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Short communication

Weight–length relationships of littoral to lower slope fishes from the western Mediterranean

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Abstract

Weight–length relationships (WLRs) are presented for 103 fish species inhabiting littoral to lower slope habitats of the Balearic Islands and the Iberian coast (western Mediterranean). Samples were collected using seven types of fishing gear and at depths ranging from 0.5 to 1713 m. Captures were made between the years 1991 and 2001. The b values in the WLR $W = aL^b$ varied between 2.072 and 3.847 and showed a mean value of 3.03 (S.E. $= \pm 0.03$). Whenever possible, the b values for the species obtained both in this study and some of the previously reported in the Mediterranean Sea were compared, showing the existence of spatial variation whose causes are discussed.

Keywords: Western Mediterranean; Weight–length relationships; Littoral to lower slope

1. Introduction

The weight–length relationship (WLR) is a useful tool in fishery assessment, that helps in predicting weight from length required in yield assessment (Garcia et al., 1998) and in the calculation of the standing crop biomass (Martin-Smith, 1996). In sampling programs, it is usually easier to measure length only (e.g., because of the bobbing motion of the boat), or weight cannot be measured simply (e.g., underwater visual censuses). The WLR of a particular species allows the inter-conversion of these parameters. Also, morphometric comparisons can be made between species and populations (King, 1996; Gonçalves et al., 1997). Furthermore, the WLR allows fish condition to be estimated. The condition factor is frequently used in the analysis of ontogenetic changes (Safran, 1992) and for between-regions life-history comparisons (Weatherley and Gill, 1987; Petrakis and Stergiou, 1995).

The relationship between the length (L) and weight (W) of a fish is usually expressed by the equation $W = aL^b$. Values of the exponent b provide information on fish growth. When $b = 3$, increase in weight is isometric. When the value of b is other than 3, weight increase is allometric (positive if $b > 3$, negative if $b < 3$).

This paper furnishes information on the WLR of 103 fish species from littoral to upper slope communities in the Balearic Sea area and the Mediterranean

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coast of Spain. These WLR are lacking for many species included herein, and therefore we complement those provided by other authors regarding the Mediterranean Sea (Quesada, 1991; Campillo, 1993; Petrakis and Stergiou, 1995; Dulčić and Kraljević, 1996; Merella et al., 1997), on the grounds that for a correct application of the WLR it is advisable to make use of local values.

2. Material and methods

Data on length and weight were collected from April 2000 to July 2001 during 11 sampling programs undertaken on a small-scale fishing vessel. Samples were collected from around the Balearic Islands and the eastern coast of the Iberian Peninsula (western Mediterranean) using trammel nets and long lines between 8 and 35 m depth, and by beam trawling between 15 and 27 m. The trammel nets were 300 m long and had a mesh size of 40 mm. The mesh sizes of the beam trawl nets were 12, 9 and 6 mm. The mouth of the net was 1.8 m × 0.8 m. Data from eight bottom trawl sampling programs have been also included. These were obtained from around the Balearic Islands, the eastern coast of the Iberian Peninsula, and also in the Alboran Sea, at depths of between 147 and 1713 m, from April 1991 to May 1998. The sampling gear was a benthic trawl net with a mouth of 14 m width and 1.8–2 m height. The cod end mesh size was 12 mm. Also, data on captures from spearfishing and hook and line championships were obtained for the Balearic Islands from 1998 to 2001, as well as from many samples from commercial vessels operating on the shelf and upper slope.

For each haul, the position, duration and depth were noted. After hauling, fish were removed and preserved on ice, but not frozen, to preserve them in fresh conditions. In the laboratory, total length (L), pelvic length (PL, for Hypotremata) or preanal length (PAL, for Macrouridae and Notacanthidae) were measured to the nearest mm. Fish in advanced rigor mortis were not considered in the analysis. The weight was measured to the nearest gram, or with a precision balance to the nearest 0.1 g whenever possible.

