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*-RESEARCH ARTICLE-*

# Relationships Between Fish and Otolith Dimensions for *Serranus hepatus* (Linnaeus, 1758) from the Southern Aegean Sea

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**Abstract**

In the present study, the relationships between sagittal otoliths (otolith length (OL), height (OH) and weight (OW)), fish size (fish length (TL) and weight (W)) in brown comber (*Serranus hepatus*, Linnaeus, 1758) were analysed. Fish specimens (N=504, 41–133 mm in TL and 1.05–31.98 g) were captured by bottom trawl vessels from off the Güllük Bay (Southern Aegean Sea) between January and December 2013. Left otolith pairs were used for calculations since there was no statistical differences between left and right otoliths ($P>0.05$). Regression formulas were used as follows: $TL= 16.94*OL+10.14$, $TL= 26.77*OH+24.88$, $TL= 375.7*OW^{0.315}$, $W= 0.251*OL^{2.431}$, $W= 2.009*OH^{1.917}$, $W= 854.0*OW+1.552$, $OH= 0.600*OL–0.394$, $OW= 0.00025*OL^{2.555}$ and $OW= 0.001*OH^{2.007}$. Calculated regressions were revealed a high coefficient of determinations ranging from 0.865 to 0.960. It is found that otolith sizes and weight are good indicators of the total length and weight of *S. hepatus*.

**Keywords:**

Brown comber, Serranidae, sagittae, otolith biometry.

**Article history:**

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## Introduction

*Serranus hepatus* is a demersal fish speces, belong to the Family: Serranidae, found over seagrass, sand, mud and rocks, and distributed in Sea of Marmara, Aegean and Mediterranean Sea (Whitehead et al., 1986). Even though, *S. hepatus* has not got any commercial importance because of its small size, it has ecological importance, because this species is prey of some

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demersal fish species. Known piscivore predators of the species are European hake (*Merluccius merluccius*) (Papaconstantinou & Stergiou, 1995), Stargazer (*Uranoscopus scaber*)(Sanz, 1985), Black scorpionfish (*Scorpaena porcus*) and Red scorpionfish (*Scorpaena scrofa*) (Bradai & Bouain, 1990) which have economically important fish species found in the Mediterranean Basin. Even when prey specimens are already partially or totally digested, intact otoliths can be found in stomachs, intestines, faeces and scats, and prey species can be identified (Al-Mamry et al., 2010; Pierce & Boyle, 1991; Granadeiro & Silva, 2000). Thus, fish, seal and seabird biologists, as well as taxonomists and archaeologists, often rely on the shape and size of preserved or undigested otoliths to reconstruct and analyse the species and size composition of the diet of fish predators (Campana, 2004). The relationship between fish length and otolith size and weight has been used in several fish species to draw conclusions on the body size and biomass of prey species (Al-Mamry et al., 2010; Frost & Lowry, 1980). Otoliths can be used in diet studies of piscivorous animals, if the whole fish is consumed or at least if the head is not discarded to such an extent that the results of the study are heavily biased (Härkönen, 1986). The aim of this study was to provide new data on the morphology and the relations between the otolith size and the fish size for the researchers studying on the stomach contents and trophic interactions among marine animals.

## Materials and Methods

Samples were captured during 2013 at seasonal intervals from off the Güllük Bay by using a commercial bottom trawl. 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 (Fig. 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 (OW–W, OL–OW, SL–OH, OH–W, OW–OH, OL–W, OL–SL, OH–OL, and OW–SL) described various relations between otolith and fish size (Tarkan et al., 2007).

## Results

The sagittal otoliths (Fig. 1) of 504 *S. hepatus* 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 91.01 mm (41-133 mm), and the length of otoliths ranged from 1.7 to 6.3 mm, height from 1.2 to 4.2 mm, and weight from 0.0019 to 0.0348 g.

