A Preliminary Study on Length-Weight Relationships for Seven Elasmobranch Species from North Aegean Sea, Turkey

Halit Filiz, Savaş Mater
Ege University, Faculty of Fisheries, Department of Hydrobiology, 35100, Bornova, Izmir, Türkiye

Abstract: In this study, length-weight relationships of seven elasmobranch species sampled from North Aegean Sea are examined. An equation expressed as $WT = a(TL)^b$ was calculated for each species. It was calculated as $WT = 0.0016TL^{3.1804} (r^2 = 0.9795)$ for *Scyliorhinus canicula*, $WT = 0.0008TL^{3.3259} (r^2 = 0.9745)$ for *Mustelus mustelus*, $WT = 0.0031TL^{3.1056} (r^2 = 0.9814)$ for *Squalus acanthias*, $WT = 0.0488TL^{2.6935} (r^2 = 0.9584)$ for *Torpedo marmorata*, $WT = 0.0016TL^{3.2914} (r^2 = 0.9337)$ for *Raja clavata*, $WT = 0.0085TL^{2.9379} (r^2 = 0.9687)$ for *Dasyatis pastinaca*, and $WT = 0.0001TL^{4.0173} (r^2 = 0.9251)$ for *Raja miraletus*. In addition, this equation was determined for both sexes. Lengths and weights of species (mean, maximum and minimum) were given in Tables.

Key Words: Length-weight relationship; Elasmobranchii; Aegean Sea.

Introduction

Throughout their evolutionary history during at least 400 million years, the cartilaginous fishes (Chondrichthyes) in general have remained major components of marine communities, having the ability to adapt varying selective pressures (Cortes, 2000). Elasmobranch fishes comprise 700-800 species occupying a wide range of habitats distributed throughout the oceans of the world (Frisk et al., 2001). Increased human exploitation over the last 2 decades, the biological features (e.g., slow growth and late sexual maturation, very low egg production and long reproductive cycles), and increasing habitat deterioration have threaten to elasmobranch population worldwide (Cortes, 2000; Ellis et al., 2002; Heessen, 2002; Prince, 2002). More than 700 000 t of cartilaginous fish have been harvested annually worldwide (Bonfil, 1994; Frisk et al., 2001). Harvesting amount in Turkey is 2115 t (0.4% of total marine fishes production) (Filiz and Togulga, 2002). It is reported that there are 64 elasmobranch species in Turkey’s waters (Bilecenoğlu et al., 2002). Although Turkey has got productive
fish stocks are over exploited by fishermen because of many basic objects are not researched. Thus, the feature of stocks will be getting endangered (Samsun et al., 1995). Basic biological data needed for stock assessment are scarce for many elasmobranch species (Cailliet and Bedford, 1983; Cailliet et al., 1991; Bonfil, 1994), as also existed in Turkey’s waters, including size values (i.e. minimum, maximum, and mean) and size relationships/conversions (i.e. length-to-weight). These data are essential for understanding growth rate, age structure and other aspects of population dynamics (Kohler et al., 1996).

This study, carried out between the period of July-1999/March-2000, is a preliminary investigation on morphology, biology and zoogeographical distribution of some cartilaginous fish species obtained from North Aegean Sea. In response to the immediate needs for management initiatives, we present length and weight data for the following seven dominant species (Scyliorhinus canicula Linnaeus., 1758, Squalus acanthias L., 1758, Mustelus mustelus L., 1758, R. clavata L., 1758, T. marmorata Risso, 1810, D. pastinaca L., 1758, and R. miraletus L., 1758).

Materials and Methods

During the study, a total of 13 species were obtained, comprising 5 shark species; Heptranchias perlo (Bonnaterre, 1788), Scyliorhinus canicula, S. stellaris (L., 1758), Mustelus mustelus, Squalus acanthias and 8 ray species; Torpedo marmorata, Raja miraletus, R. clavata, R. oxyrinchus (L., 1758), R. radula (Delaroche, 1809), Dasyatis pastinaca, Gymnura altavela (L., 1758), Myliobatis aquila (L., 1758). A total of 247 samples representing 7 dominant species (comprising 3 shark species; S. canicula, M. mustelus, S. acanthias, and 4 ray species; T. marmorata, R. clavata, D. pastinaca, R. miraletus) were measured, sexed, and weighed.

Length and weight data were collected from elasmobranch species caught by commercial fishermen and biologists from the North Aegean Sea during July-1999/March-2000 (Figure 1). Samples were caught by bottom trawl owned by research vessel (RV Egesuf) and commercial fishing boats. The fish were stored in ice until returned to the laboratory, where the length and weight measurements were taken after the fish were thawed ice.

All lengths were taken with a metal measuring tape nearest to centimeter in a straight line along the body axis with the caudal fin placed in a natural position. Total length (TL) is defined as the distance from the tip of the snout to the end of the upper caudal lobe. Total weight (WT) of each specimens was measured as gram.

Generally, length-weight relationship in fish is demonstrated as an exponential relation (Tıraşın, 1993). The form of the equation is:

\[(WT) = a \times (TL)^b\]

where, WT, is total weight (g), TL, is total length (cm), and a and b are constants for each species. Length-weight relationships, mean lengths and weights, and size ranges were determined for 7 elasmobranch species (n=247).

Results and Discussion

Minimum, maximum and mean lengths and weights of the species examined are given in Tables 1 and 2. In order to see the significant differences in slope or intercept of the
length-weight relationships among male-female, only male, and only female, we calculated one equation to represent data for each species (Figures 2–8). Mollet and Cailliet (1996) noted that the allometric size-on-size equation $y = ax^b$ (power function) has rarely been used to report elasmobranch morphometry (except for reporting length-weight relationships) and, however, it would be the most suitable equation for characterizing allometry.

Figure 1. Study areas: Edremit Bay (1), Gulbahce Bay (2), and Sigacik Bay (3).
Table 1. Min., max., and mean lengths of the examined species (CI: confidence interval, C: sexes combined, M: male, and F: female)

<table>
<thead>
<tr>
<th>Species</th>
<th>Sex</th>
<th>N</th>
<th>Mean±CI</th>
<th>Min.</th>
<th>Max.</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>C</td>
<td>113</td>
<td>36.56±1.62</td>
<td>17.50</td>
<td>52.50</td>
<td>8.80</td>
</tr>
<tr>
<td>S. canicula</td>
<td>M</td>
<td>49</td>
<td>40.37±2.16</td>
<td>24.00</td>
<td>52.50</td>
<td>7.73</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>64</td>
<td>33.65±2.08</td>
<td>21.50</td>
<td>49.40</td>
<td>8.50</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>24</td>
<td>62.02±7.25</td>
<td>38.30</td>
<td>97.50</td>
<td>18.12</td>
</tr>
<tr>
<td>M. mustelus</td>
<td>M</td>
<td>14</td>
<td>57.71±8.25</td>
<td>38.30</td>
<td>85.20</td>
<td>15.74</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>10</td>
<td>68.06±12.58</td>
<td>44.00</td>
<td>97.50</td>
<td>20.30</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>32</td>
<td>53.64±3.87</td>
<td>20.00</td>
<td>70.50</td>
<td>11.18</td>
</tr>
<tr>
<td>S. acanthias</td>
<td>M</td>
<td>16</td>
<td>47.81±2.87</td>
<td>38.00</td>
<td>56.50</td>
<td>5.86</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>16</td>
<td>59.47±6.03</td>
<td>27.00</td>
<td>70.50</td>
<td>12.30</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>24</td>
<td>52.65±7.25</td>
<td>38.30</td>
<td>99.00</td>
<td>13.80</td>
</tr>
<tr>
<td>T. marmorata</td>
<td>M</td>
<td>9</td>
<td>15.71±2.57</td>
<td>9.60</td>
<td>25.00</td>
<td>4.35</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>11</td>
<td>15.83±2.87</td>
<td>9.60</td>
<td>25.00</td>
<td>4.86</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>31</td>
<td>53.39±6.58</td>
<td>40.00</td>
<td>74.20</td>
<td>12.56</td>
</tr>
<tr>
<td>R. clavata</td>
<td>M</td>
<td>8</td>
<td>51.31±8.66</td>
<td>29.70</td>
<td>67.00</td>
<td>15.50</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>23</td>
<td>53.12±7.95</td>
<td>20.50</td>
<td>99.00</td>
<td>19.46</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>20</td>
<td>51.78±10.72</td>
<td>30.00</td>
<td>68.00</td>
<td>11.75</td>
</tr>
<tr>
<td>D. pastinaca</td>
<td>M</td>
<td>8</td>
<td>54.59±9.56</td>
<td>27.00</td>
<td>70.50</td>
<td>12.30</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>6</td>
<td>51.78±9.40</td>
<td>30.00</td>
<td>68.00</td>
<td>11.75</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>20</td>
<td>53.39±6.58</td>
<td>40.00</td>
<td>74.20</td>
<td>12.56</td>
</tr>
<tr>
<td>R. mirelatus</td>
<td>M</td>
<td>9</td>
<td>84.05±31.58</td>
<td>23.51</td>
<td>340.00</td>
<td>81.79</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>11</td>
<td>110.59±60.53</td>
<td>27.15</td>
<td>340.00</td>
<td>102.43</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>31</td>
<td>1029.74±425.44</td>
<td>28.86</td>
<td>2614.28</td>
<td>803.05</td>
</tr>
<tr>
<td>S. canicula</td>
<td>M</td>
<td>8</td>
<td>895.56±425.44</td>
<td>94.36</td>
<td>1934.80</td>
<td>613.96</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>23</td>
<td>1076.41±354.08</td>
<td>28.86</td>
<td>2614.28</td>
<td>866.40</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>14</td>
<td>1172.64±414.57</td>
<td>38.73</td>
<td>2955.00</td>
<td>791.44</td>
</tr>
<tr>
<td>T. marmorata</td>
<td>M</td>
<td>8</td>
<td>1338.41±639.10</td>
<td>38.73</td>
<td>2955.00</td>
<td>922.29</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>6</td>
<td>951.62±463.21</td>
<td>39.24</td>
<td>1750.00</td>
<td>578.90</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>13</td>
<td>1001.77±172.42</td>
<td>100.01</td>
<td>1000.54</td>
<td>371.17</td>
</tr>
</tbody>
</table>

Table 2. Min., max., and mean weights of the examined species (CI: confidence interval, C: sexes combined, M: male, and F: female)

<table>
<thead>
<tr>
<th>Species</th>
<th>Sex</th>
<th>N</th>
<th>Mean±CI</th>
<th>Min.</th>
<th>Max.</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>C</td>
<td>113</td>
<td>184.87±22.79</td>
<td>15.76</td>
<td>473.19</td>
<td>123.58</td>
</tr>
<tr>
<td>S. canicula</td>
<td>M</td>
<td>49</td>
<td>238.69±34.79</td>
<td>40.10</td>
<td>473.19</td>
<td>124.26</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>64</td>
<td>143.67±26.17</td>
<td>15.76</td>
<td>409.00</td>
<td>106.81</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>24</td>
<td>937.07±345.83</td>
<td>116.37</td>
<td>3170.00</td>
<td>864.41</td>
</tr>
<tr>
<td>M. mustelus</td>
<td>M</td>
<td>14</td>
<td>734.09±366.05</td>
<td>116.37</td>
<td>1988.00</td>
<td>698.81</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>10</td>
<td>1221.26±635.20</td>
<td>200.00</td>
<td>3170.00</td>
<td>1024.85</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>32</td>
<td>833.55±172.90</td>
<td>79.64</td>
<td>1790.14</td>
<td>499.02</td>
</tr>
<tr>
<td>S. acanthias</td>
<td>M</td>
<td>16</td>
<td>529.84±86.49</td>
<td>231.44</td>
<td>783.86</td>
<td>176.51</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>16</td>
<td>1137.25±262.38</td>
<td>79.64</td>
<td>1790.14</td>
<td>535.47</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>20</td>
<td>98.65±35.85</td>
<td>23.51</td>
<td>340.00</td>
<td>81.79</td>
</tr>
<tr>
<td>T. marmorata</td>
<td>M</td>
<td>9</td>
<td>84.05±31.58</td>
<td>23.51</td>
<td>156.94</td>
<td>48.34</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>11</td>
<td>110.59±60.53</td>
<td>27.15</td>
<td>340.00</td>
<td>102.43</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>31</td>
<td>1029.74±425.44</td>
<td>28.86</td>
<td>2614.28</td>
<td>803.05</td>
</tr>
<tr>
<td>R. clavata</td>
<td>M</td>
<td>8</td>
<td>895.56±425.44</td>
<td>94.36</td>
<td>1934.80</td>
<td>613.96</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>23</td>
<td>1076.41±354.08</td>
<td>28.86</td>
<td>2614.28</td>
<td>866.40</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>14</td>
<td>1172.64±414.57</td>
<td>38.73</td>
<td>2955.00</td>
<td>791.44</td>
</tr>
<tr>
<td>D. pastinaca</td>
<td>M</td>
<td>8</td>
<td>1338.41±639.10</td>
<td>38.73</td>
<td>2955.00</td>
<td>922.29</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>6</td>
<td>951.62±463.21</td>
<td>39.24</td>
<td>1750.00</td>
<td>578.90</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>13</td>
<td>1001.77±172.42</td>
<td>100.01</td>
<td>1000.54</td>
<td>371.17</td>
</tr>
</tbody>
</table>

S. canicula exhibited “positive allometric growth” (Fig. 2a). The functional regression b values for each sex and the pooled data were found to be bigger than “3” (Figs. 2a, b, and c). Using the coefficient of the length-weight relationship for each sex, it can be stated that lesser spotted dogfish weight
increases rapidly with growth. The length-weight relationship of lesser spotted dogfish from North Aegean Sea is similar to the data calculated by Oray (1989) for Aegean Sea \((a= 0.002193, b= 3.094561, \text{ and } r= 0.9669)\), Cihangir et al. (1997) for North Aegean Sea \((a= 0.01, b= 3.205, \text{ and } r= 0.919)\), Froese and Pauly (2000) for Bay of Biscay \((a= 0.0038, b= 3.029; a= 0.0031)\), East and West Channel, France \((a= 0.0031, b= 3.029, \text{ and } r= 0.985)\), and Balearic Islands, Spain \((a= 0.0016, b= 3.16, \text{ and } r= 0.993)\).

\[
WT = 0.0016 TL^{3.1804} \\
\text{ } \quad r^2 = 0.9795 \\
\text{ } \quad n=110
\]

\[
WT = 0.0018 TL^{3.1514} \\
\text{ } \quad r^2 = 0.9731 \\
\text{ } \quad n=62
\]

\[
WT = 0.0008 TL^{3.3259} \\
\text{ } \quad r^2 = 0.9745 \\
\text{ } \quad n=24
\]

\[
WT = 0.0006 TL^{3.3920} \\
\text{ } \quad r^2 = 0.9829 \\
\text{ } \quad n=14
\]

\[
WT = 0.0008 TL^{3.3066} \\
\text{ } \quad r^2 = 0.9638 \\
\text{ } \quad n=10
\]

Figure 2. Relationship between total length and total body weight for the lesser spotted dogfish \((S. \text{ canicula})\); male-female (a), male (b), and female (c).

