Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2018; 6(6): 496-500

Received: 02-09-2018
Accepted: 03-10-2018

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# Study on biometrics and biology of Rohu, *Labeo rohita* from Harike wetland - Ramsar site

**Armaandeep Kaur, Surjya Narayan Datta and Grishma Tewari**

**Abstract**
Present study was carried out in Harike wetland, an internationally recognized Ramsar site (31°08′N to 31°23′N) to evaluate the biometric parameters and biology of one of the economically important fish Rohu, *Labeo rohita* for a period of September 2016 – February 2017. Average length was recorded 58.2 cm, whereas, average weight recorded 2600.0 g. Negative algometric growth was observed with 'b' value ranged from 1.455 to 2.761 and condition factor (K) 1.06. Gonadosomatic Index (%) in male and female was recorded highest in the month of September and lowest in the month of October. Hepatosomatic Index (%) was recorded highest in the month of October and lowest in the month of September. Gastrosomatic index (%) in male and female recorded highest in the month of September (1.56 and 1.81) whereas, it was lowest in the month of January (0.34 and 0.86). Stomach content and relative length of gut (RLG) of *L. rohita* indicating fish is herbivore in feeding habit. Based on biometrics and biology study it can be concluded that a sufficient number of mature and healthy stock of *L. rohita* are available in Harike wetland to sustain the stock in future.

**Keywords:** Harike wetland, *Labeo rohita*, biometric parameters, length weight relationship, gonadosomatic index

## 1. Introduction
Harike wetland, an internationally recognized Ramsar site situated between 31°08′N to 31°23′N latitudes and 74°90′E to 75°12′E longitudes. It is located at the confluence of the rivers Beas and Sutlej and was formed during the construction of barrage in the year 1952, with the aim of storing and providing irrigation and drinking water to parts of the Southern Punjab and adjoining State of Rajasthan. In 1990, Harike wetland was designated as a Ramsar site. This wetland covers the land area of Tarn Taran, Ferozepur and Kapurthala districts in Punjab and is about 12 km long and 11 km in width covering an area of about 8,435 ha[1]. Moza and Mishra [2] reported a total of 55 fish species from Harike wetland and stated that Indian major carps were dominant in catch composition (26.63- 51.48%) followed by common carp (8.96 – 33. 54%) and large size catfish (4.32 – 23.65%).
The Cyprinidae family of freshwater fishes includes the carps and the members are known as cyprinids. It is the largest fish family and the largest family of vertebrate animals, with about 3,000 species under 370 genera. The family belongs to the order Cypriniformes [3]. Due to a tremendous diversity within this family, it becomes difficult to establish a phylogenetic relationship. The systematic history of Cyprinidae fishes is the most debated part and it is important to understand the phylogeny by considering the morphological characters. The biology, biometric characteristics and diversity of family Cyprinidae has not been evaluated in detail, in Punjab. Harike Pattan is the place where water of river Beas and river Sutlej get mixed, so there is every possibility of variation within fish stock. To fill the gap, the present study was carried out to evaluate biometric characteristics of one of the important fish species of family Cyprinidae; *Labeo rohita* with a detail study on biology of the species to create a data base and to find out the maturity status and availability of mature fish in this internationally important Ramsar site to sustain the stock in future.

## 2. Materials and Methods
Fish samples were collected from landing sites situated adjacent to the Harike wetland for biology biometric study for duration of 6 months (September 2016 to February 2017). Fish samples were brought under iced conditions in insulated corrugated boxes to the College of Fisheries, GADVASU and stored at -20 °C till further analysis.

The biometric characters were measured using measuring board, Vernier caliper (Least count = 0.01 mm), magnifying glasses, needles and identified up to the species level with the help of standard key given by Jayaram [4]. Minimum of twenty fishes per month were considered for biometric analysis. A total of 19 morphometric characters [weight of fish (Wt), Total length (TL), Standard length (SL), Fork length (FL), Head length (HL), Head depth (HD), Snout length (SnL), Eye diameter (ED), Inter-orbital length (IOL), Pre-dorsal length (PDL), Pre-pectoral length (PPL), Pre-pelvic length (PPeL), Pre-anal length (PAL), Height of dorsal fin (HOD), Anal fin length (AL), Body depth (BD), Caudal depth (CD), Caudal length (CL) and Caudal fin surface (CFS)] and 5 meristic counts [Dorsal fin rays (DFR), Pelvic fin rays (PeFR), Pectoral fin rays (PFR), Anal fin rays (AFR), Caudal fin rays (CFR)] were considered.

