BIBECHANA
A Multidisciplinary Journal of Science, Technology and Mathematics
ISSN 2091-0762 (Print), 2382-5340 (0nline)
Journal homepage: http://nepjol.info/index.php/BIBECHANA
Publisher: Research Council of Science and Technology, Biratnagar, Nepal

Food and feeding habit of *Tor putitora* of Mahakali River, Nepal

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Article history: Received 07 November, 2015; Accepted 29 November, 2015
DOI: http://dx.doi.org/10.3126/bibechana.v13i0.13983

Abstract

T.putitora is a sight feeder and can be categorized as column feeder, which at some stage resorts to bottom feeding as well. Depending upon the availability of food, the fish consumes a wide spectrum of dietary items varying from microscopic organisms and macrophytes to large number of insects and even small fishes.

The feeding activities of *T. putitora* appeared to be good during pre-spawning (pre-monsoon) and post-spawning season while poor during monsoon or spawning season, which is directly related to the availability of food and maturation of gonads. The estimation of GSI (Gastro-somatic Index) also supported this fact.

Keywords: Mahakali river; *Tor putitora*; Gut.

1. Introduction:

Tor putitora which is commonly known as Mahseer or Sahar or Golden Mahseer. In Nepal Mahseer is known as 'Sahar', which means a big fish. It has large scales. It is a superior game fish. Live adult Mahseer is olive green at the top of the head and back. Its lateral line is generally silvery golden. The scales on the lateral line are marked with dark colour at their bases. The fins are generally yellow and rimmed with orange red. The lips of the adult mahseer are thick and are beset with horny tubercles. Its barbels are quite short. Only four barbels are present ones being the maxillary longer than the rostral ones. Feeding is one of the most important functions of an organism. The basic functions of an organism, like growth, development, reproduction all take place at the expense of the energy, which enters the organism in the form of its food. Feeding activity influences the growth and productivity of fishes. Therefore, the study of food and feeding habits of a fish is very important.

Important contributions on food and feeding habits of the different fishes have been made by Hynes [1], Alikunhi [2], Das and Moitra [3], Menon and Chacko [4], Vashist [5], George [6], Kamal [7], Agrawal and Tyagi [8] Jan and Das [9], Majkowski and Waiwood [10], Bahuguna and Singh [11]. Some work on food and feeding habits has also been done by Pathani [12], Nautiyal [13], Sundar et al.[14], Sharma [15], DasGupta [16], Bhanja et al. [17], Hossain et al. [18], Basade and Kohli [19], Joadder and Hossain [20],

Dadebo [21], Shinkafi et al. [22], Manon and Hossain [23], Kanwal and Pathani [24], Omondi et al.[25], and Sharma et al.[26].

But there is no relevant literature on food and feeding habits of Mahseer inhabiting Mahakali river. The present investigation is the first attempt to study the feeding habit of Mahseer in its habitat. During the study period qualitative and quantitative food analysis, seasonal variations in the food items, gastrosomatic index (GSI), feeding intensity and relative length of the gut (RLG) of Mahseer were observed.

Study Area

Mahakali river originates from Indo-Nepalese glaciers, Milan glacier of India and Lipu-lekh of Nepal. The river leaves the mountains near Tanakpur and is now known as Sarada in India. Later, it reaches Sharada barrage, where it is considerably wider. Mahakali then enters into Nepal at Chandani and flows through Nepal upto Dodhara, after which it enters into Indian territory, finally confluencing with the Ghaghara.

The present studies were conducted at the Chandani and Dodhara V. D. C. (Village Development Committee). They are the V. D. C. of Kanchanpur district near the bank of Mahakali river. The study area lies between longitude $80^0 25^{'}$ East and latitude $28^0 35^{'}$ North.

Four stations (A, B, C and D) were selected. First station 'A' is an upper station, which is near at Purnagiri temple of Syavle Bajar. Second station 'B' is 4 kilometres from station A. Third station 'C', which is 4 kilometres from station B. Fourth station 'D' is a lower station, which is 4 kilometres from station C.

2. Materials and Methods

The present study was carried out for a period of two years. The period from September 2003 to August 2005 was used to collect the fishes.

Gut Analysis:

The samples were collected fortnightly; total length was recorded up to the nearest centimetre and the weight up to gram. The gut of each fish was removed, the weight of the gut and gut contents were also recorded and preserved in 5 % formaldehyde for analysis.

