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Mesozooplankton variability in the Bay of Marseille (NW Mediterranean): towards understanding the trophic context of small pelagics

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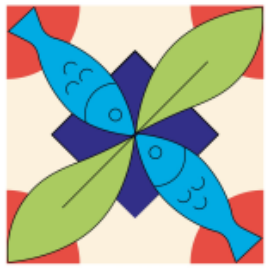
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SIBECOL
AIL MEETING
2022
3-8 JULY AVEIRO

Mesozooplankton variability in the Bay of Marseille (NW Mediterranean): towards understanding the trophic context of small pelagics.

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Institut Méditerranéen d'Océanographie, Aix-Marseille Université, campus Luminy, 13288 Marseille

Financial support: Région PACA (90%), Parc National des Calanques (10%)

Région



Provence-Alpes-Côte d'Azur



The Bay of Marseille: a particular environment

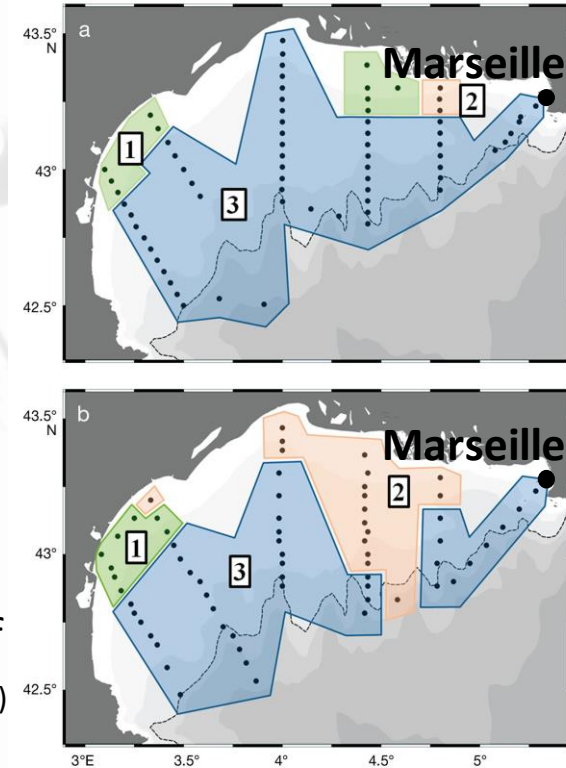


- Under coastal influence...
 - Anthropic pressures
 - Punctual phenomena
- ...and offshore influence:
 - Intrusion of North current
 - Deep convection

The Bay of Marseille: a particular environment



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- Zooplanktonic habitats characteristic of continental shelf of the Gulf of Lion (Espinasse et al. 2014)



The Bay of Marseille: a particular environment



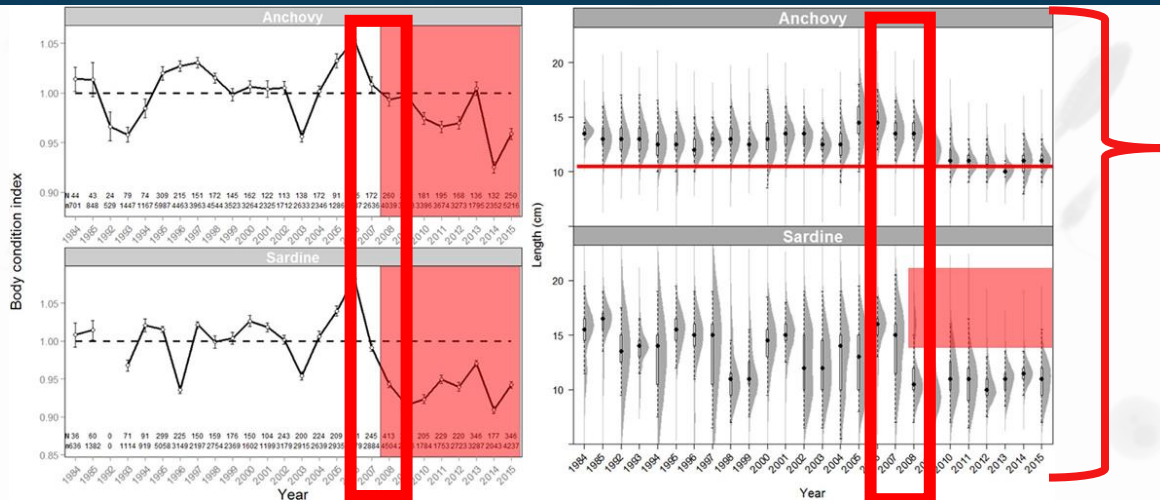
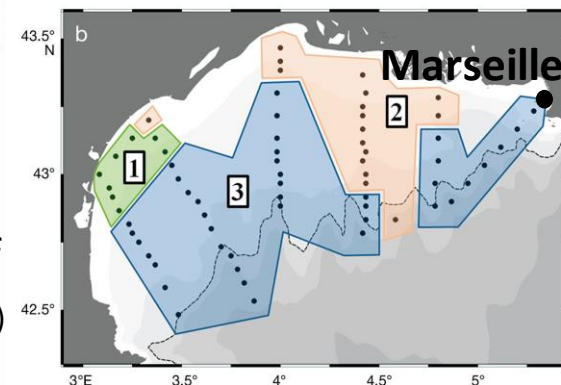
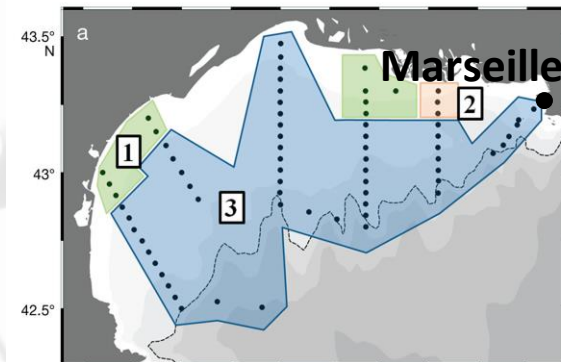
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➤ Zooplanktonic habitats characteristic of continental shelf of the Gulf of Lion (Espinasse et al. 2014)

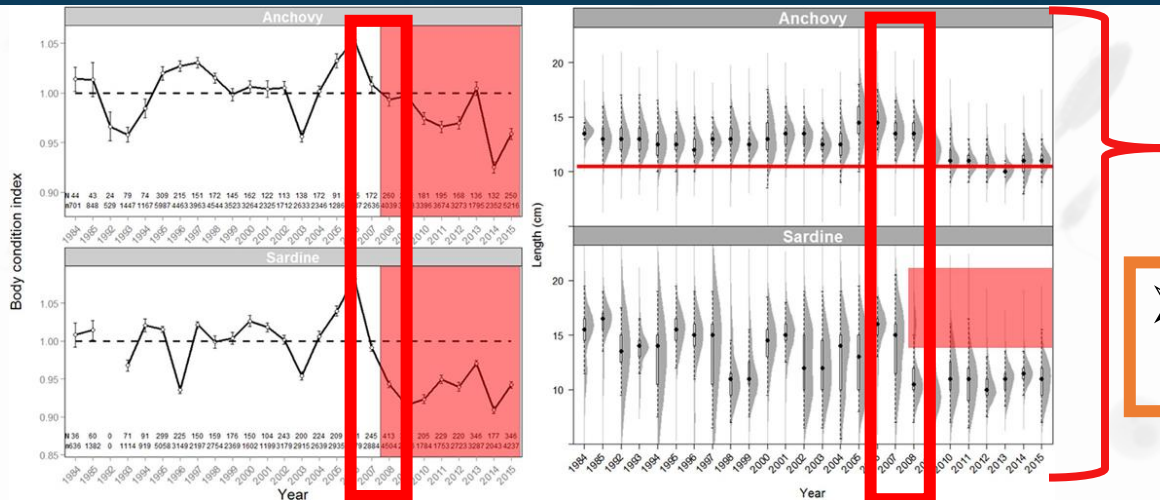
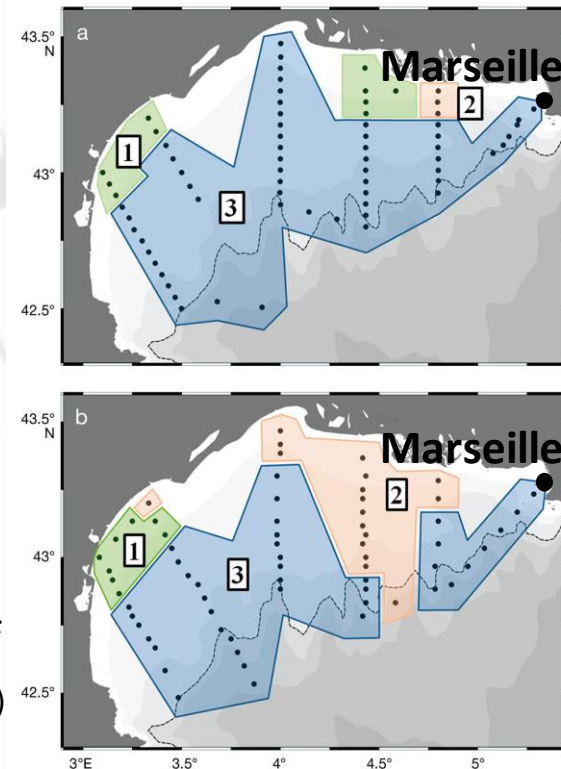


