

## Original Research Articles

# Length-weight relationships and biometry analysis of saddled seabream, *Oblada melanurus* (Linnaeus, 1758) in İzmir Bay (Central Aegean Sea of Türkiye)

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The present study presents length-weight, length-length, length-girth relationships, and biometry of male and female specimens of saddled seabream, *Oblada melanurus* (Linnaeus, 1758), in the Turkish Aegean Sea. The length-length and length-weight relationships were calculated by measuring 516 individuals. The total length values of all male and female *O. melanurus* specimens were in the range of 17.2-30.7 and 18.5-30.0 cm, respectively, and the mean values were  $21.84 \pm 2.04$  and  $22.44 \pm 2.12$  cm, respectively. The length-weight relationships were  $W=0.0110TL^{3.057}$  for males,  $W=0.0114TL^{3.043}$  for females, and  $W=0.0089TL^{3.122}$  for all the specimens. The results denoted a high correlation ( $r^2=0.966$ ;  $p<0.001$ ) in the length-length relationships. Furthermore, 287 individuals (105 females and 182 males) were examined for length-girth relationships and biometric analyses. Ten morphometric characters were analyzed to analyze biometry. In conclusion, no statistically significant differences were determined in morphology between the sexes ( $p<0.05$ ).

## INTRODUCTION

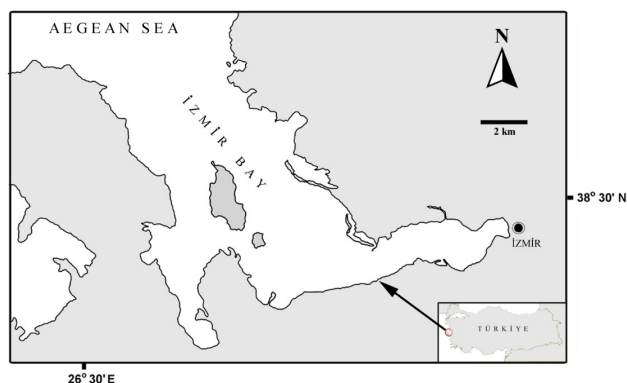
The results of length-weight (LWR) and length-length (LLR) relationship data are widely used parameters in fisheries biology and fisheries resource management.<sup>1</sup> The information on the standard length will facilitate determining the total length.<sup>2</sup> Also, the information on such relationships facilitate comparing morphological features between species or populations from different locations and habitats. Such comparisons also provide information on fish's current status, feeding habits, and swimming capacity.<sup>3-5</sup> On the other hand, the length-girth relationship (LGR) parameter is also utilized in studies on hunting gear selection.<sup>6</sup> It has been reported that the information on the length-girth relationship as an indicator of mesh size selectivity can be very useful in fisheries management.<sup>7</sup> Data on fish weight, length, and girth can also be used to predict the other metrics using various mathematical operations. Also, many researchers have emphasized the necessity of biometric studies for conserving and managing fisheries resources.<sup>8</sup>

There are studies in the literature on growth, feeding, and reproduction, especially the length-weight relationships carried out in various seas in the world<sup>9-16</sup> and in

the Turkish seas<sup>17-21</sup> However, there are no studies on the morphometric analysis of the individuals belonging to the populations of the species distributed in the Mediterranean Sea. Length-weight relationship parameters may vary in populations of the same species distributed in different regions, a variance attributed to various reasons, including feeding, reproduction, and fishing. The same species' length-weight parameters may differ in the population because of feeding, reproduction activities, fishing, etc. So, we need to know the length-weight relationships of fish captured in a given place in a certain period. Therefore, there is always a need for length-weight relationship data of fish obtained from a particular region at a specific time.<sup>22</sup>

The Sparidae family species, represented by 38 genera and 162 species in the world seas, are distributed in tropical and temperate regions of the Atlantic, Indian, and Pacific Oceans.<sup>23</sup> There are 13 species of the family belonging to 28 genera distributed in the seas of Türkiye.<sup>24</sup> *Oblada melanurus* (Linnaeus, 1758) is a member of the Sparidae family, distributed from Gibraltar to Angola, the Mediterranean Sea, the Gulf of Biscay, Madeira, Cape Verde, and the Canary Islands. The species is widespread in the Mediterranean and East Atlantic and is distributed in coastal waters on rocky grounds and Posidonia beds up to 30 meters in

