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Relationships Between Fish Length and Otolith Dimensions of Redcoat, *Sargocentron rubrum* (Forsskal, 1775) in the Southeastern Mediterranean Sea, Turkey

Türkiye'nin Güneydoğu Akdeniz Sahillerindeki Kızıldeniz Göçmeni *Sargocentron rubrum* (Forsskal, 1775)'un Balık Boy ve Otolit Boyutları Arasındaki İlişkiler

Türk Denizcilik ve Deniz Bilimleri Dergisi Cilt: 4 Sayı: 2 (2018) 156-162

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ABSTRACT

In the present study, sampling was monthly collected from commercial fishing longline boats operating in the southeastern Mediterranean Sea (Arsuz coast) during September 2017-April 2018 and the relationship between fish length and otolith dimensions (length, width and weight) of 151 redcoat samples were examined. Right otolith pairs were used for calculations since there were no statistical differences between left and right otoliths ($P>0.05$). Total fish lengths of all samples ranged from between 11.4-21.0 cm. Otolith lengths and otolith widths were calculated between 0.35-0.86 cm and 0.26-0.56 cm for all samples. Otolith weights were determined between 0.010-0.059 g. Total fish length-otolith length, total fish length-otolith width and total fish length-otolith weight relationships were determined as $OL= 0.0512TL+0.186$ ($r^2=0.865$), $OWi= 0.0255TL+0.0021$ ($r^2=0.825$) and $OW= 0.00002TL^{2.678}$ ($r^2=0.936$) on the total of 151 specimens, respectively. Linear relationships between total fish length-otolith length and total fish length-otolith width were found in all fish. The results of study will have new contributions to the field and useful to fisheries management.

Keywords: *Sargocentron rubrum*, Holocentridae, Otolith biometry, Turkey

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ÖZET

Bu çalışmada, Eylül 2017-Nisan 2018 dönemlerinde Güneydoğu Akdeniz'de (Arsuz kıyılarında) faaliyet gösteren ticari balıkçı parekete teknelerinden aylık olarak örneklenen 151 adet Kıızkdeniz göçmeni Hindistan balığı bireylerinin balık boyu ve otolit boyutları (uzunluk, genişlik, ağırlık) arasındaki ilişkisi incelenmiştir. Sağ ve sol otolitler arasında istatistiksel fark bulunmadığından, hesaplamalarda sağ otolit çiftleri kullanıldı (P> 0.05). Tüm örneklerin toplam balık uzunlukları 11.4-21.0 cm arasında değişmiştir. Tüm örnekler için otolit uzunlukları ve otolit genişlikleri 0.35-0.86 cm ile 0.26-0.56 cm arasında hesaplandı. Otolit ağırlıkları ise 0.010-0.059 g olarak belirlendi. Toplam balık boyu-otolit uzunluğu, toplam balık boyu-otolit genişliği ve toplam balık boyu-otolit ağırlık ilişkisi sırasıyla, toplam 151 örnek üzerinde; OL = 0.0512xTL + 0.186 (r^2 = 0.865), OWi = 0.0255xTL + 0.0021 (r^2 = 0.825), OW = 0.00002x$TL^{2.678}$ (r^2 = 0.9366) olarak belirlendi. Tüm balıklarda toplam balık boyu-otolit uzunluğu ve toplam balık boyu-otolit genişliği arasında doğrusal ilişki bulunmuştur. Çalışmanın sonuçları, alana yeni katkılar sağlayacak ve balıkçılık yönetimine faydalı olacaktır.

Anahtar sözcükler: *Sargocentron rubrum*, Holocentridae, Otolit biyometri, Türkiye

1. INTRODUCTION

The redcoat *Sargocentron rubrum* (Forsskal, 1775) is associated with the species (at depths ranging from 1-84 m) found in coastal reefs or wrecks in lagoons, bays, or harbors (Lieske and Myers, 1994; Randall, 1998). This species may also occur in caves and cracks of rocks during the day (Kuiter and Tonozuka, 2001) and its distribution in the Indo-West Pacific: Red Sea to the western Pacific where it ranges from southern Japan to New Caledonia, Vanuatu and New South Wales, Australia and Tonga Redcoat commonly feeds on crustaceans, fishes, and mollusca (Randall et al., 2003; Froese and Pauly, 2018).

