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Food and Feeding Habits of *Puntius sarana subnasutus* (Val.)

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The seasonal fluctuations in the food items of *Puntius sarana subnasutus* inhabiting the Veli Lake have been studied based on analyses of the gut contents for a period of one year during 1972–1973.

Points method was adopted for determining the percentage occurrence of food items. Feeding intensity of mature and immature fish was also ascertained.

From the list of food items preferred by the species, it would appear that the fish is an omnivorous bottom feeder.

Detritus formed the most preferred item of food for length groups 126–175 mm whereas this item of food was relegated to a third rank in the 176–225 mm length group. In the largest length group (226 mm and above) detritus as such formed only an insignificant item. Such fish show a preference to insects and insect larvae. The dominance of insects in the diet of the older size groups, which are actively breeding, is significant since they are feeding on the digestive tracts of the prey which serve as convenient instruments of collecting and packing the food.

The results of the present investigation are discussed in the light of earlier work and the significance of the study in aquaculture has been highlighted.

Introduction

Though the food and feeding habits of a number of marine fishes such as the Indian macekral (Bhimachar & George 1952), the ribbon fishes (James 1967), the horse mackeral (Kagwade 1967) and the sardines (Sekharan 1971) have been analysed, reports on the feeding habits of fishes inhabiting estuaries, freshwater lakes and streams are few. Since the pioneering work of Hartley (1948) on the food and feeding relationships in a community of freshwater fishes, greater attention is being paid to this aspect of inland fishery research. Studies on the dietary habits of certain cyprinid fishes including *Barbus sarana* and *Barbus chrysopoma* (Menon & Chacko 1956), *Barbus stigma*, *Cirrhina mrigala* and *Labeo rohita* (Yusuf Kamal 1967) have suggested that generalisation on food and feeding habits of freshwater fishes which live in isolated pockets unlike marine species will have to be made with great caution.

In the studies on food and feeding habits of *Barbus chrysopoma* of Madras (Menon & Chacko 1956), a synonym of *Puntius sarana subnasutus*, no mention is made of the

method of analysis of the gut contents, the seasonal fluctuations in the food items and the feeding intensity of species. Therefore, the aim of the present investigation is to present a more detailed insight into the food and feeding habits of *Puntius sarana subnasutus* (Val.) (=*Barbus chrysopoma* (Cuv. & Val.) occurring in the backwaters along the coasts of Kerala.

Materials and Methods

Different workers have adopted different methods in analysing the gut contents. Job (1940) followed the 'volumetric method', whereas Bapat & Lal (1950) estimated the percentages of the various food items of some inshore fishes by eye assessment. Hynes (1950) studied the stomach contents of freshwater sticklebacks by the 'points method'. Bhimachar and George (1952) combined both 'points method' and 'number method'. As Pillai (1952) has suggested, the method to be adopted depends entirely on the particular diet of the fish. Venkataraman (1960) employed the 'points method' with certain modifications. 'The index of preponderance' method of Natarajan and Jhingran (1962) adopted by James (1967) for ribbon fishes, was found to be apparently suitable for carnivorous fishes feeding on such food items as small fishes, shrimps and prawns, mysids and crustacean larvae. Because of the presence of diatoms, small algal remnants and plant materials in the gut contents of *Puntius sarana subnasutus*, the above mentioned methods could not be adopted for the present study. Therefore, in evaluating the different food organisms, the 'points method' of Swynnerton and Worthington (1940) as reviewed and modified by Venkataraman (1960) was followed.

The study was made on weekly collections of fish from the Veli Lake. The fish were caught in the morning hours and they were immediately brought to the laboratory. The specimens were grouped into three length groups of 50 mm intervals. After taking the morphometric data, the fish were dissected and the state of maturity of gonads was noted with a view to finding out correlations if any between feeding intensity and breeding cycle. *P. s. subnasutus*, being a cyprinid, lacks the conventional stomach, its place being demarcated by a swelling at the anterior part of the intestine, called "the intestinal bulb". Since the stomach is absent, the entire gut was taken out for the analysis of the different food items and it was interesting to note that the intestinal coils also contained undigested or semi-digested food.

