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FOOD HABITS OF STRIPED MARLIN AND SAILFISH OFF MEXICO AND SOUTHERN CALIFORNIA

By Douglas H. Evans and Paul G. Wares

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CONTENTS

ABSTRACT

Stomach contents of 924 striped marlin (*Tetrapturus audax*) landed in the sport catches at Mazatlán, Sinaloa, and Buena Vista, Baja California Sur, Mexico, and San Diego, Calif., and of 197 sailfish (*Istiophorus platypterus*) from Mazatlán and Buena Vista were examined. The striped marlin and sailfish fed primarily on pelagic fishes and cephalopods. By volume the major foods were squid (principally *Dosidicus gigas*) for striped marlin at Mazatlán and for striped marlin and sailfish at Buena Vista, northern anchovy (*Engraulis mordax*) for striped marlin at San Diego, and threadfin (*Polydactylus* sp.) for sailfish at Mazatlán. Locality differences in food habits were pronounced, and some seasonal and yearly differences were found.

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In 1967 the Tiburon Fisheries Laboratory initiated a study of the life histories of marlins and sailfish in the eastern Pacific Ocean. One phase of the program was the analysis of the stomach contents of specimens landed in the sport catch in three popular fishing areas. Sailfish (*Istiophorus platypterus*) were examined from two localities in Mexico: Mazatlán, Sinaloa (Lat. 23°12′N, Long. 106°28′W), and Buena Vista, Baja California Sur (Lat. 23°39′N, Long. 109°41′W), both near the mouth of the Gulf of California. Striped marlin (*Tetrapturus audax*) were sampled from these two localities and from San Diego, Calif., (Lat 32°40′N, Long. 117°14′W). Some blue marlin (*Makaira nigricans*) and fewer black marlin (M. *indica*) are taken in the sport catch at Mazatlán and Buena Vista but neither species is taken off California. Food of these species was not studied. Nearly all of the angling for billfish in the two Mexican locations is done by United States citizens.

The striped marlin fishing off San Diego occurs from July through November, the bulk of the catch generally being made from late August through early October. Fishing seasons at the Mexican localities are not well defined, and some billfish are taken year-round. The fishing off Mazatlán is best for striped marlin from December through May and for sailfish from April through September. At Buena Vista the striped marlin fishing is most productive from March through July. Fishing for sailfish is best there from June through November but never atains the success of striped marlin fishing. The differences in temporal distribution of the two species between the Mexican study areas, 180 miles apart on opposite sides of the Gulf, may be partly related to temperature patterns as the sea surface is as much as 4°C warmer (LaViolette and Seim, 1969) on the Mazatlán side from May through August. The area near the entrance to the Gulf is a complex zone where water from the Gulf interacts with the California Current and subtropical water (Griffiths, 1968). The general direction of circulation in the Gulf is counterclockwise.

In using the name *I. platypterus* for the sailfish we have followed the recent revision by Morrow and Harbo (1969),

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NOTE.—The Tiburon Fisheries Laboratory was transferred in October 1970 from the Bureau of Sport Fisheries and Wildlife, U.S. Fish and Wildlife Service, Department of the Interior, to the National Marine Fisheries Service, National Oceanic and Atmospheric Administration, Department of Commerce.

who regard the genus *Istiophorus* as monotypic with a worldwide distribution in warm and temperate seas. The striped marlin occurs only in the Pacific and Indian Oceans.

We give special thanks to persons who permitted us to examine specimens for our studies: Col. Eugene Walters, proprietor of Rancho Buena Vista; Mr. Bill Heimpel, proprietor of the Star Fleet at Mazatlán; and Mrs. Lois Ibey, Secretary of the San Diego Marlin Club. Their cooperation and that of the individual anglers made possible this study as well as continuing phases of our program. Larry Coe, Howard Ness, and Dan Eilers assisted in the collection of data. Drs. Richard Rosenblatt, W. I. Follett, William N. Eschmeyer, and Edmund S. Hobson, and Pearl M. Sonoda assisted with the identification of fishes. Dustin D. Chivers, John H. Wormuth, and Dr. John A. McGowan assisted with the identification of invertebrates. We also wish to thank William N. Eschmeyer and Lillian Dempster for critically reviewing the manuscript.

