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Otolith microchemistry approach to determine connectivity of anchovy populations (*Engraulis encrasicolus*) along the Atlantic Coast of Iberian Peninsula

C. Hernández*, B. Villamor*, P. Carrera*, I. Riveiro*, F. Ramos*,
S. Pérez-Mayol **, M. Pérez* B. Morales-Nin**, A. Silva***,
J. Tornero*, C. Dueñas*, E. Soares***

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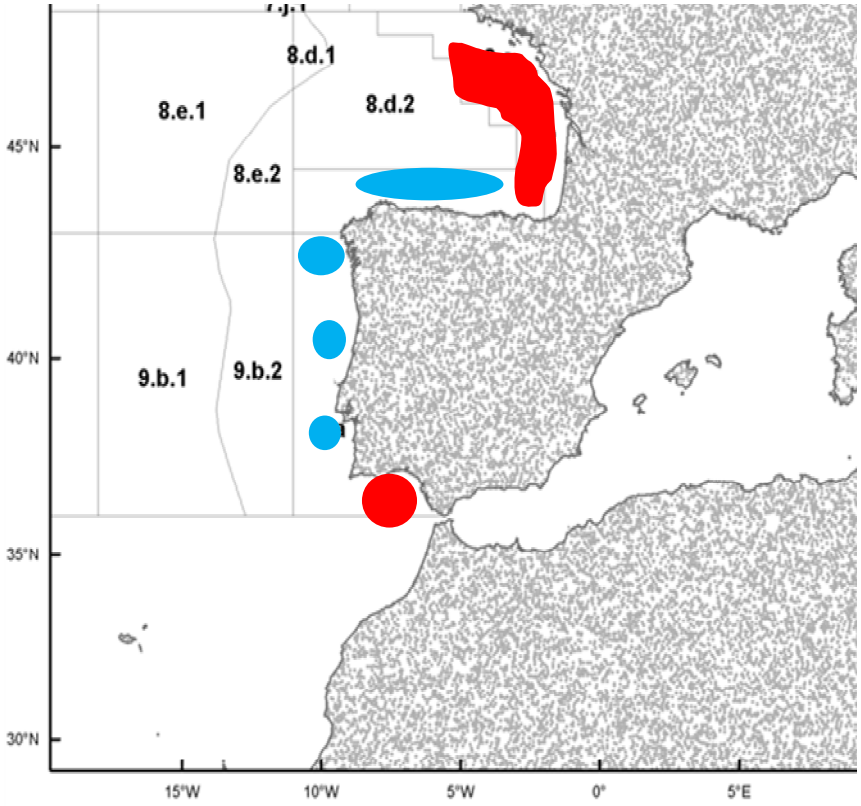
Background

In the **Atlantic Iberian Peninsula** the European Anchovy populations **:**

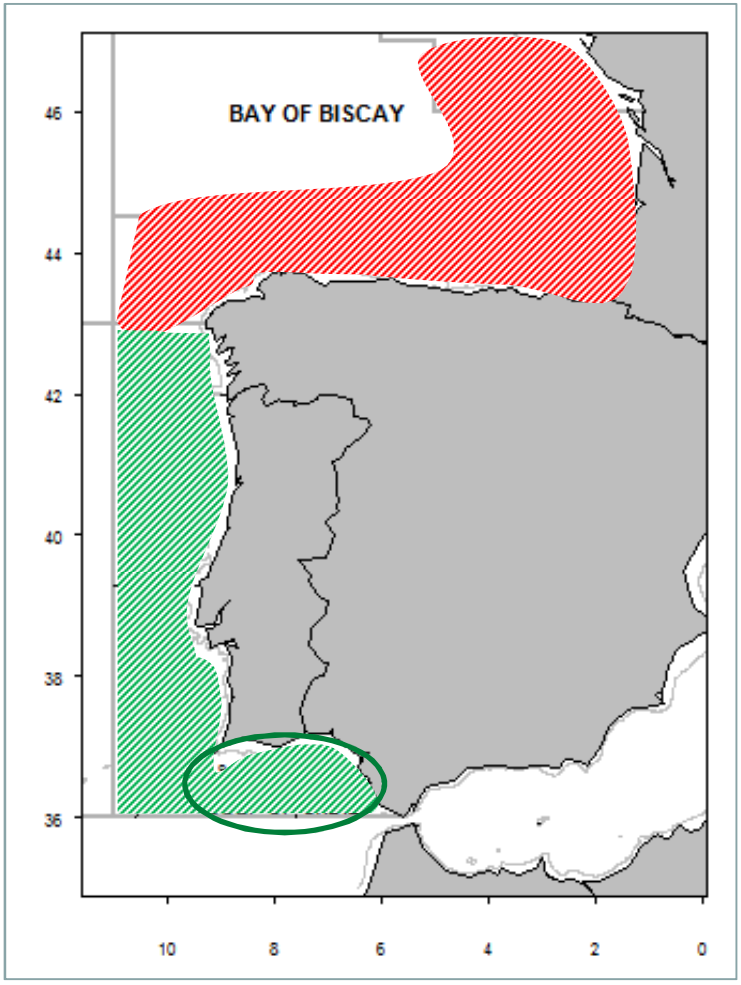
- Main population and current fisheries
- Residual populations with sporadic fisheries