After splitting the entire gut open, the contents were carefully washed in 5% formalin of known volume. The increase in volume denotes the volume of gut contents.

The intensity of feeding was recorded basing on the state of distension of gut and the amount of food contained in it, as follows: E='empty', when the gut is empty; P='poor', when the gut contained very little food and not distended; M='medium', when the gut is half-full and only slightly distended; G='good', when gut is full and distended; H='heavy', when the stomach is gorged with food and fully distended. Depending upon the degree of fullness of the gut, points 50, 40, 20, 10 and 0 were given to heavy, good, moderate, poor and empty guts respectively.

For evaluating the preference of food consumed, the different food items were assessed by eye under the categories swarms, plenty, common, a few, very little and rare, due consideration being given to the size of the food organism as well as its abundance. Points 50, 40, 30, 20, 10 and 5 were allotted to each category. The method gives roughly both the quantitative and qualitative data without the need for very detailed counts (Venkataraman 1960).

Depending upon the distension of the gut and amount of feeding, the degree of feeding (feeding intensity) of each fish can be ascertained as under any one of the five categories, heavy, good, moderate, poor or empty.

Results

The percentage composition of food and its seasonal variations for the three length groups are presented in tables 1–3. The different items of food consumed in the order of preference in the three representative length groups are summarised in table 4. The seasonal variations in the percentage composition of the major food items of the immature as well as mature specimens for a period of one year are illustrated in figures 1 and 2.

Regarding the identification of the different food items, it was found difficult to determine the species or even the genus to which the different food items belonged, as they were already subjected to the strong action of digestive juices. The following list of identifiable organisms, recovered from the alimentary canal of *P. sarana subnasutus* would indicate the diverse nature of its food.

DIATOMS : *Mastogloia* sp., *Frustulia* sp., *Brebissonia* sp., *Navicula* sp., *Nitzchia* sp.

FILAMENTOUS ALGAE : *Ulothrix* sp., *Anabaena* sp., *Spirogyra* sp., *Cylindrocapsa* sp., *Oscillatoria* sp.

OTHER ALGAE : *Closterium* sp., *Cosmarium* sp., *Eudorina* sp., *Coelastrum* sp., *Ankistrodesmus* sp.

HIGHER AQUATIC PLANTS : *Hydrilla* sp., *Elodea* sp., *Vallisneria* sp. Other aquatic grasses and their seeds. Paddy grains.

MOLLUSCS : *Melania tuberculata* (Muller), *Crustaceans. Mesopodopsis zeylanica*, small penanid prawns, Insects and insect larvae, hemipterans, coleopterans, chironomid larvae, certain unidentified larvae.

ANNELIDS : *Nereis* (*Heteronereis*) sp., Fish larvae. gobioids, anchovies. Mud and detritus (along with sand grains).

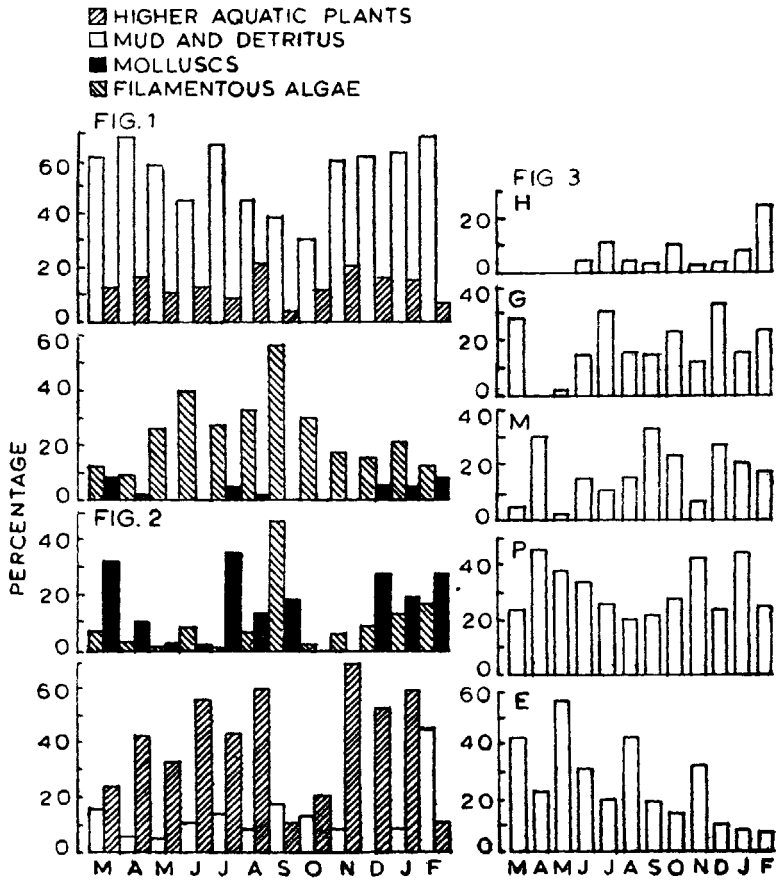
Table 1 *The nature of food items in the three length groups of* P. s. subnasutus

