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*- SHORT COMMUNICATION -*

# First morphometric aspects and growth parameters of the European flat oyster (*Ostrea edulis* Linnaeus, 1758) for the Black Sea, Turkey

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## Abstract

A total of 32 the European flat oyster (*Ostrea edulis* Linnaeus, 1758) on the rocky shores of 0-5 m depths in Ordu province in the southern Black Sea were carried out in order to evaluate morphometric aspects and growth parameters. The shell length (SL), shell width (SWi), shell thickness (ST) and shell weight (SW), total weight (W) and meat weight (MW) were measured in this study. The mean SL of the collected individuals was measured as 69.49 ± 27.10 mm (min: 22.4, max: 145.8). Moreover, the average body weight was estimated to be 66.19 ± 60.78 g (1.5–241.7). The calculated "b" value of *O.edulis* is less than 3 and the growth was negative allometric. This study presents the first morphometric properties of European flat oyster in the southern Black Sea. In addition, this is the first study conducted for *O. edulis* in the Black Sea and the maximum sizes given for the Mediterranean, Aegean and Black Sea.

**Keywords:**
*Ostrea edulis*, morphometric parameters, southern Black Sea, growth characteristics, maximum size

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## Introduction

The European flat oyster is the native oyster species of European waters (Olsen,1883). It is a commercial high value species of the world. *Ostrea edulis* (Linnaeus, 1758) is widely distributed along the Atlantic Europe and North Africa, the Norwegian Sea, around Ireland and Britain, the Iberian Peninsula, the Black Sea and the Mediterranean (Olsen,1883; Cano et al., 1997; Zaitsev & Alenxandrov, 1998; Airoldi & Beck, 2007; Pogoda, 2019). This European flat oyster mainly

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prefers relatively shallow sheltered estuaries and lives around 80 m water depth (Laing et al., 2005). While the maximum length of the *O. edulis* is given 12 cm by Sealifebase (2019), Fischer et al., (1987) recorded 20 cm for oyster. It has been consumed as an important food source in Europe since the Romans (Gerlach 2001; Becker et al., 2012). It has been reduced since the mid-twentieth century due to the excessive use on its natural populations for many years and therefore, it has been started to be cultivated (Korringa, 1976; MacKenzie et al., 1997). Oyster stocks all over the world have decreased, and *O. edulis* species have been declining and are about to disappear day by day on all European coasts, especially on the Mediterranean coast (Barnabe & Doumenge, 2001; Basurco & Lovatelli, 2003; Carlucci, et al., 2010; Pogoda, 2019). Until the World War I, the presence of *O. edulis* at the commercial level on the north-west coast of the Black Sea was mentioned, even there were factories for processing this species near Sevastopol, but these factories were destroyed by storms in 1914. In 1970, it is stated that the stocks of this species disappeared and reintroduced in the north-west Black Sea (Zaitsev & Alenxandrov, 1998). *O. edulis* is known for many years in the territorial waters of Turkey. However, there are not any studies related to biometric characterics and length-weight relationships for this speices. Therefore, this study is very significant due to being the first study in this context and will contribute new insights for future studies.

## Material and Methods

Sampling was carried out in 2018 (41º 0467' N, 37º 4871' E) by shnorkel and SCUBA diving on rocky shores of 0-5 m depths in Ordu province in southern Black Sea (Figure 1). The collected samples were put in marine water and carried to the Fisheries Laboratory at Fatsa Faculty of Marine Sciences (Ordu, Turkey) and were examined in the same day. It was kept in seawater until working time and then biometric measurements were taken.

