

FOOD AND FEEDING HABITS OF *POLYNEMUS HEPTADACTYLUS* CUV. AND VAL.¹

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ABSTRACT

The food and feeding habits of *Polynemus heptadactylus* obtained from Bombay during the period 1956-58 were studied. Empty stomachs appeared in very high percentages in both the juveniles and adults all through the year. No period of active feeding at any time of the year was indicated either by the juveniles or adults.

P. heptadactylus is carnivorous and its food composition varied widely, crustaceans ranking first, followed by fishes, polychaetes, molluscs and echinoderms. The planktonic forms, dominated by copepods, were observed in the food of juveniles alone. Crabs, molluscs and echinoderms were absent in the food of juveniles but present in that of adults. Amongst the crustaceans, *Acetes indicus* and *Squilla* spp. dominated in juveniles and penaeid and carid prawns followed by *Squilla* spp. in adults. Amongst the fish food *B. maclellandi* ranked high in both the juveniles and adults. The differences in the food composition of juveniles and adults indicate their habitat preference.

INTRODUCTION

The importance of the study of food and feeding habits of fish in understanding its behaviour in respect of migration, growth and breeding has been well established (Hynes, 1950; Kow, 1950 and Longhurst, 1957). In regard to polynemid fishes, Bal and Pradhan (1945) indicated the nature of the food of young *Eleutheronema tetradactylum*. Mookerjee *et al.* (1946) determined the food of *Polynemus sextarius*. Chacko (1949) described briefly the food of *E. tetradactylum*, *P. indicus* and *P. heptadactylus*. The food of young *E. tetradactylum* and *P. heptadactylus* were mentioned by Bapat and Bal (1952). Devanesan and Chidambaram (1953) recorded the food of *P. indicus*. Malhotra (1953) carried out an extensive study of the stomach contents of *E. tetradactylum*. Mohamed (1955) in his preliminary studies on *Polydactylus indicus* commented on the food of smaller and larger fish and later, Karekar and Bal (1958) worked out the food and feeding habits of the same species in greater detail. The food and feeding habits in *P. indicus* were studied by Kuthalingam (1960) in connection with its life history. Hida (1967) examined the stomach contents of six polynemid species, namely, *Polydactylus indicus*, *P. plebeius*, *P. xanthonemus*, *P. sextarius*, *P. sextarius* var. *mullani* and *Polynemus*

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paradiseus collected during the bottom trawling surveys in the Bay of Bengal and Arabian Sea. The present study deals with the food of *Polynemus heptadactylus* in its juvenile and adult stages and the fluctuations in the component items of food in different months of the year.

MATERIAL AND METHODS

The material for this study consisted of 1,648 specimens in 160 samples of *P. heptadactylus*, collected during the period April 1956 to March 1958 at two important fish landing places in Bombay, viz., Sassoon Dock and Versova. On an average 7 samples per month, each consisting usually of 10 specimens, were examined. As the smallest maturing fish examined measured 103 mm in furcal length (Kagwade, 1972), all specimens measuring up to 105 mm were grouped as juveniles; above this length all were grouped as adults. Accordingly, the number of juveniles examined was 464 and adults 211 in the first year and 521 juveniles and 452 adults in the second year.

The fish when brought to the laboratory, were measured for length and cut open; the sex and stage of maturity in females were noted. The fish with extroverted stomach were sorted out and discarded. The food organisms were identified up to the species wherever possible and only up to the genus and family when identification could not be made further. The food of this species was analysed by Hynes (1950) points method. Accordingly, by eye estimation the stomachs were allotted points in relation to their fullness, such as full stomach (F) - 20, $\frac{3}{4}$ full ($3F/4$) - 15, $\frac{1}{2}$ full (F/2) - 10, $\frac{1}{4}$ full (F/4) - 5 and traces (T) - 2 to 3. No fish with a gorged stomach was noticed during the study. These points were distributed among individual food items according to the estimated volume. The points gained by one individual food item during a month were added up and divided by the number of fish examined to ascertain the average feeding activity on a particular item of food.

