

OBSERVATIONS ON THE FOOD AND FEEDING HABITS OF *PARASTROMATEUS NIGER* (BLOCH) OF THE SAURASHTRA COAST

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INTRODUCTION

The pomfrets belonging to the family *Stromateidae* form a major fishery along the Saurashtra coast. Of these the Brown Pomfret, *Parastromateus niger* (Bloch) occurring during September-November and April-May, and the Silver Pomfret, *Pampus argenteus* (Euphrasen) occurring during December-March, are the most important. A third species, *Pampus chinensis* (Euphrasen) occurs only occasionally. Being esteemed tablefish of great demand, they are intensively fished along this coast. Gokhale (1960) giving the catch statistics of pomfrets in Saurashtra, has stressed the importance of studies on the biology of these fish for the rational exploitation of the stock.

Our knowledge on the biology of the pomfrets is very meagre, being restricted to the general account given by Chidambaram and Venkataraman (1946), Moses (1947), Devanesen and Chidambaram (1948) and other fisheries reports. Roze (1958) made a preliminary study on the biology and parasites of *P. argenteus* in the Bombay waters. Kulkarni (1958) studied the alimentation in this species in relation to food. Basheeruddin and Nayar (1961) gave a brief account on the food and growth rate of juveniles of *P. niger* of the Madras coast. It would appear from the above literature survey that practically no work has been done on the biology of *P. niger*. Detailed investigations were therefore made on the biology and fishery of *P. niger* at Veraval on the Saurashtra coast during 1961-63. The present paper deals with the food and feeding habits of this fish.

I am thankful to Dr. S. Jones, Director, Central Marine Fisheries Research Institute, Mandapam for suggesting the problem and providing all the facilities. My thanks are also due to Shri K. Virabhadra Rao, Senior Research Officer, for going through the paper and offering valuable suggestions.

MATERIALS AND METHODS

Samples of *P. niger* were obtained at weekly intervals from the gillnet catches at Veraval, which is the most important fishing centre of the Saurashtra coast. A few samples were also taken from the catches of the exploratory fishing vessels operating off Madhwad, Mangrol and Porbandar which are other fishing centres of the region.

The fish forms a major fishery during April-May and September-November. It is landed in stray numbers in other months except in the monsoon period from June to August when there is no fishing at all. Samples were collected from the commercial catches in all the months when they occurred, but they were particularly large during the period of fishery.

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A total number of 533 stomachs preserved in 5% formalin were examined for the study of food. The stomach contents were analysed by the modified Points method (Swynnerton and Worthington, 1940 ; Frost, 1943 ; Hynes, 1950 ; Pillay, 1952) : Depending upon the degree of fullness each stomach was classified as gorged, full, $\frac{3}{4}$ full, $\frac{1}{2}$ full, $\frac{1}{4}$ full and with traces and allotted 30, 20, 15, 10, 5, and 2 points respectively. The points so allotted were distributed to different food items depending upon their proportionate volume. All the points for each item were added up and converted into percentages of the total number of points allotted for all items in different months or size-groups as the case may be. This method would give a rather exaggerated value for the "soft" bodied forms like the thaliaceans as compared to other "solid"-bodied forms in terms of real mass. But as the gravimetric method is time-consuming and as it is difficult to weight very small quantities of food items, the points method was followed.

Notwithstanding certain drawbacks such as small size or lack of samples in certain months, and the difficulty in the identification of food species, the present study gives a fairly good picture of the food and feeding habits of the fish. The fork length was taken into account for all analyses in this paper.

FOOD AND FEEDING HABITS

(i) *The stomach contents of P. niger*

The stomach contents were analysed qualitatively and quantitatively. The food was highly macerated and mostly in an advanced state of digestion. Because of this the specific identification of the food items was difficult and there was also a high proportion of pulpy semidigested matter. The presence of the pulpy matter in the pomfret stomach was noted by other authors also (Rege, 1958; Basheeruddin and Nayar, 1961).

