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FOOD AND FEEDING HABIT OF *GONIALOSAMANMINA* (HAM.)FROM THE RIVER YAMUNA, ALLAHABAD, INDIA

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ABSTRACT

Small indigenous fish species (SIS) have high nutritional value in terms of protein, vitamins, and minerals. but due to changed hydro-biological conditions and man-made interventions many SIS have become threatened and endangered and need immediate attention for their conservation. Therefore to sustain their fishery it is important to know the food and feeding habits of SIS, which will be helpful for successful management of these fishes. The present study investigated feeding the habit and diet composition of Gonialosamanmina (Ham.), a freshwater clupeid, by regular monthly collection from the river Yamuna at Allahabad, India. During the study 295 specimens of G. manmina were examined, length range 4.7-15.3 cm. Studies have shown that this fish having plant food material 85.6% and animal food material 4.7% is strongly herbivores. The dominating food item was green algae (36.5%) followed by diatom (25.4%), BGA (12.8%) and desmids (11.0%). The contribution of crustaceans, insects, protozoan, rotifers are almost negligible. Hence the fish subsisted mainly on green algae and diatoms. The intensity of feeding (GSI) was found to be maximum during January and June and minimum during March and July. The present findings will help in filling the gap in knowledge about the feeding habit of G. manmina which will help in formulating strategies for proper development of their fishery from the system.

KEYWORDS: *Food Items, Gastro Somatic Index, Gut Content, SIS, Qualitative and Quantitative*

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INTRODUCTION

Fish like any other organisms depends on the energy received from its food to perform its biological processes such as growth, development, reproduction and other metabolic activities. Hence, food is the basis for all function of an individual fish as well as the population. Length-weight relationship and condition factor and morph metric study of *G. manmina* has already been published (Masud & Singh 2016). Feeding is one of the main concerns of daily living in fishes, in which fish devotes a large portion of its energy searching for food. Detailed data on the diet, feeding ecology and trophic inter-relationship of fishes is fundamental for the better understanding of fish life history including growth, breeding, migration and the functional role of the different fishes within the aquatic ecosystem. The same species occupy different habitat may feed on different types of food or even in the same habitat the diet may vary at different times and at different stages of its lifecycle (Islam 2004, Masud, 2014).

In the past, among the smaller species, *A. mola*, *S. phasa, O. cotio, R. corsula, S. cascasia, J. gangeticus, A. coila, G. chapra*, *G. manmina, A. morar, S. bacaila*, etc., largely because of their comparatively small size were not regarded as economically important fish especially in comparison with major carps and catfishes which attain much bigger sizes. Small indigenous fishes (SIS) usually include those species which attain a maximum length of 25-30 cm in the mature or adult stage of their lifecycle (Felts *et al.*1996). The SIS are prolific breeders, need little or no management and grow in the rice fields, irrigation, and drainage channels, almost all lentic and lotic water systems. Earlier SIS was considered as weed fish or trash fish and was removed as vermin, with negative implications for the conservation of species of interest. But the decline in larger species enhanced the importance of smaller species fetching a good price. Nevertheless, marketable as all these species are, they have positive nutritive and economic values (Hossain and Afroze, 1991; Hossain et al, 1994; Masud&Haldar 2016, 2017) and can play a more significant role in the national food economy if their fisheries are developed (Jhingran, 1966). Recent socio-economic studies have identified *G. chapra* as both an important food resource and a crucial source of micronutrients essential in preventing malnutrition and vitamins and mineral deficiencies in rural communities, particularly among women and children in Bangladesh (Thilsted et al, 1997; Thilsted, 2003).

