

Temporal changes in feeding and bio-indices of *Polynemus paradiseus* Linnaeus, 1758 occurring in Hooghly-Matlah estuary, West Bengal

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Temporal changes in feeding and bio-indices of *Polynemus paradiseus* were studied at selected stretches of Hooghly-Matlah estuary for a period of eight months (December to July). It indicated that the fish mainly feeds on shrimps, fishes, and insects. The highest amount of shrimps (45.49%) was recorded in December and those of fishes (16.10%) during June and copepods and insects (7.31%) in July. The presence of a considerable amount of small fishes, insects and crustaceans in gut contents indicated carnivore-feeding habits of fish. Adult size of the species mainly feeds on shrimps and fishes whereas juveniles feed on shrimps, copepods, insects, and zoobenthos. Gastro-somatic index (GaSI) was maximum during March and April and minimum during June and December in fish. The monthly mean gonado-somatic index (GSI) values varied from 0.74 (December) to 1.32 (June) in males and 0.82 (December) to 5.44 (June) for female fish, respectively.

[Keywords: Gastro-somatic index; Gonado-somatic index; Food and feeding habits; Hooghly-Matlah estuary; *Polynemus paradiseus*]

Introduction

Polynemus paradiseus Linnaeus, 1758, commonly known as Paradise threadfin and locally called as 'Topse' or 'Tapsya' belongs to the family Polynemidae under Perciformes has been distributed in the Indo-Pacific Ocean including the Bay of Bengal¹. The species form a lucrative fishery in the Hooghly-Matlah estuarine system and is considered next in importance to the *Tenualosa ilisha* fishery in terms of commercial value². This is a demersal amphidromous fish and well distributed in marine, freshwater, and brackish water³. The species lives in the sandy bottom and enters to the freshwater during the breeding season, feeds mainly on crustaceans (especially shrimps), small fishes and benthic organisms⁴.

Feeding is one among the vital functions of living organisms to generate nutritional sources for various fundamental biological activities⁵. Study on food and feeding habits of fishes form one of the main aspects of the study of its biology⁶. Studies on food and feeding habits of Polynemids are very much scanty in recent years⁷⁻¹⁴. Very limited literature is available on several biological parameters of the species under family Polynemidae in Indian context^{6, 12-15}. However, no detailed investigation on the feeding behaviour of *Polynemus paradiseus* has been carried out so far from Hooghly-Matlah estuary of West Bengal despite

its high commercial value. The present paper deals with the studies on food and feeding habits of *P. paradiseus* collected from Hooghly-Matlah estuary from West Bengal.

Materials and Methods

The present study is based on the analysis of gut contents of 258 specimens of *Polynemus paradiseus* in the length range of 107 to 265 mm total length collected at fortnight intervals from December to next July (2007-2008), from Kakdwip, Sagar Island, Bokkhali and 8-Jetighat under Hooghly-Matlah estuarine system of West Bengal, India (Map 1). They are mainly captured by gillnet and stationary bag net locally called Beenjal, Behundijal which are multi-species non-selective small meshed nets. These specimens include both juveniles and adult fish. After recording the length, weight, sex, and stages of maturity of the fish, the guts were removed and preserved in 10% formalin for analysis in the laboratory using standard methodology followed by Natrangan and Jhingran¹⁶ and Hyslop¹⁷.

Before analysis, the weight of the gut, as well as the condition of the gut, was recorded by electronic balance and visual estimation, respectively. Gut contents were analyzed following the points method¹⁸. The food items in the gut were identified up to generic level and sometimes species level depending upon the

state of digestion^{19,16}. The food items, in an advanced state of digestion, were treated as semi-digested matter. Sand and mud found in the gut contents were treated as accidental food and excluded while grading various food items. The unidentified materials are grouped under the miscellaneous group. For quantitative analysis of different food items (Zoo benthos), *Sedgwick Rafter* cell counting chamber was used. To study the feeding intensity of the fish, gastro-somatic index (GaSI) was calculated by the

following formula: $GaSI = \text{Weight of gut} / \text{weight of the body} \times 100^{20}$. To measure the sexual maturity of the fish, gonado-somatic index (GSI) was calculated using the formula: $GSI = \text{Weight of gonad} / \text{weight of the body} \times 100^{21}$.

