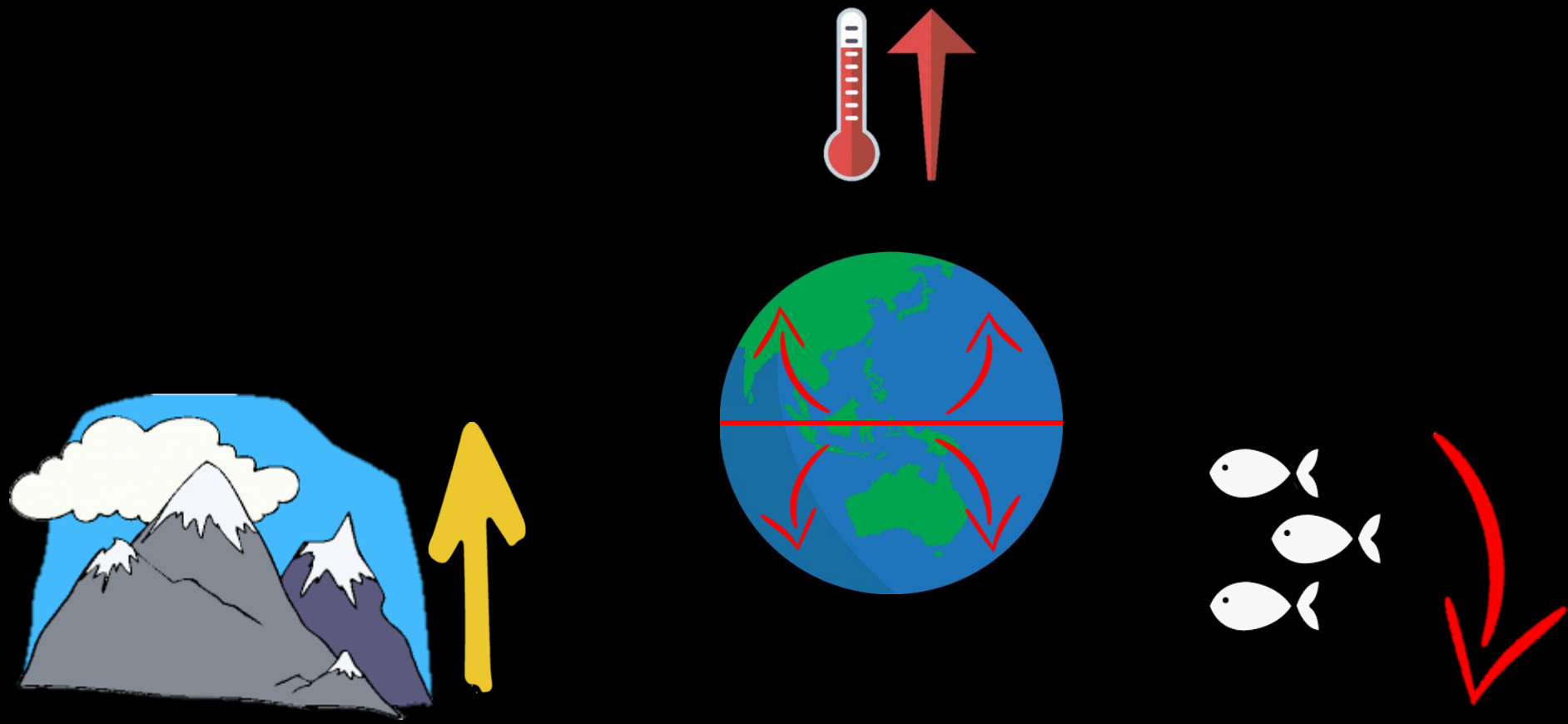
Temporal shifts in fish functional diversity in tropicalized reefs are similar to cross-shelf spatial changes

M. Paula Sgarlatta

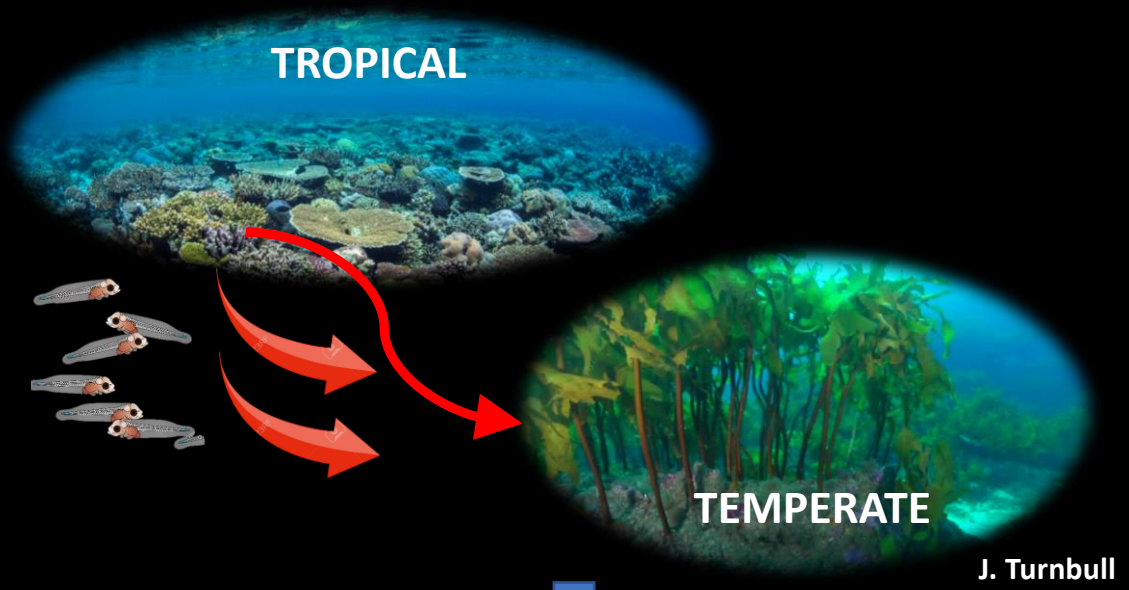
Camille Magneville, Sébastien Villéger, Hamish Malcolm, Iain Suthers & Adriana Vergés

UNSW Biological, Earth and Environmental Sciences

Climate change - redistribution of species



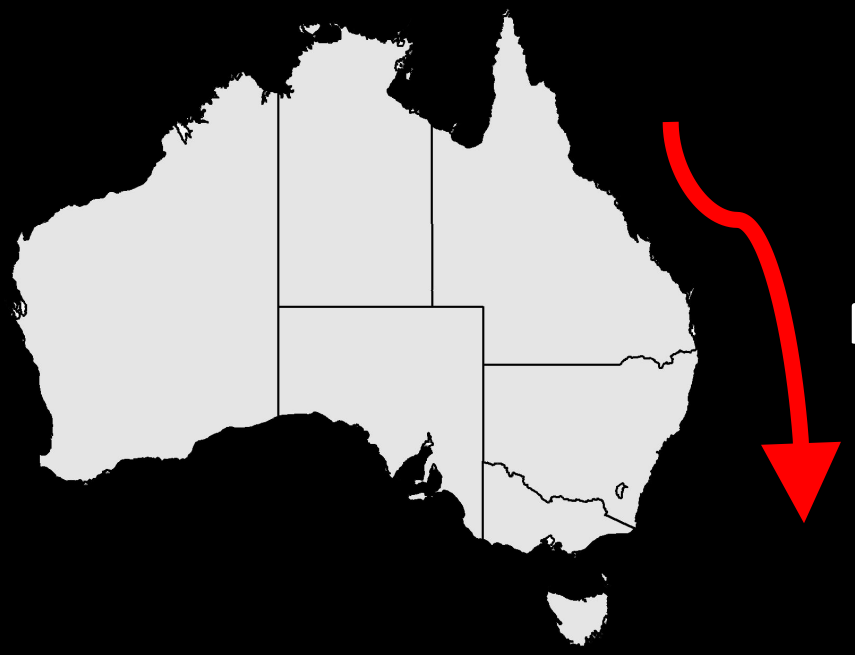
Species are moving faster in the ocean than on land