The gut content of each fish was transferred in to a petridish and examined under a microscope. Each food item was sorted out and identified. The food item per fish was examined by the frequency of occurrence method and point's method of Hynes [1].

Qualitative analysis and food volume:

In this method food items were sorted out and were identified up to genus level only. Food volume was measured in partially filled graduated cylinder. The entire gut content was kept in 10-125 ml graduated measuring cylinder. The settling was done for 24 hours, after which the volume was read and recorded for each fish, in the catches of each fortnight. The fullness of stomach was classified as very full, ¾ full, ½ full, ¼ full and empty. The points were awarded for each category as 20, 15, 10, 5 and 0, respectively. The resultant fullness index was based on mean number of points, which was calculated by the total number of the awarded points divided by the number of stomachs examined in each fortnight. This

depends on eye estimation of distension of intestinal bulb confirmed by ratio of the capacity of the intestinal bulb to total food.

Quantitative analysis

Quantitative study of fish food in each intestinal bulb was measured by Hynes [1] method. For quantitative accuracy only the intestinal bulb content was considered as gut content. The Sedgwick Rafter method was used for counting each food item and was given a point, according to their size as seen in Sedgwick Rafter slide, using a research microscope. GSI (Gastro somatic index) was calculated by following formula:

$$GSI = \frac{\text{Total weight of the alimentary canal of fish}}{\text{Total weight of fish}} X100$$

$$RLG = \frac{\text{Length of entire alimentary canal}}{\text{Length of fish in fresh condition}}$$

3. Results

Qualitative Monthly Fluctuation in Food Items

The identified food items are listed in Tabl 1. The identified food items were grouped under 12 categories, Chlorophyceae, Cyanophyceae, Bacillariophyceae, Xanthophyceae, Protozoa, Rotifera, Crustacea, Fish parts, Insects, unidentified plant matter, unidentified animal matter and sand and debris.The Chlorophyceae, Cyanophyceae, Bacillariophyceae were found throughout the year during entire study period and are considered as preferred food. Xanthophyceae was found only in three months during the first year and two months in second year from the gut of *Tor putitora*. Protozoan, Rotifers, Crustaceans, Fish parts and Insects were found in low amount in few months of both years (Table 2 & 3).

Quantitative Monthly Fluctuation in Food Items:

Chlorophyceae

The group Chlorophyceae consisted of *Chlorella, Ankistrodesmus, Gonatozygon, Scenedesmus, Mougeotia, Chlamydomonas, Periastrum, Spirogyra, Desmidium, Coelastrum, Cylindocystis, Coefastrum, Dictyosphaerium, Ulothrix* and *Cladophora.*

This group occurred throughout the investigation in the gut of *T. putitora*. During the first year, it varied from a minimum of 12.40 % (September 2003) and maximum of 43.10 % (February 2004). In second year, this alga varied from minimum 19.23 in December 2004 and maximum 39.13 % in the month of May 2005 (Table 4 & 5).

The important constituents of this alga were *Chlorella, Spirogyra,* and *Gonatozygon*. The annual mean percentages of these algae were 28.58 and 25.94 during first and second year, respectively (Table 4 & 5).

Cyanophyceae

The maximum contribution of Cyanophyceae was recorded during the month of October 18.62 % and minimum 4.31 % in the month of February during the first year while in second year, the maximum value was recorded 17.47 % in the month of March and minimum 7.24 %in the month of September (Table 4 & 5). *Microcystis* was the most prevalent form of this group. The annual mean percentage of this group was

11.55 % and 12.54 % during first and second year, respectively (Table 4 & 5). Cyanophyceae was recorded throughout the study period.

Bacillariophyceae

Bacillariophyceae was the second most important alga which was found throughout the twenty four months of the study period, in the gut of *T. putitora*. The percentage value of Bacillariophyceae varied from 5.78 % (June 2004) to 33.61 % (April 2004) during the first year while in second year, it varied from 9.63 % (August 2005) to 32.29 % (February 2005). The important diatoms were *Diatoma* and *Synedra* which were found almost throughout the study period. The annual mean percentages of this group were 20.92 % and 22.39 % during first and second year, respectively (Table 4 & 5).

Xanthophyceae

This group of alga was rarely found in the gut of *T. putitora*. Xanthophyceae was found only in the months of April, May and July during the first year while in September and January in second year of investigation. *Tribonema* and *Tetraedriella* were important forms of this group. The annual mean percentages of this group were 0.84 and 0.24 % during first and second year, respectively (Table 4 & 5).

