

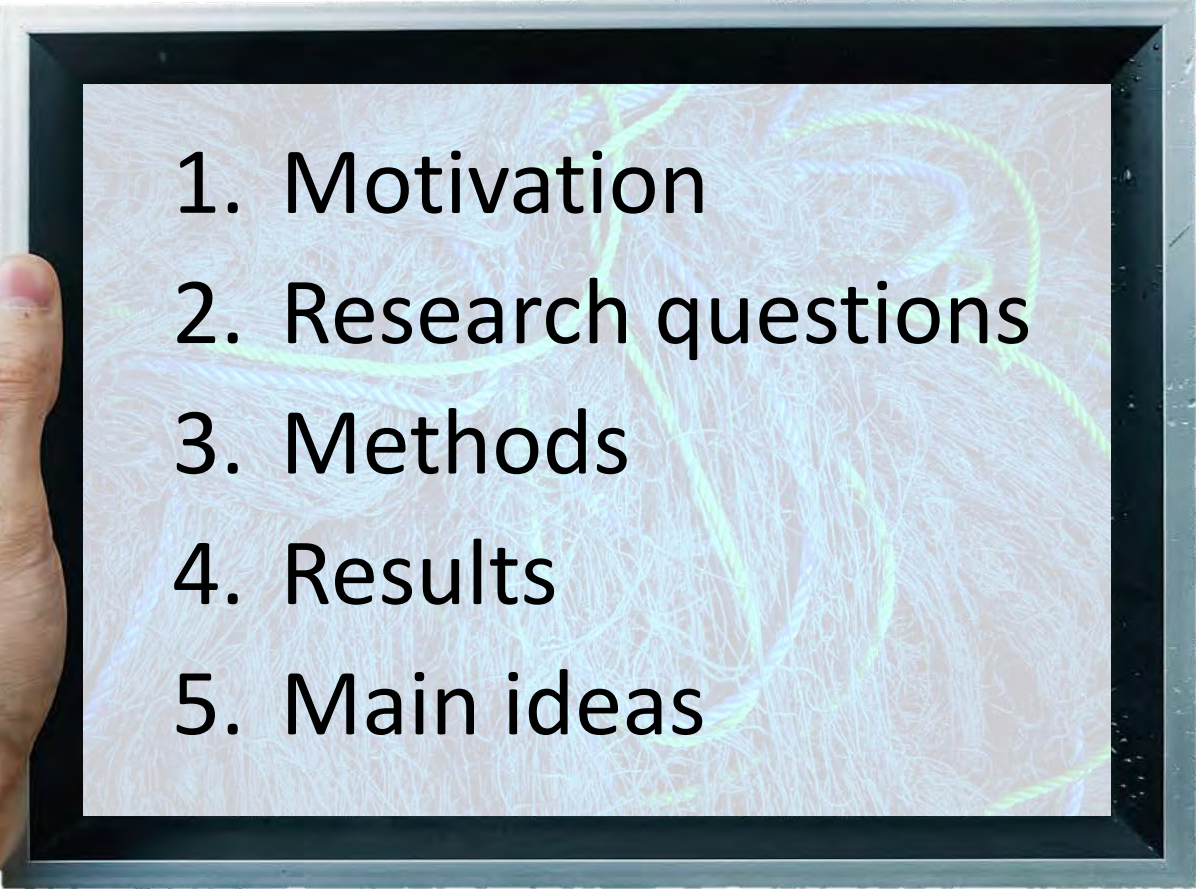


Institutional settings, climate change and the re-distribution of tropical tuna fisheries

Iratxe Rubio, Unai Ganzedo, Alistair Hobday, Elena Ojea



OUTLINE

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1. Motivation
 2. Research questions
 3. Methods
 4. Results
 5. Main ideas

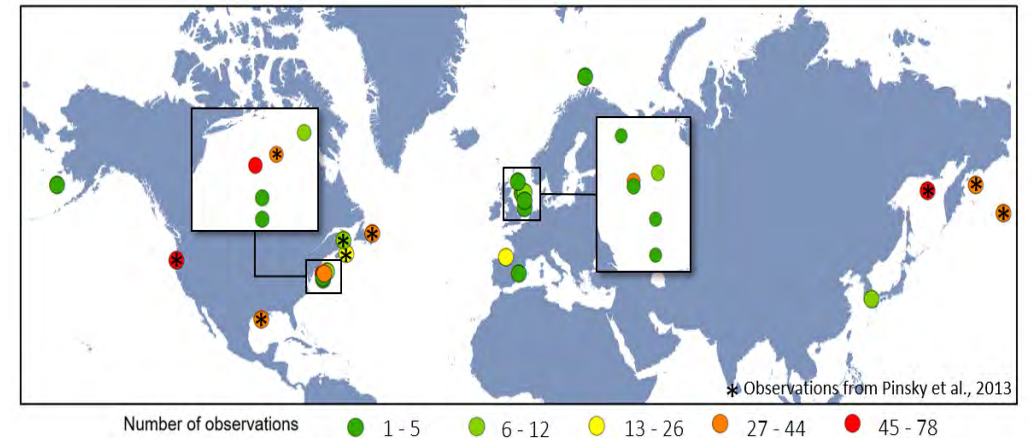
1. MOTIVATION

- Climate change is causing shifts in fish distribution worldwide (*Poloczanska et al., 2016*)
- Evidence concentrates mostly in the North Atlantic Ocean, lacking observations in tropical regions (*Aguión et al., ongoing research*)
- The strongest ocean warming will be in tropical and Northern Hemisphere subtropical regions (*IPCC, 2014*)
- Importance of tropical tunas for fisheries economies (*Miyake et al. 2010; FAO 2016*)



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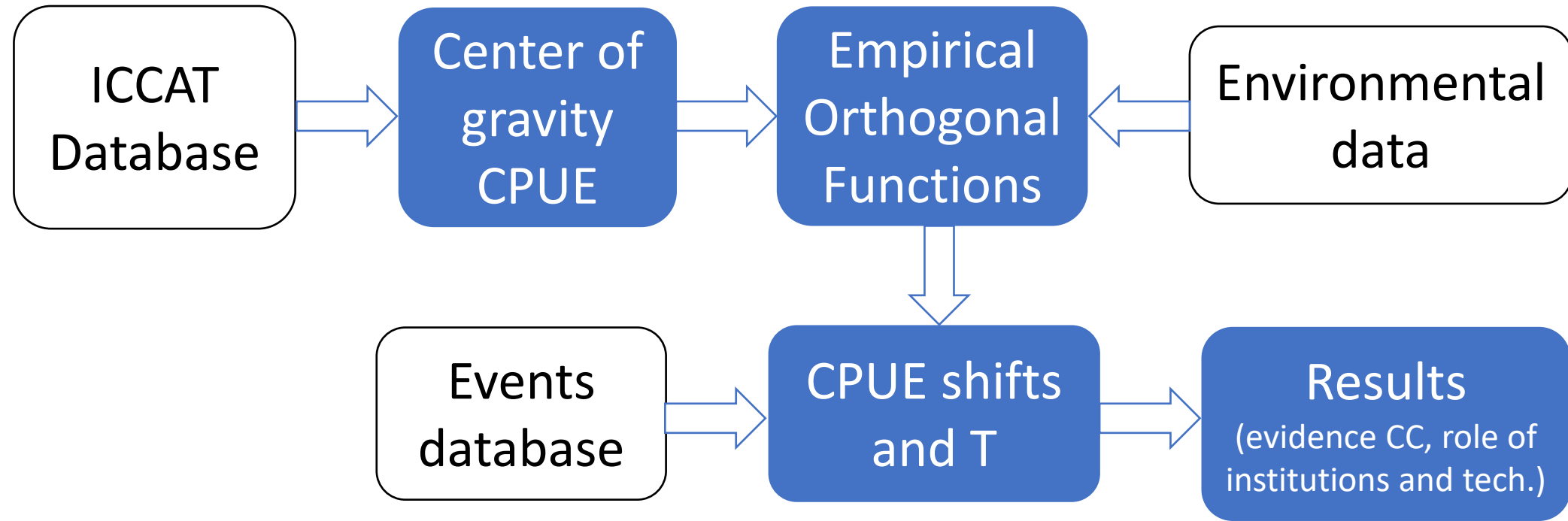
2. RESEARCH QUESTIONS