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**Figure 1. Map of the study area**

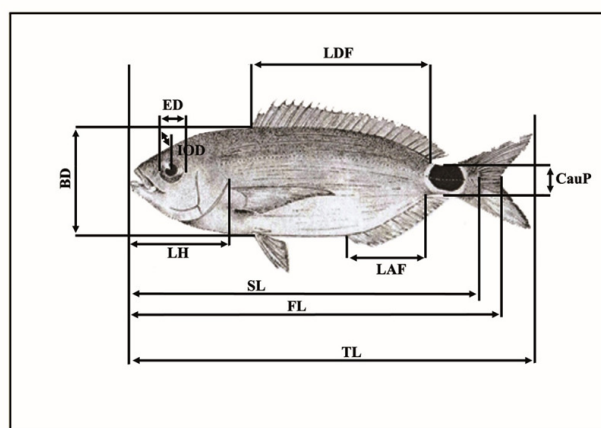
depth.<sup>25</sup> According to the Türkiye's fishery statistics for the last ten years, the average fishery production of *Oblada melanurus* is 83.3 tons.<sup>26</sup>

The present study aimed to determine the length-length, length-weight, length-girth relationships, and morphometric characteristics of *Oblada melanurus* obtained monthly from İzmir Bay between March 2021 and February 2022. The data obtained from the research results will shed light on the biometric identification of the species distributed in the Aegean Sea. The present study will contribute to the studies on fisheries biology and fisheries management in the near future.

## MATERIALS AND METHODS

The specimens were collected monthly during commercial fishing trials carried out using gillnets and trammel nets from March 2021 to February 2022 in the İzmir Bay (Aegean Sea of Türkiye) (Figure 1). Saddled seabream specimens were provided from fishing boats, placed in wooden boxes and immediately transferred to the laboratory. The total length (TL), fork length (FL), and standard length (SL) to the nearest 0.1 cm were determined. The weight values were determined utilizing a digital scale with an accuracy of  $\pm 0.01$  g. The sex of the specimens was determined according to the shape and appearance of the gonads. Length-length and length-weight relationships of 516 individuals obtained during the field study were calculated. The length-girth and morphometric measurements were taken from 287 individuals, 105 males and 182 females.

The length-weight relationships for weight were determined employing the equation  $W=aL^b$ ,<sup>1</sup> where “a” is a coefficient related to body form, and “b” is an exponent expressing the species' growth type. When the value of b is different from 3, the species presents an allometric growth (negative when  $b<3$  and positive when  $b>3$ ). When the b is equal to 3, the species presents an isometric growth.<sup>27</sup> The coefficient of determination ( $r^2$ ) was estimated by linear regressions on the transformed equation,  $\text{LogBW}=\text{loga}+b\text{logSL}$ . Statistical differences between males and females and the hypothesis of the isometric growth were analyzed by the student's t-test.<sup>28</sup> Also, (1) TL vs. FL; (2) FL vs. SL; and (3) SL vs TL relationships were calcu-

