

Half century at-sea monitoring on top predators in the Bay of Biscay: changes in relative abundances and impacts of oceano-climatic conditions

E. Milon¹, I. Castège¹, Jean d’Elbée², Frank D’Amico³

1 Centre de la Mer de Biarritz, Boulevard du Prince de Galles, 64 200, Biarritz, France.
2 LAPHY, 1341 chemin d’Agerrea 64210 Ahetze, France
3 UNIVERSITE DE PAU & PAYS ADOUR, Laboratoire de Mathématiques et de leurs Applications de Pau UMR CNRS 5142 (FED 4155 MIRA), 64600 Anglet, France.

INTRODUCTION

The Bay of Biscay is an important area for marine biodiversity, which encompasses cold and hot water species. In this study, we examine the changes in relative abundances about 17 species in relation to climate changes in the south of the Bay of Biscay performing a multivariate oceanic and climatic index (MOCI) called SBC (South Biscay Climate Index; Hémery, *et al.* 2008).

MOCI represent integrated synthetic indicators capable of better quantifying and communicating relevant environmental changes than single (García-Reyes, & Sydeman, 2017).



METHODS

SBC index: 36 initial variables describing the oceanic and atmospheric conditions and characterizing the four annual seasons in the study area

Data: long-term dataset from 1976 to 2023 (115,586 data) of seabirds and cetaceans using a standardized monitoring based on line transects from ships (Castège & Hémery, 2009) and focused on the south of the Bay of Biscay. 17 species sorted in relation to their thermal preferendum: hot water, cold water or no preferendum.

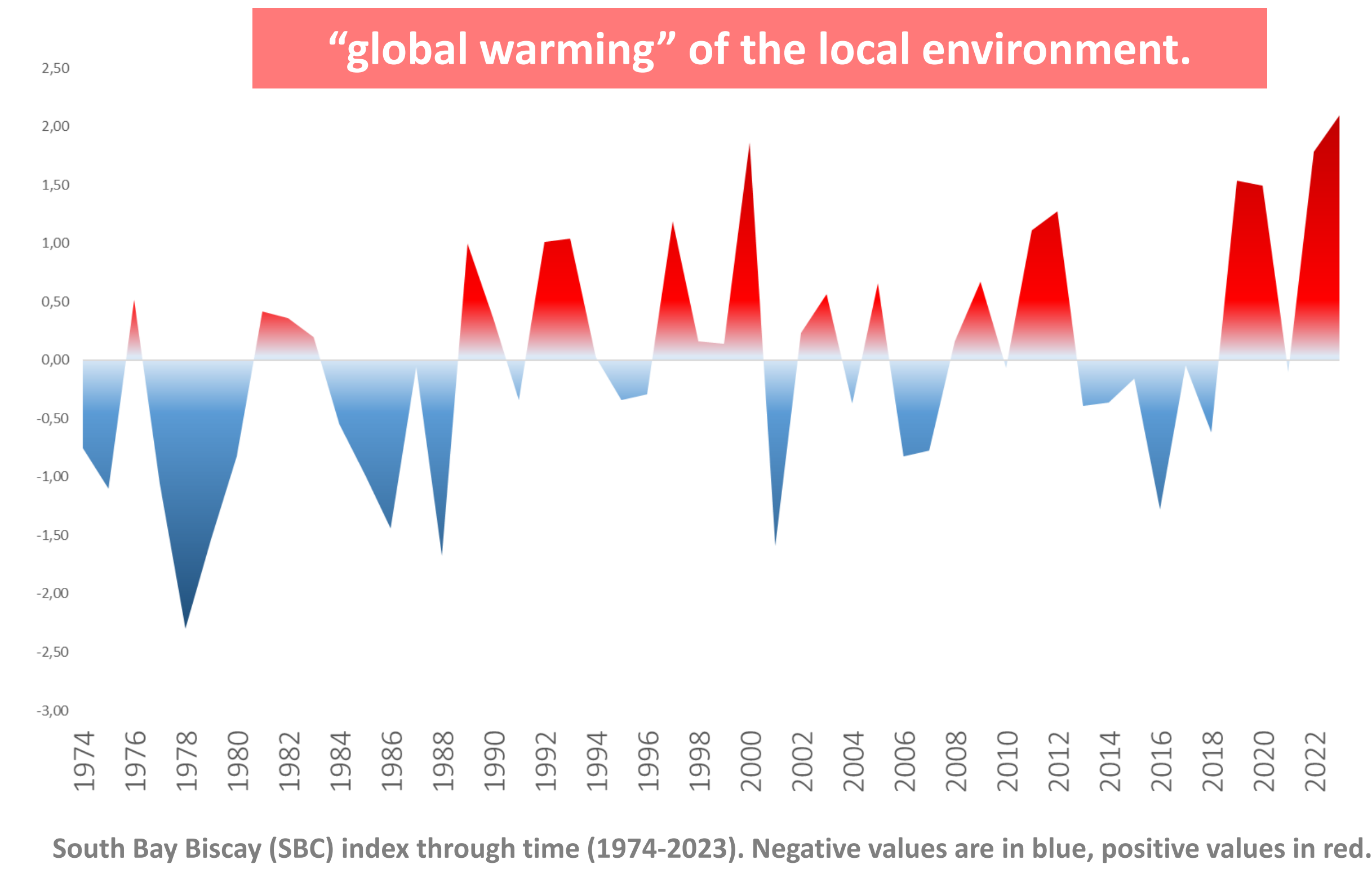
Statistical approach: Pearson, Spearman and Kendall test; Principal Component Analysis

