Length-Weight relationships of (9) fish species from Derbendikhan Reservoir- Kurdistan region, Iraq.
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Abstract
Length-weight relationships were estimated for 9 fish species represented by 1022 individuals, Carassius auratus, Cyprinus carpio, Capoeta damascina, Barbus esocinus, Barbus grypus, Barbus xanhoptherus, Heteropneustes fossilis, Aspius vorax, Silurus triostegus caught from the Derbendikhan Reservoir (South east Sulaimani City, Kurdistan region, Iraq) located on 35° 6’ 35" N, 45° 41’ 20" E. Samples collected from January to December, 2009. The formula \( W = aL^b \) was applied to each individual fish and the individual value \( a \) were determined. \( r^2 \) value ranged from 0.65 in Silurus triostegus to 0.99 in Capoeta damascina. The value of \( b=3 \) for all species means that the growth was isometric.

Keywords: length-weight relationships, Derbendikhan reservoir

Introduction:
Length-weight relationship (LWR) is of great importance in fishery assessments (Gonçalves et al.,1996). Length and weight measurements provide information on the stock composition, life span, mortality, growth and production (Bolger and Connoly, 1989; King, 1996; Moutopoulos and Stergiou, 2000). There are many studies on length-weight relationships of fishes worldwide. Length–weight relationships provide useful information on fish species in a given geographic region (Anderson & Gutreuter, 1983; Gonçalves, et al.1996; Stergiou & Moutopoulos,2001; Özaydin & Taskavak.,2007).

Length-weight relationships were determined for 11 fish species from the Gulf of Tunis (SW Mediterranean Sea, Tunisia). (Cherif et al.,2008). Another study was carried out by Gökhan, et al.,(2007) on Length–weight relationships of 7 fish species from the North Aegean Sea, Turkey, data on their functional LWR is important for fish stock assessment, another study was done by Muto, et al.,(2000) on the Length-Weight Relationship of Marine Fish Species off Sao Sebastiao System, Sao Paulo, Southeastern Brazil. Cube law, condition factor and weight-length relationships, history, meta-analysis and recommendations were provided by Froese,(2006). Length weight relationship and condition factor of Pterygoplichthys pardalis (Pisces: Loricariidae) in Malaysia Peninsula was determined by Samat, et al.(2008). Some Population Parameters of
Clarotes Laticeps (Ruppell, 1829) from the Fresh Water Reaches of Lower Nun River, Niger Delta Nigeria was studied by Abowei (2009).

This study was carried out in order to get some information about fish assessment in Derbendikhan Reservoir, by presenting the length-weight relationship (LWR) parameters of the most abundant species in this reservoir. Because of the ecological and economic importance of these species, length –Weight relationships (LWR) used to estimate the weight corresponding to a given length, and condition factors are used for comparing the condition, fatness, or well-being (Tesch, 1968) of fish, based on the assumption that heavier fish of a given length are in better condition. Results obtained from this study are useful to fisheries biologist. Length and weight data are a useful and standard result of fish sampling programs. These data are needed to estimate growth rates, length and age structures, and other components of fish population dynamics (Kolher et al., 1995).

Description of the study area

Darbandikhan Lake is one of the three large lakes in Kurdistan,. It is fed by two main tributaries: the Tanjero River, which flows from Sulaimani, and the Sirwan River, (Rasheed, 2008). from Iran Derbendikhan reservoir is an artificial lake, its located at 35° 6' 35" N, 45° 41' 20" E. south-east of Sulaimani City in Kurdistan of Iraq. at an altitude of about 485 m above sea level (Lehner and Doll, 2004). The annual water exchange in the reservoir is rather low; hence it is clearly stratified, and regards thermal and oxygen conditions. Consequently Derbendikhan can be classified as limnetic water body; as warm and monomictic with only one circulation period in winter and a water temperature that never falls below 4 C° (Szczerbowski, et al. 2001) Fig. (1).