New interactions

New tropicalized ecosystem

Species are moving faster in the ocean than on land



Major climate change hot-spot

New tropicalized ecosystem

Loss of kelp in the Solitary Islands

2002 2009 2011

Loss of kelp in the Solitary Islands

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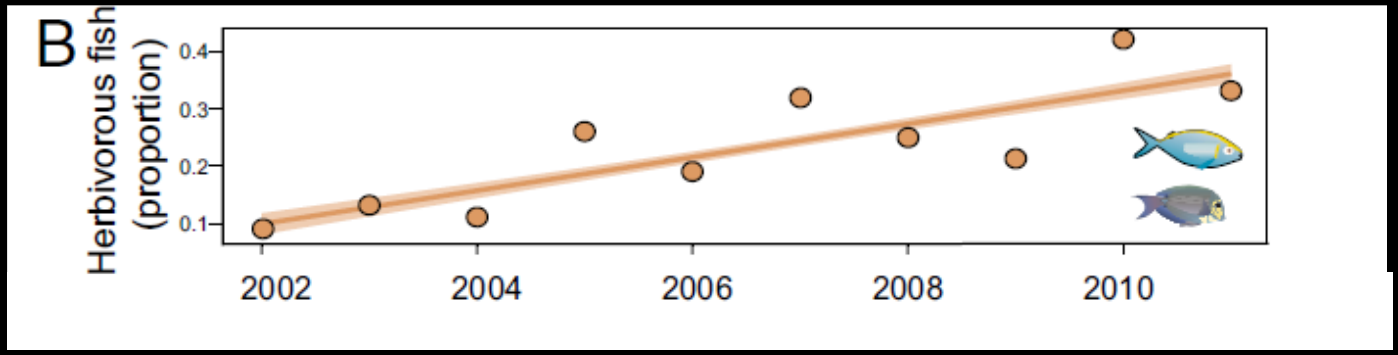
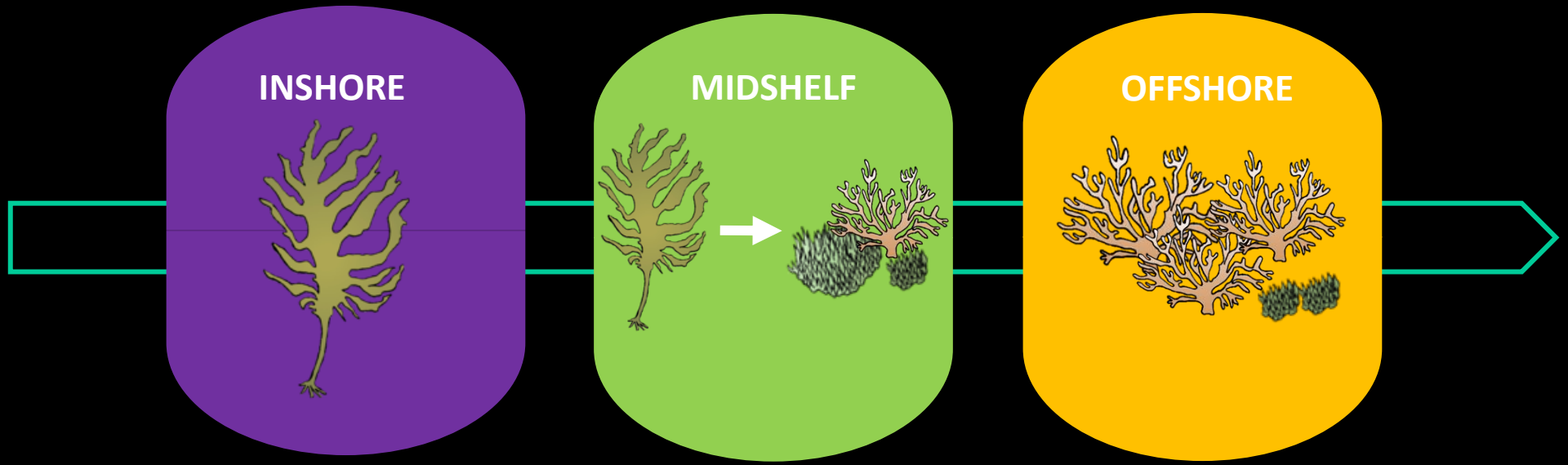


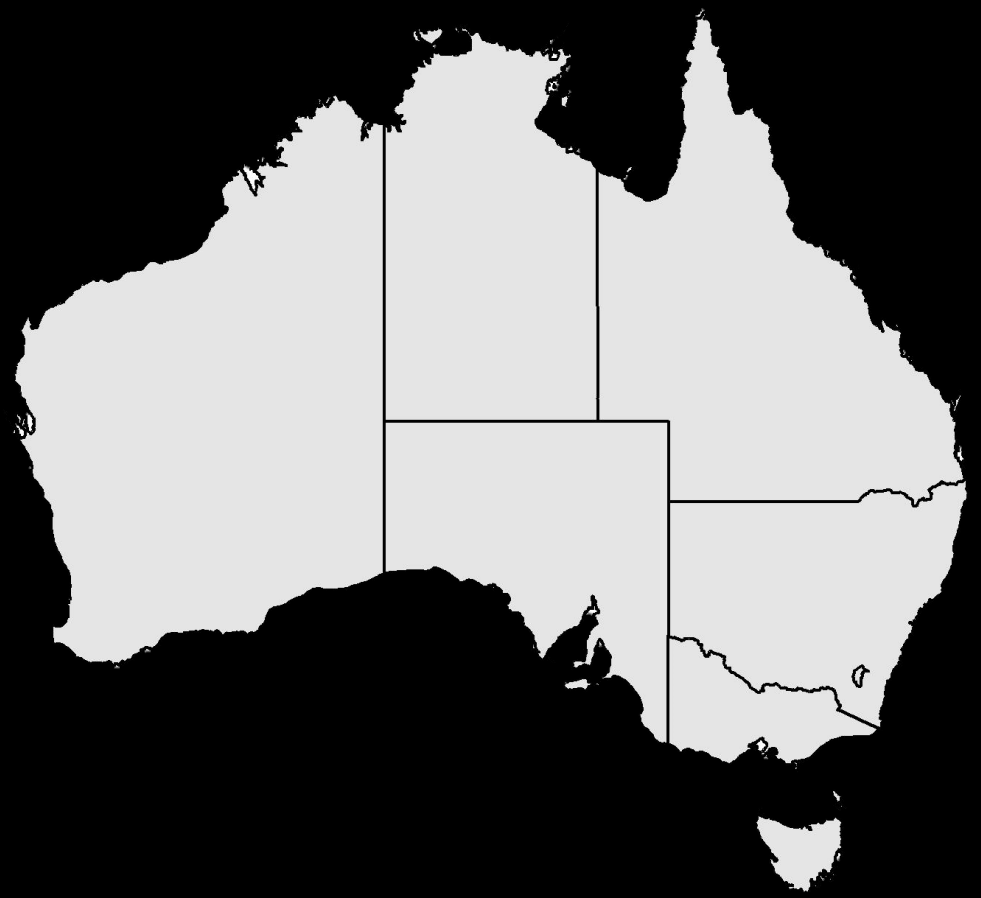
Vergés *et al.*, 2016

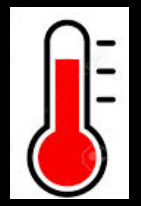
Solitary Islands – mix of tropical and temperate species

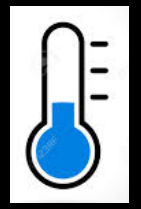


Drawings: Zuhairah Dindar

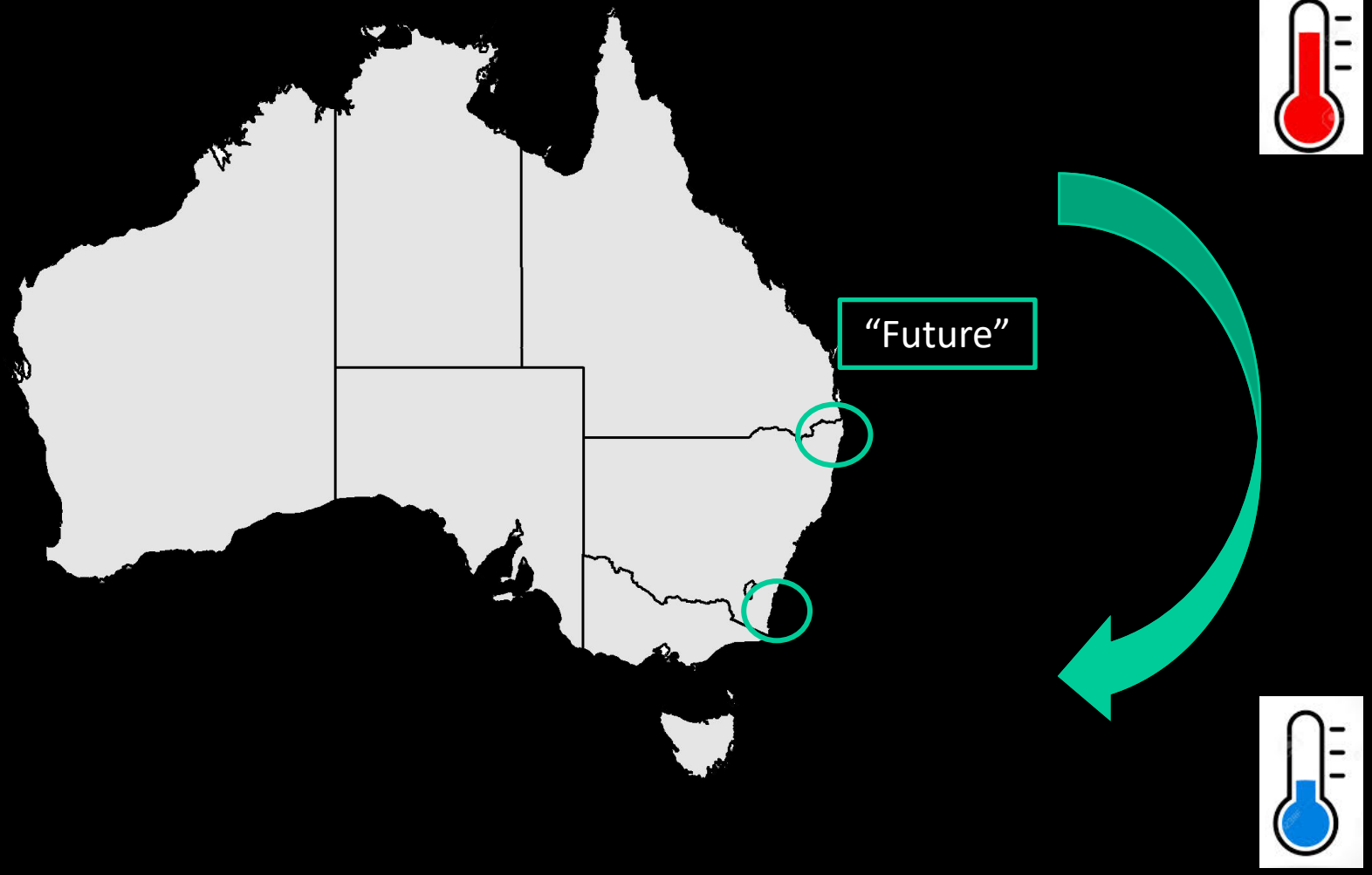
Space-for-time substitution to predict changes







