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Length-Weight and Length-Length Relationships of the Main Commercial Fish Species in Izmir Bay (Aegean Sea Coast of Turkey) / 2020-2021 Fishing Season [*]

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Abstract: In this study, a total of 366 samples were collected and 30 of them belonged to *Sardina pilchardus*, 54 of *Engraulis encrasicolus*, 30 of *Belone svetovidovi*, 18 of *Caranx rhonchus*, 12 of *Trachurus mediterraneus*, 10 of *Trachurus trachurus*, 21 of *Mullus Barbatus*, 30 of *Mullus surmuletus*, 30 of *Boopss boops*, 35 of *Oblada melanura*, 46 of *Scomber colias*, 22 of *Scomber scombrus* and 28 of *Solea solea*, were obtained by commercial fishermen in the Izmir Bay (Aegean sea coast of Turkey) during period of 2020 and 2021 fishing season.

Negative allometry was determined for *Caranx rhonchus*, *Scomber colias* and *Solea solea* while positive allometry was present for *Engraulis encrasicolus* and the remaining 9 fish species have isometric growth.

The results indicated further that the length-length relationships were highly correlated for all examined fish species (r^2>0.900, P<0.05).

Keywords: Fishes, length-weight relationship, length-length relationship, izmir bay, aegean sea.

İzmir Körfezi'nde (Türkiye'nin Ege Denizi Kıyısı) Başlıca Ticari Balık Türlerinin Boy-Ağırlık ve Boy-Boy İlişkileri / 2020-2021 Av Sezonu

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Öz: Bu çalışmada 30'u *Sardina pilchardus*, 54'ü *Engraulis encrasicolus*, 30'u *Belone svetovidovi*, 18'i *Caranx rhonchus*, 12'si *Trachurus mediterraneus*, 10'u *Trachurus trachurus*, 21'i *Mullus Barbatus*, 30'u *Mullus surmuletus*, 30'u *Boopss boops*, 35'i *Oblada melanura*, 46'sı *Scomber colias*, 22'si *Scomber scombrus* ve 28'i *Solea solea* olmak üzere toplam 366 adet örnek 2020-2021 balıkçılık sezonunda İzmir Körfezi (Türkiye'nin Ege Denizi kıyıları)'nde avlanan ticari balıkçılardan elde edilmiştir.

Caranx rhonchus, *Scomber colias* ve *Solea solea* için negatif allometri belirlenirken, *Engraulis encrasicolus* için pozitif allometri ve diğer 9 balık türü isometrik büyüme saptanmıştır.

Sonuçlar ayrıca incelenen tüm balık türleri için boy-boy ilişkilerinin yüksek düzeyde ilişkili olduğunu göstermiştir (r^2>0,900, P<0,05).

Anahtar kelimeler: Balıklar, boy-ağırlık ilişkisi, boy-boy ilişkisi, izmir körfezi, ege denizi.

INTRODUCTION

The length-weight relationship (LWR) in fish is described by the power function $W = aL^b$, where W is weight, L is length and a and b are the species-specific parameters of the function, which can be estimated by regression analysis (Le Cren, 1951). Length-weight relationships (LWRs) have been commonly used by fisheries managers and aquatic biologists to appraise the fish stocks, the fisheries ecology and the population dynamics in aquatic ecosystems. and semi-controlled aquatic environments

(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 useful in local and interregional morphological and life historical comparisons in species and populations. Also the productivity level and ecological health of aquatic ecosystems could be assessed via length-weight models (Deekae & Abowei, 2010). These models help to evaluate the well-being and the growth patterns of fishes (Muchlisin et al., 2010; Ndiaye et al., 2015).

In fisheries studies, fish length can often be measured more rapidly and easily than mass.The knowledge of the length-weight relationship makes it easier to determine the mass where only the length is known. In the field, the tail fin are often cut which makes it difficult to measure the total length accurately. Knowing the standard length will enable us figure out the total length.