1. Is there evidence of climate change impacting the distribution of tropical tuna fisheries?



2. What has been the role of institutional/ technological events in these shifts?

3. METHODS



database

analysis

3. METHODS

ICCAT
Database

- Monthly catch and effort data (CPUE calculation: t/hour)
- Resolution: 1° x 1° aggregated to 5° x 5° and by season
- Time series: 1991-2015

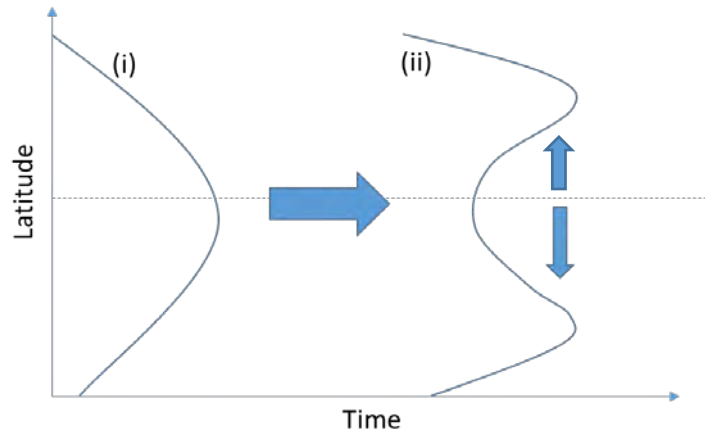


3 species	1 gear 2010-2016 (SCRS, 2017)
Yellowfin Tuna (YFT) Bigeye Tuna (BET) Skipjack Tuna (SKJ)	Purse seiners (PS) ~73% of total YFT landings ~36 of total BET landings ~81 of total SKJ landings

3. METHODS

Center of gravity CPUE

- Center of gravity (COG) of fleets per species and year (*Saraux et al., 2014*).
- Gear: PS
- East Atlantic



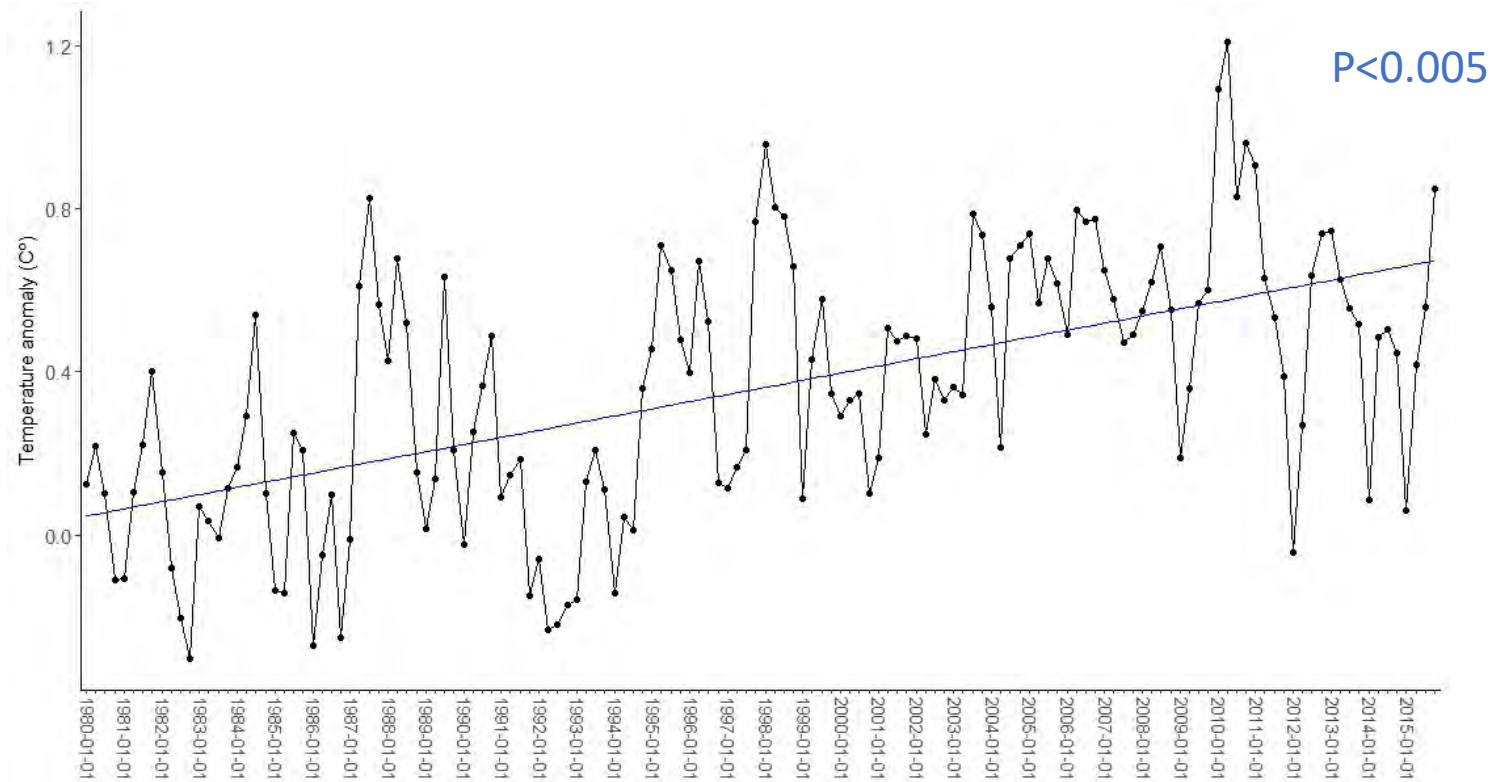
$$\text{COG} = \frac{\sum_{i=1}^n \text{Latitude}_i \cdot \text{CPUE}_i}{\sum_{i=1}^n \text{CPUE}_i}$$

COG N
COG S

3. METHODS

Environmental data

- Monthly SST anomaly
- 1991-2015
- 5°x5°
- Source: NOAA Kaplan Extended SST V2 ([link](#))
- Aggregation by season



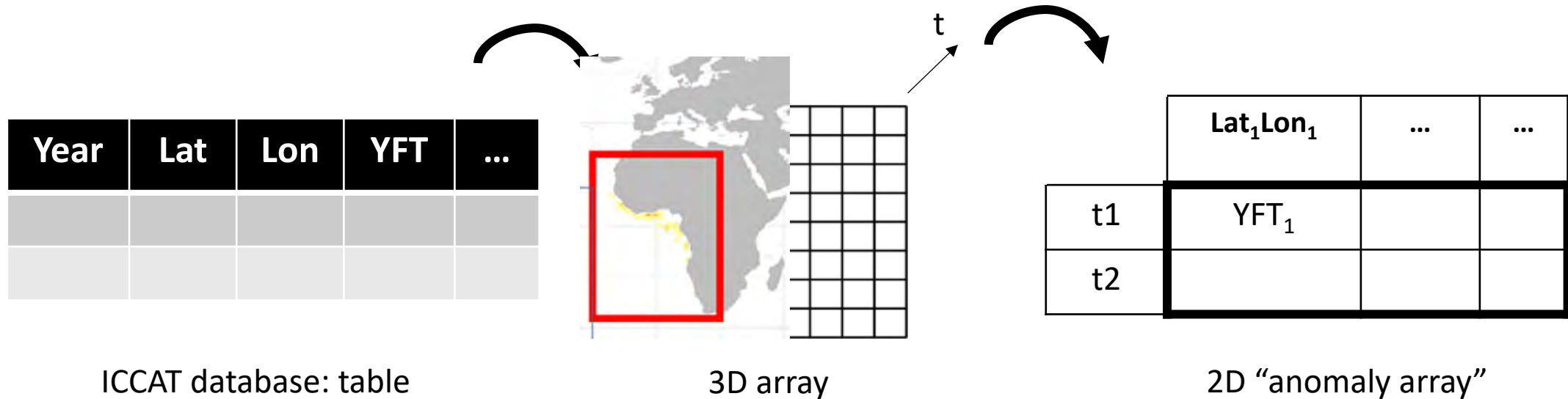
Temperature anomaly changes in the study period and area