EMPTY STOMACHS

During the course of this study empty stomachs appeared to occur in very high percentage, both amongst the juvenile and adult fish. In the first year of observation 201 juveniles amongst 464 examined forming 43%. 119 adults amongst 211 forming 56% and in the second year 233 juveniles amongst 521 forming 45% and 257 adults amongst 452 forming 57%, had their stomachs empty. It is seen that in both the years empty stomachs occurred in a higher proportion in adults than in juveniles. The high percentage of empty stomachs occurring in this species does not seem to be unusual as similar instances have been observed in several other fishes like *Pomadasys juvelini*, *Drepane punctata* and *Trygon marginata* by Longhurst (1957) and in yellow-fin tuna, *Neothunnus macropterus* by Alverson (1963). Amongst the trawler catches on the Indian coasts, empty or extroverted stomachs were reported by Mohamed (1955) in *Pseudosciaena diacanthus* and *Otolithoides ruber* and by Meenakshisundaram and Marathe (1963) in *Ilisha filigera*.

The fluctuations in the percentage occurrence of empty stomachs were highly irregular from month to month in juveniles and adults in both the years. They neither showed any relationship to the season nor to the size of the fish.

FEEDING ACTIVITY

The food analysis of *P. heptadactylus* is based on 551 juveniles and 287 adults. Table 1 shows the percentages of different degrees of fullness of stomachs in juveniles and adults during the years 1956-'57 and 1957-'58. It is seen that, amongst the juveniles, both the half-full and quarter-full stomachs occurred in good percentages while in adults, only the quarter-fulls. The percentages of full stomachs were more or less the same in both the years, being 27 and 25 for the juveniles and 22 and 20 for the adults.

TABLE 1. *Percentage occurrence of stomachs in different degrees of fullness in juvenile and adult P. heptadactylus during 1956 - '58*

Year	Juveniles					Adults				
	F	3F/4	F/2	F/4	T	F	3F/4	F/2	F/4	T
1956-57	27	1	36	33	3	22	9	17	41	11
1957-58	25	1	27	46	1	20	1	27	51	1

TABLE 2. *Percentage occurrence of stomachs in different degrees of fullness in juvenile P. heptadactylus during April 1956 to March 1958*

Month	1956—1957					1957—1958				
	F	3F/4	F/2	F/4	T	F	3F/4	F/2	F/4	T
April	—	7	43	50	—	33	—	25	42	—
May	6	—	11	83	—	14	—	22	64	—
June	—	—	17	83	—	14	—	38	48	—
July	—	—	71	29	—	20	—	40	40	—
August	—	—	100	—	—	40	—	17	43	—
September	—	—	—	—	—	28	—	22	50	—
October	—	—	—	100	—	16	—	26	58	—
November	50	—	25	25	—	20	—	—	80	—
December	36	—	40	18	6	15	—	27	58	—
January	45	3	35	16	1	29	3	37	31	—
February	42	—	33	25	—	30	—	35	35	—
March	12	—	55	33	—	37	—	44	13	6

TABLE 3. *Percentage occurrence of stomachs in different degrees of fullness in adult P. heptadactylus during April 1956 - March 1958*

	1956—1957					1957—1958				
	F	3F/4	F/2	F/4	T	F	3F/4	F/2	F/4	T
April	9	5	14	45	27	35	—	30	35	—
May	—	22	14	64	—	31	—	25	44	—
June	100	—	—	—	—	—	—	40	60	—
July	—	—	—	—	—	17	—	8	75	—
August	—	50	—	50	—	50	—	20	20	—
September	—	—	—	—	—	17	4	31	48	—
October	16	—	23	46	16	57	15	14	14	—
November	31	7	31	31	—	13	—	13	74	—
December	25	—	—	—	75	21	—	11	68	—
January	100	—	—	—	—	36	—	—	64	—
February	40	—	40	20	—	9	—	26	60	5
March	50	—	—	50	—	9	4	55	32	—

In order to determine the seasonal variation in the degrees of fullness of stomachs, monthly analysis was attempted for juveniles and adults separately. The data are presented in Tables 2 and 3.

From the tables it is evident that the active feeding periods of neither the juveniles nor the adults are clearly indicated. The different degrees of fullness of stomachs showed no periodicity, as indicated by wide fluctuation in the percentages in the different months.

COMPOSITION OF FOOD

The composition of food of *P. heptadactylus* in both the juveniles and adults is presented in Fig. 1. It is noticed that crustaceans dominated throughout forming the major food item. Next to crustaceans came fishes and polychaetes in the order of abundance. Sometimes molluscs and echinoderms were also noticed in the food of this fish. Occasionally, sand and mud were found in the stomachs of adults.

The monthly distribution of different items of food in juveniles and adults is shown in Figs. 2 to 5.

Crustaceans

The crustacean food (Figs. 2 and 3) of juveniles mainly consisted of planktonic forms like copepods, cypris stage of *Lepas*, amphipods and other crustaceans such as small prawns and stomatopods. The food of the adults was comprised of penaeid and carid prawns, stomatopods and brachyurans. Often crustacean appendages alone were noticed in the stomach of this fish.

