

LENGTH-WEIGHT RELATIONSHIP, CONDITION FACTOR, GUT  
CONTENT ANALYSIS AND GASTRO-SOMATIC INDEX OF  
OLIVE BARB (*Puntius sarana*) IN DANDA RIVER,  
BHAIRAHAWA, NEPAL



Entry 21

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Fish Biology and Aquaculture

Submitted to

Central Department of Zoology

Institute of Science and Technology

Tribhuvan University

Kirtipur, Kathmandu, Nepal

September, 2022

## DECLARATION

I hereby declare that the work presented in this thesis has been done by myself, and has not been submitted elsewhere for the award of any degree. All sources of information have been specifically acknowledged by reference to the author or institution.

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This is to recommend that the thesis entitled, “**Length-Weight relationship, Condition factor, Gut content analysis and Gastro somatic index in *Puntius sarana***” has been carried out by **Saru Poudel Chhetri** for the partial fulfillment of Master’s Degree of Science in Zoology with a special paper Fish Biology and Aquaculture. This is her original work and has been carried out under my supervision. To the best of my knowledge, this thesis work has not been submitted for any other degree in any institutions.

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On the recommendation of supervisor "**Dr. Archana Prasad**" this thesis submitted by **Ms. Saru Poudel Chhetri** entitled "**Length-Weight relationship, Condition factor, Gut content analysis and Gastro somatic index in *Puntius sarana***" is approved for the examination in partial fulfillment of requirements of Master's Degree of Science in Zoology with special paper Fish Biology and Aquaculture.

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## CERTIFICATE OF ACCEPTANCE

This thesis work submitted by **Ms. Saru Poudel Chhetri** entitled “**Length-Weight relationship, condition factor, Gut content analysis and Gastro somatic index in *Puntius sarana***” has been accepted as a partial fulfillment for the requirements of Master’s Degree of Science in Zoology with a special paper Fish Biology and Aquaculture.

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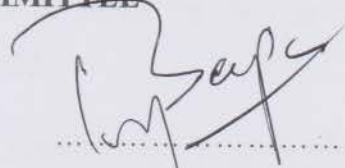
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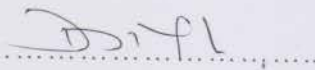
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## LIST OF ABBREVIATIONS

Abbreviated form	Details of abbreviations
GSI	Gastro somatic index
IAAS	Institute of agriculture and animal science
K	Condition factor
LWRs	Length-Weight relationship
<i>P. sarana</i>	<i>Puntius sarana</i>
TL	Total length
TW	Total weight

## ABSTRACT

In fisheries assessment, Length-Weight relationship (LWRs), condition factor and gut content are crucial because they reveal information about fish development, general health and fitness. Length-Weight relationship and gut content analysis of 101 specimens of *Puntius sarana* from the month of November 2021 to June 2022 from the river Danda, Rupandehi were analyzed. The result depicts that almost all specimens showed negative allometric growth ( $b < 3$ , t test,  $p < 0.05$ ). The coefficient of determination fluctuated from 0.147 to 0.904 and correlation coefficient between 0.48 to 0.923. Significant correlation and regression observed in all months ( $p < 0.05$ ) except in the month of November ( $p > 0.05$ ). The condition factor fluctuated between 1.186 to 4.3 indicating wellbeing of fish in all observed months. The gut content of fish was analyzed using Qualitative and Quantitative methods. The stomach was found to be containing various kinds of phytoplankton, algae, zooplankton, insect parts, mud, dried leaves etc. Among all content Chlorophyceae (47%) dominated the stomach followed by Bacillariophyceae (44%) whereas animal content like insect antennae, copepod eggs, miscellaneous items like mud, dried leaves, found very less in amount. Gastro somatic index of *P. sarana* fluctuated between 3.51 to 7.71. High GSI is observed in the month of November and low in the month of June due to the spawning period of *P. sarana*. Based on this research, analysis of a variety of parameters, such as development stage, gonad maturity is needed, Stomach content identification up to species level would be better.

# 1. INTRODUCTION

## 1.1 Background

*Puntius sarana*, a small, delectable native fish of the warm water family of minnows, is abundantly available in Bangladesh, India, Nepal, and Afghanistan. It is highly sought after in Bangladesh and other Asian nations due to its flavor. It grows to a maximum length of 42 cm and a weight of 1.4 kg and has a slower pace of growth than the big carps. The species was once widely distributed both in lotic and lentic fresh and brackish water and was available all around the year. However, It is in risk of extinction due to its habitat exploitation, destruction of breeding grounds, water pollution, lack of proper management, ecological changes in natural environment etc Chakraborty (2003), Hossain et al. (2009).

Fish growth is defined as an increase in size over time that occurs continuously throughout life but slows down at the commencement of sexual maturity and is influenced by environmental and genetic factors, with weight being a function of length (Darsetal.2010). Fisheries management should take into account all potential outcomes or determinants for the sustainability of fish stocks, and biometric analysis is regarded as a key technique because it provides details about the length, weight, and condition of fish (Jisir et al. 2018) . Measurements of length and weight provide standard results for fish sampling programs and serve as indicators for understanding survival, growth, maturity, reproduction, and overall health evaluating fish stock structure and (Koushlesh et al. 2018). WLRs help in estimating the weight corresponding to a given length (Lelli et al. 2018).

## 1.2 Length -Weight relation

The length weight relationship is usually denoted by equation  $W=a L^b$  where a ( intercept) represents the nutritional condition of the fish which can change according to the geographical regions ,development phases, different biotic and abiotic factor and b(slope) express type of growth which may change during different period of time which can be estimated by linear regression based on logarithms(Acosta et al. 2004).

$\ln (W)= \ln (a) + b \ln (L)$ , where L denotes total length of fish and W denotes total weight of fish (Harrison 2001).In fish, the growth pattern typically follows the cube

law i.e,  $b=3$  Elftman (1946) but the actual relationship may deviate from this (Le Cren 1951). When the value of  $b = 3$  increase in weight is said to be isometric that means length increases in equal proportion with the weight of body. If the value of  $b$  is other than 3 (Positive if  $b > 3$ ) causes the fish to get steadily stouter or deeper bodied as it grows in length whereas negative allometric growth causes the fish to become increasingly slender as it gains weight (Hile 1936).

### **1.3 Condition factor (K)**

Condition factor is an indication of health; it presents the health condition, energy consumption and metabolism of Fish (Sarkar et al. 2009 and Muchlisin et al. 2010). Informs about the well-being of the entire community based on the hypothesis that fish having more weight are healthy and in better condition (Bagenaland Tesch 1975). It can be used as a barometer to know the condition of aquatic ecosystems (Ighwela et al. 2011). This factor compares different species living in the same or different environment, observes feeding activity, and gonad maturation. Biotic, abiotic factors, parasitism have an important impact on the condition of fish (Le Cren 1951). This factor relates length and weight of fish to describe condition of individual fish at a place Froese (2006) and is indirectly proportional to length of fish (Ndiaye et al. 2015).

$K > 1$  of given fish is considered as fish is in good condition while  $K < 1$  considered as fish is in poor condition.

### **1.4 Stomach content analysis and Gastro- somatic index**

Nutrition is prerequisite for various metabolic functions, Proper aquaculture practice requires good knowledge on food and feeding habits of respective species (Bhattacharya et al. 2020). Different organisms show different levels of diet habits and specialization within and between species which can affect food web dynamics as well as their feeding strategies depending upon ontogeny changes, prey abundance etc (Landry et al. 2018). A food habit study investigates the most frequently consumed prey as well as determines the relative importance of different food types (V et al. 2019).

The diet of fish changes with various factors like size, area, behavior, and species. So, Analysis of a fish gut contents offers crucial focus on its feeding habits along with ecological factors, such as behavior, condition, habitat utilization, energy intake,

interactions, which are important for ecosystem based fisheries management etc (Manko 2016). Moreover, Knowledge in food items can help to provide different food items in different life stages (Nath et al. 2015). Feeding ecology is important in developing trophic models for conservation management strategies for both the species and its environment (Mukherjee et al. 2016). Gut analysis informed about seasonal and life history by determining population level depends upon the amount of food available Okey et al. (2017) and also provides invaluable information about the prey species consumed , their taxonomic detail , rates of digestion, seasonal changes in their diets, and uncommon prey items (Blanco-Parra et al. 2011).Gastro-somatic index helps in determining the feeding intensity of fish (Sangma et al. 2019).

### **1.5. Objective of study**

The main objectives of study were to investigate length-weight relation, condition factor, stomach content analysis and Gastro somatic index of *Puntius sarana* from Danda River, Rupandehi, Nepal. While the Specific objectives were:

- To investigate length weight relation.
- To know the growth pattern in *P. sarana*.
- To determine condition factor.
- To analyze stomach content.
- To Determine Gastro-somatic index.

### **1.6 Rationale of the study**

In the field of research in fisheries, morphological study with gut content analysis of indigenous fish, *Puntius sarana* is still unexplored. Food and feeding habit of growth performance and condition factors are important aspects in fish life, fisheries management and conservation. So, the investigation of length weight relationship, condition factor and gut analysis of *Puntius sarana* form river Danda, will provide some valuable information about the growth of fish, its general wellbeing, and fitness which has great importance in management and conservation of species.

## **1.7 Limitations**

Every research study faces certain difficulties. So this research study also has to face the following problems:.

This experiment was not able to collect an equal number of samples in analyzed months.

