Article

Length - Weight Relationships, Relative Condition Factor and Relative Weight of Characidae Fish in Jebel Aulia Dam, Sudan

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Abstract: The length-weight relationship, relative condition factor ($K_{rel}$) and relative weight ($W_r$) for Characidae fish in Jebel Aulia Dam Reservoir were studied. 1931 specimens were measured and weighed. The values of the exponent $b$ in the length-weight relationships (LWRs) were 2.9004 for Alestes baremose, 2.7096 for Alestes dentex, 2.9999 for Alestes nurse, 3.0437 for Hydrocynus forskalii, 2.997 for Hydrocynus lineatus and 2.6797 for Hydrocynus brevis. To the authors’ knowledge, all weight-length relationships presented in this paper is reported for the first time from the Jebel Aulia Dam, and in the case of this is the first reference worldwide.

Keywords: Length-weight relationship; Relative condition factor; Relative weight; Jebel Aulia Dam.

1. Introduction

Information regarding fish taxonomy and distribution within the Nile as general and Jebel Aulia reservoir in particular, taxonomy and characteristic of fishes of the Nile were reported by Boluenger (1907) work on the taxonomy and characteristic of the fish. Girgis (1948) recorded 18 families and 62 species from the swamp and other southern tributaries of the White Nile. Sandon (1950) recorded one hundred and eight species from White Nile system. These belong to 51 genera and
25 families. Adam (1977) carried out a work on the distribution and abundance of fish in Jebel Aulia reservoir. He could recognize 48 species belonging to 26 genera and 14 families with Mormyridae constituted 23.7%, Mochocidae 23.5%, Schibeidae 21.1%, Characidae, 13.4%, Cyprinidae 5.8%, Bagriidae 8.2%, and Citharinidae 2.8%.

Bailey (1994) reported that 115 species of fish were recorded in the basin of the river Nile and Sudd swamp. Bashier (2007) reported that there are 43 species, 19 genera and 15 families in central White Nile at Goli, Kosti and Alhudiba sites.

Ahmed (1985) reported that the family Characidae was the most dominant fish constituting almost 22% of the total catch in Jebel Aulia reservoir during 1983-1985. This family includes fishes of relatively high economic value that are processed mostly for wet salting. The genera were Hydrocynus and Alestes.

Family Characidae members are found over the greater part of tropical Africa and tropical South America. Their fossils had first appeared in the upper territory of Brazil and Peru, whilst bones of tiger fish (Hydrocynus) were found in the Miocene and the early Pleistocene of Kenya. Two genera, viz. Hydrocynus and Alestes of this family are represented in White Nile (Latif, 1973).

The objective of this study was to determine WLRs and condition factors for Characidae species in the fishing grounds in Jebel Aulia Dam.

2. Materials and Methods

Jebel Aulia dam, 337m above sea level, has surface area ranging from 600 to 1500 km² (Welcomme, 1973) while the lake length extends up to 500 km and its maximum width in vicinity of the dam is between 6 and 7 km (Khalid and Hannel, 1990). The amplitude between minimum water level (end of April) and maximum water level (September) is about 6 m (Khalid and Hannel, 1990), the surface area ranges from 600 to 1500 km² (Fig.1).

Family Characidae classification by (Bouenleger1907, Sandon1950 and Latif, 1973) to the followings:

I. The genus Hydrocynus (Cuv1817) include predator fish belonging to three species Hydrocynus forskalii. (Cuv1817), Hydrocynus lineatus (Blkr), Hydrocynus brevis (Gthr).

II. The genus Alestes (M.and T, 1844) whose member are non piscivorous comprised four species, Alestes baremose (Joann), Alestes dentix(L), Alestes nurse (Riip) and Alestes macrolepidotus of these species Alestes baremose was the commonest. A total of 1931 samples were caught by one types of fishing gears, fixed gill nets of mesh sizes, 40, 60 and 80 mm.
Fig. 1: The location of study and sampling positions Jebel Aulia Dam, the Reservoir and Down Stream water on the both Banks of White Nile

The study of length weight relationship for each specimen was based on the standard formula suggested by Beverton and Holt (1966) revised and confirmed by Ricker (1975), Gulland (1983) and Spare (1989).

The correlation between the length (L) and the weight (W) of fish can generally expressed by the Empirical equation:

\[ W = a L^b \]  \hspace{1cm} (1)

where \( W \) = weight of the fish (g)
\( L \) = standard length (cm).

Parameters \( a \) and \( b \) of the weight-length relationship was estimated by linear regression analysis based on logarithms:

\[ \log (W) = \log(a) + b \log(L) \]  \hspace{1cm} (2)

The 95% confidence limits of parameters \( a \) and \( b \) and the coefficient of determination were also calculated.

To demonstrate significant difference of obtained \( b \)-value in equation from the isometric value 3, a t-test was used, expressed by the following equation (Sokal and Rohlf, 1987):

\[ t_b = \frac{b-3}{s_b} \]  \hspace{1cm} (3)
where t is the t-test value, b the slope and \( s_b \) the standard error of the slope (b). Comparison between obtained values of t-test and the respective critical values table allowed for determination of b values statistically significant, and their replacement in the isometric range (b=3) or allometric range (negative allometric; b<3 or positive allometric; b>3).

