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Studies on length-weight relationship of fish *Puntius sophore* (Hamilton) from the river Ghargharia at Cooch Behar, West Bengal, India

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Abstract

A true relationship exists between the length and weight of an animal. Generally the growth pattern follows the cube laws in fishes. Such relationship will be valid when the fish growth is isometric. The experimental value must be exactly 3 in such cases. This value may depart from the ideal value due to environmental conditions or condition of fish in reality. This relationship is expressed by the equation "$W = a L^b$". Present study attempts to develop a comprehensive length-weight relationship of Puntius sophore collected from river Ghargharia at Cooch Behar in West Bengal. In this study, a total of 25 fish specimen comprises of Puntius sophore ranged from 4.5 cm to 8.2 cm in length and 1.11 gm to 8.14 gm in weight were studied for the length-weight relationship. The entire length-weight data were analysed by least square method. The corresponding parabolic representation is $W = 0.007524L^{3.3204}$. The equilibrium constant "b" is found to be 3.3204. The equilibrium constant does not obey the cube law because it deviates from 3. It indicates the environment of Ghargharia River was found good for healthy development of Puntius sophore.

Keywords: Length-weight relationship, *Puntius sophore*, cube law, Ghargharia River.

Introduction

The study of length-weight relationship is performed to obtain information of biological significance such as maturity, taxonomic differences in species, population dynamics, suitability of habitat etc. The growth of any animal is considered in terms of increase in volume. The volume is expressed by weight, which is related to the cube of linear dimensions. Thus, there is a true relationship exists between the length and weight of an animal. Generally the growth pattern follows the cube laws in fishes. Such relationship will be valid when the fish growth is isometric. In such cases, the experimental value must be exactly 3. But in reality, the actual relationship between length-weight may depart from the ideal value due to environmental conditions or condition of fish. This relationship is expressed by the equation "$W = a L^b$". This mathematical relationship between length and weight is a practical index suitable for understanding their survival, growth, maturity, gonadal development and general well being of the fish[1]. This general equation also forms the basis for the calculation of unknown weights from known lengths or unknown lengths from known weights. The general expectation is that the weight increases as the cube of length[2,3]. In addition, the length-weight relationship indicates the degrees of stabilization of taxonomic characters in fish species and very useful in the management and exploitation of fish populations[4]. This is also a useful tool that provides important information concerning the structure and function of fish populations[5].

The Pool barb, *Puntius sophore* (Hamilton 1822), belongs to the family Cyprinidae. It resides in the Indian sub-continent including Bangladesh, Bhutan, India, Nepal, and Pakistan[6-9]. This fish is also reported from Afghanistan, Myanmar and Yunnan (China)[7,9,10]. This fish species is an important target species for small scale fishers[12,13], because it dominantly inhabits in the rivers, streams, ponds, *beels*, floodplains, *baors*, *haors* in plains and sub-montane regions[11,6].

A variety of traditional fishing gears are used by the fishers to catch them. This fish is a regular diet of rural small-scale farmers and also serves as a major source of animal protein and micronutrients to them[14]. In addition, *Puntius sophore* is very much popular food fish item[12], as well as it can also be used as an aquarium fish[15]. However, due to heavy fishing pressure, *P. sophore* is declining rapidly in their habitats. In some recent studies from the Indian water bodies, it is categorized as lower risk near threatened in the Western Ghat[16], in Harike wetland, a Ramsar site[17] and in Gomti River, a tributary of river Ganga[18].

A number of studies on a variety of aspects on *Puntius sophore* population including its biology, length-weight relationship (LWR), and relative condition factor in Indian waters[9,6,19], growth in Jamuna river, Bangladesh[20], length-weight and length-length relationships in the Mathabhanga river, northwestern Bangladesh[21], biodiversity in Pravana Sangam district Ahmednagar, India[22] and breeding ground profile in Damodar River System, India[23] have been conducted.

Presently, there are limited studies done on the freshwater fishes in Cooch Behar district of West Bengal (India) which emphasises on the length-weight relationship and their relation to the environmental conditions. Therefore this study aims to describe the length-weight relationship of the species *Puntius sophore* in the Ghargharia River in Cooch Behar district of West Bengal.

