



## RESEARCH ARTICLE

### Age, growth and reproduction of *Neogobius melanostomus* (Pallas 1814) (Perciformes: Gobiidae) in the southern Black Sea

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#### ABSTRACT

Round goby (*Neogobius melanostomus*, Pallas 1814) which belongs to Gobiidae, inhabits in the Black Sea, the Marmara Sea, the Caspian Sea and the rivers that flows into fore stated seas. The main population parameters, such as age, length, sexual composition, length-weight relationship, growth, condition factor, gonadosomatic index and reproduction of *N. melanostomus* were investigated from coasts of the southern Black Sea in this study. A total of 2408 individuals were sampled between July 2017 and June 2018. Results showed that average length and weight were found 14.97 cm (10.50-26.20) and 43.90 g (15.28-212.2), respectively. Sex ratio between female and male was found 1:1.77 ( $P>0.05$ ). Age of samples varied between one and eight years old. The von Bertalanffy growth parameters were calculated as  $L_{\infty} = 26.5$  cm,  $k = 0.1980 \text{ year}^{-1}$  and  $t_0 = -1.3487$  year for all individuals. The length-weight relationship was found as  $W = 0.0069 \text{ TL}^{3.1972}$  for all individuals. Total mortality, natural mortality, fishing mortality, growth performance index and condition factor were calculated as 0.625, 0.479, 0.145, 2.143, and 1.66, respectively. Spawning occurs between March and May and the maximum value of gonadosomatic index reached in April. Average relative fecundity was 318.88 number/g (124.8-958.9), while average diameter of eggs was found  $2025.58 \mu\text{m} \pm 262.86$  (1112.0-2703.4). This study will contribute for information gap on the species as well as provide information source for future studies.

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#### Introduction

Round goby, *Neogobius melanostomus* Pallas 1814, distributes widely in coastal shallow waters of tropical and

subtropical region. There are 1578 identified species of goby in the world. There are 74 goby species in the Black Sea and Mediterranean Sea, 35 of them were reported from coasts of Turkey (Miller, 1986; Nelson, 1994; Froese and Pauly, 2009;

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Engin and Bektaş, 2010; Sezgin et al. 2017). The Black Sea, the Marmara Sea and the Caspian Sea are natural habitats for species of *N. melanostomus* (Berg, 1949). It is also reported that the species distribute in various seas (Baltic, Gulf of Gdańsk, North America etc.) as an invasive species carried by ballast water (Skora and Storlarski, 1993).

The species is invasive and opportunistic because it has well adaptive skills, high fecundity, short life-span and rapid growth properties (Lodge, 1993). The species prefers habitats of sandy, rocky and pebble in shallow waters down to 20 m in the Black Sea and Sea of Azov (Miller, 1986), especially vegetative (*Zostera spp.*) habitats down to 70 m in the Caspian Sea (Moskal'kova, 1996). While Jude and Deboe (1996) reported that the species distribute from creep flow rivers, lagoon to brackish waters down to 20 m in spring and autumn, Miller (1986) reported their migration to deeper water down to 60 m.

*N. melanostomus* is one of the benthic feeding habit species. Crustaceans and mollusks contribute to an important portion of their diet. Additionally, it is reported that their diet includes species of polychaetas, small fish and benthic eggs (Berg, 1949; Miller, 1986).

It can be classified as discard fish in coastal fisheries of the Black Sea. Öztürk (1998) reported it has low abundance for Turkish coastal waters of the Black Sea. Recently, it became more abundant species in fishing operations, and it has started to sold commercially in fish markets (approx. 3 USD) (Dr. Mehmet AYDIN personal observations). The species is not commonly known and not preferred by local people.

There are various studies in the regions for this species (Slastenenko, 1956; Kovtun, 1979; Abdoli et al., 2009; Yankova et al., 2011, Hôrková and Kováč, 2014; Macun, 2017) however studies from the Black Sea, especially the southern part are scarce (Engin, 2008; Gözler et al., 2003; Kurt, 2005; Kasapoğlu, 2016).

In scope of this study, it is aimed to determine the main population parameters (age, length, sexual composition, length and weight relationships, growth, condition factor, gonadosomatic index and breeding properties) of *N. melanostomus* from coasts of the central-southern Black Sea. This research will be one of the most detailed study for the Turkish coast of the Black Sea focus on the marine environment and it will provide a significant value to the literature for the future of population.

## Material and Methods

The study was conducted between July 2017 and June 2018 by using trammel net (1000 m length, 2 m depth) with mesh size of 17-24 mm which is used commonly by fishers from

southern coasts of the Black Sea. A total of 2408 individuals were sampled in 48 operations during the period of the study.

The study was performed in central coasts (41°08'41.93"N-37°17'41.29"E and 40°57'55.68"N- 38°07'24.97"E) of the southern Black Sea, off Ordu province (Figure 1).

