Length-Weight Relationship and Mortalities of *Mullus barbatus ponticus* Essipov, 1927 in the Central Black Sea, Turkey

Orta Karadeniz'de (Türkiye) *Mullus barbatus ponticus* Essipov, 1927 Balığının Boy-Ağırlık İlişkisi ve Ölüm Oranları

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ABSTRACT

A total of 1301 red mullet specimens were monthly collected from commercial gill/trammel net and bottom trawl fisheries, especially landings to Sinop fishing ports between September 2016 and February 2017. Total length and weight of red mullet specimens were ranged from 8.2 cm to 20.2 cm (average: 13.5 ±0.05 cm), and 5.6 g to 86.5 g (average: 28.2 ±0.36 g), respectively. The samples were grouped densely between 12 and 14 cm. The 34.4% of all samples in this study are under legal size. The LWR equation calculated was $W = 0.008 \times TL^{3.1076}$ ($R^2 = 0.9591$). Age groups of red mullets in the Central Black Sea were ranged from I to IV. Mean lengths according to age groups were 10.1, 14.02 ±0.22, 16.63 ±1.30 and 19.6 ±0.15, respectively. Also, von Bertalanffy Growth Parameters were $L_\infty = 19.21$ ±1.55 cm, $K = 0.68$ ±0.27 year^{-1}, $t_0 = -0.13$ ±0.48. Mortalities (M, F and Z) and exploitation rate (E) of red mullet from the Black Sea were 0.335 year^{-1}, 0.398 year^{-1}, 0.733 year^{-1} and 0.54 year^{-1}, respectively.

Keywords: Red mullet, *Mullus barbatus ponticus*, measure, length, weight, exploitation, Central Black Sea.

ÖZET

Toplam 1301 barbunya balığı bireyi Eylül 2016-Şubat 2017 tarihleri arasında Sinop limanına getirilen, ticari kıyı uzatma ağları ve trol ağları ile yakalanan balıklardan aylık olarak örneklenmiştir. Barbunya balığı bireylerinin toplam boy ve ağırlıkları sırasıyla 8,2-20,2 cm (ortalama: 13,5 ±0,05 cm), ve 5,6-86,5 g (ortalama: 28,2 ±0,36 g) arasında değişmektedir. En fazla örneğin bulunduğu boy sınıfı 12-14 cm'dir. Çalışmada incelenen örneklerin %34,4'ü yasal boyun altındadır. Boy-ağırlık ilişkisi eşitliği $W = 0,008 \times TL^{3,1076}$ ($R^2 = 0.9591$) olarak hesaplanmıştır. Orta Karadeniz'de barbunya balığının yaş grupları I ve IV arasında olup, yaş gruplarına göre ortalama boylar sırasıyla; 10,1, 14,02 ±0,22, 16,63 ±1,30 ve 19,6 ±0,15 cm olarak belirlenmiştir. Von Bertalanffy büyüme parametreleri $L_\infty = 19,21 \pm 1,55$ cm, $K = 0,68 \pm 0,27$ yıl^{-1}, $t_0 = -0,13 \pm 0,48$ yıl^{-1} olarak hesaplanmıştır. Karadeniz'de barbunya balığının ölüm (M, F ve Z) ve sömürme oranı (E) sırasıyla; 0,335 yıl^{-1}, 0,398 yıl^{-1}, 0,733 yıl^{-1} ve 0,54 yıl^{-1} olarak hesaplanmıştır.

Anahtar sözcükler: Barbunya balığı, *Mullus barbatus ponticus*, ölçüm, boy, ağırlık, sömürme, Orta Karadeniz.

1. INTRODUCTION

Red mullets (or Goatfishes, Family Mullidae) are small to moderate size demersal fishes found mainly in shallow waters to the depth range 100-300 m and the most characteristic feature of the family is a pair of barbels on the chin which are used for locating the prey by stirring and probing the substrate. They feed on small benthic invertebrates such as crustaceans, worms and mollusks (Golani et al., 2006; Froese and Pauly, 2017). The family consists of six genera and about 62 species are present in the Atlantic, Indian and Pacific oceans. Five species of goatfishes are present in the Mediterranean Sea: the indigenous *Mullus barbatus* Linnaeus, 1758 and *M. surmuletus* Linnaeus, 1758; the exotic *Upeneus moluccensis* (Bleeker, 1855) and *U. pori* Ben-Tuvia and Golani, 1989 of Indo-Pacific origin; and *Pseudupeneus prayensis* (Cuvier, 1829) from the Atlantic (Bariche et al., 2013). And recently a new species of mullids, *Parupeneus forsskali* (Fourmanoir and Guézé, 1976) was captured the north of Beirut (Bariche et al., 2013).