The relationship between weight and total length, $W = aL^b$ was converted into its logarithmic expression: $\ln W = \ln a + b \ln L$. The parameters a and b were calculated by least-squares regression, as was the coefficient of determination (R^2). The b value for each species was tested by a t-test at the 0.05 significance level to verify if it was significantly different from 3. The same method was used to compare the b values for those species appearing both in this study and those given by other authors from the Mediterranean Sea (Petrakis and Stergiou, 1995; Dulčić and Kraljević, 1996; Merella et al., 1997), with the aim to verify the existence of spatial variation in WLR.

3. Results and discussion

The 103 species of fish belonging to 47 families were sampled. Species that gave too small a sample size ($n < 10$) were not taken into account. Table 1 shows, for each species, the sample size, the minimum, maximum and mean length (±S.E.), the minimum and maximum weight measured, the WLR parameters a and b, the standard error of the slope and the coefficient of determination, R^2. Information on the kind of growth (isometric or allometric) of each species is provided, as well as the type of the fishing gear that caught it.

The sample size ranged from 11 individuals for *Gobius ater*, *Microchirus ocellatus*, and *Scorpaena maderensis*, to 980 for *Scorpaena porcus*. The R^2 values ranged from 0.524 for *Gadiculus argenteus* to 0.998 for *Engraulis encrasicholus* and *Lichia amia*. All regressions were highly significant ($P < 0.001$). Sixty-nine of the 103 species showed R^2 values greater than 0.95, while only two of them presented $R^2 < 0.6$. The b values ranged from 2.072 for *Capros aper* to 3.847 for *Lesueurigobius friesii*. Six species showed $b < 2.5$, and in eight cases b was >3.5. The mean value of b was 3.03 (S.E. = ±0.03). The median value of b was 3.046, whereas 50% of the values ranged between 2.927 and 3.193 (Fig. 1). The kind of growth was determined by the t-test. Forty-eight species showed isometric growth, 21 negative allometric, and 34 positive allometric growth (Fig. 2). The nature of the sampling did not allow the evaluation of sexual dimorphism in the species. The comparison of b values for the species appearing both in this study and those obtained by other authors in the Mediterranean Sea (Table 2) suggested inter-regional differences. The number of common species analyzed

Table 1
WLRs for 103 fish species from the Balearic Islands and the eastern coast of the Iberian Peninsula