METHODS

Most of the fish examined were caught within 25 miles of San Diego or within 10 to 20 miles of the Mexican ports at which they were landed. Stomach samples were obtained usually within 4 to 6 hours after capture. Stomachs from a total of 924 striped marlin and 197 sailfish were examined. Stomachs that were everted or that contained only fluid were regarded as empty. The number of empty stomachs was not recorded in the 1967 data from Mexico. Dates of sampling and numbers of striped marlin stomachs examined at each location were as follows: Mazatlán—4/10-5/6/67, 57 stomachs; 4/11-5/23/68, 105 stomachs (82 or 78% with food); 12/4-12/11/68, 4 stomachs (all with food); Buena Vista—5/18-6/5/67, 29 stomachs; 4/18-7/16/68, 392 stomachs (274 or 70% with food); San Diego —8/16-9/24/67, 177 stomachs (116 or 66% (132 or 83% with food). Sailfish stomachs were examined as follows: Mazatlán with food); 8/30-10/25/68, 160 stomachs —4/16-5/7/67, 41 stomachs; 4/13-6/9/68, 130 stomachs (105 or 81% with food); 12/4-12/11/68, 5 stomachs (all with food); Buena Vista—4/27-7/16/68, 21 stomachs (14 or 67% with food). In addition, during 1969, 600 striped marlin and 50 sailfish stomachs were examined in Mexico for the occurrence of prey species not found the previous 2 years. Average weights of the striped marlin examined from Mexican localities were 103 pounds in 1967 and 107 pounds in 1968. San Diego marlin averaged 119 pounds in 1967 and 134 pounds in 1968. Sailfish averaged 76 pounds in 1967 and 79 pounds in 1968.

Food items were preserved in formalin and later sorted, identified to the lowest taxon possible, and counted. The volume in fluid ounces of each taxonomic group was measured by water displacement, except for the 1967 samples from San Diego, for which only the total volume of the contents of each stomach was measured. Baits (principally flying fish, mullets, sardines, and mackerels) were identifiable by the mark of the hook or by the presence of thread used to harness the bait and were not included in the analysis. We have no estimate of the extent to which partial or complete regurgitation of stomach contents may have occurred.

RESULTS

Food for striped marlin and sailfish consisted of invertebrates and fishes (table 1). The invertebrates most frequently eaten were various squids and the paper nautilus (*Argonauta* sp.); others occurred occasionally in trace amounts. The digested condition of most

of the squid precluded identification, but, several intact specimens were retained for study. Of these, *Loligo opalescens* was identified from the stomachs of San Diego striped marlin. *Dosidicus gigas* was common in the material from the two areas in Mexico. One specimen each of *Symplectoteuthis luminosa* (from a striped marlin) and *Thelidoteuthis alessandrini* (from a sailfish) was identified from the Buena Vista material. At least 38 species of fishes representing 23 families occurred in stomochs of striped marlin from the three study areas. Sailfish stomachs contained at least 24 species of fishes (15 families). All of the fishes were teleosts, with the exception of two occurrences of small thresher sharks (*Alopias vulpinus*) in San Diego striped marlin.

Many of the stomachs had ulcers. These were in varying stages from perforated ulcers to ones healed over with mounds of scare tissue. We have not made a histological analysis of them, but on several occasions anglers at the scene who were medical doctors remarked that they appeared similiar to human gastric ulcers. Of 563 striped marlin stomachs checked in 1968, 14% had ulcers; of 151 sailfish stomachs 22% had ulcers. We suspect that injuries from the spines of prey species are a factor in the ulceration of the stomach. The dorsal spines of triggerfishes especially might cause such injuries. The istiophorid stomach is a blind pouch with an opening only at the anterior end, and many of the ulcers were located at the distal end of the stomach, where squid beaks and bony debris tend to accumulate. Iversen and Kelly (in press) have found ulcers in blue and black marlin from Hawaiian waters. They reported a lower occurrence rate (8%) for blue marlin than we found for striped marlin or sailfish and reported the presence of nematodes in several of the ulcers.

The data were examined for differences in food habits between the species, between sexes, between localities, and with time. Pronounced differences were found between the species and locations and with time. The data are therefore reported separately for the two species, and locality, seasonal, and yearly differences are discussed for each. Variations due to size and sex differences were minor, so the data for all sizes and both sexes were combined. A preliminary inspection of the data suggested a periodicity in total food volumes and average volumes of squid per stomach. However, we looked for possible correlations between these two variables and the lunar cycle but found no consistent correlation in either.

