

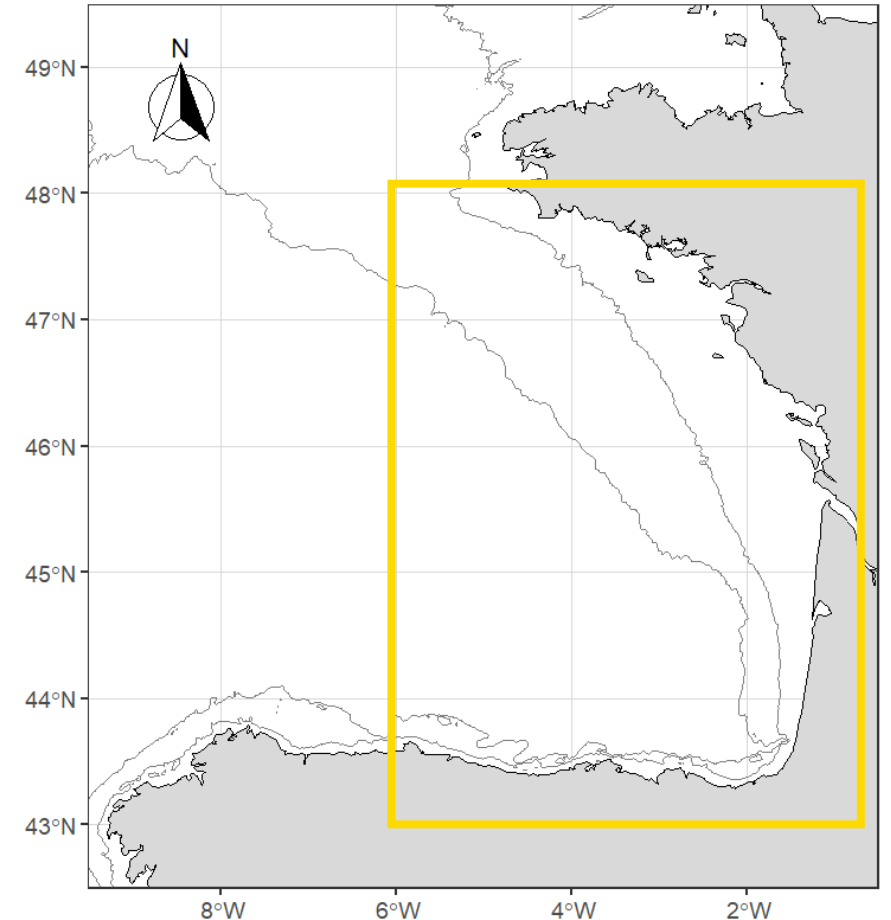


Spawning habitat and alternating dominance of anchovy and sardine in the Bay of Biscay

Leire Ibaibarriaga, Leire Citores, Naroa Aldanondo, Elorri Arevalo, Guillem Chust and Maria Santos

INTRODUCTION

- Past studies have identified alternating anchovy-sardine regimes around the world (Lluch-Belda et al. 1989, Izquierdo-Peña et al. 2019, etc.)
- Identified mechanisms are related to interacting factors: large-scale climate variability, species-specific thermal traits, trophic and density-dependence processes, etc.
- Both anchovy (*Engraulis encrasicolus*) and sardine (*Sardina pilchardus*) inhabit in the Bay of Biscay and are important commercial species.
- No clear pattern has been identified so far.

