

Effects of Prestige fuel spill: First attempt to study daily growth and microstructure of four-spot megrim otoliths

by

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Introduction:

Fish otoliths are calcified structures used to estimate the growth of the species and contain valuable information, including the history of environmental and growth conditions of the fish (Stevenson and Campana, 1992). Microstructure changes in fish otoliths can be induced by habitat degradation associated with environmental perturbation, such as the Prestige oil spill in the Galician and Cantabrian Sea shelf. In that region, four-spot megrim (*Lepidorhombus boschii*) is a common flatfish species that inhabits depths ranging from 100 to 450 m, and feeding on muddy bottom crustaceans (Sanchez et al., 1998). While annual growth rates of this species in the area have been studied (Landa et al., 2002), nothing has been reported on its daily growth rate or on the microstructure of its otolith.

Objective:

This study ultimately aims to evaluate differences in growth rates and otolith microstructure of four-spot megrim juveniles (0-age group) before and after the Prestige oil spill which took place in November 2002. Here we report initial results based on: 1) the assumption that growth increments are deposited daily and 2) the comparison of daily growth rates estimated directly and derived from estimates of juvenile annual growth rates. We also report on the methodology developed for the study of the juvenile otolith microstructure.

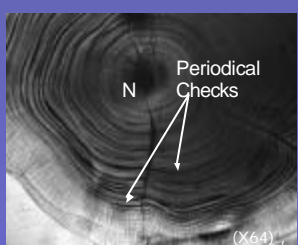


Fig. 3. -SS of left otolith showing the microstructure and the edge overpolished. FL:100 mm

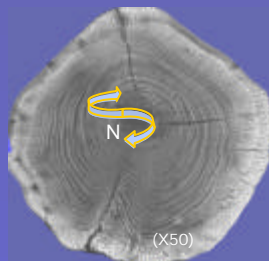


Fig. 1. - Saggita otoliths from four spot megrim

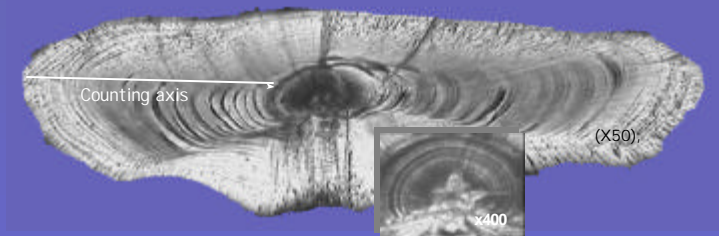


Fig. 2. - TS of right otolith FL:100 mm

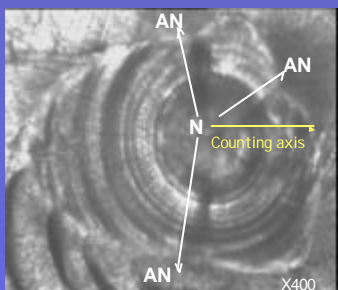


Fig. 4. - Primordium area of SS showing accessory nuclei and the counting axis

Table 1

| SS Primordium | Fish TL (mm) | N. increments | Radius (µm) |
|---------------|--------------|---------------|-------------|
| Mean | 133 | 27 | 41.5 |
| Sdv | 54.3 | 1.91 | 2.2 |
| Cv | 40.7 | 7.2 | 5.3 |
| Range | 100-196 | 25-29 | 39-43 |

Table 2

| TS | Fish TL (mm) | N. increments | Radius (µm) |
|-------|--------------|---------------|-------------|
| Mean | 134 | 177 | 925.9 |
| Sdv | 39 | 53 | 244.4 |
| Cv | 29.2 | 29.9 | 26.4 |
| Range | 103-189 | 127-248 | 668-1264 |