\textbf{M. mustelus} exhibited “positive allometric growth” (Fig. 3a). The functional regression \(b\) values for each sex and the pooled data were found to be bigger than “3” (Figs. 3a, b, and c) Using the coefficient of the length-weight relationship for each sex, it can be stated that smooth-hound dogfish weight increases rapidly with growth. In spite of our extreme endeavors and efforts, unfortunately we couldn’t find any study to confirm this information.

\[
WT = 0.0008 TL^{3.3259} \\
\text{ } \quad r^2 = 0.9745 \\
\text{ } \quad n=24
\]

\[
WT = 0.0006 TL^{3.3920} \\
\text{ } \quad r^2 = 0.9829 \\
\text{ } \quad n=14
\]

\[
WT = 0.0008 TL^{3.3066} \\
\text{ } \quad r^2 = 0.9638 \\
\text{ } \quad n=10
\]

Figure 3. Relationship between total length and total body weight for the smooth-hound dogfish \((M. \text{ mustelus})\); male-female (a), male (b), and female (c).

\textbf{S. acanthias} exhibited “positive allometric growth” (Fig. 4a). From the coefficient of the length-weight relationship for spiny dogfish, it is seen that its weight increases rapidly with growth. The length-weight relationship constants of spiny dogfish from North Aegean Sea are similar to the data given by Jones and Geen (1977) for the Strait of Georgia, British Columbia \((a= 0.0017 \text{ and } b= 3.47)\), Kutaygil and Bilecik (1998) for SW Black Sea coast \((a= 0.027 \text{ and } b= 3.02)\), and Froese and Pauly (2003) for North Puget Sound, USA \((a= 0.004 \text{ and } b= 3.004)\) and South Africa \((a= 0.0015 \text{ and } b= 3.22)\). However, the “\(b\)” value
given by Avsar (1996) and (2001) as $W = 0.0040L^{2.95}$ for southeastern Black Sea was smaller than this in the present study ($b = 3.1056$). The reason of this difference was explained by the investigator as, “this may be due to differences in sampling times of the studies reflecting inter-population variation”. In addition, according to Avsar (2001), “the functional regression b-values for males, females and the pooled data were found to be smaller than ‘3’ (intercepts: 0.0045, 0.0035, 0.0040; slopes: 2.92, 2.99, 2.95; coefficients=0.987, 0.993, 0.988, respectively). While the confidence intervals for the b-values of males (2.87-2.97), females (2.90-3.08) and the pooled data (2.92-2.98) implies that the body shape of the females displays both of negative and positive allometric growth characteristics, the males and sexes combined show negative allometric form”. Comparing values of “b” coefficient, the weights in females increase faster in relation to length than those in males (Figs. 4b, and c). A similar situation is reported by Samsun et al. (1995), Avsar (1996, 2001) and Froese and Pauly (2003), whereas Kutaygil and Bilecik (1998) reported the “b” values for males and females as 3.0046 and 2.9294, respectively. Soldat (2002) also reported “positive allometric growth” both males and females ($b = 3.955$ and 3.148, respectively).

*T. marmorata* exhibited “negative allometric growth” (Fig. 5a). The functional regression b values for each sex and the pooled data were found to be smaller than “3” (Figs. 5a, b, and c). But, no study was found to confirm this information.

*R. clavata* exhibited “positive allometric growth” (Fig. 6a). The functional regression b values for each sex and the pooled data were found to be bigger than “3” (Figs. 6a, b, and c). The length-weight relationship of thornback ray from North Aegean Sea is similar to the data given by Düzgüneş et al. (1999) for East Black Sea ($a = 0.003, b = 3.1841$ and $r^2 = 0.9954$), Froese and Pauly (2000) for Bay of Biscay, France ($a = 0.00324$ and $b = 3.201$), and Erdem et al. (2001) for Sinop coast, Black Sea ($a = 0.0026, b = 3.1980$ and $r^2 = 0.98$).

**Figure 4.** Relationship between total length and total body weight for the spiny dogfish (*S. acanthias*); male-female (a), male (b), and female (c).