The relationship between length and weight of fish were analysed by measuring length and weight of fish specimens collected from landing centre using the parabolic equation by Le Cren [5]. Fulton's condition factor (K) was calculated according to Htun-Han [6] equation. Gonado-somatic index and Hepatosomatic index (HSI) was calculated based on the equation given by Barber and Blake [7]. Gastrosomatic index (GaSI) of the fish was determined by the following formula

$$\text{Gastrosomatic index} = \frac{\text{Weight of stomach content}}{\text{Weight of fish}} \times 100$$

The relative length of gut (RLG) was calculated using the equation derived by Yamagishi *et al.* [8]

$$\text{Relative length of gut} = \frac{\text{gut length (cm)}}{\text{Fork length (cm)}}$$

Gut contents were analyzed both qualitatively and quantitatively. The qualitative analysis was performed based on complete identification of the organisms in the gut contents and the quantitative analysis were performed based on Frequency of Occurrence method ($O_i$) [9] with the following formula

$$\text{Frequency of Occurrence} = \frac{\text{Ji}}{\text{P}}$$

Where, $J_i$ is the number of fish containing prey i and P is the number of fish with food in their stomach. Stomach contents are examined and the individual food organisms sorted and identified. The number of stomach in which each item occurred was recorded and expressed as a percentage of the total number of stomach examined. Statistical analysis was performed on SPSS -16 software package.

## 3. Results and Discussion

### 3.1 Study on biometrics

In *L. rohita* length and weight was recorded maximum in the month of September (67.60 cm and 3600.8 g) and minimum in February (51.30 cm, 1700.0 g). Average Wt, TL, SL and FL recorded 2600 g (1700-3600 g), 58.2 cm (51.3-67.6 cm), 48.0 cm (42.5-55.5 cm), 46.00 cm (38.0-54.5cm), respectively. DFR, PeFR, PFR, AFR, CFR ranged from 14-16, 9, 16-18, 5-6, 18-20 respectively. Detail of the biometric study is presented in Table 1.

### 3.2 Length-weight relationship

Length – weight relationship, co-efficient 'b' and logarithmic relationship between length and weight with regression equation is depicted in Figure 1. In present study 'b' value varied 1.455 to 2.761. Growth is said to be positive allometric when the weight of an organism increases more than length (b>3) and negative allometric when length increases more than the weight (b<3) [10]. When TL was regressed with BW, the slope value was significantly lower than critical isometric value i.e. 3. In present study negative algometric growth was observed in *L. rohita*; thus species became slender as it increased in length [11]. The results of the present study is in conformity with the views of Le Cren [5] and Chauhan [12] that a fish normally does not retain the same shape or body outline throughout their lifespan and specific gravity of tissue may not remain constant, the actual relationship may depart significantly from the cube law.

Choudhury *et al.* [13] reported negative allometric growth (b = 2.347) of *L. rohita* from river Brahmaputra, Assam. Bhat [14] reported growth coefficient (b) as 2.97 and coefficient of determination ($r^2$) as 0.98 from Phuj reservoir, Jhansi in *L. rohita.* Prasad *et al.* [15] also reported negative allometric growth pattern of *L. rohita* from Govindgarh Lake, Rewa. Variation in slope may be attributed due to variation in sample size, life stages and environmental factors [16].

The co-efficient of determination ($r^2$) values explains the proper fit of the model for growth. In the present study, value of $r^2$ of *L. rohita* was calculated as 0.971 (97% variability) indicating more than 97% variability by the model and good fitness.

