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Length-length and length-weight relationships of several fish species from the North Aegean Sea (Greece)

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In this paper, length-length and total length-weight relationships for 60 fish species from the North Aegean Sea, Greece are presented. Additionally, comparisons are made between different seasons and sex for the five and 29 most abundant species, respectively.

Key words: fish species, length-length relationships, length-weight relationships, season, sex, Aegean Sea.

INTRODUCTION

The importance of length-length and length-weight relationships in fisheries science has been well documented (Pauly, 1993; Petrakis & Stergiou, 1995; Binohlan & Pauly, 2000; Binohlan *et al*., 2000; Froese & Pauly, 2000; Froese, 2006). In this paper, we present length-length and length-weight relationships for 60 species from the N-NW Aegean Sea; for four of these species (*Caranx rhonchus*, *Gaidropsarus biscayensis*, *Monochirus hispidus*, and *Pomatomus saltatrix*) there is no information from the Mediterranean. Additionally, the length-weight relationships were established per season and sex, for five and 29 species, respectively.

MATERIALS AND METHODS

Samples were collected from Thermaikos Gulf and the N-NW Aegean Sea, on a seasonal basis from June 2001 to January 2006, using professional fishing vessels (purse seiners, trawlers, and small-scale gill netters). All individuals (preserved in 10% formalin) were measured for total (TL), fork (FL), and standard length (SL) to the nearest mm and weighted (W, wet weight) to the nearest 0.1 g. The following relationships were established using linear regression analysis: a) W-TL, b) FL-TL, c) SL-TL, and d) SL-FL. A diagram comparing the values of the parameters a and b of the length-weight relationship, which can be used to detect outliers (Froese, 2000, 2006), was constructed (Froese, 2000; "Froese diagram": Lamprakis, 2004).

The length-weight relationships were further computed for the most abundant species in the four seasons (all years combined) and the two sexes. The slopes of these regressions were compared by using analysis of covariance (ANCOVA; Zar, 1999).

RESULTS AND DISCUSSION

Overall, 7132 specimens from 60 fish species were examined. The number of individuals per species ranged from six to 759 (Tables 1 and 2). The relationships between TL, FL, and SL are presented in Table 1, while the parameters of the length-weight relationships in Table 2. The values of b of the length-weight relationships ranged from 1.627 (*Cepola macrophthalma*) to 3.822 (*Engraulis encrasicolus*) (for all species: mean = 3.026 ± 0.05; median = 3.089). For the majority of species (47 species; 78.3%), b values ranged between 2.8 and 3.4. Log(a) values were negatively correlated with the corresponding b values, while outside the ± 2 standard deviation (s.d.) limits

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TABLE 1. Relationships between total (TL), fork (FL) and standard (SL) length for 60 species from the N-NW Aegean Sea. DL: disk length; N: sample size; $s.e._{(b)}$: standard error of the slope b; and r^2: coefficient of determination