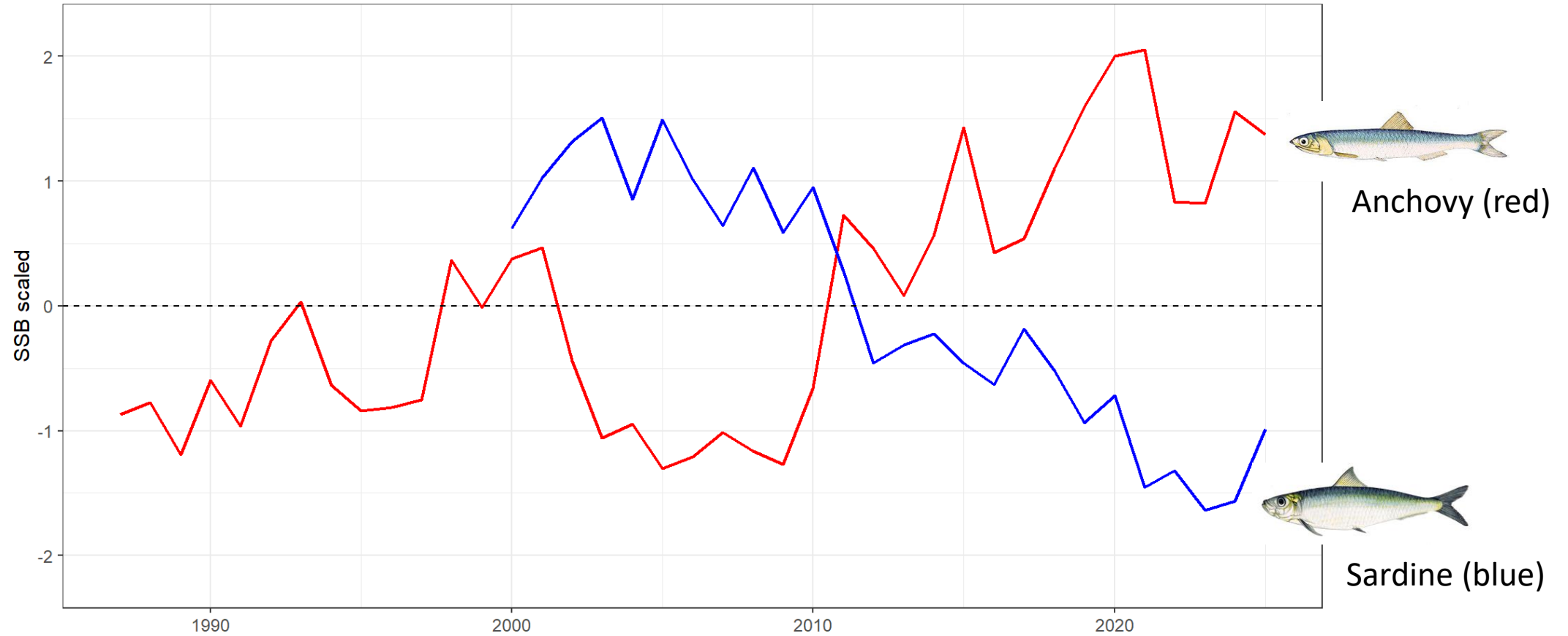


OBJECTIVES

1) Test for anchovy-sardine cycles in the Bay of Biscay

2) Assess the environmental conditions at spawning for each species

ANCHOVY-SARDINE CYCLES IN BoB



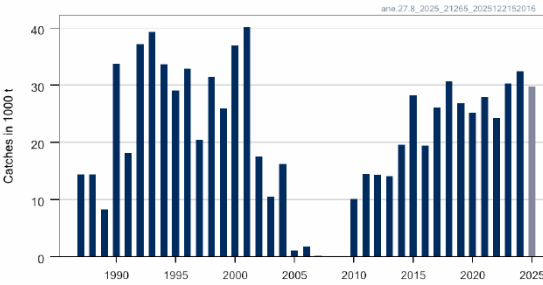
Two periods: 2000-2010 and 2011-2025

CLOSER LOOK TO EACH STOCK

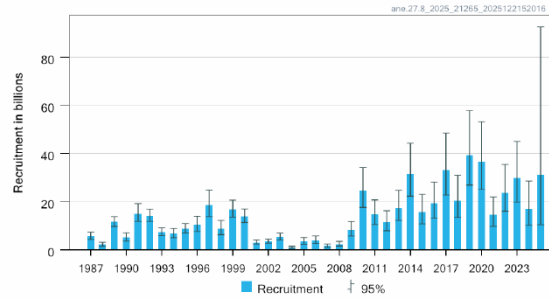


ICES (2025)

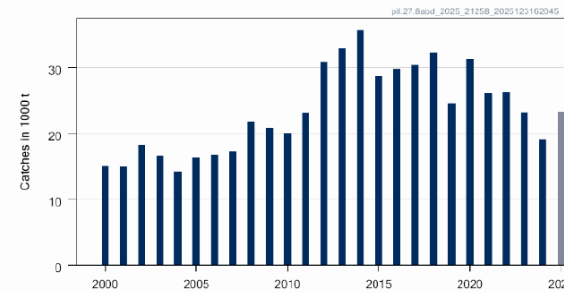
Catches



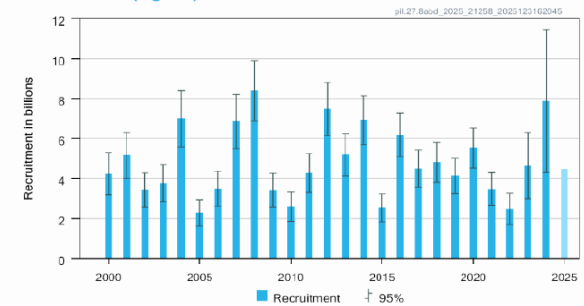
Recruitment (age 0)



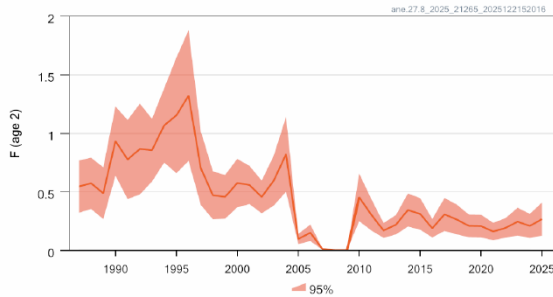
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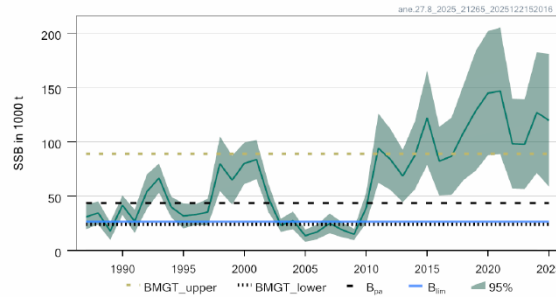
Recruitment (age 0)



