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*- RESEARCH ARTICLE-*

# Otolith biometry of *Serranus scriba* (Linnaeus, 1758) from the Southern Aegean Sea

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**Abstract**

Otoliths are widely used in stomach content analysis in fisheries biology, other than age determination or ichthyo-archeological studies, because they have species specific morphological features. It is possible determine size and species of the prey fishes in the digestive system of the piscivorous aquatic predators. In this study, the relationships were calculated between sagittal otolith measurements (otolith length (OL), height (OH) and weight (OW)) and fish size (length (TL), weight (W)) in painted comber *Serranus scriba* (Linnaeus, 1758) specimens (N=763, 68–241 mm in TL and 3.66–228.72 g). Fish specimens captured via bottom trawl vessels from off the Güllük Bay (Southern Aegean Sea) between January and December 2013. Regression equations were calculated as follows: TL= 20.11*OL+40.28, TL= 44.07*OH+50.24, TL= $969.1*OW^{0.410}$, W= $1.212*OL^{2.194}$, W= $11.16*OH^{1.850}$, W= 5913*OW–12.22, OH= 0.218*OL+1.213, OW= $0.00045*OL^{1.843}$, OW= $0.002*OH^{1.672}$. Calculated regressions were displayed a high coefficient of determinations ranging between 0.822 - 0.892. Otolith length ($R^2$= 0.890) is the best indicator of the prediction of the fish length by examining the regression coefficients for *S. scriba*.

**Keywords:**

Painted comber, Serranidae, sagittae, sagittal otolith biometry.

**Article history:**

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## Introduction

Otolith biometry in fish biology studies are used such as the anatomy of species, identifying new species, systematic revision of a fish taxa, determination of phylogenetic relations, eco-morphological studies, determination of relations fish and otolith growth (Tuset et al., 2008). Fish otoliths are also, widely used in stomach content analysis because they are one of the last species

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specific features to be digested in the digestive systems of piscivorous predators (Smale et al., 1995). There is also linear or non-linear correlation between otolith (otolith length, height and weight) and fish sizes (fish length and weight). Thus, it is possible to calculate a digested fish length and weight from the size and mass of its sagittal otolith. To better understand trophic levels and relationships in to the marine environment of Turkish waters, morphological otolith characteristics and the otolith determined species by species. *Serranus scriba* is distributed in the Mediterranean Sea and adjacent eastern Atlantic from Bay of Biscay and Azores south to Mauritania, and it is found in Black Sea, Sea of Marmara, Aegean Sea and Mediterranean coasts of Turkey (Fricke et al., 2007). According to Red List categories were stated by IUCN, *S. scriba* is categorised as near threatened (NT) (Smith-Vaniz, 2015) and; the main threats were reported by Fricke et al. (2007) as FIT (a species that is commercially exploited as a target species), HAB (a species that is threatened by a loss of its habitat (silted sand bottoms due to eutrophication, disappearing seagrass beds, etc.)), EUT (a species that is threatened by effects of eutrophication (nutrient-rich water, oxygen deficiency, etc.), or various effects of organic or inorganic pollution, such as oil spills, various chemicals, hormones etc) for this species.

Up to date, studies on the morphology of sagittal otoliths or its size relationship with the body size, are very limited on the member of the genus *Serranus* within the range of their distribution area: Tuset et al. (2003a), were studied on the shape indices to identify regional differences in otolith morphology of *Serranus cabrilla* in the Canary Islands (Central-eastern Atlantic) and in Alicante (West Mediterranean). Tuset et al. (2003b) were determined comparative morphology of the sagittal otolith in *Serranus* spp., including *S. scriba*, in the Canary Islands. Tuset et al. (2006) were used sagittal otolith shape of the genus *Serranus* collected from the Canary Islands for the first time in a biological application as fish taxonomy. Uyan et al. (2016) were otolith biometry and fish length relations of *S. cabrilla* from Ildır Bay (Northern Aegean Sea). Bilge & Filiz (2018) were determined the relationships in sagittal otolith biometry and body size of *S. cabrilla* distributed in southern Aegean Sea. The aim of this study was to examine the otolith and fish size relations of *S. scriba* in the southern Aegean Sea in order to provide a reliable tool for researchers studying food habits of top predators to determine the size and weight of prey fish from the length or weight of the otoliths recovered.

