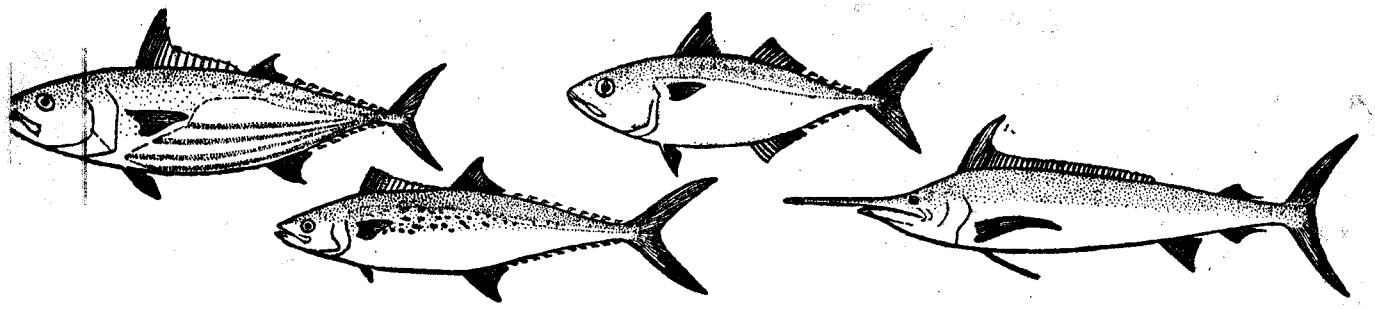
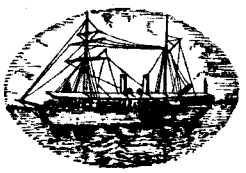


SYMPOSIUM ON SCOMBROID FISHES

PART II



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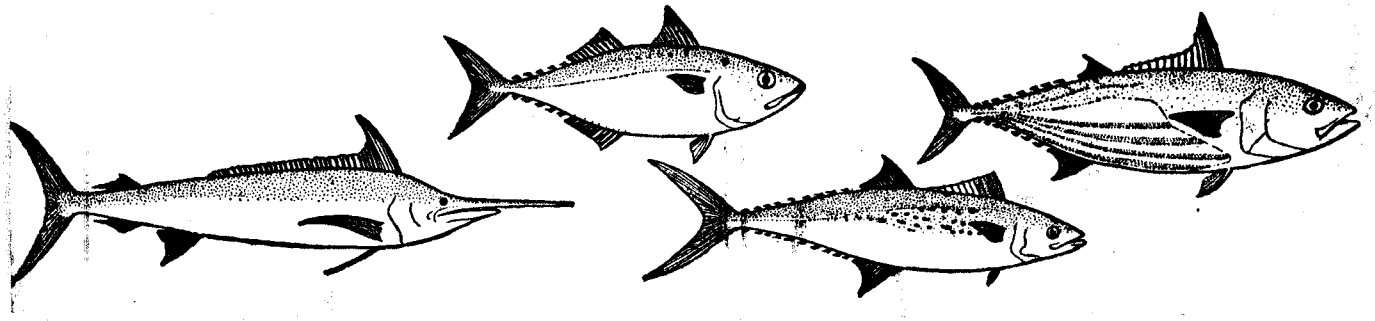

PROCEEDINGS OF THE

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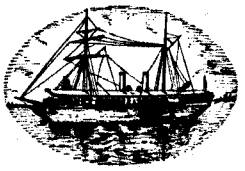
SCOMBROID FISHES

HELD AT MANDAPAM CAMP FROM JAN. 12-15, 1962

PART II



SYMPOSIUM SERIES I

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STUDIES ON THE FOOD OF *EUTHYNNUS AFFINIS AFFINIS* (CANTOR), *AUXIS THAZARD* (LACÉPÈDE), *AUXIS THYNNOIDES* BLEEKER AND *SARDA ORIENTALIS* (TEMMINCK AND SCHLEGEL)*