Results and Discussion

The percentage composition of diet during different months of *P. paradiseus* is provided in Figure 1. The analysis of gut contents revealed that it comprised of



Map 1 — Map showing study area under Hooghly-Matlah estuary (source: Google)

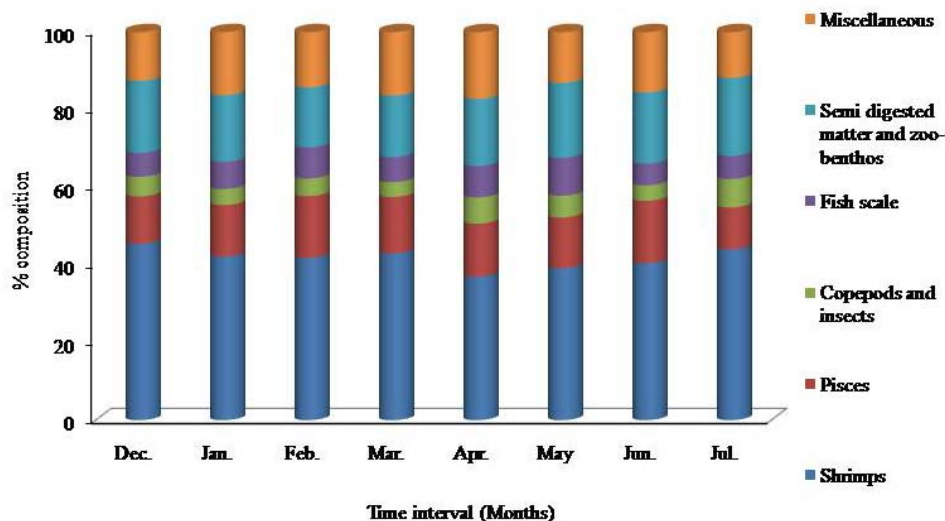


Fig. 1 — Month-wise percentage share of food items in the gut content of *P. paradiseus*

crustaceans, insects, small fishes, copepods and miscellaneous items. Shrimps were the principal food items followed by fishes and insects. The common shrimp species observed in the gut of the species were *Parapeneopsis stylifera* and *P. indicus*. Among the food items maximum amount of shrimps (45.49%) was recorded in December, Pisces (16.10%) in June, copepods, and insects (7.31%) during July and fish scale (9.78%) during May. The presence of a considerable amount of small fishes, insects, and crustaceans indicates that the fish is a carnivore in nature and feeds mainly on a wide variety of animal matters.

Size range wise food items revealed that occurrences of shrimps, pisces and fish scales were more in group-II (146-165 mm length group) but copepods and insects, semi-digested matter and zoobenthos and miscellaneous items were more in group-I (107-145 mm length group) (Fig. 2).

Jones and Menon²² mentioned that crustaceans were the most important food components for the species *Polynemus paradiseus*. There were monthly variations in the gut contents of the species. Karekar and Bal¹² examined stomach content of *Polydactylus indicus* and found that the juveniles fed primarily on shrimps, stomatopods, and fishes. Malhotra¹⁰ observed that *Eleutheronema tetradactylum* exhibits different feeding habits in different sized groups. Smaller size groups (7-30 mm) fed exclusively on copepods and mysids and occasionally on lucifers; medium size groups (30-60 mm) fed on planktonic crustaceans, larvae and post-larvae of fishes and large size groups (more than 60 mm) fed on crustacean and fishes. Mohamed¹¹ reported food and feeding habits of *Polydactylus indicus* and found crustaceans dominated the food items along with fishes and molluscs in the Bombay

and Saurashtra waters. Karekar and Bal¹² studied food and feeding habits of *Polynemus indicus* from Bombay waters and observed that the food of the species mainly consists of teleosts and crustaceans with minor amounts of cephalopods. Among teleosts, *Harpadon nehereus*, *Coilia dussumieri*, *Polynemus heptadactylus*, *Scianoides brunneus*, *Otolithes ruber*, etc. dominated the food items and among crustaceans *Parapeneopsis sculptilis*, *P. stylifera*, *P. coromandeliga*, *Leander tenuipes*, *L. stylifera*, etc. dominated the food items. Bhatt *et al.*²³ also observed that crustaceans constituted the largest single item of food, followed by teleost fishes in gut contents of *Polydactylus indicus*.

