

FOOD AND FEEDING HABITS OF *PENAEUS SEMISULCATUS* DE HAAN AT MANDAPAM

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ABSTRACT

Penaeus semisulcatus feed on a variety of food items viz., polychaetes, crustaceans, molluscs diatoms, foraminiferans and radiolarians, eventhough, detritus and sand formed bulk of the stomach contents. There was marked difference in the food composition of the species from the Palk Bay and Gulf of Mannar. Actively fed prawns were found to be more in the night catches. The species do not exhibit preference to any particular food item. It is concluded that the abundance of a particular food item was dependent on its availability during the season when they are predominant. There was no significant difference in the food and feeding habits in the various size groups.

INTRODUCTION

From the studies on the food of commercially important prawns of India, by Gopalakrishnan (1952), Menon (1951, 1953), Kunju (1955), Panikkar and Menon (1956), George (1959, 1976), Ibrahim (1962), Subrahmanyam (1963), Rao (1967), Thomas (1973) and Kuttyamma (1974), the food in general is believed to consist of bottom living organisms and organic detritus mixed with sand and mud of the bottom where they feed. Mainly diatoms, algae, polychaetes, crustaceans and molluscs are reported from the gut contents. The omnivorous habit has been emphasised by several workers while others hold that prawns are carnivorous feeding on a variety of small bottom living animals. Hall (1962) observed that the food of *Penaeus semisulcatus* from Singapore consisted of polychaetes, crustaceans, molluscs, pisces and vegetable matter, in the order of importance. The results of the detailed study of the food and feeding habits of *P. semisulcatus* from Mandapam area are presented here.

MATERIAL AND METHODS

Regular samples were collected over the period from April 1967 to March 1969 from the trawl catches at Mandapam. Samples from Palk Bay and Gulf of Mannar were analysed separately, as preliminary examination revealed difference in the nature and importance of the individual food items from the two areas.

The extent of feeding was determined by the degree of distension of the stomachs due to the quantity of food inside the cardiac portion of the stomach. The condition of feed was expressed as gorged, full, three-fourth full, half-full, quarter-full, trace and empty and each was assigned 100, 80, 60, 40, 20, 10 and 0 points, respectively. The cardiac portion of the stomach was cut open and the contents examined under a microscope. Percentages of occurrence of the various conditions of feeding were calculated from the conditions of individual prawns. Depending on the relative volume of each item, points were given for each food item and from these volume of each food item was calculated. The percentage volume was then computed for the individual items. The percentage occurrences of different food items were determined from the total number of occurrences of all items in each month. The indices of preponderance were computed (Natarajan and Jhingran 1961) which were taken to indicate the food preferences of the prawns.

QUANTITATIVE AND QUALITATIVE ANALYSIS

During the present study, 689 stomachs of *P. semisulcatus* from Mandapam — Palk Bay and Gulf of Mannar — were analysed. The composition of the food and abundance of the individual items varied between stomach contents of specimens from Palk Bay and Gulf of Mannar. This may be due to the difference in the nature of the sea bottom. In Palk Bay, the sea bottom was either sandy or muddy or sandy with soft mud while in the Gulf of Mannar, the bottom was hard with rocks and coral reefs around the numerous small islands, although, in certain areas it was sandy with little mud.

Diatoms: This item was present in the stomach contents in small quantities. In June, July and September they occupied third, fifth and fourth places in specimens from the Palk Bay (Table 1). The species present were *Coscinodiscus* spp., *Pleurosigma elegans*, *P. normani* and *P. angulatum*. The same pattern was found during the second year of observation also.

Radiolarians: Shells of Radiolaria were present in very small quantities during the months of May, July, August, October and March, with peak occurrence in October (Table 1). During 1968-69 this item was absent only in October and November.

Foraminiferans: Foraminiferan shells were also found in small quantities, occurring in the months of April, May, June, October and March. In the second year they were present during April to July 68, ranking only last.

Polychaetes: These worms formed an important item of the food of these prawns. They were present in good quantities in all the months, ranking second in July and October, third in April, August and March, fourth in May and June and sixth in September. These worms were crushed into pulp-like mass with setae embedded in it. Hence, the identification up to species and genera was not possible. More or less same frequency of occurrence was noticed in the second year also.

