Length-weight relationship
7.0. Length - weight relationship

7.1. Introduction

The length weight relationship (LWR) of fish is an important piece of information in fishery biology. Basic informations knowledge on parameters that relate weight to length of fish is scanty (Vazzoler 1996). Pauly (1993) reported the importance of length weight relationship (LWR) in the calculation of the fishes average weight at a certain length class and the conversion of an equation of growth in length in to an equation of growth in weight. The mathematical parameters of the relationship between the length and weight of fish furnish further information on the weight variation of individuals in ration to their length (condition factor Kn). These factors estimate the general well - being of the individuals are frequently used in three cases: (1) Comparison of two or more co- specific populations living in similar or different conditions of
food, density or climate among others; (2) determination of the period and
duration of gonad maturation and (3) observations on the changes, possibly due
to modifications in food resources (Weatherley and Gill, 1987).

Generally, a growth model in fish follows the "Cube law" and hence the use of
the Fulton's conditions factors or isometric factor \( R = \frac{W}{L^b} \), attributing to the
weight - length exponent \( b \) a value equal to 3 (Gulland, 1983). In this case, body
form maintains weight equal proportion to body length (Weatherly and Gill,
1987). However, all fishes obey the "cube law" and the deviations are measured
by condition factor \( (Kn) \). Le crens (1955) proposed condition factor related to
feeding, sexual maturity, and age and growth parameters. In modern fisheries
research, ageing of fishes is considered very important because it has been
realized that knowledge of age and growth rate of fish are of great importance
to many practical and scientific questions (Erna, 1994; Jhingran, 1952; Entgua et
al., 1995). However no information is available on the length - weight
relationship of evaluation of growth and general well - being of *M. gulio*.

7.2. Materials and Methods

Totally 573 fishes of *M. gulio* (356 males and 217 females) were
collected from Tambaraparani river (Tamil Nadu) during June 2002 - May
2003. After blotting the specimens the total length (TL) nearest millimeter
and weight as gram (g) were measured. Length weight relationship was
expressed as; \( W = aL^b \), the logarithmic transformation which gave the linear equation

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

The relationship between length and weight was assessed by method of least square and both values are transformed to logarithmic form and fitting into straight-line regression. The regression and significance of regression are analyzed by systat software.

Relative condition factor \((Kn)\) as per Le cren (1951) method is as follows

\[
Kn = \frac{W}{w}
\]

Where \( Kn \) = relative condition factor
\( W \) = Observed weight
\( W \) = Cal. Weight derived from LWR

7.3. Results

Length weight relationship of male and female *M. gulio* is expressed as follows.

Female: \( \log w = -5.0532 + 2.1578 \ r = 0.8143 \)

Male : \( \log w = -3.0018 + 3.1807 \ r = 0.9947 \)

The logarithmic relationship between female and male of *M. gulio* correlation coefficient is depicted (Fig 7.1 and 7.2). The ‘\( r \)’ value found in male was 0.9947 and female was 0.8143. The ‘\( t \)’ test to confirmed are exciting good relationship between length and weight parameters of both sexes (\( P<0.01 \)). But standard
Fig: 7.1. Length weight relationship of female population

female

![Graph showing length weight relationship for female population with the equation: \( \log W = -5.0532 + 2.1578 \) and \( r = 0.8143 \).]

Fig: 7.2. Length weight relationship of male population

male

![Graph showing length weight relationship for male population with the equation: \( \log W = -3.0018 + 3.1807 \) and \( r = 0.9947 \).]
error was more in the case of female population than the male population due to overlapping of same value many times. The 't' test confirmed that (Table 7.1) male population grows better than female population. The value of regression coefficient of male and female were 3.1807 and 2.1578 respectively. The value for males as 11.19 (df: 356) and females as 1.15717 (df: 217) showed that males significant from '3'. Seasonal fluctuations of relative condition factor (Kn) of both males and females are depicted in Fig 7.3. During the study period male population showed less growth was noticed from June to July after that the Kn value increased up to September and then decreased (0.6) in December and after that there was a small increase till to May. But female population did not show such differences.

| Table: 7.1. Statistical details of no of fish examined (n) intercept (log, a), regression coefficient (b), standards error of b (sb) and result of Bailys t- test on “b” and “t” test on correlation coefficient (b). |
|-----------------|-------|-------|-------|-------|-------|-------|-------|-------|
| Sex      | N    | Log a | b      | Sb    | t     | P     | r     | t     | P     |
| Female   | 356  | -5.0532 | 2.157  | 0.115 | 1.571 | <0.01 | 0.814 | 32.47 | <0.01 |
| Male     | 217  | -3.0018 | 3.180  | 0.075 | 11.19 | <0.01 | 0.994 | 41.18 | <0.01 |

7.4. Discussion

In fish, the weight is considered as function of length (Weatherley and Gill, 1987). According to Wooton (1992), if the fish retains the same shape then its specific gravity remains unchanged during lifetime. In fish growth isometric and the value of exponent "b" would be exactly 3.0. A value
Fig: 7.3 Seasonal variations in relative condition factor (Kn) of *M. gulio* during 2002-2003
significantly larger or smaller than 3.0 indicates allometric growth. A value less than 3.0 indicates that the fish becomes lighter (negative allometric) or greater than 3.0 indicates that the fish becomes heavier (Positive allometric) for a particular length as it increase in size (Wotton, 1998). In the present investigation higher 'b' value were observed in male population (3.1807) than female population (2.1578). The 'b' value of male population obeys the “Cube law” i.e. isometric growth pattern than the female (allomertic pattern of growth). Isometric growth pattern has been reported in *Catla catla* (Zaper *et al.*, 2001; Choudary *et al.*, 1982), *Harpodon nehereus* (Nurul Amin, 2001), *Mystus numurus* (Khan *et al.*, 1991), *Cirrhinus mrigala* (Soni&Kathal, 1979), *Perca fluviatillis* (Le cren, 1951), and *Puntius dorsalis* (Sivakami, 1987).

Similarly allometric pattern of growth has also been observed in *Labeo dussumieri* (Jhingran, 1952, Kurup, 1990), *Clarias gariepinus* (King, 1996), *Heteropnustus fosilis* (Thakur and Das, 1974). The differences in growth pattern may be due to environmental and intrinsic factors. Metabolic process also influences length - weight relationship. The variations in fish size indicates that the population ranged from immature to matured individuals (Frota *et al.*, 2004). In present study allometric growth pattern observed in female population may be due to differencing maturity of ovary and feeding intensity. For instance, GSI values were much higher in female population during breeding season; this may be the main reason for allometric growth pattern of female population.