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INTRODUCTION

THE present study was undertaken with a view to obtain information on the relative abundance of different kinds of organisms forming the food of some of the common tunas, especially juveniles, occurring in appreciable numbers in the southern part of Indian coastal waters. There is hardly any information concerning the food of the four species of tunas dealt with in this account. Considerable work has been done on the food of yellowfin tuna, *Neothunnus macropterus* the more important ones being those by Nakamura (1936), Ronquillo (1953), Reintjes and King (1953), King and Ikehara (1956) and on the food of skipjack, *Katsuwonus pelamis* by Ronquillo (*op. cit.*), Hotta and Ogawa (1955) and Welsh (1949). Tester and Nakamura (1957) analysed the stomach contents of 32 specimens of *Euthynnus yaito* collected from Hawaii and reported that Serranidae, *Priacanthus* spp., *Decapterus* spp., caridean shrimp and megalopa formed the major food items. The same authors on examination of 2 specimens of frigate mackerel, *Auxis thazard* (Lacépède) reported the presence of megalopa larvae, stomatopod larvae, anomura larvae and a small octopus. Welsh (*op. cit.*) examined 196 specimens of *E. yaito* and found that crustaceans formed the major food, with fish next in importance.

MATERIAL AND METHODS

Juveniles and adults of *Euthynnus affinis affinis*, *Auxis thynnoides* and *Auxis thazard* usually occur in the commercial catches at Vizhingam while *Sarda orientalis* is found in stray numbers at Calicut, Vizhingam and some other landing centres. The material for examination was obtained from Tuticorin, Vizhingam and Cape Comorin during the years 1958-59. Adult *Euthynnus* specimens from Vizhingam and Tuticorin were caught by hooks and lines and *Auxis*, *Sarda* and small *Euthynnus* were obtained from boat-seine and shore-seine collections. 147 specimens of *E. affinis affinis*, 11 of *A. thazard*, 31 of *A. thynnoides* and 43 of *S. orientalis* ranging in size from 41 mm. to 660 mm., 49 mm. to 132 mm., 170 mm. to 252 mm., and 85 mm. to 305 mm. (fork length) respectively were examined.

The stomach contents of the preserved specimens were studied only after the lapse of some months. Since almost all the specimens were caught by shore-seines and boat-seines and as the bait used to capture adult *Euthynnus* by hooks and lines when present in the stomachs were omitted from the analysis, it is expected that the error usually observed is reduced to the minimum. The number of individuals in each group was noted and the volume of the different food items was determined by the displacement method using a graduated cylinder. The volumetric composition of each food item is expressed as percentage of the total volume of the stomach contents of all the fish examined. Volumetric method by displacement, despite its limitations was found to be the most suitable in the present study since these fishes are carnivorous in habits.

OBSERVATIONS ON FOOD HABITS

Euthynnus affinis affinis (Cantor)

147 specimens collected from Vizhingam and Tuticorin ranging in size from 41 mm. to 660 mm. (fork length) were examined. Analysis of the stomach contents of all specimens shows that molluscs, fish and crustacea form its main food. Molluscs formed the most important constituent of the

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food, being as much as 56.5% of the total food consumed even though only 13.7% of the stomachs contained this item. This low percentage of occurrence can be attributed to the predominance of squid only in large specimens. Fish formed 38.3% and crustacea 5.2% of the total stomach contents, and 87.1% and 20.4% respectively of the fish examined contained these items. The quantitative and qualitative analysis of data for all the specimens examined are presented in Table I, the percentage of occurrence in Fig. 1, and the percentage volume of the important food constituents in Fig. 2.