The present study however reveals that *P. niger* is carnivorous, feeding mostly on zooplankton. The mean percentage composition of the stomach contents for the whole period of investigation is as follows: thaliaceans 42.8, prawns 14.8, fish scales 6.7, crustacean larvae 4.0, amphipods 3.7, other crustaceans 1.1, cuttlefish remains 0.7, polychaetes 0.4, medusae 0.2, semidigested matter 25.6. This shows the relative importance of various groups as food of *P. niger*. The semidigested matter, though listed as one of the items for the purpose of a quantitative analysis, does not belong to any particular group. But its constant occurrence and high proportion in the pomfret stomach irrespective of the size of fish or the time of capture is remarkable.

The thaliacea were the most abundant items in the stomach contents of *P. niger* and they included solitary and aggregate forms of many species of salps. *Jasis zonaria* was the most important among them, other species being *Pegea confoederata*, *Salpa cylindrica* and *Thalia* sp. These species were commonly met with in the plankton collected from the fishing grounds.

Crustaceans including many groups were next in importance in the diet of *P. niger*. Prawns, shrimps (*Acetes* sp.) and amphipods formed a major portion of the food. Crustacean larvae mainly represented by stomatopod larvae besides phyllosomae, megalopae and zoeae, were present in considerable quantities. Other crustaceans, such as *Lucifer*, mysids, ostracods and copepods were also observed occasionally.

TABLE I
Showing seasonal variation in the food as shown by percentages of different food items in the stomachs during different months

Year & month . . .	1961			1962									1963					
	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May
No. of fish . . .	18	18	15	5	2	5	23	16	34	62	54	49	103	30	30	15	38	16
Percent of empty stomachs . . .	5.5	50.0	..	..	50.0	..	21.8	56.3	26.5	58.1	27.7	32.6	25.2	16.6	20.0	33.3	36.8	50.0
1. Thaliaceans . . .	22.9	16.9	77.8	10.0	..	..	17.0	2.9	38.3	31.4	86.9	54.2	23.3	46.0	14.5	71.2	..	9.1
2. Prawns . . .	2.3	20.3	..	20.0	..	..	2.1	29.4	3.1	5.6	4.0	14.7	33.6	..	15.5	..	10.1	..
3. Amphipods . . .	2.3	..	8.0	10.0	..	..	8.5	2.9	5.5	15.0	2.9	2.7	2.5	..	..	7.6	..	..
4. Stomatopod larvae	33.3	22.0	..	..	..	..	6.4	14.7	12.5	4.2	1.3	..	..	..	..	..	15.2	13.6
5. Phyllosomae . . .	1.2	..	..	..	..	..	..	..	..	2.6	..	..	..	..	..	..	..	..
6. Megalopae . . .	..	..	..	..	..	..	..	..	6.6	0.3	..	..	..	..	..	..	..	..
7. Zoeae . . .	..	..	1.2	..	..	..	..	..	0.8	..	..	..	..	..	..	..	..	..
8. Lucifer . . .	..	..	..	..	..	..	..	..	..	0.3	..	..	..	..	..	..	..	..
9. Mysids . . .	..	..	..	..	..	..	..	..	..	0.3	..	..	..	..	..	..	..	..
10. Copepods . . .	..	..	..	..	..	..	..	..	3.5	0.3	..	2.1	1.8	..	..	..	..	..
11. Ostracods . . .	..	..	..	..	..	..	..	1.5	..	..	..	..	..	..	..	..	..	..
12. Polychaetes . . .	..	..	..	..	..	..	..	..	..	..	0.6	..	1.0	..	..	..	..	..
13. Cuttlefish . . .	..	..	..	..	..	..	..	14.7	..	..	..	..	1.9	..	..	..	..	..
14. Medusae . . .	..	..	..	..	..	..	..	..	0.8	..	..	1.3	..	..	..	..	..	..
15. Fish scales . . .	2.3	..	..	..	..	..	2.1	..	..	1.3	..	4.8	13.2	16.2	26.9	..	..	..
16. Semidigested matter	35.7	40.8	13.0	60.0	100.0	100.0	63.9	33.9	28.9	38.7	4.3	20.2	22.7	36.9	44.1	21.2	74.7	77.3

Polychaetes, cuttlefish remains and medusae were noticed occasionally. Fish scales were also present in good quantities in the stomach contents.

