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Research Article

Observation and analysis of the gut contents of some common edible fresh water cat fishes of river Gomti at district Sultanpur

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ABSTRACT

The present study was carried out to observe and analyze the gut contents of some common edible fresh water cat fishes (*Heteropneustes fossilis, Clarias batrachus, M. seenghala and Wallago attu*) of river Gomti at district Sultanpur, Uttar Pradesh, India during March 2019 to February 2020. The information on the food and feeding habit of fish helps to know about the interspecific relationship of aquatic fauna and the productivity of the water body. The result so obtained were used to compute percentage volume of food items in the gut (% V_i), and frequency of occurrence of guts having particular food items (% O_i) of experimental cat fishes. In the present study, the gut content analysis showed that the *H. fossilis* and *C. batrachus* feeds on insects, crustaceans and rotifers as a basic or main food, fish larvae and fish remains as an occasional or secondary food and plant matter as obligatory food; *M. seenghala* feeds on small fishes as a basic or main food, insects, crustaceans and rotifers as an occasional or secondary food and plant matter as an incidental food; *W. attu* feeds on small fishes as a basic or main food and crustaceans, insects and rotifers as an occasional or secondary food. Hence, it can be concluded that the *H. fossilis* and *C. batrachus* are carnivorous but not piscivorous whereas *M. seenghala* and *W. attu* are carnivorous and piscivorous. These findings were also verified by the index of preponderance of various food items.

INTRODUCTION

Fishes are good source of aquatic food that provides macronutrients (Proteins and Lipids) as well as micronutrients (Vitamins and Minerals) and gives nourishment to the human's body (Mishra, 2020a). The cat fishes possess a good market demand because they are more nutritious and of high medicinal value. The observation and analysis of gut contents provides an important insight in to feeding patterns and quantitative assessment of feeding habits (Mishra, 2020b). The information on diet and food habits are valuable in the decision making process related to natural resources (Kido, 1996). The analysis of the gut contents for the study of food and feeding habits of fishes is a continuous exercise because it provides information for successful fisheries management (Agbabiaka, 2012; Mishra, 2020c). Food habit study might be conducted to investigate the most frequently consumed prey or to determine the relative importance of different food types to fish nutrition and to quantify the ingestion rate of individual food types (Kariman *et al.*, 2009). The knowledge of diet of fishes gives up information on their relative position in the food chains of ecosystem (Padmakumar *et al.*, 2009). Information on the diet of fishes is important to understand prey-predator size relationship, ontogenic diet shift and selection of habitat (Chipps and Garvey, 2007).

The study of feeding habits of fish based on direct examination of stomach contents has become a standard practice for many years (Hyslop, 1980). The direct gut content analysis and observation carried out commonly through dissection or evacuation and examination of stomach contents is still the most used and easiest method with great potential and good enough for most biological studies (Babare *et al.*, 2013; Manko, 2016; Mishra, 2020d). The qualitative and quantitative dietary analysis of fish in their natural habitats enhances the understanding of the growth (Hynes, 1950). Abundance, productivity of water body (Nansimole *et al.*, 2014) and used to describe food habits and feeding patterns of fishes (Ekpo *et al.*, 2014).

The knowledge of diet of fishes gives us information on their relative position in the food chains of ecosystem. Information on the diet of fishes is important to understand prey-predator size relationship, ontogenic diet shifts and selection of habitat (MacDonald *et al.*, 1983). Size of the

fish is an important factor that would define prey preference of the species. Nikolsky (1963) classified the natural food of fishes in to four categories- (i) Main or Basic food (ii) Occasional or secondary food (iii) Incidental food and (iv) Emergency or Obligatory food. Das and Moitra (1963) classified the fishes based on the relationship between fishes and their food and categorized them in to herbivores, carnivores and omnivores. The importance of prey items in fish diets can be evaluated in a variety of ways (Hyslop, 1980; MacDonald and Green, 1983; Agbabaika, 2012; Ekpo *et al.,* 2014). A dietary survey of fish under natural conditions (George *et al.* 2013; Jab and Udo, 2002) is prerequisite for proper assessment of its bio-control potentiality. Gut contents of fish ascertain dietary requirements in their natural habitat, the relationship between fish and the abiotic environment and to establish trophic inter-relationship (Srivastava *et al.,* 2000; Mishra, 2020d).

