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Research article

Length-weight relationship and stomach contents of glass perchlet (*Chanda nama*) in Begnas Lake, Nepal

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Abstract

Elongated glass perchlet is a freshwater fish species in the Asiatic glassfish, family Ambassidae and order Perciformes. Length-weight relationship, condition factor, stomach contents and gastro-somatic index (Ga.SI) of *Chanda nama* were analyzed between February and April 2024 from the Begnas Lake of Pokhara Valley, Nepal. The total length was recorded in the range of 4.8 cm to 7.5 cm and total weight in the range of 0.81 gm to 5.52 gm. Similarly, the gut length and gut weight were in the range of 0.7 cm to 2 cm and 0.15 gm to 0.91 gm, respectively. Total length and body weight were positively correlated ($R = 0.95$, $p < 0.05$) whereas gut length and gut weight were negatively correlated ($R = -0.19$, $p = 0.15$). The value of growth exponential ($b = 3.02$) indicated positive allometric growth. The frequency of each of food items observed in stomach contents were scales (91.7%), insects (33.3%), zoobenthos (50%), eggs (41.7%), algae (25%), nostoc (36.7%) and unidentified materials (20%) throughout the study period. In conclusion, *C. nama* was lepidophagy. The Ga.SI value was used to determine feeding intensity and was found to be highest in the month of March and lowest in April. The present study suggested for further study about the *C. nama* and other fishes of the lake to know their status.

Keywords: Condition factors; Gastro-somatic index; length- weight relationship; Pokhara Lake cluster

1 | Introduction

Elongated glass perchlet (*Chanda nama*) is a freshwater fish species known locally as Sisha Maccha. It has been recorded in Begnas Lake from 2018 (Husen et al. 2019) and in Phewa from 2020 (Basaula et al. 2023). It is a popular food fish as it has high nutritional value due to the presence of high amount of protein, fat, mineral, and vitamin A contents. Additionally, it is a well-liked aquarium fish with a high demand from enthusiasts of ornamental fish (Moazzam & Osmany, 2022). This fish is exported to different nations too (Gupta, 2015). The glass fish is widely distributed and found in running and standing fresh and brackish waters in Pakistan, India, Bangladesh, Myanmar and other countries on the Indian subcontinent (Ahmed et al. 2019).

Grubh and Winemiller (2004) demonstrated *C. nama* as facultative scale feeder, or lepidophagy. In the Kulekhani reservoir, it was reported that 66.66 % and 33.33 % of native fish were found dead due to scale fall out and the presence of *C. nama*, respectively (Dahal et al. 2012). It is uncertain how these fish were introduced to the lake, nevertheless; it is likely that fries were accidentally released into the water (Chakraborty et al. 2018). After the introduction of glass fish in the Begnas Lake, the catch of other fishes started to decline (Basaula et al. 2023).

During development, organisms typically increase in length and weight. The amount of food available, the quantity of fish using the same diet, temperature, oxygen, and other water quality elements, in addition to the fish's size, age, and sexual maturity, are the most important factors influencing their growth. The length-weight relationship is a typical way for obtaining accurate biological information and is extremely important in fishery assessments (Kuriakose 2014). Fish vary in their length to weight ratios depending on the species. The variation in the intra-specific populations' length-weight relationships within the same body of water, numerous biological parameters, including sex, fish size, physiological state, gonadal development, and fatness, have a major impact on the link between fish length-weight relationships (Mahapatra et al. 2014). Furthermore, measurements of length and weight provide significant information about changes in the environment, climate, and human subsistence patterns (Sarkar et al. 2013).

A lot of research on fisheries and fish biology make use of Fulton's condition factor (K). To characterize the condition of each individual fish, this factor is determined based on the relationship between the fish's weight and length (Froese 2006). It depends on the idea that fish which weigh more for a given length have superior physiological conditions (Mahapatra et al. 2014). The condition factor aids in evaluating the health of fish by assuming that fish with more weight for a given length are in better condition. Accordingly, a fish is considered to be in good condition if it has $K > 1$ (Chhetri 2022). Condition can indicate food availability and growth in the weeks (Kuriakose 2014).