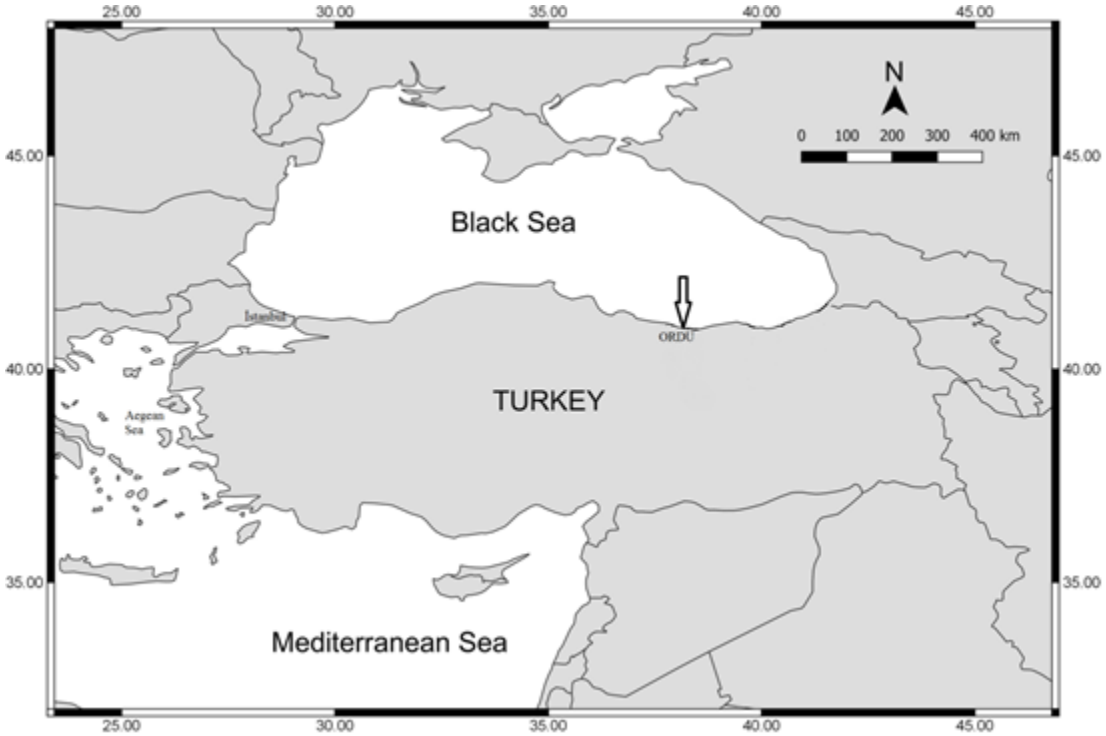


Figure 1. The map showing the sampling area.

In this study, shell length (SL), shell width (SWi) and shell thickness (ST) parameters of a total of 32 *O. edulis* were measured with a digital compass with 0.1 mm sensitivity (Figure 2). After these measurements, samples were dried on drying paper and total weight (W) of the individual was measured with a Precisa sensitive scale with a sensitivity of 0.01 g. Meat weight (MW) and shell weight (SW) were also measured with the same scale. SL-W, SL-SW and SL-MW relationships ($Y=aX^b$) were estimated by using Ricker (1975). SL-SWi, SL-ST, W-MW, SWi-ST and SW-MW relationships (Y=a+bx) were estimated by using Arneri et al., (1995).

Where a (intersection point) and b (slope) are regression constants, W is total body weight (g) and SL is shell length (mm). Ricker (1975) revealed that the regression coefficient "b" in length-weight relationship of marine organisms is usually 3. If b=3, growth is isometric where length increment is proportionate to weight increment. If it is greater than 3, the growth is positive allometric and if it is lower than 3, the marine organism exhibits negative allometric growth.