	Species[a]	Sample size, n	Length[b]	Length characteristics				Weight characteristics[c]		Parameters of the relationship[d]			
				Mean	S.E.	Minimum	Maximum	Minimum	Maximum	a	b	S.E.(b)	R^2
1	*Antonogadus megalokynodon* (3)[e]	13		10.18	0.568	7.5	12.6	2.0	18.0	0.0079	2.8801 I	0.178	0.914
2	*Aphia minuta* (4)	65		3.61	0.076	2.4	4.3	0.1	0.5	0.0018	3.8176 P	0.113	0.975
3	*Apogon imberbis* (2)[e]	63		7.65	0.203	3.8	10.8	0.7	17.4	0.0093	3.2021 P	0.085	0.986
4	*Ariosoma balearicum* (6)	53		22.74	0.392	16.7	28.4	7.6	35.1	0.0012	3.0711 I	0.078	0.963
5	*B. boops* (1, 5, 6)	42		18.62	0.341	9.8	22.8	8.3	127.0	0.0119	2.8554 I	0.166	0.851
6	*Bothus podas* (1, 2)	225		15.10	0.276	3.1	21.9	0.4	124.0	0.0094	3.0791 P	0.114	0.992
7	*Callionymus maculatus* (3)	35		6.80	0.245	4.5	10.5	0.5	5.0	0.0131	2.5903 I	0.36	0.696
8	*C. aper* (3)	24		6.77	0.317	2.5	10.6	1.0	20.0	0.1165	2.0722 N	0.216	0.858
9	*Centracanthus cirrus* (3)	32		17.15	0.219	14.2	19.5	18.6	62.5	0.0018	3.5174 P	0.038	0.98
10	*Cepola rubescens* (3)	29		35.31	2.555	13.5	60.5	4.0	92.0	0.0134	2.1802 N	0.209	0.959
11	*Coelorhynchus coelorhynchus* (3)[e]	175	PAL	5.94	0.220	2.1	12.3	1.4	287.0	0.0925	3.1417 P	0.275	0.970
12	*Coelorhynchus labiatus* (3)[e]	114	PAL	6.63	0.156	2.5	9.6	10.0	30.0	0.1016	2.6845 N	0.196	0.944
13	*C. julis* (1, 2, 6)	473		10.37	0.114	1.9	16.8	0.1	47.0	0.007	3.0462 P	0.129	0.976
14	*Chalinura Mediterranea* (3)[e]	168	PAL	3.73	0.053	2.0	5.37	1.0	20.0	0.1994	2.6927 N	0.239	0.826
15	*Chromis chromis* (2)	369		8.73	0.057	5.1	11.7	2.1	26.5	0.0189	2.9271 I	0.1	0.935
16	*Dactylopterus volitans* (1)	27		35.07	1.031	26.7	48.6	181.0	880.0	0.0153	2.8633 I	0.088	0.962
17	*Dasyatis pastinaca* (1, 6)	44	PL	24.37	1.027	15.1	53.9	171.0	7345.0	0.0498	2.9918 I	0.196	0.935
18	*Deltentosteus quadrimaculatus* (3)	47		7.57	0.199	4.2	9.7	0.5	9.0	0.0022	3.6321 P	0.299	0.857
19	*Dentex dentex* (1, 7)	38		34.85	1.669	25.2	63.4	214.0	3446.0	0.0113	3.0349 I	0.072	0.991
