Turk. J. Fish.& Aquat. Sci. 19(1),71-79
http://doi.org/10.4194/1303-2712-v19_1_09

SHORT PAPER

Turkish Journal of FISHERIES and AQUATIC SCIENCES

Length-Weigth Relationships for Nine Chondrichthyes Fish Species from Edremit Bay (North Aegean Sea)

Dilek Türker[1,*], Kadriye Zengin[1], Özgür Kemal Tünay[1]

[1] Department of Biology, Faculty of Science and Arts, Balikesir University, Balikesir, Turkey

Article History
Received 09 October 2017
Accepted 13 February 2018
First Online 18 February 2018

Corresponding Author
Tel.: +90 0266 612 10 00
E-mail: dturker@balikesir.edu.tr

Keywords
Chondrichthyes
Length-Weight Relationship
Edremit Bay

Abstract

Length-weight relationships were calculated for 9 chondrichthyes fish species totalizing 284 inviduals from Edremit Bay (North Aegean Sea) caught with bottom trawls between June 2007 and June 2009. It was calculated as W=0.1306 TL $^{2.1701}$ (r^2=0.8645) for *Dasyatis pastinaca,* W=0.1139 TL $^{2.7088}$ (r^2=0.9768) for *Mustelus mustelus,* W=0.0014 TL $^{3.1795}$ (r^2=0.8742) for *Myliobatis aquila,* W=0.0322 TL $^{2.5597}$ (r^2=0.8836) for *Raja clavata,* W=0.0215 TL $^{2.5654}$ (r^2=0.7152) for *Raja miraletus,* W=0.0029 TL $^{3.2142}$ (r^2=0.9262) for *Raja radula,* W=0.000006 TL $^{2.8817}$ (r^2=0.8138) for *Scyliorhinus canicula,* W=0.0004 TL $^{3.6397}$ (r^2=0.6365) for *Scyliorhinus stellaris,* W=0.1297 TL $^{2.4665}$ (r^2=0.8022) for *Torpedo marmorata.* In addition, 157 previous studies were carried out on the characterization of L–W relationships for 12 chondricthtyes fish species in Turkey waters. The values of the *b* values identified by other authors varied from 2.122 to 4.15. The mean value of *b* was 3.165 (SE = ±0.025).

Introduction

Fisheries management and research often require the use of biometric relationships in order to transform data collected in the field into appropriate indexes (Anderson & Gutreuter, 1983; Ecoutin & Albaret, 2003). One of the most commonly used in any analysis of fishery data is the length-weight relationship ($W=aL^b$). According to Andrade and Campos (2002), this is particularly useful when sampling large species, because of the difficulty and time required to record weight in the field. Besides the estimation of weight from length (Beyer, 1991; Martin-Smith, 1996), the length-weight relationship has several applications, including the conversion of a growth equation in length into a growth equation in weight (Pauly, 1993; Pérez & Contreras, 1995; Merella, Qetglas, Alemany, & Carbonell, 1997). Establishment of a relationship between length and weight is essential for the calculation of production and biomass of a fish population (Anderson & Gutreuter, 1983; Safran, 1992; Petrakis & Stergiou, 1995; Dulčić & Kraljevic, 1996; Moutopoulos & Stergiou, 2002), allowing also for morphological comparisons among species or among populations of the same species from different habitats and/or regions (Gonçalves *et al*., 1997; Moutopoulos & Stergiou, 2002). It is frequently used to follow seasonal variations in fish growth and to estimate condition indexes (Anderson & Gutreuter, 1983; Safran, 1992; Richter, Lückstädt, Focken & Becker, 2000). Estimates of the relationship parameters a and b can be related to ecological processes and life history. They are also useful for between-region comparisons of life histories of a certain species (Pauly, 1993; Petrakis & Stergiou, 1995; Gonçalves *et al.,* 1997; Merella *et al.,* 1997).

Previous studies were carried out on the characterization of L–W relationships for chondricthtyes species in Turkey waters, e.g. Demirhan, Engin, Seyhan and Akamca (2005), Demirhan and Seyhan (2007) in the Southeastrn Black Sea, Bök, Gokturk, Kahraman and Alicli (2011) in Marmara Sea, Yeldan and Avsar (2007), Yeldan, Avsar and Manasırlı (2008), Yeldan, Avsar and Manasırlı (2009) in the Northeastern Mediterranean, Guven, Kebepcıoglu and Deval (2011) in the Eastern

Mediterranean, Filiz and Mater (2002), Filiz and Bilge (2004), Karakulak, Erk and Bilgin (2006), Ismen, Ozen, Altinagac, Ozekinci and Ayaz (2007), Ozaydın, Uckun, Akalın, Leblebici and Tosunoglu (2007), Cakir-Turker, Koc-Torcu, Basusta and Basusta (2008), Ilkyaz, Metin, Soykan and Kinacigil (2008), Hepkafadar (2008), Yigin and Ismen (2009), Ismen, Yigin, Altinagac and Ayaz (2009) northern and in the east coasts of Aegean Sea. In the present study, length-weight relationships were estimated for nine chondricththyes fish species (*Dasyatis pastinaca* (Linnaeus, 1758)*, Mustelus mustelus* (Linnaeus, 1758)*, Myliobatis aquila* (Linnaeus, 1758)*, Raja clavata* Linnaeus, 1758*, Raja miraletus* Linnaeus, 1758*, Raja radula* Delaroche, 1809*, Scyliorhinus canicula* (Linnaeus, 1758)*, Scyliorhinus stellaris* (Linnaeus, 1758) and *Torpedo marmorata* Risso, 1810) captured in the Edremit Bay (North Aegean Sea) for which few data are available in the scientific literature. The present contribution aims to compensate for this lack of information.