The relative condition factor (\( K_{rel} \)) for each individual was calculated according to Le Cren (1951) equation:

\[
K_{rel} = \frac{W}{aL^b} \quad \text{......................................................... (4)}
\]

where W is the body weight (g), and L, fork length (cm), and a and b, the parameters of the WLR.

Fulton’s condition factor K was calculated by the formula (Htun-Han, 1978):

\[
K= 100 \frac{W}{L^3} \quad \text{......................................................... (5)}
\]

3. Results and Discussion

3.1. Results

Descriptive statistics on the length and sample size (n), regression parameters a and b of the WLR, 95% confidence intervals of a and b, the coefficient of determination (\( r^2 \)) of six analyzed species with are shown in Table 1.

<table>
<thead>
<tr>
<th>Family/species</th>
<th>Length (cm)</th>
<th>WLR parameters and statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>Mean</td>
</tr>
<tr>
<td>Alestes baremose</td>
<td>300</td>
<td>18.99</td>
</tr>
<tr>
<td>Alestes dentex</td>
<td>421</td>
<td>16.81</td>
</tr>
<tr>
<td>Alestes nurse</td>
<td>264</td>
<td>11.88</td>
</tr>
<tr>
<td>Hydrocynus forskali</td>
<td>481</td>
<td>22.69</td>
</tr>
<tr>
<td>Hydrocynus lineatus</td>
<td>275</td>
<td>21.82</td>
</tr>
<tr>
<td>Hydrocynus brevis</td>
<td>190</td>
<td>24.29</td>
</tr>
</tbody>
</table>

(n: sample size, S.E: standard error; Min: minimum, Max: maximum, a and b:parameters of equation W = aL^b, CL 95%: confidence limits, \( r^2 \): coefficient of determination)

These results displayed that there was a significant relationship between length and weight for all species (P <0.001). In this study, the b value ranged from 3.044 (Hydrocynus forskali) to 2.680 (Hydrocynus brevis) and Coefficient of determination (\( r^2 \)) ranged between 0.897 in Hydrocynus brevis and 0.984 in Alestes baremose. The growth was negative allometric (b<3, P<0.05) for Alestes
baremose. *Alestes dentex, Alestes nurse, Hydrocynus forskalii, Hydrocynus lineatus* and *Hydrocynus brevis* isometric growth (b = 3, P ≥ 0.05) (Table 2).

### Table 2: Type of growth for Characidae fish of the Jebel Aulia dam reservoir

<table>
<thead>
<tr>
<th>Family/species</th>
<th>number</th>
<th>T (value)</th>
<th>b</th>
<th>Growth type</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Alestes baremose</em></td>
<td>300</td>
<td>0.034</td>
<td>2.900</td>
<td>isometric</td>
</tr>
<tr>
<td><em>Alestes dentex</em></td>
<td>421</td>
<td>0.139</td>
<td>2.710</td>
<td>isometric</td>
</tr>
<tr>
<td><em>Alestes nurse</em></td>
<td>264</td>
<td>0</td>
<td>3.000</td>
<td>isometric</td>
</tr>
<tr>
<td><em>Hydrocynus forskalii</em></td>
<td>481</td>
<td>0.015</td>
<td>3.044</td>
<td>isometric</td>
</tr>
<tr>
<td><em>Hydrocynus lineatus</em></td>
<td>275</td>
<td>0.001</td>
<td>2.997</td>
<td>isometric</td>
</tr>
<tr>
<td><em>Hydrocynus brevis</em></td>
<td>190</td>
<td>0.052</td>
<td>2.680</td>
<td>isometric</td>
</tr>
</tbody>
</table>

3.2. Discussion

The result of weight-length relationship of family Characidae total number 1931 fish in Jebel Aulia revealed that, the growth of family Characidae is isometric for both males and females with the regression coefficients value ranging from 2.71 to 3.04 in Jebel Aulia. These revealed a close similarity between the results and literature reports by other investigators confirming the consistency of the isometricity of this growth (Ahmed, 1985). The comparison of the two results does not show highly significant difference in the value of (b). Thus, we can say that the species under the two sides of studies show to some isometric growth.

The development, maturation and breeding of the fish species examined were found to be dependent upon environmental feature of the habitat. Other factors that were effective in influencing growth such as decreased water discharge and hence high water levels, high water transparency and high electric conductivity of the water.

The general correlation of growth, development, maturation and breeding of fish in Jebel Aulia Dam reservoir to the environmental condition of this habitat clearly suggested that fish responded to the environmental variable in the same general way as the rest of vertebrates and that their maturation and breeding activities are still primarily governed by the photoperiod (Ahmed, 1989).

Length-weight relationships are not constant over the year and Length-weight relationships parameter may vary significantly due to biological, food availability, temporal and sampling factors, health and sex (Bagenal and Tesch, 1978; Froese, 2006) all of which were not considered for in this study. Since all the specimens were collected over several season, data are not representative of a
specific season of the year. The parameters a and b in this study should only be considered as mean annual values.

4. Conclusions

This study presented the basic information on the Weight-length relationships and condition factors for *Characidae* species from the Jebel Aulia dam in White Nile River, which would be useful for fishery managers as well as the sustainable management of its stocks in the region. Moreover, there are no conditions factors currently in the Fish Base for these species and therefore, our results may contribute to this invaluable database.

References


