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FOOD AND FEEDING BIOLOGY OF A NEAR THREATENED FRESHWATER ORNAMENTAL FISH NOBEL GOURAMI, *CTENOPS NOBILIS* MCCLELLAND, 1845

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ABSTRACT: *Noble gourami, Ctenops nobilis McClelland, 1845 is one of the most valuable freshwater indigenous ornamental fish currently depends only on natural collection for its trade. In order to decline the population of fish, suppliers cannot meet the market demand so breeding and large scale seed production of C. nobilis is an urgent need. The knowledge of food and feeding habit of fish has been profitably utilised in culture operation. The gut content analysis showed the maximum amount of zooplankton with 31% and tiny crustacean with 27%. The length of alimentary canal and the RLG value (1.06-2.18) implies that the fish is carnivorous in nature. Seasonal changes in RLG and monthly changes in GaSI value recorded for the fish. The values of GaSI have been observed to become high during March to May with the peak being in March. Tubifex and Daphnia gave the higher rate growth with 1.63 FCR.*

KEYWORDS: Nobel gourami, alimentary canal, feeding habit, growth

INTRODUCTION

In natural condition, fish can regulate their feed intake from wide varieties of natural food to fulfill their nutritional requirement. The study reveals that the fish is strictly carnivorous in nature and mainly preferred live fish food. Irregular availability of natural food for culture of ornamental fish under captivity is the main bottleneck. Standardization of optimal nutritional requirement and feed supplement for different stages of ornamental fishes will very important database for development of diet required for maturation and successful breeding and culture of ornamental fishes under captivity. Nutrition, in terms of food is the essential requisites for all living beings for all energy to perform its biological processes such as growth, development, reproduction and other metabolic activities. The success of good scientific research and fish farming largely depends on the knowledge of their food and feeding habits (Begum *et al*., 2008). Study on food and feeding habits of fish have numerous importances in fish biological studies (Singh *et al*., 2013). Al-Hussaini, 1949 is the pioneer to work out the relative length of alimentary canal of a large number of fish in relation to food and feeding habits. The relationship between alimentary canal and feeding habits was studied for many fishes by different authors viz. Chakraborty *et al*., 2016; Dey *et al*., 2016 and Khongngain *et al*., 2017 etc. The study on food and feeding habit of some small indigenous ornamental fish were carried out by different previous workers (Das *et al*., 2013; Dey *et al*., 2014; Mahapatra and Lakra, 2014; Gupta, 2015; Mahapatra, 2016; Mahapatra *et al*., 2016; Bhattacharya and Mahapatra, 2018; Dutta *et al*., 2020). Apart from some scattered data on the natural feeding habit of *C. nobilis* (McClelland, 1845; IUCN Bangladesh, 2000; Rossman, 2008, Bhattacharya *et*

al., 2016) no such details feeding behaviour have been studied previously. In present study the details facial and alimentary canal morphology, feeding habit, feeding intensity and growth of the fish recorded.

MATERIALS AND METHODS

To know the natural feeding habit of a particular fish gut content analysis is very important. After collecting the fish from natural habitat during April, 2016 to March, 2017; the total length, mouth to anus length and weight of 50 specimens recorded, after that alimentary canal was dissect out and preserved in 10% formalin for microscopic examination of food items. Gut content analysis has been performed following the percentage of occurrence method by Hynes, 1950. This method is based on the count of particular food item in gut. The formula used:

Percentage by number, $\% O_i = \frac{N_i}{N_t} x\ 100$

Where: $\% O_i$ is the percentage of particular food item in gut; N_i is number of that particular food item in gut and N_t is number of total food items in gut.

For determination of the food and feeding habits of the fish species GaSI, gut content, mouth size and shape were studied of all 50 fish species as per standard methods. Length of intestine was measured for comparison with total length of fish. The weight of gut was taken and the feeding intensity was measured by calculating the GaSI.

$$\text{GaSI} = \frac{\text{Weight of gut (gm)}}{\text{Total weight of fish (gm)}} \text{x}100$$

Relative Length of Gut (RLG) value has been measured by the formula of Al-Hussaini, 1949.

$$\text{RLG} = \frac{\text{Total length of gut (mm)}}{\text{Total body length (mm)}}$$

The relationship between total length and the length of intestine and total length was calculated by the formula-

$Y = a + bX$

Where, Y = Intestine length (IL), X = Total length (TL), 'a' is the interception on the ordinate and 'b' is the regression co-efficient.

