BIOLOGY AND FISHERY OF 'CHOO PARAI', *SELAROIDES LEPTOLEPIS* (CUVIER AND VALENCIENNES)

1. Food and Feeding Habits

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INTRODUCTION

CARANGIDS form a commercially important group of fishes in India but very little work has been done on their biology. The few available references to the subject being those of Chacko (1949), Mahadevan (1950), Datar (1954), Kuthalingam (1955 *b*), Chacko and Mathew (1956) and Vijayaraghavan (1957) on various species of horse-mackerel. The author, therefore, took up the study of *Selaroides leptolepis* (Cuv. & Val.), one of the common food Carangids of the Gulf of Mannar and the Palk Bay in the vicinity of Mandapam. The work was initiated in May 1957 and was carried out at the Central Marine Fisheries Research Station, Mandapam Camp. The present paper deals with the food of this fish.

MATERIAL AND METHODS

The material was collected weekly from Pudumadam and Rameswaram Road on the Gulf of Mannar and Thangachimadam and Rameswaram on the Palk Bay depending upon the fishing season, except on certain occasions when samples were available only fortnightly or monthly. A sample of 30–50 fish comprising different size-groups was brought to the laboratory each time for complete analysis. Shore-seines ('kara valai' and 'ola valai') and bag-nets ('madi valai') accounted for the catch of fish.

Each fish was examined in the fresh state for length, weight and stage of maturity except on two occasions when the analysis was done on the preserved material. The fresh fish after preliminary examination were numbered, dated and preserved in 5% formalin for further studies. The fork length—taken from the tip of the lower jaw to the tip of the shortest fin ray in the caudal fork—is used for all calculations.

To analyse the food of *S. leptolepis* Points method (Swynnerton and Worthington, 1940; Frost, 1943; Hynes, 1950) was used. The percentage frequency of each item was determined by the Occurrence method.

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The food items were identified as far as possible up to the genera.

Food Analysis

(a) Distribution of food items in the stomachs of S. leptolepis at different centres during different months.

Since the material for examination was available from different centres, the work was so planned as to facilitate a comparative study of the food of the fish in the different localities.

Tables I, II and III represent the distribution of various food items in the stomachs of *S. leptolepis* from Pudumadam, Rameswaram Road and Rameswaram respectively.

In 1957 the specimens for examination from Pudumadam (Table I) were available during May, June, September, November and December. Crustaceans formed the main item of the food—*Acetes*, *Lucifer* and *Acartia* being the most important among them.

Molluscan larvæ and shells contributed a little share to the food of the fish.

Fishes (*Anchoviella*) were next in importance to crustaceans and were common in May, June, November and December.

A certain amount of plant material, *viz.*, filamentous algæ (*Hypnea*, *Sarconema* and *Enteromorpha*) and diatoms (*Coscinodiscus*, *Navicula* and *Leptocylindrus*) was also recorded in some months.

During 1958, the material was available in all the months except October. *Lucifer* occurred from January to March, May, August, November and December in different proportions with the peak in March. A comparison of May 1957 and 1958 shows that *Lucifer* formed a very low percentage of food in 1958, whereas they remained almost at the same level in December of each year. Mysids were recorded during February, March, June and July with the maximum of 20% in February. *Acetes* was an important item of food throughout the year with the exception of March and August. In September of 1957 and 1958 it formed the entire food of the fish and recorded an increase in June, November and December 1958 over 1957. *Acartia* occurred in March and May, its proportion being greater in May 1958. Copepod eggs were observed in August only. *Euterpina*, *Oithona* and decapod larvæ were of minor importance.

Molluscan larvæ and shells occurred in March and December and formed a negligible portion of the food. Pteropods were present in March and August.

TABLE I

Percentage of different food items in the stomach contents during different months—Pudumadam

