

Age estimation of sardine (*Sardina pilchardus*) and round sardinella (*Sardinella aurita*) in Northwest Africa

Estimation de l'âge de la sardine (*Sardina pilchardus*) et de la sardinelle ronde (*Sardinella aurita*) en Afrique du nord-ouest

(English only/En anglais seulement)

M. Sylla, A. Wagué, A. El Youssoufi, A. Mendy, A. Diagne, K. Amenzoui, F. Darboe, M.T.G. Santamaria, N. Timoshenko, C. Morgado, A.M. Caramelo and M. Tandstad*

*FAO, Viale delle Terme di Caracalla, 00153 Rome, Italy
merete.tandstad@fao.org

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ABSTRACT

Several initiatives including otolith exchanges and workshops have been undertaken in Northwest Africa in recent years to address problems and discrepancies in the age determination of sardine (*Sardina pilchardus*) and round sardinella (*Sardinella aurita*). The main objective of these initiatives was to standardize sardinella and sardine age reading methodologies in the region through the establishment of age reading criteria and a common understanding on the interpretation of these criteria. Different research institutes (Morocco, Mauritania, The Gambia, Senegal, Spain and Russia) and the Food and Agriculture Organization of the United Nations (FAO) were involved.

In the exchanges several otolith collections were circulated among readers. The otolith collections covered the whole year and a large length range. The results were then combined and analysed applying the method developed by Eltink *et al.* (2001). During the workshops several otoliths from the exchange sets were analysed by all readers to have consensual age estimation. After the individual readings, the otolith was projected on a screen and readers were asked to explain their own age interpretation and the criteria applied. Subsequently, all the rules used for sardine and sardinella age estimation were discussed and common criteria were agreed.

The results of the last workshop held in December 2006 show that for *Sardina pilchardus* the majority of readers show no bias between them, indicating an improvement in age reading precision. The total percentage of agreement was 54.3 percent with a coefficient of variance (CV) of 34.2 percent. Furthermore, the majority of the readers showed an improvement in the sardinella (*Sardinella aurita*) age interpretation. In spite of this improvement, less experienced readers still tended to overestimate younger ages and underestimate ages older than 2 years. Less experienced readers show a tendency to consider as the first *annulus* a false ring that appears before the first *annulus*.

Keywords: Age reading, otoliths, *Sardina pilchardus*, *Sardinella aurita*, Northwest Africa

RÉSUMÉ

Différentes initiatives (ateliers et échanges d'otolithes) ont été entreprises en Afrique du nord-ouest ces dernières années pour aborder certains problèmes et divergences dans la détermination de l'âge chez la sardine (*Sardina pilchardus*) et la sardinelle ronde (*Sardinella aurita*). L'objectif principal de ces initiatives était d'uniformiser la méthodologie de la lecture de l'âge de la sardine et de la sardinelle dans la région et d'établir une interprétation commune des critères actuels de lecture de l'âge. Différents instituts scientifiques (du Maroc, de Mauritanie, de Gambie, du Sénégal, d'Espagne et de la Russie) et l'Organisation des Nations Unies pour l'alimentation et l'agriculture (FAO) y ont participé.

Pendant les échanges, plusieurs collections d'otolithes ont circulé entre les lecteurs. Les collections d'otolithes couvraient toute l'année et un large intervalle de classes de longueur. Les résultats des lectures d'âge ont été combinés et analysés en utilisant des méthodes développées par Eltink *et al.* (2000). Pendant l'atelier plusieurs otolithes ont été analysés par tous les lecteurs de façon à obtenir une estimation consensuelle de l'âge. Après les lectures individuelles, l'image des otolithes était projetée sur un écran et il a été demandé aux lecteurs d'expliquer leurs interprétations personnelles de l'âge et les critères appliqués. Par la suite, toutes les règles adoptées pour la détermination de l'âge de la sardine et de la sardinelle ont été débattues et des critères communs ont été établis.