In parallel, diminution of body condition of small pelagic fish in the Gulf of Lion, around 2008 (van Beveren et al. 2014, Saraux et al. 2019)

The Bay of Marseille: a particular environment



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➤ Since 2005, bi-weekly monitoring of zooplankton and environmental conditions (SOMLIT) in the Bay of Marseille.

The Bay of Marseille monitoring allow to study the detailed biological and physico-chemical zooplankton environment.

Biological and physico-chemical environment

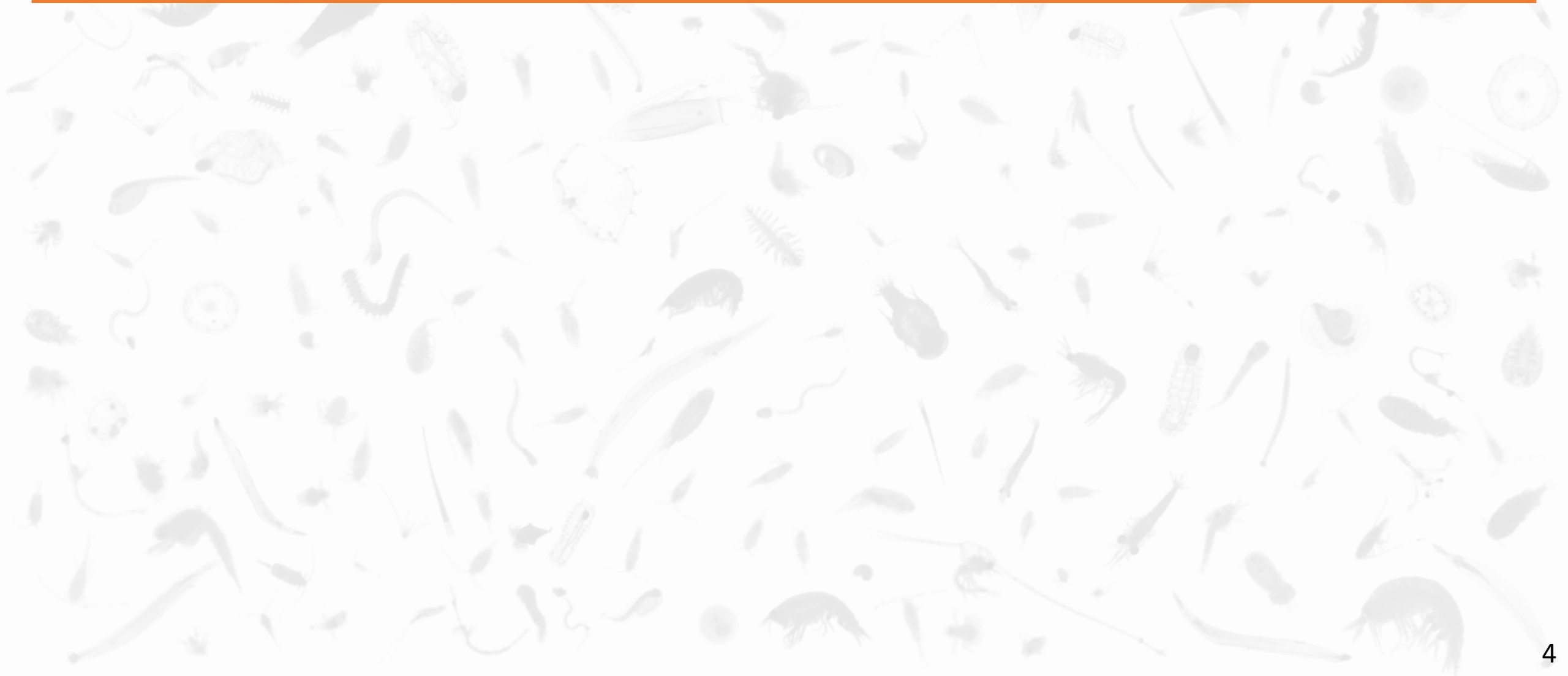
Nature of the variable	Number of variables	Example
Climatic index	2	West Mediterranean Oscillations
Meteorological	2	Precipitations
Somlit (physico-chemical)	12	Temperature, salinity, oxygene
Microphytoplankton <i>(2010-2013, 2016-2021)</i>	2	Ratio Diat:Dino
Flow cytometry <i>(since 2009)</i>	16	Abundance of picoplankton, picoplankton size
TOTAL	34	

Zooplankton compartment

Nature of the variable <i>(Acquisition mode)</i>	Nombre of variables	Example or remark
Size class biomass <i>(weighing)</i>	4	Biomass 200-300 μm
Community structure <i>(imaging)</i>	3	Indexes derived from abundance tables
Size structure <i>(imaging)</i>	2	Indexes derived from functional PCA of individual size
Abundance <i>(imaging)</i>	14	Abundance of <i>calanoids</i> , total zooplankton
TOTAL	23	

Aims:

- To explore different modes of zooplankton variations and their link with environmental modification.
- To furnish elements at the understanding of trophic context of small pelagic fish.



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- Interannual evolution
 - Zooplankton: *moving average and shift detection*
 - Link with the environment: *Dynamic factor analysis (DFA)*
- Seasonal variations
 - Zooplankton: *Level plot and dates of quantile 0.3*
 - Link with the environment: *Correlation 2 x 2 between dates of quantile 0.3 and winter mean of environmental variables*

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- **Interannual evolution**

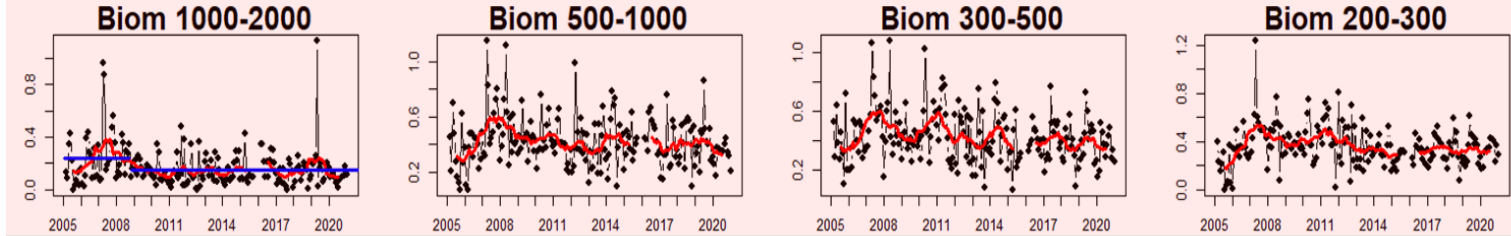
- **Zooplankton: *moving average and shift detection***
- Link with the environment: *Dynamic factor analysis (DFA)*

