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LENGTH–WEIGHT RELATIONS OF 34 FISH SPECIES CAUGHT BY SMALL-SCALE FISHERY IN KORINTHIAKOS GULF (CENTRAL GREECE)

Dimitrios K. MOUTOPOULOS*, Alexios RAMFOS, Aikaterini MOUKA, and George KATSELIS

Technological Educational Institute of Mesolonghi, Department of Aquaculture and Fisheries Management, Laboratory of Hydrobiology and Fisheries Management, 30200 Mesolonghi, Greece

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Abstract. Length–weight (*L–W*) relations are presented for 34 fish species covering a full annual fishing period (231 fishing days) of professional small-scale fishery in Korinthiakos Gulf during 2008–2009. These were the typical fish species caught by Greek small-scale fishery. Mean annual values of *b* ranged from 2.751 to 3.704. The *L–W* relations were positively allometric for 12 species, negatively allometric for seven species and isometric for 15 species. Twenty-two out of 66 species-season combinations showed that the intercept *a* and/or slope *b* values differed significantly among seasons. For Greek waters no information regarding the *L–W* relations existed for three of the 34 recorded species (i.e., *Dentex macrophthalmus*, *Trachinotus ovatus*, and *Scyliorhinus canicula*).

Keywords: length–weight relations, season, small-scale fishery, Korinthiakos Gulf, Mediterranean Sea

Body size is the most easily measured universal characteristic and its relation with body weight has been extensively documented in fisheries research (Froese et al. 2011). The Length–weight (*L–W*) relation of a species depends on many factors (i.e. sex, size range, habitat, food availability, and fishing pressure), but may also vary seasonally (Froese 2006, Karachle and Stergiou 2008, Liousia et al. 2012). However, studies focusing on seasonal *L–W* relations are rather limited compared with those on annual estimates, because most of the estimates are based on samplings conducted during short-term periods in an annual basis.

In Greek fisheries, *L–W* relations are mostly derived from sampling conducted in open sea (using trawls and purse seines; for reviews see: Stergiou and Moutopoulos 2001, Karachle and Stergiou 2008) than in coastal waters (small-scale fishery; Moutopoulos and Stergiou 2002), despite of the multi-gear nature of the fishery. Small-scale fishery is of great importance to the Greek fishery contributing 57.3% to the total Greek fisheries landings (Moutopoulos and Stergiou 2012). It involves approximately 30 000 fishers characterized by low income, elementary education and living in small and isolated islands (Tzanatos et al. 2005). Likewise, in the study area (Korinthiakos Gulf) the small-scale fishery component is highly contributing to providing approximately 74% of the total landings (Moutopoulos and Stergiou 2012).

In the presently reported study, we calculated annual and seasonal estimates of *L–W* relations for the most abundant fish species caught by a professional small-scale vessel in Korinthiakos Gulf during a full annual fishing period: European hake, *Merluccius merluccius* (Linnaeus, 1758); white seabream, *Diplodus sargus* (Linnaeus, 1758); common pandora, *Pagellus erythrinus* (Linnaeus, 1758); bogue, *Boops boops* (Linnaeus, 1758); surmullet, *Mullus surmuletus* Linnaeus, 1758; Mediterranean horse mackerel, *Trachurus mediterraneus* (Steindachner, 1868); large-eye dentex, *Dentex macrophthalmus* (Bloch, 1791); annular seabream, *Diplodus annularis* (Linnaeus, 1758); spotted flounder, *Citharus linguatula* (Linnaeus, 1758); red mullet, *Mullus barbatus* Linnaeus, 1758; common two-banded seabream, *Diplodus vulgaris* (Geoffroy Saint-Hilaire, 1817); blotched picarel, *Spicara maena* (Linnaeus, 1758); stargazer, *Uranoscopus scaber* Linnaeus, 1758; comber, *Serranus cabrilla* (Linnaeus, 1758); blue whiting, *Micromesistius poutassou* (Risso, 1827); European pilchard, *Sardina pilchardus* (Walbaum, 1792); red porgy, *Pagrus pagrus* (Linnaeus, 1758); picare, *Spicara smaris* (Linnaeus, 1758); black scorpionfish, *Scorpaena porcus* Linnaeus, 1758; golden grey mullet, *Liza aurata* (Risso, 1810); round sardinella, *Sardinella aurita* Valenciennes, 1847; European barracuda, *Sphyraena sphyraena* (Linnaeus, 1758); greater weever, *Trachinus draco* Linnaeus, 1758; saddled seabream, *Oblada melanura* (Linnaeus, 1758); salema, *Sarpa salpa* (Linnaeus, 1758); red scorpionfish, *Scorpaena scrofa* Linnaeus, 1758; common dentex, *Dentex dentex* (Linnaeus, 1758); flathead grey mullet, *Mugil cephalus* Linnaeus, 1758; black