3. METHODS

Empirical Orthogonal Functions

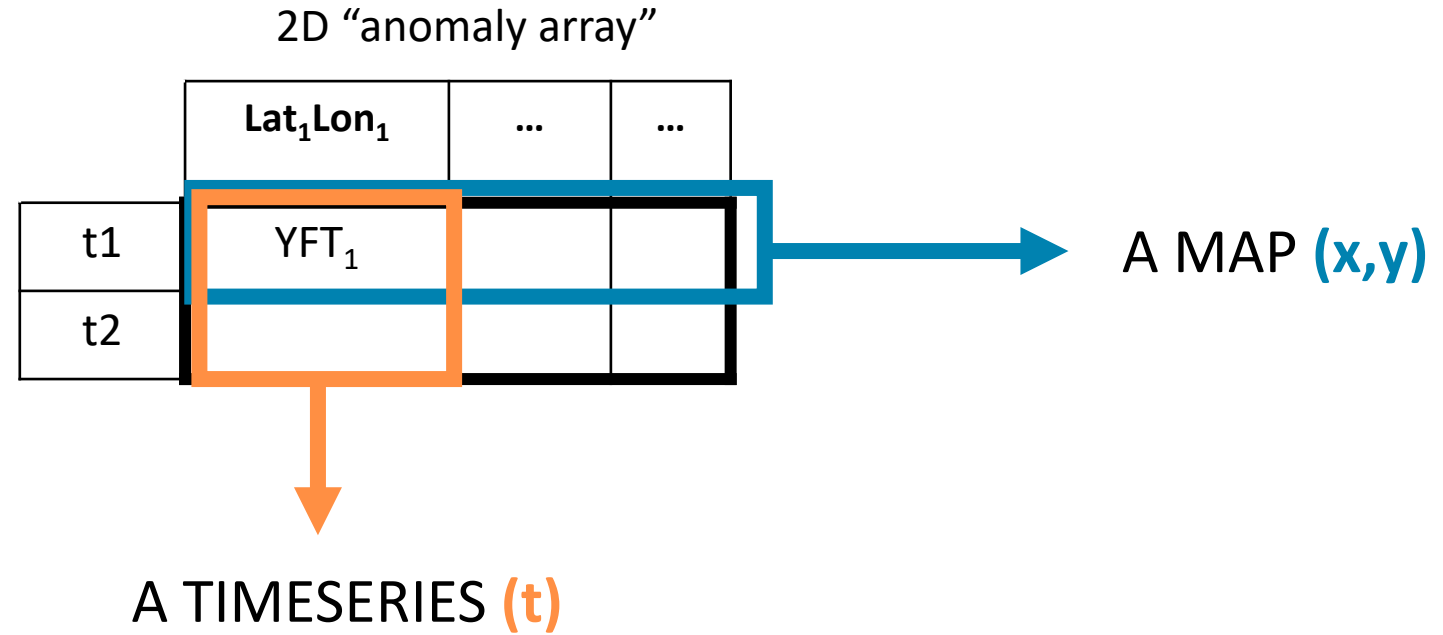
Empirical Orthogonal Functions (EOFs) of CPUE and T

- To study possible spatial modes (ie, patterns) of variability and how they change with time (*Saraux et al. 2014; Björnsson and Venegas 1997*)
- Correlation CPUE vs temperature



3. METHODS

Empirical
Orthogonal
Functions



3. METHODS

Empirical Orthogonal Functions

- DINEOF reconstruction (*Beckers et al. 2006; Gancedo et al. 2013*)
- Covariance matrix
- Eigenvector and eigenvalue problem solution
- % data variance (PC1 and EOF 1 max. value, then PC2, EOF2...)

$$"X(x, y, t) = \sum_{m=1}^M PC_m(t) \cdot EOF_m(x, y)"$$

Variation of
spatial modes
through time

Spatial modes

3. METHODS

Events
database

Timeline of institutional and technological events

Institutional-Access

Data on EU fishing agreements
1991 – 2015 (*Le Manach et al. 2013 and own elaboration from agreements*)

Institutional-Conservation

Events data on TACs, capacity limit,
closures, 3 species status
1991-2015 (*ICCAT resolutions*)

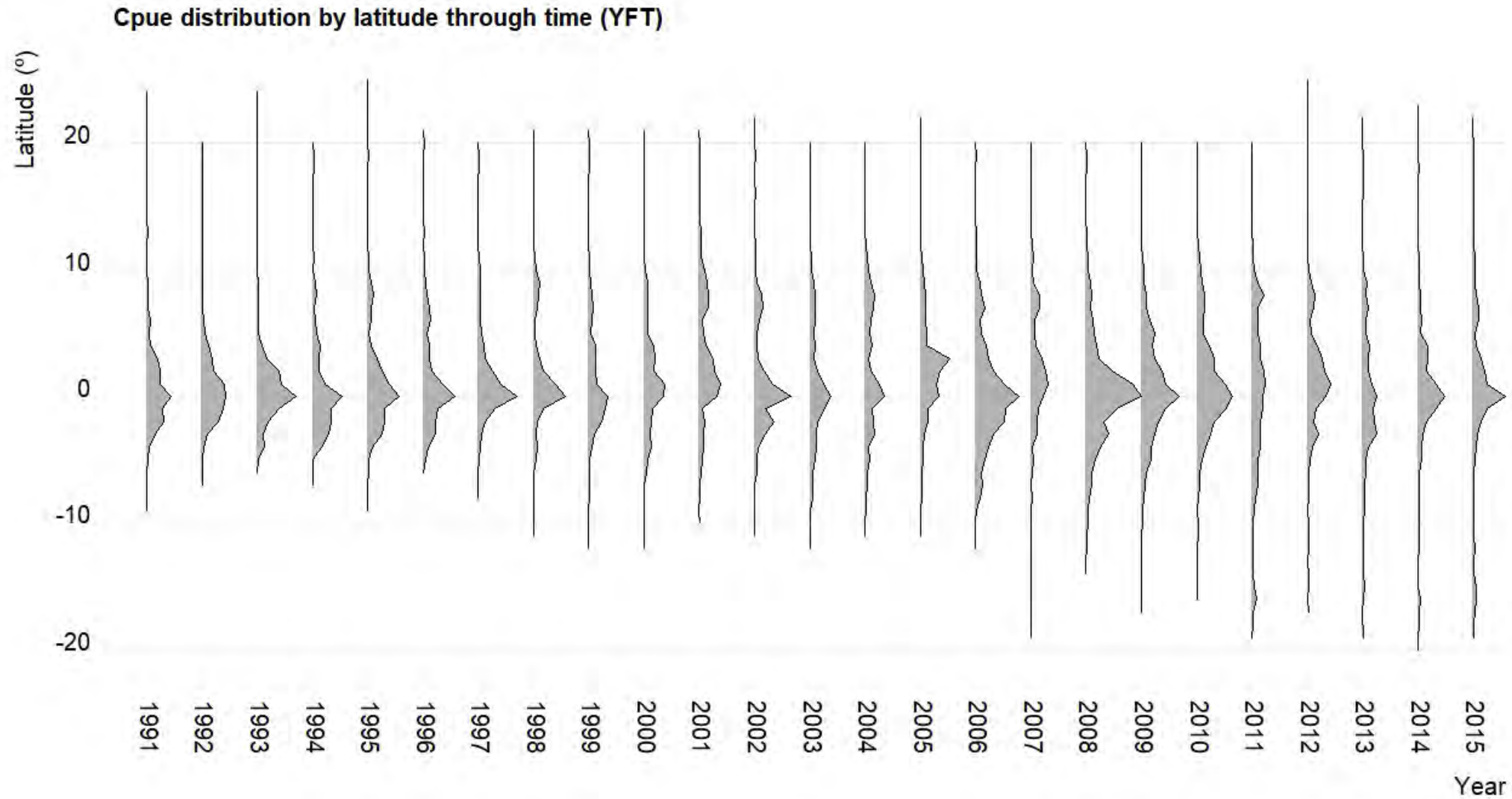


Technological changes

Events data on technological
changes 1991-2015 (*López et al. 2014*)