Materials and Methods

Samples were collected at depths ranging from 20 to 100 m in Edremit Bay, North Aegean Sea at monthly sampling intervals using a commercial bottom trawl net from June 2007 to June 2009. Fishes were caught by using deep trawl nets with 24 mm cod end mesh size; tow duration was restricted to 30 min. Fish were measured to the nearest cm (total length) and weighed to the nearest g (total weight). The relationship between total length and weight, $W = aL^b$ 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 $P = 0.05$ significance level to verify if it was significantly different from 3. Species with too small a sample size (N<7) were not take into account. In the length weight equation a is the intercept and b is slope (=exponent) of the length-weight curve (King, 1996; Cakir-Turker *et al.,* 2008)

Results and Discussion

Analyzed were 284 individuals belonging to 16 Chondrichthyes species from 10 families: Lamnidae, 1 species; Cetorhinidae, 1; Scyliorhinidae 2; Triakidae 2; Squalidae 1; Torpenidae 1; Rajidae, 5; Dasyatidae, 1; Gymnuridae, 1; and Myliobatidae, 1 species. All sample sizes, minimum and maximum length and weight, parameters of length–weight relationship (*a* and *b*), and the coefficient of determination (r^2) are given in Table 1 for nine species where a sufficient n was available. In the present study the r^2 values ranged from 0.9768 for *M. mustelus* to 0.6365 for *S. stellaris*. The *b* values ranged from 2.1701 for *D. pastinaca* to 3.6397 for *S. stellaris*. The kind of growth given with t-test in Table 1. Two species (*D. pastinaca* and *T. marmorata*) showed b<2.5, and in one case (*S. stellaris*) was b>3.5. The mean value of *b* was 2.82 (SE = ±0.15). Six species (*D. pastinaca*, *M. mustelus, R. clavata, R. miraletus, S. canicula and T. marmorata*) showed negative allometric, and three species (*M. aquila*, *R. radula and S. stellaris*) positive allometric growth in Table 1.

Descriptive statistics for seven species (*Carcharodon carcharias* (Linnaeus, 1758)*, Cetorhinus maximus* (Gunnerus, 1765)*, Galeorhinus galeus* (Linnaeus, 1758), *Gymnura altavela* (Linnaeus, 1758)*, Leucoraja naevus* (Müller & Henle, 1841)*, Rostroraja alba* (Lacepède, 1803)*, Squalus acanthias* Linnaeus, 1758) where sample size was below 7 are presented in Table 2. Despite this small sampling, the length-weight relationship can be computed for these rare specimens (Froese, 2006). Previous studies providing length–weight relationships for some of the species are given in Table 3 for comparative purposes. As can be seen in Table 3, *b* values identified by other authors varied from 2.122 to 4.15. The mean value of *b* was 3.165 (SE = ±0.025). The median value of *b* was 3.23, whereas 50% of the values ranged between 2.93 and 3.39 (Figure. 1). From the coefficient of the length–weight relationship for *S. canicula* and *M. mustelus*, it is seen that their weight

Table 1. Length-weight relationships for nine Chondrichthyes fish spesies caught in Edremit Bay, North Aegean Sea.(N: Sample Size; Min: Minimum; Max: Maximum; a and b, Intercept and Slope of Length–Weight Relationships; r^2, Coefficient of Determination; C, Combined; -A: Negative Allometric; +A: Positive Allometric; 95% C.I. of b: 95% Confidence Intervals of b)

Species	Sex	N	Length (cm)		Weight (g).		Relationship parameters			Type of growth (b=3, P=0.05)	95% C.I. of b
			Min.	Max.	Min.	Max	*a*	*B*	r^2		
Dasyatis pastinaca	C	10	23.5	40.61	128	401.8	0.1306	2.1701	0.8645	- A	2.1701±0.095
Mustelus mustelus	C	60	39.4	75	2486	13940	0.1139	2.7088	0.9768	-A	2.7088±0.041
Myliobatis aquila	C	12	41.5	58.5	179.2	645	0.0014	3.1795	0.8742	+A	3.1795±0.069
Raja clavata	C	33	29.9	74.5	200	3400	0.0322	2.5597	0.8836	-A	2.5597±0.104
Raja miraletus	C	13	34.5	41.5	184.4	324.2	0.0215	2.5654	0.7152	-A	2.5654±0.045
Raja radula	C	23	25	51	98.4	1088	0.0029	3.2142	0.9262	+A	3.2142±0.072
Scyliorhinus canicula	C	108	246	830	63.67	2680	0.000006	2.8817	0.8138	-A	2.8817±0.281
Scyliorhinus stellaris	C	8	41.5	85	222.6	5804	0.0004	3.6397	0.6365	+A	3.6397±0.274
Torpedo marmorata	C	9	21	38	225	1275.1	0.1297	2.4665	0.8022	-A	2.4665±0.102

Table 2. Descriptive statistics for 7 Chondrichthyes fish species caught in Edremit Bay, North Aegean Sea (N: Sample Size; F: Female; M: Male; Min: Minimum; Max: Maximum)

			Total Length (cm)			Weight (g)		
Species	Sex	N	Min	Max	Mean	Min	Max	Mean
Carcharodon carcharias	F	1			180.0			47.5
Cetorhinus maximus	M	1			1180.0			2000000
Galeorhinus galeus	M	2	57.5	63	60.25	642.0	845.8	743.9
Gymnura altavela	F	1			66.0			725.0
Leucoraja naevus	M	1			47.0			815.0
Rostroraja alba	M	2	30.5	70.5	50,5	154.6	170.5	162.55
Squalus acanthias	M	2	65.5	70.2	67.85	850.0	920.0	885.0

Table 3. Length–weight relationship parameters of Chondrichthyes fish species obtained by other authors from coasts of Turkey (C: Combined; F:Female; M:Male; *: unidentified sex; TL:Total Length; DW:Disc Width; N:Sample size; a and b: Intercept and Slope of Length–Weight Relationships; r^2, Coefficient of Determination)

