Length-weight relationship and condition factor of *Cyprinus carpio var. communis* (Linnaeus, 1758) reared in bheries of South 24 Parganas district in West Bengal

N. Rishikanta Singh, S. K. Das, Sanjeev Kumar, S. Behera, T.S. Nagesh

**Abstract**

An attempt was made to study length-weight relationship and condition factor of exotic carp, *Cyprinus carpio var. communis* reared in bheries at Bhamanghata of South 24 Parganas district in West Bengal. Samples of 344 fishes having a size range of 87 mm to 245 mm were taken to estimate the length-weight relationship. The regression equation was found as logW=-4.570+3.062 logL (r=0.889) for male, logW= -4.645+3.143 logL (r=0.889) for female and logW= -4.627+3.097 logL (r=0.903) for pooled sample and it exhibited significant correlation between length and weight. It was found that the exponent ‘b’ value was not significantly deviating from ‘3’ indicating isometric growth. The mean relative condition factor (Kn) was found to vary from 0.93 to 1.19 during the period of investigation. It varied significantly (F11, 213=17.60, P<0.01) during different months which were attributed to food and feeding habit of fish.

**Keywords:** Length-weight relationship, Relative condition factor, *Cyprinus carpio*.

1. Introduction

Fish and Fisheries play an important role in the economy of developing countries by contributing to animal protein intake, employment generation, household incomes and foreign exchange earnings. The existence of varied topography and different agro-climatic conditions in the state of West Bengal has bestowed upon a productive fishery resources. Fish production in the country has increased from 3.8 million tonnes in 1990-1991 to 9.579 million tonnes during 2013-14 (DAFD, Statistics 2014), registering an annual growth rate of 6% during the period. India has emerged as the second largest aquaculture producer in the world. Freshwater aquaculture showed an overwhelming ten-fold growth from 0.37 million tonnes in 1980 to 6.136 million tonnes in 2014; with mean annual growth rates of over 6%. Freshwater aquaculture has been able to meet the increasing fish requirement of the country when the production from marine capture and other open water system has remained almost stagnant. It is estimated that only about 40% of the available area of 2.36 million ha of ponds and tanks have been put to use and there exists scope for expansion of area under freshwater aquaculture.

Common carp was first introduced to India from Ceylon in 1939 and later again from Bangkok in 1957. The common carp is mainly bottom dwellers, but search for food in the middle and upper layers of the water body. Common carp can reach 0.6 to 1.0 kg body weight within one season in the polyculture fish ponds of subtropical/tropical areas. Growth is much slower in the temperate zone, where the fish reach the 1 to 2 kg body weight after 2 to 4 rearing seasons. The length-weight relationship gives an idea about the mathematical relationship between length and weight. The variation is influenced by fatness, feeding intensity or gonadal development of the fish (Le Cren, 1951) [9]. The study of length-weight relationship in fishes is of primary importance in setting up yield equations (Ricker, 1958) [10], estimating the number of fish landed and in comparing population in the time and space (Chanchal et al., 1974 and Pathak, 1975) [21, 15, 16]. But the actual relationship may depart significantly from it (Le Cren, 1951) [9] as fishes normally do not retain the same shape throughout their life span. The value of exponent ‘b’ in the equation \( W = aL^b \) usually lies between 2.5 to 4.0 (Hile, 1936 and Martin, 1949) [4, 10]. The relative condition factor (Kn) is the important biological parameter which indicate the suitability of a specific water body for...
the growth of fish (Le Cren, 1951) [9]. The relative condition factor is the ratio between observed weight and calculated weight of the fish. The values of this factor depend on physiological features of fish namely maturity, spawning, environmental factors and food availability in a water body (Ujjania et al., 2012) [28].

