www.trjfas.org
ISSN 1303-2712
Turkish Journal of Fisheries and Aquatic Sciences 17:995-1002 (2017) DOI: 10.4194/1303-2712-v17_5_14

RESEARCH PAPER

Length-Weight Relationships of 16 Fish Species from Deep Water of Northern Aegean Sea (500-900 m)

Onur Gönülal[1],*

[1] İstanbul University, Gökceada Marine Research Department, Kaleköy-Gökçeada / Çanakkale.

* Corresponding Author: Tel.: +90.286 8873492; Fax: +90.286 8872380;
E-mail: ogonulal@istanbul.edu.tr

Received 16 February 2017
Accepted 14 March 2017

Abstract

In this study was conducted between 500 and 900 at Northern Aegean Sea using by deep longline. Length-weight relationships (LWR) were presented for 16 deep species. Length and weight of each individual were measured, of which 10 species also r^2 and SE *(b)* were calcuated. Values of b was statiscivaly significantly differ than "3" for all species except *Helicolenus dactylopterus.* The results show that the general bigger deeper phenomenon for both *Merluccius merluccius* and *Phycis blennoides*. The present study reports the first knowledge on the LWR for deep fishes that caught greater than 500 m depth. The aim of this study to obtain the missing biological data on the LWR of deep sea fish species of northern Aegean deep waters and to be as a reference for future studies conducted in deeper areas.

Keywords: Deep fishes, deep longline, Northern Aegean Sea, length-weight relationships.

Introduction

The deep-sea environment is characterized by distinct vertical gradients of pressure, light and temperature. Despite the scarce food availability, the habitat is known as the largest repository of biodiversity in the biosphere (Gage & Tyler, 1991).

Northern Aegean deep waters is one of the least studied regions of the Mediterranean Sea. The bottom topography of the northern Aegean is characterized by alternation deep trenches and troughs (reaching 1600 m) (Lykousis & Collins, 1987). The northern Aegean Sea also receives nutrient inputs from Black Sea out flowing through the Dardanelles Strait (Ünlüata, Oguz, Latif, & Özsoy, 1990) and freshwater runoff along its northern rim Greek and Turkish mainland (Poulos, Drakopoulos, & Collins, 1997). Muddy sediments generally predominate on the shelf and slope from 100 to 1000 m depth (Lykousis & Collins, 1987). In addition, deep-north Aegean Sea has the higher nutrient and plant pigment concentrations, in comparison to the rest of eastern Mediterranean, that is characterised as one of the most oligotrophic characteristics marine regions of the world (Stergiou & Pollard, 1994).

Length-weight relationships data can be used for; (a) fisheries stock assessment (Richter, Luckstadt, Focken, & Becker, 2000) (b) yield biological data (Garcia et al., 1998) (c) calculating total biomas (Petrakis & Stergiou, 1995) (d) morphological comparisions between different populations and habitats (Pauly, 1993) and other fish populations parameters.

Even though several previous studies were conducted on LWR of different fishes species in Turkish waters, also in the Greek Aegean coast (i.e., Gündoğdu, Baylan, & Çevik, 2015; Bilge, Yapici, Filiz, & Cerim, 2014; Megalofonou, Damalas, & De Metrio, 2005; Papaconstantinou et al., 1993), Yet, there is still a lack of knowledge for the deep sea fishes. Up to now, any fishing activities aren't carried out by Turkish fishermen in the sampling area. Therefore, fish abundance of deep waters of north Aegean Sea is unlikely to be affected from the fishing pressure. But it is known the traditional shallow fishing to turn to deep-sea species (Morato, Watson, Pitcher, & Pauly, 2006). Current study aims to collect the missing biological data on the LWR of deep sea fish species of northern Aegean deep waters to contribute to the knowledge on deep sea fisheries stock assessment. LWR studies provide a very useful tool in estimating population biomass, determining the stock status of fishes, contributing to the comparison of morphological aspect of populations among different areas (Froese, 2006; Stergiou & Pollard, 1994). All of these is necessary for the purpose of management and conservation of fishery stock in unexplored area such as deep of northern Aegean Sea.

Materials and Methods

Samples were obtained at depths between 500 and 900 m in Northern Aegean Sea using deep longline (Figure 1). The study conducted from March 2016 to August 2016. Fishing operations were carried out from a 12 m boat named "Fırtına İÜ" belong to the İstanbul University. The deep longline was baited with pieces of different fishes (sardine, southern shortfin squid, mackerel etc.) and fished in the daylight. Depending on the weather conditions, the longline was retrieved 4-6 hours later. A total of 6000 hooks were used during the study.

Fishes were measured to the nearest cm (total lenght) and weighted g (total weight). Total length and total weight were measured for all the caught specimen. LWR were calculated using least squares fitting methods; $W=aL^b$

Where "W" is the weight in gram, "L" is the total lenght in cm. The constants *a* and *b*, is related body shape and the slope balancing of dimension of the equation, respectively. The t-test was applied to test for variance of the b value to verify the significant difference from isometric grow (b=3) at the 0.05 significance level for each species.

For species with simple size less than 5 individual (*Alopias vulpinus*, *Centrolophus niger*, *Dipturus oxyrinchus Hexanchus griseus*, *Polyprion americanus* and *Pteroplatytrygon violacea*) even though length and weight measurement were reported, LWR were not calculated due to the small sample size of the species. In additions, a simple linear regression analysis between depth and mean size was calculated to inform dept-size trend of both *M. merluccius* and *P. blennoides*.

Results

Overall, 10 Elasmobranch species and 6 Actinopterygii species were analyzed. Length and weight of all caught specimen were measured, parameters of LWR (a, b and r^{2}), 95% confidence intervals of b are given in Table 1.

