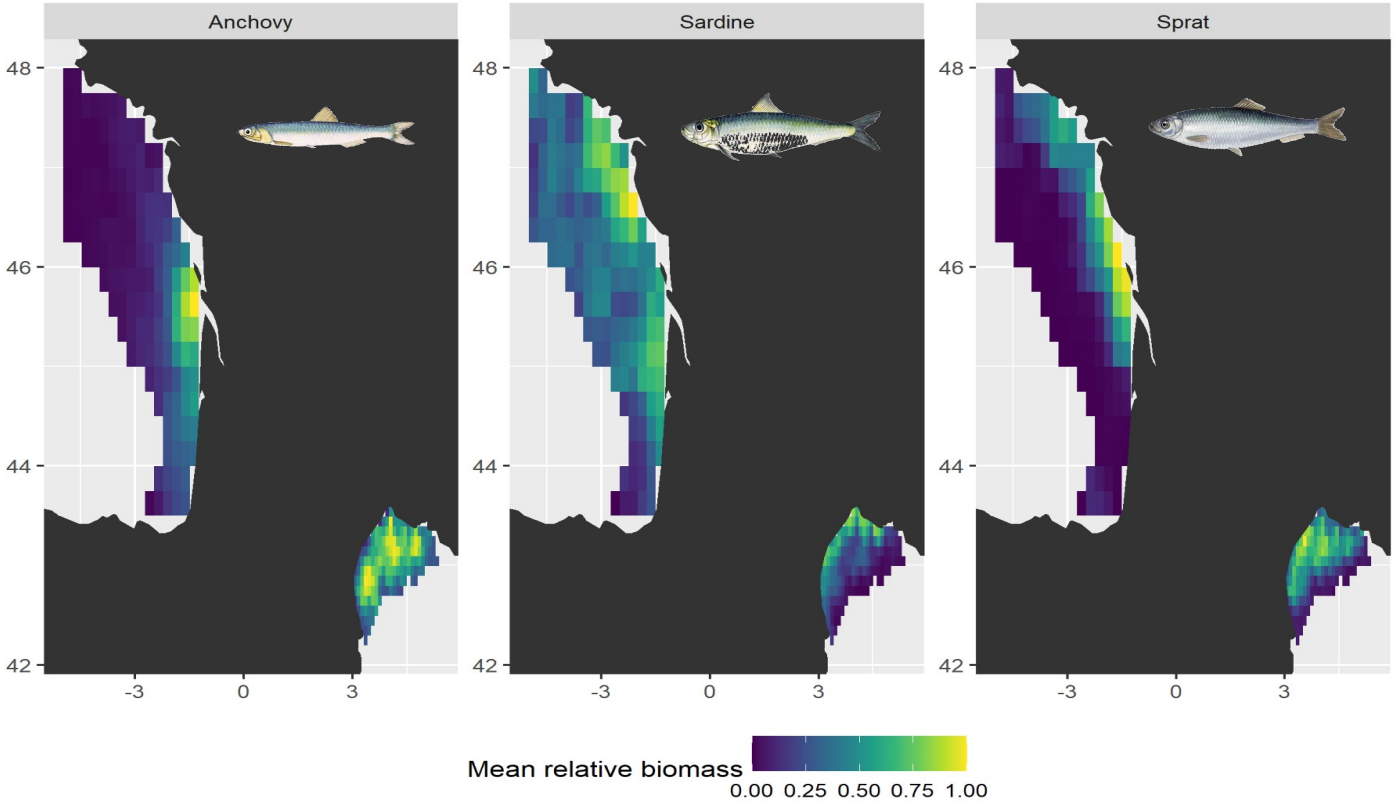
Space-time dynamics of size-structured clupeiformes communities in Atlantic and Mediterranean habitats



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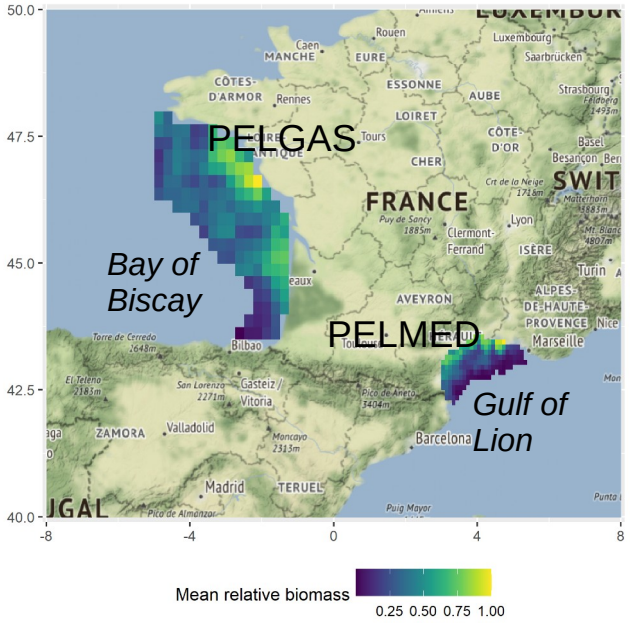
Introduction

- Global decrease in clupeiformes size since 2000 in two contrasted French shelf seas:
  - Gulf of Lion (GoL, Mediterranean) and Bay of Biscay (BoB, temperate)
- Comparative, space-time analysis of size structured clupeiform communities and sub-populations
- Main factors shaping species/size distributions?
  - Local/global changes ?
  - Inter/intra-species interactions ?
  - Local or larger scale environmental forcing ?
- Spatial reshuffling of communities / size class ?
  - Space-time dynamics of key species / size class