Species	N	FL = a + bTL	$s.e._{(b)}$	r^2	SL = a + bTL	$s.e._{(b)}$	r^2	SL = a + bFL	$s.e._{(b)}$	r^2
Alosa fallax	27	FL=–0.3732+0.8956TL	0.010	1.00	SL=–0.4730+0.8409TL	0.006	1.00	SL=–0.0801+0.9370FL	0.009	1.00
Anthias anthias	9	FL=3.1806+0.5524TL	0.056	0.93	SL=2.4653+0.4932TL	0.067	0.89	SL=–0.4845+0.9027FL	0.060	0.97
Apogon imberbis	37	FL=–0.6194+0.9992TL	0.026	0.98	SL=–0.4534+0.8400TL	0.024	0.97	SL=0.2051+0.8262FL	0.028	0.96
Arnoglossus laterna	212				SL=–0.1559+0.8428TL	0.003	1.00			
Belone belone [2]	69	FL=0.3294+0.9508TL	0.005	0.99	SL=0.6582+0.9141TL	0.005	1.00	SL=0.3667+0.9606FL	0.005	1.00
Blennius ocellaris	23				SL=–0.0546+0.8088TL	0.015	0.99			
Boops boops [1]	106	FL=0.6932+0.8449TL	0.006	1.00	SL=0.5383+0.7880TL	0.007	0.99	SL=–0.0983+0.9319FL	0.006	1.00
Bothus podas [1]	22				SL=–0.3759+0.8489TL	0.020	0.99			
Caranx rhonchus	16	FL=–0.4758+0.9056TL	0.063	0.94	SL=0.2365+0.8065TL	0.077	0.89	SL=0.2365+0.8065FL	0.054	0.89
Cepola macrophthalma	195				SL=0.5352+0.8704TL	0.006	0.99			
Chelidonichthys lucernus	15	FL=–0.0192+0.9611TL	0.003	1.00	SL=0.0682+0.8115TL	0.004	1.00	SL=0.0847+0.8443FL	0.003	1.00
Chromis chromis	97	FL=0.3002+0.8116TL	0.011	0.98	SL=–0.1481+0.7656TL	0.012	0.98	SL=–0.3797+0.9377FL	0.013	0.98
Citharus linguatula [1]	170				SL=–0.1277+0.8225TL	0.003	1.00			
Conger conger	31				SL=–0.1623+0.9904TL	0.004	1.00			
Coris julis	78				SL=–0.6089+0.9088TL	0.012	0.99			
Diplodus annularis [1]	427	FL=–0.0150+0.9077TL	0.004	0.99	SL=–0.2768+0.8253TL	0.004	0.99	SL=–0.2337+0.9062FL	0.004	0.99
Diplodus vulgaris [1]	50	FL=0.1809+0.8434TL	0.010	0.99	SL=–0.2209+0.7935TL	0.011	0.99	SL=–0.3865+0.9404FL	0.009	1.00
Engraulis encrasicolus [2]	759	FL=–0.1258+0.9235TL	0.003	0.99	SL=–0.4847+0.8887TL	0.002	1.00	SL=–0.3369+0.9598FL	0.002	1.00
Gaidropsarus biscayensis	65				SL=0.4282+0.8531TL	0.011	0.99			
Gaidropsarus mediterraneus	15				SL=–0.0069+0.8891TL	0.016	1.00			
Lesueurigobius suerii	141				SL=0.2395+0.7421TL	0.017	0.93			
Lophius budegassa	45				SL=–0.2725+0.8695TL	0.004	1.00			
Merlangius merlangus	44				SL=–1.3461+0.9663TL	0.011	1.00			
Merluccius merluccius [1]	23				SL=–0.6326+0.9305TL	0.004	1.00			
Micromesistius poutassou	77	FL=–0.0461+0.9624TL	0.004	1.00	SL=–0.0567+0.9068TL	0.005	1.00	SL=–0.0113+0.9421FL	0.004	1.00
Monochirus hispidus	24				SL=–0.2917+0.8453TL	0.026	0.98			
Mullus surmuletus [1]	55	FL=0.1332+0.8586TL	0.008	1.00	SL=–0.5225+0.8313TL	0.007	1.00	SL=–0.6316+0.9667FL	0.007	1.00
Oblada melanura [1]	56	FL=–0.0011+0.8722TL	0.006	1.00	SL=–0.2246+0.8104TL	0.006	1.00	SL=–0.2166+0.9287FL	0.005	1.00
Pagellus acarne [1]	63	FL=0.2003+0.8762TL	0.013	0.99	SL=–0.4049+0.8416TL	0.012	0.99	SL=–0.5166+0.9544FL	0.014	0.99
Pagellus bogaraveo	72	FL=0.3394+0.8655TL	0.004	1.00	SL=0.0585+0.8020TL	0.004	1.00	SL=–0.2522+0.9263FL	0.003	1.00
Pagellus erythrinus [1]	59	FL=0.5154+0.8333TL	0.014	0.98	SL=0.4353+0.7592TL	0.015	0.98	SL=–0.0251+0.9102FL	0.011	0.99