Materials and methods

Study site: The present study was carried out in the river Ghargharia, a tributary of the Torsa river and one of the main resources having a water stretch of 65 km flowing from Uttar Sonapur, Alipurduar district (origin) to Bhelakopa Pratham Khanda, Cooch Behar district (meeting point with Sil Torsa river) and flowing majorly through the Cooch Behar district of West Bengal covering mostly rural areas. One study point with 26° 31´ 41″ North latitude and 89° 55´ 41″ East longitude on that river was selected for present study.

Sample collection: Fishes were collected from the study site with the help of local expert fishermen using different types of conventional fishing gears including nets.

Identification: The fish obtained from sampling location were identified by consulting the literatures like Talwar and Jhingran[9] and Jayaram[24] (1999) and the FISHBASE[25] online fish identification sheet. The identification was done *in-situ* when possible.

Measurements: The length measurements of the samples were recorded as total length (TL) in cm and the fish was weighed (W) in gram. The total length (TL) of each fish was taken from the tip of the snout (mouth closed) to the extended tip of the caudal fin to the nearest centimeter (nearest ± 0.01cm). The weight (W) of each fish was weighted to the nearest gram (nearest ± 0.001gm) using a top loading balance.

Length-weight relationship (LWR): The relationship between length and weight of fish was analyzed by measuring length and weight of fish specimens collected the from study area. The statistical relationship between these parameters of fishes was established by using the parabolic equation by Wooton[26].

$$W = a\,L^b$$

Where, W = weight of fish in grams, L = Total length of fish in centimetre, a = constant, b = an exponent.

For practical purpose this relationship is usually expressed in its logarithmic form and the Log form of the above equation is used in present work as given by Le Cren[1]:

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

Statistical Analysis: Parameters '*a*' and '*b*' were estimated by linear regression analysis based on natural logarithms. Statistical analysis and some graphical representation are made using Microsoft excel (Version Windows 2007), a computer based programmer for windows. Some of the calculations are made with the help of PAST software.

Results and discussion

A total of 25 collected specimens of fish *Puntius sophore* were computed for length-weight relationship. Total length ranged from 4.5 cm to 8.2 cm and weight from 1.11 gm to 8.14 gm. The data on length and weight was transformed to logarithmic form (Table-1).

Table-1: Transformed logarithmic form of length and weight of all collected fishes.

Weight (gm)	$\log_{10}W$	Length (cm)	$\log_{10}L$
1.11	0.0453	4.5	0.6532
1.31	0.1173	4.6	0.6628
1.58	0.1987	4.7	0.6721
1.72	0.2355	4.9	0.6902
1.80	0.2553	4.9	0.6902
1.90	0.2788	5.1	0.7076
2.08	0.3181	5.2	0.7160
2.25	0.3522	5.3	0.7243
2.41	0.3820	5.6	0.7482
2.67	0.4265	5.6	0.7482
2.78	0.4440	5.7	0.7559
2.91	0.4639	5.8	0.7634
3.27	0.5145	6.0	0.7782
3.63	0.5599	6.2	0.7924
3.95	0.5966	6.5	0.8129
4.28	0.6314	6.8	0.8325
4.62	0.6646	6.9	0.8388
4.71	0.6730	7.1	0.8513
5.26	0.7210	7.3	0.8633
5.83	0.7657	7.4	0.8692
6.36	0.8035	7.5	0.8751
6.94	0.8414	7.7	0.8865
7.40	0.8692	7.8	0.8921
7.90	0.8976	8.0	0.9031
8.14	0.9106	8.2	0.9138

The total length - total weight relationships were separately evaluated for all individuals. The scattered plot for length and weight for *Puntius sophore* has been presented in Figure-1. Scattered plot also showed that length and weight followed a parabolic (exponential) relationship.

On the basis of results the parabolic relationship for weight and length were obtained. The result of logarithmic length-weight relationship in *Puntius sophore* under the present study is as follows during the period of investigation in Ghargharia River in Cooch Behar.

As, $a = 0.007524$ and $b = 3.3204$ and $Log\ a = -2.1235$

Then, $Log\ W = -2.1235 + 3.3204\ Log\ L$

Or, $W = 0.007524\ L^{3.3204}$

Another Linear Regression line was also prepared to estimate the relation between Log Total Length (cm) and Log Body Weight (g) of *Puntius sophore*. The result are shown in Figure-2.