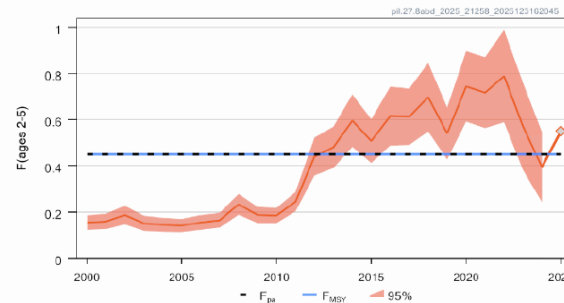
F



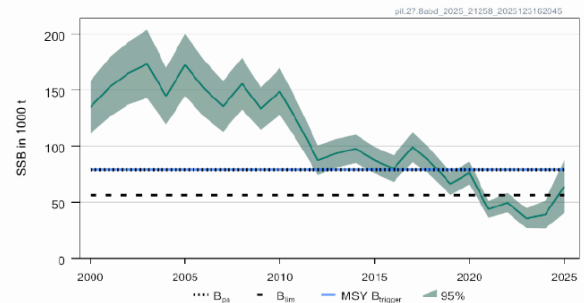
SSB



F



SSB



Low anchovy period (2000-2010) related to high F's and successive low R's
Low sardine period (2011-2025) after high F's period