The length-weight relationships of the fish populations which examined this research were described by previous studies both in Turkish seas and in other localities (Torres et al., 2012; Daley, 2018; Froese & Pauly, 2022).

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 present study provides information on the length-weight and length-length relationships of 13 fish species, including some commercially important, found in Izmir Bay (central Aegean Sea of Turkey) in 2020 and 2021. The spesies studied are *Sardina pilchardus, Engraulis encrasicolus, Belone svetovidovi, Caranx rhonchus, Trachurus mediterraneus, Trachurus trachurus, Mullus barbatus, Mullus surmuletus, Boops boops, Oblada melanura, Scomber colias, Scomber scombrus* and *Solea solea*.

MATERIALS AND METHODS

In this study, 366 specimens were obtained from commercial fishermen in the Izmir Bay (central Aegean Sea of Turkey) between 2020 and 2021. Izmir Bay has a great ecological and economic importance of many fish species in the Aegean Sea coast of Turkey. Total length (TL), fork length (FL) and standart length (SL) of all 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 (Ricker, 199). The statistical significance level of r^2 was estimated by linear regressions on the transformed equation. 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.

Moreover, (1) TL vs FL; (2) FL vs SL; and (3) SL vs TL relationships were calculated by linear regressions. Length-length relationship (LLR) was measured as TL = a + bSL equations to standardize the length values used in other studies.

In order to test for likely significant differences in both slope and intercept, covariance analysis was performed. All statistical analyses were evaluated at $p<0.05$ significance level.

RESULTS

Fish from 13 species from 8 families and five orders were analyzed in present study. All examined individuals of *Sardina pilchardus* showed length group values of 11.1-15.0 cm. Mean total length and weight values of the species were 12.2±0.15 cm and 13.9±0.59 g, respectively. Total length-weight relationship was found $W = 0.0054*TL^{3.137}$ (r^2 = 0.904) with an isometric growth. 54 individuals of *Engraulis encrasicolus* species exhibited minimum maximum length range of 9.2-11.0 cm. Its mean total length and weight values were 10.2±0.09 cm and 13.9±0.59 g, respectively. Total length and weight relationship was $W = 0.0011*TL^{3.726}$ (r^2 = 0.886) with a positive allometric growth. 30 individuals of *Belone svetovidovi* had a minimum maximum length range of 28.8-36.7 cm. Its mean total length and weight values were 33.1±0.42 cm and 38.5±1.73 g, respectively. Total length weight relationship was $W = 0.0003*TL^{3.356}$ (r^2 = 0.849) with an isometric growth. 18 individuals of *Caranx rhonchus* had a minimum maximum length range of 13.5-18.1 cm. Its mean total length and weight values were 15.5±0.28 cm and 32.6±1.49 g, respectively. Total length weight relationship was $W = 0.0968*TL^{2.239}$ (r^2 = 0.809) with a negative allometric growth. 12 individuals of *Trachurus mediterraneus* species exhibited minimum maximum length range of 11.5-17.8 cm. Its mean total length and weight values were 13.8±0.49 cm and 22.3±2.95 g, respectively. Total length and weight relationship was $W = 0.0038*TL^{3.137}$ (r^2 = 0.904) with an isometric growth. 10 individuals of *Trachurus trachurus* had a minimum maximum length range of 20.5-24.5 cm. Its mean total length and weight values were 12.8±0.41 cm and 102.3±4.84 g, respectively. Total length weight relationship was $W = 0.0486*TL^{2.444}$ (r^2 = 0.816) with an isometric growth. 21 individuals of *Mullus barbatus* had a minimum maximum length range of 14.0-18.8 cm. Its mean total length and weight values were 15.8±0.26 cm and 42.4±2.12 g, respectively. Total length weight relationship was $W = 0.0177*TL^{2.815}$ (r^2 = 0.903) with

