A STUDY ON LENGTH AND WEIGHT RELATIONSHIP WITH RELATIVE CONDITION FACTOR OF LABEO DYOCEILUS FROM W. RAMGANGA RIVER, CENTRAL HIMALAYA, INDIA

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ABSTRACT

Present study deals with length-weight relationship and condition factor of Labeo dyocheilus investigated from Western Ramganga River, Uttarakhand, India for two years 2009 to 2011. Log transformed regressions were used to test the allometric growth. Each fish was measured and weighed by electronic instrument. Samples were collected by using nets at depths ranging from 1 to 3 meters. The Length Weight Correlation Coefficient of Spot-II (r=0.959) is found to be higher when compared to that of Spot-I (r=0.941), this correlation was not less than 0.910, shows that the results of length weight relationship were highly significant in all months during the period of observation. In the present study the parabolic equation "b" values ranged from 1.012 to 1.889 for Spot-I and 1.133 to 2.105 for Spot-II whereas relative condition factor (K_n) for the Spot-I and Spot-II ranged from 0.959 to1.021 and 0.968 to 1.023 respectively.

Keywords: Length-Weight Relationship, Allometric Growth, Condition Factor, Labeo Dyocheilus, W. Ramganga River.

I INTRODUCTION

Studies on length-weight relationship are of considerable importance in fishery because it shows relevance to fish population dynamics and pattern of growth on fish stocks. Length and weight measurements in conjunction with age data can give information on the stock composition, age at maturity, life span, mortality, growth and production. Knowledge of length weight relationship is of paramount importance in fishery biology as it serves several practical purposes. This expression had been extensively used in the study of fish population dynamics for estimating the unknown weights from known lengths in yield assessments [1], in setting up yield equation for estimating population strength [2, 3], in estimating the number of fish landed and in comparing the populations over space and time [4]. It also yields information on growth, gonadal development and general condition of fish [5] and therefore, useful for comparison of body forms of different groups of fishes. The length-weight relationship has a biological basis also as it depicts the pattern of growth of fishes.

The study of weight-length has its applied value in fish biology. These studies are also widely used for conversion of the growth-in length equation to growth-in-weight for use in stock assessment models and estimation of biomass from length observations [6, 7, 8]. In addition, the data on length and weight can also be used to compare fish life history between regions in species and populations [6, 9, 10]. Length-weight relationship is of great importance in fishery assessments [9]. Length and weight measurements can give information on the stock composition, life span, mortality, growth and production [11, 12, 13, 14].

The estimation of population size of a fish stock for the purpose of its rational exploitation often requires knowledge of individual body length weight relationship in the population [15]. Length weight relationship have several applications, namely on fish biology, physiology, ecology and fisheries assessment. Length weight relationship gives us life history and morphological comparisons between different fish species or between different fish populations from different habitats [9, 16, 17]. Length-weight relationships are very useful for fisheries research because they; allow the conversion of growth-in-length equations to growth-in-weight for use in stock assessment models; allow the estimation of biomass from length observations; allow an estimate of the condition of the fish; and are useful for between region comparisons of life histories of certain species [9, 14, 18]. They are an important component of Fish Base [18].

Length-weight relationship has been commonly used to describe the mathematical model between length and weight so as to derive one from the other. Since length can be easily and accurately measured, the data on length are available in various studies. It is highly valuable in cases where weight can be determined from length already known and vice versa. Along with above length weight relationship is used to compute the departure from the expected weight for length of the individual fish or a group of fishes as indications of fatness or degree of well being of fish, this relationship is called “condition factor” [7]. This parameter helps to assess the experimental improvements in environment for an existing fish and for the purpose of new stocking. The importance of the study in fishes is to assess the growth of fish in different environments.

The length weight relationship provides an opportunity to calculate an index commonly used by fisheries biologists to compare the relative condition factor or well being of a fish. It was also aimed to collect some important information through statistically analyzing the regression coefficient that might have the important implication towards its conservation and management. The relative condition factor is also affected by several other factors like environment, feeding, breeding etc. [5]. The relative condition factor is an essential part of the culture biology. The higher values of condition factor shows well being of the fish and lower values indicate the fish are in poor condition. The condition of a fish is affected by the seasonal changes of food and feeding habits, gonadal cycle and health affected by disease etc. Condition indices have been used by fish culturists as indicators of the general ‘well-being or fitness’ of the population under consideration.