## 2. LITERATURE REVIEW

For assessing a stock's commercial potential, life history, cultural practices, and management of its fisheries, biology knowledge is crucial. So, Fishery management tools need to have the right length for their weight to determine the general health of a fish population (Bolger & Connolly 1989). Since the number of people in a population depends on the amount of food available, studies of food and feeding patterns are helpful in determining the population level. Because the kinds and quantity of food available as well as the season it occurs in have a vital effect in the life cycle of fish, gut content analysis provides information on seasonal and life history changes of fish (Okey et al. 2017). Many researchers have studied feeding and growth patterns in the number of fishes. The following sections seek to summarize the significant contributions made by various researchers on the nutrition and feeding, length-weight relationship, and fishes from various geographic areas.

### 2.1 Length weight relation

Negative allometric value  $b$  value less than 3 found in both *Clarias gariepinus* and *Oreochromis niloticus* from all sites of Wudil river (Gesto et al. 2017). Similarly Jisr et al. (2018) observed different  $b$  values less than 3 during warm and cold periods of 9 fish species from the marine area of North Lebanon. Alike them Dewiyanti et al.(2020) observed negative allometric growth in three dominant species in Kaula Gigieng waters with high correlation coefficient and condition factor. Among fifty-two species in south Sicily Falsone et al.(2022) noticed 45.8% of species exhibited negative allometric growth while 33.4% and 20.8% positive and isometric growth respectively.

Tabassum et al. (2013) observed high average length and weight during pre-monsoon season with both positive and negative allometric growth, and post-monsoon with positive allometric growth 3 in all size classes of *Magalaspis cordyla* in Karachi. Whereas, Chakraborty et al. (2019) noticed negative allometric growth both in summer and monsoon in *Mystus vittatus* with high correlation in summer. Ontomwa et al. (2018) found most species with negative allometric growth in both northeast and south east monsoon. AE et al. (2015) observed allometric growth in summer and autumn whereas isometric in spring.

*Puntius saphore* shows highly significant b value  $>3$  with  $a= 2.13$  of *Puntius saphore* in Kolkata (Pal & B. K. Mahapatra 2013). Similarly, Rainbow trout shows b value 3.39 with condition factor 1.8 (Sharma and Bhat 2015). Isometric growths have been observed in male species of *Cyprinus carpio* by Aera et al. (2014) but are negative allometric in females. Similarly, it is highly significant with isometric growth in male but positive allometric growth found in female fish of *Crrihnus reba* (Jewel et al. 2019). Dhakal, Raj (2003) found  $b>3$  (3.96) in females and 2.43 in male. isometric growth in both male and female brooders with high significance difference in length and weight noticed by (Migiro et al. 2014).

## **2.2 Condition factor**

Condition Factor (k) gives information when comparing two populations living in specific feeding, density, climatic and other conditions, figuring out the period of gonad maturation, and tracking a species level of eating activity to check if it is effectively exploiting its feeding source.

The Fulton's condition factor (K) value found to be  $> 1$  in *P. saranain* Bangladesh (Khan & Nilla 2012). Similar results were observed by Das et al. (2015) Kn value  $> 1$  in sub adult *P. Sarana* while  $< 1$  in adult *sarana* in the river of Central Myanmar (Aye & Khaing 2017). Pramanik (2016) in his study in edible fishes which showed high K during pre and low during spawning and post spawning period. Similarly same thing noticed in *Rastrelliger kanagurt* in the persian gulf (Daghooghi et al. 2018). Moreover, less Kn value is noticed during spawning period and high during pre and post spawning period in *Trichogaster lalius* and *Chanda nama* (Sangma et al. 2019).

## **2.3 Stomach content analysis**

It has long been routine practice to research the feeding behaviors of fish and other animals by directly inspecting their stomach contents (Sagar et al. 2019). Mainly there are two types of stomach content analysis method: Qualitative and Quantitative method. The stomach contents organisms are completely identified as part of the qualitative examination. It is only feasible to distinguish them from digested, broken, and finely comminuted materials with a great deal of knowledge and the help of reliable references. Quantitative methods include different methods: Numerical method, Gravimetric method, volumetric method.

Hossain et al. (2012) percentage of occurrence and point method in *Puntius Sarana* to analyzed content of stomach and found omnivores in nature with Chlorophyceae, Bacillariophyceae, and Cynophyceae dominated the stomach with highest point 22.39 for chlorophyceae. However, Verma et al. (2020) found *P. sarana* as a herbivore with high count of Chlorophyceae. Similarly, Risal et al. (2019) applied the percentage of occurrence in *Puntius saphore* and noticed green algae dominated the stomach. Nath et al. (2015) applied all 3 types of quantitative methods along with index of preopence and found copepods dominated the stomach along with fish parts, sand and fish scales. M. A. (2015) studies on stomach contents of some species in the Nigerian river using the frequency of occurrence method showed that *Oreochromis niloticus* was a herbivore with a penchant for eating plants and plant products. *Bagrusbayad*, *Lates niloticus* and *Hydrocynus brevis* was found to be a carnivore and *Synodontis vermiculatus* as an omnivore. Similarly, *Channa punctata*, *Channa striata*, *Glossobius giuris* and *Notopteru snopterus* were found to be omnivores (Das et al. 2018). Haque et al. (2021) demonstrated crustaceans were the crucial dietary items for *R. rita* in Padma river whereas, Nishad et al. (2021) revealed *R. rita* fish fed more on mollusks and arthropods than plant matters and insects.

#### **2.4 Gastro-somatic index**

Manon and Hossain (2011) studied 137 specimens of *Cyprinus carpio var. specularis* from different fish markets from November 2012 to August 2011, found a high percentage of vacant stomach in April 2011 and the lowest percentage in the month of August 2011. In the contrast, stomach with high content found in the month of August was and with low content in April. *Cyprinus carpio* from different fish ponds of Larkana, Pakistan consumed more in summer with highest percentage of fullness of the gut in the month of August, September and October and the lowest in January (Mangi & Memon 2017). Similarly, Joadder (2014) found highest percentage of fullness in September and lowest in December in *Labeobata* and Hossain et al. (2012) found highest % of full stomach in August and highest vacuity in December in *Puntius sarana*. Weight of fore-gut contents, found to be significantly high in winter and spring than in summer and autumn in *H. swinhonis* and *C. giurinus* and significantly higher in autumn than in spring and summer for *P. parva* (Xie 2000).

### **3. MATERIALS AND METHODS**

#### **3.1 Study area**

The experiment was conducted in the Danda River of Paklihawa campus, Bhairhawa, Rupandehi lies at Latitude: 2.482441 and Longitude: 83.447464151 from November 2021 to June 2022.

#### **3.2 Materials required**

Apparatus used: Cast net, 10% Formalin, Scissor, Scale, Weighing machine, Compound microscope, Phone Camera.

#### **3.3 Sample collection**

Specimens of *P. sarana* were collected monthly from November 2021 to June 2022 from Danda River, Bhairahawa, Nepal. A total 101 fish were collected using cast net with the help of local fishermen. The fish were immediately taken to the laboratory of the Institute of Agriculture and Animal Science. In the laboratory fish were cleaned then total length, total weight, gut weight were recorded using scale and weighing machine.

#### **3.4 Length and weight measurement**

Total length of fish was measured using scale and weight was measured using a digital balance machine, Total length of fish was measured from tip of snout to the tip of tail. Body of the fish was measured nearest to 0.1 cm. Body weight was measured nearest to 0.1 gm with the help of a weighing balance machine. The fish was dissected and gut removed from the body using scissors. The weight of the gut was taken then again the gut was dissected and the content was poured in a porcelain basin.

#### **3.5 Diet analysis**

Small sample of content placed in another porcelain basin had mixed some water to make a thin texture then sorted using a compound microscope. Pictures under microscope were taken using mobile cameras and then identification of prey was done with the help of papers, Book (Vuuren et al. 2006), Internet etc. Diet composition was assessed according to Qualitative and Quantitative analysis like frequency of occurrence, Index of fullness with eye estimation.

### 3.6 Data analysis

#### 3.6.1 Length weight relationship

The relation between Total length and Total weight relation of fish was estimated by using parabolic equation  $TW = a TL^b$ . where TW is weight of fish in gm, TL is length of fish in cm, a is the intercept (constant), b is the slope (growth exponent) and using the linear regression of ln transformed  $\ln(TW) = \ln(a) + b \ln(TL)$ , the parameters a and b were calculated. Value of b (slope) gives knowledge on fish growth. The slopes were compared with ideal number 3 using t test. When  $b = 3$ , the increase in weight is isometric, otherwise it is allometric (positive allometric if  $b > 3$ , negative allometric if  $b < 3$ ). The association of degree between TL and TW was determined by determination of coefficient ( $r^2$ ), Correlation coefficient was determined. Scatter Plot diagrams were plotted for total length and total weight of the fishes.

#### 3.6.2 Condition Factor

Condition factor helps us to assess the condition of wellbeing of fish based on a condition that fish having more weight in a given length are in good condition. So,  $k > 1$  of given fish is considered as fish is in good condition while  $k < 1$  considered as fish is in poor condition.

The coefficient of condition was calculated using Fulton's formula:-

$$K = 100 \times \left( \frac{\text{Total weight}}{\text{Total length}^3} \right)$$

#### 3.6.3 Qualitative and Quantitative analysis of gut content

Qualitative analysis involves complete identification of organisms in gut content with the help of references.

##### Quantitative method:

- **Frequency of occurrence**

The number of stomachs in which each item occurs is recorded and expressed as a percentage of the total number of stomachs examined (Frost 1954).

$$\text{Frequency of occurrence} = \frac{\text{Number of fish containing particular items}}{\text{Total number of stomach containing food items}}$$

- **Index of fullness by eye estimation method**

It is the quantity of food present in the stomach. In this study each stomach was observed and classified as full, moderate, half, vacant on a monthly basis.

