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Studies on length-weight relationship of hill stream fish, *Pseudecheneis sulcata* (Mccelland, 1842) from the snow-fed Tamor river in Eastern Nepal

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Abstract

The present paper aims to describe the length-weight (LW) relationship of the hill stream fish *Pseudecheneis sulcata*. Fish of various lengths and weights were collected from the Tamor River in Eastern Nepal from December 1 to 15, 2023. A total of 42 fish specimens were stored in a freezer and then transported to the Ichthyological Laboratory at the Department of Zoology, Degree Campus, Biratnagar. The measurements of the fish samples were conducted with maximum accuracy. The data obtained from the measurements were analyzed using the formula. The estimated slope value (b) for the total length and weight in the length-weight relationship is 3.410, indicating positive allometric growth. This suggests that under optimal conditions for growth, as the length increases, there is a proportionately greater increase in weight.

Keywords: Allometric growth, fish growth, freshwater river, ichthyology, relationship

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Introduction

Pseudecheneis sulcate (McClelland, 1842), commonly known as the sucker throat catfish or locally referred to as Kabre, is a torrential catfish adapted to hill stream environments. This species inhabits fast-flowing hill streams with sandy, gravelly, and rocky bottoms and is native to freshwater bodies in Southern Asia, including Bangladesh and India (Ng, 2010). In Nepal, it can be found in freshwater bodies such as the Gandaki, Seti, and Koshi rivers (Shrestha, 2019). As a small indigenous fish species (SIS), it typically reaches a maximum length of up to 20 cm in Nepal (Shrestha, 2019).

The catfish features a sucker-like mouth surrounded by numerous fimbriated barbs and has ventrally situated adhesive pads with up to 16 transverse ridges, which are among its adaptive modifications. Being a bottom dweller, it primarily feeds on crustaceans, algae attached to rocks, and various aquatic insects and larvae.

Studying the length-weight relationship of fish is essential for fishery biologists. It aids in establishing yield equations for population dynamics, understanding taxonomic differences, and examining life history events such as metamorphosis and maturity (Le Cren, 1951). This relationship helps determine the growth patterns of fish stocks and assists fisheries officials in developing effective management and conservation policies. The mathematical relationship between the length and weight of fish is a practical index for understanding their survival, growth, maturity, reproduction, and overall well-being (Le Cren, 1951). This relationship is typically expressed by the equation: $W = aL^s$.

Several researchers, including Mohammed (1956), Jhingran (1959), Sinha (1973), Pandey *et al*. (1974), Pathak (1975), Kumar *et al.* (1979), Subba and Ghosh (2000), Subba and Pandey (2000),

Soomro *et al*. (2007), and Ansumala and Subba (2009), have applied this equation to various fish species in different environmental conditions. Understanding length-weight relationships is valuable in fishery management for both applied and basic purposes (Pitcher and Hart, 1982), including: (i) estimating weight based on length observations; (ii) calculating the production and biomass of fish populations; and (iii) providing information on the condition of stocks at the organismal level.

Materials and methods

A total of 42 specimens were collected from the Tamor River in Eastern Nepal between December 1 and December 15, 2023. The total length (L) of each specimen was measured using a scale (in cm), while the total weight (W), which included the gut and gonads, was measured using a digital weighing scale. The specimens ranged in length from 5.5 cm to 13.5 cm and weighed between 1 g and 16 g.

The length-weight relationship was determined using the formula $W = aL^b$, where W represents the weight of the fish in grams (g), L is the length of the fish in centimeters (cm), b is the exponent that describes the rate of variation in weight with respect to length, and a is the coefficient of the length-weight relationship. The values of constants a and b were estimated from the log-transformed values of length and weight using linear regression, represented by the equation log W = log a + b log L.

An ideal value for b is 3, which indicates isometric growth. If b is less than 3, the fish becomes slimmer as it increases in length, resulting in negative allometric growth. Conversely, when b is greater than 3, the fish becomes heavier, indicating positive allometric growth, which reflects optimal conditions for growth (Bagenal and Tesch, 1978).

Results

The body weight of *Pseudechenies sulcata* showed clearly increasing trend with the increase in body weight. When Logarithmic values of weight were plotted on the co-ordinate (Y-axis) against those of respective length on the abscissa (X-axis) the graph is shown in figures 1 and 2.