* Correspondence: Dr Dimitrios K. Moutopoulos, Technological Educational Institute of Mesolonghi, Department of Aquaculture and Fisheries Management, Laboratory of Hydrobiology and Fisheries Management, Nea Ktiria, 30200, Mesolonghi, Greece, tel: +30 26310 58202, fax: +30 26310 58202, e-mail: *dmoutopo@teimes.gr*.

seabream, *Spondyliosoma cantharus* (Linnaeus, 1758); gilt-head seabream, *Sparus aurata* Linnaeus, 1758; John dory, *Zeus faber* Linnaeus, 1758; pompano, *Trachinotus ovatus* (Linnaeus, 1758); Small-spotted catshark, *Scyliorhinus canicula* (Linnaeus, 1758); sharpsnout seabream, *Diplodus puntazzo* (Walbaum, 1792).

The samples were obtained from 231 daily fishing trials conducted with a professional small vessel (length 5.8 m; 33.5 kW engine) in the Korinthiakos Gulf (38°16′50″N, 22°11′40″E) during June 2008–August 2009. Specimens were caught using gill nets (mesh sizes of 22, 24, and 32 mm nominal bar length; 500 m) and trammel nets (mesh size of 22 mm nominal bar length; 500–600 m) at depths ranging from 50 to 300 m. Fishing trials were conducted simultaneously on the same fishing grounds using the aforementioned fishing gear. The fishing grounds were selected by the fisher in traditional areas in order to ensure that fishing was as similar as possible to the professional fishing activities employed in Korinthiakos Gulf.

Fish were measured in the field for total length (TL) to the nearest cm, and weighed (*W*, wet weight) to the nearest g. Length–weight (*L–W*) relations were estimated using the equation

$$W = a\mathrm{TL}^b$$

where: *a* and *b* are the equation parameters calculated by the least squares method using the logarithmic form of the equation:

$$\log (W) = \log (a) + b \cdot \log (\mathrm{TL})$$

The *b*-value of each species was tested by Student's *t*-test to verify if it was significantly different from isometric growth ($b = 3$, $P < 0.05$) (Froese et al. 2011).

In addition, for the most abundant species *L–W* relations were separately estimated per season (i.e., autumn 2008, winter 2008–2009, spring 2009, and summer 2008–2009). For each species, the intercepts and the slopes of the *L–W* regressions were compared for between-season differences using analysis of covariance (ANCOVA) (Zar 1999).

L–W relations are estimated for the 34 most abundant species (9598 specimens) during June 2008–August 2009 (Table 1). The studied species represent the most typical fish species caught by small-scale fishery in Greece (Moutopoulos and Stergiou 2012). The sample size ranged from 10, for *Diplodus puntazzo*, to 1408, for *Merluccius merluccius*. The low number of specimens for some species (< 30 individuals) could be attributed to the low selective properties of the gear used in the study area.

All relations were highly significant ($P < 0.001$), with R^2 values being greater than 0.908 indicating a high degree of positive relation between TL and *W*. The mean (± standard deviation) value of the exponent b was 3.038 ± 0.17 and for all species the *b* values laid within the expected range of 2.5–3.5 estimated by Froese (2006) (Table 1): from 2.751, for *Sphyraena sphyraena*, to 3.396, for *Micromesistius poutassou*.

For 12 out of 34 species the *b* values of the *L–W* relations were higher than 3 (Student's *t*-test; $P < 0.05$) exhibiting a positive allometric growth, for seven species the *b* values were lower than 3 (*t*-test; $P < 0.05$) exhibiting a negative allometric growth and for the remaining species the *b* values did not differ significantly (*t*-test; $P > 0.05$) from 3 showing an isometric growth (Table 1). For the majority of species (29 out of 34) the estimated b and the 95% confidence limit ($CL_{95\%}$) values felt within the range reported in FishBase (Froese and Pauly 2012) (Table 1), whereas for four species were greater than the maximum values and for one species (*Dentex macrophthalmus*) their values were lower than the minimum values reported in FishBase. Such differences in b values could be attributed to one or more of the following factors (Moutopoulos and Stergiou 2002, Froese 2006):

- differences in the number of specimens examined,
- area/season effects, and
- differences in the observed length ranges and the type of length used.

