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Stomach content analysis of freshwater cat fishes from Semara Taal, a wetland of district Siddharthnagar, U.P.

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Abstract
The quality and quantity of available food in a particular aquatic environment affect the growth of fish. Present study is an attempt to investigate the food and feeding habit of catfishes, *Heteropnetues fossilis* (Bloch) and *Clarias batrachus* (Linnaeus). The gut content analysis of both fishes showed various types of food items such as zooplanktons (Rotifers & crustacean), animal matter (worms, insect, molluscan & small fishes), phytoplankton (Chlorophyceae, Bacillariophyceae & myxophyceae), plant matter (diatoms & macrophytes) and dead organic matter but the quantity of animal origin matter is higher than plant origin matter. The quantitative analysis of gut content shows that about 70% and 90% animal origin matter present in the gut of *Clarias batrachus* and *Heteropnetues fossilis*, respectively where as the plant origin food about 6% and 29% was present in the gut content of *Heteropnetues fossilis* and *Clarias batrachus*, respectively. On the basis of these findings it was concluded that both cat fish, *Clarias batrachus* and *Heteropnetues fossilis* feeds on animal and plant origin matter hence omnivorous in habitat.

Keywords: Gut content analysis, omnivorous, cat fishes.

Introduction
Gut content analysis is a method for determining the food and feeding habits of fishes by which we can easily find what the fish take as food. The qualitative and quantitative food analysis of fish in their natural habitats helps in understanding the growth, abundance, productivity of water body. Fishes have become adapted to a wide variety of food and used to describe food habits, feeding patterns of fishes. Fishes are highly adaptable in their feeding habits and utilize the readily available food (Prakash, 2016) [12]. Fish performs their various physiological activities such as growth, development, locomotion and reproduction etc. with the help of energy obtained from the food and is highly adopted in their feeding habits with utilizing most of the readily available food components.

Nilsson (1955)[9] stated 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. The food and feeding habits of fish vary with the time of day and season of the year and depends upon the availability of food components (Prakash, 2015) [11]. Thus gut content analysis provides an important insight in to the feeding pattern and qualitative as well as quantitative assessment of feeding habits of fish (Prakash, 2017) [13].The variations of the different food items generally depend upon their availability or any preference shown by the fish, as also the intensity of feeding which is influenced by the growth and maturation in many fishes.

Study of food and feeding habits of fishes is considered very important in fishery management, conservation and ecological studies. The study of food requirements of fish is helpful in understating some aspects of fishery biology. Without knowledge of the food requirements, feeding behaviour pattern and predator-prey relationships, it is not possible to understand the predicted changes that might result from any natural or anthropogenic intervention. The same species occupying different habitat, may feed on different types of food (Hyndes *et al.* 1997) [4] or even in the same habitat the diet may vary at different times.

Nikol'sky (1963) [8] divided natural food of fishes into following four categories.

1. Main or basic food - the natural food of fishes comprising main part of the gut contents.

2. Occasional or secondary food - taken by the fishes in small quantities, when available.
3. Incidental food - rarely enters the gut along with other items.
4. Emergency or obligatory food - it is ingested in the absence of basic food.

Khan (1934) [5] and Das and Moitra (1955) [1] have classified the fishes into three categories on the basis of feeding behaviour in occupied areas of their water bodies –
1. Surface feeder (*Catla catla*),
2. Mid or column feeder (*Labeo rohita, Labeo bata*),
3. Bottom feeder (*Cirrhina mrigala, Cirrhina reba*, *Labeo calbasu*).

According to Moyle and Cech, Jr. (2000) [6]. Fishes are classified as deteritivores, herbivores, carnivores and omnivores based on the type of food. Food and feeding habit of fish are important biological factors for selecting a group of fish for culture in ponds to avoid the competition for food among themselves and live in association and to utilize all the available food (Oronsaye and Nakpodia, 2005) [10].