Species	Area	Sex	Type of Length	Size Range (cm)	Weight (g)	N	a	b	r^2	Authors
D. pastinaca	North Aegean Sea	F	TL	40.3-68	392.42-1750	6	0.0108	2.8574	0.9808	Filiz and Mater (2002)
D. pastinaca	North Aegean Sea	M	TL	40.0-74.2	387.83-2955	8	0.0092	2.9334	0.978	Filiz and Mater (2002)
D. pastinaca	North Aegean Sea	C	TL	40-74.20	387.83-2955	14	0.0085	2.9379	0.9687	Filiz and Mater (2002)
D. pastinaca	İskenderun Bay	F	TL	20.5-88	*	110	0.00091	3.44	0.94	İsmen (2003)
D. pastinaca	İskenderun Bay	M	TL	20-73	*	146	0.00237	3.17	0.95	İsmen (2003)
D. pastinaca	İskenderun Bay	C	TL	20-88	*	256	0.00144	3.31	0.94	İsmen (2003)
D. pastinaca	North Aegean Sea	C	TL	37.3-74.2	333.23-2955	29	0.0149	2.81	0.85	Filiz and Bilge (2004)
D. pastinaca	North Aegean Sea	*	TL	29.2-37.8	*	12	0.1168	2.122	0.642	Karakulak *et al.* (2006)
D. pastinaca	Saros Bay	C	DW	20.5-66	282-14602	48	0.01259	3.3024	0.99	Ismen *et al.* (2007)
D. pastinaca	Izmir Bay	*	TL	44.2-138	*	16	0.0023	3.248	0.986	Ozaydin *et al.* (2007)
D. pastinaca	Northeastern Mediterranean	F	TL	29-100.9	45.3-6800.1	189	0.0025	3.186	0.97	Yeldan and Avsar (2007)
D. pastinaca	Northeastern Mediterranean	M	TL	23.4-69.5	22.5-2950.2	145	0.0014	3.338	0.95	Yeldan and Avsar (2007)
D. pastinaca	Northeastern Mediterranean	C	TL	23.4-109.9	22.5-6800.1	334	0.002	3.242	0.97	Yeldan and Avsar (2007)
D. pastinaca	Cenral Aegean Sea	C	DW	19-43.2	*	31	0.0102	3.37	0.984	Ilkyaz *et al.* (2008)
D. pastinaca	Saros Bay	M	TL	40-110.0	440-16560	26	0.00052	3.64	0.951	Yığın and Ismen (2009)
D. pastinaca	Saros Bay	F	TL	37.5-114.0	282.4-14750	45	0.00078	3.54	0.956	Yığın and Ismen (2009)
D. pastinaca	Saros Bay	C	TL	37.5-114.0	282.40-16560	71	0.00074	3.55	0.957	Yığın and Ismen (2009)
D. pastinaca	Northeastern Mediterranean	C	TL	14.60-100.9	22.5-6800	346	0.0033	3.1429	*	Yeldan *et al.* (2009)
D. pastinaca	İskenderun Bay	M	DW	15-64	96-8660	195	0.0419	3.3169	0.84	Başusta *et al.* (2012)
D. pastinaca	North Aegean Sea	F	TL	37.5-114	282.4-14750	52	0.0008	3.507	0.96	Yığın and Ismen (2012)
D. pastinaca	North Aegean Sea	M	TL	40-110	440-16560	32	0.0005	3.609	0.94	Yığın and İsmen (2012)
D. pastinaca	Central Aegean Sea	F	TL	33.4-138	191.38-21100	42	0.9713	3.51	0.971	Eronat and Özaydın (2014)
D. pastinaca	Central Aegean Sea	M	TL	36.5-80	295.14-4000	36	0.0021	3.29	0.954	Eronat and Özaydın (2014)
D. pastinaca	Central Aegean Sea	C	TL	33.4-138	191.38-21100	78	0.0011	3.46	0.968	Eronat and Özaydın (2014)
D. pastinaca	İskenderun Bay	C	DW	16.60-69.30	94-10564	384	0.0252	3.0804	0.972	Girgin and Başusta (2016)
G. altavela	North Aegean Sea	C	TL	37.5-72	1188-9000	9	0.0268	2.96	0.98	Filiz and Bilge (2004)
G. altavela	Izmir Bay	C	TL	37.6-95	*	17	0.0449	2.84	0.986	Ozaydin *et al.* (2007)
G. altavela	Northeastern Mediterranean	F	TL	30.2-79.8	450.1-1500	69	0.0011	3.208	0.97	Yeldan and Avsar (2007)
G. altavela	Northeastern Mediterranean	M	TL	30.7-83.5	360.5-2400.1	38	0.0057	3.358	0.97	Yeldan and Avsar (2007)
G. altavela	Northeastern Mediterranean	C	TL	30.2-83.5	360.5-2400.1	107	0.009	3.234	0.98	Yeldan and Avsar (2007)
G. altavela	Central Aegean Sea	C	DW	47.1-88.3	*	9	0.0025	3.27	0.97	Ilkyaz *et al.* (2008)
G. altavela	İskenderun Bay	M	DW	30-127	250-15800	48	0.017	2.7948	0.73	Başusta *et al.* (2012)
M. mustelus	North Aegean Sea	F	TL	44-97.5	200-3170	10	0.0008	3.3066	0.9638	Filiz and Mater (2002)
M. mustelus	North Aegean Sea	M	TL	38.3-85.2	116.37-1988	14	0.0006	3.392	0.9829	Filiz and Mater (2002)
M. mustelus	North Aegean Sea	C	TL	38.3-97.5	116.37-3170	24	0.0008	3.3259	0.9745	Filiz and Mater (2002)
M. mustelus	North Aegean Sea	C	TL	38.3-97.5	116.37-3170	35	0.0011	3.25	0.97	Filiz and Bilge (2004)
M. mustelus	Saros Bay	C	TL	58.9-152.2	560-14430	26	0.00131	3.1895	0.986	Ismen *et al.* (2007)
M. mustelus	Izmir Bay	C	TL	51.4-95.5	*	17	0.0044	2.912	0.982	Ozaydin *et al.* (2007)
M. mustelus	Izmir Bay	F	TL	38.9-141.1	400-7500	110	0.1353	2.2187	0.902	Hepkafadar (2008)
M. mustelus	Izmir Bay	M	TL	34.0-138.1	500-7300	80	0.0902	2.311	0.9073	Hepkafadar (2008)
M. mustelus	Izmir Bay	C	TL	34.0-141.1	400-7500	190	0.106	2.274	0.91	Hepkafadar (2008)
M. mustelus	Central Aegean Sea	C	TL	25.6-125.1	*	148	0.0027	3.05	0.979	Ilkyaz *et al.* (2008)