In bony fishes, the otolith sagitta are the largest pair among the three pairs of otoliths that the fishes have in their inner ear (Harvey et al. 2000). Fishery biologists have used sagitta in different aspects of biological studies due to their large size and distinct growth rings (Boehlert, 1985; Sumerfelt and Hall, 1987).

The use of the relationship between otolith size and fish size did not become a common practice until the early second half of the twentieth century till Trout (1954) and Templemann and Squires (1956) demonstrated their usage in retrieving the fish size from the size of their otolith (Echeveria 1987; Aydin et al., 2004; Jawad et al., 2011).

There are scarce studies (Rivaton, and Bourret, 1999) about redcoat in the world that refer to aspects of otolith characters. No information currently exists on the otolith characters of *S. rubrum* in the Mediterranean coast of Turkey.

In this study, relationships total fish length and otolith morphology of redcoat was examined for the first time. This study is an important new contribution for sustainable fisheries management in the area.

2. MATERIAL AND METHOD

A total 151 redcoat samples was monthly collected from commercial fishing longline boats operating in the southeastern

Mediterranean Sea (Arsuz and Iskenderun coast) during September 2017-April 2018 (Figure 1).

All captured 151 individuals were measured to the nearest 0.1 cm for total length (TL; most anterior point to the posterior tip of the caudal fin). Sagittal otoliths were removed, wiped clean, and stored dry in U-plates, then placed in glycerol for examination under reflected light using a trinocular microscope.

The right otolith was used for otolith width and otolith length. Otolith length (OL) and otolith width (OWi) (± 0.001 mm) were determined by Olympus SZX-7. Otolith length was defined as the greatest distance between anterior and posterior edge and otolith width was described as the greatest distance from dorsal to ventral edge (Figure 2).

Otoliths were weighted using Precisa precision scales (OW) (± 0.0001 g). The paired t-test was used to check the differences between left and right otolith.

The fish length-otolith length and fish length-otolith width relationships were examined by using the linear regression model and following equation: $y = a + bx$, where: x; fish length, y; otolith length-otolith width, a; intercept value, b; coefficient value. However, the total fish length-otolith weight relationship was described using non-linear power model as: $y = ax^b$. Relationships with the highest coefficient variation of determination (r^2) were adopted as the best predictor (Zar, 1999). Descriptive statistics were derived using SPSS 21.0 package program.

Figure 1. Sampling area

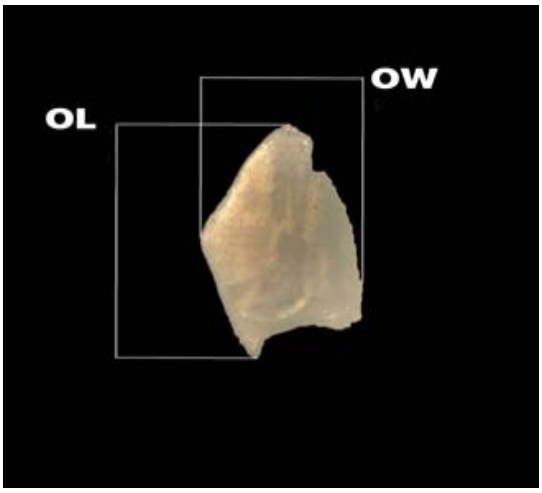

Figure 2. Sagittal otolith (right) of the redcoat, *Sargocentron rubrum* in the Southeastern Mediterranean Sea, Turkey (Total length of the fish = 151, otolith length = 6.1 mm; OL = otolith length, OW = otolith width.

3. RESULTS

In this study, the relationship between fish size and otolith size of 151 redcoat samples were examined. Total fish lengths of all samples ranged from between 11.4-21.0 cm. Otolith lengths determined between 0.35-0.86 cm, otolith width 0.26-0.56 cm, for all samples. Otolith weights were determined between 0.010-0.059 g (Table 1).

The right otolith pairs were used for calculations since there were no statistical

differences between left and right otoliths (P>0.05). A linear regression model was used to determine the relationship between fish length and otolith size, whereas an exponential regression model was used to describe the relationships between fish total lengths and weights of otoliths.

