



LENGTH-WEIGHT RELATIONSHIP AND CONDITION OF *HETEROPNEUSTES FOSSILIS* (BLOCH) OF VELLAYANI LAKE, KERALA, INDIA

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ABSTRACT

The present study relates the length-weight relationship and condition factor of *Heteropneustes fossilis* (Bloch) from Vellayani Lake, Thiruvananthapuram, Kerala. The study was carried out using fishes belonging to different size categories during December 2017 to May 2018. A total of 128 specimens of *Heteropneustes fossilis* were used for the analysis. The total length of the fishes analysed ranged from 18cm to 31.8 cm with a mean length of 25.27 cm and the total weight ranged from 11.94 g to 216.41 g with an average weight of 116.23 g. The length – weight relationship calculated for the total fishes was $W = 0.000070501 L^{2.7414}$. The slope value was lower than the critical isometric value of 3 exhibiting negative allometric growth in larger length groups (25-35 cm) whereas 'b' exhibits positive allometric growth in smaller (15-25cm) forms. The condition factor of *Heteropneustes fossilis* observed ranges from 0.5078 to 1.0284 with a mean value of 0.8802. The negative allometric growth observed in the largest category may be due to lower feeding proficiencies or may be the result of loss of energy for breeding purpose.

KEYWORDS: Length-Weight relationship, condition factor, *Heteropneustes fossilis*, Vellayani Lake.

INTRODUCTION

The Indian stinging catfish, *Heteropneustes fossilis* (Bloch), belong to the fish family Heteropneustidae is found throughout south and Southeast Asian countries including.

Bangladesh, India, Laos, Myan-mar, Nepal, Pakistan, Sri Lanka and Thailand (Talwar and Jhingran, 1991). *H.fossilis* is considered as a significant fish commercially and aqua culturally in many Asian countries (Hossain *et al.*, 2015). Due to the accessory respiratory structures it can survive even in oxygen depleted water. It is heavily fished for its energizing meat quality that includes taste, nutritional, and medicinal values. There are high amounts of protein, iron (226 mg/100g) and calcium in its muscles (Saha and Guha, 1939; Alok *et al.*, 1993). Being a lean fish (fat content only $2.57 \pm 0.24\%$), it is conducive to people on low-fat diets (Rahman *et al.*, 1982).

Length- weight relationship is one of the most popular aspects which are being extensively studied in fishery biological investigations. It establishes the mathematical relationship between the two variables and helps in assessing growth, maturity, reproduction, general well being, and it enables conversion of one variable to another (Bagenal and Tesch, 1978; Pauly, 1983; 1993). The length-weight relationship can be extended for the

estimation of fish condition assuming that a heavier fish of a given length is in a better condition (Le Cren, 1951). Variations in fish's condition factor primarily reflect its state of sexual maturity, degree of nourishment and the general well being of the individuals.

Inland fisheries have a great scope in Kerala, as the state is endowed with fresh water resources consisting of rivers, backwaters, estuaries, fresh water lakes, reservoirs, minor irrigation tanks and ponds. The inland fish production provides significant contribution to the animal protein supplies in rural areas of the state. Vellayani Lake, spread over 7.5 acres is one of the three rain-fed freshwater lakes in Kerala and is the largest fresh water lake in Thiruvananthapuram district, located 9 Kms from Thiruvananthapuram the capital city of Kerala. The lake water is extensively used for drinking and irrigational purposes in addition to the fish culture by the Fisheries Department, Government of Kerala.

Morphometric relationships of length and weight have been determined in several species of fresh water fishes. However, limited information is available on air breathing fish species. The Stinging Catfish *Heteropneustes fossilis* commonly known as 'Kaari' in Kerala is one of the major fish species in terms of abundance in the Vellayani Lake.

Therefore, the present study was undertaken to determine the length-weight relationship and condition factor of *Heteropneustes fossilis* inhabiting Vellayani Lake.

MATERIALS AND METHODS

In the present study 128 numbers of live samples of *Heteropneustes fossilis* of various age groups were collected from different parts of the Vellayani Lake during the period December 2017 to May 2018. The total length and standard length of the fishes were measured to the nearest mm and weight to the nearest 0.1 g. Length-weight (log-transformed) relationships were determined by linear regression analysis using the data analysis package in SPSS software (version-16). The mean, standard deviation and correlation coefficient of total length, standard length and body weight were also calculated. It was calculated for two length categories (15-25 cm and 25-35 cm) and for the total fishes collected.

The length-weight relationship was worked out as per cube law given by Le Cren (1951)

$$W=aL^b$$

Where, W = weight of fish (g), L = the observed total length (cm), 'a' is the rate of change of weight with length (regression intercept) and 'b' is the weight at unit length (regression slope).