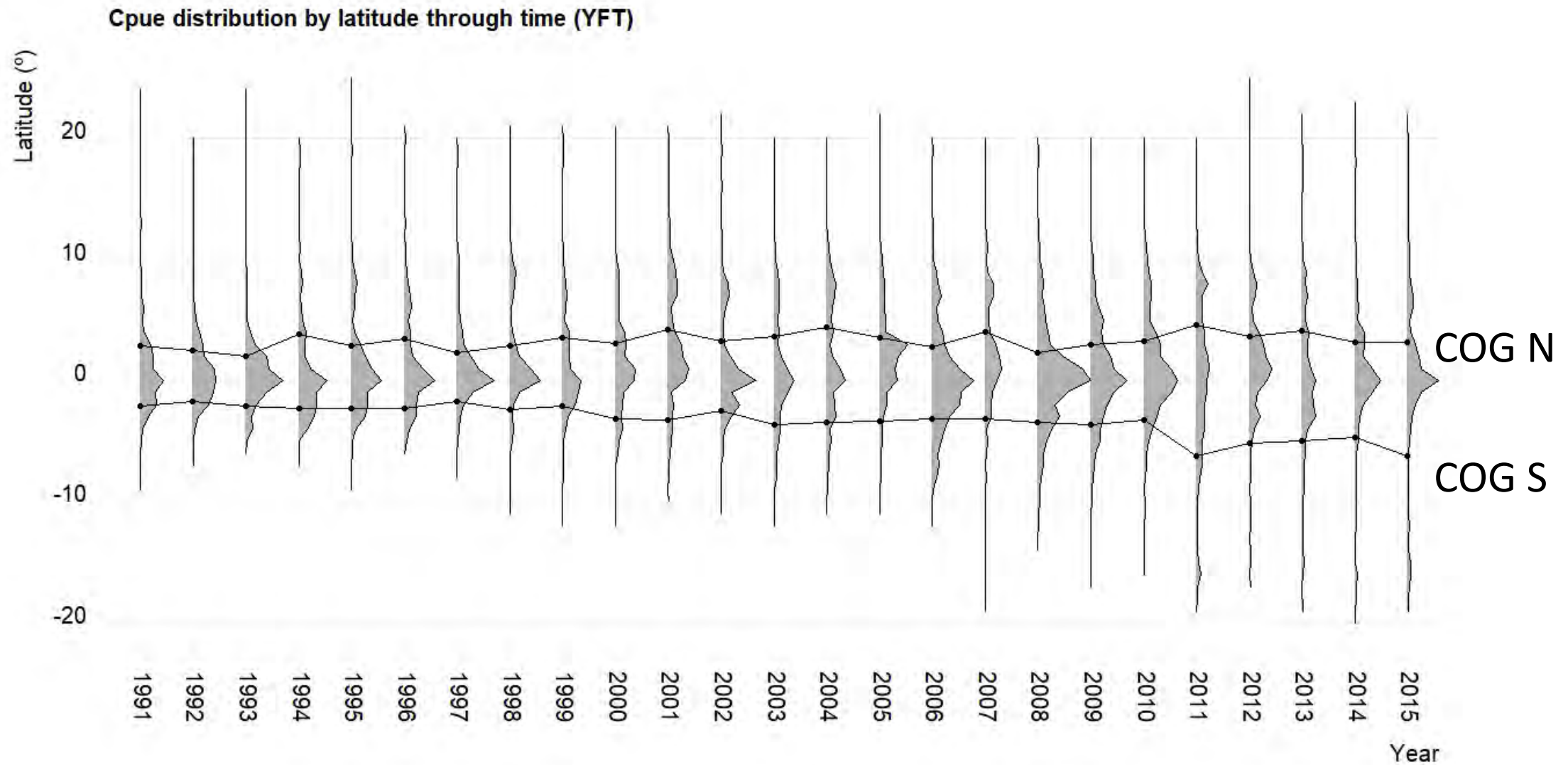
4. RESULTS

Changes in CPUE distribution



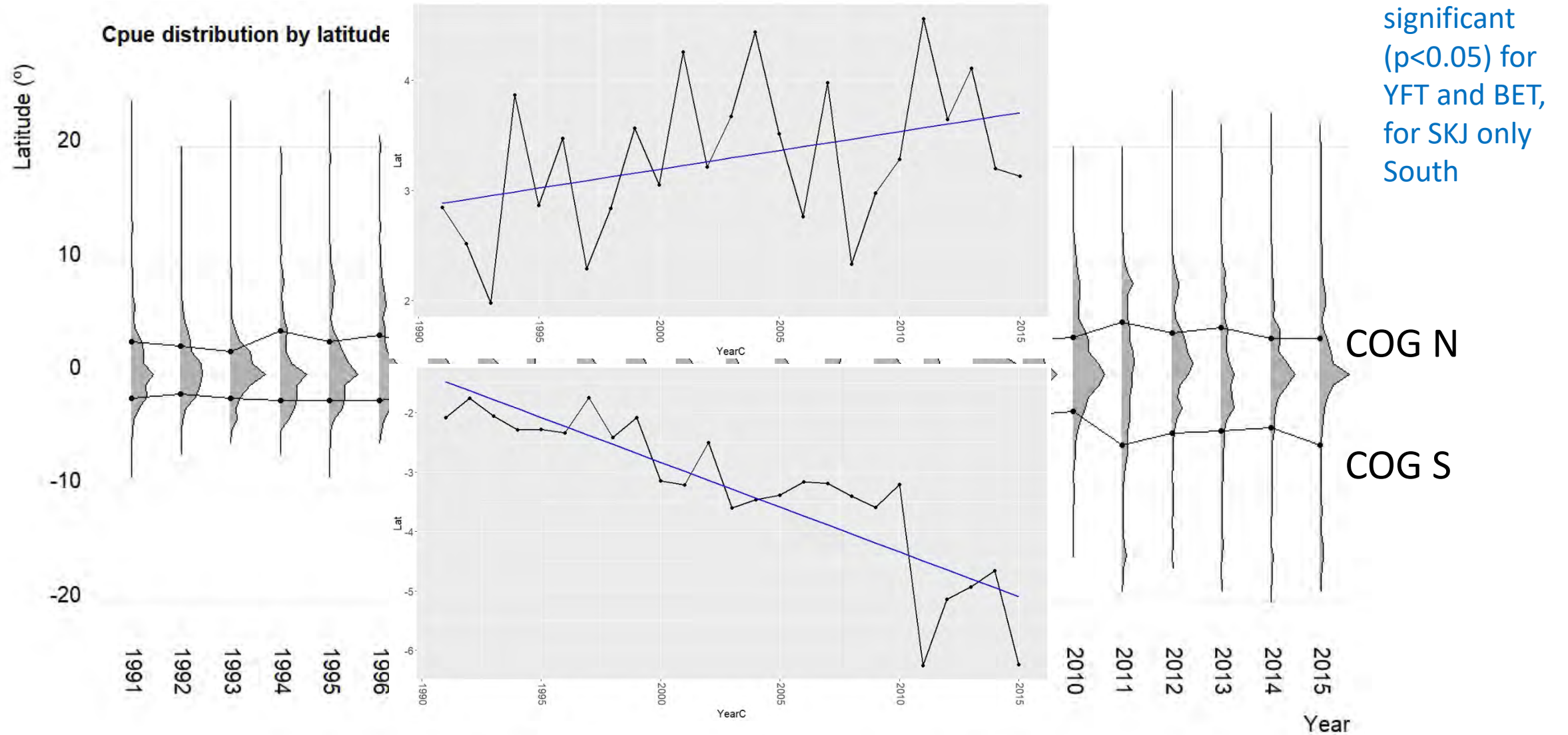
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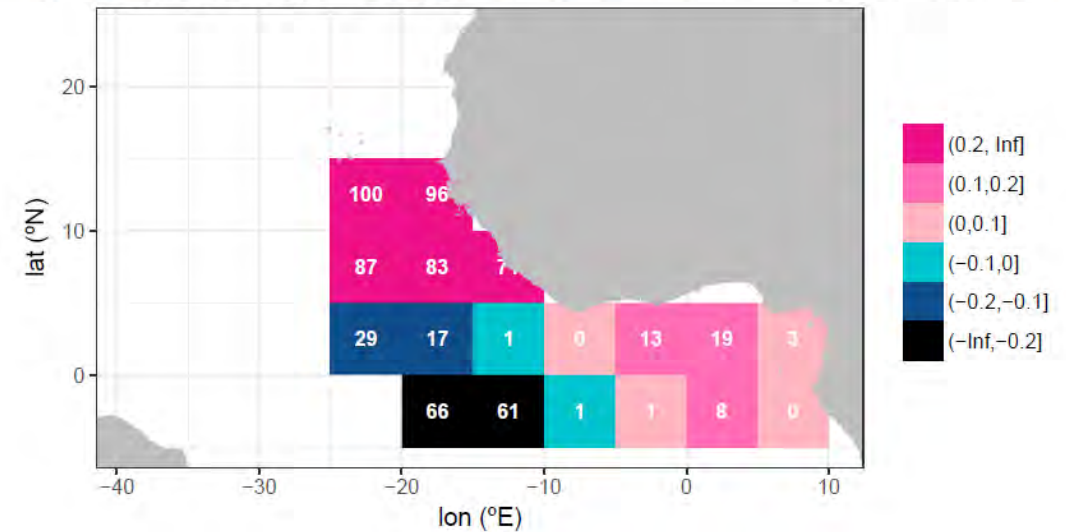