In fishes, Condition factor (k) reflects through its variations and provides information on the physiological state of the fish in relation to its welfare. From nutritional point of view, there is accumulation of fat in the abdominal parts of the body and the gonads [5] and from reproductive point of view, the highest (k) values are reached in some species such as *Amblypharygodon mola, Botia lohachata* & *Rhinomugil corsula* [19, 20, 21, 22, 23]. Condition factor (k) also gives information about two comparative populations of different feeding zones, density, climate, and other conditions, in determining the period of gonadal maturation and the degree of feeding activity of a species to verify whether it is making good use of its feeding source [24, 25, 26].

As no or very few information were available so far on the length-weight relationship and condition factor of *Labeo dyocheilus* and therefore, the present study was under taken to establish the pattern of growth and general condition of this fish species from the natural waters for direct use in fishery assessment. It is for the first time that this species is being studied from this region.

II MATERIALS AND METHODS

For the present study the total length and total weight of fish were recorded in fresh condition. Moreover, the other parameters were measured within a fortnight of collection. Two spots were selected for the study which was geographically much isolated from each other, named Chaukhutia and Masi. Then statically analysis was also made for pooled data. The Length-weight relationship (LWR) was derived from equation: $W=aL^b$ [5, 27]. The logarithm transformation of the equation was expressed as: Log W= Log a + b Log L [5, 28]. This equation is sometimes known as the length- weight key [29]. Where 'a' and 'b' are constants estimated by regression analysis, 'W' is weight of fish and 'L' is length of fish. If fish retains the same shape, it grows isometrically and the length exponent "b" has the value b = 3.0 [7], a value significantly larger or smaller than b = 3.0 shows allometric growth [25]. A value less than b = 3.0 shows that the fish becomes lighter for its length and if greater than b = 3.0, indicates that the fish becomes heavier for its length as it grows. The linearity of regression was tested by the analysis of variance. The length-weight relationship provides an opportunity to calculate an index commonly used by fisheries biologists to compare the "condition factor" or "well being" of a fish [30]. This index is condition factor, "K" ($K= 100 \times W/L^3$). Where 'K' is relative condition factor, 'W' is weight of fish and 'L' is length of fish. Fish with a high value of K are heavy for its length, while fish with a low "K" value are lighter [30].

III RESULTS AND DISCUSSION

The length and weight of *Labeo dyocheilus* was observed for month wise, two year during 2009 to 2011 that has been presented in given table. The Length Weight Correlation Coefficient "r"of Spot-II (r=0.959) is found to be higher when compared to that of Spot-I (r=0.941). In the present study the monthly value of r was found to be 0.910 to 0.991 in Spot-I and 0.938 to 0.994 in Spot-II. In Spot-I the lowest r value i.e. 0.910 were obtained in September and highest r value is 0.999 obtained in January. In Spot-II the lowest r value i.e. 0.938 were obtained in June and highest r value is 0.994 obtained in July. In the present study the value of correlation coefficient (r) was not less than

0.910 shows that the results of length weight relationship were highly significant in all months during the period of observation. In the present study the parabolic equation "b" values ranged from 1.012 to 1.889 for Spot-I and 1.133 to 2.105 for Spot-II was observed that show in the Table. For the both side the lowest value observed in the month of January whereas highest value in the month of August, showing the close impact of environment into parabolic equation "b". The results of the monthly mean relative condition factor (K_n) for the Spot-I and Spot-II ranged from 0.959 to1.021 and 0.968 to 1.023 respectively. The minimum K_n value (0.959) for the Spot-I was observed in August, first maximum K_n value (1.021) was observed in January month, in respect of the Spot-II the minimum K_n value (0.968) were observed in the month of August, K_n max (1.023) values were obtained in January.

Length and weight of a particular species of fish are closely related to each other [5]. Therefore, mathematical representation of length-weight relationship from a study of number of specimens of different sizes can be derived. Since length is a linear measure and weight is a measure of volume, it takes a cube form. Hence, a cube law generally expresses length-weight relationship. The length-weight relationship of a stock from a particular area of a fish is a very useful tool for the study of population dynamics. In addition, it also gives an idea about the general condition of the population.

Hayes [31] performed simulations of length–weight regressions and found that for sample sizes commonly used in fisheries research, estimates of the mean-weight-at-length were biased low, whereas estimates of the intercept were biased high. The specific gravity or outline of the fish were subject to change, the cube law does not necessarily hold good always [32]. We also follow this statement for our favor in this particular. The research in *Channa punctatus* concluded that of both sites were growing with negative allometry, recorded values are "b" as 2.9 for site 1 and 2.29 for site 2 [33]. Values of "b" recorded between 2.5 to 3.44 for the fishes studied in different marine body [34]. Length weight relationship in *T. putitora*, from Beas River, observed low regression coefficient (2.5) in the male fishes [35].