#### **3.6.4 Gastro-somatic index:**

GSI helps in determine feeding intensity of fishes in response to weather, environmental condition, breeding season etc. It was calculated using the standard formula (Bhatnagar & Karamchandani 1970) given as below:

$$\text{GSI} = \frac{\text{Total weight of Gut}}{\text{Total weight of Body}} \times 100$$

#### **3.7 Statistical analysis**

Statistical analysis was performed using Ms. excel and R studio. The t test was used to test the level of significance of weight on length. All statistical analyses were considered significant at 5% ( $p < 0.05$ ).

## 4. RESULTS

### 4.1 Length -Weight relation in *P. sarana*

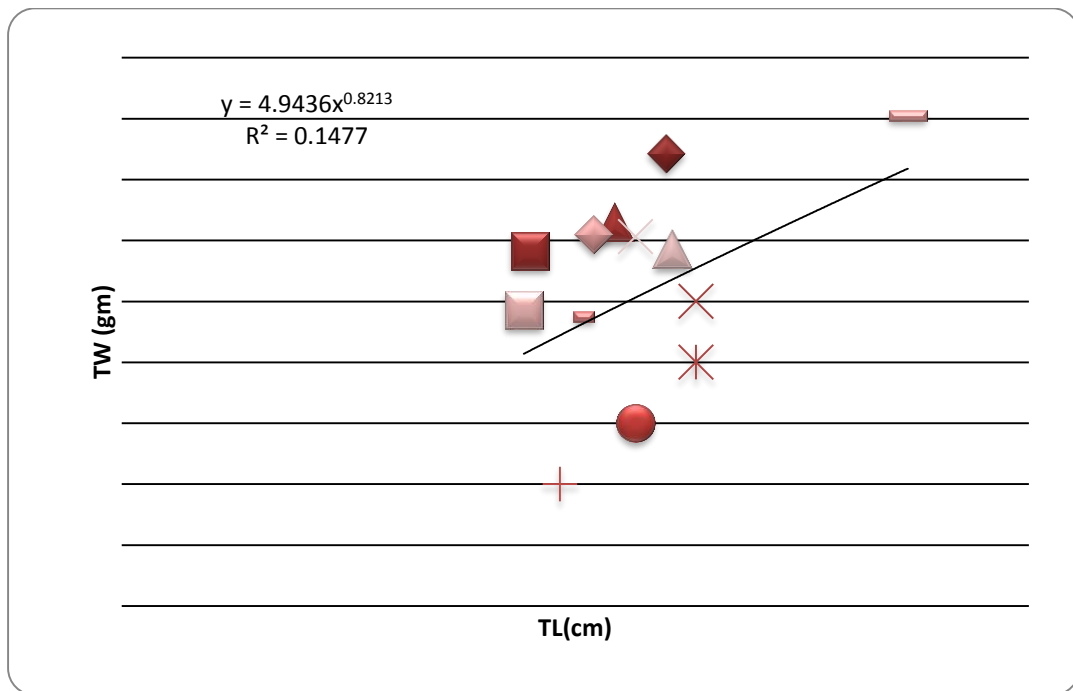
A total of 101 specimens of *Puntius sarana* were collected during the study period to meet the objective of study. The total length of *P. sarana* ranges between 7– 21.59 cm. Minimum length observed in the month of February and maximum in the month of November and May and total weight ranged from 20- 247.72 gm minimum in the month of November and maximum in May respectively. The correlation coefficient ranged between 0.48-0.923 and coefficient of determination ranged from 0.147-0.904. Significant correlation and regression observed in all months ( $p < 0.05$ ) except in the month of November ( $p > 0.05$ ), a value ranging from -0.027 to 2.69 and b value from 0.53 to 2.06 showed negative allometric growth in all months.

**Table 1:** Minimum and Maximum length and weight of fish from November 2021 to June 2022.

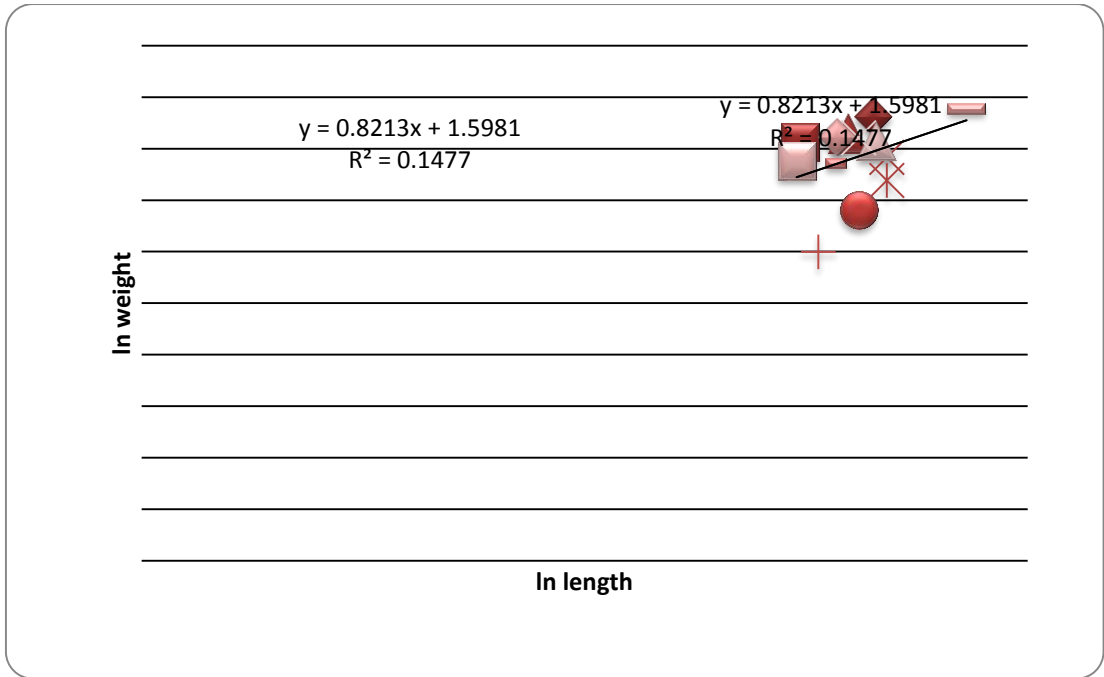
Month	Minimum	Maximum	Minimum	Maximum
	Length(cm)	Length(cm)	Weight(gm)	Weight(gm)
November	13.3±0.91	26±0.91	20±4.62	80.5±4.62
December	14.32±0.53	20.5±0.53	54.3±9.23	148.59±9.23
January	8±0.57	14±0.57	38±1.81	65±1.81
February	7±1.46	23±1.46	34±14.98	204.12±14.98
March	13.4±0.79	21.59±0.79	56.67±7.98	147.58±7.98
April	15.5±0.48	21±0.48	53±4.5	116.34±4.5
May	14±0.91	26±0.91	72.04±13.4	247.72±13.4
June	12±0.7	20.7±0.7	47.5±7.03	125.05±7.03

**Table 2:** The length- weight relationship of *P. sarana* from November to June.

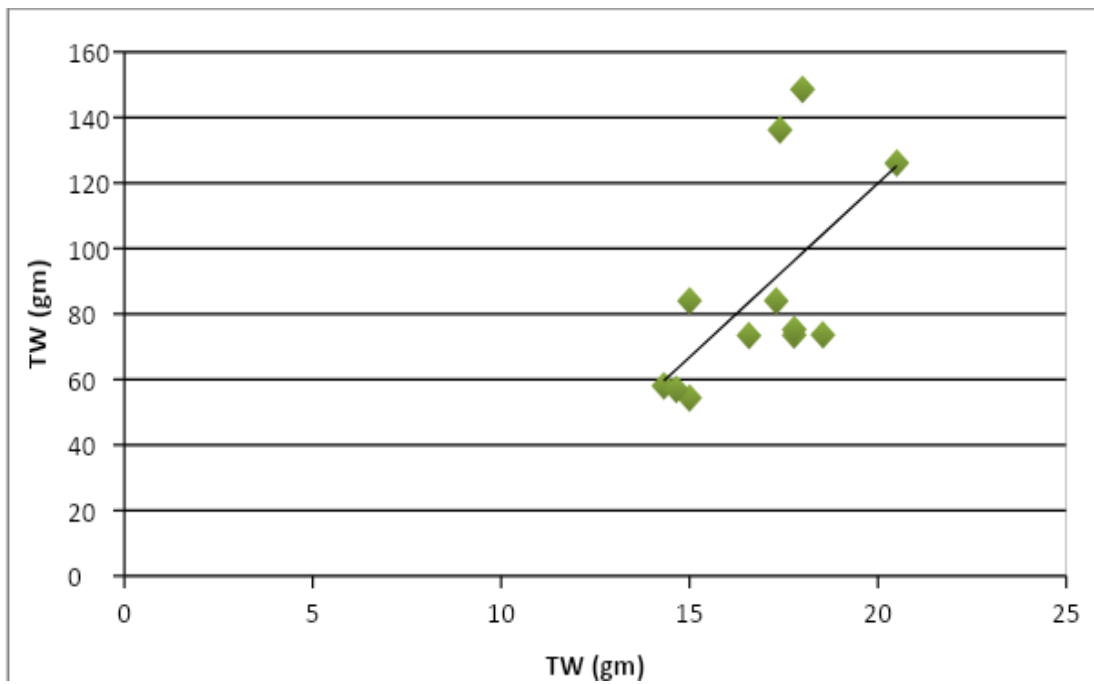
Month	a	B	r	r <sup>2</sup>	W=aL <sup>b</sup>	P value for r <sup>2</sup>	Growth type
November	1.598	0.82	0.48	0.147	W=1.59L <sup>0.82</sup>	0.19472	-ve.
December	1.41	2.06	0.62	0.448	W=1.41L <sup>2.06</sup>	0.01728	-ve
January	2.61	0.53	0.76	0.618	W=2.61L <sup>0.53</sup>	0.00142	-ve
February	0.52	1.46	0.923	0.904	W=0.52L <sup>1.46</sup>	1.84e <sup>-07</sup>	-ve
March	0.87	1.315	0.763	0.54	W=0.87L <sup>1.315</sup>	0.00246	-ve
April	0.39	1.43	0.66	0.450	W=0.39L <sup>1.43</sup>	0.0169	-ve
May	-0.027	1.66	0.823	0.664	W=0.027L <sup>1.66</sup>	0.00124	-ve
June	0.13	1.51	0.782	0.718	W=0.13L <sup>1.5</sup>	0.000981	-ve