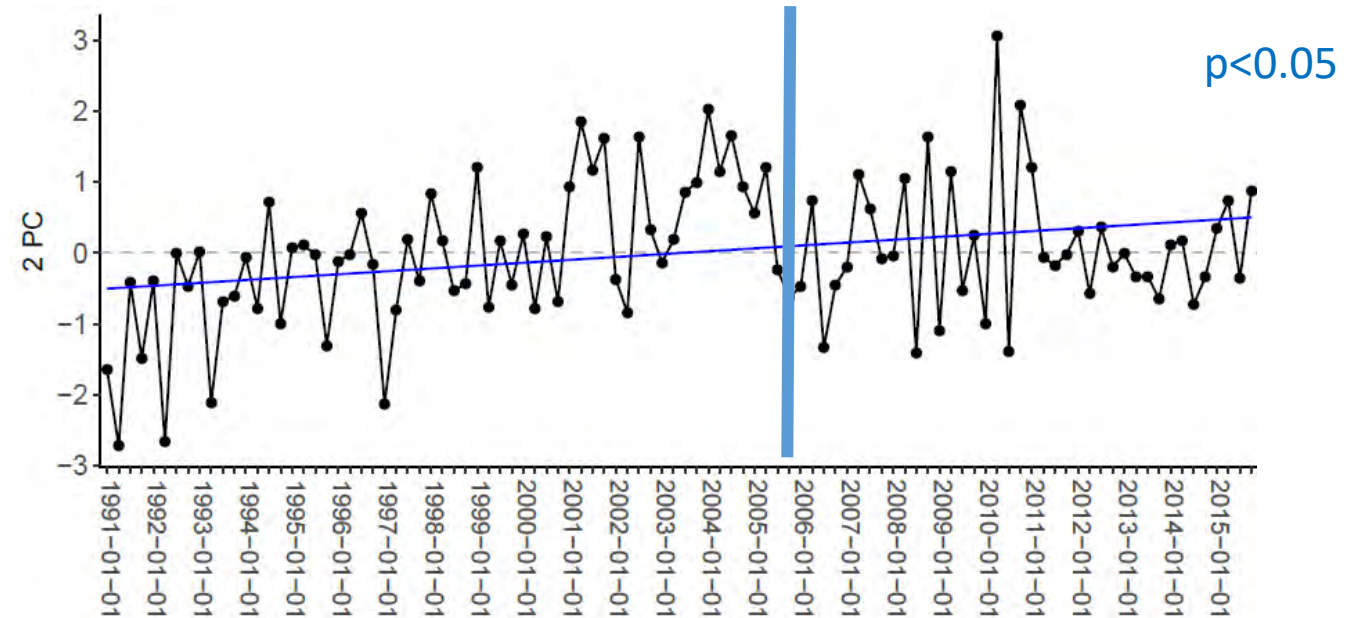
Changes in CPUE distribution



4. RESULTS

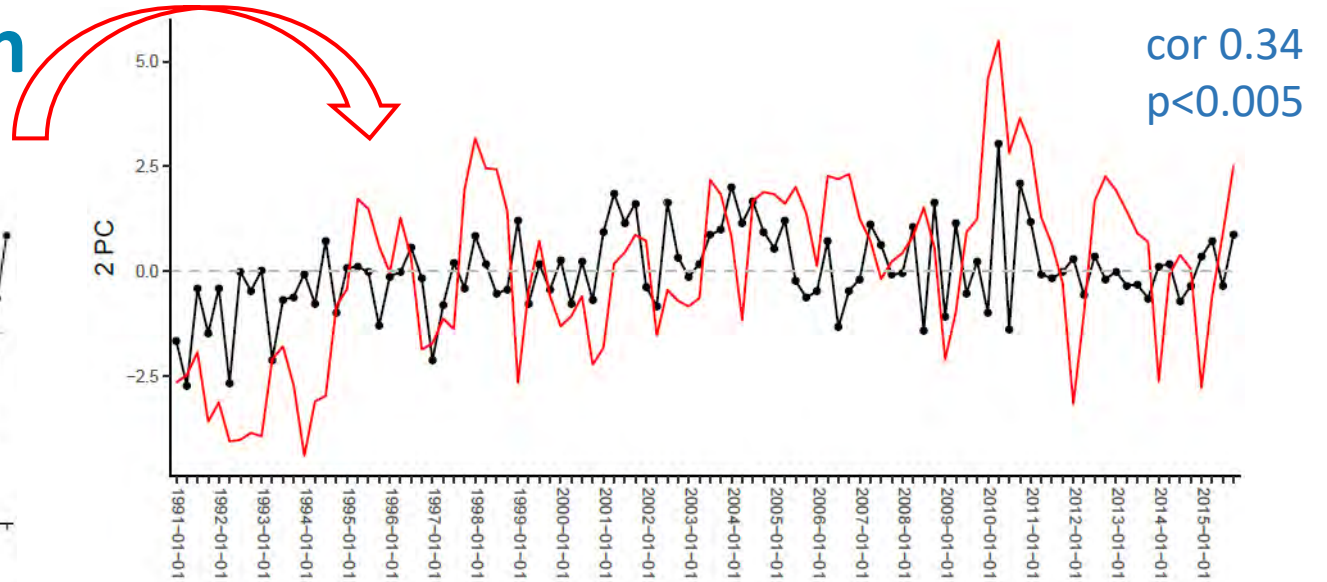
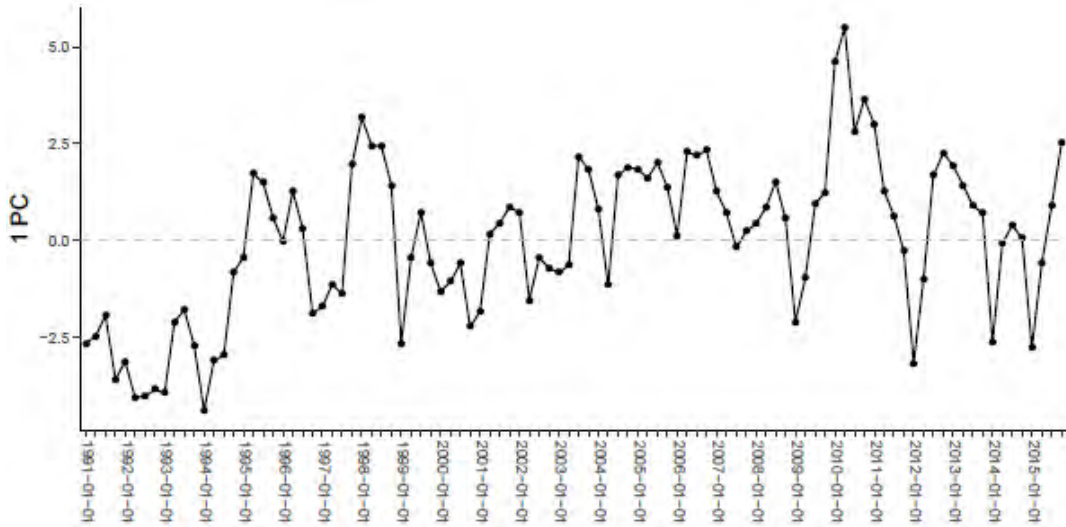
Changes in CPUE distribution