The fish have distinct eating and feeding behaviors at different phases of their lives. The type of food available in the living environment, the size or sexual stage of the fish, the environmental factors, and the competition between and among species, all have a

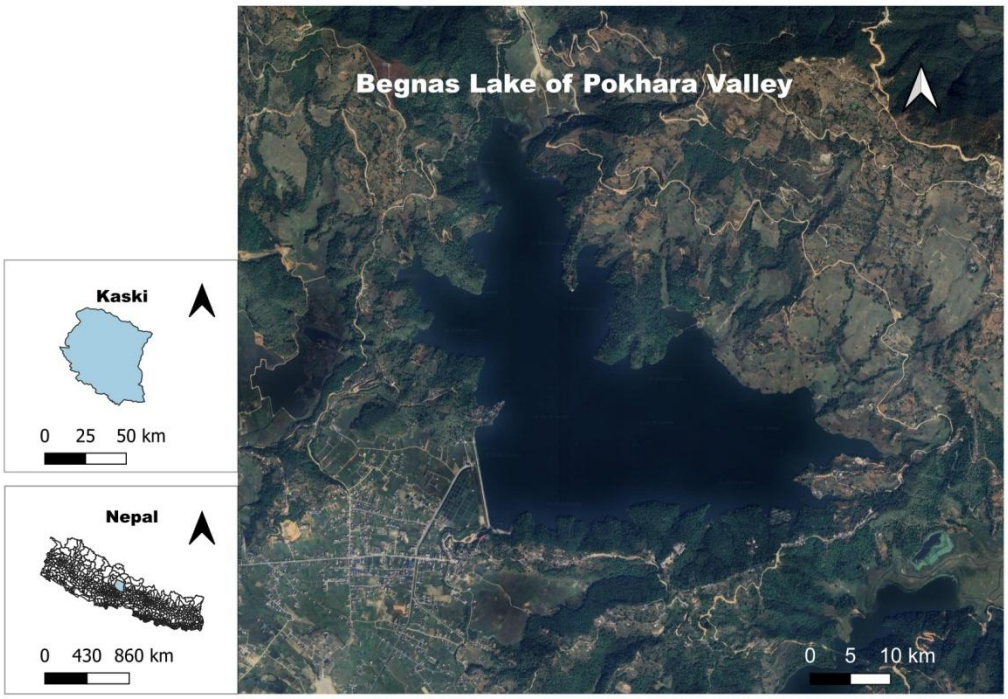

Figure 1. Aerial view of Begnas Lake, the study area in the Gandaki Province, Nepal

significant impact on dietary preferences (Koundal et al. 2013). For many years, it has been a common procedure to examine the stomach contents of fish and other animals to learn about their dietary habits (Verma et al. 2020). Stomach content gives valuable information on the ecological and biological components that influence fish behavior, condition, habitat usage, energy intake, and inter and intra-specific associations. It is a critical component of ichthyological study, fishing, and fish protection. Accurate descriptions of fish diets and feeding behaviors can serve as the foundation for understanding relationships between tropic groups in aquatic food webs (Manko 2016). Fish food and eating habits alter with the seasons, although seasonal temperature changes have no effect on the consumption of food. The majority of fish in nature feeds on bacteria, desmids, diatoms, and other minute planktons, both plant and animal (Verma et al. 2020).

Glass fish is a surface and column feeder. They also play an important function in providing quality proteins in an individual's diet. The nutritional composition of *C. nama*, weighs 68.12 ± 0.06%, 5.59 ± 0.02%, 14.86 ± 0.04%, 0.33 ± 0.04%, and 11.09 ± 0.07%, respectively, were the contents of moisture, ash, total protein, total carbohydrate, and total lipids, according to the proximate analysis (Chakraborty et al. 2018). Non-lethal methods such as gastroscopes, stomach tubes, suction devices, flushing techniques, and emetics have been widely used to examine fish stomach contents (Kamler & Pope 2001). Among these, stomach flushing, often aided by syringes in smaller fish or mechanized pressure in larger specimens, has proven particularly effective across a range of fish sizes.

To understand fish growth, reproduction, and migration, it is essential to study their diet and feeding behavior. The gastro-somatic index (Ga.SI), which measures stomach weight relative to body weight, helps assess feeding intensity (Sangma et al. 2019), which varies with food availability, spawning season, and environmental conditions. This study investigates the length-weight relationship, condition factor, stomach contents, and Ga.SI of Glass perchlet in Begnas Lake, Pokhara Valley, Nepal. The findings will contribute to understanding the species' ecological role and support effective fisheries management.

2 | Materials and methods

2.1 | Study area

The research area for analyzing the length-weight relationships and food contents of Glass Perchlet (*C. nama*) is Begnas Lake (Figure 1), a freshwater lake lies in Pokhara Metropolitan in Kaski district of Nepal situated in the eastern part of the Pokhara Valley, with a surface area of 3.28 km^2, a maximum depth of 10 m, and an average depth of 6.6 m (Khadka, 2019). Begnas Lake, positioned at coordinates 28°10'26.2″N and 84°05'50.4″E, is the second largest lake of Pokhara. The lake receives a constant water supply from a perennial stream that originates from a catchment area spanning 19 square kilometers (Husen *et al.* 2019). It is known for its astonishing beauty and peaceful surroundings and provides a habitat for several aquatic lives.