STRIPED MARLIN

Locality differences

At San Diego the bulk of the diet was composed of three species of fish which do not range into the Mexican study areas. These species are the northern anchovy (*Engraulis mordax*), the Jack mackerel (*Trachurus symmetricus*), and the Pacific saury (*Cololabis saira*), which respectively occurred in 90%, 31%, and 15% of the stomachs with food. Squid were found in 54% and 69% of the stomachs at Mazatlán and Buena Vista, respectively, but in only 4% at San Diego. The round herring (*Etrumeus teres*) occurred in 27% of the Buena Vista stomachs but in none of the stomachs at Mazatlán or San Diego, although both these regions are within its range. The paper nautilus, triggerfish (*Balistes* sp.), and threadfin (*Polydactylus* sp.) were found at Mazatlán (17%, 8%, and 6%, respectively) but not at Buena Vista or San Diego. The chub mackerel (*Scomber japonicus*) and the Mexican scad (*Decapterus hypodus*) were more common in striped marlin from Buena Vista than from Mazatlán, whereas cornetfish (*Fistularia* sp.) and several other species occurred more frequently in the Mazatlán samples (table 1).

TABLE 1.—*Percent occurrence of prey species in stomachs of striped marlin and sailfish sampled at San Diego, Mazatlán, and Buena Vista in 1967 and 1968*

[Data are based on the number of stomachs which contained food; X denotes species noted during qualitative observations in 1969 at the Mexican localities; T denotes trace occurrence]

	Striped marlin			Sailfish	
	Mazatlán	Buena Vista	San Diego	Mazatlán	Buena Vista
Number of stomachs	143	303	248	151	14
Invertebrates:					
Crustacea:					
Pasiphaea affinis	---	T	---	---	--
Unidentified shrimp	1	---	---	1	--
Unidentified galatheid	---	T	---	---	--
Portunus xantusii	---	---	---	2	--
Cephalopoda:					
Japetella sp.	---	X	---	---	--
Argonauta sp.	17	X	T	26	7
Squid	54	69	4	38	50
Fishes:					
Lamnidae:					
Alopias vulpinus	---	---	1	---	--
Clupeidae:					
Etrumeus teres	---	27	---	---	14
Sardinops sagax	---	---	2	---	--
Engraulidae:					
Engraulis mordax	---	---	90	---	--
Synodontidae:					
Synodus scituliceps	X	---	---	2	--
Myctophidae:					
Unidentified	---	T	---	---	--
Gonostomatidae:					
Vinciguerria lucetia	---	---	---	---	7
Congridae:					
Ariosoma balearica	---	---	---	---	X
Scomberesocidae:					
Cololabis saira	---	---	15	---	--
Belonidae:					
Unidentified [1]	4	---	---	---	--
Exocoetidae:					
Unidentified	1	1	2	---	--
Fistulariidae:					
Fistularia sp.[2]	31	11	---	40	14
Serranidae:					
Diplectrum pacificum	---	---	---	1	--
Lobotidae:					
Lobotes pacificus	2	---	---	---	--
Lutjanidae:					
Lutjanus peru	---	X	---	---	--
Carangidae:					
Caranx caballus	---	2	---	---	--
C. hippos	---	---	---	1	--
Chloroscombrus orqueta	---	---	---	1	--
Decapterus hypodus	1	6	---	1	--
Hemicaranx sp.	1	---	---	6	--
Naucrates ductor	4	1	---	5	14
Oligoplites refulgens	X	---	---	---	--
Selar crumenopthalmus	2	---	---	1	--
Trachurus symmetricus	---	---	31	---	--
Vomer declivifrons	2	---	---	4	--
Unidentified	---	---	---	8	--
Pomadasyidae:					
Lythrulon flaviguttatum	---	T	---	---	--
Scorpidae:					
Medialuna californiensis	---	---	2	---	--
Chaetodontidae:					
Chaetodon humeralis	4	X	---	6	--
Trichiuridae:					
Trichiurus nitens	---	T	---	---	--
Scombridae:					
Auxis thazard	3	3	---	2	--
Scomber japonicus	2	7	---	15	--
Thunnus sp.	2	---	---	---	--
Sarda chiliensis	---	---	1	---	--
Scomberomorus sp.	X	---	---	---	7
Unidentified	---	1	---	---	
Scorpaenidae:					
Scorpaena sonorae	---	---	---	1	--
Stromateidae:					
Cubiceps sp.	---	X	---	---	X
Palometa sp.	---	---	---	1	--
Mugilidae:					
Mugil cephalus	---	---	T	---	--
Unidentified [3]	5	---	---	5	--
Polynemidae:					
Polydactylus sp.[4]	6	---	---	34	--

