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LENGTH-WEIGHT RELATIONSHIP OF FRESH WATER FISH *LABEO BATA* (HAM.) FROM RIVER GHAGHRA

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ABSTRACT

The length-weight relationship (LWR) was estimated in *Labeo bata.* It was observed that this fish did not follow the cube law strictly and the weight increased at a rate more than the cube of the length. The analysis of covariance did not show any significant difference in the value of 'n' between the fishes of different size, sex and maturity stages in a population. The males were slightly heavier than females at smaller sizes and females were heavier than males at larger sizes and the two length - weight intersected at a point between 245 mm and 270 mm. This point of intersection represents the size at first maturity of the fish.

Key words: length-weight relationship, *Labeo bata*

INTRODUCTION

The mathematical relationship between length and weight of fishes is a practical index suitable for understanding their survival, growth, maturity, reproduction, general wellbeing of the fish and development, time of spawning and the size at the first maturity. Length and weight data are of paramount importance and finds its applications in fish stock assessment studies and in the estimation of potential yield per recruit. In addition, it establishes the mathematical relationship between the two variables, the length and weight so the unknown variable can be readily calculated from the known variable. Besides the relative condition factor could also be estimated to assess the general wellbeing of fishes. Since the species exhibits growth variation, it is necessary to study the actual relationship between the length and weight , which may depart from the cube value 3 owing to the environmental condition in which animal lives. The relationship could also depart due to the physiological condition of the fish.

Length-weight relationships are useful in fishery management for both applied and basic use therefore, it was extensively studied by scientists from time to time (Tripathi,P. N., et al.,2010). However, the present study reports the length-weight relationship of *Labeo bata* of the Ghaghra River from the district Kheri – Lakhimpur and Bahraich in Uttar Pradesh, India.

MATERIAL AND METHODS

The length-weight relationship of *Labeo bata* is based on fishes collected from river Ghaghra at Dhakerwa Fish Market (District : Kheri – Lakhimpur). The total length of the fish was measured up to the nearest mm from the tip of the snout to the end of the largest caudal fin ray. The weight of the fish was taken up to the nearest mg on a pan balance. Sexes were determined by an examination of gonads. The fishes were divided into three groups, viz., immature, mature and combined. The length-weight relationship of the fish has been described be the cube law, i.e., $W = CL^3$, where 'W' and 'L' are weight and length of fish, respectively and 'C' is a constant. The cube law is based on the assumption that the weight is a volume function and length is a linear function and weight of the fish is roughly equal to the cube of the length. This law can, however, be applicable if the form and specific gravity of the fish remain constant throughout the life. However, the requirements are rarely met since the specific gravity of the fish does not remain constant and varies considerably according to different conditions of the life. Therefore, to eliminate such limitations, the equation $W = aL^n$ (where, W and L are weight and length of the fish respectively and 'a' and 'n' are constants to be determined empirically) has been used.

The length-weight of the fish was converted into log weight in order to obtain a straight line relationship. The relation of the log weight or log length was calculated by least square method and the equation Log W = Log a + n log L, was worked out separately for each group of the fish.

$$\log a = \frac{\Sigma \log W . \Sigma(\log L)^2 - \Sigma \log L (\log L . \log W)}{N \Sigma(\log L)^2 - (\Sigma \log L)^2}$$

Where,

W = Weight of the fish in g

L = Length of the fish in mm

N = Number of observations

Log 'a' is the intercept and 'n' is slope

$$n = \frac{\Sigma \log W - N \log a}{\sum \log N}$$

The length and weight were two variables and a correlation coefficient known as 'r' was computed as follows –

$$r = \frac{N\Sigma XY - \Sigma X \Sigma Y}{\sqrt{\left[N \Sigma X^2 - (\Sigma X)^2\right]} . \sqrt{\left[N \Sigma Y^2 - (\Sigma Y)^2\right]}}$$

The regression of log weight on log length of the fishes of different groups was compared by adopting covariance analysis (Snedecor and Cochran, 1989).

The food of *L. bata* (Ham.) consists chiefly of phytoplankton (green algae, diatoms, blue green algae, desmids, phytoflagellates, algal spores and zygotes), macro-vegetation and decayed organic matter (*Seston*). Zooplanktons are very rare in the diet of the adult fishes. However, zooplanktons are the main food of fingerlings and as the fish grow, they change their feeding habits from zooplankton to phytoplankton. Green algae and diatoms were the most important food items and constituted about 35.4% of the total food.