Space-for-time substitution to predict changes

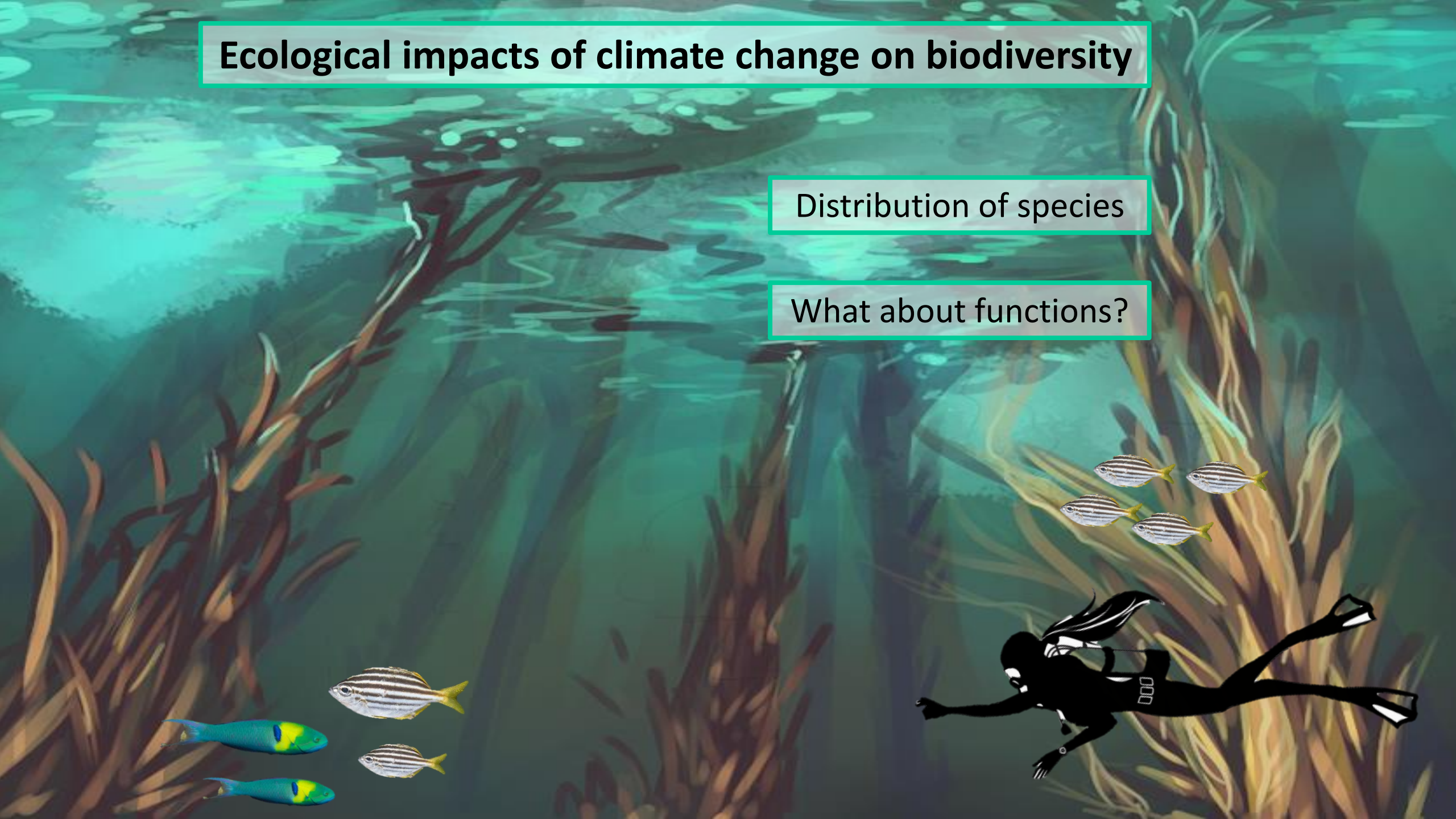


Space ~ time?

Ecological impacts of climate change on biodiversity

Distribution of species

What about functions?



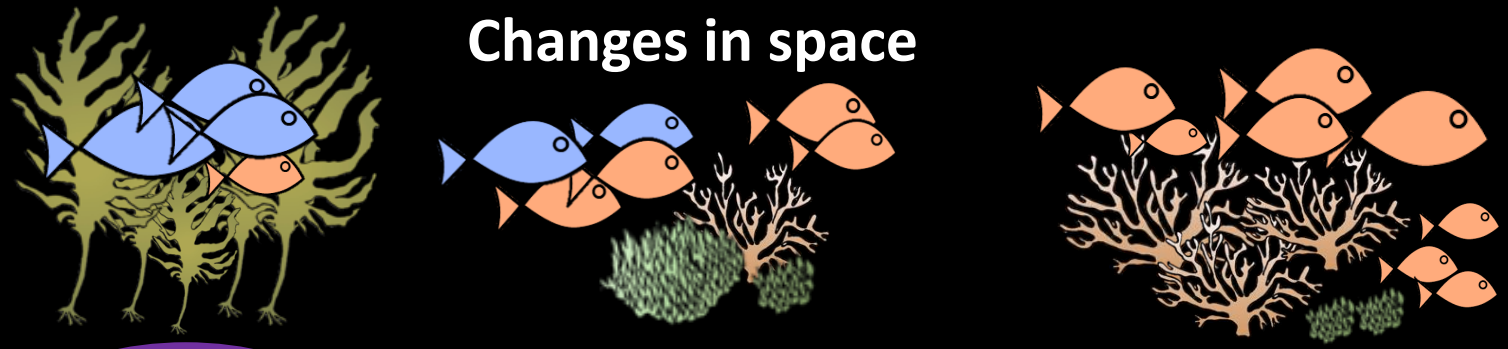
Ecological impacts of climate change on biodiversity

Distribution of species

What about functions?

Trait-based approaches

Changes in space

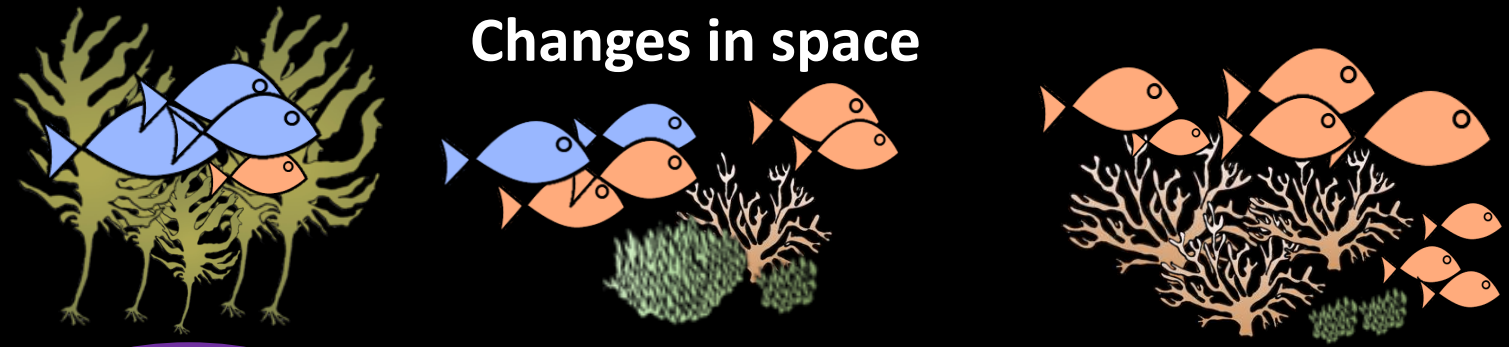


INSHORE

MIDSHELF

OFFSHORE

Changes in space

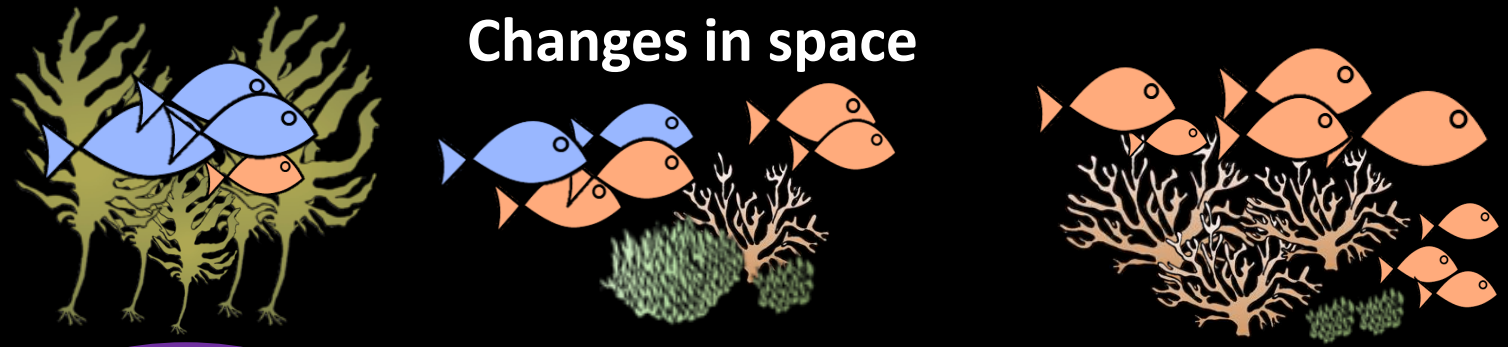


INSHORE | **MIDSHELF** | **OFFSHORE**

"Future" conditions

Can we use this cross-shelf gradient, from inshore to offshore, as a space for time substitution approach?