EOFs, YFT (anomaly)

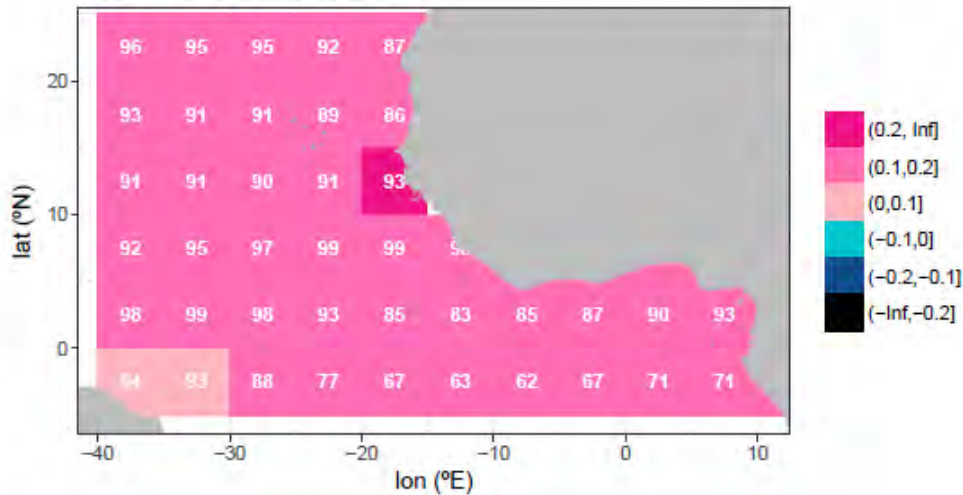


4. RESULTS

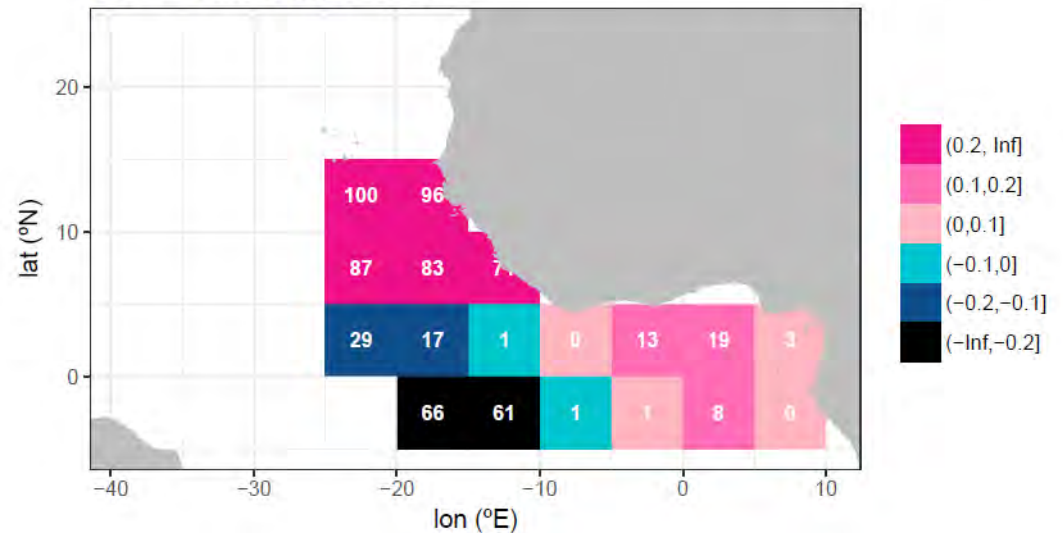
Changes in CPUE distribution



1 EOF - 62 % of total variance



2 EOF - 34 % of total variance



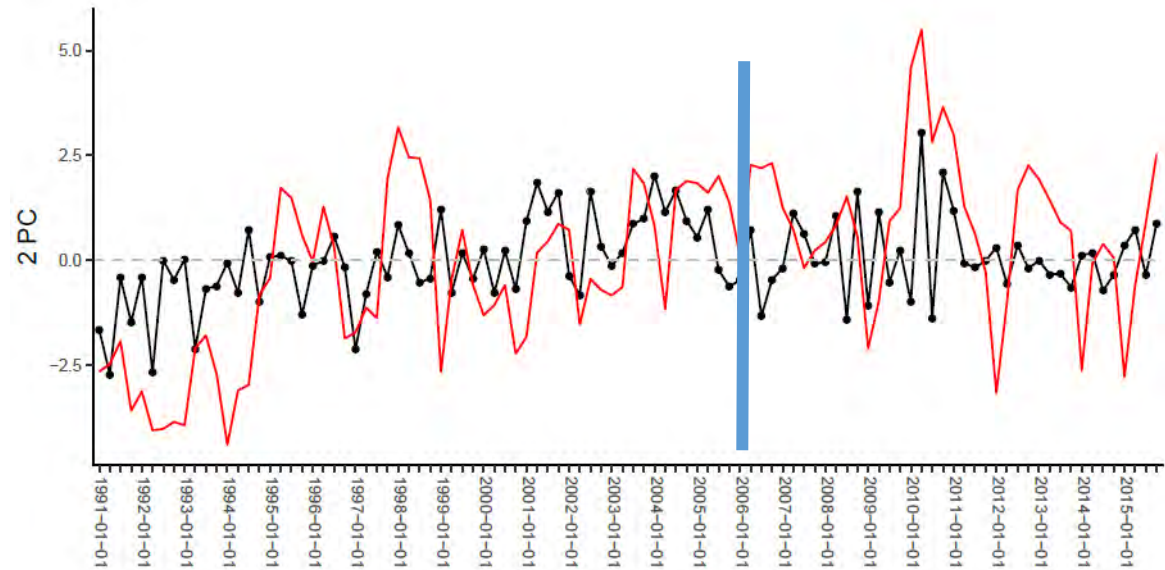
4. RESULTS

Changes in CPUE distribution

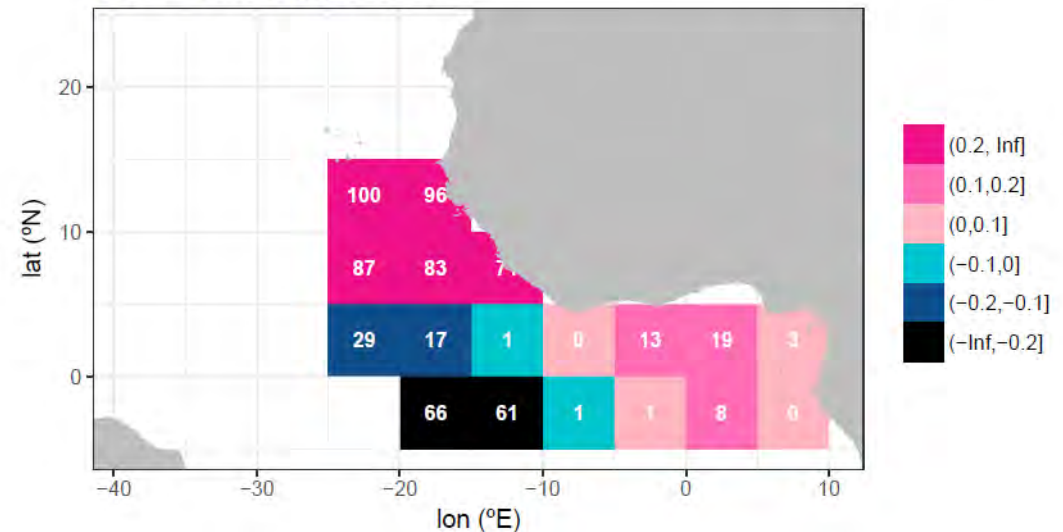