	1957								1958			
	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April
No. of fish examined ..	40	10	..	..	11	..	16	16	10	12	53	47
Lucifer ..	46·06	..	..	..	..	..	..	28·76	21·50	25·40	56·00	..
Mysids ..	..	22·40	..	..	..	..	8·00	2·70	..	20·00	2·88	..
Acetes ..	0·56	6·40	..	..	100·00	..	26·50	34·52	41·00	25·60	8·62	..
Acartia ..	14·85	42·20	..	..	..	..	40·00	..	..	..	16·16	..
Euterpina ..	..	..	..	..	..	..	2·00	..	..	..	0·43	..
Oithona ..	..	..	..	..	..	..	..	..	..	..	0·43	..
Decapod larvæ ..	0·25	..	..	..	..	..	0·50	..	..	1·00	0·50	..
Copepod eggs ..	..	..	..	..	..	..	..	..	..	..	..	..
Pteropod shells ..	..	..	..	..	..	..	..	..	..	..	4·31	..
Molluscan larvæ ..	11·22	1·20	..	..	..	..	6·00	4·32	..	..	1·28	..
Fishes ..	18·25	12·50	..	..	..	..	10·00	16·74	31·50	18·00	4·16	80·00
Alcyonarian spicules ..	..	..	..	..	..	..	..	..	..	..	0·43	..
Foraminiferan shells ..	3·00	0·70	..	..	..	..	3·00	..	2·09	2·00	0·64	..
Algæ ..	5·25	5·00	..	..	..	..	..	..	..	..	3·04	..
Diatoms ..	..	..	..	..	..	..	2·00	..	..	2·00	..	..
Sand grains ..	0·56	9·60	..	..	..	..	2·00	12·96	4·00	6·00	1·12	20·00

	1958								1959			
	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March.	April
No. of fish examined ..	14	13	30	25	7	..	28	24	12	57	40	..
Lucifer ..	1·30	..	..	34·90	..	..	30·10	28·05	78·61	29·81	57·72	..
Mysids ..	..	6·40	3·60	..	..	..	..	..	4·65	21·86	6·17	..
Acetes ..	..	88·20	83·00	7·90	100·00	..	39·80	59·73	13·95	3·74	2·82	..
Acartia ..	61·	..	..	..	..	..	..	..	..	0·12	15·30	..
Euterpina ..	..	..	..	..	..	..	..	3·41	..	0·37	..	..
Oithona ..	..	..	..	..	..	..	..	..	..	..	..	..
Decapod larvæ ..	..	..	..	..	..	..	..	1·25	..	..	0·94	..
Copepod eggs ..	..	..	..	6·50	..	..	..	..	..	..	..	..
Pteropod shells ..	..	..	..	11·90	..	..	..	..	..	..	..	..
Molluscan larvæ ..	..	..	..	..	..	..	..	0·73	..	..	..	..
Fishes ..	7·90	..	9·80	38·80	..	..	30·10	0·73	0·93	44·10	15·84	..
Alcyonarian spicules ..	..	..	..	..	..	..	..	..	..	..	..	..
Foraminiferan shells ..	..	..	..	..	..	..	..	..	..	..	0·13	..
Algæ ..	..	..	..	..	..	..	..	0·73	1·86	..	0·94	..
Diatoms ..	..	..	..	..	..	..	..	..	..	..	0·13	..
Sand grains ..	29·50	5·40	3·60	..	..	..	..	5·37	..	..	..	..

Juveniles of *Anchoviella* formed the major item of the food during January to May, July to August, and November to December.

Filamentous algæ were noticed in March and December, and diatoms in February.

Foraminiferan shells and sand grains were of minor importance.

In 1959 fish were examined in January, February and March. Attempts were made to collect the fish in April also but without any success.

Lucifer occurred in greater proportion in January and February 1959 as compared to 1958 and was almost at the same level in March of each year. Mysids did not show any appreciable increase in February 1959 as compared to February 1958, but an increase was recorded in March 1959. *Acetes* occurred in lesser amount in the food as compared to 1958. *Acartia* was noticed in a negligible quantity in February but was more or less at the same level in March 1958 and 1959. *Euterpina* and decapod larvæ were much less common in the food as compared to other items.

Fishes showed a decrease in January and increase in February and March when compared to the same months in 1958.

Filamentous algæ were recorded in January and March and diatoms in March only.

Table II indicates the distribution of various food items in the stomachs of the fish at Rameswaram Road. Fishes were available during December 1957, February to April and December 1958 and January to April 1959.

In December 1957 when only six specimens were available for examination, Mysids, molluscan larvæ, fishes, Alcyonarian spicules, foraminiferan shells, algæ and sand grains were recorded.

In 1958, *Lucifer* was present throughout, the minimum in February and the maximum in March. Mysids and *Acetes* occurred in February and April, the latter was also recorded in December. Of the other crustaceans, *Acartia* was the most favoured item in March.

Molluscan larvæ showed a considerable decline in December when compared to the same month in 1957.

Fishes occurred in all the four months showing an increase in December 1958 over 1957.