Changes in space

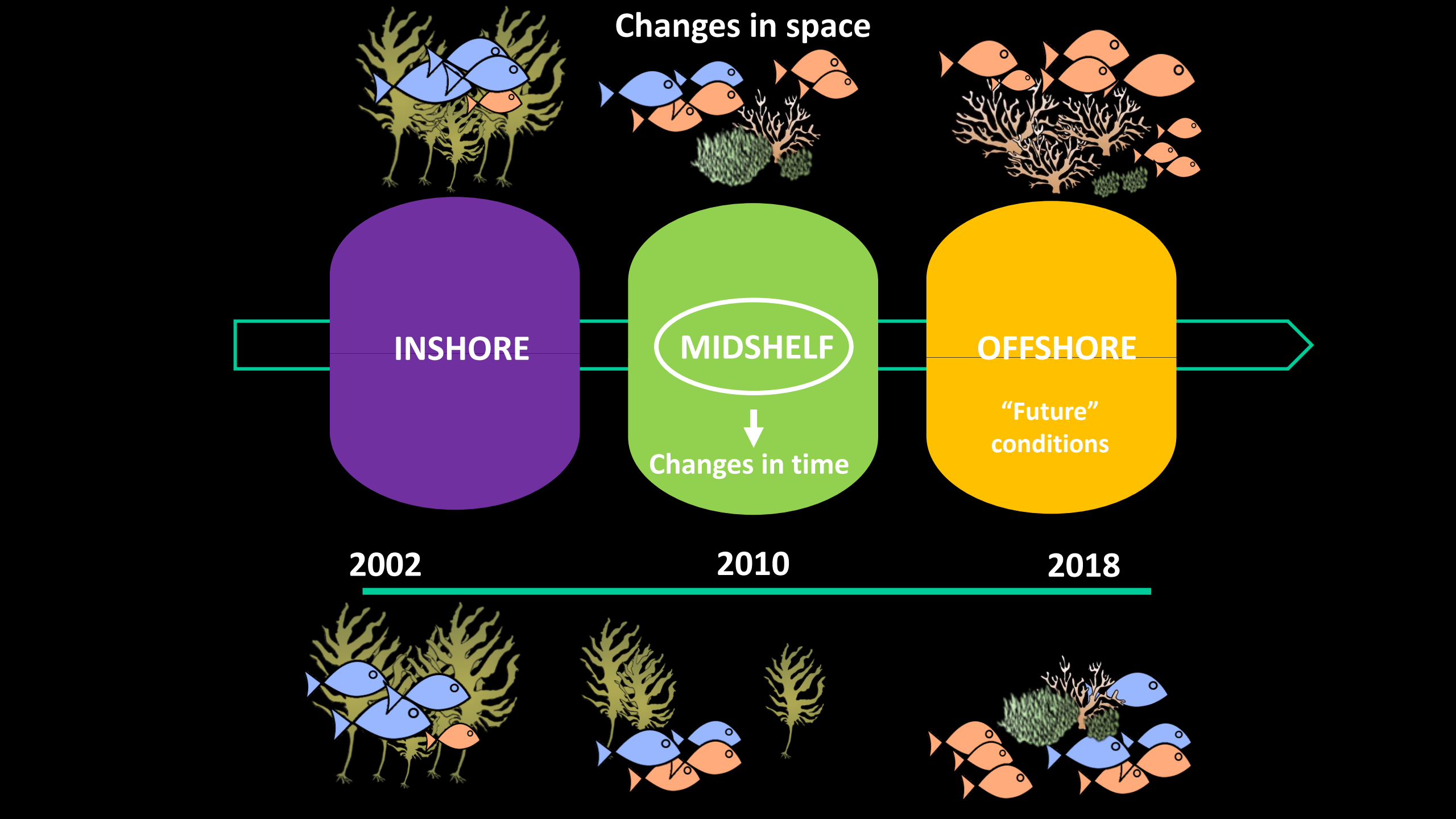


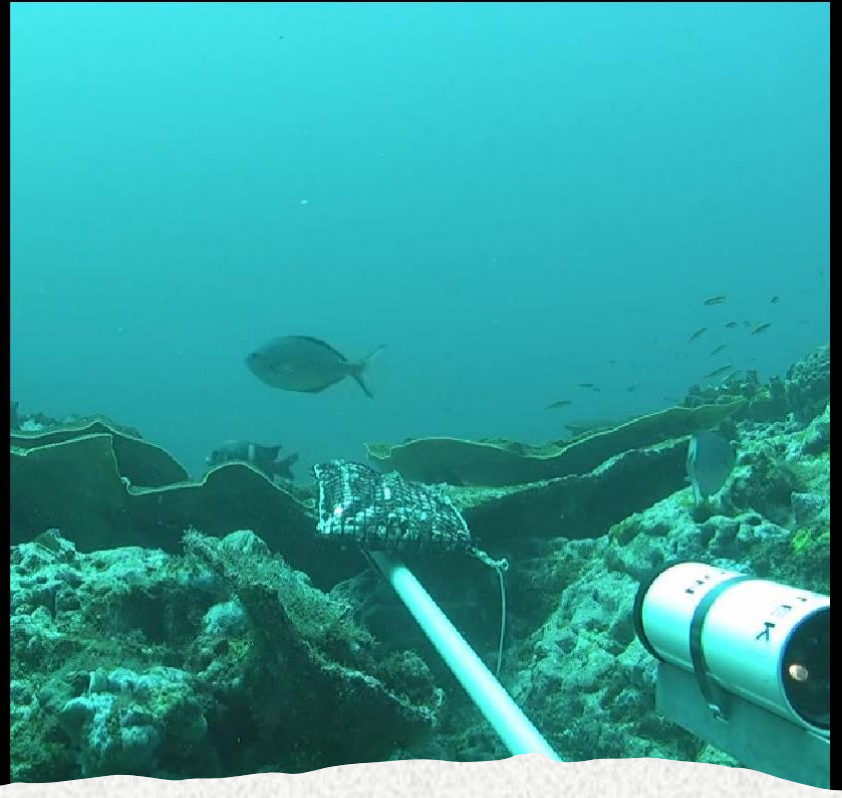
INSHORE | **MIDSHELF** | **OFFSHORE**

"Future" conditions

Can we use this cross-shelf gradient, from inshore to offshore, as a space for time substitution approach?

Limitations of this approach?

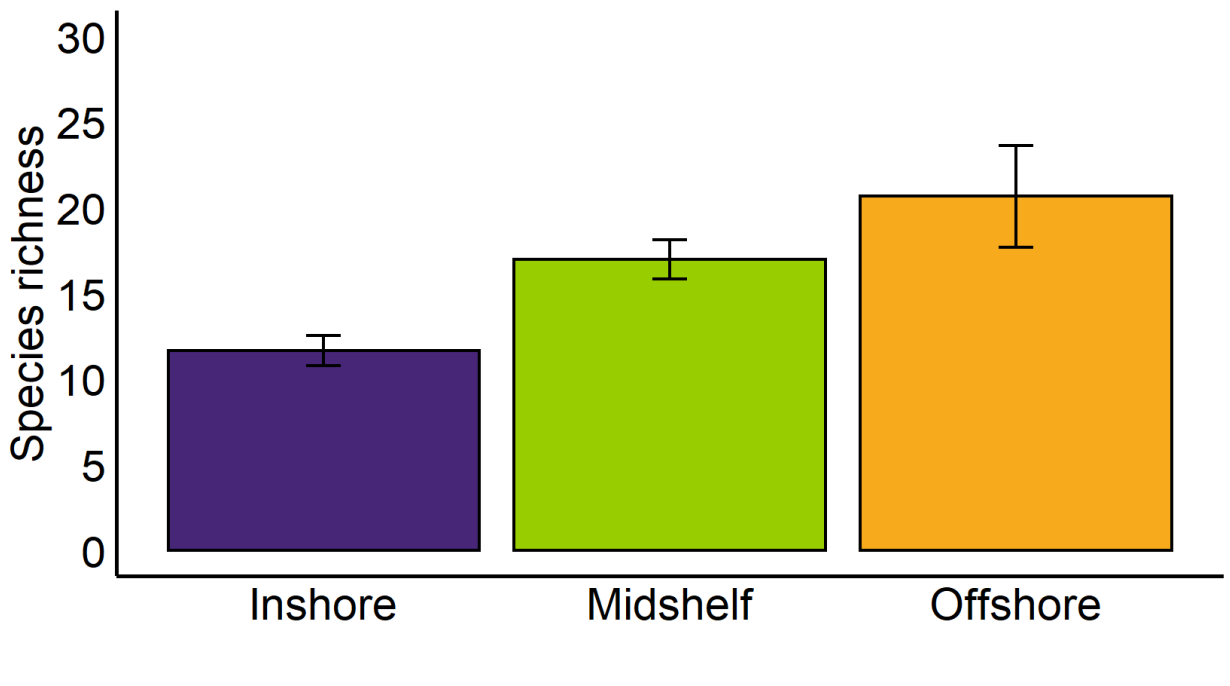

Changes in space
INSHORE
MIDSHELF
Changes in time
OFFSHORE
"Future" conditions
2002
2010
2018



Aim

To understand how fish taxonomic and functional diversity are changing over time and space in tropicalized reefs.

