

The effects of climate change and the collapse of the shrimp fishery on fish communities' diversity and ecological functions in a tropical context: The case of the continental shelf off French Guiana

4th International Symposium ECCWO, June 4-8, 2018, Washington DC



Vincent Vallée¹, Ilan Perez¹, Maria Ching Villanueva² & Fabian Blanchard¹

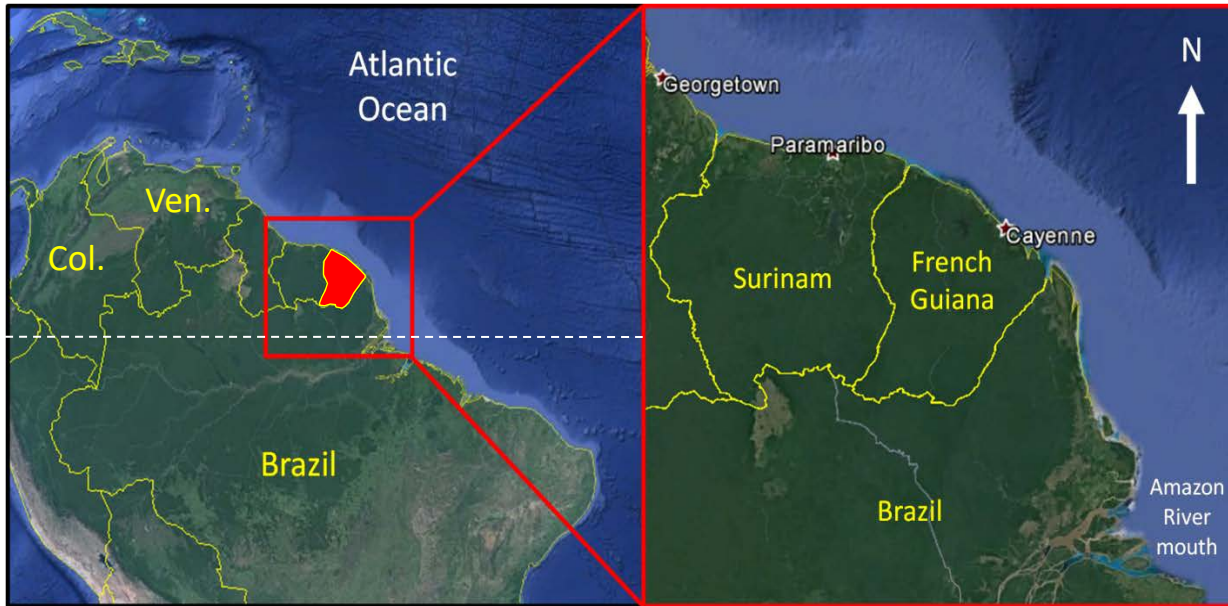
¹ Ifremer Guyane, Fisheries Biodiversity Unit

UMSR LEEISA, University of Guyane - CNRS - Ifremer

² Ifremer Centre de Bretagne, Fisheries Biology Laboratory



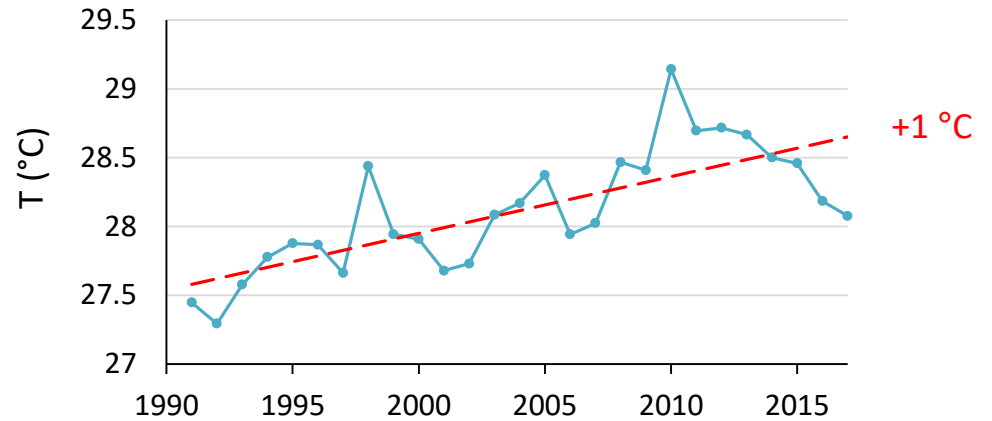
Local context



A high fish diversity between 400 and 500 species

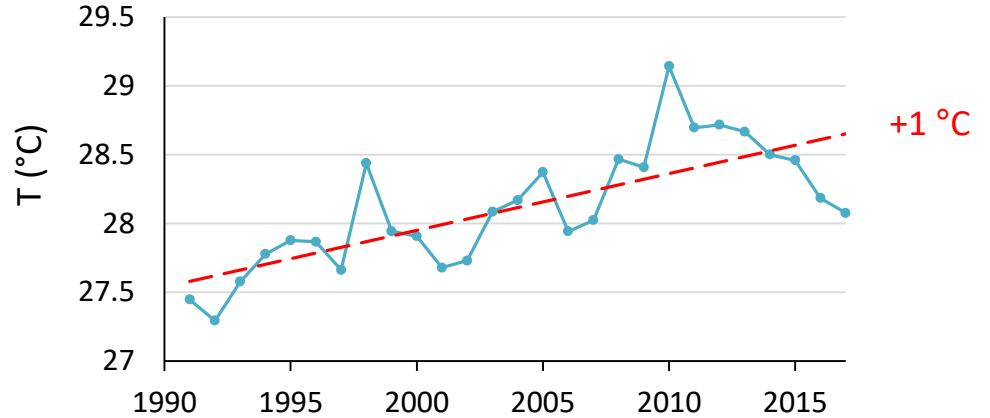
Local context

- An **increasing SST** (sea surface temperature)

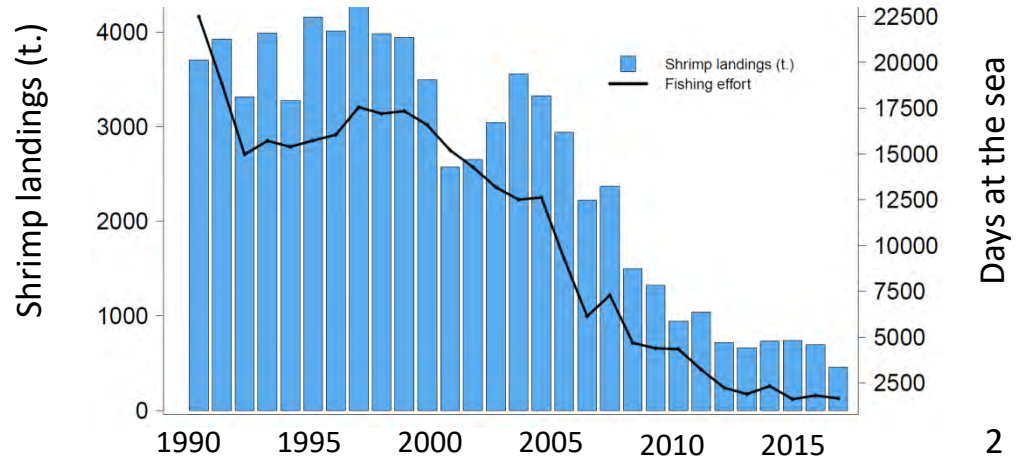


Local context

- An **increasing SST** (sea surface temperature)



- A **collapsing fishing pressure** by bottom trawling (shrimp fishery)



Objectives and interests

- Describe the effects of **climate change** and a **decreasing fishing pressure** on **tropical fish communities**
- Provide a better understanding of the **tropical fish communities' functioning** in order to plan how they could respond to **future climatic and fishing scenarios**
- Set up **future ecological and economic implementations**

Samplings



RESUBGUY

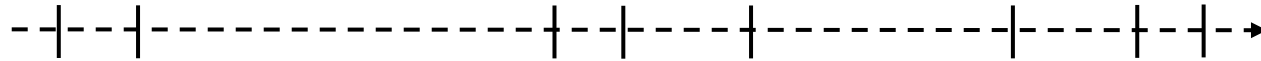


CHALOUBE



STUDY

1993



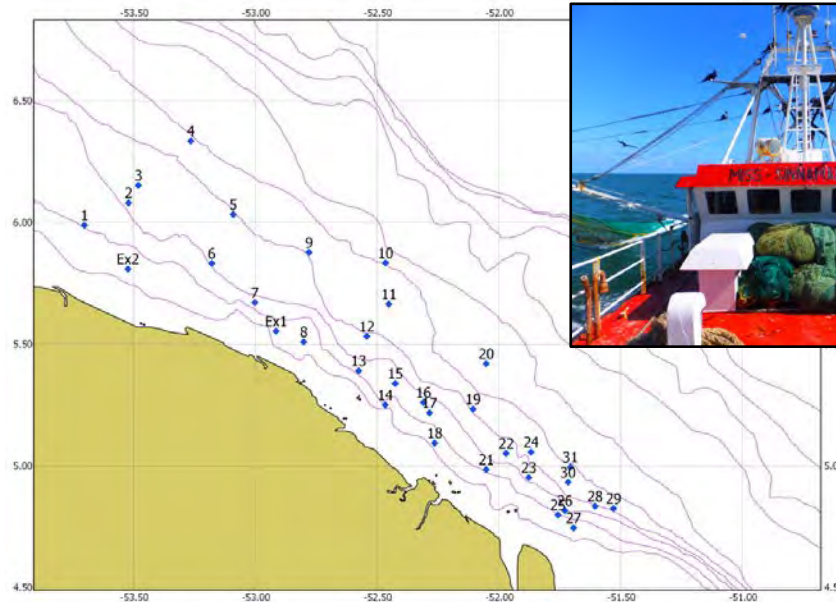
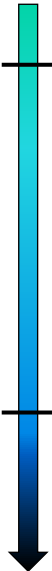
2017