Regression equation for length-weight relationship;

$W=0.002L^{3.410}$

$r^2=0.946$

LOGW=3.410L -2.588

a' = -2.588

a =0.002582

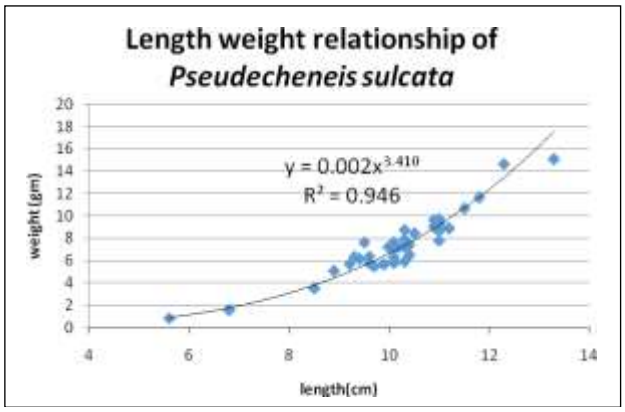

Figure 1. Graph with regression equation and coefficient of determination (r^2) for all specimens showing length-weight relation.

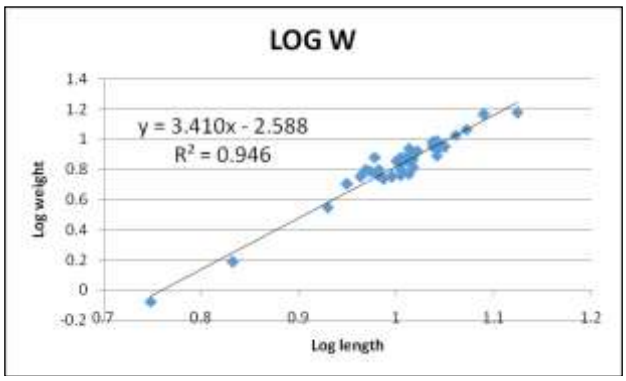

Figure 2. Graphs with regression equation and coefficient of determination (r^2) for all specimen showing length-weight relation Log W= 3.410L-2.588

The exponent b values for the total length and weight is 3.410. The value of regression coefficient (b) for all length-weight relation came greater than 3. The b value shows a positive allometric growth. i.e., with respect to length, weight is increasing.

Discussion

Several workers have made estimations on length-weight in different fish species. LeCren (1951) has stated that the length-weight relationship in fishes are probably related to the seasonal variation since fat and water content of fish may vary according to temperature The change in 'b' value shows allometric growth of the body due to the influence of numerous factors viz., seasonal fluctuations, change in physiological condition during spawning periods, gonad development, sex, physico-chemical conditions of the environment and nutrition conditions of the environment (Sinha, 1973). Sekharan (1998) have also observed an inter specific for 'b' that remains constant at '3.0' for an ideal fish.

In the present fish sample, the calculated values for 'b' for length and weight relation were higher than 3 i.e. 3.410 which were of expected range and indicated that the growth is positive allometric in *Pseudecheneis sulcata*.

Similar differences in slope value have been reported by Pandey *et al*. (1974), Thakur and Das (1974), Subba and Gosh (2000), Subba and Pandey (2000), Ansumala and Subba (2009), and Subba *et al*. (2009) on *Heteropneustes fossilis*, *Glyptothorax telchitta*, *Schistura rupicola*, *Gudusia godanahiae* and *Neolissochilus hexagonolepis*. Le Cren (1951) stated that the length-weight relationship in fishes is probably related to the seasonal variations as fishes do not retain the same shape or body contour throughout the year.

So there should be slight change in slope values in different seasonal studies. The values of coefficient of determination 'r^2' calculated for length-weight relationship of *Pseudecheneis sulcata* is 0.946 and b value is 3.410. The value 'b' calculated from the measurement of total length and total body weight of *Schistura rupicola* were 3.0508.

The computed value of correlation coefficient (r) was 0.9970. The value of b calculated from the measurement of total length and total body weight of *Gudusia godanahiae* were b=2.9017. The value of b calculated from measurement of total length and total weight of *Glyptothorax telchitta* were 2.991. Similarly, the b value reported in *Neolissochilus hexagonolepis* was 3.056. The reported exponent values for 'b' for different fishes ranged between 2.5 to 4.0 (Hile, 1936) and 2 to 4 (Bagenal and Tesch, 1978; Koutrakis and Tsikliras, 2003). If ideal value of b is 3, that represents an isometric growth. When b is less than 3, a fish becomes slimmer with increasing length and growth will be negative allometric. When b is greater than 3.0, fish becomes heavier showing a positive allometric growth and reflecting optimum conditions for growth (Bagenal and Tesch, 1978).

The present study will provide baseline information about length-weight relationship of hill stream torrential catfish *Pseudecheneis sulcata*. This will be helpful for biological researchers and fishery managers

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