Small Pelagic Fish:
New Frontiers in Science and Sustainable Management
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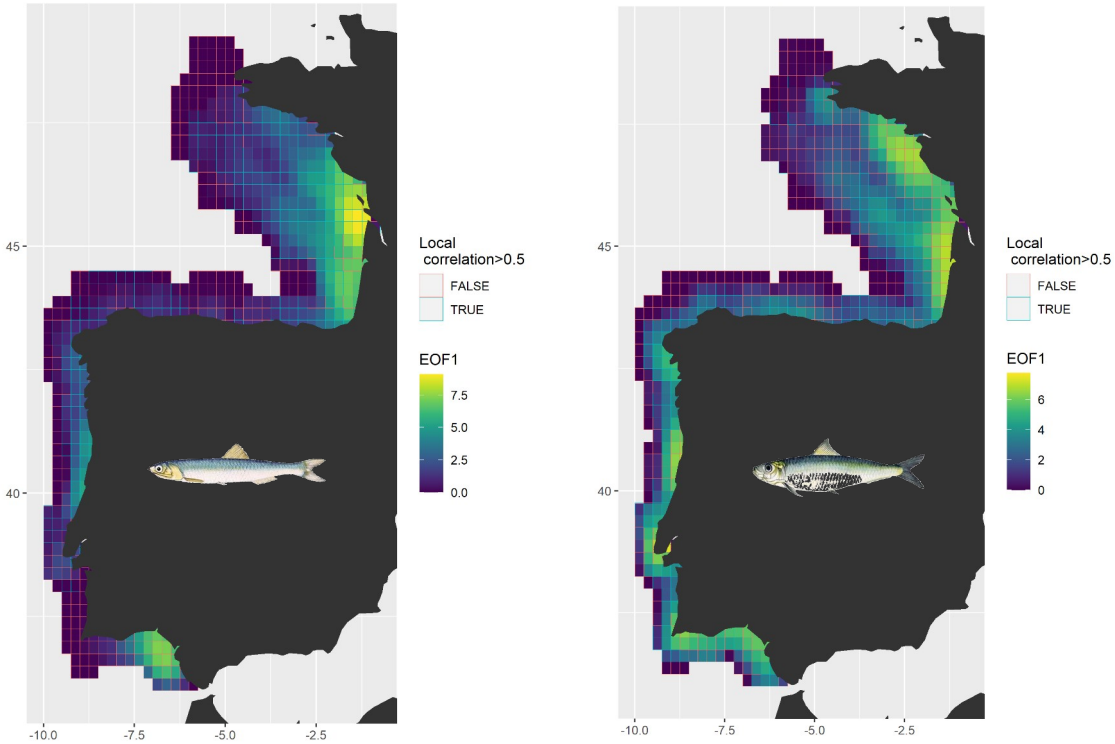
Anchovy and sardine springtime habitats in the European Atlantic area



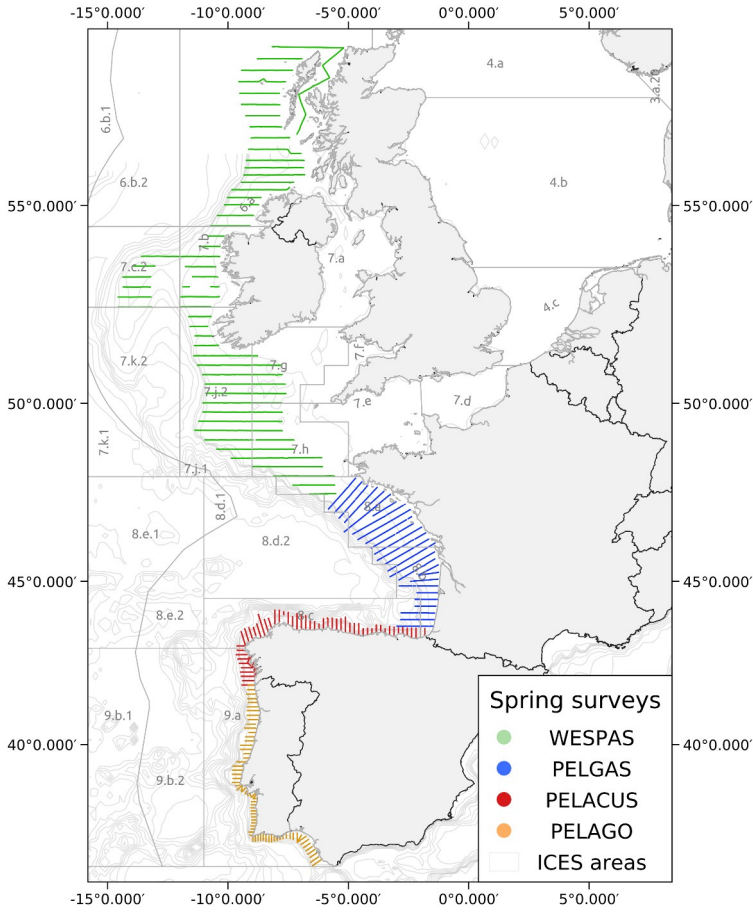
Mathieu Doray[1], Pablo Carrera, Pedro Amorim, Anna Moreno, Erwan Duhamel, Guillermo Boyra, Ciaran O'Donnell, Maria Santos, Jeroen Van Der Kooij, Maria Manuel Angelico, Cristina Nunes, Silvia Rodriguez-Climent, Fabio Campanella, Fernando Ramos, Paz Diaz, Paz Jimenez, Pierre Petitgas, Martin Huret

