Turkish Journal of Fisheries and Aquatic Sciences 7: 33-36 (2007)

Length-Weight Relationship of 10 Fish Species Caught by Bottom Trawl and Midwater Trawl from the Middle Black Sea, Turkey

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Received 10 April 2006
Accepted 01 February 2007

Abstract

Length-weight relationships are described for ten important demersal and pelagic fish species caught with bottom trawl: *Merlangius merlangus*, *Mullus barbatus*, *Gobius niger, Alosa pontica, Spicara smaris, Scorpaena porcus*, and midwater trawl: *Engraulis encrasicolus*, *Sprattus sprattus*, *Trachurus trachurus*, *Pomatomus saltatrix* from the Middle Black Sea. The samples sizes, minimum and maximum lengths and weights, length-weights relationships, ±95% CI of b, r^2, growth type, and statistical analysis of the relationship between the sexes are summarized.

Key words: Middle Black Sea, length-weight relationships, growth.

Introduction

Length and weight data are useful standard results of fish sampling programs (Morato *et al.*, 2001). In fish, size is generally more biologically relevant than age, mainly because several ecological and physiological factors are more size-dependent than age-dependent. Consequently, variability in size has important implications for diverse aspects of fisheries science and population dynamics (Erzini, 1994). Length-weight regressions have been used frequently to estimate weight from length because direct weight measurements can be time-consuming in the field (Sinovcic *et al.*, 2004). One of the most commonly used analyses of fisheries data is length-weight relationship (Mendes *et al.*, 2004).

Previous studies were carried out on the characteristics of length-weight relationship for fish species in the Portuguese waters, the Adriatic Sea, the Atlantic, the Mediterranean, and the North Aegean Sea (Santos *et al.*, 2002; Mendes *et al.*, 2004; Dulcic and Kraljevic, 1996; Sinovcic *et al.*, 2004; Morato *et al.*, 2001; Morey *et al.*, 2003; Filiz and Bilge, 2004). Only one study was conducted in the Central Black Sea region of Turkey for some commercial fish species (Erkoyuncu *et al.*, 1994).

In this study, the length-weight relationships were estimated for 6 demersal fish species that are the most dominant and commercial species caught with bottom trawl and 4 pelagic species caught with midwater trawl from the Central Black Sea region of Turkey. This is the first study on the length-weight relationship of 10 fish species, and the first record of the differences of length-weight relationship between sexes in the Black Sea.

Materials and Methods

Data were collected during the monthly surveys, between November 2004 and April 2005 with bottom trawl for demersal fish species in the legal bottom trawling areas at Sinop and Samsun, between November 2004 and May 2005 with midwater trawl for pelagic fish species at Samsun region in the Central Black Sea. From the fresh samples, total length (TL) and body weight (W) were measured to the nearest 0.1 cm and 0.01 g, respectively.

The length-weight relationships were estimated from the allometric formula, $W = a L^b$, where W is total body weight (g), L the total length (cm), a and b are the coefficients of the functional regression between W and L (Ricker, 1973). In order to confirm whether b values obtained in the linear regressions were significantly different from the isometric value (b=3), t-tests with appropriate degrees of freedom were used (Sümbüloğlu and Sümbüloğlu, 2000). The comparison between obtained values of t statistics and respective tabled critical values allowed for the determination of (statistical significance) the b-values, and their inclusion in the isometric range (b=3) or allometric ranges (negative allometric: b<3 or positive allometric: b>3). An ANCOVA was used to determine if there were significant differences in the length-weight relationships between the sexes (Zar, 1999).

Result and Discussion

The sample size, minimum and maximum lengths and weights, length-weight relationships, ±95% CI of b values, coefficient of determination (r^2),

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growth type (isometric or allometric), and statistical analysis of the relationship between the sexes for each species are summarized in Table 1. The sample size ranged from 83 individuals for *Spicara smaris,* to 5087 for *Sprattus sprattus.* The mean value of coefficient "b" was found to be 2.9481±0.05 (2.83-3.06 95% confidence interval of b). The coefficient "b" was 3.0248, 2.9633, 3.0337, 2.9849 for overall samples of *Merlangius merlangus*, *Mullus barbatus*, *Scorpaena porcus* and *Trachurus trachurus,* respectively, and growth of these species was isometric (b=3). The growth was negative allometric (b<3, P<0.05) for overall samples of *Gobius niger, Engraulis encrasicolus*, *S. sprattus* and *Pomatomus saltatrix*. The *Alosa pontica* and *S. smaris* showed positive allometric growth (b>3, P<0.05) for overall samples. The coefficient of determination (r^2) of all species was very high. ANCOVA of length-weight relationships was significant between sexes for *M. merlangus*, *M. barbatus, A. pontica, S. smaris, S. porcus, S. sprattus* and *P. saltatrix* (P<0.05). Significant sexual differences in length and weight were observed in all these species except in *A. pontica*. The significant differences in slope of length-weight relationship between females and males could be due to this difference of length and weight in sexes.