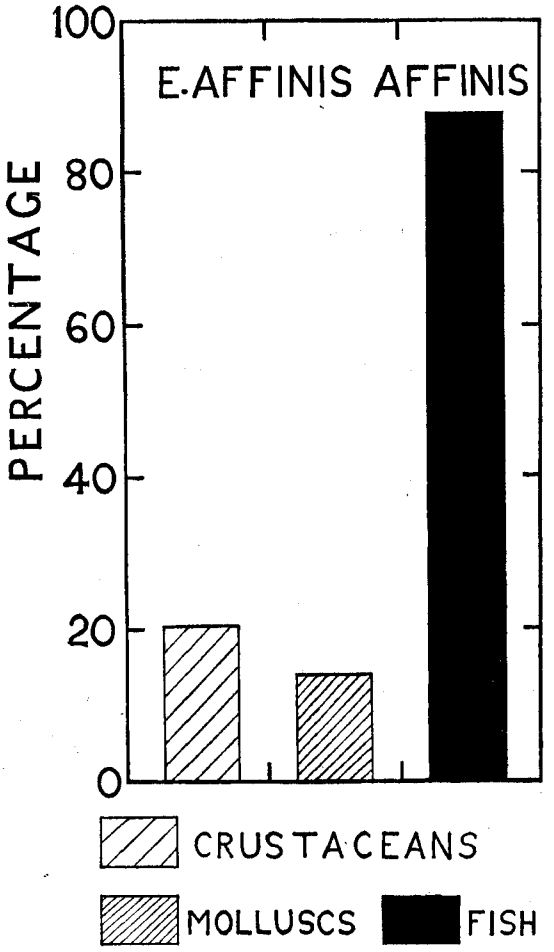

Fig. 1. Percentage of occurrence of important food groups in *Euthynnus affinis affinis*.

Mollusca.—Squids formed an important item of food encountered, particularly in the stomachs of large specimens.

Fish.—Several species of fishes and their larvae were recovered from the stomachs. Some of the common items were *Anchoviella tri* (3.4%), *A. commersonii* (1%), *Megalaspis cordyla* (8.5%), *Decapterus russelli* (4%), *Leiognathus insidiator* (5.2%) and *L. bindus* (1.2%). Unidentified fish and larvae formed 9.5% by volume. *Sardinella* spp., *Saurida* sp., *Sphyraena* sp., *Caranx* spp. and *Sillago sihama* were occasionally found. A specimen 100 mm. long had a 38 mm. long semi-

digested *E. affinis affinis* in its stomach. One *Auxis* larva was also found in one stomach. Generally medium-sized fishes were seen to have been eaten.

TABLE 1

List of food items of E. affinis affinis

Food items	Number of food organisms	Percentage of prevalence	Percentage by volume
Crustacea :	(140)	(20.4)	(5.2)
Isopods	7	2.8	—
Amphipods	9	2.8	—
Copepods	9	3.4	0.1
Penaeus sp.	3	1.4	0.1
Phyllosoma larvae	6	2.7	0.1
Megalopa larvae	8	2.0	0.1
Squilla sp.	2	0.7	—
Alima larvae	82	5.5	3.4
Unidentified crustaceans	17	5.5	1.1
Gastropoda :			
Pteropods	5	1.4	—
Cephalopoda :	(27)	(12.3)	(56.5)
Sepioteuthis sp.	25	10.9	55.7
Loligo sp.	2	1.4	0.8
Vertebrata (Pisces) :..	(308)	(87.1)	(38.3)
Sardinella spp.	10	5.5	0.7
Anchoviella commersonii	15	6.8	1.0
Anchoviella tri	56	23.7	3.4
Other clupeids	6	3.4	0.5
Saurida sp.	4	2.0	0.4
Leptocephalus	3	1.4	0.1
Hemirhamphus sp.	1	0.7	—
Holocentrus sp.	3	1.4	0.6
Sphyraena sp.	5	2.7	—
Sillago sihama	7	4.1	0.4
Lactarius lactarius	1	0.7	0.1
Carangids	18	5.5	13.8
Leiognathus spp.	141	32.5	6.8
Sciaena sp.	1	0.7	—
Euthynnus affinis affinis	1	0.7	—
Triacanthus sp.	1	0.7	0.2
Unidentified fish including larvae	36	14.9	9.5

Crustacea.—The predominant constituents of this group were alima, megalopa, phyllosoma, *Penaeus* sp., and amphipods. Alima larvae formed 3.4% by volume of the total food consumed, the next in importance being megalopa larvae. Copepods and isopods were found occasionally.