[1] DECOD, IFREMER, INRAE, Institut Agro, Nantes, France

Introduction

- SPF acoustic and egg surveys in European Atlantic area (EA) coordinated by ICES ACEGG working group since early 2000s
  - Standard methodology, spatial grid
  - Gridded maps database, 2003-present, spring/summer/automn
    - Acoustic density (NASC) and egg counts
    - In-situ surf. salinity and temperature

- Anchovy and sardine realised habitats in the European Atlantic area in springtime?
- Influence of environmental and populational / fishing covariates ?

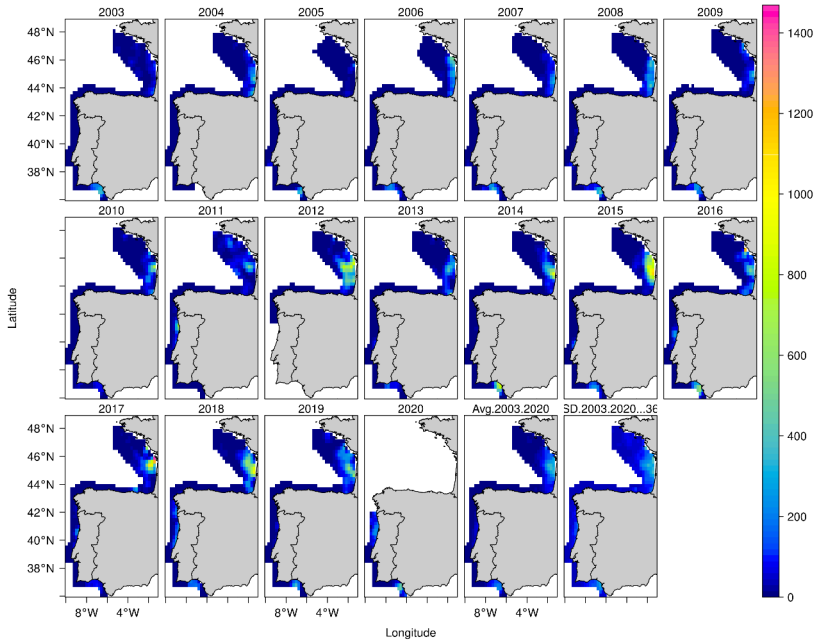


Massé, J., Uriarte, A., Angelico, M.M., Carrera, P., 2018. Pelagic survey series for sardine and anchovy in ICES subareas 8 and 9 (WGACEGG) – Towards an ecosystem approach. ICES Coop. Res. Rep. 332.

Doray, M., Van Der Kooij, J., Boyra, G. (Eds.), 2021. ICES Survey Protocols - Manual for acoustic surveys coordinated under the ICES Working Group on Acoustic and Egg Surveys for Small Pelagic Fish (WGACEGG). https://doi.org/10.17895/ICES.PUB.7462