TABLE 1. *Indices of preponderance of the various food items of Penaeus semisulcatus from Palk Bay.*

	Stomach contents								
	Diatoms	Radio-laria	Forami-nifera	Polych-etes	Mol-luscs	Crusta-ceans	Pisces	Detritus	Sand
Apr 67	5.19	—	0.03	10.20	1.78	0.91	—	68.83	13.06
May 67	2.76	0.01	0.01	2.77	0.87	6.36	0.01	73.30	12.88
Jun 67	5.80	—	—	5.52	0.35	1.40	—	74.24	12.69
Jul 67	5.95	1.02	0.02	22.57	2.54	9.01	0.02	50.41	7.66
Aug 67	1.63	0.01	—	11.79	16.49	10.88	5.82	61.91	5.81
Sept 67	7.07	—	—	5.21	11.01	8.06	0.75	61.91	5.81
Oct 67	0.66	10.06	0.05	19.20	4.03	18.86	1.07	31.69	14.38
Mar 68	0.90	1.45	0.02	21.02	36.38	24.69	—	15.08	0.46
Apr 68	0.67	1.04	0.03	21.26	29.65	27.03	—	16.69	3.63
May 68	0.52	1.84	0.33	14.06	23.47	18.31	2.57	32.53	6.37
Jun 68	0.89	0.64	0.09	9.89	21.94	9.58	5.45	36.16	15.36
Jul 68	0.91	0.03	0.01	0.46	15.24	3.14	4.11	64.88	11.22
Aug 68	1.07	—	0.01	2.87	8.77	2.66	0.08	71.58	12.96
Sept 68	2.61	—	0.01	0.40	9.48	1.61	—	72.93	12.96
Oct 68	0.24	—	—	0.56	9.32	4.18	3.81	69.30	12.59
Nov 68	—	—	—	0.06	2.00	4.24	—	71.95	21.75

Molluscs: Lamellibranch molluscs were regularly occurring in the stomach contents examined in all the months. Although crushed shells of various forms only were usually observed, the fresh appearance of these shells indicated that they might have been alive when they were eaten and the soft parts subsequently digested and absorbed. Small gastropod shells were also encountered in the stomach contents. Molluscan item ranked first in March while it was second in August and September. In other months they were less abundant, occupying only fifth, sixth and seventh places in the order of importance. They were first to fourth in abundance during the different months of the second year.

Crustaceans: Crustaceans formed an important constituent of the dietary components of *P. semisulcatus*, ranking second in March 68, third in May, July, September and October 67. In June and April they formed only fifth and sixth respectively in the order of abundance. The crustaceans included portions of penaeid prawns, mysids and isopods. Copepods also were met with occasionally. From the nature of the decapod remains in the stomachs it seems quite likely that these prawns may eat the exuviae of juvenile prawns along with bottom mud. However, in many instances, portions of these crustaceans were found in fresh as well as semi-digested conditions. As this item was almost always present in the stomach contents it was certain that this formed a regular food item of the species, throughout the year.

Pisces: This item was less important than crustaceans, molluscs and polychaetes. It was present in the form of skeletal structures viz., vertebrae and scales. In a few instances, the crystalline lenses of the eyes were found in tact. This item occupied sixth place during May and August while it was seventh in September and October and eighth in July. Fish was not present in the stomachs examined in April and June 67 and March 68. Although the importance of this item was a little increased, they were absent during three months in the second year.

Detritus: Heavy concentrations of detritus was found in the gut contents during all the months, ranking first in importance among the food items during April to October 67 while it was only fourth in March 1968. The presence of large quantities of detritus in the stomachs may be due to bottom feeding habit of these prawns coupled with the thorough mastication to which the food is subjected during feeding. Detritus was abundant in the second year as it was in the first year, being first in all the months, except April.

Sand: Sand was also found in all the months. This item which was probably an accidental inclusion during the feeding at the bottom, was predominant in April, May and June. In July and October this occupied only fourth rank while it was fifth in August and September and seventh in March 68. During the second year this item registered increase in quantity in the stomachs.

In a few instances, spicules of the sponge and anchor plates of holothurians were also found in the stomachs. Since the quantity of these items was negligible they were not taken into account.