For Greek seas no information regarding the *L–W* relations existed for *D. macrophthalmus*, *Trachinus ovatus*, and *Scyliorhinus canicula*.

Seasonal *L–W* relations were estimated separately for the 13 most abundant species (those with $n > 30$ per season) (Table 2). Exceptions were the specimens of *Trachurus mediterraneus* in autumn ($n = 26$) and *Serranus cabrilla* in spring ($n = 16$). All relations were highly significant ($P < 0.001$), with most R^2 values being greater than 0.834. The value of the exponent *b* ranged from 2.642, for *Dentex macrophthalmus* in autumn, to 3.518, for *Mullus surmuletus* in summer (Table 2).

Comparisons between all pairs of species-season combinations (Table 3) showed that for 44 out of 66 species-season combinations intercept *a* and/or slope *b* values did not differ significantly (ANCOVA: $P > 0.05$) with season. In particular, for 14 out of the 44 non-significant combinations both the intercept *a* and the slope *b* did not differ with season, whereas for 11 and 19 combinations the intercept *a* or the slope *b*, respectively, showed non-significant differences with season. For the remaining 22 species-season combinations, *L–W* estimates showed significant (ANCOVA: $P < 0.05$) differences with season, from which 14 are attributed to the effect of summer (Table 3).

Seasonal differences in *L–W* relations can be attributed to biological (e.g., reproduction, sex, food availability) and/or abiotic (e.g., water temperature) factors (Wootton 1998, Moutopoulos et al. 2011). The effects of abiotic factors and those of sex and food availability are not examined in the present study. Yet, the spawning and gonad activity could cause seasonal variations in the values of parameter b of the *L–W* relation for the most abundant species (Table 2).

In particular, in six out 13 species (*Pagellus erythrinus*, *Boops boops*, *Mullus surmuletus*, *Dentex macrophthalmus*, *Citharus linguatula*, and *Serranus cabrilla*) *b* values were significantly higher during spawning period, as given by Tsikliras et al. (2010) than the other seasons/months (Tables 2, 3). For the remaining seven species, for two species (*Trachurus mediterraneus* and *Diplodus vulgaris*) *b* values did not significantly differed among seasons, for two species (*Merluccius merluccius*

Table 1

Estimated parameters of the length–weight relation for 34 fish species from Korinthiakos Gulf from daily samplings, 2008–2009

Species	n	Fraction of season [%]				TL [cm]			L–W relation					Range of b	G
		Au	Wi	Sp	Su	Median	Min	Max	a	SE_a	b	SE_b	R^2	FishBase[1]	
Merluccius merluccius	1408	2.8	15.4	23.4	58.4	28.8	14.8	60.6	0.0043	0.022	3.136	0.015	0.984	2.353–3.408	+
Diplodus sargus	1055	2.9	0.5	0.1	96.5	17.2	11.2	25.7	0.0140	0.028	3.056	0.022	0.973	2.500–3.314	+
Pagellus erythrinus	773	23.5	17.5	37.3	21.7	18.0	10.8	38.0	0.0177	0.029	2.863	0.023	0.976	2.428–3.116	–
Boops boops	724	9.1	50.1	13.4	27.3	21.1	11.7	34.0	0.0070	0.041	3.098	0.031	0.965	2.812–3.390	+
Mullus surmuletus	678	26.8	31.4	30.1	11.7	20.4	11.9	33.6	0.0037	0.035	3.381	0.027	0.979	2.669–3.512	+
Trachurus mediterraneus	671	3.9	25.2	20.0	51.0	28.0	15.4	51.0	0.0086	0.027	2.980	0.019	0.987	2.760–3.374	=
*Dentex macrophthalmus**	646	15.5	12.8	26.3	45.4	17.2	12.8	28.4	0.0185	0.048	2.850	0.039	0.946	2.980–3.120	–
Diplodus annularis	409	37.2	9.5	12.5	40.8	12.9	9.5	20.1	0.0114	0.032	3.114	0.028	0.984	2.677–3.506	+
Citharus linguatula	377	21.0	14.9	50.9	13.3	16.6	11.5	39.7	0.0070	0.054	3.009	0.044	0.962	2.293–3.725	=
Mullus barbatus	373	1.3	4.8	71.0	22.8	19.0	13.4	24.0	0.0058	0.050	3.219	0.039	0.974	2.508–3.380	+
Diplodus vulgaris	345	11.0	1.2	0.3	87.5	17.7	11.0	23.5	0.0123	0.039	3.070	0.031	0.983	2.431–3.590	+
Spicara flexuosa	339	0.0	13.9	77.3	8.8	16.9	13.2	19.5	0.0132	0.048	3.040	0.039	0.974	2.627–3.696	=
Uranoscopus scaber	296	17.6	15.5	23.3	43.6	18.7	13.6	30.4	0.0120	0.043	3.101	0.034	0.983	2.829–3.228	+
Serranus cabrilla	215	14.0	28.4	50.2	7.4	18.0	12.5	26.2	0.0159	0.082	2.874	0.065	0.949	2.410–3.220	–
Micromesistius poutassou	155	0.0	0.6	1.9	97.4	26.2	16.9	33.1	0.0020	0.107	3.396	0.076	0.964	2.900–3.212	+
Sardina pilchardus	152	0.0	87.5	5.9	6.6	13.0	10.2	16.1	0.0036	0.094	3.257	0.085	0.953	2.754–3.741	+
Pagrus pagrus	129	10.9	4.7	30.2	54.3	20.5	13.7	42.2	0.0182	0.032	2.946	0.024	0.996	2.866–3.343	–
Spicara smaris	123	0.0	1.6	95.9	2.4	14.2	10.9	16.8	0.0176	0.135	2.781	0.117	0.908	2.594–3.572	–
Scorpaena porcus	103	16.5	12.6	6.8	64.1	15.5	10.5	31.8	0.0192	0.091	2.965	0.076	0.969	2.590–3.343	=
Liza aurata	80	50.0	26.3	3.8	20.0	30.0	23.9	42.5	0.0032	0.117	3.257	0.079	0.978	2.490–3.230	+

