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Gut Content Analysis of Two Small Indigenous Snake Headed Fishes : Implication for Aquaculture

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Abstract Small indigenous fishes are important part of aquatic food webs and are needed for monitoring their role in maintenance of the integrity of the food web. Thus these fish species have great importance in conservation of a community itself. The snake headed fishes are members of the freshwater perciforms of the family Channidae. Stomach content analysis provides important insight into fish feeding habit and the types of food materials present in the particular trophic level of the ecosystem. Aim of the present study is to look after the feeding patterns, food habit and investigation on the food types. The morphological adaptation of alimentary tract of small fishes was assessed by finding out the Relative gut length (RGL) value of these fishes and the diet breadth of the fish species was measured. Similarity and dissimilarity of feeding habits of fishes was compared in the study and finally whether the two species are generalist or specialist in their feeding habit.

Keywords Gut content analysis, Small indigenous fishes, RI, RGL, Schoener index.

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Introduction

Indigenous fishes are critical component of healthy aquatic ecosystems as they form an inportant part of the aquatic food web and fulfil several important ecological functions (Chandra et al. 2008). The snakeheads are members of the freshwater perciform fish of family Channidae and are native to different parts of Africa and Asia (Roe 1991). These are elongated distinguished by their long dorsal fin, large mouths and shiny teeth. They breathe air with gills, which allows them to migrate short distances over land. These are important target species for small scale fisher, in the Indian subcontinent, who use a variety of traditional fishing gears (Kibria and Ahmed 2005, Craig et al. 2004). Fish is one of the most easily available source of animal protein to supply essential nutrients in the

diet contributing about 63% of animal protein to our daily diet. The majority of fish eaten by the rural poorpeople is the small indigenous fish species. It is highly nutritional, easy to culture with other major species in same water body. There are various types of small indigenous fish species found in different aquatic medium and due to their different food habit they are found in different heights of water.

The study of feeding habit of fish based upon analysis of stomach content analysis provides important insight into fish feeding patterns and quantitative assessment of food habit is an important aspect of fisheries management (Zacharia and Abdurahiman 2004). Types of food materials present in the trophic level for the particular fish species is reflected by gut content and ultimately it is a representation of food in the ecosystem (Hyslop 1980). Gut content study of predatory fishes is an important aspect in the determination of dependence of these top carnivores to maintain the balance in ecosystem (Babare et al. 2013). Analysis of gut content is widely used to ascertain the food and feeding habit of a fish species. Precise portrayal of diets and the feeding behaviors carries the basis for thoughtful understanding of the trophic interactions in aquatic food webs (Vander Zanden et al. 2000). Ecosystem based management studies of fisheries is gaining importance and trophodynamics is an integral part of the same (Sivadas and Bhaskaran 2009). Gut contents only indicate what the fish would feed on. Accurate description of fish diets and feeding habits also provides the basis for understanding trophic interactions in aquatic food webs. A food habit study might be conducted to determine the most frequently consumed prey or to determine the relative importance of different food types to fish nutrition and to quantify the consumption rate of individual prey types.

The basic aims and objectives of this research work are to look after the feeding patterns (column/bottom/surface feeder), habit (carnivorous/herbivorous/omnivorous) and various food types. We tried to compare the morphological adaptation of alimentary tract of small fishes by finding out the RGL value of these fishes. Idea about the aquatic medium from where they collected and the diet breadth of the fish species was measured. Similarity and dissimilarity of feeding habits of fishes was compared in the study.

Materials and Methods

Study areas

Purulia has a subtropical climate nature and is characterized by high temperature, low rainfall and low precipitation. Temperature is high in summer (35^{o}C–45^{o}C) and low in winter (2^{o}C–4^{o}C). Water present in aquatic bodies mainly depend on rain water and 50% water run off due to the undulation topography of this area. The sample fish species are collected from different culture and nonculture pond by fishing and from local markets.

Collection of fish sample

Total 10 individuals each fish species are selected for examine from the above spots. Both live and fresh dead fish are collected. The live species are collected in polythene bag with water and the dead species are preserved in 30% formalin solutions and carried to laboratory. Fish individual per taxa were leveled with local name, the name of sampling sytation and the date of collection. fishes were identified according to Jayaram (2009). Collection of fish samples in each sampling station was done 3 to 4 times in our total sampling period of 3 months.

