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ARAŞTIRMA MAKALESİ RESEARCH PAPER

Morphometric Aspects and Growth Parameters of the Wedge Clam (*Donax trunculus*) of the Black Sea, Turkey

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Abstract: *Donax trunculus*, known as wedge clam, is an Atlantic-Mediterranean bivalve colonizing in fine sand beaches of the upper subtidal zone. Aim of this study is to determine the biometric features of wedge clam in sandy beaches, where they live in high-density, and the relationships between these features. The samples were collected for between March 2014-February 2015 from an unexploited population from Black Sea. A total of 11045 samples were collected during this study. The shell length, shell width, shell thickness and shell weight, total weight and meat weight were measured. SL changes between 4.5 and 35.5 mm with an average value of 18.6 ± 8.5 mm. Average TW of the total sampling group was 1.2 ± 1.1 g (0.007-4.64). Relationships between SL and SWe, SWi and SWe, ST and SWe were found as $SWe=0.0001\ SL^{2.9659}$ ($R^2=0.98$), $SWe=0.0002SWi^{3.3938}$ ($R^2=0.97$) and $SWe=0.0072ST^{2.6968}$ ($R^2=0.89$), respectively. Average MW of wedge clam was calculated as 0.2 ± 0.2 g (0.001-2.74). The relationships between growth parameters were detailed by cluster analyses (CA), correlation analyses and comparison analyses. Results of this study have an important contribution to the present knowledge on the morphometric aspects and the growth parameters of the wedge clam in the Black Sea.

Keywords: *Donax trunculus*, growth, morphometric, shell, length-weight relationships.

Karadeniz'deki (Türkiye) kum şırlanının (*Donax trunculus* Linnaeus, 1758) büyüme ve morfometrik parametreleri

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Öz: Kum şırlanı olarak bilinen, *Donax trunculus*, sığ kıyısal alanlarda kolinize olmuş Atlantik-Akdeniz kökenli bir çift kabuklu türdür. Bu çalışmada, dalga hareketlerinin çok yüksek olduğu kumsal alanlarda yaşayan, kum şırlanı türünün biyometrik özellikleri ve bu özelliklerin birbiriyle ilişkileri belirlenmiştir. Çalışma, Güney Karadeniz Bölgesi kıyılarında hiç sömürülmemiş kum şırlanı popülasyonunda 12 ay (Mart 2014-Şubat 2015) boyunca periyodik örnekleme yapılarak gerçekleştirilmiştir. Çalışma süresi boyunca 11045 adet birey örneklenmiştir. Örneklenen bireylerde kabuk boyu, kabuk eni, kabuk kalınlığı, kabuk ağırlığı, toplam ağırlık ve et ağırlığı ölçümleri yapılmıştır. Kabuk boyları 4.5 ve 35.5 mm uzunlukları arasında değişmekte olup ortalama kabuk boyu 18.6 ± 8.5 mm olarak hesaplanmıştır. Toplam ağırlık ortalaması ise 1.2 ± 1.1 g (0.007-4.64) olarak belirlenmiştir. KB-W, KE-W ve KK-W arasındaki ilişki sırasıyla $W=0.0001\ KB^{2.9659}$ ($R^2=0.98$), $W=0.0002KE^{3.3938}$ ($R^2=0.97$) ve $W=0.0072KK^{2.6968}$ ($R^2=0.89$) olarak tespit edilmiştir. Ortalama et ağırlığı ise 0.2 ± 0.2 g (0.001-2.74) olarak belirlenmiştir. Yapılan bu çalışma ile kum şırlanının Karadeniz Bölgesi'ndeki popülasyonunun büyüme parametreleri ve morfometrik özelliklerinin belirlenmesi açısından önemli katkılar sağlamıştır.

Anahtar kelimeler: *Donax trunculus*, büyüme, morfometri, kabuk, boy-ağırlık ilişkisi.

INTRODUCTION

Species *Donax trunculus* Linnaeus, 1758 is widely distributed from Senegal, the north Atlantic Ocean coasts of France (Deval, 2009; Çolakoğlu, 2011) to the Black Sea and the Mediterranean Sea (Bayed & Guillou, 1985; Çokaloğlu, 2014). Özden et al., (2009) reported that it is a commercially important species that is found abundantly in the northern Sea of Marmara. It is known that, the densest populations are formed in sand and tidal zones, especially in high-energetic seas (Gaspar et al., 1999). It feeds on organic material, specially by filtering phytoplankton (Mouëza & Chessel, 1976). This species inhabits depths of 0-2 m in the Mediterranean Sea and 0-6 m in the Atlantic, generally forming stock in depths of 0-3 m (Gaspar et al., 2002a). There are stocks of *D. trunculus* in the coast of Turkey's Mediterranean Sea, Aegean Sea, Sea of Marmara and the Black Sea (Öztürk et al., 2014). Though it is not consumed as a food source in Turkey, it is extensively used for coastal fisheries as bait for pole or longlines. All the production is exported. There are legal legislations on the species in Turkey and it is illegal to harvest between 15^{th} April – 31^{th} August. Additionally, the minimum harvesting size is 2.5 cm (BSGM, 2016).