Alcyonarian spicules, foraminifera, and sand grains were of minor importance. Filamentous algæ and diatoms were somewhat prominent the former in February and March and the latter in February only.

TABLE II

Percentage of different food items in the stomach contents during different months—Rameswaram Road

	1957	1958											1959			
	Dec.	Jan.	Feb.	March.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March.	Apr.
	6	..	36	20	22	..	..	..	..	..	..	..	41	4	72	32	20
Lucifer ..	..	..	4·80	77·28	72·09	..	..	..	..	..	..	..	26·65	63·75	24·32	72·41	21·64
Mysids ..	27·5	..	14·00	..	7·44	..	..	..	..	..	..	..	..	20·00	30·27	6·85	16·06
Acetes ..	..	..	48·57	..	3·46	..	..	..	..	..	..	..	59·24	2·50	15·77	0·37	0·98
Acartia ..	..	..	..	5·10	..	..	..	..	..	..	..	..	..	..	..	..	..
Eutcrpina ..	..	..	..	2·00	..	..	..	..	..	..	..	..	..	..	..	..	..
Oithona ..	..	..	..	3·20	..	..	..	..	..	..	..	..	..	..	..	..	..
Decapod larvæ ..	..	..	0·23	..	..	..	..	..	..	..	..	..	..	..	0·16	..	0·33
Copepod eggs ..	..	..	..	..	..	..	..	..	..	..	..	..	..	7·50	..	..	..
Pteropod shells ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	4·22	..	..
Molluscan larvæ ..	20·50	..	..	0·57	..	..	..	..	..	..	..	..	1·70	..	0·24	..	0·33
Fishes ..	7·50	..	20·40	8·00	17·01	..	..	..	..	..	..	..	10·01	6·25	25·02	15·37	60·66
Alcyonarian spicules ..	2·50	..	..	0·57	..	..	..	..	..	..	..	..	..	..	..	..	..
Foraminiferan shells ..	2·00	..	1·40	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Algæ ..	2·50	..	4·40	2·30	..	..	..	..	..	..	..	..	..	..	..	..	..
Diatoms ..	..	..	1·30	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Sand grains ..	37·50	..	4·90	0·41	..	..	..	..	..	..	..	..	2·40	..	..	5·00	..

In 1959 *Lucifer*, Mysids, *Acetes* and fishes were common in all the months. Of these *Lucifer* was most common in January and March, Mysids in February and fishes in April.

A comparison with 1958 reveals that fall of *Lucifer* in February 1958 is compensated by the increase of *Acetes* in that month and increase in fish diet compensates the fall of *Lucifer* in April 1959.

Decapod and molluscan larvæ were negligible in the diet. Pteropod shells occurred in February only.

Food analysis of specimens collected from Rameswaram is presented in Table III. Due to irregular timings and fluctuations in fishery, it was not possible to collect the fishes in all the months. Hence, examination of fish was possible only during June, July and August in 1957 and May and September in 1958.

Lucifer was less common in June and July 1957 and May 1958, Mysids were recorded only in August 1957 and May 1958 whereas *Acetes* occurred in June, July and August 1957. *Acartia* occurred in fairly a good percentage in all the months except September 1958 when it was totally absent. Of the other crustaceans, *Euterpina*, *Oithona* and decapod larvæ were of greater importance than *Centropages*, *Pseudodiaptomus*, *Corycæus* and cypris larvæ.

Pteropod shells formed 41·40% of the food in September 1958, the highest ever recorded from any other place during the course of this investigation. Molluscan larvæ were common during June and July 1957 and May 1958.

Fishes occurred in all the months maximum being in September 1958.

Examination of fishes from Thangachimadam did not reveal the presence of any food item except for a few scales.

(*b*) *Occurrence of food organisms in different size-groups.*—A total of 830 fish was examined from Pudumadam, Rameswaram Road and Rameswaram. Fish examined from Thangachimadam are not included in this analysis since the stomachs were invariably empty except for a few scales. A sample of 50 fish was procured from Madras (East Coast) and another of 18 from Vizhingam (West Coast) for a comparative study of the food.

Specimens less than 5·0 cm. were rare in the catches and hence the food of smaller individuals could not be examined. A single specimen, 4·5 cm. in length, was collected from the shore-seine catches and attempt to collect more individuals under light fishing also proved futile.