(ii) *Seasonal variation in the food of P. niger*

The percentage composition of various food items during different months is given in Table I to show the variation in the groups comprising the food and their proportion.

Thaliaceans formed the major item in the stomach contents, supplemented by stomatopod larvae. Prawns, amphipods, phyllosomae, zoeae and fish scales were present in lesser quantities during October to December 1961.

During 1962, as also in the previous year, thaliaceans, prawns and amphipods formed the bulk of the stomach contents. Stomatopod larvae occurred in considerable quantity during April to October, phyllosomae, megalopae and zoeae only during August to September, traces of *Lucifer* and mysids in September, ostracods in May, a few copepods during August to December, cuttlefish remains in May and December, medusae in August and November and fish scales in considerable proportion during November-December.

During 1963, fish were examined only during January to May. Thaliaceans were predominant from January to March, while stomatopod larvae were important in April, May. Other items observed were prawns, amphipods and fish scales which occurred in considerable quantities.

(iii) *Composition of food in different size-groups of P. niger*

The size range of *P. niger* examined during the period of study was 10.1 to 52.1 cm. The fish were all grouped into 5 cm sizegroups and the percentage composition of food of fish in each size-group was calculated. These data presented in Table II show the preferential feeding by different size-groups of the fish.

Thaliaceans were an important item of food in all size-groups of the fish. But they were very predominant in fish above 20 cm and conspicuously low in fish below that size. The maximum of 85.9 was noticed in 25-30 cm. group.

Prawns were present in almost all the size-groups and they constituted a high percentage of the diet of smaller fish of 15-20cm.

Amphipods were a regular food of considerable importance in fish above 20 cm. while they occurred in very low quantities in the smaller fish.

Stomatopod larvae were observed in fish of all sizes. However they were in greater abundance in the smaller size-groups, particularly in 20-25 cm group. Phyllosomae, megalopae and zoeae occurred in small quantities in fish ranging from 30-50 cm in size.

Other crustaceans, polychaetes, cuttlefish remains and medusae occurred in small quantities in haphazard manner among various sizes of fish.

There was a high percentage of fish scales in fish ranging from 10-25 cm, but low among other size groups.

TABLE II

Showing variation in the food of different size-groups of fish, as shown by percentages of different food items in the stomachs

Size-groups (cm.)	10—15	15—20	20—25	25—30	30—35	35—40	40—45	45—50	50—55	Average
Number of fish	38	136	15	50	127	105	50	10	2	533
Percent of empty stomachs	52.6	22.8	26.7	34.0	33.8	28.5	32.0	30.0	..	27.2
1. Thaliaceans	12.6	16.7	58.9	85.9	55.7	57.2	38.0	54.4	25.0	42.8
2. Prawns	4.0	33.1	3.9	..	6.9	3.1	4.9	7.0	..	14.8
3. Amphipods	0.6	1.1	7.8	3.8	3.9	6.8	5.6	10.5	..	3.6
4. Stomatopod larvae	6.8	1.5	10.8	0.9	2.3	5.0	7.6	3.5	..	3.3
5. Phyllosomae . . . . .	..	..	..	..	..	..	2.3	1.8	..	0.2
6. Megalopae . . . . .	..	..	..	..	0.1	1.4	..	2.6	..	0.3
7. Zoeae . . . . .	..	..	..	..	0.4	0.2	..	..	..	0.1
8. Lucifer . . . . .	..	..	..	..	..	..	..	0.9	..	0.02
9. Mysids . . . . .	..	..	..	..	0.2	..	..	0.9	..	0.05
10. Copepods	4.0	1.5	..	..	0.1	0.6	0.6	0.9	..	1.0
11. Ostracods . . . . .	..	..	0.4	..	..	..	..	..	..	0.01
12. Polychaetes . . . . .	..	0.8	..	..	0.6	..	..	..	..	0.4
13. Cuttlefish . . . . .	..	1.5	3.9	..	..	..	..	..	..	0.7
14. Medusae	1.1	0.3	..	..	..	..	0.6	..	..	0.2
15. Fish scales	10.3	14.8	10.1	..	0.4	1.6	1.2	..	..	6.7
16. Semidigested matter	60.6	28.7	4.2	9.4	29.4	24.4	39.2	17.5	75.0	25.6