The subspecies *Mullus barbatus ponticus* Essipov, 1927 inhabits in the Black Sea and the Sea of Azov, while *Mullus barbatus* Linnaeus, 1758 is common in all Turkish seas (i.e. Marmara, Aegean and southern coast of Turkey). It is distinguished from *M. barbatus barbatus* by the number of suborbital scales, the length of maxillae and also by its general silver colour and darker colour between the dorsal fins and the lateral line (Hureau, 1986).

Mullus barbatus ponticus is a very commercial fish species along the coasts of Black Sea and it is mainly caught by trawl and gillnets along the Turkish coasts of the Black Sea. Dinçer and Bahar (2008) stated that the gillnets were predominant gear owing to prohibition of area within the 3 miles range for bottom trawls and also the existence of unfavourable bottom structure. Total catch amount of red mullet in the Black Sea in 2015 was about 415 tons, of which 351 tons in eastern and 64 tons in western parts of the Black Sea. Catch amount of *M. barbatus ponticus* in the Black Sea is 1/3 in all red mullet's production of Turkey (TUIK, 2015). It is seen that there is an intensive fishing on red mullet stocks in the Black Sea. Thus, this study provides some actual information such as length, weight, age and mortality rates of red mullet population in the southern Black Sea in order to detect whether fishing pressure or not.

2. MATERIAL AND METHODS

A total of 1301 red mullets from the Central Black Sea were monthly (between September 2016 to February 2017) collected from commercial coastal gillnet and bottom trawl fisheries, especially landings to Sinop fishing ports.

Total length (TL) and weight of fish has been measured to the nearest ± 0.1 cm and ± 0.1 g. Length-weight relationship (LWR) was computed from the following formula: $W = a \times TL^b$. Where TL is total length and W is weight, *a* and *b* are constants.

A total of 88 otoliths were used for ageing. Sagittal otoliths were removed, wiped clean, and stored dry, and then otoliths were placed in glycerol and were examined (10X magnification) under reflected light using a binocular microscope (SOIF XSZ-7GX).

Natural mortality of red mullet was computed from Pauly (1980)'s following multiple regression formula: $\ln M = -0.0152 - 0.279 * \ln L_\infty + 0.6543 * \ln K + 0.463 * \ln T$. Where M is natural mortality in a given stock, L_∞ is asymptotic length, K is growth coefficient and the value of T is the annual mean temperature (in ºC) of the sea water. Non-seasonal growth parameters, L_∞ and K, were estimated with von Bertalanffy growth formula in the FISAT (FAO-ICLARM Stock Assessment Tools) computer programme (Gayanilo et al., 1994). Mean annual temperature (T) for the Black Sea was obtained from Turkey's Statistical Yearbook (TUIK, 2010).

Total mortality (Z) was estimated from the mean size in the catch, developed by Beverton and Holt (1957). Z can be estimated from mean length in the catch from a given population by means of $Z = K (L_\infty - L_{mean}) / (L_{mean} - L_c)$. Where L_∞ and K are parameters of the von Bertalanffy growth equations; Erkoyuncu (1995) stated that if L_c is not available, L' can use in the formula instead of the L_c, i.e. $L_c = L'$. L_{mean} is the mean length computed from L' upward, the latter being a length not smaller than the smallest length of fish fully represented in catch samples (Pauly and Soriano, 1986). Note that L' is the lower limit of the corresponding length interval (Sparre and Venema, 1998).

Fishing mortality (F) can be estimated from F=Z-M. Once values of F and M are available, an exploitation ratio (E) can be computed from E = F / Z. Which allows one to assess if a stock is overfished or not, on the assumption that the optimal value of E (E_{opt}) is about equal to 0.5 (Pauly, 1980). All of the means were given with standard error (± SE).

3. RESULTS

Length and weight of red mullet specimens were ranged from 8.2 cm to 20.2 cm (average: 13.5 ±0.05 cm), and 5.6 g to 86.5 g (average: 28.2 ±0.36 g). The samples were grouped densely between 12 and 14 cm (Figure 1).

Minimum landing size (MLS) is 13 cm for *Mullus barbatus* according to Turkish Fisheries Regulation Circular (TFRC). Thus, 34.4% of all samples in this study are under legal size (Figure 2).

The LWR equation calculated was $W = 0.008 \times TL^{3.1076}$ (R^2= 0.9591) (Figure 3). It seems that there is a positive allometry in terms of *b* value.