Gut content analysis

The materials are required for gut content analysis are-scissors, needle, petri dishes, blotting paper, scalpel, forceps, slides, dropper and pipette and for measurements scales, electronic balances were used (Hyslop 1980, Babare et al. 2013), Photographs of the fishes were taken with a hand held camera.

Process of a fish gut dissection

Using appropriate size of scissors to cut the fish samples on the ventral side, from just behind the isthmus of the gill posterior to the anal fin. Two transverse cut was make at each end of the 1st cut to open the coelom and expose the viscera. Using a sharp scissor, the esophagus was intersected in the last few mm of the intestine and the mesentery at its dorsal point of

attachment. Abdominal cavity of the fishes was examined to find any infection. Intact digestive tracts were separated (esophagus, stomach and intestine) from the other visceral organs. Length and weight were measured using scale and electrical balance machine (Hossain et al. 2006). Weight of the stomach and its content were recorded. Afterwards, the stomach was dissected and its content was preserved in 70% ethanol or the content mixed with a few drops saline water for instant examination. Then the dissected and empty stomach was weighted again. The difference between the weight of the intact stomach and empty stomach was the total weight of the stomach contents. The stomach was then examined under a microscope and the content were enumerated and identified to the lower taxa possible.

Process of gut content preparation

After measuring the gut, open the gut segment by fine scissor. Then remove the content with soft brash and collected in a petri dish. Weighted the content then add saline water (Average 3 ml). Now in a slide take few drop sample (1ml) placed a cover slide on it and examine under a microscope for further analysis (Azzourro et al. 2007).

Methods

The fullness of the stomach is judged and classified as gorged or distended, full or half full, by naked eye estimation. Fish diets can be detected in a variety of way. Methods of gut contents examination are comprise surely distinguishable into two sections, that is qualitative and quantitative. The quantitative investigation encompasses the comprehensive documentation of the organisms present in the gut. Just with far reaching knowledge and with the support of good references it is possible to recognise them from digested, broken and finely converted materials (Zacharia and Abdurahiman 2004).

Quantitative methods for the study are three types numerical gravimetric and volumetric. These types of investigation are broadly utilized by various worker. Each prey item is scaled from 0 to 1 using a 0.05 by point method, with the total contents regarded as 1 (Hobson 1974). The result of this point method was the volumetric scale value of each prey item . Then the weight of each prey item in the stomach of an individual fish sample was determined by multiplying the total weight of stomach content with its volumetric scale.

Ranking index

Food or prey items of each fish taxa were ranked following the formula of Hobson (1974) :

$$RI = (A/B)\,(C)$$

Where, RI=Ranking Index of each prey item, A=no. of fish individual per taxa containing each prey item, B =total no. of fish individual per taxa with stomach content and C=percentage of each prey item which can be computed :

Volumetric scale of prey item × 100/volumetric scale of all prey items combined index of measurement

Relative gut length (RGL) (Al-Hussany 1949)

Relative gut length is the ratio of gut length and total length of fish.

RGL = Length of gut/total body length

Index of fullness (Chiou et al. 2006)

Fraction of food weight to body weight is considered as an index of fullness. This index can be applied to the food in the stomach, or to the food in the stomach, or to the in the whole digestive tract. It is uaually expressed as parts per 10,000 :

Fullness record = Weight of stomach content × 10,000/Wight of fish
Where w =Weight of the gut content, W=Weight of the fish

The Schoener index of overlap (Schoener 1968) was used to assess the diet similarity of the two fish species. The mean per cent number was calculated for each food item. This index was then calculated as follows :

$$\alpha = 1 - 0.5\,(\sum |p_{ij} - p_{ik}|)$$

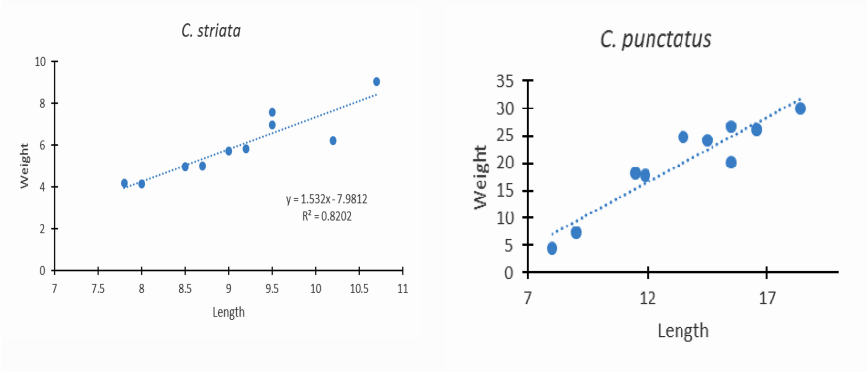

Fig. 1. Length-weight relationship of the two experimental fish species.