According to Pervin and Mortuza [36], these values usually ranged from 2.5 to 4.0 for many fish species. When $b = 3$, the fish grows isometrically resulting in ideal shape of fish such as observed for *L. lineatus* and *O. microcephalus* in both areas. When the value of b is less than 3.0, the fish experiences a negative allometric growth [36, 37].

Many factors could contribute to the differences of growth of fish such as differences of habitat, fish activities, food habits and seasonal growth rates [38, 39]. Other factors such as temperature, trophic level and food availability in the community were also important. The correction coefficient (r) for length weight relationship for both years is high which indicates that the length increases with increase in weight of the fish. This is in agreement with previous studies on different fish species from various water bodies [40, 41, 42, 43]. No significant difference in the length-weight relationship of hill stream loach *Botia dayi* Hora in different seasons, but observed good growth during spring-summer month which pressed the value of "n" to go high [44]. Work in the fish *Barilius bendelisis* show that the length and weight relationship very close between 0.921 to 0.909 [45]. The length-weight relationship of *B. bendelisis* is found significantly closed but the value of "b" fluctuated from a minimum of 1.72 to 3.74 in summer in female and again it reaches its peak in autumn. This research finding was in our support as the higher values may be due to maturation of gonads, differences in food availability in lotic and lentic environments and other environmental conditions.

The study of length weight relationship has been made [5] on *Perca fluviatilis* who reviewed the cubic parabola in to a general parabola as $W = a L^b$, where b is an exponent to which is an initial growth depends. The value of "b" may vary from 2.5 to 4.0 if fish retains the same shape [46]. The growth rate, however, is quite low due to longer life span (7.5 years age). *Tor putitora* has a long life span (17+ years) and had very low K value ie. 0.055 per year, *Cirrhinus mrigala* (L=850 mm and K= 0.43 per year), *Catla catla* (L = 700 mm & K = 0.73 per year), *Labeo rohita* (L4= 510 mm & K= 0.80 per year) and *Labeo calbasu* (L = 525 mm & K= 0.76 per year) [47].

In fish, the factor of condition (K) reflects, through its variations, information on the physiological state of the fish in relation to its welfare. Two parameters of growth such as asymptotic length (L¥) and growth coefficient (K) are inversely proportional to each other [2]. Nutritional point of view, there is the accumulation of fat and gonadal development [5], reproductive point of view; the highest K values are reached in some species [19]. Condition factor also gives information when comparing two populations living in certain feeding, density, climate and other conditions; when determining the period of gonadal maturation and when following up the degree of feeding activity of a species to verify whether it is making good use of its feeding source [48]. Furthermore, studies confirmed that lowest K values during the more developed gonadal stages might mean resource transfer to the gonads during the reproductive period [49], values of the condition factor vary according to seasons and are influenced by environmental conditions [50].

The Central Himalaya is a region of an exceedingly diversified climate and natural aqua-resources [51]. The Uttarakhand region is blessed with splendor, varied natural water resources such as of snow fed rivers and upland lakes which serve as potential fishery resources of cold water fish species [52]. Environmental annual and seasonal changes are responsible for variation in growth of biological factors of river [53], ecological condition of fish, niche in the ecosystem and preferred food items determine growth of fish [54], gonadal structure, functions and growth in fishes are controlled by environmental factors [55], seasonality shows in gonadal biochemicals changes that associates with variation in growth, even among the individuals of the same species [56, 57, 58]. Above cited literature or research work especially on Labeo dyocheilus at Western Ramganga River, were also similar and in support of our work and research findings.

IV TABLE AND FIGURES

Table1. Month wise values of analyzed two years summarized data, statistical modeling based on Length-Weight relationship, Regression analysis, coefficient of Correlation on length weight relationship and Relative condition factor (K_n)