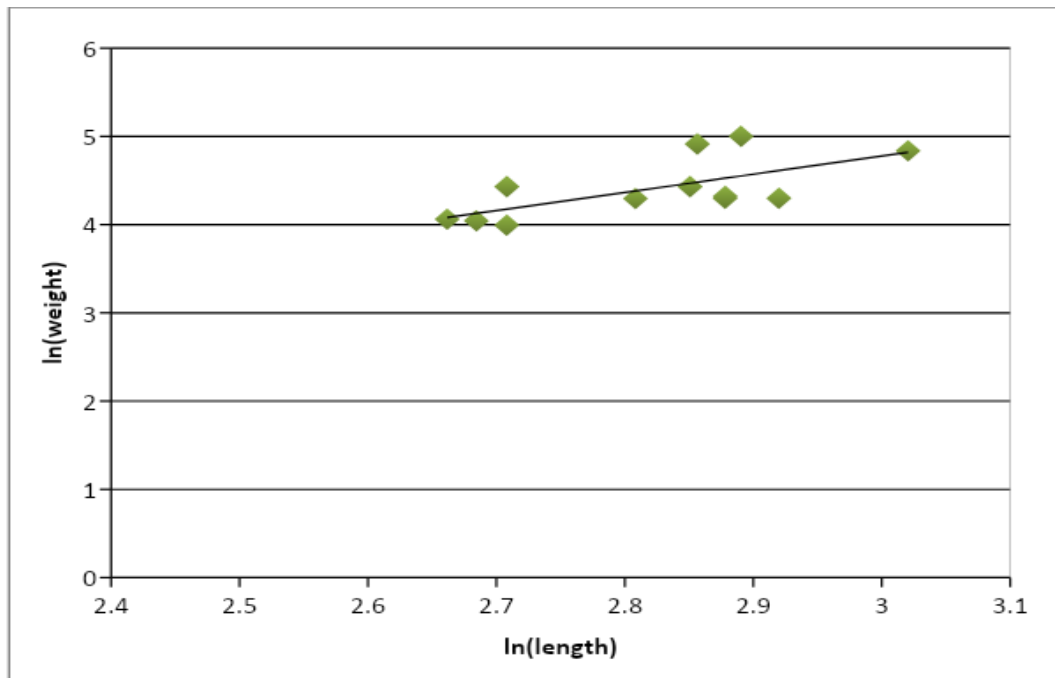
**Figure 1:** Length-Weight relation in the month of November



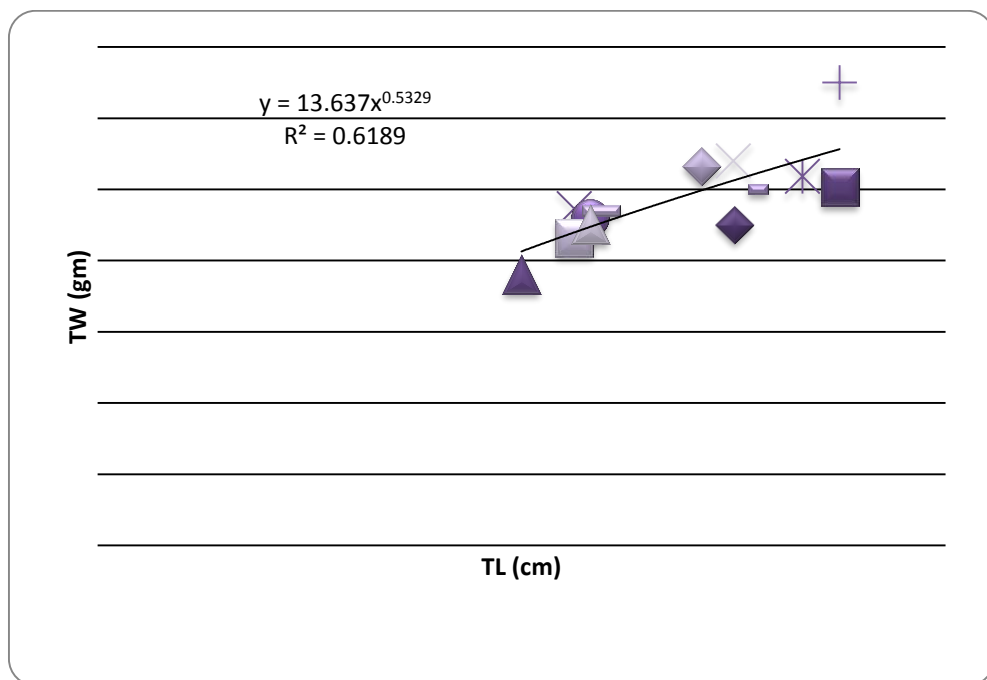
**Figure 2:** Logarithm relation in month of November



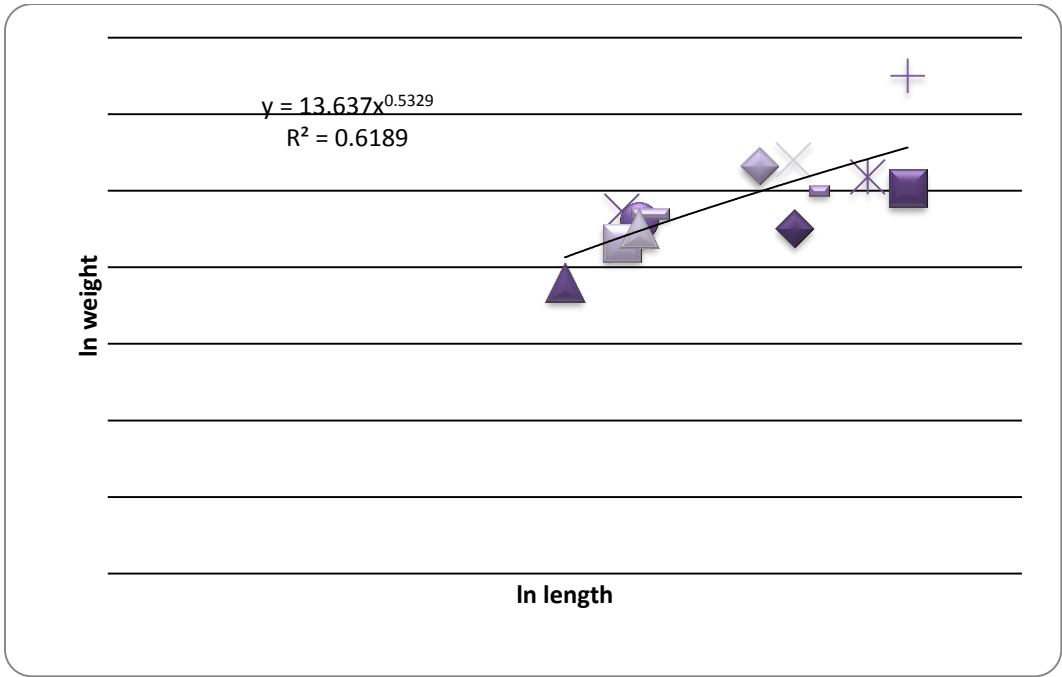
**Figure 3:** Length-Weight relation of month December



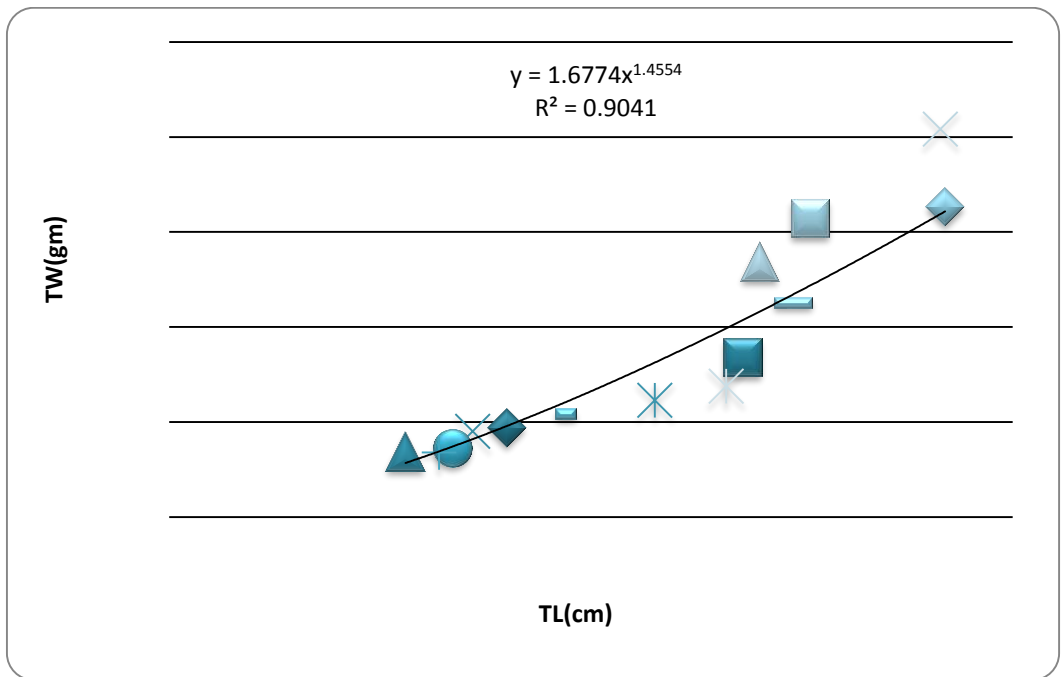
**Figure 4:** Logarithm relation of month December