2. Materials and Methods

2.1 Length Weight Relationship

This study was based on a total of 344 samples of Cyprinus carpio var. communis having size ranging from 85 mm to 245 mm collected from bheries at Bhamanghata of South 24 Parganas district in West Bengal between July 2011 and June 2012. The total length and the total weight of the sample fishes were measured by using millimetre scale and monopan balance.

The nonlinear equation in the form of \( W = aL^b \) [Le Cren, 1951] [9], which explains the length and weight relationship of fishes, was used in the present study. The equation in linear form is written as, \( y = A + Bx \) where \( y = \log W \) and \( x = \log L \). The isometric or allometric growth was tested by ‘t’ test.

2.2 Relative Condition Factor (\( K_n \))

The data used for length weight relationship were also utilized for calculating relative condition factor of the fishes. The relative condition factor is given by the formula,

\[
k_n = \frac{W_o}{\bar{W}}
\]

Where, \( W_o \) = observed weight and \( \bar{W} \) = calculated weight. Monthly mean values of \( K_n \) were calculated for each species of fish and weighted average of the \( K_n \) was also calculated for the whole period (July 2011 to June 2012) for both the species of fish.

2.3 Statistical Analysis

The exponent (b value) in the length-weight relationship was tested for significance following Fisher’s t-test.

3. Result and Discussion

3.1 Length weight relationship

During the period of study total length and body weight of 344 samples of Cyprinus carpio were recorded. In the case of male the total length and body weight varied from 87 mm to 245 mm and 32 grams to 557 grams respectively. Whereas in the case of female the total length ranged from 85 mm to 232 mm and body weight ranged from 36 grams to 548 grams. The computed length weight relationship of Cyprinus carpio (Table No.1) was as follows:

a. Male: \( W = 0.0000269 \times L^{3.062} \quad r^2 = 0.898 \)

b. Female: \( W = 0.0000224 \times L^{3.143} \quad r^2 = 0.889 \)

c. Pooled: \( W = 0.0000236 \times L^{3.097} \quad r^2 = 0.903 \)

Table 1: Length-weight relationship

<table>
<thead>
<tr>
<th>Sex</th>
<th>No. of sample</th>
<th>a</th>
<th>b</th>
<th>Logarithmic Equation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Male</td>
<td>176</td>
<td>0.0000269</td>
<td>( \log W = -4.570 + 3.062 \log L ) (( r = 0.898 ))</td>
</tr>
<tr>
<td>2</td>
<td>Female</td>
<td>168</td>
<td>0.0000224</td>
<td>( \log W = -4.649 + 3.143 \log L ) (( r = 0.889 ))</td>
</tr>
<tr>
<td>3</td>
<td>Pooled</td>
<td>344</td>
<td>0.0000236</td>
<td>( \log W = -4.627 + 3.097 \log L ) (( r = 0.903 ))</td>
</tr>
</tbody>
</table>

The length-weight relationship in the present study depicted that the ‘b’ value of 3.062 in male, 3.143 in female and 3.097 in case of pooled samples. The ‘b’ value was found to be not significantly different from 3 indicating isometric growth. A perusal of length-weight relationship, worked for mirror carp from Dal Lake, shows that the value of b was 2.98, slightly less than 3, thus not satisfying the cube law. It may be said that the weight of the fish in Dal Lake increases in proportion slightly less than the cube of its length (Sunder et al., 1984) [27]. The reported regression values in the common carp (Cyprinus carpio var. communis) varied as 3.75 from Sagar Lake (Soni and Kathal, 1979) [24], 2.98 from Dal Lake (Sunder et al., 1984) [27] and 2.42 from Gobindasgarh (Sharma, 1986-1987) [23]. Jhingran (1952) [6] also observed the deviations from isometric values of 2.9002 and 2.7088 in common carp, Cyprinus carpio var. communis and grass carp, Ctenopharyngodon idella (computed with total length) in composite fish culture in Himachal Pradesh.