(iv) Intensity of feeding and incidence of empty stomachs

The intensity of feeding as shown by the average number of points per stomach, and the incidence of empty stomachs in percentage during different months are given in Table III. This gives a picture of the general feeding activity of *P. niger*.

It can be seen that the intensity of feeding was generally low, ranging from 1.0 to 10.8 points per stomach compared to 20 points allotted for a full stomach. The incidence of empty stomachs was also high, its highest value being 58%. The feeding intensity was comparatively high during the post-monsoonic months, October to December, when the incidence of empty stomachs was low. During other months the feeding intensity was low, but the incidence of empty stomachs high.

GENERAL OBSERVATIONS

The present study of the food of the Brown Pomfret reveals that it is carnivorous, feeding on larger zooplanktonic organisms. Basheeruddin and Nayar (1961) recorded white pulpy matter, scales and bones of fishes, copepods and *Acetes* in the stomachs of juveniles of *P. niger* in Madras waters. Except for this there is no information on the food of this fish. However, some information is available on the food of the Silver Pomfret, *P. argentus*. Suyehiro (1942) observed some gelatinous substance and medusae in the stomach of this fish in Japanese waters. Rege (1958) noticed salps, hydromedusae, amphipods, copepods, shrimps and small fish besides gelatinous material among the stomach contents, but he did not make a quantitative study of the food. Kulkarni (1958), besides making a quantitative study of the food, correlated the structural modifications of alimentary canal with the food and feeding habits of the fish. He recorded a high percentage of tunicates besides prawns, copepods, isopods, medusae and fishes.

It will be seen that *P. niger* takes similar items of food as *P. argentus*. But the former does not appear to feed on fishes although fish scales are noticed in the stomachs. The crustacean larvae which form an important food of *P. niger* are not taken by *P. argentus*. Minor crustaceans such as *Lucifer*, mysids, ostracods etc., polychaetes and cuttle fish form stray food only in the former fish.

It is well-known that there is often a positive correlation between the quantity and the specific type of plankton and the abundance of fish (Hela and Laevastu, 1961, p. 66), and that some food species can be used as indicators of the abundance of the fish. In Indian waters, Nair and Subramanyan (1955) and Seshappa and Bhimachar (1955) reported the probability of such indicators for the Oil Sardine and the Malabar Sole. In the case of *P. niger* the thaliaceans are the most important item of food among which the salp, *Jasiszonaria* is the commonest. It is possible that this species can be utilized as an indicator of the abundance of *P. niger*, though no quantitative data were collected to support this view. It is the common practice of the Saurashtra fishermen to look for the jellylike salps and medusae before shooting their driftnets for a bumper catch of Brown Pomfrets. In the case of *P. argentus* the ctenophores and medusae may prove to be indicator organisms (Chopra 1960).

TABLE III

Showing size-range and number of fish examined, incidence of empty stomachs and feeding intensity during different months

Months	Size range (cm.)	No. of fish	% of empty stomachs	Feeding intensity (points per stomach)
October 1961	17.8—50.4	18	5.56	4.58
November	10.3—32.9	18	50.00	3.27
December	24.3—40.5	15	..	10.80
January 1962	31.5—34.7	5	..	4.00
February	16.3—45.6	2	50.00	1.00
March	35.4—39.5	5	..	2.00
April	22.7—46.2	23	21.82	2.04
May	12.2—41.7	16	56.25	2.12
August	27.0—46.8	34	26.27	3.76
September	26.0—46.0	62	58.06	2.48
October	19.8—52.1	54	27.77	8.77
November	10.1—40.6	49	32.65	7.61
December	12.0—38.1	103	25.24	7.64
January 1963	15.7—37.0	30	16.66	3.74
February	14.3—20.5	30	20.00	5.06
March	27.9—38.9	15	33.33	4.40
April	29.7—44.8	38	36.84	2.08
May	30.0—37.5	16	50.00	1.37

