

Weight-Length Relationship of the Flying Barb, *Esomus danricus* (Hamilton-Buchanan, 1822), a Commercially Important Ornamental Fish of Nagaland

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Abstract

Present study was made on 150 freshwater wild *Esomus danricus* (Hamilton-Buchanan, 1822) of various sizes ranging from a total length of 4.2 to 7.4 cm and weighing 0.5 to 4.2 g. They were sampled from different lentic and lotic water bodies of Nagaland, to investigate the weight-length relationship. Each fish was measured and weight was taken. Log transformed regressions were used to test the growth trend. It was observed that growth in weight is not exactly proportional to the cube of its length. Coefficient of correlation values for both male and female and for mixed population on this relationship were found to be highly significant.

Key words : *Esomus danricus*, Weight-length relationship, Predictive equations.

Esomus danricus (Hamilton-Buchanan, 1822), also commonly called as the flying barb, belonging to the family Cyprinidae and sub-family Rasborinae is a small fish with an elongated and slim, strongly compressed body having a pointed head with small lips. It has two pairs of barbels with the maxillary pair extremely long and extending up to the posterior region of the pelvic fin. The body is olive-green with a pearly iridescence and sprinkled with fine dots in live condition with a broad dark lateral band from the mouth to the base of the caudal fin. The belly is silvery-white. Fins are hyaline, with a reddish tinge at the pelvic and brownish to orange in the other fins. *Esomus danricus* (Hamilton-Buchanan, 1822) is a common fish found in the pools, ditches and streams and is abundantly distributed in India, Pakistan, Srilanka, Bangladesh, Myanmar and Nepal. It has got immense importance in ornamental fisheries and is also relished as a food fish by the people of low-income groups. The present study on the weight-length relationship is important for the studies on biology, population and management of the species and their fisheries (1, 2). The significance of the studies in fishes is to assess the growth of fishes in different environment (3). The growth in animal is considered in terms of increase in

volume. The volume is represented by weight, which is related to the cube of linear dimensions. It is therefore, true that a relationship exists between length (linear dimension) and weight in animal (4). According to Wootton (5) measurement of growth as length quantify axial growth, measurement as weight quantify growth in bulk. These two categories of growth are highly correlated. A fish can change its weight without changing in length or vice versa. The relationship between weight and length for fish of a given population can be analyzed either by measuring weight and length of the same fish throughout their life or of a sample fish taken at a particular time.

Methods

Live fish specimens of *Esomus danricus* (Hamilton-Buchanan) were collected from the rivers and streams of Dhansiri and lentic water bodies of Dimapur district, Nagaland, during the month of May to August, 2009. Fishes were selected at random and were preserved in 7—8% formalin solution as warranted. They were subsequently dried for 30 seconds to 1 minute in the folds of a blotting paper and then measured by a meter scale and weighed on a sensi-

tive balance. All the data retrieved from the field, camp laboratory and Experimental Fishery Station, Department of Fisheries, Government of Nagaland established at Dimapur, encompassing the present investigation were studied, computed and analyzed in the Industrial Fishery Laboratory, Department of Zoology, Gauhati University. Bio-statistical tables were used throughout the study for the calculation of various factors necessary for the expression of length-weight relationship. Length is used as type and weight as the array. The equation adopted is that of the general parabola: $W = cL^n$ (1). This equation when expressed in logarithmic form becomes $\log W = \log c + n \log L$, where W = total weight (g) of the fish; L = total length (cm) of the fish; c = proportionality constant; n = exponential value or regression coefficient, which when graphically represented assumes a linear form. The value of c and n are determined empirically by the following formulae,

$$\text{Log } C = \frac{\sum \log W \cdot \sum (\log L)^2 - \sum \log L \cdot \sum (\log L \cdot \log W)}{N \cdot \sum (\log L)^2 - (\sum \log L)^2}$$

$$\text{and } n = \frac{\sum \log W - N \cdot \log c}{\sum \log L}$$

The weight-length relationship in the present species has been estimated for mixed population (male and Female combined), and male and female separately for the species.

Results and Discussion

Weight-Length Relationship in Mixed Population of Esomus danricus

The data of mixed population consists of measurements of 150 specimens ranging in total length from 4.2 cm to 7.4 cm and in weight from 0.5 to 4.2 gm. The formula correlating the length and weight of the fish has been found to be,

$$\text{Weight} = -2.768 \times \text{Length}^{3.389}$$

The logarithmic form of the above equation is

$$\text{Log Weight} = 0.442 + 3.389 \log \text{length}$$

The coefficients of correlation between log

length and log weight is + 0.973 and the standard error of estimate in terms of logs is ± 0.01

The test of significance of the relationship, t -test is performed, and the correlation between log length and log weight is found significant at 5% probability level.