SIS, which are ubiquitous in every biotope and compete for food with commercially important fishes, have been studied by various workers. The main studies are on *G.giuris* (Bhowmick, 1962); Alikunhi and Chaudhuri (1954) on *Chelaphulo*; Parameswaran et al. (1971) on *O. cotio*; Natrajan et al. (1975) determined the food and feeding habits of various size groups of 10 trash fishes, viz., *Ambassisnama*,*A. ranga*, *O.* cotio, *E. danrica*, *A. mola*, *P. sophor*, *P. ticto, Chela bacaila*,*B. barna*and *C. laubuca*of the Tilaiya and Konar reservoirs. In India, out of 765 freshwater fishes 450 species are categorized as small indigenous fishes (SIFs) (lakra, 2010).Das and Moitra (1955, 1956a, 1956b) worked extensively on the food and feeding habits of indigenous fishes. Jhingran (1966) assessed extensively the food and feeding habits of *G. Chapra* from the river Ganga at Allahabad. Proper knowledge about the food and feeding habits of fish is a very important factor for increasing fish production. The food habits of fishes vary with time of the day, size of the fish, the season of the year, locality and availability of various foodstuffs. Various workers have also been studied the food and feeding habits of fishes. But so far literature reviewed no published report was found on food and feeding habits of *G. manmina*; therefore, the aim of this study is to evaluate the food and feeding habit of *G. manmina* (SIS) from the river Yamuna which might be helpful to the fish management policy for the increase of production of fish in different water bodies.

G.manmina(Ham.) belongs to family clupeideae, comes under the category of trash fish but during recent years it is considered as an important fishery. It is highly nutritious in terms of protein, fats, and minerals (Masud & Haldar 2016, 2017). It is widely distributed in freshwater rivers and associated water bodies of Sri Lanka, India and Bangladesh (Talwar&Jhingran, 1991) and found abundantly throughout the year (Masud 2014).

MATERIAL AND METHODS

Collection of Data on Fish Landings

The data on the fish caught from river Yamuna was collected from Sadiapur fish landing center just on the left bank of the river. Studies have shown that bulk of the night catches from the river is brought to this wholesale fish market for disposal. The day fish catches are disposed of at Gaughat and KarelaBagh retail fish markets during evening figure 1. These retail markets were also explored for data on fish catch. All precautions were taken to avoid the duplication of data as the retailers purchase fish from Sadiapur fish market and sale in these markets. The data was collected species-wise.

For the purpose of the collection of data a stratified sampling design was adopted (Tyagi and Mandal, 2008). A month was divided into four strata of seven or eight consecutive days, depending upon the month. From each stratum, data was collected for two randomly selected days. All the three markets were covered on the sampling days.

Figure 1: Map Showing Sampling Sites and Fishing Villages Feeding Fish Markets

A total of 295 specimens were collected from the river Yamuna at Allahabad, samples were dissected out, weighed and preserved in 5% formalin. The gut contents were analyzed through quantitative and qualitative methods (Pillay, 1952, Hynes, 1950). The various food items were identified up to generic level with the help of Needham and Needham (1962), Ward and Whipple (1918). Gastro somatic index (Ga.S.I.) was determined for each fish to study the seasonal variations in food by the formula (Keast, 1965).

$$\text{GaSI} = \frac{\text{Weight of the gut content}}{\text{Weight of fish}} \times 100$$

The data was analyzed to correlate various observations like feeding intensity with different months of the year, feed with season and size or stages of life.

RESULTS AND DISCUSSIONS

An examination of the gut contents of *G. manmina* revealed the presence of various food items. Their monthly variations are shown in Table 1, and the percentage contribution of various food items in Figure 2. The contribution of various food groups for all the samples, length group- wise and season- wise are depicted in Table. 2.

It is evident from the Table 1 and Figure 2 that the gut contents consisted mainly green algae (36.5%), the highest percentage of green algae encountered in the month of July (63.3%), and the minimum was recorded in January (7.6%), Diatom formed the second most important food item with a contribution of 25.4% in total food items. They were found the maximum in January and constituted 62.8% and minimum in the month of October (3.3%), Blue-green algae group constituted about 12.8% of the total food item. It was maximum in December (27.1%) and minimum in July (3.0%) and desmids constituted 11%, it was maximum in October (28.6%) and minimum in January (3.1%). The less significant food groups were protozoa (3.2%), insects (1.1%), crustacea (0.3%), rotifer (0.1%) and miscellaneous (9.6%). Algae and other

plant matters constituted the bulk of the gut content (85.7%) followed by animal matter are 4.7% which clearly indicated that fish is herbivorous.