20	*Dicentrarchus labrax* (6, 7)	14		43.02	2.759	30.9	61.5	248.0	2500.0	0.0051	3.1589 I	0.073	0.992
21	*Diplodus annularis* (1, 2)	848		8.36	0.098	2.2	21.8	0.1	156.0	0.0115	3.1668 P	0.197	0.972
22	*Diplodus puntazzo* (1, 2)	43		24.57	0.869	10.2	36.5	22.6	662.0	0.026	2.8188 N	0.08	0.988
23	*Diplodus sargus* (1, 2, 5, 6)	75		25.68	0.684	12.2	33.5	27.0	687.0	0.0114	3.1317 P	0.087	0.989
24	*Diplodus vulgaris* (1, 2, 5)	328		13.78	0.386	3.8	28.2	0.7	352.0	0.0149	3.0058 I	0.093	0.997
25	*Engraulis encrasicholus* (4)	17		11.03	0.529	5.7	12.9	1.0	12.7	0.0048	3.0706 I	0.036	0.998
26	*Epinephelus costae* (1, 5, 7)	16		46.56	3.573	23.9	77.4	162.0	4160.0	0.0134	2.9671 I	0.107	0.988
27	*Epinephelus marginatus* (1, 7)	222		47.69	1.187	13.4	105.6	42.1	22290.0	0.0104	3.121 P	0.088	0.995
28	*G. argenteus* (3)	50		6.89	0.186	4.0	11	1.0	14.0	0.0562	2.1066 N	0.376	0.524
29	*Galeus melastomus* (3)	180		22.45	0.656	11.3	42	3.5	173.4	0.0023	3.0211 I	0.179	0.978
30	*Glossanodon leioglossus* (3)	50		9.71	0.488	5.5	19.8	1.0	37.0	0.0032	3.2068 P	0.234	0.915
31	*G. ater* (2)[e]	11		5.50	0.572	2.4	7.9	0.1	5.1	0.006	3.2259 I	0.177	0.983
32	*Gobius auratus* (2)[e]	16		6.23	0.254	4.4	7.6	0.8	3.4	0.0133	2.7404 I	0.142	0.923
33	*Gobius cruentatus* (2)[e]	49		11.28	0.343	4.4	14.4	0.7	43.3	0.0044	3.4108 P	0.067	0.994
34	*Gobius niger* (2, 3)	21		9.11	0.589	8.9	14.5	1.4	35.0	0.0089	3.0853 I	0.088	0.992
35	*Gobius paganellus* (2)	12		8.70	0.245	7.0	10.1	3.5	12.1	0.0033	3.5738 I	0.06	0.975
36	*Gymnammodytes cicerelus* (4)[e]	29		6.45	0.150	4.6	7.6	0.2	1.0	0.0009	3.5046 P	0.087	0.967
37	*Hoplostethus mediterraneus* (3)	49		12.49	0.442	5.4	23.1	2.7	192.3	0.0104	3.0608 I	0.112	0.979
38	*Hymenocephalus italicus* (3)[e]	69	PAL	3.39	0.095	2.2	5.1	1.0	11.8	0.1277	2.7964 N	0.12	0.965
39	*Labrus merula* (1, 2, 7)	124		30.21	0.286	15.0	37.3	48.0	831.0	0.0076	3.1862 P	0.076	0.959