10 m

33 stations



60 m



Samplings



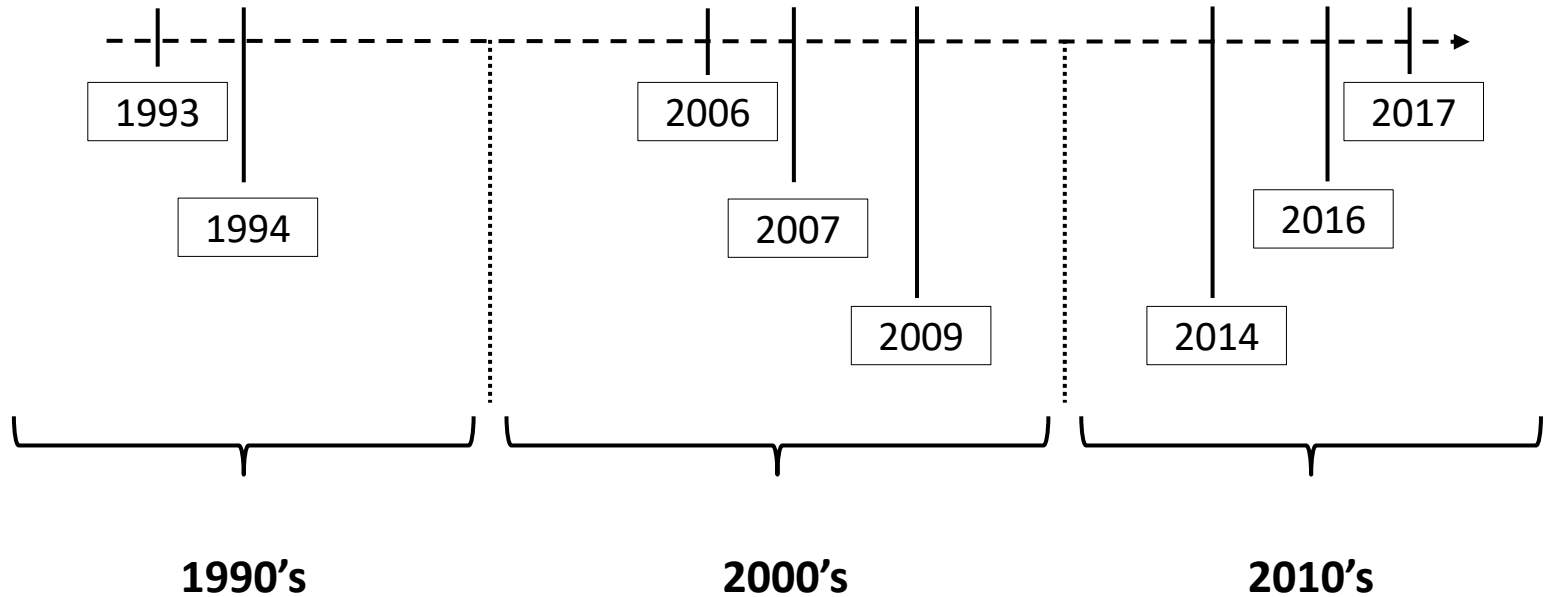
RESUBGUY



CHALOUPE



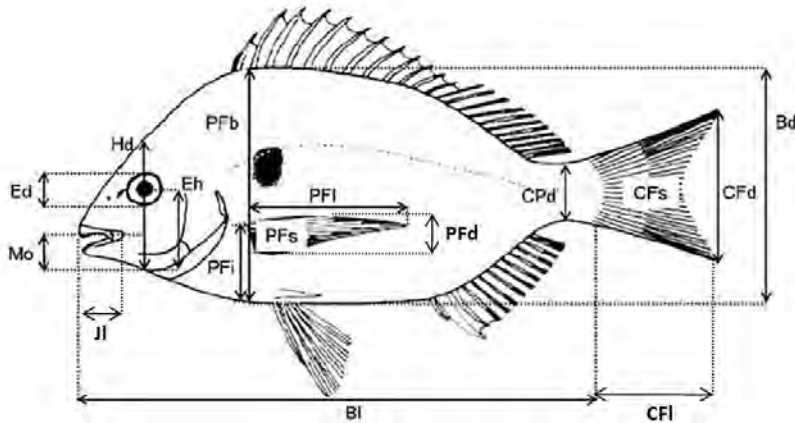
STUDY



Functional diversity: the traits based approach

Functional Richness (**FRic**), Functional Dispersion (**FDis**) Functional Specialization (**FSpe**)

14 morphological traits



Modified from Villéger et al., 2010

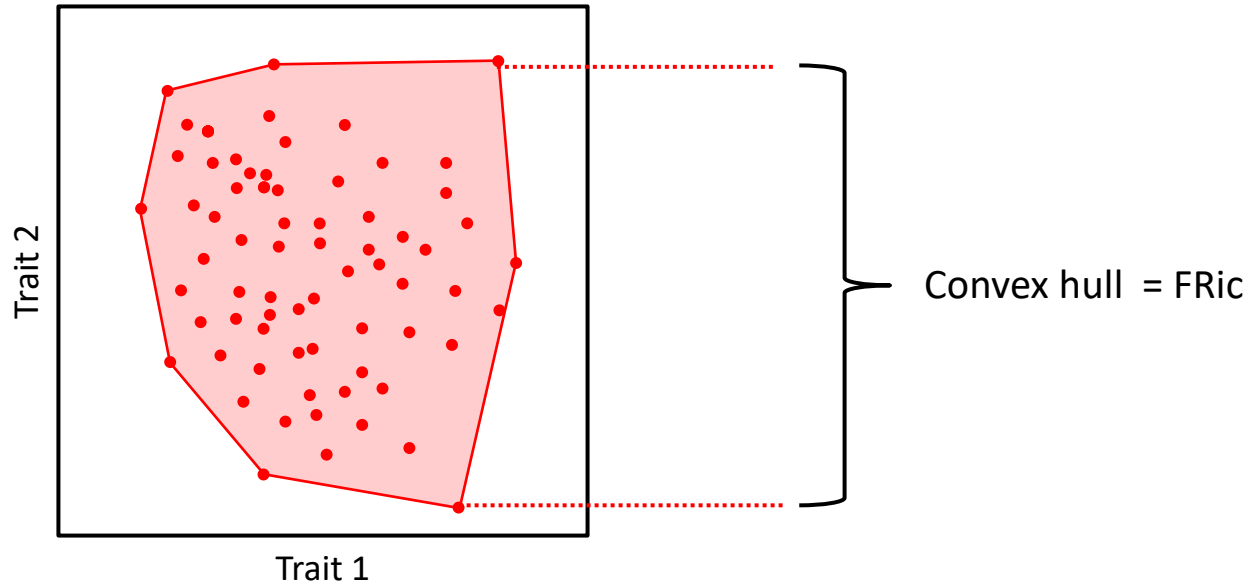
Measured from 1 to 10 collected individuals for 174 species

2 ecological traits

- Trophic group
 - planktivorous
 - invertivorous
 - piscivorous
 - omnivorous
- Habitat
 - benthic
 - demersal
 - pelagic

Functional indices

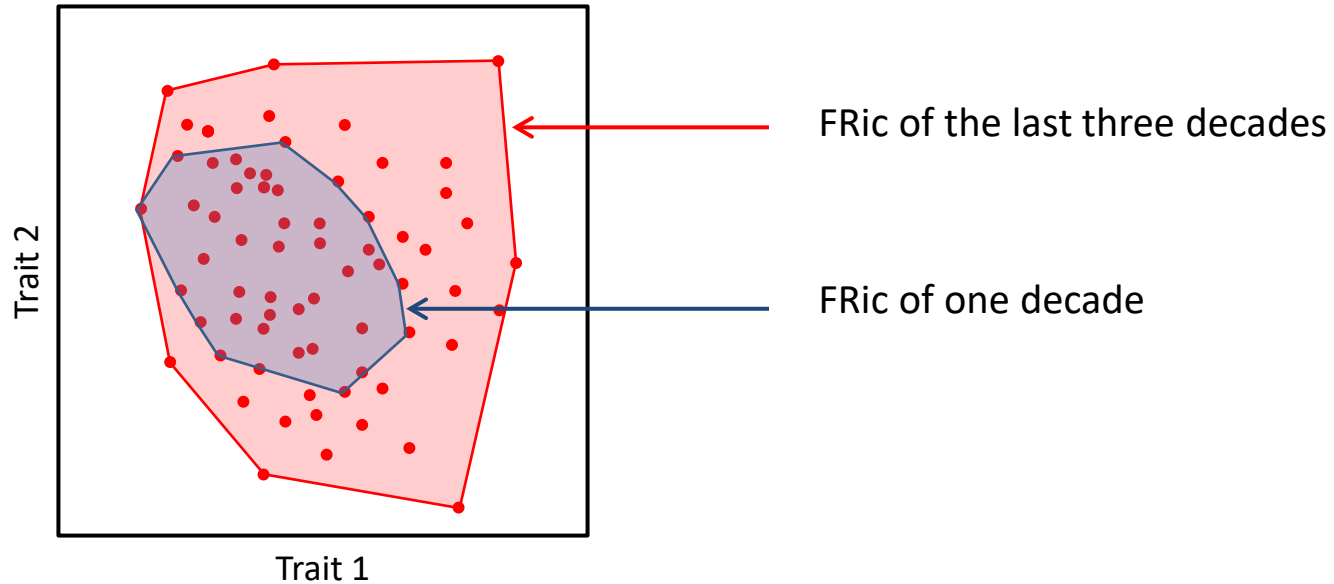
Functional richness (FRic)



FRic = the portion of the functional space filled by a species assemblage

Functional indices

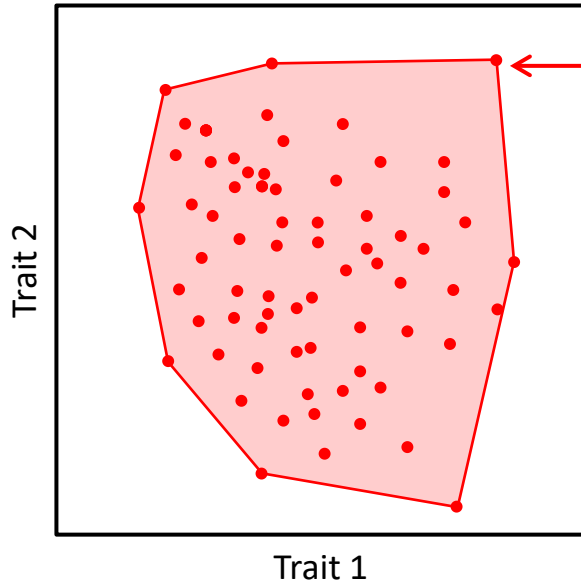
Functional richness (FRic)