There is a significant “weak” correlation between PC1 SST ANOMALY and PC2 of the 3 species during the study period **1991-2015**

But when dividing the time series...

No correlation between 2006-2015
FADs influence + time lapse?

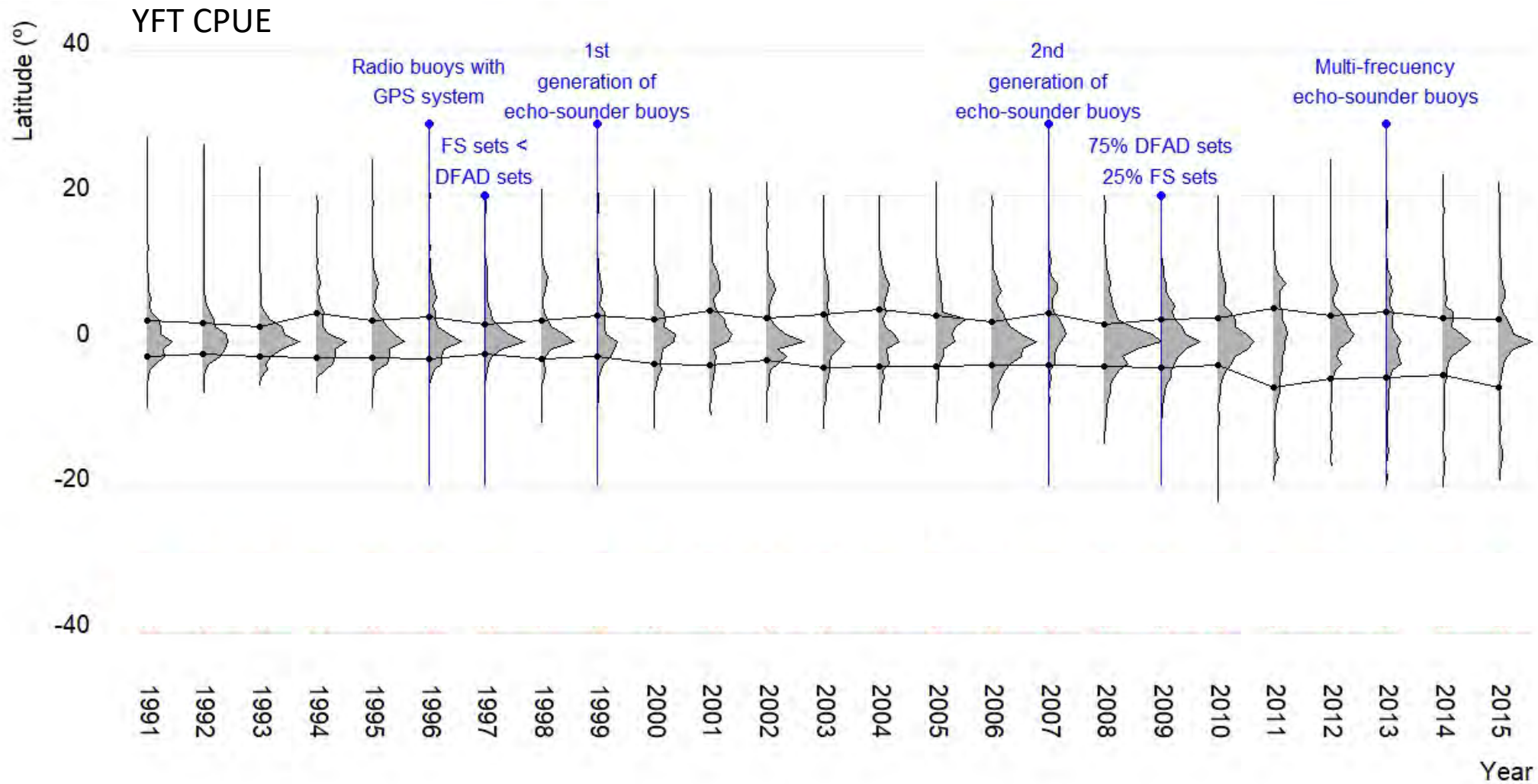


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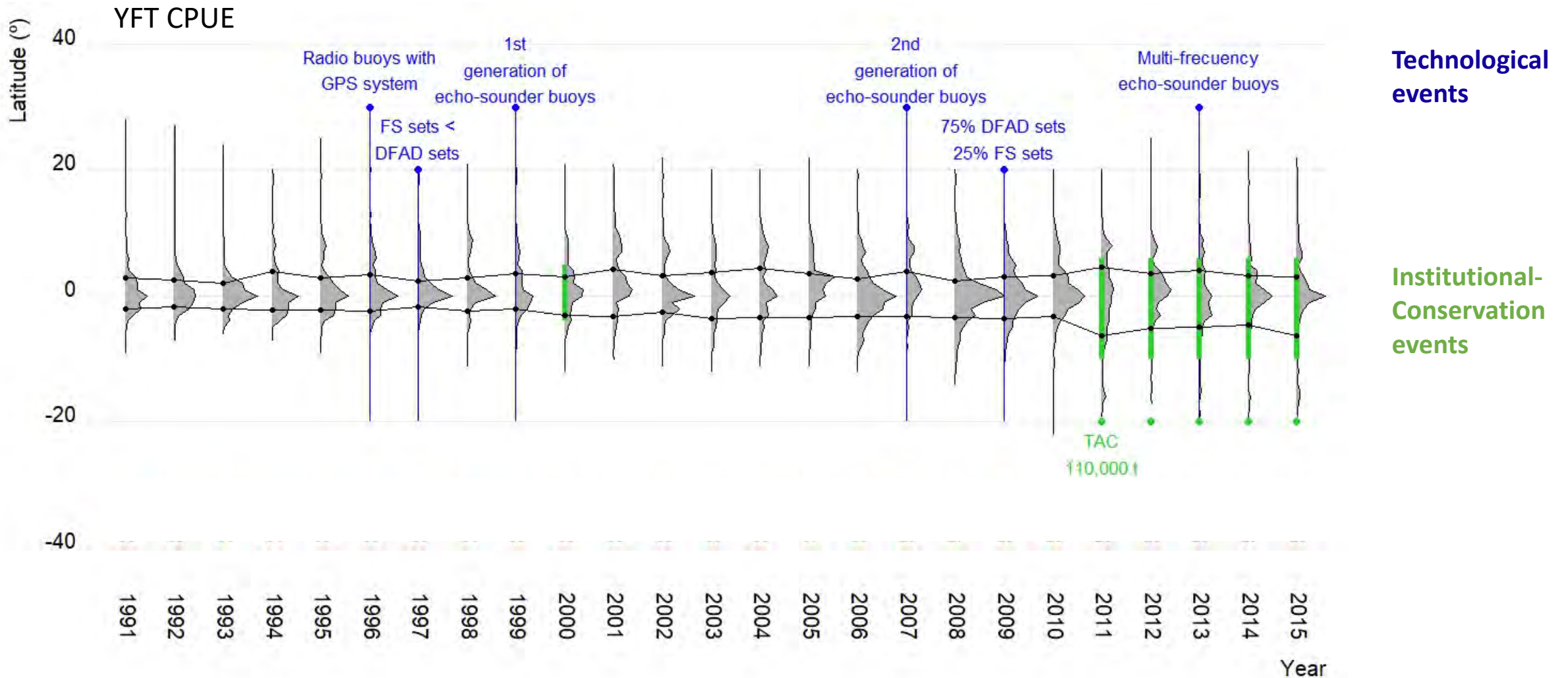
Timeline of institutional and technological events