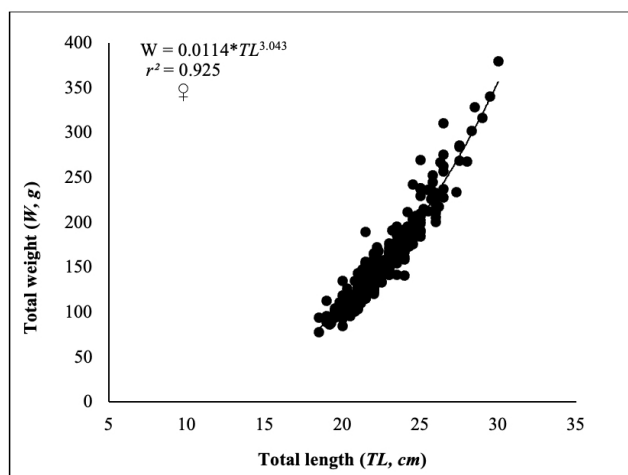


**Figure 2. Morphometric characteristics of the saddled seabream, *O. melanurus***

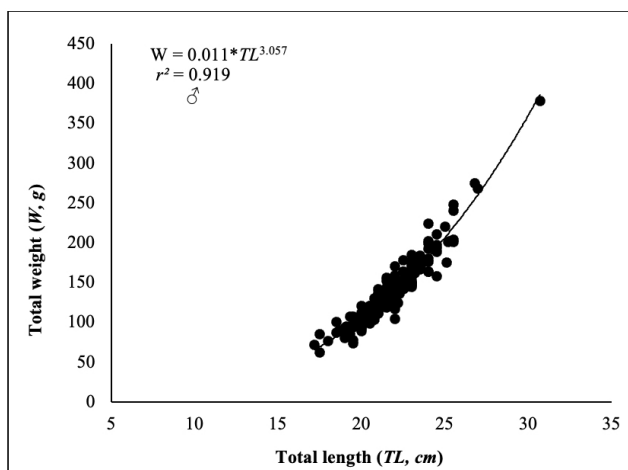
lated by linear regressions. The level of significance was set to  $P<0.05$ . Four different girths were measured: G1 - body perimeter around the eye; G2 - body perimeter immediately behind the operculum; G3 - body perimeter immediately behind the dorsal fin and G4 - the circumference of the thickest part of a fish's body. The relationships between length and girth were estimated using the equation:  $G=a+b\times TL$ , where G is the girth, TL is the total length, “a” is the intercept, and “b” is the regression slope.<sup>29</sup> Measurements of length, girth, and weight were used to estimate length-girth and length-weight relationships using the least-square regression.<sup>28</sup> Length-girth relationships (LGRs) are an important component for (a) biological (e.g., condition and swimming capability) (Wootton 1998); (b) ecological (e.g. predator-prey relationships, trophic level estimation) (Stergiou and Karpouzi 2003); and (c) fisheries assessments (e.g., quantifying the catching efficiency of fishing gear) (Kyritsi et al. 2018). Moreover, the species-specific LGRs allow the computation of girth from length measurements, the latter of which is easier and less expensive to obtain (Moutopoulos et al. 2017). Ten morphometric measurements (TL – total length, FL – fork length, SL – standard length, ED – eye diameter, IOD - Interorbital distance, LH – head length, BD – maximum body depth, CauP - Caudal peduncle height, LDF - Length of the dorsal fin basis, and LAF - Length of the anal fin basis) were carried out (Figure 2). They were expressed as % of fork length (FL). Fork length was expressed as % of total length (TL).

## RESULTS

During the research, 516 individuals were examined, of which 149 were male, 344 were female, 2 were hermaphrodites, and 21 were indeterminate. The total length minimum and maximum values of all male and female *O. melanurus* specimens were in the range of 17.2-30.7 and 18.5-30.0 cm, respectively, and the mean values were  $21.84\pm 2.04$  and  $22.44\pm 2.12$  cm, respectively. All male and female *O. melanurus* specimens' body weight minimum and maximum values were 71.48-378.26 and 77.32-379.71 g,



**Figure 3. Length-weight relationship of female *O. melanurus*, in İzmir Bay (Aegean Sea of Türkiye) from March 2021 to February 2022**



**Figure 4. Length-weight relationship of male *O. melanurus*, in İzmir Bay (Aegean Sea of Türkiye) from March 2021 to February 2022**

respectively, and the mean values were  $140.77 \pm 44.48$  and  $152.05 \pm 48.78$  g, respectively. The  $r^2$  values of LWRs varied between 0.862 and 0.980 and were highly significant ( $P < 0.05$ ). The parameter  $b$  in the LWRs averaged  $2.947$  ( $SE = \pm 0.103$ ). The lowest and highest  $b$  values were 2.203 and 3.676 for female individuals in September and October, respectively. Negative allometric growth ( $b < 3$ ) was found only for female individuals in November. Positive allometric growth ( $b > 3$ ) was found for male individuals and all individuals of the population in October. The isometric growth ( $b \sim 3$ ) was found for females and males in all other months (Table 1). The length-weight relationships for females and males are given in Figure 3 and Figure 4, respectively.