Studies on Gomti River at district Sultanpur (U.P.) have been made in the past by various workers especially on its physico-chemical and biological characteristics, planktons, fish fauna etc. but the observation and gut content analysis remain untouched. Considering its importance, the present study was undertaken to observe and analyze the gut contents of some common edible fresh water cat fishes (*H. fossilis; C. batrachus; M. seenghala and Wallago attu*) for the accurate knowledge of food and feeding habits in its natural habitat.

MATERIALS AND METHODS

Fishes were collected on a monthly basis (10 fishes of each species par month) from river Gomti by the help of local fisherman during investigation period from February 2019 to January 2020. Just after collection 10% formalin solution was injected in to the gut of all fishes in order to stop digestion of food items. All the experiments were carried out in the laboratory of the Post Graduate Department of Zoology, Ganpat Sahai P.G.College Sultanpur, Uttar Pradesh, India. The gut was then cut open and contents of each stomach were washed with normal saline and were examined under binocular microscope. The identification of the different food items to the generic/specific level was difficult due to the action of digestive enzymes. The exoskeleton remains were used as indicator for the identification of food items.

Volume of food is considered as a more satisfactory method by many workers for quantitative analysis of gut contents. The volume of each category of organisms was determined by the displacement method (Pillay, 1952). The volume was then expressed as percentage of total volume of the entire stomach contents.

Percentage by Volume (% V_i) = (V_i) / (V_t) × 100

Where, V_i = Volume of food item (i); V_t = Total volume of food

Each food item occurred in number of stomachs is recorded and expressed as a percentage of the total number of fish stomachs examined (Baker, *et al.,* 2014; Mishra, 2020d).

Frequency of occurrence (% O_i) = (N_i) / (N_t) × 100

Where, N_i = Number of stomachs containing prey (i); N_t = Total number of stomachs examined

To evaluate the importance of each food item, the index of preponderance (Natarajan and Jhingran, 1961) gives a single value for each attribute based on frequency of occurrence and volume of various food items.

Index of preponderance has enormous advantages particularly when studying fish diet in open waters where animals have ingress to various organisms (Mohan and Sankaran, 1988). They also consider it to be an objective and suitable measure of food dominance within the diet (Marshall and Elliot, 1997; Mishra, 2020 c&d). The index of Preponderance was obtained by using formula:

Index of Preponderance (I) = $(V_i \times O_i) / \sum (V_i \times O_i) \times 100$

Where, V_i = Percentage volume of food item (i); O_i = Frequency of occurrence of food item (i)

RESULTS AND DISCUSSION

The gut contents of 120 specimens of each type of cat fishes were analyzed during February 2019 to January 2020 from river Gomti at district Sultanpur, Uttar Pradesh, India. The observation and analysis of gut contents of edible fresh water cat fishes (*H. fossilis; C. batrachus; M. seenghala and Wallago attu*) are illustrated separately by Tables and diagrams.

Gut Contents of H. fossilis

The findings of present study revealed that the food items of *H. fossilis* consists of Unicellular algae (forming 3.2% by volume and 2.5% by occurrence), Multicellular algae (forming 5.4% by volume and 4.2% by occurrence), Aquatic weeds (forming 2.2% by volume and 3.3% by occurrence), Rotifers (forming 18.6% by volume and 20.8% by occurrence), Crustaceans (forming 19.6% by volume and 21.7% by occurrence), Insects and their larvae (forming 24.8% by volume and 19.2% by occurrence), Fish and its remains (forming 16.5% by volume and 18.3% by occurrence), Sand and Mud (forming 8.4% by volume and 7.5% by occurrence) and Miscellaneous and unidentified substances (forming 1.3% by volume and 2.5% by occurrence) (Table: 1).