- **Seasonal variations**

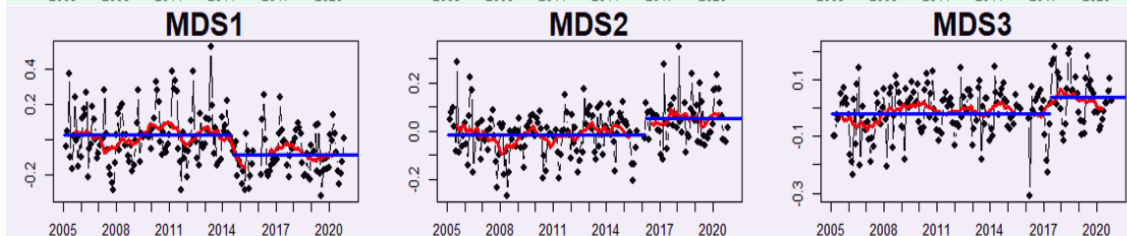
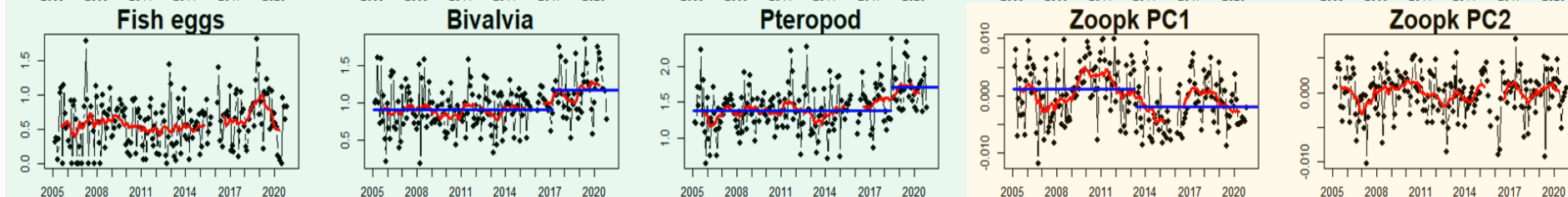
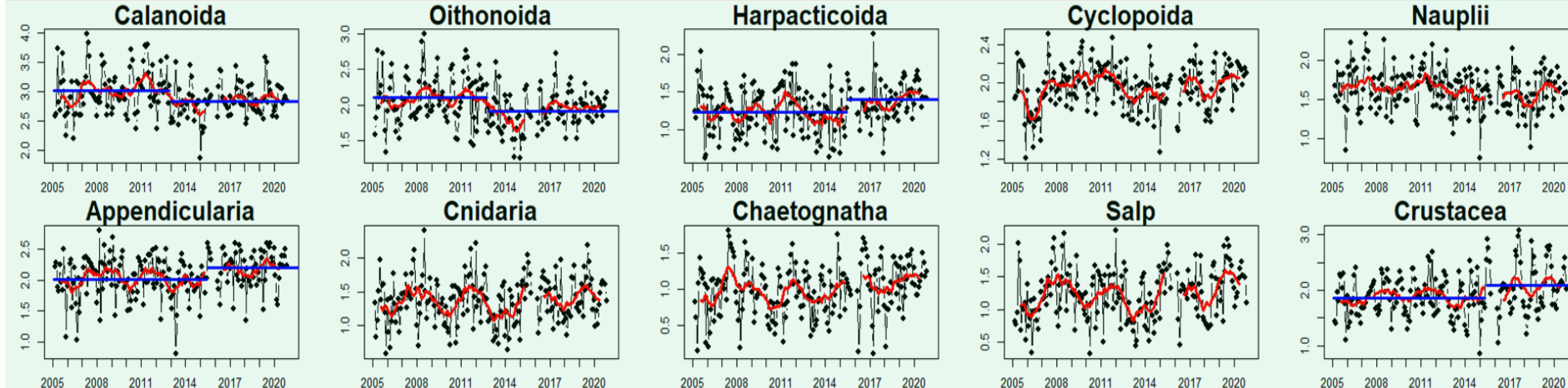
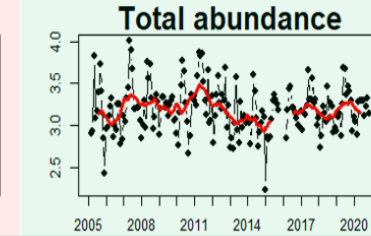
- Zooplankton: *Level plot and dates of quantile 0.3*
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Univariate analysis of zooplankton series highlight multiple shifts and trends

Biomasses



Abundances

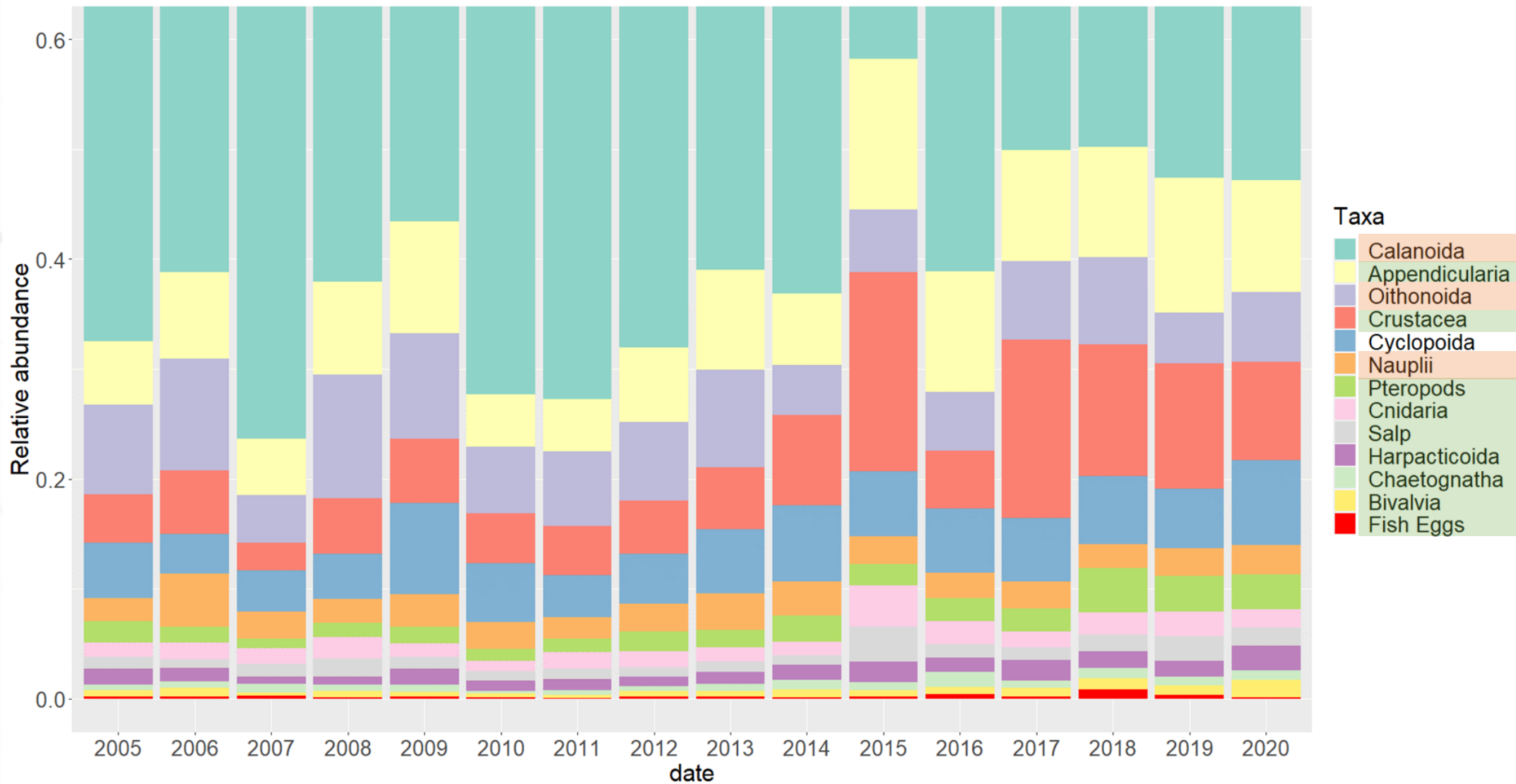


Size structure

- biomasses
- abundances
calanoids, nauplii
copepods, oithonoids
vs abundances of
other groups
- Modification of size structure and community structure
- Multiple shifts between 2013-2014

Community structure

Univariate analysis of zooplankton series highlight multiple shifts and trends



➤ Diminution of calanoid and oithonoid relative abundance vs increase of other taxonomic groups.