Material and methods

- Long-term time-series of gridded maps
  - Anchovy, sardine, sprat acoustic biomass-at-length from PELGAS (BoB, 2000-2019) and PELMED (GoL, 2003-2019) surveys
  - Survey (hydro) and satellite (Chl-a) environmental covariates

30km resolution



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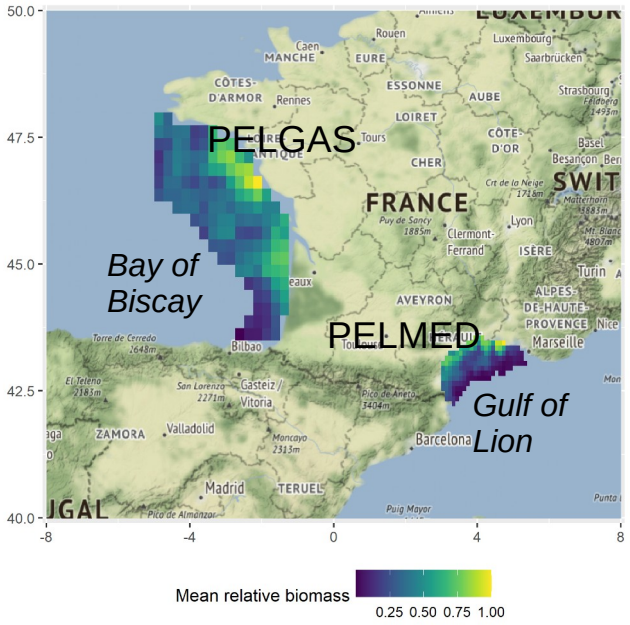
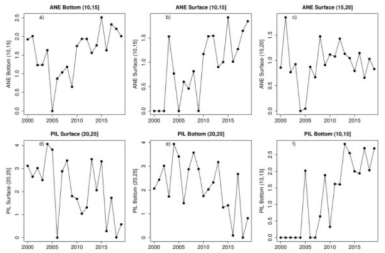


- Multivariate space-time ordination

Selection

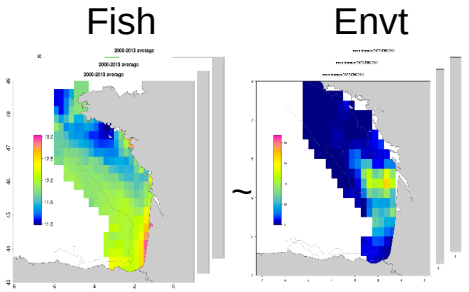
Min-Max Autocorrelation Functions (MAF) on mean fish maps time series

1. Tipping points in fish community



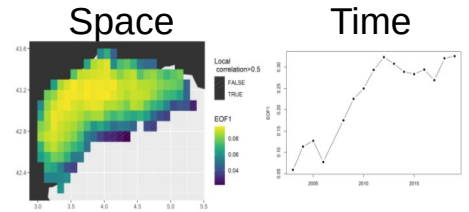
Multiple Factor Analysis (MFA) on fish and envt maps time series

2. Community and realised habitat definition



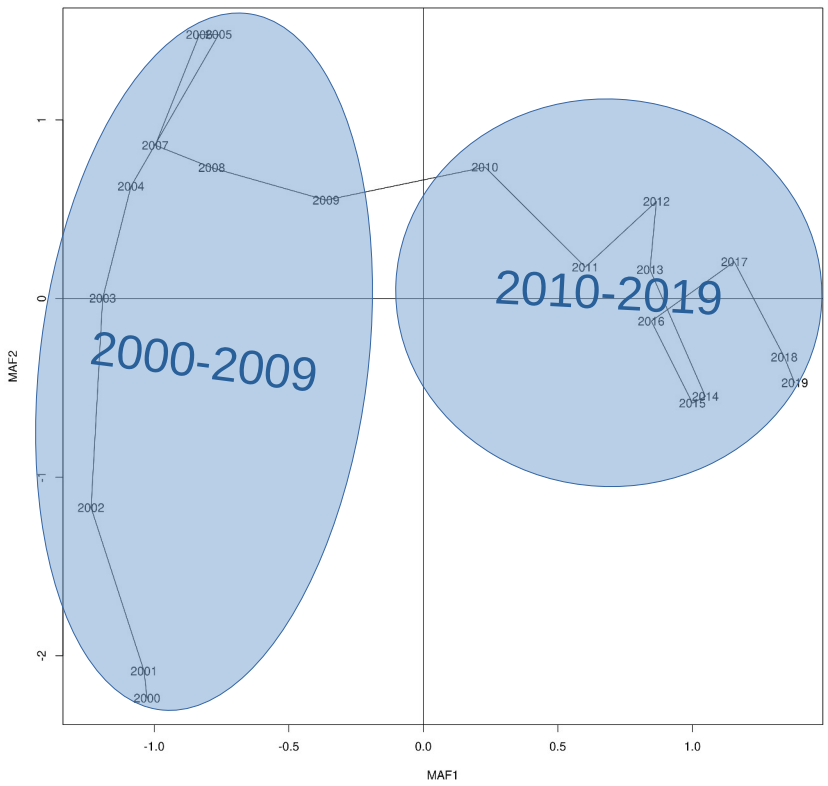
Empirical Orthogonal Functions (EOFs)