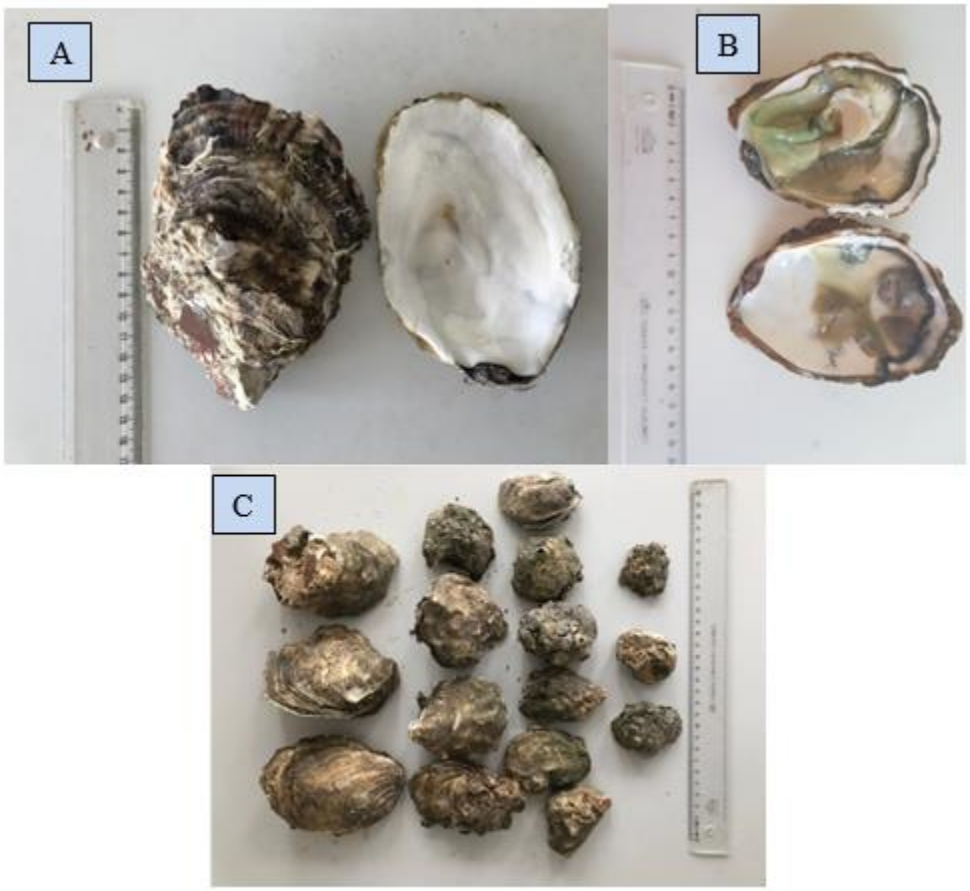


Figure 2. *Ostrea edulis* collected in the southern Black Sea. A) biggest individual B) soft parts of the *Ostrea edulis* C) individuals in different sizes.

The condition index in bivalve molluscs is used to compare two or more living stocks where environmental conditions are the same or different, to determine the time and duration of sexual maturity in stocks, and to monitor monthly and seasonal changes in nutritional activity of living species. In this study, soft tissue of the shell cavity was calculated by the following formula based on live, wet weight and shell weight (Okumuş, 1993).

Condition Index = wet soft tissue weigh / ( live weight – shell weight) x 100

**Results**

Totally, thirty two *O.edulis* were collected in this study and determined 80% of the samples belong to 40–70 mm SL length group (Figure 3).