There are various studies conducted on wedge clam from the Atlantic Ocean (Bayed & Guillou, 1985; Bayed, 1991, 1998; Guillou & Bayed, 1991) and from the Mediterrranean Sea (Mouëza, 1972; Mouëza & Chessel, 1976; Ansell & Bodoy, 1979; Neuberger-Cywiak et al., 1990; Deval, 2009; Hafsaoui et al., 2016).

In this study, some biological and biometric features of *D. trunculus* were examined. There is limited information on the species from Turkey. This study will be a first on the species for the Turkish coast of the southern Black Sea.

MATERIAL AND METHOD

Sampling Area: Research was conducted between March 2014 – February 2015 in supralittoral sandy habitats between 0-1.5 m in depth, where the species is the densest, on the coast of Ordu, Black Sea (Figure 1).

Samples were collected with a hand dredge (1.3 cm mesh size) and sieves (1-10 mm mesh size). Samples were preserved in seawater and were examined the same day. Shell length (SL), shell width (SWi) and shell thickness (ST) of *D. trunculus* were measured with a digital compass with 0.1 mm sensitivity. After these measurements, samples were dried on drying paper and total weight (TW) of the individual was measured with a Precisa sensitive scale with a sensitivity of 0.01 g. Meat weight (MW) and shell weight (SWe) were also measured with the same scale for condition index. Length and weight relationship estimations were done by using Ricker (1975)'s exponential relationship models,

$$TW = a.SL^b \text{ or } logTW = log\ a + b\ (logSL)$$

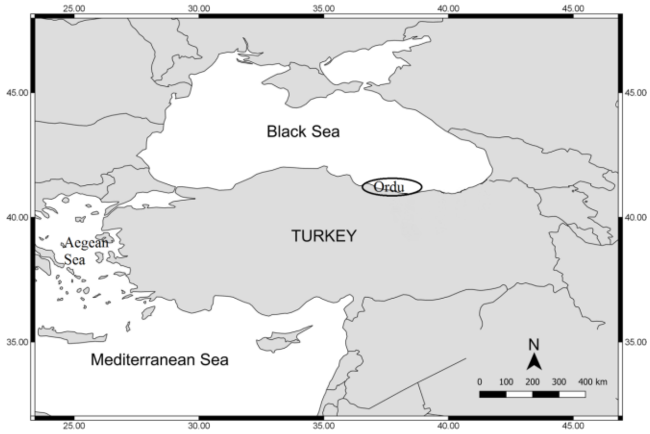

Figure 1. Sampling area.

Where a (intersection point) and b (slope) are regression constants, TW is total body weight (g) and SL is shell length (mm). The "b" value was tested by t-test to check whether it was significantly different from 3. When b = 3, it reflects an isometric growth, when it is b ≠3 it reflects an allometric growth (positive b > 3 or negative b < 3) (Froese, 2006; Aydın & Sözer, 2019).

Estimation of SL-SWi, SL-ST and ST- SWi relationships were done using linear relationship models,

(SWi = a + b.SL, ST = a + b.SL, ST = a+ b.SWi)

To estimate the growth rate, SL and TW were used with the following equations:

Shell length increase percentage = [(SLn – SLn-1) / SLn-1] x100,

Weight increase percentage = [(TWn – TWn-1) / TWn-1] x100

D. trunculus condition index (CI) ratio was estimated using TW, MW and SWe (Çolakoğlu & Tokaç, 2011),

CI= MW / (TW- SWe) x 100

SPSS Statistical Package and MS Office-Excel software were used for data analyzes. Distribution of the data was checked, and monthly averages of the data were compared. Due to high sample numbers, Kolmogorov-Smirnov test was chosen amongst the distribution tests and found out that the data showed nonparametric distribution. Nonparametric tests were used to compare monthly averages. To determine if there were differences between months and seasons, Kruskal Wallis test was used, and Mann Whitney-U test was used to determine which months and seasons were different (Aydın et al., 2014). All these tests were conducted within 95 % confidence level on SPSS v.21 (IMB, USA). Correlation analysis were done to evaluate the relationships between parameters. Spearman correlation analysis was chosen because the data were nonparametric. Cluster analysis was used for evaluation of similarities among variables. Ward method was used with Euclidean Distance, and Z-score correction was also done for cluster analysis (Tunca et al., 2016).