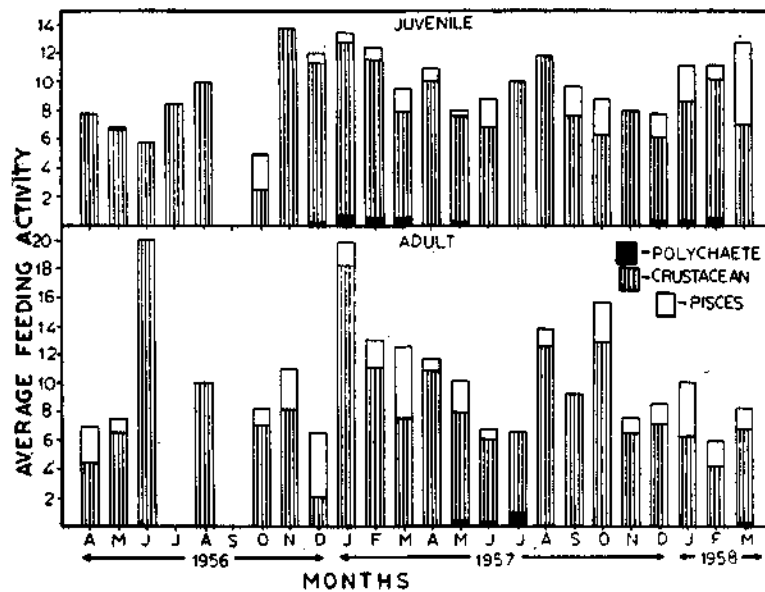


FIG. 1. Food composition of juvenile and adult *P. heptadactylus* during April 1956-March 1958.

Amongst the crustaceans, prawns ranked very high in the food of this fish throughout its life. The stomach contents of juveniles revealed *Acetes indicus*, and of adults, in addition to this, *Parapenaeopsis sculptilis*, *Hippolyssmata ensirostris* and *Palaemon tenuipes*. Next to prawns, *Squilla* spp. representing Stomatopoda ranked second amongst the crustacean food. As a member of Brachyura crab was found in the stomachs of adults only and ranked third amongst crustaceans.

Of the planktonic food items found in the juveniles, copepods occupied the first place. They were the calanoid, cyclopoid and harpacticoid forms. The cypris stage of *Lepas*, amphipods and *Lucifer* sp. appeared in the food of juveniles only.

Fishes

Altogether 11 species of bony fishes occurred in the food of *P. heptadactylus* (Figs. 4 and 5). Of these clupeid larvae, *Bregmaceros maclellandi*, *Coilia dussumieri*, *Harpodon nehereus* and *Sciaena* spp. were common in both the juveniles and adults. *Apogon* spp., *P. heptadactylus* and *Mugil* spp. were found occurring only in juveniles, and *Trichiurus* spp., *Periophthalmus* spp. and *Cynoglossus* spp. only in adults. In the fish food of juveniles clupeid larvae and *B. maclellandi* were the most common and the rest rare while in that of the adults *B. maclellandi*, *Periophthalmus* spp., *Trichiurus* spp. and *Sciaena* spp. were the most common and the rest rare.

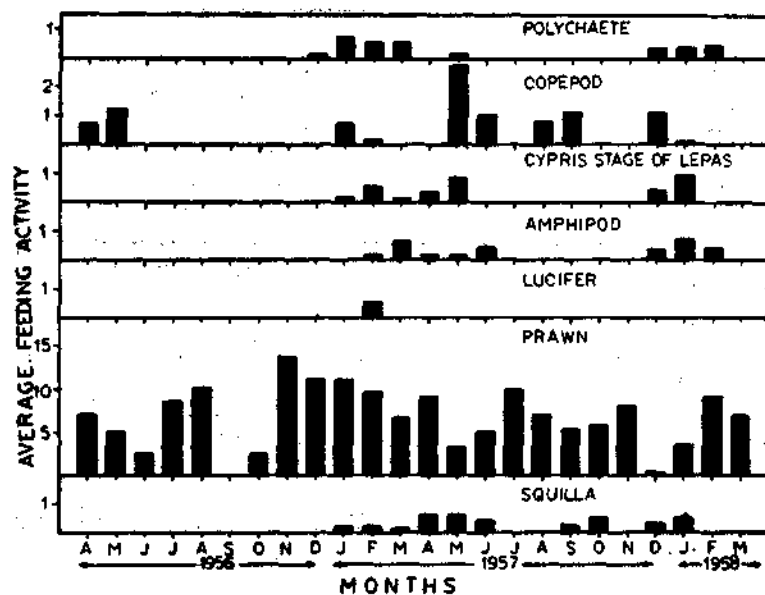


FIG. 2. Occurrence of polychaete and crustacean food items in the stomachs of juvenile *P. heptadactylus* during April 1956-March 1958.