TABLE III

Percentage of different food items in the stomach contents during different months—Rameswaram

	1957							1958								
	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March.	Apr.	May	June	July	Aug.	Sept.
No. of fish examined ..	44	14	15	..	..	..	..	..	..	..	..	31	..	..	..	8
Lucifer ..	2·12	4·00	..	..	..	..	..	..	..		..	0·42	..	..	..	50·00
Mysids ..	..	..	8·20	..	..	..	..	..	..	..	..	0·84	..	..	..	..
Acetes ..	1·88	9·68	81·02	..	..	..	..	..	..	..	..	..	..	..	..	..
Acartia ..	46·00	39·60	8·40	..	..	..	..	..	..	..	..	55·58	..	..	..	..
Euterpina ..	4·12	5·41	..	..	..	..	..	..	..	..	..	5·05	..	..	..	..
Oithona ..	2·75	7·56	..	..	..	..	..	..	..	..	..	16·63	..	..	..	..
Decapod larvæ ..	27·38	5·00	..	..	..	..	..	..	..	..	..	1·89	..	..	..	..
Centropages ..	2·00	..	..	..	..	..	..	..	..	..	..	0·84	..	..	..	..
Pseudodiaptomus ..	0·25	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Corycæus ..	0·37	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Cypris larvæ ..	..	..	..	..	..	..	..	..	..	..	..	0·84	..	..	..	..
Pteropod shells ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	41·40
Molluscan larvæ ..	7·50	15·37	..	..	..	..	..	..	..	..	..	10·53	..	..	..	..
Fishes ..	2·75	3·26	2·04	..	..	..	..	..	..	..	..	4·21	..	..	..	8·60
Foraminiferan shells ..	0·12	0·54	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Sand grains ..	0·50	2·00	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Diatoms ..	0·25	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Aglæ ..	2·00	7·58	0·34	..	..	..	..	..	..	..	..	3·16	..	..	..	..

Fishes were grouped at 1 cm. interval. The percentage occurrence of different items of food in various size-groups is given in Table IV. The relative importance of the items is represented graphically in Figs. 1–2. *Lucifer* was not recorded from 4·1 to 6·0 cm. but occurred in all other sizes. Mysids were restricted from 7·1 to 15·0 groups. *Acetes*, like *Lucifer*, occurred in all the sizes above 6·0 cm. *Acartia* was recorded in all the sizes except 14·1 to 15·0 cm., its occurrence being much more common in the younger individuals than in the older ones. *Euterpina* and *Oithona* were of common occurrence from the young to 11·0 cm., the former also occurring in a very low percentage in 12·1 to 13·0 cm. Decapod larvæ were recorded from all the groups. *Centropages*, *Pseudodiaptomus*, *Corycæus* and cypris larvæ were of rare occurrence in the smaller individuals. They were completely absent in the older ones. Copepod eggs were noticed from 9·1 to 14·0 cm.

Molluscan larvæ (*Pteria*) and shells were recorded from all the sizes except the last group whereas Pteropod shells occurred from 9·1 to 14·0 cm.

Fishes and fish scales were recorded from all the groups except 4·1 to 5·0 cm. They, like *Lucifer*, reached their maximum in 13·1 to 14·0 cm.

Foraminiferan shells were maximum in 7·1 to 8·0 cm. while Alcyonarian spicules in 10·1 to 11·0 cm.

Of the filamentous algæ (*Hypnea*, *Sarconema* and *Enteromorpha*) and diatoms (*Coscinodiscus*, *Rhabdonema*, *Navicula* and *Leptocylindrus*) the former occurred more frequently than the latter.

(*c*) *Relation with the plankton.*—Qualitative analysis of the plankton collected from the Gulf of Mannar at fortnightly intervals was made and the results are summarized below:

Lucifer.—They were common during the months of May, June, September, November and December 1957 but less common in July and August. In 1958, they were common during March to June, November to December but showed a decline in the months of January, February, July and September. During January to April 1959, a similar picture to 1958 was observed.

Acartia.—From May 1957 it was common in the collections with the exception of September and October and showed somewhat similar trend in 1958. It was also common from January to April 1959.

Decapod larvæ.—They were less common during the months of September and October 1957 and July and October 1958 as compared to the rest of the months.

