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Length –Weight Relationship (LWR) of Freshwater Ampullariidae *Pila virens* from Grand and Lower anicut Reservoir, Tamilnadu

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Abstract

Length – weight relationship has been bio statistically evidenced to have a constant relationship between total length and weight of an individual. LWR is of considerable importance in fishery biology for the calculation of average weight at a certain length and the conversion of an equation of growth in terms of weight at a certain length and conversion of growth equation in terms of length and weight. The formula expresses the relation between weight and length better than the cubic formula W = CL3, Where, W = weight, L = length and C = constant. Basic statistics *viz.*, arithmetic mean and standard deviation were calculated for all the variables and are given as X ± STD. Their relationship explained R^2 value immature (529) $\log_e$ Wt= Log W = 0.682 Log L 0.350; Male (950) $\log_e$ Wt= Log W = 3.030 Log L 3.566; and Female (931) $\log_e$ Wt= Log W = 3.047 Log L 3.589 of variation. As exposed in the table there is no significant difference between b value and the cube value in both the sexes and immature. This indicates that both the male and females follow isometric growth. The LWR of the shell length to and weight are linear relationship of the shell length to width is linear. These results are mainly in agreement with the results reported for other snails with similar relationships between the measured snail parameters.

Keywords: LWR, Ampullariidae, Growth rate, Pila virens and Reservoir.

INTRODUCTION

Length and weight are two important components in the biology of species at the individual and population stages. Knowledge on LWR is essential for proper appraisal and administration of these

fisheries (1). The Length-Weight relationship (LWR) studies are made determine mathematically the relationship between the two variables enable to calculate the length and weight. In molluscs, the growth rate of various body characteristics is not uniform, with the result that the relative proportions of the body change with an increase in body size. Growth rate in mussels vary not only from place to place although also within the same population.

Length-weight relationship measurements are in conjunction with age at maturity, life span, mortality, growth and production (2-3). The growth of one part in relation to the whole organisms is termed allometric growth. The concepts of allometry are useful since expected weight for various length groups can be calculated in organisms known to change their form or shape during growth. It is useful in knowing the variations from the expected weight for various length groups, as some organisms are known to change their form or shape during growth (4).

Le Cren (1951) reported that LWR serves two purposes viz;

(i) To establish a mathematical relationship between two variables length and weight

(ii) To know variation from the expected weight for various length groups.

The insight on length-weight relationship, particularly in molluscs has both pragmatic and intrinsic value. For example, ecological attention is being focused mostly on the biomass and productivity parameters of natural populations and length – weight conversion equation have found considerable utility (5). Moreover, information on the values of proportionality constants obtained in these types of equation may give valuable insight into the underlying nature of shell geometry. Length-weight relationship of freshwater gastropods is not well documented. The length weight relationship formula besides providing a means for calculating weight from length, a direct way of converting logarithmic growth rates evaluated on length into growth rates. The length - weight relationship can be asserted graphically by plotting the observed length and weight as a scattered diagram. The pragmatic relationship between the length weights of the ampullariidae enhances the knowledge regarding the commercially important ampullariidae species. Unfortunately, limited works have been done on the length weight relationship of ampullariidae from the Tamil Nadu. In the present study the length weight relationship of Pila virens were attempted.

MATERIALS AND METHODS

Collection Method

The freshwater snail P. virens were collected from river basin grand and lower anicut reservoir. Mature gastropods were selected for the present study. The shells of these gastropods were brushed and washed with fresh and clean water to remove algal biomass mud and other waste material. Most of the molluscs are sufficiently large

conspicuous and can easily picked up. A hand net or water net fitted with a wooden handle is useful to drag over the aquatic vegetation, and when filled with aquatic weeds the contents are poured out on a spread out cloth piece. The leaves and branches of the plant carefully searched out and the snails are picked up with hand or forceps. The specimens are then transferred to specimen tubes or bottles. All the relevant data should be noted down in the field into a note book or data sheet.

Sampling and analysis

About 1910 individuals of P. virens (Immature – 318; Male-745; Female-847) were collected from the anicut reservoir in the study period of (April – 2013 to March – 2015). The length of the snails was measured in mm from the curved larger end of the body whorl to the tip of the spiral apex (Shell length L) using a vernier caliper corrected to 0.1 mm. The snails were accurately weighted with a single pan electronic digital balance and the readings were then converted into milligrams. In this way total weight of live animal with shell (Total weight (W)), weight of the flesh without shell (Tissue Weight (T.W)) were recorded. Measured snails were segregated depends on size groups and histogram plots showed normal distribution of length. Normality was tested at 95% confidence level.