The logarithmic transformation of the formula is

$$\text{Log } W = \log a + b \log L$$

When 'b' is equal to 3 isometric pattern of growth occurs, but when 'b' is not equal to 3, allometric pattern of growth occurs, which may be positive if >3 or negative if <3. Bailey's t- test (Snedecor and Cochran, 1967) was employed to determine if regression coefficients differed significantly from the isometric value of 3 following the formula,

$$t = b-3/S_b, \text{ where}$$

b = regression coefficient of log transformed data and S_b = standard error of b

Condition factor (K), a measure of the well-being or plumpness of fish, was calculated following the equation proposed by Fulton (1904), assuming that the weight of a fish is proportional to the cube of length.

$$K=100x(W/L^3)$$

Where, W = body weight of the fish and L= total length of the fish

RESULTS AND DISCUSSION

The total length and weight of *Heteropneustes fossilis* used in the present study varied from 18cm to 31.8 cm and 11.94 g to 216.41 g respectively. Range and mean \pm SD of total length, standard length and body weight for *Heteropneustes fossilis* are given in the Table-1.

Tables II and III represents the size related variations in the total length - weight relationship and standard length weight relationship of the fish. Regression equation revealed that the value of b for the total fishes collected (2.7414) is significantly different from 3 (t- test<0.05)

indicating that length – weight relationship of the species depart significantly from isometry. The value of 'b' remains constant at '3' in an ideal fish (Allen, 1938), but under natural conditions the value of 'b' usually ranges between 2.5 and 4 (Hile, 1936; Martin, 1949). When b=3, the growth is isometric and the increase in weight is proportional to the cube of length. When the value of b varies from 3, weight increase is said to be allometric. In the present study 'b' varied between 2.414 and 3.209 in the various size categories. The slope value was lower than the critical isometric value of 3 in larger length groups whereas the 'b' value is higher than 3 in smaller sizes.

Any indication in biological events could be recorded by allometric law since 'a' and 'b' of allometric formula might vary within a wide range for very similar data and very sensitive to even slight variations in various factors. Variations in the slope mostly reflect the change in the body form when the weight of the fish gets affected by environmental factors like temperature, food supply, spawning conditions and other factors like life stages, sex, fishing area, fishing time and sample size variations (Ricker, 1973; Bagenal and Tesch, 1978; Kleantids *et al.*, 1999). Allometric growth is negative (b < 3) if the fish gets relatively thinner as it grows larger, and positive (b > 3) if it gets plumper as it grows larger. The results of the present study is in conformity with the views of Le Cren (1951), Wootton (1992), Khan *et al.* (2011), Myla *et al.* (2012), Kuldeep Kumar *et al.* (2013) and Preetha G Nair *et al.* (2015) that the fish normally does not retain the same shape or body outline throughout their life span and specific gravity of tissues may not remain constant and the actual relationship may depart significantly from the cube law. Higher metabolic activity with spawning season lowers the 'b' value while less metabolic activities; accumulation of fat, weight of gonad etc. during the pre-spawning period increases the values (Weatherly and Gill, 1987). The negative allometric growth due to loss of energy in gonad development at breeding season was reported by Das *et al.* (1997). The closeness of 'b' values to 3 also suggests a healthy environment for the fishes with respect to feeding and growth. Figs. 1-6 illustrates the length-weight relationship in *Heteropneustes fossilis* of Vellayani lake. Standard length- weight relationship of the species in the lake was also allometric (b= 2.619 for total fishes) and the allometry was towards positive (b= 3.083) in the smallest size category (15-25 cm). The correlation coefficient 'r' in length- weight relationship of total fishes ($r^2 = 0.9575$) and that in the lowest size category ($r^2 = 0.9515$) were closest to 1.

The condition factor is used in fisheries science to compare the 'condition', 'fatness' or wellbeing of fish. It is based on the hypothesis that heavier fish of a particular length is in the better physiological condition than lower weight (Bagenal, 1978). Condition factor basically represents the quality of fish, which is actually the result of the interactions between biotic and abiotic factors and

their effect on the physiological condition of the fish. Condition factor is primarily used as an index for monitoring the state of sexual maturity and the feeding intensity of fish (Wootton, 1990; Williams, 2000). When condition factor value is higher it means that the fish has attained a better condition. The condition factor observed for *Heteropneustes fossilis* in the present study fluctuated from 0.5078 to 1.0284 and the values (mean) were comparatively higher in lower size category (Table IV). Fluctuations in condition factor were reported earlier in various species of fishes in relation to reproductive cycle, feeding rhythms, age, physiological state and physico-chemical factors of the environment (Kurup and Samuel, 1987; Kurup, 1990; Kalita and Jayabalan, 1997; Alex Nehemia *et al.*, 2012; Preetha G.Nair *et al.*, 2015; Das *et al.*, 2015; Anila Kumary and Smrithy raj, 2016; Anila

Kumary and Pooja Moncy 2017; Anila Kumary and Karthika, 2017). The variations in condition factor in the size categories analyzed can be attributed to factors such as life stages, faster growth rate of young ones, differences in food reserves, food preferences and variations in the samples collected.