Oceanic variables	Atmospheric variables
- Sea Surface Temperature (SST) - Sea surface agitation	- Atmospheric pressure - Temperature (mean and max) - Cumulated rainfall - Sunshine duration - Maximal instantaneous wind: - number of days <25 km/h - number of days >60 km/h
Data from 1974 to 2023	
PCA first axis (18,79%) = SBC index	

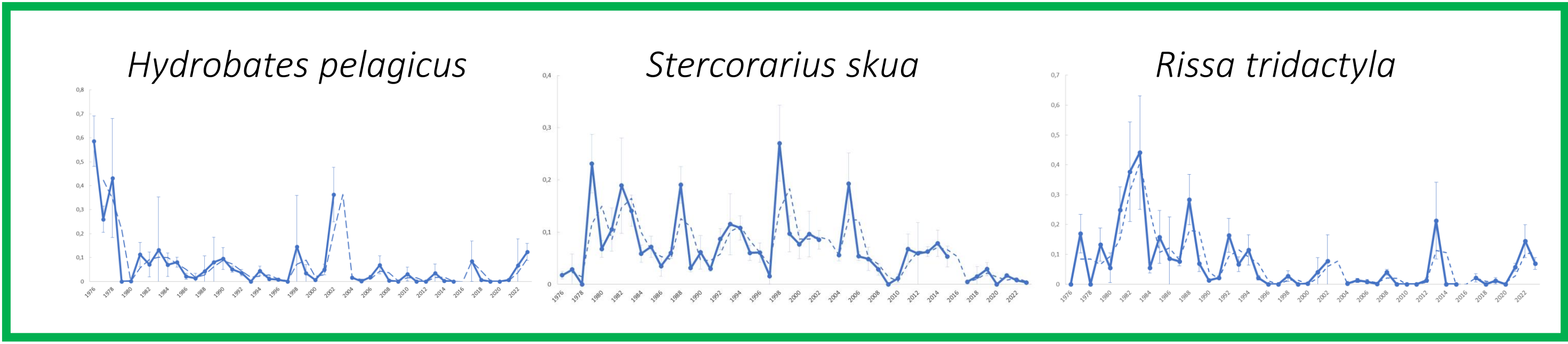
RESULTS

Oceano-climatic changes

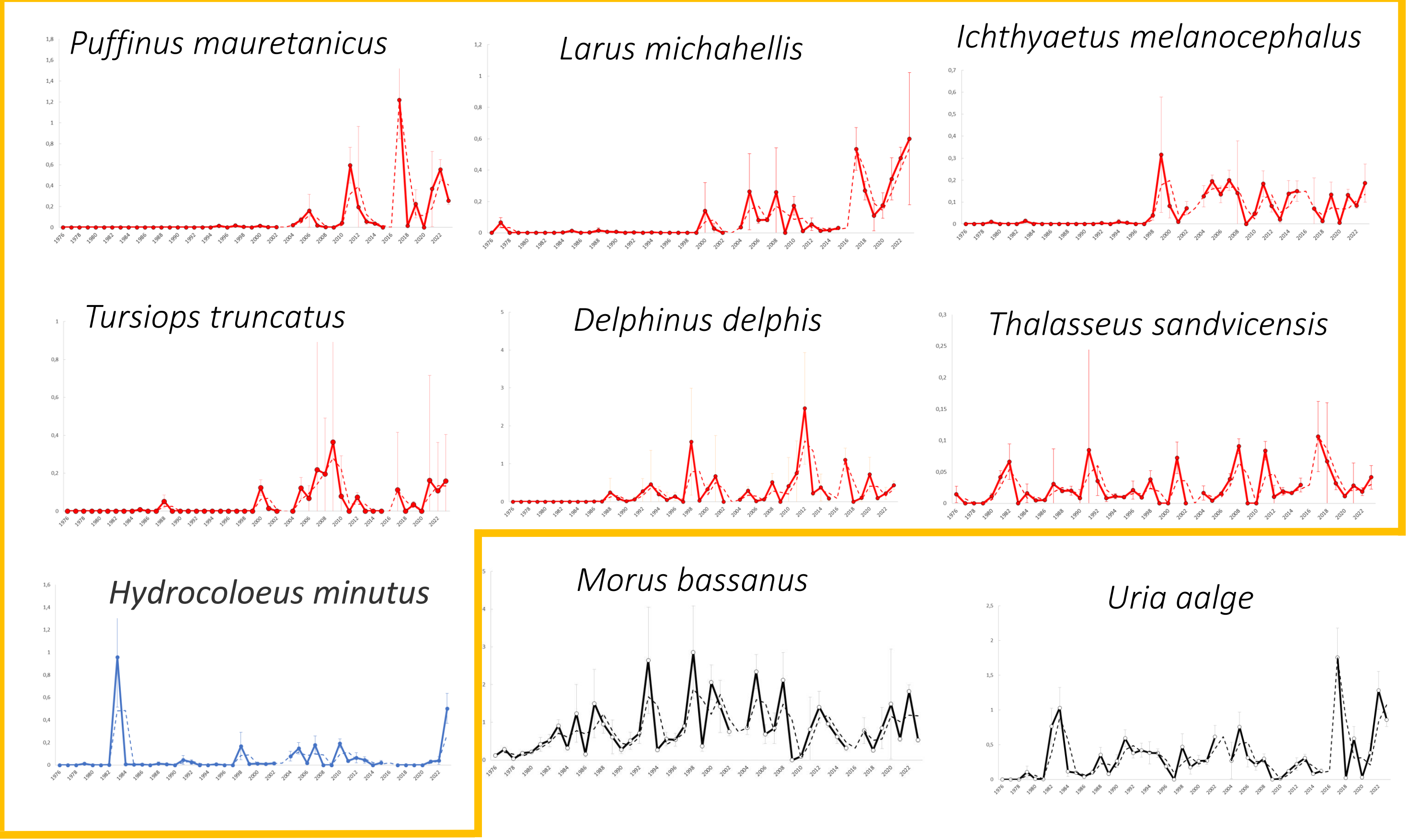
- Correlation between SBC index and winter NAO ($\rho = + 0.457$; $p=0.001$)
- SBC index significant increases** ($\tau = + 0.259$; $p=0.008$)