In other words,

$$r = + 0.973 \pm 0.01, P < 0.05.$$

Weight-Length Relationship in Male Population of Esomus danricus

The data of male population consists of measurements of 65 specimens ranging in total length from 4.2 cm to 6.4 cm and in weight from 0.5 to 2.1 g. The formula correlating the length and weight of the fish is found to be

$$\text{Weight} = -1.975 \times \text{Length}^{2.746}$$

The logarithmic form of the above equation is

$$\text{Log weight} = - 0.295 + 2.746 \log \text{length}$$

The coefficients of correlation between log length and log weight is + 0.978 and the standard error of estimate in terms of logs is ± 0.01 . The test of significance of the relationship, t -test is performed, and the correlation between log length and log weight is found significant at 5% probability level.

Therefore, $r = + 0.978 \pm 0.01, P < 0.05$

Weight-Length Relationship in Female Population of Esomus danricus

The data of female population consists of measurements of 85 specimens ranging in total length from 5.5 cm to 7.4 cm and in weight from 1.4 to 4.2 g. The formula correlating the length and weight of the fish is found to be

$$\text{Weight} = -2.988 \times \text{Length}^{3.276}$$

The logarithmic form of the above equation is

$$\text{Log weight} = 0.475 + 3.276 \log \text{length}$$

The coefficient of correlation between log length and log weight is + 0.979 and the standard error of estimate in terms of logs is ± 0.01 .

The test of significance of the relationship, *t*-test is performed, and the correlation between log length and log weight is found significant at 5% probability level.

$$\text{So, } r = + 0.979 \pm 0.01, P < 0.05$$

The main objective of the present study has been to derive the mathematical formulae, correlating the two variables weight and length, in a general manner, for calculating one from the other within a range of error. In view of this a reasonable size range of the fish has been included in the study, which is wild caught, from the rivers, streams and rice fields of Nagaland. The sex factor is not reckoned as also the gonad condition and the gut contents. The material is therefore, heterogeneous. The general fact which has been elucidated by Clark (6), Walford (7) and Schultz (8) for other species has also been taken into consideration in the study under report. Pervin and Mortuza (9) cited that the length-weight relationship is important for proper exploitation and management of fish species population. The economic value of fish depends upon its length weight relationship. With a view to supplement this, the present investigation was under taken and overall values of *c* and *n* of the species have been derived to understand a coherent picture on the accretion profile of the species, *Esomus danricus* (Hamilton-Buchanan, 1822) hitherto remained unattended from any drainage system of Nagaland.

Value of the regression coefficient *n* usually lies between 2.5 to 4.0 according to Hile (10) and Martin (11) and ideally fishes maintain the shape *n* = 3. The relationship between Weight (*W*) and Length (*L*) typically takes the allometric form : $W = cL^n$, or in the linear form : $\text{Log } W = \text{log } c + n \text{ log } L$, where *c* and *n* are constants estimated by regression analysis. If fishes retains the same shape, it grows isometrically and the length exponent *n* has the value *n* = 3, a value significantly larger or smaller than *n* = 3 shows allometric growth. A value less than *n* = 3 shows that the fish becomes lighter for its length and if greater than *n* = 3 indicates that the fish becomes heavier for its length as it grows (12, 13).

The exact relationship between length and weight differs among species of fish according to their inherited, body shape and within a species according to the condition of individual fish (14). The values in the present study for mixed population is 3.389, in male 2.746 and in female 3.276, showing positive allometric type of growth both in mixed and female population except in the case of male population which is showing negative allometric growth. The coefficient of correlation (*r*) between log of length and log of observed weight estimated in both overall, male and female fish population is positive and limited and the relationship is tested significant in all cases at 5% probability level. Similar observation were also made by Subba and Ghosh (15) and Pawar and Mane (16) in *Glyptothorax telchitta* and *Glossogobius giuris* respectively.

In general, adult fishes follow an isometric growth (17). The variation in *n* values may therefore be attributed to environmental factors, seasons, food availability, sex, life stage and other physiological factors of the test species. The results also indicated that, the condition was variable and dynamic and reflected its food availability and growth within the weeks prior to sampling concurring the view of Gokhan et al. (18) reported in some commercial fish species from the North Aegean Sea.

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