Table continues on next page.

Table 1 cont.

Species	n	Fraction of season [%]				TL [cm]			L–W relation					Range of b	G
		Au	Wi	Sp	Su	Median	Min	Max	a	SE_a	b	SE_b	R^2	FishBase[1]	
Sardinella aurita	73	20.5	15.1	43.8	20.5	22.1	11.6	36.0	0.0067	0.039	3.022	0.030	0.997	2.804–3.439	=
Sphyraena sphyraena	73	32.9	31.5	1.4	34.2	39.9	28.4	70.0	0.0090	0.129	2.751	0.080	0.971	2.086–3.175	–
Trachinus draco	67	9.0	14.9	25.4	50.7	21.1	17.0	32.9	0.0114	0.116	2.806	0.087	0.970	2.578–3.873	–
Oblada melanura	59	62.7	16.9	0.0	20.3	17.6	14.6	29.5	0.0146	0.058	2.932	0.046	0.993	2.831–3.567	=
Sarpa salpa	53	11.3	5.7	0.0	83.0	24.0	15.8	30.7	0.0091	0.115	3.095	0.084	0.982	2.778–3.265	=
Scorpaena scrofa	53	24.5	9.4	41.5	24.5	15.3	11.7	36.8	0.0169	0.101	3.002	0.083	0.981	2.730–3.298	=
Dentex dentex	43	32.6	4.7	2.3	60.5	28.1	17.1	48.0	0.0130	0.077	2.987	0.053	0.994	2.966–3.530	=
Mugil cephalus	33	69.7	27.3	3.0	0.0	23.5	20.3	44.0	0.0047	0.078	3.165	0.056	0.995	2.779–3.125	+
Spondyliosoma cantharus	29	3.4	3.4	0.0	93.1	16.9	13.9	22.2	0.0063	0.236	3.304	0.192	0.957	2.849–3.150	=
Sparus aurata	18	77.8	22.2	0.0	0.0	39.7	23.0	53.0	0.0066	0.261	3.190	0.166	0.979	2.736–3.337	=
Zeus faber	13	0.0	7.7	30.8	61.5	27.8	16.7	49.5	0.0183	0.133	2.908	0.092	0.995	2.500–2.950	=
*Trachinotus ovatus**	12	25.0	0.0	0.0	75.0	27.6	22.7	43.2	0.0232	0.554	2.754	0.377	0.918	2.730–2.730	=
*Scyliorhinus canicula**	11	0.0	81.8	0.0	18.2	38.7	34.2	43.8	0.0019	0.654	3.139	0.412	0.931	2.779–3.615	=
Diplodus puntazzo	10	0.0	0.0	0.0	100.0	18.4	17.7	20.7	0.0243	0.412	2.831	0.324	0.951	2.662–3.273	=

n = sample size; Au = autumn, Wi = winter, Sp = spring, Su = summer; TL = total length; a and b = parameters of the L–W relation and their standard errors (SE_a and SE_b, respectively), R^2 = coefficient of determination; G = type of growth: allometric (–), positive allometric (+), and (=) isometric; [1]Froese and Pauly (2012); * first record from Greek waters.