Food composition of different size groups :—

To see whether there are any changes in the food composition with growth, the data for different size groups were examined. The prevalence, in percentage, of important food constituents calculated according to the three size groups—only of an arbitrary nature—is represented in Fig. 3, and the volumetric composition of the food of each group is given in Table II. It is evident from Table II that the stomachs of the smaller fish contained more fish than did those of the larger specimens. The food of early juveniles (upto 75 mm. in fork length) formed mainly of fish as evidenced by volume (86.7%) and percentage of occurrence (95.8%) and molluscs (9.3%) were next in importance. The fish consumed consisted mainly of *Leiognathus* spp. which indicates that they were feeding in the inshore areas. Copepods were found only in the stomachs of fishes of this size group. In the next size group (76 mm. to 150 mm.) much difference was not observed

from that of the foregoing group excepting for the presence of specimens of *Sardinella* spp. and *Sillago sihama* in a few specimens. Considerable increase in the cephalopods (77.3%) and the

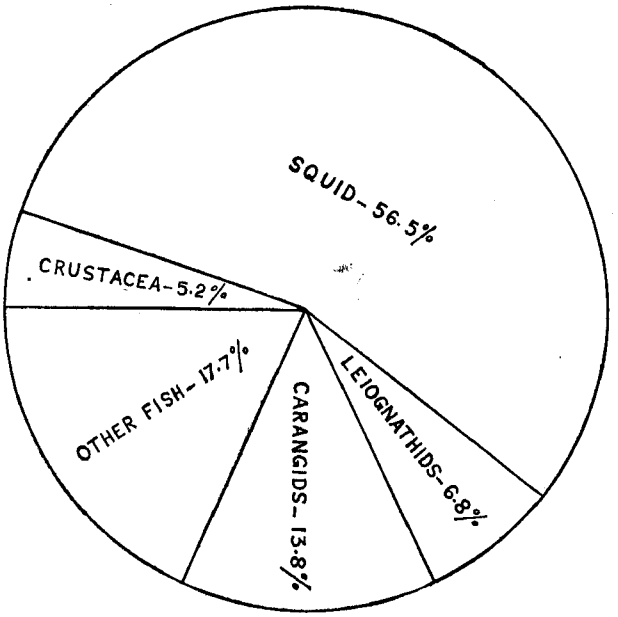

Fig. 2. Volumetric composition of the food of *E. affinis affinis*.

decrease in the fish consumed (19.9%) were the most important features observed in the next size group (151 mm. to 660 mm.). 58.3% of the specimens examined had fish, 45% had squid and 54.2% had crustacea. The high percentage by volume of the squid (77.3%) in large fishes can only be explained by the fact that these squids were large and only partially digested and that the fish eaten were comparatively small. Squilla larvae, squids, *Megalaspis cordyla*, *Decapterus russelli* etc., formed important items of food. Slight decrease in the quantity of crustacea was also observed. Empty or almost empty stomachs were found mostly in large-sized fishes.

TABLE 2

Volumetric composition of the food of different size groups of Euthynnus affinis affinis. *Number of specimens examined is shown in parentheses.*

Length group	41-75 mm. (48)	76-150 mm. (75)	151-660 mm. (24)
Items of food	%	%	%
Crustacea	4.0	4.5	2.8
Molluscs	9.3	10.9	77.3
Fish	86.7	84.6	19.9

Auxis thazard (Lacépède)

11 juveniles of *A. thazard* ranging in size from 49 mm. to 132 mm. collected from Vizhingam were examined. Analysis showed that the food of small specimens consists of fish (88%) and crustacea (12%) and that squid was entirely absent. In specimens larger than 75 mm. fish formed 39% and crustaceans 42% by volume. *Anchoviella* spp. and *Leiognathus* spp. were more common. Small squids were occasionally encountered.