Materials and Methods:

Fish samples were obtained from derbendikhan Reservoir, from January to December 2009. Monthly random sampling was carried out, covering an area about 114.30 km² with the maximum depth of 75.0 m, while the Mean depth is 14.8-24.9m, (Rasheed, 2008). Fig.(1) present Maps show the location of Derbendikhan reservoir. In the laboratory, specimens were sorted; total length of individual fish was taken from the tip of the snout to the extended tip of the caudal fin using a measuring board. Body weight was taken to the nearest gram using electronic balance. The relationship between the length and weight of a fish is usually expressed by the equation W= aL^b (Ricker, 1973) where W is body weight (g), L is total length (cm), a is intercept and b is the slope (fish growth rate) (Beverton & Holt, 1996). The parameters a and b of the length-weight relationships were estimated by the least-square method based on the predictive or Type I linear regression model (Sokal & Rohlf, 1981), using W as the dependent variable and L as the independent variable.
Fig. (1): Maps show the location of Derbendikhan reservoir (after United
Equation (1) was applied to each individual fish and the individual values of $a$ was determined.

$$ W = a L^b \quad (1) $$

The estimated parameters and length characteristics of the length-weight relationship are given in Table I. Parameters of the length-weight relationships were calculated by method using the equation (2)

$$ \log W = \log a + b \log L \quad (2) $$

The statistical significance level of $r^2$ of the parameters $a$ and $b$ were estimated (Santos et al., 2002). The condition factor of fish was calculated by the equation (3), and represented by the letter K.

$$ K = \frac{100W}{L^b} \quad (3) $$

Where $W$ is the weight in g

$L$ is the length in mm, and $b$ is the value obtained from the equation (2).

### Results and Discussion

During the study period from January to December 2009, length-weight relationships were presented for the studied 9 species of 1022 individuals, in Derbendikhan reservoir, included *Carassius auratus*, *Cyprinus carpio*, *Capoeta damascina*, *Barbus esocinus*, *Barbus grypus*, *Barbus xanthopterus*, *Heteropneustes fossilis*, *Aspius vorax*, and *Silurus triostegus*. The estimated parameters of the weight-length relationships are given in Table (1). The degree of adjustment of the model studied was assessed by the correlation coefficient ($r$), here ($r^2$) was ranged from 0.65 in *Silurus triostegus* to 0.99 in *Capoeta damascina*. In general, the variation in $b$–value may return to many factors such as difference in the number of specimen examined, area/season effects and differences in the observed length ranged of the specimen caught (Gökhan, et.al, 2007). On the other hand, Froese (2006) concluded that small specimens have a different LWR from larger specimens, and that the new regression better predicts weight from length within the size range for which it is likely to be used. The value of $b=3$ indicated the isometric growth of studied fish and it is apparent from table (1) that the values of $b$ taken from the slope of the logarithmic graph satisfy the conditions of yielding a value of the constant $a$ which is independent of mass. The same results were obtained by Ancsel (1928). Also, this implies that the “Cube low” can be applied for the fish in Derbendikhan reservoir (Muto, et.al, 2000). Exploring the relevance of seasonal changes in condition is not a priority in current stock assessment work, probably because the general pattern in adult fishes is well known: a decrease during times of low temperatures and/or low availability of food, an increase towards the spawning season, a sharp decline after spawning, especially in females, and a second increase after spawning, Froese (2006). present significant differences of 3.0, indicating the type of a growth: isometric ($b=3.0$), (Spiegel,1991). In all cases a statistic significance of 5% was adopted.

Some other siluriformes members however have the $b$ value close to the isometric value ($=3$) such as those exhibited by *Chrysichthys nigrodigitatus* (family: Bagridae) with $b=3.042$ as studied by (Samat,2008).
Table (1): Length-weight relationships for the 9 fish species caught from the Derbendikhan Reservoir.