For food preference study the fish was given Tubifex, Daphnia, Mosquito larvae, Artemia and dry feed (Commercial dry food by Finsters with 24% crude protein and 4% lipid) for 5 days @ 2% of body weight and noticed the acceptance. For the growth study these 5 types of feed was given @ 2.5% body weight at twice a day (morning 10 AM and evening 5.30 PM) for 90 days. Each experiment was done in duplicate and with 6 numbers of fish (Average size length 45-60 mm and 2-3.5 g weight) in each tank. At that time water temperature varies between 24-28^{o}C. Un-utilised feed collected daily and dried to calculate the actual feed intake by the fish. The growth and FCR values calculated in different types of feed given to the fish.

RESULT

Facial and alimentary canal morphology:

Terminal mouth position with little protruding. The mouth is bounded by thin upper and lower lips. The mouth opens into laterally compressed bucco-pharyngeal cavity. In *C. nobilis* there are three pairs of well-developed gill arches with minute but closely packed filamentous gill rackers. The first gill arch modified into vascularised labarynth organ. Each gill arch comprises of double row of gill rakers on its concave aspects and gill filaments on convex side. The mouth gape 0.3 cm of adult size (Ranges between 72-100mm). The oesophagus is very short in length and leads into the intestine. Intestine is characterised by short, thick walled and straight (**figure 1**).

Gut content analysis:

With a thorough microscopic examination of the gut contents of the fish of different size groups during April, 2016 to March, 2017 indicates the presence of various food items which are classified into five broad classes namely Zooplankton, micro worms, tiny Crustacean, insect larvae and Unidentified Species. Results of gut content following percentage of occurrence method have been presented in **figure 2**.

Feed preference and growth study:

As the fish is naturally larvae eaters so it is observed that the fish preferred to take live feed especially Daphnia, Mosquito larvae, Artemia larvae and small Tubifex. The feed preference study of the fish conclude that the feed preference sequence of the fish is Mosquito larvae, Daphnia > Live Tubifex > Artemia larvae > Live Blood worm > Dry feed. From the experimental data on growth of the fish with these types of food items, it is observed that although the fish mainly preferred to take Mosquito larvae and Daphnia but in captivity maximum growth rate was observed with Tubifex diet (0.73g and 27mm) (**Table 1**).

The fish generally take feed @ 1.5-2% of total body weight but the amount of feed intake increase up to 2.5% just after the breeding. The highest FCR is about 1.63 observed in the adult fish with Daphnia and Tubifex diet (**Table 2**).

Relative Length of Gut (RLG):

The alimentary canal is short in length and the Relative Gut Length is about 1.06-2.18 depending on size group of 25-98mm (**Table 3**). The RLG value of the fish implies that it is carnivorous in nature.

Relationship between total length and intestinal length:

The length of intestine (IL) plotted against the total length of fish (TL) is shown in **figure 3** which reveals that the length of intestine increases in proportion to the total length of fish. The equation for regression line is: **IL= -0.147 + 0.766 TL.**

The coefficient of correlation 'r' is calculated to be 0.985 (**Table 4**). The above relationship is worked out on 100 specimens for the fishes belonging to length range from 25 mm to 100 mm.

Gastrosomatic Index:

The Gastrosomatic Index (GaSI) of total 48 fishes (4 No. of fish in each month) has been observed to become highest in winter which is about 2.30 and become very low in monsoon time which is near about 1.68 (**Table 5**). Month wise trend of GaSI of the fish is displayed by scattered diagram (**Figure 4**) which shows that at the month of March, April and May the GaSI is higher than other times of the year. Then May onwards the GaSI tending lower and again from October it shows higher growth. In the month of August it reached the lowest point of GaSI.