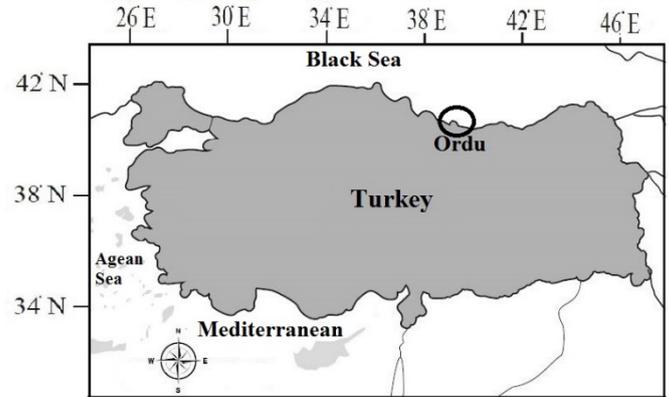


Figure 1. Study area

Captured fish were preserved in iceboxes till examination in the laboratory. Total length (TL, in nearest 0.1 cm), total weight (W) and gonad weight (GW) (at 0.01 g precision) of all specimens were recorded. The sex of each specimen was determined by gonads macroscopically.

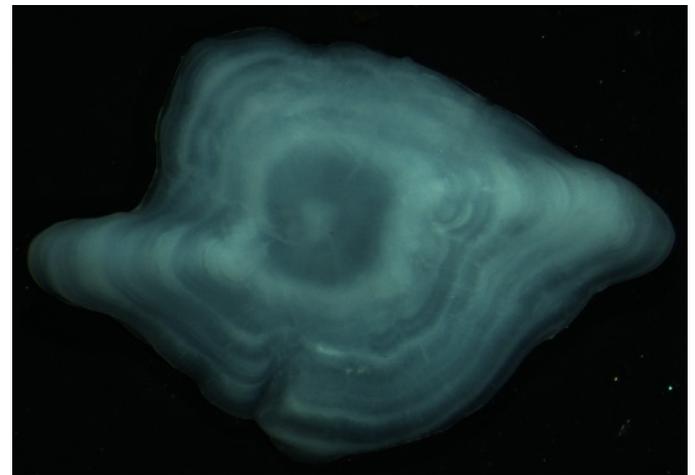


Figure 2. Otolith of 5 years old specimens of *Neogobius melanostomus*

### Age Determination

Otolith of each specimen was used for age determination in this study. Otoliths were prepared for age determination and placed into black plate. Stereomicroscope (up to X10 zoom) was used by illumination from top and side.

### Length and Weight Relationships

The total length-weight relationship (LWR) of the species was estimated by the exponential regression model,  $W = aTL^b$ , where  $a$  and  $b$  are constants (Ricker, 1975). LWR relationships

were performed by using all samples as well as female and male, separately. The regression co-efficient for isometric growth is “3”, while values greater or lesser than this value indicate an allometric growth. The Pauly’s *t*-test was used to compare the “*b*” values of male and female groups (Pauly, 1984) whether significant difference or not.

### Growth Parameters

The von Bertalanffy growth equation (VBGE) was used to describe the growth of *N. melanostomus* for the whole individuals sampled (Sparre and Venema, 1992; King, 1995).

$$L_t = L_{\infty}(1 - e^{-k(t-t_0)})$$

where  $L_t$  is the total length at age  $t$ ,  $L_{\infty}$  is the asymptotic length,  $k$  is the growth coefficient, and  $t_0$  is the theoretical age when the fish was at zero total length. The same function was used for growth in weight;

$$W_t = W_{\infty}(1 - e^{-k(t-t_0)})^b$$

where  $W_t$  is the total weight,  $W_{\infty}$  is the asymptotic weight, and  $b$  is the power constant of the length-weight relationship. Values of  $L_{\infty}$ ,  $t_0$  and  $K$ , which are parameters of the von Bertalanffy growth equation (VBGE), were estimated by using method of Ford-Walford (Pauly, 1984; Gulland, 1988). Growth parameters by using these values in following formulas were found (Sparre and Venema, 1992; King, 1995):

$$L_{\infty} = \frac{a}{1 - b}$$

$$k = \ln b$$

$$t_0 = t + \left(\frac{1}{k}\right) \times \ln \left[1 - \left(\frac{L_t}{L_{\infty}}\right)\right]$$

Munro’s phi-prime growth performance ( $\Phi'$ ) was calculated the formula of Pauly and Munro (1984):

$$\phi' = \log(k) + 2 \log(L_{\infty})$$

### Condition Factor

Fulton’s coefficient of condition factor ( $C$ ) of *N. melanostomus* was calculated monthly for the sampling by

$$C = \left(\frac{W}{TL^3}\right) \times 100 \text{ (Ricker, 1975)}$$

### Gonadosomatic Index

Monthly values of the gonadosomatic index (GSI) were calculated for each sex.

$$GSI = \left(\frac{GW}{W}\right) \times 100 \text{ (Devlaming et al., 1982)}$$

### Fecundity

Eggs of female individuals were collected and counted in April and May, when GSI reached the maximum in spawning season. A total of 206 individuals were examined for this purpose. The gonads were collected and eggs were counted in ovaries, immediately. Subsamples were counted using the gravimetric method and then calculated according to the following formula (Holden and Raitt, 1974):

$$F = \frac{G}{g} \times n$$

where;  $F$  is the total number of eggs in the ovary,  $G$  is ovary weight (g),  $g$  is the weight of the subsample taken from the ovary (g), and “ $n$ ” is the total number of eggs (including previtellogenic oocytes) in the ovary. It should be noted that only mature oocytes were taken into account while measuring egg diameters.