TABLE 1. continued

Species	N	FL=a+bTL	s.e.$_{(b)}$	r^2	SL=a+bTL	s.e.$_{(b)}$	r^2	SL=a+bFL	s.e.$_{(b)}$	r^2
Pagrus pagrus [1]	10	FL=0.4006+0.8500TL	0.014	1.00	SL=0.2180+0.7789TL	0.018	1.00	SL=–0.1331+0.9149FL	0.239	0.99
Phycis blennoides	30				SL=–0.2459+0.8944TL	0.003	1.00			
Pomatomus saltatrix	6	FL=0.0018+0.9199TL	0.017	1.00	SL=–0.2185+0.8360TL	0.016	1.00	SL=–0.2075+0.9080FL	0.020	1.00
Sardina pilchardus [2]	752	FL=0.1437+0.8876TL	0.003	0.99	SL=–0.1898+0.8484TL	0.004	0.99	SL=–0.2930+0.9528FL	0.003	0.99
Sardinella aurita [1,2]	230	FL=0.1993+0.8690TL	0.003	1.00	SL=–0.2993+0.8427TL	0.004	1.00	SL=–0.4910+0.9697FL	0.003	1.00
Sarpa salpa [1]	25	FL=0.4032+0.8650TL	0.109	1.00	SL=0.2730+0.8090TL	0.017	0.99	SL=–0.1138+0.9360FL	0.014	0.99
Sciaena umbra	11				SL=–0.0260+0.7970TL	0.049	0.97			
Scomber japonicus [1,2]	371	FL=0.3257+0.8939TL	0.003	1.00	SL=0.1345+0.8565TL	0.003	1.00	SL=–0.1605+0.9570FL	0.003	1.00
Scomber scombrus [2]	204	FL=0.3544+0.9018TL	0.005	0.99	SL=0.2529+0.8553TL	0.005	0.99	SL=–0.0550+0.9470FL	0.004	1.00
Scorpaena notata	43				SL=–0.1672+0.7915TL	0.009	0.99			
Scorpaena porcus [1]	98				SL=–0.3896+0.8075TL	0.004	1.00			
Scyliorhinus canicula	34				SL=0.1000+0.9646TL	0.009	1.00			
Serranus cabrilla [1]	43	FL=0.2494+0.9315TL	0.007	1.00	SL=0.6340+0.7858TL	0.011	0.99	SL=0.4260+0.8434FL	0.010	0.99
Serranus hepatus	123	FL=–0.1237+0.9766TL	0.005	1.00	SL=–0.3924+0.8578TL	0.009	0.99	SL=–0.2843+0.8784FL	0.008	0.99
Serranus scriba [1]	84				SL=–0.1543+0.8516TL	0.006	1.00			
Sphyraena sphyraena	104	FL=0.5562+0.9063TL	0.009	0.99	SL=–0.2656+0.8824TL	0.007	0.99	SL=–0.6045+0.9663FL	0.010	0.99
Spicara maena [1]	282	FL=–0.0239+0.9103TL	0.004	1.00	SL=– 0.2261+0.8403TL	0.004	0.99	SL=–0.1837+0.9215FL	0.004	0.99
Spicara smaris	118	FL=–0.0176+0.9119TL	0.006	0.99	SL=–0.3328+0.8636TL	0.005	1.00	SL=–0.2814+0.9438FL	0.007	0.99
Spondyliosoma cantharus [1]	82	FL=0.3365+0.8777TL	0.010	0.99	SL=–0.0665+0.8169TL	0.012	0.98	SL=–0.3596+0.9288FL	0.011	0.99
Symphodus mediterraneus	10				SL=1.0312+0.7276TL	0.036	0.98			
Symphodus tinca [1]	221				SL=0.1885+0.8245TL	0.005	0.99			
Symphurus nigrescens	10				SL=–0.3920+0.9483TL	0.013	1.00			
Torpedo marmorata	118				SL=–0.0106+0.5369TL	0.005	0.99			
Trachinus draco [1]	25	FL=0.0761+0.9579TL	0.008	1.00	SL=–0.5504+0.8617TL	0.013	1.00	SL=–0.6115+0.8992FL	0.012	1.00
Trachurus mediterraneus [1]	627	FL=0.2367+0.8761TL	0.002	1.00	SL=–0.0463+0.8324TL	0.002	1.00	SL=–0.2542+0.9487FL	0.002	1.00
Trachurus trachurus [1]	133	FL=0.1543+0.8931TL	0.002	1.00	SL=–0.0919+0.8437TL	0.002	1.00	SL=–0.2357+0.9445FL	0.002	1.00
Trisopterus minutus	170				SL=–0.2211+0.9042TL	0.003	1.00			
Uranoscopus scaber [1]	70				SL=–0.5124+0.8279TL	0.008	0.99			
Xyrichtys novacula [1]	12				SL=–0.3622+0.8761TL	0.023	0.99			

[1] species included in Moutopoulos & Stergiou (2002); [2] species included in Sinovčić *et al*. (2004)

TABLE 2. Estimated parameters of the length-weight relationship ($W=aTL^b$) for 60 species from the N-NW Aegean Sea. N: sample size; min and max: the minimum and maximum total length (in cm) observed; a and b: parameters of the relationship; $s.e._{(b)}$: standard error of the slope b; r^2: coefficient of determination