<table>
<thead>
<tr>
<th>Fish Species</th>
<th>N</th>
<th>A</th>
<th>L_{min}-L_{max}</th>
<th>Median length</th>
<th>W_{min}-W_{max}</th>
<th>Median weight</th>
<th>b</th>
<th>r^2</th>
<th>K</th>
</tr>
</thead>
<tbody>
<tr>
<td>C. auratus</td>
<td>176</td>
<td>0.081</td>
<td>33-59</td>
<td>42</td>
<td>120-1600</td>
<td>600</td>
<td>3</td>
<td>0.92</td>
<td>0.80</td>
</tr>
<tr>
<td>C. carpio</td>
<td>274</td>
<td>0.071</td>
<td>20-40</td>
<td>26</td>
<td>125-1000</td>
<td>125</td>
<td>3</td>
<td>0.89</td>
<td>0.71</td>
</tr>
<tr>
<td>C. damascina</td>
<td>3</td>
<td>0.034</td>
<td>24-26</td>
<td>25</td>
<td>50-55</td>
<td>53</td>
<td>3</td>
<td>0.99</td>
<td>0.34</td>
</tr>
<tr>
<td>B. esocinus</td>
<td>261</td>
<td>0.091</td>
<td>18-35</td>
<td>28</td>
<td>50-1000</td>
<td>200</td>
<td>3</td>
<td>0.94</td>
<td>0.91</td>
</tr>
<tr>
<td>B. grypus</td>
<td>35</td>
<td>0.097</td>
<td>13-90</td>
<td>33</td>
<td>110-11000</td>
<td>350</td>
<td>3</td>
<td>0.92</td>
<td>0.97</td>
</tr>
<tr>
<td>B. xanthopterus</td>
<td>17</td>
<td>0.10</td>
<td>13-37</td>
<td>27</td>
<td>125-575</td>
<td>200</td>
<td>3</td>
<td>0.73</td>
<td>1.02</td>
</tr>
<tr>
<td>H. fossilis</td>
<td>169</td>
<td>0.082</td>
<td>20-50</td>
<td>23</td>
<td>97-800</td>
<td>100</td>
<td>3</td>
<td>0.83</td>
<td>0.82</td>
</tr>
<tr>
<td>A. vorax</td>
<td>60</td>
<td>0.10</td>
<td>20-34</td>
<td>27</td>
<td>100-300</td>
<td>199</td>
<td>3</td>
<td>0.89</td>
<td>1.01</td>
</tr>
<tr>
<td>S. triostegus</td>
<td>27</td>
<td>0.11</td>
<td>24-63</td>
<td>30</td>
<td>250-2500</td>
<td>288</td>
<td>3</td>
<td>0.65</td>
<td>1.07</td>
</tr>
</tbody>
</table>

Min: minimum; max: maximum; w: weight (g m) ;L:length(mm); N:sample size; a: intercept of the relationship; b: slope of the relationship ; \(r^2\): coefficient of determination . K: Condition factor

The degree of wellbeing or relative robustness of the fish is expressed by the coefficient of condition also known as the “condition factor or length–weight factor” (Samat, 2008). The Condition Factor (K) of fish samples was ranged from (0.34-1.07) as shown in table (1). In fact, the variation in the condition factor reflect the state of sexual maturity and degree of nourishment. This factor in fish may also vary with the age, and in some species with the sex.

Gomiero, and Braga, (2005), described the condition factor as an indicator of fish welfare in their habitat. In the dry season the water level was not less than one meter at any studied site, thus there should be no shortage of food available for the fish during dry season and the fish growth was expected to be unaffected.

**Conclusions and Recommendations:**

1- Studied fish in Derbendikhan reservoir has isometric growth.
2- Water level as well as dry season not affects the nutrition of fish
3- The condition factor is less in comparison to other fish in other aquatic ecosystems of most researches carried out throughout the world, this may be due to the water quality of Derbendikhan reservoir.

4- Carrying out more studies about fish types, habitat, nutrition and growth.

5- Studying the relationship of many ecological factors with the growth of fish in Derbendikhan reservoir and other reservoirs.

References:


