Research Article

Length-Weight Relationships of 10 Fish Species from the Southern Black Sea, Turkey

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Abstract: In this study, the length-weight relationships of 10 fish species collected with gill and trammel nets during June 2010 and June 2011 from the Eastern Black Sea coasts of Turkey, were investigated. The b values of the length-weight relationships for 10 fish species ranged from 2.549 to 3.301 with a mean value of 3.070 ± 0.039 (S.E.). Five, four and one species showed isometric, positive allometric and negative allometric growth, respectively. The differences in b values of male and female of Engraulis encrasicolus, Merlangius merlangus, Mullus barbatus, Scorpaena porcus, Solea solea, Spicara maena and Uranoscopus scaber were significant. (ANCOVA, P < 0.05).

Keywords: Length-weight relationship, fish species, growth type, Southern Black Sea.

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Introduction

Length-weight data are widely used to gather information on biology of fishes. In general, this and other different kind of analysis have become one of the standard methods used in fisheries biology (Le Cren, 1951; Kohler et al., 1995). These data are necessary in estimation of the growth rates, age and length composition of fish populations (Kohler et al., 1995). In fish, size is generally more biologically relevant than age, mainly because several ecological and physiological factors are more size-dependent than age. Consequently, variability in size has important implications in diverse aspects of fisheries science and population dynamics (Erzini, 1994). A length-weight relationship (LWR) presents useful information for understanding the relative condition of fish stocks. In addition, LWR is used in various important applications for evaluation of fish stocks (Ricker, 1968; Pauly, 1993; Garcia et al., 1998; Haimovici and Velasco, 2000). Some of these applications include assessment of available fish stock and comparison of fish populations existing in different regions (Petrakis and Stergiou, 1995). Furthermore, length-weight (L-W) relationships have special importance in fisheries research because they (a) are used to convert growth-in-length equations to growth-in-weight in stock assessment models, (b) allow the estimation of the biomass of a species from length frequency distributions, (c) the condition of fish; and (d) are useful for between region comparisons of life histories of a certain species (Gonçalves et al., 1997; Binohlan and Pauly, 2000).

The aim of this study is to determine the length-weight relationships of 10 fish species, most of which are demersal species caught by gill and trammel nets in the Eastern Black Sea of Turkey. The reported results may contribute to management of fisheries resources in the area.

Materials and Methods

Samples were collected from the monthly fishing trials performed between June 2010 and June 2011 in the Eastern Black Sea of Turkey. The reported results may contribute to management of fisheries resources in the area.

### Table 1. Descriptive statistics and estimated parameters of length-weight relationship of 10 fish species caught by gillnet and trammel nets in the Eastern Black Sea, Turkey.

<table>
<thead>
<tr>
<th>Species</th>
<th>Sex</th>
<th>N</th>
<th>Length (cm) min-max</th>
<th>Weight (g) min-max</th>
<th>Parameters of the relationship</th>
<th>Growth (t-test)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>a</td>
<td>b</td>
<td>S.E. (b)</td>
</tr>
<tr>
<td>Alosa fallax pontica</td>
<td>M</td>
<td>17</td>
<td>16.1-22.7</td>
<td>26.57-77.52</td>
<td>0.0032</td>
<td>3.279</td>
<td>0.228</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>23</td>
<td>16.2-23.5</td>
<td>31.57-104.72</td>
<td>0.0056</td>
<td>3.092</td>
<td>0.125</td>
</tr>
<tr>
<td></td>
<td>All</td>
<td>42</td>
<td>16.1-23.5</td>
<td>26.57-104.72</td>
<td>0.0046</td>
<td>3.163</td>
<td>0.107</td>
</tr>
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<td>Engraulis encrasicolus</td>
<td></td>
<td>19</td>
<td>6.2-13.5</td>
<td>1.72-13.64</td>
<td>0.0182</td>
<td>2.549</td>
<td>0.102</td>
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<td>Merlangius merlangus</td>
<td>M</td>
<td>1314</td>
<td>8.0-23.6</td>
<td>4.08-111.54</td>
<td>0.0042</td>
<td>3.226</td>
<td>0.021</td>
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<td></td>
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<td>1331</td>
<td>7.6-24.2</td>
<td>3.33-106.91</td>
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<td>3.168</td>
<td>0.020</td>
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<td>3.33-111.54</td>
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<td>3.195</td>
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<td>8.49-66.21</td>
<td>0.0090</td>
<td>2.993</td>
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<td>F</td>
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<td>672</td>
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<td>2.68-102.50</td>
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<td>24.70-55.83</td>
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<td>9.19-470.0</td>
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<td>12.2-22.2</td>
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<td>13.25-104.71</td>
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<td>Uranoscopus scaber</td>
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<td>244</td>
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<td>10.81-147.85</td>
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<td>6.9-25.5</td>
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<td>0.0103</td>
<td>3.176</td>
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</table>

* = Significant (P < 0.05), ns = not significant (P > 0.05); F = Female; M = Male
N = number of samples; min = minimum, max = maximum; a and b are the parameters of relationship; S.E. = standard error; r² = coefficient of determination
Sea coasts of Turkey. Fish specimens were collected using gill and trammel nets at depths ranging from 8 m to 95 m. The length of gill and trammel nets consisting of five different mesh sizes (16, 17, 18, 20, 22 mm bar length) were 639 m and 590 m, respectively. The total length (TL) and weight (W) of each fish were measured to the nearest 0.1 cm and 0.01 g, respectively. The relationships between length and weight is expressed by W = a × L^b, which was converted to linear form as lnW = lna + b lnL, where W is total body weight (g), L is the total length (cm), a = intercept and b = slope regression coefficients (Ricker, 1973; King, 2007). When b values equal to 3, less than and higher than 3, then fish species in questions is said to show isometric, negative allometric and positive allometric growth, respectively (Bagenal and Tesch, 1978; Santos et al., 2002). The b value for each species was tested with a t-test at the 0.05 level of significance to verify whether it was significantly different from the predicted values for isometric growth (Morey et al., 2003). For this test, the following equation was used (Sokal and Rohlf, 1987);

$$t_s = \frac{(b - 3)}{s_b}$$

Where $t_s$ is the value of t test, b is the slope and $s_b$ is the standard error of b. Analysis of covariance (ANCOVA) was used to determine whether there was significant difference in slopes between sexes (Zar, 1999).

### Results and Discussion

A total of 5353 individuals belonging to 10 fish species sampled during in the study. The sample size ranged from 11 individuals for Parablennius gattorugine to 2705 for Merlangius merlangus euxinus. Table 1 presents the sample sizes, the minimum and maximum L-W values, the coefficients of determination ($r^2$), regression coefficients and the growth types of each species. In order to compare the results of the present study with those of other length-weight relationship studies in different areas were presented in Table 2. The length-weight relationship parameter, b value, generally ranges between 2 and 4 (Bagenal and Tesch, 1978), often close to 3 (Jobling, 2002). The b values ranged from 2.549 for E. encrasicolus to 3.301 for S. porcus with mean value of 3.070 ± 0.039 (S.E.). The coefficient of determination ($r^2$) value

<table>
<thead>
<tr>
<th>Species</th>
<th>Length (cm) min-max</th>
<th>a</th>
<th>b</th>
<th>Location</th>
<th>References</th>
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<td>İşmen, 2002</td>
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<td>2.960</td>
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</table>

Table 2: Some study results of length-weight relationship for the fish species in different areas.
was calculated 0.901 for S. solea and 0.974 for E. encrasicolus with mean value of 0.935 ± 0.007 (S.E.). Five, four and one species showed isometric, positive allometric and negative allometric growth, respectively. Analysis of covariance (ANCOVA) showed that the differences in slopes (b values) between the sexes for growth, respectively. Analysis of covariance (ANCOVA) showed isometric, positive allometric and negative allometric with mean value of 0.935 ± 0.007 (S.E.). Five, four and one species was calculated 0.901 for S. solea and 0.974 for E. encrasicolus, M. merlangus, M. barbatus, S. porcus, S. solea, S. maena and U. scaber were significant (P < 0.05).

The length-weight relationship varies among species according to genetically body shape and to the condition of individuals of a fish species. The condition sometimes reflects the presence of nutrients and the growth before in the sampling week, but condition is variable and dynamic. Individuals within the same sampling considerably vary, however, the average condition of individuals in each population differs according to years and seasons. For some species, sex and gonad development are important variables (Schneider et al., 2000). Also, many factors such as habitat, diet, locality, and stomach fullness are the other important variables that affect the length–weight relationship in fishes (Esmaeili and Ebrahim, 2006).

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