Table 1. Comparison of total-length (TL), body-weight (BW), gut-length (GL) and gut-weight (GW) during different months (Bold values represent the significant result)

S.N.	Variables	February	March	April	
		Median (Range)	Median (Range)	Median (Range)	Kruskal Wallis test
1	T L (cm)	5.75 (4.80-7.50)	5.40 (4.90-8.20)	5.70 (4.90-7.50)	H = 5.27, p = 0.07
2	BW (gm)	1.86 (0.81-3.48)	1.40 (0.99-5.52)	1.67 (1.08-3.77)	H = 8.39, p = 0.01
3	GL (cm)	1.1 (0.70-1.80)	1.10 (0.70-2.00)	1.20 (0.80-1.80)	H = 2.96, p = 0.23
4	GW (gm)	0.25 (0.15-0.91)	0.33 (0.16-0.90)	0.12 (0.06-0.37)	H = 18.46, p < 0.001

2.2 | Methods

60 specimens of *C. nama* were taken from Begnas Lake with the help of skillful fishermen. The samples were collected from February to April 2024. Then the samples were brought to the Laboratory of Zoology, Prithvi Narayan Campus to investigate several biological parameters of the specimen. The total lengths (TL) were measured to the nearest 0.01 cm using a vernier caliper and the total body weights (TW) of the fish specimens were measured to the nearest 0.01 gm using electronic weighing machine. The fish's total length was measured from the tip of its nose to its tail fin. The fish was dissected using scissors then separated their gut. Then its length and weight were measured. The stomach contents were extracted after dissecting the fish's gut.

The length-weight relationship was determined using the least square method (Bhuvaneswari & Serfoji, 2018) applying the formula:

$W = a L^b$

The equation expressed in natural logarithms as:

$Ln\ W = Ln\ a + b\ Ln\ L$

where, W= weight of the fish (gm),

L= Length of the fish (cm),

a= intercept (constant) and

b= slope (growth exponential)

The simple linear regression equation Y = a + b X,

where X = Total length (TL) and

Y= Total body weight (TW)

Similarly, the simple linear regression equation Y = a + b X,

Where X = Gut length (GL) and

Y= Gut weight (GW)

The value of b provides information on the growth of fish. When b = 3, the increase in weight is isometric, positive allometric if b > 3, and negative allometric if b < 3. The association of degrees between TL & TW and GL & GW were determined by correlation coefficient (R) that shows whether the relation is positive or negative. The regression lines were plotted for total length & total body weight and gut length & gut weight of the fishes.

All statistical analyses were performed using Microsoft Excel and R programming (R Core Team, 2024). Shapiro-Wilk normality test was done to test the normality of the variables. Kruskal Wallis test was used to compare the results due to skewed data. All statistical analyses were considered significant at 5% ($p < 0.05$).

The coefficient of condition was calculated using Fulton's formula (Fulton 1904):

$$K = 100 \times \frac{\text{Total weight}}{\text{Total length}^3}$$

All the stomach contents were transferred into Petri dish. They were thoroughly mixed with water and were examined under the stereomicroscope. The contents of the stomach were identified where possible and analyzed by the frequency of occurrence method. The frequency of occurrence of a particular food item was calculated on the basis of the following formula:

$$\text{Frequency of occurrence of a food type} = \frac{\text{Number of gut where the food occurred}}{\text{Total no. of gut analysed}} \times 100$$

The gastro-somatic index was calculated by the formulae

$$\text{Gastro} - \text{somatic Index (Ga. SI)} = \frac{\text{Weight of gut}}{\text{Weight of fish}} \times 100$$

3 | Results

3.1 | Morphometrics of fishes

The maximum total length ranged from 4.80 to7.50 cm with a median of 5.27 cm in the month of February; and body weights in the same month ranged from 0.81 to 3.48 gm with a median of 8.39 gm. Similarly, gut length was maximum in April ranging from 0.80 to 1.80 cm with a median of 2.96 and gut weights in the month of March ranging from 0.16 to 0.90 gm with a median of 18.46 were recorded (Table 1). The value of growth exponential (b = 3.02) indicated positive allometric growth.

The correlation coefficient (R = 0.95) shows the positive correlation between the total body weight with total body length (Figure 2). The relationship shows that the body weight increases with the increase in the total length of the fish. While the correlation coefficient (R = -0.19) showed the negative correlation between the gut weight with gut length (Figure 3) that demonstrates the gut length did not increase with the increase in the gut weight of the fish.