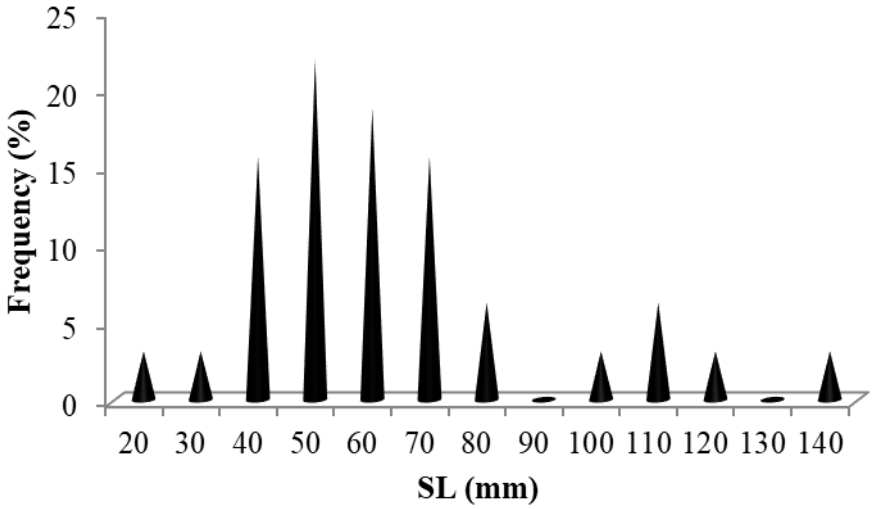


Figure 3. *Ostrea edulis* length–frequency distributions

In the measurements, the mean SL of the collected individuals was calculated as 69.49 ± 27.10 mm (min: 22.4, max: 145.8). Additionally, the average body weight was found to be 66.19 ± 60.78 g (1.5–241.7) (Table 1). The measured maximum SL is the largest individulals in the Mediterranean, Aegean, and Black Sea (Figure 2a).

Table 1. The biometric measurements of *Ostrea edulis*.

| | **SL (mm) N:32** | **SWi (mm) N:32** | **ST (mm) N:32** | **W (g) N:32** | **MW (g) N:32** | **SW (g) N:32** |
|---|---|---|---|---|---|---|
| **Mean** | 69.49 | 53.36 | 24.59 | 66.19 | 8.82 | 47.69 |
| **Minimum** | 22.4 | 18.8 | 4.7 | 1.5 | 0.2 | 1.1 |
| **Maximum** | 145.8 | 102.0 | 63.0 | 241.7 | 28.6 | 202.4 |
| **±SD** | 27.10 | 19.20 | 10.95 | 60.78 | 7.79 | 48.37 |

SL: shell length, W: total weight SWi: shell width, ST: shell thickness, MW: meat weight, SW: shell weight, SD: standart deviation, **N**: Number of individuals

SL-W, SL-SW and SL-MW relationships have been found to be an exponential relationship and all relationship parameters are given in Table 2.

Table 2. SL-W, SL-SW and SL-MW relationships for *Ostrea edulis*

| | N | Formula | a | b | $R^2$ | Growth |
|---|---|---|---|---|---|---|
| **SL – W** | 32 | W= a $SL^b$ | 0.0016 | 2.457 | 0.912 | Negative Allometric |
| **SL-SW** | 32 | SW= a $SL^b$ | 0.0012 | 2.448 | 0.887 | Negative Allometric |
| **SL-MW** | 32 | MW= a $SL^b$ | 0.0002 | 2.458 | 0.911 | Negative Allometric |

SL: shell length, W: total weight, MW: meat weight, SW: shell weight, **N**: Number of individuals **a**: intercept, **b**: slope, $\mathbf{R^2}$: determination coefficient

When the relationships between SL-W, SL-SW and SL-MW are examined, it is calculated that the value of "b" is less than 3 and the growth indicates a negative allometric growth (Figure 4). SL-SWi, SL-ST, W-MW, SWi-ST and SW-MW relationships were found to be linear relationship and all relationship parameters are given in Table 3.

