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Length–weight relationships for 18 Lessepsian (Red Sea) immigrant fish species from the eastern Mediterranean coast of Turkey

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Length–weight relationships were estimated for 18 Red Sea immigrant fish species from the eastern Mediterranean coasts of Turkey. The values of the exponent b in the length–weight regression ($W=aL^b$) ranged between 2.482 and 3.355. The median value was 3.018 and 50% of the values ranged between 2.835 and 3.121.

As with most parts of the Levant basin, the eastern Mediterranean coast of Turkey is influenced by the Lessepsian (Red Sea) immigration evidently. Although fish have been the most studied taxa among all Red Sea invaders in the region, a majority of the studies are of an inventory nature (see Gücü et al., 1994) and biological information is available only for a limited number of species.

Knowledge of the relationship between length and weight of a fish species in a given geographical area is a practical index of the condition of fish (Petrakis & Stergiou, 1995). Weight of a given individual fish of known length or length classes of fish can be estimated (Petrakis & Stergiou, 1995; Dulcic & Kraljevic, 1996), life history and morphological comparisons of populations from different regions can be made (Goncalves et al., 1997) and these relationships are often used to calculate standing stock biomass and several other aspects of fish population dynamics (Morato et al., 2001). For the Mediterranean coast of Turkey, length–weight relationships have been published for only three Lessepsian species out of 29 known from the region: *Scomberomorus commerson* (Buhan et al., 1997), *Upeneus moluccensis* (Kaya et al., 1999), *Siganus rivulatus* (Bilecenoglu & Kaya, in press). In this study, we report length–weight relationships ($W=aL^b$) for 18 Lessepsian fish species from the eastern Mediterranean coast of Turkey. These fish are the most important species of the bottom trawl and gill net fisheries in the study area, accounting for more than 60% of the total landings by weight (Gücü et al., 1994). Our results constitute the first information for 16 Lessepsian fish of the 29 species inhabiting the Turkish Mediterranean coasts.

Sampling was carried out in Mersin and Iskenderun Bays (eastern Mediterranean, Turkey), in December 1997, February 1998, May 1998 and August 1998 with a commercial fishing vessel (boat length 29 m, engine horsepower 540 HP). All samples were collected at depths ranging 10–80 m by bottom trawling (mesh size 24 mm at the cod-end), except for three species (*Pempheris vanicolensis*, *Sargocentron rubrum* and *Siganus rivulatus*) that were collected with gill nets. All fish (N=1796)

Table 1. *Descriptive statistics and estimated parameters of the length–weight relationship for 18 species collected from the eastern Mediterranean coast of Turkey.*

	Length characteristics				Parameters of the relationship			
Species	N	Mean	±SE	Range	*a*	*b*	SE (*b*)	r^2
Alepes djedaba (Forskål, 1775)	70	153.70	1.92	130–192	0.0007459	2.816	0.048	0.86
Apogon nigripinnis Cuvier, 1828	22	63.55	3.29	41–85	0.0000203	3.001	0.089	0.99
Callionymus filamentosus Valenciennes, 1837	92	83.36	2.04	58–102	0.0000265	2.835	0.016	0.96
Cynoglossus sinusarabici (Chabanaud, 1931)	32	113.65	2.55	96–133	0.0000801	2.482	0.017	0.96
Dussumieria acuta Valenciennes, 1847	27	150.25	2.44	140–169	0.0000058	3.031	0.105	0.88
Lagocephalus spadiceus (Richardson, 1844)	19	180.22	4.86	159–199	0.0000208	2.951	0.093	0.97
Leiognathus klunzingeri (Steindachner, 1898)	156	78.55	1.35	49–104	0.0000035	3.271	0.094	0.96
Liza carinata (Ehrenberg, 1836)	15	177.00	3.86	167–187	0.0000221	2.864	0.139	0.94
Oxyurichthys petersi (Klunzinger, 1871)	112	103.93	5.08	61–122	0.0000089	3.057	0.020	0.98
Pelates quadrilineatus (Bloch, 1790)	76	102.15	2.47	79–121	0.0000148	2.958	0.013	0.97
Pempheris vanicolensis Cuvier, 1831	46	117.15	6.69	77–155	0.0000113	3.026	0.034	0.95
Sargocentron rubrum (Forskål, 1775)	38	147.67	6.18	120–167	0.0000174	3.015	0.099	0.94
Siganus rivulatus Forskål, 1775	355	169.32	11.96	107–241	0.0000047	3.203	0.042	0.98
Sillago sihama (Forskål, 1775)	108	142.19	8.79	94–203	0.0000014	3.355	0.101	0.93
Sphyraena chrysotaenia Klunzinger, 1884	54	158.80	11.66	126–231	0.0000290	2.632	0.027	0.96
Stephanolepis diaspros Fraser & Brunner, 1940	207	89.27	2.41	71–130	0.0000068	3.186	0.103	0.92
Upeneus moluccensis (Bleeker, 1855)	265	136.12	3.37	102–170	0.0000135	3.021	0.039	0.97
Upeneus pori (Ben-Tuvia & Golani, 1989)	102	113.50	4.38	91–147	0.0000028	3.256	0.085	0.98

N, sample size; SE, standard error; Range, minimum and maximum; *a* and *b*, parameters of the length–weight relationship; r^2, coefficient of determination.

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were measured to the nearest millimetre total length (TL) (except for *Callionymus filamentosus* and *Oxyurichthys petersi*, where standard lengths of fish were measured) and weighed to the nearest gram. Weights (g) and total lengths (mm) were log-transformed and the linearized relationship fitted by least-squares regression ($\log W = \log a + b \log L$).

The descriptive statistics and estimated parameters of the length–weight relationship are given in Table 1. All regressions showed a good fit to the exponential curve for the complete data set, eleven species have r^2 values greater than 0.95 and the lowest value was for *Alepes djedaba* ($r^2 = 0.86$). The mean value of the parameter b was 2.998 (SE = 0.052), with a range between 2.482 for *Cynoglossus sinusarabici* and 3.355 for *Sillago sihama*. The median value of b was 3.018, and 50% of the values ranged between the lower (2.835) and upper quartiles (3.121).

Samples of all species were obtained from throughout the year, thus these data are not representative of a particular season and thus estimated length–weight parameters should be considered as mean annual values. According to Dulcic & Kraljevic (1996), the estimated parameters of length–weight relationships may differ among seasons and years primarily due to physico-chemical characteristics of the environment, sex and maturity stage of a given species. In contrast, Goncalves et al. (1997) stated that the annual variation of the parameter b is not significant, unlike the parameter a, which may even vary daily. As pointed out by Petrakis & Stergiou (1995) and Dulcic & Kraljevic (1996), the use of length–weight regressions should be limited to the sizes used to estimate the parameters. Due to size selective properties of the trawl net used during the study, our fish samples do not include small sized individuals for the majority of the species. However, samples of most species include sizes close to maximum lengths hitherto reported from the study area (Gücü et al., 1994). Thus these results should be applicable for all but the smallest individuals of these 18 species.

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