Species	Length characteristics			Parameters of the relationship			
	N	min	max	a	b	$s.e._{(b)}$	r^2
Alosa fallax	27	15.0	46.8	0.0028	3.3370	0.057	0.99
Anthias anthias	9	12.7	16.6	0.2022	1.8060	0.331	0.81
Apogon imberbis	37	8.0	11.5	0.0187	2.9230	0.288	0.75
Arnoglossus laterna [6,7]	212	4.5	16.9	0.0032	3.3210	0.024	0.99
Belone belone [4]	69	27.2	53.5	0.0011	2.9720	0.087	0.95
Blennius ocellaris [3,6,7]	23	7.0	13.7	0.0094	3.1630	0.090	0.98
Boops boops [1,2,6,7]	106	11.2	19.9	0.0081	3.0870	0.045	0.98
Bothus podas [2,6]	22	11.3	17.2	0.0107	3.0340	0.196	0.92
Caranx rhonchus	16	18.0	19.8	0.0099	2.9970	0.412	0.79
Cepola macrophthalma [2,3,6,7]	195	13.2	54.9	0.0672	1.6270	0.040	0.89
Chelidonichthys lucernus [2,6,7]	15	6.0	21.6	0.0061	3.1300	0.048	1.00
Chromis chromis [1,2,6]	97	8.6	13.3	0.0236	2.8950	0.115	0.87
Citharus linguatula [1,2,6]	170	3.9	24.3	0.0047	3.1130	0.026	0.99
Conger conger [2,5,6,7]	31	34.1	99.8	0.0006	3.2460	0.130	0.96
Coris julis [1,2,3,6,7]	78	11.3	18.2	0.0091	3.0360	0.118	0.90
Diplodus annularis [1,2,4,6,7]	427	6.1	17.5	0.0104	3.1920	0.029	0.97
Diplodus vulgaris [1,2,6,7]	50	9.0	16.7	0.0119	3.1250	0.070	0.98
Engraulis encrasicolus [2,4,7]	759	5.8	14.0	0.0008	3.8220	0.032	0.95
Gaidropsarus biscayensis	65	9.0	15.3	0.0075	2.8460	0.093	0.94
Gaidropsarus mediterraneus [3]	15	8.5	14.5	0.0069	2.8670	0.171	0.96
Lesueurigobius suerii [3]	141	5.8	9.4	0.0086	2.9280	0.099	0.86
Lophius budegassa [2]	45	5.0	38.4	0.0231	2.8760	0.053	0.99
Merlangius merlangus [2,7]	44	14.1	29.1	0.0044	3.1830	0.076	0.98
Merluccius merluccius [2,6,7]	23	11.7	37.0	0.0033	3.2770	0.006	0.99
Micromesistius poutassou [2,7]	77	9.2	24.0	0.0043	3.1410	0.058	0.98
Monochirus hispidus	24	9.2	12.8	0.0537	2.4570	0.183	0.89
Mullus surmuletus [1,2,4,6]	55	9.1	23.1	0.0030	3.4920	0.039	0.99
Oblada melanura [2]	56	12.6	22.7	0.0124	3.0220	0.049	0.99
Pagellus acarne [1,2,6]	63	10.5	19.2	0.0107	3.0510	0.060	0.98
Pagellus bogaraveo [2,6,7]	72	9.3	23.1	0.0087	3.1670	0.023	1.00
Pagellus erythrinus [1,2,6,7]	59	8.4	16.4	0.0144	2.9660	0.063	0.97
Pagrus pagrus [2,6]	10	10.2	15.5	0.0182	2.9800	0.151	0.98
Phycis blennoides [2,5,7]	30	8.1	37.4	0.0038	3.2270	0.045	0.99
Pomatomus saltatrix	6	13.1	18.5	0.0026	3.4440	0.206	0.99
Sardina pilchardus [1,2,4]	752	7.6	16.7	0.0053	3.1440	0.039	0.90
Sardinella aurita [1,2,4]	230	8.4	23.9	0.0059	3.0820	0.026	0.98
Sarpa salpa [2,4]	25	11.7	19.5	0.0275	2.7400	0.148	0.94
Sciaena umbra	11	12.2	16.0	0.0242	2.7080	0.252	0.93
Scomber japonicus [1,2,7]	371	8.8	26.8	0.0027	3.3770	0.026	0.98
Scomber scombrus [1,2,7]	204	13.3	27.4	0.0036	3.2330	0.050	0.95
Scorpaena notata [1,2,6,7]	43	8.3	17.8	0.0106	3.2500	0.049	0.99
Scorpaena porcus [1,2,6,7]	98	8.2	26.4	0.0122	3.1820	0.043	0.98
Scyliorhinus canicula [5,6,7]	34	24.1	45.1	0.0011	3.3130	0.165	0.93
Serranus cabrilla [1,2,6,7]	43	9.5	23.1	0.0144	2.9350	0.051	0.99
Serranus hepatus [2,3,6]	123	5.7	13.1	0.0093	3.2580	0.052	0.97