Values of b were reported between 1,76

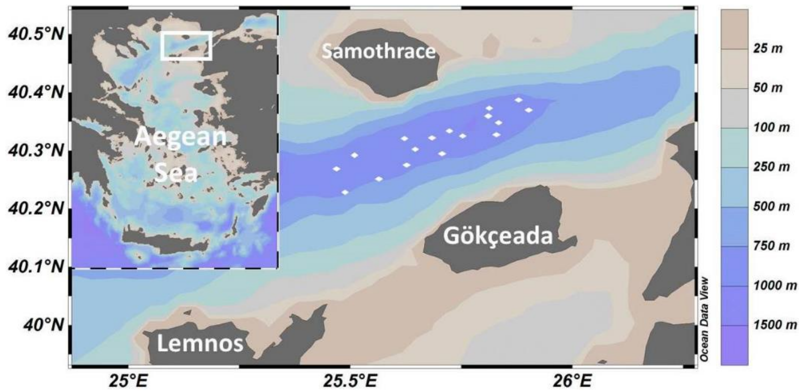

Figure 1. Sampling stations.

Table 1. Lenght-weight parameters for 16 species from deep water of northern Aegean Sea withtenspecies which LWR were calcutated; A (+)=positive allometry, A (-) = negative allometry, I = Isometric,

Species	n	Lenght (cm)		Weight (g)		a	b	SE (b)	r^2	Allometry
		min	max	min	max					
Alopias vulpinus	1	124	-	16,4	-	-	-	-	-	
Centrolophus niger	3	28	61	550	1672	-	-	-	-	
Conger conger	19	52.6	101.9	250	2010	0. 0005	3,2926	0.45	0,9437	A (+)
Dalatias licha	4	37,6	94	217	880	0,0184	3,1978	0.38	0,8855	A (+)
Dipturus oxyrinchus	2	79	-	565	-	-	-	-	-	
Etmopterus spinax	12	29,2	44,3	110	235	0,3514	1,7649	0.11	0,6863	A (-)
Galeus melastemus	26 (F)	36,2	52,3	125	525	0,0003	3,652	0.20	0,9555	A (+)
	13 (M)	26,1	47,8	135	435	0,1746	2,0819	0.19	0,8537	A (-)
Helicolenus dactylopterus	9	26,9	38,4	305	532,4	0,0054	2,9522	0.07	0,8773	I
Hexanchus griseus	3	1290	1650	8615	20585		-	-	-	
Merluccius merluccius	79	34,9	91,8	318,11	3572	0,0136	2,8595	0.14	0,9638	A (-)
Mustelus mustelus	11	64,7	74,2	1460	2280	0,0014	3,3083	0.03	0,9051	A (+)
Phycis blennoides	68	36	64,5	425	1380	0,0654	2,4653	0.16	0,8287	A (-)
Polyprion americanus	3	36	71	680	5100	-	-	-	-	
Prionace glauca	6	104	133	3200	9450	0,105	3,8495	0.10	0,9279	A (+)
Pteroplatytrygon violacea	1	86	-	2400	-	-	-	-	-	
Scyliorhinus stellaris	28	31,4	69	110,5	780	0,041	3,102	0.25	0,8955	A (+)

(*Etmopterus spinax*) and 3,84 (*Prionace glauca*). Values of b expected between 2,5 and 3,5 (Froese, 2006). *Etmopterus spinax, Phycis blennoides* and *Prionace glauca* were not within the range. In additions, b values for these species were significantly different from 3 ($P<0.05$). *P. glauca* represented as the most isometrically growth fishes (b = 3.84) in this study

According to the type of growth, *Conger conger, Galeus melastemus* (female), *Dalatias licha, Mustelus mustelus* and *Prionace glauca* showed positive allometry, *Etmopterus spinax, Galeus melastemus* (male), *Merluccius merluccius*, *Phycis blennoides* showed negative allometry and *Helicolenus dactylopterus* showed isometry (Table 1).

When the sex ratio significantly different from 1 : 1, LWR were calculated separately as female and male individuals (Froese, 2006). Because of the differences in sample size between male and female for only *G. melastemus,* LWR were calculated separately for the species.

Comparision between the LWR results of previous studies were also reported in Table 2. A simple linear regression analysis between depth and mean size was calculated to inform dept-size trend of both *M. merluccius* and *P. blennoides.* Result of the analysis showed that fish size correlated strongly with maximum depth for both species. The variables of r^2 was calculated as 0.8062 and 0.8954 for *M. merluccius* and *P. blennoides* respectively (Figure 2).

Discussions

This paper is the first estimation of LWR for fishes in the deep water of northern Aegean Sea.

Current study assessed LWR of 16 deep-sea fishes of north Aegean Sea, of which six of them carried economical value, i.e. *Helicolenus dactylopterus, Merluccius merluccius, Mustelus mustelus, Polyprion americanus, Phycis blennoides*, *Prionace glauca*. Moreover, *M. mustelus* and *P. glauca* are listed as “Vulnerable (VU)” and “Near Threatened (NT)” respectively, by the IUCN Red List

Among the previous LWR studies, longline was used only by Öztekin, Özekinci and Daban (2016). When our result compared for b value with the study that also conducted at relatively deep water (up to 400 m), only *P. blennoides* showed remarkable difference. Low food availability may affect the *b*-value (Froese, 2006). Longlines are selective compared to other hunting gears (Bjordal & Løkkeborg, 1996). Hence, our sampling individuals are not juvenile. While *b*-value ranged from 2.94 to 3.26 for *E. spinax* in the previous studies (see Table 2). We calculated *b*-value was 1.76 for *E. spinax.* The highest difference can be associated with the food availability or the difference in the sampling methods.