SUMMARY

Studies on the food and feeding habits of *P. niger* off Veraval, show that the fish is a carnivore and that it feeds mostly on large zooplanktonic organisms.

Thaliaceans were the most important food, supplemented by prawns, amphipods and crustacean larvae. Other crustaceans, polychaetes, cuttlefish, medusae etc. formed only occasional food of the fish.

The smaller fish preferred prawns and stomatopod larvae while the larger fish preferred thaliaceans, amphipods and other crustaceans.

Feeding intensity in general was low. The incidence of empty stomachs was low during October to December and high in other months.

REFERENCES

- Basheeruddin, S. and Nayar, K. N. (1961). A preliminary study of the juvenile fishes of the coastal waters off Madras city. *Indian J. Fish.*, 8(1) : 169—188.
- Chidambaram, K. and Venkataraman, R. S. (1964). *Tabular statement of the natural history of certain marine food fishes of the Madras Presidency—West coast.* Govt. Press, Madras.
- Chopra, S. (1960). A note on the sudden outburst of ctenophores and medusae in the waters off Bombay. *Curr. Sci.*, 29(10) : 392—393.
- Devancsen, D. W. and Chidambaram, K. (1948). *The common food fishes of the Madras Presidency.* Govt. Press, Madras.
- Directorate of Fisheries, Gujarat state (1960). *The Fishing Industry of Gujarat*, Ahmedabad.
(1961). *Fisheries of Gujarat*, Ahmedabad.
- Frost, W. E. (1943). The natural history of minnow, *Phoxinus phoxinus*. *J. Anim. Ecol.*, 12 : 139—162.
- Gokhale, S. V. (1960). Need for fisheries research in Gujarat. In 'The Fishing Industry of Gujarat', Ahmedabad.
- Hela, I. and Laevastu, T. (1961). *Fisheries Hydrography.* Fishing News (Books) Ltd., London.
- Hynes, H. B. N. (1950). The food of the fresh water sticklebacks (*Gasterosteus aculeatus* and *Pygosteus pungitius*) with a review of methods used in studies of the food of fishes. *J. Anim. Ecol.*, 19 : 36—58.
- Kulkarni, A. V. (1958). *Studies on alimentation and rate of digestion in some of the teleosts of Bombay.* M. Sc. Thesis, University of Bombay.
- Moses, S. T. (1947). Baroda Fisheries. *Bull. No. XI, Dept. of Fisheries, Baroda State.*
- Nair, R. V. and Subrahmanian, R. (1955). The diatom, *Fragilaria oceanica* Cleve, an indicator of abundance of the Indian Oil Sardine, *Sardinella longiceps* (Cuv. and Val.). *Curr. Sci.* 24 (2) : 41—42.
- Pillay, T. V. R. (1952). A critique of the methods of study of food of fishes. *J. zool. Soc. India*, 4 (2) : 186—200.
- Reje, M. S. (1958). *A study of the Stromateid fishes of Bombay.* Ph. D. Thesis, University of Bombay.
- Seshappa, G. and Bhimachar, B. S. (1955). Studies on the fishery and biology of the Malbar Sole, *Cynoglossus semifasciatus* Day. *Indian J. Fish.*, 2 (1) : 180—230.
- Suyehiro, Y.* (1942). A study on the digestive system and feeding habits of fish. *Japan. J. Zool.*, 10.
- Swynnerton, G. H. and Worthington, E. B. (1940). Note on the food of fish in Haweswater (Westmorland). *J. Anim. Ecol.*, 12 : 183—187.

*Not Consulted in original.