

## Short Communication

# Weight–length relationships for 20 Lessepsian fish species caught by bottom trawl on the coast of Iskenderun Bay (NE Mediterranean Sea, Turkey)

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### Summary

Weight–length relationships were estimated for 20 Lessepsian fish species of the Iskenderun Bay, namely, *Apogon nigripinnis*, *Apogon queketti*, *Callionymus filamentosus*, *Cynoglossus sinu-rabici*, *Dussumieria elopoides*, *Etrumeus teres*, *Fistularia commersonii*, *Lagocephalus spadiceus*, *Lagocephalus suezensis*, *Leiognathus kluzingeri*, *Nemipterus japonicus*, *Oxyurichthys petersenii*, *Saurida undosquamis*, *Sillago sihama*, *Siganus luridus*, *Siganus rivulatus*, *Sphyrna chrysotaenia*, *Stephanolepis diaspros*, *Upeneus moluccensis* and *Upeneus pori*. All regressions were found to be significant for all species. This study presents the first estimation of weight–length relationships for six species (*A. queketti*, *E. teres*, *F. commersonii*, *L. suezensis*, *Nemipterus randalli*, and *S. luridus*) inhabiting coastal areas of the northeastern Mediterranean Sea.

### Introduction

After the opening of the Suez Canal in 1869, a migration began from the Red Sea with many species of Indo-Pacific origin penetrating the eastern Mediterranean Sea. Many Lessepsian fish species able to adapt rapidly to the new environment spread to the Mediterranean to establish new populations. In 2002, 33 Lessepsian fish species were documented on Turkish coasts (Bilecenoglu et al., 2002a). In recent years five more Lessepsian species were added to the Mediterranean ichthyofauna (Bilecenoglu et al., 2002b; Akyol et al., 2005; Çinar et al., 2006; Eryilmaz and Dalyan, 2006; Gokoglu et al., 2008; Bilecenoglu and Russell, 2008).

Weight–length relationships are commonly used in fisheries biology applications and can provide information on the standing stock biomass, calculation of condition indices and several aspects of fish population dynamics (Bagenal and Tesch, 1978; Martin-Smith, 1996; Gonçalves et al., 1997).

Some studies have been made on length–weight relationships of fishes in the north-eastern Mediterranean (Can et al., 2002; Cicek et al., 2006; Sangun et al., 2007). However, studies are scarce with regard to weight–length relationships for Lessepsian immigrant fish species from the eastern Mediterranean coast (Taskavak and Bilecenoglu, 2001; Bilecenoglu and Kaya, 2002).

Weight–length relationships of 20 Lessepsian fish species from the coast of Iskenderun Bay (north-eastern Mediterranean Sea, Turkey) were investigated, whereby six of these species (*Apogon queketti*, *Etrumeus teres*, *Fistularia commerso-*

*nii*, *Lagocephalus suezensis*, *Nemipterus randalli*, and *Siganus luridus*) are estimated for the first time.

### Materials and methods

The Iskenderun Bay is a very important fishing area in the north-eastern Mediterranean. Four samplings were conducted on the coast of Iskenderun Bay (the coasts of Yumurtalik, Iskenderun and Samandag) in May, October and December 2007 and February 2008.

Samples were caught by bottom trawl on RV ‘Mustafa Kemal I’ (18 m length, 280 HP engine) and commercial bottom trawl (24 m length, 480 HP). Species were caught at depths ranging from 12 to 120 m. In the laboratory individuals were weighed with a digital balance to an accuracy of 0.01 g and measured to 0.1 cm total length. Fish species were identified according to Whitehead et al. (1986) and Turan et al. (2007) and checked with FishBase (Froese and Pauly, 2008).

The relationship between weight and total length,  $W = aL^b$  was converted into the logarithmic expression:  $\ln W = \ln a + b \ln L$ . Parameters  $a$  and  $b$  were calculated by least-squares regression, as was the coefficient of determination ( $r^2$ ). The  $b$  value for each species was tested by  $t$ -test at 0.001 significance level to verify if significantly different from 3.

### Results and discussion

Totals of 2124 fish specimens representing 20 species and 15 families were sampled. Descriptive statistics and weight–length relationship parameters for 20 fish species caught in the Iskenderun Bay are given in Table 1.

Sample sizes ranged from 10 for the Randall’s threadfin bream *N. randalli* to 358 for the Kluzinger’s ponyfish *Leiognathus kluzingeri*. The  $r^2$  values ranged from 0.887 for *Oxyurichthys petersenii* to 0.998 for *Saurida undosquamis*. All regression values were found to be highly significant ( $P < 0.001$ ).