### Mortality Rates

The natural mortality ( $M$ ) and fishing mortality ( $F$ ) rates were calculated by means of the following relationships. Total mortality rate ( $Z$ ) is calculated by using the survival rate ( $S$ ). (Gulland, 1969; Ricker, 1975).

$$S_{(t)} = \frac{N_{(t+1)}}{N_{(t)}}$$

where  $N_{(t)}$  is the number of fish in the related age group and  $N_{(t+1)}$  is the number of fish in the related age group at the end of one year. In this equation, the relation between the survival rate and the total mortality rate is as follows:

$$S_{(t)} = e^{-Z(t)}$$

Total mortality rate ( $Z$ ) is calculated as follows:

$$Z = -\ln(S)$$

Natural mortality ( $M$ ) is calculated according to Pauly (1980).

$$\log M = -0.0066 - 0.279 \log L_{\infty} + 0.6543 \log k + 0.463 \log T$$

Here,  $T$  is the CTD derived average annual water temperature of the environment in which the *N. melanostomus* lives ( $^{\circ}\text{C}$ ). Fishing mortality ( $F$ ) was estimated as

$$F = Z - M \text{ (Beverton and Holt, 1957).}$$

**Statistical Analysis**

T-test and  $\chi^2$  square test were used to compare statistically the parameters obtained in this study. Statistical applications

were performed by using software's of Microsoft Office Excel and SPSS 18.

**Table 1.** Sex ratio data according to months

Months	N		(F:M)	Chi-square ( $\chi^2$ )
	Female	Male		
July 2017	17	37	1 : 2.17	7.407*
August 2017	9	28	1 : 3.11	9.757*
September 2017	11	21	1 : 1.90	3.125
October 2017	10	121	1 : 12.10	94.053*
November 2017	52	285	1 : 5.48	161.095*
December 2017	37	235	1 : 6.35	144.132*
January 2018	73	228	1 : 3.12	79.817*
February 2018	108	155	1 : 1.43	8.399*
March 2018	178	145	1 : 0.81	3.372
April 2018	138	144	1 : 1.04	0.128
May 2018	233	132	1 : 0.56	27.948*
June 2018	4	7	1 : 1.75	0.818
<b>Total</b>	<b>870</b>	<b>1538</b>	<b>1:1.77</b>	<b>185.309*</b>
	<b>2408</b>			

Note: \* (1df, 5%)

**Table 2.** Total length and weight data of *N. melanostomus* for each sex and the pooled data

	L (cm)			W (g)		
	Mean ± SD	Min.	Max.	Mean ± SD	Min.	Max.
<b>All</b>	14.97±2.43	10.50	26.20	43.90±27.63	15.28	212.20
<b>Female</b>	13.55±1.40	10.50	20.90	31.06±13.24	15.28	133.91
<b>Male</b>	15.78±2.51	11.90	26.20	51.17±30.82	15.86	212.20

**Results**

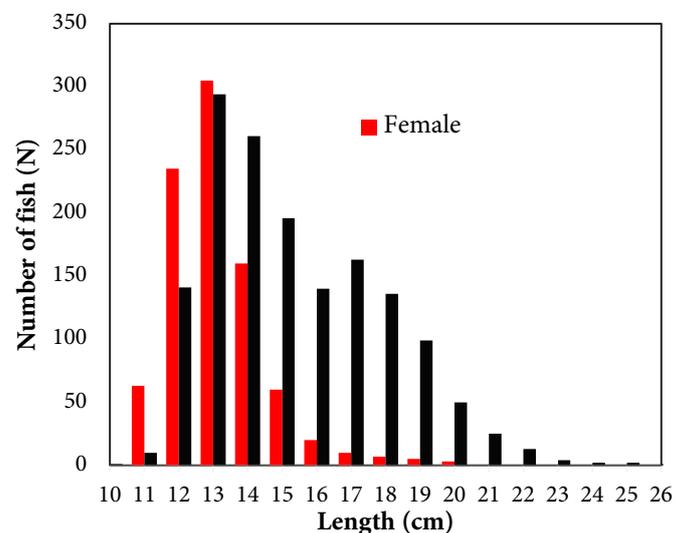
**Length-Frequency Distribution**

A total of 2408 individuals were obtained between 1-120 m depth during the study period. Especially, the big size males were caught around 120 m depth. A large amount of samples (1652 individuals) were ranged between 12-15 cm length (68.60%). The highest frequency was found 13 cm length group with 599 individuals (24.87%). While minimum length was 10.5 cm, the maximum length was 26.2 cm. Frequency distribution of each length group and monthly length frequency distribution were presented in Figure 3 and 4, respectively. Weight distribution of sampling ranged between 15.28 g and 212.2 g.