Food item in %	I Length group 126–175 mm	II Length group 176–225 mm	III Length group 226 mm and above
Mud and detritus	54.76	12.54	0.5
Filamentous algae	24.80	10.01	0.6
Higher aquatic plants	12.82	40.64	17.6
Insects and insect larvae	4.64	6.77	13.26
Molluscs	2.82	18.78	12.5
Annelids	0.56	0.82	0.3
Diatoms	0.06	0.9	0.6
Fish	—	1.03	0.2
Crustaceans	—	0.65	4.1
Other algae	—	1.8	—

(i) Fluctuations in the composition of the food for the length group 126–175 mm

In table 1 is presented data on the order of preference of food items in the three length groups. Also the average percentage composition of the food items consumed by the three length groups during the period of investigation is also given in parenthesis.

About 85% of the 66 specimens. all of them being adolescent fish, had recognisable food remains in their digestive tracts. Mud and detritus formed the major food items (54.76%) in the guts throughout the year without wide fluctuations (figure 1). Ranking second in importance were the filamentous algae (24.80%) which were available in abundance growing attached to rocks and such other anchorages at the bottom and



Figures 1–3: *1,* Monthly variations in the percentage composition of major food items of *Puntius sarana subnasutus* of length group 126–175mm; *2,* Monthly variations in the percentage composition of major food items of *P. sarana subnasutus* of the length group 176–225 mm; *3,* Monthly variations in the condition of gut of *P. sarana subnasutus*

E, empty; **P,** poor; **M,** moderate; **G,** good; **H,** heavy

margins of the lake. Next in importance was the green leaves of aquatic weeds and grasses which were seen in a crushed or semidigested condition in substantial quantities (12.82%) in the diet throughout the year. Insect larvae constituted yet another item of food representing as much as 4.64% and in October 1972 they formed 25.4% of the total food consumed. Molluscs that occur on the algal fronds or on submerged stones, annelids, both polychaetes and oligochaetes as well as diatoms were also represented in small quantities in the gut contents. The consistent occurrence of sand particles in the gut contents may be attributed to accidental swallowing while feeding on the decaying organic matter (detritus) at the bottom.

(ii) Fluctuations in the composition of the food items for the length group, 176–225 mm

The percentage composition of various food items in the diet of adults and data on the order of preference of food items are presented in table 1.