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- **Interannual evolution**

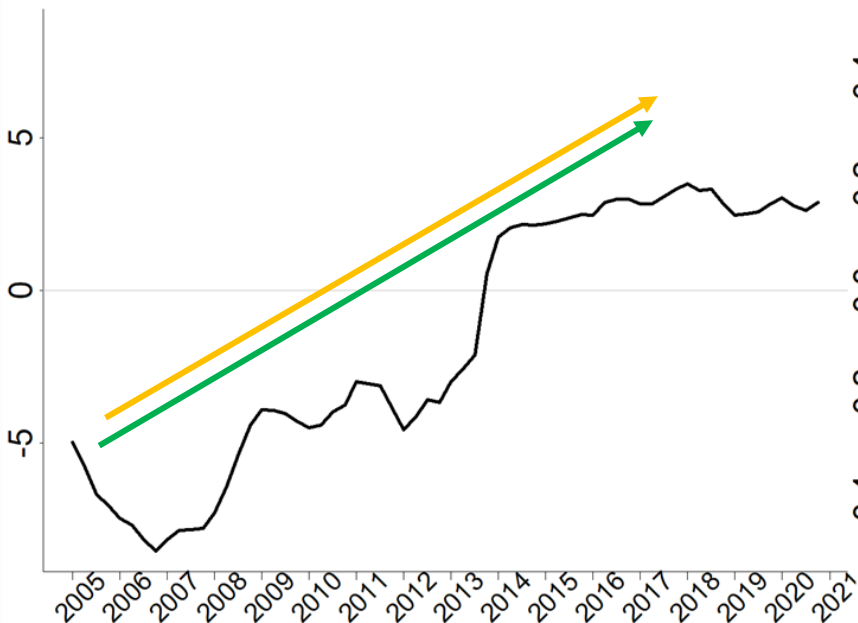
- Zooplankton: *moving average and shift detection*
- **Link with the environment: *Dynamic factor analysis (DFA)***

- **Seasonal variations**

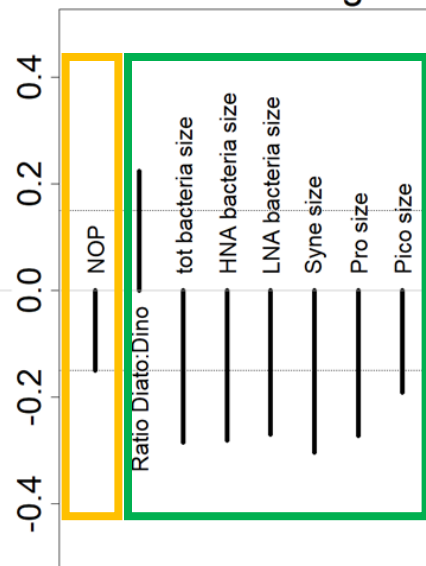
- Zooplankton: *Level plot and dates of quantile 0.3*
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Trend analysis (DFA) of zooplankton environment variables evidenced 2 commons trends

