

Technical contribution

Relationship of otolith length to fish total length in six demersal species from the NW Mediterranean Sea

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Summary

Relationships between otolith major axis length (mm) and fish size (total length, cm) were described by means of linear regression analysis for six demersal fish species from the NW Mediterranean: blue whiting (*Micromesistius poutassou*), greater forkbeard (*Phycis blennoides*), red mullet (*Mullus barbatus*), poor cod (*Trisopterus minutus capelanus*), horse mackerel (*Trachurus trachurus*), and Mediterranean mackerel (*Trachurus mediterraneus*). Results show that reconstruction of body size from otolith measurement is possible by applying this approach based on the relationship of otolith length – fish length.

Introduction

Otoliths are usually used to identify fish species and to estimate their age and size, which is information useful for population dynamics and feeding habit studies. In feeding studies, for example, the ability to estimate the original size of an ingested prey item is an important step in deriving biological and ecological information, such as predator consumption rates, biomass of the prey consumed, and selectivity of a predator towards a specific size class of prey (Granadeiro and Silva, 2000; Watanabe et al., 2004; Battaglia et al., 2010). The rebuilding of body size from otolith measurement is possible by involving the correlation between

otolith length and fish size (Templemann and Squires, 1956; Echeveria, 1987; Panfili et al., 2002).

The present work is aimed at estimating the relationship between otolith length and fish length in six demersal fish species of the Ligurian and northern-central Tyrrhenian seas (NW Mediterranean): blue whiting (*Micromesistius poutassou*), greater forkbeard (*Phycis blennoides*), red mullet (*Mullus barbatus*), poor cod (*Trisopterus minutus capelanus*), horse mackerel (*Trachurus trachurus*), and Mediterranean mackerel (*Trachurus mediterraneus*). These data are useful to researchers studying food habits of predator species, to determine the size of prey from the length of recovered otoliths.

Materials and methods

The specimens used in the present study were collected from 50 trawl stations sampled in June 2013 during an experimental bottom trawl survey, the Mediterranean International Trawl Survey (MEDITS; see Bertrand et al., 2002, for technical specifications) in the Ligurian and northern Tyrrhenian seas (FAO Geographical Sub-Area 9, GSA9, 41°00′–44°00′N; 08°00′–13°00′E, NW Mediterranean).

The collected specimens were measured for total length (TL); otoliths (sagittae) were removed, cleaned and stored dry in vials. To standardize procedures and analyses, only the left otoliths were used in the analyses. Otolith major axis length was measured to the nearest 0.1 mm

Table 1
Otolith major axis length – fish size (length) relationship

Species	n	TL range (cm)	Otolith length range (mm)	a	SE	b	SE	r ²	F
<i>Micromesistius poutassou</i>	88	6.5–39.0	3.2–19.0	1.442	0.079	1.132	0.025	0.977	*
<i>Phycis blennoides</i>	76	4.5–54.0	2.9–18.2	0.909	0.067	1.377	0.027	0.983	*
<i>Mullus barbatus</i>	149	6.5–21.5	1.8–4.0	2.732	0.245	1.484	0.057	0.934	*
<i>Trisopterus minutus capelanus</i>	68	5.5–25.0	3.5–12.0	1.052	0.047	1.291	0.020	0.984	*
<i>Trachurus trachurus</i>	170	6.0–41.5	2.2–13.4	2.289	0.081	1.134	0.011	0.959	*
<i>Trachurus mediterraneus</i>	163	5.0–42.0	1.8–11.4	2.199	0.068	1.178	0.012	0.962	*

n, number of specimens; a, intercept; b, slope; SE, standard error; r², determination coefficient; F, significance level of the ANOVA F-test (H₀: β = 0).

*P < 0.01.

using a dissection microscope provided with a micrometre eyepiece.

The relationship between otolith major axis length (mm) and fish size (TL, cm) was described by means of the power equation $TL = a \cdot OL^b$, where OL is the otolith length, and TL is the fish total length. Parameters a and b were estimated using ordinary least-square regression after transforming data into natural logarithms (Ricker, 1973). An ANOVA F -test was used to test the significance of the slope of the regression (testing the null hypothesis $H_0: \beta = 0$). Data exploration and analyses were carried out using the package R 2.15.2 (R Core Team, 2012; www.r-project.org).

Results and discussion

Values of a and b of the otolith length – fish length relationships for the six species investigated, and the associated statistical information are provided in Table 1. The highest value of b was observed for *Mullus barbatus*. A high value of the parameter b of the otolith length – fish length relationship indicates that the growth rate in body size is proportionally higher than the growth rate in length of the otolith. In fact, the otoliths of *M. barbatus* are oval in shape, while those of the other investigated species, which show values of b slightly lower than *M. barbatus*, are lanceolated-elliptic (see Tuset et al., 2008).

This study represents the first reference on the relationship between otolith length and fish size for the six species investigated in the Ligurian and northern-central Tyrrhenian seas (NW Mediterranean). It is hoped that the results of this work will be helpful for population dynamics and stock assessment purposes, as well as for future ecological and feeding studies focusing on the rebuilding of prey size and biomass from otoliths recovered from the stomach contents of predator species.

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