

BIOLOGY AND FISHERY OF THE PIG-FACE BREAM, *LETHRINUS*

LENTJAN LACÈPÈDE

I. FOOD AND FEEDING HABITS

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INTRODUCTION

The study of the food of fishes attracted the attention of fishery biologists from the beginning of the present century in view of the recognised importance of food as an environmental factor influencing the growth and distribution of fishes and the success of their fishery. A great deal of work has been done on the food and feeding habits of fishes from Indian waters. A perusal of the literature shows that although casual observations have been made on the food of lethrinids by Al-Hussaini (1947), Devanesan and Chidambaram (1948) and Wheeler (1953), very little information is available about the qualitative and quantitative aspects of the food of these fishes. The present investigation was undertaken to get a clear picture of the food and feeding habits of *Lethrinus lentjan*, and attention was devoted to the following aspects during the study: (i) qualitative and quantitative analyses of the food, (ii) feeding intensity, (iii) feeding habits and (iv) composition of food in relation to the size of the fish.

MATERIAL AND METHOD

The material for these studies was collected during June 1960 to July 1962 from fish landing places at Theedai, and Rameswaram (Palk Bay) and Vedalai, Kilakarai and Tuticorin (Gulf of Mannar). Altogether the gut contents of 1,272 specimens of *L. lentjan*, captured by shore seines and hooks and lines, were examined. The specimens of *L. lentjan* caught in basket traps, although utilised for other investigations, were excluded from the present study as their stomachs usually contained only the remains of baits that were used, viz., dried holothurians, starfishes and crabs. The fish were brought to the laboratory in fresh condition or preserved in formalin. The entire gut contents were removed and examined immediately if time permitted or preserved in 5% formalin and labelled with particulars of size, sex, weight, locality, date and method of capture, for study at a later date. The data on food items were treated separately for catches by each type of gear.

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Various methods have been adopted by different workers in analysing the food of fishes and these had already been discussed by Hynes (1950) and Pillay (1952). Recently, Natarajan and Jhingran (1961) discussed the scope of the existing methods for evaluating the different food items in stomachs of fishes and proposed a method called 'Index of Preponderance' for grading the food elements in the stomach analysis of fishes. Hynes (*op. cit.*) stated that any of the commonly applied methods, viz., (i) Occurrence method, (ii) Number method, (iii) Volume and weight method, (iv) Dominance method, (v) Fullness method and (vi) Points method, for assessing the composition of food from their gut contents, will give substantially the same results. Pillay (*op. cit.*) expressed a similar opinion and pointed out that technique to be adopted will have to be based on the nature of food consumed by the fish. In the present investigation, 'the points or volume index method' (Swynnerton and Worthington, 1940) was applied. The food organisms were identified up to generic rank, and to species level wherever possible.

For the quantitative analysis of food, the stomachs were classified as 'full', ' $\frac{3}{4}$ full', ' $\frac{1}{2}$ full', ' $\frac{1}{4}$ full' and 'empty' and points were allotted as 20, 15, 10, 5 and 0 respectively, depending upon the state of distension of stomach and the amount of food in it. While allotting points to different food items the size of the fish and state of stomach were taken into consideration. Following this, points were allotted to different food items based on their relative volumes as assessed by visual estimation.

OBSERVATIONS

From the qualitative analysis of food of *Lethrinus lentjan* it has been observed that the food of the fish is composed of a variety of organisms. For the sake of brevity and simplicity in allotting the points, the various food items were grouped as indicated in the list given below:—

- i. Polychaetes
- ii. Crustacean larvae
- iii. Amphipods
- iv. Isopods
- v. Copepods—*Macrosetella gracilis*
- vi. Crabs—*Charybdis*, *Thalamita* and other Brachyura
- vii. Other crustaceans—(i) *Squilla* (ii) *Alpheus* (iii) prawns
- viii. Molluscan eggs (ribbons) and larvae
- ix. Molluscs (i) bivalves (*Arca*, *Chama*, *Paphia*, *Modiolus*, Oyster remains? *Pinctada vulgaris*)
 - (ii) gastropods (*Turbo*, *Phallium*, *Murex*)
 - (iii) opisthobranchs (*Philine*)
 - (iv) Amphineura (Chitons)

- x. Echinoderms—echinoids, ophiuroids
- xi. Ascidians
- xii. Fishes (*Balistes*, *Diodon*, *Otolithus*, Clupeoids and other unidentified fishes)
- xiii. Miscellaneous—coral pieces, sponge portions, sea grass and digested food material.

Sand grains were present in most of the gut contents examined.

The Relative Importance of Different Food Items:

Detailed data on the distribution of different food items in the gut contents of *L. lentjan* examined from Theedai, Rameswaram, Vedalai, Kilakarai and Tuticorin are presented in Tables I, II and III.