DISCUSSION

In *C. nobilis* pipe shaped mouth bounded with thin upper and lower lip and lower lip is little upturned and longer than the upper one. It is recorded that tiny crustacean, zooplankton and insect larvae have higher rate of occurrence in gut so it can be also concluded that these may be their food preference in natural habitat. Zooplankton with 31% and tiny crustacean with 27% has been observed as the most abundant group in the gut content of the *C. nobilis*. Rossman, 2008 also observed crustacean, micro worms and zooplankton occurrence in the gut of the fish. Daphnia, Mosquito larvae and Tubifex are main preferred food for the fish in captivity. Islam *et al*., 2016 also recorded that mosquito larvae are also preferred food for *T. fasciata*. The nutritional requirements for the growth of *C. lalia* also studied by Sahoo, 20. A gradual increase in RLG was noticed among the fish of different size groups from 22-100 mm which varies from 1.06-2.18 and it showed that the fish is carnivorous in nature. Al-Hussaini, 1949 classified the fish depending on RLG values as - carnivorous (0.5-2.4), omnivorous (1.3-4.3) and herbivorous (3.7-6.0) fishes. Dasgupta, 2004 mentioned that the gourami species *T. fasciata* is omnivore in nature and Rao, 2014 mentioned that *T. lalius* is carnivorous fish. The mean monthly values of Gastro-Somatic-Index (GaSI) have been observed to become high during March to May with the peak being in March. Then it started to drop down from May onwards. The lowest value was observed in the month of November. Then it gradually started to increase from December onwards and reach the peak again in the month of April. The lower values along with the decreasing trend of GaSI observed from May to October, depicting the poor feeding intensity of the fish which is correspondence with their breeding periodicity.

CONCLUSION

C. nobilis is one of the most important ornamental fish species but as the fish is endangered in natural habitat so captive breeding is the main mode of conservation of the fish. Knowledge about the feeding habit and optimize the nutritional requirement and food supplement under captivity is the main bottleneck for captive maturation and breeding of the fish. The above study proves very helpful for the farmers for rearing in captivity and artificial breeding of the fish species.

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Table 1. Somatic growth of *C. nobilis* with different food items

Feed types	Avg. Weight gain (g)	Avg. Length gain (mm)
Mosquito larvae	0.68	24
Daphnia	0.61	18
Tubifex	0.73	27
Artemia	0.52	16
Dry feed	0.39	10

Table 2: Variation of FCR of *C. nobilis* with different food items

Feed Applied	FCR
Mosquito larvae	1.59
Daphnia	1.63
Tubifex	1.63
Artemia	1.26
Dry feed	0.78

Table 3: Changes of Relative gut length with the total length of *C. nobilis*

Length range (mm)	**No. of fish examined**	**Average values of RLG**
22-47	10	1.06
48-55	5	1.58
56-69	8	1.81
70-100	9	2.18

Table 4. Descriptive Statistics of length of intestine (IL) and the total length of fish (TL) of *C. nobilis*

	Sample size (N)	Range	Mean	R	R Square	Calculated 't' value	Significance
TL (mm)	100	25-100	57.73	0.958[a]	0.918	3.13	S
IL (mm)	100	17-42	31.13				

S= Significantly different at 1% level.

Table 5: Seasonal changes in Gastrosomatic Index of *C. nobilis*

Seasons	No. of Fish examined	Average GaSI
Pre-monsoon (April to June)	9	2.12
Monsoon (July to September)	10	1.68
Post-Monsoon (October-December)	8	1.96
Winter (January to March)	7	2.30