Table 2

Estimated parameters of the length–weight relation per season for the most abundant fish species caught in Korinthiakos Gulf, 2008–2009

Species	Season	*n*	TL [cm]			*L–W* relation					S
			Median	Min	Max	*a*	SE_a	*b*	SE_b	R^2	
Merluccius merluccius	Autumn	40	36.0	23.0	47.3	0.0086	0.10	2.932	0.07	0.990	*
	Winter	217	27.1	15.1	60.6	0.0047	0.05	3.104	0.04	0.985	*
	Spring	329	26.7	14.8	54.2	0.0036	0.04	3.183	0.03	0.988	*
	Summer	822	29.6	15.4	55.5	0.0056	0.03	3.068	0.02	0.980	*
Pagellus erythrinus	Autumn	182	17.3	12.8	34.7	0.0217	0.05	2.798	0.04	0.982	
	Winter	135	18.3	13.8	32.5	0.0198	0.07	2.814	0.06	0.973	
	Spring	288	18.9	12.5	38.0	0.0134	0.06	2.951	0.04	0.970	*
	Summer	168	17.1	10.8	36.3	0.0147	0.05	2.944	0.04	0.986	*
Boops boops	Autumn	66	21.5	15.0	26.0	0.0082	0.09	3.047	0.07	0.985	
	Winter	363	21.2	11.7	28.6	0.0060	0.07	3.137	0.05	0.958	*
	Spring	97	20.4	15.9	33.7	0.0040	0.10	3.281	0.08	0.975	*
	Summer	198	20.7	12.4	34.0	0.0077	0.06	3.093	0.04	0.982	
Mullus surmuletus	Autumn	182	19.5	13.7	26.5	0.0078	0.07	3.121	0.06	0.971	
	Winter	213	20.2	11.9	33.6	0.0030	0.07	3.446	0.05	0.977	
	Spring	204	21.8	17.1	27.9	0.0048	0.07	3.298	0.05	0.976	
	Summer	79	19.7	13.4	26.7	0.0025	0.09	3.518	0.07	0.986	*
Trachurus mediterraneus	Autumn	26	26.6	21.9	44.0	0.0155	0.19	2.805	0.13	0.973	
	Winter	169	28.8	18.7	42.6	0.0023	0.09	3.385	0.06	0.974	
	Spring	134	29.1	16.4	44.7	0.0070	0.06	3.033	0.04	0.990	*
	Summer	342	25.7	15.4	51.0	0.0104	0.03	2.921	0.02	0.990	*
Dentex macrophthalmus	Autumn	100	17.4	12.8	25.0	0.0341	0.13	2.642	0.10	0.934	
	Winter	83	17.5	14.0	21.8	0.0121	0.19	2.983	0.16	0.906	
	Spring	170	17.5	13.5	26.1	0.0153	0.07	2.905	0.06	0.969	
	Summer	293	16.7	13.5	28.4	0.0149	0.07	2.935	0.05	0.955	*

Table continues on next page.

Table 2 cont.