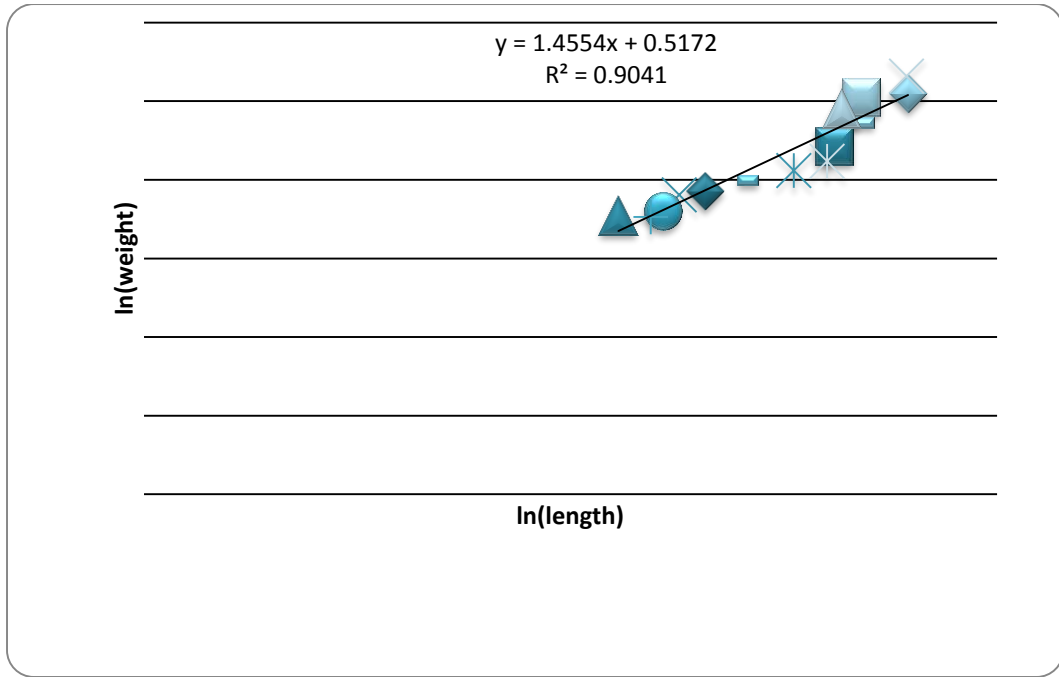
**Figure 5:** Length-Weight relation of month January



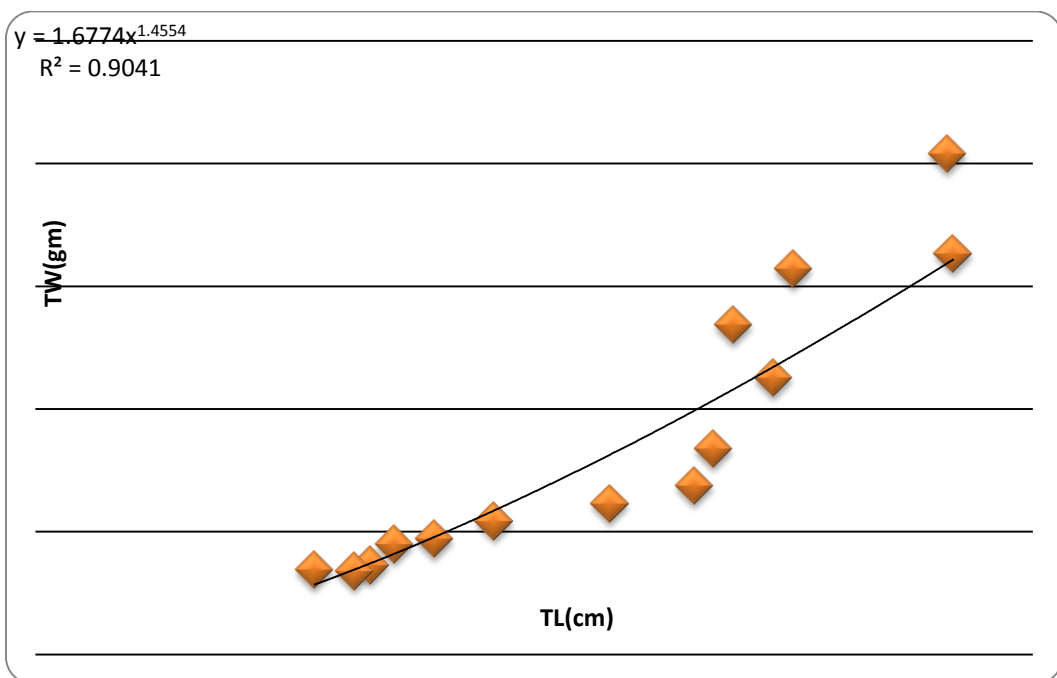
**Figure 6:** Logarithm relation of month January



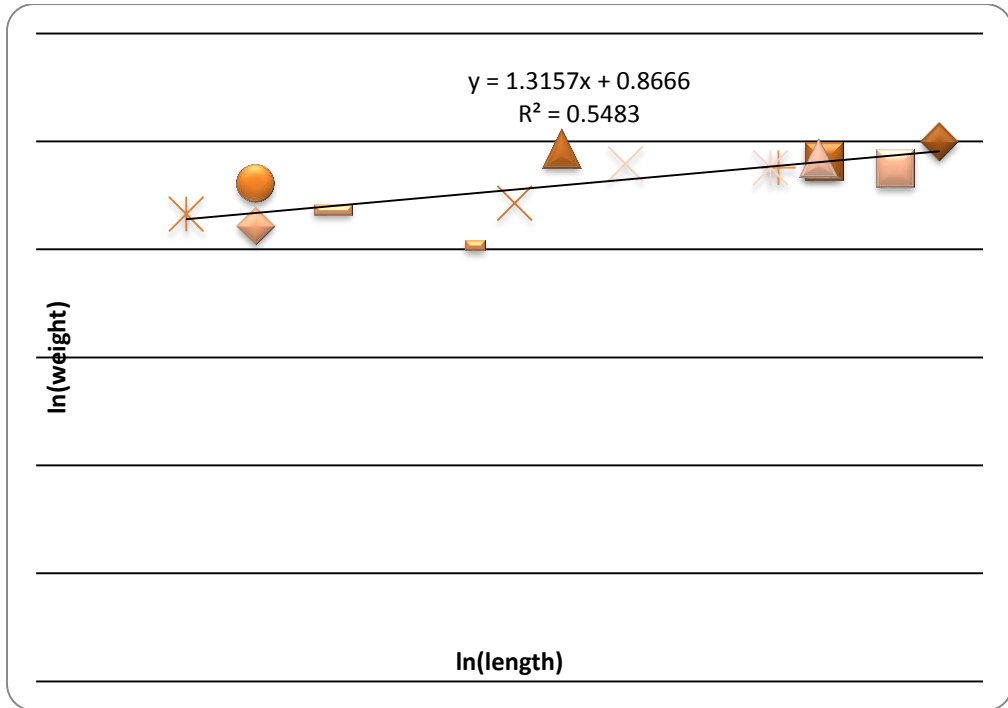
**Figure 7:** Length-Weight relation of month February



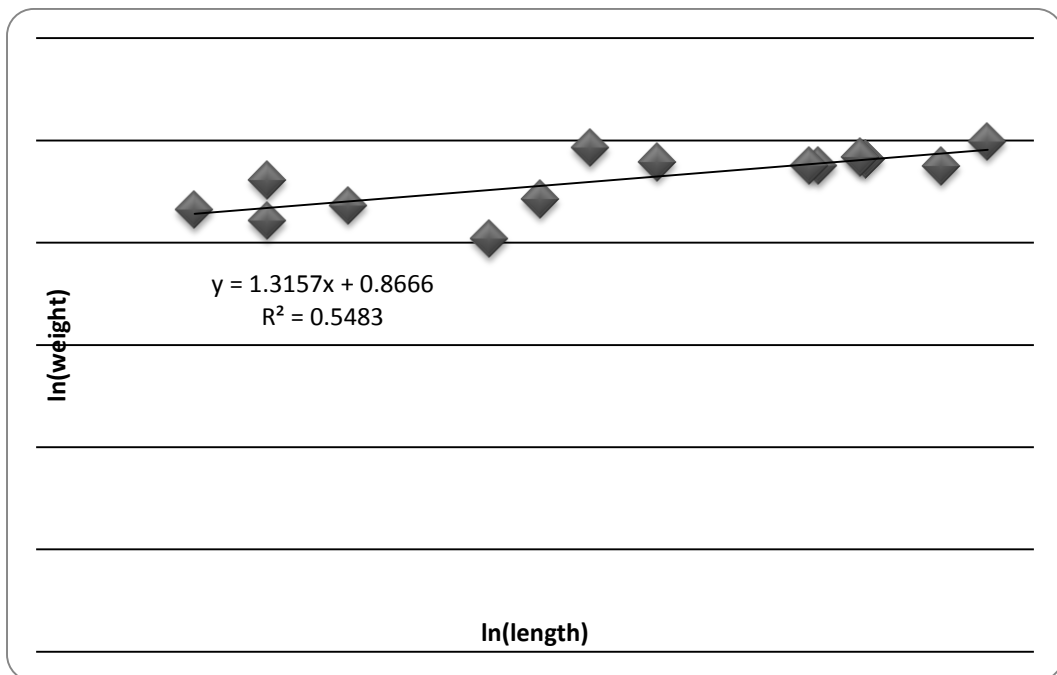
**Figure 8:** Logarithm relation of month February