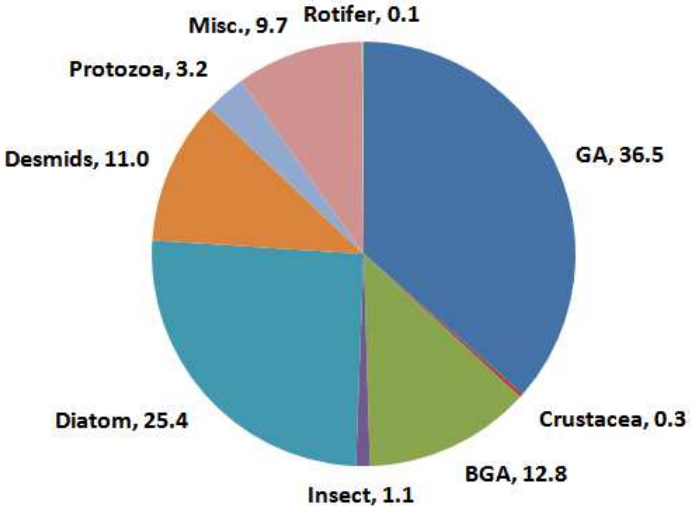

Figure 2: Gut content (%) of *G. Manmina*

Table 1: Monthly Contribution (%) of Food Items in Gut Content of *G. Manmina*(Ham)

Group	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
Ga	7.6	52.3	38.3	36.1	29.5	52.5	63.3	38.4	36.6	48.0	48.9	14.0	36.5
Bga	17.6	8.5	7.9	16.3	16.3	6.0	3.0	15.6	8.1	10.0	10.1	27.1	12.8
Dia	62.8	15.8	26.9	17.0	18.6	16.6	18.1	19.0	31.8	3.3	11.0	44.5	25.4
Des	3.0	9.3	7.3	11.5	20.5	12.9	6.5	9.3	8.8	28.6	12.9	6.1	11.0
Pro	0.3	1.5	4.2	5.9	4.4	1.1	0.0	4.2	3.5	2.1	4.9	2.2	3.2
Cru	0.0	0.8	0.7	0.2	0.0	0.0	0.0	0.0	0.2	0.0	1.4	0.0	0.3
Rot	0.0	0.0	0.9	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1
Ins	0.1	0.2	5.1	0.1	0.7	0.9	0.5	0.3	0.0	0.0	1.8	0.1	1.1
Mis	8.6	11.6	8.7	12.9	10.0	10.0	8.6	13.1	11.0	7.9	8.9	5.9	9.7

ga: green algae; bga: blue-green algae; dia: diatom; des: desmids; pro: protozoa

cru: crustacean; rot: rotifer; ins: insect; mis: miscellaneous

Feeding in Relation to Size

The percentage composition of food groups in various size groups is given in Table 2, which indicated that *G. manmina* showed a progressive increase in animal matter content with increase in length (1.8 to 5.1%). Plant materials constituted the most consumed food item fed on in the three size groups of *G. manmina*. Among phytoplankton the contribution of BGA increased with increase in length (6.4 to 15.9%), however, green algae proportion showed an inverse relationship (55.6 to 28.4%). The fishes of higher length groups showed a good preference for diatoms.

Table 2: Contribution (%) of Various Food Groups for all Samples, Length Group–Wise and Season-Wise in *G. Manmina*

Group	Total samples	L.gr. I	L.gr. II	L. gr. III	Winter	Summer	Monsoon
ga	36.5	55.6	48.3	28.4	28.4	38.6	46.3
bga	12.8	6.4	8.1	15.9	16.1	11.9	8.7
dia	25.4	17.4	16.9	31.1	35.7	20.1	18.3
des	11.0	8.0	12.4	10.1	7.7	12.2	14.3
pro	3.2	1.6	3.8	2.8	2.3	4.2	2.4
cru	0.3	0.0	0.1	0.5	0.6	0.3	0.1
rot	0.1	0.0	0.0	0.2	0.0	0.3	0.0
ins	1.1	0.2	0.2	1.6	0.7	1.8	0.2
mis	9.6	10.8	10.1	9.4	8.5	10.6	9.7
P	85.7	87.4	85.7	85.5	87.9	82.8	87.6
A	4.7	1.8	4.1	5.1	3.6	6.6	2.7
M	9.6	10.8	10.1	9.4	8.5	10.6	9.7
Length groups: L. gr. I: <=7cm; L. gr. II: >7 & <=10cm; L.Gr. III: >10cm							