Balistidae:					
Balistes sp.[5]	8	X	---	5	X
Alutera scripta	4	---	---	---	--
Ostraciidae:					
Lactoria diaphana	1	---	---	---	--
Tetraodontidae:					
Sphoeroides sp.[6]	6	X	---	15	--
Lagocephalus lagocephalus	---	X	---	---	X
Unidentified fish remains	27	22	6	52	14

[1] Some probably *Strongylura* sp.
[2] Several identified as *F. corneta.*
[3] Some identified as *Mugil curema.*
[4] Many were identified as *P. opercularis.*
[5] Some identified as *B. polylepis.*
[6] Some identified as *S. lobatus.*

By volume (table 2), squid ranked first for Mazatlán and Buena Vista samples (63% and 49%, respectively). Round herring ranked second (30%) for the Buena Vista samples, but at Mazatlán no single group was of major secondary importance. Anchovies were most important (60%) and Jack mackerel ranked second (27%) at San Diego.

By number of individual food items (Table 3), the paper nautilus ranked first (36%) for the Mazatlán fish, though it composed only 7% by volume. Otherwise, the ranking of food categories is quite similar to that made on the basis of volume.

The diversity of fishes utilized as food by striped marlin was greatest at Mazatlán, with a total of 22 species found in the diet. Buena Vista striped marlin fed on 17 species, and San Diego marlin utilized only 9 species.

TABLE 2.—*Percent of volume for major food categories (those 5% or more) for marlin and sailfish in each area*

[Data for 1967 and 1968 combined except the San Diego figures are based on 1968 data only]

	Striped marlin			Sailfish	
	Mazatlán	Buena Vista	San Diego	Mazatlán	Buena Vista
Argonauta sp.	7	---	---	10	--
Squid	63	49	---	21	35
Etrumeus teres	---	30	---	---	29
Engraulis mordax	---	---	60	---	--
Cololabis saira	---	---	5	---	--
Fistularia sp.	5	---	---	8	22
Naucrates ductor	---	---	---	---	7
Trachurus symmetricus	---	---	27	---	--
Scomber japonicus	---	7	---	5	--
Mugil sp.	---	---	---	5	--
Polydactylus sp.	---	---	---	27	--
Balistes sp.	7	---	---	---	--
Unidentified fish remains	---	---	---	14	--

TABLE 3.— *Percent of number of individuals for major food categories (those 5% or more) for marlin and sailfish in each area, 1967 and 1968 combined*

	Striped marlin			Sailfish	
	Mazatlán	Buena Vista	San Diego	Mazatlán	Buena Vista
Argonauta sp.	36	---	---	25	--
Squid	34	57	---	9	47
Etrumeus teres	---	19	---	---	11
Engraulis mordax	---	---	92	---	--
Vinciguerria lucetia	---	---	---	---	16
Fistularia sp.	13	6	---	8	18
Scomber japonicus	---	12	---	---	--
Polydactylus sp.	5	---	---	42	--

Seasonal differences

Since information on the fluctuations in abundance of prey species in the environment is not available, we simply report fluctuations in the stomach contents. The 1967 data were insufficient to reveal seasonal trends, so only the 1968 food volume data are presented. At Buena Vista (fig. 1) during the first three days of sampling (April 18-20) squid were by far the major item in the stomach contents. A few days later the average volume of squid per stomach declined while the volume of round herring increased. During the first two-thirds of May, squid increased while the volume of round herring decreased. Round herring increased again in the diet in early June, after which both round herring and squid declined. Other species were less prevalent in the diet. The volume of chub mackerel increased substantially in late May. Frigate mackerel (*Auxis thazard*) and green jack (*Caranx caballus*) increased in late June at a time when squid and round herring volumes were low, so that frigate mackerel, squid, and green jack were of similar importance. Mexican scad first appeared in striped marlin stomachs at Buena Vista in early June and by mid-July were more important than squid, although all volumes were very low at this time. The stomach samples obtained in November 1969 from Buena Vista revealed two species previously found only in the Mazatlán material—triggerfish and a butterflyfish (*Chaetodon humeralis*).