Protozoa

This group of food item was found during several months in the entire study period, but in little amount. The peak of this group was observed in the month of July 6.29 % and February 12.50 % during first and second year, respectively. This group was represented by *Paramecium, Spirostomum* and *Verticella.* The annual mean percentages of this group were 2.67 and 3.17 during first and second year, respectively (Table 4 & 5).

Rotifers

This group was represented *by Keretella, Nothalca, Rotaria, Brachionus, Philodina, Mytilina* and *Dinobryon* but *Kiretella* was the important form of this group. Rotifers were observed throughout the year during first year while they have absent from January 2005 to March 2005 during the second year. The peak of this group was observed in the month of June (15.70 %) and September (10.14 %) during first and second year, respectively. The annual mean percentages of this group were 8.01 in first and 5.40 % during second year (Table 4 & 5).

Crustaceans

Crustaceans were observed in several months, during the period of investigation. *Daphnia* and *Cyclops* were main form of this group. The peak of this group were observed in the month of June (10.74 %) and December (16.34 %) during the first and second year, respectively. The annual mean percentages of this group were 5.23 and 4.40 during respective year (Table 4 & 5).

Fish Remains

Only in the month of September, some parts of fish were observed in the gut of *T. putitora*, during the first year. In second year of observations, they were found in various months (September. October, January, April, June) while absent in the remaining seven months of the year. The annual mean percentage of fish parts was very low (0.55 %) during the first year while 2.85 % during the second year (Table 4 & 5).

Insects

Some parts of insects were found in the gut of *T. putitora* in few months (December, January and August) of first year. In second year, they were present in the month of September, December, January, March,

May and August. The peak of this group was observed in the month of August in both years. The annual mean percentages were 1.27 and 3.57 during first and second years, respectively (Table 4 & 5).

Unidentified Plant Matter

This group of food item was observed in decayed or semi decayed state. It was found in appreciable quantities throughout the year during whole study period. Its percentage of occurrence was highest in the month of October (11.76 % and 10.52 %) during both years of investigation. The lowest value of this group was 3.14 % in the month of July 2004 and 1.94 % in the month of March 2005 during respective years. The annual mean percentages were observed 6.41 and 6.33 during first and second year, respectively (Table 4 & 5).

Unidentified Animal Matter

This group of food item was observed in a decayed or semi decayed state like unidentified plant matter. It was also found throughout the year during investigation. Its percentage of occurrence was highest in the month of February (8.62) and lowest in the month of April (3.36) during the first year while in second year, the highest value was observed in the month of May (6.52 %) and lowest in the month of April (1.98 %). The annual mean percentages were 5.72 and 3.62 during first and second years of observations (Table 4 & 5).

Sand and Debris

The sand and debris were observed within the gut content throughout the year. Their percentage varied from 3.42 (January 2004) to 18.69 (August 2004) and 2.98 (January 2005) to 26.50 (August 2005) during the first and second years of investigation, respectively (Table 4 & 5). The peak was observed in the month of August (monsoon) during whole study period, when turbidity was as its peak.

Gastro-Somatic Index

The gastro-somatic index (GSI) is a relationship between weight of alimentary canal and weight of fish, which helps in determining the feeding condition in different months and seasons. The average gastro-somatic index of *T. putitora* ranged from 1.33 to 4.59 during the first year while 1.65 to 4.73 in second year of the study. The peak of gastro-somatic index was observed during the pre monsoon season (April 2004 and March 2005) when the plankton was as its peak during the entire study period (Fig 1).

Gastro-somatic index was as high as 3.44 and 3.08 during post-spawning season in the month of November and December during the first year of study. In the second year of observation, the gastro somatic index was as high as 3.69 and 3.90 in the same month during post- spawning season like first year (Fig 1). The general picture emerges that voracious feeding takes place during post spawning season and whenever plenty of food items were available in the river.

Relative Length of Gut

The length of intestine varies from fish to fish, but for a particular species, it has a definite relation with length of fish which helps to determine the feeding habits of the fish species. Relative length of gut (RLG) differs in different stages of life history of fish. The relative length of gut values of *T. putitora* varied from 1.48 to 2.18 during the first year while in second year its value ranged between 1.32 to 2.07 (Fig 2). The maximum values were obtained in the months of January (2004) and May (2005) during the first and second year of study, respectively. The minimum values were obtained in the months of May (2004) and July (2005) during the respective years of study period. The quantitative food and study of the

alimentary canal show, this fish to be more of a herbivore than an omnivore. Therefore, *T. putitora* has been categorized to be of herbi-omnivorous nature.