About 72% of the 221 specimens examined had recognisable food remains in their digestive tracts. A greater variety has been noticed in the food preference of this length group, contrary to the food preference shown by the length group 126–175 mm. Higher aquatic plants formed the dominant item of food of these adult specimens (40.64%) and they were present in a crushed or semidigested condition in fairly high proportions during the major part of the year (figure 2). Ranking second in importance were the molluscs (18.78%) which contributed a substantial amount of food to this length group. The quantity of molluscs ingested showed an increase especially during February, March and July (28.9%, 32.6% and 35.5% respectively). All the shells were assignable to the Subclass Prosobranchia of Gastropoda, and the family Pleuroceridae, the most frequently observed species being *Melania tuberculata* (Muller). In most cases young shells were noticed in large numbers within the large shell. As in *Heteropneustes fossilis* (Bhatt 1968), in certain cases of the present study, portions of the gut were seen dilated almost to the bursting point as a result of the contained molluscs. Intact bivalves were hardly encountered in the gut. Mud and detritus which constituted more than 50% of the gut contents of the previous length group almost throughout the period of study, has been reduced to an average of 12.54% in this length group. Quantity of filamentous algae consumed by fish of this length group also showed a decline (10.01%, as compared to 24.80% of the first length group). Insects and insect larvae constituted a significant item of food in the gut contents (6.77%), being most abundant during April and May (21.10% and 39.6% respectively). Other items which were represented sporadically throughout the year were algae (1.8%), fish (1.03%), diatoms (0.9%) annelids (0.82%) and crustaceans (0.65%).

(iii) Fluctuations in the major food items of older specimens of length group 225mm and above

About 50% of the 19 specimens examined had recognisable food remains in the gut. The number of individuals available for study was not great owing to the relative scarcity of this length group in the catches. In this length group also, higher aquatic plants were the most important item of food (17.6%), insect and insect larvae ranking next in importance (13.26%). Molluscs also seemed to be of equal importance as insects (12.5%). Insects were more prevalent during October (48.8%) and November (50%) whereas molluscs formed a significant part during May and December (50% and 100% respectively). Crustaceans were an item of importance when compared to the two earlier size groups. In contrast to this, the quantity of filamentous algae and detritus showed such a reduction that they could not be regarded as food of any significance to this length group. Diatoms and fish too were negligible in quantity (0.6% and 0.2% respectively) in the food of these large sized fish throughout the period of study.

(iv) Seasonal variation in the rate of feeding

Since 95% of the individuals of the first length group (126 mm–176 mm) had been either immature or maturing for the first time, they are considered here as the

immature group. The remaining two length groups (176 mm to 225 and above) together constitute the mature group. The average volume of gut contents of both immature and mature fish is shown in figure 4; figure 3 gives an idea regarding the monthly variations in the condition of the gut during the different months of the present investigation.

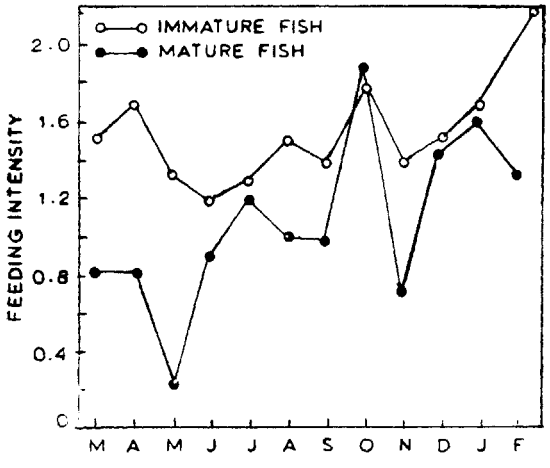


Figure 4 Monthly variations in the average volume of gut contents of immature and mature specimens of *P. sarana subnasutus*

In figure 4 three modes are discernible, the first one in July, the second in October and the third in January. Sobhana and Nair (1974) have reported that the breeding season of this species in the Veli Lake extends from late May to early November. Peak spawning occurs in July and October. Thus the first two modes coincide with the time just after spawning when the largest number of spent ovaries are encountered in the samples. Such reduced feeding during peak maturity followed by intensive feeding after spawning has been recorded for many other teleosts (Qayyum & Qasim 1964). The third mode in January representing a high rate of feeding from December to March may be suggestive of the high requirements of the food for the building up of the gonads, during which time the spent ovaries recover and the virgins mature.

