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Feeding behaviour of fish *Catla catla* (Hamilton, 1822) with special reference to gut content analysis

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Abstract
In the current study, the intestinal content of *Catla catla* fish was examined. The fish were gathered in Uttarakhand's Tumaria Reservoir near Udham Singh Nagar. It was noted that the crustaceans (Cladocerans and Copepods) made up the majority of the gut contents, accounting for 31.00% by volume and 42.15% by occurrence. Rotifers came in second in terms of dominance, accounting for 18.60% by volume and 15.20% by occurrence, followed by insects, which accounted for 13.00% by volume and 10.20% by occurrence. Additionally, the group of green algae or Chlorophyceae, made up 15.00 percent of the intestinal material by volume and 9.70 percent by occurrence. Diatoms, or Bacillariophyceae, were the next significant component of the gut contents, accounting for 10.0% of the volume and 7.30% of the occurrence, myxophyceae was 7 % by volume and 6.50 percent by occurence. It was observed that catla is planktophagus and feeds primarily on zooplankton. Studies on gastrosomatic index (GaSI) of *Catla catla* revealed that the feeding intensity remained high during winter months and reduced during summer months.

Keywords: *Catla catla*, Gut content analysis, crustaceans, algae, major carp

Introduction
India is the world's second-largest producer of fish. This industry accounts for roughly 5% of the world's fish production. The primary carps in freshwater aquaculture in India are the Mrigal (*Cirrhinus mrigala*), Catla (*Catla catla*), and Rohu (*Labeo rohita*). Due to their rapid growth and increased consumer acceptability, big carps are the most popular farm fish. The most farmed fish in India are Indian big carps, which account for over 87% of the nation's total freshwater aquaculture output. Indian carps are Labeo rohita, *Catla catla*, and Cirrhinus mrigala mori (FAO, 2017). The cyprinidae family of freshwater fishes includes *Catla catla* which is economically significant. In India, Bangladesh, Nepal, and Pakistan, catla is indigenous to rivers, lakes and reservoirs. The *Catla catla* is a fish with a broad, huge head, an upturned mouth, and a large, protruding lower jaw. It feeds on the surface and in mid-water. At two years old, it reaches sexual maturity and reaches a weight of two to three kilograms. During the monsoon season, catlas breed in aquatic ecosystems (FAO, 2003).
The majority of adult fish species can go for weeks without eating, but in order to maintain their condition as study subjects, they need be fed food that is both appetizing and satisfies their fundamental nutritional needs. A balanced combination of foods present in the diet of individuals of the species that are free-ranging should offer sufficient nourishment if the life stage and nutritional needs are unknown. It is not a given that providing natural foods, particularly of a single kind, will satisfy the captive fishes' full nutritional needs. Fish diet composition has a significant impact on fish dispersal throughout various aquatic ecosystem strata and gastrointestinal examination. This study is basically aim to find out the gut content analysis of fish *Catla catla*.

Materials and Methods
Study Area: The Tumaria reservoir is located at 29^{0}20 N latitude and 78055 E longitude and 288 meters above sea level, Tumaria Reservoir is situated northwest of Kashipur in District Udham Singh Nagar, close to Tumaria village, which is 21 kilometers from Kashipur. A 20.4-kilometer earthen dam between the Dhela and Phika Rivers, the Tumaria main reservoir was constructed initially, followed by the Tumaria construction. The primary reservoir of Tumaria was built in 1961–1962 and its extension reservoir in 1969–1970.

Catla catla (Hamilton)
Fin Formula: D.3-4/14-16; P.18-20;V.9;A.3/5;C.18-19 (Talwar and Jhingran 1991)
Local Name : Katla
Classification:
Kingdom- Animalia
Phylum- Chordata
Class- Actinopterygii
Order- Cypriniformes
Family- Cyprinidae
Genus – *Catla*
Species- *catla*

Fig 1: Studied fish and its systematic position

Methodology for Food and Feeding Biology: Length and weight of alimentary canal was measured with food and without food. The gut was preserved in 4% formalin for analysis of quality of food. For the food and feeding biology following parameters were carried out for nature of food, relative length of gut, index of fullness, feeding intensity

and gastro-somatic index. Nature was also analyzed by gut content analysis and relative length of gut (RLG) was calculated by following formula.

Relative length of gut (RLG) =

$$\frac{Total\ Length\ of\ Gut}{Total\ Length\ of\ Fish}$$

To estimate the feeding intensity of fish gastro-somatic index (GaSI) was calculated by following formula.