Background

For **management purposes**, the European anchovy present in the **Atlantic Iberian Peninsula** is separated in **two stock** units distributed in :

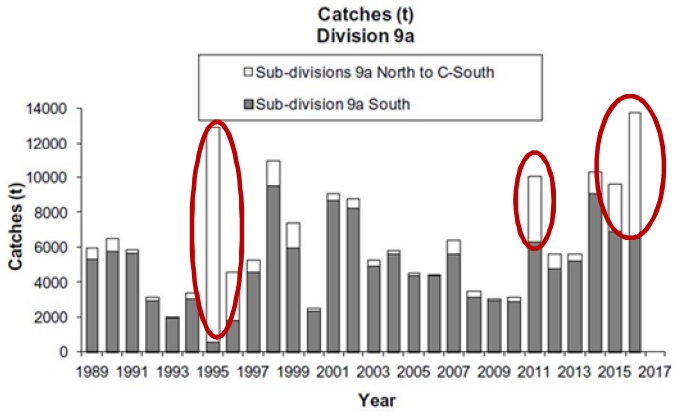
- **Bay of Biscay (ICES Subarea 8)**
- **Portuguese** and **Spanish** waters of the **Southern Galicia** and the **Gulf of Cádiz (ICES Division 9.a)**



The advice of **ICES Working Group (WGHANSA) on the assessment of Division 9.a** stock is based on the information coming from **Subdivision 9.a South** (Algarve and Cádiz areas) because it is the only **persistent population** in the area.

Background

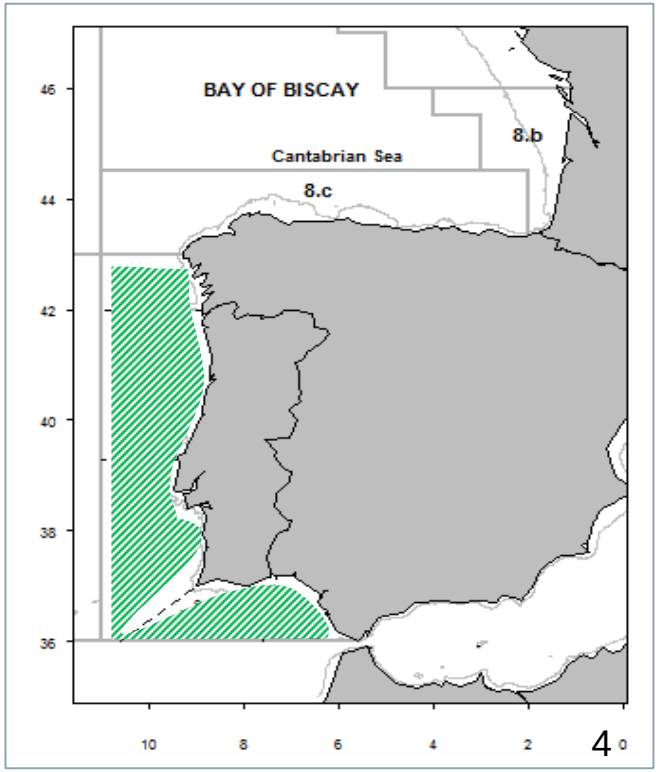
A phenomenon of **sporadic increases** in the availability of anchovy in northern part of the ICES Division 9.a is observed in the last years.