Changes in species richness over time and space



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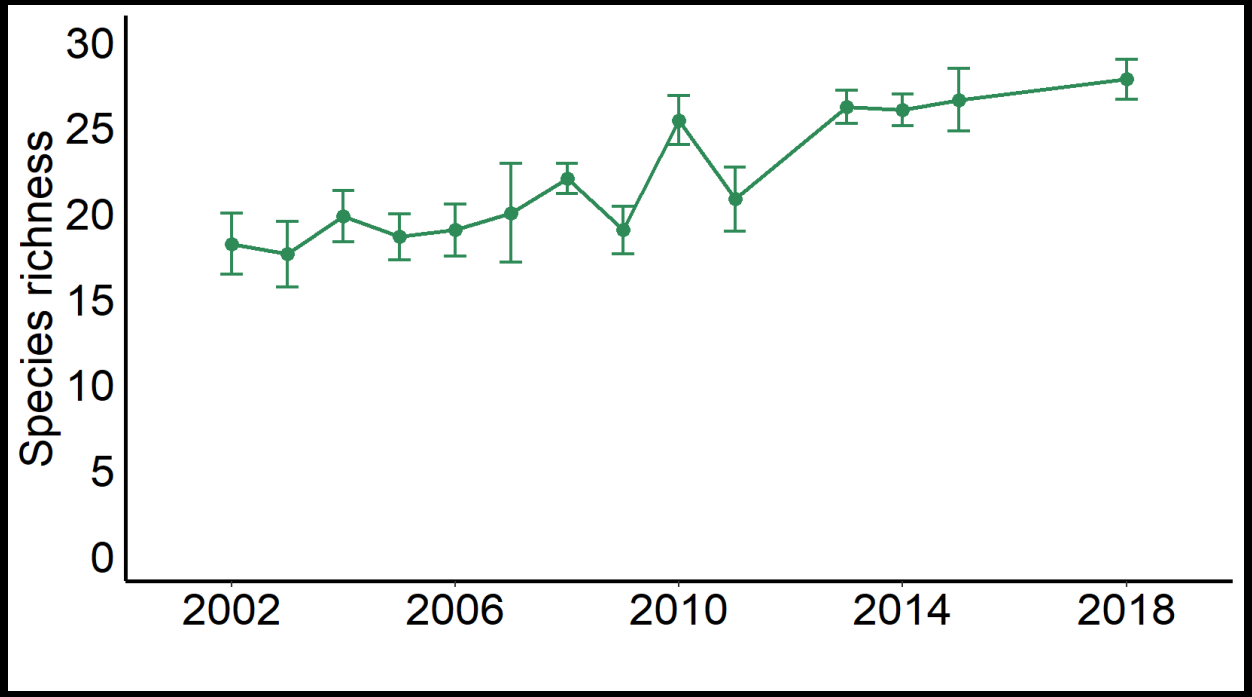
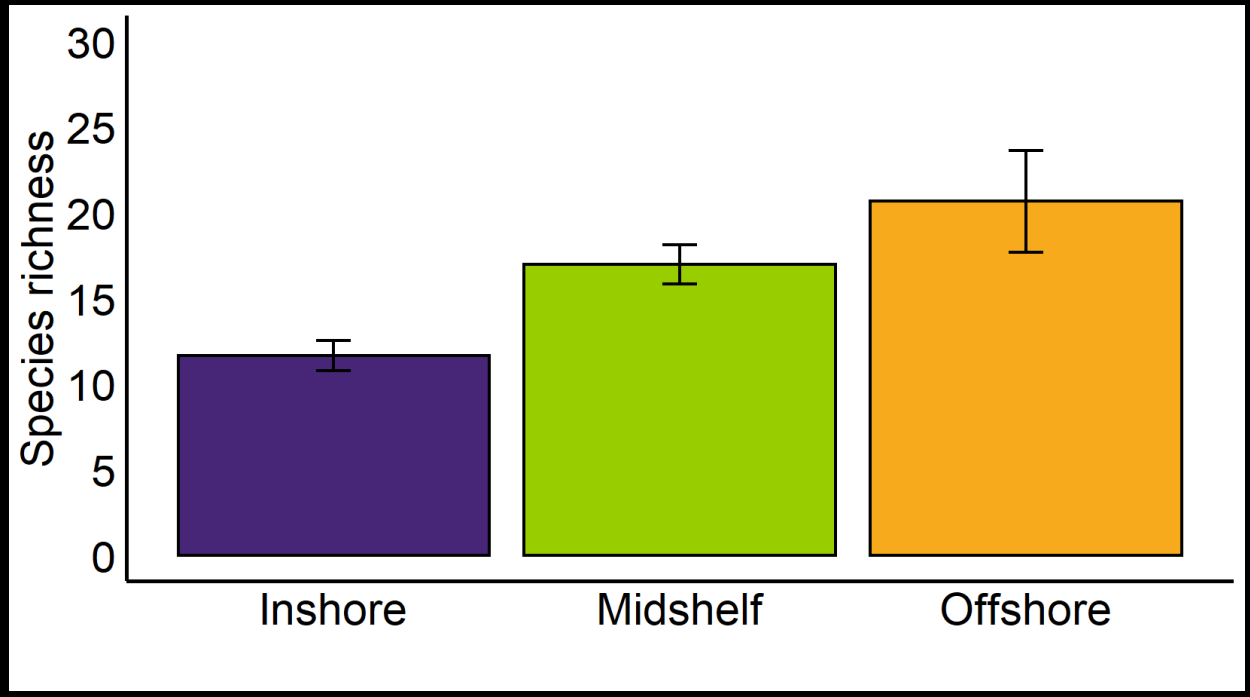
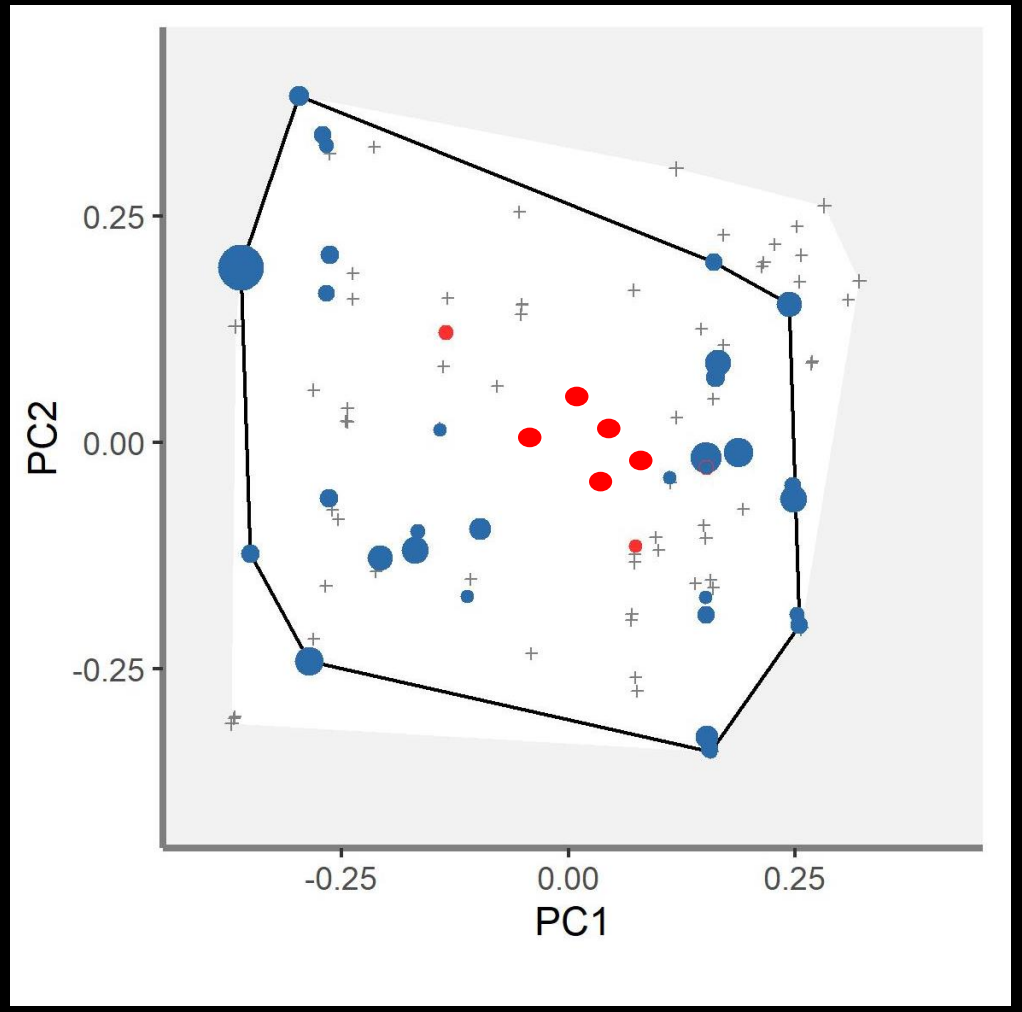




Increase ~ 2 times greater

- Maximum length
- Common aggregation
- Vertical position
- Diet
- Maximum growth rate

