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Length-Weight relationship of *Esomus danricus* (Hamilton) from upper Assam, India

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Abstract
Length-weight relationship of *Esomus danricus* (Ham.) had been carried out from two different waterbodies of upper Assam during 2011-2013. The co-efficient of regression (b) was recorded as 1.007 in juveniles; 1.01 in males; 1.232 in females. The result reveals that females have better growth than males and juvenile. Again, the 'b' value was almost similar trend in all length groups of male while in case of female 'b' value was increasing with increase of length and recorded the highest 2.033 in >5 cm group. The finding indicates that both the sexes show allometric growth. Coefficient of correlation (r) shows more or less similar trend in all length groups' irrespective male and female. Condition factor 'K' was found to be the highest (1.0198) in the 3-4 cm length group and that of the lowest (0.8141) in the >5 cm length group. In overall, the 'b' value of both sexes was also found to be similar trend in all the seasons and indicates that both the sexes did not follow the cube law (b=3). The lowest (0.789) 'r' was recorded in post-monsoon and highest (0.881) in pre-monsoon for males while the minimum (0.86) 'r' was observed in winter and the maximum (0.910) in pre-monsoon for females. Condition factor 'K' for male was found to be highest (1.344) in pre-monsoon and lowest (0.951) in winter, whereas for females it fluctuated from 0.876 (post-monsoon) to 1.238 (pre-monsoon).

Keywords: *Esomus danricus*, length-weight relationship, Condition factor, Assam, India

1. Introduction

Length-weight relationship and condition factor are important not only the mathematical relationship between its length and weight, but also to study the biology of a fish. Moreover, it is one of the important morphometric characters that can be used for taxonomy and ultimately in fish stock assessment. Length-weight relationship of a fish is essential, since various important biological aspects, viz., general well being of fish, appearance of first maturity, onset of spawning, etc., can be assessed with the help of condition factor, a derivative of this relationship [1]. In fishery science, the condition factor or K- factor is used in order to compare the 'condition', 'fatness' or well being of fish and it is based on the hypothesis that heavier fish of a given length are in better condition [2]. Moreover, the length-weight relationship of fish is an important fishery management tool because they allow the estimation of the average weight of the fish of a given length group by establishing a mathematical relationship between the two [3]. This analysis will reveal the extent to which the two variables, length and weight are related to each other and thereby help one to calculate with ease one variable when the other is known [4].

The study length-weight relationship of *Esomus danricus* (Hamilton) is very limited. So far, the length-weight relationship and condition factor of *E. danricus* from different freshwater environments was investigated [5]. *s* commonly a small fresh water fish, belonging to the family Cyprinidae. Generally they prefer to live in wetland, water logged bodies, paddy fields, pond, road side ditches. *E. danricus* is included under "Lower Risk least concern" (LR-lc) category [6]. In Assam, they are fairly common in their abundance and probably the most important food fish in the rural areas. Due to their colour, size and playful behaviour, they are also highly rated as aquarium fish. A good number of them have been collected from the wild waters and made available to the domestic and overseas market for trade. From the above fact the present investigation has been taken up from the different waterbody of upper Assam.

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2. Materials and Methods

Length-weight relationship of an ornamental fish, *E. danricus* had been carried out from the Maijan wetland (27°30′ 14.4″ N and 094°58′ 04.8″ E) and Guijan Ghat (27°34′ 40.27″ N and 95°19′29.54″ E) of Brahmaputra river of upper Assam during 2009-2011. A total number of 500 specimens were dissected and out of which 383 males and 117 females. Body weight ranged from 0.82 to 1.02 g and length ranged from 3.6 to 4.1 cm. The length-weight relationship is expressed as allometric growth equation: W = a Ln 1. Converting it into logarithmic form, the equation is Log W = Log a + b Log L, Where, W = weight of fishes; L = length of fishes; a = Initial growth index of fish and in a constant; b = equilibrium constant or growth co-efficient. Condition factor (K) has been calculated by using formula [7].

$$K = \frac{W \times 10^3}{L^3}$$

Where, K=condition factor; W= weight of the fish (g); L = length of the fish (cm).