an isometric growth. 30 individuals of *Mullus surmuletus* species exhibited minimum maximum length range of 13.0-15.3 cm. Its mean total length and weight values were 14.2±0.11 cm and 34.9±0.88 g, respectively. Total length and weight relationship was $W = 0.0094*TL^{3.098}$ ($r^2 = 0.889$) with an isometric growth. 30 individuals of *Boops boops* had a minimum maximum length range of 13.0-19.0 cm. Its mean total length and weight values were 15.9±0.31 cm and 39.6±2.37 g, respectively. Total length weight relationship was $W = 0.0053*TL^{3.209}$ ($r^2 = 0.969$) with an isometric growth. 35 individuals of *Oblada melanura* species exhibited minimum maximum length range of 19.1-26.0 cm. Its mean total length and weight values were 22.2±0.29 cm and 143.6±5.85 g, respectively. Total length and weight relationship was $W = 0.0182*TL^{2.889}$ ($r^2 = 0.951$) with an isometric growth. 46 individuals of *Scomber colias* species exhibited minimum maximum length range of 23.0-30.0 cm. Its mean total length and weight values were 26.6±0.31 cm and 166.8±5.13 g, respectively. Total length and weight relationship was $W = 0.0483*TL^{2.480}$ ($r^2 = 0.877$) with a negative allometric growth. 30 individuals of *Scomber scombrus* had a minimum maximum length range of 25.5-31.8 cm. Its mean total length and weight values were 28.2±0.32 cm and 169.8±6.44 g, respectively. Total length weight relationship was $W = 0.0071*TL^{3.015}$ ($r^2 = 0.837$) with an isometric growth. 28 individuals of *Solea solea* species exhibited minimum maximum length range of 20.5-24.0 cm. Its mean total length and weight values were 22.6±0.17 cm and 98.9±1.85 g, respectively. Total length and weight relationship was $W = 0.0676*TL^{1.598}$ ($r^2 = 0.386$) with a negative allometric growth (Table 1).

All LLRs presented in Table 2 were highly significant ($p<0.05$), with all coefficient of determination values being greater than 0.980.

Table 1. Descriptive statistics and estimated parameters of length-weight relationships of main commercial fish species in Izmir Bay (Aegean Sea of Turkey) from 2020 to 2021 (N: number of individuals, a: intercept, b: slope, r^2: coefficient of determination).

Ordo	Family	Species	N	TL range (cm) (Min.-Max. Mean ± SE)	W range (g) (Min.-Max. Mean ± SE)	*a*	*b*	SE of *b*	95% C.I. of *b*	r^2	*t*-test	Growth type
Clupeiformes	Clupeidae	*Sardina pilchardus* (Walbaum, 1792)	30	11.1-15.0 12.2±0.15	9.6-23.8 13.9±0.59	0.0054	3.137	0.193	2.751-3.523	0.904	0.710	isometric
	Engraulidae	*Engraulis encrasicolus* (Linnaeus, 1758)	54	9.2-11.0 10.2±0.09	4.6-8.7 6.2±0.41	0.0011	3.726	0.186	3.354-4.098	0.886	3.903*	+allometry
Beloniformes	Belonidae	*Belone svetovidovi* Collette & Parin, 1970	30	28.8-36.7 33.1±0.42	20.5-56.4 38.5±1.73	0.0003	3.356	0.268	2.820-3.892	0.849	1.328	isometric
Perciformes	Carangidae	*Caranx rhonchus* E. Geoffroy Saint-Hilaire, 1877	18	13.5-18.1 15.5±0.28	21.9-49.7 32.6±1.49	0.0968	2.239	0.272	1.695-2.783	0.809	-2.798	-allometry
		Trachurus mediterraneus (Steindachner, 1868)	12	11.5-17.8 13.8±0.49	12.1-48.5 22.3±2.95	0.0038	3.137	0.193	2.751-3.523	0.904	0.710	isometric
		Trachurus trachurus (Linnaeus, 1758)	10	20.5-24.5 22.8±0.41	73.1-117.7 102.3±4.84	0.0486	2.444	0.410	1.624-3.264	0.816	-1.316	isometric
	Mullidae	*Mullus barbatus* Linnaeus, 1758	21	14.0-18.8 15.8±0.26	28.8-64.5 42.4±2.12	0.0177	2.815	0.212	2.391-3.239	0.903	-0.873	isometric
		Mullus surmuletus Linnaeus, 1758	30	13.0-15.3 14.2±0.11	26.7-43.5 34.9±0.88	0.0094	3.098	0.207	2.684-3.512	0.889	0.473	isometric
	Sparidae	*Boops boops* (Linnaeus. 1758)	30	13.0-19.0 15.9±0.31	21.4-65.0 39.6±2.37	0.0053	3.209	0.109	2.991-3.427	0.969	1.917	isometric
		Oblada melanura (Linnaeus, 1758)	35	19.1-26.0 22.2±0.29	94.97-232.99 143.6±5.85	0.0182	2.889	0.114	2.661-3.117	0.951	-0.974	isometric
Scombriformes	Scombridae	*Scomber colias* Gmelin, 1789	46	23.0-30.0 26.6±0.31	109.9-243.8 166.8±5.13	0.0483	2.480	0.140	2.200-2.760	0.877	-3.714	-allometry
		Scomber scombrus Linnaeus, 1758	22	25.5-31.8 28.2±0.32	120.78-228.35 169.8±6.44	0.0071	3.015	0.297	2.421-3.609	0.837	0.051	isometric
Pleuronectiformes	Soleidae	*Solea solea* (Linnaeus, 1758)	28	20.5-24.0 22.6±0.17	91.0-121.1 98.9±1.85	0.0676	1.598	0.395	0.808-2.388	0.386	-3.549	-allometry
Total			**366**									