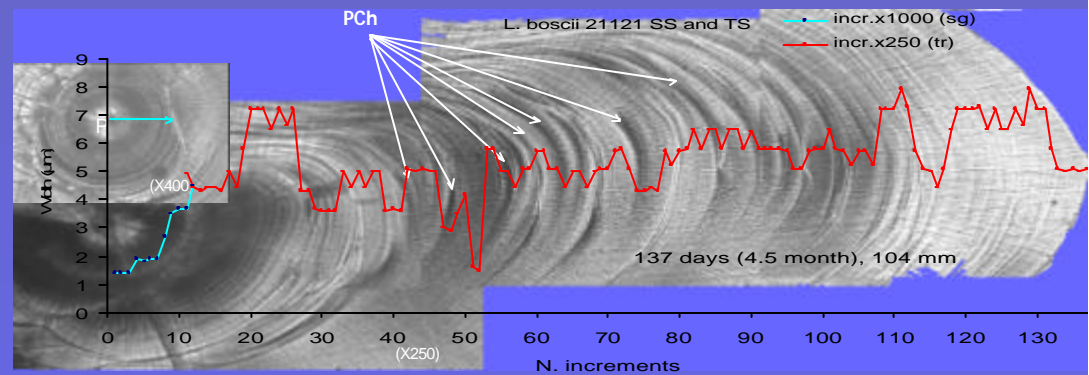


Fig. 5. -Example of a reading interpretation combining: the TS (between the periphery and edge of primordium, in red) and the SS (into the primordium area, in blue)

Material and Methods

A total of 20 pairs of otoliths (sagitta) from fish (<20 cm TL) collected during the IEO spring survey carried out off Galicia in 2003 were examined. Both otoliths were included in polyester resin and polished with a graded series of aluminium oxide. A thin saggital section (SS) was obtained from the left otolith, and a transversal section (TS) from the right one (Fig. 1). The magnification used was from X250 to X1000, the larger for the central area (primordium). The analysis of microstructure on both SS and TS was done following the same axis by using the OTO V3 and Image Analysis System (NOESIS/TNPC).

TS counting was done following the maximal growth axis between the periphery and the well defined edge of primordium (Fig. 2). The SS counting was made into the primordium area along the transversal axis from the center to the boundary of accessory primordium in the ventral face (Fig. 3 and 4). The growth rate was estimated by the slope of the linear function linking TL and the age estimated by daily increment counting from both sections.

Results

Only 9 of the 20 SS and TS could be read due to various problems (e.g., broken section, anatomical plane and over grinding, unclear microstructure). The otolith microstructure is similar to other flatfish with a very regular pattern of daily rings formation with prominent checks at periodical intervals (Fig. 3), linked to lunar cycles and tidally controlled feeding rhythms (Geffen and Nash, 1995).

The SS presents a central region characterized by a nucleus surrounded by a polygonal primordium with accessory nuclei, followed by discontinuous growth (Fig 4), which complicate measurement of increment width. The preparation quality is seldom uniform along any axis due to anatomical plane.

The central region of TS tends to be dark with poorly defined increments; increments are, difficult to interpret in the primordium area (Fig. 5) but afterwards the microstructure shows regularly spaced, clear increments. The fish and otolith sizes, number of increments and total radius recorded are summarised in Tables 1 and 2.

Data from the analysis of SS and TS yielded estimates of growth rates of 0.70 ± 0.036 mm. day⁻¹ (mean±sd, n=9) which are much higher than those derived from earlier annual growth estimates of 0.44 mm day⁻¹ (Landa et al. 2002).

Discussion and Conclusions

- The average growth rate of the juveniles studied in 2003 is higher than that reported in pre-oil spill studies. This result does not support present knowledge of effects of crude oil on fish growth rates and could be due to density dependent effects. Nevertheless, this result should be taken with caution as is based on few samples and comparison of growth rates estimated with different techniques.
- Although the resolution of micro increments needs to be improved, TS show a microstructure easier to interpret than SS, and can be recommended to study daily growth of this species.
- Further work has to be done with the same technique comparing 2003 otoliths with otoliths from previous years in order to confirm if the growth rate of four-spot megrim has been affected by the Prestige oil spill.