Values of the exponent  $b$  provide information on fish growth. When  $b = 3$ , increase in weight is isometric. When the value of  $b$  is greater than 3, weight increase is allometric (positive if  $b > 3$ , negative if  $b < 3$ ). In the present study, the  $b$  values ranged from 2.491 for *Apogon nigripinnis* to 3.710 for *L. kluzingeri*. Eight species showed isometric growth: *A. queketti*, *E. teres*, *L. suezensis*, *S. undosquamis*, *Sillago sihama*, *S. luridus*, *Stephanolepis diaspros*, and *Upeneus pori*; eight species showed negative allometric growth: *A. nigripinnis*, *Callionymus filamentosus*, *Cynoglossus*

Table 1

Descriptive statistics and weight–length relationship parameters for 20 fish species caught in Iskenderun Bay (eastern Mediterranean coast)

| Species                                    | Weight (g) |            |            |                                 |            | Length (cm) |                                 |        |       | Relationship parameters |               |       |  |
|--------------------------------------------|------------|------------|------------|---------------------------------|------------|-------------|---------------------------------|--------|-------|-------------------------|---------------|-------|--|
|                                            | n          | $W_{\min}$ | $W_{\max}$ | $W_{\text{mean}} \pm \text{SD}$ | $L_{\min}$ | $L_{\max}$  | $L_{\text{mean}} \pm \text{SD}$ | $a$    | $b$   | SE of $b$               | 95% CI of $b$ | $r^2$ |  |
| <i>Apogon nigripinnis</i>                  | 30         | 2.02       | 5.69       | 3.52 $\pm$ 1.03                 | 4.50       | 7.10        | 5.53 $\pm$ 0.63                 | 0.0484 | 2.491 | 0.071                   | 2.346–2.637   | 0.978 |  |
| <i>Apogon queketti</i> <sup>a</sup>        | 48         | 7.02       | 36.00      | 18.59 $\pm$ 6.97                | 7.10       | 12.30       | 9.94 $\pm$ 1.27                 | 0.0157 | 3.059 | 0.100                   | 2.857–3.260   | 0.953 |  |
| <i>Callionymus filamentosus</i>            | 43         | 4.55       | 12.08      | 8.61 $\pm$ 2.17                 | 7.20       | 10.70       | 9.15 $\pm$ 0.96                 | 0.0323 | 2.513 | 0.107                   | 2.296–2.729   | 0.930 |  |
| <i>Cynoglossus sinuabici</i>               | 53         | 4.50       | 32.00      | 14.32 $\pm$ 5.00                | 8.00       | 17.10       | 12.48 $\pm$ 1.62                | 0.0239 | 2.520 | 0.050                   | 2.421–2.620   | 0.981 |  |
| <i>Dussimieria elopsoides</i>              | 59         | 7.02       | 34.92      | 15.66 $\pm$ 8.79                | 9.90       | 16.40       | 12.42 $\pm$ 2.02                | 0.0055 | 3.123 | 0.048                   | 3.028–3.219   | 0.987 |  |
| <i>Etrumeus teres</i> <sup>a</sup>         | 61         | 7.38       | 35.77      | 19.34 $\pm$ 6.53                | 10.00      | 16.70       | 13.46 $\pm$ 1.63                | 0.0078 | 2.989 | 0.072                   | 2.846–3.133   | 0.967 |  |
| <i>Fistularia commersonii</i> <sup>a</sup> | 12         | 74.70      | 98.20      | 80.91 $\pm$ 6.80                | 58.00      | 65.00       | 60.00 $\pm$ 1.93                | 0.0112 | 2.504 | 0.108                   | 2.263–2.745   | 0.981 |  |
| <i>Lagocephalus spadiceus</i>              | 89         | 8.17       | 308.02     | 84.33 $\pm$ 78.07               | 6.90       | 26.90       | 15.94 $\pm$ 4.98                | 0.0204 | 2.901 | 0.076                   | 2.748–3.051   | 0.943 |  |
| <i>Lagocephalus suezensis</i> <sup>a</sup> | 86         | 12.50      | 54.88      | 27.83 $\pm$ 9.90                | 10.20      | 16.70       | 12.90 $\pm$ 1.57                | 0.0236 | 2.749 | 0.063                   | 2.624–2.875   | 0.957 |  |
| <i>Leiognathus klunzingeri</i>             | 358        | 0.03       | 14.51      | 5.39 $\pm$ 3.86                 | 2.20       | 10.90       | 7.29 $\pm$ 2.03                 | 0.0026 | 3.710 | 0.059                   | 3.595–3.827   | 0.917 |  |
| <i>Nemipterus randalli</i> <sup>a</sup>    | 10         | 0.71       | 17.06      | 8.05 $\pm$ 5.79                 | 4.60       | 15.30       | 10.05 $\pm$ 3.65                | 0.0130 | 2.687 | 0.138                   | 2.368–3.006   | 0.979 |  |
| <i>Oxyurichthys petersenii</i>             | 175        | 1.15       | 28.32      | 11.34 $\pm$ 5.27                | 6.10       | 19.20       | 13.30 $\pm$ 1.99                | 0.0064 | 2.861 | 0.078                   | 2.708–3.015   | 0.887 |  |
| <i>Saurida undosquamis</i>                 | 304        | 2.79       | 218.42     | 65.47 $\pm$ 57.73               | 8.20       | 34.00       | 19.92 $\pm$ 7.81                | 0.0063 | 2.968 | 0.019                   | 2.931–3.005   | 0.988 |  |
| <i>Sillago sihama</i>                      | 23         | 3.96       | 46.00      | 21.85 $\pm$ 12.84               | 8.70       | 20.50       | 14.52 $\pm$ 3.17                | 0.0053 | 3.064 | 0.132                   | 2.791–3.338   | 0.962 |  |
| <i>Siganus luridus</i> <sup>a</sup>        | 21         | 32.10      | 46.90      | 15.54 $\pm$ 0.77                | 14.50      | 16.30       | 14.19 $\pm$ 5.93                | 0.0136 | 2.920 | 0.162                   | 2.581–3.259   | 0.945 |  |
| <i>Siganus rivulatus</i>                   | 122        | 28.49      | 54.20      | 41.48 $\pm$ 6.10                | 14.10      | 18.00       | 15.61 $\pm$ 0.80                | 0.0170 | 2.823 | 0.089                   | 2.646–3.000   | 0.892 |  |
| <i>Sphyræna chrysotaenia</i>               | 67         | 78.20      | 128.10     | 104.61 $\pm$ 17.13              | 27.00      | 32.20       | 28.93 $\pm$ 1.35                | 0.0011 | 3.413 | 0.145                   | 3.122–3.702   | 0.895 |  |
| <i>Stephanolepis diaspros</i>              | 56         | 9.20       | 47.80      | 30.20 $\pm$ 12.37               | 8.00       | 13.50       | 11.62 $\pm$ 1.77                | 0.0146 | 3.083 | 0.055                   | 2.974–3.193   | 0.983 |  |
| <i>Upeneus moluccensis</i>                 | 297        | 1.00       | 72.30      | 21.31 $\pm$ 16.72               | 5.00       | 17.70       | 11.98 $\pm$ 2.49                | 0.0034 | 3.439 | 0.047                   | 3.345–3.532   | 0.947 |  |
| <i>Upeneus pori</i>                        | 210        | 1.14       | 48.00      | 18.78 $\pm$ 11.59               | 5.20       | 17.00       | 11.63 $\pm$ 3.23                | 0.0157 | 2.816 | 0.039                   | 2.739–2.894   | 0.961 |  |