Technological events

4. RESULTS

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4. RESULTS

Timeline of instit

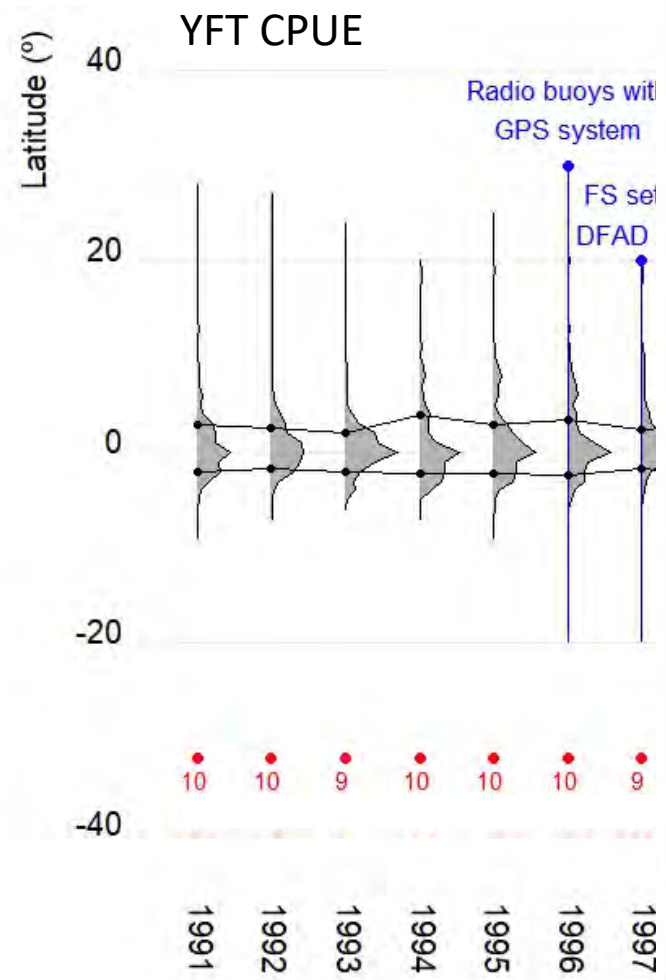
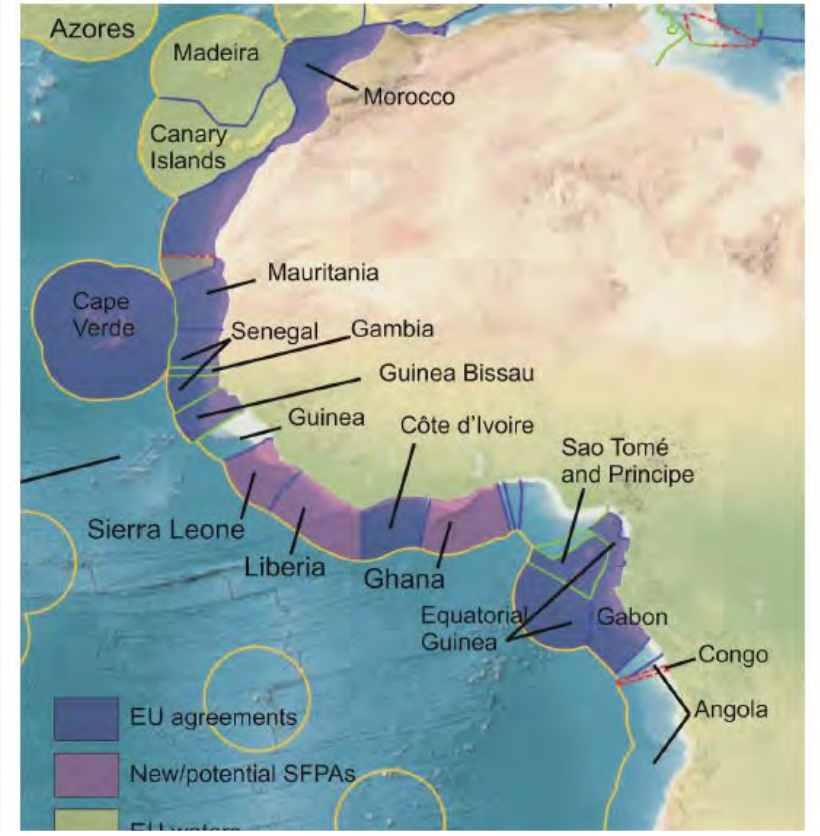


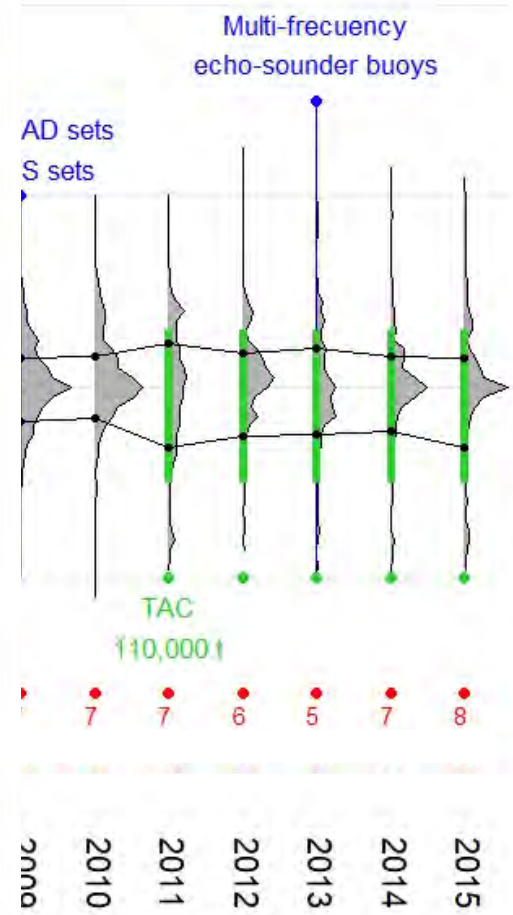
Figure 1 – EU agreements in West Africa, including new and potential SFPAs



Data source: MarineRegions.org, accessed on 27 June 2016. Different types of boundaries are indicated for the waters of coastal states: in yellow the 200 nautical mile line, in green boundaries established by treaties, in blue the median lines and in red disputed boundaries (also in figures 2 and 3).

(EU briefing, 2016)

Technological events



Technological events

Institutional-Conservation events

Institutional-access (EU agreements)

Year

5. MAIN IDEAS

- Center of gravity moves polewards
- Changes in CPUE distribution are correlated with SST changes
- However, this relationship is until the “FADs technological bloom” (1991-2005)
- Conservation and access agreements events happened in the last period, suggesting that these may have a bigger role in CPUE distribution than SST (2006-2015)