Material and Methods

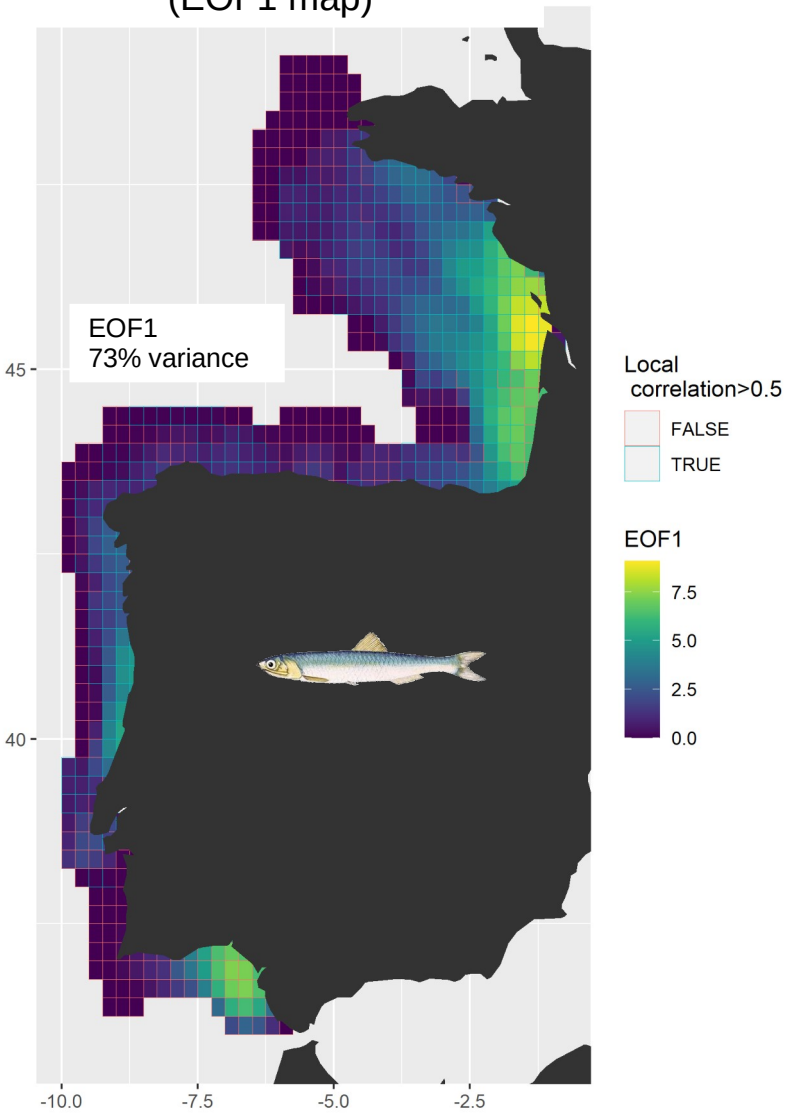
- Gridmaps (30km res.) from WGACEGG joint spring acoustic surveys
  - Adult anchovy and sardine acoustic densities (NASC)
  - Surface temperature and salinity + satellite Chl-a



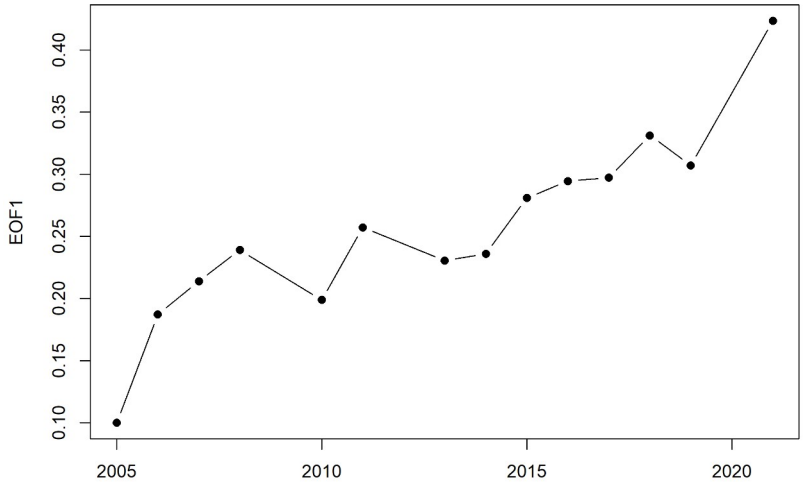
- Empirical Orthogonal Functions (EOF) on fish maps
  - main spatial patterns and time-varying amplitudes
  - EOF clustering : anchovy and sardine co-occurence
- Fish EOF ~ environment + stock assessment
  - Anchovy and sardine habitats and populationnal / fishing impacts in the European Atlantic area

Anchovy NASC space-time pattern 1

Main spatial pattern
(EOF1 map)