Table 2: Length-length relationships between total length (TL), fork length (FL) and standard length (SL) of main commercial fish species in Izmir Bay (Aegean Sea of Turkey) from 2020 to 2021 (N: number of individuals, *a*: intercept, *b*: slope, r^2: coefficient of determination).

Ordo	Family	Species	Equation	N	*a*	*b*	r^2
Clupeiformes	Clupeidae	*Sardina pilchardus* (Walbaum, 1792)	FL=a+bSL	30	0.4036	1.0144	0.980
			TL=a+bFL TL=a+bSL		-0.0118	1.1091	0.974
					0.3147	1.1366	0.975
	Engraulidae	*Engraulis encrasicolus* (Linnaeus, 1758)	FL=a+bSL	54	1.0804	0.9353	0.971
			TL=a+bFL TL=a+bSL		-0.3269	1.1420	0.956
					0.7497	1.0862	0.960
Beloniformes	Belonidae	*Belone svetovidovi* Collette & Parin, 1970	FL=a+bSL	30	1.2031	0.9859	0.985
			TL=a+bFL TL=a+bSL		-0.3253	1.0491	0.991
					1.0047	1.0322	0.972
Perciformes	Carangidae	*Caranx rhonchus* E. Geoffroy Saint-Hilaire, 1877	FL=a+bSL	18	0.8571	0.9827	0.983
			TL=a+bFL TL=a+bSL		2.3677	0.9684	0.958
					2.6798	0.9917	0.903
		Trachurus mediterraneus (Steindachner, 1868)	FL=a+bSL	12	0.4775	1.0069	0.997
			TL=a+bFL TL=a+bSL		-0.3765	1.1496	0.991
					0.1460	1.1598	0.991
		Trachurus trachurus (Linnaeus, 1758)	FL=a+bSL	10	2.1965	0.9303	0.902
			TL=a+bFL TL=a+bSL		-0.9895	1.1728	0.985
					1.3899	1.1012	0.995
	Mullidae	*Mullus barbatus* Linnaeus, 1758	FL=a+bSL	21	-0.4914	1.1250	0.975
			TL=a+bFL TL=a+bSL		-0.6115	1.1784	0.969
					-1.1902	1.3257	0.945
		Mullus surmuletus Linnaeus, 1758	FL=a+bSL	30	0.4824	1.0303	0.923
			TL=a+bFL TL=a+bSL		1.0182	1.0601	0.938
					1.1781	1.1227	0.915
	Sparidae	*Boops boops* (Linnaeus, 1758)	FL=a+bSL	30	0.6479	1.0099	0.993
			TL=a+bFL TL=a+bSL		0.4236	1.1613	0.989
					0.2767	1.1767	0.989
		Oblada melanura (Linnaeus, 1758)	FL=a+bSL	35	-0.6765	1.1253	0.971
			TL=a+bFL TL=a+bSL		0.7476	1.1113	0.976
					0.2678	1.2654	0.970
Scombriformes	Scombridae	*Scomber colias* Gmelin, 1789	FL=a+bSL	46	0.2743	1.0106	0.958
			TL=a+bFL TL=a+bSL		-1.1094	1.1428	0.927
					-1.0425	1.1653	0.975
		Scomber scombrus Linnaeus, 1758	FL=a+bSL	22	1.4348	0.9659	0.989
			TL=a+bFL TL=a+bSL		3.0606	0.9632	0.959
					4.3443	0.9342	0.956
Pleuronectiformes	Soleidae	*Solea solea* (Linnaeus, 1758)	TL=a+bSL	28	2.2075	1.0209	0.908

