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SC 12 - JM 09

Terms of Reference age jack mackerel workshop

Chile



Proposal of terms of reference for the Jack mackerel (*Trachurus murphyi*) otolith reading workshop between SPRFMO ageing laboratories.

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Abstract

The SC requested to validate the jack mackerel (*Trachurus murphyi*) otolith reading protocols in order to improve the age estimation. In this context, Chile carried 3 research projects. The first project validated the “annual rings” through microstructure analysis; following of strong modal classes; and bomb radiocarbon, and found a fast growth rate during the first 2 years of life. The second project validated the daily periodicity of microincrements and confirmed the fast growth rates during the first 2 years of life. Third project validated the second annulus through microincrements readings, elaborated a reference collection to train new readers, a new protocol for otolith preparation and reading, and the adjustment of the historical jack mackerel otolith readings database to the validated new criterion for age estimation. Considering that the age and growth laboratories interested in doing jack mackerel readings should share their experience and research, a ToR is proposed with the aim to present the jack mackerel (*Trachurus murphyi*) otolith readings criteria used by the age and growth laboratories from the SPRFMO member countries. The objectives are 1) To discuss otolith reading criteria and annuli interpretation; 2) To carry out remote reading exercises based in otolith digital images from IFOP’s jack mackerel otolith reference collection, 3) To carry out a in person otolith reading exercise, and 4) To define a jack mackerel otolith readings quality control plan between the age and growth laboratories from the SPRFMO member countries.

Introduction

The South Pacific Regional Fisheries Management Organization (SPRFMO) requested to validate the jack mackerel (*Trachurus murphyi*) otolith reading protocols in order to improve the age estimation. In this context, Chile carried 3 research projects. The first project was FIPA 2014-32 “Protocolo de lectura de jurel”, which validated the “annual rings” or “*annuli*” through microstructure analysis, the following of strong modal classes and bomb radiocarbon, and estimated a fast growth rate during the first 2 years of life, slowing down from the third year of life. Subsequently, the project FIPA 2017-61 “Validación de la formación de los anillos de crecimiento diario de jurel” that validated the daily periodicity of microincrements and confirmed the fast growth rates during the first 2 years of life. Finally, the project FIPA 2021-21 “Actualización de información asociada a edad y crecimiento de jurel (*Trachurus murphyi*), en el context de la OROP-PS” that had as result the validation of the second *annulus* through microincrements readings, the elaboration of a reference collection to train



new readers, a new protocol for otolith preparation and reading, and the adjustment of the historical jack mackerel otolith readings database to the validated new criterion for age estimation.

The evidence compiled by these projects indicates that the jack mackerel's age was being overestimated by 2 years, due to the semestral periodicity of the first rings, previously accounted as *annuli* (Cerna et al. 2022). Because of this reason, within the framework of the project FIPA 2021-21 the workshop "Calibración de lectura de *annuli* en otolitos sagittae del jurel (*Trachurus murphyi*)" with the objective of analyze and discuss the reading criteria of the *annuli* in juvenile and adult specimens, and the workshop "Chilean jack mackerel ageing protocol, homologation of the new ageing criteria" whose objective was to analyze and discuss *annuli* reading criteria of jack mackerel adults. These workshops had as result an improvement in reading precision and a decrease in bias between readers from different Chilean institutions.

The jack mackerel stock assessment is supported by the historical catch's age structure series provided by Chile, which is the only country that has maintained jack mackerel age estimations uninterrupted since 1975. Currently, the age-length keys provided by Chile are used by the European Union to expand their own catch by age. An important improvement in the data used in the stock assessment would be the incorporation of age-length keys from each fishing fleet, in order to have catch's age structures that accurately characterize each fishing zone. In this context, it is necessary that the age and growth laboratories interested in doing jack mackerel readings share their experience and research. Once each country develops their own readings data, the age precision analysis must be permanent, through periodic reading quality controls between laboratories, following a similar formula as ICES, which carries out reading workshops for 3 *Trachurus* species every 3 years, discussing the methodologies and ageing criteria in order to improve the ageing protocols (ICES 2023).