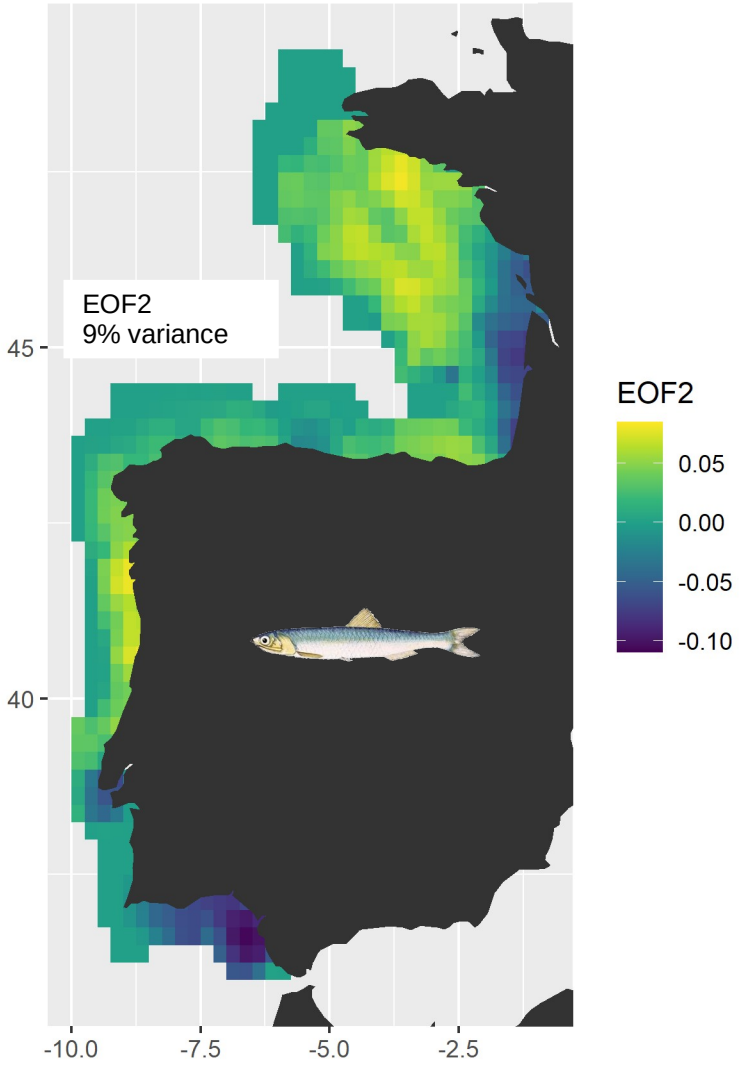
Time trend
(EOF1 amplitudes)



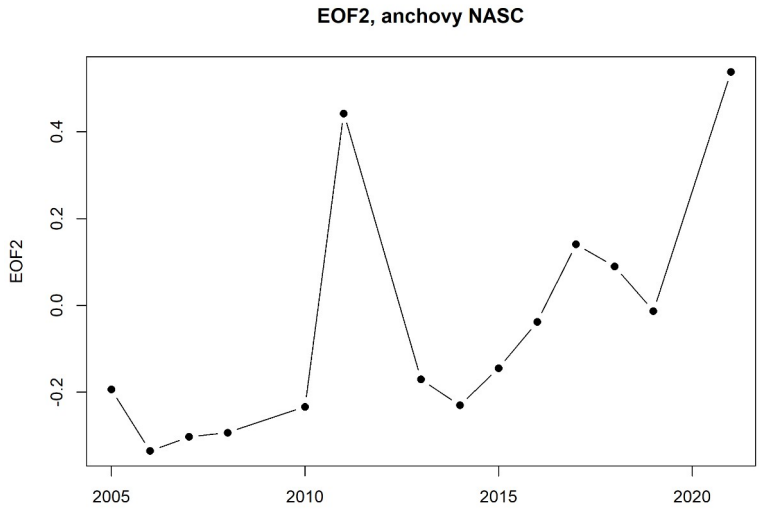
- **Mean spatial patterns**
  - Anchovy <u>core distribution areas</u>
  - N-S positive temperature and salinity gradient
  - Lower salinity and higher Chl-a in river plumes
- **Time trends**
  - No correlation with environmental covariates
  - <u>Positive correlation with anchovy SSB</u>

Anchovy NASC space-time pattern 2

Main spatial pattern
(EOF2 map)



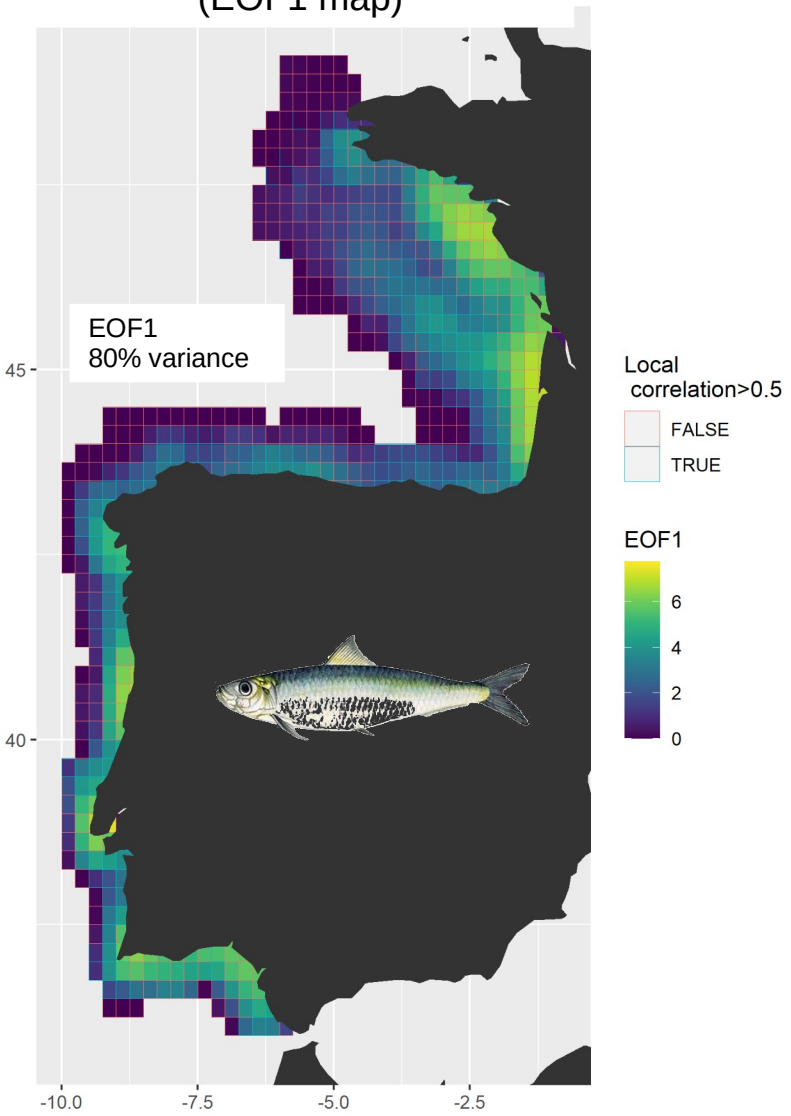
Time trend
(EOF2 amplitudes)