Study area: The Semara Taal, a wetland under exploration is situated in Shohratgarh tahsil of district Siddharthnagar of Uttar Pradesh. It is situated between the latitude 27.4025^0N-82.9597^0. The total area of this taal is 466.66 acre. The maximum depth of water in the pond is 15 feet during mansoon and minimum 5 feet in summer. The Taal is enriched with several type of macrophytes.

Fig 1: Satellite view of Semara Taal, a wetland

Materials and Methods

Total 360 adult specimens of Catfish, *Clarias batrachus* and *Heteropneustes fossilis* were collected from Semara Taal with the help of fisherman during July, 2016 to June, 2017. The collected fishes were dissected to collect gut contents for analysis. Gut contents were preserved in 4% formalin solution and brought to Research laboratory, Department of Zoology, MLKPG College, Balrampur for further analysis under binocular microscope for the food composition, preference and relative importance of various food items. The observation of gut contents were grouped in different categories zooplanktons (Rotifers & crustacean), animal matter (worms, insect, molluscan & small fishes), phytoplankton (Chlorophyceae, Bacillariophyceae & myxophyceae), plant matter (diatoms & macrophytes) and dead organic matter. The relative importance of all food contents was quantified by the index of preponderance and was calculated with the help of percentage composition (volume and occurrence) of food contents to follow the equation of Natrajan and Jhingran (1963) [7]

$$\text{Percentage by Volume (\%Vi)} = \frac{\text{Volume of individuals food item (Vi)}}{\text{Total volume of gut contents (Vt)}} \text{ X } 100$$

$$\text{Percentage of Occurrence (\% Oi)} = \frac{\text{Number of Stomach containing prey (Ni)}}{\text{Total Number of Stomach examined (Nt)}} \text{ X } 100$$

$$\text{Index of Preponderance (I)} = \frac{\text{Vi x Oi}}{\sum \text{Vi xOi}} \text{ X } 100$$

Result and Discussion

Gut content analysis would not be correct term because it is difficult to collect and identify the food items collected from the intestinal region of animals where the food get partially digested called chime or nearly digested and in the stage of absorption. Therefore, 'stomach content analysis 'will be the best term to know the food item consumed by fishes and various other animals. The identification of food items eaten by a particular species of fish in its habitat was the direct interlink between the trophic components in an ecosystem. In the present study, the gut contents of *Clarias batrachus* and *Heteropneustes fossilis* had been analysed and grading was assigned to different food items.

The percentage composition of food items in the gut of *Clarias batrachus* and *Heteropneustes fossilis* as observed in different seasons has been presented in the table 1&2. The gut content of *Clarias batrachus* and *Heteropneustes fossilis* have been grouped into five categories *i.e.* zooplanktons (Rotifers & crustacean), animal matter (worms, insect, molluscan & small fishes), phytoplankton (Chlorophyceae, Bacillariophyceae & myxophyceae), plant matter (diatoms & macrophytes) and dead organic matters. It was seen that there were considerable variations in the percentage of different food items during different seasons.

Table 1: Gut content and grading of various food items of *Clarias batrachus*

Food item	% composition of items		Vi x Oi	Preponderance Index (I)	Grading
	Volume (Vi)	Occurrence (Oi)			
Rainy Season					
Zooplankton	40.05	39.57	1584.77	54.76	I
Animal matter	23.25	23.81	553.58	19.13	III
Phytoplankton	27.36	25.74	704.25	24.33	II
Plant matter	5.85	5.68	33.23	1.15	IV
Decay organic matter	3.49	5.20	18.15	0.63	V
Total ∑	100.0	100.0	**2893.98**	100.0	
Winter season					
Zooplankton	42.48	37.12	1576.86	51.33	I