Age groups of red mullets in the Black Sea were ranged from I to IV. Mean lengths according to age groups were 10.1, 14.02 ±0.22, 16.63 ±1.30 and 19.6 ±0.15, respectively. Also, von Bertalanffy Growth Parameters were L_∞ = 19.21 ±1.55 cm, K = 0.68 ±0.27 year^{-1}, t_0 = -0.13 ±0.48 (Figure 4).

Mortalities (M, F and Z) and exploitation rate (E) of red mullet from the Black Sea were 0.335 year^{-1}, 0.398 year^{-1}, 0.733 year^{-1} and 0.54 year^{-1}, respectively. The mean annual habitat temperature (T), L_{mean} and L' are assumed as 16ºC, 13.5 cm and 8.2 cm, respectively.
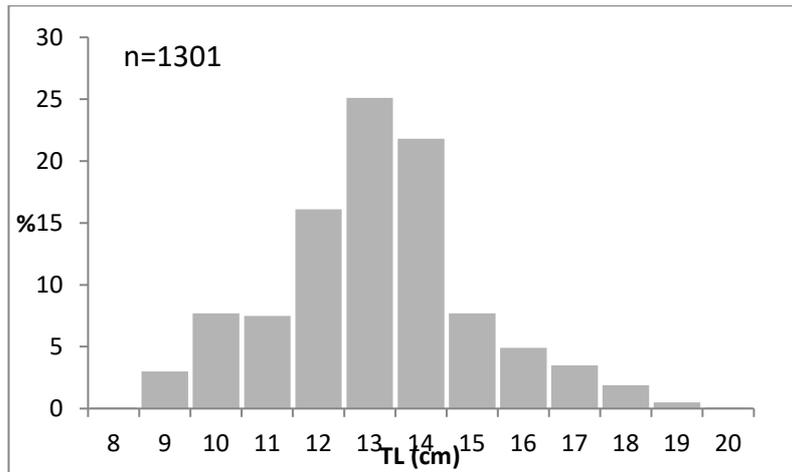
Figure 1. Length frequency of *Mullus barbatus ponticus* in the Central Black Sea
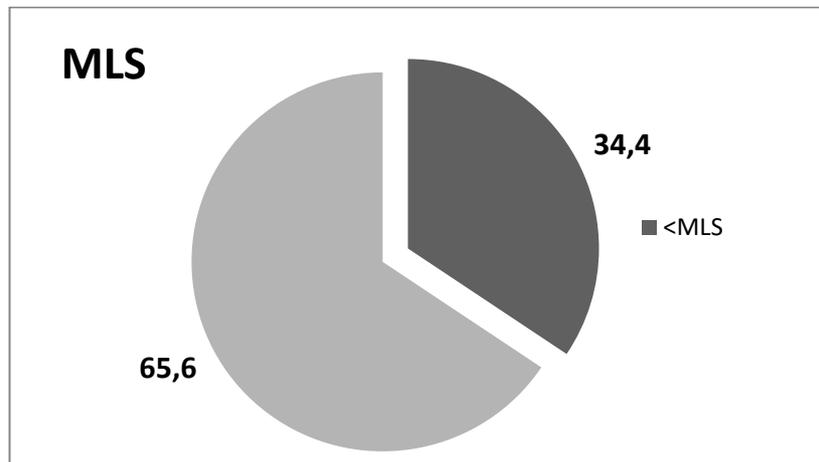
Figure 2. MLS percentages for *Mullus barbatus ponticus* in the Central Black Sea
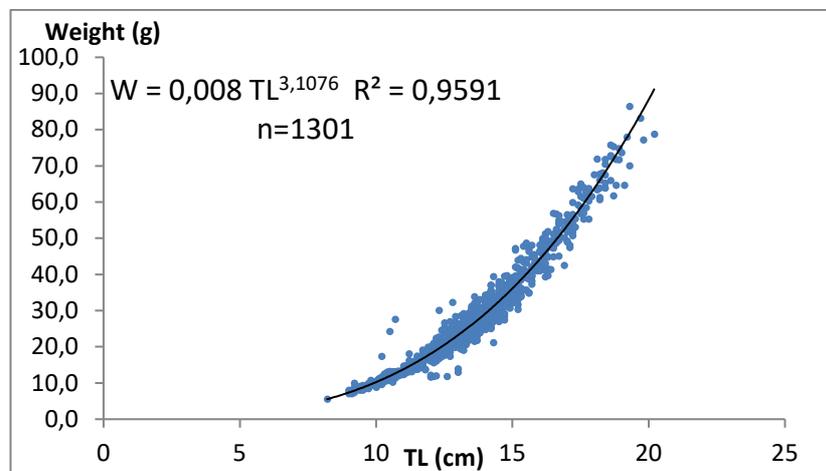
Figure 3. Length-weight relationship of *Mullus barbatus ponticus* in the Central Black Sea
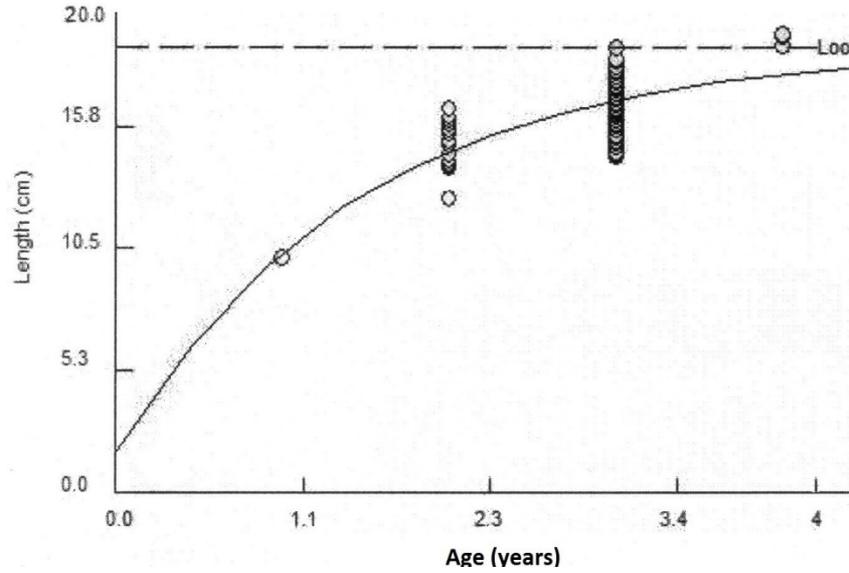
Figure 4. Age-length curve of *Mullus barbatus ponticus* in the Central Black Sea