Traits and functional space



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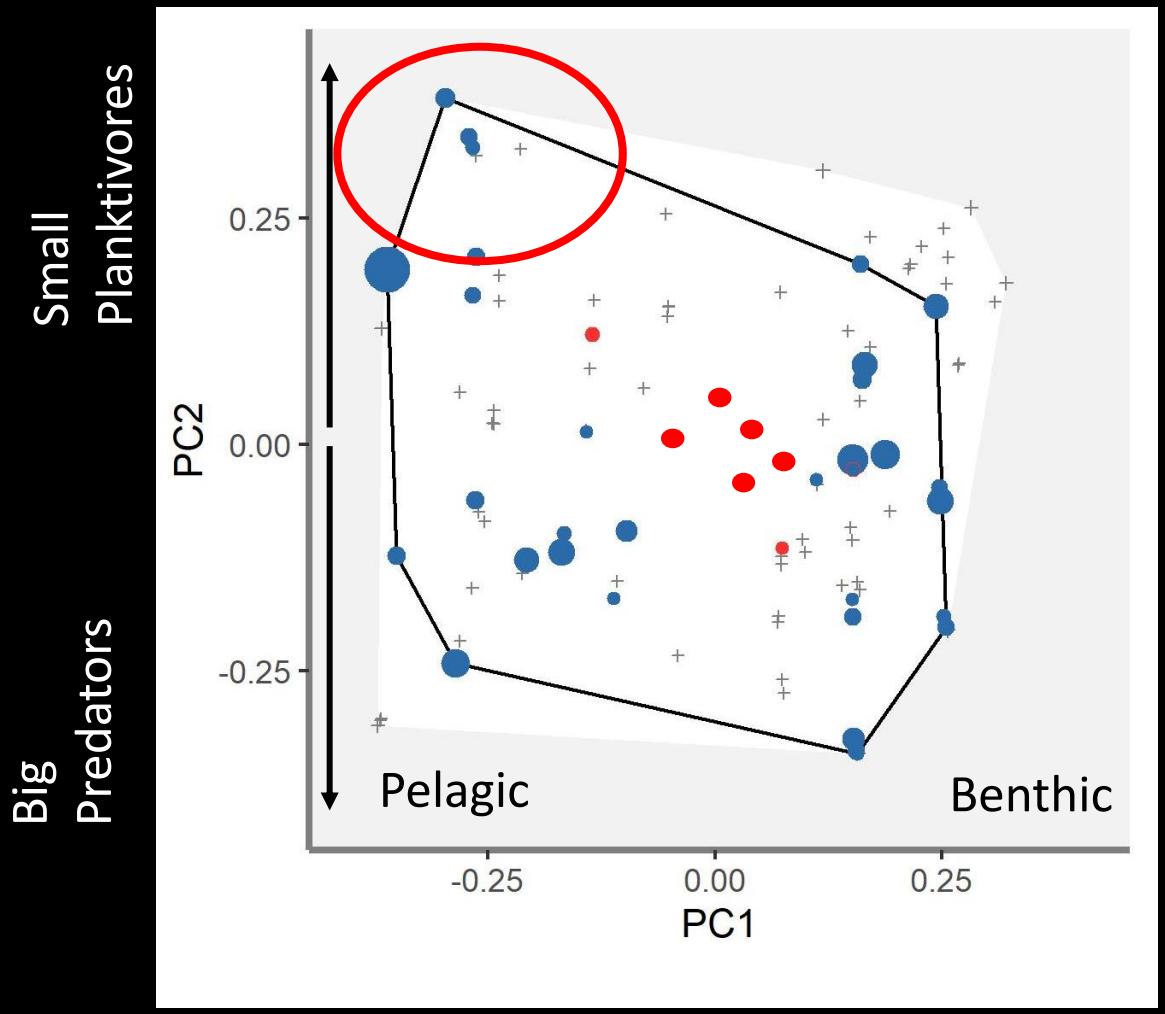
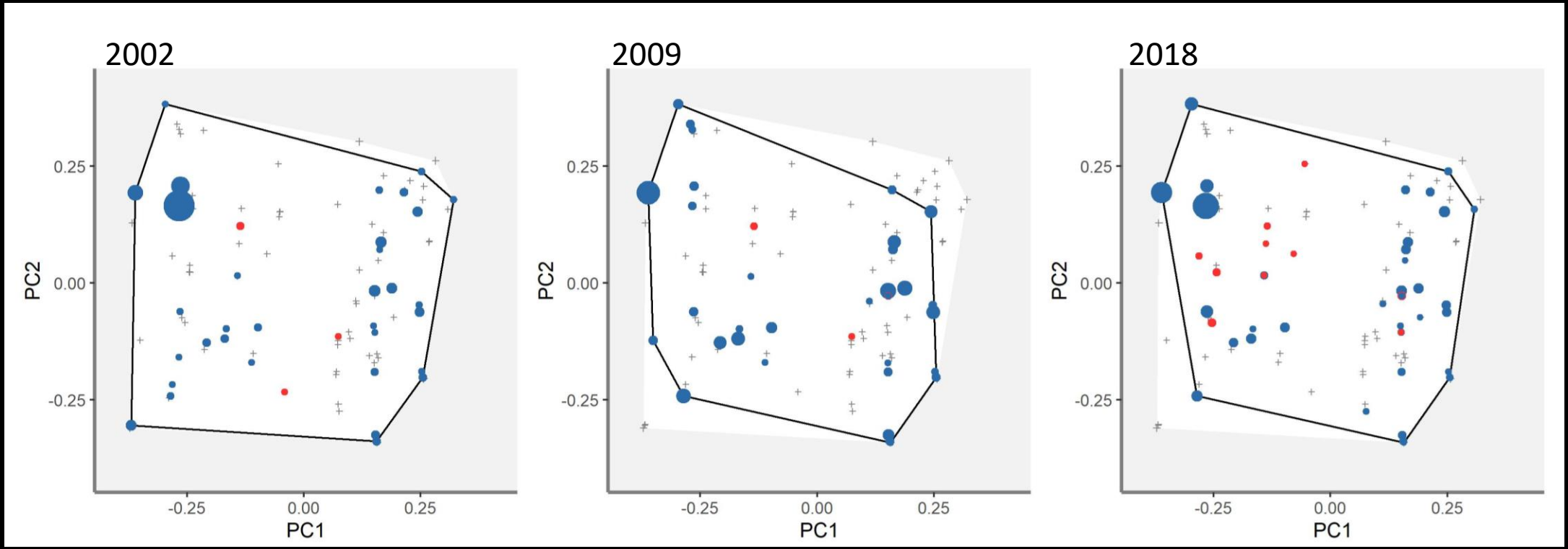
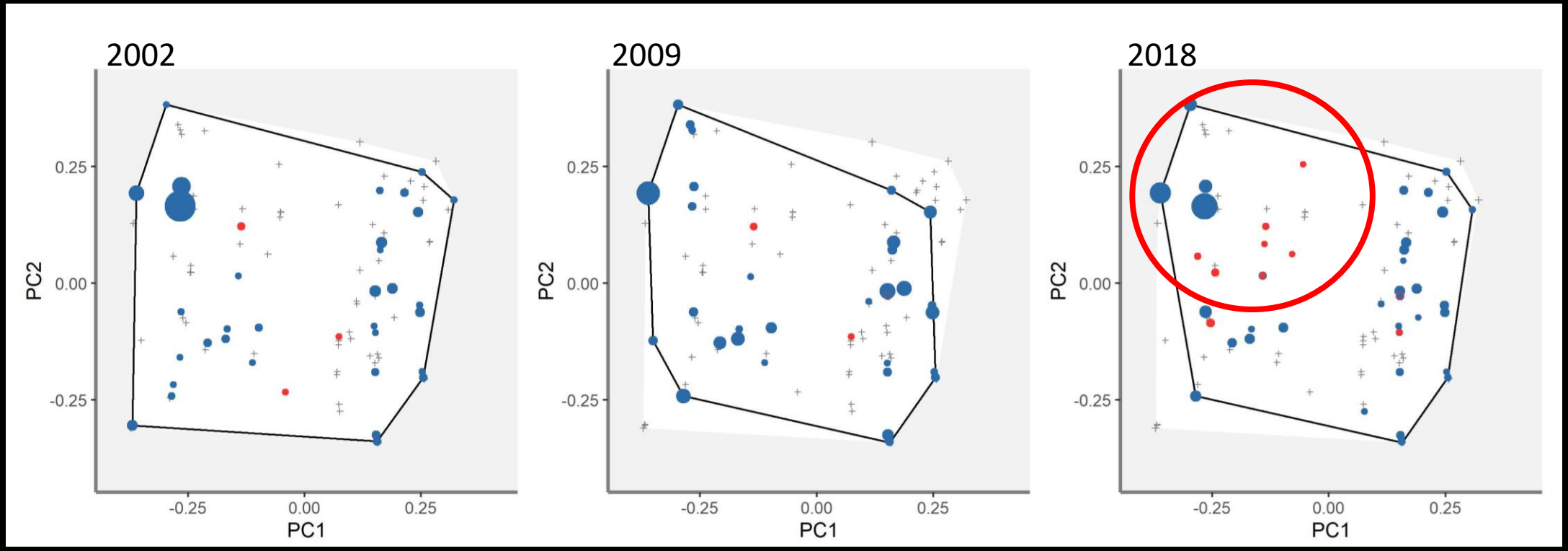