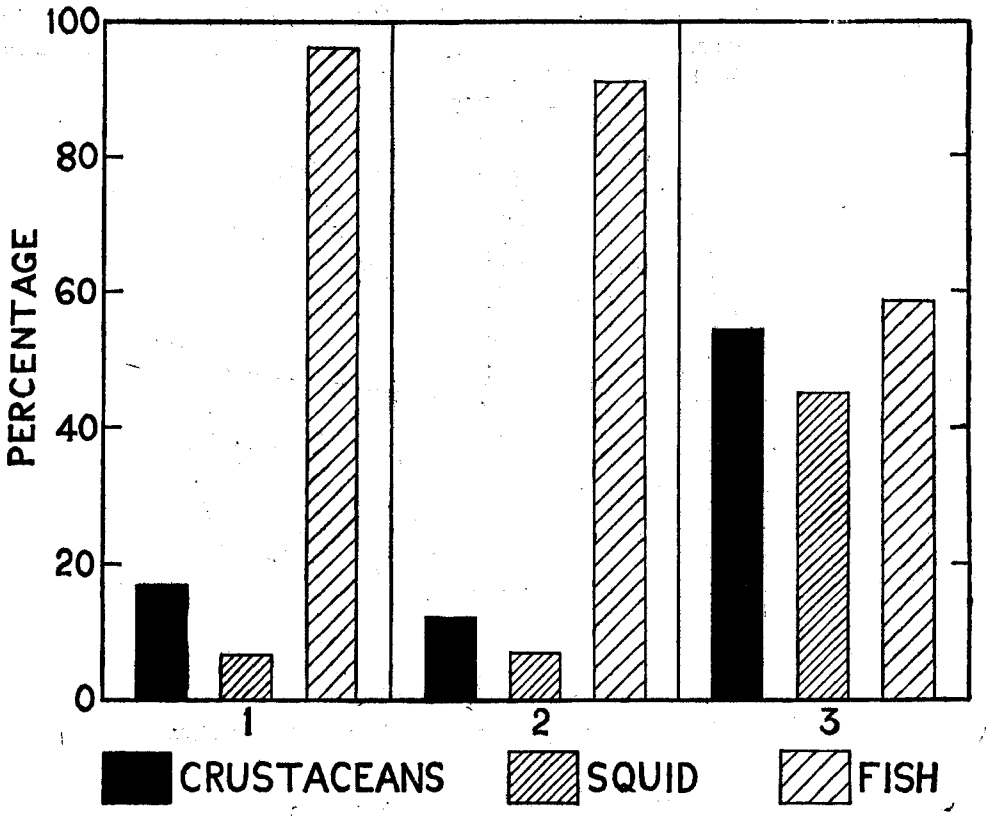

Fig. 3. Histogram showing the percentage of occurrence of major food constituents according to size groups in *E. affinis affinis*. (1) 49-75 mm., (2) 76-150 mm., (3) 151-660 mm.

Auxis thynnoides (Bleeker)

31 specimens measuring 170 mm. to 252 mm. in fork length collected from Vizhingam were examined in detail. The average volumetric composition of the food obtained by the analysis of the stomach contents is represented in Fig. 4. It can be seen that fish formed the most important item of food. 42.3% by volume of the food consisted of this item and 80% of the specimens examined had contained them. The next item of importance was crustacea which formed 24.4% of the total stomach contents and this occurred in 77% of the specimens examined. Cephalopods formed 22.7% of the food consumed. The quantitative and qualitative analytical data for the stomachs examined are presented in Table III. It is of interest to note that larval stomatopods and *Lucifer* formed the major part of the stomach contents of some of the specimens landed at Quilandy on the west coast in October 1956 (Jones, personal communication).

