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## CHARACTERISATION OF ANTARCTIC FISH OTOLITHS SAGITTAE FROM THE *Notothenia rossii* AND *Notothenia coriiceps* OF ADMIRALTY BAY

Tânia Zaleski, Mariana Forgati, Bruna Aline dos Santos Souza, Flavia Sant'Anna Rios & Lucélia Donatti\*

Laboratório de Biologia Adaptativa – Departamento de Biologia Celular -Universidade Federal do Paraná. R. Cel. Francisco Heráclito dos Santos, 210, Jardim das Américas, Curitiba - PR, 81531-970, Brazil

\*e-mail: [donatti@ufpr.br](mailto:donatti@ufpr.br)

**Abstract:** The aim of this study is to characterize the otoliths sagittae of notothenioid fishes *Notothenia rossii* and *Notothenia coriiceps*, identifying morphological aspects, important for understanding the biology of species and their conservation. The otoliths of both species exhibit oval shaped, toothed margins, being more remarkable in *N. coriiceps*, characteristic of groundfish species associated with rocky or soft substrate. The rostrum and anti-rostrum are very evident. The otoliths of *N. rossii* are larger and heavier than those of *N. coriiceps*. The relationships between the standard length and the total length of the otolith growth indicates allometric positive ( $b < 1$ ) in the two species, as observed for the perimeter to the area of the otoliths and the weight of the fish.

**Keywords:** Otolith Morphology, Notothenioids, Ecology

### Introduction

Otoliths are acellular, calcareous concretions, constituted by calcium carbonate and other inorganic salts. Such structures develop on a protein matrix in the inner ear of vertebrates and teleost fish. Three pairs are to be found: *sagittae*, *asterisci* and *lapilli*. The *sagitta* is the most widely used bone structure for age and growth studies (Gaemers, 1984). These pair of otoliths consists of two concave elliptical bodies, constricted on the sides with its largest axis geared towards the anteroposterior direction of the animal, each *sagitta* is the mirror image of one another (Pannella, 1980). The morphology and morphometry of this pair of otoliths are utilised in the majority of trophic studies as well as in the identification of populations and species (Yefanov & Khorevin, 1979). Thus, the morphological description of otoliths' both macro and microstructure have been carried out in many Antarctic fishes (Radtke & Kellermann, 1991, Ruzicka & Radtke, 1995, Avallone *et al.* 2003).

In this study, *sagittae* otoliths of *Notothenia rossii* and *Notothenia coriiceps*, both species of the family

Nototheniidae, have had their morphology described and associated with ecomorphological aspects.

### Materials and Methods

Samples of *Notothenia rossii* and *N. coriiceps* were caught with hook and line in the Admiralty Bay, King George Island, South Shetlands Archipelago, Commandant Ferraz Antarctic Station (EACF) (61°S and 63°30'S and 53°55'W and 62°50'W),

After capture, fishes were measured in their total length (TL) and standard length (SL), weighed and sex determined. Both right and left *sagittae* otoliths were removed, washed with distilled water and conserved in plastic tubes. Their shape, contour, form and position of the acoustic sulcus were available. The *sagittae* otoliths were measured in their total length (TLO), width (WO), perimeter (PeO) and area (HO) through the programme Image J. The comparisons between species and between the right and left otoliths were carried out using the test *T* de Student ( $p < 0.05$ ).