In conclusion, LWR values of current study are different from the previous studies (Table 2). The maximum sampling depth reached was 400-500 m in these studies. The difference is possibly originated from differences temperature, salinity, food availability and size (Weatherley & Gill, 1987). Its highly possible that the depth factor was the main driver of these difference, with the current study holding the deepest samplings.

Our size records in total length for *M. merluccius* and *P. blennoides* are between 34,9 and 91,8 cm; 36 and 64,5 cm respectively. If the results are compared with these conducted below 500 m depth (see Table 2), the mean lenghts for both *M. merluccius* and *P. blennoides* in this study were greater. Many studies showed that the general bigger deeper trends observed within fish species (Macpherson & Duarte, 1991; Madurell, Cartes, & Labrapoulou, 2004; Papiol, Cartes, Fanelli, & Maynou, 2012 etc). *P. blennoides* shows that distinct bathymetric distribution of the small and large sized specimens. While bigger individuals only occur at great depths, smaller size individuals prefer at the shallow depths (Massutí, Morales-Nin, & Lloris, 1996). This trend is probably related to feeding strategy. While adults feed on larger crustaceans species and fishes, juvenile ones prefer small crustaceans (Gallordo, 1986). Similar results were found for *M. merluccius* migrating from coastal areas to the mid-shelf and a changed bathymetric distribution are related to a change in diet from small

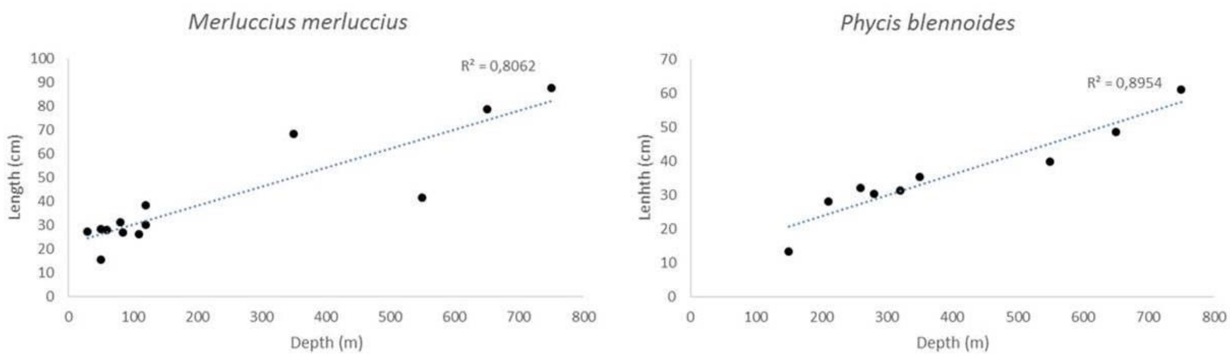

Figure 2. Bigger-deeper phenomenon.

