Preliminary results on age validation in European anchovy (*Engraulis encrasicolus)* in Gulf of Cádiz (ICES 9a South)

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WKARA3
Workshop on Age reading of European anchovy (*Engraulis encrasicolus*).
On line: 23-25 November 2021

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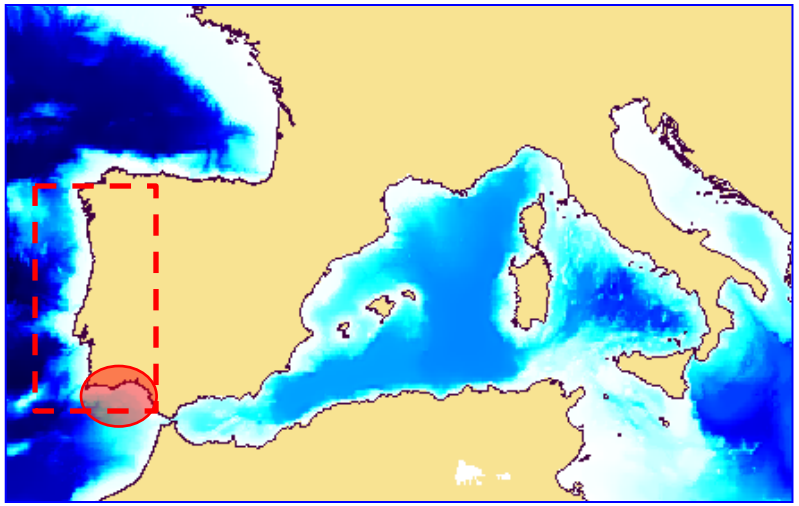
Background

The Spanish waters of the Gulf of Cadiz (GoC, ICES Subdivision 9a South) is one of the core areas of the distribution of anchovy in the Division 9a.

The spawning season extends from late winter to early autumn with a **peak spawning** time occurring from **June to August**.

GoC anchovy shows a protracted spawning season which could cause that anchovies from different **spawning batches** (say Spring, Summer and Autumn-born) could show **different growth** patterns.



For this reason it is necessary to carry out **growth validation studies**. The validation of the annual deposition of seasonal zones and the checks in the otolith represent the focal point to improve the precision in the anchovy age determination.

Previus works attempting to validate annuli of anchovy in the GoC apply the qualitative method (Millán and Tornero, 2009; Tornero, 2016). But more validation age studies should be carried out for all anchovy stocks, and especially for those ones, such as this stock, which are **assessed analytically**.

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Objectives

✓**Validate** the periodicity of the **otolith increment** formation in European anchovy through :

- Otolith marginal increment analysis (**MIA**)
- Otolith edge seasonal growth pattern (**EA**) **IN PROCESS**

✓**Evaluate** the temporal **link** between the **reproductive cycle** and the **somatic conditions** with the **otolith edge** formation and the **patterns of monthly** increments.

- Reproductive and body condition cycle (**GSI** and **FC**)

Material&Methods

Sampling. A total of 6359 *E. encrasicolus* from the Gulf of Cádiz(ICES SubDiv. 9.aS) were analyzed. The total length, total weight, gutted weight, gonad weight and the otoliths were monthly collected from landings between 2015-16, from scientific acoustic **surveys** "ECOCADIZ" during **July-August** and "ECOCADIZ-RECLUTAS" during **October.**

Age estimation. Otoliths were aged following standardized criteria (WKARA 2009, WKARA2 2016) A total of 3038 age-group 1 individuals were selected for this study.

Age corroboration studies. The following analyses were performed to determine the seasonality in the annuli formation:

- Marginal increment analysis (**MIA**): was analyzed by calculating the total radius minus the radius of the last complete hyaline zone in a ramdom selection of ten one-year-old fishes per month
- Nature of the edge (**EA**): the percentage of hyaline (H) and opaque (O) edge was estimated by month.

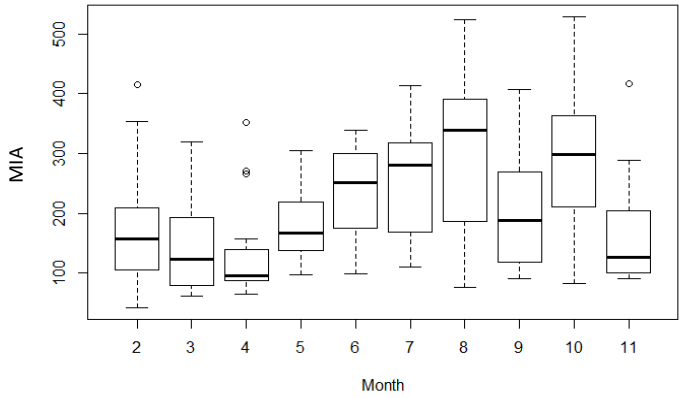
Reproductive cycle and somatic condition. The gonadosomatic index (GSI, only for females) and the condition factor (CF) for the age group 1 were computed.