ga: green algae; bga: blue-green algae; dia: diatom; des: demids; pro: protozoa

cru: crustacean; rot: rotifer; ins: insect; mis: miscellaneous

Seasonal Variation in Gut Content

Table 2 represents the seasonal variation of the gut contents of *G. manmina*. The fish fed mainly on plant materials in all the season (82.8 to 87.9%). During summer the proportion of animal food showed some increase as compared to monsoon and winter seasons, the main increase was in protozoan. However, the most preferred food of the fish in all the season was green algae (28.4 – 46.3%) followed by diatoms (18.3- 35.7%), with a change in pattern over the season. The analysis of season-wise data did not reflect much variation in the proportion of plant and animal matter in food items of *G. manmina*.

Gastro Somatic Index (GaSI)

Monthly variations in gastro-somatic-index are shown in figure 3. A well-pronounced feeding activity was noticed during January and June. The minimum feeding intensity was observed in March and July, which may be the main breeding season of the species. Hossain and Haque (2005) reported that it breeds mainly from April to July. The species did not reflect any regular trends of ups and down in feeding intensity. Thus, it could be inferred that it breeds throughout the year with two peaks in March and July. Hossain et al. (2003) specified that some smaller species breed throughout the year with less frequency in the winters this observation was also noticed in the present study. Several workers reported *G. chapra* breeds twice in a year. Kabir et al (1998) reported two spawning peaks, one in April and another in August. Hossain and Haque (2005) observed its breeding season as January to March and July to October. As evident from the figure 3 the feeding intensity declined in February and March followed by a steep upward peak up to June and then a sharp declined to a minimum in July this may be inferred with peak breeding season then again it shows a rise during August and September afterward start declining up to December and showed an abrupt increase in January it may be due to recovery after breeding, another peak observed in June which may also coincide with recovery after breeding. High feeding activity

during January and June might be due to intensive feeding by spent fishes as well as those in the early stage of maturity. Keshava et al (1988) reported that *Etroplus suratensis* during spawning season reduces the feeding rate. The drop in gut content from January to March and June to July that is pre-breeding period may be attributed to the growing size of gonads especially ovaries which in turn exerts pressure on gut and leaves a minimum space for the gut, therefore, fishes go on starvation type situation. Kurup (1993) also stated that these variations may be related to the maturation of the gonads as fully developed gonads limit the space for stomach and spawning.

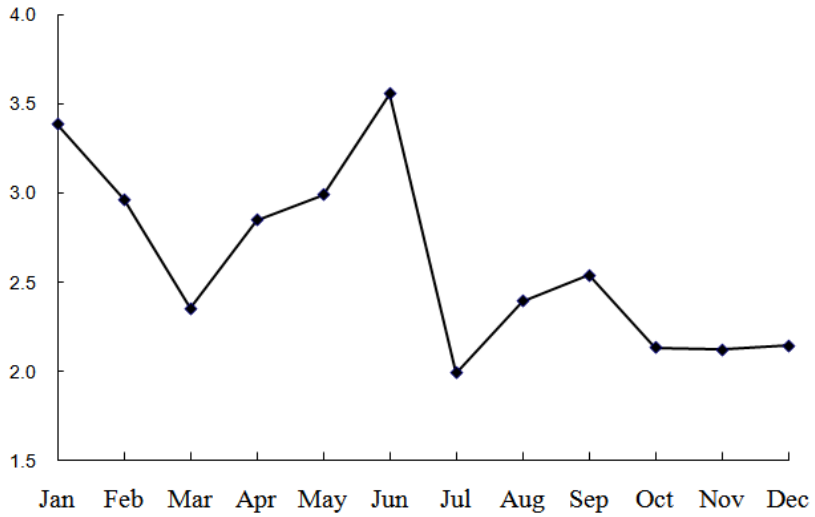

Figure 3: Monthly Fluctuations in Feeding Index (GaSI) of *G. Manmina*

The nature of the alimentary canal and its modification has a direct relationship with the nature of the diet consumed by the fish. In *G. manmina* modifications in respect of alimentary canal, especially concerning the uptake of food, feeding, digestion, and absorption are fully suited for their herbivorous feeding habits. Similar structural modifications are also reported in some cyprinids Suychiro, (1942); Das and Moitra (1956a, 1956b); Kurup (1993) the inferior and slightly protractible mouth of *G. manmina* is well adapted for browsing of food buried in mud or sheltered under crevices of the river fringes.