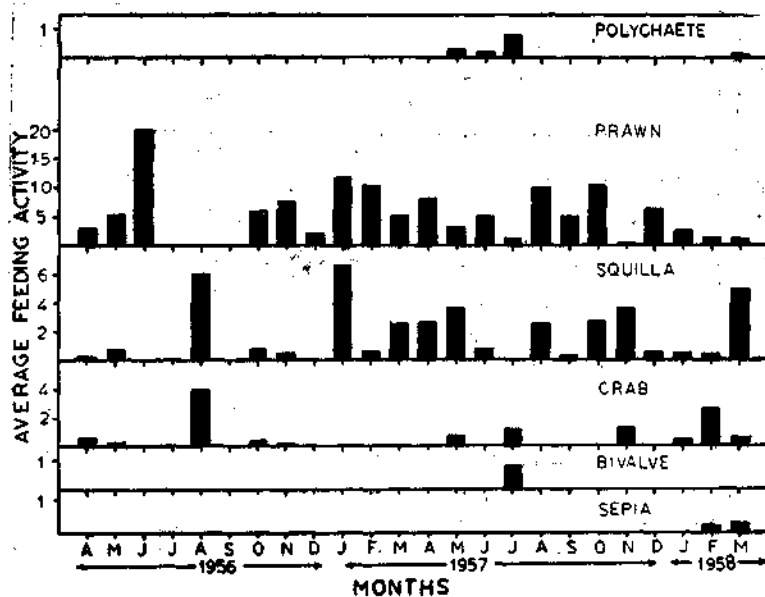


FIG. 3. Occurrence of polychaete, crustacean and molluscan food items in the stomachs of adult *P. heptadactylus* during April 1956-March 1958.

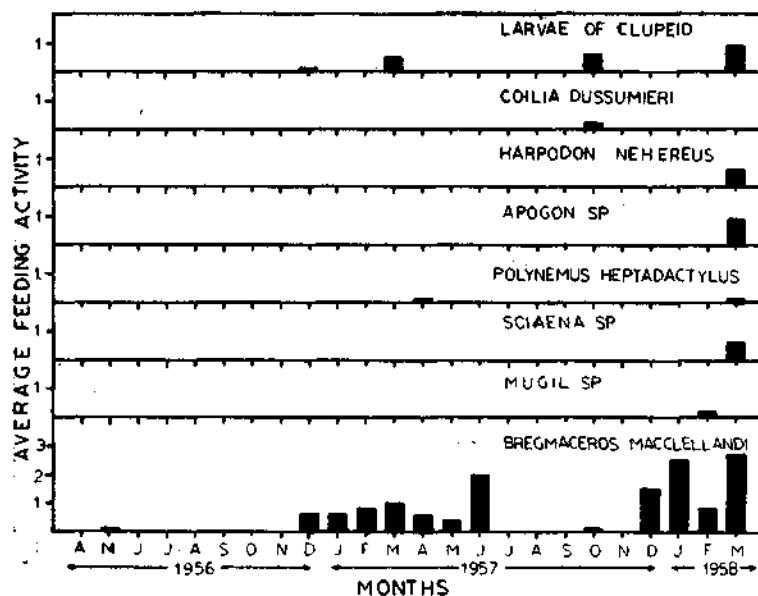


FIG. 4. Occurrence of fish food items in the stomachs of juvenile *P. heptadactylus* during April 1956-March 1958.