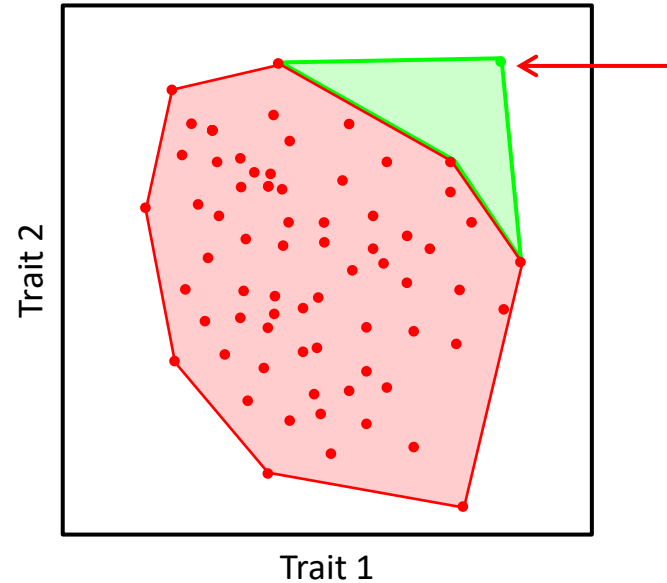
FRic = the portion of the functional space filled by a species assemblage

Functional indices

Functional richness (FRic)



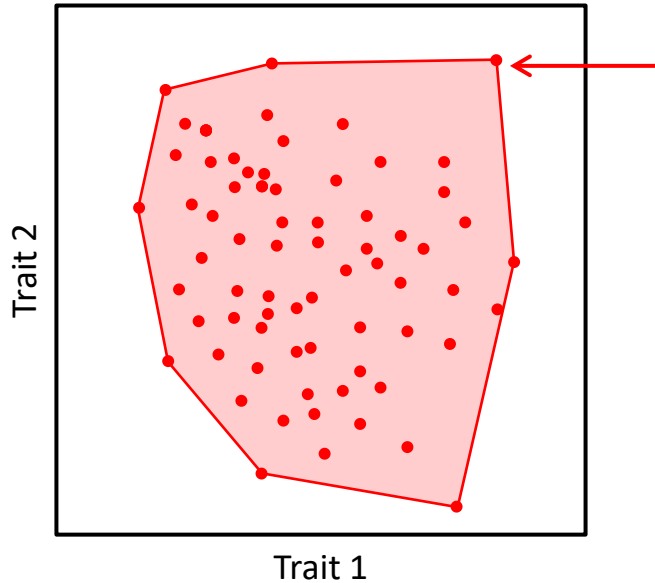
Rare species
with an
extreme
combination
of traits



FRic = the portion of the functional space filled by a species assemblage

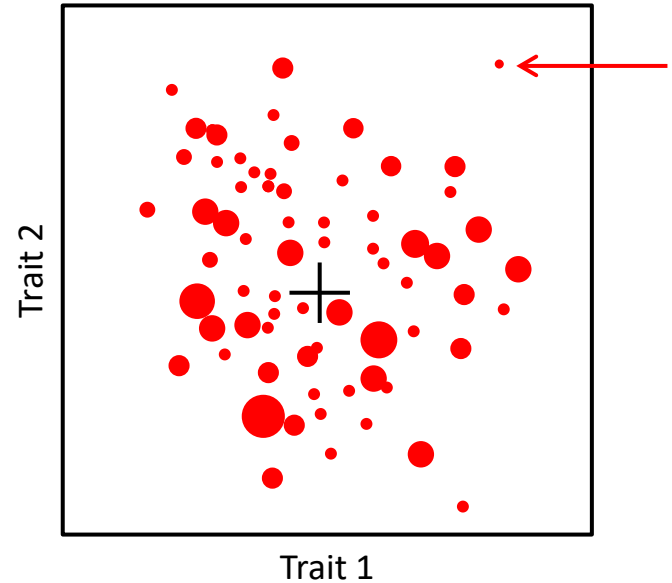
Functional indices

Functional richness (FRic)



FRic = the portion of the functional space filled by a species assemblage

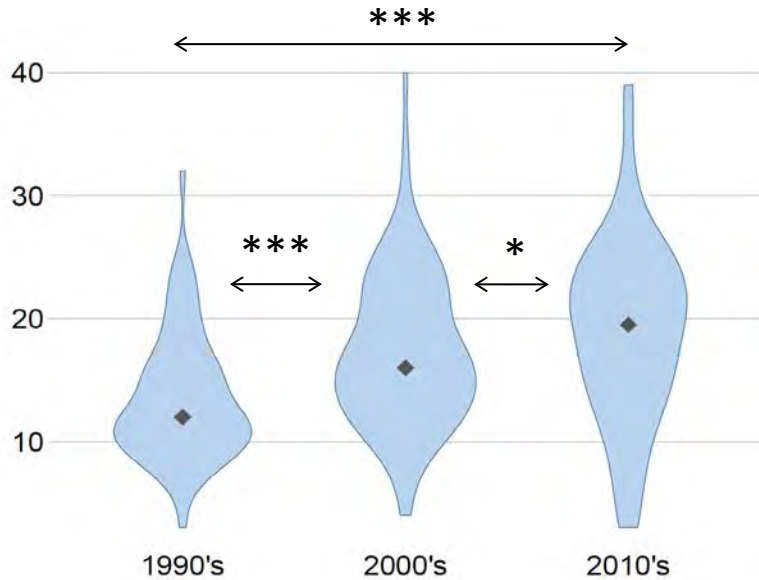
Functional Dispersion (FDis)



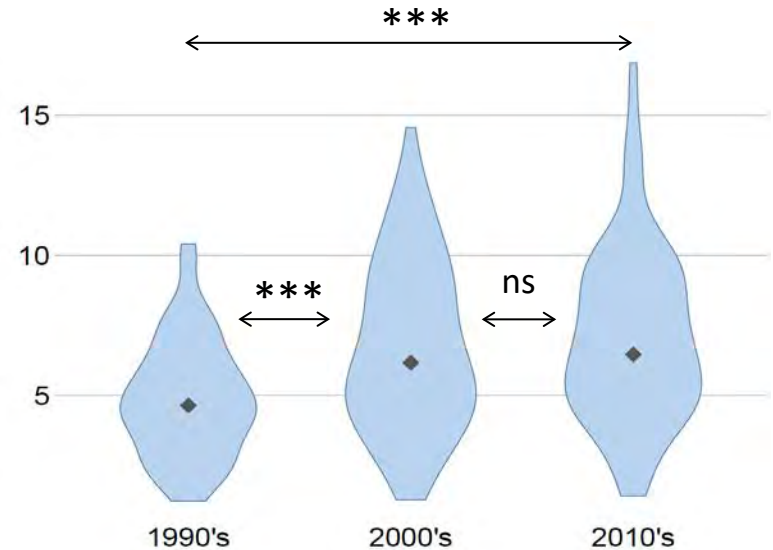
FDis = **abundance weighted** deviation of species trait values from the center of the functional space filled by the community

Taxonomic indices

Species richness (S)

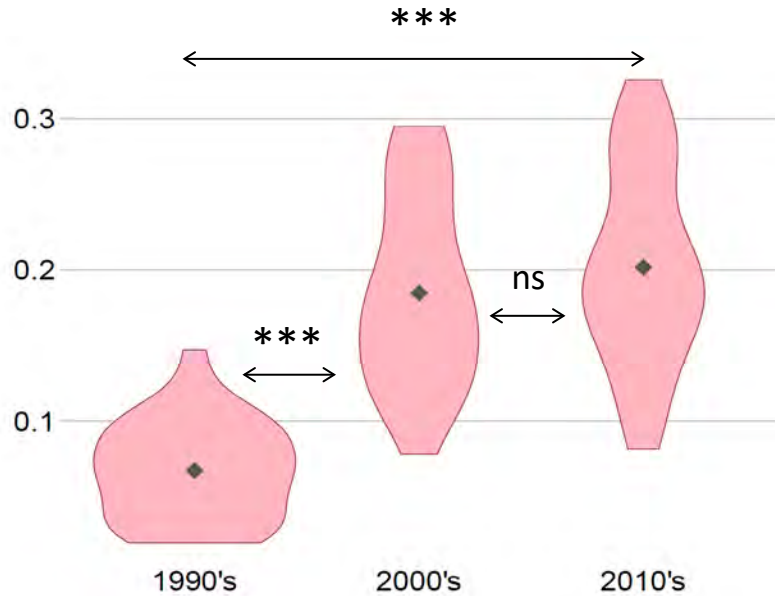


Shannon exponential (H')

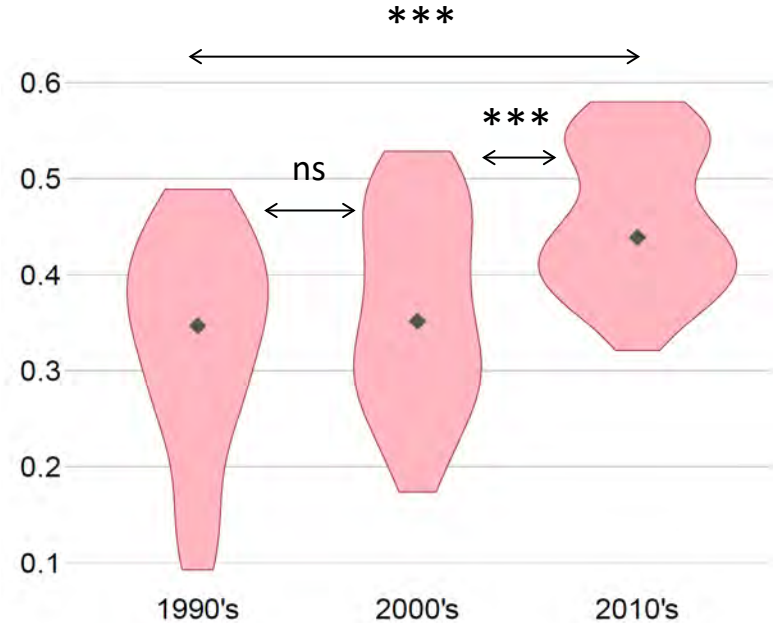


Functional indices

Functional richness (FRic)