FOOD DIFFERENCES IN RELATION TO DIFFERENCE IN FISHING GROUNDS

Considerable differences were noticed between the stomach contents of specimens from Palk Bay and Gulf of Mannar. Although detritus formed bulk of the stomach contents of Palk Bay specimens, molluscs were dominating in the Gulf of Mannar specimen, during the months of December 67, January 68 while in November 67 and February 68 detritus ranked first in importance. During the second year molluscs maintained the first rank in importance, pushing detritus to fourth and fifth ranks. Similarly, specimens from Gulf of Mannar had more crustaceans in their stomachs than those from Palk Bay, ranking third in all the months of the first year while this item retained the second position in December 68, February and March 69 and the third position in January 69. The importance of polychaetes remained the same in the specimens from Palk Bay and Gulf of Mannar. Foraminiferans were more important in the stomach contents of prawns from Gulf of Mannar. Remains of fishes also were less important in Gulf of Mannar specimens. Sand was of less magnitude in the stomachs examined from Gulf of Mannar. These differences are due to the difference in the nature of the sea bottom between the two localities. The sea bottom in Palk Bay is sandy or muddy while in Gulf of Mannar the fringing coral reefs and the associated flora and fauna leave less sandy and muddy areas

TABLE 2. *Indices of preponderance of the various food items of P. semisulcatus from Gulf of Mannar.*

	Stomach contents								
	Diatoms	Radio-laria	Forami-niera	Polych-aetes	Mol-luscs	Crusta-ceans	Pisces	Detritus	Sand
Nov 67	8.87	11.17	0.33	10.19	20.26	17.52	—	31.65	0.01
Dec 67	0.08	2.92	0.02	2.98	43.23	19.98	—	23.57	7.30
Jan 68	—	0.03	0.08	15.88	46.93	13.95	0.01	8.28	11.84
Feb 68	1.02	—	0.06	30.29	12.28	16.28	0.33	34.23	5.51
Dec 68	—	6.15	0.02	14.12	29.31	26.29	—	10.85	13.26
Jan 69	—	3.59	0.01	23.54	30.72	22.19	—	10.29	9.66
Feb 69	—	0.35	—	15.34	33.94	30.31	0.11	12.31	7.64
Mar 69	—	0.88	—	16.38	42.28	20.53	—	9.26	10.66

for the prawns. The colour differences observed between specimens collected from these two localities gives clear indication of the differences between these two environments.

FOOD HABITS IN RELATION TO THE SIZE OF PRAWNS

Percentage occurrence of food items of *P. semisulcatus* in various size groups during April 1967 to March 69 are given in Table 3. It can be seen from the table that prawns of carapace length less than 25 mm from Palk Bay did not eat radiolarians, foraminiferans, molluscs and fishes in the year while foraminiferans and fishes were absent in the gut contents of this size group in the second year from the same locality. Similarly, larger sizes of above 45 mm carapace length did not have radiolarians and foraminiferans in their stomachs in

TABLE 3. *Percentage occurrence of food items present in the stomach contents of P. semisulcatus in various size groups.*

Carapace length	No. of prawns	Stomach contents								
		Diatoms	Radio-laria	Forami-nifera	Poly-chaetes	Mol-luscs	Crusta-ceans	Pisces	Detritus	Sand
Palk Bay										
		1967-78								
Below 25 mm	16	69.26	25.00	—	68.34	8.05	52.78	—	67.78	63.34
25-34 mm	215	41.14	9.22	4.05	33.28	42.89	33.86	15.41	62.33	51.35
35-44 mm	198	46.72	14.28	5.06	50.42	45.62	50.25	14.23	72.52	58.60
Above 45 mm	19	29.32	—	—	70.45	70.45	66.55	2.28	70.67	63.41
Gulf of Mannar										
		1967-1969								
Below 25 mm	27	40.50	57.12	34.38	70.92	80.64	76.13	—	82.35	51.64
25-34 mm	110	23.72	38.90	5.68	68.95	89.15	85.46	2.24	72.02	64.38
35-44 mm	86	13.86	62.19	6.88	83.45	86.78	71.91	0.74	87.34	76.43
Above 45 mm	5	8.34	16.67	—	100.00	33.33	—	—	33.33	25.00

TABLE 4. *Percentage occurrence of actively feeding P. semisulcatus in each month*

Palk Bay	1967-1968							
	Apr 1967	May 1967	Jun 1967	Jul 1967	Aug 1967	Sep 1967	Oct 1967	Mar 1968
Percentage	—	11.54	—	27.58	25.00	14.70	29.63	55.88
	1967-1968							
	Apr 1968	May 1968	Jun 1968	Jul 1968	Aug 1968	Sep 1968	Oct 1968	Nov 1968
Percentage	61.76	34.38	49.99	6.66	26.92	13.33	18.76	5.88
Gulf of Mannar	1967-1969							
	Nov 1967	Dec 1967	Jan 1968	Feb 1968	Dec 1968	Jan 1969	Feb 1969	Mar 1969
Percentage	70.00	58.06	85.00	42.00	78.78	72.72	57.57	78.78

both the years. But, pisces were not represented in the gut contents during the first year alone. The size ranges 25-34 mm and 35-44 mm carapace length ate all these food items in varying quantities, during the two years (Table 3).