4. Discussion

Nikolsky [27] classified the food of fish into four categories basic, secondary, accidental and obligatory food. The basic food of *T. putitora* constitutes phytoplankton specially Chlorophyceae (28.58 % during first year and 25.94 % in second year), Bacillariophyceae (20.92 % in first year and 22.39 % in second year), Cyanophyceae (11.55 and 12.54 % during first and second year, respectively).

The Rotifers, Protozoans, Crustaceans and Insects comprise the secondary food, which were found frequently in the gut but in small amounts. Fish parts and Xanthophyceae group of phytoplankton were observed as accidental food in the gut of *T. putitora*. The sand and debris were also present throughout the year but in small amount.

The food and feeding habits and adaptations of the gut have been worked out by many authors. It is a fact that the vegetable matter requires more time for digestion, hence herbivorous fishes have higher RLG (Relative length of gut) value than omnivorous fishes.

In the present study, two years mean of RLG value of *T. putitora* was 1.73. On this basis, *T. putitora* may be kept in the category of herbi - omnivorous fishes. This observation is in conformation with the observations made by Das and Pathani [28], who have considered *T. putitora* to be a herbi-omnivore on the basis of RLG value, percentage of food items and position of the bile duct. The herbi-omnivorous nature of *T. putitora* has been considered to be a peculiar example of evolutionary transition from herbivorous to omnivorous nature (Das and Pathani, [28]). However, the result of present study differs from the opinion of Badola and Singh [29], who have categorized *T. putitora* to be a carni - omnivorous fish.

In the present study, the maximum feeding intensity in *T. putitora* was recorded during pre-monsoon as well as pre-spawning season (April 2004 and March 2005), during which the planktons were plenty in number. During the post spawning season also (November and December), the feeding intensity was high (3.44, 3.08 and 3.69, 3.90 during first and second year, respectively). High feeding intensity during pre-spawning is due to maturation and enlargement of the gonads while during post-spawning it may be due to spent and starved condition of the fishes. Feeding intensity is correlated with the post- spawning period and the availability of food in the river Mahakali, which confirms the view of Malhotra [30], Jyoti and Malhotra [31], and Jyoti [32].

During monsoon season (July and August) shortage of food items in the Mahakali river and the abdomen being filled with mature gonads may be the reason for lowering of feeding intensity. In general, the GSI is maximum during the post spawning period when plenty of food items are available and minimum during the breeding season when food materials become less.

Therefore, it may be concluded that *T. putitora* of Mahakali river feeds voraciously during pre-spawning when plenty of food items are available followed by the post-spawning season when its abdomen becomes empty due to spent phase.

Acknowledgements

Thanks are due to the campus chief of S.N.Science Campus, Mahendranagar for providing the necessary facilities to present work. The author is thankful also to Dr. (Mrs.) Manju Lata Bisht, Department of zoology, D.S.B. Campus, Kumaun University, Nainital for her valuable guidance.

Table 1: List of Food Items Found in the Gut of *T. putitora* during 2003/05.

Species

Chlorophyce

Chlorella Sp.
Ankistrodesmus Sp.
Gonatozygon Sp.
Scenedesmus Sp.
Mougeotia Sp.
Chlamydomonas Sp.
Pediastrum Sp.
Spirogyra Sp.
Desmidium Sp.
Coelastrum Sp.
Cylindrocystis Sp.
Dictyosphaerium Sp.
Ulothrix Sp.
Cladophora Sp.

Cyanophyceae

Microcystis Sp.
Chroococcus Sp.
Aphanizomenon Sp.
Spirulina Sp.
Anabaena Sp.

Bacillariophyceae

Diatoma Sp.
Asterionella Sp.
Synedra Sp.
Gomphonema Sp.
Gyrosigma Sp.
Tabellaria Sp.
Navicula Sp.
Fragilaria Sp.
Cymbella Sp.

Xanthophyceae

Tribonema Sp.
Tetraedriella Sp.
Chrysoamphitrema Sp.

Protozoa

Paramecium Sp.
Spirostomum Sp.
Vorticella Sp.

Rotifera

Keratella Sp.
Notholca Sp.
Rotaria Sp.
Brachionus Sp.
Philodina Sp.
Mytilina Sp.

Crustacea

Daphnia Sp.
Cyclops Sp.
Chirocephalus Sp.
Orchestia Sp.