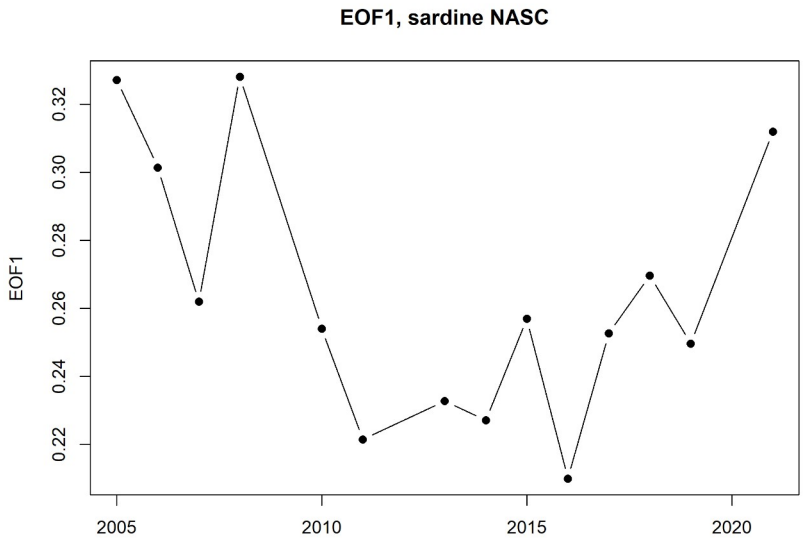
- **Mean spatial patterns**
  - <u>"New" habitats</u>
    - NW expansion in BoB
    - Return in Cantabrian, increase in NW Iberia
- **Time trends**
  - No correlation with environmental covariates
  - <u>Positive correlation with anchovy SSB</u> in BoB and Iberian waters

Sardine NASC space-time pattern 1

Main spatial pattern
(EOF1 map)



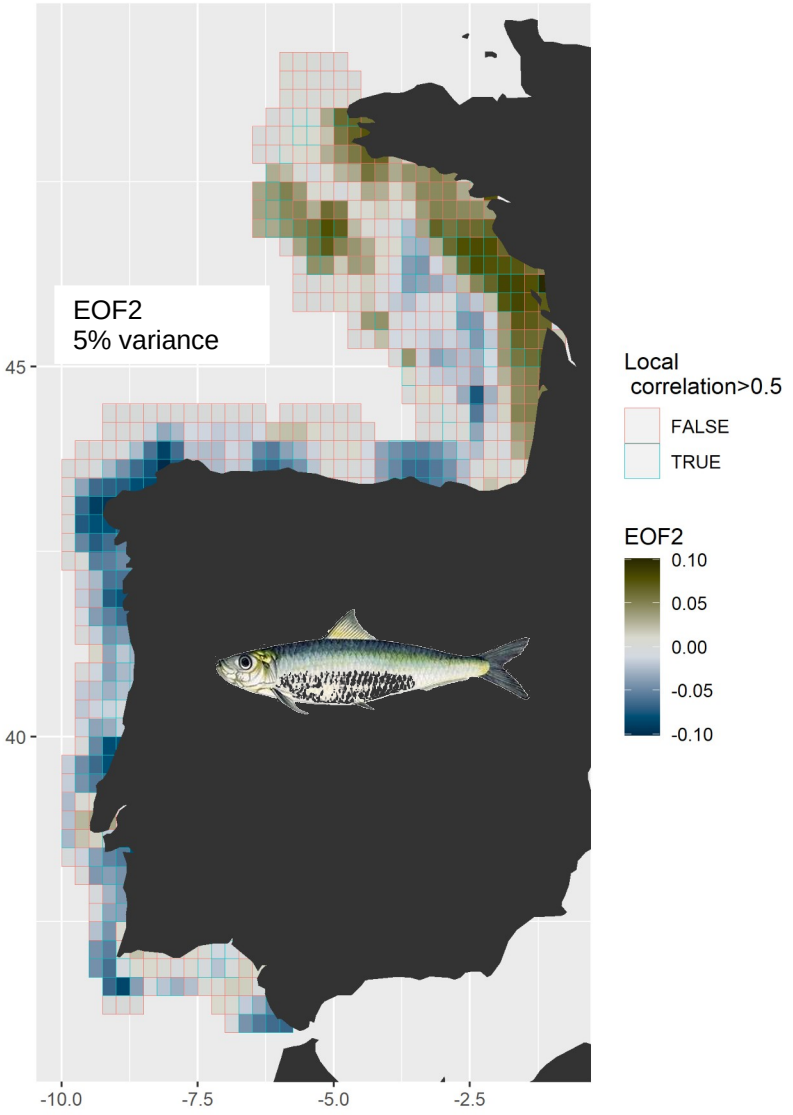
Time trend
(EOF1 amplitudes)