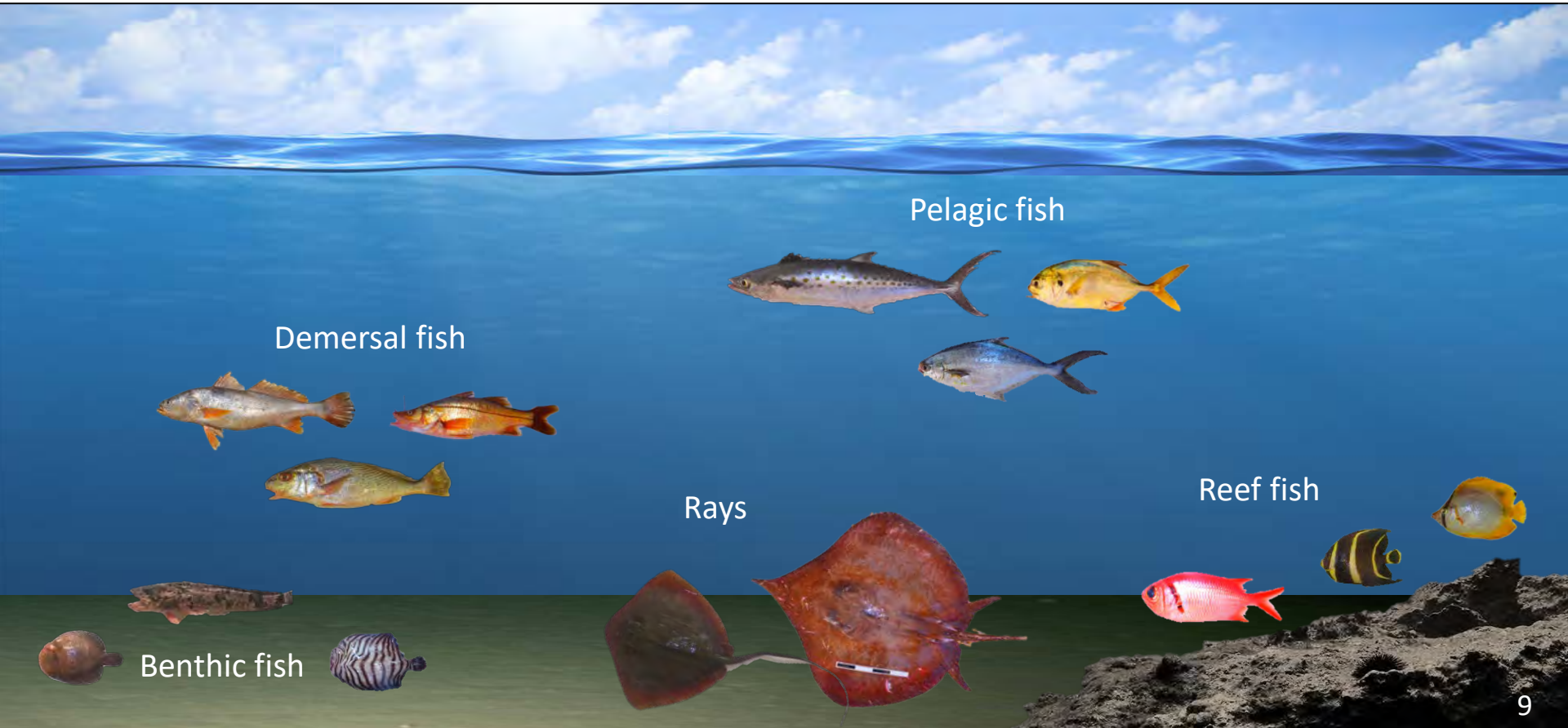


Functional Dispersion (FDis)



The same trend is observed for the functional specialization (**FSpe**)