Table 3. Contiuned

Species	Area	Sex	Type of Length	SizeRange(cm)	Weight (g)	N	a	b	r^2	Authors
M. mustelus	Saros Bay	F	TL	49-152.2	382-14431	24	0.0025	3.0583	*0.991*	Ismen *et al*. (2009)
M. mustelus	Saros Bay	M	TL	46.8-148.3	390-10270	46	0.0036	2.964	*0.987*	Ismen *et al*. (2009)
M. mustelus	Saros Bay	C	TL	46.8-152.2	382-14431	70	0.0034	2.9789	*0.988*	Ismen *et al*. (2009)
M. mustelus	Antalya Bay	F	TL	52.6-87.4	565.2-2260	4	0.0974	2.77	*0.999*	Guven *et al*. (2011)
M. mustelus	Central Aegean Sea	F	TL	42-113.3	190-4780	13	0.0017	3.16	*0.971*	Eronat and Özaydin (2014)
M. mustelus	Central Aegean Sea	M	TL	41.8-91.5	121.8-2690	28	0.0006	3.39	*0.981*	Eronat and Özaydin (2014)
M. mustelus	Central Aegean Sea	C	TL	41.8-113.3	121.8-4780	41	0.001	3.27	*0.971*	Eronat and Özaydin (2014)
M. aquila	North Aegean Sea	C	TL	47.5-76.5	274.09-1500	14	0.0008	3.34	*0.93*	Filiz and Bilge (2004)
M. aquila	Saros Bay	C	TL	23.5-100	184-12990	14	0.01252	3.0233	*0.971*	Ismen *et al*. (2007)
M. aquila	Central Aegean Sea	C	TL	23.5-54.5	*	39	0.0058	3.28	*0.986*	Ilkyaz et al. (2008)
M. aquila	Saros Bay	F	TL	41-121	146-12990	33	0.00007	3.89	*0.934*	Yığın and Ismen (2009)
M. aquila	Saros Bay	M	TL	29.5-90.5	120-2848	33	0.00139	3.15	*0.918*	Yığın and Ismen (2009)
M. aquila	Saros Bay	C	TL	29.5-121	120-12990	66	0.00027	3.56	*0.916*	Yığın and Ismen (2009)
R. clavata	North Aegean Sea	F	TL	20.5-99	28.86-2614.28	21	0.0018	3.2532	*0.9281*	Filiz and Mater (2002)
R. clavata	North Aegean Sea	M	TL	29.7-67	94.36-1934.8	8	0.0006	3.5629	*0.9839*	Filiz and Mater (2002)
R. clavata	North Aegean Sea	C	TL	20.5-99	28.86-2614.28	29	0.0016	3.2914	*0.9337*	Filiz and Mater (2002)
R. clavata	North Aegean Sea	C	TL	20.5-99	28.86-2614.28	37	0.0016	3.3	*0.94*	Filiz and Bilge (2004)
R. clavata	Southeastern Black Sea	F	TL	34.3-88.2	170-5450	*	0.0003	3.7	*0.94*	Demirhan *et al*. (2005)
R. clavata	Southeastern Black Sea	M	TL	48-95	620-5000	*	0.005	3.02	*0.96*	Demirhan *et al*. (2005)
R. clavata	Southeastern Black Sea	C	TL	34.3-95	170-5450	*	0.001	3.42	*0.91*	Demirhan *et al*. (2005)
R. clavata	Saros Bay	C	DW	6.0-60.0	5.0-4610.0	112	0.013	3.1163	*0.997*	Ismen *et al*. (2007)
R. clavata	Northeastern Mediterranean	F	TL	29.3-64.6	110-1120.1	30	0.0046	3.032	*0.99*	Yeldan and Avsar (2007)
R. clavata	Northeastern Mediterranean	M	TL	38.9-57.8	208-995.1	47	0.002	3.232	*0.97*	Yeldan and Avsar (2007)
R. clavata	Northeastern Mediterranean	C	TL	29.3-64.6	110-1120,1	77	0.0037	3.08	*0.98*	Yeldan and Avsar (2007)
R. clavata	Northeastern Mediterranean	F	TL	29.3-64.6	110-1120	37	0.047	3.0174	*0.98*	Yeldan *et al*. (2008)
R. clavata	Northeastern Mediterranean	M	TL	35.9-57.8	208-995	53	0.012	3.3884	*0.99*	Yeldan *et al*. (2008)
R. clavata	Northeastern Mediterranean	C	TL	29.3-64.6	110-1120	90	0.0034	3.1003	*0.99*	Yeldan *et al*. (2008)
R. clavata	Central Aegean Sea	C	DW	29-51.3	*	24	0.0335	2.89	*0.956*	Ilkyaz *et al*. (2008)
R. clavata	Saros Bay	F	TL	10.0-88.0	5.0-4622.0	128	0.00181	3.31	*0.991*	Yığın and Ismen (2009)
R. clavata	Saros Bay	M	TL	11.0-76.0	6.30-2900	98	0.00146	3.34	*0.991*	Yığın and Ismen (2009)
R. clavata	Saros Bay	C	TL	10.0-88.0	5.0-4622.0	226	0.00163	3.32	*0.99*	Yığın and Ismen (2009)
R. clavata	Sea of Marmara	C	TL	12.2-70	0.015-2628	24	0.00001	2.867	*0.893*	Bök *et al*. (2011)
R. clavata	Sea of Marmara	F	DW	10.5-65.0	*	35	0.028	2.9	*0.981*	Demirel and Dalkara (2012)
R. clavata	Sea of Marmara	M	DW	9.6-45.0	*	23	0.028	2.887	*0.99*	Demirel and Dalkara (2012)
R. clavata	Sea of Marmara	C	DW	9.6-65.0	*	170	0.113	2.42	*0.774*	Demirel and Dalkara (2012)
R. clavata	Central Aegean Sea	F	TL	12.6-70.2	6.01-2160	78	0.0007	3.48	*0.991*	Eronat and Özaydin (2014)
R. clavata	Central Aegean Sea	M	TL	12.7-60.5	5.97-1200	59	0.0007	3.5	*0.974*	Eronat and Özaydin (2014)
R. clavata	Central Aegean Sea	C	TL	12.6-70.2	5.97-2160	137	0.0006	3.52	*0.963*	Eronat and Özaydin (2014)
R. clavata	İskenderun Bay	M	DW	25-70	145-2260	38	0.023	2.6421	*0.76*	Başusta et.al. (2012)