In prawns from the Gulf of Mannar also more or less same pattern was observed. During the first year fishes were not encountered in the gut contents of prawns of size less than 25 mm carapace length. In larger size (above 45 mm) there were no foraminiferans, crustaceans and pisces in the first year. But, in the next year, diatoms were not represented in the size less than 25 mm and above 45 mm. The medium sized prawns had all the constituents of the food in the guts examined, during both the years.

CONDITION OF FEED

Prawns with stomach gorged, full, three-fourth-full, and half-full were taken to have fed actively while quarter-full, trace and empty were considered as poorly fed. The percentages of occurrence of actively fed prawns are shown in Table 4.

In the prawns from Palk Bay, feeding was usually poor. The percentage of actively fed ones ranged from 5.88 to 61.76. During the months of May, June and September this was less than 20% in the first year while this condition was observed during July, September and November only in the second year of observation. In year 67-68 the actively fed prawns formed about 30% in the samples analysed during the months of July, August and October while it was 55.88% in March. The year 68-69 registered better percentages of actively fed prawns. In July and November only, the percentages of actively fed prawns were less than 10%, while in August it was 26%. Higher percentages were recorded from 34 in May to about 50 in June and 60 in April (Table 4).

TABLE 5. Percentage occurrence of stomachs of *P. semisulcatus* in various degree of fulness.

	Gorged	Full	¾ full	Condition of feed		Trace	Empty
				¼ full	½ full		
							1967-1968
Palk Bay							
Apr 67	—	—	—	—	41.18	29.41	29.41
May	—	3.85	—	7.69	19.23	50.00	19.23
June	—	—	—	4.76	23.81	33.33	38.10
Jul	—	—	17.24	10.34	20.69	20.69	31.03
Aug	—	—	3.57	14.29	35.71	35.71	3.51
Sept	—	—	5.88	8.82	11.76	41.18	32.35
Oct	—	3.70	18.51	7.41	14.81	18.51	37.04
Mar 68	2.94	8.82	23.53	20.59	29.41	5.88	8.82
Apr	—	8.82	35.29	17.65	17.65	5.88	14.71
May	—	6.25	18.75	9.38	12.50	9.38	43.75
Jun	—	8.82	29.41	11.76	11.76	23.53	14.71
Jul	—	—	3.33	3.33	33.33	23.33	36.67
Aug	—	15.38	3.85	7.69	30.77	26.92	15.38
Sept	—	—	3.33	10.00	33.33	33.33	20.00
Oct	—	3.13	6.25	9.38	9.38	28.13	43.75
Nov	—	—	—	5.88	17.65	35.29	41.18
							1967-1969
Gulf of Mannar							
Nov 67	—	6.67	20.00	43.33	16.67	6.67	6.67
Dec	—	—	19.35	38.71	16.73	22.58	3.23
Jan 68	10.00	10.00	25.00	40.00	15.00	—	—
Feb	—	4.00	12.00	24.00	48.00	—	12.00
Dec	—	12.12	33.33	33.33	15.15	—	6.06
Jan 69	3.03	15.15	30.30	24.24	24.24	—	3.03
Feb	—	9.90	21.21	27.27	12.12	9.09	21.21
Mar	—	12.12	30.30	36.36	15.15	3.03	3.03

The condition of feed of the prawns collected from the Gulf of Mannar was better during both the years. The percentages of actively fed prawns in the samples examined during November 67 to February 68 had a range of 42 to 85 (peak being in January in the first year) and 57.6 to 78.8 during December 68 to March 69.

prawns of different sizes revealed no difference in the intensity of feeding. There was no variation, in this respect, between months also. Thus from the Palk Bay samples a few specimens were obtained in actively fed condition, both in smaller size (25-28 mm) and larger (37-40 mm) during May and September 67.

In the Gulf of Mannar, actively fed prawns ranged in size from 21 to 34 mm in December 67 whereas, this range was from 21-46 mm in January and from 25 to 50 mm in February 68. In all the four months of the second

year, prawns of size 19-20 mm to 39-40 mm were found to be actively feeding. There was no marked difference in the condition of feed of *P. semisulcatus* of the various size groups.