4. TARTIŞMA VE SONUÇ

LWR of red mullet seems that there is a positive allometric growth (*b* = 3.11). Other LWR parameters and minimum and maximum lengths and weights of red mullet in the Black Sea were shown in Table 1.

Age groups of red mullets in the present study were ranged from I to IV; the largest group was III. Aydın and Karadurmuş (2013) reported similarly that age groups of II and III accounted for the majority of the red mullet population in the Eastern Black Sea. L_∞ value (19.21 cm) is similar with Aksu et al. (2011)'s study (20.15 cm), whereas, lower than study of Aydın and Karadurmuş (2013) (27.4 cm). Although, similar length ranges of the fish are sampled, this variation may be due to the calculation methodology. Aksu et al. (2011) reported that the 59% of fish was under MLS, while 34.4% of fish was under MLS in this study. This reduction of <MLS might be arisen by strict surveillance of net meshes or accurate resource management.

Table 1. Substantial LWR records of red mullet in the Black Sea

Authors	n	L_{min}-L_{max}	W_{min}-W_{max}	*a*	*b*	R^2
Kalaycı et al. (2007)	176	6.6-18.4	2.9-60.2	0.011	2.96	0.98
Demirhan and Can (2007)	432	6.8-14.6	-	0.005	3.24	0.97
Ak et al. (2009)	714	6.1-21.9	2.1-161.1	0.007	3.14	0.99
Aksu et al. (2011)	699	7.3-18.7	-	0.011	2.97	0.98
Özdemir and Duyar (2013)	225	9.3-20.1	8.6-87.9	0.011	2.98	0.97
Aydın and Karadurmuş (2013)	1435	6.4-21.5	2.1-105.4	0.009	3.03	0.97
This study	1301	8.2-20.2	5.6-86.5	0.008	3.11	0.96

Thus, the absence of larger and older fish in our samples may suggest heavy fishing pressure on red mullet stocks in the Black Sea. Moreover, the estimate of fishing mortality (F = 0.398) is some higher than natural mortality (M = 0.335), and according to exploitation rate (E = 0.54), red mullet fishery tends to go overfishing. Dinçer and Bahar (2008) recommended that 36 mm mesh size of gillnet was the

most appropriate for red mullet gillnet fishery in terms of MLS. However, the selectivity study should also be done for trawl fishery in the area. So, the author proposes that fishing effort of the fleets has to determine and selectivity studies of the gears must made for sustainable red mullet fishery.

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5. REFERENCES

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