Table 1: Gut contents and Index of Preponderance of various food items of *H. fossilis*

Food items	**V_i**	**(O_i**	**$V_i \times O_i$**	**I**
Unicellular algae	3.2	2.5	8.00	0.49
Multicellular algae	5.4	4.2	22.68	1.38
Aquatic weeds	2.2	3.3	7.26	0.44
Rotifers	18.6	20.8	386.88	23.62
Crustaceans	19.6	21.7	425.32	25.98
Insects and larvae	24.8	19.2	476.16	29.07
Fishes and its remains	16.5	18.3	301.95	18.44
Sand and Mud	8.4	7.5	6.30	0.38
Miscellaneous	1.3	2.5	3.25	0.20
Summation	100	100	1637.8	100

Index of preponderance gives summarized information for the percentage of volume and frequency of occurrence of various food items. It also provides preferences of various food items quantitatively in order of mathematical dominance. In case of *H. fossilis* the main food is Insects and their larvae (29.07%) > Crustaceans (25.98%) > Rotifers (23.62%) > Fish and its remains (18.44%) > Multicellular algae (1.38%) > Unicellular algae (0.49%) > Sand and Mud (0.38%) > Miscellaneous and unidentified substances (0.20%).

Gut Contents of C. batrachus

The findings of present study revealed that the food items of *C. batrachus* consists of Unicellular algae (forming 2.8% by volume and 3.3% by occurrence), Multicellular algae (forming 8.6% by volume and 10.8% by occurrence), Aquatic weeds (forming 2.3% by volume and 2.5% by occurrence), Rotifers (forming 17.9% by volume and 19.2% by occurrence), Crustaceans (forming 22.7% by volume and 20.8% by occurrence), Insects and their larvae (forming 20.6% by volume and 18.3% by occurrence), Fishes and its remains (14.5% by volume and 17.5% by occurrence), Sand and Mud (forming 9.2% by volume and 5.8% by occurrence),Miscellaneous and unidentified substances (forming 1.4% by volume and 1.6% by occurrence) (Table:2).

Table 2: Gut contents and Index of Preponderance of various food items of *C. batrachus*

Food items	V_i	(O_i	$V_i \times O_i$	**I**
Unicellular algae	2.8	3.3	9.24	0.57
Multicellular algae	8.6	10.8	92.88	5.77
Aquatic weeds	2.3	2.5	5.75	0.36
Rotifers	17.9	19.2	343.68	21.25
Crustaceans	22.7	20.8	472.16	29.33
Insects and larvae	20.6	18.3	376.98	23.41
Fishes and its remains	14.5	17.5	253.75	15.76
Sand and Mud	9.2	5.8	53.36	3.31
Miscellaneous	1.4	1.6	2.24	0.14
Summation	100	100	1610.04	100

Index of preponderance gives summarized information for the percentage of volume and frequency of occurrence of various food items. It also provides preferences of various food items in order of mathematical dominance. In case of *C. batrachus* the most preferred foods are Crustaceans (29.33%) > Insects and their larvae (23.41%) > Rotifers (21.25%) > Fish and its remains (15.76%) > Multicellular algae (5.77%) > Sand and Mud (3.31%) > Unicellular algae (0.57%) > Aquatic weeds (0.36%) > Miscellaneous and unidentified food substances (0.14%).

Gut Contents of M. seenghala

The findings of the present study revealed that the gut contents of *M. seenghala* consists of Multicellular algae (forming 4.8% by volume and 4.2% by occurrence), Aquatic weeds (forming 3.4% by volume and 2.5% by occurrence), Rotifers (forming 10.2% by volume and 11.7% by occurrence), Crustaceans (forming 21.3% by volume and 20.8% by occurrence), Insects and their larvae (forming 16.2% by volume and 17.5% by occurrence), Fish and its remains (forming 42.9% by volume and 41.6% by occurrence), Miscellaneous and unidentified food substances (forming 1.2% by volume and 1.7% by occurrence). The Unicellular algae and Sand and Mud are completely absent in the gut contents of *Mystus seenghala.*

Index of preponderance gives summarized information for the percentage of volume and frequency of occurrence of various food items of the gut contents. It also provides food preferences quantitatively in order of mathematical dominance.