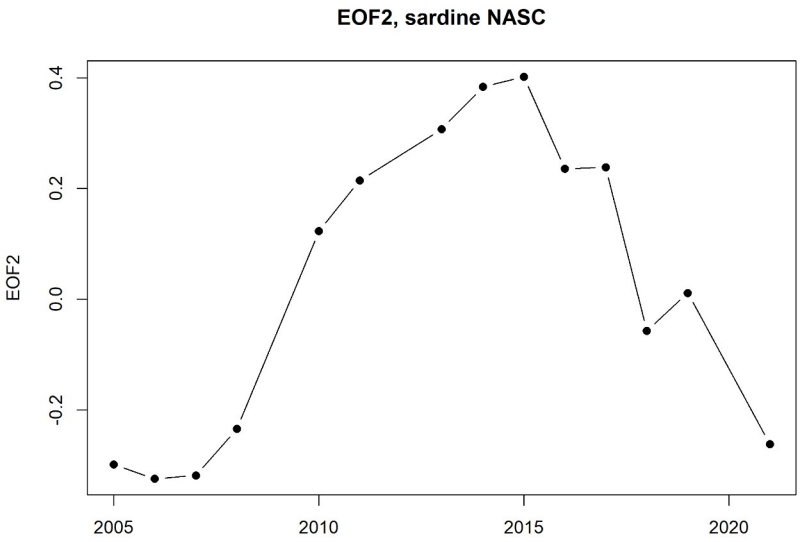
- **Mean spatial patterns**
  - Sardine <u>core distribution areas</u>
  - N-S positive temperature and salinity gradient
  - Lower salinity and higher Chl-a in river plumes
- **Time trends**
  - No correlation with environmental covariates
  - <u>Significant positive correlation with sardine SSB</u>

Sardine NASC space-time pattern 2

Main spatial pattern
(EOF2 map)



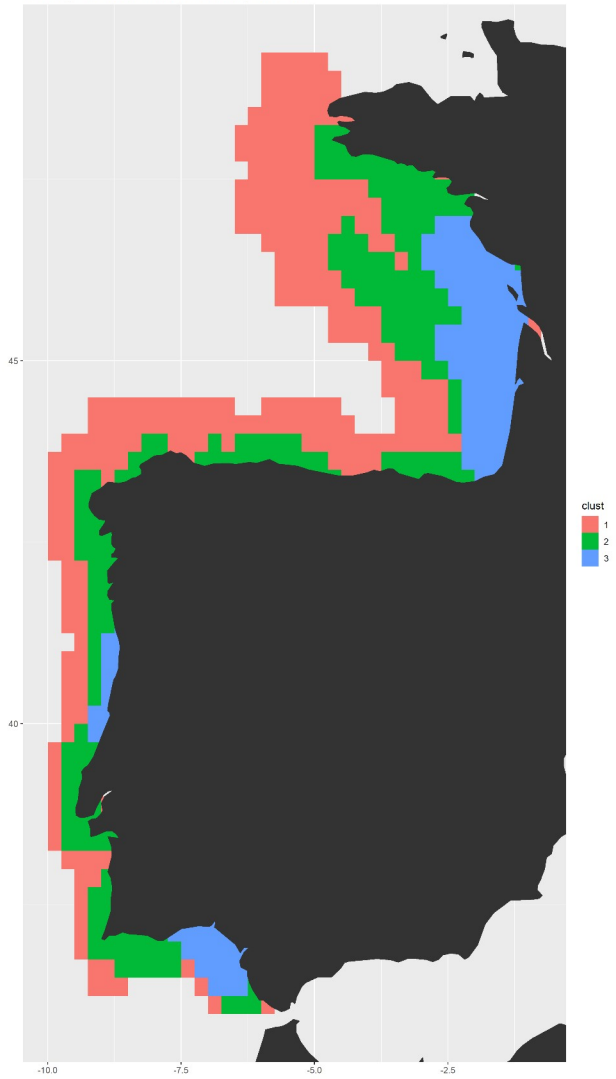
Time trend
(EOF2 amplitudes)