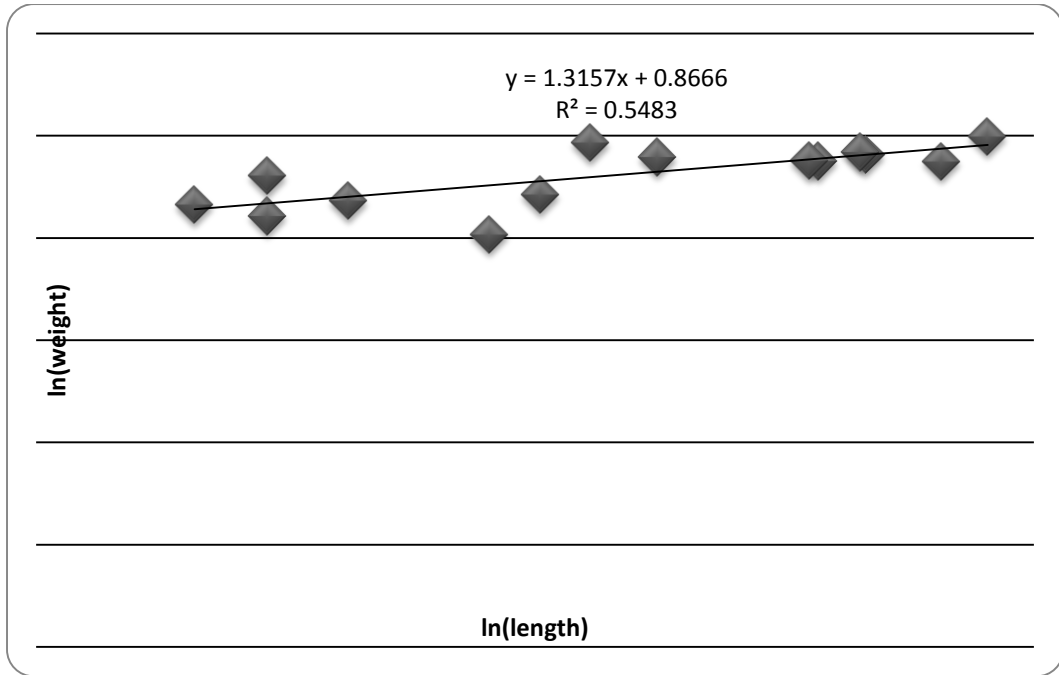
**Figure 9:** Length-Weight relation of month March



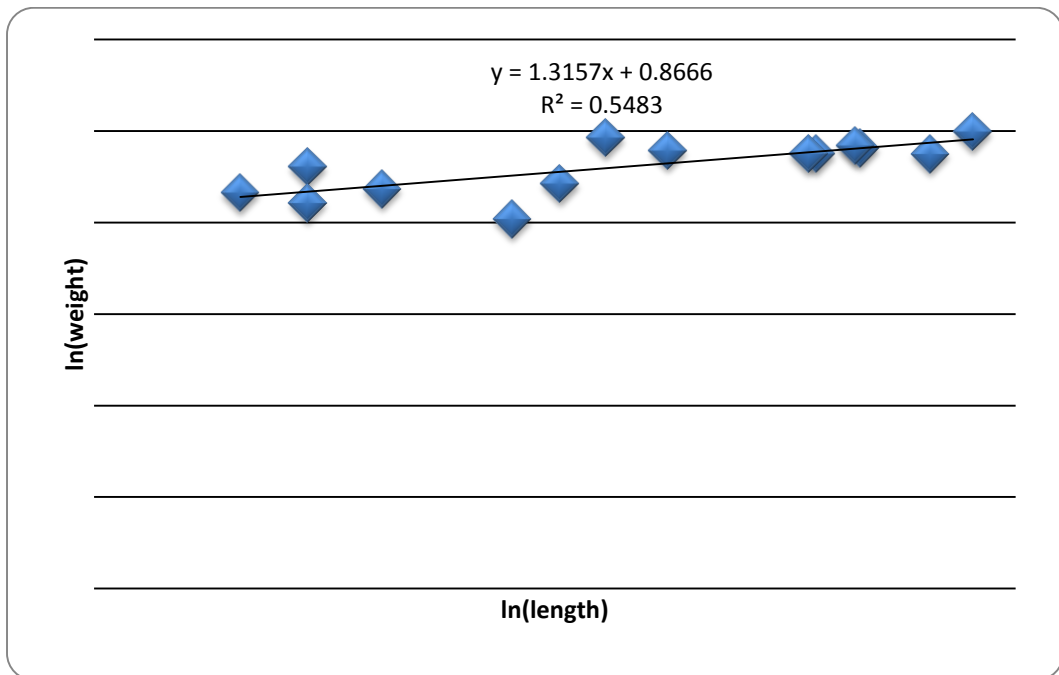
**Figure 10:** Logarithm relation of month March



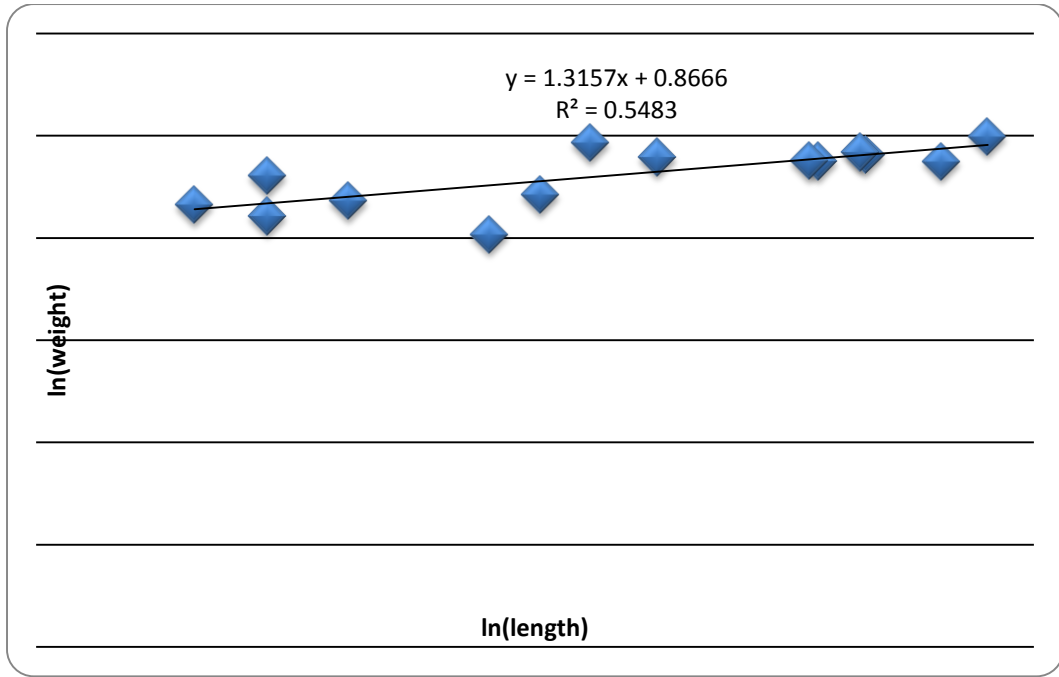
**Figure 11:** Length-Weight relation of month April



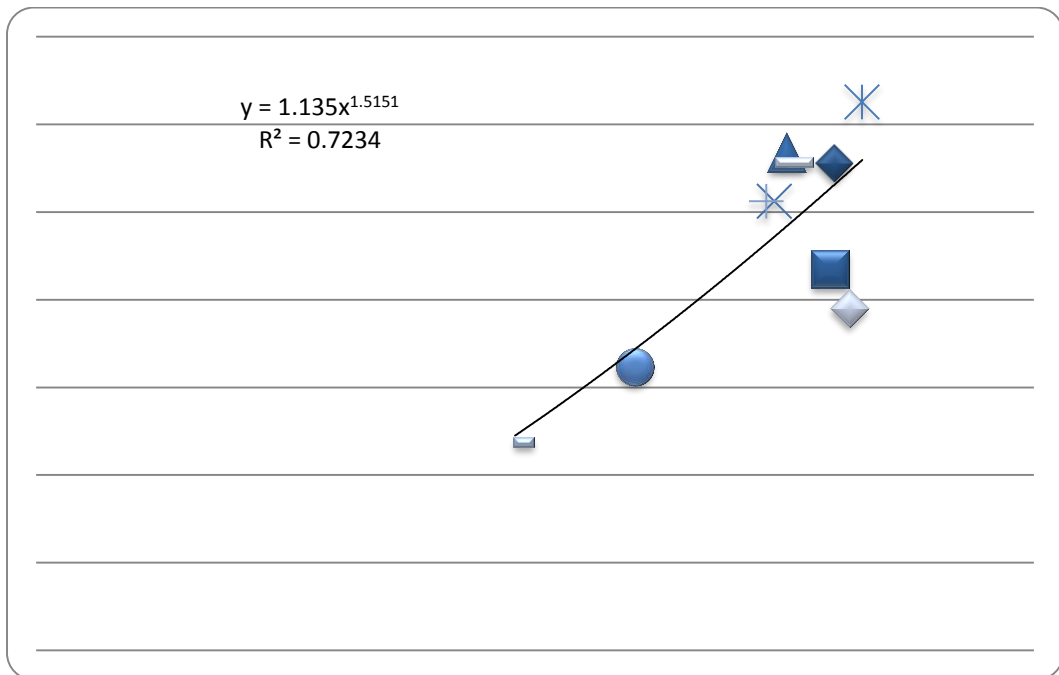
**Figure 12:** Logarithm relation of month April