TABLE IV*

Percentage occurrence of different food items in various size-groups

Size-groups (cm.)	No. of fish examined	*Lucifer*	Mysids	*Acetes*	*Acartia*	*Euterpina*	*Oithona*	Decapod larvæ	*Centropages*	*Pseudo-diaptomus*	*Corycæus*
4·1– 5·0	1	..	..	..	100·00 (1)	100·00 (1)	100·00 (1)	100·00 (1)	..	..	..
5·1– 6·0	13	..	..	..	100·00 (13)	69·23 (9)	53·85 (7)	76·92 (10)	7·70 (1)	7·70 (1)	7·70 (1)
6·1– 7·0	45	15·56 (7)	..	15·56 (7)	95·56 (43)	55·56 (25)	51·11 (23)	66·67 (30)	22·22 (10)	4·44 (2)	4·44 (2)
7·1– 8·0	37	16·22 (6)	16·22 (6)	27·03 (10)	72·97 (27)	32·43 (12)	24·32 (9)	43·24 (16)	..	..	..
8·1– 9·0	55	25·45 (14)	3·64 (2)	60·00 (33)	18·18 (10)	10·91 (6)	5·45 (3)	9·09 (5)	..	..	..
9·1–10·0	83	45·78 (38)	19·28 (16)	60·24 (50)	28·92 (24)	6·02 (5)	2·41 (2)	10·84 (9)	..	..	..
10·1–11·0	179	64·80 (116)	27·37 (49)	28·49 (51)	18·99 (34)	2·79 (5)	1·68 (3)	5·59 (10)	..	..	..
11·1–12·0	186	65·59 (122)	31·18 (58)	32·80 (61)	8·60 (16)	..	..	4·84 (9)	..	..	..
12·1–13·0	155	65·81 (102)	61·94 (96)	54·19 (84)	2·58 (4)	0·64 (1)	..	5·81 (9)	..	..	..
13·1–14·0	71	66·20 (47)	50·70 (36)	50·70 (36)	5·63 (4)	..	..	5·63 (4)	..	..	..
14·1–15·0	5	60·00 (3)	40·00 (2)	40·00 (2)	..	..	..	20·00 (1)	..	..	..

TABLE IV*—(*Contd.*)

Size-groups (cm.)	No. of fish examined	Cypris larvæ	Copepod eggs	Pteropod shells	Molluscan larvæ	Fishes	Alcyonarian spicules	Foraminiferan shells	Algæ	Diatoms
4·1– 5·0	1	..	..	..	100·00 (1)	..	..	..	..	..
5·1– 6·0	13	7·70 (1)	..	..	84·62 (11)	15·38 (2)	..	..	15·38 (2)	..
6·1– 7·0	45	4·44 (2)	..	..	80·00 (36)	22·22 (10)	..	4·44 (2)	13·33 (6)	8·89 (4)
7·1– 8·0	37	2·70 (1)	..	..	59·46 (22)	29·73 (11)	..	13·51 (5)	13·51 (5)	5·40 (2)
8·1– 9·0	55	..	..	..	14·54 (8)	29·09 (16)	..	5·45 (3)	9·09 (5)	.
9·1–10·0	83	..	6·02 (5)	8·43 (7)	26·51 (22)	43·37 (36)	..	8·43 (7)	19·28 (16)	1·20 (1)
10·1–11·0	179	..	7·82 (14)	13·41 (24)	12·29 (22)	39·78 (107)	1·68 (3)	4·47 (8)	6·14 (11)	1·68 (3)
11·1–12·0	186	..	1·61 (3)	5·91 (11)	9·14 (17)	62·90 (117)	1·61 (3)	3·76 (7)	10·22 (19)	0·54 (1)
12·1–13·0	155	..	2·58 (4)	1·94 (3)	12·90 (20)	64·52 (100)	0·64 (1)	8·39 (13)	20·64 (32)	3·22 (5)
13·1–14·0	71	..	2·82 (2)	2·82 (2)	9·86 (7)	100·00 (71)	..	12·68 (9)	16·90 (12)	5·63 (4)
14·1–15·0	5	..	..	..	..	60·00 (3)	..	..	..	..

* Figures in brackets indicate the number of fish in which each item has occurred.

Pteropod shells.—Their occurrence was seasonal and they were common from August to November 1957, January to March, September and November 1958 and January to March 1959.