Table 3. Contiuned

Species	Area	Sex	Type of Length	SizeRange (cm)	Weight (g)	N	a	b	r^2	Authors
R. miraletus	North Aegean Sea	C	TL	30-56.5	100.01-1000.54	13	0.0001	4.0173	0.9251	Filiz and Mater (2002)
R. miraletus	North Aegean Sea	C	TL	30-50.5	100-900	13	0.0001	4.15	0.93	Filiz and Bilge (2004)
R. miraletus	Saros Bay	C	DW	6.5-30.5	6-530	30	0.00891	3.2231	0.968	Ismen *et al.* (2007)
R. miraletus	Izmir Bay	C	TL	39-53.5	*	12	0.0063	2.948	0.969	Ozaydin *et al.* (2007)
R. miraletus	Saros Bay	F	TL	25.5-47.7	90-530	29	0.00175	3.28	0.924	Yığın and Ismen (2009)
R. miraletus	Saros Bay	M	TL	10.5-53.5	5.82-1010	23	0.00246	3.15	0.952	Yigin and Ismen (2009)
R. miraletus	Saros Bay	C	TL	10.5-53.5	5.82-1010	52	0.00173	3.27	0.951	Yığın and Ismen (2009)
R. miraletus	İskenderun Bay	M	DW	24-54	58-998	11	0.0021	3.262	0.95	Başusta *et al.* (2012)
R. radula	Northern Aegean Sea	C	TL	17.4-70	*	25	0.003	3.217	0.937	Karakulak *et al.* (2006)
R. radula	Saros Bay	C	DW	12.5-39	46-1661	49	0.01131	3.2491	0.981	Ismen *et al.* (2007)
R. radula	Northeastern Mediterranean	F	TL	22.6-68.1	25.6-1610	144	0.0013	3.354	0.99	Yeldan and Avsar (2007)
R. radula	Northeastern Mediterranean	M	TL	21.1-58.1	26.4-1102.5	152	0.0011	3.363	0.98	Yeldan and Avsar (2007)
R. radula	Northeastern Mediterranean	C	TL	21.1-68.1	25.6-1610	295	0.0012	3.358	0.99	Yeldan and Avsar (2007)
R. radula	Saros Bay	F	TL	17-61	40-1661	118	0.00199	3.34	0.974	Yığın and Ismen (2009)
R. radula	Saros Bay	M	TL	19-54	46-1112	86	0.00251	3.25	0.972	Yığın and Ismen (2009)
R. radula	Saros Bay	C	TL	17-61	40-1661	204	0.00205	3.32	0.971	Yığın and Ismen (2009)
R. radula	Central Aegean Sea	F	TL	43.2-61.2	480-1604	10	0.0018	3.33	0.946	Eronat and Özaydın (2014)
R. radula	Central Aegean Sea	M	TL	41.5-57.4	418.58-1160	6	0.0035	3.14	0.959	Eronat and Özaydın (2014)
R. radula	Central Aegean Sea	*C*	TL	41.5-61.2	418.58-1604	16	0.0017	3.33	0.94	Eronat and Özaydın (2014)
R. alba	Saros Bay	C	DW	9.5-93	8-11723	43	0.00662	3.2012	0.994	Ismen *et al.* (2007)
R. alba	Izmir Bay	C	TL	25.2-53.4	*	11	0.009	3.478	0.985	Ozaydin *et al.* (2007)
R. alba	Central Aegean Sea	C	DW	16.1-35.2	*	5	0.0083	3.13	0.99	Ilkyaz *et al.* (2008)
R. alba	Saros Bay	F	TL	18.1-159	16-33000	67	0.00216	3.25	0.968	Yığın and Ismen (2009)
R. alba	Saros Bay	M	TL	14-135	7.93 -14500	59	0.00167	3.3	0.995	Yığın and Ismen (2009)
R. alba	Saros Bay	C	TL	14 -159	7.93- 33000	126	0.00194	3.27	0.98	Yığın and Ismen (2009)
R. alba	Aegean Sea	C	TL	26.1-52	*	12	0.0021	3.214	0.99	Yapici *et al.* (2015)
R. alba	Central Aegean Sea	F	TL	25.1-124	74-15000	6	0.0014	3.35	0.997	Eronat and Özaydın (2014)
R. alba	Central Aegean Sea	*C*	TL	25.1-124	74-15000	10	0.0016	3.32	0.997	Eronat and Özaydın (2014)
S. canicula	North Aegean Sea	*C*	TL	10.5-50.9	2.68-466.23	637	0.0012	3.26	0.99	Filiz and Bilge (2004)