RESULTS

Length and weight frequency distribution: In total 11045 individuals of *D. trunculus* were sampled and shell lengths ranged between 4.5 and 35.5 mm. The length and weight frequencies of *D. trunculus* are given in Figure 2.

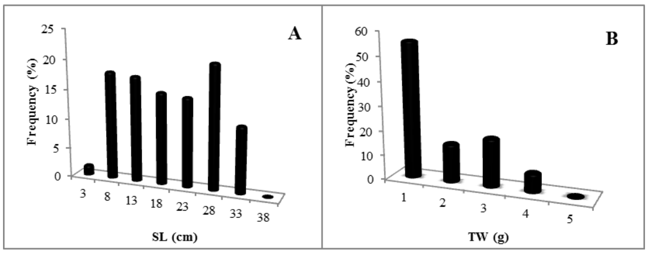

Figure 2. *D. trunculus* length frequency (A) weight frequency (B).

Monthly length frequency distribution: Monthly length frequencies of the samples are given in Figure 3.

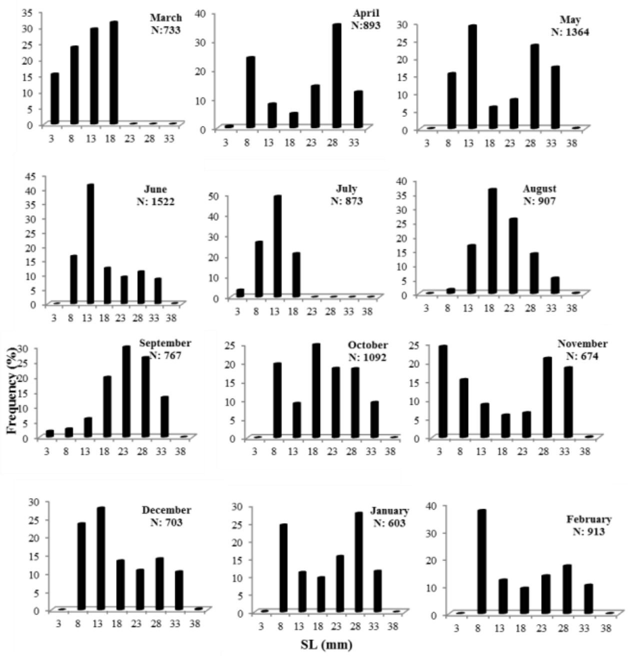

Figure 3. Monthly length frequencies.

Biometric data: The average shell length was calculated as 18.6±8.5 mm (min: 4.5 - max: 35.5). The average total weight was 1.2±1.1 g (0.007-4.64). Biometric measurements of all the samples are given in Table 1.

Table1. *D .trunculus* biometric measurements.

	SL (mm) N:11045	SWi (mm) N:11045	ST (mm) N:11045	TW (g) N:11045	MW (g) N:8092	SW (g) N:6903
Mean	18.6±8.5	10.7±4.3	5.5±2.5	1.2±1.1	0.2±0.2	0.7±0.7
Minimum	4.5	2.5	0.5	0.007	0.001	0.007
Maximum	35.5	20	11	4.64	2.74	2.95

In this study, the relationship between SWi and TW showed positive allometry (b>3), and negative allometry between ST and TW, and SL and TW (b<3) (Figure 4).

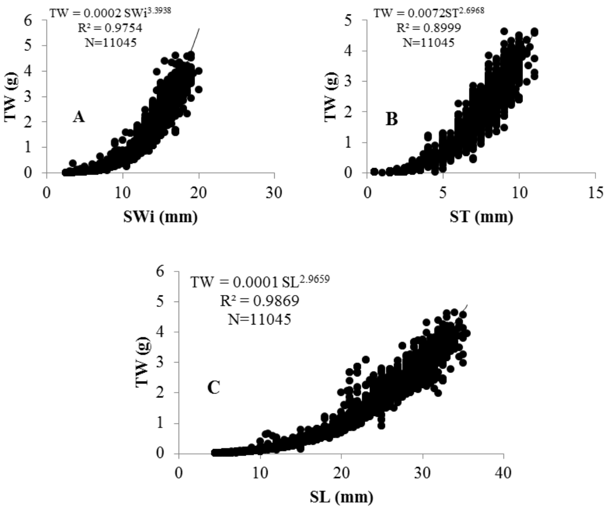

Figure 4. Relationships between shell width – total weight (A), shell thickness - total weight (B), shell length – total weight (C).

Linear relationships were identified between SL and SWi, SL and ST and SWi and ST for all the *D. trunculus* samples (Figure 5).