The intensity of feeding was maximum during post-monsoon (October-November) and winter months (December-February) and low during post-winter (March-April), summer (May and June) and monsoon months (July-August). An increase in the feeding intensity of the fish during winter seems to be related to the availability of the algal bloom in the aquatic environment in which the fish lives and during the season when the flood water carries a lot of silt and plankton production is greatly decreased. The feeding intensity is also reduced owing to the scarcity of the food. Besides, the gonadal maturation also affects the feeding intensity of the fish as minimum food intake was found in ripe fishes. No difference was observed between the food of males and females fishes.

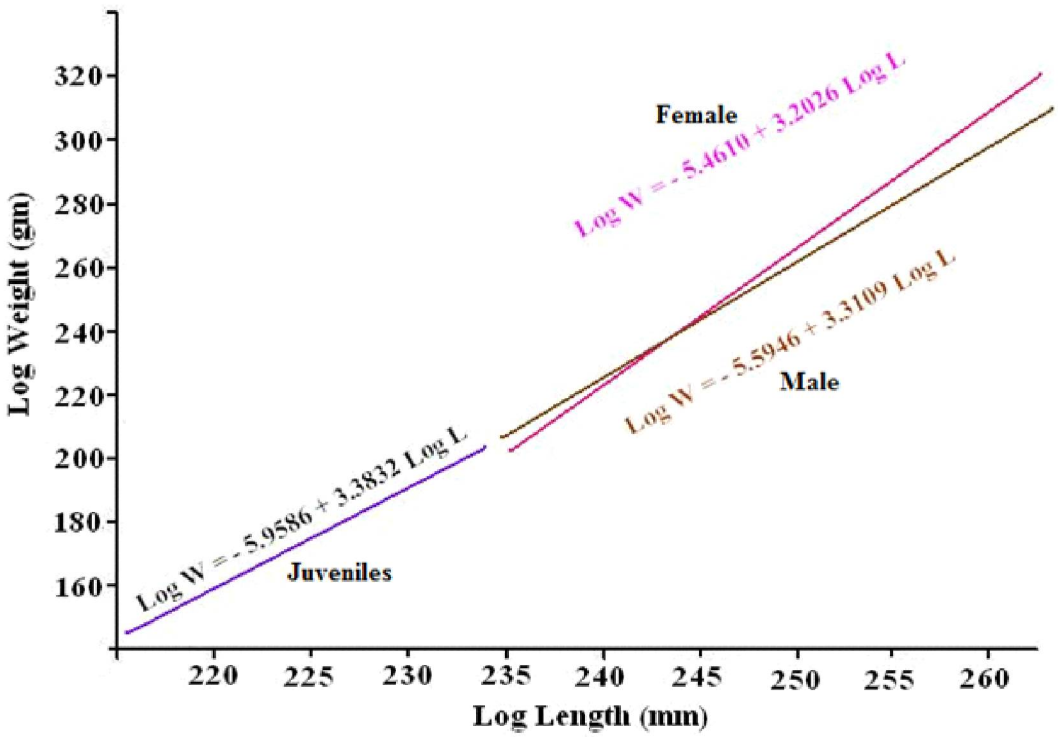

Fig.1 : Length-weight relationship of Male, Female and Juveniles of *Labeo bata*.

RESULT AND DISCUSSION

Regression analysis of length-weight relationship along with the test of significance showed that the 'n' values were found to differ from one group to other and were 3.2027 in ripe females and 3.3108 in ripe male. The value of 'n' was highest (3.3830) in juveniles and lowest in females (3.2025). It was significant to note that 'n' values calculated at 95% confidence intervals for male, female and juvenile were always higher than 3. (Fig.1)

The length-weight relationship of males, females, juveniles (Fig.1) and of combined fishes can be expressed with the following equations –

Juvenile Log W = -5.9586 + 3.3832 Log L
Male Log W = -5.5946 + 3.3109 Log L
Female Log W = -5.4610 + 3.2026 Log L
Combined Log W = -5.3106 + 3.1665 Log L

It may be seen that the increases in weight in relation to length was well appreciable above 200 mm. Females were found lighter than males up to length of 245 mm while the males were lighter than females at higher lengths and the length-weight curves of the two sexes intersected at a point between 245 mm and 270 mm.