At Mazatlán the average volume of squid in striped marlin stomachs sampled increased threefold from mid-April to late April and early May, after which it decreased sharply (fig. 2). Other foods were of minor importance, and none showed a compensatory increase when the volume of squid declined. The Mexican scad occurred in stomachs sampled in December 1968, whereas previously it was found only in Buena Vista striped marlin.

At San Diego anchovies in the diet increased from an average of 8.7 oz per stomach in early September to 9.9 oz in mid-September and then declined steadily (fig. 3). The volume of jack mackerel, the second most important food species, was

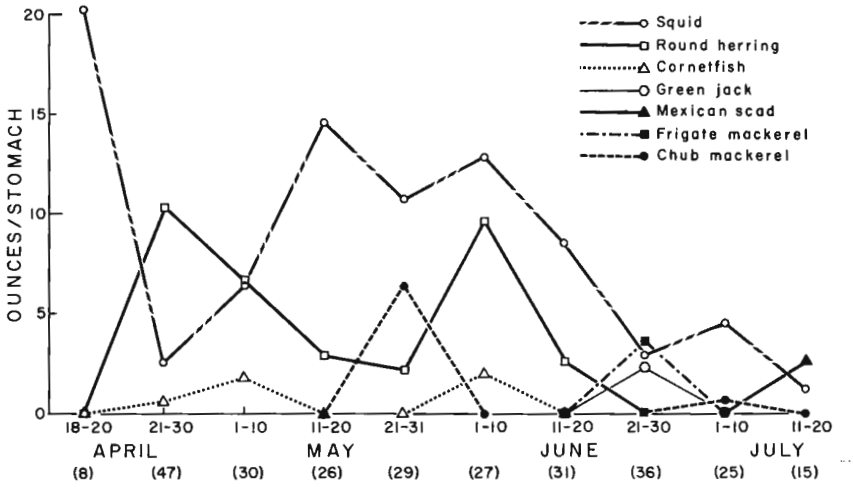

FIGURE 1.—Temporal variations in average volume of the major prey species in striped marlin stomachs sampled in 1968 at Buena Vista. Data are expressed as fluid ounces per stomach containing food for each species which comprised at least 10% of the volume during one or more 10-day sample periods. Amounts less than 0.5 oz are not shown. Sample sizes are given in parentheses below dates.

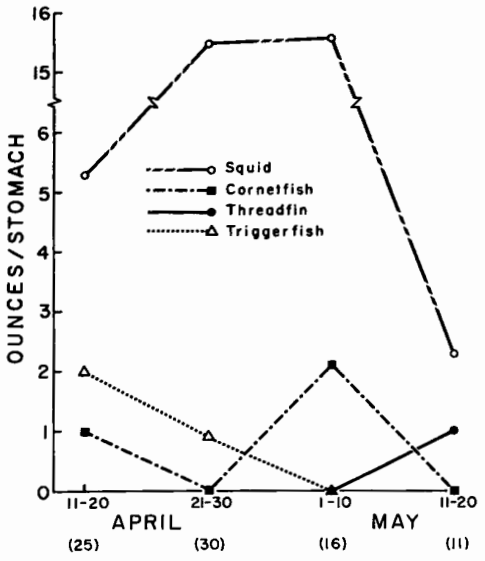

FIGURE 2.—Temporal variations in average volume of the major prey species in striped marlin stomachs sampled in 1968 at Mazatlán. Data are expressed as fluid ounces per stomach containing food for each species which comprised at least 10% of the volume during one or more 10-day sample periods. Amounts less than 0.5 oz are not shown. Sample sizes are given in parentheses below dates.

lowest in late September and greatest in mid-October, when it exceeded anchovies in volume per stomach. Sauries were a minor component in the diet, but in mid-October the volume increased to 3.4 oz per stomach.

Yearly differences

There were some striking differences between the 1967 and 1968 data for Mazatlán marlin (not shown separately in tables 1-3). In 1967 the paper nautilus was the major food item (40% by volume), and squid and mullets each constituted 21% by volume. In 1968 the paper nautilus constituted only 0.1%, while squid constituted 75% and mullets were absent. At Buena Vista and San Diego yearly differences were less pronounced. In 1967 the major food items at Buena Vista were round herring, 41% by volume; squid 36%; and chub mackerel 16%. For the same dates in 1968 squid constituted 55%, round herring 18%, and chub mackerel 20%. Anchovies constituted 94% by number of the diet of San Diego marlin in 1967 and 91% in 1968.