Morpho-ecological groups



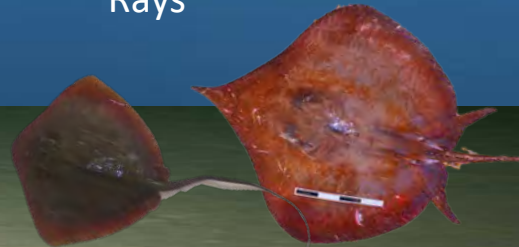
Pelagic fish



Demersal fish



Rays



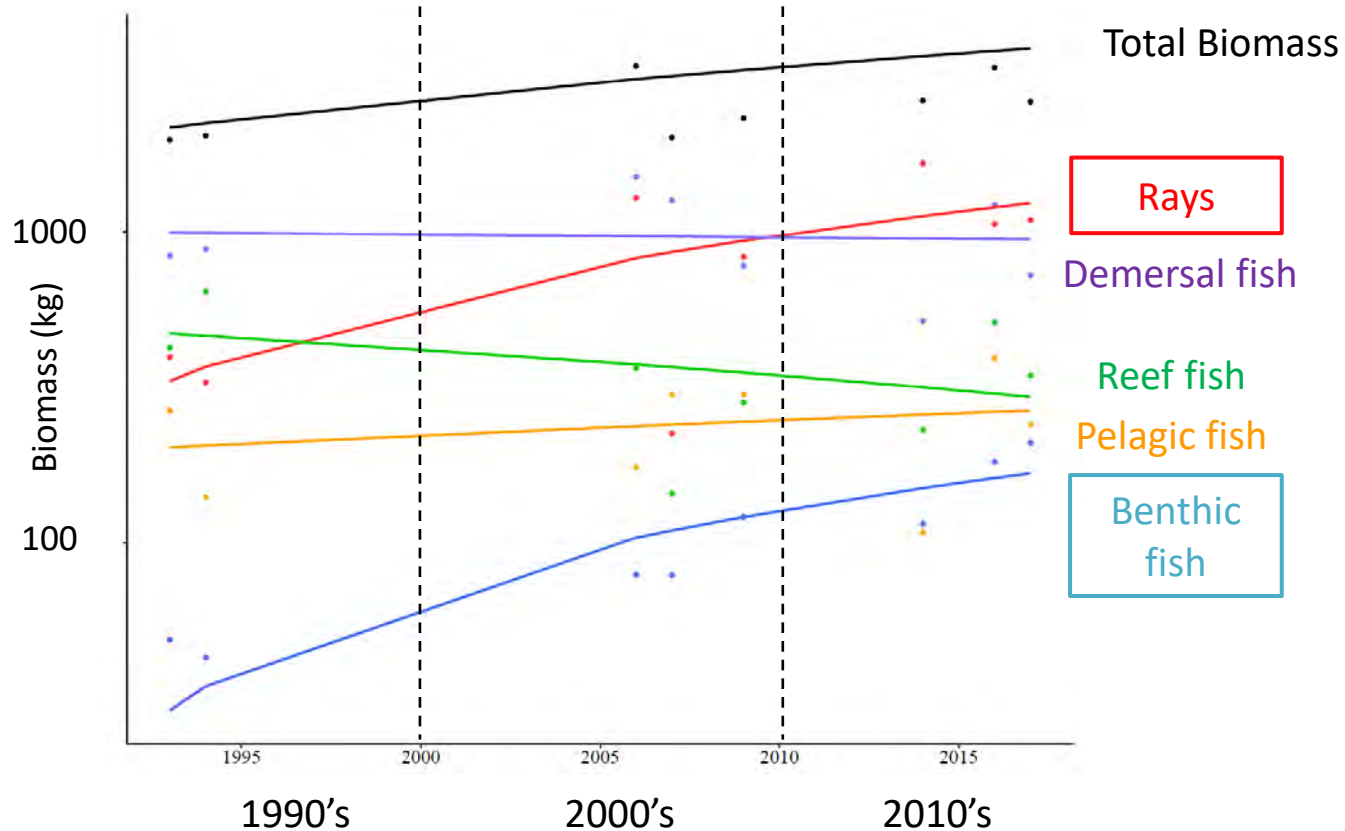
Reef fish



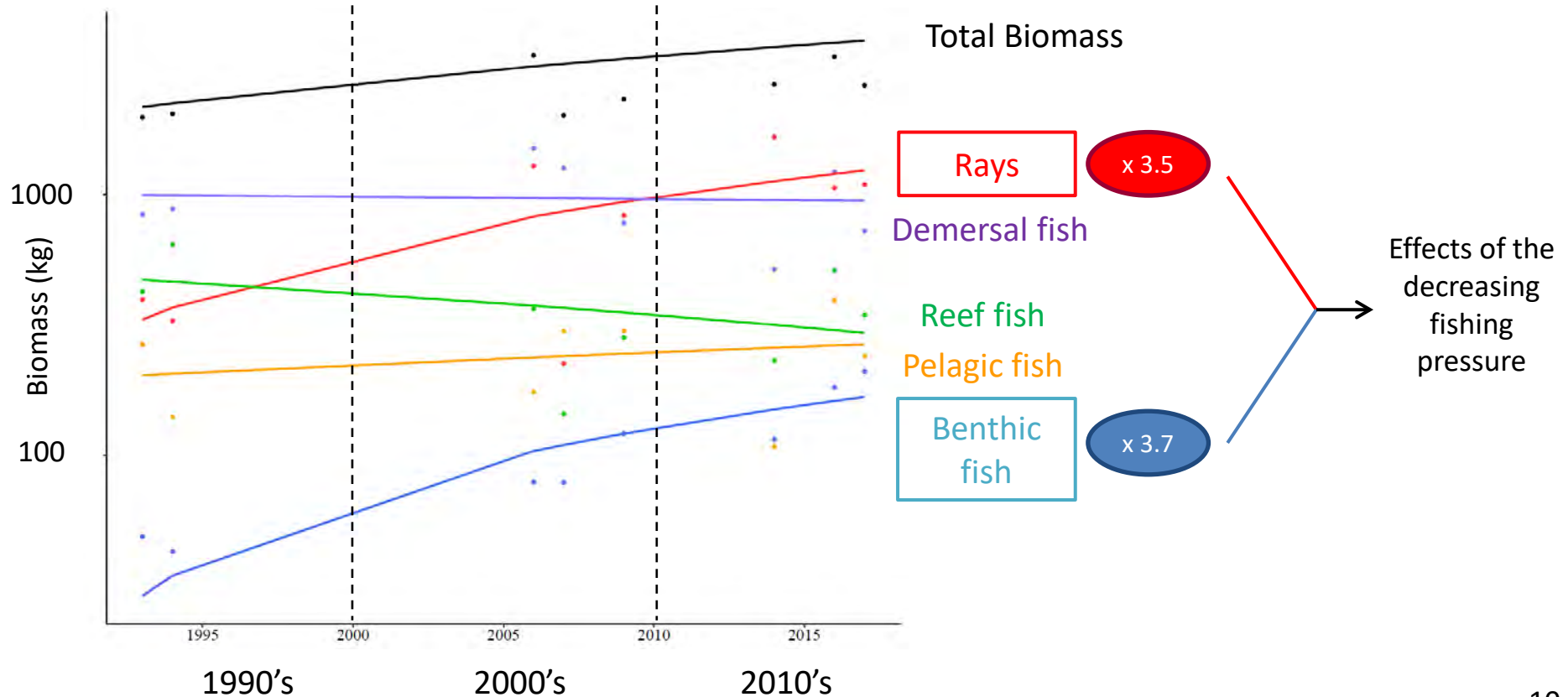
Benthic fish



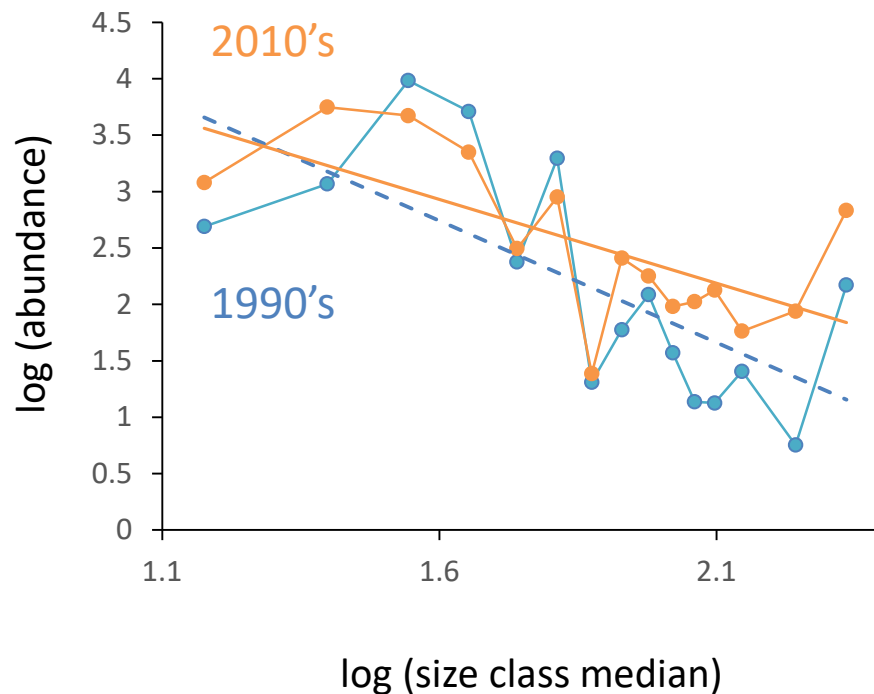
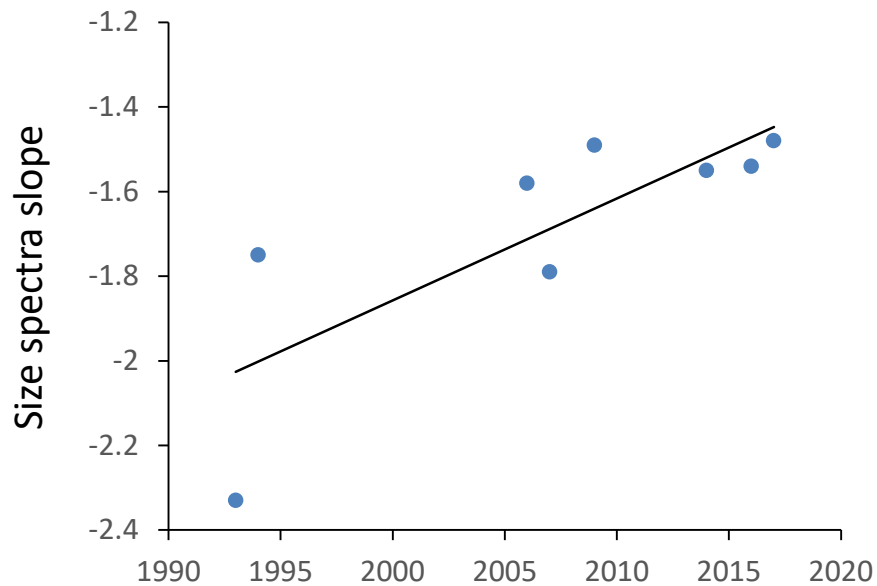
Morpho-ecological groups



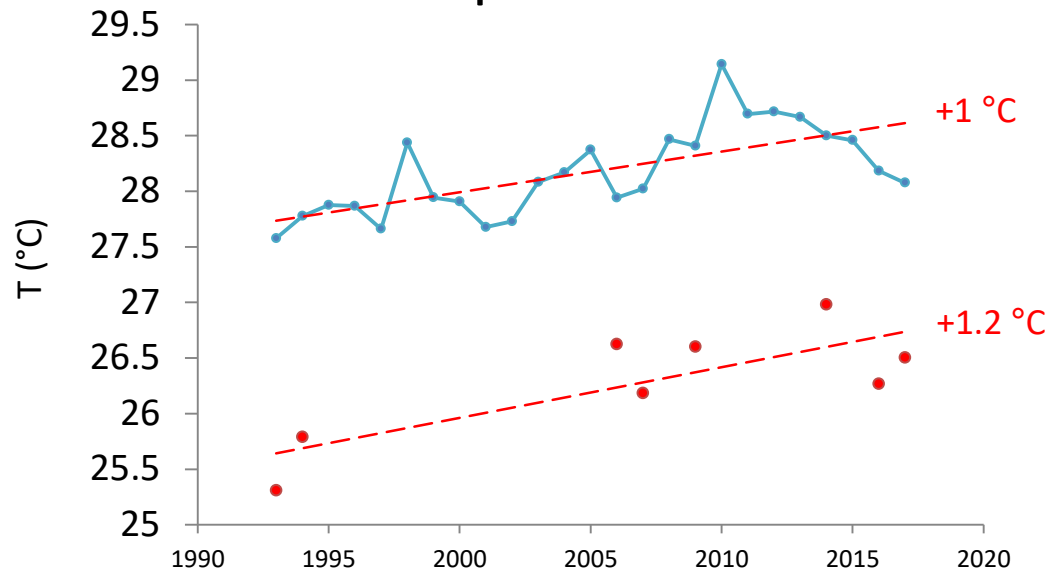
Morpho-ecological groups



Size Spectra Slope (SSS)

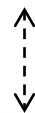


Mean Temperature of the Survey Community (MTSC)



● Mean annual SST

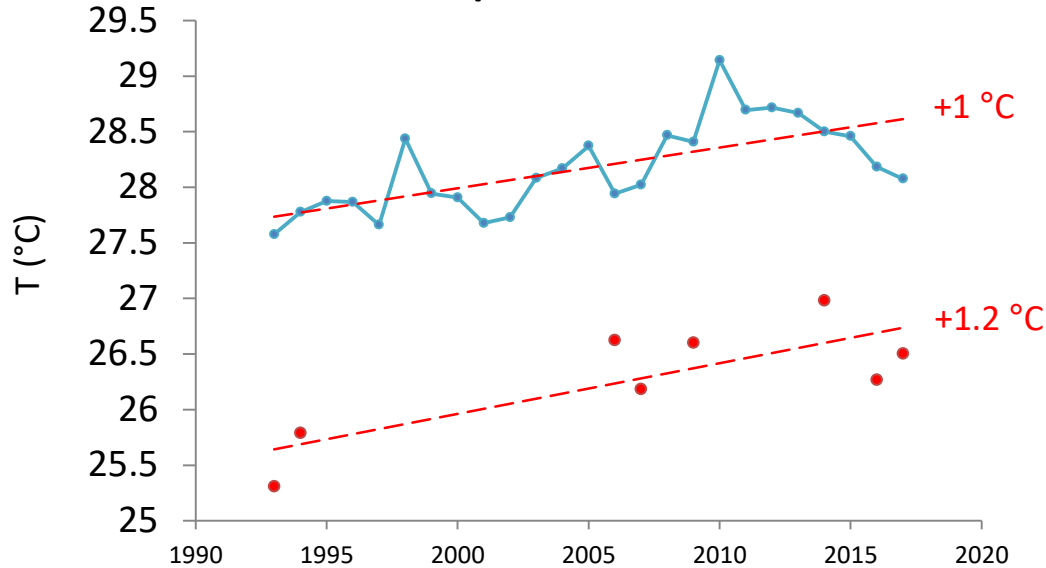
● MTSC



$$MTC_{yr} = \frac{\sum_i^n T_i C_{i,yr}}{\sum_i^n C_{i,yr}}$$

Cheung et al., 2013

Mean Temperature of the Survey Community (MTSC)