Species in bold also represented in Fishbase.

<sup>a</sup>First report of weight–length relationships for Turkey.

*sinuabici*, *F. commersonii*, *L. suezensis*, *N. randalli*, *O. petersenii*, and *Siganus rivulatus*; and four species positive allometric growth: *Dussimieria elopsoides*, *Leiognathus klunzingeri*, *Sphyræna chrysotaenia*, and *Upeneus moluccensis*. Additionally, weight–length estimates for 14 species (Table 1 in bold) are available in the Fishbase database (Froese and Pauly, 2008).

For all species, data were not representative for all months within a year. Thus, these data should be considered as representing only a particular season or time of year. According to Bagenal and Tesch (1978) and Gonçalves et al. (1997), the  $b$  parameters generally do not vary significantly throughout the year, unlike parameter  $a$  which may vary seasonally, daily and between habitats. As pointed out by Petrakis and Stergiou (1995), use of the weight–length relationship should be limited to the sizes in the estimation of the parameters.

Taskavak and Bilecenoglu (2001) presented length–weight relationships for 18 Lessepsian fish species from the eastern Mediterranean coast, 13 of which are also included herein (Table 1). For all species given in the present paper the  $b$  values were generally similar. However, a number of factors are known to influence weight–length relationships in fishes, including growth phase, season effect, size range, general fish condition and size selectivity of the sampling gear (Tesch, 1971). These factors were not accounted for in the present study.

To the best of our knowledge, there is no information on weight–length relationships for six of the species presented here. Consequently the present study is a preliminary reference on these species (*A. queketti*, *E. teres*, *F. commersonii*, *L. suezensis*, *N. randalli*, and *S. luridus*) in the north-eastern Mediterranean Sea.

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