It was observed that the fish examined even from far off localities exhibited similar food items in their gut contents. From Tables I, II and III it may be seen that crustaceans, molluscs and echinoderms were mostly taken as food by the fish. Crustaceans, especially the brachyuran remains, were dominant throughout. Molluscs ranked second and in some months they constituted the bulk of the food. Though fishes were eaten by the fish, they never figured as the main food item. Usually, lethrinid fishes are known as 'scavengers' but it appears that *L. lentjan*, a carnivorous bottom feeder, generally prefers certain food items while feeding. The juveniles showed greater preference for amphipods and crustacean larvae. The adult fish prefer crustaceans, molluscs and echinoderms. The fish do take polychaetes, molluscan larvae and egg-ribbons of molluscs, ascidians etc., but these form less than 15% of the total food.

It was observed that there was active feeding during day time and the fish were not feeding in late hours of evening. The fish caught in morning hours by shore seines at Vedalai (Gulf of Mannar) were having undigested crab appendages, shrimps and bivalves in their stomachs. Just before noon the stomach contents of the fish (hauled by the same gear and at the same place) showed the remains of crustacean appendages and broken shells of molluscs which probably indicate the high rate of digestion.

Intensity of Feeding:

As already stated, the degree of feeding was based on the distension of the stomach and the quantity of food contained in it. The state of stomach was classified as 'full', $\frac{3}{4}$ full', $\frac{1}{2}$ full', $\frac{1}{4}$ full' and 'empty', the fish coming under the first two categories were considered as actively fed. Fish caught in shore seines showed the higher number of full stomachs varying between 42% and 76%, while the fish caught on hook and lines had very low number with full stomachs. The details of the results obtained are tabulated in Tables IV, V and VI.

TABLE I

Percentage of different food items in the gut contents of *L. lentjan* from shore seine catches during different months at Theedai, Rameswaram, Vedalai and Kilakarai from August 1960 to 1962

No. of specimens examined	1960					1961							
	Aug. 25	Sep. 16	Oct. 30	Nov. 25	Dec. 20	Jan. 18	Feb. 25	Mar. 22	Apr. 24	May 25	June 8	July ..	Aug. ..
<i>Food items :</i>													
Amphipods . . .	5.74	3.63	6.93	3.82	14.49	3.64	..	..	6.85	8.12	7.32	..	..
Isopods . . .	2.30	..	0.99	..	2.90	..	..	..	..	..	2.44	..	..
Crustacean larvae . . .	3.45	3.64	2.97	3.37	4.35	1.82	..	4.11	2.74	..	..	..	..
Molluscan larvae . . .	..	1.82	..	1.12	..	..	..	..	1.37	..	..	..	..
Crabs . . .	43.68	52.73	44.55	41.57	34.78	47.27	51.85	42.46	39.72	24.35	31.71	..	..
Other crustaceans . . .	1.15	7.27	2.98	5.62	..	5.45	..	4.11	7.85	..	7.32	..	..
Molluscs . . .	33.33	21.82	32.67	24.72	24.64	26.18	30.86	21.92	26.03	35.71	34.71	..	..
Echinoderms . . .	4.60	5.45	3.96	2.92	7.24	5.45	16.05	12.33	8.59	14.61	..	..	..
Polychaetes . . .	..	..	..	3.37	..	..	..	4.11	..	..	2.44	..	..
Fishes . . .	..	..	2.97	6.75	7.24	6.46	..	4.11	..	11.36	7.32	..	..
Ascidians . . .	..	..	..	..	..	..	..	..	..	..	..	..	..
Miscellaneous . . .	3.45	3.64	1.98	3.37	1.45	..	..	4.11	2.74	..	2.44	..	..
Sand grains . . .	2.30	..	..	3.37	2.90	3.64	1.23	2.74	4.11	5.84	4.38	..	..

No. of specimens examined	1961				1962							
	Sep. 19	Oct. 40	Nov. 35	Dec. 38	Jan. 25	Feb. 18	Mar. 26	Apr. 23	May 28	June 11	July 18	
<i>Food items :</i>												
Amphipods	3.39	3.85	14.85	..	7.04	..	2.98	..	..	..	5.17
Isopods	..	1.54	1.98	..	..	..	..	..	..	..	..
Crustacean larvae	3.39	2.31	3.96	2.77	4.22	8.33	..	5.88	3.66	..	3.45	
Molluscan larvae	..	..	2.97	..	..	..	..	7.85*	..	..	..
Crabs	37.29	38.46	38.61	38.89	38.03	36.67	29.85	37.25	40.24	39.39	20.69	
Other crustaceans	..	5.38	2.97	..	2.82	6.67	14.93	7.85	..	..	31.03
Molluscs	22.03	25.38	24.75	30.55	25.35	26.00	26.87	27.45	26.83	25.45	27.59	
Echinoderms	16.95	6.15	5.94	8.33	7.35	7.33	7.46	5.88	10.98	..	5.17	
Polychaetes	5.08	3.08	..	3.70	5.63	..	..	3.92	..	6.06	..
Fishes	3.39	5.38	..	10.18	..	3.33	9.96	..	7.31	..	3.45	
Ascidians	..	1.54	..	..	..	..	..	..	..	..	..
Miscellaneous	3.39	1.54	0.99	5.55	2.82	5.66	2.98	..	7.32	3.03	..	
Sand grains	5.08	3.08	2.97	4.63	7.04	6.00	5.97	3.92	3.66	6.06	3.45	