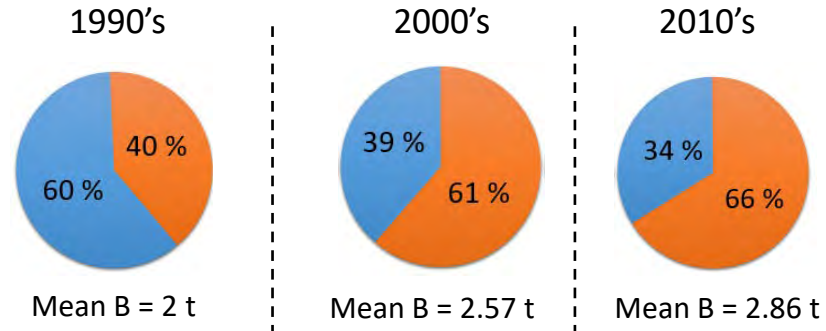


● Mean annual SST

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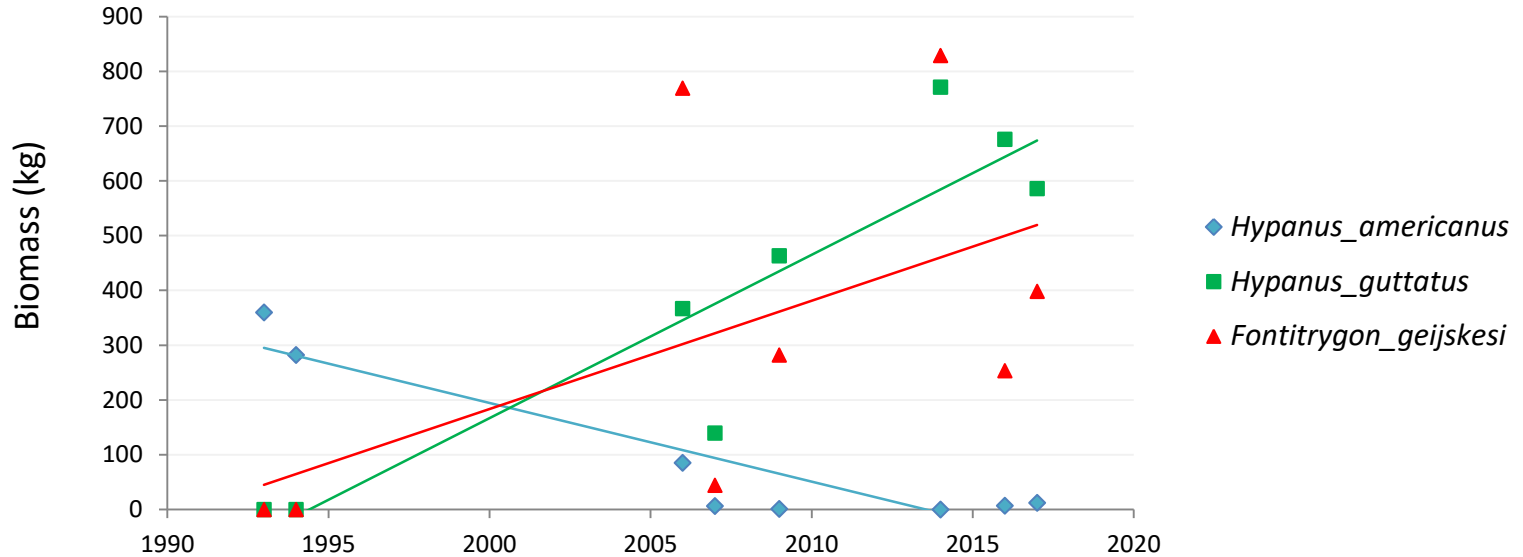
Cheung et al., 2013








■ Tropical species

■ Sub-tropical species

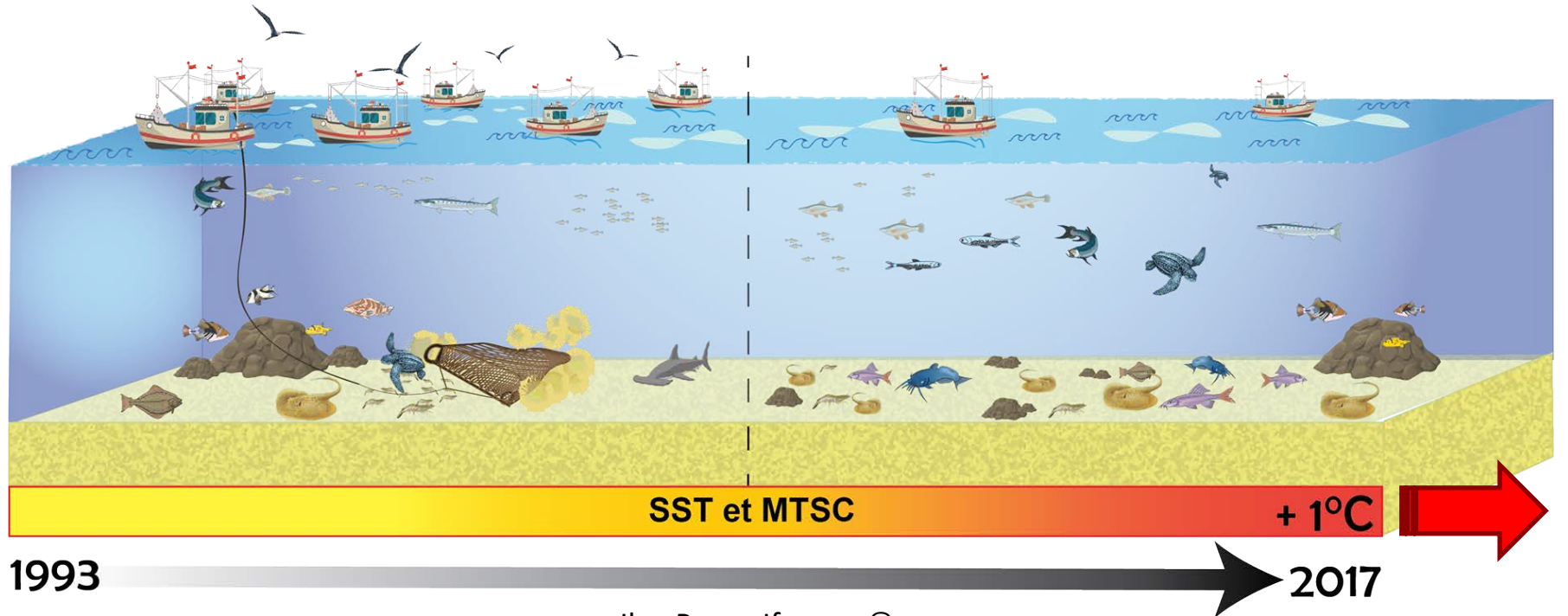
The Rays group



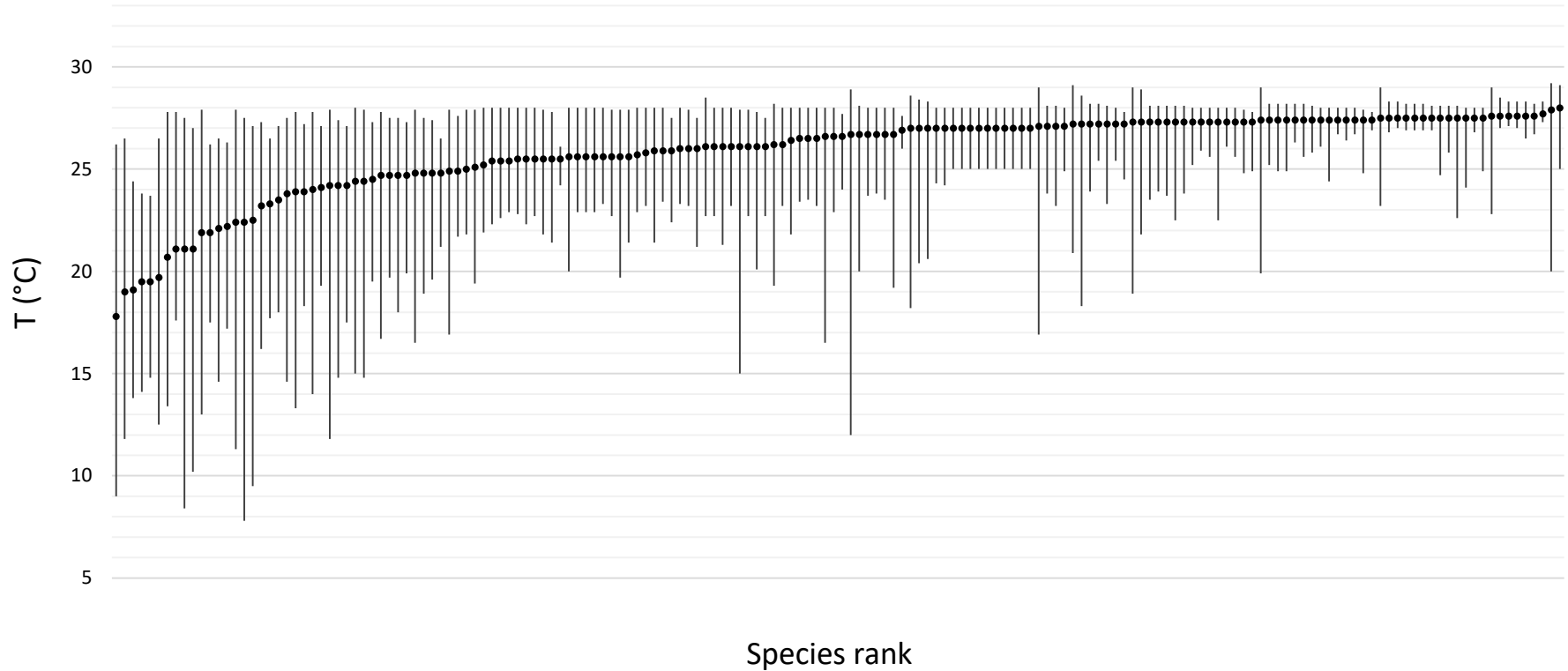
	1990's	2000's	2010's	
 <i>H. americanus</i>	90%	4%	0.5%	 Sub-tropical species  Tropical species
 <i>H. guttatus</i>	0%	41%	53%	
 <i>F. geijskesi</i>	0%	47%	38%	