GaSI = Weight of the gut/Weight of fish X 100

Results and discussion

Gut content analysis

One of the key factors in determining fish feeding habits and the ecological relationships of the aquatic body is the examination of fish stomach material. It is crucial for fishery management planning. The eating and feeding habits of *Catla catla* have been researched in light of this fact. In the study, gut examination was performed on adults and mature individuals. Each fish was investigated in about 20–30 individuals. Below is a description of the gut content analysis's findings:

Gut content analysis of fish *Catla catla*

Generally speaking, the amount and quality of food that is available and ingested by a fish affects its growth. Therefore, any change in the amount and quality of food sources will have an impact on the fish's rate of growth. Numerous biotic and abiotic elements affect the natural food materials' qualitative and quantitative fluctuations in a body of water. A fish's gut contents can be analyzed both qualitatively and quantitatively, and the gastrosomatic index can be estimated to determine these variances. Fisheries researchers have long been interested in the diet and feeding patterns of carps.

Natarajan and Jhingran (1961) [10] studied the food habits of *Catla catla* and reported a Zooplankton dominated food preference for *Catla catla*. Various food items and their percentage composition (by volume and occurrence) found in the gut of *Catla catla* are enumerated in Table-1. The Table-1 also depicts the Preponderance index of different food items observed in the guts of the species. During the study period crustaceans (Cladocerans and Copepods) made up the majority of the gut contents, accounting for 31.00% by volume and 41.90% by occurrence. Rotifers came in second in terms of dominance, accounting for 18.60% by volume and 15.20% by occurrence, followed by insects, which accounted for 13.00% by volume and 10.30% by occurrence. Additionally, the group of green algae, or Chlorophyceae, made up 15.50 percent of the intestinal material by volume and 9.70 percent by occurrence. Diatoms, or Bacillariophyceae, were the next significant component of the stomach contents, accounting for 9.40% of the volume and 7.00% of the incidence. Similar observations also found by Sangeetha. and Susithra (2023) [13] who made study on food and feeding habits of major carps *Catla catla*, male and female.

The major genera of cladocerans and copepods in the diet of the species were *Daphnia, Moina, Simocephalus, Bosmina, Cyclops, Ceriodaphnia, Nauplius larvae and Diphanosoma*. The rotifers group was mainly represented by *Keratella, Brachionus, Trichocerca* and *Filina*. The major genera of Chlorophyceae in the diet of the species were *Pediastrum, Cosmarium, Oedogonium, Pandorina, Spirogyra*and *Tetraspora*. Amongst the Bacillariophyceae, the abundant genera were Amphora, *Fragilaria, Frustulia, Gomphoneis, Diatoma* and *Navicula*. In Myxophyceae, the major genera were *Nostoc, Spirulina, Anabaena*, and *Ocillatoria*.

Gastrosomatic index (GaSI)

Gastrosomatic index (GaSI) of *Catla catla* was calculated from the fish samples collected during winter, summer and monsoon season, November-February and April-June for the study of feeding intensity because of the legal restrictions on fishing. The value of GaSI was higher during winter months as compared to summer months. In this study the main gut content of fish *Catla catla* mainly comprised In this study the main gut content of fish *Catla catla* mainly comprised crustaceans (31%) and rotifers (18.60%) followed by insects (13%), Bacillariophyceae (10%), Chlorophyceae (15%), Myxophyceae (7%) and plant material (5%). The decayed organic matter formed negligible (1%) amount of the gut content. It is reported that generally during spawning season, feeding rate would be relatively lower and it increases immediately after spawning as the organisms feed voraciously to recover from fast. Padvi, *et. al.* (2024) [11] also studied on food and feeding habits Indian major carps and illustrated that various factors such as maturity, seasonal variation, sex, availability food etc. influence the GaSI of Indian major carps.