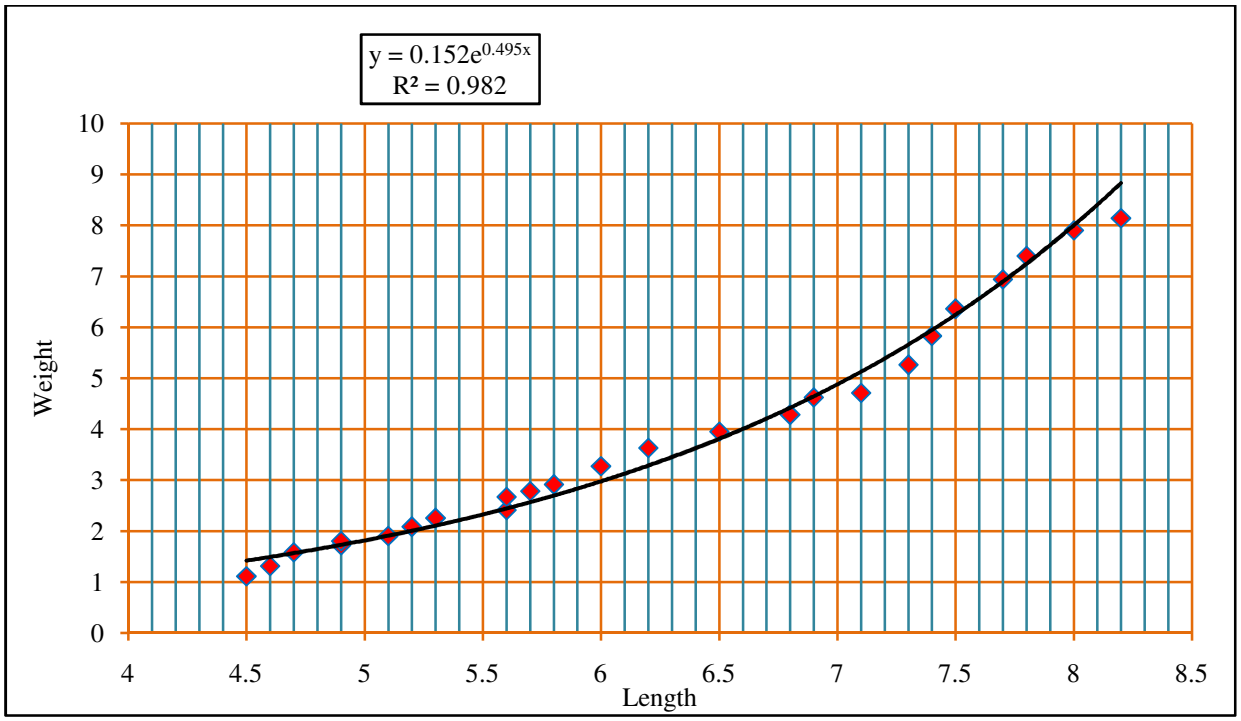

Figure-1: Length–weight relationship of *Puntius sophore* (showing exponential curve).