Where p_{ij} is the proportion of food item used by species j, and p_{ik} is the proportion of food item i used by species k, the value of α varies between 0 and 1.0, representing no. to complete food overlap, respectively. The degree of overlap between two species diets is considered significant when the index is greater than 0.60.

The diet breadth was calculated using Levin's standardized index (Krebs 1998) :

$$B_i = 1/(n-1)\ [1/\sum(P_{xi})^2 - 1]$$

Where, *Bi*=Levin's standardized index for predator *i, pxi* = proportion of diet of predator *i* that is made up of prey *x, n* = number of prey categories. Value of this index ranges from 0 to 1; low values indicate diets dominated by few prey items (specialist predators); higher values indicate generalist diets.

Results and Discussion

Both species of Channidae family are collected from different aquatic medium have maximum length of 7-20 cm and have weight of 4-30 g categories are in small group of fish (Fig.1). Their relative gut length and other indexes indicate that their feeding habit carnivorous like and properstomach is present. The value of index of fullness in *Channa punctatus* and *Channa striata* is 69.536 and 34.142.

Gut length changed as function of body length in both of the fish species (Fig. 2). The average gut length was 5.62 cm and gut weight was 0.4223 g and only cotent weight was 0.0204 g (Fig. 3) for the species *Channa punctatus* and for species (*Channa striata* were 5.62 cm, 0.062 g and 0.024 g.

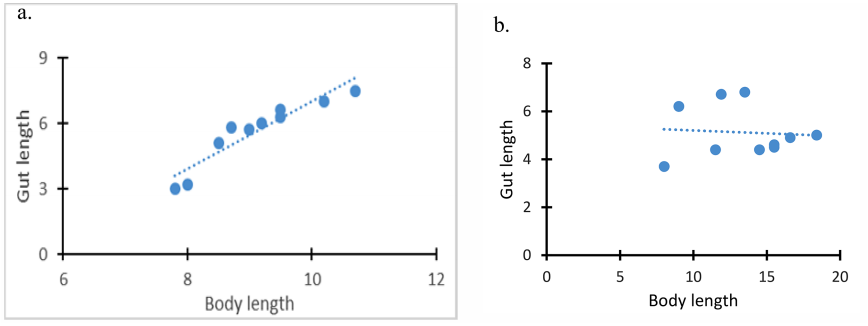

Fig. 2. Body length-gut length relationship of the two experimental fish species a) *C. striata* and b) *C. punctatus.*

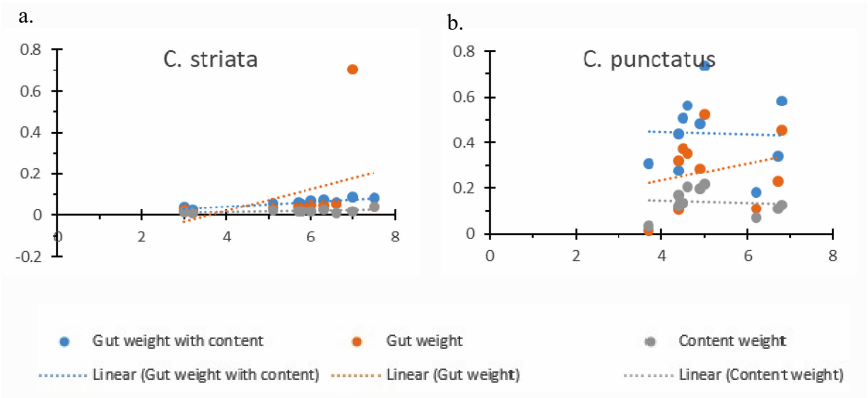

Fig. 3. Pattern of gut weight with content , gut weight and content weight of the two experimental fishes, a) *C.striata* and *C. punctatus.*