Significant

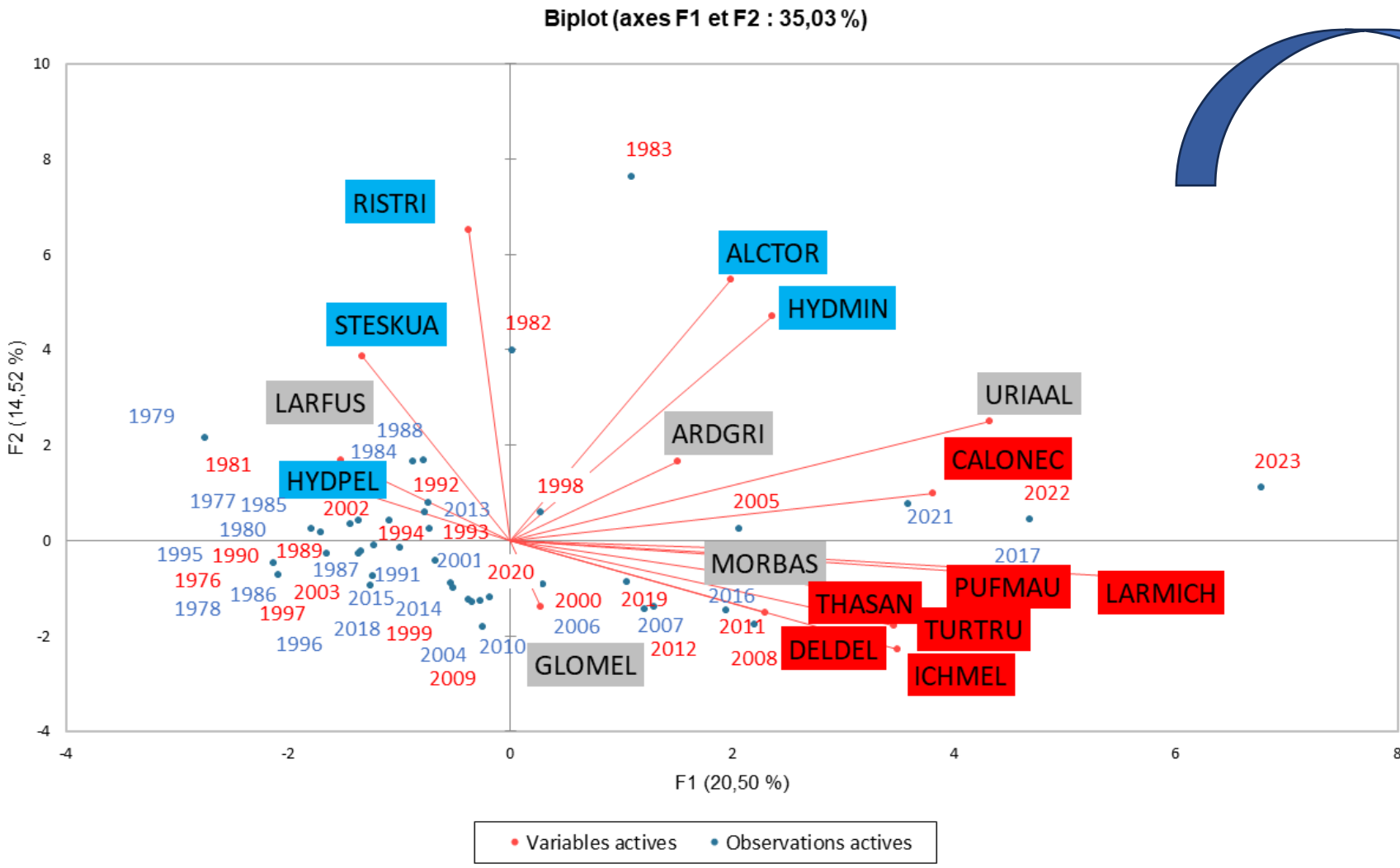


Significant

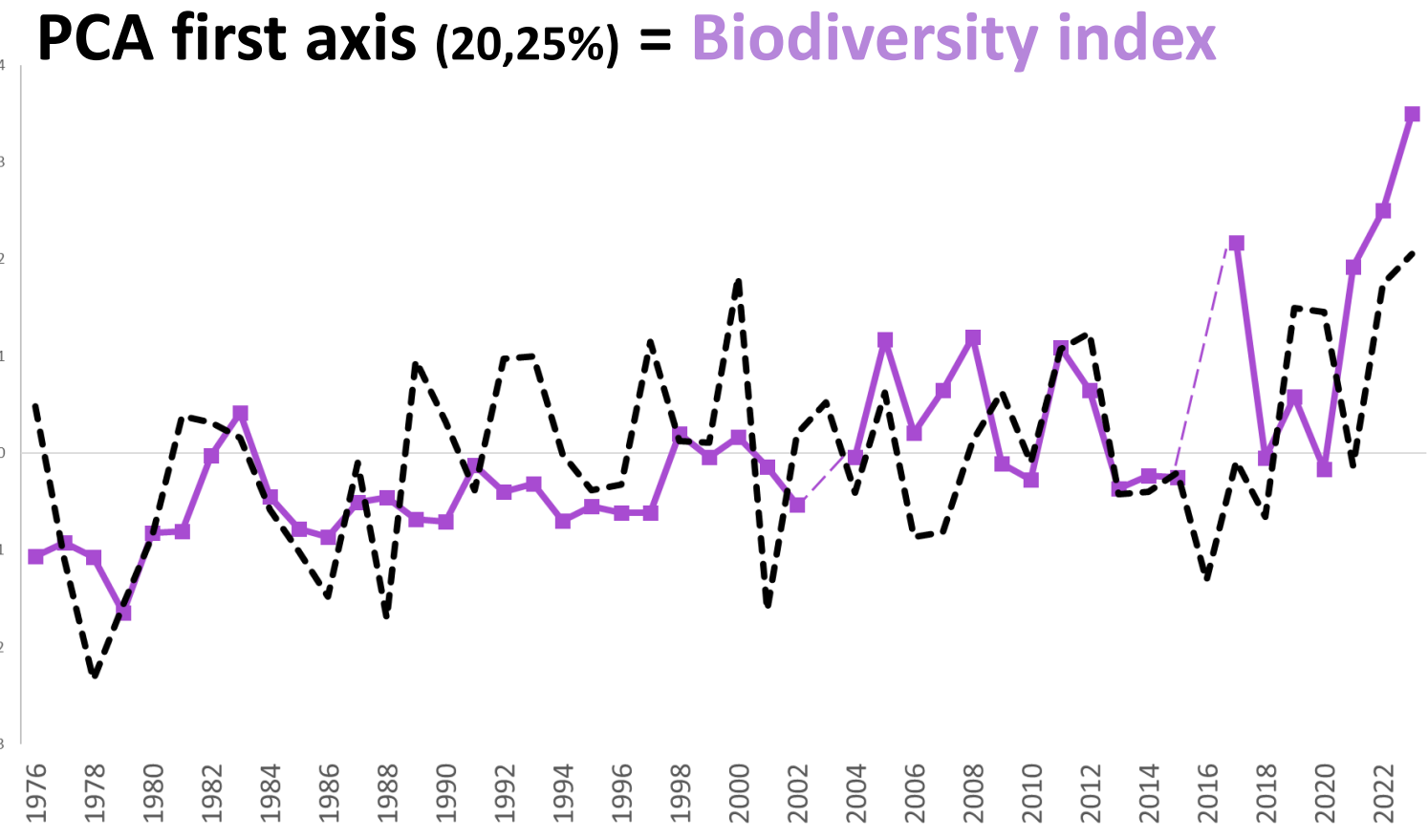


Changes in relation with oceano-climatic conditions at community level

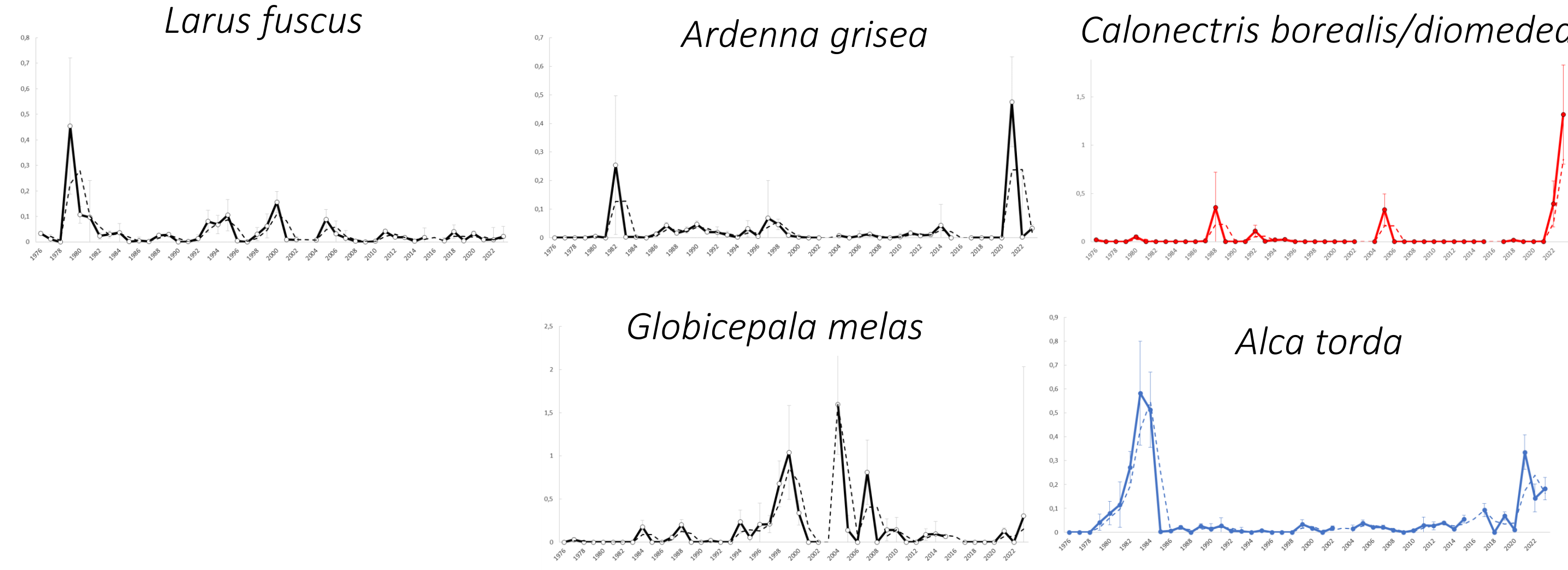
Biodiversity index increases ($\tau = + 0.585$; $p < 0.001$) in relation to SBC index ($\rho = + 0.341$; $p=0,018$)



PCA of the 17 species according to their thermal preferendum (blue= cold water; red = hot water; grey = no thermal preferendum). Years (1976-2023) are colored by positive (red) or negative (blue) value of SBC index



Temporal evolution of SBC index (dotted black lines) and the biodiversity index (purple line) from 1976 to 2023 in the south of the Bay of Biscay.