3. Results and Discussion

3.1 Length-weight relationship in different maturity stages and size groups

In *E. danricus*, the co-efficient of regression (b) was 1.007 in juvenile; 1.01 in male and 1.232 in case of females. As a whole, *E. danricus* did not follow the cube law (b=3). The regression equations for juvenile has been calculated as Y= -3.018+1.007X, for male as Y= - 3.115+1.010 X and for female as Y= - 4.34+1.232 X. Further, the result reveals that females have better growth than males and juvenile. Again, the 'b' value for both sexes was slightly over 1 in all length groups except in female in > 5 cm group (Table 1). The finding indicates that both the sexes show allometric growth. However, the higher values of 'b' were observed in higher length groups in both the sexes. Co-efficient of correlation (r) shows more or less similar trend in all length groups, irrespective of both males and females (Table 1). The length and weight were positively correlated in both sexes. The lowest 'r' value was found in the 4-5 cm length group; moderate was recorded in the 3-4 cm length group and highest recorded in the > 5 cm length group. Condition factor 'K' was found to be highest (1.0198) in the length group of 3-4 cm and that of lowest (0.8141) in the >5 cm length group.

Table 1: Length-weight relationship of *Esomus danricus* in different size groups

Length Group (cm)	Sex	'r'	'b'	'a'	'K'	Regression equation
3-4	♂	0.783	1.004	-3.07	1.0198	Y= -3.07 + 1.004X
	♀	0.763	1.022	-3.24	0.9861	Y= -3.24 + 1.022X
4-5	♂	0.503	1.12	-3.928	0.8801	Y= -3.928 + 1.12X
	♀	0.628	1.217	-4.464	0.8864	Y= -4.464 + 1.217X
> 5	♂	0.795	1.315	-5.689	0.8141	Y= -5.689+ 1.315X
	♀	0.875	2.033	-9.411	0.8156	Y= -9.411+ 2.033X

3.2 Length-weight relationship in different seasons

The regression coefficient (b) of male *Esomus danricus* was found to be highest (1.038) in the monsoon while lowest (1.004) in pre-monsoon. In case of females, it varied between 1.118 (post-monsoon) and 1.315 (pre-monsoon). In different season too, *E. danricus* did not follow the cube law (b=3) and both sexes showed allometric growth (Table 2). The highest co-efficient of correlation (r) for males in *E. danricus* ranged from 0.789 (post-monsoon) to 0.881 (pre-monsoon) while in females, the 'r' value was varied from 0.86 to 0.910 during winter and pre-monsoon respectively. The value of 'r' for both males and females were strongly positive correlated in different season. Condition factor 'K' for male was found to be highest (1.344) in pre-monsoon and that of lowest (0.951) in winter, whereas females 'K' value fluctuated from 0.876 to 1.238 during post-monsoon and pre-monsoon.

Table 2: Length-weight relationship of *Esomus danricus* in different seasons

Season	Sex	'r'	'b'	'a'	'K'	Regression equation
Winter (Dec-Feb)	♂	0.837	1.022	-3.658	1.091	Y= -3.658 + 1.022 X
	♀	0.86	1.174	-4.762	0.894	Y= -4.762 + 1.174 X
Pre-monsoon (Mar-May)	♂	0.881	1.004	-3.276	1.344	Y= -3.276 + 1.004 X
	♀	0.910	1.315	-5.052	1.238	Y= -5.052 + 1.315 X
Monsoon (Jun-Aug)	♂	0.867	1.038	-3.474	1.269	Y= -3.472 + 1.038 X
	♀	0.901	1.153	-4.100	1.204	Y= -4.100 + 1.153 X
Post-monsoon (Sep-Nov)	♂	0.789	1.013	-3.745	0.951	Y= -3.745 + 1.013 X
	♀	0.90	1.118	-4.492	0.876	Y= -4.492 + 1.118 X

In the present study, the females of *E. danricus* showed better growth rate than male and juvenile (Fig. 1 - 3). The exponent value (b) of the specimens is significantly different from cube law and this indicates negative allometric growth. The slope (b) values slightly over 1, except in adult female (> 5cm) of E. *danricus* group obtained of the fish specimens in this study shows that the growth of the species is allometric. The correlation coefficient (r) for LWR was a high and indicating increase in weight with an increase in every unit of length. A positive correlation was found in the length group as well as in various seasons. These agreed with earlier studies on length and weight in other fish species [8], Merella *et al*., 1997 [9, 10, 11], Paswan *et al*., 2012 [12].
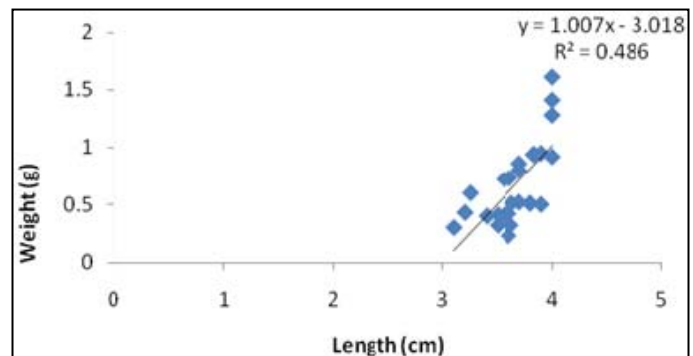