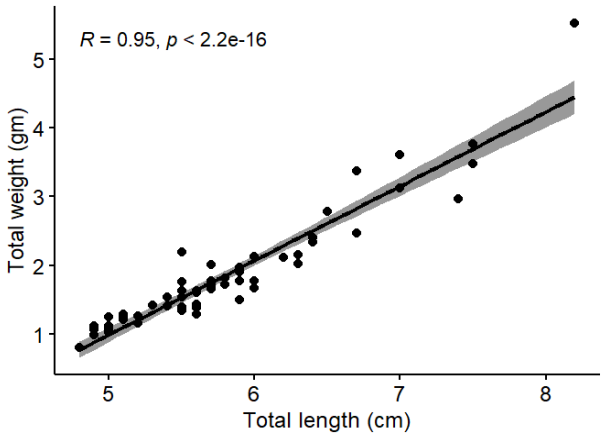

Figure 2: Relation between total body weights with total length

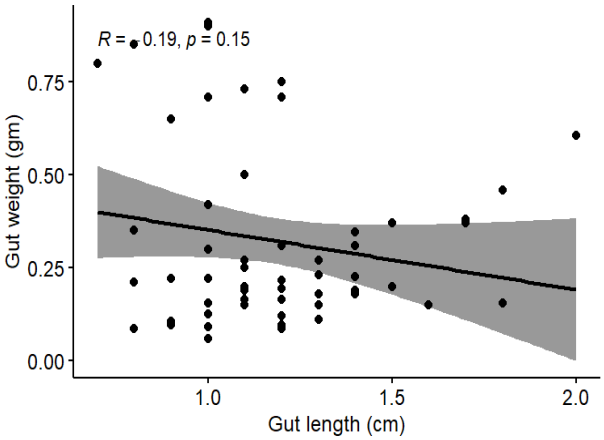

Figure 3: Relation between gut weights with gut length

The mean condition factor (K) for *C. nama* was 0.91 (Table 2). The condition factor of *C. nama* was slightly less than 1 that indicates not in a good health condition of the species.

3.2 | Stomach contents

To represent diet and eating habits, the stomachs of 60 specimens ranging in size from 4.80 cm to 7.50 cm were analyzed. The results on the occurrence of food items in *C. nama* from February 2024 to April 2024 are provided in Figure 4. The food items namely scale, insects, zoo benthos, eggs, algae and nostoc were reported

Table 2: Monthly variation of condition factors

S.N.	Months	Condition factor (K)	Mean
1	February	0.94	0.91
2	March	0.88	
3	April	0.90	

India, with K_n values ranging from 0.49 to 2.28 and 0.60 to 1.52, respectively. In both instances, the K_n value slowly increased to reach the maximum close to the heavier fish after first decreasing to the minimum in medium-sized fish samples (Sheikh et al. 2017). The *Parambassis ranga's* condition factor (K) from Kolkata was 0.0014, indicating that the fish were in poor condition (Mahapatra et al. 2014). Sangma et al. (2019) reported condition factor 0.93 for *C. nama* indicated good health of the fish.