Table 3. Contiuned

Species	Area	Sex	Type of Length	Size Range(cm)	Weight (g)	N	a	b	r^2	Authors
S. canicula	Edremit Bay	C	TL	24.6-78.6	63.67-2424	291	0.000006	2.9276	*0.8266*	Turker-Cakir *et al*. (2005)
S. canicula	Edremit Bay	C	TL	246-786	63.67-2424	112	0.000002	3.0999	*0.864*	Cakir-Turker *et al*. (2008)
S. canicula	Saros Bay	C	TL	9.6-62	2-956	1501	0.00169	3.1709	*0.993*	Ismen *et al*. (2007)
S. canicula	Izmir Bay	C	TL	28.6-51.5	*	187	0.0006	3.437	*0.954*	Ozaydin et. al. (2007)
S. canicula	Central Aegean Sea	F	TL	24.7-48.5	*	350	0.0006	3.48	*0.959*	Ilkyaz *et al*. (2008)
S. canicula	Central Aegean Sea	M	TL	25.5-51.2	*	394	0.0015	3.22	*0.962*	Ilkyaz *et al*. (2008)
S. canicula	Central Aegean Sea	C	TL	24.7-51.2	*	744	0.0012	3.29	*0.955*	Ilkyaz *et al*. (2008)
S. canicula	Saros Bay	C	TL	9.6-91.3	2.1-955.8	1888	0.0017	3.1735	*0.976*	Ismen *et al*. (2009)
S. canicula	Antalya Bay	F	TL	9-38.5	2-205.3	312	0.001	3.33	*0.951*	Guven *et al*. (2011)
S. canicula	Antalya Bay	M	TL	11.9-38.4	3.6-182.6	335	0.0014	3.22	*0.979*	Guven *et al*. (2011)
S. canicula	Antalya Bay	C	TL	9-38.5	2-205.3	647	0.0012	3.27	*0.963*	Guven *et al*. (2011)
S. canicula	Sea of Marmara	F	TL	25.3-50	*	30	0.021	2.471	*0.817*	Demirel and Dalkara (2012)
S. canicula	Sea of Marmara	M	TL	25-41.7	*	31	0.002	3.041	*0.825*	Demirel and Dalkara (2012)
S. canicula	Sea of Marmara	C	TL	20-50	*	189	0.004	2.869	*0.868*	Demirel and Dalkara (2012)
S. canicula	Central Aegean Sea	F	TL	7.8-50.9	0.63-461.66	620	0.0011	3.27	*0.983*	Eronat and Özaydın (2014)
S. canicula	Central Aegean Sea	M	TL	7.8-51.2	0,31-458	590	0.0012	3.25	*0.973*	Eronat and Özaydın (2014)
S. canicula	Central Aegean Sea	C	TL	7.8-51.2	0.31-461.66	1210	0.0012	3.26	*0.978*	Eronat and Özaydın (2014)
S. stellaris	Central Aegean Sea	C	TL	24.1-78.2	*	11	0.002	3.23	*0.995*	İlkyaz *et al*. (2008)
S. stellaris	Izmir Bay	C	TL	14.5-71	*	34	0.0065	2.817	*0.975*	Ozaydin *et al*. (2007)
S. stellaris	Saros Bay	C	TL	16.5-61.6	12.2-1049.3	12	0.0009	3.3653	*0.996*	Ismen *et al*. (2009)
S. stellaris	Central Aegean Sea	F		41.6-46.6	265.84-423.26	5	0.0002	3.78	*0.658*	Eronat and Özaydın (2014)
S. stellaris	Central Aegean Sea	M		25.8-69.7	60.13-1685.6	14	0.0006	3.46	*0.968*	Eronat and Özaydın (2014)
S. stellaris	Central Aegean Sea	C		25.8-69.7	60.13-1685.6	19	0.0006	3.46	*0.964*	Eronat and Özaydın (2014)
S. acanthias	North Aegean Sea	F	TL	27-70.5	79.64-1790.14	16	0.0112	2.7745	*0.9063*	Filiz and Mater (2002)
S. acanthias	North Aegean Sea	M	TL	38-56.5	233.14-783.86	16	0.0023	3.1823	*0.9941*	Filiz and Mater (2002)
S. acanthias	North Aegean Sea	C	TL	27-70.5	79.64-1790.14	32	0.0031	3.1056	*0.9814*	Filiz and Mater (2002)
S. acanthias	Aegean Sea	C	TL	27-70.5	79.64-1790.14	32	0.0031	3.11	*0.98*	Filiz and Bilge (2004)
S. acanthias	Southern Black Sea	F	TL	*	*	151	0.0000004	3.51	*0.97*	Demirhan and Seyhan (2007)
S. acanthias	Southern Black Sea	M	TL	*	*	24	0.0000008	3.32	*0.98*	Demirhan and Seyhan (2007)
S. acanthias	Saros Bay	F	TL	17.1-115	20-5784	312	0.0027	3.128	*0.975*	Ismen *et al*. (2009)
S. acanthias	Saros Bay	M	TL	20.8-87.5	36-2452	253	0.0072	2.8678	*0.956*	Ismen *et al*. (2009)
S. acanthias	Saros Bay	C	TL	17.1-115	20-5784	565	0.0037	3.0477	*0.967*	Ismen *et al*. (2009)
S. acanthias	Sea of Marmara	C	TL	41-52	500-950	8	0.00003	2.619	*0.957*	Bök *et al*. (2011)
T. marmorata	North Aegean Sea	F	TL	11.0-25.0	27.15-340	11	0.0274	2.9227	*0.9933*	Filiz and Mater(2002)
T. marmorata	North Aegean Sea	M	TL	9.6-20.5	23.51-156.94	9	0.1191	2.3461	*0.9295*	Filiz and Mater(2002)
T. marmorata	North Aegean Sea	C	TL	9.6-25	23.51-340	20	0.0488	2.6935	*0.9584*	Filiz and Mater(2002)
T. marmorata	Aegean Sea	C	TL	9.2-34	14.88-862.11	37	0.0273	2.91	*0.98*	Filiz and Bilge (2004)
T. marmorata	North Aegean Sea	C	TL	16.4-38.9	*	22	0.0139	3.103	*0.952*	Karakulak *et al*. (2006)
T. marmorata	Saros Bay	C	TL	13.2-28.6	52-450	20	0.0592	2.6433	*0.987*	Ismen *et al*. (2007)
T. marmorata	Izmir Bay	C	TL	10.3-37	*	12	0.0535	2.639	*0.981*	Ozaydin *et al*. (2007)
T. marmorata	Central Aegean Sea	C	TL	9.9-42	*	35	0.0232	2.98	*0.99*	Ilkyaz *et al*. (2008)

Table 3. Contiuned

Species	Area	Sex	Type of Length	Size Range (cm)	Weight (g)	N	a	b	r^2	Authors
T. marmorata	İskenderun Bay	F	TL	15.2-40	56-1308	61	0.017	3.0396	*0.922*	Duman and Başusta (2013)
T. marmorata	İskenderun Bay	M	TL	9.3-30.3	16-474	56	0.0315	2.8171	*0.9217*	Duman and Başusta (2013)
T. marmorata	İskenderun Bay	C	TL	9.3-40	16-1308	117	0.0195	2.9856	*0.9263*	Duman and Başusta (2013)
T. marmorata	Central Aegean Sea	F	TL	9.6-39.3	7.98-1310.42	59	0.0188	3.02	*0.985*	Eronat and Özaydin (2014)
T. marmorata	Central Aegean Sea	M	TL	10-27.9	24.57-413.29	48	0.0365	2.79	*0.985*	Eronat and Özaydin (2014)
T. marmorata	Central Aegean Sea	C	TL	9.6-39.3	7.98-1310.42	107	0.023	2.96	*0.939*	Eronat and Özaydin (2014)

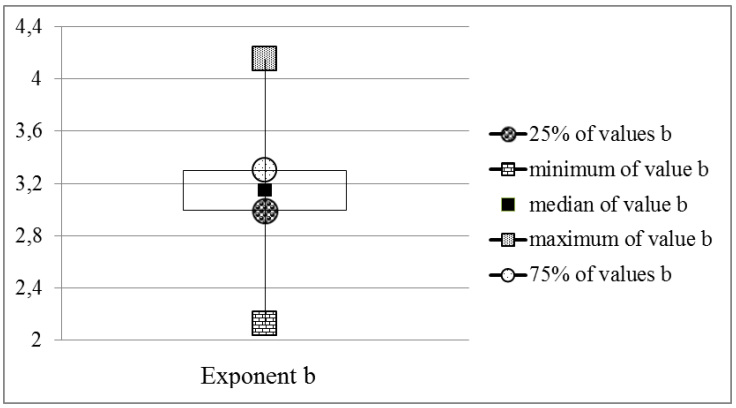

Figure 1.: Box–Whiskers plots of the exponent *b* of the LWR of the other studys for 12 species from coasts of Turkey. . The central box covers 50% of data values, the horizontal line indicates the median, and the vertical line represents the range of the values

increases rapidly with growth. The length–weight relationship constants of *S. canicula* and *M. mustelus* from Edremit Bay were similar to the the North Aegean Sea data calculated by Cakir-Turker *et al.* (2008) and Ozaydin *et al.* (2007). The results obtained from this study are useful to fisheries scientists, because the data were sampled from a relatively undisturbed area. *S. stellaris* had no length–weight relationship available in Fishbase (Froese & Pauly, 2017) and hence our results contribute to the knowledge of this species. The length ranges covered for each species should be considered when using parameters of length-weight relationships, as to some extent the smallest specimens may change the parameters. The differences in *b* values may be attributed to one or more factors: the season and effects of different areas, differences in water temperature and salinity, sex, food availability, differences in the number of specimens examined, as well as in the observed length ranges of the species caught. Differences in the sampling design may also affect the relationships, as the numbers of specimens and length ranges of the species were distinct among localities (Tesch, 1971; Sparre, Ursin & Venema, 1998; Mommsen, 1998; Moutopoulos & Stergiou, 2002; Froese, 2006). The results obtained in this study are useful to fishery scientists because the data were sampled from a relatively undisturbed area. Length–weight relationship for *S. stellaris* was not yet available in Fishbase (Froese & Pauly, 2017) and hence these results contribute to our knowledge of this species.