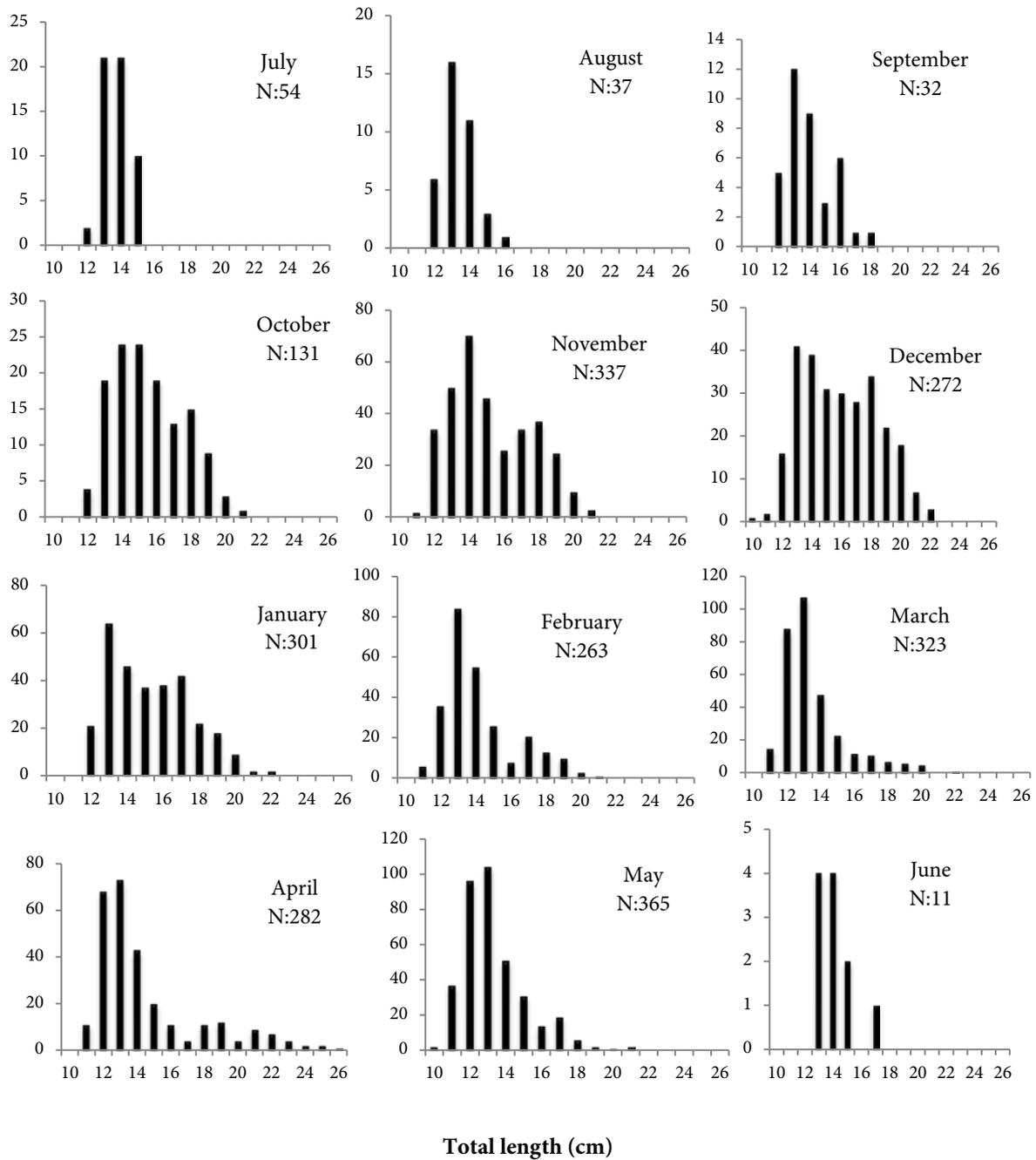
**Sex Composition**

Results showed that percentages of female and male individuals were calculated as 36.13 % (870) and 63.87 % (1538)

during this study, respectively. Sex ratio of female and male was found 1:1.77 (Table 1). It should also be noted that difference between sex was statistically significant ( $\chi^2 = 185.309$ ,  $df = 1$ ,  $P > 0.05$ ).