* Egg ribbons of molluscs

TABLE II

Percentage of different food items in the gut contents of *L. lentjan* from hook and line catches during different months at Theedai, Rameswaram, Vedalai and Kilakarai from June 1960 to June 1962

No. of specimens examined	1960							1961					
	June 24	July 35	Aug. 25	Sep. ..	Oct. ..	Nov. 12	Dec. 5	Jan. 6	Feb. 2	Mar. 10	Apr. 8	May 37	June 55
<i>Food items :</i>													
Amphipods	3.70	5.45	..	..	..	3.91	..	14.00	..	..	..	1.22	..
Isopods	..	3.18	..	..	..	..	..	..	..	..	5.88	..	..
Crustacean larvae	..	0.91	..	..	..	3.91	..	10.00	..	7.50	5.88	..	..
Molluscan larvae	..	4.55	..	..	..	—	..	10.00*	..	8.33*	..	..	2.94*
Crabs	44.45	34.09	44.00	..	..	42.19	32.26	32.00	60.00	42.50	35.29	40.24	41.96
Other crustaceans	7.41	6.82	10.00	..	..	7.81	..	4.00	..	4.17	11.77	3.66	3.53
Molluscs	25.93	25.00	26.00	..	..	19.53	74.19	20.00	30.00	16.67	25.53	29.27	33.73
Echinoderms	..	9.09	6.00	..	..	7.81	16.13	..	5.00	8.33	11.77	10.97	10.98
Polychaetes	3.70	..	2.00	..	..	..	..	..	..	..	..	1.22	..
Fishes	7.41	4.55	8.00	..	..	0.78	24.19	4.00	..	4.17	..	6.10	3.53
Ascidians	..	..	..	..	..	7.81	..	..	..	..	..	3.66	..
Miscellaneous	3.70	2.27	..	..	..	2.34	..	..	..	5.00	..	1.22	..
Sand grains	3.70	4.09	4.00	..	..	3.91	3.23	6.00	5.00	3.33	5.88	2.44	3.37

* Egg ribbons of molluscs

No. of specimens examined	1961						1962					
	July 52	Aug. 46	Sept. 21	Oct. 3	Nov. ..	Dec. 9	Jan. 8	Feb. 4	Mar. ..	Apr. ..	May 25	June 27
<i>Food items :</i>												
Amphipods	..	..	..	..	..	5.55	1.67	..	..	..	6.60	2.25
Isopods	..	..	..	..	..	..	1.67	..	..	..	4.40	..
Crustacean larvae	0.97	..	..	..	..	5.55	3.34	..	..	..	2.20	4.50
Molluscan larvae	..	2.06*	..	..	..	..	..	..	..	..	..	..
Crabs	35.15	37.12	45.10	60.00	..	38.85	53.44	46.20	..	..	50.60	58.50
Other crustaceans	4.66	4.12	9.80	..	..	..	..	..	..	..	6.60	11.25
Molluscs	28.16	31.96	25.49	40.00	..	33.30	25.05	42.35	..	..	17.60	13.50
Echinoderms	11.65	9.49	7.85	..	..	11.10	..	7.70	..	..	4.40	4.50
Polychaetes	..	2.06	3.92	..	..	..	8.35	..	..	..	..	..
Fishes	7.77	4.95	..	..	..	..	..	..	..	..	4.40	..
Ascidians	3.88	3.09	..	..	..	..	..	..	..	..	..	..
Miscellaneous	1.94	1.03	1.96	..	..	..	..	..	..	..	..	4.50
Sand grains	2.91	4.12	5.88	..	..	5.55	6.68	3.85	..	..	2.20	2.50

*Egg ribbons of molluscs.

TABLE III

Percentage of different food items in the gut contents of *L. lentjan* from hook and line catches during different months at Tuticorin from June 1961 to June 1962

No. of specimens examined	1961							1962					
	June 22	July 25	Aug. ..	Sept. 20	Oct. 24	Nov. 35	Dec. 30	Jan. 26	Feb. 33	Mar. 29	Apr. 40	May 27	June 22
<i>Food items :</i>													
Amphipods	..	..	..	..	..	..	..	..	1.67	..	..	..	..
Isopods	..	..	..	..	..	..	..	..	..	..	..	..	..
Crustacean larvae	..	..	..	..	..	..	..	..	3.33	..	..	..	..
Molluscan larvae	..	2.78*	..	..	..	..	..	..	..	..	2.59*	1.45*	4.44*
Crabs	51.34	48.61	..	51.43	39.01	40.53	46.27	40.80	31.67	40.66	40.50	32.46	42.22
Other crustaceans	4.48	2.78	..	..	3.70	10.67	7.46	14.00	5.67	3.30	..	2.90	4.44
Molluscs	31.34	30.56	..	25.71	29.63	22.67	28.36	34.00	30.00	35.16	29.31	42.90	35.56
Echinoderms	2.99	8.61	..	8.57	7.41	7.45	5.97	8.00	18.33	5.49	7.76	8.70	8.90
Polychaetes	1.49	..	..	5.71	1.23	..	..	..	1.67	1.10	1.72	..	2.22
Fishes	4.48	3.89	..	5.71	13.58	12.00	8.96	..	3.33	10.99	11.21	5.80	..
Ascidians	..	1.39	..	..	1.73	..	..	..	..	..	2.59	..	..
Miscellaneous	2.99	1.39	..	2.86	1.23	2.67	1.49	..	1.67	1.10	0.86	..	..
Sand grains	2.39	2.78	..	..	2.47	4.00	1.49	3.20	1.67	2.20	3.45	2.90	2.22