However, only the minimum, maximum, and mean length and weight values were calculated for males in the January 2022 period with fewer than 5 individuals. As a result, *O. melanurus* (2 individuals) had mean total length and weight values of  $25.75 \pm 1.77$  cm and  $239.46 \pm 41.04$  g, respec-

tively (Table 1). All the LLR values in Table 3 were highly significant ( $P < 0.001$ ). All the values for the coefficient of determination were higher than 0.966. The overall data of morphometric characters of measured body proportions for saddled seabream *O. melanurus* males ( $n = 105$ ) and females are presented in Table 2. The ranges of all observed morphometric relationships were within narrow limits, and their variability coefficients ( $V$ ) were relatively low ( $p < 0.05$ ) (Table 2).

## DISCUSSION

The length and weight relationship in fish is determined by measuring the length and weight of fish obtained from a particular region in a certain period.<sup>4</sup> LWRs in fish can vary seasonally, monthly, and even daily throughout the year. At the same time, the parameters of the length-weight relationship vary according to morphology and geography, habitat, sex, reproductive period, diet composition, stomach fullness, and health.<sup>12,30-33</sup> According to,<sup>31,34</sup> the allometric coefficient ( $b$ ) can vary between 2 and 4. All allometric coefficients ( $b$ ) calculated in the present study were in the expected range of 2.3 to 3.7. The species is found both in Turkish seas<sup>17,18,20,21</sup> and in other seas.<sup>10-16</sup> The data on the parameters of the length-weight relationship are given in Table 4 in chronological order. According to the results obtained from all research results, it can be argued that the species generally shows an isometric growth tendency. The parameters of the length-weight relationship can be used to standardize the data of researchers who measured different lengths in their studies when making comparisons.

The length-girth relationship is a critical morphological parameter in fisheries biology.<sup>29,30,35-37</sup> Information on this calculated relationship can be used as an indicator of the condition of the fish, their swimming capacity,<sup>30,38</sup> and net selectivity.<sup>7</sup> During the study period, length-weight and morphometric measurements were made monthly for one year. Therefore, data on length-weight relationships can be used for monthly comparisons with data obtained from other studies. Various environmental measurements of fish are used to calculate the selectivity parameters of fishing gear.<sup>36</sup> Four different parameters ( $G1$ ,  $G2$ ,  $G3$ ,  $G4$ ) are used in selectivity studies of fishing nets.<sup>7,36,38,39</sup> Different environmental conditions determine the probability of different capture methods.<sup>39</sup> Fishing activities will likely affect length-weight and length-girth relationships at different depths.<sup>7</sup> Also, individuals with different body forms and from different geographical regions may show different length-weight relationships.<sup>7,37,40-43</sup> The present study's results indicate the accuracy of the abovementioned approaches. It has also been reported that the factors determining the length-girth relationship can be similar to those affecting the length-weight relationship.<sup>6</sup>

No statistical differences existed between the male and female individuals of *O. melanurus* obtained from İzmir Bay measured monthly in the 2021-2022 period (Table 2). Therefore, it was determined that the species did not show sexual dimorphism. On the other hand, in some other morphometric studies conducted with different species, statis-

**Table 1. Monthly descriptive statistics and estimated parameters of length-weight relationships for both sexes of *O. melanurus* in İzmir Bay (Aegean Sea of Türkiye) from March 2021 to February 2022 (♂: male, ♀: female, Σ: all sexes, *n*: number of individuals, *a*: intercept, *b*: slope, CI: confidence limits, *r*<sup>2</sup>: coefficient of determination)**