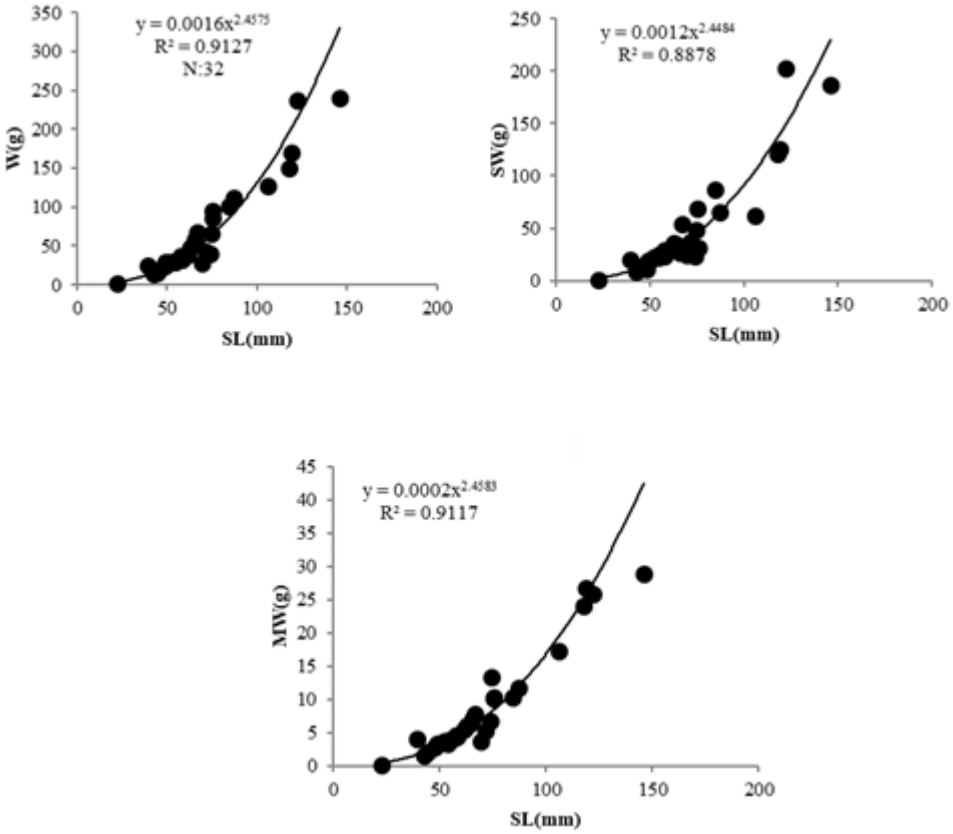


Figure 4. SL-W, SL-SW and SL-MW relationships for *O. edulis*

Table 3. SL-SWi, SL-ST, W-MW, SWi-ST and SW-MW relationships for *Ostrea edulis*.

| | N | Formula | a | b | $R^2$ |
|---|---|---|---|---|---|
| **SL-SWi** | 32 | SWi =bSL+a | 7.8971 | 0.6543 | 0.8528 |
| **SL-ST** | 32 | ST =bSL+a | -0.2100 | 0.3569 | 0.7792 |
| **W-MW** | 32 | MW =bW+a | 0.318 | 0.124 | 0.9363 |
| **SWi-ST** | 32 | ST =bSWi+a | -1.2166 | 0.4836 | 0.7182 |
| **SW-MW** | 32 | MW =bSW+a | 1.3317 | 0.1508 | 0.8770 |

SL: shell length, W: total weight, MW: meat weight, SW: shell weight, **N**: Number of individuals **a**: intercept, **b**: slope, $\mathbf{R^2}$: determination coefficient