* Egg ribbons of molluscs.

TABLE IV

State of stomach (in percentage) in different degrees of fullness in *L. lentjan* from shore seine catches, during August 1960 to July 1962 at Theedai, Rameswaram, Vedalai and Kilakarai

No. of specimens examined	1960					1961						
	Aug. 25	Sept. 16	Oct. 30	Nov. 25	Dec. 20	Jan. 18	Feb. 25	Mar. 22	Apr. 24	May 25	June 8	July ..
<i>Degrees of fullness :</i>												
'Full'	72.00 (18)	68.75 (11)	73.33 (22)	76.00 (19)	70.00 (14)	61.11 (11)	64.00 (16)	54.55 (12)	58.33 (14)	48.00 (12)	37.50 (3)	..
' $\frac{3}{4}$ full'	8.00 (2)	6.25 (1)	..	12.00 (3)	5.00 (1)	..	..	27.27 (6)	4.17 (1)	16.00 (4)	12.50 (1)	..
' $\frac{1}{2}$ full'	16.00 (4)	25.00 (4)	16.67 (5)	8.00 (2)	25.00 (5)	22.22 (4)	32.00 (8)	13.64 (3)	25.00 (6)	32.00 (8)	25.00 (2)	..
' $\frac{1}{4}$ full'	4.00 (1)	..	10.00 (3)	4.00 (1)	..	16.67 (3)	4.00 (1)	4.54 (1)	8.33 (2)	..	25.00 (2)	..
'Empty'	..	..	..	..	..	..	..	..	4.17 (1)	4.00 (1)	..	..

TABLE IV—(contd.)

No. of specimens examined	1961					1962						
	Aug. ..	Sept. 19	Oct. 40	Nov. 35	Dec. 38	Jan. 25	Feb. 18	Mar. 26	Apr. 23	May 28	June 11	July 18
<i>Degrees of fullness :</i>												
' Full '	47.37 (9)	60.00 (24)	42.86 (15)	52.63 (20)	40.00 (10)	66.66 (12)	61.54 (16)	60.87 (14)	46.43 (13)	54.55 (6)	55.55 (10)
' $\frac{2}{3}$ full '	15.79 (3)	10.00 (4)	5.71 (2)	2.63 (1)	16.00 (4)	5.56 (1)	11.54 (3)	..	21.43 (6)	9.09 (1)	5.56 (1)
' $\frac{1}{3}$ full '	36.84 (7)	25.00 (10)	48.57 (17)	26.32 (10)	36.00 (9)	22.22 (4)	26.92 (7)	26.09 (6)	17.86 (5)	27.27 (3)	16.67 (3)
' $\frac{1}{2}$ full '	5.00 (2)	2.86 (1)	13.16 (5)	4.00 (1)	5.56 (1)	..	13.04 (3)	7.14 (2)	..	5.55 (1)
' Empty '	5.26 (2)	4.00 (1)	..	..	..	7.14 (2)	9.09 (1)	16.67 (3)

NBRE.—Figures given in brackets are the number of specimens.

TABLE V

State of stomach (in percentage) in different degrees of fullness in L. lentjan from hook and line catches, during June 1960 to June 1962 at Theedai Rameswaram, Vedalai and Kilakarai

No. of specimens examined	1960							1961					
	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June
	24	35	25	..	..	12	5	6	2	10	8	37	55
<i>Degrees of fullness :</i>													
'Full'	..	5.71 (2)	4.00 (1)	..	..	..	..	16.67 (1)	..	20.00 (2)	..	10.81 (4)	5.45 (3)
' $\frac{3}{4}$ full'	4.17 (1)	8.57 (3)	8.00 (2)	..	..	..	40.00 (2)	..	..	10.00 (1)	25.00 (2)	16.22 (6)	22.73 (7)
' $\frac{1}{2}$ full'	25.00 (6)	51.43 (18)	72.00 (18)	..	..	100.00 (12)	40.00 (2)	50.00 (3)	100.00 (2)	60.00 (6)	62.50 (5)	64.87 (24)	56.36 (31)
' $\frac{1}{4}$ full'	50.00 (12)	25.72 (9)	16.00 (4)	..	..	..	20.00 (1)	..	..	10.00 (1)	..	..	9.09 (5)
'Empty'	20.83 (5)	8.57 (3)	..	..	..	..	..	33.33 (2)	..	..	12.50 (1)	8.10 (3)	16.37 (9)

TABLE V—(contd.)