| Sampling period | Sex | <i>n</i> | Length characteristics |              | Weight characteristics |              | Relationship parameters |          |                |                    |                       |             |
|-----------------|-----|----------|------------------------|--------------|------------------------|--------------|-------------------------|----------|----------------|--------------------|-----------------------|-------------|
|                 |     |          | TL Range(cm)           | Mean TL(±SD) | W Range (g)            | Mean W (±SD) | <i>a</i>                | <i>b</i> | SE of <i>b</i> | 95 %CI of <i>b</i> | <i>r</i> <sup>2</sup> | Growth type |
| March, 2021     | ♂   | 19       | 19.1-25.3              | 21.82±1.63   | 94.97-202.26           | 135.58±28.40 | 0.0359                  | 2.668    | 0.137          | 2.394-2.942        | 0.967                 | isometric   |
|                 | ♀   | 16       | 19.8-26.0              | 22.61±1.85   | 110.95-232.99          | 153.06±39.58 | 0.0099                  | 3.085    | 0.187          | 2.711-3.459        | 0.968                 | isometric   |
| April           | ♂   | 13       | 21.5-25.5              | 22.85±1.19   | 131.48-240.21          | 166.48±59.36 | 0.0064                  | 3.245    | 0.210          | 2.825-3.665        | 0.967                 | isometric   |
|                 | ♀   | 22       | 20.2-30.0              | 23.52±2.26   | 105.66-379.71          | 179.60±59.36 | 0.0115                  | 3.048    | 0.119          | 2.810-3.286        | 0.980                 | isometric   |
| May             | ♂   | 11       | 19.0-23.0              | 20.75±1.40   | 80.38-170.56           | 111.85±25.84 | 0.0117                  | 3.018    | 0.340          | 2.338-3.698        | 0.882                 | isometric   |
|                 | ♀   | 23       | 18.5-27.5              | 22.89±2.38   | 77.32-286.03           | 160.58±59.08 | 0.0036                  | 3.402    | 0.157          | 3.088-3.716        | 0.956                 | isometric   |
| June            | ♂   | 9        | 19.5-25.1              | 21.41±1.67   | 93.83-174.74           | 124.87±26.57 | 0.0499                  | 2.550    | 0.280          | 1.990-3.110        | 0.915                 | isometric   |
|                 | ♀   | 21       | 19.5-28.3              | 23.19±2.79   | 99.64-302.01           | 168.19±61.64 | 0.0171                  | 2.912    | 0.117          | 2.678-3.146        | 0.965                 | isometric   |
| July            | ♂   | 13       | 17.2-24.0              | 20.41±2.08   | 71.48-198.62           | 114.01±37.80 | 0.0131                  | 2.988    | 0.209          | 2.570-3.406        | 0.949                 | isometric   |
|                 | ♀   | 23       | 19.0-26.5              | 21.26±1.82   | 93.72-275.39           | 126.09±39.71 | 0.0135                  | 2.983    | 0.214          | 2.555-3.411        | 0.887                 | isometric   |
| August          | ♂   | 8        | 17.5-24.5              | 21.56±2.60   | 62.23-164.03           | 124.83±36.86 | 0.0301                  | 2.703    | 0.203          | 2.297-3.109        | 0.969                 | isometric   |
|                 | ♀   | 11       | 19.2-22.8              | 20.71±1.29   | 86.40-142.25           | 110.84±19.41 | 0.0337                  | 2.669    | 0.237          | 2.195-3.143        | 0.937                 | isometric   |
| September       | ♂   | 15       | 20.8-24.5              | 22.11±1.24   | 114.39-188.52          | 151.01±21.81 | 0.1167                  | 2.312    | 0.355          | 1.602-3.022        | 0.871                 | isometric   |
|                 | ♀   | 14       | 19.0-24.2              | 21.44±1.87   | 90.23-195.44           | 128.80±27.91 | 0.1485                  | 2.203    | 0.256          | 1.691-2.715        | 0.851                 | -allometry  |
| October         | ♂   | 19       | 18.5-26.8              | 22.44±2.22   | 100.46-275.7           | 156.35±57.60 | 0.0016                  | 3.676    | 0.301          | 3.074-4.278        | 0.920                 | +allometry  |
|                 | ♀   | 40       | 20.0-26.5              | 22.97±1.79   | 84.58-262.74           | 163.22±42.01 | 0.0072                  | 3.192    | 0.194          | 2.804-3.580        | 0.865                 | isometric   |
| November        | ♂   | 17       | 17.5-30.7              | 22.41±2.78   | 84.75-378.26           | 157.11±65.09 | 0.0319                  | 2.721    | 0.164          | 2.393-3.049        | 0.971                 | isometric   |
|                 | ♀   | 25       | 20.0-26.0              | 22.14±1.43   | 107.33-226.36          | 147.18±26.76 | 0.0541                  | 2.550    | 0.222          | 2.106-2.994        | 0.862                 | -allometry  |
| December        | ♂   | 5        | 20.0-24.0              | 21.50±1.50   | 92.60-163.68           | 124.50±26.92 | 0.0126                  | 2.995    | 0.574          | 1.847-4.143        | 0.904                 | isometric   |
|                 | ♀   | 66       | 18.5-29.5              | 22.63±2.31   | 94.24-340.20           | 157.45±53.87 | 0.0142                  | 2.975    | 0.108          | 2.759-3.191        | 0.938                 | isometric   |
| January, 2022   | ♂   | 2        | 24.5-27.0              | 25.75±1.77   | 210.44-268.48          | 239.46±41.04 | -                       | -        | -              | -                  | -                     | -           |
|                 | ♀   | 71       | 19.0-26.5              | 22.31±2.02   | 95.42-310.34           | 149.05±46.98 | 0.0112                  | 3.048    | 0.112          | 2.824-3.272        | 0.888                 | isometric   |
| February        | ♂   | 18       | 19.0-25.5              | 21.47±1.91   | 92.33-220.29           | 132.83±38.75 | 0.0191                  | 2.876    | 0.291          | 2.294-3.458        | 0.885                 | isometric   |
|                 | ♀   | 12       | 20.0-23.5              | 21.61±1.24   | 92.93-170.97           | 131.10±28.82 | 0.0021                  | 3.582    | 0.515          | 2.552-4.612        | 0.841                 | isometric   |
| Overall         | ♂   | 149      | 17.2-30.7              | 21.84±2.04   | 71.48-378.26           | 140.77±44.48 | 0.0110                  | 3.057    | 0.081          | 2.895-3.219        | 0.919                 | isometric   |
|                 | ♀   | 344      | 18.5-30.0              | 22.44±2.12   | 77.32-379.71           | 152.05±48.78 | 0.0114                  | 3.043    | 0.048          | 2.947-3.139        | 0.925                 | isometric   |
|                 | Σ   | 516      | 16.5-30.7              | 22.18±2.13   | 55.77-379.71           | 146.80±48.30 | 0.0089                  | 3.122    | 0.061          | 3.000-3.244        | 0.919                 | +allometry  |