Table 1: Grading of various food items of gut contents in *Catla catla*

Food items	Percentage of items by		V_IO_I	Index of Preponderance $I=V_IO_I$ X100/$\sum V_IO_I$	Grading
	Volume (V_I)	Occurrence (O_I)			
Crustaceans	31.00	42.15	1306.65	64.84	I
Rotifers	18.60	15.20	282.72	14.03	II
Insects	13.00	10.20	132.6	6.57	III
Chlorophyceae	15.00	9.70	145.5	7.22	IV
Bacillariophycea	10.00	7.34	73.4	3.64	V
Myxophyceae	7.00	6.50	45.5	2.25	VI
Plant material	5.00	5.11	25.55	1.26	VII
Decayed Organic matter	1.00	3.80	3.8	0.18	VIII
$\sum V_IO_I$=2015.72					

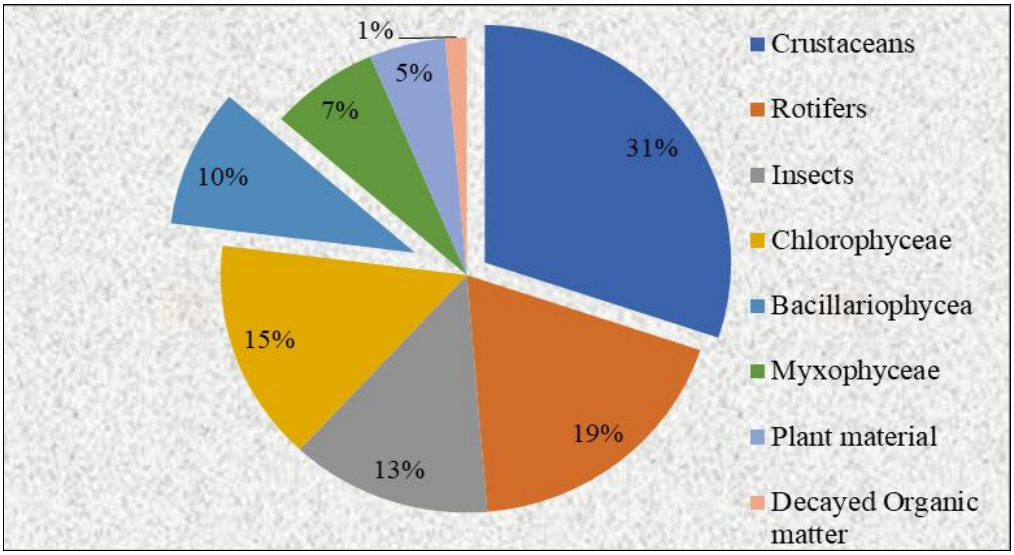
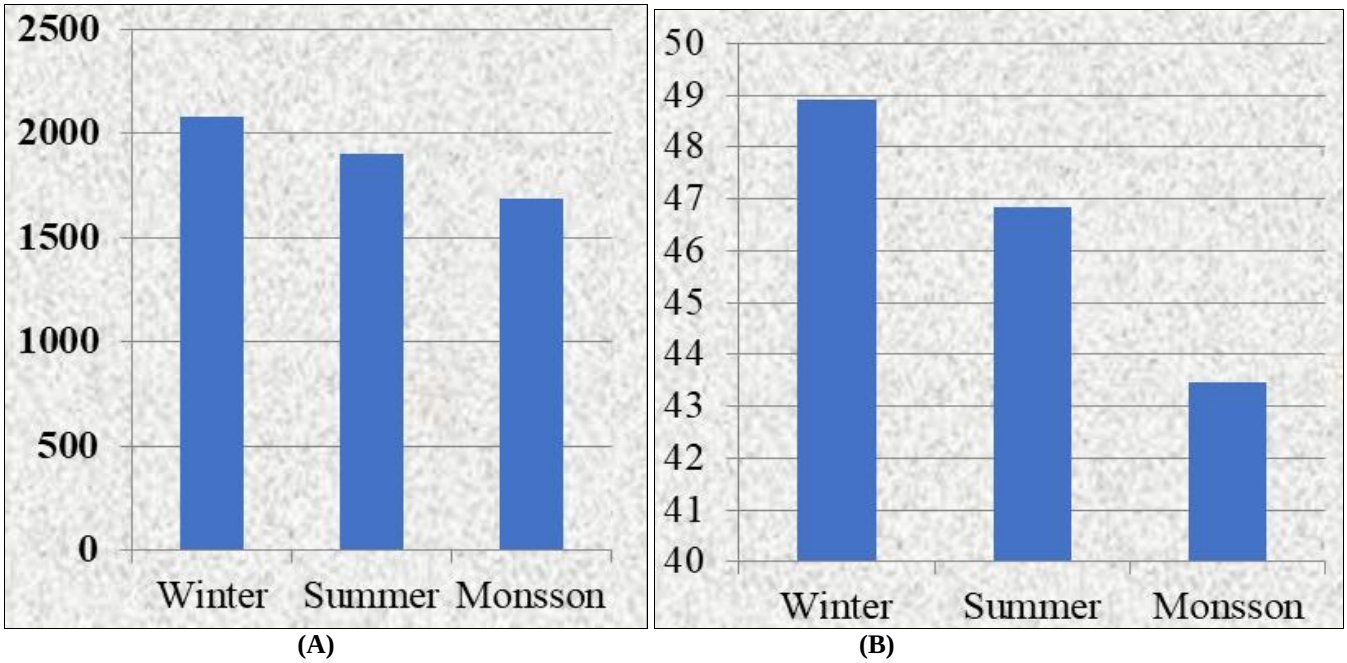