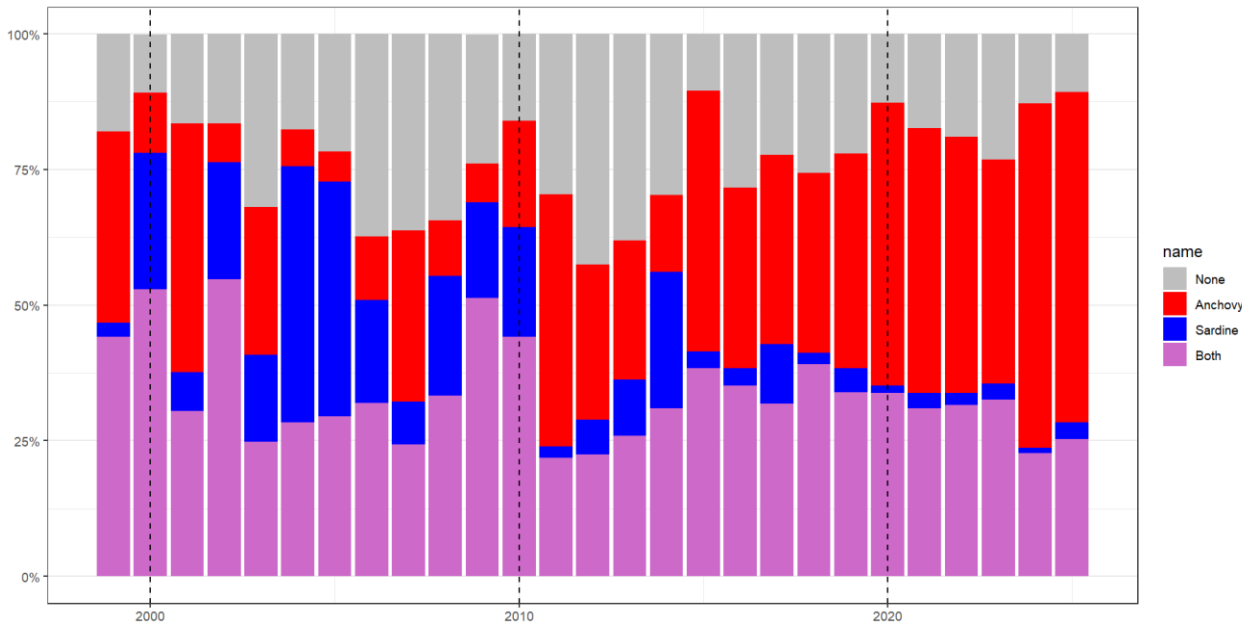
BIOMAN SURVEYS



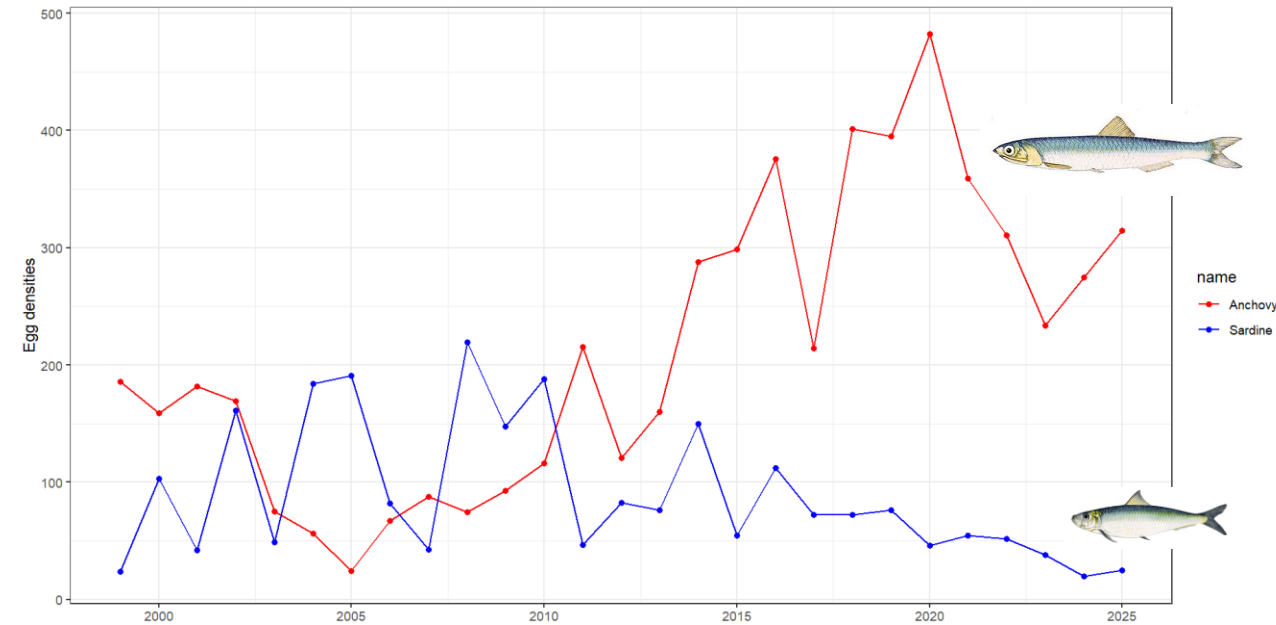
- BIOMAN surveys: 1987-present (Santos et al. 2023)
- Daily Egg Production Method for anchovy and sardine
- Spawning: anchovy in late spring and sardine from autumn spring.
- Two research vessels:
 - Adults
 - Ichthyoplankton + other
- Ichthyoplankton sampling:
 - PairoVET (vertical hauls) + CTD
 - Adaptive design: transects 15 nmi and stations 3 nmi

EGG PRESENCES AND DENSITIES

Changes in egg presence % by station

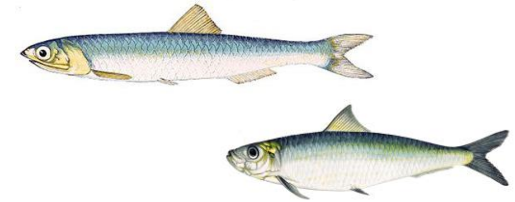


Changes in egg densities

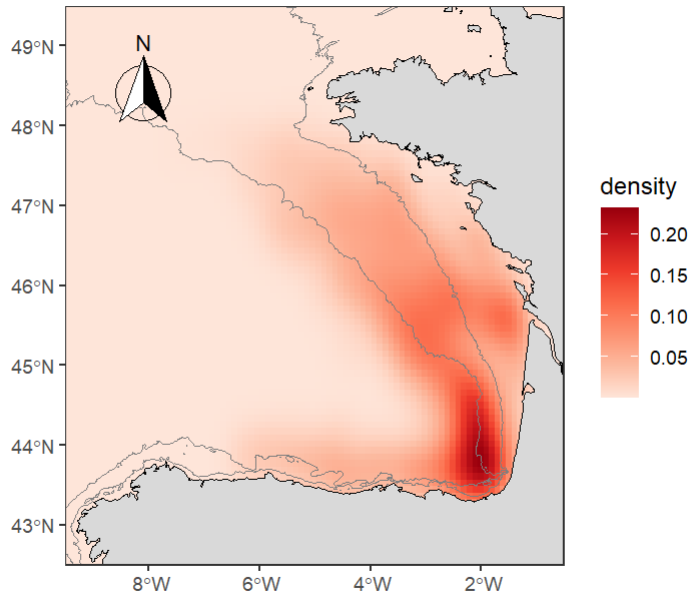


For both species at high SSB periods, more stations with eggs and larger egg densities

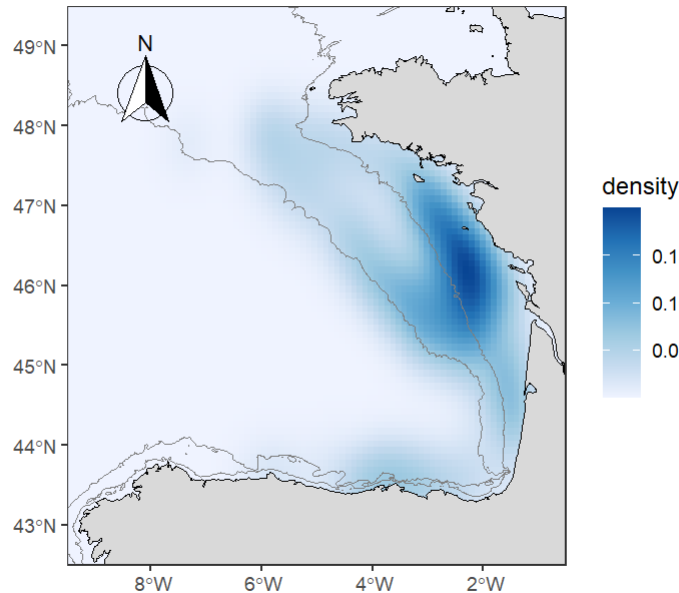
SIMILARITIES AND DIFFERENCES IN PRESENCE