DISCUSSION

This studies is based on a **48 years at-sea monitoring on seabirds and cetaceans**. We revealed **deep changes in megafauna community explained at ~ 34% by oceano-climatic conditions**. Further studies are needed to investigate other parameters such as prey availability.

As top predators, marine mammals and seabirds are **good indicators and can contribute to our understanding of climate change effects on marine ecosystems**. Besides theses researches are fundamental to **species conservation** in the context of MPAs management.

This work is a part of the program ERMMA



References

CASTÈGE, I., HÉMER, G. (coords), 2009. Oiseaux marins et cétacés du golfe de Gascogne. Répartition, évolution des populations et éléments pour la définition des aires marines protégées. Biotopie, Mèze ; Muséum national d'Histoire naturelle, Paris, 176 p.

GARCÍA-REYES, M., SYDEMAN, W.J., 2017. California Multivariate Ocean Climate Indicator (MOCI) and marine ecosystem dynamics. Ecological Indicators, 72, 521–529.

HÉMER, G., D'AMICO, F., CASTÈGE, I., DUPONT, B., D'ELBÉE, J., LALANNE, Y., MOUCHÈS, C. 2008. Detecting the impact of oceano-climatic changes on marine ecosystems using a multivariate index: The case of the Bay of Biscay (North Atlantic-European Ocean). Global Change Biology 14: 27–38.