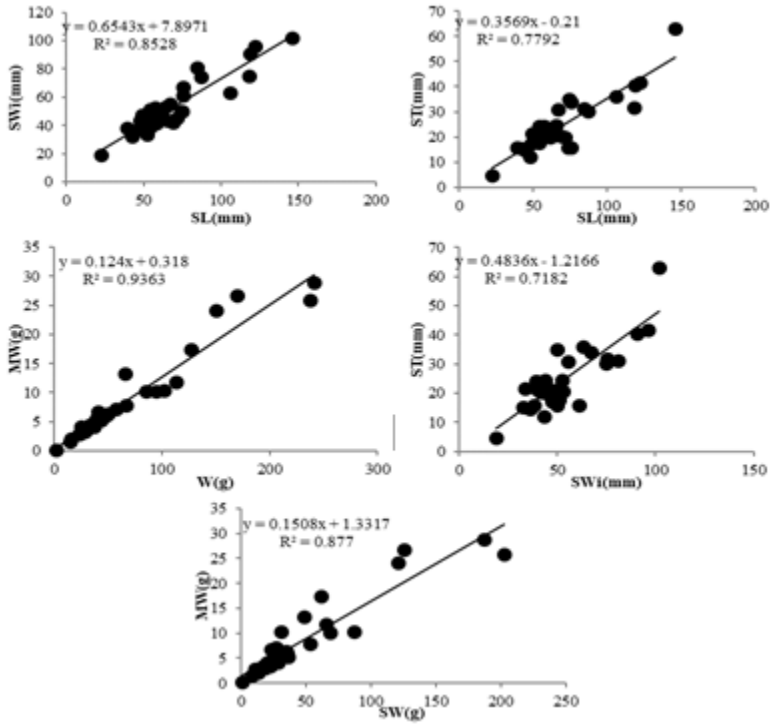


Figure 5. SL-SWi, SL-ST, W-MW, SWi-ST and SW-MW relationships. The condition index of European flat oyster individuals was averagely calculated as 54.0 $\pm$ 21.4 (18.9–89.9).

**Discussion**

The natural stocks of European flat oyster have declined day by day throughout he European and Mediterranean coasts and are in danger of extinction (Barnabe & Doumenge, 2001; Basurco and Lovatelli, 2003; Carlucci et al., 2010; Pogoda, 2019). The presence of oysters in the Black Sea has been known for many years (Zaitsev & Alenxandrov, 1998; Öztürk et al., 2014). In this study, biometric characterics and length-weight relationship of the population in the Black Sea were recorded for the first time. The maximum length of the *O. edulis* is given 12 cm by Sealifebase (2019), Fischer et al., (1987) recorded 20 cm for European flat oyster. In this study, SL was averagely calculated as 69.49 ± 27.10 mm (min: 22 mm, max: 145 mm). Çolakoğlu & Ormancı

(2018) carried out that individuals in the 53-109 mm length group were sampled in their study in the Dardanelles. In this research, the measured maximum length is the largest length throughout the Mediterranean, Aegean and Black Sea. Carlucci et al. (2010) recorded the total minimum and maximum weight as 4.0–173.7 g respectively, while Çolakoğlu & Ormancı (2018) calculated these values as 17.3–263.7 g. In our study, the average weight was recorded as 66.19 g (1.5–241.7). The values for maximum total weight obtained in this study are higher than the study of Carlucci et al. (2010), but are lower than the values measured by Çolakoğlu & Ormancı (2018). Nevertheless, in their study, Çolakoğlu & Ormancı (2018) carried out that the meat weight was averagely 11.53 g. In this study, average meat weight was 8.82 g. It is thought that the difference between MW is due to the size of the samples. The condition index was calculated 56.59 by Çolakoğlu & Ormancı (2018), while in this study; the condition index was comparably recorded as 54.00. The intercept and slope in the estimated weight–length relationship were 1.48 and 1.74 (r=0.81), (Carlucci et al., 2010). In this study, these values were obtained as 0.0016 and 2.4575 ($R^2$: 0.9127). In both studies, the growth shows a negative allometric. Acarlı et al., (2011) indicated that b values was 3.148 and also was isometric growth for in the Aegean Sea. This is the first study conducted for morphometric properties of European flat oyster in the southern Black Sea.

## Conclusion

The morphometric properties and growth parameters of European flat osyster (*Ostrea edulis*) collected from rocky shores in the southern Black Sea enable significant contributions for the growth characterisctics. This study shows that:

1. The mean value of Shell Length (SL) of the collected individuals was recorded 69.49 ± 27.10 mm. Nevertheless, the average body weight was calculated 66.19 ± 60.78 g (1.5–241.7).
2. The measured maximum SL in this study is the largest length in the Mediterranean, Aegean, and Black Sea.
3. The relationships between SL-W, SL-SW and SL-MW was calculated that the value of "b" is less than 3 and the growth shows a negative allometric growth.
4. The condition index of *O. edulis* was averagely recorded 54.0 $\pm$ 21.4 (18.9–89.9).

**Conflict of Interest:** The authors declare that they have no conflict of interest.

**Ethical approval:** For this type of study formal consent is not required.

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