For *Labeo bata* the values of slope 'n' were always higher than 3 and significantly different. Hence the length-weight relationship did not follow the cube law strictly. It is quite clear from the result that the weight of fishes increased more than the cube of the length. In other carps higher values of 'n' was more than 3 have also been reported. Natarajan and Jhingran (1963) observed a value of 3.2328 in case of *Catla catla* while Jhingran (1952) reported a value of 3.221 in *Cirrhinus mrigala*. Chakrabarty and Singh (1963) also observed that the value of 'n' was considerably higher than 3 in *Cirrhinus mrigala*. These authors have considered total length as a parameter in calculating the value of 'n' while Jhingran (1952) in studying the length-weight relationship of the major carps, used furcal length as a parameter and calculated the value of 'n' as 3.15172, 32483 and 31460 in case of *C. mrigala*, *C. catla* and *L. rohita* respectively. His observation showed that the departs from 3 was least in case of *L. rohita* and was not significant. Khan (1972) also observed that value of 'n' as 3592 and 3520 in case of *L. rohita* and *C. mrigala* respectively. Bhatnagar (1972) reported the value of 'n' in *Labeo fimbriatus* as 3802. Sinha (1972) estimated a value of 'n' to be 32 in *Puntius sarana*. However, Khumar and Siddiqui (1991) reported the value of 'n' in *P. sarana* to be more than 3 in case of female, juvenile and combined fish from river Ganga and Yamuna, but surprisingly the value of 'n' in males from both the environment was very close to 3 (2.9610 and 2.9588 in fish from river Ganga and river Yamuna), respectively. Chatterjee (1981) reported the value of 'n' to be 3.1010, 3981, 3.1322 and 3.7794 in male, female, juvenile and combined fishes, respectively in *L. gonius*. He (1981) also reported higher values of 'n' in *Labeo bata*. Nisha Shukla (2002) found values of 'n' to be 3.341775, 2.562666 and 3.341775 in immature fish, mature fish and combined (both immature and mature fishes combined) to be 3.341775 in case of *Labeo gonius*. These investigations show that the value of 'n was always higher than 3 in case of carps, except that reported by Nisha Shukla (2002) in case of *L. gonius*. The present study also reveals a clear departs from 3.

Jhingran (1952) in *L. rohita* and Khan (1972) in *L. rohita* and *C. mrigala* found an interesting relationship between observed and calculated

Figure 1 juvenile

Figure 2 (a) male (b) female

weight of the fishes. They found that the observed weight of the fish was lesser than the calculated weight of the fish. This case was found to be completely reversed in larger fishes and in these groups Nisha Shukla (2002) found that the observed weight was lesser than the calculated weight in *L. gonius* measuring 240 – 390 mm in length. A similar case has been noted in *L. bata* when a comparison was made between observed and calculated weights in smaller and larger fishes.

In fish of different maturity stages 'n' values were found to be higher in ripe fishes and lower in spent fishes. It was because of the fact that in the spawning season the weight of gonads increased considerably and thereby measuring the weight of fishes and as soon as the fishes discharged their gonad products, their weight suddenly decreased which consequently affected the 'n'. Such changes in the value of 'n' reflect the extent of the spawning season of the fish.

Several workers have reported that females are heavier than males in smaller-sized fishes while males are heavier than females in larger-sized fishes (Natarajan and Jhingran, 1963 and Khan, 1972). In the present case also the length-weight curve of males lies above the length-weight curve of female up to the length of 250 mm and beneath the length-weight curve of females thereafter. The point of intersection is between 245-270 mm. According to Olsen and Herriman, (1946 quoted by Chatterjee, 1981) the point of intersect represents the size at first maturity of the fish. Natarajan and Jhingran (1963) concluded that the two curves in *Catla catla* intersected at a point between 500 mm and 650 mm. Khan (1972) found that the length-weight curves of males and females of *L. rohita* intersected at a point between 500 and 600 mm. Chakrabarty and Singh (1963) reported a reverse phenomenon in the case of *C. mrigala*. They found that males are heavier in smaller fishes and females in larger fishes.

However, in the present investigation, the point of intersection of length-weight curves of males and females was observed to be between 245 mm and 270 mm, the range of size at which both sexes attain first maturity. This point of intersection represents the size at first maturity of the fish.

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