TABLE 2. continued

Species	Length characteristics			Parameters of the relationship			
	N	min	max	a	b	s.e.$_{(b)}$	r^2
Serranus scriba [1, 2, 6]	84	10.6	23.6	0.0117	3.0900	0.060	0.97
Sphyraena sphyraena [1, 2]	104	21.6	45.1	0.0162	2.5890	0.061	0.95
Spicara maena [1, 2, 6, 7]	282	9.0	20.2	0.0068	3.1800	0.040	0.96
Spicara smaris [1, 2, 6, 7]	118	7.0	18.5	0.0097	2.9910	0.055	0.96
Spondyliosoma cantharus [1, 2, 6, 7]	82	9.7	14.0	0.0224	2.8600	0.058	0.97
Symphodus mediterraneus [1, 2, 6]	10	9.8	14.1	0.1209	2.1400	0.194	0.94
Symphodus tinca [1, 2, 6]	221	11.1	22.0	0.0239	2.7990	0.038	0.96
Symphurus nigrescens [3]	10	6.4	11.9	0.0024	3.4160	0.123	0.99
Torpedo marmorata [3, 5, 6, 7]	118	8.8	37.3	0.0579	2.7330	0.038	0.98
Trachinus draco [2, 6, 7]	25	15.0	30.5	0.0054	3.0620	0.164	0.94
Trachurus mediterraneus [1, 2, 4, 6, 7]	627	7.0	25.8	0.0038	3.2780	0.021	0.97
Trachurus trachurus [1, 2, 6, 7]	133	6.3	23.9	0.0062	3.1140	0.054	1.00
Trisopterus minutus [2, 6, 7]	174	5.7	24.5	0.0056	3.2460	0.024	0.99
Uranoscopus scaber [2, 6, 7]	70	8.7	26.9	0.0135	3.0910	0.050	0.98
Xyrichtys novacula [2]	12	12.3	17.1	0.0130	3.0160	0.283	0.92

[1] species included in Petrakis & Stergiou (1995); [2] species included in Stergiou & Moutopoulos (2001); [3] species included in Lamprakis *et al*. (2003); [4] species included in Koutrakis & Tsikliras (2003); [5] species included in Filiz & Bilge (2004); [6] species included in Özaydin *et al*. (2007); [7] species included in Ismen *et al*. (2007)