Fish.—*Sardinella* spp., *Anchoviella* spp., *Leiognathus* spp., and carangids were found to be the most predominant items.

Crustacea.—Megalopa larvae constituted about 21% of the food and 38.7% of the fish examined had consumed them. The next in importance among crustacea were Alima larvae and mysids.

Molluscs.—22.7% of the food consumed were squid but these occurred only in 16% of the total fish examined probably due to the fact that squids predominated in large specimens and consumed rarely by juveniles.

Other items of food.—It is of interest to mention that as much as 580 chaetognaths were present in one of the stomachs. Two halobates were seen in the stomach of one fish and 14 polychaetes were recovered from another specimen.

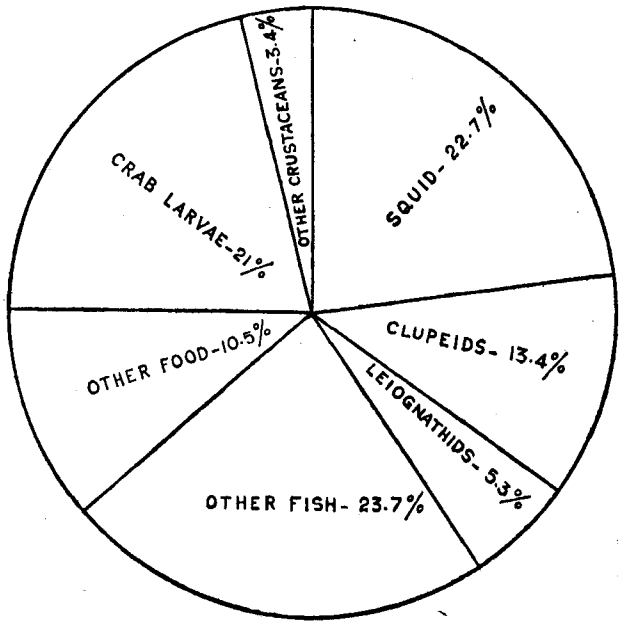

Fig. 4. Volumetric composition of the food of *A. thynnoides.*

TABLE 3

List of food items of Auxis thynnoides

Food items	Number of food organisms	Percentage of prevalence	Percentage by volume
Polychaeta :	14	3.2	1.2
Crustacea :	(142)	(77.4)	(24.4)
Amphipods	8	16.1	0.9
Mysis stage of prawn	8	12.9	0.9
Megalopa larvae	118	38.7	21.0
Alima larvae	5	12.9	0.9
Unidentified crustaceans	3	6.4	0.6
Insecta :			
Halobates	2	3.2	0.6
Chaetognatha :			
Sagitta spp.	580	3.2	8.7
Cephalopoda :			
Sepioteuthis sp.	7	16.1	22.7
Vertebrata (Pisces)	(78)	(80.6)	(42.3)
Sardinella spp.	5	9.7	3.5
Clupeid larvae	8	6.4	2.9
Anchoviella commersonii	3	6.4	2.3
Anchoviella tri	7	12.9	4.7
Hemirhamphus sp.	3	6.4	2.7
Sphyraena sp.	2	3.2	2.3
Caranx sp.	3	9.7	1.8
Carangid larvae	22	9.7	2.1
Leiognathus sp.	8	16.1	5.3
Unidentified fish and larvae	17	25.5	14.5

Sarda orientalis (Temminck and Schlegel)

43 specimens ranging from 85 mm. to 305 mm. in fork length collected from Vizhingam and Cape Comorin in October and November 1959 were examined. In Table IV, the results obtained by the quantitative and qualitative analysis of the stomach contents are presented.

The food consumed by this fish was found to be somewhat different from that of the other two in the entire absence of squid and the almost entire absence of crustacea in the stomachs. Alima larvae were found only in four of the specimens. Eleven stomachs were empty. *Anchoviella commersonii* (45.3% by volume) formed the most important single item of food. *Leiognathus insidiator, Decapterus russelli* and *Sardinella* sp. were found occasionally.