Trends showed by both population demonstrate the **independent dynamics** of the anchovy in the **northern part of the 9.a** from the dynamics of the population **in 9.a south** (ICES, 2017; Ramos, 2015), these are:

- **Differences** between **length distributions**, **mean length-** and **mean weight at age**, and **maturity-length ogives.**

Is also a **population** with a **complex structure** which has produced **conflicting** results in **genetic** studies.

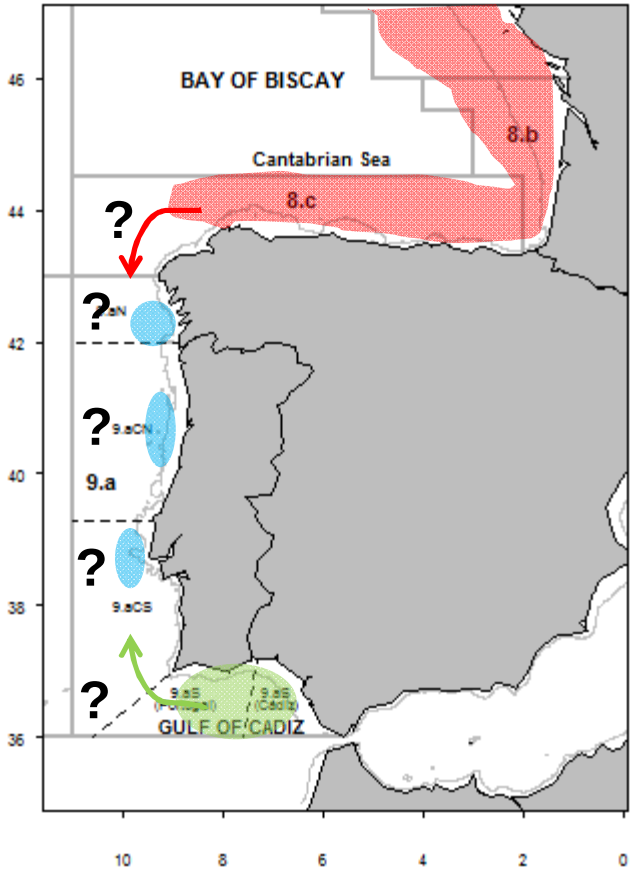


Objetives

The **specific objective** of this work was to identify homogeneity/heterogeneity in the natal origin of this individuals belonging to single or multiple stocks.

The approach of this was to determine which of the following **hypotheses** were correct:

1. The increase in this anchovy availability is due to an exceptional **increase of local residual populations**, unrelated to the established management units.
2. The increase in availability is a consequence of the **increase in banks from one of the established populations** (ICES Division 9.a or Subarea 8).