Information on condition factor can be vital for fisheries management in capture fisheries sector and provides information on specific condition under which organisms are developing [17]. The condition factor (K) of a fish reflects physical and biological circumstances and fluctuations by interaction among feeding conditions, parasitic infections and physiological factors [5]. This also indicates the changes in food reserves and therefore acts as an indicator of the general fish condition. Moreover, body condition provides an alternative to the expensive *in vitro* proximate analyses of tissues [18]. The values of condition factor 'K' recorded for *L. rohita* in the present study was 1.06. Condition factor of greater than one reflects the well-being of fishes in natural water bodies. In present study the condition factor of *L. rohita* recorded greater than one indicating that the fish of the Harike wetland maintaining a healthy condition. Ujjania *et al.* [19] reported condition factor > 1.0 (1.69) in *L. rohita* at Mahi Bajaj Sagar reservoir, in Banswara district of Rajasthan.

### 3.3 Gonadosomatic index (GSI)

Gonadosomatic index (GSI) is particularly helpful in identifying days and seasons of spawning, as the ovaries of gravid females and testis of male swiftly increase in size just prior to spawning. In *L. rohita* highest GSI (%) in male and female was recorded in the month of September (1.42 and 3.20) whereas, it was lowest in the month of October (0.53 and 1.05). Clinical observations of gametes also confirmed the presence of unspawned eggs and sperms in female and male fish, respectively indicating spent phase in September. The study revealed that in the month of October, GSI of both male and female fish were lowest followed by GSI value increased subsequently from the month of November (0.61 and 1.22), December (0.85 and 1.23), January (1.12 and 1.87) and February (1.28 and 2.06). Lower GSI in October denoted

resting phase followed by February revealed the preparatory phase (Fig.2). The mean values differed significantly during different months within the species ($p<0.05$). Priyadharshini *et al.* [20] evaluated GSI of *L. rohita* ranged from 1.45-0.55 and 1.05-3.22 (September to February) for males and females, respectively in water bodies of Tamilnadu.

### 3.4 Hepatosomatic Index (HSI %)

Highest HSI (%) of male and female fish was recorded in the month of October (0.95 and 1.49, respectively) whereas; it was lowest in the month of September (0.68 and 0.59, respectively). The mean values differed significantly during different months within the species. It can be stated during the breeding season of *L. rohita* (June –July in Punjab water) when a major portion of lipid transferred from the liver towards the gonad during the process of vitellogenesis, hence immediate after breeding lowest HSI was observed both in male and female. HSI value increased in subsequent months and recorded highest in the month of October. Subsequently HSI value again decreased during winter months which may be due to decreased feeding by fish and most of the stored energy utilized to maintain the physiological activity. HSI varied seasonally and inversely correlated with GSI (Fig 3).

### 3.5 Gastro-Somatic Index (GaSI)

The feeding intensity of a fish is measured by Gastrosomatic index. Highest GaSI (%) in male and female recorded in the month of September (1.56 and 1.81) whereas, it was lowest in the month of January (0.34 and 0.86). The mean values differed significantly during different months within the species ($p<0.05$). Based on this result it can be concluded that the feeding intensity was reduced as the onset of winter thus GaSI value was also decreased in winter months as compared with post- monsoon months ( Fig.4).

### 3.6 Relative length of gut (RLG)

Relative length of the gut (RLG) is a useful index which provides an idea of the nature of food consumed. Relative length of gut (RLG) differs in different stages of the life history of fish. Al-Hussaini [21] gave a view that purely herbivorous fishes have a long gut.

In present study Relative length of the gut of *L. rohita* varied from 6.19 to 7.02 in male and 6.78 to 7.21 in female during the study period. The average RLG value in male and female fish was recorded 6.55 and 6.97, respectively (Fig.5). Relative length of gut (RLG) of *L. rohita* was 6.19 to 7.21 times higher than that of the total body length indicating that the fish is herbivore in feeding habit. AL-Hussaini[21] also stated that in herbivorous fishes gut length is more than the body length. The gut content analysis also revealed that *L. rohita* is an herbivorous fish.