In case of *M. seenghala* the most preferred foods are Fishes and its remains (67.06%) > Crustaceans (16.65%) > Insects and their larvae (10.65%) > Rotifers (4.48%) > Multicellular algae (0.76%) > Aquatic weeds (0.32%) > Miscellaneous and unidentified food substances (0.08%) (Table: 3).

Table 3: Gut contents and Index of Preponderance of various food items of *M. seenghala*

Food items	V_i	(O_i	$V_i \times O_i$	**I**
Unicellular algae	-	-	-	-
Multicellular algae	4.8	4.2	20.16	0.76
Aquatic weeds	3.4	2.5	8.50	0.32
Rotifers	10.2	11.7	119.34	4.48
Crustaceans	21.3	20.8	443.04	16.65
Insects and larvae	16.2	17.5	283.50	10.65
Fishes and its remains	42.9	41.6	1784.64	67.06
Sand and Mud	-	-	-	-
Miscellaneous	1.2	1.7	2.04	0.08
Summation	100	100	2661.22	100

Gut Contents of W. attu

The findings of the present study revealed that the gut contents of *W. attu* lacks completely plant materials (Unicellular algae, Multicellular algae, Aquatic weeds, Sand and Muds etc.) and consists of animal foods only like Rotifers (forming 11.8% by volume and 10.8% by occurrence), Crustaceans (forming 23.7% by volume and 24.2% by occurrence), Insects and their larvae (forming 15.4% by volume and 17.5% by occurrence), Fishes and its remains (forming 48.1% by volume and 45.8% by occurrence) and Miscellaneous and unidentified food substances (forming 1.0% by volume and 1.7% by occurrence) (Table: 4).

Table 4: Gut contents and Index of Preponderance of various food items of *W. attu*

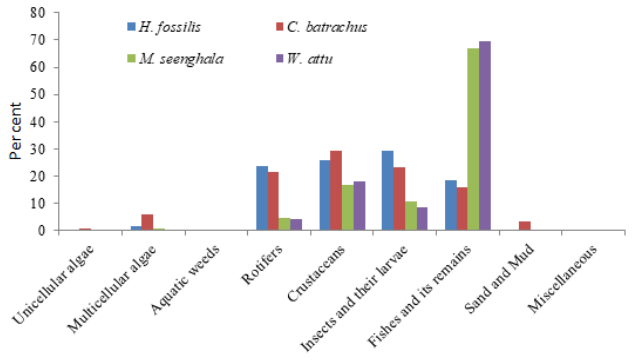
Food items	V_i	(O_i	$V_i \times O_i$	**I**
Unicellular algae	-	-	-	-
Multicellular algae	-	-	-	-
Aquatic weeds	-	-	-	-
Rotifers	11.8	10.8	127.44	4.01
Crustaceans	23.7	24.2	573.54	18.06
Insects and larvae	15.4	17.5	269.50	8.49
Fishes and its remains	48.1	45.8	2202.98	69.38
Sand and Mud	-	-	-	-
Miscellaneous	1.0	1.7	1.70	0.06
Summation	100	100	3175.16	100

Index of preponderance gives summarized information for the percentage of volume and frequency of occurrence of various food items of gut contents (Table: 5). It also provides food preferences in order of mathematical dominance, Fishes and its remains (69.38%) > Crustaceans (18.06%) > Insects and their larvae (8.49%) > Rotifers (4.01%) > Miscellaneous and unidentified food substances (0.05%).