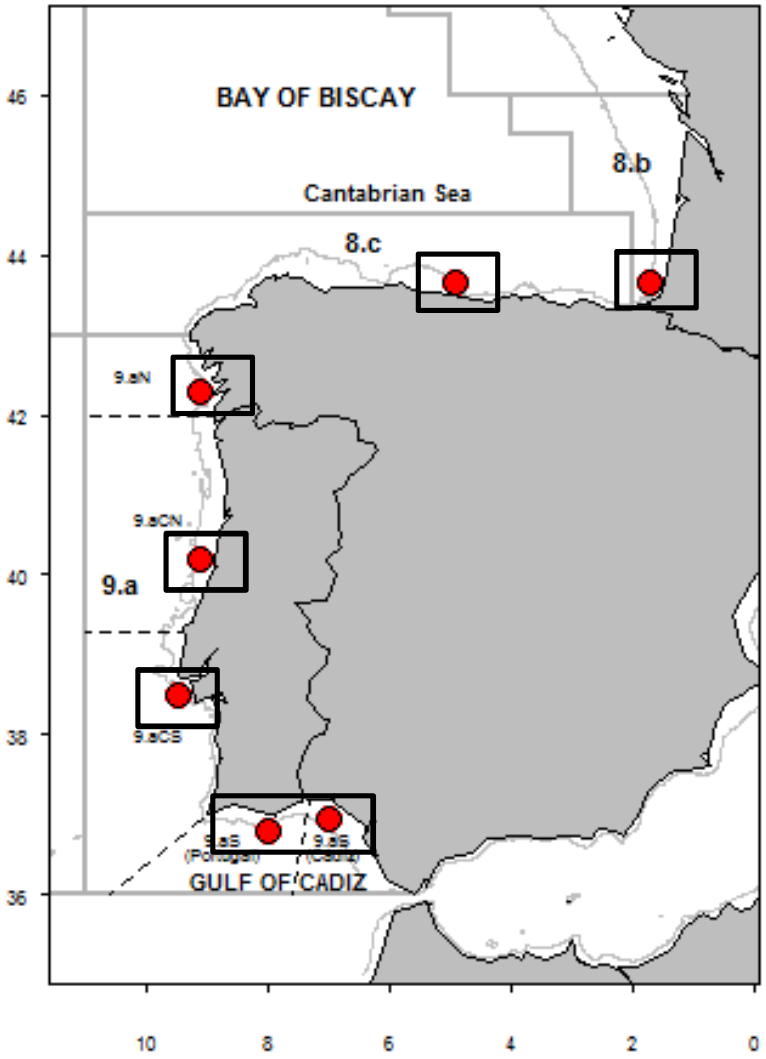


This work was carried out through **otolith microchemical analysis**

Material & Methods

Otolith collection :

IEO Spring and Summer Acoustic Surveys (PELACUS & ECOCADIZ)
IPMA Spring Acoustic Survey (PELAGO)
year 2015



Sampling	Collection	ICES SubDiv.	Lt (cm) Mean	Lt (cm) SD	N Total	N Age1	N Age2
PELACUS survey & Commercial Fleet	Bay of Biscay	8.b	14.3	0.7	54	24	30
PELACUS survey & Commercial Fleet	Cantabrian Sea	8.c	14.7	1.2	60	30	30
Commercial Fleet	Galician Waters	9.aN	14.0	1.2	59	29	30
PELAGO survey	Portugal Waters	9.aCN	15.5	0.5	22	4	18
		9.aCS	9.3	0.6	18	18	-
		9.aS	13.5	0.6	20	9	11
ECOCADIZ survey	Gulf of Cadiz	9.aS	13.7	2.1	37	30	7
Total					270	144	126

Otolith **Age determination** by expert readers of **IEO**

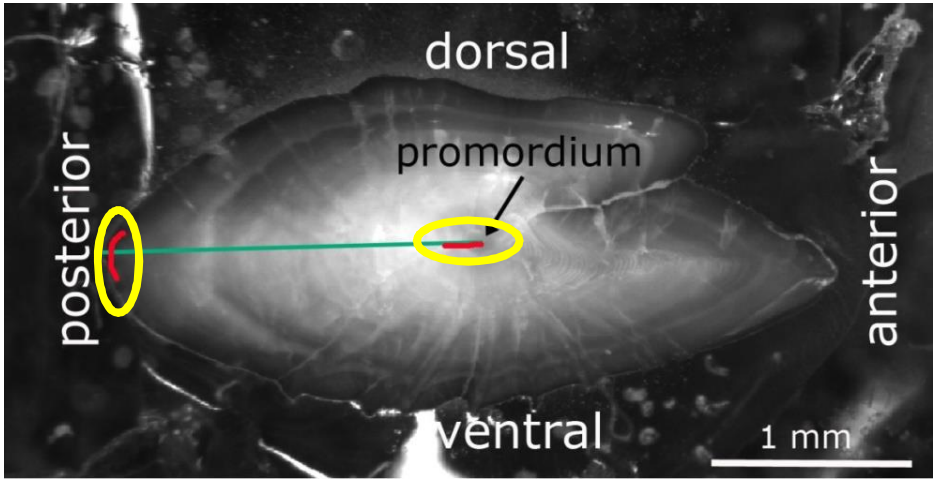
Material & Methods

Prepared by the Sclerochronology Service at **IMEDEA** (CSIC-UIB) in Mallorca (Spain)