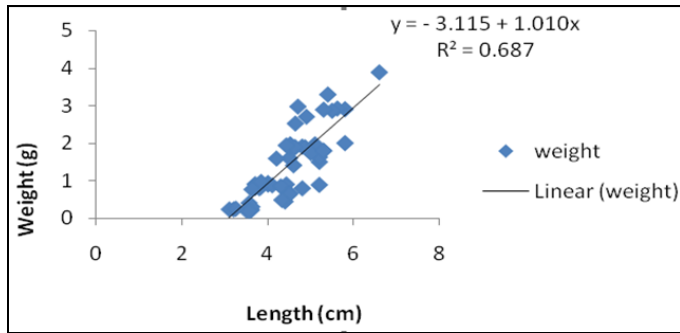**Fig 1:** Length-weight relationship of *E. danricus* (Juveniles)

Fig 2: Length-weight relationship of *E. danricus* (Males)
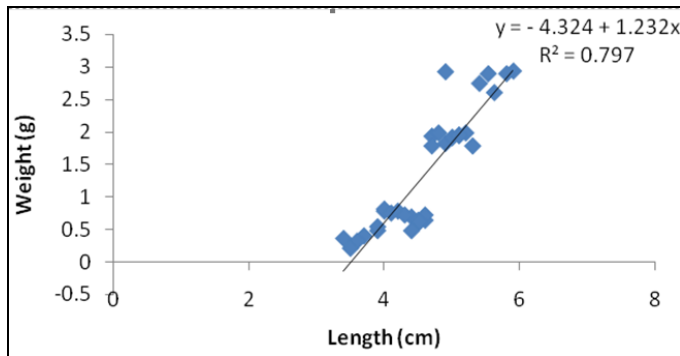

Fig 3: Length-weight relationship of *E. danricus* (Females)

The variation in the exponential value (b) is supposed to be under the influence of numerous factors viz, seasonal fluctuation, the physiological condition of the fish at the time of collection, sex, gonadal development and nutritive condition of the environment of the fishes as reported [1]. The (b) values for juvenile, males and females of the species were found to be lower than 3; indicating allometric growth. It has also observed an intraspecific difference in the power function (b) of length in relation to body weight in Rita rita, Sardinella albella, S. gibbosa and Acrossocheilus hexagonolepis respectively at different stages of their growth [13, 14, 15]. There was also report of 'b' value of less than 3 for Labeo calbasu from Soni River [16] and the 'b' value may change seasonally and even daily and also between habitats [17, 18]. Again, the value of 'b' is generally closely to 3 and may vary between 2.5 and 4.0 [19] while, it also reported that the values less than 3 for the males and females of Rasbora daniconius from Karnataka [20].

The condition factor (K) is an indicator of general well-being of the fish, its relative robustness, suitability of habitat and to some extent the size at first maturity and peak period of spawning. In the present study, the mean K value was found to be greater than 1 and this shows that the studied specimens are in good condition. The variation in mean K values was higher during pre-monsoon and monsoon season, related to the breeding activities of the fish due to depletion of reserves during rainy season. Condition factor has also been closely linked with reproductive cycle for fishes in other water bodies [21]. In Indian major carps (IMC), feeding influenced the condition factor, while the sexual cycle had no direct influence [22]. The species display considerable changes in average condition, reflecting normal seasonal fluctuations in their metabolic balance and in the pattern of maturation and subsequent release of reproductive products. Even fullness of the alimentary canal may influence 'K' factor [23]. Month wise and size group fluctuation of K factor shows no specific trend. Variations in the condition factor may be attributed to different

factors, such as environmental condition, food availability and the gonadal maturity as has been suggested by many workers [25].

4. Conclusion
The exponent value (b) of *E. danricus* does not follow the cube law and this indicates negative allometric growth. Correlation coefficient (r) for length-weight relation is high, indicating increase in weight with increase in every unit of length with a positive correlation in the length group as well as during the season. The (b) values for juvenile, males and females of both the species were found to be below 3; showing an allometric growth rate. K value for the fish species is found to be greater than one, and this indicate that the studied fish species are in good condition. Again, males were brighter than the females and females are always bigger in size as well as more weight than their male counterpart. In mature female the abdomen was soft and swollen, pelvic fins were smooth and caudal fin was deeply forked with the arrival of the spawning season their distended abdomen is easily recognize.

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