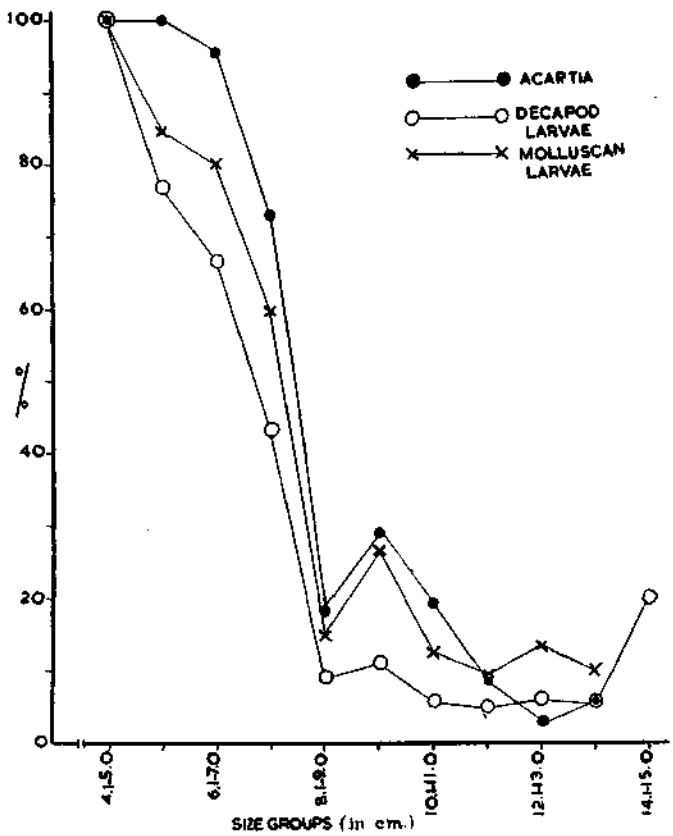

FIG. 1. Showing the relative importance of food items in various size-groups.

Molluscan larvæ.—They were common in all the months except June 1957, February, April and June 1958.

Diatoms.—They were present in all the months with the peak in October and November and sometimes plenty in December.

A comparison of Tables I to IV with the plankton observations leads to the conclusion that the occurrence and the extent of distribution of the food items in the stomachs of *S. leptolepis* have a combination with their distribution in the plankton in different months. Table IV indicates that in the lower size-groups *Acartia, Euterpina, Oithona,* decapod larvæ and molluscan larvæ constitute favourite food and as the fish grows their occurrence tends to

decrease and the fish eats more and more of *Lucifer*, *Acetes*, Mysids and fishes. Thus, as the fish grows it shows a tendency to feed on the bigger items. It is interesting to point out here that on several occasions the stomachs were noticed to have either *Lucifer* or *Acetes* or Mysids or fishes only.

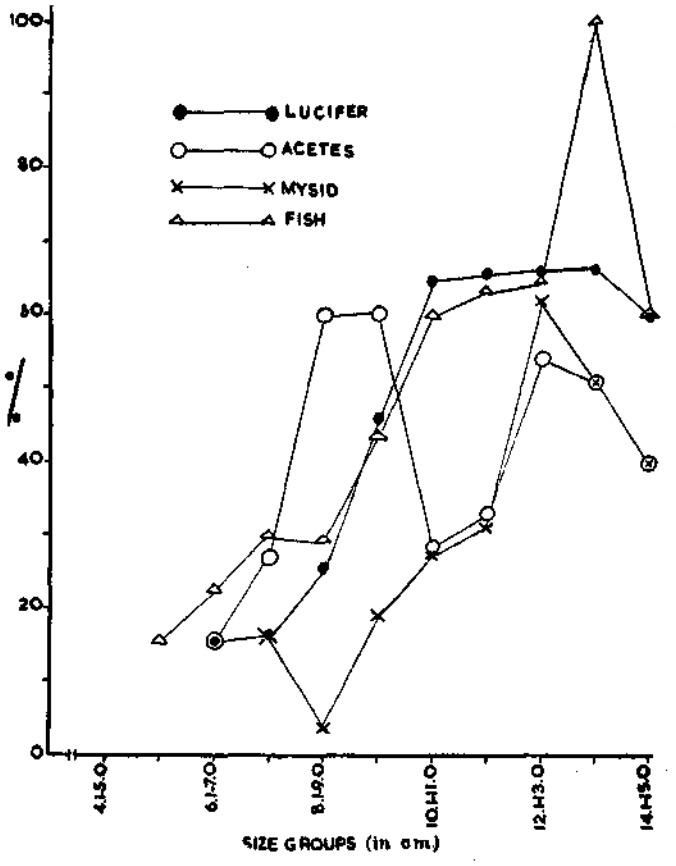

FIG. 2. Showing the relative importance of food items in varous size-groups.