Fig 2: Grading of various food items of gut contents by volume in *Catla catla*

Gastrosomatic index (GaSI) of *Catla catla* were calculated from the 10 fish samples randomly collected from the landing centre of Tumaria reservoir during the study period from (January, 2024 to December 2024) for the study of feeding intensity. The values of GaSI are given in Table -2.

Table 2: Gastro-somatic index of fish *Catla catla* from Tumaria reservoir during year 2024.

	Winter Season			**Summer Season**			**Monsoon Season**		
S.N.	Weight of fish in gm	Weight of gut in gm	GaSI	Weight of fish in gm	Weight of gut in gm	GaSI	Weight of fish in gm	Weight of gut in gm	**GaSI**
1.	1800	34.10	1.89	1710	33.00	1.93	1600	32.00	2.00
2.	1150	29.70	2.58	1190	28.40	2.39	1030	23.00	2.23
3.	2800	78.00	2.78	2700	75.00	2.78	2200	70.00	3.18
4.	2300	49.30	2.14	2000	56.00	2.80	2020	50.30	2.49
5.	2290	60.00	2.62	2100	50.80	2.42	2000	53.90	2.70
6.	3000	80.10	2.67	2500	82.20	3.29	2300	72.40	3.15
7.	1450	30.40	2.09	1200	28.10	2.34	1105	25.10	2.27
8.	1760	38.00	1.89	1100	35.40	3.22	1306	30.10	2.30
9.	1730	34.00	1.96	1350	33.10	2.45	1205	30.50	2.53
10.	1710	38.00	2.22	1500	36.10	2.41	1510	32.00	2.12
Mean	1999	47.16	2.284	1735	45.81	2.603	1627.6	41.93	2.497



(A) **(B)**

Fig 3: (A-B): Mean value of weight of fish (A) and gut of fish (B) *Catla catla* during different seasons from Tumaria reservoir during study i.e. 2024