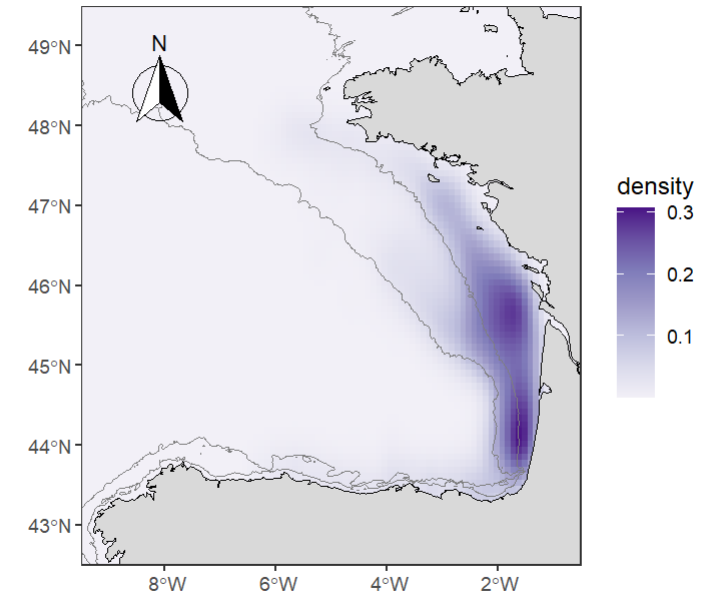
Presence anchovy only



Presence sardine only



Presence anchovy and sardine



Stations with both species located close to the coast in the river mouths.
Stations with only anchovy in the south and only sardine in the north.



1) Data preparation

- Compile BIOMAN data: geographical position, date, total egg abundance for anchovy and sardine
- Download data from Copernicus Marine Environment Monitoring Service (CMEMS): Atlantic-Iberian Biscay Irish-Ocean Physics and BioGeoChemistry (daily)
- Extract environmental variables at each position/date



2) Habitat modelling (presence/absence)

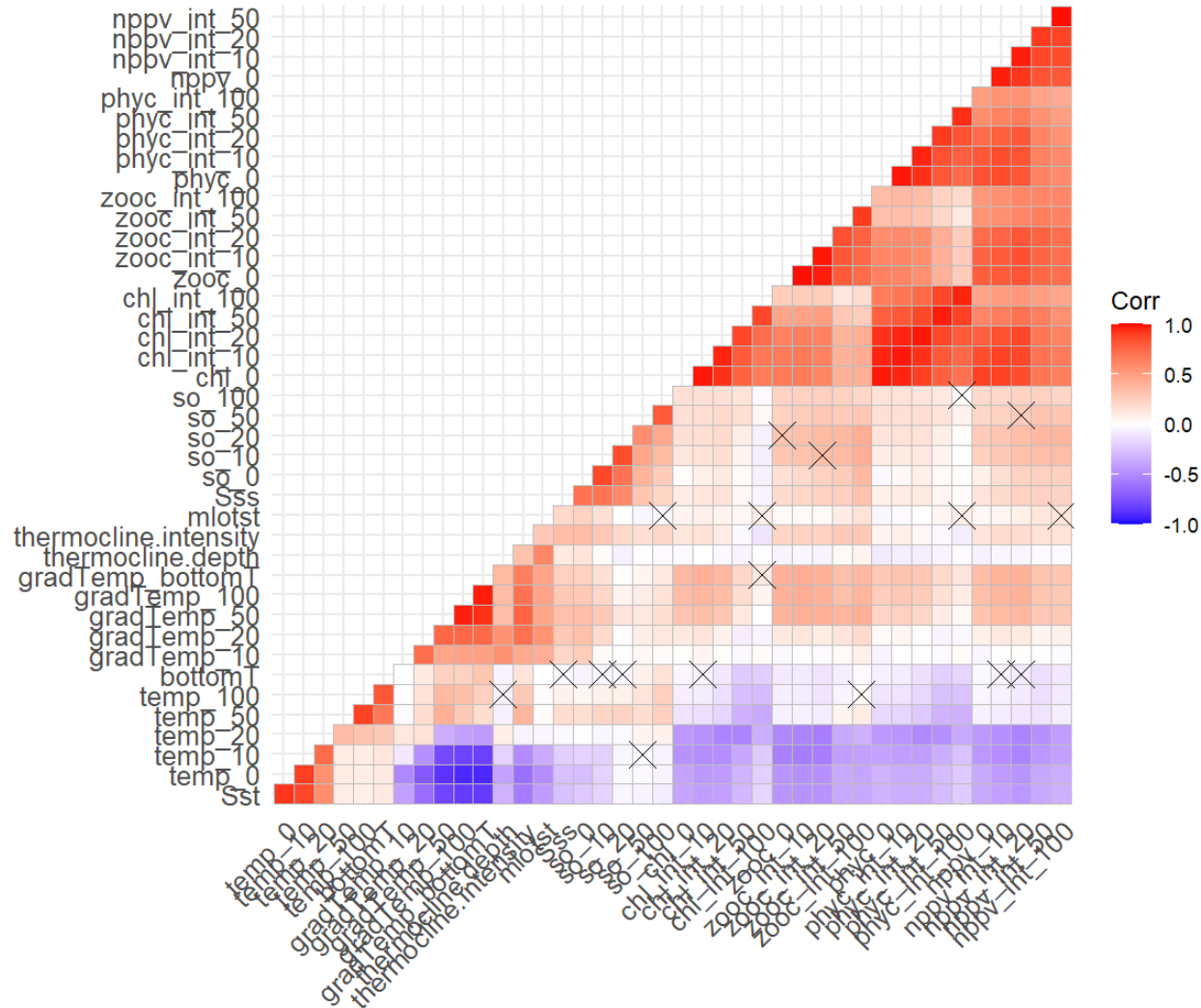
- Exploratory plots
- Fit univariate GAMs (Wood, 2017)
- Fit univariate SC-GAMs (Pya and Wood 2015, Citores et al. 2020)