No. of specimens examined	1961						1962					
	July 52	Aug. 46	Sept. 21	Oct. 3	Nov. ..	Dec. 9	Jan. 8	Feb. 4	Mar. ..	Apr. ..	May 25	June 27
<i>Degrees of fullness :</i>												
'Full'	17-39	23-81 (8)	.. (5)	..	..	12-50 (1)	..	..	..	..	12-00 (3)	7-41 (2)
'½ full'	6-52 (3)	9-53 (2)	..	..	22-22 (2)	11-50 (1)	..	..	..	..	4-00 (1)	11-11 (3)
'¼ full'	44-23 (23)	45-65 (21)	52-37 (11)	66-67 (2)	..	66-67 (6)	62-50 (5)	50-00 (2)	..	..	52-00 (13)	29-63 (8)
'½ full'	40-38 (21)	30-44 (14)	14-29 (3)	33-33 (1)	..	11-11 (1)	..	25-00 (1)	..	..	16-00 (4)	40-74 (11)
'Empty'	15-39 (8)	..	..	..	..	..	12-50 (1)	25-00 (1)	..	..	16-00 (4)	11-11 (3)

NOTE.—Figures given in brackets are the number of specimens.

TABLE VI
State of stomach (in percentage) in different degrees of fullness in L. lentjan from hook and line catches during June 1961—June 1962 at Tuicorin

No. of specimens examined	1961							1962					
	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June
	22	25	..	20	24	35	30	26	33	29	40	27	22
<i>Degrees of fullness :</i>													
'Full'	4.55 (1)	..	..	..	12.50 (3)	11.43 (4)	..	..	3.03 (1)	6.90 (2)	5.00 (2)	..	..
' $\frac{3}{4}$ full'	18.18 (4)	32.00 (8)	..	30.00 (6)	37.50 (9)	37.14 (13)	36.66 (11)	15.38 (4)	15.15 (5)	31.05 (9)	12.50 (5)	22.22 (6)	13.63 (3)
' $\frac{1}{2}$ full'	54.55 (12)	44.00 (11)	..	45.00 (9)	41.66 (10)	40.00 (14)	40.00 (12)	30.77 (8)	42.43 (14)	31.05 (9)	62.50 (25)	51.85 (14)	31.82 (7)
' $\frac{1}{4}$ full'	13.63 (3)	12.00 (3)	..	15.00 (3)	8.33 (2)	11.43 (4)	20.00 (6)	38.47 (10)	39.39 (13)	20.70 (6)	20.00 (8)	25.93 (7)	36.37 (8)
'Empty'	9.09 (2)	12.00 (3)	..	10.00 (2)	..	..	3.33 (1)	15.38 (4)	..	10.35 (3)	..	..	18.18 (4)

NOTE.—Figures given in brackets are the number of specimens.

In order to assess the feeding intensity of mature fish (collected from Tuticorin) during the different months of the years 1961 and 1962, the 'feeding index' (Tham Ah Kow, 1950) was worked out. This index has been successfully applied by Venkataraman (1960) while studying the food and feeding relationship of the fishes off Calicut on the Malabar Coast. 'Feeding index' for any one particular month is the ratio of the number of fishes whose feeding intensity was either 'full' or $\frac{3}{4}$ full' to the number of specimens examined during that month multiplied by 100. The results are presented in Table VII.

TABLE VII

'Feeding Index' values for L. lentjan in different months during June 1961 to June 1962 at Tuticorin

Year and month	Value of 'Feeding index'
1961	
June	22.72
July	32.00
August	30.00
September	30.00
October	50.00
November	48.55
December	40.00
1962	
January	15.38
February	18.18
March	37.33
April	55.55
May	22.22
June	14.28

From Table VII it may be seen that during June 1961 to June 1962 the 'feeding index' was high in October, November and December 1961 and in

March and April 1962. There is fall in the 'feeding index' from November 1961 to January 1962. The maximum value of 'feeding index' was noticed in April 1962, and the lowest during June 1962 (Fig. 1).

