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Length-weight relationship and condition factor of captive raised moustached Danio, *Danio dangila* (Hamilton, 1822)

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Abstract
Danio dangila (Hamilton, 1822), common English name Moustached Danio [9, 10] as it has two pairs of extended barbels on its top lip, one pair being particularly long. It is an important ornamental danid found in north eastern states of India. Length-weight Relationship and condition factor was estimated from captive raised fish ranges from 2.9cm-8.8 cm and weight ranged from 0.18gm-9.4gm. The analysed L-W data showed the 'b' value is 3.18 which indicate its positive allometric growth. The 'K' value is 1.18 indicating robustness or well-being of fishes.

Keywords: Length-weight relationship, condition factor, captive condition, *Danio dangila*

1. Introduction
The Length-Weight relationship (LWR) and Fulton's condition factor (K) are two main parameters used in fishery research, and have been closely related since they were first proposed [6]. Length-weight relationship gives information on the condition and growth patterns of fish [1]. It is important parameter in fisheries and fish biology because they allow the estimation of the average weight of the fish of a given length group by establishing a mathematical relation between them [19]. This parameter is used in fishery science to estimate weight of individual fish from its length, to calculate condition indices, to compare life history and morphology of populations belonging to different regions [23]. Various works have done on length weight relationship on different species [16, 17, 20, 3, 5]. It can also be used to predict weight from the length measurement made in the yield assessment [21]. Knowledge of the length-weight relationship of a fish is essential for stock assessment modelling and when evaluating the relative condition of fish among populations [13]. Condition factor helps in assessing the proper condition of fish. In fisheries, conditioning factor is crucial as a quantitative parameter because the heavier the fish species of a given length, the better the physiological condition of the aquatic organism [2, 31]. These two parameters are very much needed for determining possible differences among different stocks of the same species [12]. It is a numerical index by which weight and length in particular samples are usually compared under standard conditions. This Condition factor is used to measure various ecological and biological factors such as degree of fitness, gonad development and the suitability of the environment with regard to the feeding condition [15]. *Danio dangila*, (Hamilton, 1822) is a beautiful ornamental fish which has very good popularity among the hobbyists. This is also used as food fish in some north-eastern states like Nagaland [28]. It is identified by olive back, blue and silvery sides with mottled colour pattern. It belongs in Cyprinidae family under Cypriniformes order. It has two paired barbels which look like moustache and therefore it is known as moustached danio (Fig.1). They inhibit mainly in freshwater of hilly stream areas and very hardy in captive conditions. This is categorised as least concern species by IUCN [30] but natural stock is gradually decreasing due to over exploitation. Fish can attain three types of growth i.e. Isometric growth when the regression co-efficient value is (b=3), Positive allometric growth (b> 3) and negative allometric growth (b< 3) [22]. Growth of the body parts is proportional to the growth of the total length. The growth assessment and well-being is checked with the calculation of condition factor (K) [6]. The present study is designed with objective to analyse these measurements for *Danio dangila*.

Fig 1: *Danio dangila* (Hamilton, 1822), Moustached Danio

2. Materials and Methods

Fish samples were collected initially from the wild and acclimatized in the wet laboratory of ICAR-CIFE, Kolkata centre (22.57° N latitude, 88.43° E longitude). Fishes were maintained in glass aquarium and provided with live feed. From the captive raised stock, random sampling were done during 2015 to 2016 covering the length ranges from 2.9-8.8 cm and weight ranges from 0.18-9.4gm. After removing the excess water on the specimens by pressing with blotting paper, length was measured by digital calliper to the nearest cm from the tip of snout to tip of the longest ray in caudal fin [8] and weighted up to nearest gm by using an electrical balance. Altogether 219 fish specimens were sampled and detailed data were recorded. Length-Weight Relationship and Condition factor was calculated using the Equation, $W = aL^b$ [11] where W=weight of the fish (gm), L=Length of the fish (cm), a=Regression intercept, b=Regression slope. The logarithmic transformation of which gives the linear equation; Log W= Log a + b log L. 'a' and 'b' value was estimated by using Microsoft excel. The Fulton's Conditioning factor (K) was calculated as per the following formula $K=W\times100/L^3$ [6], where W= Weight of the fish (gm); L= Length of the fish (cm). This equation has been adopted for calculation of condition factor.