### 3.7 Gut content analysis

Food is considered as one of the prime needs of every creature in any ecosystem and feeding is one of the most important basic functions of an organism, like growth, development, reproduction etc. In the present study gut content of *L. rohita* comprised of detritus (46.00%), phytoplankton (36.40%), zooplankton (5.75%), insects (5.71%) and unidentified matter (7.00%) (Fig.6).The phytoplankton component included the members of Chlorophyceae such as *Chlorella* sp., *Zygnema* sp. etc; Bacillariophyceae such as *Tabellaria* sp, *Diatoma sp.*, *Pinnularia sp*. etc. Detritus formed the main component of the gut content. In addition, some parts of leaves and roots of unidentified species were also noted. Zooplankton, comprising of rotifera, cladocera and copepoda constituted about 5.75% of gut content. Insects (dipteran larvae), crustacean appendages and molluscan eggs formed 5.71% of the food mass. Only 7.00% unidentified matter was recorded in *L. rohita.* The presence of wide variety of food items in the gut from different ecological niche along with higher levels of phytoplankton definitely signifies that the fish is column feeder with herbivore in feeding habit**.** A similar conclusion was also drawn by Thomas [22] in *L. rohita.*

**Table 1:** Morphometric characteristics of *Labeo rohita* during the study period

| | September | October | November | December | January | February | Average |
|---|---|---|---|---|---|---|---|
| **Morphometric characters** | | | | | | | |
| Wt(g) | $3600^{a}\pm0.58$ | $3300^{b}\pm0.25$ | $3200^{c}\pm11.25$ | $2200^{d}\pm14.54$ | $1800^{e}\pm4.58$ | $1700^{f}\pm0.24$ | 2600±5.64 |
| TL(cm) | $67.6^{a}\pm5.65$ | $63.1^{b}\pm1.25$ | $60.8^{c}\pm0.25$ | $53.0^{d}\pm6.54$ | $53.3^{d}\pm7.54$ | $51.3^{e}\pm0.85$ | 58.2±5.65 |
| SL (cm) | $55.5^{a}\pm4.25$ | $51.5^{b}\pm1.65$ | $50.6^{c}\pm1.35$ | $45.0^{d}\pm3.25$ | $43.0^{e}\pm3.25$ | $42.5^{f}\pm4.51$ | 48.0±8.54 |
| FL(cm) | $54.5^{a}\pm9.65$ | $54.6^{a}\pm0.25$ | $49.0^{b}\pm1.25$ | $46.3^{c}\pm1.24$ | $41.7^{d}\pm1.24$ | $38.0^{e}\pm1.02$ | 46.0±0.25 |
| HL (cm) | $26.4^{a}\pm4.52$ | $23.0^{b}\pm0.02$ | $23.0^{b}\pm0.24$ | $11.1^{c}\pm0.02$ | $10.0^{d}\pm4.25$ | $9.5^{e}\pm0.25$ | 15.2±4.15 |
| HD (cm) | $10.2^{a}\pm0.58$ | $10.2^{a}\pm0.84$ | $10.1^{a}\pm0.45$ | $7.4^{b}\pm0.65$ | $7.3^{b}\pm0.25$ | $6.6^{c}\pm0.24$ | 8.4±0.37 |
| SnL (cm) | $5.0^{a}\pm0.31$ | $4.8^{b}\pm0.57$ | $4.7^{b}\pm1.25$ | $4.1^{c}\pm0.24$ | $3.9^{d}\pm0.35$ | $3.4^{e}\pm0.65$ | 4.3±0.98 |
| ED (cm) | $1.8^{a}\pm0.02$ | $1.7^{b}\pm0.05$ | $1.7^{b}\pm0.00$ | $1.4^{c}\pm0.01$ | $0.9^{d}\pm0.00$ | $0.9^{d}\pm0.01$ | 1.3±0.01 |
| IOL (cm) | $8.9^{a}\pm0.21$ | $8.6^{b}\pm0.34$ | $8.3^{c}\pm0.54$ | $7.2^{d}\pm1.69$ | $6.3^{e}\pm0.35$ | $5.6^{c}\pm0.25$ | 7.3±0.97 |