The overall average volume of food per stomach containing some food was similar at Mazatlán, Buena Vista, and San Diego during 1968 (14.3 to 14.9 oz per stomach). In 1967, at San Diego the average volume was much higher (22.9 oz. per stomach). Bias in technique was a factor in this difference: only total volumes were measured in 1967, and they included stomach juices and unidentified debris which were excluded in 1968, when volume of each prey species was measured individually.

SAILFISH

Locality differences

The data from the two localities are scarcely comparable, since only 11 stom-

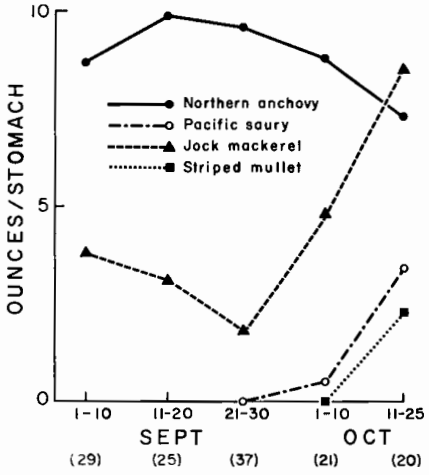

FIGURE 3.—Temporal variations in average volume of the major prey species in striped marlin stomachs sampled in 1968 at San Diego. Data are expressed as fluid ounces per stomach containing food for each species which composed at least 10% of the volume during one or more 10-day sample periods. Amounts less than 0.5 oz are not shown. Sample sizes are given in parentheses below dates.

achs with food were found at Buena Vista during the time the sailfish were being caught at Mazatlán. The major foods by volume, however, were threadfin 27%, squid 21%, and paper nautilus 10% at Mazatlán, and squid 35%, round herring 29%, and cornetfish 22% at Buena Vista.

Seasonal and yearly differences

In the 1968 studies at Mazatlán (fig. 4), cornetfish predominated in average volume per stomach during mid-April, squid in late April and early May, and threadfins through the rest of May. In early June the paper nautilus composed the major portion of the stomach content volume. Data from 1967 and from Buena Vista in 1968 were insufficient to reveal seasonal trends in utilization of prey species.

For the same calendar dates at Mazatlán, 44% of the diet by volume in 1967 consisted of squid, which constituted 59% in 1968. Threadfins constituted 17% in 1967, but only 0.6% in 1968, and triggerfish constituted 6% in 1967, but were not found during the same period in 1968.

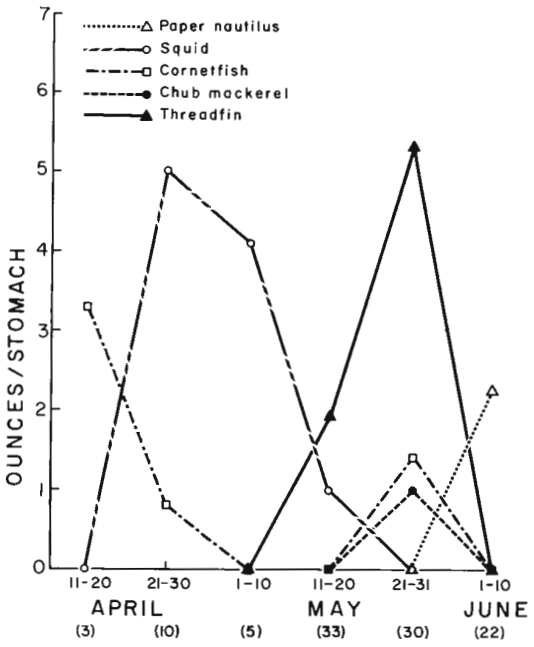

FIGURE 4.—Temporal variations in average volume of the major prey species in sailfish stomachs sampled in 1968 at Mazatlán. Data are expressed as fluid ounces per stomach containing food for each species which composed at least 10% of the volume during one or more 10-day sample periods. Amounts less than 0.5 oz are not shown. Sample sizes are given in parentheses below dates.

Comparison with striped marlin diet

During the period from mid-April to mid-May when both striped marlin and sailfish were being landed at Mazatlán, there was much similarity in the diets of the two species (figs. 2 and 4). In the diets of both species, squid volume went through a cycle of increase and decline, but squid dominated the diets from late April to early May. In mid-May threadfin became important in the diets of both species, though it was the dominant food group only for the sailfish. Cornetfish formed the second most important group in both diets but constituted only 5% of the striped marlin diet and 10% of the sailfish diet. Both striped marlin and sailfish utilized squid and paper nautilus plus 11 species of fishes during this time, but only five of the 11 species occurred in both diets. Triggerfish constituted 7% of the marlin diet but were not utilized at all by sailfish during the same period.