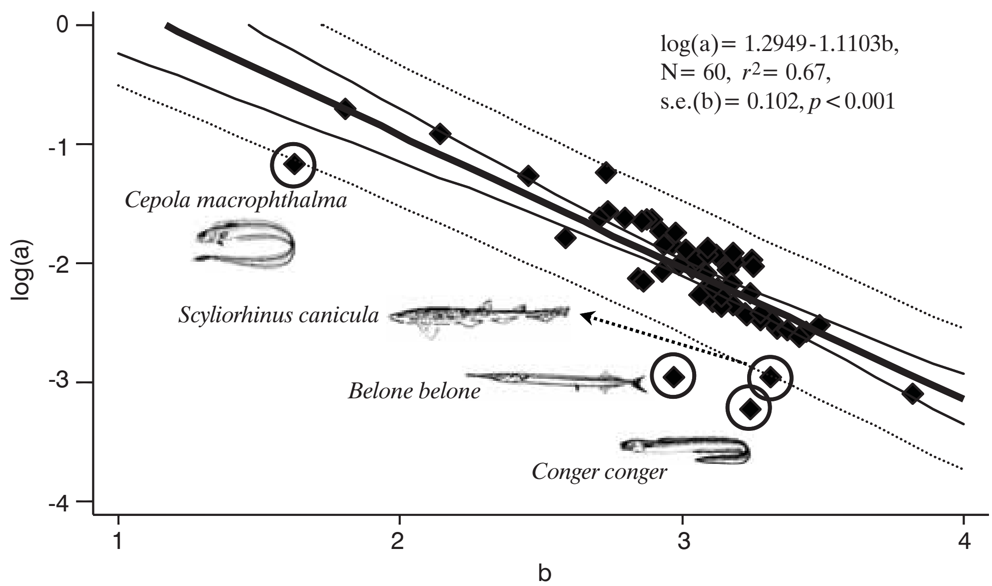

FIG. 1. "Froese diagram". Linear regression between the parameters log(a) and b of the length-weight equation for 60 fish species (N-NW Aegean Sea, June 2001-January 2006). Drawings originate from FishBase (www.fishbase.org; Froese & Pauly, 2007).

four species were found, all being characterized by an extremely elongate body form (Fig. 1).

Length-weight relationships were estimated separately for the five more abundant species and for all seasons (Table 3). The comparison of the seasonal slopes b showed that for the combinations of spring with another season (i.e. spring-summer, spring-autumn, spring-winter) there was no significant difference (ANCOVA: $p > 0.05$; Table 4) in the majority of the cases (three out of five combinations). In contrast, a difference was observed (ANCOVA: $p < 0.05$; Table 4) for the comparison autumn-winter in the

TABLE 3. Estimated parameters of the length-weight relationship ($W = aTL^b$) for the five most abundant species, per season, from the N-NW Aegean Sea. N: sample size; min and max: minimum and maximum total length (in cm) observed; a and b: parameters of the relationship; $s.e._{(b)}$: standard error of the slope b; r^2: coefficient of determination

Species		Length characteristics			Parameters of the relationship					Length characteristics			Parameters of the relationship			
		N	min	max	a	b	$s.e._{(b)}$	r^2		N	min	max	a	b	$s.e._{(b)}$	r^2
Engraulis encrasicolus	Autumn	33	8.5	14.0	0.0026	3.3280	0.115	0.96	Spring	179	8.6	16.2	0.0027	3.3520	0.047	0.97
Sardina pilchardus		146	9.7	16.3	0.0060	3.0640	0.046	0.97		227	7.9	16.7	0.0168	2.6980	0.092	0.80
Scomber japonicus		165	12.2	21.8	0.0027	3.3740	0.039	0.98		32	14.4	21.7	0.0022	3.4630	0.253	0.86
Spicara maena		83	10.4	17.4	0.0036	3.4130	0.060	0.98		129	9.0	20.2	0.0108	2.9950	0.048	0.97
Trachurus mediterraneus		117	8.6	21.6	0.0083	2.9710	0.031	0.99		161	8.3	25.8	0.0095	2.9460	0.035	0.98
Engraulis encrasicolus	Winter	304	6.7	14.1	0.0005	3.9870	0.051	0.95	Summer	243	10.3	16.0	0.0051	3.0960	0.061	0.91
Sardina pilchardus		180	10.1	15.9	0.0154	2.7030	0.095	0.82		199	7.6	16.5	0.0027	3.4330	0.042	0.97
Scomber japonicus		47	11.8	18.1	0.0058	3.0460	0.144	0.91		127	8.8	26.8	0.0037	3.2810	0.021	0.99
Spicara maena		42	12.1	15.8	0.0215	2.7570	0.151	0.89		28	13.1	17.1	0.0373	2.5870	0.234	0.82
Trachurus mediterraneus		237	7.0	21.1	0.0065	3.0290	0.026	0.98		112	9.4	22.9	0.0098	2.9700	0.049	0.97

TABLE 4. Results of the analysis of covariance (ANCOVA) for the five most abundant species between the different seasons. Cases where $p < 0.05$ are shown in bold. AU; autumn; WI: winter; SP: spring: SU: summer

Species	AU-WI	AU-SP	AU-SU	SP-WI	SP-SU	SU-WI
Engraulis encrasicolus	**0.01**	0.87	0.12	**0.00**	**0.00**	**0.00**
Sardina pilchardus	**0.00**	**0.00**	**0.00**	0.97	**0.00**	**0.00**
Scomber japonicus	**0.00**	0.58	**0.04**	0.14	0.28	**0.04**
Spicara maena	**0.00**	**0.00**	**0.00**	0.25	0.09	0.52
Trachurus mediterraneus	0.16	0.61	0.99	**0.05**	0.69	0.25