3) Comparison anchovy and sardine curves

- Compare habitat preferences between two species

ENVIRONMENTAL VARIABLES



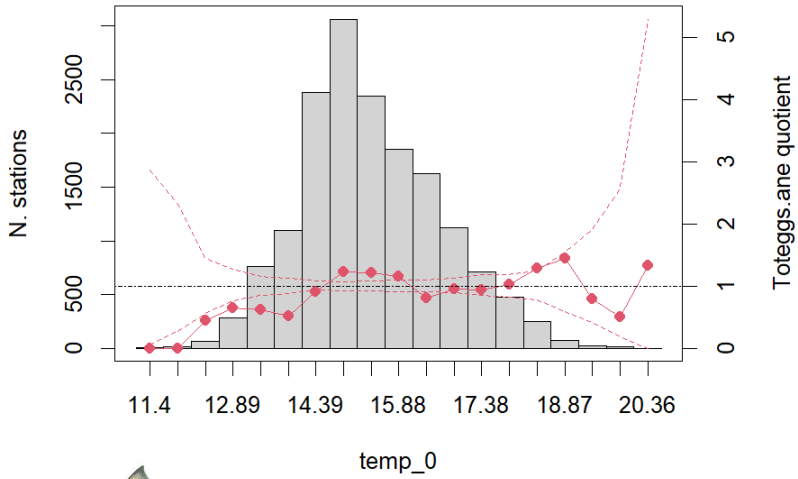
Temperature
Salinity
Temperature gradient wrt surface
Thermocline depth and intensity
Mixed layer depth
Net primary production (sum)
Chlorophyll (sum)
Zooplankton (sum)
Phytoplakton (sum)