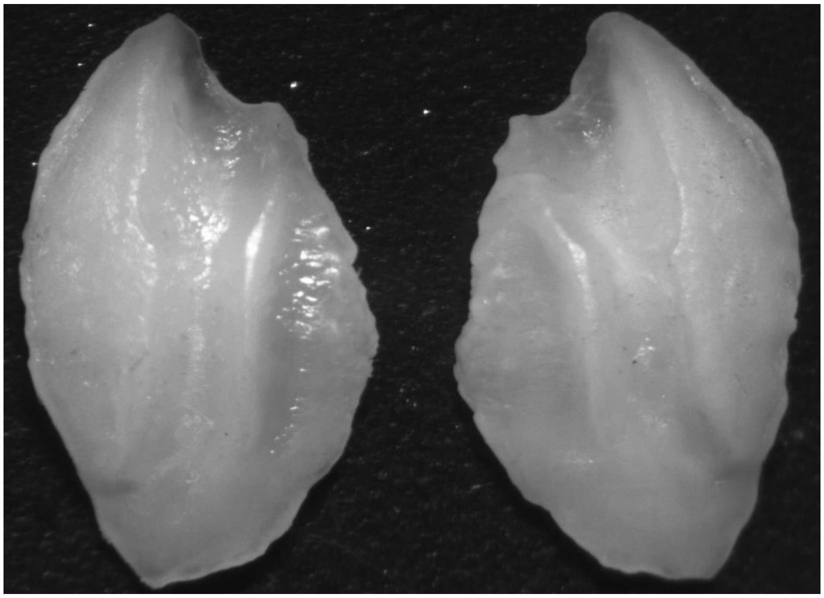

Fig 1. Sagittal otoliths of *S. hepatus*.

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)** | 41-133 | 91.01 (±17.29) |
| **W (g)** | 1.05-31.98 | 12.180 (±5.946) |
| **OL (mm)** | 1.7-6.3 | 4.771 (±1.001) |
| **OH (mm)** | 1.2-4.2 | 2.470 (±0.624) |
| **OW (g)** | 0.0019-0.0348 | 0.0124 (±0.0067) |

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 were displayed a high coefficient of determinations ranging between 0.865 - 0.960. 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. hepatus*.

| | Relationship | Regression | a | b | $r^2$ |
|---|---|---|---|---|---|
| Fish Length | TL vs. OL | L | 16.94 | 10.14 | 0.960 |
| | TL vs. OH | L | 26.77 | 24.88 | 0.933 |
| | TL vs. OW | E | 375.7 | 0.315 | 0.936 |
| Fish Weight | W vs. OL | E | 0.251 | 2.431 | 0.941 |
| | W vs. OH | E | 2.009 | 1.917 | 0.917 |
| | W vs. OW | L | 854 | 1.522 | 0.940 |
| Otolith | OW vs. OL | E | 0.00025 | 2.555 | 0.894 |
| | OH vs. OL | L | 0.6 | -0.394 | 0.925 |
| | OW vs. OH | E | 0.001 | 2.007 | 0.865 |

## Discussion

Tuset et al. (2008) were described sagittal otolith morphology of the species as follow: Shape: elliptic, sinuate margins. Sulcus acusticus: heterosulcoid, ostial, median. Ostium: funnel-like, shorter than the cauda. Cauda: tubular, curved, strongly flexed from the middle region, ending close to the posteriorventral margin. Anterior region: peaked; rostrum long, broad, pointed; antirostrum absent or short, broad, round; excisura wide, with a shallow notch. Posterior region: round to angled. They also reported a % ratio relationships between the length of *S. scriba* (53, 80 and 134 mm TL, n = 3) and sagitta sizes as OL/TL= 4.8-5.0 and OH/OL= 48.8-53.1; in the present study (41-133 mm TL, n=504) these ratios were calculated as OL/TL= 4.1-5.8 and OH/OL= 37.3-59.2.

Fish growth rates may vary among populations (Campana & Casselman 1993). Therefore, the relations found in this study may not describe the otolith growth in other parts of the range. The otolith growth characteristics of *S. hepatus* should be studied separately throughout its distribution.

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