The present study has revealed that there is significant deviation in the slope value from the critical isometric value of 3 in *Heteropneustes fossilis* of Vellayani lake and shows low condition factor in the environment. The lower size group shows insignificant positive allometric growth while the larger size groups exhibits significant negative allometric growth. The study suggests that effective management measures should be adopted for the conservation of the species in the study area.

Table 1: Range and mean \pm SD of total length, standard length and body weight for *Heteropneustes fossilis*.

Morphometry	Minimum	Maximum	Mean \pm SD
Total Length(cm)	18.00	31.80	25.27 \pm 3.68
Standard Length(cm)	15.80	28.70	22.56 \pm 3.43
Total weight(g)	11.94	216.41	116.23 \pm 45.03

Table II: Size - related variations in total length - weight relationship of *Heteropneustes fossilis*.

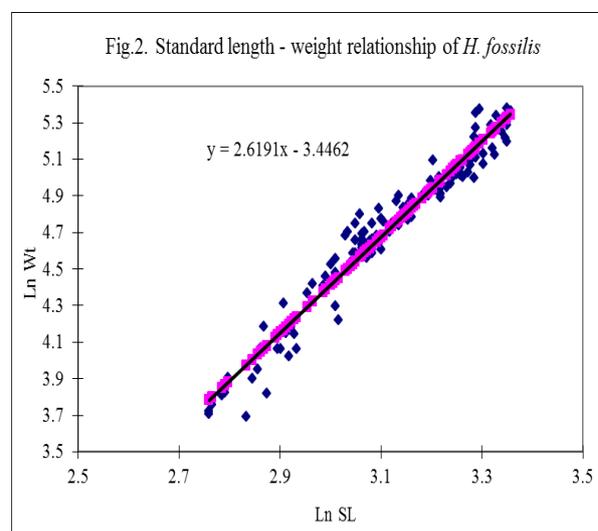
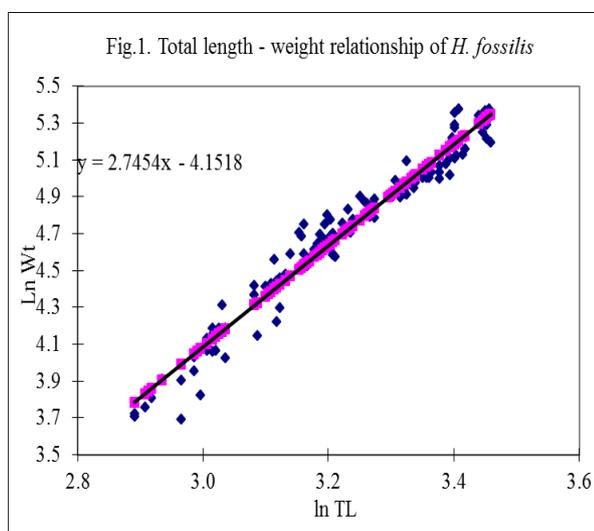
Category	No. of samples	Regression equation (log W= log a+ b log L)	Parabolic equation (W= a L ^b)
15-25cm	62	-5754+3.2093 log L	0.000002658 L ^{3.2093}
25-35cm	66	-3.0568+2.414 log L	0.0008774 L ^{2.414}

