First attempt to validate the age estimation of chub mackerel (*Scomber colias*) in the Bay of Biscay using otoliths.

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**INTRODUCTION**

The Atlantic chub mackerel (*Scomber colias*) is a pelagic fish distributed in warm and temperate Atlantic waters and in the Mediterranean Sea. In eastern Atlantic, chub mackerel occurs from the Bay of Biscay to southern waters.

Age determination is an essential feature in fish stock assessment to estimate the rates of mortality and growth. *S. colias* is not an exception, and the use of otoliths (a fish saddle bone), which is the primary focus of this paper, is a widely used technique to estimate ages. Otoliths were mainly collected in the years 1992 and 1993 from the Bay of Biscay.

**MATERIAL & METHODS**

A total of 946 *S. colias* collected from landings of commercial vessels during the years 2011 (Cantabrian Sea) and 2012 and 2013 (Bay of Biscay) were sampled. In addition, 261 individuals were sampled during the acoustic survey (PELACUS surveys) and 9 individuals from the trawl survey (DNO-RAAS11 and DNO-RAAS13), carried out during April and September of 2013, respectively. The total length (LTL) of all the mackerel was measured in the nearest mm.

A total of 999 pairs of otoliths were aged, 668 of which from the first semester and 216 from the second. The nature of the edge (opaque or aplagic) was also recorded for all of them. Otoliths were observed by a binocular microscope under reflected light.

- Diameter and radius of the otoliths were measured, as well as the radius of each annulus.
- The absolute marginal distance (AMD) is the distance between the end of the last opaque annulus and the edge and the distance between the last two opaque annulus (Di+1) were also measured in 523 of these otoliths, for estimating the relative marginal distance (RMD) = the AMD of the Di+1 relative to the AMD of the Di.

**RESULTS & DISCUSSION**

### Otolith radius/Fish length relationship

The linear model shows a good fit between fish length and otolith radius.

\[ y = ax + b \]

The distribution of such annulus of *S. colias* is assumed to be a decreasing otolith growth rate with age. A linear decreasing interval between increments is a verification criterion that forms the basis of age estimation (May, 1996).

### Otolith edge study

The monthly proportion of edge type of *S. colias* indicates an annual periodicity in the formation of the opaque and opaque annulus, appearing the opaque edge mainly appearing from June to November (see sample available in December). The opaque (phalangeal) annulus seems to be entirely formed in March. In other studies, similar results were obtained with slight geographical differences (see table). A gradient in the edge formation seems to be observed, with earlier beginning of the opaque-edge in southern areas.

<table>
<thead>
<tr>
<th>Area</th>
<th>Opaque edge</th>
<th>Reference</th>
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</thead>
<tbody>
<tr>
<td>ICES Div.: (Bay of Biscay)</td>
<td>Jan - Nov</td>
<td>Present study</td>
</tr>
<tr>
<td>ICES Div.: (Sail of Cadiz)</td>
<td>May - Aug</td>
<td>Martins, 1983</td>
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<tr>
<td>ICES Div.: (Sail of Cadiz)</td>
<td>May - Aug</td>
<td>Rodriguez-Rodríguez, 2002</td>
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<tr>
<td>ICES Div.: (Sail of Cadiz)</td>
<td>May - Oct</td>
<td>Veale et al., 2011</td>
</tr>
<tr>
<td>ICES Div.: (Sail of Cadiz)</td>
<td>May - Oct</td>
<td>Camacho et al., 2002</td>
</tr>
<tr>
<td>Madrid Islands</td>
<td>May - June</td>
<td>Veale et al., 2006</td>
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<td>Canaries Islands</td>
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<td>Azores Islands</td>
<td>May - Sept</td>
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<tr>
<td>Mediteranean (Cuban waters)</td>
<td>Spring - Summer</td>
<td>Perello et al., 2005</td>
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<td>E Mediterranean (Ibiza)</td>
<td>May - Sept</td>
<td>Gómez et al., 2003</td>
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<tr>
<td>E Mediterranean (Moroccan waters)</td>
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<td>Tugores, M. 1997</td>
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RMD was possible to estimate only for some months (those with ≥5 values) due to few otoliths with marginal distance calculated. Although higher RMD values are observed in three months with dominance of opaque edge, conclusive results can not be achieved. AOV and RMD should be recalculated when more information is available.

### Growth pattern

The mean length values of *S. colias* here obtained are in the range of those from previous studies. Vasconcelos (2006) in Madeira islands and the present study show high mean lengths up to age 5. For ages 6–9 years, our growth pattern is very similar to that in northerly waters, also of the Barents Sea (Martins, 2016).

In the present and other Iberian Atlantic studies, few specimens <40 cm were sampled and the mean lengths of ages >7 show values close to 38–40 cm, lengths that seem to show the asymptote of the growth curve in this area. This can be explained by considering that the age classes 5 and 6 poorly represented in the area, that can occur due to the probability that the fish size of *S. colias* increases with depth as in several areas of the species range (Barbeau, 1978; Perello, 1992; Martins, 2012). Since the acoustic surveys do not go beyond the shelf edge (~200 m) and the main fishing (pneumatic nets) is conducted within the 100 m, the large individuals are less available and probably under-sampled. Besides, the larger individuals are expected to swim faster than smaller ones, being therefore less catchable, as demonstrated for mackerel (Stech, 2007).

Other complementary hypothesis is that the Portugal-Cabo waters is a nursery area of a large population operating in Moroccan waters (Martins, 2010). There is evidence of an increasing clupeoid gradient from the Portugal/Cabo area to the Moroccan waters (Martins, 2010).

This is a preliminary study of this species in the area based on samples of a year. Additional information from more years will strengthen the results obtained.

**ACKNOWLEDGEMENTS**

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**REFERENCES**