



A preliminary study of fecundity of whiting, *Merlangius merlangus euxinus* (Linnaeus, 1758) in coast of Tirebolu (Eastern Black Sea)

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ABSTRACT

In this research, a preliminary study was carried out in January and February 2014 to determine the fecundity of the whiting species in Tirebolu, Eastern Black Sea. After the total length (cm) and weight (0.01 g) of the 70 fish specimens were measured in the laboratory, they were dissected for sex determination. Using the 20 ovaries at the third and fourth maturation stages, 3 sub-samples which is 2-5% of the total ovary weight (from the anterior, median and posterior parts of the ovary) were taken from each ovary to determine the fecundity, and hydrated oocytes were counted with gravimetric method. Total fecundity, total oocytes number in the ovary were computed with the formula $F=(n \times G)/g$. The total length-weight values were 12.6-23.3 cm (mean 17.08 ± 2.12) and 15.59-95.72 g (mean 41.07 ± 16.75), respectively, and total length-weight relationship was computed as $W=0.0073L^{3.024}$ ($R^2=0.94$) for the 70 fishes evaluated. Fecundity was computed as 3.247-30.534 (mean: 10.139 ± 6.953) eggs and a linear relationship between fecundity and total length was calculated as $F=0.0186L^{4.5631}$ ($R^2=0.70$). In conclusion, the fecundity results of this preliminary study were compared with similar studies on the whiting species from Black Sea and other seas.

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Introduction

Whiting, *Merlangius merlangus* (L., 1758) is a cold water species and the adults prefer water temperatures between 5 and 16°C. Whiting inhabits inshore waters over muddy grounds and forms shoals at depths between 30-100 m, but generally does not live deeper than 85 m (Whitehead et al., 1986). The species is known as batch Spawners (literature knowledge), i.e., only a portion of the Yolked (literature knowledge) oocyte is spawn in each batch, and spawning continues throughout the year (Murua and Saborido-Rey, 2003). The whiting, which is native to the Northeast Atlantic in which the Mediterranean and the Black Sea are located, is assessed in the LC (Least Concern) category by IUCN. Although the total biomass estimates and stock assessments of *Merlangius merlangus* in the world have not stable structure and fluctuates from place to place, in the Black Sea they have referred to an increase in recent years (Nedreaas et al., 2014).

Although there are various studies about the biological properties of the species on a universal basis and in Turkey (Volodin, 1996; Bradova and Prodanov, 2003; Maximov et al., 2007; Milić and Kraljević, 2011; Şahin and Akbulut, 1997; Samsun and Erkoyuncu, 1998; Çiloğlu et al., 2001; Göksungur and Erdem, 2005; Atasoy

et al. 2006; Bilgin et al., 2012; Sağlam and Sağlam, 2012; Mazlum and Bilgin, 2014), studies on fecundity are a very few. In the various studies, the whiting's fecundity was determined by Kandler (1958) for Baltic Sea, Merstorff (1959) for the Southern North Sea, Hislop and Hall (1974) for North Sea, Minch and Iceland, Hislop (1975) for North Sea and Ismen (1995) for the Black Sea coasts of Turkey.

Whiting is an important species in Turkey, particularly in the Black Sea fisheries and according to the TUIK (Turkish Statistical Institute) data of the year 2016, the total fishing is 11540.8 tons. For this reason, the continuity of the species' population is extremely important. Information such as breeding time and duration, first breeding length, fecundity and sex ratio of a fish species is vitally important in having more information about the stock status (Murua et al., 2003). Studies on fecundity of fish species are pertinent and useful for systematics in racial studies related to total population estimation and productivity (Adebiyi, 2013).

In this preliminary study; some information about the breeding biology has been tried to be obtained by determining spawning efficiency and egg diameter values in January and February for whiting which is an

economically important species in the Black Sea fisheries. In the future, with the whole year sampling it may be aimed to carry out more detailed studies such as determination of spawning season depending on gonad development and microscopic evaluation of gonads by histological studies, and as a result to reveal the precise reproduction parameters of the species.