Acknowledgements

We would like to thank Aylin YARMAZ and Fatih ERDOĞAN for field survey.

References

Anderson, R., & Gutreuter, S. (1983). Length, weight and associated structural indices. In: L. Nielsen & D. Johnson (eds.), *Fisheries Techniques* (pp. 283–300). American Fisheries Society, Bethesda, Maryland.

Andrade, H. A., & Campos, R. O. (2002) Allometry coefficient variations of the length-weight relationship skipjack tuna (*Katsuwonus pelamis*) caught in the southwest South Atlantic. *Fisheries Research, 55*(1-3), 307–312.

Başusta, A., Başusta N., Sulikowski, J.A., Driggers, W.B., Demirhan, S.A., & Çiçek, E. (2012). Length-Weigth relationships for nine species of batoids fort he İskenderun Bay, Turkey. *Journal of Applied Ichthyology,*

28(5), 850-851. https://dx.doi.org/10.1111/j.1439-0426.2012.02013.x

Beyer, J. E., (1991). On length-weight relationships: Part II. Computing mean weights from length statistics. *Fishbyte, 9*(2), 50–54.

Bök, T. D., Gokturk, D., Kahraman, A. E., & Alicli, T. Z. (2011). Length-Weight Relationships Of 34 Fish Species From The Sea Of Marmara, Turkey. *Journal of Animal and Veterinary Advances, 10*(23), 3037-3042. https://dx.doi.org/10.3923/javaa.2011.3037.3042

Cakir-Turker, D., Koc-Torcu, H., Basusta, A., & Basusta, N. (2008). Length-Weight Relationships Of 24 Fish Species From Edremit Bay Aegean Sea. *e-Journal of New World Sciences Academy Natural and Applied Sciences, 3*, 47-51.

Demirel, N., & Dalkara, E.M. (2012). Weight-Length relationships of 28 fish species in the sea of Marmara. *Turkish Journal of Zoology, 36*(6), 785-791. https://dx.doi.org/10.3906/zoo-1111-29

Demirhan, S. A., Engin, S., Seyhan, K., & Akamca, E. (2005). Some Biological Aspects of Thornback Ray (*Raja clavata* L., 1758) in the Southeastern Black Sea. *Turkish Journal of Fisheries and Aquatic Sciences, 5*, 75-83.

Demirhan, S. A., & Seyhan, K., (2007). Life history of spiny dogfish, *Squalus acanthias* (L. 1758), in the southern Black Sea. *Fisheries Research, 85*(1-2), 210–216. https://dx.doi.org/10.1016/j.fishres.2007.02.009

Dulčić, J., & Kraljevic, M. (1996). Weight-length relationship for 40 fish species in the eastern Adriatic (Croatian waters). *Fisheries Research, 28*(3), 243-251

Duman, V.,Ö., & Başusta, N. (2013). Age and Growth Charakteristics and Marbled Electric Ray *Torpedo marmorata* (Risso, 1810) in habiting İskenderun Bay, North-Eastern Mediterranean Sea. *Turkish Journal of Fisheries and Aquatic Science, 13*, 541-549. https://dx.doi.org/10.4194/1303-2712-v13_3_19

Ecoutin, J. M., & Albaret, J. J. (2003). Length-weight relationship of 52 fish species from West African estuaries and lagoons. *Cybium, 27*(1), 3–9.

Eronat, E.,G.,T., & Ozaydın, O. (2014). Length-weight relationship of cartilaginous fish species from Central Aegean Sea (Izmir Bay and Sığacık Bay), *Ege Journal of Fisheries Aquatic Science, 31*(3), 119-125. https://dx.doi.org/10.12714/egejfas.2014.31.3.01

Filiz, H., & Mater, S. (2002). A Preliminary Study on Length-Weight Relationships for Seven Elasmobranch Species from North Aegean Sea, Turkey. *Ege Journal of Fisheries Aquatic Science, 19*(3-4), 401–409.

Filiz, H., & Bilge, G. (2004). Length–weight relationships of 24 fish species from the North Aegean Sea, Turkey. *Journal of Applied Ichthyology, 20*(3), 431–432. https://dx.doi.org/10.1111/j.1439-0426.2004.00582.x

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

Froese, R. & Pauly, D. (2017). *FishBase*. http://www.fishbase.org, (version 09／2017).

Girgin, H., & Başusta N. (2016). Testing staining techniques to determine age and growth of *Dasyatis pastinaca* (Linnaeus, 1758) captured in Iskenderun Bay, northeastern Mediterranean. *Journal of Applied Ichthyology, 32*, 595-601. https://dx.doi.org/10.1111/jai.13077

Gonçalves, J. M. S., Bentes, L., Lino, P. G.; Ribeiro, J., Canário, A. V. M., & Erzini, K. (1997). Weight-length relationships for selected fish species of the small-scale demersal fisheries of the south and south-west coast of Portugal. *Fisheries Research, 30*(3), 253–256. https://dx.doi.org/10.1016/S0165-7836(96)00569-3

Guven, O., Kebapcıoglu, T., & Deval, M. C. (2011). Length–weight relationships of sharks in Antalya Bay, Eastern Mediterranean. *Journal of Applied Ichthyology, 28*, 278–279. https://dx.doi.org/10.1111/j.1439-0426.2011.01823.x

Hepkafadar, O. (2008). *İzmir Körfezi'nde Adi Köpekbalığı (Mustelus mustelus Linnaeus, 1758) Avcılığı ve Bazı Biyolojik Özellikleri Üzerine Araştırmalar* (Master Thesis). Ege University, Izmir, Turkey

Ilkyaz, A. T., Metin, G., Soykan, O., & Kinacigil, H. T. (2008). Length–weight relationship of 62 fish species from the Central Aegean Sea, Turkey. *Journal of Applied Ichthyology, 24*, 699-702. https://dx.doi.org/10.1111/j.1439-0426.2008.01167.x