| PDL (cm) | $24.0^{a}\pm1.24$ | $23.6^{b}\pm0.21$ | $22.4^{c}\pm0.25$ | $18.5^{d}\pm2.34$ | $17.7^{e}\pm0.35$ | $16.3^{f}\pm0.23$ | 20.4±1.87 |
| PPL (cm) | $12.03^{a}\pm1.25$ | $11.3^{b}\pm0.25$ | $11.5^{b}\pm1.49$ | $9.9^{d}\pm1.25$ | $10.4^{c}\pm0.54$ | $9.4^{d}\pm0.65$ | 10.7±0.25 |
| PPeL (cm) | $28.0^{a}\pm6.35$ | $28.1^{a}\pm4.58$ | $27.6^{b}\pm4.58$ | $22.4^{c}\pm0.58$ | $21.8^{d}\pm0.21$ | $21.3^{d}\pm0.59$ | 24.9±1.23 |
| PAL (cm) | $42.7^{b}\pm0.21$ | $43.0^{a}\pm2.31$ | $41.0^{c}\pm0.25$ | $34.5^{d}\pm0.32$ | $33.0^{e}\pm0.32$ | $32.3^{f}\pm0.75$ | 37.7±0.27 |
| HOD (cm) | $6.4^{a}\pm1.25$ | $6.3^{a}\pm0.24$ | $6.0^{b}\pm0.65$ | $5.6^{c}\pm0.47$ | $5.8^{c}\pm0.57$ | $5.7^{c}\pm0.32$ | 6.0±0.35 |
| AL (cm) | $10.7^{a}\pm2.35$ | $9.8^{b}\pm0.25$ | $8.8^{c}\pm0.65$ | $7.5^{d}\pm0.46$ | $8.3^{c}\pm6.32$ | $8.1^{c}\pm1.58$ | 8.8±2.78 |
| BD (cm) | $16.0^{a}\pm1.41$ | $16.8^{a}\pm0.24$ | $16.3^{a}\pm2.56$ | $13.3^{b}\pm1.49$ | $13.2^{b}\pm4.25$ | $13.5^{b}\pm5.85$ | 14.8±1.89 |
| CD (cm) | $7.6^{a}\pm0.52$ | $7.4^{a}\pm0.61$ | $7.4^{a}\pm1.45$ | $7.0^{a}\pm1.35$ | $6.2^{b}\pm0.85$ | $6.5^{b}\pm0.65$ | 7.2±0.97 |
| CL (cm) | $11.9^{a}\pm0.85$ | $11.8^{a}\pm0.94$ | $11.9^{a}\pm0.54$ | $11.2^{a}\pm2.62$ | $10.8^{b}\pm2.58$ | $10.6^{b}\pm1.65$ | 11.3±2.57 |
| CFS (cm) | $10.4^{b}\pm1.41$ | $12.3^{a}\pm0.87$ | $10.3^{b}\pm2.35$ | $9.6^{c}\pm0.58$ | $9.0^{c}\pm0.54$ | $8.8^{d}\pm0.50$ | 10.1±1.35 |
| **Meristic characters** | | | | | | | |
| DFR | $15^{a}\pm1.00$ | $15^{a}\pm0.00$ | $15^{a}\pm2.00$ | $14^{a}\pm1.00$ | $14^{b}\pm1.00$ | $14^{a}\pm1.00$ | 15±1.00 |
| PeFR | $9^{a}\pm0.00$ | $9^{a}\pm0.00$ | $9^{a}\pm0.00$ | $9^{a}\pm0.00$ | $9^{a}\pm0.00$ | $9^{a}\pm0.00$ | 9±0.00 |
| PFR | $18^{a}\pm1.00$ | $18^{a}\pm0.00$ | $18^{a}\pm0.00$ | $16^{a}\pm0.00$ | $16^{a}\pm2.00$ | $16^{a}\pm1.00$ | 17±1.00 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| AFR | 6[a] ±0.00 | 6[a] ±1.00 | 6[a] ±0.00 | 5[a] ±0.00 | 6[a]±1.00 | 5[a] ±0.00 | 6±0.00 |
| CFR | 20[a] ±1.00 | 20[a] ±0.00 | 20[a] ±0.00 | 19[a] ±2.00 | 18[a] ±2.00 | 18[a] ±2.00 | 19±1.00 |

*(Weight of fish (Wt), Total length (TL), Standard length (SL), Fork length (FL), Head length (HL), Head depth (HD), Snout length (SnL), Eye diameter (ED), Inter-orbital length (IOL), Pre-dorsal length (PDL), Pre-pectoral length (PPL), Pre-pelvic length (PPeL), Pre-anal length (PAL), Height of dorsal fin (HOD), Anal fin length (AL), Body depth (BD), Caudal depth (CD), Caudal length (CL) and Caudal fin surface (CFS).
** Dorsal fin rays (DFR), pelvic fin rays (PeFR), Pectoral fin rays (PFR), Anal fin rays (AFR), Caudal fin rays (CFR).
*** The values (mean ± standard error) with different alphabetical superscripts (a, b, c…) differ significantly between the months (in a row).