Fish parts
Insects
Unidentified plant matter
Unidentified animal matter
Sand and debris

Table 2: Monthly average no. of different food items (Groups) in gut of *T.putitora* during 2003/04.

Month / **Food groups**	**Sep.**	**Oct.**	**Nov.**	**Dec.**	**Jan.**	**Feb.**	**Mar.**	**Apr.**	**May**	**Jun.**	**Jul.**	**Aug.**	**Total**
Chlorophyceae	15	22	39	47	49	50	33	35	27	29	32	27	405
Cyanophyceae	19	19	14	08	13	05	11	12	13	17	15	15	161
Bacillariophyceae	30	14	21	25	43	26	36	40	23	07	21	12	298
Xanthophyceae	-	-	-	-	-	-	-	05	03	-	04	-	012
Protozoa	03	04	02	-	-	04	-	-	03	07	08	06	037
Rotifera	11	08	06	05	06	08	10	12	08	19	09	10	112
Crustacea	07	08	06	11	09	-	-	-	10	13	11	-	075
Fish parts	08	-	-	-	-	-	-	-	-	-	-	-	008
Insect	-	-	-	04	08	-	-	-	-	-	-	07	019
Unidentified plant matter	10	12	09	08	07	08	07	05	06	07	04	06	089
Unidentified animal matter	08	07	08	09	06	10	06	04	07	06	05	04	080
Sand & debris	10	08	07	06	05	05	06	06	07	16	18	20	114
Total	121	102	112	123	146	116	109	119	107	121	127	107	1410

Table 3: Monthly Average no. of different food items (Groups) in gut of *T.putitora* during 2004/05.

Month / **Food groups**	**Sep.**	**Oct.**	**Nov.**	**Dec.**	**Jan.**	**Feb.**	**Mar.**	**Apr.**	**May**	**Jun.**	**Jul.**	**Aug.**	**Total**
Chlorophyceae	32	22	28	20	35	26	33	29	36	23	21	16	321
Cyanophyceae	10	08	13	12	21	15	18	14	08	09	13	14	155
Bacillariophyceae	32	21	23	27	31	31	29	26	14	21	18	08	281
Xanthophyceae	02	-	-	-	02	-	-	-	-	-	-	-	004
Protozoa	02	03	02	-	-	12	03	-	-	-	12	04	038
Rotifera	14	09	09	02	-	-	-	08	09	02	09	05	067
Crustacea	08	07	06	17	13	-	-	-	02	-	06	-	059
Fish parts	07	06	-	-	08	-	-	09	-	07	-	-	037
Insect	07	-	-	08	10	-	08	-	06	-	-	07	046
Unidentified plant matter	08	10	09	07	05	03	02	07	06	09	06	05	077
Unidentified animal matter	04	03	05	06	05	04	03	02	06	02	03	02	045
Sand & debris	12	06	07	05	04	05	07	06	05	15	18	22	112
Total	138	95	102	104	134	96	103	101	92	88	106	83	1242

Table 4: Monthly average percentage of different food items (groups) in gut of *T.putitora* during 2003/04.

Month / Food groups	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Average
Chlorophyceae	12.40	21.56	34.82	38.21	33.56	43.10	30.27	29.41	25.23	23.96	25.19	25.23	28.58
Cyanophyceae	15.70	18.62	12.50	6.50	8.90	4.31	10.09	10.08	12.14	14.04	11.81	14.01	11.55
Bacillariophycea	24.79	13.72	18.75	20.32	29.45	22.41	33.02	33.61	21.50	5.78	16.53	11.21	20.92
Xanthophyceae	-	-	-	-	-	-	-	4.20	2.80	-	3.14	-	0.84
Protozoa	2.47	3.92	1.78	-	-	3.45	-	-	2.80	5.78	6.29	5.60	2.67
Rotifera	9.09	7.84	5.35	4.06	4.10	6.89	9.17	10.08	7.47	15.70	7.08	9.34	8.01
Crustacea	5.78	7.84	5.35	8.94	6.16	-	-	-	9.34	10.74	8.66	-	5.23
Fish parts	6.61	-	-	-	-	-	-	-	-	-	-	-	0.55
Insect	-	-	-	3.25	5.47	-	-	-	-	-	-	6.54	1.27
Unidentified plant Matter	8.26	11.76	8.03	6.50	4.79	6.89	6.42	4.20	5.60	5.78	3.14	5.60	6.41
Unidentified animal matter	6.61	6.86	7.14	7.31	4.10	8.62	5.50	3.36	6.54	4.95	3.93	3.73	5.72
Sand & debris	8.26	7.84	6.25	4.87	3.42	4.31	5.50	5.04	6.54	13.22	14.17	18.69	8.17

Table 5: Monthly average percentage of different food items (groups) in gut of *T.putitora* during 2004/05.