SELECTIVITY OF FEEDING

Analysis of the stomach contents of *P. semisulcatus* has shown that they do not exhibit preference to any particular type of food item, although, in certain months some of the items were predominant in the stomachs. This may be due to the fact that during these months there was abundance of these items at the bottom rather than due to selective feeding by the individual prawns. This is evident because there is no consistent favouritism shown by these prawns to any food item during all the months. Thus, polychaetes which formed important food item in July and October 67 and again in March and April 68 were eaten in very little quantities during the months of July to November 68 (Table 1). Similarly, molluscs and crustaceans also formed bulk of the food of the prawns in some months while they were ingested in much less quantities in certain other months. This shows that these prawns do not search for any particular item; but, feed on any of these items which come across during their feeding activities.

FEEDING HABITS

P. semisulcatus, like other prawns, feed on the bottom living animals viz., lamellibranch and gastropod molluscs, polychaetes, crustaceans (isopods, copepods, decapods, etc.), foraminiferans and radiolarians in addition to large quantities of detritus settled at the bottom along with mud and sand. During certain months, the stomachs were almost full of polychaetes while in other months the lamellibranchs were the most dominant food item of this species. Majority of the stomachs contained more than one food item, in varying degree of abundance, which indicated that there was no preference exhibited for any food item in particular.

Consequent to the increased activity of these prawns in the night, the intensity of feeding also was more during the dark hours of the day. This habit is one of the reasons for the occurrence of better condition of feed in specimens from Gulf of Mannar where fishing was mostly done at night. *P. semisulcatus* kept in aquaria have been observed to be more active during the night. They kept themselves burried in the bottom of the tank (sand or mud) during day time, coming out only when food was given.

DISCUSSION

Several workers have reported that the main items of food of prawns consisted of detritus; bottom living animals viz., foraminiferans, polychaetes and small crustaceans in addition to daitoms and algal filaments. Gopalakrishnan (1952) observed that crustaceans and vegetable matter formed bulk of the gut contents of *P. indicus* while *M. dobsoni* is reported (Menon, 1951) to feed on

small animals and diatoms along with mud and sand. The food of *Parapenaopsis stylifera* consisted of detritus and small animals (Menon, 1953). Panikkar and Menon (1956) also found that *P. indicus*, *M. dobsoni* and *P. stylifera* were detritus feeders, although, small amounts of animal remains, sand and mud were also encountered in their gut contents. Subrahmanyam (1967) concluded that *M. affinis* was carnivorous in habit. This view was supported by Thomas (1972) in the case of *Penaeus monodon* from the Korapuzha Estuary. Kishinoye (1900), Ikematsu (1955), Kubo (1956) and Yasuda (1955) also reported the carnivorous habits of various penaeid prawns they studied. Kuttyamma (1974) found that the food of *M. dobsoni* from Cochin area consisted mainly of debris. Plant and animal materials were also of equal importance, crustaceans forming the major part of the animal matter. She did not observe any difference in the diets of different size groups. George (1976) noticed that the gut contents of smaller specimens of *M. monoceros* contained more unrecognisable materials including mud and detritus than those of larger specimens and that they exhibited selective feeding in different size groups. The present investigations showed that there was no marked differences between the food and feeding habits of *P. semisulcatus* of various size groups. Gopalakrishnan (1952) also did not notice any such differences in the diet of small and large specimens of *P. indicus* from Madras. But, Menon (1951) observed that vegetable matter was eaten by larger individuals of *M. dobsoni*. The pronounced bottom feeding habit was also exhibited by *P. semisulcatus* as in the case of the penaeid prawns studied by Kuttyamma (1974).

Hall (1962) noticed that the diet of *P. semisulcatus* from Singapore consisted of polychaetes, crustaceans, pisces and vegetable matter. In general, the food and feeding habits of *P. semisulcatus* from Palk Bay and Gulf of Mannar are similar to those reported by Hall (1962) from Singapore. The major food items of *P. semisulcatus* from Palk Bay and Gulf of Mannar were polychaetes, crustaceans and molluscs, especially bivalves. The plant material met with in the stomachs were mainly diatoms unlike the abundance of vegetable matter belonging to higher groups of plants in the food of the same species from the Singapore prawn ponds. Detritus, both organic and inorganic, formed bulk of the gut contents in most of the specimens examined. This was partly due to the efficient masticatory mechanism of these prawns which reduce most of the food items into a pulp-like consistency within a short time after actual ingestion.

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