A total weight of the fish increases as an exponential function of its length irrespective of its size (Chacko and Ganapati, 1951; Kamal, 1969; Srivastava and Pandey, 1981) [1, 8, 19]. The present study reveals that the length-weight relationship follows the cube-law. Therefore, it may be stated that this fish had an isometric growth. Hossain et al. (2010) [5] had shown an allometric growth of the species in Nasti boar, Bangladesh with observed b values 3.132 in February, 3.130 in March and a 3.112 in April with correlation coefficient (r) 0.992, 0.956 and 0.969 respectively.

3.2. Relative condition factor of Cyprinus carpio

The mean relative condition factor (\( K_n \)) calculated during different months is shown in Table No.2, and Figure No.1.

Table 2: Variations in the monthly average of Relative condition factor (\( K_n \))

<table>
<thead>
<tr>
<th>Months</th>
<th>Cyprinus carpio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
</tr>
<tr>
<td>July, 2011</td>
<td>1.1</td>
</tr>
<tr>
<td>August, 2011</td>
<td>1.03</td>
</tr>
<tr>
<td>September, 2011</td>
<td>0.94</td>
</tr>
<tr>
<td>October, 2011</td>
<td>0.93</td>
</tr>
<tr>
<td>November, 2011</td>
<td>1.08</td>
</tr>
<tr>
<td>December, 2011</td>
<td>1.09</td>
</tr>
<tr>
<td>January, 2012</td>
<td>1.07</td>
</tr>
<tr>
<td>February, 2012</td>
<td>1.02</td>
</tr>
<tr>
<td>March, 2012</td>
<td>0.96</td>
</tr>
<tr>
<td>April, 2012</td>
<td>0.97</td>
</tr>
<tr>
<td>May, 2012</td>
<td>1.04</td>
</tr>
<tr>
<td>June, 2012</td>
<td>1.09</td>
</tr>
</tbody>
</table>
In the present study, the relative condition factor $K_n$ of *Cyprinus carpio* varied from 0.93 to 1.10 in male and 0.95 to 1.19 in female. Thus the study indicated the fish in the polyculture pond have relatively good condition. The relative condition factor of common carp observed in the present study exhibited significant difference ($F_{11, 11} = 21.00$) during different months at 1% level of significance. The $K_n$ values also showed significant difference ($F_{1, 11} = 17.60, P<0.01$) between the sex of the fish which might be attributed to variation in feeding intensity and maturity. Sinha (1972) [22] reported that monthly condition values are known to be influenced by mainly three factors viz. maturity of gonads, amount of undigested food in the alimentary canal and changes in the amount of fat stored in body tissue.

Pandey and Sharma (1997) [14] studied the condition of four exotic carps and reported that only the common carp, *Cyprinus carpio var. communis* was found to have value above 1 (1.0109). Pandey & Sharma (1998) [14] reported high $K_n$ values for *Labeo rohita* (1.0129) and *C. catla* (1.0007) and low values for *Cirrhinus mirgala* (0.9967). The values of $K_n$ of scale carp in Dal lake during different months was reported by Sunder et al. (1984) [26] indicated a peak in March (1.25) followed decline trend and a minimum in July (0.95). Thereafter, a gradual increase till December was recorded (0.98-1.21) and again declined during January (1.10). It was found that common carp exhibited two peaks in $K_n$ during June-July as well as December-January which might be due to higher gonadal development. Higher $K_n$ values during August and February can be attributed to more feeding after spawning. This is in agreement with the earlier workers such as Pillay (1954), Sarojini (1957) and Narasimham (1970) [17, 20, 11].

Therefore $K_n$ value was exhibiting higher magnitude during the period of study.  

4. References

5. Hossain MY. Morphometric relationships of length-weight and length-length of four Cyprinid small indigenous fish species from the Padma River (NW Bangladesh), Turkish Journal of Fisheries and Aquatic Sciences 2010; 10:213-216.
22. Sharma BK. The biology and fishery of *Cyprinus carpio*