In *G. manmina* a well-developed stomach is totally absent which is a character common to a larger number of herbivorous species (Das & Moitra 1956a) However, the swelled portion of the proximal part of intestine, the intestinal bulb, may be analogous with the stomach of teleosts Rogick (1931); Sarabhai (1940). Generally, fishes posing a well-developed masticatory structure do not have a well-defined stomach Suychiro (1942). The gut of these species is long, coiled and may provide a longer surface area for absorption of the decayed plant and phytoplankton matter.

The relative occurrence of different food organisms varied from month to month. Such variation appeared due to varied production or supply of the food items in the environment. The occurrence of green algae in the gut of the fish was recorded throughout the year and its total percentage remained always higher than any other food item. The occurrence of green algae, diatoms, BGA and desmids in the gut of the fish was recorded throughout the year (tab.1) which clearly indicated that fish is herbivorous. The consumption of the green algae was always higher than BGA. The percentage of a particular species diatoms or algal matter tended to be maximum at the time of its high production. This appears due to the succession of species within the population. It may be concluded that the occurrence of the different type of food items in gut contents of the fish in different months of the year depends on their availability rather than selection by the fish. It has

been observed that *G. manmina* feeds selectively. The more readily available the food organism, the more it is taken by the fish. Nilsson (1955) observed that the feeding habits of fish are ruled by a complex behavior mechanism, involving a sort of conditioning on a certain food object being in abundance at a certain time. He further showed Nilsson (1955,1957) in white fishes and salmonids the display of a sort of learning on certain food objects when these reach some state that makes them easily available than any other food occurring in the fauna at that time. This he termed as 'changeable food specialization'. This was also observed in this species in the present study. The presence of a particular food item in marked abundance indicating that it was carefully selected and preferred by the fish to other items present in lesser qualities.

Observations on the food and feeding habits of *G. manmina* revealed that this species is herbivorous in nature feeding mainly on phytoplankton consisting of algae and diatoms. The zooplankton and animal matter identified from the gut contents could not be treated as the food of this species as is evident from their sporadic and sparse representation and probably they might have entered accidentally while engulfing the phytoplankton.

Thus, the present investigation concluded that *G. manmina* (Ham.) mainly feeds on algae hence it is algae feeder fish which comes under the category of herbivorous nature. Das and Moitra (1963) also reported the similar observation. This information will provide an important baseline for future studies within the Yamuna River in particular and of similar nature other water bodies in general, that will be useful for its future fishery management.

CONCLUSIONS

In spite of the tremendous potential for development, fish production from natural waters in India has been gradually declining over the years especially inland water capture fisheries. The SIS may be potential species for the future fishery from the system. For the proper development of fishery of these species, they should be given a chance to breed at least once. For this restrictions should be imposed on the use of smaller mesh sized gears. These species (SIS) breeds mainly with the onset of monsoon, fishing may be restricted during the period. The invasion of exotic species in the system may be detrimental to the studied species. As the exotic species may be omnivorous in nature and there will be tough competition for food. Further, these exotics are destructive in nature and *C. Carpio* uproots the aquatic vegetation. Thus, it will destroy the breeding grounds of studied species which breeds mainly in marginal areas of the river with submerged vegetation. Measures should be taken to control the further development of exotic species in the open aquatic system. It is the need of the hour that planners should look into the judicious water budgeting with a fair share for fisheries sector when planning water requirement for other sectors, up till now it is almost ignored. However, in recent aquaculture practice culture of SIS with carps have proven to be prudent as it results in overall pond fish production.

SIS though existing at present as minor fisheries these species promise to be expanded to encompass larger magnitudes in years to come. SIS is a valuable and easily available source of food rich in protein, PUFA, and minerals for the socio-economically poor. These fishes may be a potential and alternate source of IMCs and various fish products may be developed with the amalgamation of phyto protein to uplift the socio-economic condition of fishermen community as suggested by Rizvi et al (2011).

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