Table 2. The LWR results of previous studies

Species	n	Lenght (cm)		Weight (g)		a	b	r^2	References	Area	Depth (m)
		min	max	min	max						
A. vulpinus	7	211	514	-	-	-	-	-	Megalofonou *et al*. (2005)	EMS	-
	3	250	600	-	-	-	-	-	Kabasakal and Kabasakal (2004)	NAS	<400
D. licha	5	32,1	54,7	151,68	786,39	-	-	-	Eronat and Özaydın (2014)	İzmir-Sığacık Bay	<500
	3	34.5	97	173.4	5800	0.0117	3	-	Güven, Kebapcioglu, and Deval (2012)	Antalya Bay	200-800
	5	33.8	41.9	-	-	-	-	-	Kabasakal and Kabasakal (2004)	NAS	<400
D. oxyrinchus	90 (M)	15.2	86.5	-	-	0.00088	3.34	0.996	Yığın and İşmen (2010)	Saros Bay	5-450
	89 (F)	14.9	100	-	-	0.00077	3.37	0.997	Yığın and İşmen (2010)	Saros Bay	5-450
	8	17.9	62.2	10.44	850.48	0.0007	3.4	0.99	Filiz and Bilge (2004)	Sığacık Central Aegan	70-378
	118	10	63.2	9	4056	0.00423	3.2909	0.0998	İşmen, Ozen, Altinagac, Ozekinci and Ayaz (2007)	Saros Bay	28-370
	240 (F)	16.5	105	30	5300	0.0013	3.2338	0.9696	Kadri, Marouani, Bradai, Bouaïn, and Morize (2014)	Gulf of Gabes	80-170
	280 (M)	15.5	95	30	3650	0.0035	3.0179	0.9723	Kadri *et al*. (2014)	Gulf of Gabes	80-170
	45	24.3	59	-	-	-	-	-	Bayhan, Ergüden, and Cartes (2017)	Mersin Bay (Turkey)	300-601
	8	18.1	46.5	14.78	285.04	0.0309	3.13	0.995	Eronat and Özaydın (2014)	İzmir-Sığacık Bay	<500
E. spinax	11	10.6	45	4.3	363.6	0.0023	3.2256	0.952	İsmen, Yigin, Altinagac, and Ayaz (2009)	Saros Bay	5-500
	24	10.6	45	4	364	0.00172	3.2659	0.92	İsmen *et al* (2007)	Saros Bay	28-370
	129	8.6	31.7	2.2	150.81	0.0035	3.08	0.98	Eronat and Özaydın (2014)	İzmir-Sığacık Bay	<500
	150	10	39.4	4.2	249.8	0.0052	2,94	0.973	Güven *et al*. (2012)	Antalya Bay	200-800
	220	11	22.7	-	-	-	-	-	Kabasakal and Kabasakal (2004)	NAS	<400
	Numerous	15	30.5	-	-	-	-	-	Bayhan *et al*. (2017)	Mersin Bay (Turkey)	300-601
G.melastomus	303	11.3	31.7	3.5	86.4	0.0016	3.175	0.953	İsmen *et al*. (2009)	Saros Bay	5-500
	180	11.3	42	-	-	-	-	-	Morey *et al*. (2003)	W. Mediterranean Sea	-
	93	12	31.7	5	86	0.00238	3.029	0.98	İsmen *et al*. (2007)	Saros Bay	28-370
	235	8.9	45	1.13	278.77	0.0019	3.14	0.95	Eronat and Özaydın (2014)	İzmir-Sığacık Bay	<500
	544	11.5	57.5	4.6	693.3	0.0026	3	0.982	Güven *et al*. (2012)	Antalya Bay	200-800
	183	165	175	-	-	-	-	-	Kabasakal and Kabasakal (2004)	NAS	<400
	49	32.5	67.0	-	-	-	-	-	Bayhan *et al*. (2017)	Mersin Bay (Turkey)	300-601
H. griseus	21	250	600	200 kg	1000 kg	-	-	-	Kabasakal (2006)	In Turkish waters	-
	7	80	170	165 kg	228.5 kg	0.0002	3.606	0.982	İsmen *et al*. (2009)	Saros Bay	5-500
	5	80	114	165 kg	580 kg	0.00008	3.8222	0.913	İsmen *et al*. (2007)	Saros Bay	28-370
	37	182	600	54 kg	<300 kg	-	-	-	Celona, De Maddalena, and Romeo (2005)	Eastern North Sicilian	40-250
	1	90	-	-	-	-	-	-	Bayhan *et al*. (2017)	Mersin Bay (Turkey)	300-601
M. mustelus	41	41.8	113.3	121.8	4780	0.001	3.27	0.971	Eronat and Özaydın (2014)	İzmir-Sığacık Bay	<500
	4	52.6	87.4	565.2	2260	0.0974	2.77	0.999	Güven *et al*. (2012)	Antalya Bay	200-800
	26	58.9	152.2	560	14430	0.00131	3.1895	0.986	İsmen *et al*. (2007)	Saros Bay	28-370
	70	46.8	152.2	382	14431	0.0034	2.9789	0.988	İsmen *et al*. (2009)	Saros Bay	5-500
	17	51.4	95.5	-	-	0.0044	2.912	0.982	Özaydın, Uçkun, Akalın, Leblebici, and Tosunoğlu (2007)	İzmir Bay	<50
	35	38.3	97.5	116.37	3170	0.0011	3.25	0.97	Filiz and Bilge (2004)	Sığacık	70-378
	148	25.6	125.1	-	-	0.0027	3.05	0.979	Ilkyaz, Metin, Soykan, and Kinacigil (2008)	CAS	30-70
	74	34.9	101.7	-	-	0.0053	2.843	0.989	Bilge *et al*. (2014)	SAS	30-225
P. glauca	116	100.5	329	-	-	-	-	-	Megalofonou *et al*. (2005)	EMS	-
	870	70	349	-	-	-	-	-	Megalofonou, Damalas, and Metrio (2009)	EMS	-
	2	98	350	3 kg	100 kg	-	-	-	Kabasakal (2010)	Edremit Bay	-
	3	51	250	-	-	-	-	-	Kabasakal and Kabasakal (2004)	NAS	<400
	77	100	215	-	-	3.4996	3.40368	-	García-Cortés & Mejuto (2002)	northeast Atlantic	-
	119	93	254	5 kg	119 kg	-	-	-	Mejuto, Ramos-Cartelle, Quintans, González, and Carroceda (2008)	Atlantic	-

Table 2. Continued.