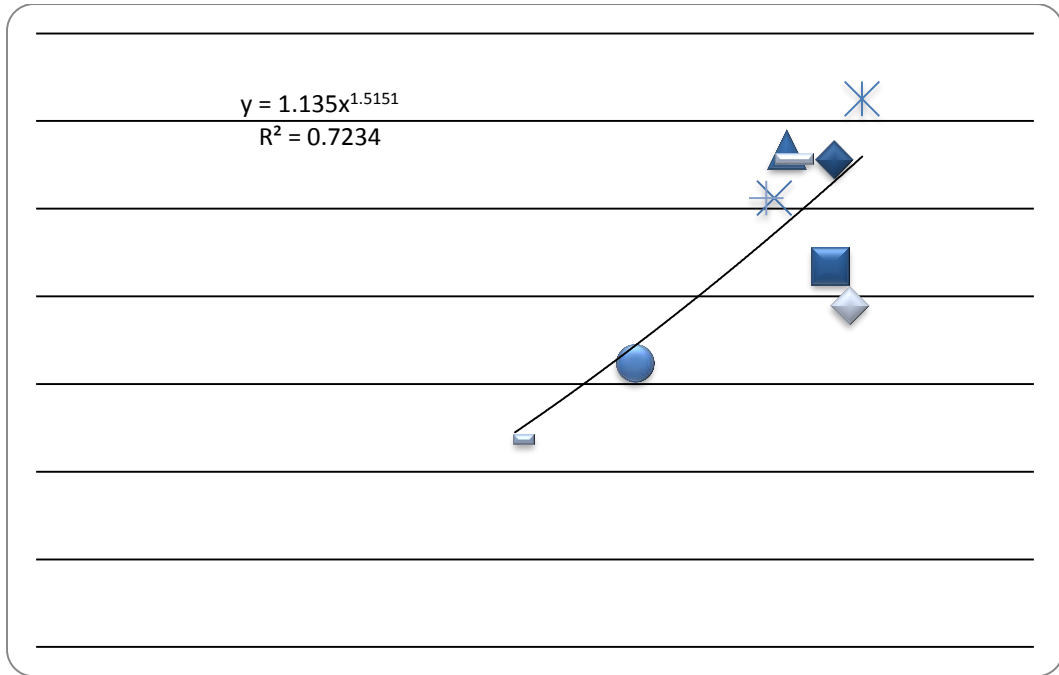
**Figure 13:** Length-Weight relation of month May



**Figure 14:** Logarithm relation of month May



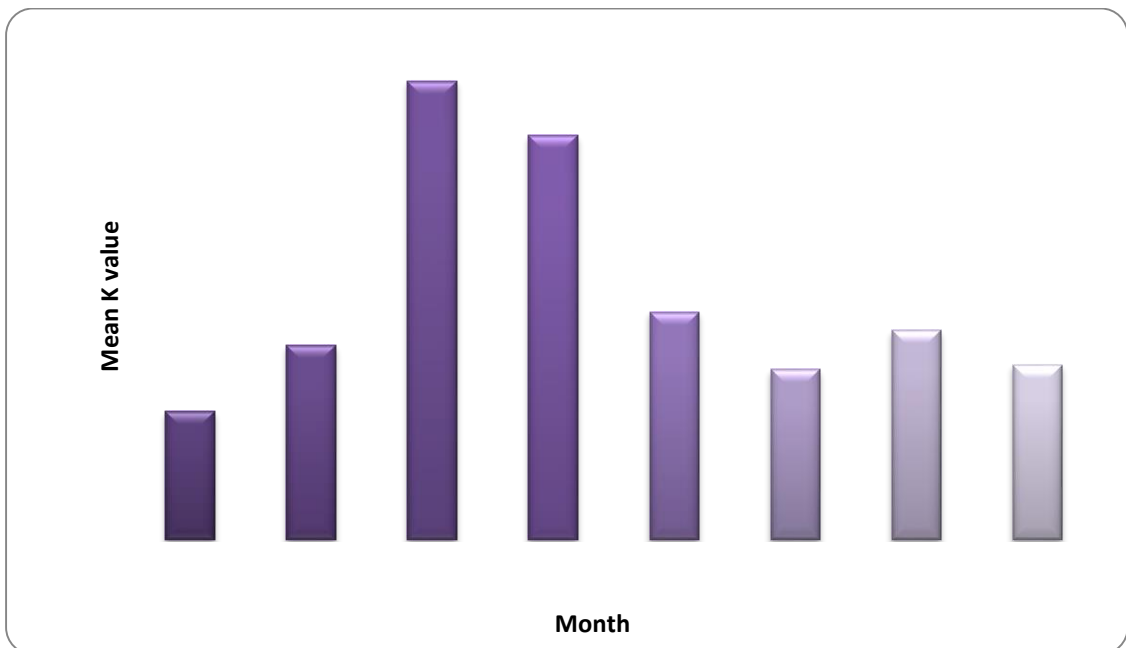
**Figure 15:** Length-Weight relation of month June



**Figure 16:** Logarithm relation of month June

#### 4.2 Condition factor of *P. sarana* from November 2021 to June 2022

Mean value of condition factor ranged from  $1.186 \pm 0.14$  to  $4.23 \pm 0.54$ . The highest mean K value was noticed in the month of January depicting smaller fishes were in better condition lowest in the month of June. Over all, the mean K value recorded higher than 1 infers fish was in better condition.



**Figure 17:** Mean condition factor from November to June.

### 4.3 Qualitative and Quantitative analysis of Gut content.

*Puntius sarana's* stomach contents revealed that the fish consume a range of foods. Stomachs of 101 specimens were analyzed with the help of microscopic examination and depicted the food and feeding habit during the study period from November to June. Over all 61 stomachs were having content inside and 40 were found to be vacant. Various items like Chlorophyceae, Bacillariophyceae, Cyanophyceae, Zooplankton, sand, unidentified matters etc were found in the stomach among which Chlorophyceae dominated the stomach. Food items found in stomach presented in Table 3.

**Table 3:** Food items found in stomach of *P. sarana*

<b>Stomach content found inside</b>	<b>Food items</b>
Plant materials	<i>Volvox, Oedogonium, Spirogyra</i> , Diatoms, Blue green algae, <i>Ulothrix, Zygnema</i> etc.
Animal materials	Insect's antennae Copepod eggs
Unidentified materials	Digested material Mud Dried leaves

Among all the food items found in the stomach of *P. sarana* the occurrence of Chlorophyceae dominated the stomach on the basis of frequency of occurrence, found in 47 stomachs followed by Bacillariophyceae in 44 stomachs. Moreover, Animal matter is found in 5 stomachs and miscellaneous items in 16 stomachs. Diet composition based on frequency of occurrence given in Table 4.

**Table 4:** Diet composition based on frequency of occurrence

<b>Food of fish</b>	<b>Frequency of Occurrence</b>	<b>Percentage of Occurrence</b>
Chlorophyceae	47	77.04
Bascillariophyceae	44	72.21
Chyrophyceae	2	3.27
Rhodophyceae	3	4.91
Phaeophyceae	2	3.27

Cyanophyceae	4	6.5
Zygoen	5	8.1
Antennae	2	3.27
Worms	1	1.63
Zooplankton	1	1.63
Copepod eggs	1	1.63
Miscellaneous items	16	26.2

#### 4.4 Index of fullness by eye estimation method.

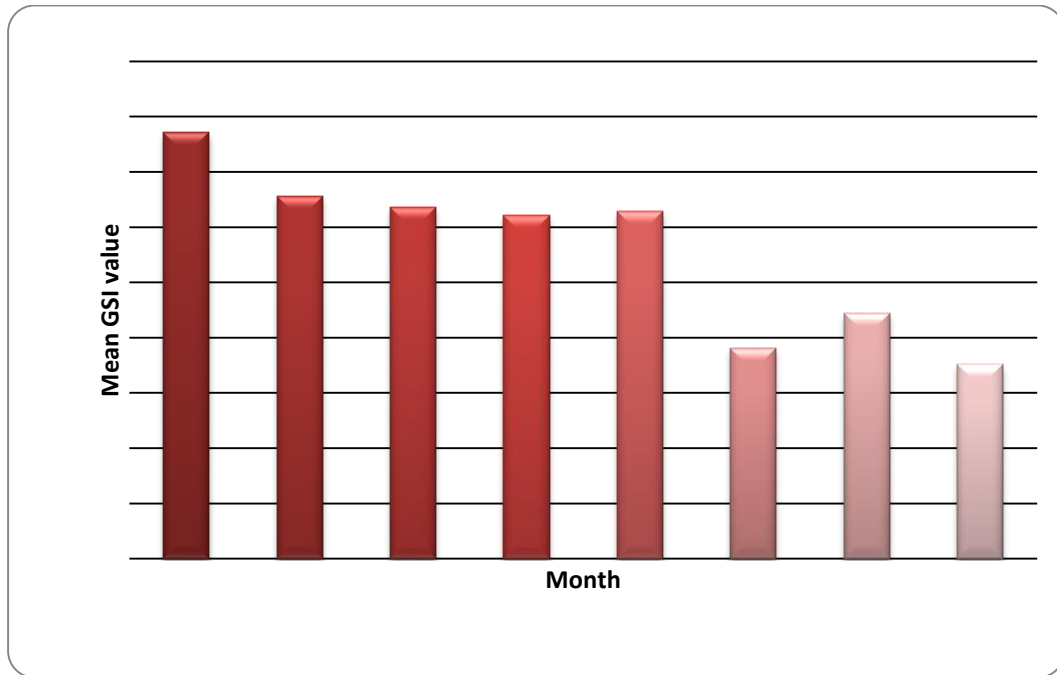
Fish with a full or half stomach were thought to be actively feeding, while fish with a stomach with only 25% filled were thought to be feeding badly and vacant stomachs were supposed to be poorly feeding or not feeding at all. Among 101 stomachs 40 stomachs were found vacant. In the current study, the highest % of fullness (30.76%) of the stomach was recorded in the month of November and lowest % of fullness in the month of June. Similarly, highest % (45.87%) and lowest % (16.675%) of half stomachs were recorded in November and May and stomachs with only 25% of content found high in the month of May and low in the month of November. The highest % of vacuity was seen in June and lowest in November respectively.