S.No.	Month	(Parabolic Equation) $W = a \quad L^{n}$ Spot-I & Spot-II	(Correlation Coefficient "r") Spot-I & Spot-II	(K_n Average) Spot-I & Spot-II	(K_n S.D.) Spot-I & Spot-II
1.	Jan	$W = -5.742 \quad L^{1.756}$ $W = -6.346 \quad L^{1.995}$	**0.991** 0.976	0.986 - 1.128 0.887 - 1.132	**1.021 ± 0.035** **1.023 ± 0.059**
2.	Feb	$W = -9.114 \quad L^{1.564}$ $W = -8.731 \quad L^{1.476}$	0.920 0.988	0.966 - 1.125 0.897 - 1.089	0.999 ± 0.030 1.002 ± 0.074
3.	Mar	$W = -4.031 \quad L^{1.321}$ $W = -8.025 \quad L^{1.558}$	0.947 0.970	0.918 - 1.117 0.921- 1.141	1.0± 0.084 1.006 ± 0.069
4.	Apr	$W = -5.644 \quad L^{1.430}$ $W = -7.602 \quad L^{1.697}$	0.964 0.964	0.967 - 1.059 0.890 - 1.105	1.002 ± 0.052 1.009 ± 0.078
5.	May	$W = -5.940 \quad L^{1.582}$ $W = -5.822 \quad L^{1.812}$	0.981 0.966	0.944 - 1.071 0.880 - 1.106	1.006 ± 0.058 1.010 ± 0.074
6.	Jun	$W = -7.844 \quad L^{1.681}$ $W = -7.633 \quad L^{1.978}$	0.968 **0.938**	0.969 - 1.132 0.926 - 1.187	1.008 ± 0.041 1.012 ± 0.070
7.	Jul	$W = -8.412 \quad L^{1.889}$ $W = -9.256 \quad L^{2.105}$	0.912 **0.994**	0.981 -1.046 0.940 - 1.052	1.010 ± 0.027 1.014 ± 0.041
8.	Aug	$W = -6.123 \quad L^{1.345}$ $W = -7.251 \quad L^{1.487}$	0.924 0.955	0.929 - 0.997 0.875 - 1.030	**0.959 ± 0.031** **0.968 ± 0.087**
9.	Sep	$W = -5.461 \quad L^{1.012}$ $W = -6.121 \quad L^{1.133}$	**0.910** 0.967	0.956 - 1.032 0.925 - 1.021	0.989 ± 0.028 0.994 ± 0.079
10.	Oct	$W = -4.697 \quad L^{1.023}$ $W = -6.873 \quad L^{1.309}$	0.945 0.935	0.961 - 1.142 0.869 - 1.112	0.999 ± 0.025 0.979 ± 0.084
11.	Nov	$W = -4.143 \quad L^{1.032}$ $W = -4.542 \quad L^{1.165}$	0.955 0.948	0.905 - 1.164 0.927 - 1.011	1.008 ± 0.070 0.989 ± 0.019
12.	Dec	$W = -6.104 \quad L^{1.140}$ $W = -4.989 \quad L^{1.255}$	0.930 0.967	0.995 - 1.121 0.883 - 1.128	1.011 ± 0.011 0.997 ± 0.055

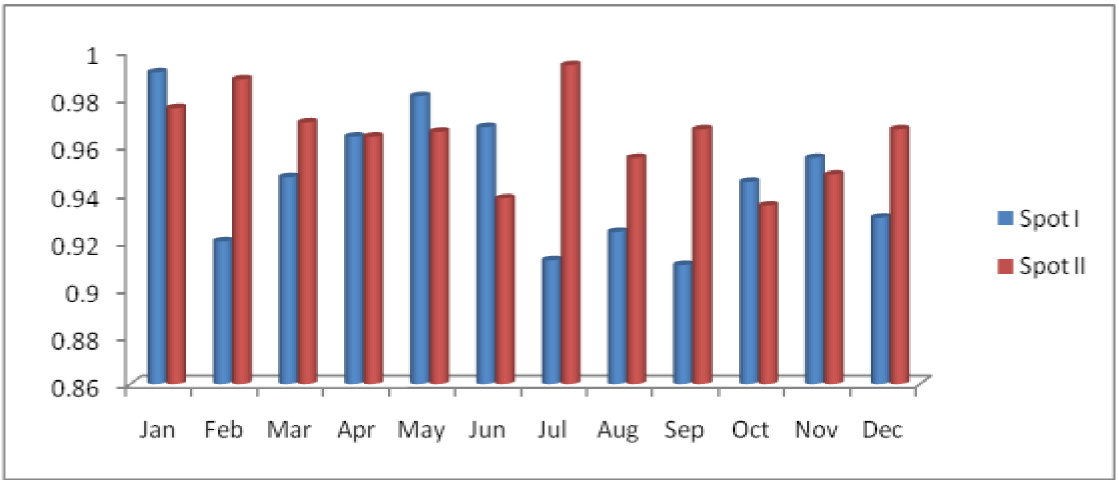

Figure 1. Length Weight Correlation Coefficient were high near one, in all months during study

V CONCLUSIONS

In summary, we can say that the growth in weight is almost proportional to the cube of its length. Condition factor (K_n) has positive influence with increasing length or weight. Regression parameters were found to be highly significant. Findings of the present study can used in the study of fish population dynamics, comparison of body forms of different fish groups, pattern of growth of fishes, to compare fish life history between regions and morphological comparisons between different fish species or between different fish populations from different habitats.

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