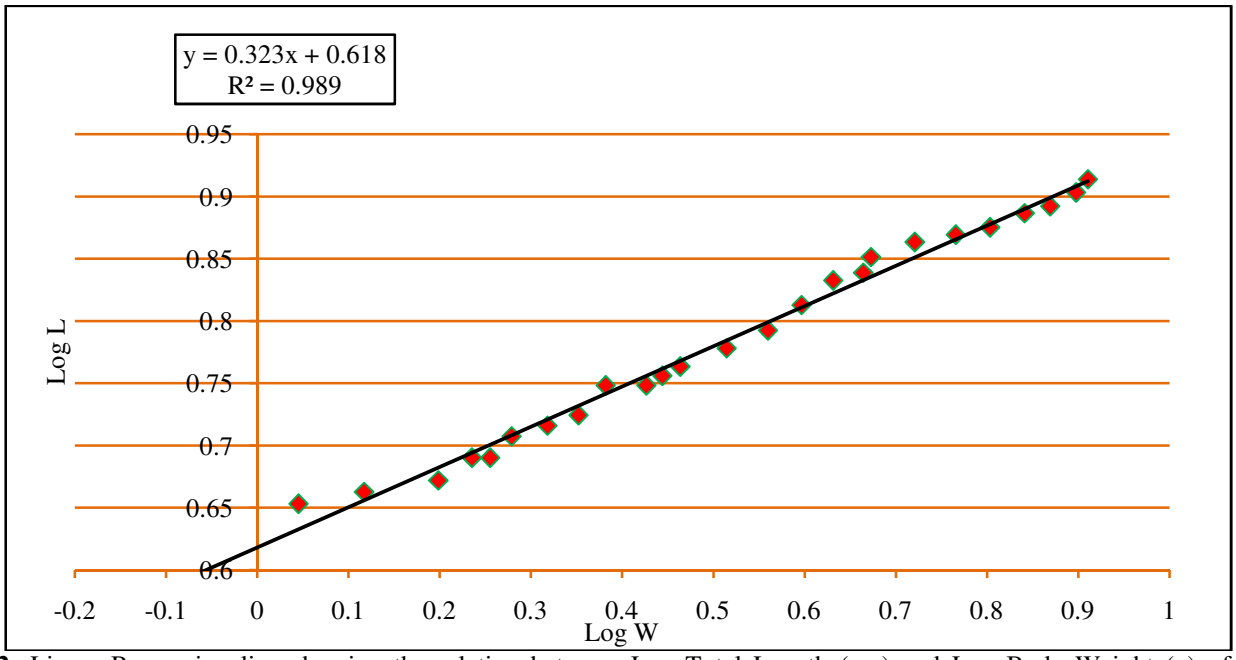

Figure-2: Linear Regression line showing the relation between Log Total Length (cm) and Log Body Weight (g) of *Puntius sophore*.

Figure-3: Some photographs of our work on length and weight of *Puntius sophore.*

The regression slope, '*b*', was 3.3204, which is also higher than the allometry coefficient value of 3. So, the '*b*' value was within the limits 2.5-3.5 reported by Froese[27] for most fishes. This indicates that the growth was positively allometric, i.e. faster in weight than in length[28]. Variations in the *b* values may be attributed to differences in ecological conditions of the habits or variation in the physiology of animals, or both[1]. The cube law of Le Cren's concept hypothetically stated that the value of '*b*' in ideal fish to be 3, indicating an isometric growth, which is widely used as a scale in length–weight relationship study. The values of '*b*' in the present study 3.3204. This indicates that the fish had positive allometric growth.

Various workers have studied the length weight relationship of many fish species from different water bodies. Hossain *et al.*[29] studied length -weight relationship of 10 small fish species from the Ganges, Bangladesh and Sarkar *et al.*[30] studied the length weight relationship of an commercially important species *Chitala chitala* (state fish of Uttar Pradesh) from river Ganga basin. The length-weight relationship (LWR) is a useful tool in fishery assessment, which helps in predicting weight from length required in yield assessment[31] and in the calculation of biomass[32]. The effective management of any fishery requires considerable knowledge of population parameters such as length-weight relationship. This relationship is very important in fisheries biology because it allows estimation of average weight of the fish of a given length group[33], assess the well-being of individuals and to determine possible differences between separate unit stocks of the same species[34]. The relationship is also important in fisheries management for comparative growth studies[35,36]. An investigation by Pauly[37] found that length-weight relationship (LWR) provides valuable information on the habitat where the fish lives while Kulbicki[38] stressed on the importance of LWR in modeling aquatic ecosystems. Length-weight relationship gives the condition and growth patterns of fish. It provides important information concerning the structure and function of fish populations[39]. The length-weight determination of *Puntius sophore* in Ghargharia River was considered to be of significant interest. Apart from assisting in the prediction of the average weight of this fish at a given length, it was also used to assess the well-being of its population in this river.

Conclusion

The obtained result from this study will provide baseline information on length-weight relationship of *Puntius sophore* from Ghargharia River in Cooch Behar district of West Bengal. Present study concludes that the length and weight of *Puntius sophore* from Ghargharia River in Cooch Behar followed a parabolic (exponential) relationship. The corresponding parabolic representation is $W = 0.007524L^{3.3204}$. The equilibrium constant "*b*" is found to be *3.3204*. This indicates that the fish has positive allometric growth in the Ghargharia River of Cooch Behar. The information obtained from the present study is believed to become an important knowledge on length-weight relationship of *Puntius sophore* from Ghargharia River in Cooch Behar district of West Bengal and also for future comparison in other locations.

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