Research Article

A Study on Length-Weight Relationship and Condition Factor of Three Important Freshwater Fish Species of Maijan Beel, Dibrugarh, Assam, India

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ABSTRACT

The aim of current investigation is to report the length-weight relationship (LWRs) of three economically important as well as ornamental fish species, namely *Channa stewartii, Heteropneustes fossilis* and *Trichogaster fasciata* found in Maijan Beel, Dibrugarh, Assam, India. 148 fish specimens belonging to the families Chanidae, Clariidae and Belontiidae were collected and used for the study. The result reported that the exponent 'b' in the LWRs ($W=aL^b$) were ranged between 2.61 and 3.00 showing allometric and isometric pattern of growth. The coefficient of correlation (r) recorded in the range of 0.91 to 0.96 and showed high degree correlation in all the species. The Fulton's condition factor (K) value was varied for each species from 0.53 to 1.79. These parameters are of great important to evaluate the biology, habitat condition, management of the population dynamics and stock assessment of the fishes.

Key words: Condition factor, Correlation-coefficient, Length-weight relationship, Maijan Beel, Isometric growth.

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INTRODUCTION

Assam is endowed with abundant fishery resources that support plenteous freshwater fish biodiversity. In spite of this, the state has not been able to cater to the needs of its ever increasing population and fish is depend largely on other states like Andhra Pradesh, West Bengal, Orissa etc.[1] More than 95% of the total population of the state preferred fish as their main food item leading to ever increasing demand for the fish.[2] Thus, the fishery sector is considered to play a pivotal role in the socio-economic development of this region, providing employment, improving the knowledge and skills of the farmers and their farming practices.[3] As natural fish production is declining so fast, knowing the ecology and biology of the fish is the need of the hour for developing management strategies for sustainable aquaculture to make the state self-sufficient in fish production.

Length-weight relationship (LWR) is considered to be fundamental fishery management tool as it provides information on the fish population dynamics and stock condition.[4,5] This relationship is useful to estimate various aspects of fishery sciences namely, general wellbeing of fish, study on maturity stages, start of spawning etc. with the help of condition factor K, a derivative of the relationship.[6,7] Like other morphometric measurements, length-weight relationship may change during the events of life cycle like metamorphosis, growth and onset of maturity.[8] Furthermore, length-weight relationships have been useful in fisheries research as they allow the estimation of production and biomass of a population.[9] In fish biology, this relationship permits the determination of average weight of the fish of a specified length group by establishing a mathematical relationship between them.[10]

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The condition factor or K- factor is employed in assessing the 'condition', 'robustness' or health of a fish specimen.[11] It accounts on the hypothesis of heavier the fish of a particular length better is the physiological condition.[12] It also reflects the interaction between the biotic and abiotic environmental factors and fluctuates with change in the physiological condition of the fish.[13] This study will explain the extent to which the two variables, length and weight are correlated to each other and which further assist in estimating the health status of an aquatic body in which the fish live.[14] Thus, the aim of the present investigation is to provide a baseline data on the LWR and K value of the three important freshwater species, *Channa stewartii, Heteropneustes fossilis* and *Trichogaster fasciata* from Maijan Beel, Dibrugarh, Assam.

MATERIALS AND METHODS

A total of 148 fish specimens of three species were collected from the landing centres of Maijan Beel, Dibrugarh, Assam at monthly intervals from January-June, 2019. The Beel is an open wetland with 27^{0}32'N latitude and 94^{0}58'E longitude (Figure 1). The selected species were represented by *C. stewartii* (*n*=31) (Figure 2a), *H. fossilis* (*n*=42) (Figure 2b) and *T. fasciata* (*n*=75) (Figure 2c). Fresh specimens preserved in formalin (10%) were brought to the laboratory for further analysis. Total length (TL) of the sample specimens were measured using a digital vernier calliper to the nearest 0.01 cm. The fishes were weighed to the nearest 0.001g using standard analytical balance (Shimadzu, Japan). Identification of the fish specimens was carried out following Talwar[15] and Viswanath.[16]

The length-weight relationship (LWR) was performed following Le Cren,[6]

The LWR was converted into logarithmic expression:

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

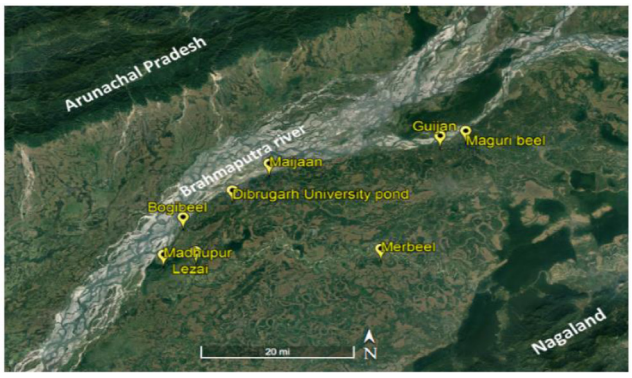

Figure 1: Geographical location of sampling sites in Maijan Beel, Dibrugarh, Assam, India.