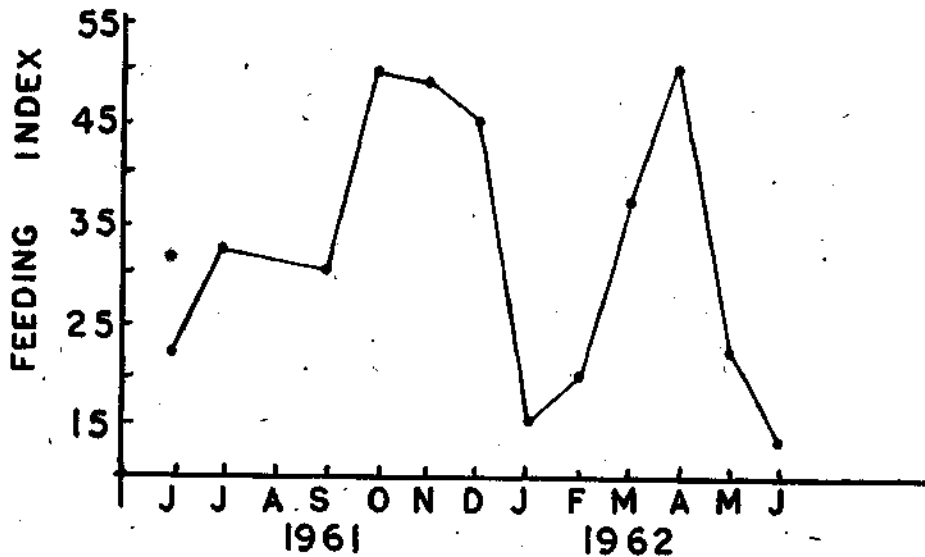


FIG. 1 Graph showing feeding index for thirteen months, June 61 to June 62

As the rise and fall in 'feeding index' of mature fish do not strictly coincide with spawning period (June to August and December to February—Toor, 1963), it is rather difficult to conclude whether the fall in the 'feeding index' is entirely due to the spawning activity of the fish, even though reduced feeding activity was noticed in spawners.

Occurrence of the food items in different size groups of fish :

Since the fish examined during the present study covered a wide range of size, *i.e.*, 40 mm. to 502 mm. in total length, the food analysis showed differences in the feeding habits of the fish in relation to their sizes. The fishes were grouped at 25 mm. interval. The percentage occurrence of various food items recorded in the gut contents of the fish in different size groups is shown in Table VIII. The relative occurrence of the important food items of the fish in different size groups is also shown graphically (Fig. 2).

The data presented in Table VIII indicate that the fish below 50 mm. had amphipods in their gut contents. They were completely absent in fish above 300 mm. Isopods were recorded in fish up to 225 mm. in size. Crustacean larvae were very common in the food of the fish measuring up to 100 mm. in total length and gradually their percentages of occurrence fell to 2.74% and they never occurred in the fish above 250 mm. Molluscan larvae

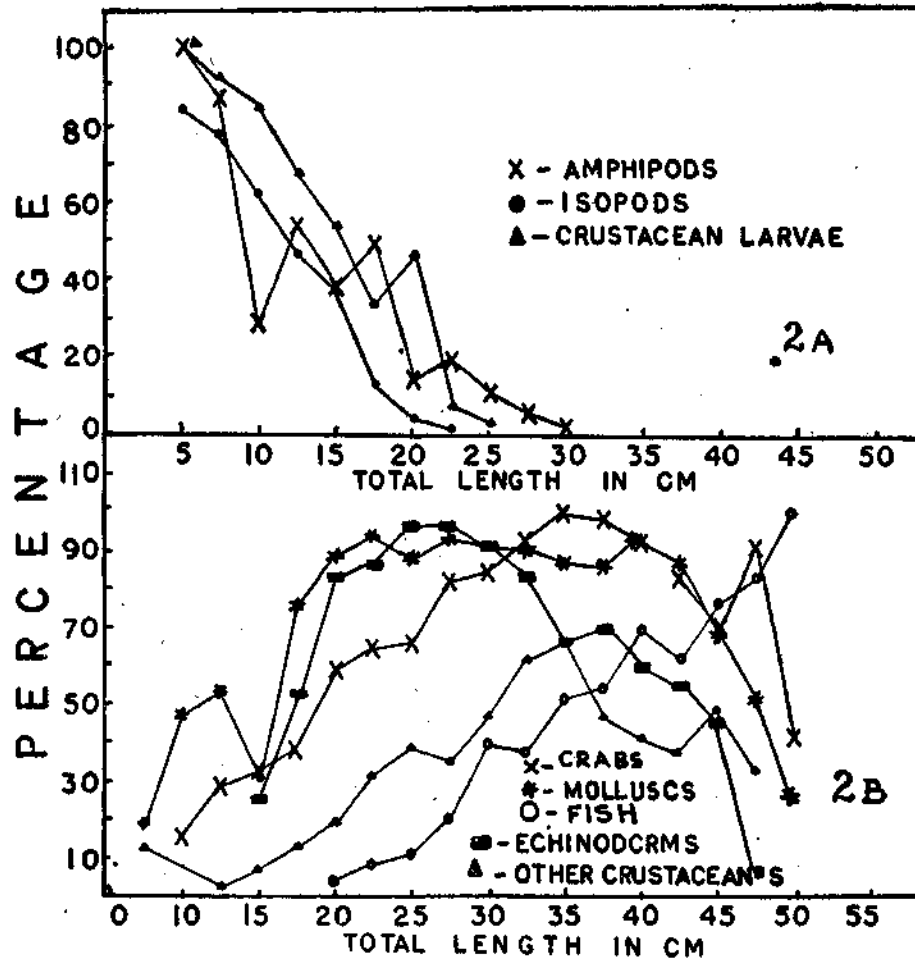


FIG. 2A & 2B. The relative importance of food items in various size groups of *Lethrinus lentjan*.