3. Space-time patterns of main species:length maps

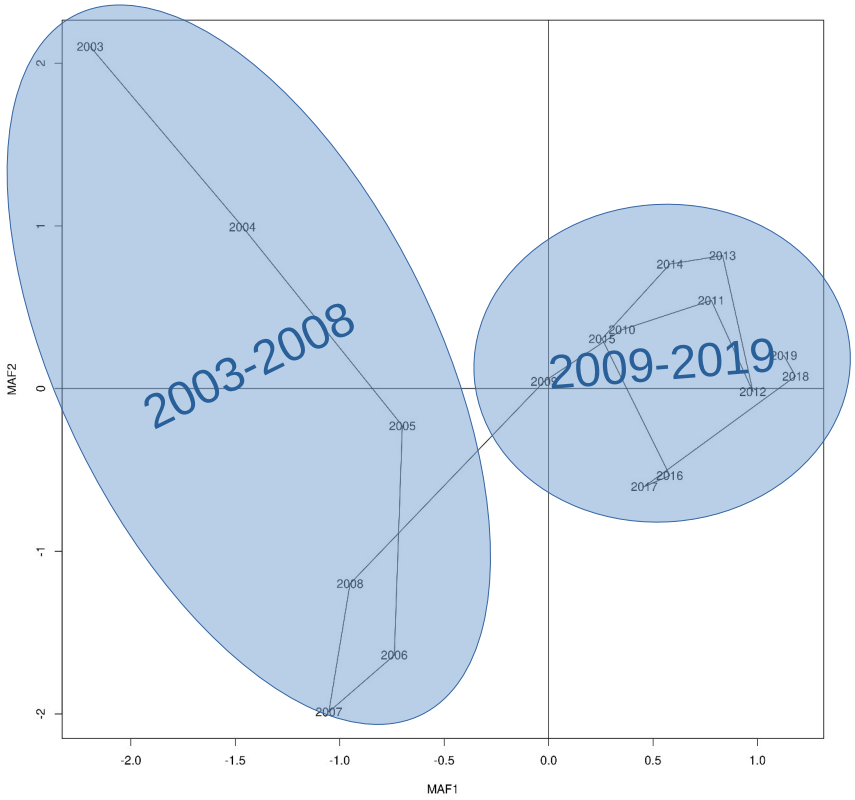


Clupeiformes communities trajectories

Atlantic (Bay of Biscay), 2000-2019



Mediterranean (Gulf of Lion), 2003-2019



Factor planes of Min-max Autocorrelation Functions (MAF) on mean maps

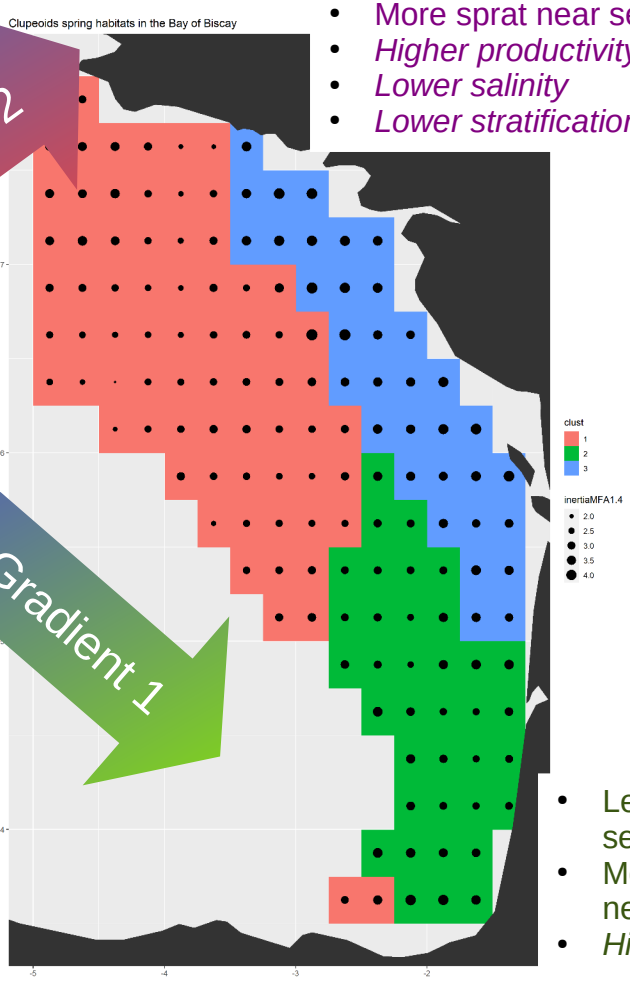
Clupeiformes communities and habitats Bay of Biscay, springtime

