Length-weight Relationships of Seven Flatfishes (Pisces: Pleuronectiformes) from Aegean Sea

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Abstract

Length-weight relationships were estimated for *Citharus linguatula, Arnoglossus kessleri, Arnoglossus laterna, Arnoglossus thori, Buglossidium luteum, Microchirus variegatus* and *Solea solea* sampled from Izmir Bay, Aegean Sea, Turkey. The slopes (b) of the length-weight relationship ranged between 2.160 and 3.416 with a mean of 2.790. Negative allometry was determined for *A. kessleri, A. thori, S. solea* and *B. luteum* while positive allometry was present for *C. linguatula, A. laterna* and *M. variegatus.*

Key words: Flatfishes, pleuronectiformes, length-weight relationship, Izmir Bay, Aegean Sea.

Introduction

The length-weight (LWR) relationships are applied for basic uses to assess fish stocks and populations (Ricker, 1968). The length-weight relationships help evaluate the condition, reproduction history, life cycle and the general health of fish species (Pauly, 1993) and are also useful in local and interregional morphological and life historical comparisons in species and populations. The length-weight relationships of the different flatfish populations were described by previous studies both in Turkish seas (Mater and Şahinoğlu, 2000; Özütok and Avşar, 2002; Çakır *et al.*, 2003; Çakır *et al.*, 2005; Karakulak *et al.*, 2006; Özaydın and Taşkavak, 2006) and in other localities (Giovanardi and Piccinetti, 1983; Pereda and Villamor, 1991; Vassilopolou and Papaconstantinou, 1994; Petrakis and Stergiou, 1995; Dulčić and Kraljević, 1997; Merella *et al.*, 1997; Abdallah, 2002; Moutopoulos and Stergiou, 2002; Santos *et al.*, 2002; Kautrakis and Tsikliras, 2003).

However, the length-weight parameters of the same species may be different in the population because of feeding, reproduction activities and fishing etc. Therefore, we need to know length-weight relationships of fish which are captured in a given place in a certain period of time. The study conducted for this purpose established length-weight relationships of seven flatfish inhabiting Izmir Bay in Aegean Sea in 2002.

Material and Methods

Samples were collected by trawl in Izmir Bay, Turkish Aegean Sea from January 2002 to December 2002 when trawl sampling was also performed in the coordinates between 38º22' N 26º40' E - 38º28' N 26º40' E and 38º28' N 26º46' E - 38º26' N 26º50' E where conventional demersal trawl net with 44 mm codend mesh size was used to catch the fish.

Total length (TL) of 1.702 individuals was measured using a 0.1 cm class interval and a total weight (W) of each specimen was measured to the nearest 0.01 g.

Total length of all specimens was used in order to calculate the length-weight relationship (LWR), which was calculated by log transformed data log:

$$W = \log a + b \log L$$

where, (W) is the total weight (g), (L) is the total length (cm), (a) the intercept and (b) the slope or allometric coefficient. Allometric coefficient (b) larger or smaller than 3.0 shows an allometric growth (Bagenal and Tesch, 1978). Value b is > 3 and it can be said to have a positive allometric growth. However, b<3 showed a negative allometric growth or isometric growth when equal to 3.0.

Results and Discussion

Of the 1,702 individuals in 7 heterosomata species, the family Citharidae was represented by one species while each family of Bothidae and Soleidae represented by 3 species. Sample sizes (n), minimum and maximum values of lengths and weights, as well as parameters a and b of the length weight relationships, %95 confidence intervals for b, a and the coefficient of determination (r^2) are presented for each species in Table 1, according to which positive allometry was found in *C. linguatula, A. laterna, M. variegates*, whereas negative allometry was found in *A. kessleri, A. thori, S. solea* and *B.luteum*.

Table 1. Descriptive statistics and estimated parameters of length-weight relationships for seven heterosomata species in Izmir Bay (Aegean Sea) from January 2002 to December 2002

Family	Species	n	TL range (cm)	W range (g)	a	95% C.I. of a	b	95% C.I. of b	r²
Citharidae	*Citharus linguatula*	716	8.2 - 22.8	4.21-70.38	0.0048	0.0045 - 0.0051	3.138	3.108 - 3.168	0.985
Bothidae	*Arnoglossus kessleri*	76	6.0 - 8.9	1.72-5.62	0.0179	0.0079- 0.0279	2.601	2.375 - 2.827	0.878
	Arnoglossus laterna	796	5.6 - 17.1	1.20-37.83	0.0073	0.0053 - 0.0093	3.009	2.931 - 3.087	0.966
	Arnoglossus thori	6	6.7 - 9.0	2.52-5.04	0.0442	0.0162 - 0.0722	2.160	2.004 - 2.316	0.950
Soleidae	*Solea solea*	44	19.6 - 29.5	65.82-231.95	0.0232	0.0012 - 0.0452	2.727	2.229 - 3.225	0.741
	Microchirus variegatus	36	9.2 - 15.5	6.52-35.72	0.0030	0.0028 - 0.0032	3.416	3.058 - 3.774	0.989
	Buglossidium luteum	28	7.3 - 9.6	3.80-8.40	0.0240	0.0231 - 0.0249	2.566	2.012 - 3.120	0.785

n: sample size, min: minimum, max: maximum,
a and b: parameters of length-weight relationships,
95% C.I of a and b: 95% confidence intervals of a and b,

All allometric coefficients (b) estimated in this study were within the expected range of 2.2-3.4. And according to Benegal and Tesh (1978), Koutrakis and Tsikliras (2003), they may range from 2 to 4. The findings of length-weight relationships in flatfish species in Turkish and other seas are as follows: (i) positive allometric growth for *C. linguatula* (Vassilopolou and Papaconstantinou, 1994; Dulčić and Kraljević, 1997; Abdallah, 2002; Çakır *et al.*, 2005; Karakulak *et al.*, 2006), *A. laterna* (Pereda and Villamor, 1991; Özütok and Avşar, 2002; Özaydın and Taşkavak, 2006), *A. thori* (Merella *et al.*, 1997), *S. solea* (Kautrakis and Tsikliras, 2003), *M. variegatus* (Pereda and Villamor, 1991) and for *B. luteum* (Pereda and Villamor, 1991) (ii) negative allometric growth for *C. linguatula* (Petrakis and Stergiou, 1995; Moutopoulos and Stergiou, 2002; Santos *et al.*, 2002; Özaydın and Taşkavak, 2006), *A. kessleri* (Çakır *et al.*, 2003), *A. laterna* (Mater and Şahinoğlu, 2000; Karakulak *et al.*, 2006); and for *M. variegatus* (Merella *et al.*, 1997) and (iii) isometric growth for *A. laterna* (Giovanardi and Piccinetti, 1983).

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 (Bagenal and Tesch, 1978; Froese, 2006). 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 (Moutopoulos and Stergiou, 2002).

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