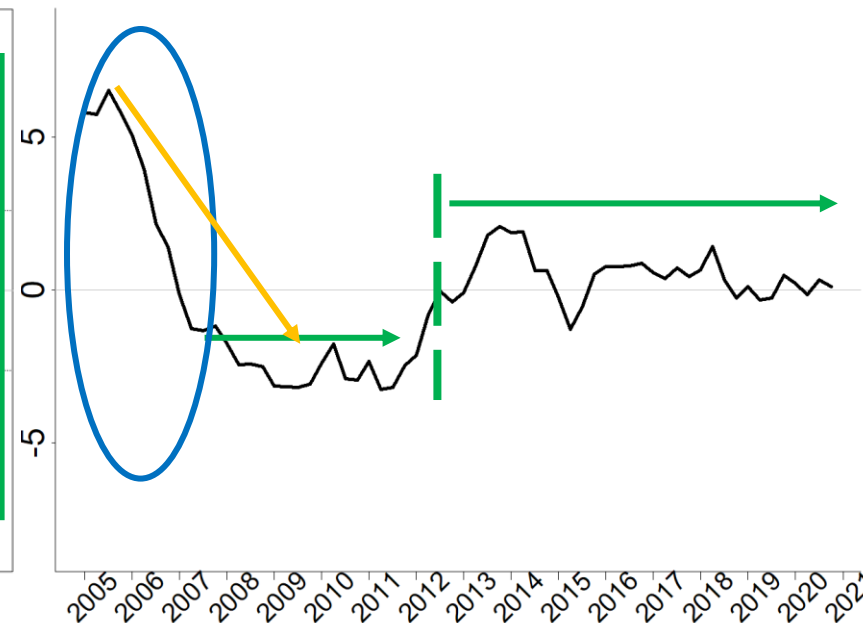
Environmental trend 1



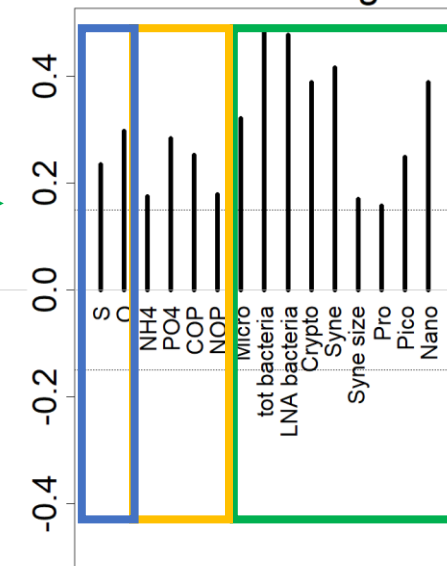
Factor loadings



Environmental trend 2



Factor loadings

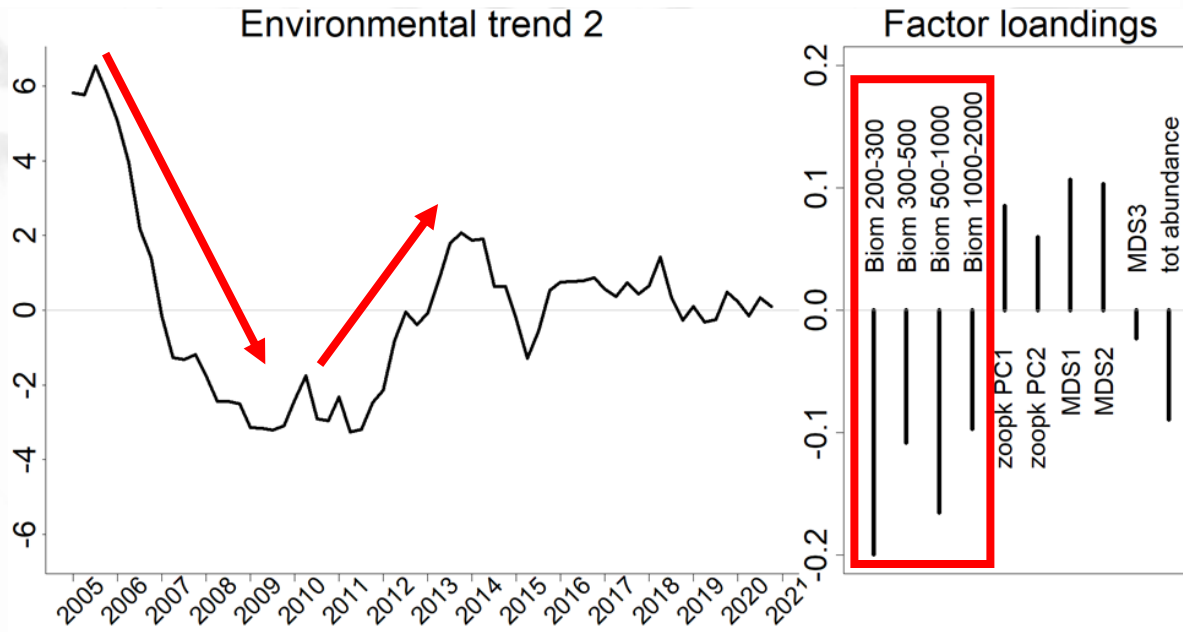
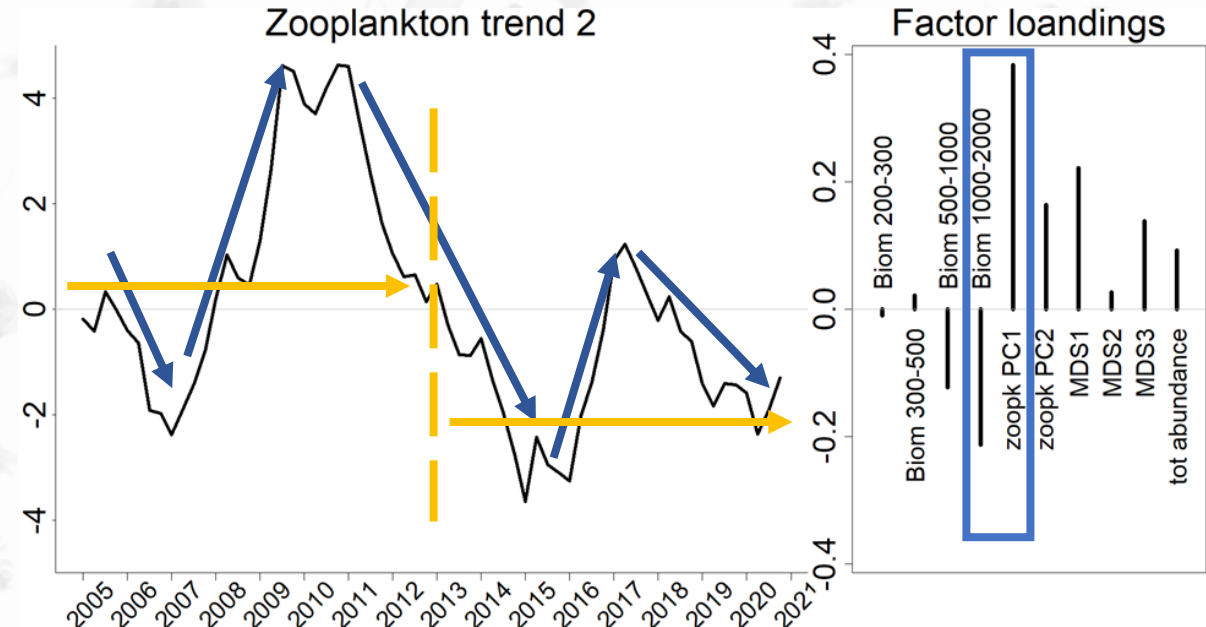
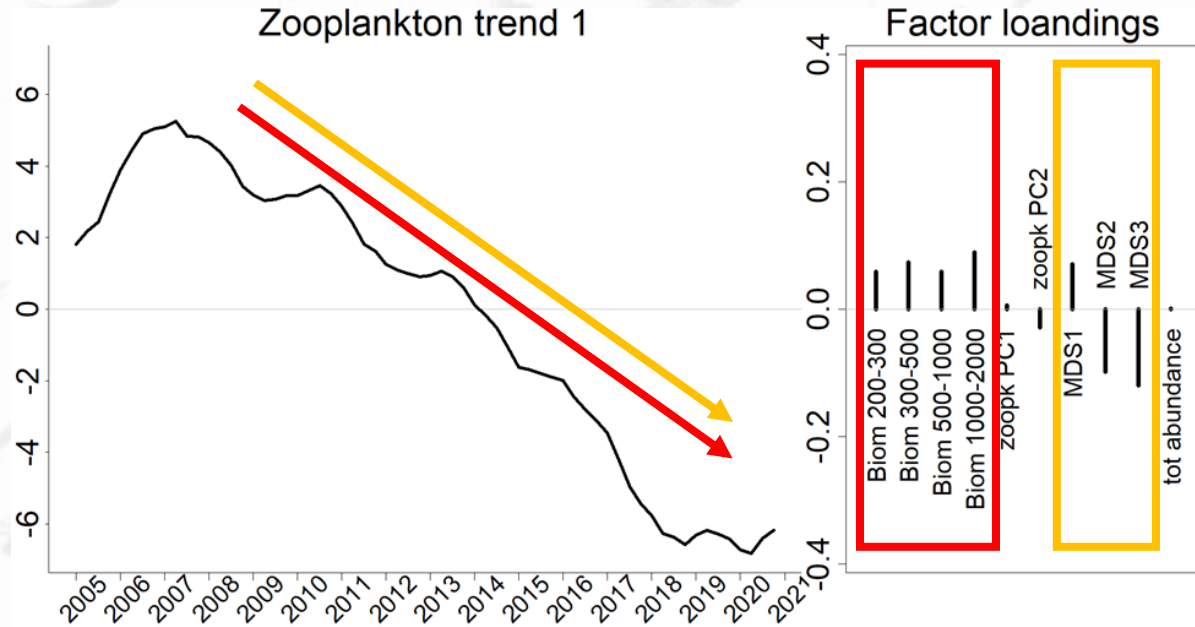


- ↘ of nutrients, particulate and detrital matter.

- Offshore signal of S and O between 2005-2007 (Mayot et al. 2017)

- Modifications of phytoplanktonic community:
 - ↗ abundance
 - ↘ of size
 - ↗ ratio diato : dino

Trend analysis (DFA) of zooplankton variables evidenced 3 commons trends



- **2 trends inherent to zooplankton + 1 trend explained by environment:**

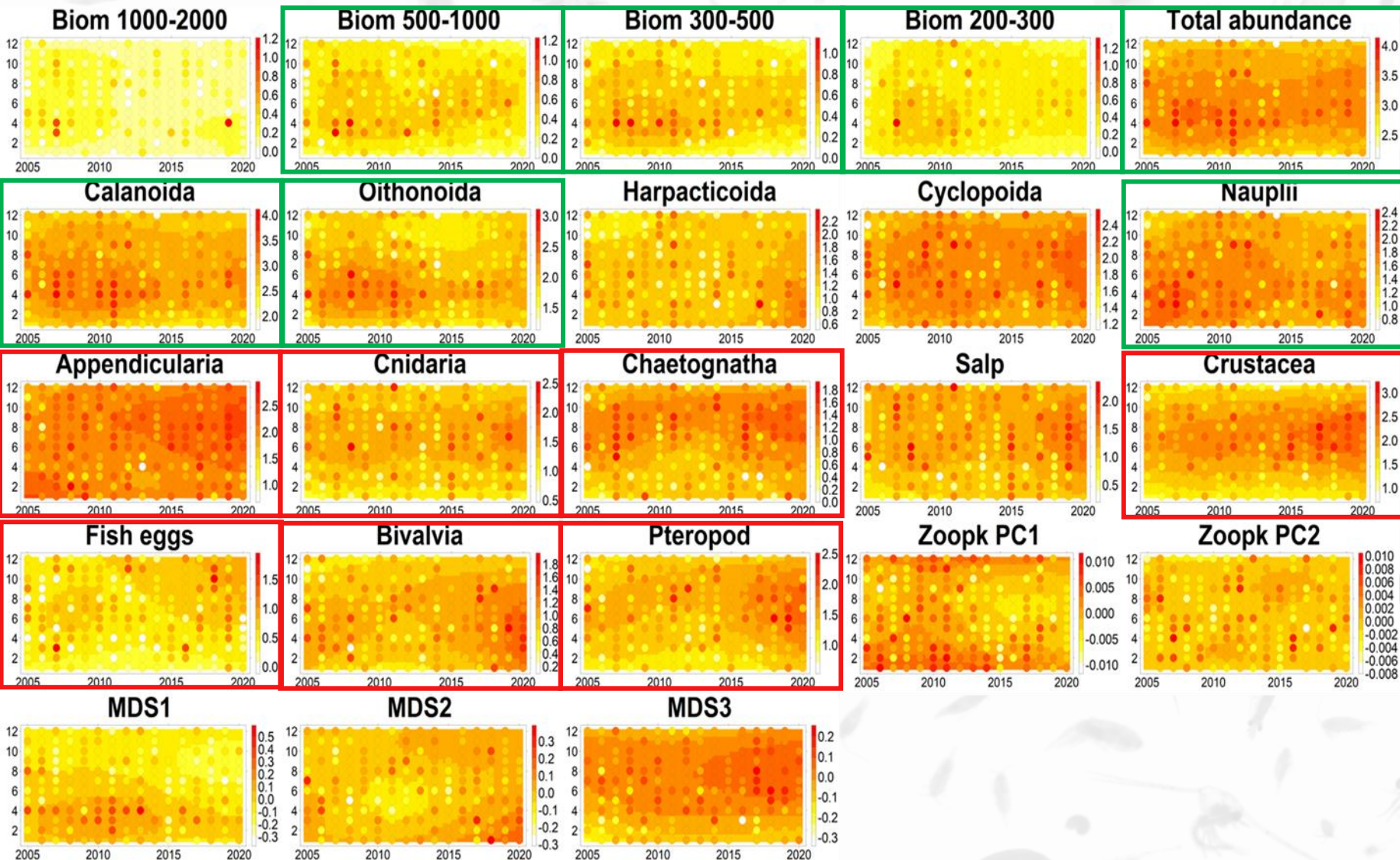
- biomass
- of size + modification of community structure
- Association between size structure and biomass of bigger size fraction (follow the diminution of bigger size class biomass in 2008)

