SCIENZE A SISTEMA PER LA SOSTENIBILITÀ
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The real architecture of Antarctic biodiversity
TROPHIC ECOLOGY RESEARCH GROUP

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Seasonal Sea-Ice Dynamics and Ecological Interactions in Antarctica

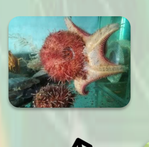
In Antarctica, and especially in the Ross Sea, primary productivity and trophic interactions are closely linked to the seasonal sea-ice dynamics. These factors affect biodiversity persistence, ecosystem functioning, and pollutant transfer pathways. The sea-ice decline due to climate change is threatening local biodiversity, whose response to disturbances could be driven by the configuration of trophic links. Augmenting the limited current data and answering central hypotheses about the architecture of biodiversity is necessary to understand how variations in sea-ice dynamics might affect the stability of these highly biodiverse communities.

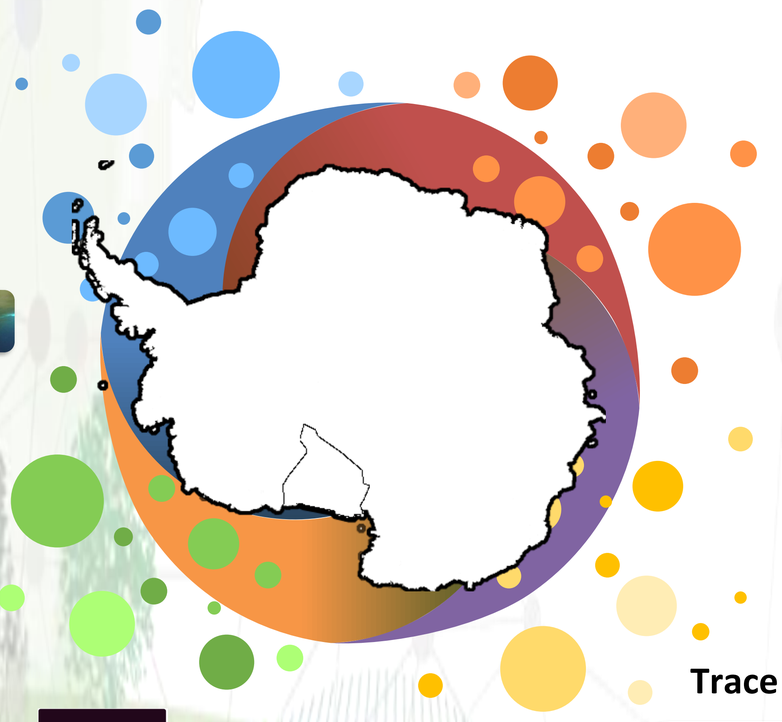
Main Research Results

NOVELTY n°1 - ***Sea-ice Dynamics Affect The Antarctic Food Webs And Trace Elements Transfer***

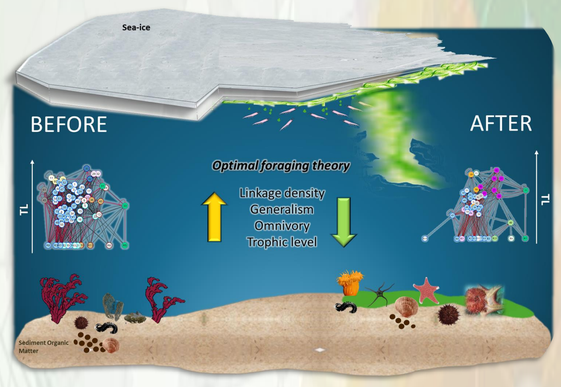
The stability of Antarctic biodiversity depends on the trophic links configuration driving the exchange of energy and matter within and between benthic, pelagic, and sympagic compartments. This configuration is in turn affected by sea-ice dynamics and persistence. The loss of a species can trigger cascading effects, potentially resulting in the loss of multiple species, depending on the food web complexity.





Benthic food webs



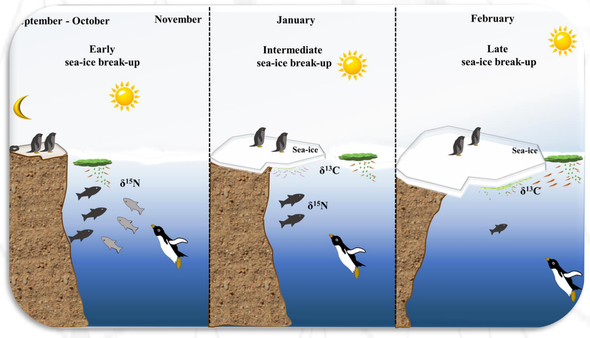
Sporta Caputi et al. 2020

Rossi et al., 2019

Calizza et al. 2018

Signa et al., 2019

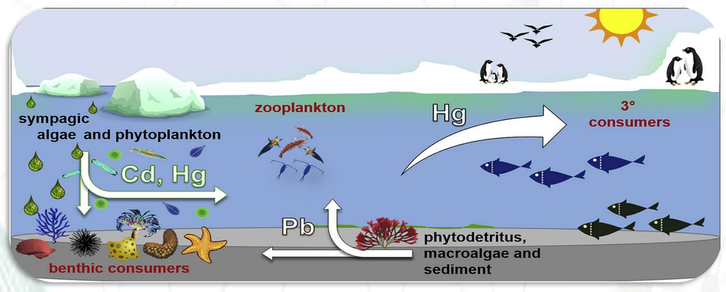
Sea-Ice persistence effects on key species



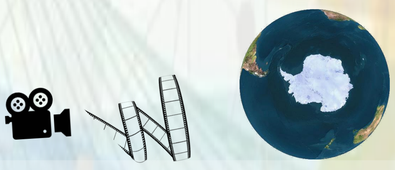
Maccapan et al. 2023

Jafari et al. 2021

Trace element and trophic transfers



Calizza et al. 2021



*NOVELTY n°2 -****Trophic interactions underlies the biodiversity persistence***

Trophic interactions are fundamental in maintaining biodiversity stability allowing the understanding of the:

- **Biodiversity Architecture**: food web structure regulates energy flow pathways and influence species' persistence due to environmental changes. ***Individual dietary variation*** within species allows efficient resource use, while the organisation into ***sub-webs*** makes communities less vulnerable to disturbances. Notably, a ***food web core*** was found to remain stable regardless of resource availability.
- **Pollutant Trophic Pathways**: food web analysis allows to monitor how pollutants move through food chains and amplify at higher trophic levels (including fish species, actually or potentially subject to capture, and top predators such as Adélie and Emperor penguins).
- **Biodiversity Responses to Climate Change**: The interconnected nature of species within a food web means that the loss of one species can have cascading effects throughout the marine community. This vulnerability to diversity loss depends on the complexity and redundancy of the food web. Changes in sea-ice dynamics can change the energy, mass, and nutrient exchange crucial for maintaining ecological balance.

Conclusion

Antarctic biodiversity is highly adapted to the pulsed supply of food sources provided by seasonal sea ice dynamics. By focusing on the complexity of trophic interactions and key species in the community structure, we can better predict the response of polar biodiversity to climate change drivers.

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