Objective

To present the jack mackerel (*Trachurus murphyi*) otolith readings criteria used by the age and growth laboratories from the SPRFMO member countries.

Specific objectives

To discuss otolith reading criteria and *annuli* interpretation.

To carry out remote reading exercises based in otolith digital images from IFOP's jack mackerel otolith reference collection.

To carry out a in person otolith reading exercise.

To define a jack mackerel otolith readings quality control plan between the age and growth laboratories from the SPRFMO member countries.



Methodology

Stage I

1.1 First, an in-person meeting to present in detail the methodologies for jack mackerel age estimation used by the age and growth laboratories and to carry out a in situ otolith reading exercise.

1.2 The reading exercise will be based in the analysis of whole sagittal otoliths and their respective transversal section cuts, from IFOP's reference collection, with help from an expert age and growth researcher. Participants will be provided an Excel sheet where they must input:

- a) Number of *annuli* counted
- b) *Annuli* radii
- c) Edge type (H = Hyaline, O = Opaque)
- d) Assigned age
- e) Image quality (VG = very good, G = good, R = regular, B = bad)
- f) A copy image with the *annuli* interpretation (i.e. Otolith image marking the *annuli*)

We propose to work on 50 otolith set (50 whole otoliths and 50 transversal sections) divided in 10 length groups from 12 cm to 60 cm fork length (FL). The radii measurements will be compared through a one-way ANOVA (p : 0.05) and Tukey post-hoc test (p : 0.05). Readings precision will be analyzed through Coefficient of Variation (CV) calculation (eq.1) and Average Percentage Error (APE) calculation (eq. 2) (Campana 2001). Bias will be assessed by an Evans-Hoening symmetry test (eq. 3) because is the most appropriate symmetry test in species where precision is particularly low (McBride 2015). Bland-Altman with a Generalized Lineal Model graphic will be made using the FSA package for R by Ogle 2015, to visualize the bias between readers and account which ages are more complicated.

$$(1) CV = 100\% \times \frac{\sqrt{\frac{\sum_{i=1}^R (X_{ij}-X_j)^2}{R-1}}}{X_j}$$

$$(2) APE = 100\% \times \frac{1}{R} \sum_{i=1}^R \frac{|X_{ij}-X_j|}{X_j}$$

Where X_{ij} is the i th age estimation of the j th fish, X_j is the average age estimated for the j th fish and R is the number of age estimations.

$$(3) X^2 = \sum_{p=1}^{m-1} \frac{\left(\sum_{j=1}^{m-p} (n_{p+j,j} - n_{j,p+j}) \right)^2}{\sum_{j=1}^{m-p} (n_{p+j,j} + n_{j,p+j})}$$

Where m is the maximum estimated age, n_{ij} is the observed frequency in the i th row and the j th column, and n_{ji} is the observed frequency in the j th row and i th column and $p = j - i$.



1.3 The results from this exercise should be discuss the last day of the in person meeting. In this meeting will be also important to identify difficulties and challenges in the interpretation of *annuli* and propose new studies that would help to overcome these challenges.

Stage II

An online meeting will be held after the in-person workshop to evaluate the age estimation precision between the age and growth laboratories from the SPRFMO member countries that could not participate in the in-person exercise. A first online meeting will be held to discuss the results from the in-person workshop and to coordinate an online reading exercise following a similar methodology to the one proposed in the Stage I, but this time otoliths' digital images will be read. A second online meeting will be held to discuss the results from the online reading exercise.

Activity calendar

	September	October	November	December	January 2025
TTR Presentation	X				
In person workshop			X		
Online Meeting I				X	
Online otolith reading exercise				X	X
Online meeting II					X

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