Species	Season	n	TL [cm]			L–W relation					S
			Median	Min	Max	a	SE_a	b	SE_b	R^2	
Diplodus annularis	Autumn	152	13.3	11.1	19.9	0.0064	0.06	3.334	0.05	0.983	
	Winter	39	13.2	11.2	20.1	0.0094	0.09	3.182	0.08	0.990	
	Spring	51	12.8	11.1	15.5	0.0122	0.12	3.094	0.10	0.973	*
	Summer	167	12.5	9.5	19.4	0.0154	0.05	2.995	0.04	0.984	*
Citharus linguatula	Autumn	79	17.2	13.5	39.7	0.0043	0.09	3.166	0.07	0.981	*
	Winter	56	16.8	11.5	34.6	0.0102	0.12	2.895	0.09	0.973	
	Spring	192	16.5	11.6	25.0	0.0065	0.07	3.029	0.06	0.965	
	Summer	50	16.2	13.2	21.4	0.0080	0.34	2.975	0.28	0.834	
Mullus barbatus	Winter	18	19.9	15.9	21.9	0.0043	0.06	3.324	0.04	0.977	
	Spring	265	19.1	14.2	24.0	0.0051	0.25	3.247	0.19	0.973	*
	Summer	85	18.0	13.4	23.8	0.0120	0.10	2.957	0.08	0.969	*
Diplodus vulgaris	Winter	38	15.0	11.5	18.1	0.0121	0.07	3.083	0.06	0.978	*
	Summer	302	18.0	11.0	21.6	0.0133	0.05	3.042	0.04	0.979	
Uranoscopus scaber	Autumn	52	19.8	13.6	25.5	0.0112	0.09	3.121	0.07	0.988	*
	Winter	46	18.0	14.7	28.0	0.0130	0.13	3.076	0.10	0.976	*
	Spring	69	18.5	13.8	28.9	0.0113	0.15	3.129	0.12	0.954	*
	Summer	129	18.8	13.7	27.8	0.0108	0.07	3.136	0.06	0.980	*
Serranus cabrilla	Autumn	30	18.4	14.0	23.0	0.0215	0.25	2.798	0.20	0.938	
	Winter	61	18.1	15.0	23.6	0.0202	0.15	2.796	0.12	0.953	
	Spring	108	18.0	14.2	26.2	0.0136	0.11	2.917	0.09	0.952	*
	Summer	16	17.7	12.5	23.3	0.0203	0.15	2.793	0.12	0.986	*
Pagrus pagrus	Spring	39	20.4	14.2	38.9	0.0168	0.06	2.972	0.04	0.996	
	Summer	62	20.7	14.7	32.2	0.0155	0.09	3.000	0.07	0.985	

n = sample size; TL = total length; a and b = parameters of the L–W relation and their standard errors (SE_a and SE_b, respectively), R^2 = coefficient of determination; S = spawning period of Mediterranean fish species according to Tsikliras et al. (2010); * significantly differences of b parameters with season (ANCOVA: $P < 0.05$).

Table 3

Results of the analysis of covariance (ANCOVA, $P < 0.05$) for pairs of *L*–*W* relations for the most abundant fish species caught in Korinthiakos Gulf, 2008–2009 for different species–season combinations

Species	Season	Autumn		Winter		Spring	
		P of *a*	*P* of *b*	*P* of *a*	*P* of *b*	*P* of *a*	*P* of *b*
	Winter	*	ns				
Merluccius merluccius	Spring	ns	ns	ns	*		
	Summer	*	ns	*	*	*	*
	Winter	*	*				
Pagellus erythrinus	Spring	*	ns	ns	*		
	Summer	*	*	*	*	*	ns
	Winter	*	ns				
Boops boops	Spring	ns	*	*	*		
	Summer	*	*	*	*	*	*
	Winter	*	*				
Mullus surmuletus	Spring	*	*	*	ns		
	Summer	*	ns	ns	*	*	*
	Winter	ns	ns				
Trachurus mediterraneus	Spring	ns	ns	ns	ns		
	Summer	*	ns	*	ns	*	ns
	Winter	*	ns				
Dentex macrophthalmus	Spring	*	ns	ns	ns		
	Summer	*	*	*	*	*	ns
	Winter	ns	ns				
Diplodus annularis	Spring	*	*	ns	*		
	Summer	*	*	ns	*	ns	ns
	Winter	ns	*				
Citharus linguatula	Spring	ns	*	*	*		
	Summer	*	*	ns	*	*	ns
Mullus barbatus	Spring			*	*		
	Summer			*	ns	*	ns
Diplodus vulgaris	Summer			*	ns		
	Winter	ns	ns				
Uranoscopus scaber	Spring	ns	ns	ns	ns		
	Summer	ns	*	ns	ns	ns	ns
	Winter	*	ns				
Serranus cabrilla	Spring	*	ns	ns	ns		
	Summer	ns	ns	ns	*	*	*
Pagrus pagrus	Summer					*	*

a and *b* = parameters of the *L*–*W* relation; ns = non significant difference ($P > 0.05$), * significant difference ($P < 0.05$).

and *Uranoscopus scaber*) their spawning period have been reported all year round, for one species (*Pagrus pagrus*) there is not any reference on its spawning period and for two species (*Diplodus annularis* and *Mullus barbatus*) *b* values were significantly higher during non-spawning periods. All the above relations are of great importance, since they determine fish growth patterns, which in turn are essential for developing of ecosystem-based models for fisheries.

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