2.1. Statistical analysis

Length-Weight relationship was calculated according to the method mentioned by Le Cren (1951) [14]. Linear relationship between the logarithm length and logarithm weight was found from the examination of scatter diagram. All data were calculated in MS-Excel 2010.

3. Results and Discussion

The present results revealed that length and weight measurements of the fish are related to each other. The descriptive statistics of length weight data is presented in Table 1 where the minimum and maximum recorded range of TL varies from 2.9cm -9.4 cm, TW range varies from 0.18gm -9.4 gm. Average value of total length is 5.34 cm and total weight is 1.80 gm. Here 'r' value shows a positive correlation. The regression equation of *Danio dangila* is, Log W= -2.1377+3.1855 Log L. $W = aL^b$ was found to be fit with length-weight data. The value of exponent 'b' was found 3.18 (Table 2). According to the theory of 'Cube law', if the 'b' value in length weight relationship is reported as 3, then the growth in fish is isometric [26, 29]. The value of the regression co-efficient usually lies between 2.5 and 3.0 only and ideal fish maintains the shape i.e. b = 3.When b<3 it can be said to have a negative allometric growth and is defined hypoallometry; instead when b>3, it shows a positive allometric growth which is defined hyperallometry [8, 18, 25]. In this present study, b value was found 3.18 which indicate positive allometric growth. So, it can be said that the fish does not follow the cube law (i.e. b=3).

Table 1: The descriptive statistics of length weight characteristics of *Danio dangila*

Total Length (TL) (cm)			Weight (W) (gm)		
Max	**Min**	**Average**	**Max**	**Min**	**Average**
7.8	2.9	5.34	9.4	0.18	1.80

Scatter diagram was prepared by putting L-W data and it was represented in Fig. 2. Through scatter diagram linear relationship can be seen.

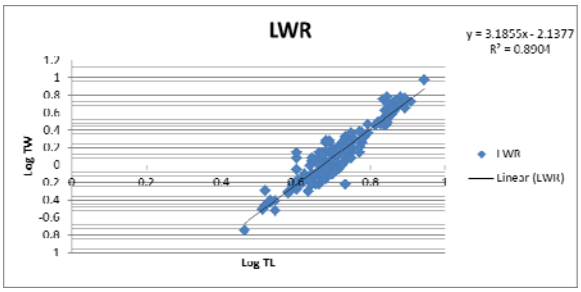

Fig 2: Relationship between Log Total Length (TL) and that of body Weight (WT) in *Danio dangila*

Fulton's conditioning factor (K) or Ponderal Index was also calculated. This expresses the degree of wellbeing, robustness, fatness in numerical terms. From this study, the value was found (K=1.18) which was found positively correlated. This value also indicates the increased fat deposition into the body due to adaptability and high feeding activity of fish. Length- weight relationship equation and 'K' value is given in Table 2.

Table 2: Length- weight relationship equation and 'K' value of *Danio dangila*

Regression Equation	'b' value	'K' value
Log W= - 2.1377+3.1855 Log L	3.18	1.18

Calculation of coefficient of correlation (r) along with coefficient of determination (r^2), adjusted r^2 and Standard Error of the estimate were presented in the Table 3 from where it can be said that high degree of correlation was found between r and r^2 parameters which justified strong significant relationship between length and weight. $r^2 = 0.890$ which is an indicator of the quality of the linear regressions [24]. The value of adjusted r^2 was found 0.889 and standard error value is 0.098 which represents the accuracy of the present result. Correlation coefficient was found to be significant here as the value of 'r' is found to be 0.5 the length weight relationship is positively correlated [4] and here r =0.943. So Table 3 represents a good degree of positive correlation between the TL and TW.

Table 3: Calculation of coefficient of correlation along with r^2, adjusted $r^2$and Std. Error

r	r^2	Adjusted r^2	Std. Error
0.943	0.890	0.889	0.098

4. Conclusion

These findings are enlightened on the knowledge of length-weight relationship of *Danio dangila*. The positive allometric growth and robustness of the fish is found in captive condition. Results of the research work will be helpful in artificial propagation and conservation of *Danio dangila.*

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