Total fish length-otolith length, total fish length-otolith width and total fish length-otolith weight relationships were found OL= 0.0512xTL+0.186 (r^2=0.865), OWi= 0.0255xTL+0.0021 (r^2=0.825) and OW= $0.00002xTL^{2.678}$ (r^2=0.936), on the total of 151 specimens, respectively (Figure 3, Figure 4 and) Figure 5). It has been determined that there is high correlation relationship between otolith sizes and fish sizes. Linear relationship between total fish length-otolith length and total fish length-otolith width were found in all fish. Calculated regressions were revealed a high coefficient of determinations ranging from 0.825 to 0.936. The otolith length, otolith width and otolith weight measurements are given in Table 1.

Table 1. Fish and Otolith measurement of *S. rubrum* in Iskenderun Bay

Measurements	N	Min. (cm)	Max. (cm)	Mean (cm)±SE
Fish total length	151	11.40	21.00	16.01±1.867
Otolith length	151	0.35	0.86	0.63±0.102
Otolith width	151	0.26	0.56	0.41±0.051
Otolith weight	151	0.010	0.059	0.033±0.008

N: sample size, min: minimum, max: maximum, TL: total length (cm), OL: otolith length (cm), OWi: otolith width (cm), SE; Standart Error

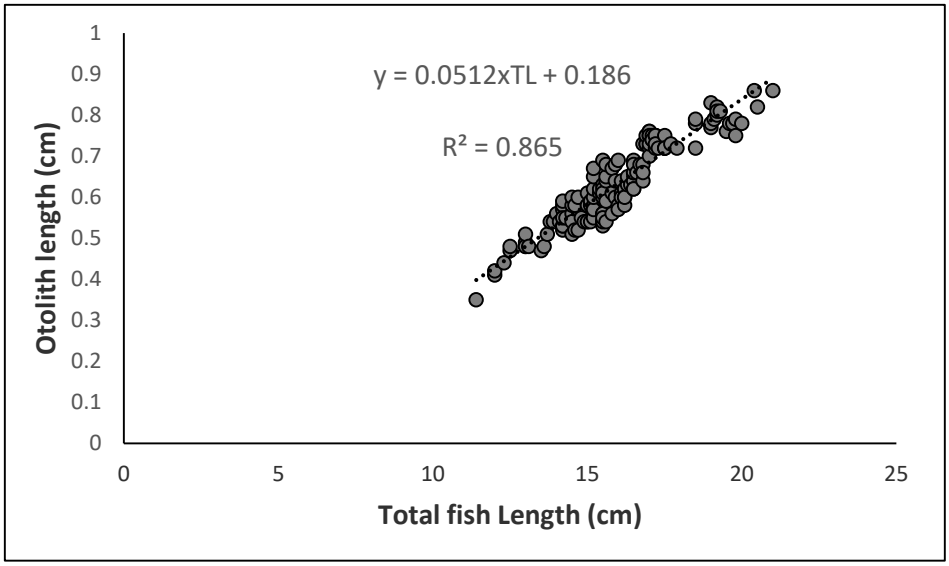

Figure 3. Relationships total fish length- otolith length for *S. rubrum*

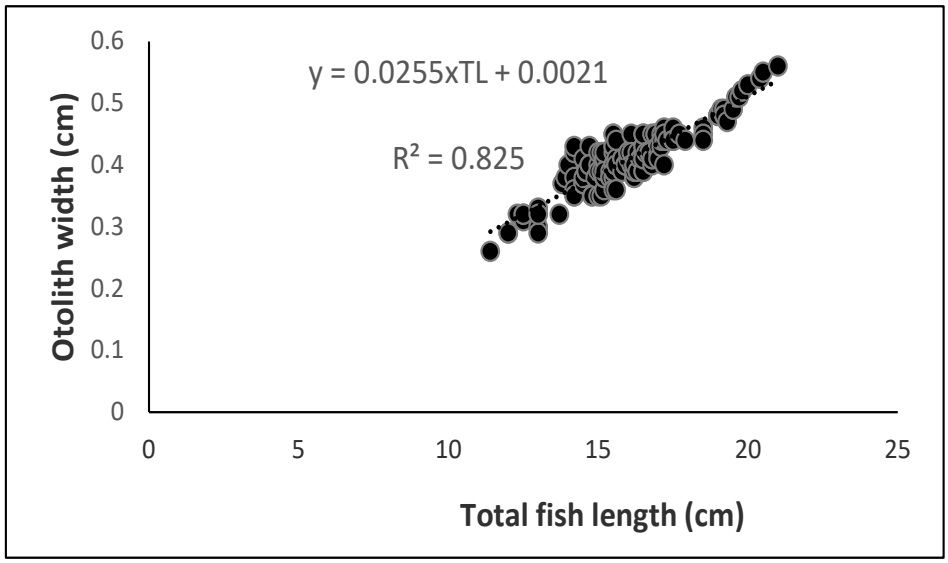

Figure 4. Relationships total fish length-otolith width for *S. rubrum*

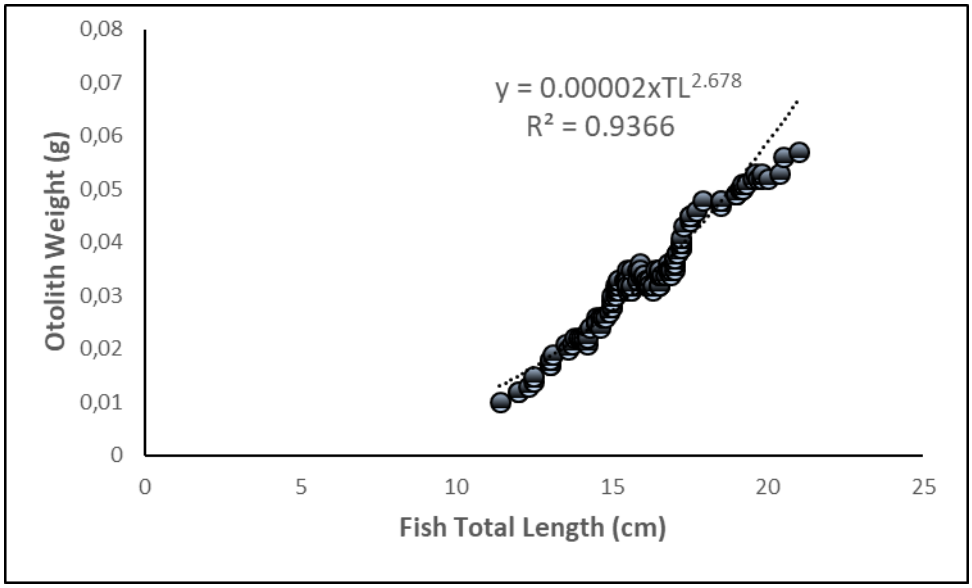

Figure 5. Relationships total fish length-otolith weight for *S. rubrum*

Otoliths commonly are used to determine the taxon and age of fishes. This information is useful for population management, predator-prey studies, and archaeological research (Harvey et al., 2000).

In our study, the smallest otolith size was determined as 0.35 cm and the largest otolith size as 0.86 cm. averages and standard deviation as 0.63±0.10. Minimum fish length, 11.40 cm, maximum fish length, 21.00 cm, average and standard