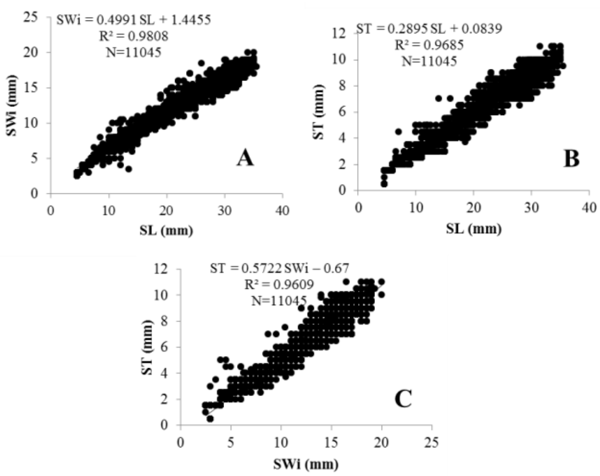

Figure 5. Relationships between shell length – shell width (A), shell length – shell thickness (B) shell width – shell thickness (C).

Linear relationships were identified between SW and MW and TW and MW. An exponential function was fitted for the relationship between SL and MW (Figure 6).

Growth Rate: The growth rate was estimated using SL and TW. The highest growth rate by weight was estimated for the 10-15 mm length group (326.3 %) and the lowest for the 35-40 mm length group (23.1 %). The highest growth by length was estimated for 5-10 mm length group (63.1 %) and the lowest was estimated for 30-35 mm length group (13.0 %) (Table 2).

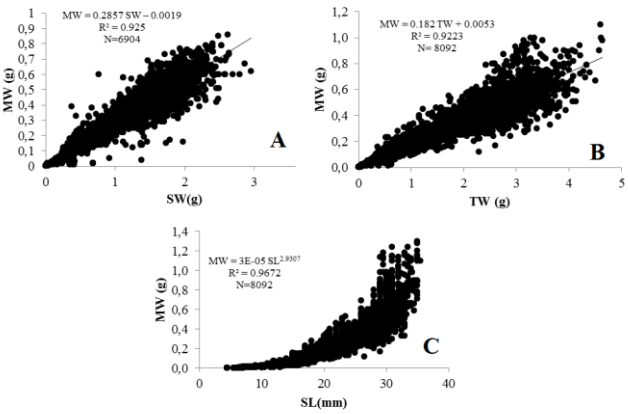

Figure 6. Relationships between shell weight – meat weight (A), total weight – meat weight (B), shell length – meat weight (C)

Table 2. Growth performance value of *D. trunculus*.

SL (mm)	N	%	Mean SL (mm)	Mean TW (g)	Increasing in length (%)	Increasing in weight (%)
0-5	191	1.73	4.5 ± 0.01	0.02± 0.001	-	-
5-10	2005	18.15	7.3 ± 0.9	0.05 ± 0.02	**63.1**	160.0
10-15	1957	17.72	11.7 ± 1.5	0.2 ± 0.1	59.9	**326.3**
15-20	1704	15.43	17.2 ± 1.5	0.6 ± 0.2	46.9	201.5
20-25	1654	14.98	22.1 ± 1.4	1.3 ± 0.3	28.3	116.7
25-30	2292	20.75	27.4 ± 1.4	2.3 ± 0.4	23.8	81.7
30-35	1232	11.16	30.9 ± 1.0	3.1 ± 0.3	**13.0**	32.5
35-40	10	0.08	35.1 ± 0.2	3.8 ± 0.5	13.4	**23.1**
Total	**11045**	**100**	**18.62±8.47**	**1.17±1.12**	**35.5**	**134.5**

Condition Index: The condition index, that represents the fullness of the soft tissue in the shell cavity of a bivalve mollusk, is expressed as the rate of occupancy using the method of condition index by weight, was calculated by examining 6929 individuals. The highest average value was estimated for May (121.3±18.2) and the lowest was August (42.8±19.82) (Table 3).

Statistical Analyzes: The monthly average values of the parameters are given in Table 3.

Table 3. Monthly comparison of size parameters and condition index ($p < 0.05$)