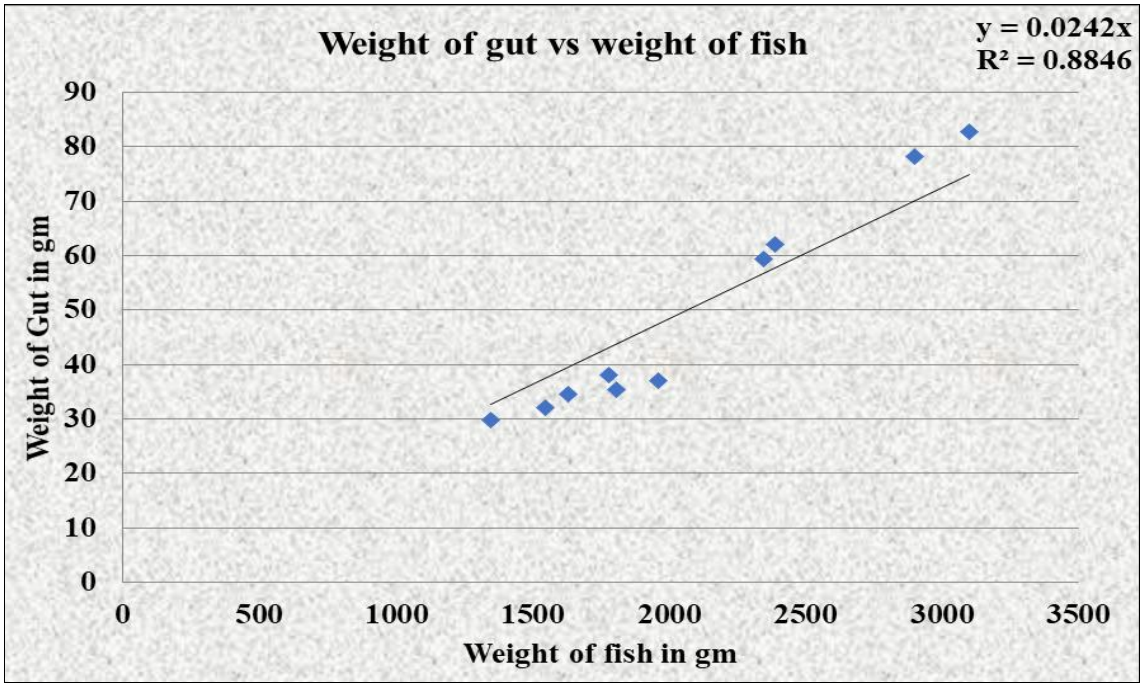


Fig 4: Regression between weight of fish and weight of gut of fish *Catla catla* during Study period

Fisheries researchers have long been interested in the diet and feeding patterns of carps. Numerous studies on fish gut content, food consumption, and feeding habits have been conducted by Natarajan and Jhingran (1961) [10], *Catla catla*'s feeding preferences were dominated by zooplankton. Different foods and the proportion of each food item (by volume and incidence) that is present in the *Catla catla*'s gut. One of the most crucial aspects of fisheries management is gut content analysis, as demonstrated by Abila (2011) [1] studied on the gut content of a few significant fish. During the study period, Crustaceans (cladocerans and copepods) formed the main item of gut contents forming 31.00 % by volume and 42.10 % by occurrence. Similar results also found by Satoh *et al.* (2004) [12].

The primary cladoceran and copepod genera that the species consumed were Canthocampus, Cyclops, Diaptomus, Moina, Bosmina, Macrothrix, and Daphnia. The current study observed that fishes' eating and feeding habits are also influenced by seasonal change. Our findings are also supported by Handeland, *et al.* (2008) [7].

Next in line for supremacy were the rotifers, which made up 18.56 percent of the stomach contents of *Catla catla* by volume and 15.21 percent by occurrence. Similar findings were made by Babare et al. (2013) about several teleostes. Pediastrum, Cosmarium, Gonatozygon, Hydrodictyon, Protococcus, and Coelastrum were the main Chlorophyceae genera that the species found in gut. The genera Fragilaria, Synedra, Pinnularia, Diatoma, and Navicula were the most prevalent among the Bacillariophyceae. Behade and Tantarpale (2023) [2] studied on gut content analysis of freshwater fish and described that gut content is one of the most important aspects in fisheries management. The proportion of Myxophyceae in the species' stomach contents was 6.56% by occurrence and 7.19% by volume. The four main genera in the Myxophyceae family were Aphanizomenon, Polycystis, Anabaena, and Nostoc. Kumar, *et al.* (2012) [8] similarly observed that the food composition of Catla fish was comparable. According to Dudgeon (1983) [3], one of the most crucial factors pertaining to fish and fisheries is GaSI. In comparison to the summer, the GaSI levels were greater in the winter. Crustaceans (30%) and rotifers (19%) made up the majority of the intestinal content of the fish *Catla catla* in this study. Insects (13%), Bacillariophyceae (10%), Chlorophyceae (15%), Myxophyceae (7%), and plant material (5%), came next. Decomposed organic materials made up a very small (1%) portion of the intestinal content. Dwivedi (2025) [4] also reviewed on food and feeding behaviour of *Labeo calbasu* and concluded that seasonal varioation certainly affect the gut content analysis of fishes. Similarly, Mohale (2023) [9] studied on food and feeding habit of *wallago attu* in Bhadar Reservoir and found that high GaSI in winter as compared to summer and monsoon. The current findings support those of previous researchers who indicated that the catla is a planktophagus and mostly consumes zooplankton. Research on *Catla catla*'s gastrosomatic index (GaSI) showed that feeding intensity decreased in the summer and stayed high in the winter.

Conclusion

The stomach contents of *Catla catla* were analyzed in this study, and the results showed that the fish's diet included aquatic zooplankton, phytoplankton, insects, plant matter, organic detritus, and miscellaneous. The primary food source for *Catla catla* is plankton, making it a planktivorous fish. *Catla catla* is not typically a bottom feeder, in contrast to several other carp species. It filters plankton from the water with its gill rakers, making it a surface and midwater feeder. Although it mostly eats zooplankton, it also consumes tiny invertebrates and phytoplankton.

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