The overall average total volume of food per stomach for sailfish at Mazatlán was 6.9 oz, approximately half that found for striped marlin.

DISCUSSION

Because of the scarcity of information on relative abundance of prey species, it is difficult to assess whether the billfish studied have preference for certain foods. Some information is available for the San Diego area from the California Cooperative Fisheries Investigations (CalCOFI) pelagic fish survey cruises and Bureau of Commercial Fisheries egg and larva surveys, but comparable data are lacking for the Mexican study areas. We are thus limited to consideration of striped marlin

at San Diego. Generally the CalCOFI studies have shown that the anchovy population increased ninefold between 1951 and 1968 (Ahlstrom, 1968) and that the saury population has remained relatively constant during the last 20 years (Smith, Ahlstrom, and Casey, in press). Hubbs and Wisner (1953) found that the major foods of 32 striped marlin taken in the sport fishery at San Diego in 1951 were Pacific sauries 72% by volume, northern anchovies 12%, Pacific sardines (*Sardinops sagax*) 9%, and jack mackerel 3%. They found that anchovies predominated in the diet in 1952 (Wisner, personal communication). It may therefore be that the importance of anchovies as a striped marlin food off southern California existed prior to the apparent increase in anchovy abundance.

The dominance of fish and virtual absence of squid from the diet of striped marlin at San Diego is in sharp contrast to the composition of the diet at the Mexican areas where squid were dominant. The CalCOFI data include observations of squid but do not give an adequate indication of their abundance relative to the abundance of pelagic fishes. These reports do indicate that squid (primarily *Loligo opalescens*) occur concurrently with marlin off San Diego (California Marine Research Committee, 1966a, 1966b, 1969, and unpublished data).

The diet of striped marlin in other areas of the Pacific also varies with locality and time, generally with either squids, sauries, anchovies, scombrids, or carangids as the major food in a given study. Off New Zealand, Morrow (1952) reported saury (*Scomberesox saurus*) as the major food species, whereas Baker (1966) found squids and carangids to be the major foods. LaMonte (1955) reported only squid in the stomachs of striped marlin off Peru and Chile, but de Sylva (1962) noted anchovy (*Engraulis ringens*), squid, jack mackerel (*Trachurus symmetricus murphyi*), and saury (*Scomberesox equirostrum*) in the stomachs of three striped marlin taken off Chile. Royce (1957) found "tunalike fishes, some identifiable as *Auxis*, and miscellaneous remains of other fish, shrimp, and squid" in stomachs of striped marlin from equatorial waters of the central Pacific.

Other authors report food habits of sailfish from other areas to be similar to our findings off Mexico. In nine sailfish stomachs from the central Pacific, Royce (1957) noted that squid was the predominant food, with octopus, nautilus, *Alepisaurus*, one bramid, and one pilot fish also occurring. Voss (1953) reported fishes (principally scombrids, carangids, hemirhamphids, and belonids) to be the most important foods (83% by number) of 241 sailfish off Florida, with cephalopods, the majority of which were paper nautilus, composing the remainder of the diet.

Most of the prey species identified in our study are epipelagic, but several are typically inshore species such as the butterflyfish, the sea bass (*Diplectrum pacificum*), the tripletail (*Lobotes pacificus*), the scorpionfish (*Scorpaena sonorae*), the triggerfish, and the cornetfish. Although inshore species sometimes occur offshore in association with floating objects (Hunter and Mitchell, 1967; Hunter, 1968), the predominance of the occurrences of these species at Mazatlán, where an extensive shelf occurs in the fishing area, suggests that at least some may have been captured in their normal habitat. Also, the lack of deep water off Mazatlán may explain the lower utilization of pelagic fishes by billfish there as compared with Buena Vista and San Diego. At Buena Vista several intermediate to deep-water forms occurred: the octopod *Japetella* sp., the shrimp *Pasiphaea affinis*, a myctophid, a gonostomatid, and a trichiurid.

We did not have an opportunity to observe feeding behavior, but we found two carangids in the stomach contents of

striped marlin which appeared to have been impaled by the bill prior to ingestion.

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