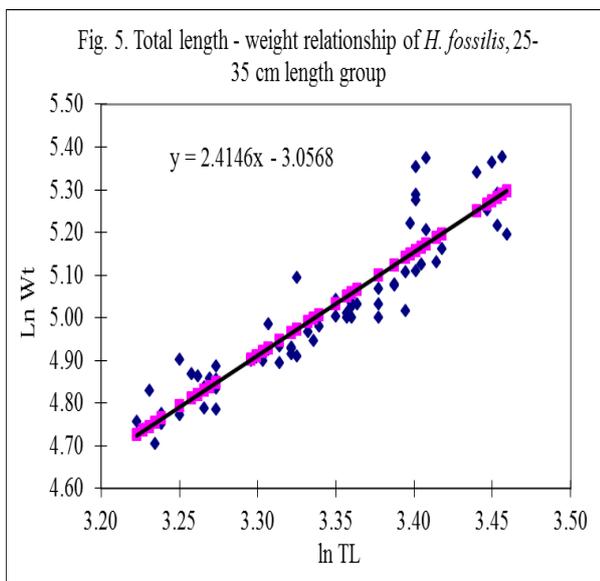
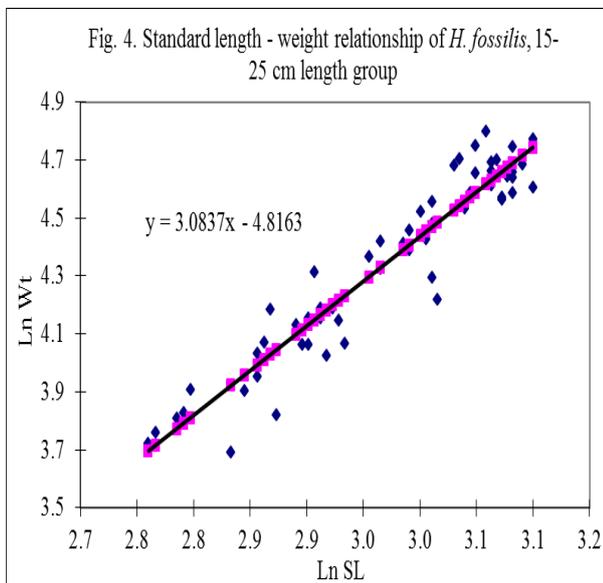
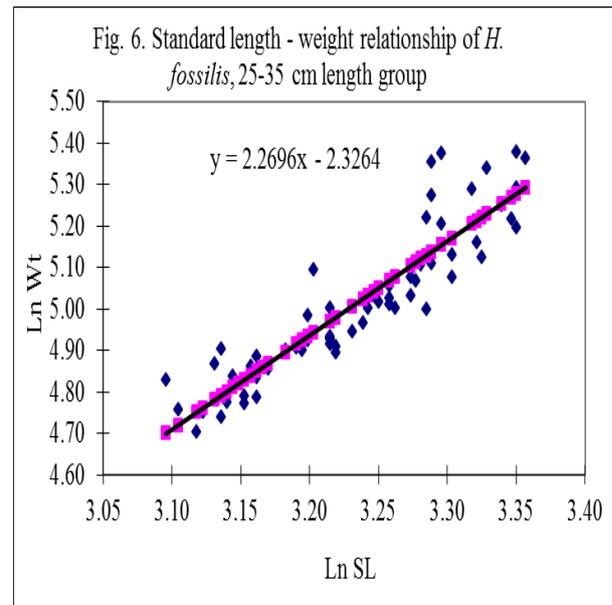
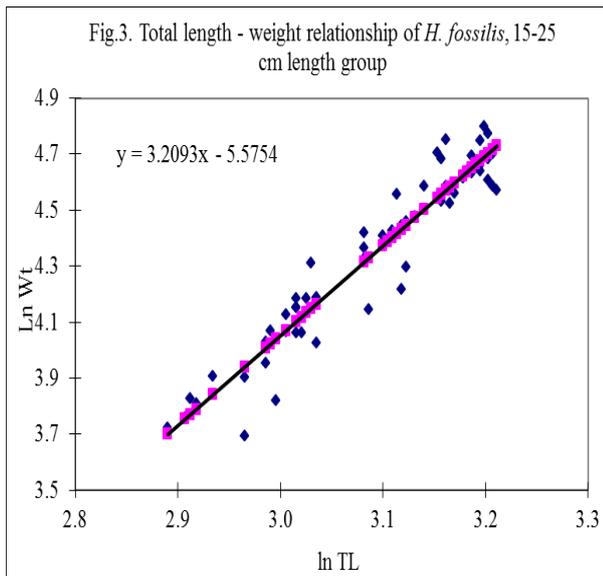
Table III- Size - related variations in standard length - weight relationship of *Heteropneustes fossilis*

Category	No. of samples	Regression equation (log W= log a+ b log L)	Parabolic equation (W= a L ^b)
Total	128	-3.4462+2.6191 logL	0.0003579 L ^{2.6191}
15-25cm	62	-4.8163+3.0837 logL	0.00001562 L ^{3.0837}
25-35cm	66	-2.3264+2.2696 logL	0.004716 L ^{2.2696}

Table IV: Size dependent variations in condition factor of *Heteropneustes fossilis*.

Category	No. of samples	Minimum	Maximum	Mean
Total	128	0.5078	1.0284	0.8802
15-25cm	62	0.5078	1.0284	0.9216
25-35cm	66	0.5612	0.9724	0.7591





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