In both species of channa punctatus and *Channa striata,* various types of algae like filamentous algae, Diatoms found and their gut content possess 75-85% of algae and Diatoms like foods. Some other kinds of foods are also present in their gut in low quantity, these are phytoplakton 40-60%, zooplankton 20-30% (Copepod, Rotifer) and some arthropod segment fragments are observed in their gut content (Fig. 4). The low gastrosomatic index indicate short feeding by the two species (Table 1). Their feeding habit is very similar to each other and according to Schoener's Index value (0.539116) their diet does not overlap for the two predator species, suggesting their culture in the same aquatic system may be performed, even though *C. punctatus* and *C. striata* both are bottom feeder, they does not share same niche of the aquatic system. Levin's standardized index of *C. punctatus* and *C.striata* are 0.66 and 0.24 respectively. As the value of Levin's Index for *C. punctatus* (0.66) is greater than 0.6 it is assumed that the diet of predator species is dominated by very few types of prey, Indi-

Table 1. Comparative representation of the relative gut length, gastro-somatic index and index of fullness of the two snakeheads.

Name of the fish	Relative gut length	Gastro somatic index	Index of fullness
C. striata	0.616	0.0175	34.142
C. punctatus	0.375	0.014	69.536

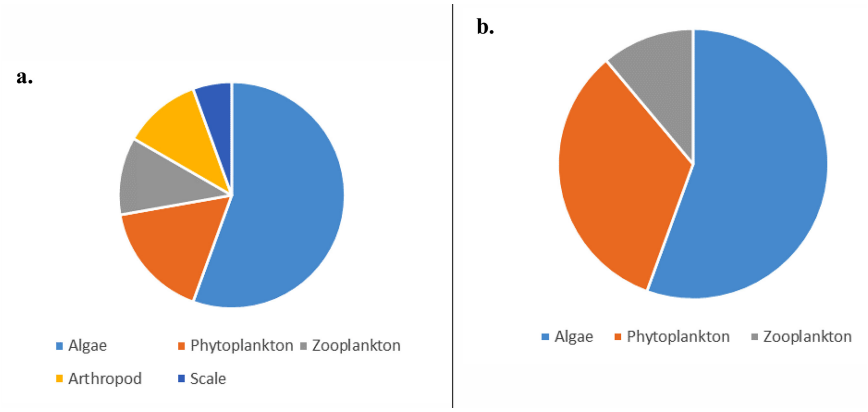

Fig. 4. Percentage of food items consumed by a) *C.striata* and b) *C. punctatus.*

Table 2. Prey items and their relative abundance, ranking index and Levin's index for the species *C. striata.*

Prey items	% of the fish containing the prey item	% of pray item	Ranking index	Levin's standardized index
Algae	100	64.68	67	
Phytoplankton	30	9.81	3.6	
Zooplankton	20	3.06	0.9	0.249
Arthropod	20	19.38	15.2	
Scale	10	1.02	0.1	

Table 3. Prey items and their relative abundance, ranking index and Levin's index (Hobson 1974) for the species *C.punctatus*.

Prey items	% of the fish containing the prey item	% of prey item	Ranking index	Levin's standardized index
Algae	100	78.12	32	
Phytoplankton	60	18.75	51	0.661
Zooplankton	20	3.12	2.4	

cating the species is specialist for the diets. The value of Levin's Index for *C. striata* (0.24) is less than 0.6 (Tables 2, 3) it is assumed that the diet of predator species is dominated by large number of prey types, indicating the species is generalist for the diets.

Conclusion

In the study of gut content analysis of two species in Channidae family we conclude that their feeding habit is more or less similar and carnivorous in nature. The principal feed types for *C. striata* are Algae, phytoplankton, zooplankton, arthropod, arthropod body parts and fish scale and for *C. punctatus* these are algae, phytoplankton and zooplankton. The ranking index of feed items show clear preference for zooplankton in both the predator species. Their relative gut length (0.616 and 0.375 for *C.striata* and *C. punctatus* respectively) for both the species are below 1, suggesting strongly that these are carnivorous fishes, although a certain amount of algae was observed in the gut of the both snakeheads.

Schoener's Index value (0.539116) suggest their close feeding habit. Diet of the both species do not overlap. The value of Levin's Index for *C. punctatus* (0.66) assumes *C. punctatus* is specialist for the diets while *C. striata* (0.24) is generalist for the diets.

So, it is assumed that these species are carnivorous and their diet not overlap although they share common niche and for this the two species may be cultured in the same aquatic system for their potential higher production and thereby suggesting their implication for development in aquaculture.

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