**Figure 3.** Frequency distribution of total length for male and female



**Figure 4.** Monthly total length- frequency distributions

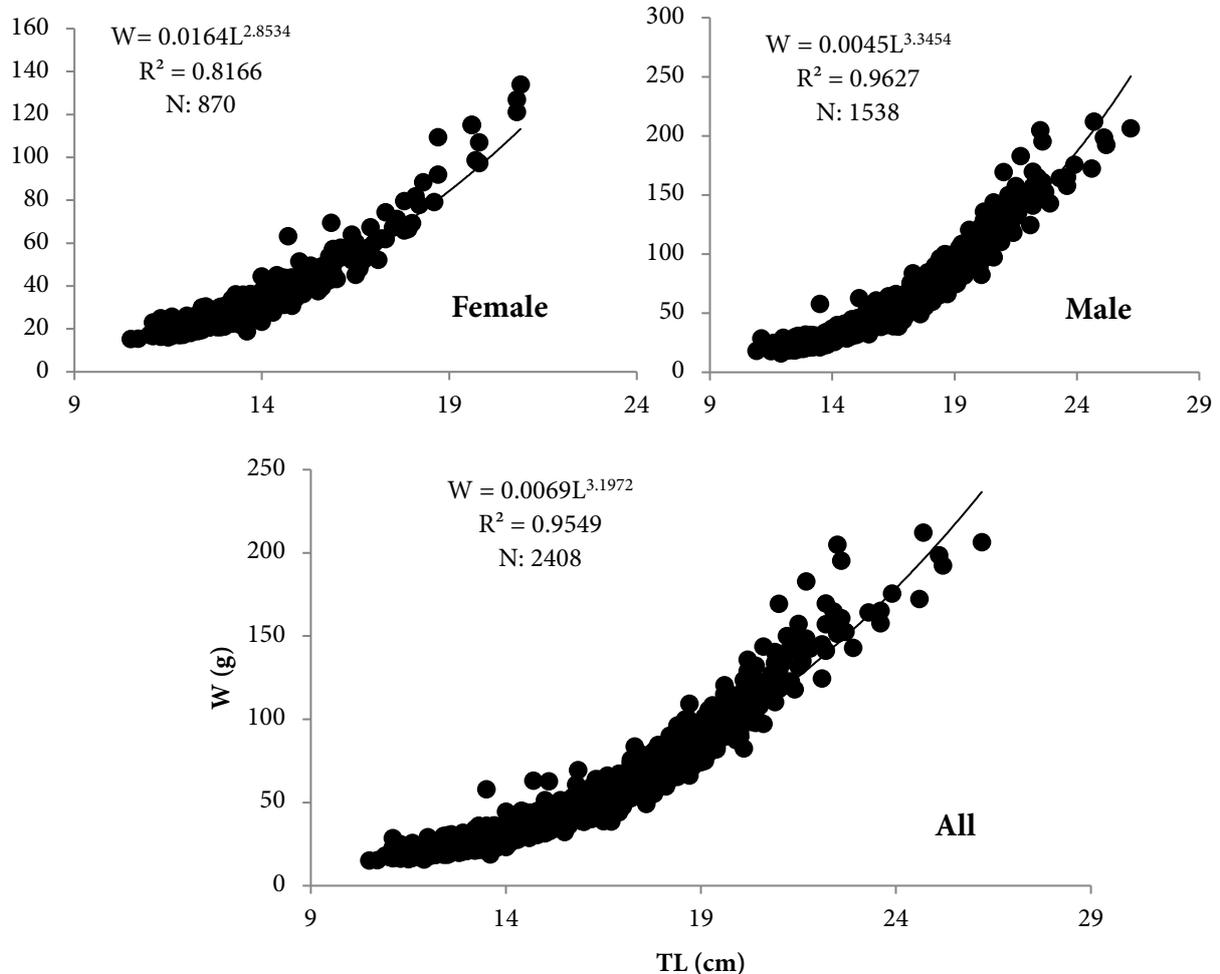
**Table 3.** Total length and weight data of the *N. melanostomus* by age

Age	(N)	%	L (cm) (Mean ± SD)	W (g) (Mean ± SD)
1	3	0.1	10.7±0.20	16.3±1.52
2	1387	57.6	13.40±0.86	28.1±5.73
3	473	19.6	15.59±1.31	44.9±12.07
4	282	11.7	18.15±1.61	77.6±23.91
5	172	7.1	18.72±1.44	85.6±26.28
6	74	3.1	19.98±1.50	110.3±36.01
7	13	0.5	22.54±2.67	155.0±46.54

8	4	0.2	22.63±3.64	150.1±57.80
<b>Total</b>	<b>2408</b>	<b>100</b>	<b>Mean: 14.97±2.43</b>	<b>Mean: 43.90±27.63</b>

**Table 4.** Von Bertalanffy growth parameters and growth equations in *N. melanostomus*

Growth Parameters			Length-growth functions		Weight-growth functions	
$L_{\infty}$	$W_{\infty}$	K	$t_0$	b	$L(t) = L_{\infty} (1 - e^{-k(t-t_0)})$	$W(t) = W_{\infty} (1 - e^{-k(t-t_0)})^b$
26.5	245.05	0.1980	-1.3487	3.1972	$L(t) = 26.5 (1 - e^{-0.1980(t+1.3487)})$	$W(t) = 245.05 (1 - e^{-0.1980(t+1.3487)})^{3.1972}$



**Figure 5.** Total length-weight relationship of *N. melanostomus*

**Length and Weight Relationship**

LWR was determined by using a total of 2408 individuals in this study. The relationship was found for all individuals and each sex, separately (Figure 5). The average length and weight were presented in Table 2. Results indicated that as female (Pauly’s t test:  $t = 1.326, P > 0.05$ ) cluster showed negative allometry ( $b < 3$ ), clusters of all individuals (Pauly’s t test:  $t = 13.96, P < 0.05$ ) and male (Pauly’s t test:  $t = 20.28, P < 0.05$ ) showed positive allometry ( $b > 3$ ) (Figure 5).

