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Length-weight relationships of marine fishes off Yumurtalık coast (İskenderun Bay), Turkey

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Abstract: In this study, length and weight data are presented for 33 fish species inhabiting littoral habitats off the Yumurtalık coast. Samples were collected with combined gill and trammel nets. Parameters of the length-weight relationships were estimated for 14 species. The *b* values ranged between 2.35 and 3.53. For remained 19 species, the parameter *a* was estimated by setting *b* = 3.0.

Key words: Length-weight relationships, marine fish species, Yumurtalık, Turkey

Yumurtalık (İskenderun Körfezi, Türkiye) açıklarındaki balıkların boy-ağırlık ilişkileri

Özet: Bu çalışmada, Yumurtalık açıklarında kıyısal bölgede yaşayan 33 balık türüne ait boy ağırlık ilişkileri sunulmuştur. Örnekler çatılı uzatma ağı ile toplanmıştır. Boy ağırlık ilişkileri 14 balık türü için hesaplanmıştır. Bu türler için *b* değeri 2,35 ile 3,53 arasında değişim göstermektedir. Geri kalan 19 tür için *a* parametresi *b* = 3,0 olarak kabul edilip hesaplanmıştır.

Anahtar sözcükler: Boy-ağırlık ilişkisi, deniz balık türleri, Yumurtalık, Türkiye

Introduction

The length-weight relationships were originally used for estimating the weight corresponding to a given length and to provide information on the condition of fish (Tesch, 1968). They may also help to determine whether somatic growth is isometric or allometric (Ricker, 1975). Length-weight relationships of fish, in general, are important because they: (a) allow an estimate of the condition of fish (Goncalves et al., 1997; Stergiou and Moutopoulos, 2001; Santos et al., 2002); (b) allow the estimation of biomass from length observations (Goncalves et al., 1997; Morato et al., 2001; Stergiou and Moutopoulos, 2001; Taskavak and Bilecenoglu, 2001; Can et al., 2002; Santos et al., 2002); (c) allow the estimation of weight-at-age (Santos et al., 2002) and the conversion of growth-in-length equations to growth-in-weight (Goncalves et al., 1997; Stergiou and Moutopoulos, 2001); and (d) are useful for between-region comparisons of life histories of species (Goncalves et al., 1997; Diaz et al., 2000; Stergiou and Moutopoulos, 2001; Filiz and Bilge, 2004; Santos et al., 2002).

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In this study, the parameters of length-weight relationships were presented for 33 fish species caught with combined gillnet off Yumurtalık Coast in İskenderun Bay, Turkey. The data presented here could be used for comparison with similar studies of bays of the Mediterranean, and part of recovery programs, or other management and conservation activities.

Materials and methods

This study is carried out off Yumurtalık (İskenderun Bay, Adana, Turkey) with a commercial artisanal fishing boat (8 m long, Yabangülü). The sampling gear was a combined gillnet to trammel net consisting of 2 panels (1 upper panel (gillnet) and 1 lower panel (trammel net)) with total of 300 m length and 5 m depth. The fishing trials were conducted in September 2008 and May 2009, at 18-19 m in depth off Yumurtalık coast. All fishes were identified to the species level and measured fresh in the laboratory. Data on total length (TL) in mm and total weight in g were recorded for each fish in the laboratory. Fishes were identified based on Whitehead et al. (1986) and scientific names were checked with FishBase (Froese and Pauly, 2009).

The length-weight relationships were estimated using the equation $W = aL^b$, where W is total weight (g), L total length (cm), a intercept, and b slope. The degree of association between the variables was computed by the determination coefficient, r^2. The parameters a and b were estimated by linear regression on the Log-transformed (Log_{10}) equation $\log(W) = \log(a) + b \log(L)$. The significance of the regression was assessed by ANOVA, and the b-value for each species was tested by t-test to verify that it was significantly different from the predictions for isometric growth ($b = 3$). The species represented by a suitable size range and sampling size were merely taken into consideration. For species for which the relationship could not be fitted because of only single specimen caught, the parameter a was estimated by setting $b = 3.0$ (Borges et al., 2003).

Results and discussion

Overall, 33 different species (totally 330 specimens) were weighed and measured to estimate length-weight relationships. However, the length–weight relationships of 14 species (totally 286 specimens) could be computed due to sufficient sampling size (Table 1). The sample sizes ranged from

Table 1. Length (L) (cm) – weight (W) (g) relationships for fishes from Yumurtalık coast, based on $W = aL^b$. min: minimum, max: maximum; C.I.: confidence intervals; S.E.: standard error; a = intercept of the relationship; b = slope of the relationship $W = aL^b$; r^2 = coefficient of determination; N = sample size; Species are listed in alphabetical order.