		Mar. (A)	Ap. (B)	May (C)	Jun. (D)	Jul. (E)	Aug. (F)	Sep. (G)	Oct. (H)	Nov. (I)	Dec. (J)	Jan. (K)	Feb. (L)
SL (mm) (N:11045)	**Mean**	18.79	20.3	19.18	16.04	19.55	19.87	19.05	22.47	17.26	16.55	19.27	16.63
	Min.	4.5	4.5	8	8	6.5	6.5	5.5	4.5	4.5	5	4.5	6.5
	Max.	34	34	35.5	35	35	35	33.5	34.5	35	35	34	34
	S.D.	0.34	0.30	0.24	0.2	0.23	0.18	0.23	0.23	0.42	0.33	0.37	0.3
	Dif.	$A^{e,f,g,k}$	B^{c}	$C^{b,e,g,k}$	$D^{i,j}$	$E^{a,c,f,g,k}$	$F^{a,e,k}$	$G^{a,c,e,k}$	H	$I^{d,j,l}$	$J^{d,i,l}$	$K^{a,c,e,f,g}$	$L^{i,j}$
SWi (mm) (N:11045)	**Mean**	10.80	11.52	11.07	9.63	11.27	11.45	10.96	12.76	9.87	9.56	10.91	9.54
	Min.	2.5	2.5	5.5	5.5	4.2	4.	3.5	3	3	3	2.5	4
	Max.	19	20	19	18.5	19	18.5	18.5	18.6	20	19.3	17.5	19
	S.D.	0.17	0.15	0.12	0.1	0.12	0.09	0.11	0.12	0.22	0.17	0.19	0.16
	Dif.	$A^{e,f,g,k}$	B^{c}	$C^{b,e,f,g}$	$D^{i,j}$	$E^{a,c,f,g,k}$	$F^{a,c,e,k}$	$G^{a,c,e,k}$	H	$I^{d,j,l}$	$J^{d,i,l}$	$K^{a,e,f,g}$	$L^{i,j}$
ST (mm) (N:11045)	**Mean**	5.6	6	5.7	4.8	5.7	5.7	5.52	6.62	4.84	4.83	5.66	5
	Min.	1.5	1.5	2.5	2.5	2	2	1.5	1.5	0.5	1.5	1	2
	Max.	11	10	10	10.5	11	11	10	10.2	11	10.5	10	10
	S.D.	0.09	0.08	0.07	0.06	0.07	0.57	0.07	0.07	0.14	0.1	0.11	0.09
	Dif.	$A^{e,f,g,k}$	$B^{c,k}$	$C^{b,e,f,g}$	$D^{i,j,l}$	$E^{a,c,f,g,k}$	$F^{a,c,e,k}$	$G^{a,c,e,k}$	H	$I^{d,j}$	$J^{d,i,l}$	$K^{a,b,e,f,g}$	$L^{d,j}$
TW (g) (N:11045)	**Mean**	1.35	1.53	1.35	0.79	1.14	1.05	1.12	1.5	1.23	0.93	1.27	1
	Min.	0.014	0.014	0.054	0.054	0.061	0.027	0.022	0.01	0.019	0.019	0.007	0.02
	Max.	4.64	4	4.08	4.34	4.62	4.58	3.95	4.22	4.28	3.9	3.77	4.4
	S.D.	0.04	0.04	0.04	0.03	0.03	0.03	0.03	0.03	0.05	0.04	0.05	0.04
	Dif.	$A^{e,f,g,k}$	B^{c}	$C^{b,f,g}$	D	$E^{a,f,g,k}$	$F^{a,c,e,k}$	$G^{a,c,e,k}$	H	$I^{j,l}$	$J^{i,l}$	$K^{a,e,f,g}$	$L^{i,j}$
CI (N:6929)	**Mean**	59.5	61.9	121.3	73.8	56.2	42.8	55.4	46.1	52.3	51.2	44.9	53.8
	Min.	16.7	12.5	15.6	17.5	16.8	15.4	14.2	8.7	16.3	16.3	13	11.5
	Max.	209.1	191.7	273.9	175.6	224.0	172.7	120.3	206.1	221.4	192.3	133.3	260.0
	S.D.	20.94	23.33	18.2	46.29	22.56	19.82	24.58	17.45	19.66	16.77	19.28	24.80
	Dif.	A^{b}	B^{a}	C	D	$E^{i,j,l}$	F	$G^{i,j}$	H^{k}	$I^{e,g,j,l}$	$J^{e,g,i,l}$	K^{h}	$L^{e,i,j}$

Explanations: A capital and a superscript letters denote comparisons between two months. There is no statistical difference at the level of 95 % between a capital letter and each superscript letter.

Given the morphometric data, statistically significant largest *D. trunculus* values were in October (Table 3). April and May followed October, and the lowest values were in June. In case of condition index, it was different and the highest statistically significance value of condition index was May, while the lowest was August. Seasonal comparison of SL, SWi and ST were as Spring = Autumn > Summer > Winter, and for TW it was as Spring > Autumn > Winter > Summer. Unlike the other parameters, TW was found significant and a statistical difference was found between Spring and Autumn.

In general, high correlation was found for all months and in the total (Table 4). The highest value was found as 1.00 (a hundred percent) in May between TW and SWe. The lowest correlation value was 0.749, between ST and SWe in June. June is also notable for SWe showing the lowest correlation with other parameters. Another low correlation was observed between MW with other parameters in November. Given the annual comparison, though correlation between MW and SWe values were strong when compared to the correlation between the other parameters, it was found to be relatively weaker.