**Material and methods**

Samples were captured between January and December 2013 at seasonal intervals from off the Güllük Bay by using a commercial bottom trawl. Because of its hermaphroditic reproductive feature, all specimens were evaluated by sexes combined. Fish total length (TL) was measured to the nearest mm and fish weight (W) was determined to the nearest 0.01 g on a digital balance.

Sagittae (Figure 1) were removed with forceps through a cut in the cranium. Otoliths were then cleaned with 10% NaOH solution, stored dry in glass vials, and the left and right otolith were considered separately. Each sagitta was placed with the sulcus acusticus oriented upwards and otolith length (OL) was measured in mm through an eye-piece micrometer under with a stereo zoom microscope (Olympus SZX-16). It was defined as the longest dimension between the rostrum and postrostrum axis (nomenclature of Smale et al., 1995, Tuset et al., 2008) through the focus of the otolith (Al-Mamry et al., 2010). Otolith height (OH) was measured in mm as the longest dimension between the ventral and dorsal surfaces of each sagitta. The image was taken of the internal side (medial or proximal) of the otolith as this side presents the sulcus acusticus (a

groove along the surface of the sagitta) (Tuset et al., 2008). Individual sagittal otolith weight (OW) was determined in mg using an electronic balance. Firstly, the paired t-test was used to check any differences between left and right otolith. When significant differences ($P < 0.05$) were not found, the $H_0$ hypothesis ($b_{right} = b_{left}$) was accepted and a single regression was used for each parameter (OL, OW, and OH). Linear regression equations ($y = ax + b$) and exponential regression equations ($y = ax^b$) were fitted to determine what equations (TL-OL, TL-OH, TL-OW, W-OL, W-OH, W-OW, OW-OL, OH-OL and OW-OH) described various relations between otolith and fish size.