**Age Composition**

Age composition was ranged between one and eight years old. Most of samples were found two years age class (57.59) (Table 3). Even though it is seems that male individuals are relatively larger than females, there was no statistically significant difference between them ( $P < 0.05$ ).

It must be noted that age zero was not determined in this study. Although, minimum mesh size (17 mm) used in this study, no individual was found smaller than 10 cm.

### Von Bertalanffy Growth Parameters

Growth parameters of von Bertalanffy and equations were calculated without any clustering such as sexes and presented in Table 4. Growth performance value ( $\Phi'$ ) was also calculated and found 2.143. Estimated and observed values of relation between length and age were presented in Figure 6.

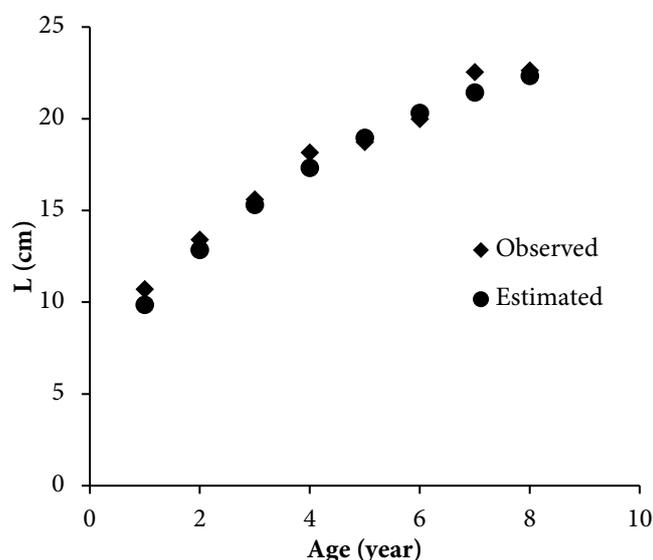


Figure 6. Age-total length relationship

### Spawning Properties

Value of GSI of each month was calculated separately. Value of GSI has started to increase after December and it reached peak in April for females. This result indicated that spawning season occurred between March to May, and spawning reached maximum in April.

The maximum value of GSI in female was estimated as 3.898 (0.56-24.4) in April, while minimum value of GSI was found as 0.131 (0.04-0.25) in August. Average value of GSI was found  $1.190 \pm 1.22$  for female individuals. The value of GSI for male cluster was systematically lower than female cluster (Figure 7).

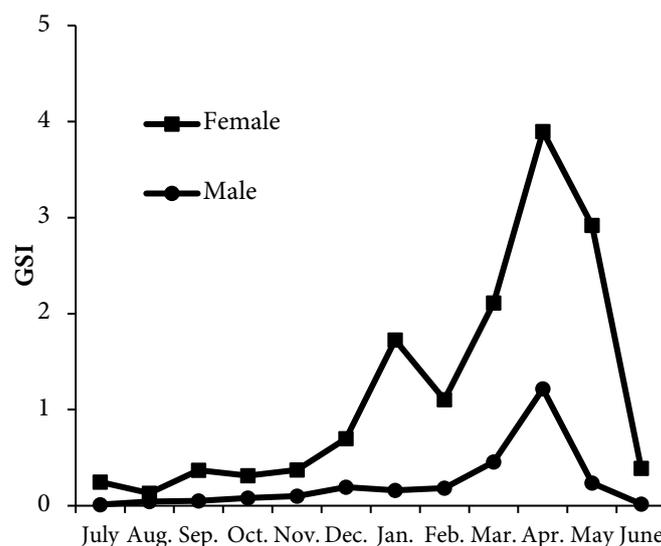


Figure 7. Monthly distribution of gonadosomatic index (GSI) values

### Fecundity

A total of 206 female individual were examined between April and May for fecundity. Individuals were dispersed between 11.0 cm and 20.8 cm lengths, and 17.3 g and 127.01 g weights, respectively. Minimum egg number was found as 355.9, the maximum number was found 3953.7. Average fecundity was calculated as  $1005.7 \pm 534.1$ . Relative fecundity was calculated as 318.88 number /1g (124.8-958.9). Average diameter of egg was  $2025.58 \mu\text{m} \pm 262.86$  (1112.0 - 2703.4).

### Condition Factor

Condition factor was determined seasonal or annual changes on feeding of organisms. In this study, average condition factor of *N. melanostomus* was calculated as  $1.66 \pm 0.04$  (1.05-1.21) (Figure 8).