deviation was determined as 16.01±1.86 cm. According to the results of the regression analysis, it were found that the relationships between the fish length-otolith length and the fish length-otolith width was strong correlations.

Rivaton and Bourret (1999) reported that the smallest otolith size was determined as 7.5 mm and the largest otolith size as 9.4 mm for left and right sagitta in the Lagon Nouvelle-Calédonie. This finding is close in agreement with the result of Rivaton and Bourret (1999).

In the present study, the otoliths of *S. rubrum* did not show significant differences in sizes between left and right sagitta. Similarly, Hunt (1992) revealed that investigation of sagitta morphometric parameters in eight species of the NW Atlantic Ocean, no statistically significant difference between left and right otoliths. Besides, Harvey et al. (2000) stated that 63 species of the Eastern North Pacific Ocean, the relationship between otolith length and body weight was no statistically significant differences between left and right otoliths all with except for one species.

Previous studies usually focused on the relationship between fish size and only one sagitta sizes (Wyllie 1987, Gamboa 1991, Granadeiro and Silva 2000, Harvey et al. 2000, Waessle et al. 2003, Battaglia et al. 2010). On the other hand, the present paper supplies additional information by considering both the otolith length (OL) and otolith width (OWi). It is more reliable to calculate more than one equation (TL-OL and TL-OWi) since the tip of the otolith rostrum or the dorsal or ventral edges of the otolith may be damaged, making it impossible to measure the OL or OWi.

4. CONCLUSIONS

The description of otolith morphometry provided in this study for *S rubrum* is given for the first time in this study area. The results of the present paper address to this need, providing TL-OL, TL-OWi and TL-OW relationships for the redcoat, *S. rubrum*. Besides, the results of study will have new contributions to the field and useful to fisheries management.