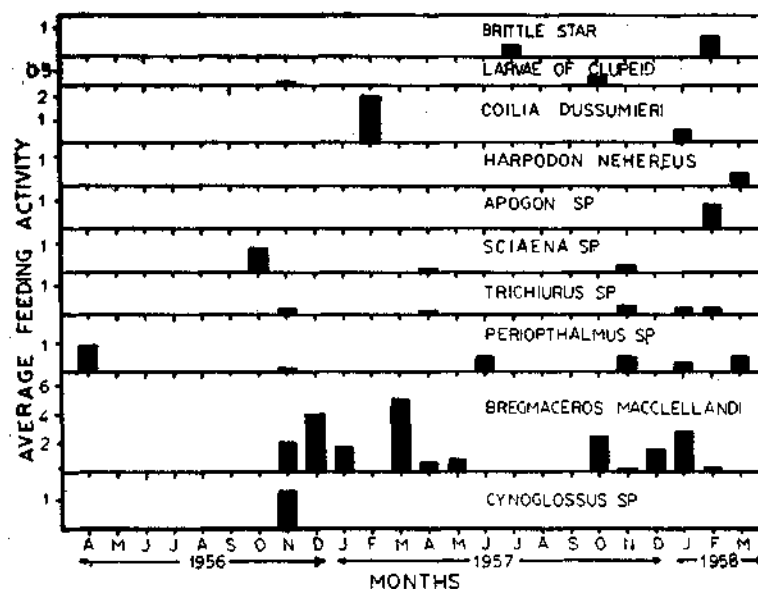


FIG. 5. Occurrence of echinoderm and fish food items in the stomachs of adult *P. heptadactylus* during April 1956-March 1958.

Polychaetes

Polychaetes (Figs. 1, 2 and 3) were found in the food of both the juveniles and adults.

Molluscs

Molluscs were poorly represented in the food of adult *P. heptadactylus* by bivalves and *Sepia* sp. (Fig. 3).

Echinoderms

The order Ophiuroidea alone was represented by brittle-star in the food of adults (Fig. 5).

DISCUSSION

Seasonal variation in temperature or other factors in the environment are known to affect the feeding rate of fish. Longhurst (1957) states that Todd (1915) had found 90% of empty stomachs in North Sea plaice during winter against only 1-2% in summer. However, in tropical waters where the range of temperature is too small, occurrence of empty stomachs in fishes cannot be attributed to temperature variations. On the other hand, drop in salinity due to influx of fresh water after rain, strong currents, disturbance of waters by powerful winds, etc., during monsoon months may adversely affect the feeding rate of fish.

Hertling (1938), as cited by Longhurst (1957), states that species in which fish forms an important item of food tend to have a high proportion of empty stomachs, the main reason for it being that the calorific value of fish is, weight for weight, higher than that of other items like crustaceans. The daily intake of ichthyophagous species can be lower and discontinuous than those whose diet consists chiefly of benthic invertebrates. *P. heptadactylus*, whose diet primarily consists of crustaceans, and of fishes only secondarily, also records high percentage of empty stomachs.

Longhurst (1957) is of the opinion that the high percentage of empty stomachs in fishes is due to differential disgorging. According to him, in fishes with mixed diet, the smaller fish become more crushed in the trawl and so more frequently disgorge. It is likely that *P. heptadactylus*, which are small fishes, when caught along with varieties of other larger fishes in the trawl net, may disgorge often and thus record a high percentage of empty stomachs.

Alverson (1963) considers that the exoskeleton of the crustaceans is digested at a slower rate than fish and remains in the stomach for a longer time, thus reducing the percentage of empty stomachs. In the present study although crustaceans rank high in the food of juveniles and adults of *P. heptadactylus*, the percentage of empty stomachs found in them has been very high.

P. heptadactylus is a carnivorous fish with a mixed diet of crustaceans, fishes, polychaetes, molluscs and echinoderms in that order of abundance. At times cannibalistic tendency is noticed in this fish. The food of juveniles consists of planktonic forms, other crustaceans, fishes and polychaetes, whereas that of adults constitute all items excepting the planktonic forms. The total absence of planktonic forms and presence of large quantities of benthic forms in the food of adults, in contrast with the food of juveniles, is apparently dependent on the habitat of the fish at these two stages.

Some of these findings are in concurrence with the preliminary observations, made on the food of this species earlier by Chacko (1949) and Bapat and Bal (1952). Kagwade (1970) was of the view that the species *Polydactylus sextarius* var. *mullani*, collected by Hida (1967) from Bombay to Oman, could be the same as *P. heptadactylus* which is studied here. The stomach contents of the species, as given by Hida (1967) consist mainly of penaeid and carid prawns, the other organisms of less importance being fish and other crustaceans like amphipods, ostracods and copepods. This agrees with the observations made in the present study.

Karekar and Bal (1958) have observed low feeding activity in *P. indicus* prior to spawning and high feeding after spawning. However, although the feeding intensity in *P. heptadactylus* varied widely in both juveniles and adults, it showed no significant fluctuation with reference to the breeding of the fish.

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