In case of cluster analyses; there were two different clusters, SL, SWi and ST measurements formed a cluster and BW, SW and MW formed the other (Figure 7). The strongest relation was observed between SL and SWi with 10.29, value of the closest Euclid distance (Table 5). Relatively the furthest distance to other parameters was observed for MW. These results also show parallelism to the annual correlation values.

Table 4. Correlation between monthly and annual parameters.

	March						April						May					
	SL	**SWi**	**ST**	**BW**	**SWe**	**MW**	**SL**	**SWi**	**ST**	**BW**	**SWe**	**MW**	**SL**	**SWi**	**ST**	**BW**	**SWe**	**MW**
SL	1						1						1					
SWi	0.969**	1					0.963**	1					0.985**	1				
ST	0.954**	0.962**	1				0.953**	0.955**	1				0.984**	0.981**	1			
BW	0.977**	0.972**	0.963**	1			0.968**	0.963**	0.965**	1			0.988**	0.983**	0.983**	1		
SWe	0.893**	0.928**	0.949**	0.917**	1		0.903**	0.939**	0.900**	0.899**	1		0.998**	0.998**	0.994**	10.000**	1	
MW	0.980**	0.973**	0.921**	0.967**	0.834**	1	0.987**	0.976**	0.939**	0.954**	0.865**	1	0.960**	0.958**	0.935**	0.960**	0.954**	1
	June						**July**						**August**					
	SL	**SWi**	**ST**	**BW**	**SWe**	**MW**	**SL**	**SWi**	**ST**	**BW**	**SWe**	**MW**	**SL**	**SWi**	**ST**	**BW**	**SWe**	**MW**
SL	1						1						1					
SWi	0.969**	1					0.963**	1					0.985**	1				
ST	0.954**	0.962**	1				0.953**	0.955**	1				0.984**	0.981**	1			
BW	0.977**	0.972**	0.963**	1			0.968**	0.963**	0.965**	1			0.988**	0.983**	0.983**	1		
SWe	0.893**	0.928**	0.949**	0.917**	1		0.903**	0.939**	0.900**	0.899**	1		0.998**	0.998**	0.994**	10.000**	1	
MW	0.980**	0.973**	0.921**	0.967**	0.834**	1	0.987**	0.976**	0.939**	0.954**	0.865**	1	0.960**	0.958**	0.935**	0.960**	0.954**	1
	September						**October**						**November**					
	SL	**SWi**	**ST**	**BW**	**SWe**	**MW**	**SL**	**SWi**	**ST**	**BW**	**SWe**	**MW**	**SL**	**SWi**	**ST**	**BW**	**SWe**	**MW**
SL	1						1						1					
SWi	0.991**	1					0.980**	1					0.985**	1				
ST	0.985**	0.981**	1				0.963**	0.954**	1				0.983**	0.976**	1			
BW	0.996**	0.991**	0.988**	1			0.993**	0.982**	0.970**	1			0.993**	0.987**	0.987**	1		
SWe	0.997**	0.989**	0.991**	0.998**	1		0.975**	0.967**	0.959**	0.981**	1		0.929**	0.880**	0.882**	0.955**	1	
MW	0.959**	0.952**	0.941**	0.963**	0.974**	1	0.950**	0.939**	0.931**	0.951**	0.961**	1	0.854**	0.821**	0.819**	0.860**	0.869**	1
	December						**January**						**February**					
	SL	**SWi**	**ST**	**BW**	**SWe**	**MW**	**SL**	**SWi**	**ST**	**BW**	**SWe**	**MW**	**SL**	**SWi**	**ST**	**BW**	**SWe**	**MW**
SL	1						1						1					
SWi	0.992**	1					0.987**	1					0.994**	1				
ST	0.989**	0.986**	1				0.973**	0.972**	1				0.944**	0.943**	1			
BW	0.998**	0.992**	0.991**	1			0.995**	0.990**	0.977**	1			0.997**	0.996**	0.947**	1		
SWe	0.975**	0.964**	0.953**	0.986**	1		0.984**	0.977**	0.962**	0.991**	1		0.994**	0.993**	0.925**	0.998**	1	
MW	0.934**	0.919**	0.910**	0.939**	0.945**	1	0.958**	0.955**	0.933**	0.964**	0.960**	1	0.986**	0.985**	0.910**	0.988**	0.989**	1
	Annual																	
	SL	**SWi**	**ST**	**BW**	**SWe**	**MW**												
SL	1																	
SWi	0.990**	1																
ST	0.984**	0.981**	1															
BW	0.992**	0.988**	0.984**	1														
SWe	0.973**	0.970**	0.965**	0.974**	1													
MW	0.978**	0.975**	0.968**	0.980**	0.969**	1												

***Correlation is significant at the 0.01 level (2-tailed).*

Table 5. Cluster analyses matrix of measured parameters.