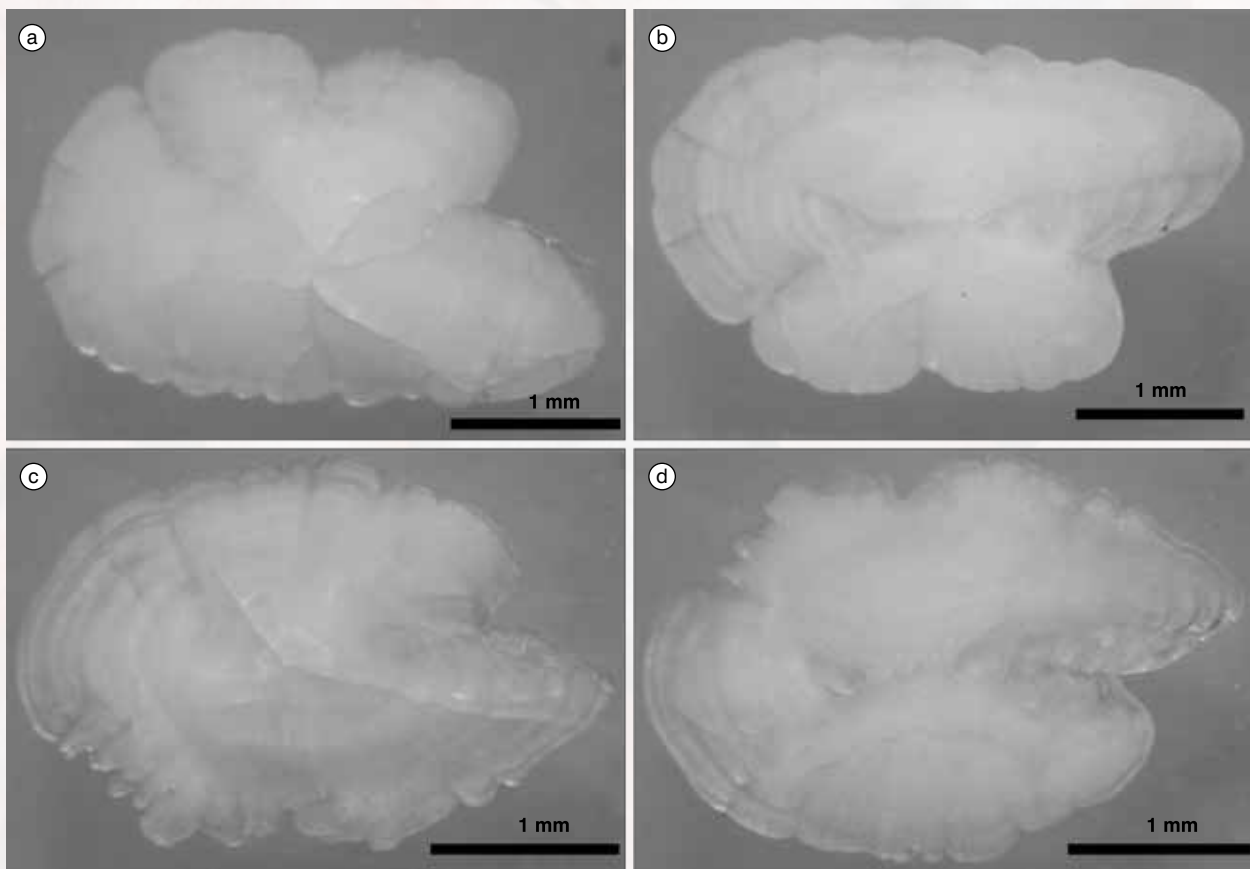
## Results

In the study period, 160 otoliths from *Notothenia rossii* were extracted, with average length of 29.61 (20.5 – 35.5 cm) and average weight of (100 – 585 g), and 146 otoliths from *N. coriiceps* with average length of 36.6 (22.5 - 47.0 cm) and average weight of 718 (150 – 1580 g). For *N. rossii*, the growth of the right and left otoliths showed no significant difference ( $p=0.07$ ), as well as for *N. coriiceps* ( $p=0.19$ ). Thus, the right otolith of both same was utilised in the following procedures of analysis and was substituted by the left when necessary.

The otoliths of the two species showed oval shape, the length greater than the height. The upper profile is slightly convex and is more marked in *N. rossii*. The dorsal margin in *N. rossii* shows gentle irregularities, whereas such irregularities are more remarkable in *N. coriiceps*, with a

quite jagged margin. The anterior margin is defined by the presence of the rostrum, which is more pointed in *N. coriiceps* and more rounded in *N. rossii*, which shows a more developed anterostrum. The acoustic sulcus in both analysed same is rectilinear regarding their orientation, different regarding their structure, being divided by the colo in the ostium and the tail. The ostium is opened in the anterior margin of the otolith in low relief, being the most concave portion of the acoustic sulcus (Figure 1).

The otoliths of the species *N. coriiceps* are bigger ( $p<0.001$ ) and heavier ( $p<0.001$ ) than those of the *N. rossii*. The ratio between the standard and total length of the otolith indicate a positive allometric growth ( $b<1$ ) in the two species, as well as ratios between standard length and the area of the otolith, which are represented by the equation  $HO=1.5TL+1.41$ ;  $r^2=0.32$  in the *N. coriiceps*; and  $HO=1.5TL+0.25$ ;  $r^2=0.43$  in the *N. rossii*.



**Figure 1.** Sagittae otoliths (orientation posterior-anterior) of *N. rossii* (A and B) and *N. coriiceps* (C and D). A and C, dorsal view, B and D, ventral view.



## Discussion

The otoliths with an oval-rounded shape observed in *N. rossii* and *N. coriiceps* are characteristic of species with benthic habits (Volpedo & Echeverría, 2003). The development of the rostrum may be associated with the type of substrate and the habitat of the organism. In the Admiralty Bay, the substrate is characterised by a complex topography and geomorphology (Siciński *et al.*, 2011). It has a diverse coastal line, which provides for a vast variety of habitats, justifying the rostrum more pointed in *N. coriiceps* and more rounded in *N. rossii* observed in this work.

The absence of morphological descriptions of *sagittae* from the studied species makes it impossible to establish a comparison with populations from other regions. The diversity of shapes in the otoliths is firstly related to balance and orientation and secondly to hearing (Popper *et al.*, 2005). Genetic and environmental factors, especially those concerning temperature, act in the formation of the otoliths' shape (Campana, 2005). In order to determine the age from the rigid structure in teleosts, a yearly deposition of the calcified tissues were generally used (Schulz-Mirbach *et al.*, 2011). However, the absence of a distinct periodicity of the hydrographical conditions in Antarctic waters difficult the determining of the age from the reading of disposition rings (Schulz-Mirbach *et al.*, 2011). Thus, techniques, which combine chemical and structural analysis of otoliths

in Antarctic fishes will not only be able to generate more precise data on the influence of environmental parameters on the growth and status of the population, but also information on the hydrography and the nutritional state of the species.

## Conclusion

Otoliths of *N. rossii* and *N. coriiceps* show an oval-rounded shape characteristic of fishes with benthic habits. The moderately developed rostrum is related to a variable substratum, which ranges from being soft to being rocky. The ratios of the fish's length and the area of the otolith indicate a positive allometric growth.

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- The background of the page features a close-up photograph of several pink salmon. The fish are arranged in a way that shows their bodies and heads. In the foreground, several otoliths (ear stones) are visible, which are small, dark, and somewhat translucent structures. The otoliths are being held or displayed, likely for scientific study. The overall color palette is dominated by the pinkish-orange of the salmon and the dark grey/black of the otoliths.
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