- Sagittal plane
- Ground and polished following clean methods
- Sampling in core and postrostrum edge

Analysed by LA-ICPMS at the Plasma-Mass Unit in **University of A Coruña (Spain)**

- Scan lines at core and edge 145µm length, 30µm diameter.
- 5 CRMs used (NIST612, NIST614, NIST616, FEBS-1 and NIES-22)
- ^{7}Li, ^{23}Na, ^{24}Mg, ^{39}K, ^{43}Ca ^{44}Ca, ^{55}Mn, ^{88}Sr and ^{138}Ba



Material & Methods

Analysed data by the Sclerochronology Service at **IMEDEA** (CSIC-UIB) in Mallorca (Spain)

- ^{43}Ca used as Internal Standard
- Data reduction from cps to concentrations following **IMEDEA** protocols based on bayesian analyses (Perez-Mayol et al., 2018, poster PC-014 IOS2018 for details)

Statistical analysis of microchemistry results **by IEO**

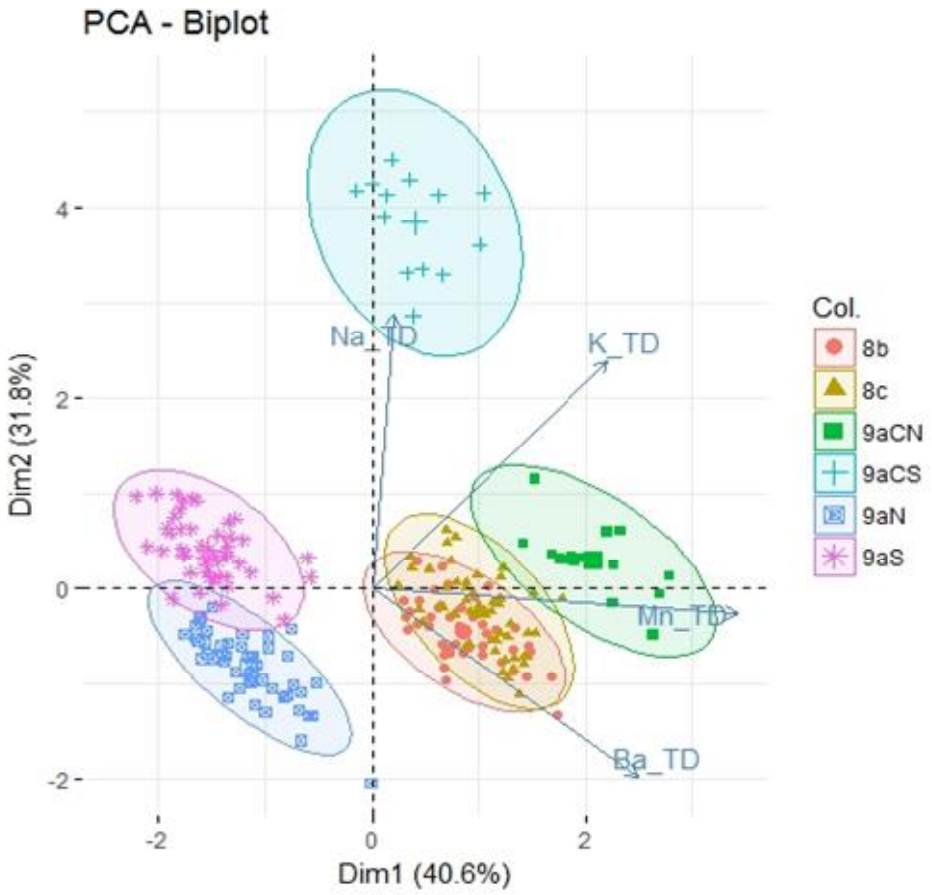
- Univariate (ANOVA) and multivariate (MANOVA) tests
- PCAs and Cluster analysis

RESULTS

Otolith edge elemental composition

Å Na, K, Mn and Ba significantly different among sampling locations.

->Different environmental conditions.