There have been some studies on length-weight relationships of these species in the Black Sea and other localities (Table 2). For all of the studied species in this study, the b values were generally in agreement with previous results. Also, it is well known that the functional regression "b" value represents the body form, and it is directly related to the weight affected by ecological factors such as temperature, food supply, spawning conditions and other factors, such as sex, age, fishing time and area and fishing vessels (Ricker, 1973).

Table 1. Descriptive statistics and estimated parameters of length-weight relationship for ten fish species caught bottom and midwater trawl in the Middle Black Sea (Turkey)

			Length (cm)	Weight (g)	$W = a L^b$					
Species	Sex	N	Min-Max	Min-Max	a	b	±95% CI of b	r^2	Growth (*t*-test)	P
Merlangius merlangus	♀	480	8.8-22.7	4.18-79.69	0.0070	3.0118	0.050	0.96	b=3	*
	♂	400	8.1-22.4	3.53-65.43	0.0840	2.9303	0.075	0.94	b=3	
	Ov	904	7.7-22.7	2.99-79.79	0.0067	3.0248	0.038	0.96	b=3	
Mullus barbatus	♀	86	8.7-18.4	6.32-60.16	0.0094	3.0253	0.089	0.98	b=3	*
	♂	75	9.1-16.1	7.32-41.85	0.0134	2.8903	0.118	0.98	b=3	
	Ov	176	6.6-18.4	2.94-60.16	0.0111	2.9633	0.054	0.98	b=3	
Gobius niger	♀	122	8.0-24.8	5.37-165.7	0.0159	2.8933	0.051	0.96	b<3	ns
	♂	105	9.0-25.3	8.18-168.7	0.0174	2.8406	0.058	0.96	b<3	
	Ov	227	8.0-25.3	5.37-168.7	0.0166	2.8690	0.039	0.96	b<3	
Alosa pontica	♀	122	12.8-26.6	12.88-158.7	0.0053	3.0670	0.063	0.94	b=3	*
	♂	105	11.9-27.5	9.99-177	0.0036	3.2160	0.075	0.94	b>3	
	Ov	227	11.9-27.6	9.99-177	0.0046	3.1237	0.048	0.94	b>3	
Spicara smaris	♀	62	11.2-18.6	14.24-64.67	0.013	2.8806	0.111	0.92	b=3	*
	♂	21	12.2-20.0	16.75-87.67	0.003	3.4126	0.105	0.98	b>3	
	Ov	83	11.2-20.0	14.24-87.67	0.0063	3.1504	0.074	0.96	b>3	
Scorpaena porcus	♀	71	9.3-29.2	14.4-508	0.0179	3.0204	0.088	0.98	b=3	*
	♂	65	8.5-20.8	13.00-172	0.0166	3.0508	0.076	0.98	b=3	
	Ov	136	8.5-29.2	13.00-508	0.0173	3.0337	0.058	0.98	b=3	
Engraulis encrasicolus	♀	303	9.8-14.7	5.53-19.14	0.0368	2.3002	0.144	0.77	b<3	ns
	♂	265	8.5-13.7	4.13-14.23	0.0192	2.5589	0.129	0.85	b<3	
	Ov	575	8.0-14.7	2.85-19.14	0.0174	2.6014	0.090	0.85	b<3	
Sprattus sprattus	♀	2958	5.60-11.2	0.96-9.61	0.0080	2.8639	0.043	0.85	b<3	*
	♂	2113	5.60-12.6	0.95-12.39	0.0076	2.8776	0.042	0.90	b<3	
	Ov	5087	5.60-12.6	0.95-12.39	0.0079	2.8676	0.030	0.88	b<3	
Trachurus trachurus	♀	358	11.5-18.3	12.19-47.38	0.0095	2.9467	0.037	0.94	b=3	ns
	♂	383	10.3-17.8	9.47-45.48	0.0079	3.0128	0.035	0.96	b=3	
	Ov	747	7.3-18.3	3.34-47.37	0.0086	2.9849	0.023	0.96	b=3	
Pomatomus saltatrix	♀	76	14.3-21.7	27.06-88.18	0.0111	2.9205	0.102	0.92	b=3	*
	♂	67	13.2-21.7	23.21-79.79	0.0155	2.7978	0.087	0.94	b<3	
	Ov	143	13.2-21.7	23.21-88.19	0.0130	2.8621	0.068	0.92	b<3	