(*d*) *Degree of feeding*.—Table V presents the state of the stomach (in percentage) in different degrees of fullness from May 1957 to May 1959. Fishes labelled as full, ¾ full and ½ full were considered to have fed actively while those labelled as ¼ full showed less feeding. The occurrence of empty stomachs was much less at Pudumadam, Rameswaram Road and Rameswaram, but very common at Thangachimadam. In April high percentage of empty stomachs was recorded from Pudumadam which was due to the difference in time of collection. The occurrence of ¼ full stomachs

TABLE V

State of the stomach in percentage in different degrees of fullness in various months from different centres

	1957								1958					
	May	June	July	August	Sep.	October	Nov.	Dec.	January	February	March	April	May	June
PUDUMADAM :														
Full ..	86·6	70·0	..	..	18·2	..	75·0	12·5	100·0	..	18·9	..	21·5	12·0
¾ full ..	8·4	..	..	..	27·3	..	6·3	37·5	..	..	18·9	..	7·1	24·0
½ full ..	5·0	10·0	..	..	18·2	..	12·4	12·5	..	..	37·8	2·1	42·8	8·0
¼ full ..	..	10·0	..	..	36·3	..	..	37·5	..	75·0	22·6	..	28·6	56·0
Empty ..	..	10·0	..	..	..	..	6·3	..	..	25·0	1·8	97·9*	..	..
RAMESWARAM ROAD :														
Full ..	..	..	..	..	..	..	..	..	..	100·0	..	95·5	..	..
¾ full ..	..	..	..	..	..	..	..	..	..	..	25·0	..	..	..
½ full ..	..	..	..	..	..	..	..	50·0	..	..	35·0	4·5	..	..
¼ full ..	..	..	..	..	..	..	..	50·0	..	..	40·0	..	..	..
Empty ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
RAMESWARAM :														
Full ..	..	90·9	85·8	92·6	..	..	..	..	..	..	..	..	61·3	..
¾ full ..	..	..	7·1	7·4	..	..	..	..	..	..	..	..	6·5	..
½ full ..	..	..	7·1	..	..	..	..	..	..	..	..	..	19·3	..
¼ full ..	..	..	..	..	..	..	..	..	..	..	..	..	12·9	..
Empty ..	..	9·1	..	..	..	..	..	..	..	..	..	..	..	..
THANGACHIMADAM :														
Empty* ..	100·0	100·0	100·0	100·0	100·0	100·0	..	..	..	..	100·0	100·0	100·0	100·0

TABLE V—(*Contd.*)

	1958						1959				
	July	August	September	October	November	December	January	February	March	April	May
PUDUMADAM :											
Full ..	33·3	76·0	57·1	..	58·0	70·8	75·0	45·6	82·5	..	..
¾ full ..	10·0	24·0	..	..	42·0	..	8·3	12·3	7·5	..	..
½ full ..	30·0	..	14·3	..	..	29·2	16·7	22·8	10·0	..	..
¼ full ..	20·0	..	28·6	..	..	..	..	17·5	..	..	..
Empty ..	6·7	..	..	..	..	..	..	1·8	..	..	..
RAMESWARAM ROAD:											
Full ..	..	..	..	..	..	73·2	100·0	68·0	56·3	45·0	..
¾ full ..	..	..	..	..	..	7·3	..	15·3	28·1	20·0	..
½ full ..	..	..		..	..	14·6	..	13·9	12·5	30·0	..
¼ full ..	..	..		..	..	4·9	..	2·8	3·1	5·0	..
RAMESWARAM :											
Full ..	..	..	0·0	..	..	..	..	..	..	..	..
THANGACHIMADAM :											
Empty* ..	100·0	100·0	100·0	100·0	100·0	..	..	..	100·0	100·0	100·0

* Fishes were caught at night.

in greater proportion in certain months in one year and much less in other at different centres in the same months may well be explained due to the difference in time of fishing.

(*e*) *Feeding in relation to sexual cycle.*—Mature fish though continue to occur throughout the year, the concentration of those individuals can be noticed only during February, March, August and September immediately followed by spent, spent recovering and juvenile stages of the fish. It can be noticed from the table for Pudumadam (Table I) that the fish collected during September 1957, and March, August and September 1958 and from January to March 1959 had fed actively during the spawning season. Similarly the table for Rameswaram Road (Table II) indicates the high degree of feeding in February and March 1958 and 1959. The observations from Rameswaram (Table III) further confirm that the fish do not stop feeding or show a sign of cessation of feeding during spawning season. Here it is worthwhile to mention that three specimens (all female) collected in the running stage in August 1958 had full stomachs containing *Lucifer*, *Acetes* and juveniles of *Anchoviella*. It can be further stated from Table IV that there is no change in the food of fish in different stages of maturity. The fish which attains a size of 10 cm. at first maturity continues to feed on the same items of food even after it has spawned. The proportions of different items, however, may vary.