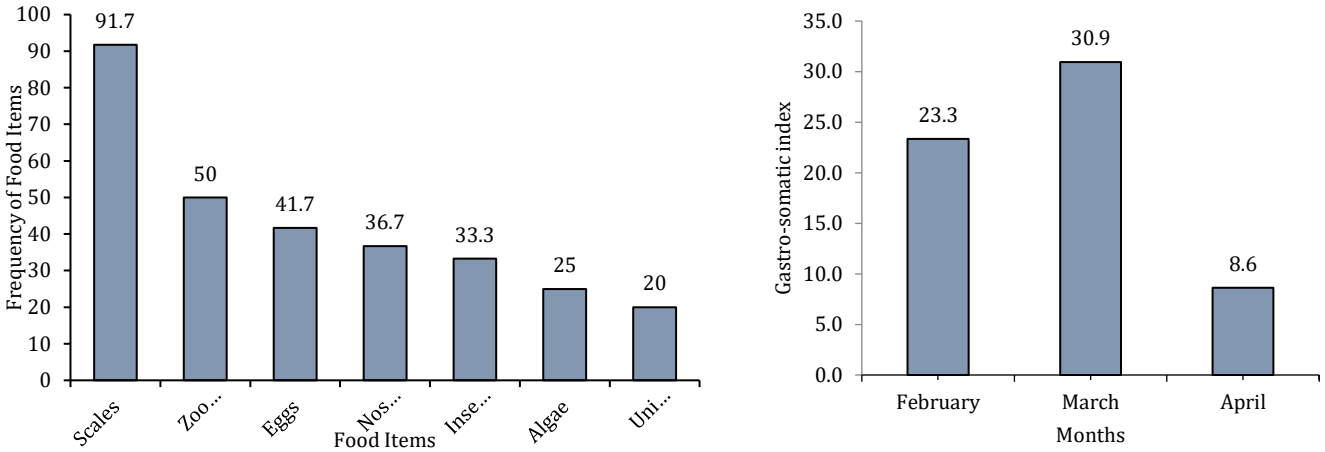

Figure 4. Frequency occurrence of different food items observed in stomach of *C. nama*

throughout the study period. The frequency percentage for scales was (91.7%), zoo benthos was (50%), eggs of fish was (41.7%), nostoc was (36.7%), insects was (33.3%) and algae was (25%). Additionally, there were some of the unidentified materials and their frequency was 20% (Figure 4).

The observation on feeding intensity was based on Gastro somatic index (Ga.SI) taken on a monthly basis (Figure 5). The value of Ga.SI was observed to become high during March and low during April. Low Ga.SI value indicated low feeding activity.

4 | Discussion

The Begnas Lake in the Pokhara valley of Nepal do not have any documentation regarding the length-weight relationships, condition factor, or dietary habits of the recently introduced glass perchlet species. While there was a negative connection (R = -0.19) between gut weight and gut length, the correlation coefficient (R = 0.95) indicated a positive link between body weight and total length. While the fish's gut length does not increase in tandem with an increase in gut weight, the fish's body weight does as its total length does. The simple linear regression equation's b value, which is 3.02, indicates the species' positive allometric growth. *Chanda nama* from Vettar River, Tamil Nadu, exhibited negative allometric development in its length-weight relationship (Bhuvaneswari & Serfoji, 2018). The Ganges River in Bangladesh has an elongated glass-perchlet *Chanda nama* with a total length (TL) ranging from 3.3 to 9.9 cm. Using the b value < 3.0, Asadujjaman *et al.* (2024), Sheikh et al. (2017), and Hossain et al. (2012) reported negative allometric growth in *C. nama.*

The Glass perchlet species' mean condition factor (K) was 0.91 in the present study, which is somewhat below 1, indicating that the species' health is not good. It might happen as a result of inadequate consumption of foods. In Chalan Beel, Bangladesh, condition factors >1 showed that *Parambassis lala, Parambassis ranga,* and *Chanda nama* were in excellent condition (Rana et al. 2022). The condition factor (K) of the same species in Ganga, Gomti, and Rapti rivers in India varied greatly between 0.76 and 2.95, with a mean of K = 1.43. This variation may have been caused by the river basin's various environmental circumstances (Sarkar et al. 2013). *Parambassis ranga* and *Chanda nama* from the Dora Beel (wetland) in Assam,

The stomach contents of elongated *C. nama* from Vettar River, Tamil Nadu were algae (47.46%), crustacean appendages (21.86%), scales (11.7%), insects (8.9%), earthworm fragments (6.73%) and prawn appendages (3.13%) (Bhuvaneswari & Serfoji, 2018). Gupta (2015) reported glass fish as carnivores in nature: insect parts, fish scales and pieces of higher aquatic plants. Khoso et al. (2018) regarded the fish as both a lepidophagous and a highly carnivorous animal by nature.

The value of Ga.SI was observed to become high during March and low during April. Low feeding activity was indicated by a low Ga.SI value. Availability of food in the environment and nutrient requirement stage might influence the feeding activity of the fish. Sangma et al. (2019) and Kar et al. (2020) calculated feeding intensity of *C. nama* lowest in July which may correspond with the fish's reproductive season.

5 | Conclusions

Total length and body weight were positively correlated whereas gut length and gut weight were negatively correlated. The value of growth exponential indicated the positive allometric growth of the perchlet. The condition factor of perchlet was slightly less than 1 that indicates 'not in good health' condition. The frequency of food items was highest for the scales and least for the algae and unidentified materials in the stomach contents of glass fish. The highest frequency of scales in stomach contains indicated that the glass fish is lepidophagy and is harmful to other carp and locally available fish in the lake. It was noted that the values of Ga.SI peaked in March and fell in April. Low Ga.SI value indicated low feeding activity of the fish.

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Authors' contributions

PT and RB conceptualized the research. PT conducted field research, data curation, formal analysis, and drafted manuscript. RB supervised the project. Both authors read and approved the final manuscript.

Conflicts of interest

The authors declare no conflict of interest.

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