Table 1 (*Continued*)

	Species[a]	Sample size, *n*	Length[b]	Length characteristics				Weight characteristics[c]		Parameters of the relationship[d]			
				Mean	S.E.	Minimum	Maximum	Minimum	Maximum	*a*	*b*	S.E.(*b*)	R^2
40	*Labrus viridis* (1, 2, 7)	63		33.69	0.678	15.8	42.2	38.0	1113.0	0.0058	3.2216 P	0.11	0.97
41	*Lampanyctus crocodilus* (3)	24		10.72	0.298	8.0	14.8	2.0	13.1	0.003	3.1562 I	0.078	0.967
42	*Lepidion lepidion* (3)	257		18.46	0.182	9.0	36	3.0	347.0	0.003	3.203 P	0.242	0.934
43	*Lepidorhombus boscii* (3)	364		19.52	0.293	1.4	37.8	2.5	488.2	0.0643	2.2685 N	0.491	0.717
44	*Lepidorhombus whiffiagonis* (3)	109		26.61	0.751	13.5	50.1	13.9	811.5	0.0064	2.9931 I	0.093	0.989
45	*L. friesii* (3)	40		6.65	0.146	4.3	8.9	0.5	9.0	0.0015	3.847 I	0.434	0.615
46	*Lichia amia* (1, 6)	13		35.60	6.586	16.6	102	35.1	7590.0	0.0086	2.9669 I	0.081	0.998
47	*Lithognathus mormyrus* (1, 6)	441		15.61	0.184	8.5	29.5	8.2	324.0	0.0102	3.0327 I	0.079	0.986
48	*Lophius piscatorius* (1)	12		36.36	2.612	21.4	52	153.0	1970.0	0.0148	2.9732 I	0.094	0.986
49	*Macroramphosus scolopax* (3)	12		8.63	0.286	6.9	10	2.0	7.0	0.004	3.1937 I	0.105	0.927
50	*Merluccius merluccius* (3)	96		12.08	0.223	7.0	23.2	2.0	78.0	0.0048	3.055 I	0.152	0.924
51	*M. ocellatus* (1)	11		15.88	0.553	11.7	18	23.0	101.0	0.0062	3.3142 I	0.102	0.947
52	*Mora moro* (3)	370		38.35	0.256	18.4	53.4	40.6	1486.0	0.0038	3.2251 P	0.146	0.928
53	*Mullus surmuletus* (1, 2, 3)	331		14.31	0.486	4.5	34.1	0.7	433.0	0.0073	3.1685 P	0.147	0.995
54	*Muraena helena* (1)[e]	43		83.44	1.632	50.5	110	253.4	2977.0	0.0006	3.2736 I	0.166	0.879
55	*Nezumia aequalis* (3)[e]	74	PAL	3.37	0.093	2.0	5.1	1.0	20.9	0.1279	2.8152 N	0.156	0.947
56	*Notacanthus bonapartei* (3)	12	PAL	7.04	0.630	3.3	11	1.5	31.0	0.125	2.2214 N	0.292	0.874
57	*Pagellus acarne* (1, 3, 6)	140		16.45	0.422	2.8	32	0.2	222.0	0.0066	3.2079 P	0.104	0.995
58	*Pagellus erythrinus* (1, 3, 6)	58		17.89	0.648	8.8	33	9.0	427.6	0.0164	2.8936 N	0.065	0.983
59	*Pagrus pagrus* (1, 2, 5, 6)	127		16.71	0.542	4.8	33.4	2.0	551.0	0.0282	2.8003 N	0.248	0.956
60	*Phycis blennoides* (3)	189		18.18	0.445	4.0	42	1.0	550.0	0.0069	2.9707 I	0.215	0.96
61	*Phycis phycis* (1, 2, 5, 7)	96		32.54	0.762	10.6	48.4	9.4	1650.0	0.0045	3.2681 P	0.098	0.988
62	*Pseudaphya ferreri* (4)[e]	32		2.91	0.050	2.3	3.4	0.1	0.3	0.0046	3.2829 I	0.115	0.892
63	*Raja radula* (1)	78	PL	25.14	0.702	9.5	37.1	22.7	1599.0	0.0283	2.9929 I	0.114	0.985
64	*Sardina pilchardus* (4)	14		11.90	0.194	10.1	13.1	6.8	14.5	0.0075	2.9577 I	0.034	0.969
65	*Sardinella aurita* (4)	60		10.02	0.504	3.2	19.8	0.2	50.0	0.0089	2.8718 N	0.095	0.993
66	*Sarpa salpa* (1, 2)	79		26.21	0.453	14.2	33.5	36.0	479.0	0.0323	2.7004 N	0.088	0.966
67	*Sciaena umbra* (1, 7)	233		32.81	0.411	14.2	58.2	30.0	2942.0	0.0053	3.2542 P	0.136	0.952
68	*S. maderensis* (7)[e]	11		11.13	0.786	6.1	15.5	4.0	62.8	0.0164	3.0354 I	0.104	0.985
69	*Scorpaena notata* (1, 2, 3)	83		11.41	0.247	5.6	16	3.8	77.8	0.01689	3.0384 I	0.07	0.988
70	*S. porcus* (1, 2)	980		21.07	0.133	6.1	35.5	7.0	640.0	0.0183	3.0202 I	0.127	0.969
71	*Scorpaena scrofa* (1, 2)	359		27.89	0.259	11.9	42.1	33.0	1340.0	0.022	2.9418 N	0.07	0.981
72	*Scyliorhinus canicula* (1)	99		48.55	0.251	40.9	53.4	182.0	500.0	0.0374	2.3776 N	0.107	0.577
73	*Seriola dumerili* (1, 7)	150		31.30	0.419	20.3	45.1	92.9	1031.0	0.0273	2.7438 N	0.081	0.97
74	*Serranus cabrilla* (1, 2, 5, 6)	298		14.94	0.213	3.2	24	0.5	165.0	0.0092	3.0658 P	0.129	0.978
75	*Serranus hepatus* (2, 3)	22		7.26	0.417	4.5	10.5	0.5	19.0	0.0044	3.5681 P	0.272	0.928
76	*Serranus scriba* (1, 2, 5, 7)	686		11.48	0.149	5.1	23	1.5	181.0	0.0104	3.1103 P	0.102	0.979
77	*Sparus aurata* (5)	14		45.07	1.552	36.7	56.7	589.0	2495.0	0.0053	3.2393 I	0.063	0.978
78	*Sphyraena viridensis* (1, 5)	13		64.01	1.678	53.7	69.8	486.0	1246.0	0.0016	3.1831 I	0.11	0.899