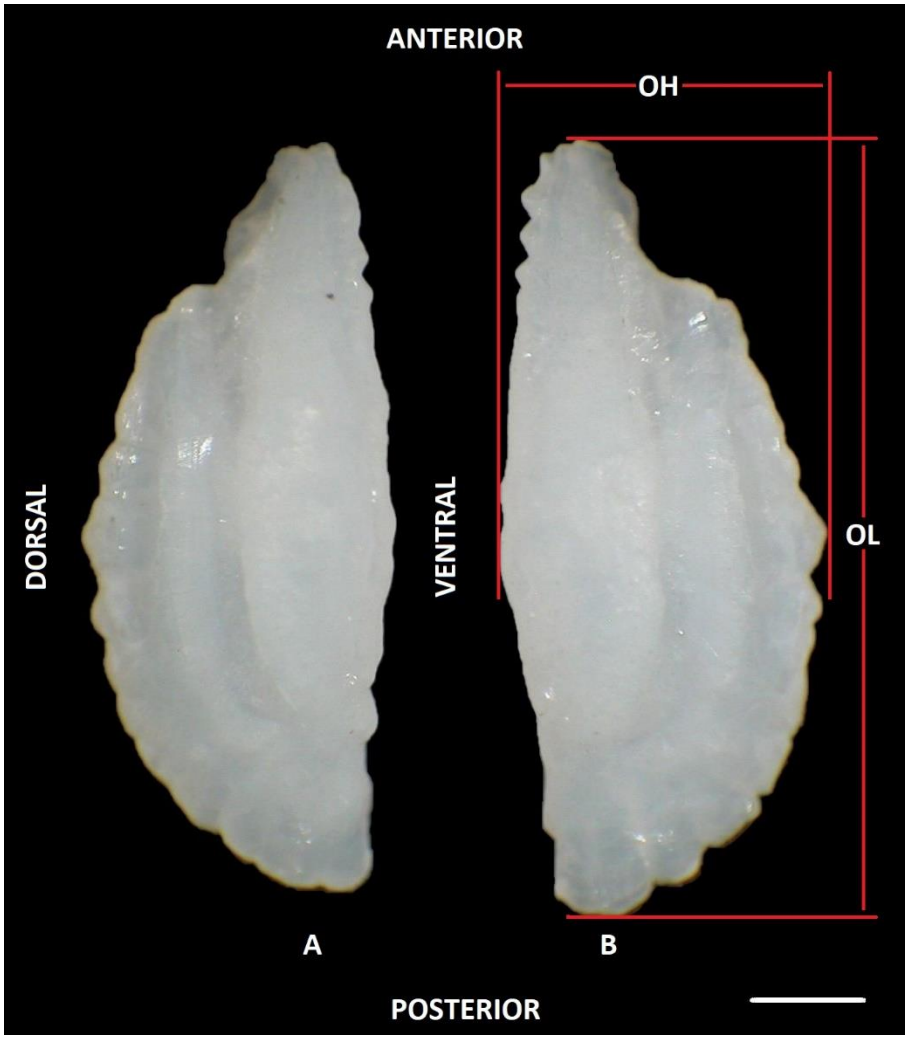


Fig 1. Sagittal otoliths (A. left, B. right) of the comber, *Serranus scriba*, sampled from the southern Aegean Sea in 2013 (Total length of the fish = 189 mm, otolith length = 8.3 mm; OL = otolith length, OH = otolith height, scale bar= 1 mm).

The sagittal otoliths of 763 *S. scriba* specimens were examined. Table 1 shows the descriptive statistics regarding length and weight of the species and its sagittal otoliths (with otolith width): the average total length was 136.549 mm (68-241 mm), and the length of otoliths ranged from 1.8 to 9.4 mm, height from 1.3 to 3.2 mm, and weight from 0.0015 to 0.0306 g.

Table 1. Descriptive statistics of length and weight data of specimens and their otoliths obtained from the Southern Aegean Sea.

| | **Range** | **Average (±S.D.)** |
|---|---|---|
| **TL (mm)** | 68-241 | 136.549 (±35.848) |
| **W (g)** | 3.66-228.72 | 42.275 (±37.535) |
| **OL (mm)** | 2.7-8.4 | 4.890 (±1.577) |
| **OH (mm)** | 1.3-3.2 | 2.121 (±0.395) |
| **OW (g)** | 0.0015-0.0306 | 0.0088 (±0.0057) |

Total length (TL), Fish weight (W), Otolith length (OL), Otolith weight (OW) and Otolith height (OH), Standart deviation (S.D.).

Relations between fish and otolith measurements were given in Table 2. Since no statistical differences between left and right otoliths ($p>0.05$), left otolith pairs were used for calculations. Calculated regressions, between fish and otolith measurements, were displayed a high coefficient of determinations ranging between 0.822 - 0.892. A linear regression model was used to determine the relationship between the fish length and otolith sizes, but an exponential regression model was used to describe the relationships between lengths and weights of otolith and fish for the species.

Table 2. Intercept values (a), regression slope (b) and coefficients of determination ($r^2$) for linear (L) and exponential (E) relationships between otolith morphometric parameters, fish length and weight of *S. scriba*.

| | **Relationship** | **Regression** | **a** | **b** | **$r^2$** |
|---|---|---|---|---|---|
| **Fish Length** | TL vs. OL | L | 2<br>0.11 | 4<br>0.28 | 0<br>.890 |
| | TL vs. OH | L | 4<br>4.07 | 5<br>0.24 | 0<br>.822 |
| | TL vs. OW | E | 9<br>69.1 | 0<br>.410 | 0<br>.872 |
| **Fish Weight** | W vs. OL | E | 1.<br>212 | 2<br>.194 | 0<br>.889 |
| | W vs. OH | E | 1<br>1.16 | 1<br>.850 | 0<br>.823 |
| | W vs. OW | L | 5<br>913 | -<br>12.22 | 0<br>.870 |
| **Otolith** | OW vs. OL | E | 0.<br>00045 | 1<br>.843 | 0<br>.886 |
| | OH vs. OL | L | 0.<br>218 | 1<br>.213 | 0<br>.892 |

| | | | | | |
|---|---|---|---|---|---|
| | OW vs. OH | E | 0.002 | 1.672 | 0.888 |

**Discussion**

Tuset et al. (2003b) were investigated variations in the morphology of sagittal otoliths of *S. atricauda*, *S. cabrilla* and *S. scriba* from the Canary Islands but they did not give any data about the equations between otolith and fish. According to their results, although the otolith gross morphology was similar among species, *S. scriba* was distinct in having a rostrum which had a slight turning at the tip and a more funnel-like ostium. They also stated that, the shallower water species (*S. scriba*) had otolith and sulcus areas which were smaller than the deeper water species (*S. cabrilla* and *S. atricauda*). The sulcus acusticus and ostium size were correlated with the habit depth of the species, with the highest values in the deepest species, *S. cabrilla*.