Synthesis

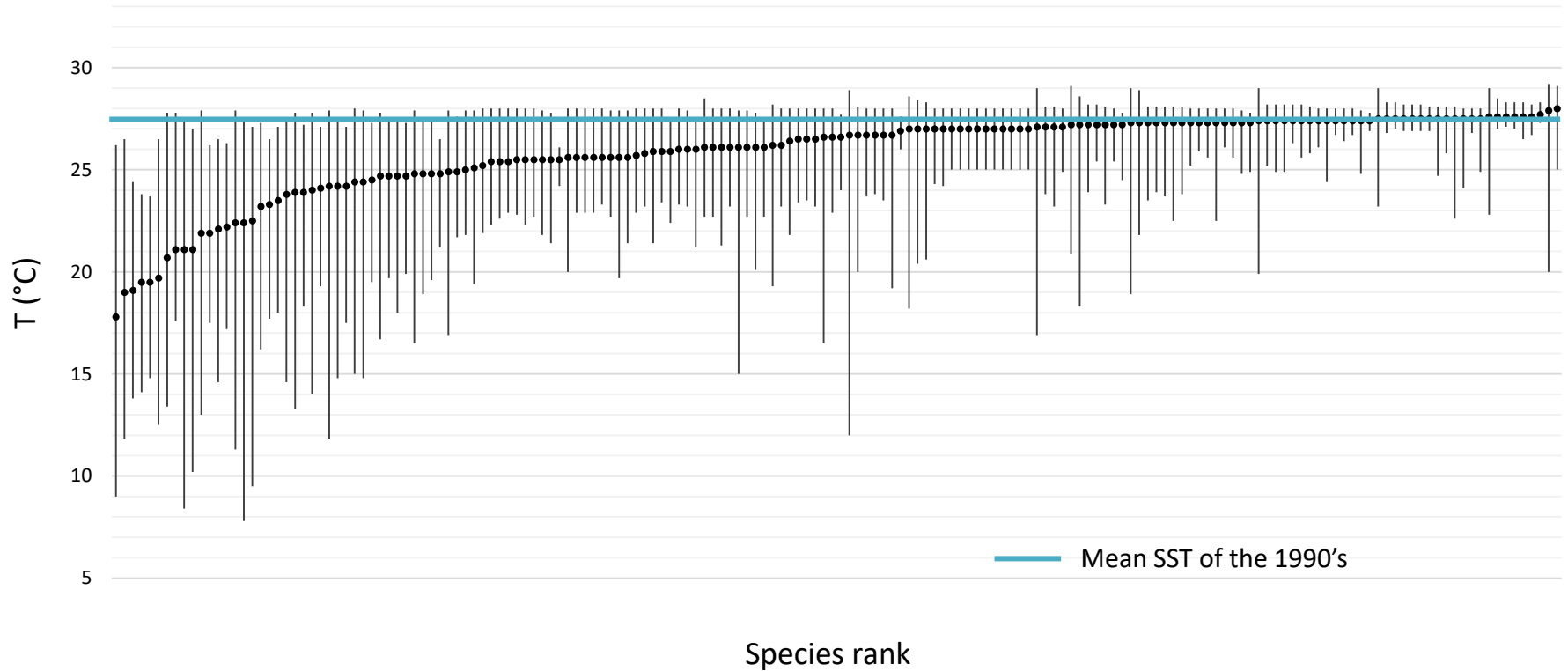
Restructuring of the fish communities so far but until when ?



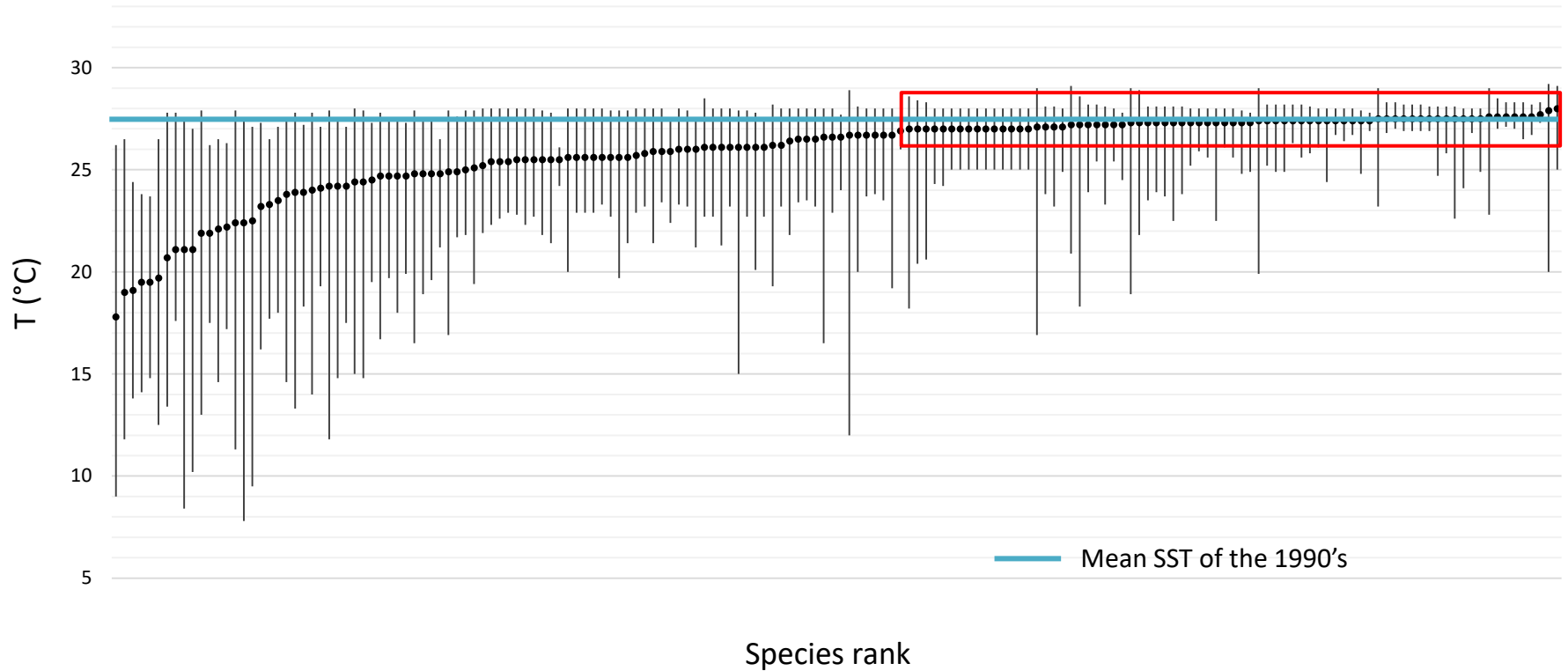
What's next about SST ?