According to Rao¹⁵ stomatopods and crabs were the important food items of *Polynemus sextarius* and *P. sexfilis*, while *P. sextarius* mainly feeds on *Metapenaeus* spp., *Acetes* spp., and *Squilla* sp. whereas *P. sexfilis* predominantly fed upon penaeid prawns. The high feeding activity was observed at all times of the day for both the species. Hida¹³ studied the gut contents of *Polynemus paradiseus* and observed that shrimps were the dominant food items followed by fishes, copepods, and crabs. Kagwade¹⁴ studied food and feeding habits of *Polynemus heptadactylus* from Bombay and found it is a carnivorous species, and mainly fed on crustaceans followed by fishes, polychaetes, molluscs, and echinoderms. The juveniles of *Polynemus heptadactylus* primarily fed on copepods, fishes, and the adults on crabs, molluscs, echinoderms, and fishes. *Polynemus heptadactylus* is a predacious carnivore and the gut contents mainly consist of prawns, stomatopods, teleosts, *Acetes* sp., crabs, amphipods, copepods, crustaceans larvae, bivalves, gastropods, polychaetes and eggs larvae²⁴. Suseelan and Nair²⁴ observed that immature specimens of

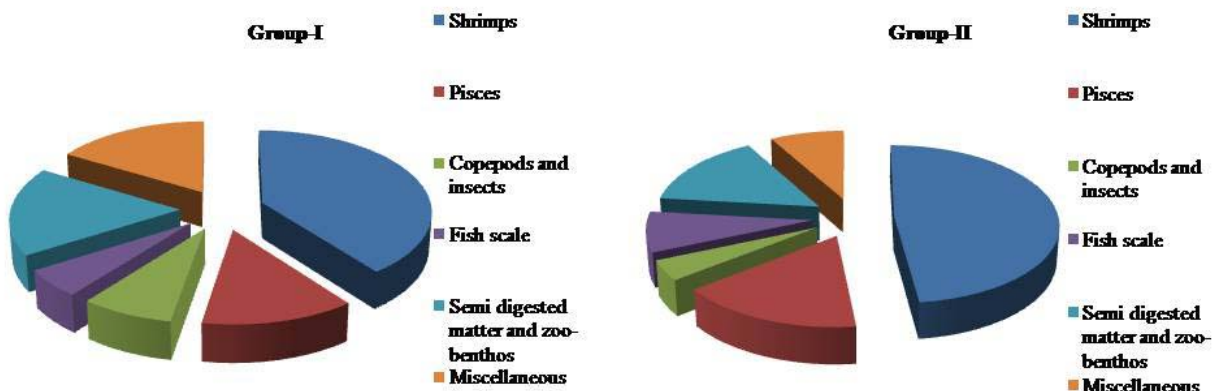


Fig. 2 — Diet composition of *P. paradiseus* as per size group

Polydactylus indicus (Shaw) fed on prawns, crabs, *Acetes indicus*, bivalves, gastropods, and scaphopods.

The present study indicated that shrimps were the main food items followed by fishes and insects of *P. paradiseus* occurring in the Hooghly-Matlah estuarine system of West Bengal, which bears similarities with the most of the studies and slightly deviated from few works. Such types of feeding differences might be due to the occurrence of various food items in the concerned environment and feeding nature of the species.

The monthly variation in GaSI and GSI of the fish is depicted in Figure 3. The values indicated that feeding intensity was very less during winter compared to the summer season. The mean GaSI values in male fish varied from 1.32 to 2.68 with the maximum value in April and lowest during December. In case of females, the mean GaSI values varied from 1.23 to 2.49 with a maximum during March and minimum during June. The value indicated that in the case of female the feeding intensity was very less during June, July, which coincides with the breeding season of the fish. A definite trend of variation in GaSI values was lacking for both the sexes of *P. paradiseus* during present observation. It was highest during pre and post-spawning period and found more prominent in the female. Higher feeding intensity was observed soon after the breeding period for both the sexes and in the pre-spawning period. A significant difference ($F_{1, 7} = 6.464, p \leq 0.05$) was observed in GaSI values in *P. paradiseus* during

different months that might be due to a seasonal variation in feeding.

The monthly mean GSI values varied from 0.74 (December) to 1.32 (June) in males and 0.82 (December) to 5.44 (June) for females. An increasing trend of variation in GSI values was recorded for both the sexes from January to June. A significant difference ($F_{1, 7} = 14.02, p \leq 0.01$) was observed in GSI values between males and females, which might be due to more gonadal weight in females compared to males.