Month / Food groups	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Average
Chlorophyceae	23.18	23.15	27.45	19.23	26.11	27.08	32.03	28.71	39.13	26.13	19.81	19.27	25.94
Cyanophyceae	7.24	8.42	12.74	11.53	15.67	15.62	17.47	13.86	8.70	10.22	12.26	16.86	12.54
Bacillariophyceae	23.18	22.10	22.54	25.96	23.13	32.29	28.15	25.74	15.21	23.86	16.98	9.63	22.39
Xanthophyceae	1.45	-	-	-	1.49	-	-	-	-	-	-	-	0.24
Protozoa	1.45	3.15	1.96	-	-	12.50	2.91	-	-	-	11.32	4.81	3.17
Rotifera	10.14	9.47	8.82	1.92	-	-	-	7.92	9.78	2.27	8.49	6.02	5.40
Crustacea	5.79	7.36	5.88	16.34	9.70	-	-	-	2.17	-	5.66	-	4.40
Fish parts	5.07	6.31	-	-	5.97	-	-	8.91	-	7.95	-	-	2.85
Insect	5.07	-	-	7.69	7.46	-	7.76	-	6.52	-	-	8.43	3.57
Unidentified plant Matter	5.79	10.52	8.82	6.73	3.73	3.12	1.94	6.93	6.52	10.22	5.66	6.02	6.33
Unidentified animal matter	2.89	3.15	4.90	5.76	3.73	4.16	2.91	1.98	6.52	2.27	2.83	2.40	3.62
Sand & debris	8.69	6.31	6.86	4.80	2.98	5.20	6.79	5.94	5.43	17.04	16.98	26.50	9.79

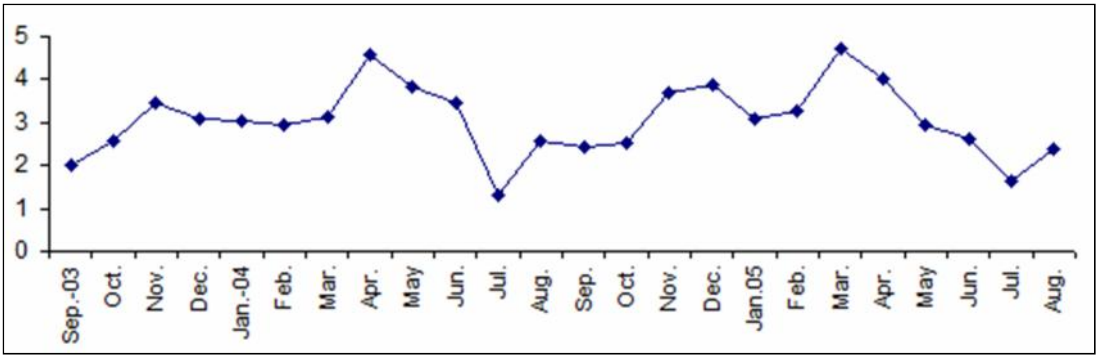

Fig. 1: Gastro-somatic index of *T. putitor*.

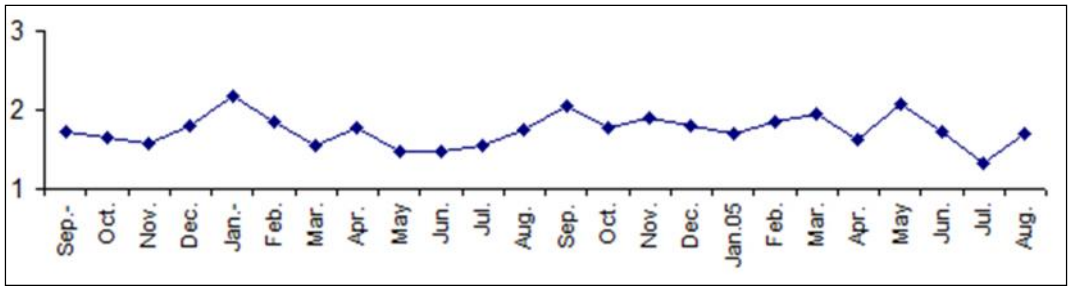

Fig. 2: Relative length of gut of *T. putitora*.

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