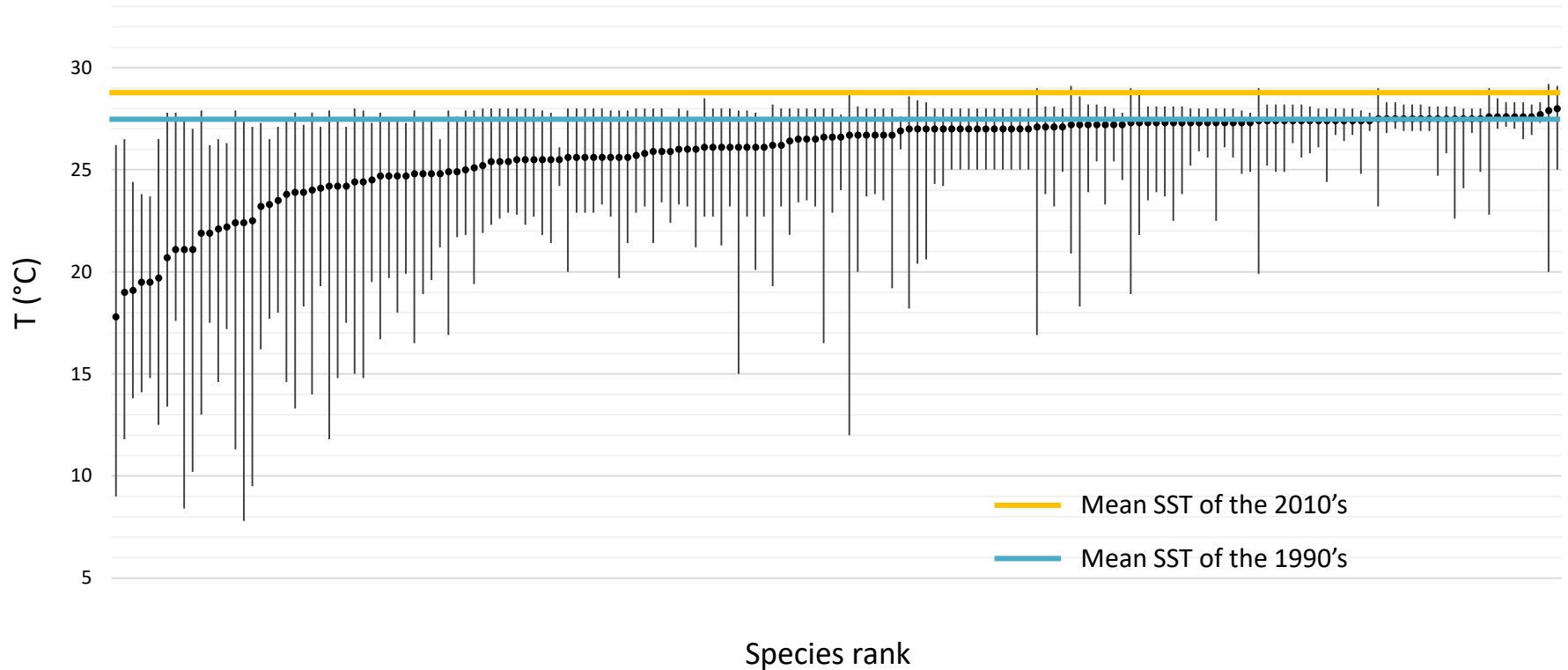
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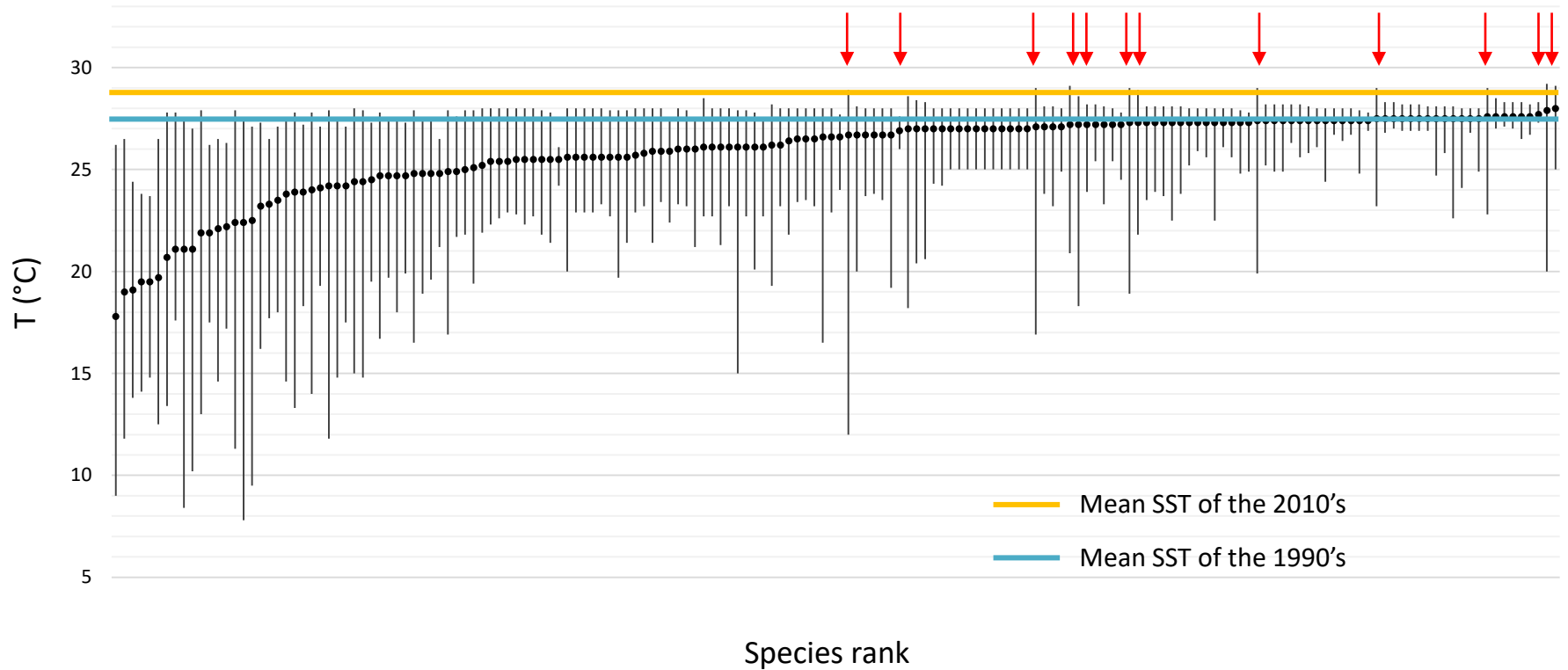
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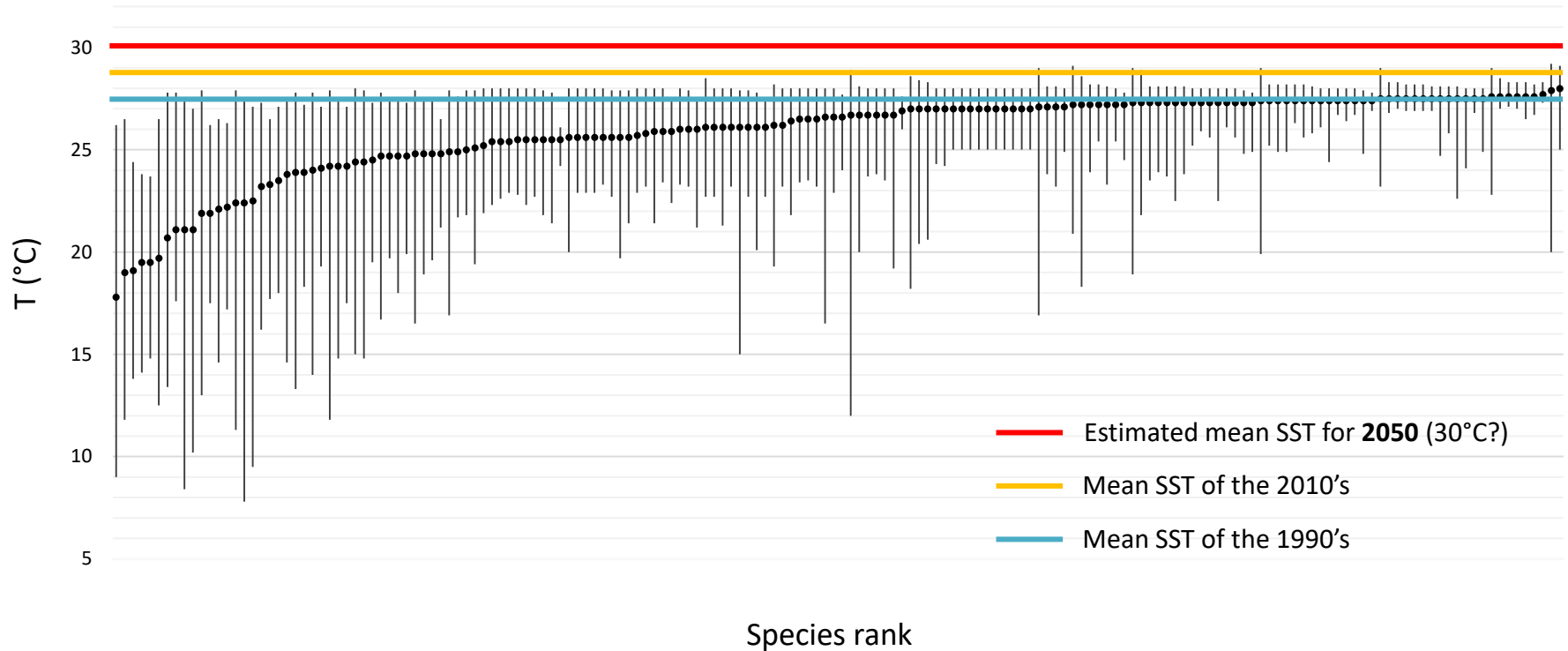
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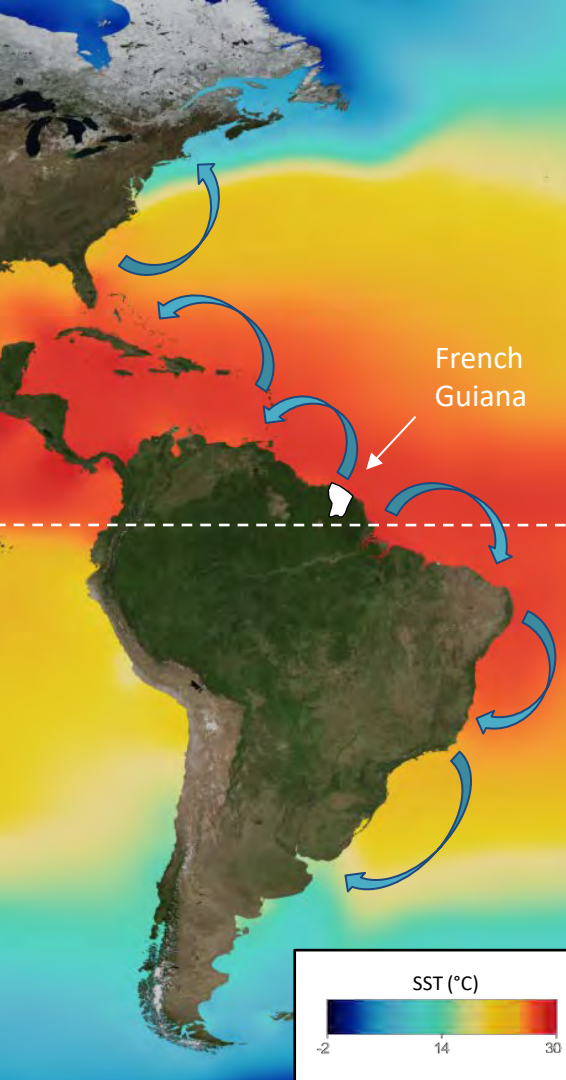


What's next about SST ?

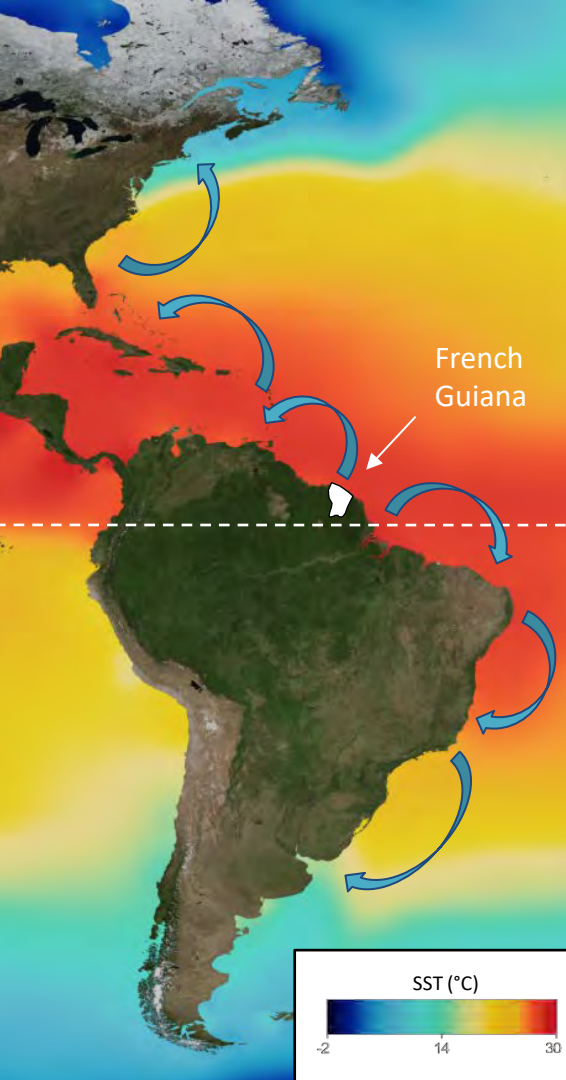


Conclusions

- Biodiversity in tropical regions is likely to be impacted by higher rate of local extinction due to warming waters
- In **French Guiana**, positive effects of the decreasing fishing pressure on the fish communities' dynamics dominates over the climate change **so far**



Conclusions



- Biodiversity in tropical regions is likely to be impacted by higher rate of local extinction due to warming waters
- In **French Guiana**, positive effects of the decreasing fishing pressure on the fish communities' dynamics dominates over the climate change **so far**
- Ecosystem approach to fisheries management
- Mechanistic approaches to evaluate impacts of future scenarios on fish communities

Thank you !

Vincent Vallée, Ilan Perez, Maria Ching Villanueva & Fabian Blanchard

Vincent Vallée
PhD Student (2016-2019)
vincent.vallee@ifremer.fr

&

Ilan Perez
MS Candidate
ilanperez.perso@gmail.com