P. violacea	1	99.6	-	-	-	-	-	-	Antonenko, Balanov, Matveichuk, and Blishak (2015)	South Kuril region	1500
	1	99	-	2.5 kg	-	-	-	-	Ellis (2007)	North Sea	70
	1	117	-	6.4 kg	-	-	-	-	Cazaux and Labourg (1971)	Bay of Biscay	-
	1	102	-	2.5 kg	-	-	-	-	Akhilesh, Manjebrayakath, Ganga, Bineesh, and Rajool Shanis (2008)	SW coast of India	150
	1	95.0		3.6 kg	-	-	-	-	Ergüden, Ergüden, Çekiç, and Altun (2017)	EMS	40
S. stellaris	19	25.8	69.7	60.13	1685.6	0.0006	3.46	0.964	Eronat and Özaydın (2014)	İzmir-Sığacık Bay	<500
	34	14.5	71	-	-	0.0065	2.817	0.975	Özaydın *et al*. (2007)	İzmir Bay	<50
	12	16.5	61.6	12.2	1049.3	0.0009	3.3653	0.996	İsmen *et al*. (2009)	Saros Bay	5-500
	11	24.1	78.2	-	-	0.02	3.23	0.995	İlkyaz *et al*. (2008)	CAS	30-70
	3	40	165	-	-	-	-	-	Kabasakal and Kabasakal (2004)	NAS	<400
	92	14.1	71.7	-	-	0.0039	2.9755	0.987	Bilge *et al*. (2014)	SAS	30-225
C. niger	2	78	103	-	-	-	-	-	Akyol (2008)	İzmir Bay	30
	1	31.6	-	-	-	-	-	-	Ceyhan and Akyol (2010)	İzmir Bay	55
	1	11.2	-	18.4	-	-	-	-	Ergüden, Yağlıoğlu, Gürlek and Turan (2012)	Iskenderun Bay	34
C. conger	20	27.7	83	-	-	0.0001	3.6	0.993	Ilkyaz *et al*. (2008)	CAS	30-70
	25	40.1	64.5	85	376	0.00039	3.3164	0.951	İsmen *et al*. (2007)	Saros Bay	28-370
	22	32.2	65.4	42.94	460.11	0.005	3.24	0.96	Filiz and Bilge (2004)	Sığacık	70-378
	10	37.2	49.5	-	-	0.0003	3.397	0.984	Özaydın *et al*. (2007)	İzmir Bay	<50
	8	20.9	62.5	-	-	0.0002	3.489	0.967	Karakulak, Erk, and Bilgin (2006)	NAS	<30
	95	26.4	136	30	7270	0.0011	3.101	0.9	Öztekin *et al*. (2016)	Saros Bay	0-400
H.dactylopterus	96	7.6	20.5	6	150	0.01628	3.0371	0.974	İsmen *et al*. (2007)	Saros Bay	28-370
	178	5.5	13.5	1.93	43.45	0.0079	3.28	0.92	Filiz and Bilge (2004)	Sığacık Bay	70-378
	524	3.3	27	0.58	288.6	0.016	2.99	0.99	Consoli *et al*. (2010)	Tyrrhenian Sea	100-600
	101	5.8	14.7	-	-	0.0093	3.23	0.988	Bilge *et al*. (2014)	SAS	30-225
	26	18.2	41.9	97	696	0.0496	2.624	0.927	Öztekin *et al*. (2016)	Saros Bay	0-400
	364	11.0	28.4	-	-	-	-	-	Bayhan *et al*. (2017)	Mersin Bay (Turkey)	300-601
M. merluccius	21	21.5	40.5	-	--	0.0061	3	0.944	Ceyhan, Akyol, and Erdem (2009)	Gökova Bay	-
	222	26.8	83.1	142	3381	0.0127	2.867	0.961	Öztekin *et al*. (2016)	Saros Bay	0-400
	55	12.7	28.3	20	170	0.0005	2.91	0.94	Kapiris and Klaoudatos (2011)	Argolikos Gulf	inshore
	319	8.9	44.8	3.8	753.68	0.0026	3.369	0.99	Bök *et al*. (2011)	Marmara Sea	30-100
	2711	2.7	48.8	-	-	0.9814	3.189	0.981	Özaydın *et al*. (2007)	İzmir Bay	<50
	22	19.7	41.1	-	-	0.0049	3.103	0.982	Karakulak *et al*. (2006)	NAS	<30
	29	13.2	31	14.2	11.63	0.033	2.353	0.93	Sangun, Akamca, and Akar (2007)	EMS	5-100
	31	16	28.7	-	-	0.0096	2.899	0.946	Özvarol (2014)	Antalya Bay	25 - 150
	152	18	50.2	-	-	0.00362	3.2	0.95	Moutopoulos and Stergiou (2002)	Naxos island	inshore
	1499	9	45.5	-	-	0.0039	3.2	0.984	İlkyaz *et al*. (2008)	CAS	30-70
	2041	7.9	66	4	2150	0.00439	3.1495	0.977	İşmen *et al*. (2007)	Saros Bay	28-370
	Numerous	14.3	57.5	-	-	-	-	-	Bayhan *et al*. (2017)	Mersin Bay (Turkey)	300-601
P. blennoides	12	12.3	15	12.43	27.1	0.0017	3.55	0.89	Filiz and Bilge (2004)	Sığacık Bay	70-378
	359	16	42.5	24	737	0.00209	3.3814	0.971	İsmen *et al*. (2007)	Saros Bay	28-370
	99	26.2	54.1	143	1540	0.0069	3.045	0.922	Öztekin *et al*. (2016)	Saros Bay	0-400
	505	6.4	50	-	-	0.00002	3.238	-	Papaconstantinou *et al*. (1993)	CAS	-
	35	21.5	45	-	-	-	-	-	Bayhan *et al*. (2017)	Mersin Bay (Turkey)	300-601
P. americanus	20	59	84	-	-	0.05286	2.737	0.944	Ferreira, Sousa, Delgado, Carvalho, and Chada (2008)	Madeira archipelago	25-1150
	-	22	27	-	-	-	-	-	Vassilopoulou and Anastasopoulou (2007)	SAS	40 - 250
	-	-	-	10 kg	116 kg	-	-	-	Machias *et al*. (2001)	Aegean Sea	-
	1	13.4	-	-	-	-	-	-	Başusta and Erdem (2000)	Karatas coast (Turkey)	30-40

crustaceans to small pelagic fishes. (Bartolino, Ottavi, Colloca, Ardizzone, & Stefánsson, 2008; Ardizzone & Corsi, 1997). Bigger deeper trends have been still a controversial subject. For example, Stefanescu, Rucabado, and Lloris (1992) reported a smaller-deeper trend for some fish species in the deep water of Catalan Sea. These species display a wide spectrum of changes in food habits. It can be considered to be ontogenetic migration undertake from coastal areas to the continental shelf as they grow larger (Macpherson & Duarte, 1991). In this study, a bigger-deeper trend clearly appeared for *Merluccius merluccius* and *Phycis blennoides* (Figure 2).

Both of the named species have high commercial importance in the Mediterranean Sea, including Turkey. Even though, *M. merluccius* is a major threat to the populations and priority species for the GFCM, *P. blennoides* has not been assessed by the GFCM. Global mean of demersal marine fishes was shifted to the deeper water species in the last years (Morato et al., 2006). Current study proved that *M. merluccius* and *P. blennoides* have bigger size in deeper waters than coastal waters. Its known that fisheries resources are declining sharply in shallower waters. Deep water of northern Aegean is new candidate for fishing resource. Even though FAO has developed a guideline for the management of deep-sea fisheries (Eayrs, 2009), fishery practices in international waters like Agean Sea, brings many complex problems. Acccording to the guidelines, fisheries exploiting deepsea fish stocks have adverse impacts on vulnerable marine ecosystems. Therefore, it is important to obtain information on deep sea species for its sustainaibility which could be under fishing pressure in near future, due to the decline of fish stocks in shallow waters.