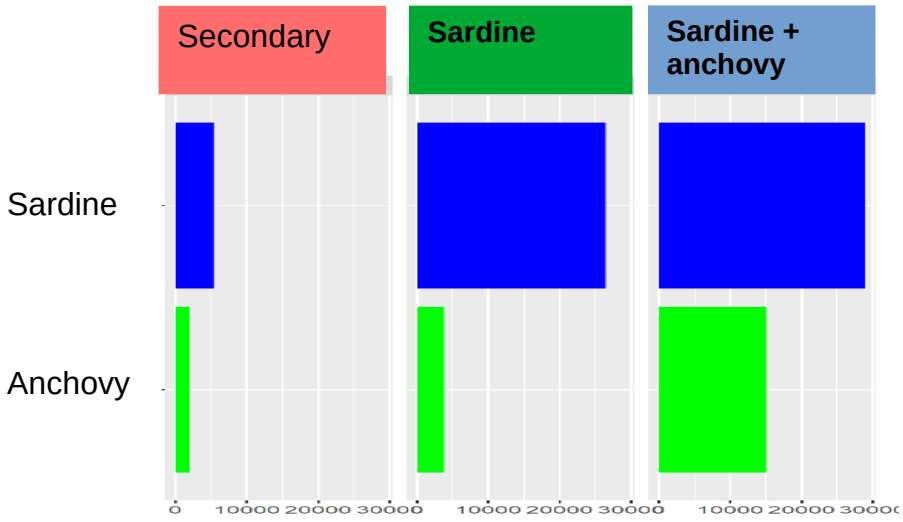


- **Mean spatial patterns**
  - Iberian vs. on/offshore BoB habitats
- **Time trends**
  - No correlation with environmental covariates
  - Significant negative correlation (-0.66) with total catch in Iberian waters