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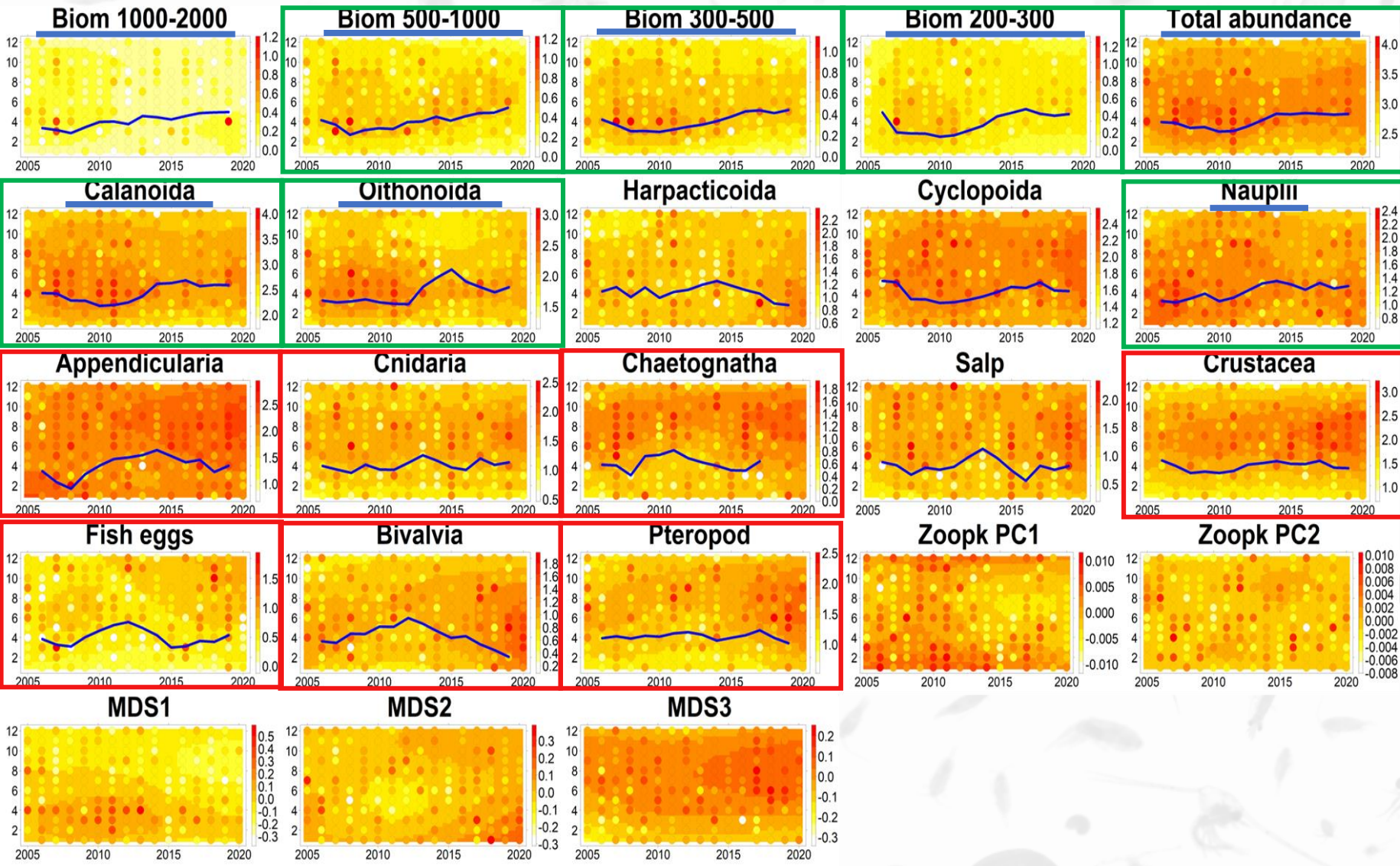
- Interannual evolution
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The *level plots* show seasonal pattern in zooplankton compartment. Date of *quantile 0.3* seemed to delayed for some groups on the 2nd part of the decade.



- Spring peak vs summer peak
 - Seasonal patterns may change

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- **Spring peak** vs **summer peak**
 - Seasonal patterns may change
- **Delay of the dates of quantile 0.3**

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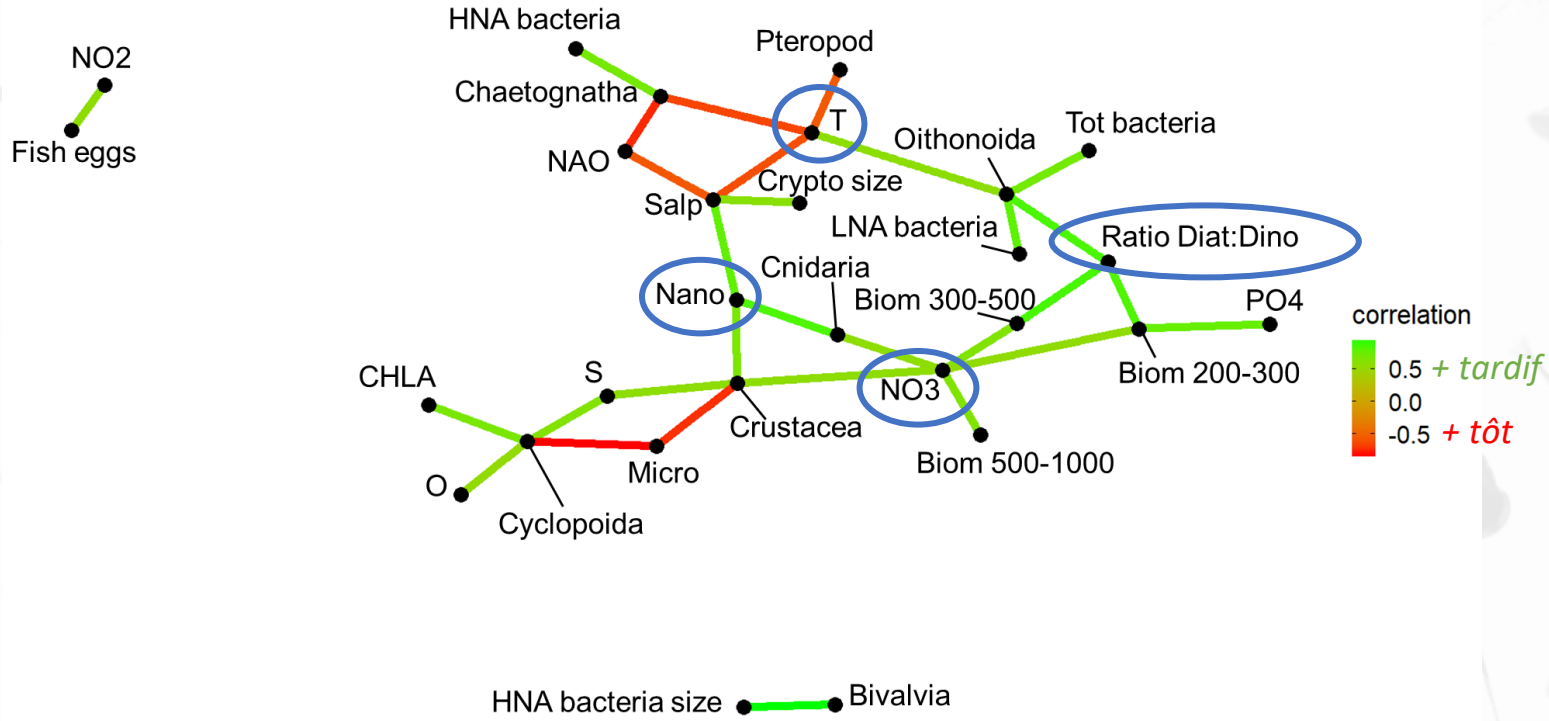
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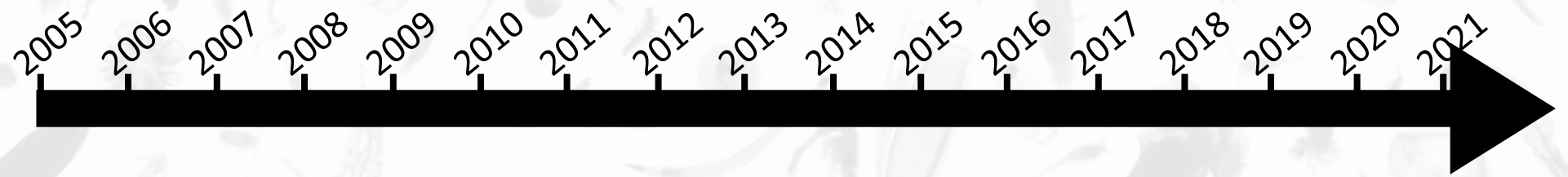
- Zooplankton: *Level plot and dates of quantile 0.3*
- **Link with the environment: *Correlation 2 x 2 between dates of quantile 0.3 and winter mean of environmental variables***