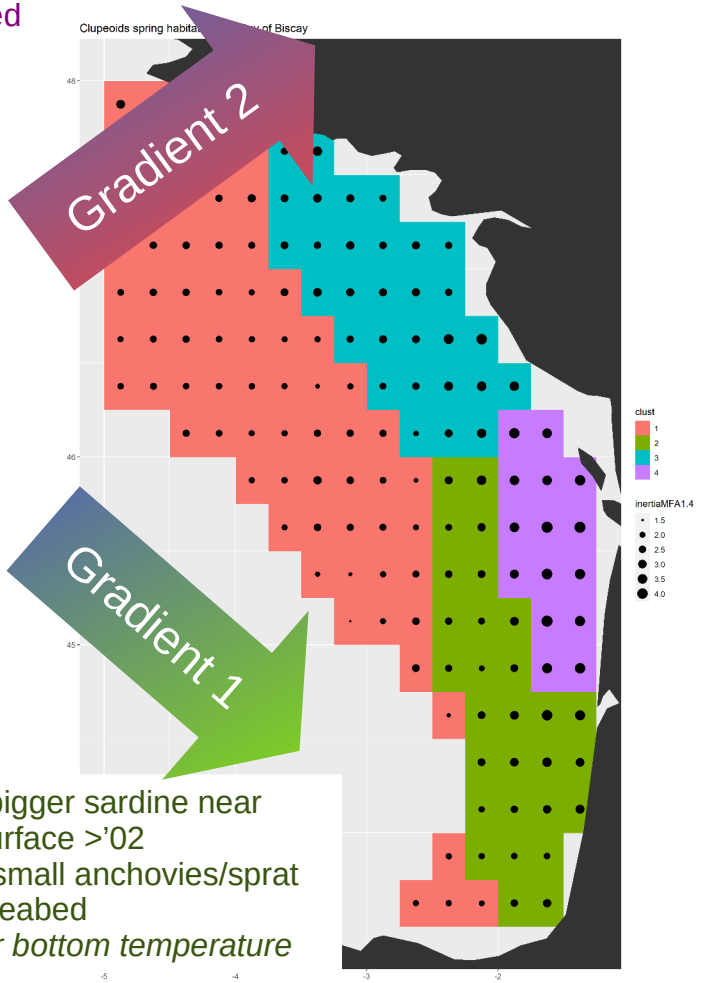
Clustering on Multiple Factor Analysis (MFA) dimensions

2000-2009

2010-2019

- More sprat near seabed
- *Higher productivity*
- *Lower salinity*
- *Lower stratification*





- Less bigger sardine near sea surface >'02
- More small anchovies/sprat near seabed
- *Higher bottom temperature*