Les résultats du dernier atelier de décembre 2006 montrent que la majorité des lecteurs ayant participé à l'atelier présentent un bon accord sur la lecture d'âge de *Sardina pilchardus*. Le pourcentage total d'accord était de 54,3 pour cent avec un coefficient de variation (CV) de 34,2 pour cent. La majorité des lecteurs impliqués dans l'atelier présente un progrès dans la lecture d'âge de la sardinelle (*Sardinella aurita*). Malgré ce progrès, les lecteurs moins expérimentés tendent à surestimer les jeunes individus et à sous-estimer les âges supérieurs à 2 ans. Ils ont également tendance à considérer le premier *annulus* comme un faux anneau apparu avant le premier *annulus*.

Mots clés: Lecture d'âge, otolithes, *Sardinella aurita*, *Sardina pilchardus*, Afrique du nord-ouest

1. INTRODUCTION

The FAO Working Group for the Assessment of Small Pelagic Fish off Northwest Africa (FAO, 2002) noted inconsistencies in the catch-at-age matrices for sardine, sardinella and horse mackerel, and it was decided that the data were too unreliable to use them in an age-structured model. These inconsistencies may be due to problems in age determination of the fish. In order to increase the reliability of assessments it was recommended that emphasis should be placed on the study of age and growth in the various species in order to obtain better data for age structured models.

Different types of information structured by ages are very important for many analytical stock assessment models. Knowing the age of fishes allows us to better understand the dynamics of fish stocks and how fish populations react to exploitation and environmental stresses, and thus can be used to analyse the effect of changes in relative exploitation patterns on the stocks and enables us to provide more precise management advice to the fisheries managers.

Fish ageing is exposed to subjectivity of the different readers and requires experience as well as knowledge and application of established procedures to ensure coherent results. To assess the age it is necessary to analyse otoliths-calcified structures related with fish equilibrium that are present in the fish head. The examination of otoliths shows different concentric structures, but only some are growth annual rings. Fish ageing is exposed to subjectivity of the different readers and requires experience as well as knowledge and application of established procedures to ensure coherent results.

Errors in age determination could have an adverse effect on the quality of the stock assessment and the scientific advice based on that assessment. Any reduction in uncertainty affecting fish-stock assessments increases the quality of scientific advice and the confidence with which policy decisions can be taken.

The main objective of these initiatives was to standardize the Northwest African sardinella and sardine age reading methodologies through the establishment of age reading criteria and a common understanding on the interpretation of these criteria.

2. MATERIAL AND METHODS

Several initiatives including otolith exchanges, workshops and onboard training have been organized at various locations (Kaliningrad, Tenerife, Dakar, Casablanca, onboard the R/V DR. FRIDTJOF NANSEN) aiming to standardize the Northwest African sardinella and sardine age reading methodologies through the establishment of age reading criteria and a common understanding of the interpretation of these criteria. Figure 1 shows the area of work.

Scientists from research institutes in Morocco, Mauritania, The Gambia, Senegal, Spain, the Russian Federation and Norway as well as FAO were involved. with their own material. More than 1 000 otoliths of *Sardinella aurita*, *Sardinella maderensis* and *Sardina pilchardus* from different countries were analysed. The otolith collections covered the whole year and a large length range in different training courses/workshops organized at various locations (Kaliningrad, Tenerife, Dakar, Casablanca, onboard the R/V DR. FRIDTJOF NANSEN).

In the exchanges several otolith collections were circulated among readers. The results were then combined and analysed applying the method developed by Eltink *et al.* (2000). This analysis is based on a reference age when there are no validated ages available, which is the case for sardinella and sardine in Northwest Africa. As reference age the modal age was chosen according to the experience level of the participants. Each reader's results were compared with the reference age – the best approach available in the absence of knowledge of the true age.

During the workshops several otoliths from the exchange sets were analysed by all readers to have consensual age estimation. After the individual readings, the otolith was projected on a screen and readers were asked to explain their own age interpretation and the criteria applied. Subsequently, all the rules used for sardine and sardinella age estimation were discussed and common criteria were agreed to.