Dates of quantile 0.3 seemed to be linked with winter values of some environmental variables.

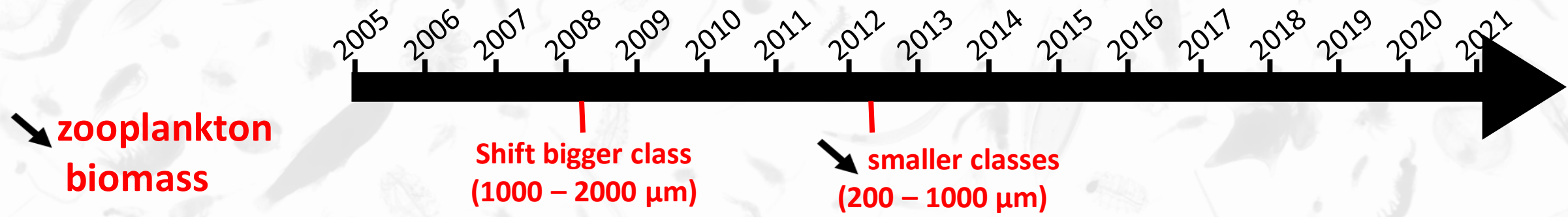


- Structured on variations of :
 - NO₃ concentrations,
 - temperature
 - ratio diat:dino
 - abundance of nanoeukaryotes

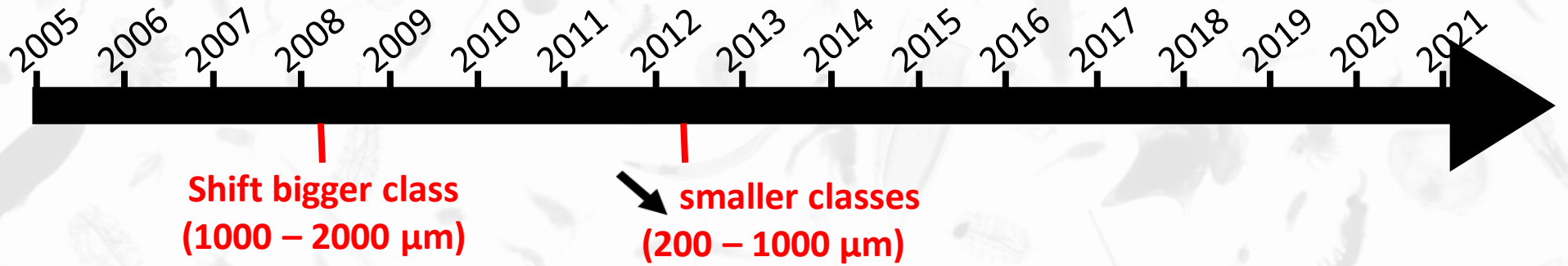
Conclusions:



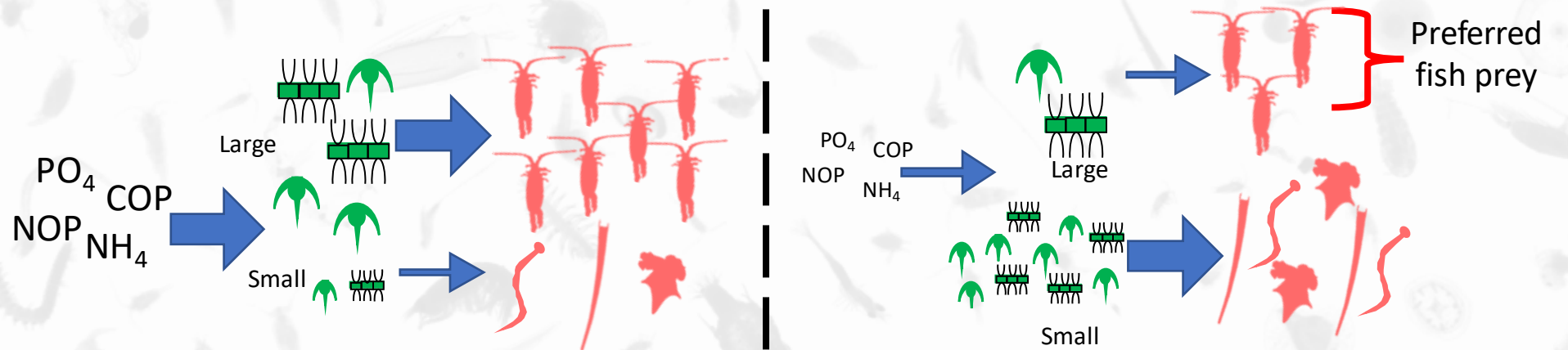
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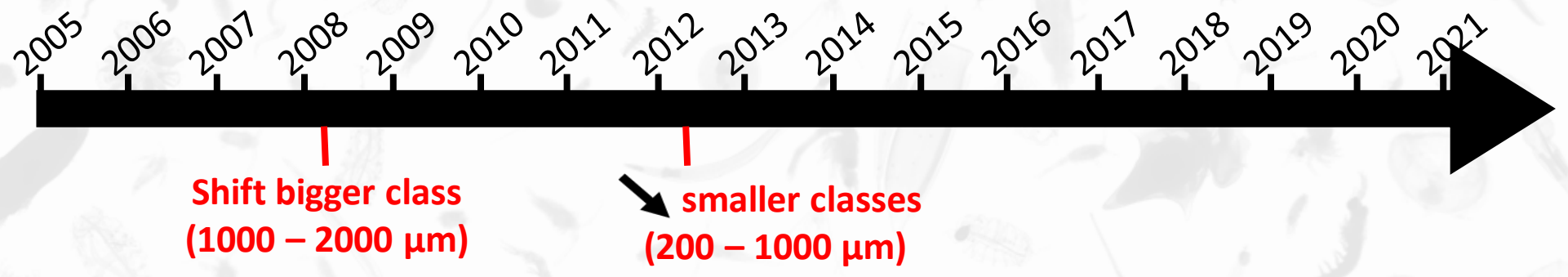
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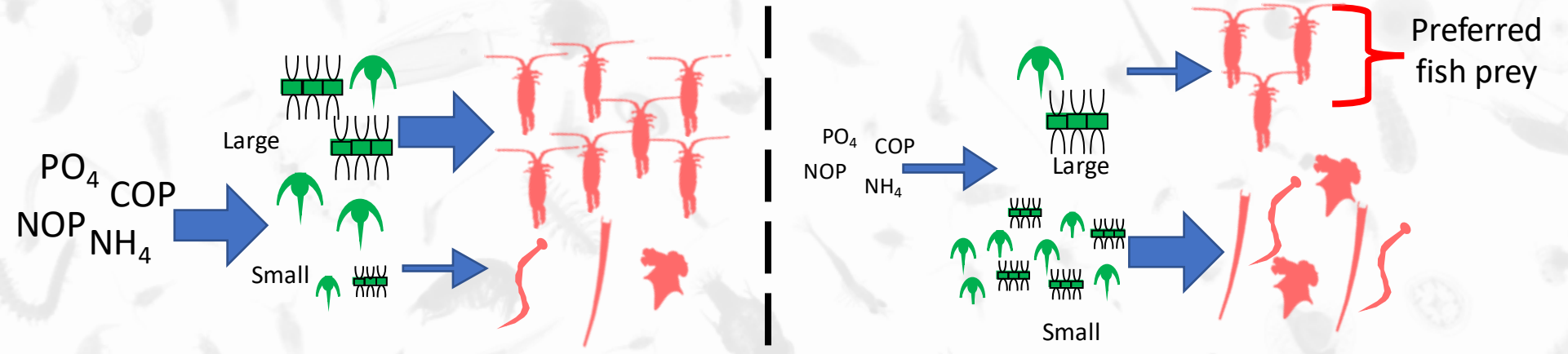
Bottom-up control of the trophic chain