**Table 2:** Month wise gut content analysis (%) (mean± SE ) of *L. rohita* during the study period

| Month | Detritus | Phytoplankton | Zooplankton | Insects | Unidentified matter |
|---|---|---|---|---|---|
| September | 52.6±0.56 | 32.1±0.90 | 4.2±0.13 | 5.1±0.08 | 5.8±0.32 |
| October | 54.3±1.05 | 43.6±0.66 | 5.4±0.18 | 3.4±0.10 | 6.1±0.22 |
| November | 46.5±1.22 | 31.2±1.79 | 7.1±0.09 | 7.2±0.22 | 7.2±0.55 |
| December | 37.9±1.60 | 34.7±1.54 | 7.2±0.56 | 6.2±0.31 | 11.4±0.15 |
| January | 45.2±1.21 | 41.2±2.03 | 5.4±0.44 | 6.8±0.07 | 5.8±0.21 |
| February | 39.7±0.87 | 35.8±1.44 | 5.2±0.08 | 5.6±0.14 | 6.1±0.63 |

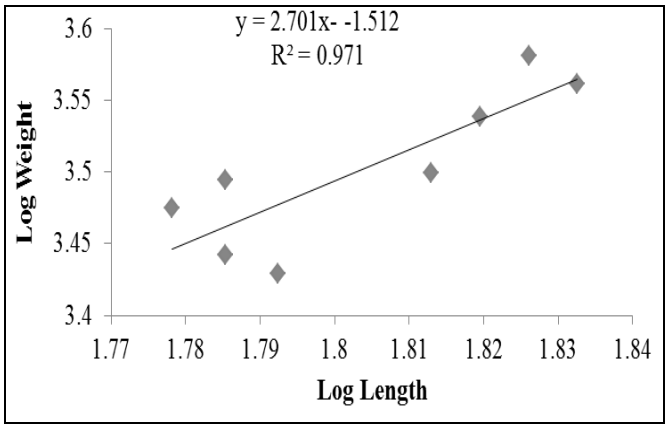


**Fig 1:** Log length and Log weight relationship of *L. rohita* in Harike wetland

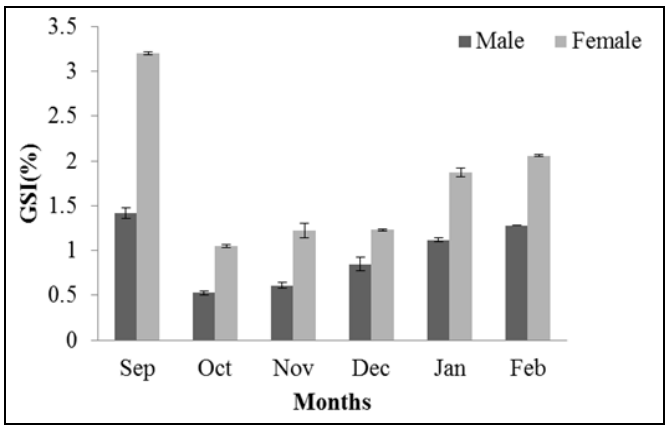


**Fig 2:** Gonadosomatic index (%) of *L. rohita* during the study period

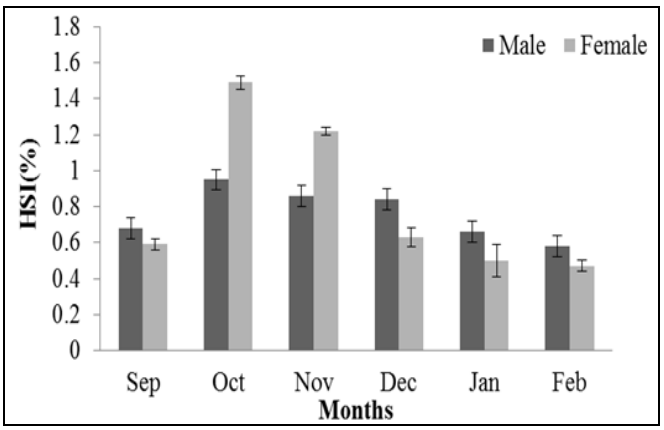


**Fig 3:** Hepatosomatic Index (%) of *L. rohita* during the study period

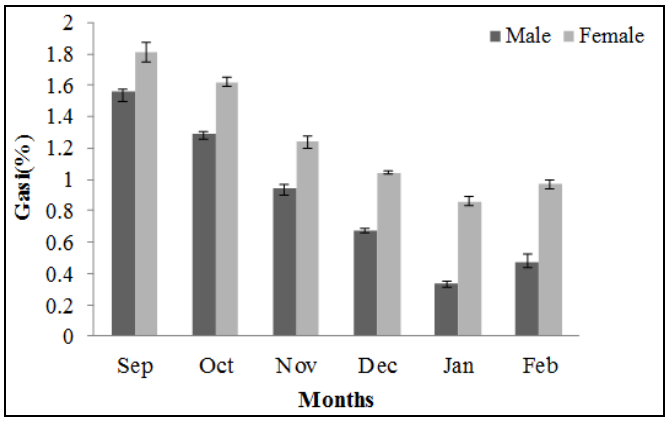


**Fig 4:** Gastro-Somatic Index of *L.rohita* during the study period

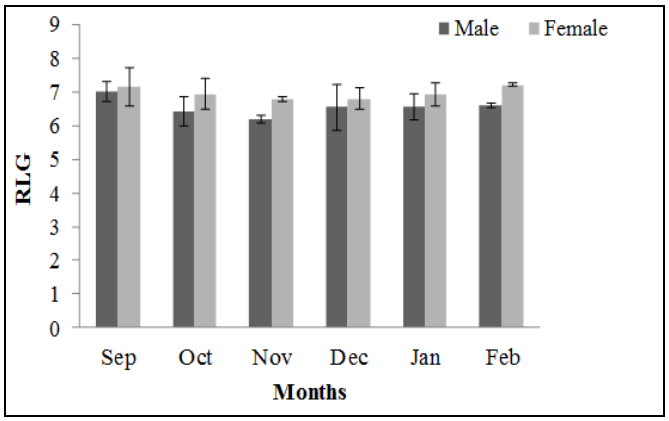


**Fig 5:** Relative gut length of *L. rohita* during the study period

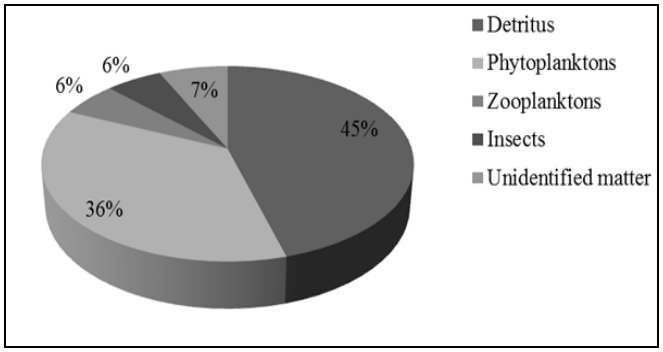


**Fig 6:** Food and feeding habit analysis (%) of *L. rohita*

## 4. Conclusion

Overall the study on biology of *L. rohita* revealed negative algometric growth thus species became slender as it increased

in length. Condition factor of *L. rohita* recorded greater than one indicating that the fish of the Harike wetland maintaining a healthy condition. Gonadosomatic index (GSI) of both male and female fish of *L. rohita* recorded during post spawning phase to preparatory phase and it was higher in September and lowest in October. GSI increased subsequent months. Hepatosomatic Index (HSI) values were inversely correlated with GSI. Relative length of gut (RLG) of *L. rohita* was higher than that of the total body length indicating that the fish is herbivore in feeding habit In *L. rohita* presence of a wide variety of food items in the gut from different ecological niche along with the presence of higher level of phytoplankton definitely signifies that the fish is column feeder. Based on biometrics and biology study it can be concluded that a sufficient number of mature and healthy stock of *L. rohita* are available in Harike wetland to sustain the stock in future.

## 5. Acknowledgments

The authors are grateful to Dean, College of Fisheries, GADVASU, Ludhiana for keen interest and facilities provided for the study.

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