79	*Spicara maena* (1, 2, 5)	86		16.88	0.151	12.5	19.9	26.0	112.8	0.0113	3.0649 I	0.084	0.905
80	*Spicara smaris* (1,2,3)	52		15.60	0.597	4.2	20.1	0.6	86.0	0.0113	2.8696 N	0.161	0.982
81	*Spondyliosoma cantharus* (1, 2, 6)	86		17.64	0.575	6.4	31.5	3.4	441.0	0.0158	2.9957 I	0.074	0.994
82	*Stomias boa* (3)[e]	22		16.54	0.633	12.2	25	2.2	25.1	0.0003	3.5062 P	0.154	0.935
83	*Symphodus cinereus* (2, 6)	202		6.44	0.097	3.0	10.7	0.2	19.1	0.0075	3.2514 P	0.144	0.958
84	*Symphodus doderleini* (2)[e]	115		8.03	0.129	5.4	10.9	1.7	18.0	0.0083	3.155 I	0.147	0.934
85	*Symphodus mediterraneus* (1, 2, 6)	214		8.71	0.147	2.4	14.4	0.2	40.6	0.0123	3.0653 P	0.089	0.988
86	*Symphodus ocellatus* (2)	836		7.20	0.047	2.1	11.6	0.1	18.0	0.0131	2.9664 I	0.118	0.957
87	*Symphodus rostratus* (2)	507		8.82	0.067	2.7	12.3	0.1	22.0	0.0069	3.2169 P	0.116	0.969
88	*Symphodus tinca* (1, 2)	375		20.10	0.301	4.7	30.1	1.2	356.0	0.0184	2.8757 N	0.094	0.991
89	*Symphurus nigrescens* (3)[e]	34		8.53	0.204	6.0	12	2.0	13.0	0.0091	2.8326 I	0.243	0.72
90	*Syngnathus abaster* (2)[e]	64		9.02	0.185	3.9	12.1	0.0	0.7	0.0004	3.1201 I	0.173	0.926
91	*Syngnathus typhle* (2)	52		21.35	0.727	5.4	29.6	0.1	10.0	0.0004	2.9512 P	0.168	0.97
92	*Synodus saurus* (1, 2)	57		25.88	0.741	9.0	38.1	5.2	475.0	0.0066	3.0428 I	0.127	0.972
93	*Torpedo marmorata* (1)[e]	28	PL	30.55	1.626	17.2	45.4	260.0	4558.0	0.055	2.9499 I	0.097	0.988
94	*Trachinotus ovatus* (6)	99		13.02	0.241	11.3	34	10.9	351.4	0.0082	2.9668 I	0.08	0.957
95	*Trachinus draco* (1, 2)	27		18.07	1.210	6.2	26.5	1.7	125.0	0.0101	2.8354 N	0.134	0.989
96	*Trachinus radiatus* (6)	52		32.84	0.882	16.5	47	39.5	1008.0	0.0052	3.2062 P	0.126	0.968
97	*Trachyrhynchus trachyrhynchus* (3)[e]	142	PAL	16.78	0.473	3.8	30.4	2.3	860.0	0.0412	3.0606 P	0.174	0.984
98	*Trigla lyra* (3)	18		11.71	1.098	9.0	29.7	4.0	272.0	0.0092	2.9308 I	0.388	0.8
99	*Trigloporus lastoviza* (1)[e]	30		21.73	0.507	17.3	29.4	54.0	201.0	0.0196	2.7988 I	0.104	0.921
100	*Trisopterus minutus* (3)	56		11.87	0.298	8.7	20.6	5.0	89.0	0.0042	3.3425 P	0.15	0.938
101	*Umbrina cirrosa* (6, 7)	72		18.50	0.621	12.3	33.8	17.4	372.0	0.0119	2.9275 N	0.078	0.99
102	*Uranoscopus scaber* (1)	112		28.13	0.350	18.3	37.2	102.0	876.0	0.0106	3.148 P	0.089	0.96
103	*Zeus faber* (1, 2)	29		33.25	1.333	17.5	48	76.0	1823.0	0.0085	3.1445 P	0.088	0.987