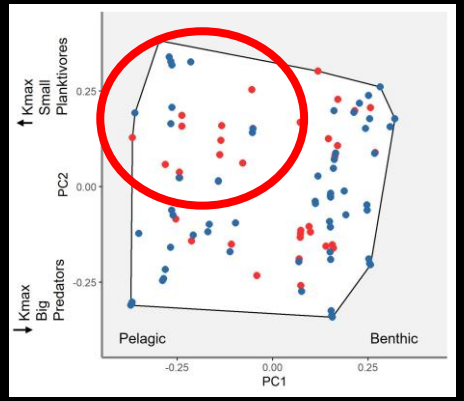
Functional richness



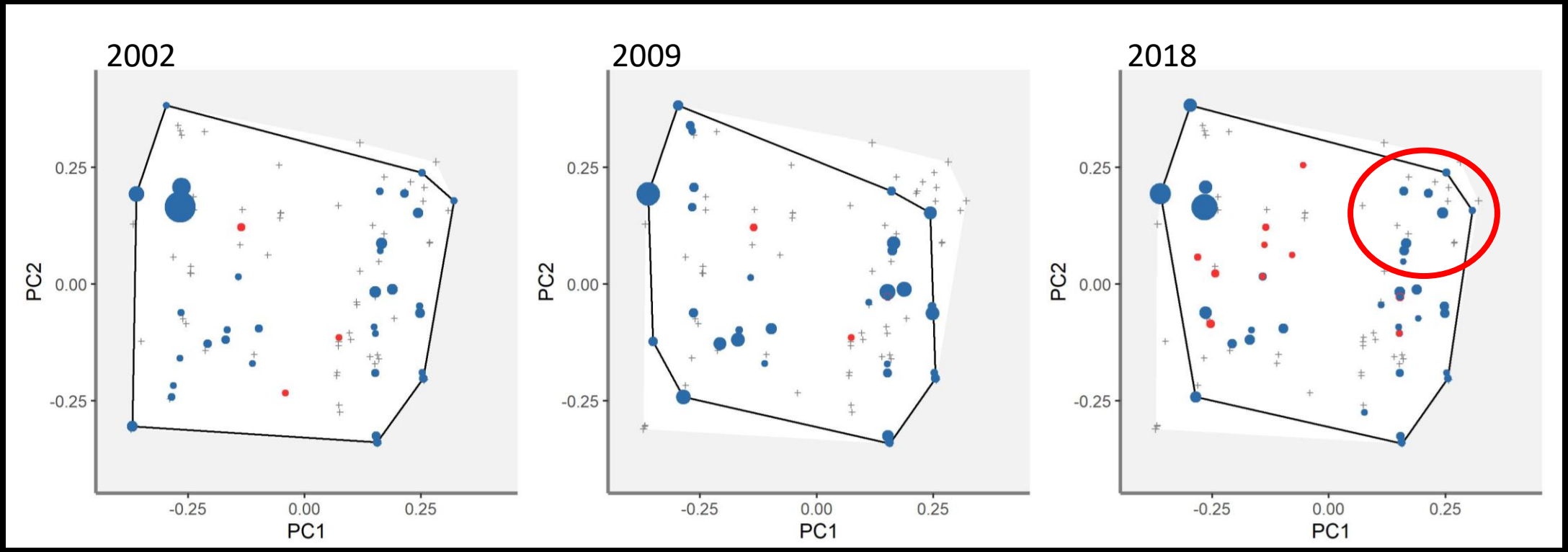
Functional richness



Small, planktivores, herbivores species

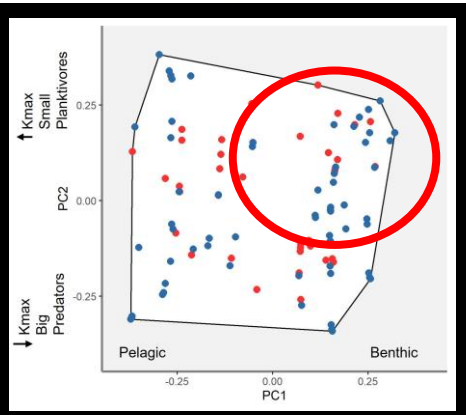


Functional richness



Small, planktivores, herbivores species

Invertivores



Shift in functional structure over time

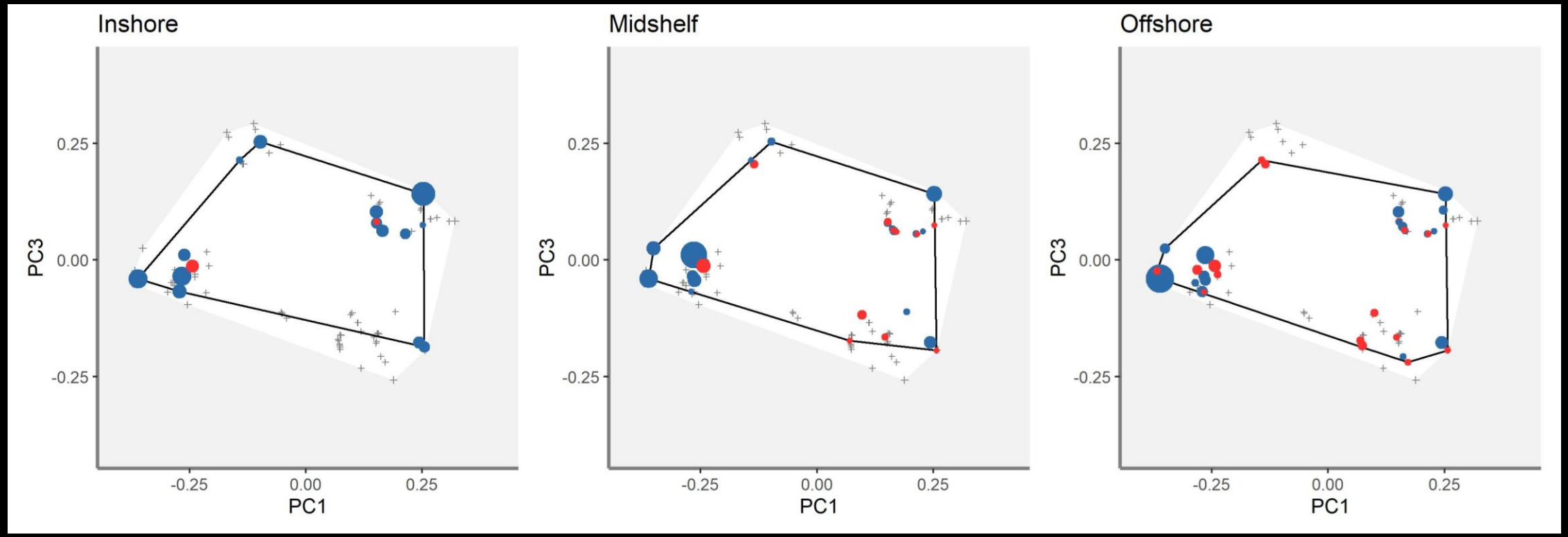
- Herbivores – well-known driver of tropicalization.
- Invertivores – benefiting from turf algae food sources.

Shift in functional structure over time

- Herbivores – well-known driver of tropicalization.
- Invertivores – benefiting from turf algae food sources.

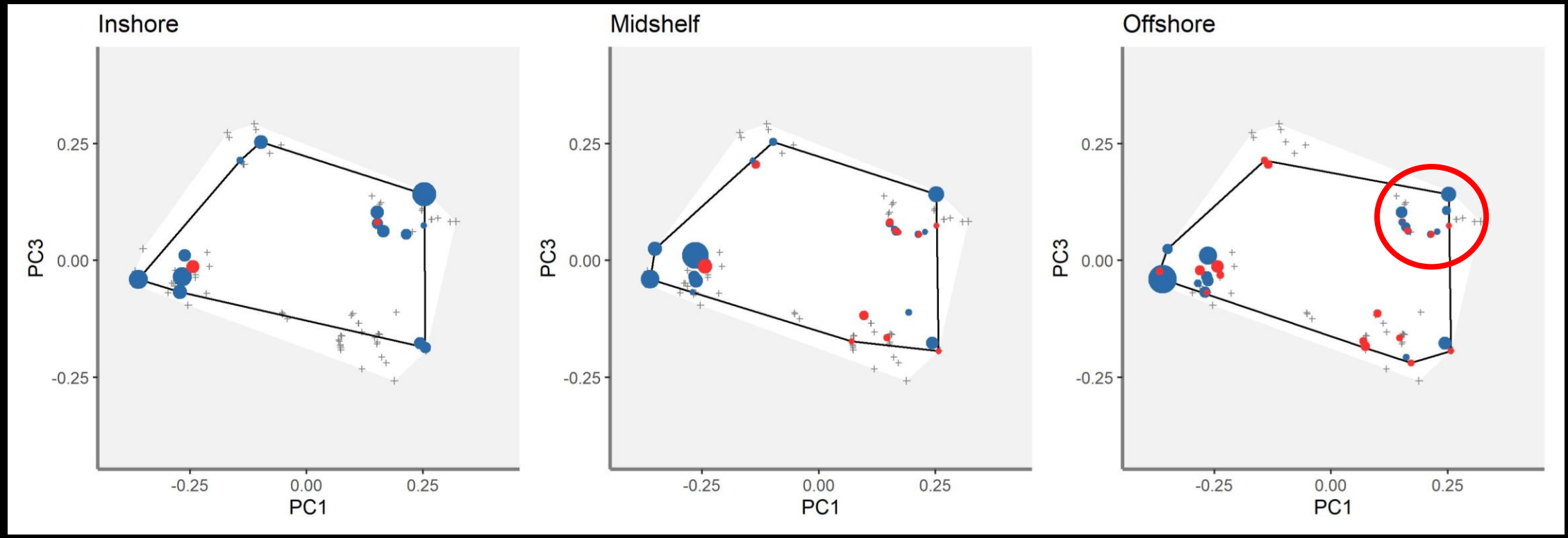
- Smaller species - impact in the ecosystem.
- Reshape food webs, impact productivity.
- Decrease in biomass?