The present data obtained in this study could potentially serve as a useful tool in ongoing fishery studies with regard to fisheries management in the area and as a future reference for comparision of similar parameter estimated in other areas.

Acknowledgement

This work was supported by the Scientific Research Projects of Istanbul University, Project Number 54441.

References

Akhilesh, K. V., Manjebrayakath, H., Ganga, U., Bineesh, K. K., & Rajool Shanis, C. P. (2008). Morphometric characteristics of the pelagic stingray Pteroplatytrygon violacea (Bonaparte, 1832) caught off Cochin, southwest coast of India. *Journal of the Marine Biological Association of India*, 50(2), 235-237.

Akyol, O. (2008). New record of the juvenile blackfish, Centrolophus niger (Centrolophidae), from the Aegean Sea (Izmir Bay, Turkey). *Cybium*, 32(1), 91-92.

Antonenko, D. V., Balanov, A. A., Matveichuk, S. P., & Blishak, N. M. (2015). Record of rare for waters of Russia pelagic stingray Pteroplatytrygon violacea (Dasyatidae) in the South Kuril region. *Journal of Ichthyology*, 55(6), 911-913. http://dx.doi.org/10.1134/S0032945215050021

Ardizzone, G. D., & Corsi, F. (1997). Atlas of Italian demersal fishery resources. Trawl surveys 1985-1987. Biologia Marina Mediterranea. Livorno, Italy, SIBM Press., 479 pp.

Bartolino, V., Ottavi, A., Colloca, F., Ardizzone, G. D., & Stefánsson, G. (2008). Bathymetric preferences of juvenile European hake (Merluccius merluccius). *ICES Journal of Marine Science*, 65(6), 963-969.

Başusta, N., & Erdem, U. (2000). İskenderun Korfezi balıkları üzerine bir araştırma. *Turk J Zool*, 24, 1–19 (in Turkish).

Bayhan, Y.K., Ergüden, D., & Cartes, J. E. (2017). Shrimp fisheries abundance and species composition of benthic fish fauna in deep sea fishery of North-Eastern Mediterranean (Turkey). *Acta Zoologica Bulgarica*, (In press).

Bjordal, A., & Løkkeborg, S. (1996). Longlining: Fishing New Books: Oxford, England, Oxford Press., 156 pp.

Bök, D.T., Göktürk, D., Kahraman, A., Alıçlı, T., Acun, T., & Ateş, C. (2011). Length-weight relationships of 34 fish species from the Sea of Marmara, Turkey. *Journal Animal Veterinary Advances*, 10, 3037-3042.

Bilge, G., Yapici, S., Filiz, H., & Cerim, H. (2014). Weight-length relations for 103 fish specıes from the southern Aegean Sea, Turkey. *Acta Ichthyologica et Piscatoria*, 44(3), 263. http://dx.doi.org/10.3750/AIP2014.44.3.11

Cazaux, C., & Labourg, P. J. (1971). Contribution à la faune de la région d'Arcachon. *Bulletin de la Société linnéenne de Bordeaux*, 1, 123-129.

Celona, A., De Maddalena, A., & Romeo, T. (2005). Bluntnose sixgill shark, Hexanchus griseus (Bonnaterre, 1788), in the Eastern North sicilian waters. *Bollettino del Museo civico di Storia naturale di Venezia*, 56, 137-151.

Ceyhan, T., Akyol, O., & Erdem, M. (2009). Length-weight relationships of fishes from Gökova Bay, Turkey (Aegean Sea). *Turkish Journal of Zoology*, 33, 69-72. http://dx.doi.org/10.3906/zoo-0802-9

Ceyhan, T., & Akyol, O. (2010). Short Communication Occurrence of the blackfish, Centrolophus niger (Gmelin 1789) (Osteichthyes: Centrolophidae), in Izmir Bay, Aegean Sea. *Journal of Applied Ichthyology*, 27, 139-140. http://dx.doi.org/10.1111/j.1439-0426.2010.01579.x

Consoli, P., Battaglia, P., Castriota, L., Esposito, V., Romeo, T., & Andaloro, F. (2010). Age, growth and feeding habits of the bluemouth rockfish, Helicolenus dactylopterus dactylopterus (Delaroche 1809) in the central Mediterranean (southern Tyrrhenian Sea). *Journal of Applied Ichthyology*, 26(4), 583-591. http://dx.doi.org/10.1111/j.1439-0426.2010.01467.x

Eayrs, S., Snedaker, S. C., & Getter, C. D. (2009). International guidelines for the management of deep-sea fisheries in the high seas (Report No. FAO 338.3727 D598). Roma Italia, FAO Press., 81 pp.

Ellis, J.R. (2007). Occurrence of pelagic stingray Pteroplatytrygon violacea (Bonaparte, 1832) in the North Sea. *Journal of Fish Biology*, 71, 933–937. http://dx.doi.org/10.1111/j.1095-8649.2007.01534.x

Ergüden, D., Yağlıoğlu, D., Gürlek, M., & Turan, C. (2012). An occurrence of the blackfish, Centrolophus niger (Gmelin, 1789), in Iskenderun Bay, (northeastern Mediterranean, Turkey). *Journal of Black Sea/Mediterranean Environment*, 18(1), 97-101.