Material and Method

In this study, a total of 70 whiting samples were obtained from commercial fishing boats fishing in Tirebolu in January and February of 2014. The total length (cm) and weight (0.01 g) of the fish specimens were measured in the laboratory, and then they were dissected for sex determination. The total length-weight relationship of the samples was evaluated according to Ricker (1975). In the evaluation of length-weight relation, the equation $W = a \times L^b$ was used. In this equation W is total weight; L, total length; a, inclination and b, regression coefficient.

The gonadal developmental stages in females were determined macroscopically according to a five-point maturity scale for partial spawners (Table 1) described by Holden and Raitt (1974). The ovaries to be used in determining the fecundity were fixed in 4% formalin solution. Subsequently, using the 20 ovaries at the third and fourth maturation stages 3 sub-samples which is 2-5% of the total ovary weight (from the anterior, median and posterior parts of the ovary) were taken from each ovary for the fecundity determination, and hydrated oocytes were counted with gravimetric method. Total fecundity, total oocytes number in the ovary were computed with the formula $F = (n \times G)/g$ (Valladolid and Przybylski 2008).

Results

The total length-weight values of the evaluated 70 fishes were 12.6-23.3 cm (mean 17.08±2.12) and 15.59-95.72 g (mean 41.07±16.75), respectively. Total length-weight relationship was computed as $W=0.0073L^{3.024}$ ($R^2=0.94$) (Fig. 1).

In our study, fecundity was computed as 3.247-30.534 (mean: 10.139±6.953) eggs. A linear relationship between fecundity and total length was calculated as

$F=0.0186L^{4.5631}$ ($R^2=0.70$) (Fig. 2). Diameter of hydrated oocytes was found as 0.98-1.30 mm (mean: 1.10±0.11).

Discussion

In this study which fecundity of the whiting samples obtained in the winter of 2014 was examined, the calculated mean length values indicate that the Tirebolu fishermen obey the fishing prohibitions applied during the January to February months in the region because of catchable length values of fish (Anonim 2016). A total of 70 specimens were examined and the relationship between length and weight was detected as $W = 0.0073L^{3.024}$ ($R^2=0.94$). The length-weight relation of the whiting population was given as $0.0064L^{3.0441}$ ($R^2=0.88$) by Sağlam and Sağlam (2012) for the Southeastern Black Sea, while Çiloğlu et. al. (2001) ($R^2=0.986$) computed those equations as $W=0.0037L^{3.2594}$ ($R^2=0.986$) and $W=0.0042L^{3.2069}$ ($R^2=0.980$) in female and male individuals, respectively, in the study conducted at the coasts of Trabzon-Yomra (Eastern Black Sea). Therefore, it is assumed that the values we obtained from the whiting samples in this study are parallel with to the findings of these researchers, and consequently they show an isometric growth during the winter period in Tirebolu.

Fecundity was determined between 3.247 and 30.534 (mean: 10.139±6.953) according to 20 ovaria examined in our study. In order to determine the fecundity, Atasoy et al. (2006) studied the individuals at the lengths between 11 and 17 centimeters in the Sea of Marmara and as a result they found the value as 14582±1220 eggs. Uysal (1990) and İşmen (1995) stated that the whiting fecundity is an average of 12000 eggs and 263000 eggs, respectively, for the eastern Black Sea. These differences emerged in the fecundity values are thought to be due to differences in fish lengths, growth rates and nutrition in different areas (Hislop and Hall, 1974).

While the egg diameters of hydrated oocytes are found to be 0.98-1.30 mm (mean: 1.10±0.11) in our study, those values were reported as 1.22±0.01 mm, 1.10-1.33 mm and 0.97-1.32 mm by Atasoy et al. (2006), Dehnik (1973) and İşmen (1995), respectively and it is thought that the values in our study are in agreement with the values of other researchers.

Table 1 A five-point maturity scale for partial spawners*

Stage	State	Description
I	Immature	Ovary and testis about 1/3rd length of body cavity. Ovaries pinkish, translucent; testis whitish. Ova not visible to naked eye.
II	Maturing virgin and recovering spent	Ovary and testis about 1/2 length of body cavity. Ovary pinkish, translucent; testis whitish, more or less symmetrical. Ova not visible to naked eye.
III	Ripening	Ovary and testis is about 2/3rds length of body cavity. Ovary pinkish-yellow colour with granular appearance, testis whitish to creamy. No trans- parent or translucent ova visible.
IV	Ripe	Ovary and testis from 2/3rds to full length of body cavity. Ovary orange-pink in colour with conspicuous superficial blood vessels. Large transparent, ripe ova visible. Testis whitish- creamy, soft.
V	Spent	Ovary and testis shrunken to about 1/2 length of body cavity. Walls loose. Ovary may contain remnants of disintegrating opaque and ripe ova, darkened or translucent. Testis bloodshot and flabby.