Table 3. LWRs of commercial fish species from different areas (N: number of individuals, *a*: intercept, *b*: slope, r^2: coefficient of determination).

Species	References	Country, Locality	N	Length range (TL, cm)	*a*	*b*	r^2	SE of *b*	95% C.I. of *b*
Sardina pilchardus	Froese and Pauly, 2022	Selected 75 studies	25820	1.7-26.0	0.0057	3.110	-	0.220	2.670-3.550
	This study	Turkey, Izmir Bay / 2020-2021	30	12.6-28.4	0.0119	3.182	0.972	0.193	2.751-3.523
Engraulis encrasicolus	Froese and Pauly, 2022	Selected 93 studies	66420	2.1-20.0	0.0055	3.040	-	0.283	2.474-3.606
	This study	Turkey, Izmir Bay / 2020-2021	54	9.2-11.0	0.0011	3.726	0.886	0.186	3.354-4.098
Belone svetovidovi	Bilge et al., 2014	Turkey, Southern Agean Sea / 2009-2010	36	28.2-41.8	0.0070	3.117	0.830	0.114	2.889-3.345
	This study	Turkey, Izmir Bay / 2020-2021	30	28.8-36.7	0.0003	3.356	0.849	0.268	2.820-3.892
Caranx rhonchus	Froese and Pauly, 2022	Selected 6 studies	132	7.0-38.0	0.0224	2.790	-	0.195	2.400-3.180
	This study	Turkey, Izmir Bay / 2020-2021	18	13.5-18.1	0.968	2.239	0.809	0.272	1.695-2.783
Trachurus mediterraneus	Froese and Pauly, 2022	Selected 24 studies	7707	3.9-51.0	0.096	2.990	-	0.200	2.590-3.390
	This study	Turkey, Izmir Bay / 2020-2021	12	11.5-17.8	0.0038	3.137	0.904	0.193	2.751-3.523
Trachurus trachurus	Froese and Pauly, 2022	Selected 60 studies	57916	2.0-46.5	0.0091	2.970	-	0.160	2.650-3.290
	This study	Turkey, Izmir Bay / 2020-2021	10	20.5-24.5	0.0486	2.444	0.816	0.410	1.624-3.264
Mullus barbatus	Froese and Pauly, 2022	Selected 69 studies	82596	5.0-38.2	0.0085	3.120	-	0.156	2.808-3.432
	This study	Turkey, Izmir Bay / 2020-2021	21	14.0-18.8	0.0177	2.815	0.903	0.212	2.391-3.239
Mullus surmuletus	Froese and Pauly, 2022	Selected 75 studies	23719	4.4-46.5	0.0083	3.160	-	0.165	2.830-3.490
	This study	Turkey, Izmir Bay / 2020-2021	30	13.0-15.3	0.0094	3.098	0.889	0.207	2.684-3.512
Boops boops	Froese and Pauly, 2022	Selected 37 studies	7182	3.7-40.0	0.0087	3.060	-	0.158	2.744-3.376
	This study	Turkey, Izmir Bay / 2020-2021	30	13.0-19.0	0.0053	3.209	0.969	0.109	2.991-3.427
Oblada melanura	Froese and Pauly, 2022	Selected 14 studies	6868	8.0-36.6	0.0098	3.090	-	0.265	2.560-3.620
	This study	Turkey, Izmir Bay / 2020-2021	35	19.1-26.0	0.0182	2.889	0.951	0.114	2.661-3.117
Scomber colias	Daley, 2018	Northwest Atlantic	1136	22.4-38.6	0.0258	2.720	-	0.070	2.580-2.860
	Torres et al., 2012	Spain, Gulf of Cadiz	1307	9.0-35.1	0.0510	3.131	0.940	-	-
	This study	Turkey, Izmir Bay / 2020-2021	46	23.0-30.0	0.0483	2.480	0.877	0.140	2.200-2.760
Scomber scombrus	Froese and Pauly, 2022	Selected 35 studies	51608	7.5-47.5	0.0035	3.250	-	0.280	2.690-3.810
	This study	Turkey, Izmir Bay / 2020-2021	22	25.5-31.8	0.0071	3.015	0.837	0.297	2.421-3.609
Solea solea	Froese and Pauly, 2022	Selected 25 studies	16855	3.0-59.0	0.0068	3.100	-	0.258	2.584-3.616
	This study	Turkey, Izmir Bay / 2020-2021	28	20.5-24.0	0.0676	1.598	0.386	0.395	0.808-2.388