Sex determination:

Each specimen was dissected ventrally with the aid of a small scissors inserted through the vent. Also a semi circular cut was made laterally on the side of specimens for better observation. The which are two parallel tubules located on the dorsal wall of the abdominal cavity were then examined with the naked eye in the case of sexually mature forms and a dissecting length microscope was employed for examination of the sexually maturing forms. The males have gonads with smooth exterior, while the females have gonads with a rough exterior.

Length- weight relationship

The length weight relationship formula besides providing a means for evaluating weight from length, a direct way of converting logarithmic growth rates calculated on length into growth rates. The length of animal increases with weight, showing that weight of animal is a function of length. As length is a linear measure and the weight a measure of volume, the relationship between length and weight can be expressed by hypothetical cubic law,

$W = CL3$,

Where, W = weight, L = length and C = constant.

If the form and specific gravity remains constant, the formula could be used to calculate the weight of known length and vice versa. The relationships of the shell length to shell width, aperture length, aperture width and shell weight were studied using regression analysis. The

length – weight relationship can be expressed graphically by plotting the observed length and weight as a scattered diagram. The present study has been carried out in P. virens in order to understand the length-weight relationships between various morphological characters.

To study the length-weight relationship, the parabolic equation

$W = aLn$

Logarithmic form as;

$\log W = \log a + n \log L$

i.e., $Y = a + bx$

Where, a=log a; b=n; y=log n & X=log L which is the linear relationship between Y and X.

At the same time, the general equation Y=bx was used to study the allometric relationship between all the bodily characters that can also be expressed in its logarithmic form as log y=log b +log X (6). A logarithmic transformation is LogeW=logea + logebL i.e., y=a+bx according to Ramasesshaiah and Murty, (1997). Where, 'w' represents weight in g and 'a' and 'b' the constants which were estimated by method of least squares.

In addition, the "b" values of males and females denote that they different growth rates from one and another, males exhibiting relatively better than females. However in the both cases the association between length and weight appears to be more or less equal. Where 'Y' are some measures of the whole body or a part, 'X' is a measure of the whole body or any part of the body and 'b' is a constant. Relationship between the total length (TL), total weight (T.Wt), shell weight (S.Wt), total tissue weight (T.T.Wt), height (H) and width (W) of male, female and immature *P. virens* were studied in all combinations using linear regression technique and correlation coefficient (7-9). Appropriate statistical tools were employed to analyze the data.

Statistical analysis

Statistical analyses were performed by using Window based statistical packages mainly, Microsoft Excel, Minitab (10) and SPSS (Statistical Package for Social Sciences; Nie *et al.* 1975). Their relationship between length and weight was assessed using linear regression equation both dependant independent variable were transform into Log_{10}. Mainly parametric tests were used to test the hypothesis and they were Analysis of variance (ANOVA) equations. Appropriate data transformations were made wherever needed. For hypothesis testing $P<0.05$, was considered and the levels of significance was indicated at appropriate places.

RESULTS

The logarithmic equations derived for male and female of the *P. virens* snails collected in the anicut reservoir evaluated. The log length and log weight of *P. virens* showed significant isometric relationship.

Their relationship explained R^2 value immature (529), male (950) and female (931) of variation.

For Immature : $\log_e$ Wt= Log W = 0.682 Log L 0.350

For Males : $\log_e$ Wt= Log W = 3.030 Log L 3.566

For Females : $\log_e$ Wt= Log W = 3.047 Log L 3.589

The correlation coefficient (r) for immature, male and female snails was found to be significant at the 0.001 level. The regression parameters of the length and weight relationships of *P. virens* and the details of sums of the squares and products of length and weight data of Immature, males and females are presented in Tables 1. The scatter diagrams of length weight for Immature, males and females are presented in Figures (1-3).

The R2 values estimated in were very close male and female, thus showing the accuracy of data and methodology followed for the estimation of relationship.

The results of statistical analysis of length weight relationships showed that the value of exponent (b value) of the length weight relationships was not significantly different from the cube value in both the sexes. This indicates that both male and female *P. virens* follows isometric growth pattern. Results of ANOCOVA showed that linear relationships of male and female *P. virens* are same. The results of the ANOCOVA on length-weight regression equation are given in Table 2. The results showed the F values are smaller than the table values at 5% level of significance. This indicates there is no significant difference between the length-weight relationship of male and female. It is evident that the correlation coefficient values for various combinations in both the sexes are highly significant. The *P. virens* have significant difference between length-weight and opined that the difference appears to be due to sexual maturity and also due to increase in size of both sexes.