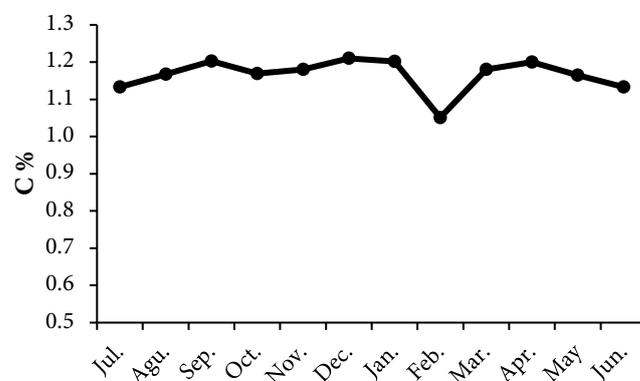


Figure 8. Monthly distribution of the Condition factor (C) for *N. melanostomus*

## Mortality

Mortality parameters are the most important indicators for showing decreases in stocks. Total mortality rate (Z) was found 0.625, while survival rate (S) was calculated as 0.535. Natural mortality rate (M) was calculated by using growth parameters of the species and average temperature at depth that species lived. It was determined that average depth was  $20 \pm 15$  m, and average temperature was  $15^\circ\text{C}$  for the species. Based on these parameters and Pauly's approach, M and F were calculated 0.479 and 0.145, respectively.

## Discussion

A total of 2408 individuals were obtained during this study. This study reached the maximum sampling size among previous studies conducted in the Black Sea (Table 5).

The sex composition is expected close 1:1 due to various reasons such as differences of natural and fishing mortality on sexes, spawning migration and, size and habitat differences between sexes (Nikolskii, 1980). Previous studies on population of *N. melanostomus* reported that male individuals were more abundant than female ones (Skora and Stolarski, 1996; Gözler et al., 2003; Gümüş and Kurt, 2009) as parallel to this study, that was found 1:1.77.

Length-weight datasets for *Neogobius melanostomus* from the Black Sea coasts given by the previous studies were tabulated in Table 5. These results state a length variation of this species between 3.6 cm (Abdoli et al., 2009) and 35 cm (Ak et al., 2009), however length distribution ranged from 10.5 cm to

26.2 cm in this study. Slastenenko (1956) and Sapota (2012) reported that this species reaches a maximum total length of 25 cm which is similar to the 24.6 cm maximum record given by Skora et al. (1999). Velkov et al. (2014) focused on the growth characteristics of this species in different habitats and concluded that populations in marine habitats have larger individual sizes than the fresh and brackish habitat populations. Results of this study clearly shows that the maximum total length is larger than many of the previous literature reports (Slastenenko, 1956; Skora et al., 1999; Sapota, 2012), but still stays well below the value reported by Ak et al. (2009).

Most frequent length cluster was reported as 13.4 cm by Gözler et al. (2003); 15.8 cm for male and 13.4 cm for female by Kurt (2005). Engin (2008) reported most frequent length ranges for each sex, which was 14.1-16 cm for males and 16.1-18 cm for females. In this study, frequent length clusters were estimated as 13 and 14 cm, which correspond to 42.36 % of the total sampling. It can be concluded that similar frequent distributions are observed with a reasonable uncertainty.

Most of the studies, including this one, reported positive allometry for this species except for Samsun (1995) who reported a negative allometry instead.

Kurt (2005), a study from the Black sea, off Samsun, reported that; even though morphological anomalies can be observed in otoliths, these rigid tissues are the most reliable part for the age determination for this species. Otoliths were used for the purpose of age determination in this study due to its proven reliability.

**Table 5.** Growth parameters of previous studies from the region

References	N	Mean	Lmin- Lmax	Wmin- Wmax	a	b	r <sup>2</sup>	Region
Samsun (1995)	1425		8.0-20.5	6.25-98.74	0.0243	2.85		Black Sea
Gözler et al. (2003)	263		9.00-23.30	9.00- 186.65	0.1145	3.08	0.93	Black Sea
Demirhan and Can (2007)	99	---	8.6-19.1		0.0047	3.39	0.95	Black Sea
Engin (2008)	300		5.1-28.4	25.9-370	0.0095 0.0055	♀3.15 ♂3.32	0.95 0.95	Black Sea
Abdoli et al. (2009)	758	---	3.6-13.3		0.0112	3.08	0.97	Caspian Sea
Ak et al. (2009)	73	--	9.1-35	8.58-381.4	0.010	3.033	0.89	Black Sea
Gümüş and Kurt (2009)	♀ 397 ♂ 471	13 14	7.5-19.7 7.4-25		0.0076 0.0110	3.23 3.07	0.94 0.96	Black Sea

Yankova et al. (2011)	3910	15.45	13.6-19.2	37.5-113	0.006	3.346	0.98	Bulgaria
Kasapoğlu (2016)	172	12.86	6.5-26.4		0.0114	3.088	0.96	Black Sea
						♀2.79		
						♂3.06		
Macun (2017)	266		9.1-19	12-119				Black Sea Freshwater
Çalık and Erdoğan Sağlam (2017)	58	--	26	8-265	0.0059	3.3062	0.99	Black Sea
<b>This study</b>	2408	14.97	10.50- 26.20	15.28- 212.20	0.0069	3.1972	0.96	Black Sea

Gözler et al. (2003) and Kurt (2005) concluded that the most frequent age cluster of this species is two. Engin (2008) reported the most frequent age as two and three for male and females respectively. These findings are in parallel with our results which indicates a most frequent age cluster of two with 57.59 % of the total sampling with an age range between one to eight years old.