DISCUSSION AND CONCLUSION

In the present study, 366 individuals belonging to eight fish family species were examined. Studies previously made on length- weight relationship for 13 species examined in the present study are shown in Table 3.

Type of growth in fish (parameter *b* of LWR) normally tends to isometry, in the majority of species, fall between 2.5 and 3.5 (Froese, 2006) or 2 to 4 (Tesch, 1971). In this study, *b* values of the studied fish species were within these expected ranges.

Normally the differences in LWR parameters between different studies are related to different environmental and biological factors (Torres et al., 2012), spatial variation (Sparre et al., 1989), due to the influence of water quality or food availability on fish growth (Mommsen, 1998), photoperiodism and water temperature (Schultz and Conover, 1997), and also to the characteristics of the sampling, e.g., size ranges, number of individuals sampled, etc. (Torres et al., 2012). 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). Furthermore. the degree of sexual maturity, diet, fullness or emptying gut and sampling techniques, number and duration of sampling can affect its value (Wootton, 2003; Eagderi et al., 2020).

In conclusion, this study provided new information about LWRs and LLRs for 13 commercial important fish species from Izmir Bay (central Aegean Sea of Turkey) of 2020-2021 fishing season, *Trachurus trachurus* of which is included in vulnerable category by International Union for Conservation of Nature (IUCN) is expected to be of great contribution to fisheries management studies in future. Also added further data to those previously reported species, which will be helpful in biological studies. It is hoped that the present study leads to an improved knowledge and better understanding of the central Aegean Sea fish community.

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REFERENCES

Bagenal, T.B. & Tesch, F.W. (1978). Age and growth. In: T. Begenal (Ed.). Methods for assessment of fish production in fresh waters. 3rd Edn. IBP Handbook No. 3. *Blackwell Science Publications*. Oxford: 101-136.

Bilge, G., Yapici, S., Filiz, H. & Cerim, H. (2014). Weight-length relationshions for 103 fish species from the southern Aegean sea, Turkey. *Acta Ichthyol. Piscat.*, ***44***(3), 263-269.

Daley, T. (2018). Growth and reproduction of Atlantic chub mackerel (*Scomber colias*) in the Northwest Atlantic. M.S. Thesis, *University of Southern Mississippi*.