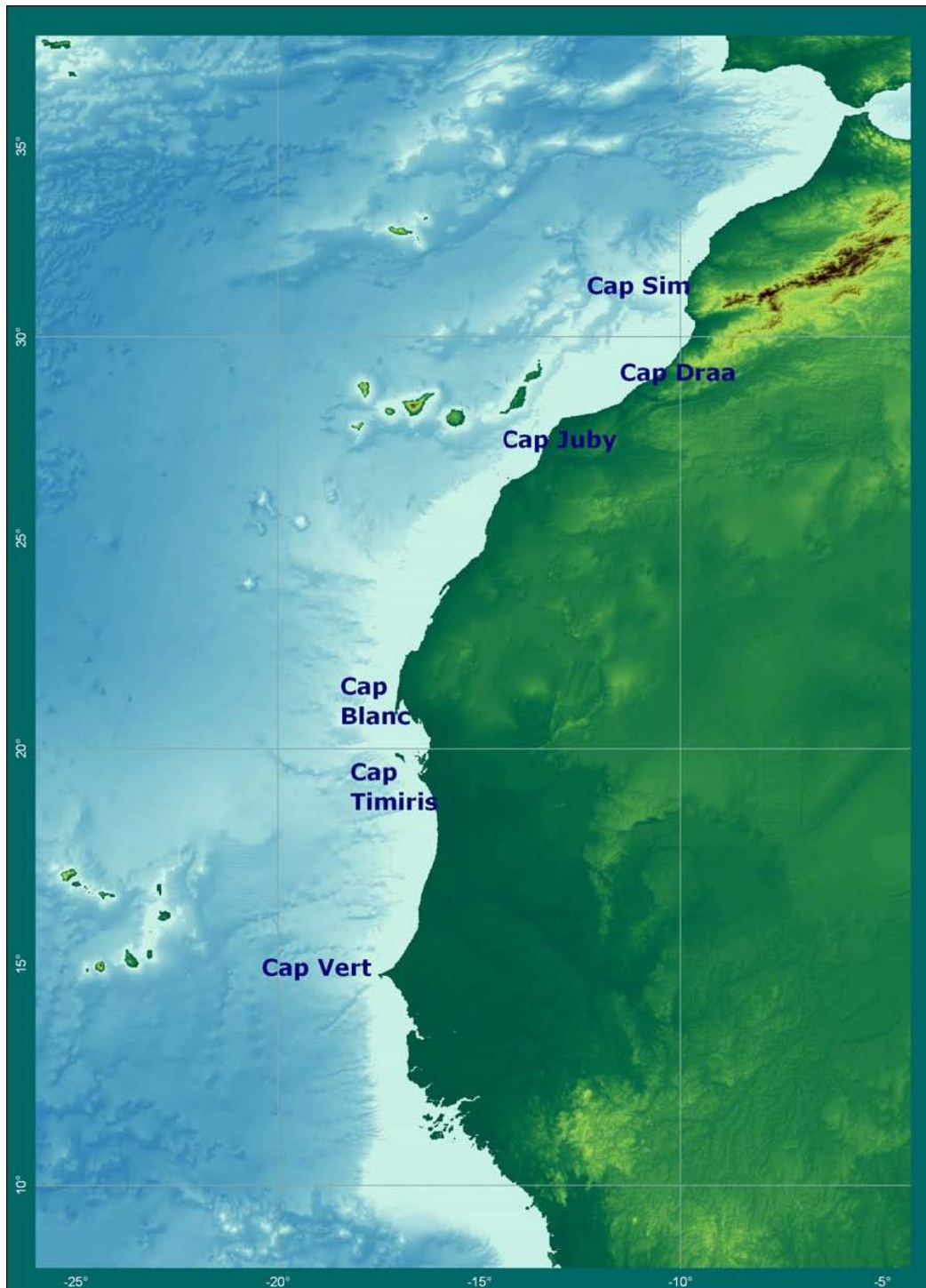


Figure 1: The Northwest African area covered by the age readings workshops

3. RESULTS AND DISCUSSION

The results of the last 2006 reading workshop held in Casablanca showed that the total percentage of agreement was 54.3 percent with a coefficient of variance (CV) of 34.2 percent for sardine and 51.7 percent with a coefficient of variance (CV) 59 percent for sardinella. In general terms, readers' biases were Figures 1, 2, 3, 4.