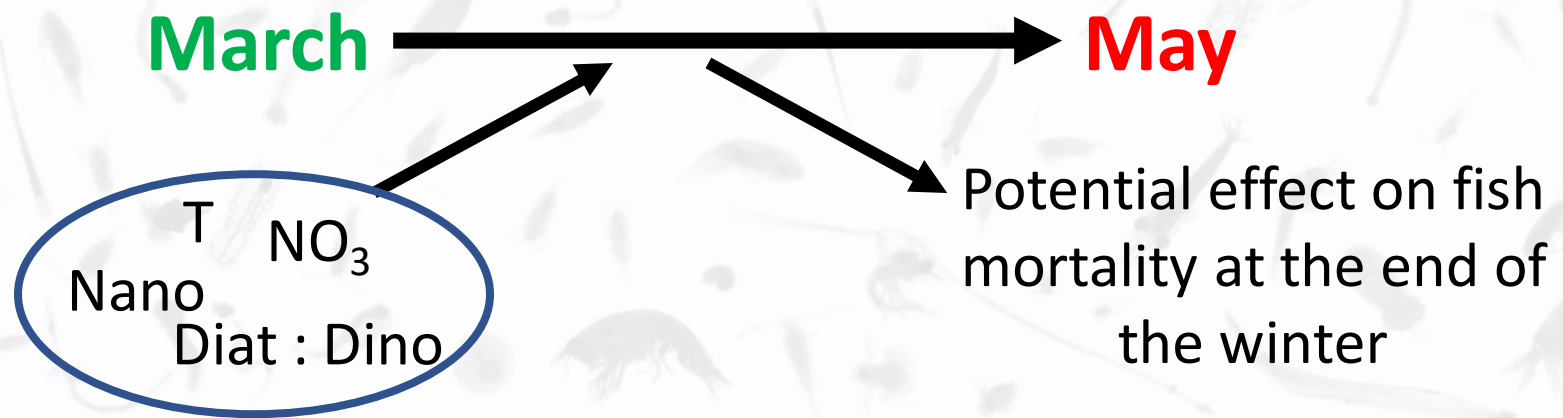
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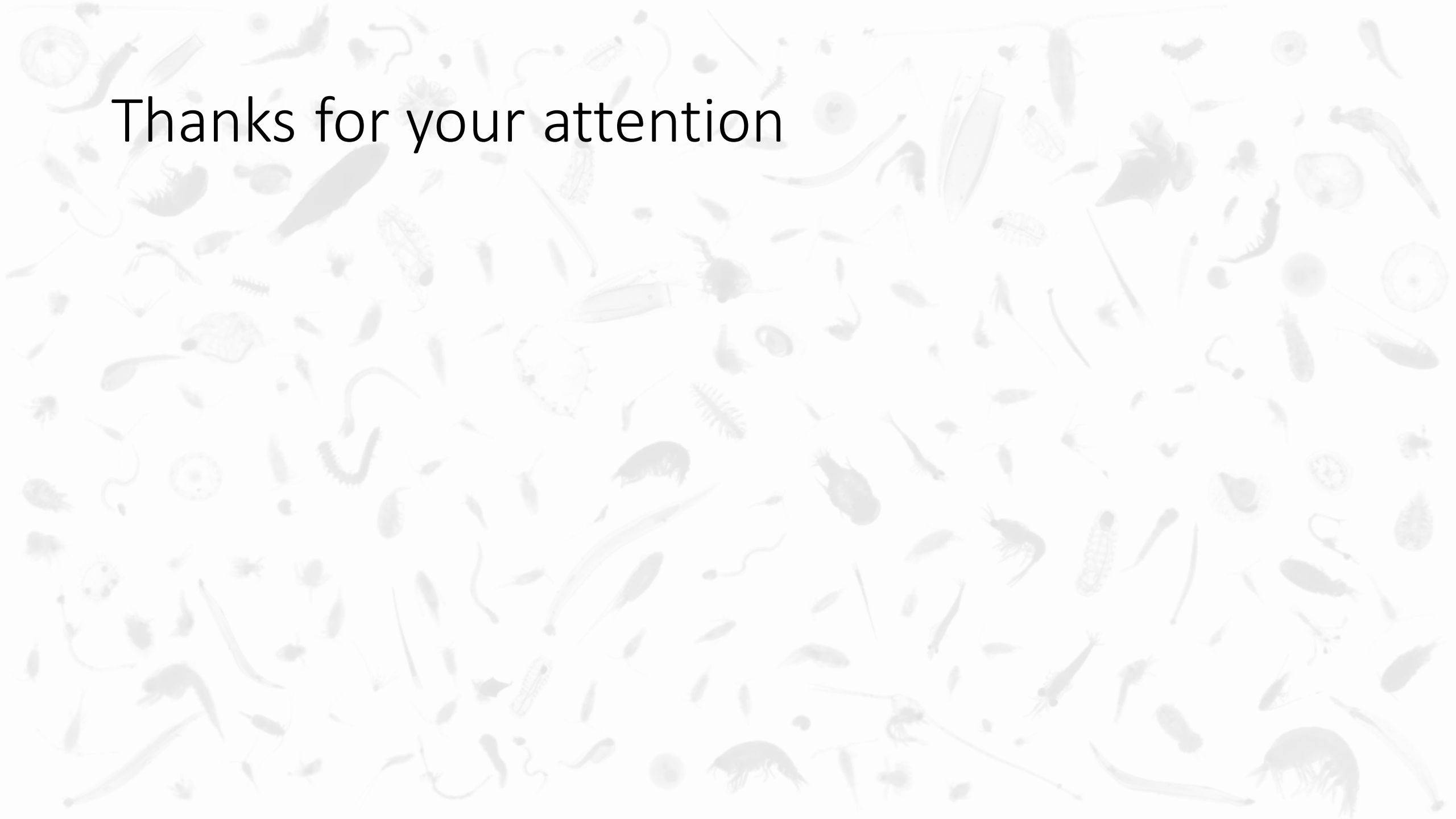
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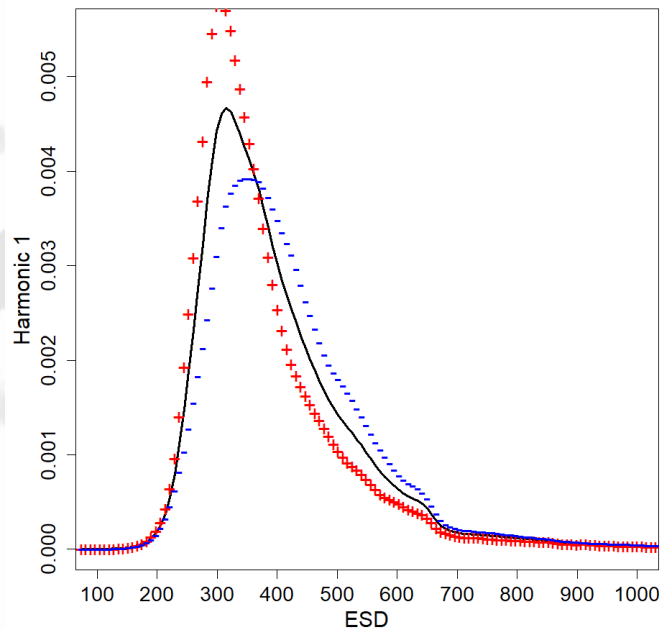
Delay of the date of quantile 0.3 for preferred fish prey



Thanks for your attention



PCA function 1 (Percentage of variability 46.6)



PCA function 2 (Percentage of variability 21.5)