Figure 2: (a) *Channa stewartii.*

Figure 2: (b) *Heteropneustes fossilis.*

Figure 2: (c) *Trichogaster fasciata.*

Where, 'W' is the weight of the fish

'L' is the total length of the fish

'a' is the regression intercept and 'b' is the regression slope.

The coefficient of correlation 'r' was estimated to determine the degree of linear relationship between the length and weight samples. It is calculated using the following formula:

$$r = \frac{\Sigma XY - n\bar{x}\bar{y}}{\sqrt{(\Sigma X^2 - n\bar{x}^2)(\Sigma Y^2 - n\bar{y}^2)}}$$

The Fulton's condition factor or Ponderal index was performed following Wooton.[17]

$$K = 100*W / L^3$$

Table 1: Computed parameters of length-weight relationship and condition factor of three freshwater fish species collected from Maijan Beel, Dibrugarh, Assam.

Family	Species	*n*	Total Length Range (cm)		Total Weight Range (g)		Regression parameters						K
			min	max	min	max	a^a	95% CL of a^a	b	95% CL of b	r	r^2	
Channidae	*C. stewartii*	31	7.9	20.6	4.5	64.0	0.0245	0.0104 -0.0575	2.61	2.28 -2.93	0.95	0.90	1.01
Clariidae	*H. fossilis*	42	9.8	19.0	5.0	37.8	0.0053	0.0028 – 0.01	3.00	2.76 -3.25	0.96	0.94	0.53
Belontiidae	*T. fasciata*	75	5.8	10.5	3.1	16.7	0.0288	0.0162 -0.0501	2.75	2.46-3.04	0.91	0.83	1.79

*n: sample size; min: minimum; max: maximum; a: intercept; b: regression coefficient; [a]- anti-log a CL: confidence of limits; r: coefficient of correlation; r^2: coefficient of determination; K: condition factor

where, 'W' is the weight of the fish (g); 'L' is the length of the fish (cm); 10^2 is the factor to bring the K- factor to unity. All statistical analysis was performed using Excel 2010.

RESULTS

In the present study, Table 1 represents the descriptive statistics and estimated parameters of LWRs, 'a' and 'b' with their 95% of confidence limits, coefficient of correlation (r), coefficient of determination (r^2) and condition factor (K) for three important freshwater fish species of Maijan Beel, Dibrugarh, Assam.

In *H. fossilis*, total lengths (TL) were recorded in the range of 9.8 to 19.0 cm with a weight range of 5.0 to 37.8 g. *T. fasciata* recorded the total length of ranged between 5.8 to 10.5 cm and weight from 3.1 to 16.7 g. And TL of *C. stewartii* was ranged from 7.9 to 20.6 cm and weight from 4.5 to 64.0 g. In this investigation, analysis on LWRs for all the fish species were found to be statically significant (p <0.05).

The value of exponent 'b' was also found within the range of 2.61 to 3.00 (Table 1). Highest 'b' value was recorded in *H. fossilis* (3.0) and lowest in *C. stewartii* (2.61). In *T. fasciata* also, the b-value was less than 3.0. The r-values for the investigated species were recorded in the range of 0.91 (*T. fasciata*) to 0.96 (*H. fossilis*). Similarly, coefficient of determination, r^2, was varied from 0.83 (*T. fasciata*) to 0.94 (*H. fossilis*) (Figure 3-5). Mean K-factor (Table 1) was observed with a range from 0.53 (*H. fossilis*) to 1.79 (*T. fasciata*).

DISCUSSION

The overall result of the current study revealed that the exponential value 'b' in all three species *C. stewartii*, *T. fasciata* and *H. fossilis* were found to be within the expected range of 2.5 to 3.5 as reported by many researchers.[18-20] In *H. fossilis*, the b-value remains constant at 3.0 showing isometric pattern of growth. A similar result was also observed by Hossain *et al.*[21] However, positive allometric growth in *H. fossilis* was observed by Khan *et al.*[22] and Islam *et al.*[23] The values of growth coefficient 'b' found in the present investigation for both *C. stewartii* and *T. fasciata* implies that there is less weight gain in comparison to cube of its length (b<3.0) thereby results negative allometric growth. This study also confirms the reports of Kalita *et al.*[24] in *C. stewartii* from Brahmaputra drainage. The growth pattern recorded in the current study on

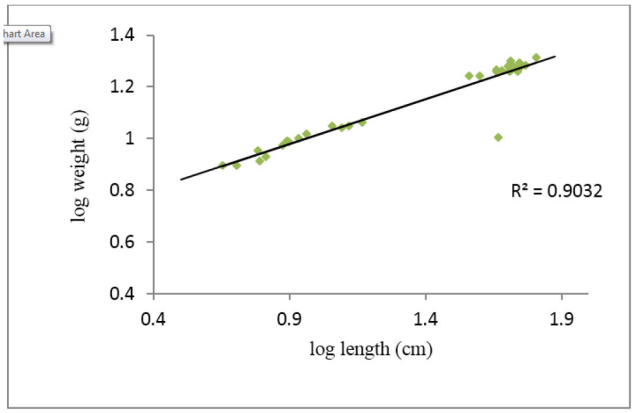

Figure 3: Length-weight relationship of *C. stewartii* from Maijan Beel.