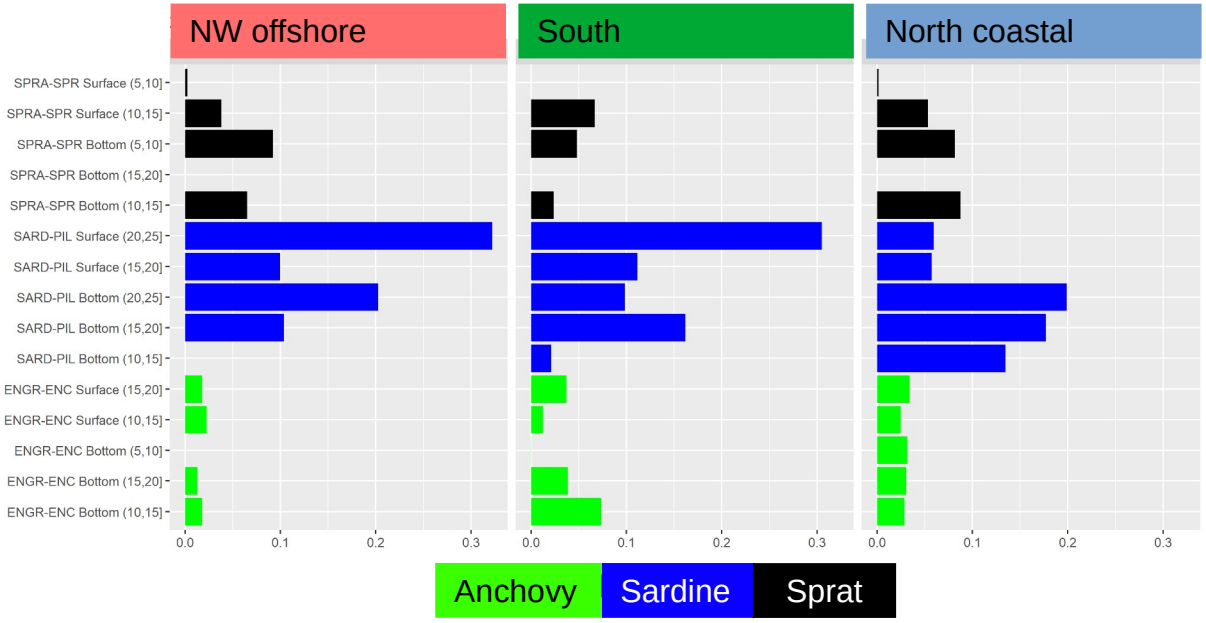
Habitats

NW offshore	
South	
North coastal	

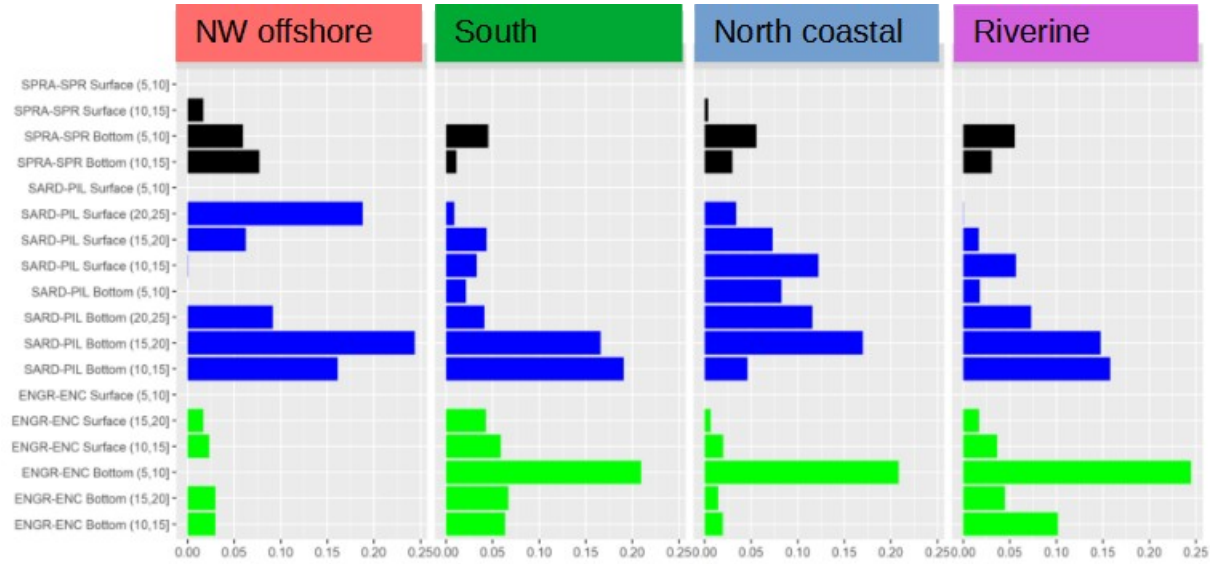
NW offshore	North coastal
South	Riverine