TABLE 5. Estimated parameters of the length-weight relationship ($W = aTL^b$) for the 29 most abundant species, per sex, from the N-NW Aegean Sea. N: sample size; min and max: minimum and maximum total length (in cm) observed; a and b: parameters of the relationship; $s.e._{(b)}$: standard error of the slope b; r^2: coefficient of determination; p: p-value from the analysis of covariance (ANCOVA)

Species	Males							Females							p
	Length characteristics			Parameters of the relationship				Length characteristics			Parameters of the relationship				
	N	min	max	a	b	$s.e._{(b)}$	r^2	N	min	max	a	b	$s.e._{(b)}$	r^2	
Arnoglossus laterna	126	4.5	16.2	0.0032	3.3150	0.038	0.98	86	5.9	16.9	0.0031	3.3270	0.027	0.99	0.82
Belone belone	34	28.1	53.5	0.0017	2.8430	0.109	0.96	35	27.2	50.0	0.0007	3.1010	0.134	0.94	0.14
Boops boops *	62	11.7	19.2	0.0104	3.0010	0.056	0.98	44	11.2	19.7	0.0059	3.1960	0.065	0.98	0.03
Cepola macrophthalma *	88	18.2	54.9	0.0714	1.5980	0.067	0.87	107	11.7	48.9	0.0627	1.6490	0.065	0.89	0.15
Chromis chromis	56	8.9	13.3	0.0285	2.8040	0.115	0.92	41	8.6	13.2	0.0252	2.8820	0.241	0.79	0.62
Citharus linguatula *	65	10.1	19.3	0.0046	3.1260	0.066	0.97	105	3.9	24.3	0.0047	3.1110	0.028	0.99	0.84
Diplodus annularis *	242	6.1	15.9	0.0111	3.1670	0.034	0.97	185	7.9	17.5	0.0093	3.2390	0.054	0.95	0.24
Engraulis encrasicolus *	389	7.2	14.2	0.0007	3.8810	0.034	0.93	370	6.7	16.2	0.0009	3.7870	0.040	0.96	0.16
Gaidropsarus biscayensis	27	9.0	15.3	0.0138	2.5890	0.112	0.96	38	9.9	14.7	0.0047	3.0400	0.142	0.93	0.02
Lesueurigibius suerii	59	5.8	9.4	0.0066	3.0140	0.104	0.94	82	6.3	9.2	0.0085	2.9630	0.126	0.87	0.75
Micromesistius poutassou	25	9.2	24.0	0.0041	3.1640	0.071	0.99	52	10.0	20.3	0.0049	3.0840	0.096	0.95	0.51
Mullus surmuletus *	24	10.5	19.7	0.0030	3.4970	0.080	0.99	31	9.1	23.1	0.0029	3.5040	0.044	0.99	0.94
Oblada melanura	30	12.6	22.4	0.0134	2.9980	0.077	0.98	26	13.6	22.7	0.0116	3.0450	0.062	0.99	0.63
Pagellus acarne *	33	10.5	19.2	0.0082	3.1540	0.075	0.98	29	11.4	16.8	0.0203	2.8090	0.090	0.97	0.01
Pagellus bogaraveo	18	10.6	22.3	0.0081	3.1990	0.063	0.99	54	9.3	23.1	0.0090	3.1570	0.024	0.99	0.48
Sardina pilchardus *	391	7.9	16.2	0.0074	3.0110	0.059	0.87	361	7.6	16.7	0.0038	3.2700	0.049	0.92	0.00
Sardinella aurita *	147	8.4	23.7	0.0071	3.0160	0.035	0.98	83	8.9	23.9	0.0044	3.1830	0.039	0.99	0.00
Scomber japonicus	195	8.8	26.0	0.0026	3.3920	0.035	0.98	176	10.3	26.8	0.0029	3.3490	0.041	0.97	0.42
Scomber scombrus	142	13.3	27.4	0.0038	3.2130	0.067	0.94	62	13.8	27.0	0.0036	3.2470	0.073	0.97	0.73
Scorpaena porcus	29	10.0	15.2	0.0353	2.7410	0.188	0.89	69	8.2	26.4	0.0122	3.1870	0.045	0.99	0.03
Sphyraena sphyraena	65	21.6	33.8	0.0183	2.5470	0.075	0.95	39	28.3	45.1	0.0755	2.1550	0.149	0.85	0.03
Spicara maena *	86	9.9	20.2	0.0200	2.7850	0.096	0.91	175	9.0	17.4	0.0057	3.2490	0.053	0.95	0.00
Spondyliosoma cantharus	42	9.8	13.5	0.0216	2.8770	0.077	0.97	40	9.7	14.0	0.0240	2.8290	0.089	0.96	0.69
Symphodus tinca	114	11.1	22.0	0.0211	2.8450	0.051	0.97	107	11.2	20.9	0.0280	2.7410	0.064	0.95	0.20
Torpedo marmorata	64	8.8	26.0	0.0737	2.6220	0.062	0.97	54	9.5	37.3	0.0571	2.7620	0.039	0.99	0.05
Trachurus mediterraneus	310	7.0	25.8	0.0039	3.2710	0.032	0.97	317	7.9	22.8	0.0037	3.2850	0.028	0.98	0.75
Trachurus trachurus *	87	6.5	23.9	0.0061	3.1150	0.018	0.99	46	6.3	21.8	0.0063	3.1120	0.032	0.99	0.94
Trisopterus minutus *	72	6.0	18.1	0.0062	3.1900	0.042	0.99	101	5.7	24.5	0.0055	3.2650	0.025	0.99	0.11
Uranoscopus scaber	31	8.7	21.5	0.0172	2.9960	0.073	0.98	39	9.2	26.9	0.0114	3.1580	0.071	0.98	0.12