Table: 1: Analysis of covariance showing difference between regressions of Length – Weight relationship of immature, male and female *P. virens*

Sources of variation	Degrees of freedom	Sum of squares	Mean squares	F	5% F
Deviation from individuals regression	1908	25.291	0.013	1.5881	3.00*
Difference between regression	1	210.520	210.52		
Deviation from average individuals regression	1909	235.812			

Table: 2: Length & weight relationship variables and Regression Coefficient of *P. virens*

S.No	Relationship Length X Weight	Variables	Coefficients (± SE)	t	F	P	R^2	Beta
1	IMMATURE	Log Weight	-0.351 ± 0.045	-7.776	357.429	<0.01	529	729
		Log Length	0.683 ± 0.036	18.906				
2	MALE	Log Weight	-3.590 ± 0.040	-90.248	1424.00	<0.01	950	975
		Log Length	3.048 ± 0.026	119.321				
3	FEMALE	Log Weight	-3.567 ± 0.044	-80.707	1150.00	<0.01	931	965
		Log Length	3.030 ± 0.028	107.216				

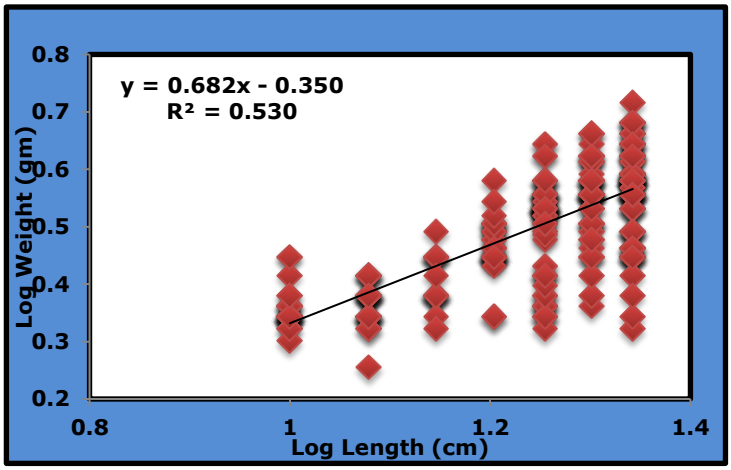

Fig. 1. Logarithmic relationship between length and weight of Immature *Pila virens* (2013-15)

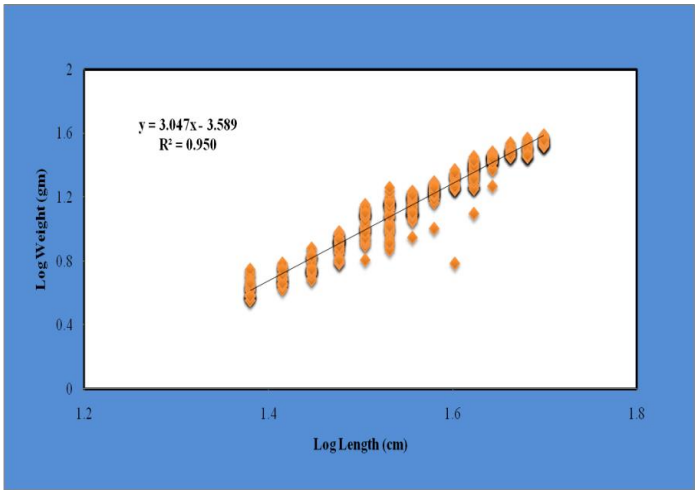

Fig. 2. Logarithmic relationship between length and weight of Male *Pila virens* (2013-15)

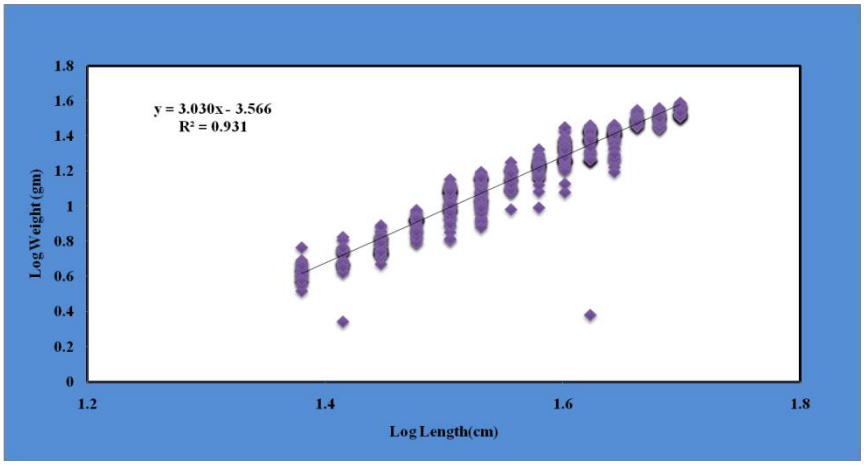

Fig. 3. Logarithmic relationship between length and weight of Female *Pila virens* (2013-15)