Deekae, S.N. & Abowei, J.F.N. (2010). *Macrobrachium mac-robrachion* (Herklots. 1851) length-weight relationship and Fulton's condition factor in Luubara creek. Ogoni land. Niger Delta. Nigeria. *International Journal of Animal and Veterinary Advances*, ***2***(4), 155-162.

Eagderi, S. Mouludi-Saleh, A. & Cicek, E. (2020). Length-weight relationship of ten species of Leuciscinae sub-family (Cyprinidae) from Iranian inland waters. *International Aquatic Research*.

12(2), 133-136. DOI: 10.22034/iar(20).2020.1891648.1004.

Froese, R. (2006). Cube law. condition factor and weight-length relationships: history. meta- analysis and recommendations. *Journal of Applied Ichthyology*. ***22***(4), 241-253. DOI: 10.1111/j.1439-0426.2006.00805.x.

Froese, R. & Pauly, D. (2022). FishBase. 2022. World Wide Web Electronic Publication. Available at: Http://Www. Fishbase. Org (Accessed on 10 February 2022).

IUCN. (2022). International Union for Conservation of Nature. https://www.iucnredlist.org/

Le Cren, E.D. (1951). The length-weight relation-ship and seasonal cycle in gonad weight and condition in the perch (*Perca fluviatilis*). *J. Anim. Ecol.*, ***20***(2), 201-219.

Mommsen, T.P. (1998). Growth and metabolism. In: EVANS, D.H. (ed.) *The Physiology of Fishes*. CRC Press, New York. 65-97 p.

Moutopoulos, D.K. & Stergiou, K.I. (2002). Length-weight and length-length relationships of fish species of the Aegean Sea (Greece). *J. Appl. Ichthyol*. ***18***(3), 200-203. DOI: 10.1046/j.1439-0426.2002.00281.x

Muchlisin, Z.A., Musman, M. & Siti Azizah, M.N. (2010). Length-weight relationships and condition factors of two threatened fishes. *Rasbora tawarensis* and *Poropuntius tawarensis*. endemic to Lake Laut Tawar. Aceh Province. Indonesia. *Journal of Applied Ichthyology*. ***26***(6). 949-953. DOI: 10.1111/j.1439-0426.2010.01524.x

Ndiaye, W., Diouf, K., Samba, O., Ndiaye, P. & Panfili, J. (2015). The length-weight relationship and condition factor of white grouper (*Epinephelus aeneus*. Geoffroy Saint Hilaire. 1817) at the south-west coast of Senegal. West Africa. *International Journal of Advanced Research*. ***3***(3), 145-153.

Pauly, D. (1993). Fishbyte Section. Editorial. Naga. ICLARM Quart. 16:26.

Ricker, W.E. (1968). Methods for assessment of fish production in fresh waters. IBP Handbook No. 3.

Ricker, W.E. (1979). Growth rates and Models. In: Hoar WS, Randall DJ & Brett JR (eds), *Fish Physiology*, Vol. VIII, Bioenergetics and Growth, Academic Press, 677-743.

Schultz, E.T. & Conover, D.O. (1997). Latitudinal differences in somatic energy storage: adaptive responses to seasonality in an estuarine fish (Atherinidae: *Menidia menidia*). *Oecologia*, ***109***(4), 516-529.

Sparre, P., Ursin, E. & Venema, S.C. (1989). Introduction to tropical fish stock assessment. Part I. Manual. In: *FAO Fisheries Technical Paper* No. 306. 407p.

Tesch, F.W. (1971). Age and growth. In W. E. Ricker (Ed.). *Methods for assessment of fish production in fresh waters* (pp. 98-130). *Blackwell Scientific Publications*.

Torres, M.A., Ramos, F. & Sobrino, I. (2012). Length-weight relationships of 76 fish species from the Gulf of Cadiz (SW Spain). *Fish. Res.*, ***127-128***, 171-175.

Wootton, R. J. (2003). *Ecology of teleost fishes*. Chapman and Hall Ltd.