 74% of the stomachs containing food and represented 91% of the total volume of the stomach contents. Relative

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Table 1. Stomach contents of Spanish mackerel collected off Cape Canaveral, Florida (72 stomachs) and off Galveston, Texas (126 stomachs).

Food Item	Frequency of Occurrence	Number	Volume
	%	%	%
CAPE CANAVERAL			
Vertebrates	86.1	86.7	93.5
Fish	86.1	86.7	93.5
Clupeidae	4.2	5.3	22.6
Engraulidae	19.4	21.3	33.2
Anchoa sp.	19.4	21.3	33.2
Sciaenidae	1.4	1.3	0.3
Unid. fish	61.1	58.7	37.4
Invertebrates (squid)	13.9	13.3	6.5
GALVESTON			
Vertebrates	100	99.4	99.8
Fish	100	99.4	99.8
Clupeidae	2.4	1.9	11.9
Brevoortia patronus	0.8	0.6	5.1
Engraulidae	38.9	49.7	53.5
Anchoa sp.	38.9	49.7	53.5
Sciaenidae	1.6	1.3	3.2
Cynoscion sp.	0.8	0.6	2.4
Unid. fish	57.1	46.5	31.2
Invertebrates (squid)	0.8	0.6	0.2

frequencies of occurrence and percent volumes by taxon were: Clupeidae (*Brevoortia* sp. and *Opisthonema oglinum*), 16 and 46; Engraulidae (*Anchoa* sp.), 30 and 30; all other fish, 28 and 15. Invertebrates (squid) had 24% frequency of occurrence and a 9% volume.

The data presented here indicate that king and Spanish mackerels are carnivorous, primarily piscivorous, as juveniles. Engraulidae (*Anchoa* sp.) and Clupeidae (*Brevoortia* sp.; *Opisthonema oglinum*) are the dominant fish families in the diet

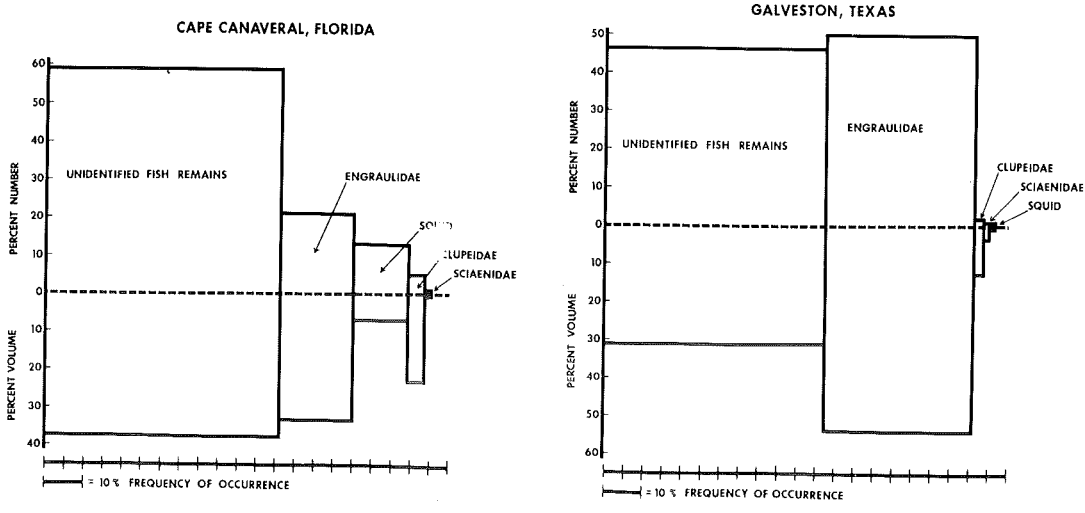

Figure 1. Relative importance of major food items of Spanish mackerel collected off Cape Canaveral, Florida, and Galveston, Texas.

Table 2. Stomach contents of king mackerel collected off Cape Canaveral, Florida (85 stomachs).

Food Item	Frequency of Occurrence	Number	Volume
	%	%	%
Vertebrates	73.6	71.1	90.8
Fish	73.6	71.1	90.8
Clupeidae	16	15.5	45.8
Opisthonema oglinum	0.9	1.0	1.0
Engraulidae	30.2	27.8	29.8
Anchoa sp.	26.4	26.8	29.0
Carangidae	0.9	1.0	3.4
Chloroscombrus chrysurus	0.9	1.0	3.4
Sciaenidae	1.9	2.1	3.2
Mugilidae	2.8	3.1	1.3
Eleotridae	0.9	1.0	1.3
Dormitator maculatus	0.9	1.0	1.3
Unid. fish	20.8	22	5.9
Invertebrates	26.4	28.9	9.2
Isopods	2.8	3.1	0.1
Squid	23.6	25.8	9.4

of small trawl-caught mackerels from Cape Canaveral and Galveston. Invertebrates are of minor importance in the juvenile mackerel diet.

Other investigators (Knapp, 1949; Randall, 1967; Menezes, 1969; DeVane, 1978; Saloman and Naughton, unpublished ms.) have described the major components of the king mackerel and Spanish mackerel diets to be clupeids (*Opisthonema oglinum; Harengula jaguana; Sardinella aurita*). The fact that we found engraulids to be more important in the diet of juvenile mackerels leads us to believe that this may represent a juvenile feeding strategy. The smaller size and diameter of engraulids (*Anchoa* sp.) would be more readily ingested by juvenile predators with smaller mouth parts.

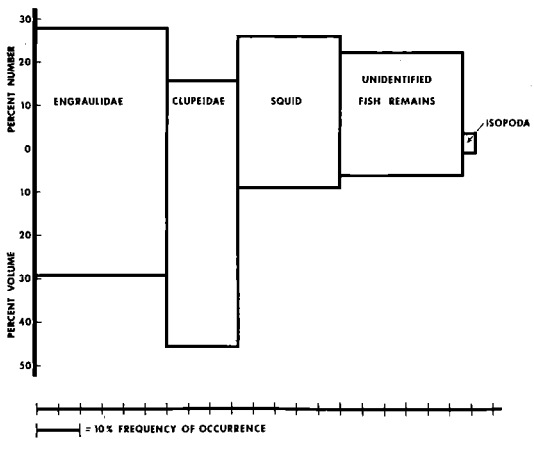

Figure 2. Relative importance of major food items of king mackerel collected off Cape Canaveral, Florida.

ACKNOWLEDGMENTS

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