TABLE 4

List of food items of Sarda orientalis

Food items	Number of food organisms	Percentage of prevalence	Percentage by volume
Crustacea :			
Squilla larvae	15	9.3	2.0
Vertebrata (Pisces) :			
Sardinella sp.	8	10.2	9.1
Dussumieria sp.	5	9.3	6.0
Anchoviella commersonii	39	44.1	45.3
Hemirhamphus sp.	1	2.3	2.6
Decapterus russelli	9	14.0	16.8
Leiognathus insidiator	14	18.6	16.0
Sciaena sp.	3	4.7	3.4

DISCUSSION

Juveniles and adults of *E. affinis affinis* and *A. thynnoides* feed mainly on fishes, crustaceans and squid. It is possible that one of the reasons for the availability of juvenile tunas in inshore areas is the abundance of crustacean larvae and small-sized fishes as evidenced by the high percentage of occurrence and volume of these items in the stomach. The fewer varieties of food organisms contained in the stomach of *S. orientalis* can only be explained as the result of collection of almost all the specimens from a single locality. They fed on fish of moderate size. In this regard *S. orientalis* contrasts sharply with *E. affinis affinis* and *A. thynnoides*. The food items remain almost the same in adults and juveniles, but difference was observed in the relative proportions of the various food constituents. Juveniles were found to feed mainly on crustacean larvae and small fishes like *Leiognathus* and *Anchoviella*. The difference in the food habits of adults and juveniles and the abundance of juveniles in inshore areas could probably be related to the nature of distribution and abundance of food species in the different environments.

In the study of the food of the yellowfin tuna from the Central Pacific, Reintjes and King (*op. cit.*) found that fish (47% by volume) predominated over squid (26%) and that crustaceans formed 25%. According to Nakamura (*op. cit.*) the most important item of food of *Neothunnus macropterus* from the Celebes Sea consists of fishes, followed by squids and stomatopods. He listed *Engraulis, Sphyraena, Leiognathus*, and *Balistes* as some of the important items of food. The results of the present investigation agree in general with these observations. The differences in the food constituents noticed could probably be due to the difference in the nature of distribution of the food organisms. Tester and Nakamura (*op. cit.*) examined 32 specimens of *Euthynnus yaito* and found that fishes composed 91.8% by volume followed by crustaceans (8.2%). This observation differs from mine because squid was found to be an important item of food in the case of larger specimens of *E. affinis affinis*.

SUMMARY

The results obtained by the analysis of the stomach contents of *Euthynnus affinis affinis*, *Auxis thazard*, *Auxis thynnoides* and *Sarda orientalis* collected from the inshore areas of Vizhingam, Tuticorin and Cape Comorin are presented in this article.

The food items of *E. affinis affinis* and *A. thynnoides* were remarkably similar, consisting of crustaceans, cephalopods and pelagic fishes. Food items common to both species were *Anchoviella*, *Leiognathus*, *Sardinella*, zoea larvae, stomatopod larvae and squids. Juveniles were found to feed at the surface in the inshore areas of Vizhingam. In the case of *E. affinis affinis* the change over to the adult feeding habits become more pronounced when the young are about 150 mm. long. Juveniles of *E. affinis affinis* fed mainly on fish and crustacea and the adults on squid, fish and crustacea, squid predominating (77. 3%).

Considerable differences in the relative proportions of the major food items were observed in the four species. Squilla larvae which formed an important item of food in *E. affinis affinis* were comparatively negligible in the stomachs of *Auxis* and *Sarda*. *S. orientalis* was found to feed almost entirely on small fishes found in the inshore waters. Variation in volume and percentage of occurrence of different items of food of the four species may have some bearing on the relative abundance and varieties of food available.

ACKNOWLEDGEMENT

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