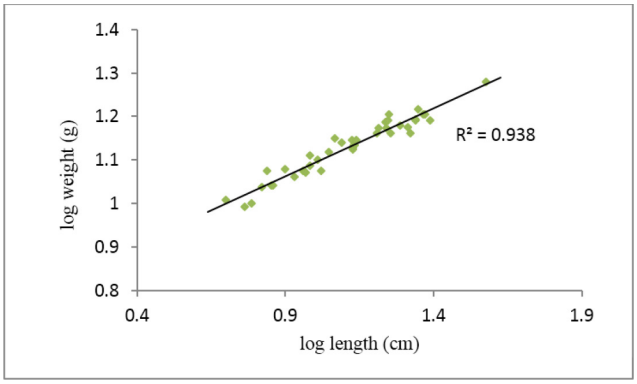

Figure 4: Length-weight relationship of *H. fossilis* from Maijan Beel.

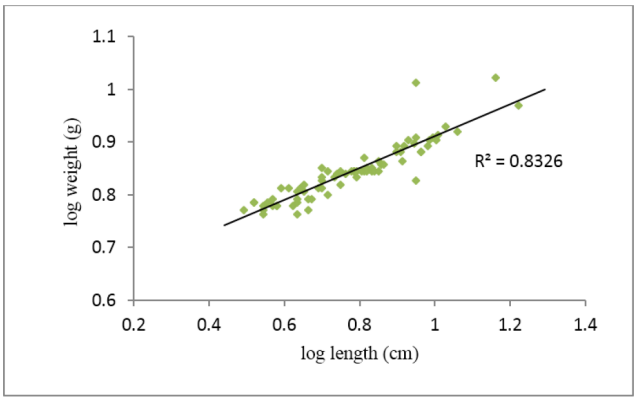

Figure 5: Length-weight relationship of *T. fasciata* from Maijan Beel.

T. fasciata also supports the findings of Rahman *et al*.[25] and Borah *et al*.[26] Variation in 'b' value can be attributed by the factors like natural habitat, behavior of the fish, time of spawning, fluctuations in environmental conditions such as temperature, water salinity, availability of food, amount of food taken by the fish, sex, maturity stages gonadal development and methods used in the samplings.[27,28]

The coefficient of correlation 'r' values explained the relationship between the length and weight of the species with a high degree of positive correlation when 'r' value is greater than 0.5.[29] Linear regression analysis were also observed highly significant ($p<0.05$) in all the three species indicates proper fit of the model for growth.

K-factor provides information on the physical and biological conditions and variations with relations to feeding circumstances, parasitic infestations and physiological factors.[30] When K-value becomes greater than 1, it shows the better healthiness of the fish.[31] Higher values of K suggest that the condition factor increase with increased in length and weight of the fish.[32] Moreover, it also reflects a good level of feeding and proper growth condition of the species.[33] In our current investigation, the *K*-value recorded in *C. stewartii* and *T. fasciata* indicates an overall wellbeing of the species in their ecosystem. The present result also supports the findings of Kashyap *et al*.[34] in *C. punctatus* and Deori *et al*. in *T. fasciata*.[35] However, *K* value recorded in *H. fossilis* (< 1) indicates poor health condition of the fish during the study. Similar results were also obtained by Muhammad *et al*.[36] The deviation of *K*-value from 1 may be due to certain factors such as changes in the abundance of food, water quality and water temperature and dissolved oxygen concentration.[37] Lizama and Ambrosio[38] also reported the influences on the condition factor by gonadal development as a large part of the energy is transferred to the gonads during the reproductive period of the fish.

CONCLUSION

The present research showed a significant correlation between length and weight of the three studied species, which is applicable to assess the growth of the population. Study of LWRs is considered to be an important tool in fisheries science, as it allows the conversion of growth-in-length equation to growth-in-weight equation. The finding of current research is also witnessed the usefulness of LWRs in assessing the biology, ecological status, wellbeing and condition and growth pattern of fish. And it will help to take proper planning for the management and strategies conservational measures for these highly important freshwater fish species of the NER.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this article.

ABBREVIATIONS

LWR: Length-weight relationship; **TL:** Total length; **CL:** Confidence of limits; **g:** Gram; **cm:** Centimeter.

SUMMARY

Length-weight relationship and condition factor are considered to be the fundamental fishery management tool as it provides vital information on the fish population dynamics and stock condition. *Channa stewartii*, *Heteropneustes fossilis* and *Trichogaster fasciata* are some of the economically important freshwater fish found in Maijan beel, Dibrugarh. Present study reports data on positive correlation between length and weight of the fishes during the period. Current investigation also observed both isometric and negative allometric pattern of growth. Additionally, the parameters employed in this investigation found *C. stewartii* and *T. fasciata* are in good health in the ecosystem while *H. fossilis* showed unfavorable condition. This study concludes the usefulness of LWRs and condition factor in determining the overall condition of the fishes and their habitats and thereby helps in its conservation on its own ecology.

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