mainly constituted the food of juveniles and were not represented in the food of the fish above 150 mm. Crabs occurred in very high percentages especially in case of fish above 200 mm., but they were never eaten by fish below 75 mm. Other crustaceans (*Squilla*, *Alpheus*, prawns) were taken by the fish above 75 mm. Molluscs were present in the food of the fish above 100 mm. Echinoderms (echinoids, ophiuroids) were noticed in the stomachs of the fish above 150 mm. The data also indicate that the fish above 175 mm. up to 325 mm. rarely fed on fishes, while more than 50% of the fish above 350 mm. consumed fishes as their food and about 82% of the fish above 475 mm. were found to be fed on fishes. Polychaetes were observed in the food of fish above 175 mm. Ascidiars occurred in the food items of the fish above 275 mm. Egg-ribbons of molluscs were also found as one of the food items of the fish above 175 mm.

TABLE VIII

The percentage occurrence of different food items in gut contents of L. lentjan in various size groups

Size Group (T.L.)mm.	N	Amphi- pods	Isopods	Crusta- cean larvae	Mullus- can larvae & egg ribbons	Crabs*	Other crusta- ceans	Molluscs	Echino- derms	Fishes	Poly- chaetes	Asci- dians
1	2	3	4	5	6	7	8	9	10	11	12	13
25—50	12	100.00	83.30	100.00	58.31	..	..	..	..	..	..	..
51—75	74	86.45	77.14	93.10	63.84	..	11.32	18.48	..	..	..	..
76—100	65	28.54	62.56	84.32	40.80	14.94	..	47.04	..	..	..	..
101—125	102	54.36	47.25	67.20	9.80	28.46	1.54	53.10	..	..	..	..
126—150	85	38.76	39.68	53.76	4.80	32.80	6.84	30.78	25.65	..	..	..
151—175	90	49.76	13.52	33.80	2.28*	37.84	12.76	76.56	53.36	..	..	..
176—200	86	13.92	4.46	46.80	..	59.57	18.59	88.66	82.94	3.48	1.16	..
201—225	70	18.02	1.43	5.88	..	64.80	30.14	94.53	85.90	7.15	..	..
226—250	73	10.96	..	2.74	5.48*	66.24	37.44	87.36	96.72	10.96	..	..
251—275	64	4.78	..	..	3.12*	81.92	34.56	92.16	96.00	20.28	17.16	..
276—300	78	1.28	..	..	..	84.56	46.81	90.60	90.60	40.70	9.06	1.51
301—325	66	..	..	..	12.98*	92.78	61.88	94.01	83.30	37.75	6.57	6.04
326—350	84	..	..	..	2.38*	100.00	66.01	86.94	66.01	51.17	..	..
351—375	62	..	..	..	9.66*	97.92	46.92	85.68	69.36	54.74	..	..

TABLE VIII—(contd.)

1	2	3	4	5	6	7	8	9	10	11	12	13
376—400	49	..	..	..	1.85*	92.50	42.55	92.50	59.20	54.12	8.16	..
401—425	54	..	..	..	..	83.80	37.80	86.40	54.00	70.38	..	1.85
426—450	37	..	..	..	10.36*	79.35	48.30	69.00	44.85	62.10	..	5.40
451—475	29	..	..	..	..	90.75	33.00	49.50	4.95	75.90	3.45	..
476—500	16	..	..	..	..	41.25	..	24.74	..	82.50	16.50	8.25
501—525	1	..	..	..	..	..	..	..	..	100.00	..	..

N—Number of fishes examined.

*—Egg-ribbons of molluscs.

Qualitative analysis of food of the different species of the Family Lethrinidae:

Herdmann (1906), Southwell (1910) and Hornell (1916) have reported that *Lethrinus* spp. feed on pearl oysters. In view of these earlier reports it was felt desirable to analyse the food of the fishes of the family Lethrinidae usually caught in and around pearl oyster beds at Tuticorin. The qualitative analyses of the food items of six species, viz., *Lethrinus nebulosus*, *L. mahsena*, *L. caeruleus*, *Lethrinella miniatus*, *L. microdon* and *L. variegatus* were made to assess the extent of predation of these fishes. The results are presented in Table IX.