Holden and Raitt (1974)

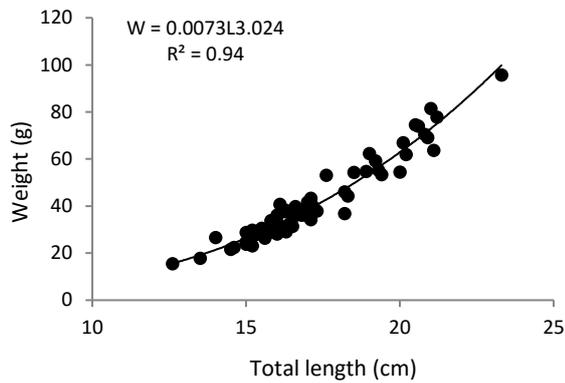


Figure 1 Total length-weight relationship of *Merlangius merlangus euxinus*

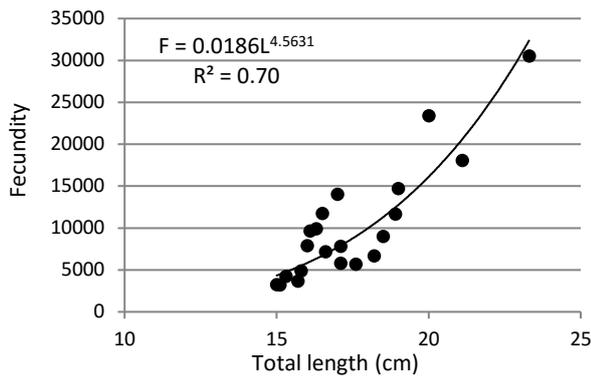


Figure 2 Fecundity-total length relationship of *Merlangius merlangus euxinus*

Kandler (1958) who studied the 37 whiting at the lengths between 25-39 cm before the spawning period in the Baltic Sea, determined fecundity as 108.000-221.000 eggs and computed the fecundity-size relationship as $Fecundity = 72.000 + 2.404 L^3$, while Merstorff (1959) found the fecundity as 120400 - 151000 eggs among 37 whiting at the lengths of 23.5-38.5 cm in the south of the North Sea and the fecundity-length relationship as $Fecundity = 0.0065 \times L^{5.28}$. On the other hand, Hislop (1975) found out the fecundity as 170.000-2.089.000 eggs for the 25-51 cm whiting samples in the North Sea. According to the study conducted by İşmen (1995) on the Black Sea coast of Turkey between 1990-1993, the fecundity-length relationships were found to be $F = aL^{2.19}$ ($r=0.75$) for the west region and $F = aL^{2.20}$ ($r=0.75$), $F = aL^{3.36}$ ($r=0.85$) and $F = aL^{2.74}$ ($r=0.80$), respectively, for the east region in three-year period. Fecundity or reproductive success is known to vary from year to year (Nikolsky, 1969). The reason for this change may be fish size, as well as alterations in environmental conditions such as food, temperature and stress. (Treasurer, 1981; Tsai and Gibson, 1971; Bagenal, 1978). The fecundity-length relation value computed in our study is quite higher than that given by İşmen (1995). The fecundity-length relation value computed in our study is quite higher than that given by İşmen (1995). Therefore, we can consider that the species has changed its reproductive performance in over 20 years based on the current conditions of the region. However, the effects of the length values of the species caught in our study may also

be relevant to this result. Similarly, it has also been suggested by Bowering (1980) that high fecundity levels are associated with maturation in the low lengths.

This study in which some reproductive characteristics of *M. merlangus euxinus*, an economically important species in our country, are determined for the winter period is a preliminary research. With sampling to be made during the overall year in the future, reproductive biology of the species may be established in detail with the determination of other breeding parameters such as spawning season, first maturity size as well as microscopic gonad development and ovulation frequency with histological studies. These results are considered to be beneficial in terms of the species' stock management.

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