*Significant (P<0.05), ns not Significant (P>0.05)

Table 2. Some study result of length-weight relationship for fish species in different area

Species	Length Min-Max	a	b	Location	References
Merlangius merlangus	9-24	0.0039	3.24	M. Black Sea	Samsun and Erkoyuncu, 1998
	5-40	0.0052	3.14	E. Black Sea	Genç *et al*., 1999
	5-32.5	0.0042	3.24	Black Sea	İşmen, 2002
		0.054	3.07	Bulgaria	Prodanov, 1980
		0.0034	3.30	M. Black Sea	Erkoyuncu *et al*., 1994
Mullus barbatus	16.9-25	0.0142	2.93	Portugal	Mendes *et al*., 2004
	17.3-24.7	-	3.12	E. Adriatic	Dulcic and Kraljevic, 1996
	4-23.5	0.0063	3.18	East Black Sea	Genç *et al*., 1999
		0.007	3.17	M. Black Sea	Erkoyuncu *et al*., 1994
Gobius niger	8.9-14.5	0.0089	3.85	Mediterranean	Morey *et al*., 2003
	6-13.3	0.016	2.89	Egypt	Abdallah, 2002
	-	0.018	2.81	M. Black Sea	Erkoyuncu *et al*., 1994
Alosa pontica	11.6-31.6	0.00212	3.39	M. Black Sea	Samsun, 1995
	9-36	0.0629	2.55	Bulgaria	Kolarov, 1991
	10-62	0.0049	3.20	Frace	Dorel, 1986
	-	0.0081	3.10	M. Black Sea	Erkoyuncu *et al*., 1994
Spicara smaris	13.1-19.8	0.046	2.54	Portugal waters	Santos *et al*., 2002
	4.2-20.1	0.013	2.87	Mediterranean	Morey *et al*., 2003
	6-21.5	0.0069	3.14	East Black Sea	Genç *et al*., 1999
	-	0.061	3.22	M. Black Sea	Erkoyuncu *et al*., 1994
Scorpaena porcus	6.1-35.5	0.0181	3.02	Mediterranean	Morey *et al*., 2003
	9.7-26.6	-	3.24	Adriatic	Dulcic and Kraljevic, 1996
	11-25	0.054	2.54	M. Black Sea	Koca, 2002
	-	0.018	3.08	M. Black Sea	Erkoyuncu *et al*., 1994
Engraulis encrasicolus	9-17.4	0.0039	3.16	Adriatic	Sinovcic *et al*., 2004
	5.7-12.9	0.0048	3.07	Mediterranean	Morey *et al*., 2003
	6-15	0.0076	2.92	M. Black Sea	Samsun *et al*., 2004
	-	0.0047	3.10	M. Black Sea	Özdamar *et al*., 1994
Sprattus sprattus	8.6-11.9	0.0226	2.51	Adriatic	Sinovcic *et al*., 2004
	3.3-13	0.0026	3.33	Black Sea	Avşar, 1995
	7.2-13.2	0.0021	3.46	E. Black Sea	Şahin, 1999
Trachurus trachurus	12.6-43.3	0.078	3.02	Portugal waters	Santos *et al*., 2002
	13.4-43.1	0.0269	2.63	Portugal waters	Mendes *et al*., 2004
	6.5-32.5	0.0061	3.07	Greece	Karlou-Riga and Sinis, 1997
	7.4-14.5	0.0048	3.22	E. Black Sea	Şahin *et al*., 1997
	6.5-19	0.0075	3.017	E. Black Sea	Genç *et al*., 1999
Pomatomus saltatrix	8.6-91	0.091	3.01	Atlantic	Morato *et al*., 2001
	-	0.0103	2.77	S. Atlantic	Barger, 1990
	8.6-25	0.076	3.05	Brazil	Haimovici, and Velasco, 2000.
	-	0.0388	2.56	M. Black Sea	Erkoyuncu *et al*., 1994

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