According to Shobana²⁵, monthly variations in feeding intensity and dietary composition of fishes are influenced not only by the maturation of gonads but also due to the availability of food in the respective environment. An inverse correlation of the gastro-somatic index with gonad weight of *P. paradiseus* was observed in the present investigation. This might be due to the less consumption of food items during the time of gonadal development or spawning season of the species. Such types of inverse relationships were also reported by Khonggain *et al.*²⁶ in *Trichogaster fasciata* and by Vahneichong *et al.*²⁷ in *Labeo calbasu* from West Bengal water bodies. Sunder *et al.*²⁸ also reported that the feeding and stomach fullness indices showed a maximum in summer and minimum during winter in the case of *Cyprinus carpio*. The present work resembles the work of Das *et al.*²⁹ who reported that the gastro-somatic and stomach fullness indices showed high feeding intensity either in pre-spawning or during

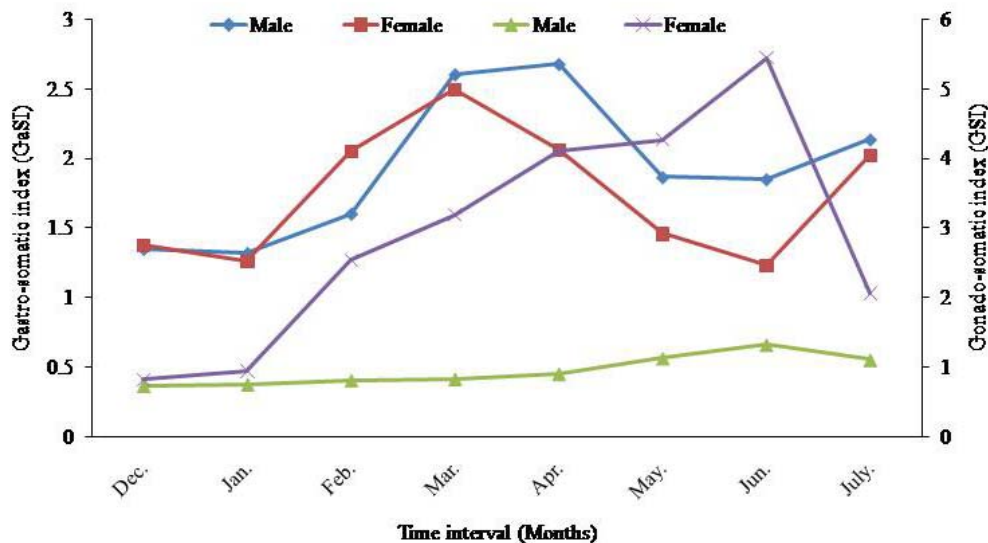


Fig. 3 — Monthly mean variation of GaSI and GSI of *P. paradiseus*

the post-spawning period in *Accrossocheilus hexagonolepis*. Rao *et al.*³⁰ studied the relationship between different maturity stages and feeding intensity of *Channa* species and observed that its feeding varies from season to season and consumes less feed during ova ripening, which agrees with the present study. Basudha and Vishwanath³¹ described seasonal fluctuation of feeding intensity and dietary composition in fishes not only influenced by the maturation of gonads but also with the non-availability of food items in the habitat.

Hussein *et al.*³² reported that the highest feeding intensity value of *Polydactylus sextarius* (Bloch and Schneider, 1801) was recorded during March. Hatikakoty and Biswas³³ studied the feeding intensity of *Oreochromis mossambicus* based on the gastro-somatic index and revealed that there was a monthly fluctuation in the feeding intensity with relatively higher GSI values during winter. Kiran and Puttaiah³⁴ observed feeding intensity of *Salmostoma untrahi* and found that the feeding intensity is related to spawning activity besides food abundance. Karodt and Radhakrishna³⁵ studied GSI value of *Arius arius* (Hamilton) along with gut contents from Cochin backwaters and found low value during monsoon which is attributed to the poor feeding tendency of the species. Thangavelu *et al.*³⁶ found that in *Arius thalassinus* feeding intensity was decreased with the increase in body size which may be due to the dietary shift of individual fish and also active feeding nature of individual with regards to age.

In the present study, the highest feeding intensity was observed during March and low during June and winter season which resemble the earlier studies. The highest feeding intensity during March i.e. pre-spawning season of the species indicates that it needs more energy for the gonadal development and it was found less active during the winter period.

Conclusion

The present study indicated that *P. paradiseus* is a carnivore fish and crustaceans constituted the main food items. There were little variations in diet composition between juveniles and adults. The preferred food items were copepods, insects, and zoobenthos in the juvenile stages and those of shrimps, and fish in adult stages. The feeding intensity was observed high during the post-monsoon and summer months and it was inversely related to the maturity of the species. *P. paradiseus* is a high priced fish and it has growing market demand in the region

so, there is a need to promote its fisheries in the estuarine region adopting suitable management practice. This work bears importance in the context of sustainable management and conservation of the species in the Hooghly-Matlah estuary.

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Conflict of interest

The authors declare that they have no conflict of interest.

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