CHAPTER - 11

LENGTH - WEIGHT RELATIONSHIP

The length–weight relationship of fishes generally indicates that an increase in length is accompanied by increase in weight. It is primarily to facilitate the conversion of one measurement into another. The length–weight relationship of fish has theoretical and practical application in the fishery science.

In certain cases length weight relationship is very useful in differentiating small taxonomic units for variations may occur within the population of different localities (LeCren, 1951 and Chonder, 1972). This relationship also gives information on the condition of the species which is measure of the variation from the expected weight for a particular length of an individual fish. The length-weight relationship of most fishes can be expressed in general equation.

\[ W = aL^n \]

Where, \( W \) = Weight
\( L \) = Length
\( a \) = a constant
\( n \) = an exponent expressing relationship between and length and weight.

The value of ‘\( n \)’ generally lies between 2.5-4.0 (Hile, 1936 and Martin, 1949) or 2.0–3.5 (Royce, 1972). For an ideal fish which maintains isometric growth, the value of ‘\( n \)’ should be 3. In majority of cases where length-weight relationship has been calculated, it has been observed that the cube law is not obeyed. Further, most fishes do change their shape as they grow (Martin, 1949), hence a cube relationship between length weight relationship could be hardly expected.

The relationship (\( W = aL^n \)) when converted into the logarithmic form give a straight line relationship graphically. The equation may be written as

\[ \log W = \log a + n \log L \]

Where ‘\( n \)’ represents the slope of the line and (\( \log a \)) is constant.

The cube law is based on the assumption that the form and specific gravity remains constant throughout the life history but in general practices the fish has to pass through many stages such as hatching, juveniles,
immature and matures, which are responsible for the deviation from the cube law.

In Indian freshwater fishes various workers e.g. (Khan and Hussain, 1945; Jhingran, 1952, 1959; Chakrabarty and Singh, 1963; Natrajan and Jhingran, 1963; Srivastava and Singh, 1964; Kamal, 1969; Devaraj and Natrajan, 1973 and Johal and Tandon, 1983a, 1987a) have studied the length-weight relationship from different localities of Indian waters using LeCren’s (1951) equation.

Many scientists have worked on the various aspects of the biology of Indian mahseers and other commercial fish species. Thus, calculation of length-weight relationships is one of the essential aspects in the fishery biology of a fish species. The important works are those of Hora and Mukerjee (1936), Khan and Hussain (1945), David (1953), Sarojini (1957), Jhingran (1952, 1959), Tandon (1961), Chakrabarty and Singh (1963), Natrajan and Jhingran (1963), Alikunhi and Sukumaran (1964), Pantulu et al. (1962), Lal (1968), Sekhran (1968), Kamal (1969), Khan (1972), Rao and Rao (1972), Devraj and Natrajan (1973), Vinci and Nair (1974) and Soni and Kaithal (1979). The length weight relationship of Tor putitora has been described by Lal and Nautiyal (1980), Johal and Tandon (1981), Nautiyal (1983) and Nautiyal (1985b) from riverine and reservoir population. Dey (1987) found the allometric growth of Acrossocheilus hexagonolepis and adaptability in the water bodies of North-Eastern India. Das Gupta (1988, 1990 and 1991) studied the length-weight relationship and condition factor of A. hexagonolepis, Tor tor and Tor putitora respectively from Simsang River (Garo Hills).

**OBSERVATIONS**

For the study of the length-weight relationship of Tor putitora the fish were brought from the field, were first measured and then the excessive moisture was removed from each fish by pressing the latter in between two blotting papers and weights were noted down for individual fish. Samples of fish collected during different months from August 1998 to January 2000 formed the part of the present studies. The observed values of lengths and weights were transformed to logarithmic values and equations were calculated by the method of least
**Fig. 11.1** : Length-Weight relationship between Total Fish Length (cm) along X-axis and Weight (gm) along Y-axis.

**Fig. 11.1** : Length-Weight relationship between Log Total Fish Length (cm) along X-axis and Log Weight (gm) along Y-axis.
squares. Males and females have been treated collectively because of small sample size.

The length–weight relationship of the data was analysed by the regression which is as follows:

1. Regression Data

   \[ r = 0.989 \]
   \[ a = -1.821 \]
   \[ b = 2.831 \]

2. Regression equation

   \[ \log W = -1.821 + 2.831 \times \log L \]
   
   or
   
   \[ W = 0.0115 L^{2.831} \]

   Where, \( W \) = weight in gm.
   \( L \) = length in mm.

3. The observed values for the corresponding length and weights are plotted and show a parabolic relationship and the increase in the total length is found to be highly correlated with the increase in the total weight (Fig. 11.1). The logarithmic values for lengths and weights when plotted give a straight line relationship (Fig. 11.2). From the parabola it is indicated that an increase in weight is more rapid from 20cm and above.

DISCUSSION

Many scientists have worked on the relationship of the lengths and weights of the fishes. Allen (1938) observed that the weight of the commercial fish increases as cube of its respective length. Hile (1936), LeCren (1951), Sarojini (1957), Pillay (1958) and Tandon (1961), in their observations on the length-weight relationship on marine fishes found that this does not hold good because it is possible only when the form of the fish and the specific gravity remain constant throughout life. Seshappa and Bhimachar (1955), Verghese (1961), Talwar (1962) and various other workers have shown that the value of the regression coefficient either lies very close to the cube of the length or differs significantly from it. According to Hile (1936) the exponent 'n' usually
Length – Weight Relationship

varied between 2.5 to 4.0 and in majority of the cases the value of ‘n’ is around 3. It differed with sex and locality. Nautiyal (1985a) observed the range between 2.3 to 3.1 and in pooled data it was 2.9. The value indicated that the length weight relationship of *T. putitora* closely follows the cube law and thus may be considered as an ideal fish.

In the present observations, the value of exponent ‘n’ is 2.831 which is closely related to cube law. Lal and Nautiyal (1980) found that the regression coefficient was less than the cube of the length which is in conformity with the present observation. The variance ratio was observed 7332.456 and correlation coefficient 0.989 which shows that the total length is highly significant for the increase in the total weight of *Tor putitora*.

MacGregor (1959) observed the value of ‘n’ less than the weight shell decrease with the increase in length and vice-versa incase the value of exponent ‘n’ is more than 3. He further stated that the value of ‘n’ can be influenced by sampling irregularities such as sampling from different localities, periods and inclusion of mature and immature specimens. The samples in the present study were from one locality thus and such an irregularity could not expected but the heterogeneity (sex, seasons, life stage) has played the role. Johal and Tandon (1981) observed that the condition factor in mahseer increases with the increase in length and this may explain the commercial importance of this fish i.e. *Tor putitora*.

It is advisable to work on the length – weight relationship of *Tor putitora* (Hamilton) from different natural waterbodies to ascertain the presence of best adapted population. It may be pointed out hare that voluminous data on other commercial carps is available for such comparisons but the similar data are lacking on *Tor putitora* (Hamilton).