**Table 2. Morphometric characters of saddled seabream *O. melanurus* males (♂n=105) and females (♀n=182) specimens from the İzmir Bay (Aegean Sea of Türkiye)**

| Relation | Sex    | Range (%)                  | $\bar{X} \pm SE$ (%)         | t-test | p      | V (%)       |
|----------|--------|----------------------------|------------------------------|--------|--------|-------------|
| FL/TL    | ♂<br>♀ | 81.67-92.59<br>85.33-95.35 | 87.721±0.134<br>88.104±0.081 | 2.539  | p≥0.05 | 1.565 1.241 |
| SL/TL    | ♂<br>♀ | 73.71-85.19<br>77.25-88.37 | 80.455±0.116<br>80.460±0.074 | 1.316  | p≥0.05 | 1.478 1.240 |
| SL/FL    | ♂<br>♀ | 88.10-97.37<br>80.00-97.30 | 91.728±0.115<br>91.312±0.081 | 1.031  | p≥0.05 | 1.284 1.197 |
| LH/TL    | ♂<br>♀ | 20.19-23.01<br>20.35-23.56 | 21.636±0.058<br>21.686±0.044 | 0.686  | p≥0.05 | 2.745 2.735 |
| LAF/TL   | ♀<br>♂ | 17.64-23.63<br>17.41-24.13 | 20.577±0.106<br>20.604±0.085 | 0.199  | p≥0.05 | 5.278 5.567 |
| LDF/TL   | ♂<br>♀ | 38.94-47.26<br>37-64-46.64 | 42.621±0.142<br>42.553±0.105 | 0.386  | p≥0.05 | 3.414 3.330 |
| BD/TL    | ♂<br>♀ | 23.59-32.17<br>25.25-30.41 | 28.248±0.125<br>28.087±0.078 | 1.093  | p≥0.05 | 4.535 3.746 |
| ED/LH    | ♂<br>♀ | 26.78-35.82<br>26.71-36.90 | 31.609±0.209<br>31.437±0.150 | 0.668  | p≥0.05 | 6.777 6.438 |
| IOD/LH   | ♂<br>♀ | 26-74-37.91<br>28.18-36.66 | 32.672±0.207<br>32.708±0.131 | 0.147  | p≥0.05 | 6.492 5.402 |