[a] Fishing gear: (1) trammel net; (2) beam trawl; (3) bottom trawl; (4) purse seine; (5) long line; (6) hook and line; and (7) spearfishing.
[b] Length (in cm) of the species is expressed as total length, except for those indicated (PL, and PAL).
[c] Weight (in g) is expressed as total weight.
[d] Kind of growth: I, isometry; P, positive allometry; N, negative allometry.
[e] Those species which their WLR is lacking in Froese and Pauly (2002).

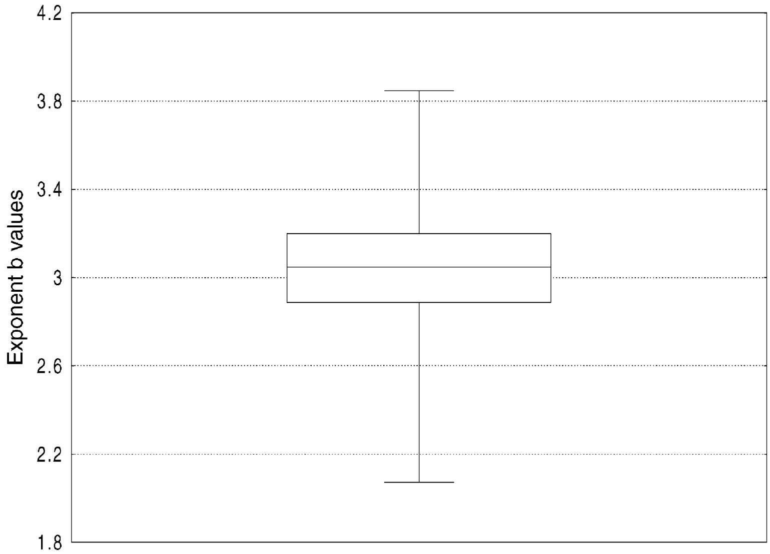

Fig. 1. Box–Whiskers plots of the exponent *b* of the WLR for the 103 species analyzed. The central box covers 50% of data values, the horizontal line indicates the median, and the vertical line represents the range of the values.

were 35 in relation to those obtained by Merella et al. (1997) in the Balearic waters, 30 in relation to those reported by Dulčić and Kraljević (1996) in the Croatian waters and 24 with regard to the WLRs calculated by Petrakis and Stergiou (1995) in Greek waters. The number of slopes significantly different from the values obtained in this study were 9 for Balearic and Greek waters, and 10 for Croatian waters. Therefore, although the WLRs may present spatial variation (Sparre et al., 1989), due to the influence of water quality or food availability on fish growth (Mommsen, 1998), we conclude that the observed differences in our comparisons can also be due to differences in sampling, since the number of specimens and length ranges of the species were distinct among localities.

For more precise weight estimations through WLRs it is advisable to make use of local values, as well to limit their application to the length ranges used to calculate the regression parameters.

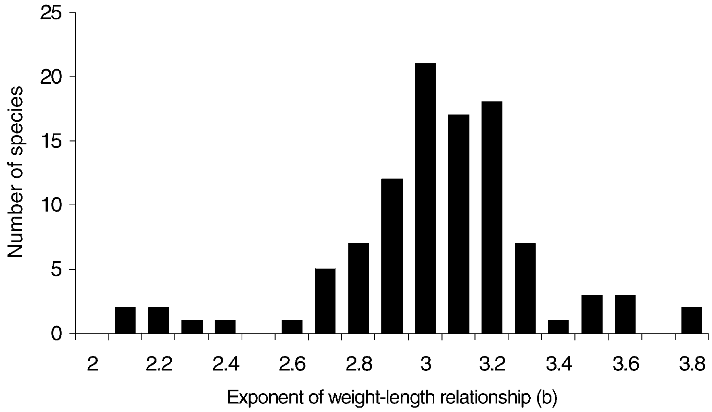

Fig. 2. Distribution of *b* values of the WLR.

Table 2
Number of specimens (*n*), total length ranges (TL range) and *b* values for those species compared between this study and Balearic waters (Merella et al., 1997), Croatian waters (Dulčić and Kraljević, 1996) and Greek waters (Petrakis and Stergiou, 1995)