* species for which length-weight relationships per sex from the Aegean Sea exist

majority of the cases (four out of five combinations). Additionally, for *Sardina pilchardus* no difference was observed (ANCOVA: $p > 0.05$; Table 4) in one out of the six combinations, whereas a difference was recorded only in one out of the six combinations for *Trachurus mediterraneus* (ANCOVA: $p < 0.05$; Table 4) (i.e. spring-winter for both species).

Finally, length-weight relationships were separately estimated for 29 species for both sexes (Table 5). The slopes b did not differ significantly (ANCOVA: $p > 0.05$; Table 5) in 20 species, whereas there was a significant difference (ANCOVA: $p < 0.05$; Table 5) in the remaining nine species.

Out of the 60 species in which length-weight and length-length relationships were studied in the present study, there is no information on length-weight relationships in FishBase (www.fishbase.org; Froese & Pauly, 2007) for five of them (i.e. *Anthias anthias*, *Gaidropsarus biscayensis*, *Lesueurigobius suerii*, *Monochirus hispidus*, and *Symphurus nigrescens*). Regarding length-length relationships, for four species (*Gaidropsarus biscayensis*, *Gaidropsarus mediterraneus*, *Lesueurigobius suerii*, and *Torpedo marmorata*) there is no information in FishBase and for 25 species data are based on various sources of FishBase, such as photos or other tables (in the fields "Brains", "Morphomet" and "Speed", as given in FishBase), the majority of which is derived from only one individual.

The "Froese diagram" (Fig. 1), is similar to that by Lamprakis (2004) for some species from the Thracian Sea. Lamprakis (2004) has reported that four species with elongated body (three of which are included in the present study) deviate from the regression line by more than ± 2 s.d.

The seasonal length-weight relationships showed variations according to the species and season (Tables 3 and 4). Such variations can be attributed to both biotic (food availability, maturity stage, and reproduction) and abiotic (water temperature) factors (Wootton, 1998). The effects of abiotic factors are not discussed. Yet, with respect to the biotic factors, differences observed in five species examined did not correspond to differences in the species' seasonal trophic level (Karachle & Stergiou, 2008). Therefore, the quality of food does not seem to have an important impact on the variations of the seasonal length-weight relationship. Additionally, the importance of the maturity stage (Karachle, unpublished data) and reproduction (Froese & Pauly, 2007) was not confirmed.

As far as differences between the two sexes are concerned, these were found only in a small number of species (Table 5). These species do not share common characteristics, regarding habitat, morphology, reproduction (Froese & Pauly, 2007), feeding habits, trophic level (Karachle & Stergiou, 2008), and functional trophic group (as identified by Stergiou & Karpouzi, 2002). The differences between the two sexes could possibly be attributed to the following reasons: a) different length range and length distributions (Reñones *et al*., 1995); b) different age/length-at-maturity ratio (Stergiou, 1991; Vassilopoulou & Papaconstantinou, 1994) leading to differences in the amount of energy available for growth; and c) differences in the reproductive physiology and behavior, such as in the case of protogynous or protandrous hermaphrodite species (Mytilineou & Papaconstantinou, 1991).

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