Animal matter	23.25	20.57	475.25	15.47	III
Phytoplankton	30.02	33.28	999.07	32.52	II
Plant matter	3.08	5.24	16.14	0.53	IV
Decay organic matter	1.17	3.79	4.43	0.15	V
Total ∑	100.0	100.0	**3071.75**	100.0	
Summer season					
Zooplankton	47.45	41.20	1954.94	60.24	I
Animal matter	20.60	19.22	395.93	12.20	III
Phytoplankton	26.25	33.09	868.61	26.76	II
Plant matter	4.77	5.15	24.57	0.76	IV
Decay organic matter	0.93	1.24	1.15	0.04	V
Total ∑	100.0	100.0	**3245.20**	100.0	

In the gut content of *Clarias batrachus* (Table1), Zooplankton percentage was highest (60.24%) in summer season and lowest in the winter season (51.33%). Phytoplankton percentage was highest (32.52%) in winter season and lowest in the rainy season (24.33%) while the animal matter was highest (19.13%) in rainy season and lowest (12.20%) in the summer season. The percentage of occurrence of plant matter and dead organic matter in the gut content was in negligible quantity in all three seasons and always less than 1.25%. Hora and Pillay (1962) [3] reported that the fish *Clarias batrachus* feed mainly on crustaceans, rotifers, insects and algae hence it categorized into plankton feeder. The present observation are in consonance with these food items as reported by earlier worker the *Clarias batrachus* is planktophagus and feeds primarily on zooplanktons.

In the gut content of *Heteropneustes fossilis* (Table2), percentage of animal matter was highest (76.41%) in summer season and lowest in the rainy season (73.62%). Zooplankton percentage was highest (18.15%) in rainy season and lowest in the winter season (16.12%) while the phytoplankton was highest (6.487%) in rainy season and lowest (4.37%) in the summer season. The percentage of occurrence of plant matter and dead organic matter in the gut content was in negligible quantity in all three seasons and always less than 2.0%. Goutam *et al*., (2009) [2] reported that the fish *Heteropneustes fossilis* feed mainly on animal origin matter that constitute about 88.2% and plant origin matter was only 9.7% in the gut content of this fish.

Table 2: Gut content and grading of various food items of *Heteropneustes fossilis*

Food item	% composition of items		Vi x Oi	Preponderance Index (I)	Grading
	Volume (Vi)	Occurrence (Oi)			
Rainy Season					
Zooplankton	25.41	24.28	616.95	18.15	II
Animal matter	50.17	49.87	2501.98	73.62	I
Phytoplankton	14.25	15.45	220.16	6.48	III
Plant matter	6.82	6.18	42.15	1.24	IV
Decay organic matter	3.35	5.22	17.49	0.51	V
Total ∑	100.0	100.0	**3398.73**	100.0	
Winter season					
Zooplankton	24.42	23.24	567.52	16.12	II
Animal matter	52.58	51.11	2687.36	76.32	I
Phytoplankton	14.26	14.01	199.78	5.67	III
Plant matter	7.24	8.54	61.83	1.76	IV
Decay organic matter	1.50	3.10	4.65	0.13	V
Total ∑	100.0	100.0	**3521.14**	100.0	
Summer season					
Zooplankton	26.47	25.14	665.46	18.12	II
Animal matter	53.12	52.84	2806.86	76.41	I
Phytoplankton	13.11	12.24	160.47	4.37	III
Plant matter	5.47	6.15	33.64	0.92	IV
Decay organic matter	1.83	3.63	6.64	0.18	V
Total ∑	100.0	100.0	**3673.07**	100.0	

The quantitative analysis of gut content shows that about 70% and 90% animal origin matter present in the gut of *Clarias batrachus* and *Heteropnetues fossilis*, respectively whereas the plant origin food about 6% and 29% was present in the gut content of *Heteropnetues fossilis* and *Clarias batrachus*, respectively. On the basis of these findings it was concluded that both cat fish, *Clarias batrachus* and *Heteropnetues fossilis* feeds on animal and plant origin matter hence omnivorous in habitat.

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