	Shell length (SL)	Shell width (SWi)	Shell thickness (ST)	Total weight (TW)	Shell weight (SW)	Meat weight (MW)
Shell length	0.000					
Shell width	10.288	0.000				
Shell thickness	13.629	16.125	0.000			
Total weight	25.084	29.429	24.672	0.000		
Shell weight	31.969	35.074	31.556	22.098	0.000	
Meat weight	33.582	36.473	33.598	25.838	30.842	0.000

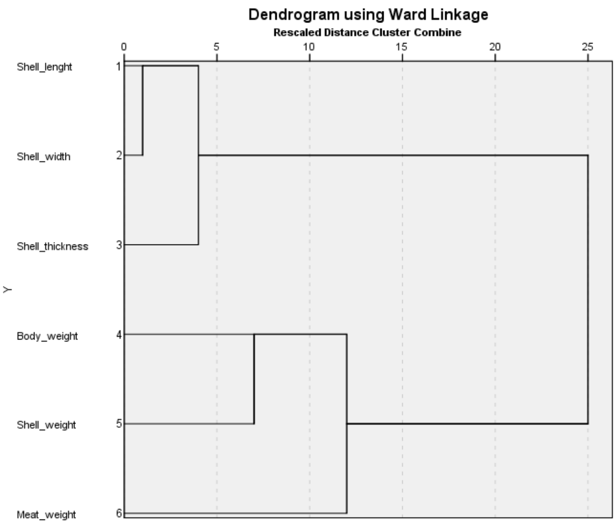

Figure 7. Cluster analyses dendrogram of the measured data.

DISCUSSION

Total of 11045 individuals of *D. trunculus* were measured. In other studies, conducted on *D. trunculus*, number of examined individuals were 995 individuals from Black Sea by Yılmazer (2005), and from Sea of Marmara; 4624 individuals by Çolakoğlu (2011), 3428 individuals by Çolakoğlu and Tokaç (2011), 2098 individuals by Deval (2009) and 2558 individuals by Çolakoğlu (2014). Among the number of individuals examined in Turkey. This study is the highest and study by Deval (2009) second.

The shell length of *D. trunculus* individuals were found between 4.5-35.5 mm in this study, where it was conducted on sandy habitats of the coastal areas of Ordu in Black Sea. The average shell length was estimated as 18.6±8.5 mm. According to the study by Yılmazer (2005) conducted at Şile coasts of west Black Sea, the smallest individual was measured to be 11.6 mm and the largest 43.1 mm. Çolakoğlu & Tokaç (2011) estimated the average length 28.7 mm, and the length range as 13 - 42 mm for Sea of Marmara. Another study, from northern Sea of Marmara by Deval (2009) found the length range was between 3-44.8 mm ($L_{average}$= 24.7 mm). Çolakoğlu (2014) reported the length range to be between 10–42 mm. The other studies from other seas reported the highest estimated length (L_∞) as 52.84 mm by Mazé & Laborda (1988) from Atlantic Ocean coasts, and the lowest estimated length (L_∞) as 35.9 mm by Bodoy (1982) from the Mediterranean Sea. In another study from the Spanish coasts the length range was found between 5 – 45 mm (Huz et al., 2002), and in the studies from the coasts of southern Portugual the length range was found between 8.9–44.3 mm ($L_{average}$= 26.5 mm) and 16-44 mm ($L_{average}$= 27.3 mm) (Gaspar et al. 2002a), and the maximum length as 31 mm (Gaspar et al., 2003). In a study conducted in the southern Adriatic coasts of

Italy, the maximum length was reported as 37 mm (Zeichen et al., 2002). The maximum length values were found in this study therefore, it can be said that, they are similar, when compared with "L_∞" values reported from Atlantic Ocean and Mediterranean Sea. Though when compared with studies conducted in Sea of Marmara, the individuals from Sea of Marmara seem to be larger than the population from the Black Sea. In both studies from Sea of Marmara, the average length and maximum length were reported to be larger. This difference is due to using different sampling gears. In this study, due to a different sampling gear, smaller individuals were sampled which resulted in smaller average length. Especially in Turkey, the study conducted in Sea of Marmara indicated that individuals in Sea of Marmara are larger from the individuals in Black Sea. It can be said that the main reasons for this difference are environmental variables such as salinity, temperature, oxygen and the difference in sampling depth and gear.