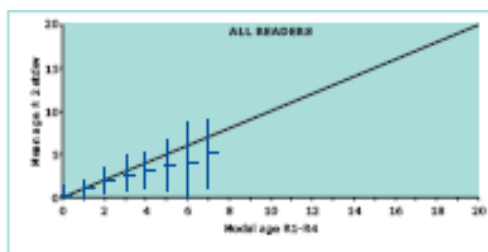


Figure 1 Age bias plots of Sardine AtlantNIRO Collection

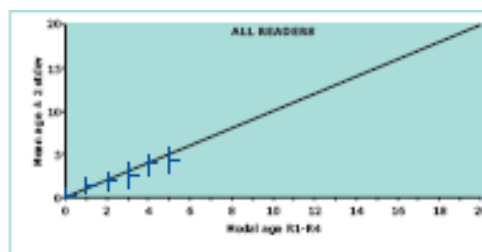


Figure 2 Age bias plots of Sardinella AtlantNIRO Collection

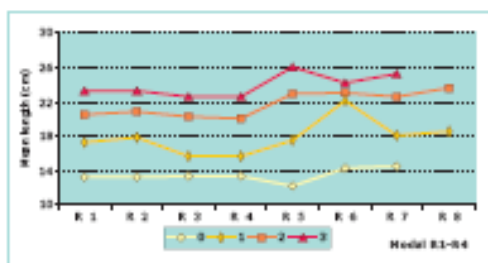


Figure 3 Mean length at age of Sardine AtlantNIRO Collection

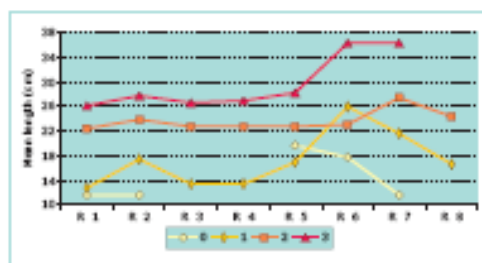


Figure 4 Mean length at age of Sardinella AtlantNIRO Collection

The majority of the readers showed an improvement in the sardinella age interpretation. In spite of this improvement, less experienced readers still tended to overestimate younger ages and underestimate ages older than 2 years. The first ring measurement is a very useful tool to assess the correct first ring identification. Less experienced readers show a tendency to consider as the first annulus a false ring that appears before. The first annulus has a radius smaller than 20 unities and should not be considered in the ageing process. The plenary discussion with otoliths images undertaken before the workshop readings was very useful, allowing readers to better understand the age reading interpretation.

4. CONCLUSIONS AND RECOMMENDATIONS

The majority of the readers involved in the age reading activities in 2006 showed:

- a good agreement in sardine age reading;
- lower bias between readers, indicating an improvement in age reading precision of sardine;
- an improvement in the sardinella age interpretation. Less experienced readers tended to overestimate younger ages and underestimate ages older than 2 years.

Less experienced readers show a tendency to consider as the first annulus a false ring that appears before the true annual ring. This false ring has a radius smaller than 20 unities and should not be considered in the ageing process.

Age estimation requires continuous effort by the people involved. Although improvements have been observed among the various readers in the region, some discrepancies still exist and it is therefore recommended to continue with otolith exchanges and workshops at regular intervals to monitor the application of the agreed criteria.

Furthermore it is recommended that a monthly sampling programme with at least ten individuals from each length class should be carried out every year. Sampling should include small and larger individuals. Biological information (total length, weight, sex, maturity stage, etc.) should be collected for each individual. Biological sampling should also be carried out onboard the research surveys.

A guideline has been developed for the age estimation of sardine and sardinella to provide the readers with a common methodology (FAO, 2007).

5. ACKNOWLEDGEMENTS

All colleagues that have participated in the various activities and thus contributed to the preparation of the guidelines are greatly acknowledged. Thanks are due to Emanuela D'Antoni and Fabio Carocci (FAO-FIMF) who assisted with the preparation of this poster.

6. REFERENCES

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