In the present study, average shell length of female P. virens is significantly larger than that of males. Females are also heavier in tissue weight indicating their growth to larger body size, than males. The overall shell length reflected in spire height implies that females grow faster than males. Consequently length - weight data for P. virens was analyzed separately for immature, males and females. The 'b' values for immature, male and female varied between 0.351, 3.567 and 3.590 for immature, males and females respectively.

Assessment of distribution of Freshwater molluscs are become a new necessity as the ecosystems face increased intimidation of loss and impairment from human activities. Knowledge of length weight relationships in the molluscan has both pragmatic and intrinsic value. The ecological attention is being focused on the standing crop (biomass) and productivity parameters of natural populations and here length dry weight conversion equations have found considerable utility. Furthermore, information on the values of proportionality constants obtained in these types of equation may give valuable insight into the underlying nature of shell geometry.

DISCUSSION

The present investigation undertakes of P. virens length - weight relationship to evaluate the snail growth. Length - weight relationship of living organism is a unique and constant feature. It is stated that the relationship of L x W takes the form W=a Lb. Similarly various other relationships such as L x T, L x TW, L x SW etc., can be derived by employing linear regression. Conversely, there are several limitations to shell length as a measure of animal size. First, as gastropod shells age, the spires begin to erode. Second, as animals increase in size there is a progressively smaller change in length for a given change in

body weight so given the limit on resolution of length change imposed by the repeatability of caliper measurements (0.1 – 0.2 mm), changes in weight will be more readily detected than changes in length. Third, in mature gastropods, where shell growth is almost negligible, body weight may still vary seasonally in association with spawning, reduced activity over the winter or increases or decreases in the food supply. These body weight changes would pass undetected if only shell length is recorded. Finally if populations differ from each other in shell shape or if there is shape variation among individuals within a single population.

Then a given length change in animals of the same initial length will be associated with different changes in body weight.

In the present investigation *P. virens* 'b' value significant male and female. The b' values obtained falls in the range mentioned for the molluscan species available from Indian waters (10). The results obtained in the present study on *P. virens* indicated that the allometric relationships of various parameters such as length x width; length x tissue weight; length x shell weight etc., are linear for length based parameters and follow cube law in the case of weight based parameters. The results showed that they followed a similar pattern observed in other species of molluscans by various authors (11). The values of "t" so calculated were found to be much significant at 5% level, thereby confirming that the cube law formula W = a Lb will be a correct representation for the length weight analysis. The correlation (r) revealed that the relation between length and weight in both males and females of P. virens was good.

Garcia et al., 1998 pointed out that biological interpretation of the numerical values of the parameters "a" and "b" is not always straight forward, expect that when growth is isometric, "a" can be interpreted as Condition factor. In addition, the "b" values of males and females denote that they different growth rates from one and another, males exhibiting relatively better than females. However in the both cases the association between length and weight appears to be more or less equal.

The change in the shape of growing animals at a point of time is due to the concurrent increase in size and weight respectively. Analysis of the length–weight relationship has become a standard practice in fishery studies. Knowledge of the length – weight relationship has a vital importance in fishery as it not only helps in establishing the yield, although in converting one variable to another. The length is easier to measure and can be converted into weight in which the catch is invariably expressed

(12). The standard comparison is used for Gastropods being total length against total weight.

CONCLUSION

The present study provides baseline information on importance and length weight relationship of Pila virens and thus can enhance the management, conservation, culture of these species for the purification of bioactive compound. The LWR relationship between body length and weight is great importance in fishery biology not only for the estimates of biomass obtained from analytical models although also the parameter b of the relationship has also an important biological meaning, indication the rate of weight gain relative to growth in the species and also observed a significant difference in growth between the male and female and also reported significant differences between length weight and opined that the differences appears to be due to sexual maturity and also due to increase in size of the sexes. The LWR relationship between total length, total weight, aperture length and aperture width can be used for scrutinize the growth of this species in the natural stipulation.

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