5. REFERENCES

Lieske, E., Myers, R. (1994). *Collins Pocket Guide. Coral reef fishes. Indo-Pacific & Caribbean including the Red Sea*. p. 400, Haper Collins Publishers.

Randall, J. E., (1998). Revision of the Indo-Pacific squirrelfishes (Beryciformes: Holocentridae: Holocentrinae) of the genus *Sargocentron*, with descriptions of four new species. *Indo-Pacific Fish*es 27: 1-105.

Kuiter, R. H., Tonozuka, T., (2001). Pictorial guide to Indonesian reef fishes. Part 1. Eels- Snappers, Muraenidae - Lutjanidae. *Zoonetics Australia* 1-302.

Randall, J. E., Williams, J. T., Smith, D. G., Kulbicki, M., Tham, G. M., Labrosse, P., Kronen, M., Clua, E., Mann, B. S., (2003). Checklist of the shore and epipelagic fishes of Tonga. *Atoll Research Bulletin* 502: 1-37.

Froese, R., Pauly, D., (2018). FishBase. World Wide Web electronic publication [version 02/2018], http://www.fishbase.org adresinden alınmıştır.

Harvey, J. T., Loughlin, T. R., Perez, M. A., Oxman, D. S. (2000). Relationship between fish size and otolith length for 63 species of fishes from the eastern North Pacific Ocean. p. 150, *NOAA Technical Report NMFS*.

Boehlert, G. W., (1985). Using objective criteria and multiple regression models for age determination in fishes. *Fishery Bulletin* 83: 103-117.

Sumerfelt, R. C., Hall, G. E., (Eds.) (1987). *The age and growth of fish*. p. 54, Iowa State University Press, Ames.

Trout, G. C. (1954). Otolith growth of the Barents Sea cod. *Rapports et procès-verbaux des réunions. International Council for the Exploration of the Sea* 150: 297-299.

Templemann, W., Squires, H. J., (1956). Relationship of otolith lengths and weights in the haddock, *Melanogrammus aeglefinus* (L.), to the growth of the fish. *Journal of Fisheries Research Board of Canada* 13: 467-487.

Echeveria, T. W., (1987). Relationship of otolith length to total length in rockfishes from northern and central California. *Fishery Bulletin* 85: 383-387.

Aydın, R., Calta, M., Sen, D., Coban, M. Z., (2004). Relationships between fish lengths and otolith length in the population of *Chondrostoma regium* (Heckel, 1843) inhabiting Keban Dam Lake. *Pakistan Journal of Biological Sciences* 7(9): 1550-1553.

Jawad, L., Al-Mamry, J., Al-Busaidi, H., (2011). Relationship between fish length and otolith length and width in the lutjanid fish, *Lutjanus bengalensi*s (Lutjanidae) collected from Muscat City coast on the Sea of Oman. *J. Black Sea/Mediterranean Environment* 17(2): 116-126.

Rivaton, J., Bourret, P., (1999). Les otolithes des poissons de l'Indo-Pacifique. IRD. *Doc. Science Techology* II 2: 1-378.

Hunt, J. J., (1992). Morphological characteristics of otoliths for selected fish in the Northwest Atlantic. Journal of Northwest. *Atlantic Fishery Sciences* 13: 63-75.

Wyllie, E. T., (1987). Relationship of otolith length to total length in rockfishes from northern and central California. *Fishery Bulletin* 85: 383-387.

Gamboa, D. A., (1991). Otolith size versus weight and body-length relationships for eleven fish species of Baja California, Mexico. *Fisheries Bulletin* U.S. 89: 701-706.

Granadeiro, J. P., Silva, M. A., (2000). The use of otoliths and vertebrae in the identification and size-estimation of fish in predator prey studies. *Cybium* 24: 383-393.

Waessle, J. A., Lasta, C. A., Bavero, M., (2003). Otolith morphology and body size relationships for juvenile Sciaenidae in the Río de la Plata estuary (35-36°S). *Scientia Marina* 67: 233-240.

Battaglia, P., Malara, D., Romeo, T., Andaloro, F., (2010). Relationship between otolith size and fish size in some mesopelagic and bathypelagic species from the Mediterranean Sea (Strait of Messina), Italy. *Marine Science* 74: 605-612.

Zar, J. H., (1999). *Biostatistical Analysis*, 4th Edition. p. 633. Prentince-Hall, Englewood Cliffs, NJ.