*D. pastinaca* exhibited “negative allometric growth” (Fig. 7a). The functional regression b values for each sex and the pooled data were found to be smaller than “3” (Figs. 7a, b, and c). However, the length-weight relationship constants given by Froese and Pauly (2000) for South Africa ($a = 0.0251, b = 3.11$) are higher than those obtained in the present study. Ismen (2003) also found that the functional regression b-values for pooled data, males and females were
higher than “3” for eastern Mediterranean (intercepts: 0.00144, 0.00237, 0.00091; slopes: 3.31, 3.17, 3.44; correlation coefficients not given, 0.95, 0.94). This may be due to differences in sampling times of the studies reflecting variation in food availability or differences in water temperatures for both regions.

Some inconsistent results may be come out because of difficulties to obtain sufficient specimen in all size classes. More extensive sampling sizes over a wider geographical range, almost equal representation of sexes, and more detailed demographic analyses including age, growth, and reproduction, is a must to be taken into consideration before certain definites of the life history of these seven species. Studies of length-weight relationships of these species in the

---

**Figure 5.** Relationship between total length and total body weight for the common crampfish (*T. marmorata*); male-female (a), male (b), and female (c).

**Figure 6.** Relationship between total length and total body weight for the thornback ray (*R. clavata*); male-female (a), male (b), and female (c).
present paper provide comparative information on these parameters for elasmobranchs existed different parts of Turkey’s waters.

\[
\text{WT} = 0.0085 \text{TL}^{2.9379} \\
\text{r}^2 = 0.9687 \\
n=14
\]

\[
\begin{align*}
\text{Total Length (cm)} & \quad \text{Total Weight (g)} \\
30 & \quad 4000 \\
40 & \quad 4000 \\
50 & \quad 4000 \\
60 & \quad 4000 \\
70 & \quad 4000 \\
80 & \quad 4000 \\
\end{align*}
\]

\[
\text{WT} = 0.0092 \text{TL}^{2.9334} \\
\text{r}^2 = 0.978 \\
n=8
\]

\[
\begin{align*}
\text{Total Length (cm)} & \quad \text{Total Weight (g)} \\
30 & \quad 4000 \\
40 & \quad 4000 \\
50 & \quad 4000 \\
60 & \quad 4000 \\
70 & \quad 4000 \\
80 & \quad 4000 \\
\end{align*}
\]

\[
\text{WT} = 0.0108 \text{TL}^{2.8574} \\
\text{r}^2 = 0.9808 \\
n=6
\]

\[
\begin{align*}
\text{Total Length (cm)} & \quad \text{Total Weight (g)} \\
30 & \quad 4000 \\
40 & \quad 4000 \\
50 & \quad 4000 \\
60 & \quad 4000 \\
70 & \quad 4000 \\
80 & \quad 4000 \\
\end{align*}
\]

\[
\text{WT} = 0.0001 \text{TL}^{4.0173} \\
\text{r}^2 = 0.9251 \\
n=13
\]

\[
\begin{align*}
\text{Total Length (cm)} & \quad \text{Total Weight (g)} \\
20 & \quad 500 \\
30 & \quad 1000 \\
40 & \quad 1500 \\
50 & \quad 2000 \\
60 & \quad 2500 \\
\end{align*}
\]

Figure 7. Relationship between total length and total body weight for the common stingray (D. pastinaca); male-female (a), male (b), and female (c).

Figure 8. Relationship between total length and total body weight (sexes combined) for the brown ray (R. miraletus).

Acknowledgments

No data could have been collected without helps and cooperations of fishermen who allowed us to their ships. The scientists and crew of RV Egesuf also assisted in obtaining specimens during sampling cruises. We would like to thank to Ertan Taskavak, Okan Ozaydin and Murat Bilecenoglu for their assistance and support.

References


İşmen, A. 2003. Age, growth, reproduction and food of common stingray (Dasyatis pastinaca L., 1758) in İskenderun Bay, the eastern Mediterranean. Fisheries Research, 60, 169-176.