at 0, 10, 20, 50 and 100 m depth

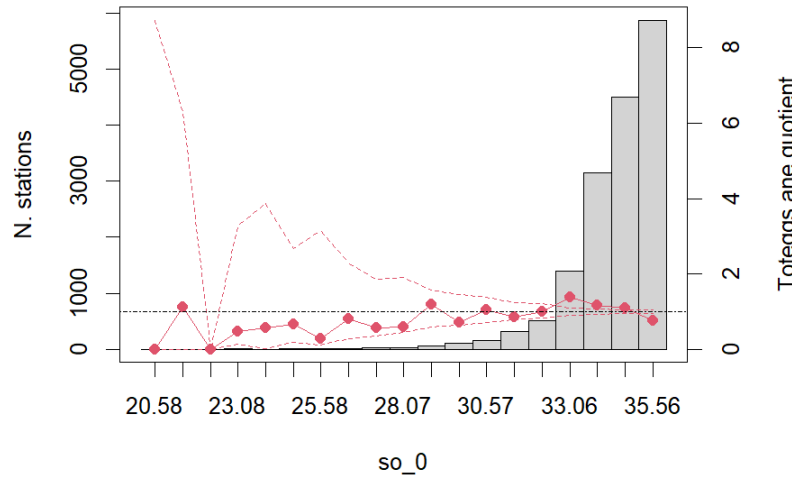
QUOTIENT LINES



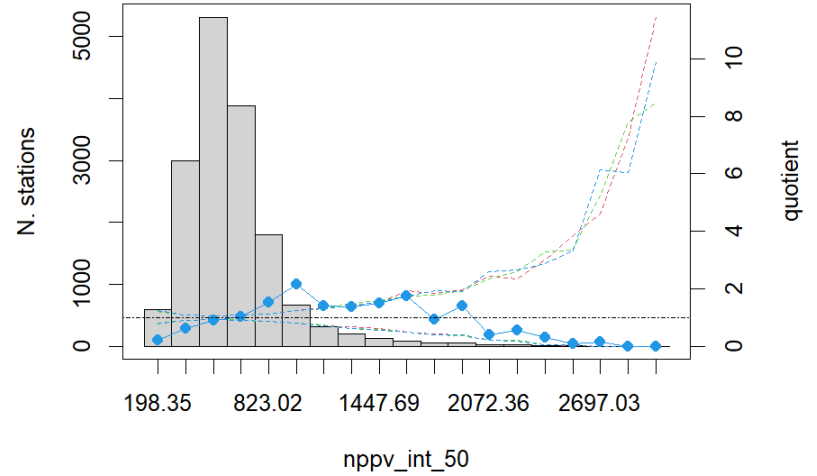
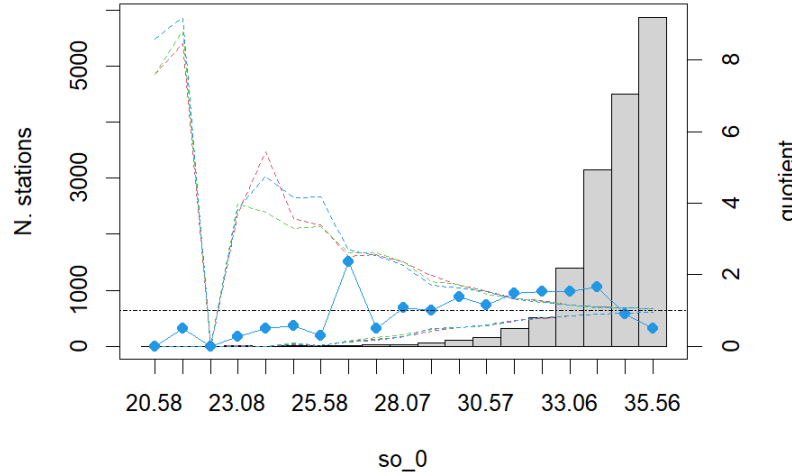
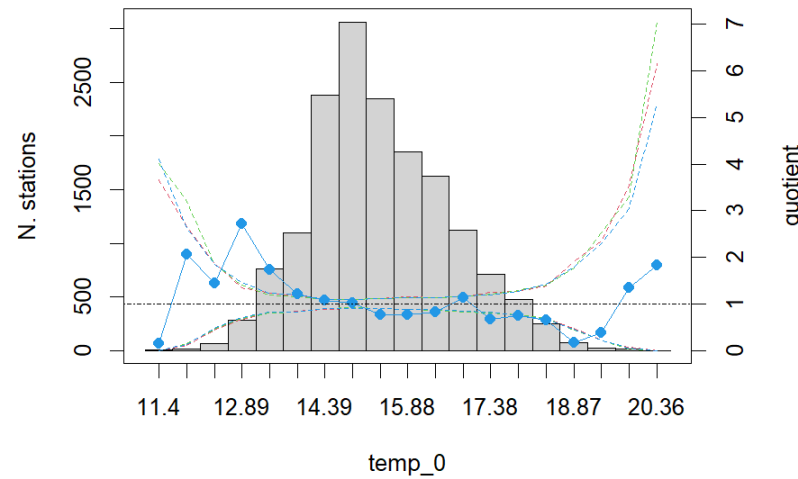
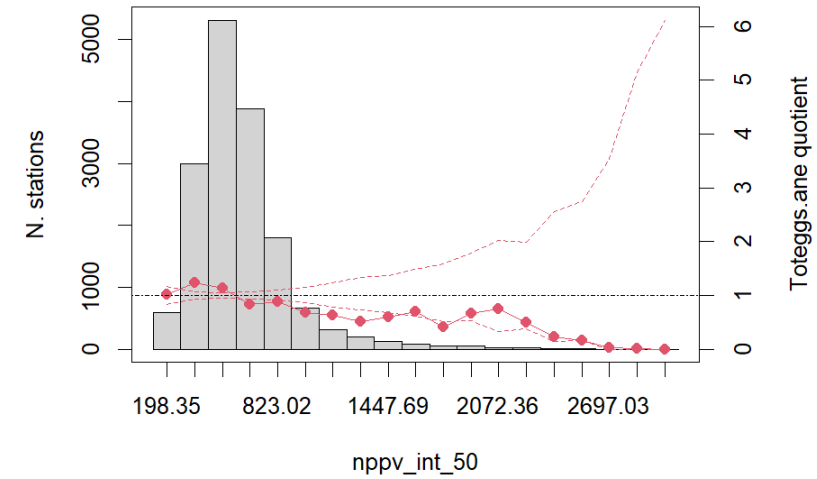
SST