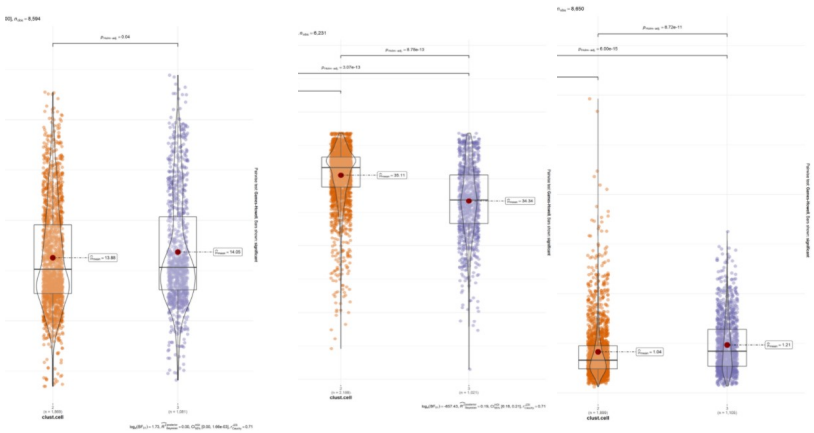
Anchovy - sardine habitats

Clustering on anchovy and sardine
EOF1



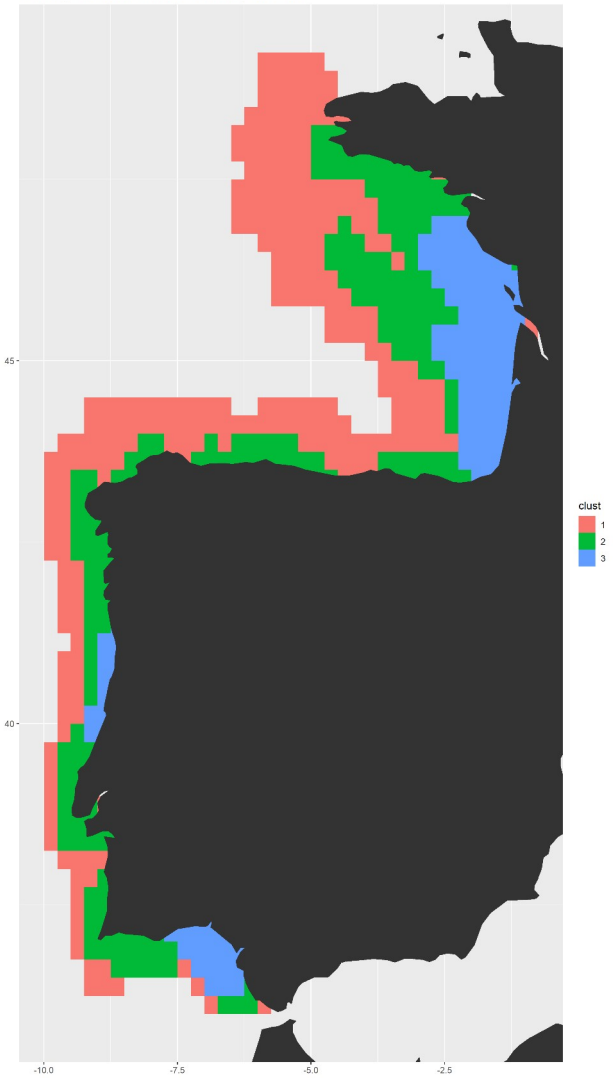


- Higher salinity and lower temperature in sardine oceanic habitats ($p<0.05$)
- Higher Chl-a in sardine + anchovy riverine habitats ($p<0.05$)

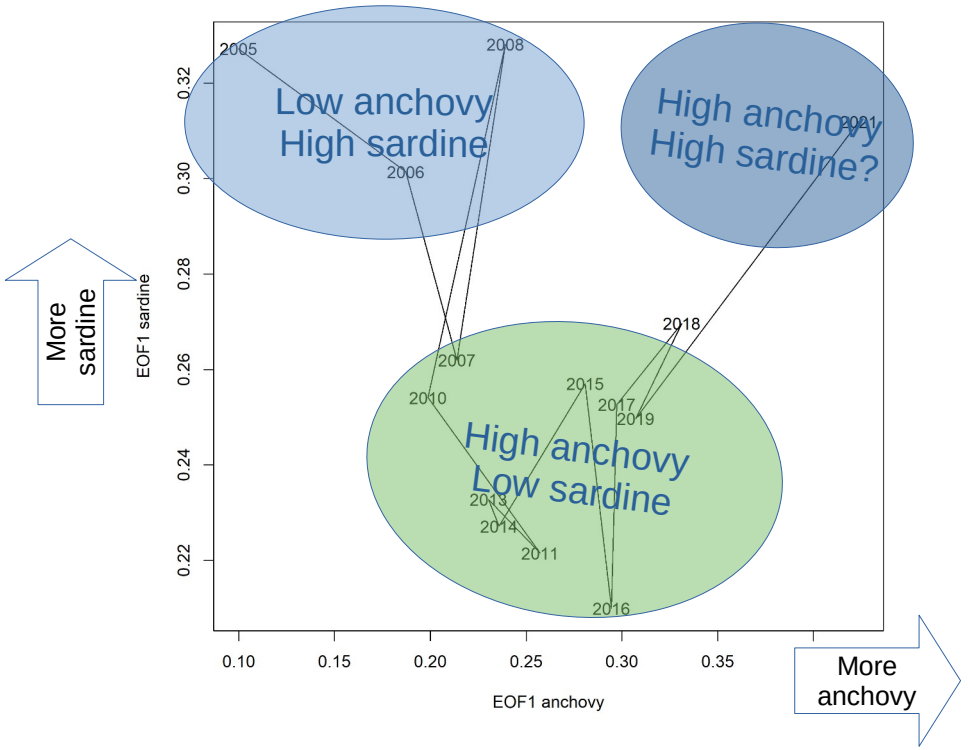


Anchovy - sardine co-occurence

Clustering on anchovy and sardine EOF1



Anchovy and sardine EOF1 biplot



Conclusions (1)

- First characterisation of realised springtime habitats of anchovy and sardine at the scale of European Atlantic shelf seas
  - Based data collected by the ICES WGACEGG international joint spring acoustic surveys over 15 years
- EOF space-time decomposition to summarize main spatial and temporal patterns and potential drivers
- Main spatial patterns shaped by mean environmental gradients
  - Anchovy and sardine co-occured in core habitats under riverine influence
  - Sardine dominant in colder and more oceanic habitats
  - No latitudinal segregation
- Secondary spatial modes related to « new » (anchovy) or fished habitats (sardine)

Conclusions (2)

- Time trends driven by fish populations / fishing pressure
  - Relative proportions of anchovy and sardine in habitats varied over time
  - No correlation between fish spatial modes and environmental time series : (still) reduced direct climate impact ?
  - Some correlation between spatial modes amplitudes and SSB/landings
- Future work :
  - Refine environmental covariates modelling
  - Apply to other WGACEGG datasets : eggs, autumn surveys …
  - Routine EOF monitoring of WGACEGG gridded maps time series

Thanks / Gracias / Merci / Obrigado