Figure 1. Structure of alimentary canal of the fish

Figure 2. Percentage of occurrence of different food items in gut

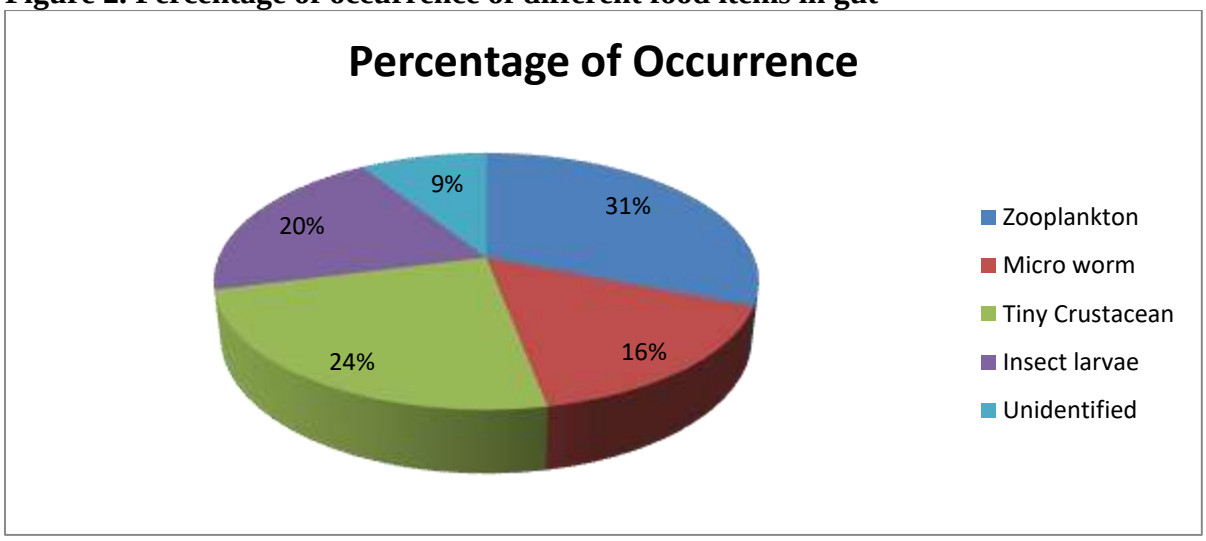

Figure 3. Total length and Intestine length relationship

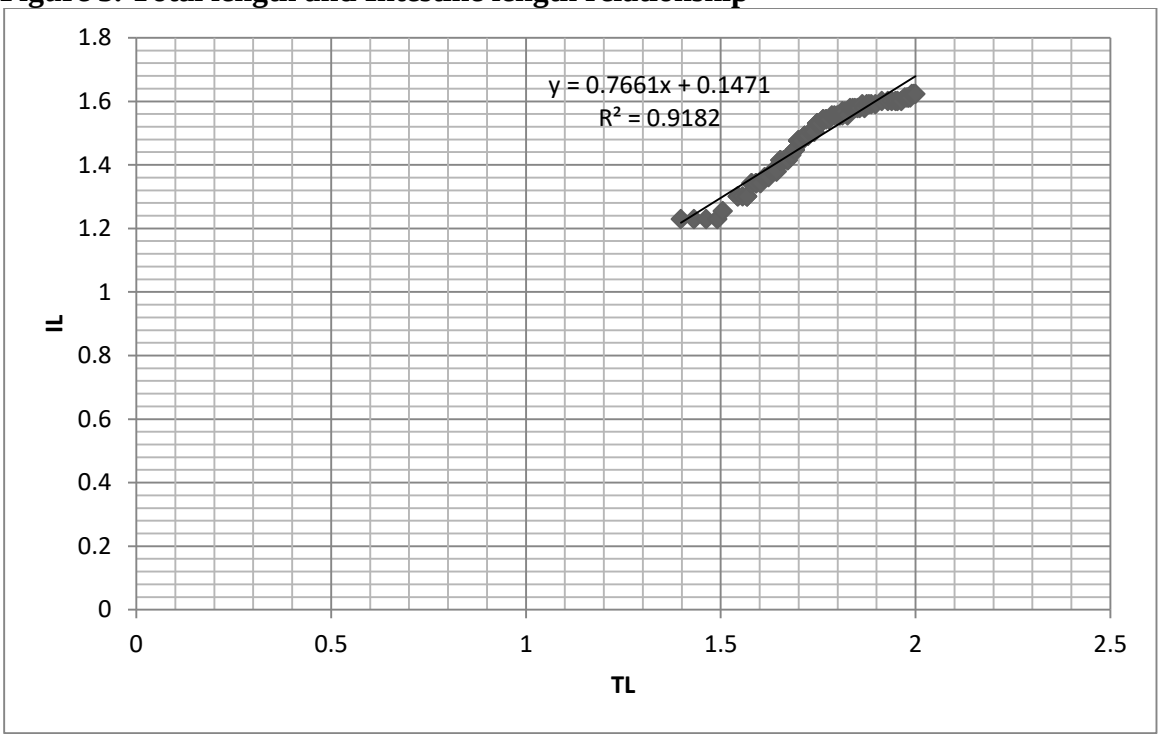

Figure 4. Month wise GaSI trend of *C. nobilis*