Clupeiformes communities composition
Bay of Biscay, springtime

2000-2009



2010-2019



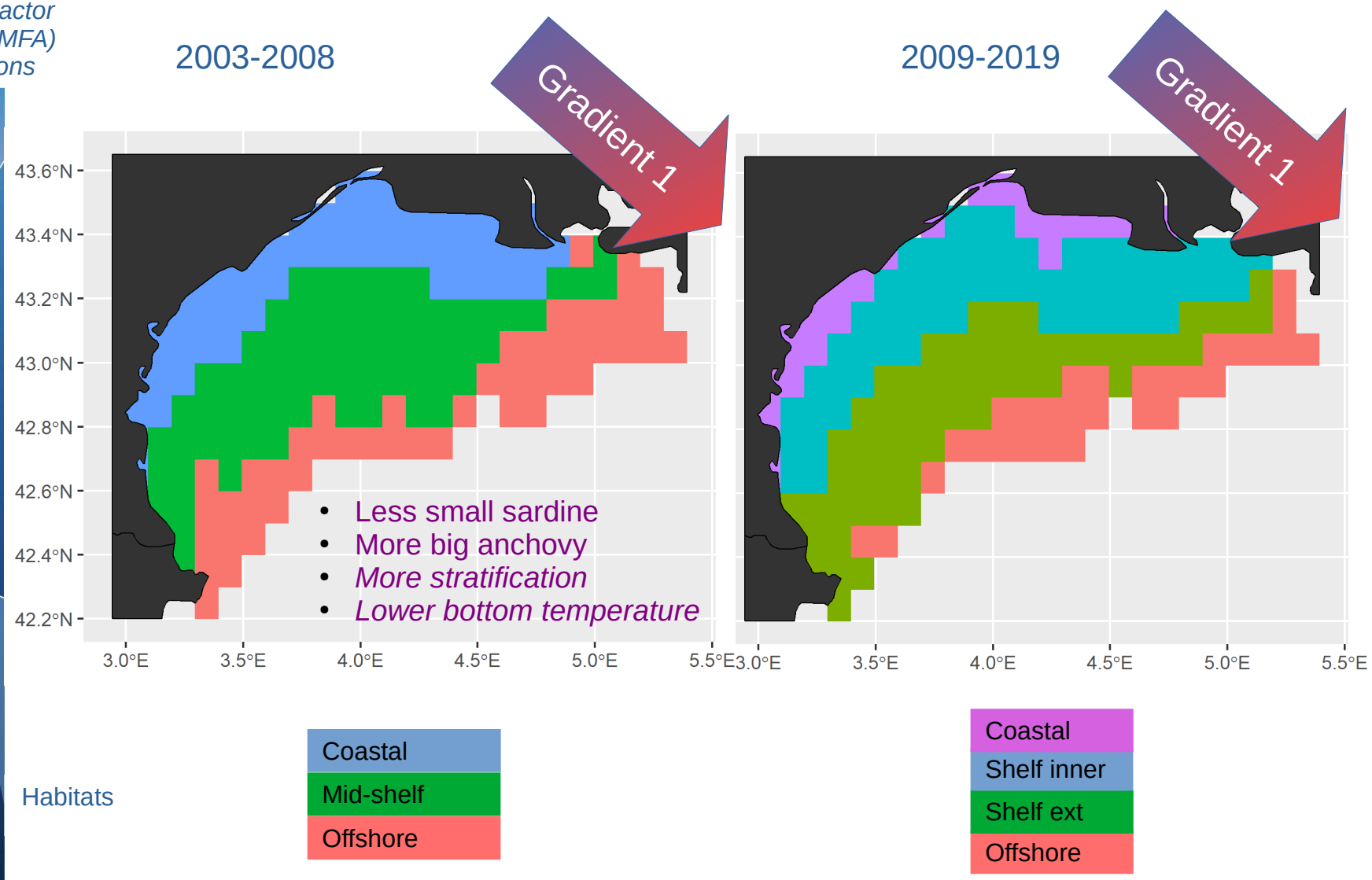
Big sardine

Small sardine

Small anchovy

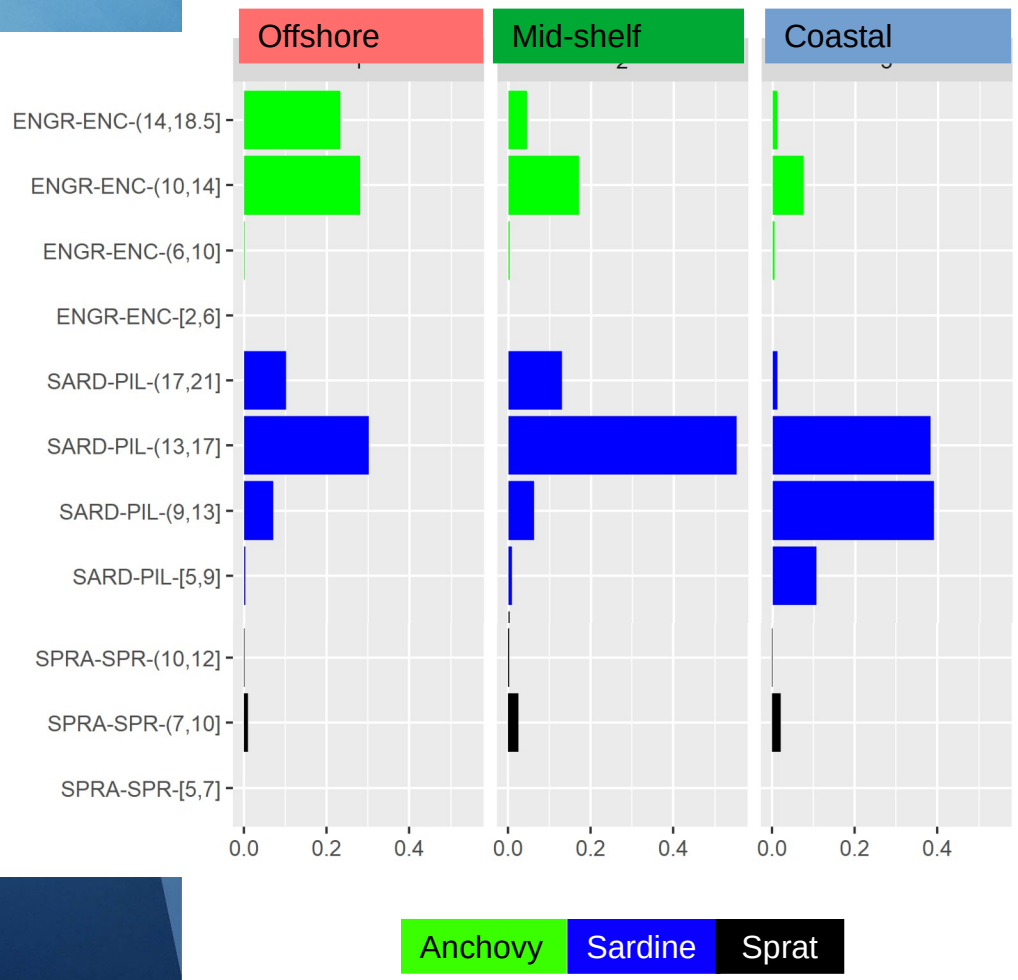
Clupeiformes communities and habitats Gulf of Lion, summer, 2003-2019