Species	Balearic waters			Croatian waters			Greek waters		
	n	TL range	*b*	*n*	TL range	*b*	*n*	TL range	*b*
Boops boops	228	12.4–26.6	3				256	9.6–24.3	3.093
C. maculatus	13	6.1–9.6	2.49						
C. aper	104	3.2–12.2	2.81[a]						
C. cirrus	57	14.4–21	3.04[a]						
C. rubescens	39	18.5–50.7	1.51[a]						
Coris julis				94	4.3–15.3	3.238	207	5.7–16.6	3.378[a]
C. chromis				1230	5.9–13.9	3.102	42	4.5–10.9	2.415[a]
D. quadrimaculatus	28	7–9.2	3.05						
D. dentex				250	18.3–85.9	3.172	22	10.9–30	3.028
D. labrax				417	24.5–88	3.146			
D. annularis	94	4.3–14.5	3.2	100	8.9–23.5	2.928	313	6.5–13.5	3.002
D. puntazzo				289	5.9–45	2.951			
D. sargus				214	14.3–39.9	3.038			
D. vulgaris				601	5.2–32.2	3.028	28	6.5–14.7	2.71[a]
G. melastomus	461	9.5–60	3.02						
G. leioglossus	18	8.3–15	3.32						
H. mediterraneus	101	4.3–21.1	3.15						
L. crocodilus	25	9–21	2.98[a]						
L. lepidion	79	8.9–23.1	3.41						
L. boscii	84	7–19.5	3.14						
L. whiffiagonis	11	9.9–18.7	3.26[a]						
L. amia				115	27.5–43.3	2.607[a]			
L. mormyrus				605	15.4–39.5	3.022			
L. piscatorius	19	7.5–16.2	3.43[a]						
M. scolopax	34	6.3–14.4	3.15						
M. merluccius	240	5.9–21.4	3.07						
M. moro	113	7.3–35	3.37						
M. surmuletus	13	10.3–16.7	3.09	127	15.4–30.9	3.512[a]	307	10.1–20.1	3.14
N. bonapartei	22	16.3–26	3.06[a]						
P. acarne	106	9.8–19.4	3.3	74	10–23.7	3.499[a]	138	9.9–18.3	3.272
P. erythrinus	12	11.7–21.2	3.01	193	10.9–46	2.944	292	9.7–29.3	3.028[a]
P. pagrus				15	11.5–49	3.343[a]			
P. blennoides	343	5.5–53.8	3.27						
P. phycis				58	26.2–56.4	3.502[a]			
S. pilchardus							82	11.8–17.2	2.754[a]
S. aurita	13	15.1–23.8	2.99				24	16.2–22	2.84
S. salpa				437	13.9–41.6	3.126[a]			
S. umbra				26	18.1–41.2	3.048			
S. notata	90	5.1–14	2.98	57	10–18.5	2.64[a]	15	9.6–20.6	2.727[a]
S. porcus				351	9.7–26.6	3.243	100	7–23.5	2.84
S. scrofa				125	19.7–56.3	3.298[a]			
S. canicula	262	7.5–42.1	3.16[a]						
S. cabrilla	23	7.2–18.6	2.82				54	7.7–18.2	2.927
S. hepatus	61	4.7–11.1	3.24						
S. scriba							70	5.8–17.8	2.924
S. maena	11	15.3–18.2	2.9	220	14.5–27.5	3.037	33	11.7–18.4	2.663[a]
S. smaris	239	10.8–19.3	2.7				123	7.7–18.5	2.987
S. cantharus				321	9.5–43.6	3.093	48	7.4–15.8	2.849
S. cinereus							48	5.4–8.8	3.521
S. mediterraneus							19	6.3–13.6	3.012
S. ocellatus				88	3.9–9.1	2.937	31	4.4–9.9	3.221[a]

Table 2 (*Continued*)

Species	Balearic waters			Croatian waters			Greek waters		
	n	TL range	*b*	*n*	TL range	*b*	*n*	TL range	*b*
S. rostratus							70	8–12	3.486[a]
S. tinca				100	12.7–30.2	2.726	31	12.7–20.8	3.068[a]
S. saurus	49	16–37.3	3.19						
T. draco	14	9.6–24.2	2.93	22	9.2–26.8	2.934			
T. lyra	11	8.8–18.3	2.96						
T. lastoviza				52	7.4–35	3.003	15	12.1–23.9	2.951
T. minutus	61	8.4–15.6	3.06	109	11.2–24–3	3.22			
U. cirrosa				41	36.2–66.5	2.851			
U. scaber				36	15.2–34.1	3.004			
Z. faber	33	7.2–16.8	2.88[a]	40	6.9–52.5	2.941[a]			

[a] *b* values significantly different of those from this study.

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