Functional richness



Increase ~ 6 times greater
than over time

Functional richness



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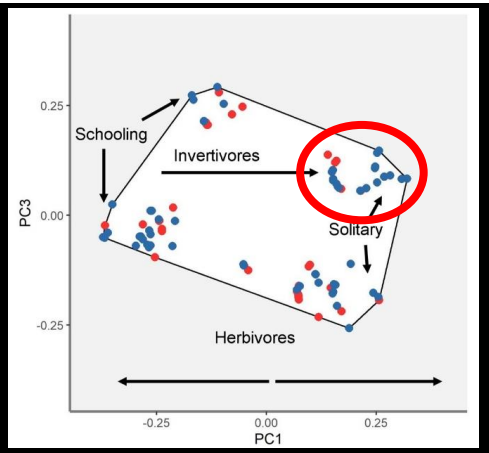
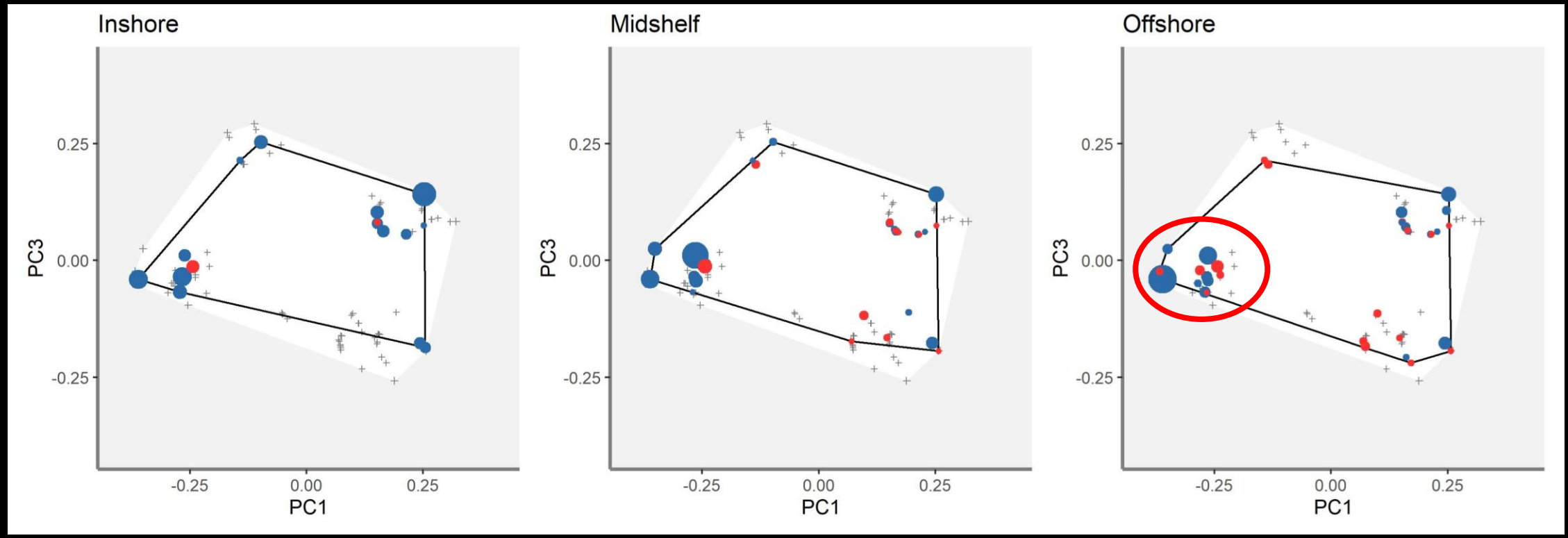
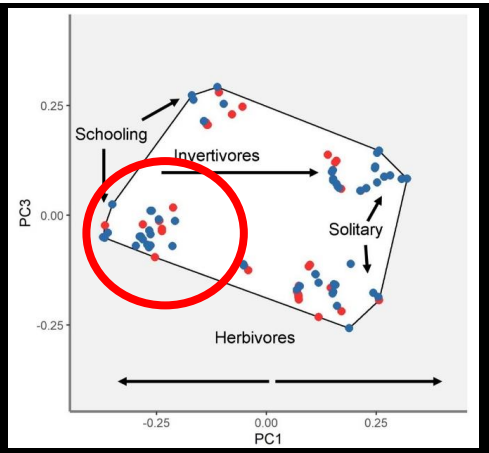


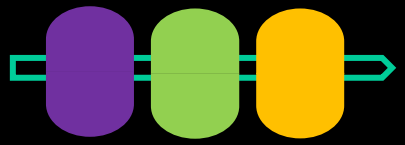
Functional richness



Invertivores

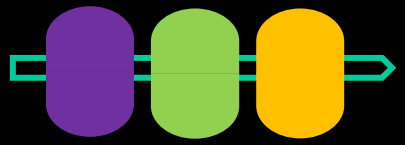
Herbivores and smaller zooplanktivores





Shift in functional structure across space

- Herbivores, invertivores, and planktivores – similar to temporal patterns.



Shift in functional structure across space

- Herbivores, invertivores, and planktivores – similar to temporal patterns.

- Smaller species - not significant but increase from inshore to offshore.

Take away messages

- Similar patterns of taxonomic and functional diversity over time and across space.
- Greater increase in functional diversity in offshore sites (“future”) than over time.
- Changes in benthic habitats may restrict or extend these shifts in functional structure.

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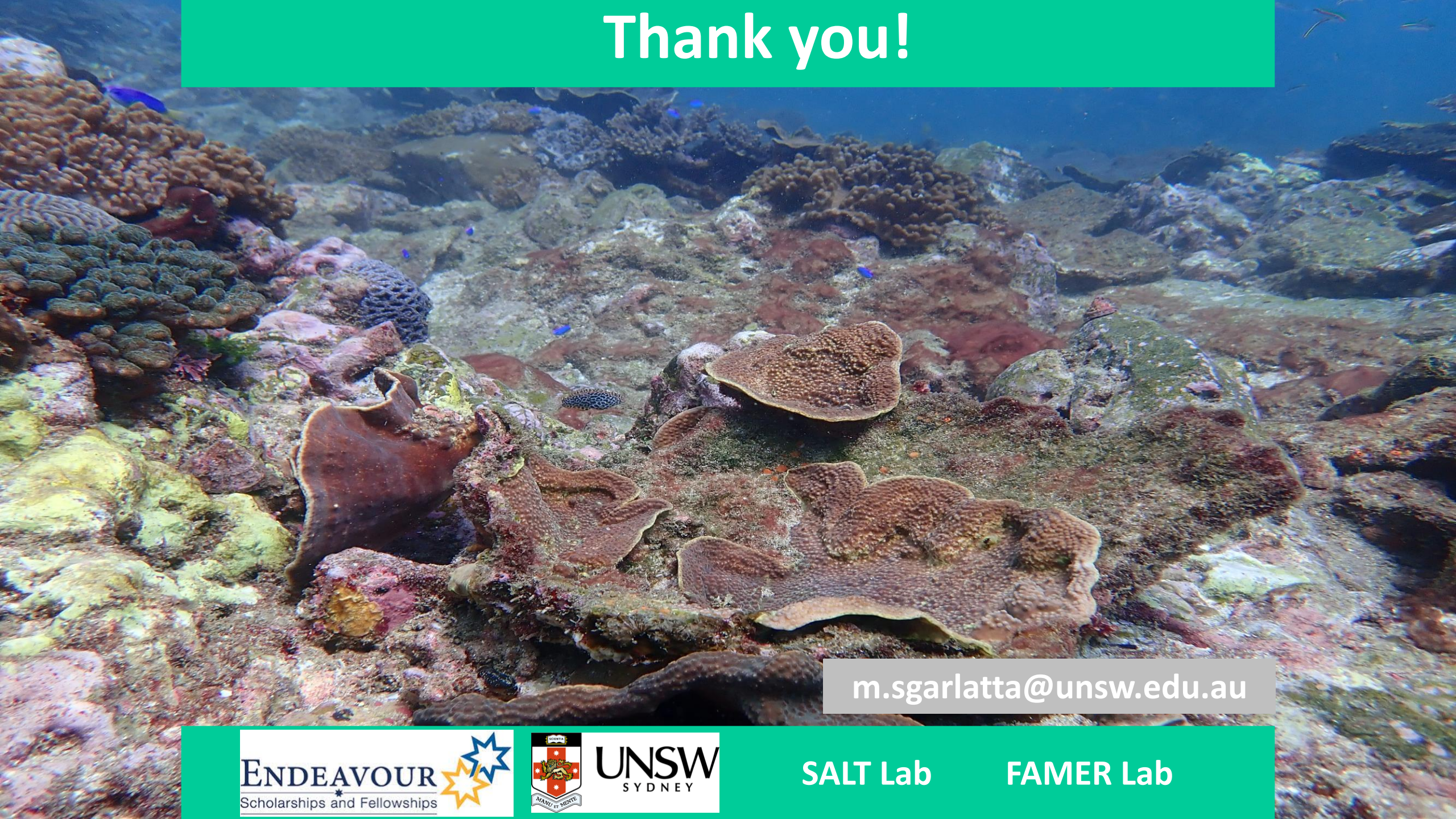
Thank you!



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