Ergüden, D., Ergüden, A. S., Çekiç, M., & Altun, A. (2017). On the occurrence of the pelagic stingray Pteroplatytrygon violacea (Bonaparte, 1832) (Chondrichthyes: Dasyatidae) in the Northeastern Mediterranean, Turkey. *Biharean Biologist*, (In press).

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

Ferreira, S., Sousa, R., Delgado, J., Carvalho, D., & Chada, T. (2008). Weight–length relationships for demersal fish species caught off the Madeira archipelago (eastern-central Atlantic). *Journal of Applied Ichthyology*, 24(1), 93-95. http://dx.doi.org/10.1111/j.1439-0426.2007. 01027.x

Filiz, H., & Bilge, G. (2004) Length–weight relationships of 24 fish species from the North Aegean Sea, Turkey. *Journal of Applied Ichthyology*, 20, 431–432. http://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. http://dx.doi.org/10.1111/j.1439-0426.2006.00805.x

Gage, J. D., & Tyler, P. A. (1991). Deep-sea biology: A natural history of organisms at the deep-sea floor. Cambridge, England, Cambridge University Press., 504 pp.

Gallardo-Cabello, M. (1986). Estudio de la ultraestructura del otolito sagita de la brótola Phycis blennoides (Brunnich, 1768) en el Mediterráneo occidental (Pisces: Gadidae). *Anales del Instituto de Ciencias del Mar y Limnología*, 13(2), 197-206.

Garcia, C.B., Duarte, J.O., Sandoval, N., Von Schiller, D., Melo, G., & Navajas, P. (1998). Length-weight relationships of demersal fishes from the Gulf of Salamanca, Colombia, Naga. *ICLARM Quartely*, 21, 30-32.

García-Cortés, B., & Mejuto, J. (2002). Size-weight relationships of the swordfish (*Xiphias gladius*) and several pelagic shark species caught in the Spanish surface longline fishery in the Atlantic, Indian and pacific oceans. *Collected Volume Science Paper ICCAT*, 54(4), 1132-1149.

Gündoğdu, S., Baylan, M., & Çevik, C. (2015). Comparative study of the Length-Weight Relationships of some fish species along the Turkish coasts. *Mediterranean Marine Science*, 17(1), 80-108.

Güven, O., Kebapcioglu, T., & Deval, M. C. (2012). Length–weight relationships of sharks in Antalya Bay, eastern Mediterranean. *Journal of Applied Ichthyology*, 28, 278–279. http://dx.doi.org/10.1111/j.1439-0426.2011.01823.x

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(6), 699-702. http://dx.doi.org/10.1111/j.1439-0426.2008.01167.x

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(6), 707-708. http://dx.doi.org/10.1111/j.1439-0426.2007.00872.x

Ismen, A., Yigin, C., Altinagac, U., & Ayaz, A. (2009). Length–weight relationships for ten shark species from Saros Bay (North Aegean Sea). *Journal of Applied Ichthyology*, 25(1), 109-112. http://dx.doi.org/10.1111/j.1439-0426.2009.01263.x

Kabasakal, H. (2006). Distribution and biology of the bluntnose sixgill shark, Hexanchus griseus (Bonnaterre, 1788) (Chondrichthyes: Hexanchidae), from Turkish waters. *Annales Series Historia Naturalis*, 16, 29-36.

Kabasakal, H. (2010). On the occurrence of the blue shark, Prionace glauca (Chondrichthyes: Carcharhinidae), off Turkish coast of northern Aegean Sea. *Marine Biodiversity Records*, 3(e31), 1-4. https://doi.org/10.1017/S1755267210000266

Kabasakal, H., & Kabasakal, E. (2004). Shark captured by commercial fishing vessels off the coast of Turkey in the northern Aegean Sea. *Annales Series Historia Naturalis*, 14, 171-180.

Kadri, H., Marouani, S., Bradai, M. N., Bouaïn, A., & Morize, E. (2014). Distribution and morphometric characters of the Mediterranean longnosed skate, Dipturus oxyrinchus (Chondrichthyans: Rajidae) in the. *Journal of Coastal Life Medicine*, 2(7), 505-510.

Kapiris, K., & Klaoudatos, D. (2011). Length-weight relationships for 21 fish species caught in the Argolikos Gulf (central Aegean Sea, eastern Mediterranean). *Turkish Journal of Zoology*, 35(5), 717-723. http://dx.doi.org/10.3906/zoo-1003-122

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, 274–278.

Lykousis, V., & Collins, M. (1987). Sedimentary environments in the northwestern Aegean Sea, identified from sea bed photography. *Thalassographica*, 10(1), 23-35.

Machias, A., Somarakıs, S., Magoulas, A., Tsimenidis, N., Divanach, P., Papadroulakis, N., Spedicato, M.T., & Suquet, M. (2001). The state of the European wreckfish (Polyprion americanus) stocks, (DGXIV 98/41 Final report).

Macpherson, E., & Duarte, C. M. (1991). Bathymetric trends in demersal fish size: is there a general relationship? *Marine Ecology Progress Series*, 71, 103–112.

Madurell, T., Cartes, J.E., & Labrapoulou, M. (2004). Changes in the structure of fish assemblages in a bathyal site of the Ionian Sea (Eastern Mediterranean). *Fisheries Research*, 66, 245–260. http://dx.doi.org/10.1016/S0165-7836(03)00205-4

Massutí, E., Morales-Nin, B., & Lloris, D. (1996). Bathymetric distribution and recruitment patterns of Phycis blennoides (Pisces: Gadidae) from the slope of the northwestern Mediterranean. *Scientia Marina*, 60(4), 481-488.