A large number of guts were empty every month. Out of the 306 mature fish examined 103 showed empty guts. The percentage of empty guts in the immature group had been considerably low and showed very little seasonal variation, most of the guts being either in "good" or "heavy" condition and hence the occurrence of empty guts in immature specimens has not been dealt with here. The presence of empty guts in gravid females and ripe males may be attributed to the reduced feeding activity during the breeding season (Job 1940). It is noteworthy that, the high incidence of empty guts especially during May (57.5) and August (44.0) coincides with the prespawning period. But the steady occurrence of at least a few empty guts throughout the year suggests the possibility of regurgitation of the food owing to shock during capture (Job 1940). Figure 3 also shows that during July, October, and December to February, there is an increase in the incidence of 'good' and 'heavy' conditions of the guts when the volume of gut contents also shows maximum values. It is interesting to note that these periods coincide either with the prematuration time or with the post-spawning time.

It is evident from the foregoing account that the fish feeds voraciously during growth stages and just after spawning. At other time the feeding intensity is noticeably reduced according to the state of ripeness of the ovary.

Discussion

According to Menon & Chacko (1956), fishes feeding on filamentous algae, molluscs and worms and in whose gut contents, sand grains in fair proportion are found, are to be placed under the group of bottom feeders. In the case of *P. s. subnasutus*, the first two length groups discussed above thus seem to belong to the group of bottom feeders as evidenced by the occurrence of mud and detritus as well as filamentous algae in their gut contents. In general, *P. s. subnasutus* can be regarded as an omnivore consuming a wide range of food materials from higher aquatic plants phytoplankton and detritus, to almost every type of available invertebrate and occasionally of even vertebrate of a size small enough to be swallowed. The gradual change of preference from detritus and filamentous algae to higher aquatic plants, molluscs and insects may be to avoid effectively the direct competition for food between the younger immature group and the mature adult group of fish. Such differences in the diet are of survival value reducing the likelihood of intraspecific competition and making it easier for fish of different sizes to occupy the same habitat. This variation in the diet has been recorded in a few other fishes also such as *Gasterosteus aculeatus* (Hynes 1950), *Bagrus docmac* (Corbet 1961), *Clarias senegalensis* (Thomas 1966) and anchovies (Bapat & Lal 1950 and Venkataraman 1960).

Suyehiro (1942) attributes the omnivorous feeding habit of the freshwater fishes including the family Cyprinidae to the limited supply of food in the habitat. The stress is more severe on brackish water animals since they have to get physiologically adapted to the widely fluctuating ecological factors such as salinity and oxygen. The wider choice with the inclusion of animal foods subsequent to the onset of maturity may be to augment the protein intake as well.

According to Chacko and Krishnamurthy (1950), the food of *Barbus chrysopoma* (synonymous to *P. sarana subnasutus*) in ponds and tanks of Tanjore and S. Canara consists of plankton, filamentous algae and insects. Observations of Menon and Chacko (1956) in Madras show that this fish is a "column feeder" feeding mainly on higher acquatic plants and larger crustaceans. Observations made during the course of the present study do not closely conform to these earlier observations. As shown already during the present study, the species seem to prefer detritus and filamentous algae during the early stages of growth and higher aquatic plants, molluscs and insects during the later stages. It thus becomes obvious that a scarcity of planktonic food is not the reason for the absence of such items in the gut contents of species. The distinct preference to benthic flora and fauna (higher aquatic plants, filamentous algae, molluscs and insects) is probably a reflection of the behaviour of the species which spend most of the time in benthic zone of the lake, because the material in the digestive tract faithfully reflects the relative environmental densities of food items falling within the ingestible size range. The small amount of detritus and algae present in the intestine of the largest size group represents either the gut contents of the prey or materials swept into the mouth during capture of the prey. Such materials may be of nutritional value to the fish. Although the detritus and algae as the gut contents of the prey have a reduced caloric per gram value such material is mechanically disrupted partially digested, prepackaged food supply which may well be assimilated with considerable efficiency. In fact the early instars of benthic insects before they have begun any significant fat deposi-

tion, contain large, fully packed digestive tracts which serve as an excellent source of food. A dominance of insects in the diet of older size groups which are actively breeding is therefore significant, since they are feeding on the digestive tracts of the prey which serve as convenient instruments of collecting and packaging the food.

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