Clustering on Multiple Factor Analysis (MFA) dimensions

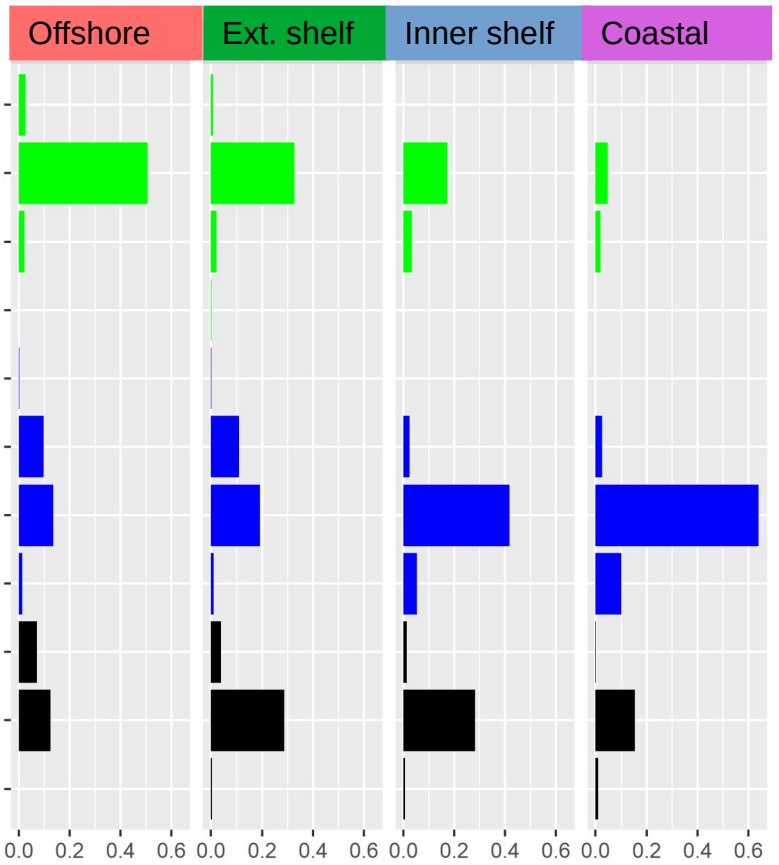


Clupeiformes communities composition Gulf of Lion, summer, 2003-2019

2003-2008



2009-2019




Big sardine


Big anchovy


Small sardine

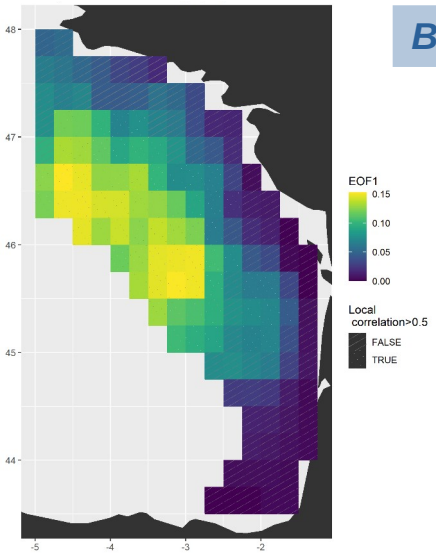

Small sprat

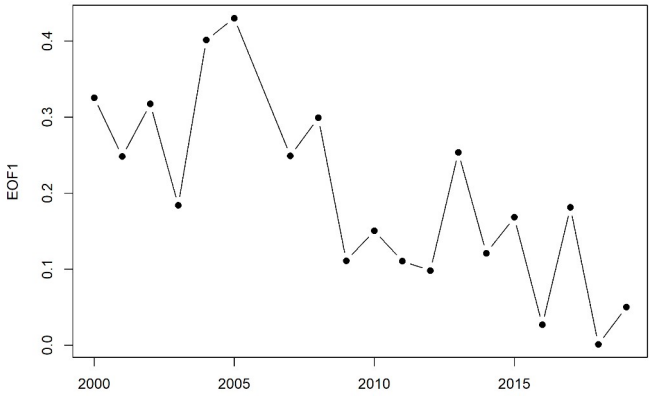
Space-time dynamics of sub-populations with consistent time-trends, Atlantic, spring

Main spatial pattern (EOF1 map)

Time trend (EOF1 amplitudes)

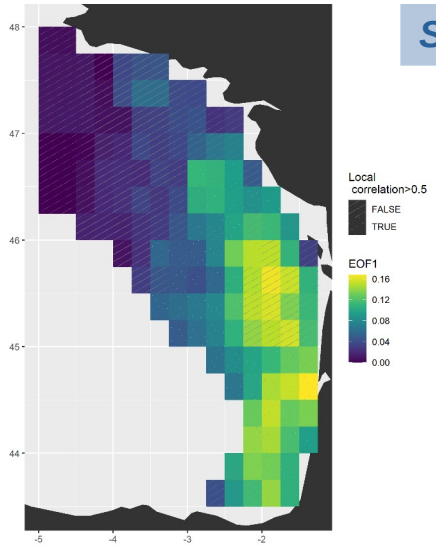
Big sardine (20-25cm) near sea surface

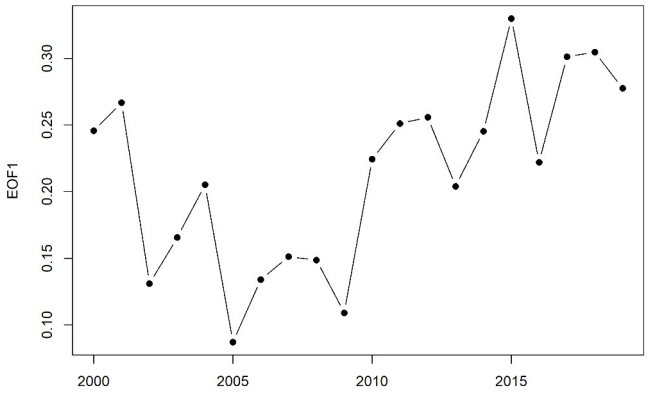




- Big sardine disappeared in NW area
- Latitudinal shift ?

Small anchovy (10-15cm) near seabed





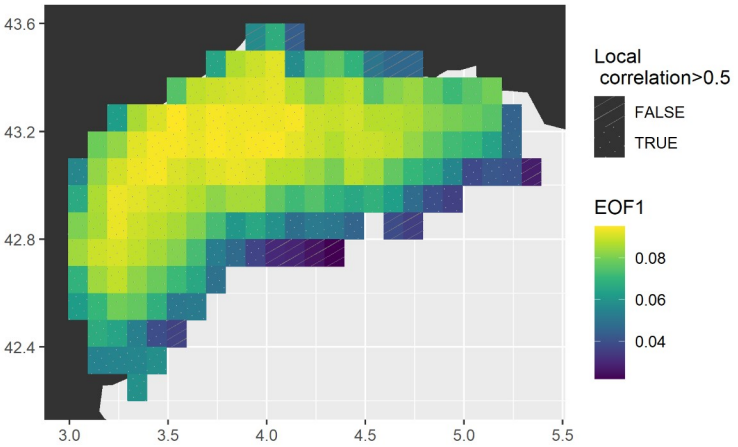
- Increase of small anchovy in Southern/riverine habitats
  - *Competition ?*
- No overlap with big sardine