Megalofonou, P., Damalas, D., & Yannopoulos, C. (2005). Composition and abundance of pelagic shark by-catch in the eastern Mediterranean Sea. *Cybium*, 29(2), 135-140.

Megalofonou, P., Damalas, D., & De Metrio, G. (2009). Biological characteristics of blue shark, Prionace glauca, in the Mediterranean Sea. *Journal of the Marine Biological Association of the United Kingdom*, 89(06), 1233-1242. http://dx.doi.org/10.1017/S0025315409000216

Mejuto, J., Ramos-Cartelle, A., Quintans, M., González, F.,

& Carroceda, A. (2008). Length-weight relationships and morphometric conversion factors between weights for the blue shark (Prionace glauca) and shortfin mako (Isurus oxyrinchus) caught by the Spanish surface longline fleet in the Atlantic Ocean. *Collected Volume Science Paper ICCAT*, 62(5), 1494-1507.

Morey, G., Moranta, J., Massuti, E., Grau, A., Linde, M., Riera, F., & Morales-Nin, B. (2003). Weight–length relationships of littoral to lower slope fishes from the western Mediterranean. *Fisheries Research*, 62(1), 89-96. http://dx.doi.org/10.1016/S0165-7836(02)00250-3

Morato, T., Watson, R., Pitcher, T. J., & Pauly, D. (2006) Fishing down the deep. *Fish and fisheries*, 7(1), 24-34. http://dx.doi.org/10.1111/j.1467-2979.2006.00205.x

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. http://dx.doi.org/10.1046/j.1439-0426.2002.00281.x

Papaconstantinou, C., Caragitsou, E., Vassilopoulou, V., Petrakis, G., Mytilineou, C., Fourtouni, C., Tursi, A., Politou, C.Y., Giagnisi, M., D' Onghia, G., Siapatis, A., Matarese, A., Economou, A., & Papageorgiou, E. (1993). Investigation of the abundance and distribution of demersal stocks of primary importance to the Greek fishery in the North Aegean Sea, Greece. (Technical Report). Athens, Hellas, National Centre for Marine Research Press., 316 pp.

Papiol, V., Cartes, J. E., Fanelli, E., & Maynou, F. (2012). Influence of environmental variables on the spatio-temporal dynamics of bentho-pelagic assemblages in the middle slope of the Balearic Basin (NW Mediterranean). *Deep Sea Research Part I: Oceanographic Research Papers*, 61, 84-99. http://dx.doi.org/10.1016/j.dsr.2011.11.008

Pauly, D., Sambilay, J.V., & Opitz, S. (1993). Estimates of relative food consumption by fish and invertebrate populations, required for modelling the Bolinao reef ecosystem, Philippines. In V. Christensen & D. Pauly (Eds.), *Trophic Models of Aquatic Ecosystems*. (pp. 236-251). Manila, Philippines, ICLARM Press., 390 pp.

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

Poulos, S. E., Drakopoulos, P. G., & Collins, M. B. (1997). Seasonal variability in sea surface oceanographic conditions in the Aegean Sea (Eastern Mediterranean): An overview. *Journal of Marine Systems*, 13 (1), 225-244. http://dx.doi.org/10.1016/S0924-7963(96)00113-3

Richter, H., Luckstadt, 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(3), 255-264. http://dx.doi.org/0944-1921/2000/48/3-226/15

Özaydın, O., Uçkun, D., Akalın, S., Leblebici, S., & Tosunoğlu, 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

Öztekin, A., Özekinci, U., & Daban, İ. B. (2016). Length-weight relationships of 26 fish species caught by longline from the Gallipoli peninsula, Turkey (northern Aegean Sea). *Cahiers de Biologie Marine*, 57, 335-342.

Özvarol, Y. (2014). Length-weight relationships of 14 fish species from the Gulf of Antalya (northeastern Mediterranean Sea, Turkey). *Turkish Journal of Zoology*, 38(3), 342-346. http:// 10.3906/zoo-1308-44

Sangun, L., Akamca, E., & Akar, M. (2007). Weight-length relationships for 39 fish species from the north-eastern Mediterranean coast of Turkey. *Turk Journal Fish Aquatic Science*, 7, 37–40.

Stefanescu, C., Rucabado,J., &Lloris, D.(1992). Depth-size trends in western Mediterranean demersal deep-sea fishes. *Marine Ecology Progress Series*, 81, 205-213.

Stergiou, K. I., & Pollard, D. A. (1994). A spatial analysis of the commercial fisheries catches from the Greek Aegean Sea. *Fisheries Research*, 20 (2), 109-135. http://dx.doi.org/10.1016/0165-7836(94)90078-7

Ünlüata, Ü., Oguz, T., Latif, M. A., & Özsoy, E. (1990). On the physical oceanography of the Turkish Straits. In G. Pratt (Eds.), *The Physical Oceanography of Sea Straits* (pp. 22-50). Kluwer Academic Press., 608 pp.

Vassilopoulou, V., & Anastasopoulou, A. (2007). Pelagic Fish Assemblages Associated with Fish Aggregation Devices (Fads). In. C. Papaconstantinou, A. Zenetos, V. Vassilopoulou & G. Tserpes (Eds.), *State of Hellenic Fisheries* (pp. 461- 466). Athens, Greece, HCMR Press., 466 pp.

Yigin, C., & Ismen, A. (2010). Age, growth, reproduction and feed oflongnosed skate, Dipturus oxyrinchus (Linnaeus, 1758) in Saros Bay, the north Aegean Sea. *Journal of Applied Ichthyology*, 26(6), 913-919. http://dx.doi.org/10.1111/j.1439-0426.2010.01510.x

Weatherley, A. H., & Gill, H. S. (1987). The biology of fish growth. London, England, Academic Press., 443 pp.