Ismen, A. (2003). Age, growth, reproduction and food of common stingray (Dasyatis pastinaca L., 1758) in İskenderun Bay, the eastern Mediterranean, *Fisheries Research, 60*(1), 169–176. https://dx.doi.org/10.1016/S0165-7836(02)00058-9

Ismen, A., Ozen, O., Altinagac, U., Ozekinci, U., & Ayaz, A. (2007). Weight–length relationships of 63 fish species in Saros Bay, Turkey. *Journal of Applied Ichthyology, 23*, 707–708. https://dx.doi.org/10.1111/j.1439-0426.2007.00872.x

Ismen, A., Yigin, C. C., Altinagac, U., & Ayaz, A. (2009). Length–weight relationships for ten shark species from Saros Bay (North Aegean Sea). *Journal of Applied Ichthyology, 25*, 109–112. https://dx.doi.org/10.1111/j.1439-0426.2009.01263.x

Karakulak, F. S., Erk, H., & Bilgin, B. (2006). Length–weight relationships for 47 coastal fish

species from the northern Aegean Sea, Turkey. *Journal of Applied Ichthyology, 22*(4), 274–278. https://dx.doi.org/10.1111/j.1439-0426.2006.00736.x

King, M., (1996): *Fisheries Biology Assessment and Management*. Fishing News Books, Oxford.

Martin-Smith, K. M. (1996). Length/weight relationships of fishes in a diverse tropical freshwater community, Sabah, Malaysia. *Journal of Fish Biology, 49*(4), 731–734. https://dx.doi.org/10.1111/j.1095-8649.1996.tb00069.x

Mommsen, T.P. (1998). *Growth and metabolism*. In: Evans, D.H. (Ed.), The Physiology of Fishes, (pp. 65–97), New York: CRC Press.

Merella, P., Quetglas, A., Alemany, F., & Carbonell, A. (1997). Length-Weight Relationships Of Fishes And Cephalopods From The Balearic Islands (Western Mediterranean). *Naga ICLARM Quarterly, 20*(3/4), 66-68.

Moutopoulos, D. K., & Stergiou, K. I., (2002). Length-weight and length-length relationships of fish species from the Aegean Sea (Greece). *Journal of Applied Ichthyology, 18*(3), 200–203. https://dx.doi.org/10.1046/j.1439-0426.2002.00281.x

Ozaydın, O., Uckun, D., Akalın, S., Leblebici, S., & Tosunoglu, Z. (2007). Length–weight relationships of fishes captured from Izmir Bay, Central Aegean Sea. *Journal of*

Applied Ichthyology, 23(6), 695–696. http://dx.doi.org/10.1111/j.1439-0426.2007.00853.x

Pauly, D., (1993). Fishbyte section editorial. *Naga ICLARM Quarterly, 16*, 26.

Pérez, P. P., & Contreras, N. P. (1995). Relaciones talla-peso de peces capturados en las campañas de arrastre demersal Demersales 0993 y Demersales 0994. *Inf. Téc. Inst. Esp. Oceanogr., 159*, 16.

Petrakis, G., & Stergiou, K. I. (1995). Weight-length relationships for 33 fish species in Greek waters. *Fisheries Research, 21*(3-4), 465–469. https://doi.org/10.1016/0165-7836(94)00294-7

Richter, H., Lückstädt, C., Focken, U., & Becker, K. (2000). An improved procedure to assess fish condition on the basis of length-weight relationships. *Archive of Fishery and Marine Research, 48*(2), 255–264.

Safran, P. (1992). Theoretical analysis of the weight-length relationships in fish juveniles. *Marine Biology, 112*(4), 545–551.

Sparre, P., Ursin, E., & Venema, S.C. (1998). *Introduction to tropical fish stock assessment. Part I. Manual*. FAO Fisheries Technical, Rome.

Tesch, F. W. (1971). *Age and growth*. In: W. E. Ricker (Ed.), Methods for assessment of fish production in fresh waters (pp 99-130). Oxford, Blackwell Scientific Publications.

Turker-Cakir, D., Torcu-Koc, H., & Erdoğan, Z. (2005). Some Biological Aspects of the Lesser Spotted Dog Fish *Scyliorhinus canicula* (Linnaeus, 1758) in Edremit Bay (The Northern Aegean Sea) Turkey. In N. Basusta, Ç. Keskin, F. Serena & B. Seret (Eds.), *The Proceedings of the International Workshop on Mediterranean Cartilaginous Fish with Emphasis on Southern-Eastern Mediterranean*, (pp. 17-27) Istanbul, Turkey.

Yapıcı, S., Karachle, P.K., & Filiz, H., (2015). First length-weigth relationships of 11 fish species in the Aegean Sea. *Journal of Applied. Ichthyology, 31*(2)*,* 398-402. https://dx.doi.org/10.1111/jai:12459

Yeldan, H., Avsar, D., & Manasırlı, M., (2009). Age, growth and feeding of the common stingray (Dasyatis pastinaca, L., 1758) in the Cilician coastal basin, northeastern Mediterranean Sea. *Journal of Applied Ichthyology, 25*(Suppl. 1) 98–102. https://dx.doi.org/10.1111/j.1439-0426.2008.01075.x

Yeldan, H., & Avsar, D., (2007). Length–weight relationship for five elasmobranch species from the Cilician Basin shelf waters (Northeastern Mediterranean). *Journal of Applied Ichthyology, 23*(6)*,* 713–714. https://dx.doi.org/10.1111/j.1439-0426.2007.00858.x

Yeldan, H., Avsar. D., & Manasırlı, M., (2008). Kuzeydoğu Akdeniz'deki Deniz Tilkisi *Raja clavata* (Linnaeus, 1758)'nın Bazı Biyolojik Özellikleri. *Ege University Journal of Fisheries Aquatic Science, 25*(3)*,* 221-228

Yigin, C. C., & Ismen, A., (2009). Length–weight relationships for seven rays from Saros Bay (North Aegean Sea). *Journal of Applied Ichthyology, 25,*(Suppl. 1), 106–108. https://dx.doi.org/10.1111/j.1439-0426.2008.01161.x

Yigin, C. C., & Ismen, A., (2012). Age, Growth and Reproduction of the common Stingray, *Dasyatis pastinaca* from the North Aegean Sea. *Marine Biology Research, 8*(7)*,* 644-653. https://dx.doi.org/10.1080/17451000.2012.659667