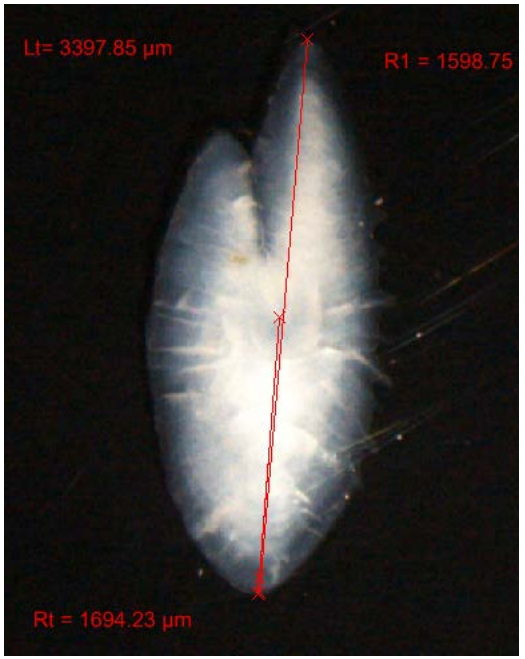
Month	1	2	3	4	5	6	7	8	9	10	11	12
Commercial		199	393	295	299	397	285	103	58		13	
ECOCADIZ							174	402				
ECOCADIZ-R										420		

*Lack/scarcity of samples in November to January due to purse-seine fishery closed season

Results

Otolith marginal increment analysis (MIA)





Analysis of the MIA variability through the year revealed that the **minimum marginal width**, which is associated to the beginning of the new annulus formation, was recorded in **April**.

In **August** the highest value is reached and a decrease is observed in the following months

} MIA

Results

Otolith edge seasonal growth pattern (EA)

IN PROCESS

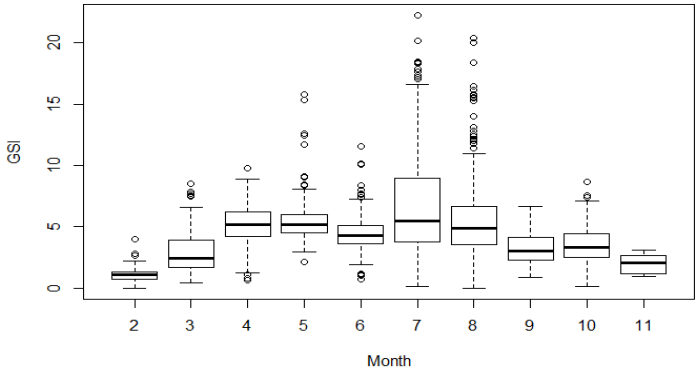
A preliminary analysis of the nature of the edge was done, but given the complexity of its determination in the otoliths of this area, a new classification needs to be done to properly address this issue (Uriarte et al. 2016, Basilone et al. 2020).

As these authors indicate, the nature of the edge must be reclassified as opaque (O), semihyaline (OH) or hyaline (H).

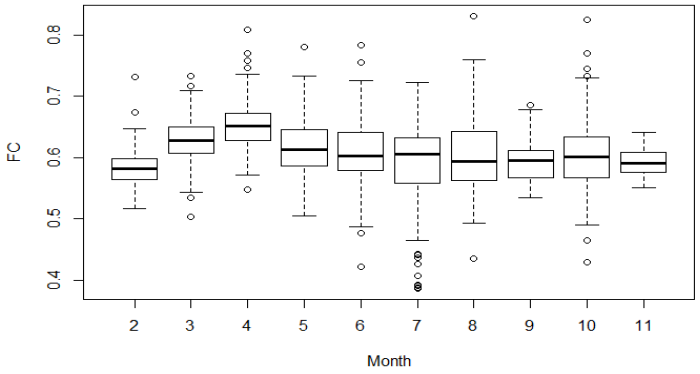
The criterion used to differentiate OH and H is the presence of the same edge around the whole otolith otherwise the OH is to be considered as opaque and thus merged with O.

Results

Reproductive cycle and somatic condition.



The boxplot of monthly **GSI** from age-1 group fish for 2015-2016, showed that the reproductive season extends mainly from April to August, with a **spawning peak** in **July**, with the index decreasing later and recording the lowest values in autumn and winter



The **CF** monthly pattern obtained for the age- group 1 fish showed a **maximum** in **April**, decreasing progressively in the following months and showing the lowest values in winter, as in GSI.

Conclusion

Our otolith study for the two analysed years shows that **the annulus formation** resulted mostly complete for this species in the Gulf of Cádiz by **April**.

A noticeable minimal marginal increments on otoliths occurred only once per these years, the annulus was accepted as valid indicator of age, supporting the consistency in the age estimation criteria.

The GSI show a **spawning peak** in July, according to the spawning season.

Uriarte et al. (2016) showed for the **Bay of Biscay** anchovy, similarities to that of the Atlantic waters studied here. For age 1, growth resumes usually during March. The **spawning peak** in the Bay of Biscay occurs between **May and June.**

The results obtained here evidenced **temporally coherent patterns**.

FUTURE WORK

✓**Otolith marginal increment analysis (MIA) and Otolith edge seasonal growth pattern (EA)**

- Analyze the data **separately** by years.

✓**Otolith edge seasonal growth pattern (EA)**

- **Reclassify** the nature of the edge and analyze the otolith edge seasonal growth pattern

✓**Evaluate the presence of significant effects on otolith structure of month, GSI and CF**

- Generalized Additive Models (**GAM**). General additive models using marginal increments as dependent variable could show the effect of the month, highlighting the presence of minima, as well as specific relationships with condition factor and gonadosomatic index.