**Table 3. Length-length and length-girth relationships of *O. melanurus* males and females from the İzmir Bay (Aegean Sea of Türkiye) (n: number of individuals,  $r^2$ : coefficient of determination; ♀: female; ♂: male)**

| Males                    |       |         | Females                  |       |         | n           |
|--------------------------|-------|---------|--------------------------|-------|---------|-------------|
| Equation                 | $r^2$ | p       | Equation                 | $r^2$ | p       |             |
| $TL = 1.065 FL + 1.432$  | 0.963 | p=0.168 | $TL = 1.066 FL + 1.361$  | 0.966 | P=0.334 | 149♂ : 344♀ |
| $TL = 1.183 SL + 1.049$  | 0.956 | P=0.170 | $TL = 1.161 SL + 1.479$  | 0.971 | P=0.332 | 149♂ : 344♀ |
| $FL = 1.096 SL - 1.102$  | 0.976 | P=0.165 | $FL = 1.071 SL + 0.440$  | 0.972 | P=0.331 | 149♂ : 344♀ |
| $LH = 0.217 TL - 0.004$  | 0.926 | P=0.177 | $LH = 0.210 TL - 0.159$  | 0.920 | P=0.358 | 105♂ : 182♀ |
| $LAF = 0.187 TL + 0.404$ | 0.754 | P=0.225 | $LAF = 0.177 TL + 0.632$ | 0.707 | P=0.480 | 105♂ : 182♀ |
| $LDF = 0.411 TL + 0.337$ | 0.887 | P=0.375 | $LDF = 0.415 TL + 0.227$ | 0.888 | P=0.375 | 105♂ : 182♀ |
| $BD = 0.282 TL + 0.018$  | 0.838 | P=0.402 | $BD = 0.281 TL - 0.032$  | 0.869 | P=0.385 | 105♂ : 182♀ |
| $ED = 0.157 LH + 0.748$  | 0.527 | P=0.598 | $ED = 0.193 LH - 0.586$  | 0.541 | P=0.589 | 105♂ : 182♀ |
| $IOD = 0.267 LH + 0.279$ | 0.655 | P=0.412 | $IOD = 0.320 LH + 0.035$ | 0.747 | P=0.455 | 105♂ : 182♀ |
| $G_1 = 0.442 TL + 0.134$ | 0.518 | P=0.604 | $G_1 = 0.419 TL + 0.765$ | 0.590 | P=0.555 | 105♂ : 182♀ |
| $G_2 = 0.622 TL - 1.025$ | 0.753 | P=0.452 | $G_2 = 0.618 TL - 0.965$ | 0.763 | P=0.446 | 105♂ : 182♀ |
| $G_3 = 0.687 TL - 0.933$ | 0.820 | P=0.412 | $G_3 = 0.672 TL - 0.600$ | 0.803 | P=0.422 | 105♂ : 182♀ |
| $G_4 = 0.693 TL - 0.074$ | 0.819 | P=0.413 | $G_4 = 0.672 TL - 0.400$ | 0.803 | P=0.422 | 105♂ : 182♀ |

tically significant differences were recorded according to sexes<sup>44-47</sup> and size groups.<sup>48-50</sup>

The LWR parameters (a, b) of the fish are affected by a series of factors such as season, habitat, gonad maturity, sex, diet, stomach fullness, health, preservation techniques and annual differences in environmental conditions.<sup>51</sup>

Such differences in values *b* can be ascribed to one or a combination of most of the factors, including differences in the number of specimens examined, area/season effects, and distinctions in the observed length ranges of the specimens caught, to which duration of sample collection can be added as well.<sup>12</sup> Girth-length data can be considered cru-