Discussion

For the purpose of comparison other Carangids, *viz.*, *Caranx melampygus*, *C. sexfasciatus*, *Selar kalla* and *S. mate* were examined. Of these the last three were caught and collected at night from Mandapam and Thangachimadam. On examination they had nothing in their stomachs except for a few scales showing similar results as in *S. leptolepis*. A sample of 18 fishes of *S. leptolepis* examined from Vizhingam (West Coast) caught at night in bag-net revealed a similar picture. Another collection from bag-nets from Madras during day at 2 P.M. revealed the presence of *Lucifer* appendages, Mysids, *Acartia*, decapod larvæ, *Labidocera*, Pteropod shells, molluscan larvæ and fishes in their stomachs. The stomachs of these fishes were only ¼ full which was due to the time of catching the fish. Examination of the stomachs of *S. leptolepis* from the shore-seine collections at night from Pudumadam also did not reveal the presence of any organism but for a few scales, which is an indication that the fish had fed long ago. This explains the higher percentage of empty stomachs in April 1958 at this place. The absence of food in the stomachs of *S. leptolepis* caught at night can be due to one of two possible causes:

1. Absence of feeding activity at night.
2. Regurgitation by the fish when hauled up.

To investigate these possibilities a critical examination of the stomach contents of the fish was made from Pudumadam, Rameswaram Road and Rameswaram. Fish were taken from different hauls at different periods of the day. It was found that the fish caught in the early hours till about 8 A.M. contained little food and those caught after 8 A.M. had stomachs in different degrees of fullness. The food items were easily identifiable due to incomplete digestion. The absence of food in the stomachs was thus not due to any regurgitation but due to the difference in time of catching the fish.

It appears that the feeding behaviour of *S. leptolepis* is similar to that observed by Bhattacharyya (1957) in larval and post-larval herrings and by Qasim (1957) in *Blennius pholis* and by Hatanaka and Murakawa (1958) in *Seriola quinqueradiata.*

Caranx sexfasciatus and *C. melampygus* were collected from shore-seines during day, the former had only *Anchoviella* in their stomachs while in the latter the stomachs were full of *Leiognathus, Anchoviella, Acetes,* Mysids and *Sepia.* An interesting feature was observed in *C. sexfasciateus* which were also caught at 3 A.M. in shore-seines. Contrary to the expectations, the stomachs were full of *Sardinella, Ilisha* and *Anchoviella.* In one specimen in addition to these items a single specimen of *Squilla* and *Selar malam* (Carangid) were also recorded. The feeding behaviour of *C. sexfasciateus* is, thus, comparable to that observed by Soemarto (1958) in *Decapterus.*

Tham Ah Kow (1950) on the food studies of *Caranx leptolepis* from Singapore Strait concluded that the fish selectively feeds on zooplankton. The presence of zooplankton and juveniles of *Anchoviella* in major quantities and occurrence of filamentous algæ and diatoms only occasionally, as noticed during the present investigations, lead one to infer that this fish is mainly carnivorous supplementing its food with phytoplankton according to their availability. These results, thus, are contrary to the view of Tham Ah Kow (1950). In this connection it is of interest to note that the occurrence of plant material in the food of Carangids has not been mentioned by Lebour (1918, 1920), Chacko (1949), Mahadevan (1950), Datar (1954) and Vijayaraghavan (1957). However, Kuthalingam (1955 *b*) and Chacko and Mathew (1956) do refer to the occurrence of very small amount of vegetable matter in the food of Indian horse-mackerel.

SUMMARY

1. During the course of two years of investigation 830 fish of various sizes were examined from Pudumadam, Rameswaram Road and Rameswaram. The stomachs of the fish examined from Thangachimadam were invariably empty.

2. Points and Occurrence methods were followed to analyse the food contents.

3. *Acartia*, *Oithona*, *Euterpina*, decapod and molluscan larvæ are preferred in the lower groups whereas *Lucifer*, *Acetes*, Mysids and fishes in the higher ones.

4. Fish show indications of cessation of feeding during night.

5. It is mainly a carnivorous fish, occasionally feeding on phytoplankton.

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