SSS

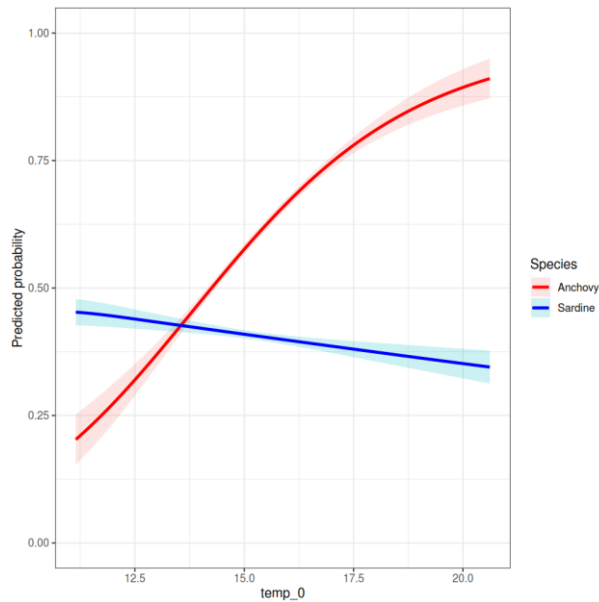


Net primary production

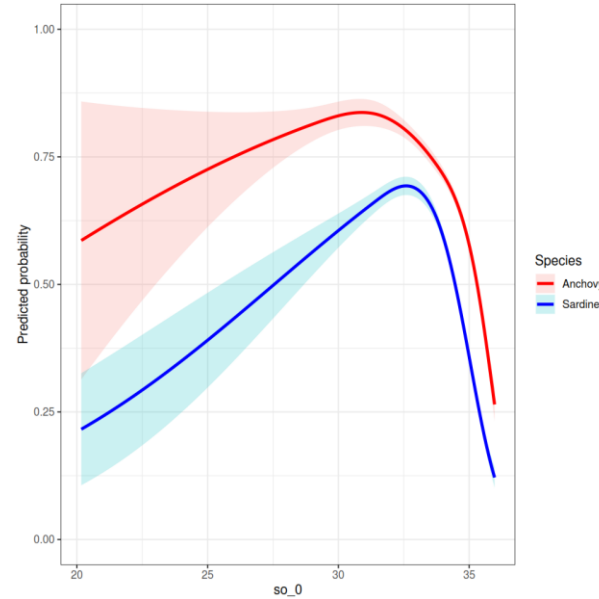


SPAWNING HABITAT MODELS: SC-GAMs

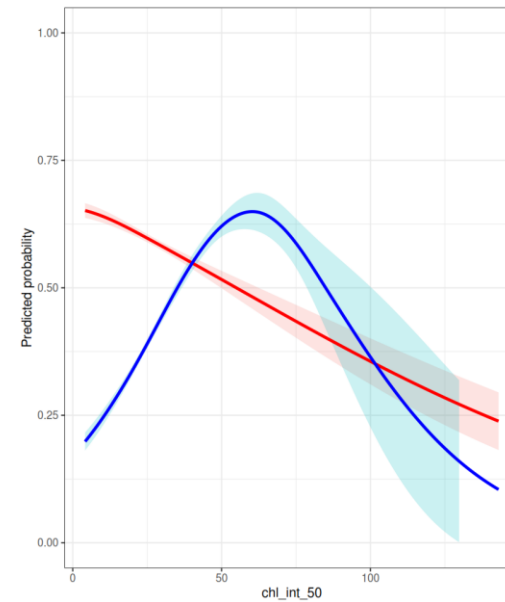
SST



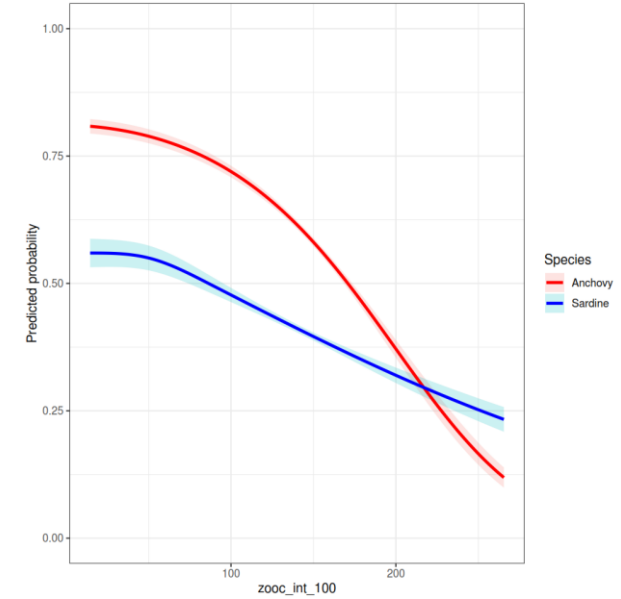
SSS



Chlorophyll



Zooplankton



Shape-constrained models with low % explained deviance (<10%), but showing different patterns by species

CONCLUSIONS AND FURTHER WORK

- We identified two alternating anchovy-sardine periods in the Bay of Biscay: 2000-2010 and 2011-2025
- Short-term patterns partly explained by changes in fishing pressure and recruitment.
- The analysis of spawning habitat using SC-GAMS allowed to identified distinct preferences for both species: higher temperature for anchovy and higher Chl for sardine. Results in agreement with past studies, e.g. Planque et al (2007), Bellier et al (2007).
- However, available time-series remain too short to assess long-term patterns in SSB trends (Siple et al. 2020) and additional processes beyond spawning distribution should be considered.
- Future work: explore additional data (historical catch, climatic indices, wider ranges)

Thank you for your attention!

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