**Table 4. Length-weight relationships of *O. melanurus* from different localities. (♂: male, ♀: female, Σ: all sexes, n: number of individuals, *a*: intercept, *b*: slope, CI: confidence limits,  $r^2$ : coefficient of determination)**

| Author(s)                      | Locality/<br>Country                  | Sex     | Length<br>range<br>(cm) | Length<br>type | <i>n</i> | <i>a</i> | <i>b</i> | $r^2$ |
|--------------------------------|---------------------------------------|---------|-------------------------|----------------|----------|----------|----------|-------|
| Gonçalves et al., 1997         | South-west coast/ Portugal            | unsexed | 22.0 - 34.0             | TL             | 23       | 0.0032   | 3.404    | 0.941 |
| Pallaoro et al., 1998          | Cape Savudrija to Lastovo Is/ Croatia | ♂       |                         | TL             | 2430     | 0.0113   | 3.017    | 0.990 |
| Pallaoro et al., 1998          | Cape Savudrija to Lastovo Is/ Croatia | ♀       |                         | TL             | 2911     | 0.0088   | 3.123    | 0.994 |
| Can et al., 2002               | Iskenderun Bay/ Türkiye               | unsexed | 15.6 - 27.0             | TL             | 22       | 0.0322   | 2.697    | 0.964 |
| Moutopoulos and Stergiou, 2002 | Kyclades/ Greece                      | Σ       | 14.2 - 28.9             | TL             | 90       | 0.0219   | 2.831    | 0.960 |
| Borges et al., 2003            | Algarve/ Portugal                     | unsexed | 20.5 - 28.2             | TL             | 49       | 0.0161   | 2.906    | 0.865 |
| Karakulak et al., 2006         | Gökceada Island/ Türkiye              | ♀       | 12.5 - 19.8             | TL             | 112      | 0.0052   | 3.310    | 0.888 |
| Karakulak et al., 2006         | Gökceada Island/ Türkiye              | ♂       | 12.1 - 17.7             | TL             | 145      | 0.0047   | 3.347    | 0.893 |
| Karakulak et al., 2006         | Gökceada Island/ Türkiye              | Σ       | 9.1 - 19.8              | TL             | 316      | 0.0034   | 3.463    | 0.918 |
| Karakulak et al., 2006         | Gökceada Island/ Türkiye              | unsexed | 8.0 - 28.2              | TL             | 25       | 0.0024   | 3.567    | 0.984 |
| Mahmoud, 2010                  | Abu Qir Bay/ Egypt                    | Σ       | 12.0 - 29.2             | TL             | 477      | 0.0170   | 2.934    | 0.994 |
| Crec'hriou et al., 2013        | French Catalan coast/ France          | unsexed | 17.0 - 36.6             | TL             | 74       | 0.0180   | 2.890    | 0.958 |
| Moutopoulos et al., 2013       | Korinthiakos Gulf/ Greece             | unsexed | 14.6 - 29.5             | TL             | 59       | 0.0146   | 2.932    | 0.993 |
| Bilge et al., 2014             | Southern Aegean Sea/ Türkiye          | unsexed | 11.6 - 25.8             | TL             | 157      | 0.0174   | 2.857    | 0.994 |
| Daban et al., 2020             | Northern Aegean Sea/ Türkiye          | ♀       | 11.6 - 29.2             | TL             | 187      | 0.0098   | 3.086    | 0.949 |
| Daban et al., 2020             | Northern Aegean Sea/ Türkiye          | ♂       | 14.6 - 27.6             | TL             | 139      | 0.0086   | 3.128    | 0.949 |
| This study                     | İzmir Bay/ Türkiye                    | ♀       | 17.2-30.7               | TL             | 149      | 0.0110   | 3.057    | 0.919 |
| This study                     | İzmir Bay/ Türkiye                    | ♂       | 18.5-30.0               | TL             | 344      | 0.0114   | 3.043    | 0.925 |
| This study                     | İzmir Bay/ Türkiye                    | Σ       | 16.5-30.7               | TL             | 516      | 0.0089   | 3.122    | 0.919 |

cial in gear selectivity studies, particularly for netters, for which the strategy on the suitable mesh size ranges needs to be taken. In addition, the estimated relations are of great importance because they determine fish growth patterns, which in turn are essential for developing ecosystem-based models for fisheries. In conclusion, the preliminary data obtained in the present study on length-length, length-weight, length-girth relationships, and morphometrics for *Oblada melanurus* will contribute to other fisheries biolo-

gists and fisheries managers conducting research in Turkish and other seas.

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