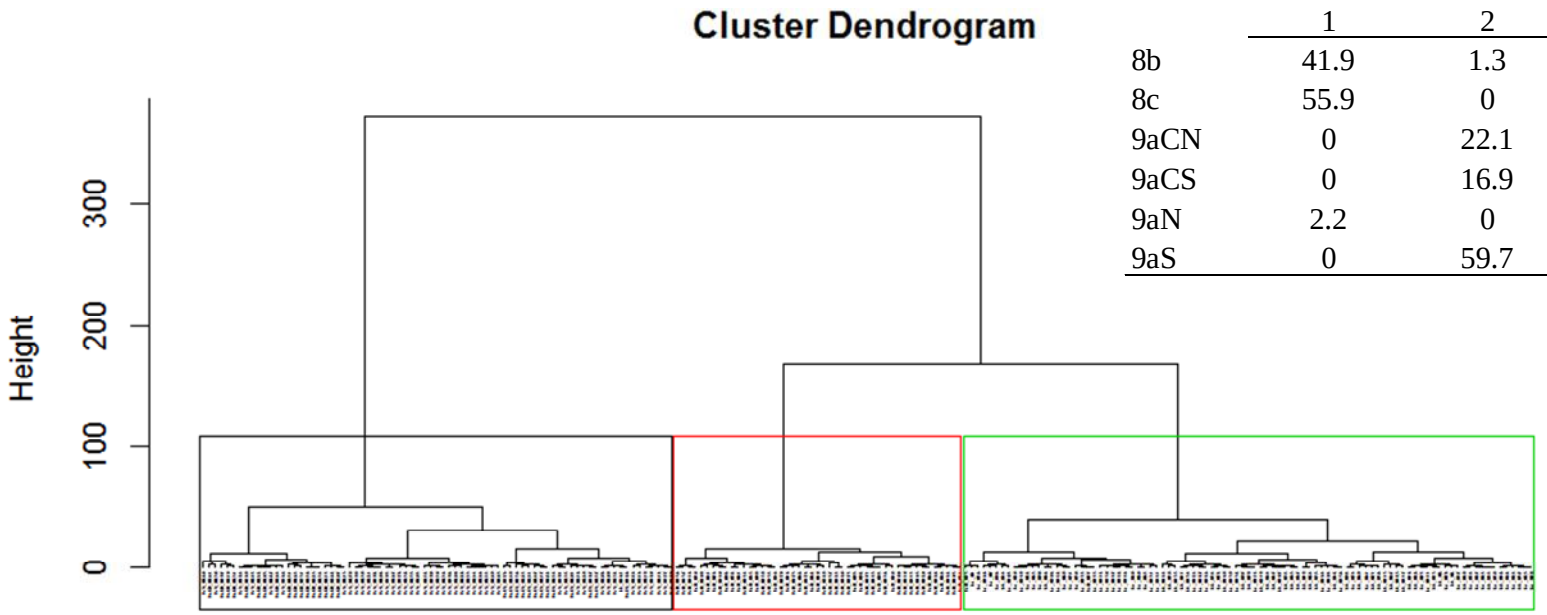
Ordination biplot of PCA of trace element concentrations in otolith edges. The variables Na, K, Mn, Ba are displayed as arrows.

RESULTS

Otolith core elemental composition

Na, Mn and Sr significantly different among sampling locations.

->Fish caught at different locations are born in different places.



	1	2	3
8b	41.9	1.3	0
8c	55.9	0	0
9aCN	0	22.1	0
9aCS	0	16.9	0
9aN	2.2	0	100
9aS	0	59.7	0

Wardsô independent agglomerative hierarchical clustering (Euclidean distances).

CONCLUSIONS

- LA-ICPMS analyses of trace element concentrations in otolith as a tool to elucidate natal origins and population movements of European anchovy along of the Atlantic waters of the Iberian Peninsula:

  ->On otolith edge (i.e. adult life of fish), univariate and multivariate analyses allows main adult distribution areas be distinguished.

  ->On otolith core (i.e. juvenile and larval life stages), cluster analysis allows recruitment areas be discriminated.

- Patterns of core microchemistry in 9aN would indicate a local increase rather than the expansion of any well established population (i.e. 9aS or Bay of Biscay)

- Stock boundaries and dynamics should be updated accordingly

Thanks for your attention