Table 5: Index of preponderance of some common edible fresh water cat fishes

Food items	Index of preponderance			
	H. fossilis	***C. batrachus***	***M. seenghala***	***W. attu***
Unicellular algae	0.49	0.57	-	-
Multicellular algae	1.38	5.77	0.76	-
Aquatic weeds	0.44	0.36	0.32	-
Rotifers	23.62	21.35	4.48	4.01
Crustaceans	25.98	29.33	16.65	18.06
Insects and their larvae	29.07	23.41	10.65	8.49
Fish and its remains	18.44	15.76	67.06	69.38
Sand and Mud	0.38	3.31	-	-
Miscellaneous	0.20	0.14	0.08	0.08

Index of preponderance of various food items of gut contents of experimental cat fishes are expressed quantitatively in order of mathematical dominance, Unicellular algae- *C. batrachus* (0.57%) > *H. fossilis* (1.38%), unicellular algae completely absent in the gut contents of *M. seenghala* and *W. attu.* Multicellular algae- *C. batrachus* (5.77%) > *H. fossilis* (1.38%) > *M. seenghala* (0.76%), multicellular algae completely absent in the gut contents of *W. attu.* Aquatic weeds- *H. fossilis* (0.44%) > *C. batrachus* (0.36%) > *M. seenghala* (0.32%), aquatic weeds are absent in the gut contents of *Wallago attu.* Crustaceans- *C. batrachus* (29.33%) > *H. fossilis* (25.98%) > *W. attu* (18.06%) > *M. seenghala* (16.65%). Insects and their larvae- *H. fossilis* (29.07%) > *C. batrachus* (23.41%) > *M. seenghala* (10.65%) > *W. attu* (8.49%). Fishes and its remains- *W. attu* (69.38%) > *M. seenghala* (67.06%) > *H. fossilis* (23.62%) > *C. batrachus* (21.35%). Sand and Mud- *C. batrachus* (3.31%) > *H. fossilis* (0.38%), sand and mud not present in the gut contents of *M. seenghala* and *W. attu*. Miscellaneous and unidentified food substances- *H. fossilis* (0.20%) > *C. batrachus* (0.14%) > *M. seenghala* (0.08%) > *W. attu* (0.06%) (Fig. 1). Pradhan and Patra (2015); Kumar, *et al.*, (2015); and Mishra, (2020 c&d) used the index of preponderance to classify feeding habits of fishes.



In the present study, the gut of *H. fossilis* and *C. batrachus* were consisted with Insects and their larvae, Crustaceans and Rotifers as basic or main food; Fish remains as secondary food and Algae and Aquatic weeds as incidental or emergency food, similar findings have also been observed Goutam *et al.* (2009). The gut of *M. seenghala* and *W. attu* were consisted with Fishes and its remains as a basic or main food, Crustaceans, Insects and their larvae as secondary food and rest food present in the gut were incidental food. Similar findings have also been observed Bhuiyan and Haque (1984), Srivastava *et al.* (2000) and Singh and Singh (1984). Das and Moitra (1963); Kumar, *et al.*, (2007); Gautam, *et al.*, (2009); Akemi, *et al.*, (2009); Wirat and Nisarat (2009); Yem *et al.*, (2009); Kumar, *et al.*, (2015); vividly explained the feeding habits of fresh water fishes in different water body.

CONCLUSION

Observation and analysis of the gut contents of experimental cat fishes showed that the quantitative preferences of food items that helps to find out the food and feeding habits in its natural habitat. In the present study, the gut of *H. fossilis* and *C. batrachus* were consisted with more carnivorous food and less herbivorous food, the gut of *M. seenghala* was consisted with more carnivorous food (especially fishes) and least amount of herbivorous food, but the gut of *W. attu* was consisted with carnivorous foods (especially fishes) only, no trace of herbivorous food was observed. On the basis of these observation and analysis, it can be concluded that the experimental cat fish *H. fossilis* and *C. batrachus* are carnivorous but not piscivorous whereas *M. seenghala* and *W. attu* are carnivorous and piscivorous in nature

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