Species	N	*L*min–*L*max	*W*min–*W*max	$W = aL^b$				
				a	*b*	SE(*b*)	CI(*b*)	r^2
Caranx crysos (Mitchill, 1815)	21	13.40–24.00	24.51–134.13	0.01	3.00	0.18	2.63-3.37	0.94
Chelidonichthys lucerna (L., 1758)	3	9.50–23.50	7.53–104.43	0.0106	2.92	0.10	2.51-3.33	0.99
Dentex dentex (L., 1758)	5	15.90–18.40	53.25–90.63	0.0031	3.53	0.10	3.24-3.82	0.99
Diplodus annularis (L., 1758)	33	12.20–15.00	26.88–51.82	0.0173	2.97	0.26	2.43-3.51	0.91
Diplodus sargus sargus (L., 1758)	26	11.60–18.10	28.58–89.51	0.0608	2.50	0.22	2.04-2.96	0.93
Diplodus vulgaris (Geoffroy Saint-Hilaire, 1817)	22	11.70–17.90	23.12–91.77	0.0089	3.19	0.09	3.01-3.37	0.99
Lithognathus mormyrus (L., 1758)	6	16.40–23.00	52.15–135.67	0.0192	2.83	0.09	2.59-3.07	0.99
Mullus barbatus barbatus L., 1758	8	11.00–20.40	15.98–91.30	0.0184	2.84	0.14	2.51-3.17	0.99
Pagellus erythrinus (L., 1758)	43	13.30–20.20	32.98–107.99	0.0412	2.58	0.17	2.24-2.92	0.95
Saurida undosquamis (Richardson, 1848)	79	12.80–36.40	11.40–203.23	0.0105	2.80	0.08	2.64-2.96	0.94
Siganus rivulatus Forsskål, 1775	5	8.00–19.90	5.55–95.95	0.0127	2.92	0.19	2.38-3.46	0.99
Spicara maena (L., 1758)	17	13.30–17.90	32.73–70.40	0.0215	2.80	0.22	2.33-3.27	0.91
Solea solea (L., 1758)	13	11.20–24.40	14.28–105.15	0.0490	2.35	0.09	2.15-2.55	0.98
Upeneus moluccensis (Bleeker, 1855)	5	12.20–19.50	19.48–89.04	0.0059	3.24	0.10	2.96-3.52	0.99

3 for *Chelidonichthys lucerna* to 79 for *Saurida undosquamis*. Relationships (linear regressions) were significant for all species ($P < 0.001$), with r^2 values being greater than 0.90 for 14 species. The r^2 values were computed as 0.99 for *Chelidonichthys lucerna*, *Dentex dentex*, *Diplodus vulgaris*, *Lithognathus mormyrus*, *Mullus barbatus barbatus*, *Siganus rivulatus*, and *Upeneus moluccensis.*

The value of *b* varied between 2.35 (*Solea solea*) and 3.53 (*Dentex dentex*). The mean value of the parameter *b* was 2.89 (SD = 0.30) for the complete data set (Figure).

Length and weight for species of which only the parameter *a* could be estimated are given in Table 2.

The length-weight relationship in fishes can be affected by a number of factors including season, habitat, gonad maturity, sex, diet, and stomach fullness, health and preservation techniques, and differences in the length ranges of the specimen caught (Tesch, 1968), which were not accounted for in the present study. Thus, differences in length-weight relationships between this and other studies could potentially be attributed to the combination of one or more of the factors given above. Observed big standard errors and wide confidence limits in Table 1 could be both the size ranges and the sample size.

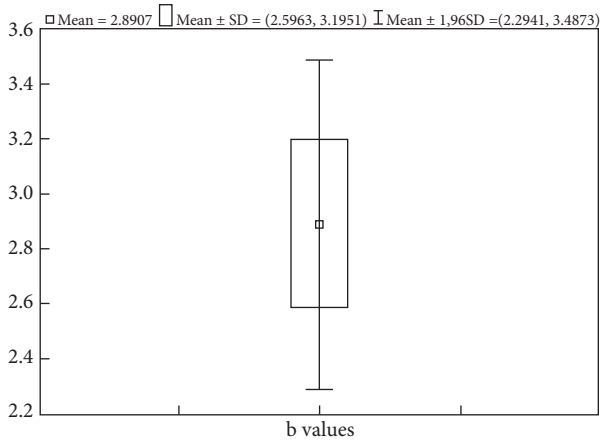

Figure. Box-Whiskers plots of the exponent *b* of length-weight relationships ($W = aL^b$) for 14 fish species.

Table 2. Length and weight data for species for which L-W relationship could not be fitted. The parameter *a* of the L-W relationship was estimated by setting $b = 3.0$.

Species	**n**	***L* (cm)**	***W* (g)**	***a***
Argyrosomus regius (Asso, 1801)	1	23.0	121.62	0.009995
Boops boops (L., 1758)	2	12.8	27.40	0.013219
Dasyatis tortonesei Capapé, 1975	1	58.3	1298.12	0.006551
Dussumieria acuta Valenciennes, 1847	1	16.6	33.65	0.007356
Engraulis encrasicolus (L., 1758)	1	9.6	6.54	0.007392
Epinephelus costae (Steindachner, 1878)	1	18.2	78.98	0.013100
Equulites klunzingeri (Steindachner, 1898)	1	10.2	13.25	0.012485
Lagocephalus spadiceus (Richardson, 1845)	2	16.2	39.34	0.009253
Mullus surmuletus L., 1758	2	15.6	43.93	0.011570
Oblada melanura (L., 1758)	17	13.5	37.55	0.015384
Pomadasys incisus (Bowdich, 1825)	3	16.6	16.83	0.003679
Rhinobatos rhinobatos (L., 1758)	1	74.6	1298.66	0.003128
Seriola dumerili (Risso, 1810)	1	27.5	246.97	0.011875
Trachinus draco L., 1758	2	20.6	55.84	0.006434
Trachurus trachurus (L., 1758)	1	18.4	52.12	0.008366
Torpedo nobiliana Bonaparte, 1835	2	22.9	235.13	0.019580
Torpedo torpedo (L., 1758)	1	47.0	2663.62	0.025655
Umbrina cirrosa (L., 1758)	2	27.6	254.60	0.012109
Uranoscopus scaber L., 1758	2	21.3	180.79	0.018841

The information gained in the present survey may enable fish biologists to derive weight estimates for the Yumurtalık coast fishes that are measured but not weighed. Consequently, the present data could be used for comparison with similar studies of different parts of the Mediterranean, and could be of considerable use in ongoing studies of the by-catch and discards of the Aegean commercial fishery when those fish populations are subjected to commercial fishing, part of recovery programs, or management and conservation activities.

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