According to the results, male individuals were statistically larger than females in this study. While average length of female was 13.55 cm, it was 15.78 cm for males. Previous studies also concluded the similarly (Gümüş and Kurt, 2009, Skora and Stolarski, 1996). Skora and Stolarski (1996) reported that males reached 21.2 cm when they are four years old. Kurt (2005) reported the length at age for both sexes as 18.2 cm and 19 cm at five years old for female and male, respectively. More detailed study by Engin (2008) reported that males can reach 28.4 cm and 93.4 g when they are seven years old, as females can reach 18 cm and 93.4 g when they are five years old. Comparison of these studies indicated remarkable length difference for the same age. It is thought that reason for this difference might be sampling in different habitats or methods.

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An extensive review for values of growth parameters of Von Bertalanffy and growth performance index were presented in Table 6.

**Table 6.** A list for values of growth parameters of von Bertalanffy ( $L_{\infty}$ ,  $k$ ,  $t_0$ ) and growth performance index ( $\Phi'$ ) from previous studies

Sex	$L_{\infty}$	$k$	$t_0$	$\Phi'$	References
♂♀	26.0	0.20	-2.24	4.12	Gözler et al. (2003)
♂	21.3	0.38	9.70	4.22	Kurt (2005)
♀	25.2	0.18	5.75	4.05	Kurt (2005)
♀	19.7	0.43	-0.04	3.84	Engin (2008)
♂	24.1	0.25	-0.06	4.10	Engin (2008)
	36.1	0.14	-1.57		Kasapoğlu (2016)
	26.5	0.19	-1.34	2.14	<b>This study</b>

The instantaneous total mortality rate ( $Z$ ), natural mortality ( $M$ ) and fishing mortality ( $F$ ) were estimated as 0.625, 0.479 and 0.145, respectively. Similarly, Kasapoğlu (2016) found  $Z=0.54$ ,  $M=0.29$  and  $F=0.145$  in similar study region.

**Table 7.** Fecundity and egg size of the species from previous studies.

Areas	Fecundity (egg/ind.) Min-Max (Avg.)	Egg diameter (mm) Min-Max (Avg.)	References
Azov Sea	325-3323		Slastenenko (1956)
Azov Sea	200-9771		Kovtun (1979)
European waters	200-9771		Charlebois et al. (1997)

Detroit River	310-5210		Macinnis and Corkum (2000)
Danube	103.5–1938.2 (557.1)	0.12–2.35 (0.81)	Lavrincikova and Kovac (2007)
Eastern Black Sea	423–2396 (1325)	1.3–2.5 (2.02)	Engin (2008)
Bulgaria	419 - 7865 (3512)	1.72 -2.75 (2.25)	Hôrková and Kováč (2014)
Slovenia	1578 - 10605 (4413)	1.50-2.73 (2.03)	Hôrková and Kováč (2014)
Black Sea	1420-2477		Macun (2017)
Black Sea	355.9-3953.7	1.11-2.70	<b>This Study</b>
	1005.7 ± 534.1	2.02±0.26	

Nikolskii (1954) reported that the species reaches sexual maturity at two years old in females and three years old in males. Engin (2008) reported it as length 9.09 cm and 6.36 cm for males and females. Studies from various regions resulted that the species has spawning period between April and November (Kazanchev, 1981; Skora and Stolarski, 1996; Lavrincikova and Kovac, 2007). Engin (2008) reported the period between April and June. Parallel to this study, Hôrková and Kováč (2014) reported from various regions that the species reach its peak in April for spawning and it continues in May. All previous studies point the same period for spawning.

Comparison among studies concluded that similar egg diameter ranges were obtained in studies from the Black Sea (Table 7). However, there are some variations in number of eggs. On the other hand, comparison among fish species showed that *N. melanostomus* has a less eggs than other species. As mentioned by Macinnis and Corkum (2000), survival rate of the species is higher due to some certain reasons. One is having larger egg diameter. Larger larval size is another reason. It is also important to choose secure place for spawning and protection of eggs by males for these strategies.

Skora et al. (1999) reported vertical distribution limit of the species is 30 m. In this study, individuals of the species, especially males, were caught from 120 m. Another information from Fishbase pointed out that the species maximum length reaches to 24.6 cm and six-year-old as maximum age (Froese and Pauly, 2009). These values are updated as 26.4 cm and seven years old by contribution of this study.

## Conclusion

Due to the decreasing stocks of the traditionally consumed fish species of the Black Sea with an economical value in Turkey, species like round goby started to become commercially valuable in recent years in the Black Sea coast of the Turkey. Being less important as a commercial product in the past, round goby did not take enough attention and there

are limited numbers of studies in the current literature where the population characteristics are hardly known yet. However, as mentioned above, the commercially growing demand should not be ignored and should be carefully managed for round goby which has a significant importance for the health of the coastal ecosystem. This can only be succeeded by understanding the population characteristics of this species by continuous monitoring studies, therefore this research is definitely important despite its regional scope.

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## Compliance with Ethical Standards

### Conflict of Interest

The author declares that there is no conflict of interest.

### Ethical Approval

This study was conducted in accordance with ethics committee procedures of animal experiments.

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