Tuset et al. (2006), were investigated shape descriptors (EllipProffitt, CircProffitt, EllipVoss, TriVoss, ConvexCM1, ConvexCM2, Intrusiveness, Protrusiveness, ConvexJ, EllipLMedS, EllipMom, TriMom, Rectil, RectRobust, SqFFT, SymmL and SymmF) of sagittae obtained by image analysis for the identification of three species of genus *Serranus* inhabiting the Canary Islands. They reported that, the standardization of otolith shape variable provided better results with respect to otolith length (82.7% of agreement) versus fish length (72.8%). When the otolith weight was added in the analysis the discrimination was better with respect to fish length (86.4%), being the variable more significant in their study.

Tuset et al. (2008) were described sagittal otolith morphology of the species as follow: Shape: fusiform, dorsal margin sinuate to irregular. Sulcus acusticus: heterosulcoid, ostial, median. Ostium: funnel-like, shorter or similar to the cauda in size. Cauda: tubular, curved, strongly flexed from the posterior region, ending close to the posterior-ventral margin. Anterior region: peaked; rostrum short to long, broad to narrow, pointed; antirostrum absent or short, broad, round; excisura wide, with or without a s hallow notch. Posterior region: round to round-irregular. They also reported a % ratio relationships between the total length of *S. scriba* (70, 175 and 240 mm TL, n = 3) and sagitta sizes as OL/TL= 2.7-4.4 and OH/OL= 35.4-42.7; in the present study (68-241 mm TL, n = 763) these ratios were calculated as OL/TL=2.7-4.0 and OH/OL= 34.5-48.1. The largest specimen examined by Tuset *et al*. (2008) was closer to the specimens in this study. In the present study, number of specimens examined was higher than those of Tuset et al. (2008).

Uyan et al. (2016), was not find any statistical difference between right and left in terms of otolith length, height and weight ($p>0.05$) of 34 *S. cabrilla* specimens collected from Northern Aegean Sea and they suggested that, the researchers working on otolith biometry of *S. cabrilla* could use each right or left otoliths without a differentiation. They also found correlations which are strongly related between fish length and otolith biometrics, which is the highest one between otolith length and fish length ($R^2= 0.904$). Bilge & Filiz (2018), also could not find any statistical difference between the biometrics of right and left otolith pairs of the same species (n= 310) collected from the Southern Aegean Sea. They were found highest $R^2$ value between otolith length and fish length ($R^2= 0.938$). In the present study, but on the *S. scriba*, otolith length ($R^2=$

0.890) measurements is the best indicator of the prediction of the fish length by examining the regression coefficients.

Most otolith guides such as Härkönen (1986), Smale et al. (1995) or Tuset et al. (2008) cover particular geographic regions and a large number of species, but with relatively lower sample sizes as compared with species-specific studies. An essential objective of researchers studying the marine predators' feeding habits is to add more information to what is already available concerning the fish otolith morphology and the estimation of specific equations, which is useful to calculate the size and mass of prey (Al-Mamry et al., 2010). Bradai & Bouain (1990) reported that the red scorpionfish (*Scorpaena scrofa*) is the predator of *S. scriba* in the Gulf of Gabes (Tunisia, eastern Mediterranean Sea). Similarly, we observed *Serranus hepatus* and *S. scriba* specimens in the gut content of some *Scorpaena porcus* and *S. scrofa* samples collected from the Gökova Bay (southern Aegean Sea). To get this data missing, in the present study, first information was given about the relationships between the lengths, heights and weights of sagittal otolith and the lengths and weights of fish samples of *S. scriba* collected from the Turkish coast of the southern Aegean Sea. These data will help researchers studying food habits of top predators to determine the size and weight of prey fish from length, height or weight of the recovered otoliths.

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