The highest growth rate in length was found in 5-10 mm length group. Neuberger-Cywiak et al., (1990) found similar results and reported the highest growth rate at the first 2.5 months, and Hafsaoui et al., (2016) reported the highest growth rate within the first year. Individuals within the length group 25-30 mm constitutes 20.75 % of overall samples. The ratio of the individual identified as juveniles (< 15 mm) corresponds to 40.9 % of the overall sample. The length at maturity was identified from Algeria by Moueza & Frenkiel-Renault (1973) as 16 mm, from Spain by Tirado & Salas (1998) as 13.3, from Portugal by Gaspar et al., (1999) as 13 mm, from Italy by Zeichen et al., (2002) as 18 mm and from Şile Black Sea coast of Istanbul by Yılmazer (2005) as 18.9 mm. The length group within this study, which had the highest number of individuals (25-30 mm), was found to be higher from the reported length at maturity from other studies. Çolakoğlu (2011) reported the weight range between 0.26 – 17.22 g and the average weight as 3.04 g. In this study, the average weight was found to be 1.2 $\pm$ 1.1 g (0.007 – 4.64 g). There is a notable difference between Çolakoğlu (2011) and this study. This difference is due to difference in sampling gears. Since metal sieves were used in this study, the number of small sized individual was very high. A 33.5 % of the total sampling of this study (3684 individuals) is lower than the smallest individual reported by Çolakoğlu (2011) (0.26 g).

Additionally, Çolakoğlu (2011) reported the relationships between SL and TW as TW= 0.153 $SL^{2.73}$ (R^2= 0.95), between ST and TW as TW= 0.667$ST^{2.68}$ (R^2= 0.93), and between SWi and TW as TW= 3.12 $SWi^{2.30}$ (R^2= 0.86). In this study the relationships were estimated between SL and TW as TW= 0.0001 $SL^{2.96}$ (R^2= 0.9659), between ST and TW as TW= 0.0072 $ST^{2.6968}$ (R^2= 0.8999), and between SWi and TW as TW= 0.0002 $SWi^{3.3938}$ (R^2= 0.9754). In both studies, except for the relationships between SWi-TW, all showed negative allometry.

The "b" value of the relationship between SL and MW was estimated as 2.9659 (b<3). The other studies from various areas on this species also reported the "b" value b<3 and growth as negative allometry (Guillou, 1980; Bayed, 1990; Mazé & Laborda, 1990; Deval, 2009; Çolakoğlu, 2011; Çolakoğlu & Tokaç, 2011; Çolakoğlu, 2014). The studies reported as the "b" value changing between 2.5-3.5 and value being smaller than 3 indicate negative allometry (Ricker, 1975; Çolakoğlu, 2011).

In this study, a strong linear relation was observed between SL and SWi (SWi = 0.4991 SL + 1.4455, R^2= 0.98). Çolakoğlu (2011) reported the relationship between SWi and SL as SWi= 0.556 SL + 0.0962 (R^2=0.87). The study conducted at the coasts of Portugal reported the relationship between length and width as Log SWi= -0.067+0.888 Log SL (R^2= 0.934) (Gaspar et al. 2002b). When all these studies are compared, the strongest relationship between SL and SWi was from this study. It is known that the difference in regression constants can be the result of difference in environmental factors effecting the species growth (Parsons et al., 1990).

Çolakoğlu (2011) reported an exponential relationship between SWi and SL (SWi= 0.658$SL^{0.965}$ (R^2 = 0.918)). In this study, the regression coefficient was found as R^2= 0.98 and can be said that the linear relationship between SWi and SL is stronger.

Çolakoğlu (2011) reported the condition index of *D. trunculus* the highest in April (95.6) in the Marmara Sea, and the lowest in July (53.9). However, Deval (2009) study from the northern Sea of Marmara reported that the condition index starts to increase in February, reaching its highest in May and lowest in August. In this study, the estimated condition index of *D. trunculus* was maximum in May (121.3 $\pm$ 18.2), and minimum in August (42.8 $\pm$ 19.82). The results showed similarity with Deval (2009) study. Since the reproduction season showed parallelism with the period of maximum condition index value, it can be said that the reproduction season is between May and August. The studies conducted in other areas also reported that the reproduction season is between May and August (Bayed, 1990; Gaspar et al., 1999; Zeichen et al., 2002). Similarly, the study conducted on Şile coasts of Black Sea reported the reproduction season between May and August (Yilmazer, 2005). Studies from other areas reported that the reproduction period is in spring and summer seasons (Zeichen et al., 2002; Deval, 2009), and the low growth period is the result of low condition values of the reproduction period.

Results of this study have an important contribution to the present knowledge on the morphometric aspects and the growth parameters of the wedge clam in the southern Black Sea region. Additionally, this study shows importance as being the first study conducted from the southern Black Sea.

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