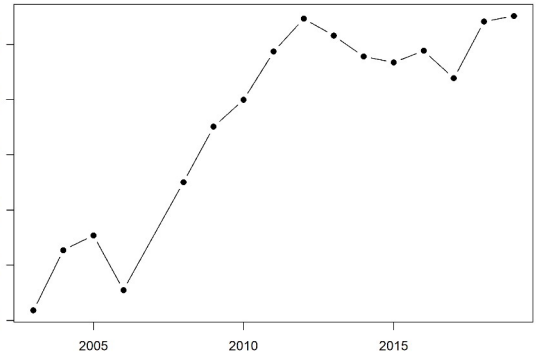
Space-time dynamics of sub-populations with consistent time-trends, Mediterranean, summer

Main spatial pattern
(EOF1 map)

Time trend
(EOF1 amplitudes)

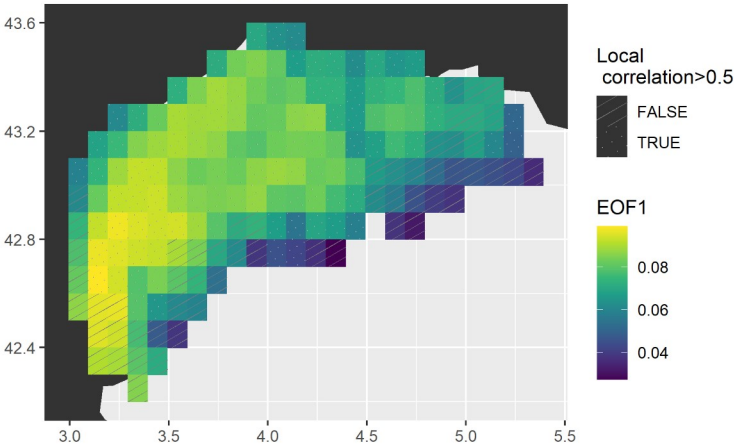
Small sprat (7-10cm)

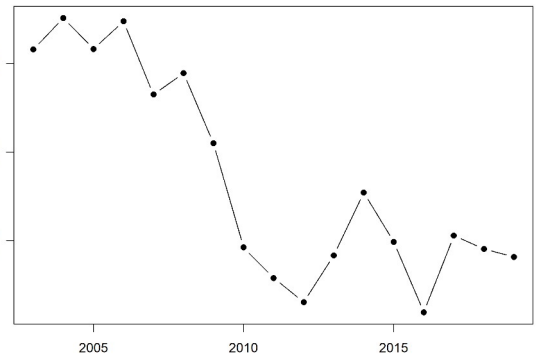




- Global expansion of small sprat since 2007

Big sardine (13-17cm)





- Global disappearance of big sardine, namely in South West
- Overlap with small sprat
  - *Competition?*

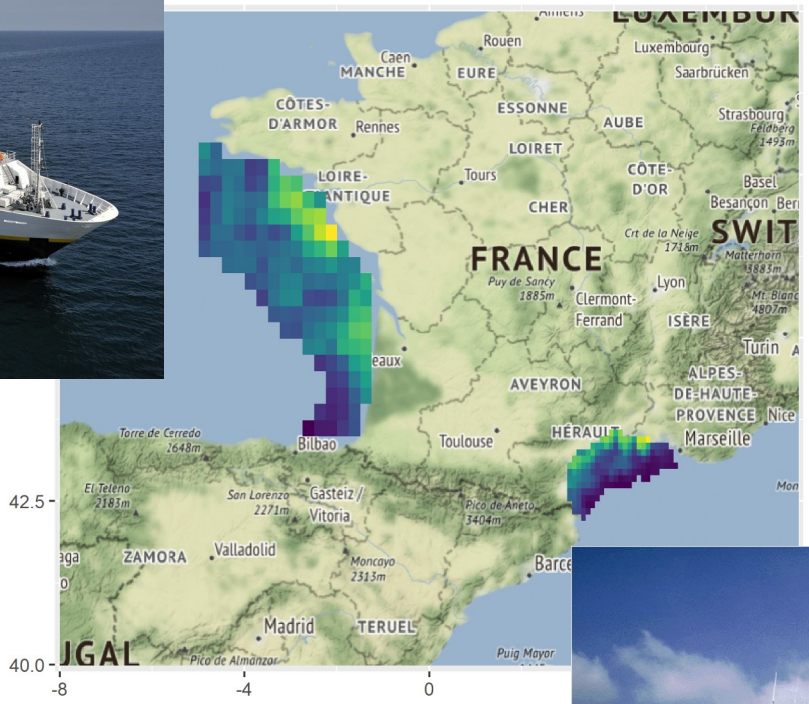
Conclusions (1)

- Comparative approach
  - GoL now proxy for future BoB under climate change?
  - Same gradients, but not in same order
  - Size decrease, with species:size successions, but not the same
    - Disappearance of big sardine
    - Increase of temperate small sprats in GoL (Med.)
    - Increase of sub-tropical small anchovy in BoB (Atl.)
  - Global changes in GoL. vs. local changes in BoB
    - Big sardine
      - Latitudinal shift in BoB ?
      - Global size-selective mortality / competition with sprat in GoL ?
    - Small clupeiformes
      - Competition in shared habitats ?

Conclusions (2)

- Importance of scale, space and size
  - Spatially explicit data from standardised integrated surveys for realised habitats mapping
  - Multivariate analysis at community and sub-population scales
  - Species:size changes in space and time may inform on ecological processes
- Environmental forcing
  - No correlation between fish and available hydrology and Chl-a time series
  - Changes in zooplankton quantity/quality under climate change?
    - Need for spatially explicit, size-structured zooplankton data

Thank you for your attention



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