**Table 5:** Index of fullness with eye estimation method

Month	Full	Half	25% content	Vacant
November	30.76	45.87	23.07	—
December	8.3	—	41.66	50.04
January	—	—	30.8	69.23
February	—	21.45	42.84	35.71
March	14.28	21.42	42.85	21.42
April	—	—	41.66	58.33
May	—	16.67	66.67	16.67
June	—	—	27.28	72.72

#### 4.5 Gastro- Somatic index (GSI)

Gastro somatic index of 101 specimens were determined individually. The mean value of GSI varies among month indicating difference in feeding intensity. Over all the mean GSI value range from  $3.51 \pm 0.6$  to  $7.71 \pm 0.57$ . The highest mean value of GSI was observed in the month of November and lowest in June.



**Figure 18:** Different mean GSI value from November 2021 to June 2022

## 5. DISCUSSION

### 5.1 Length weight relation

Generally growth in fish stocks is considered to be ideal if the  $b$  value is equal to 3 and allometric if lower or greater than 3 (Froese 2006).

The month wise length weight relation of present study of fish depicted negative allometric growth in all analyzed months i.e.  $b < 3$  suggested the species has slow growth rate and supposed to be thinner with increasing length. The negative allometric growth in all analyzed months might be due to environmental condition of Danda river, gonadal maturation, Feeding intensity etc.

The result of the current study coincides with the result of Aye and Khaing (2017) in the same species from the wetland of Assam. Jisr et al. (2018) found negative allometric value (1.986-3.016) in all observed species in eastern mediterranean city, Similarly, negative allometric growth found in *P. sarana* ( $b=2.24$ ) in Haro river (Sisodiya et al. 2018). Moreover, In the result studied by Gesto et al. (2017) found  $b$  value less than 3 from all sites of Wudil river. Similarly, negative allometric growth has been turned up in *Tor tor*, *Labeo dero*, *Labeo dyochelius*, *Cyprinus carpio*, *Rasbora daniconius* by (Hossain and Sultana 2014). This results tone with the present finding and manifest deviation of  $b$  value from ideal value 3. The observations of present study are also in agreement with those of Midhat et al. (2012) who observed the  $b$  values of 2.2749, 2.2915 and 2.2863 for *S. schall* females, males and combined sexes in River Nile at Gizza.

In the contradictory of above result, Sani et al. (2010) and Patrick et al. (2021) found the same  $b$  value 3.182 in of *P. sarana* from Vavuniya Reservoir, Sri Lanka and Gomti River, India which shows allometric growth. Similarly, Khan and Nilla (2012) got regression coefficient value more than 3 in *P. sarana*. Again, (Karna et al. 2018) got  $b > 3$  (3.2) in *P. sarana* at Hirakud reservoir. Whereas, isometric growth found in *P. sarana* from tropical river of India (Dubey et al. 2012). These isometric and positive allometric growth might be due to favorable environment condition, good feeding conditions.

## 5.2 Condition factor

The Condition factor in the present study fluctuated between and recorded high in the month of January followed by February. The examination of length-weight data has been used to determine each fish's condition shows that the heavier fish at a given length is in better condition (Bolger & Connolly 1989). Present study shows the mean condition factor from November 2021 to June 2022. This clarifies wellbeing of *P. sarana* is in better condition in all respective months but more in the month of January. In the month of January fishes with less length were caught which might be the cause of high value of condition factor which has been supported by Ndiaye et al. (2015) in his study Length weight relation and condition factor of white grouper, he stated K value is inversely proportional to the length, it means longer fish has low condition factor. During January, February and March there observed high K value which might be due to gonads maturation prior to spawning period, this result has been supported by Pramanik (2016) in his study in edible fishes which showed high K during pre and low during spawning and post spawning period. After February there has been a drop of K value which might be due to the spawning period as fish stopped feeding during that period, eggs were observed from the month April to June. This statement has been supported by De Moraes Vazzoler (1996); Daghooghi et al. (2018); Sangma et al. (2019).

## 5.3 Gut analysis

In the present study based on Frequency of occurrence and Dominance method it was found that this species feeds on phytoplankton, algae, zooplankton, crustacean animal matter, sand, mud etc. So, it can be concluded as omnivore's bottom feeder which coincides with the study of (Chondar 1999 and Kannan et al. 2016). However, (Mookherjee et al. 1946; Das et al. 1955; Chitray 1965) reported it as herbivorous fish. From the frequency of occurrence method Phylum Chlorophyceae (47%), Bacillariophyceae (44%) recorded high whereas Chryophyceae, Pheophyceae, Rhodophyceae, Cynophyceae, antennae, worms, copepod eggs found very less in stomach which is found to be similar with the study of Hossain et al. (2012) who also found more phytoplankton and less animal matter in *Puntius sarana*. High preferences of *P. sarana* for plants is also supported by the research of Gupta (2015) on his paper, A review on feeding and breeding biology of *S. sarana*.

#### **5.4 Gastro- somatic index (GSI)**

Gastro-somatic index shows the relation between gut weight and body weight helps to determine the feeding intensity of fishes in different conditions. It depends upon the fullness of gut.

In the current study, the highest GSI value observed in the month of November (7.71) might be saving energy for the spawning period, Daghooghi et al. (2018) and least in June (3.51) in *P. sarana*. The GSI value of *P. sarana* dropped down after March, 3.81 in April, 4.43 in May, and 3.51 in June as these three month shows the peak spawning time as eggs were observed from May to June .So, it can be consider that it was in its breeding period . Sangma et al. (2019) explained low GSI result of less feeding which may be due to development of gonads taking space in the abdominal cavity so that fishes tend to eat less during breeding period. Furthermore, Bhuyan and Kurbah (2018) in their study revealed GSI found to be highest during pre-breeding and lowest during the breeding period in *Monopterus cuchia*. This result of the current study has been supported by different researchers in their work.

## 6. CONCLUSION AND RECOMENDATIONS

### 6.1 Conclusion

The result of the above study provided the data on LWRs, Condition factor, Gut content and GSI of *Puntius sarana* from Danda River, Bhairahawa, Rupandehi. Almost all specimens showed a negative allometric growth. Condition factor was generally more than 1 showing overall state of wellbeing in all analyzed months and found highest in January. The result of gut content analysis suggested the fish is omnivores in nature with high preference for plant material than animal, especially feeds upon Chlorophyceae and showed variation in feeding intensity as GSI seems to be high in November and showed decreasing trend from April and lowest in June.

### 6.2 Recommendations

Based on this research, some recommendation are given below:

- Analysis of variety of parameters, such as development stage, gonad maturity, sex, size range, health, and an overall examination of fish condition, affect the length-weight relationship in fish is needed.
- There are many variables that affect condition, including environmental factors, plankton availability, fish health, fish maturation rate, and measurement of water quality.
- Stomach content identification up to species level is required.

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# PHOTO PLATES



**Location Danda River**



***Puntius sarana***



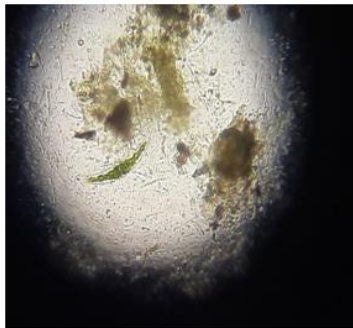
**Extraction of Gut**



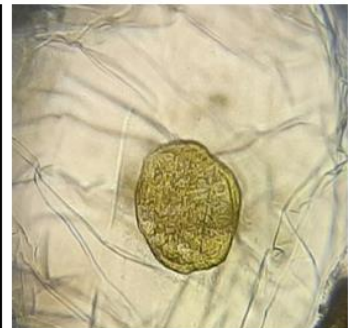
**Scissoring of Gut**



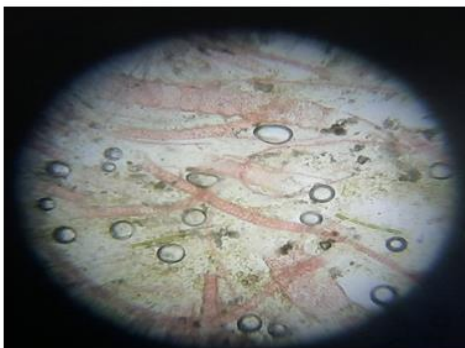
**Insect antennae**



**Closterium**



**Round alga**



**Red algae**



**Eggs inside fish**