TABLE IX

Qualitative analysis of the food of the different species of the Family Lethrinidae

Species	No. of fishes examined	Size range (S.L.) mm.	No. of fishes having oyster remains in the stomachs	Food items
<i>Lethrinus nebulosus</i>	45	300—460	3	Crab appendages; <i>Squilla</i> ; prawns; molluscs (bivalves and gastropods); ophiuroids polychaetes.
<i>L. mahsena</i>	4	190—231	..	Crustacean appendages; broken shells of gastropods.
<i>L. caeruleus</i>	11	250—393	..	Crustacean appendages; molluscs (bivalves and gastropods—one; complete shell of <i>Phalium canaliculatum</i> ; echinoderms (<i>Echinodiscus</i> , ophiuroids) fish; egg-ribbon of molluscs.
<i>Lethrinella miniatus</i>	32	285—550	5	Crustaceans (crabs, <i>Squilla</i> prawns); molluscs (bivalves and gastropods); polychaetes fishes.
<i>L. microdon</i>	24	182—384	3	Crustaceans (<i>Squilla</i> , alpheids, prawns); molluscs (mostly gastropods); echinoderms (<i>Echinodiscus</i> , ophiuroids); fishes.
<i>L. variegatus</i>	8	190—282	..	Crustacean appendages; egg-ribbons of molluscs; broken shells of molluscs (bivalves, gastropods).

The data presented in Table IX indicate that these fishes very rarely feed on pearl oysters. The proportions of the oyster remains were very low and

they were negligible when compared to the proportions of other food items of the fishes. These observations have further revealed that the fishes of the family Lethrinidae are carnivorous, bottom feeders and show special preference to crustaceans, molluscs and echinoderms. Although the species like *Lethrinella miniatus* and *L. microdon* had fishes as one of the food items in their gut contents, they did not constitute the major part of their food.

DISCUSSION

The observations made by Al-Hussaini (1947), Devanesan and Chidambaram (1948) and Wheeler (1953) indicate that lethrinids are carnivorous, bottom feeders, quite selective in their feeding. Al-Hussaini (*op. cit.*) examined the food of *L. nebulosus* and *L. mahsena* from the Red Sea and recorded a mixture of crustaceans, brittle-stars, chitons, sea urchins, gastropods and fish, as the food of the fishes. He further stated that the crustaceans seem to be their favourite prey and they exercise selection to greater extent. Devanesan and Chidambaram (1948) mentioned crabs, prawns and molluscs as food of *Lethrinus nebulosus*. Wheeler (1953) in his report on the Mauritius-Seychelles Fisheries Survey (1948-49) dealing with bottom fishes of economic importance, had recorded the following food items in the stomachs of *Lethrinus ramak*: echinoderms (sea urchins, starfish, ophiuroids, crinoids and holothurians); crustacean remains; fishes (*Balistes* spp., *Coris* spp., *Serranus fasciatus*, *Scarus* spp., eels, *Diodon* spp., and *Ostracion* spp.); molluscs (Octopus or squid, lamellibranchs and gastropods, nudibranch); sipunculids; nemerteans; polychaetes; ascidians; sponges; pieces of coral and sand grains. The present investigations have revealed that *Lethrinus lentjan* also is a carnivorous, bottom feeder. The fish feeds mainly on crustaceans and the second preference seems to be molluscs and these are supplemented by echinoderms, fishes and polychaetes.

The qualitative analyses of the food of allied species, *i.e.*, *Lethrinus nebulosus*, *L. caeruleus*, *L. mahsena*, *Lethrinella miniatus*, *L. microdon* and *L. variegatus*, concurrently made from the same area and far off places showed that the food items in their stomachs were almost identical. Thus it may be said that the fishes of family Lethrinidae show special liking for crabs, molluscs and echinoderms. However, it was observed that fishes of the genus *Lethrinella* show piscivorous tendencies.

Herdmann (1906) has pointed out that *Balistes* sp. and *Lethrinus* sp. feed upon immature oysters. Hornell (1916) has also reported that fishes like *Balistes*, *Lethrinus*, *Serranus*, *Tetrodon* and *Rhinoptera* spp. are the predators on pearl oysters. The qualitative analyses of the food of the six species of the family Lethrinidae collected from the pearl oyster beds off Tuticorin, showed rare occurrence of pearl oysters in their stomachs suggesting thereby that the lethrinids are not serious depredators to pearl oysters in this locality.

SUMMARY

From the foregoing account of food and feeding habits of *L. lentjan*, it is evident that the fish is a carnivorous, bottom feeder.

The food of the fish mainly consists of crabs (*Brachyura*, other crustaceans, amphipods, *Squilla*, prawns and alpheids) molluscs, echinoderms, polychaetes and fishes (*Balistes*, *Diodon* and *Otolithus*).

The relative importance of various food items during different months shows that the fish do exercise selection while feeding. Crustaceans and molluscs constitute the bulk of the food of *L. lentjan*.

It is interesting to note that there was no evidence of cessation of feeding during spawning season, although the feeding activities of spawners were low.

The data do not reveal any variation in the food composition of *L. lentjan* from the Palk Bay and the Gulf of Mannar.

The stomachs of the fish collected from shore seine catches were generally full whereas the stomachs of those fishes caught on hook and line were usually '¼ full' or '½ full'. Not a single case of regurgitation was noticed during the course of this investigation.

The qualitative analyses of the food of the six species of the family Lethrinidae collected from the pearl oyster beds off Tuticorin have revealed that Lethrinids are not serious depredators to pearl oysters in the Palk Bay and Gulf of Mannar. Probably, these fishes perform useful function as they feed on *Balistes*, one of the predators of pearl oysters.

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