BEeS
Heraklion
30 June - 3 July 2025

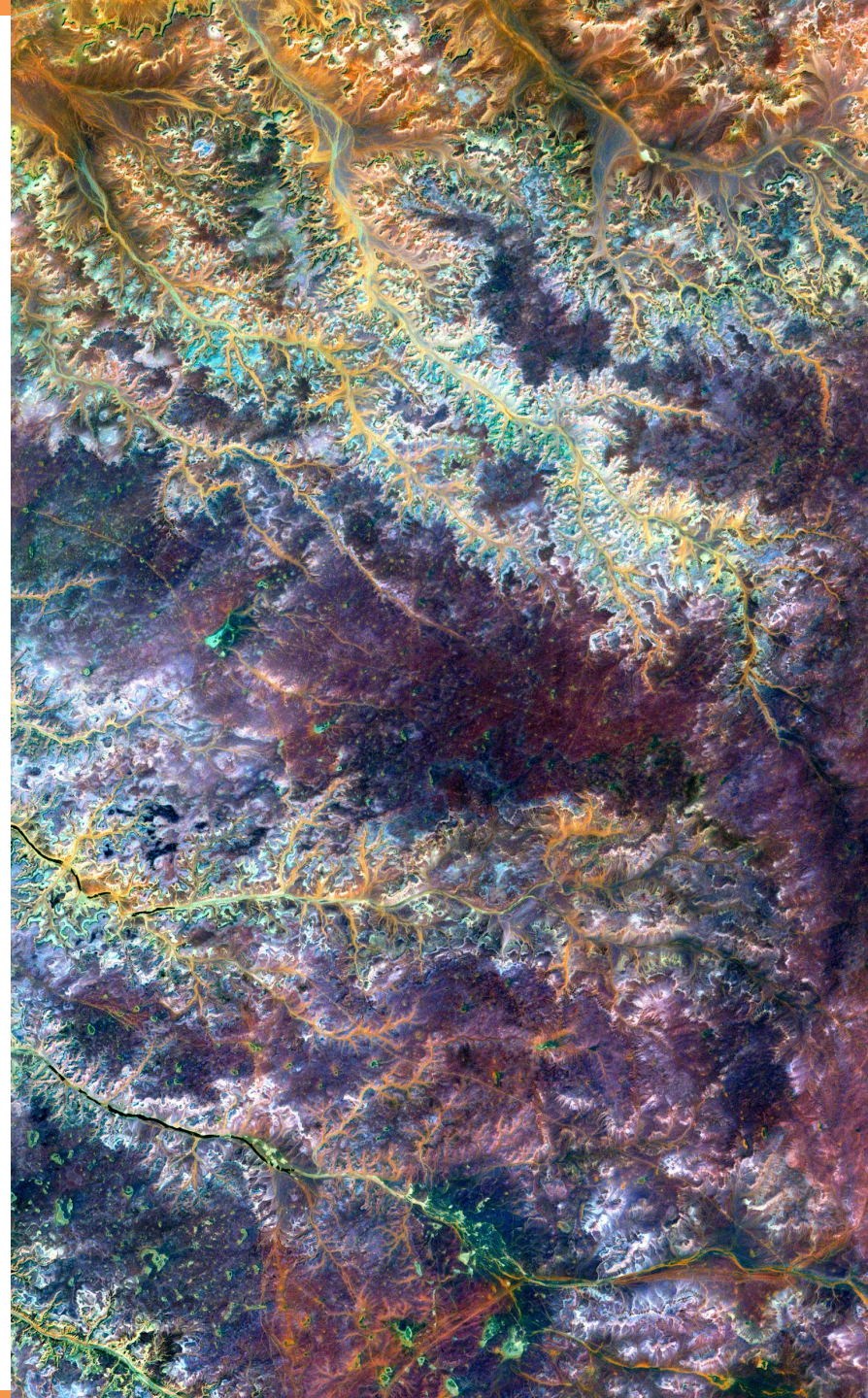
LifeWatch ERIC

hcmr
ΕΛΚΕΘΕ

iMBBC
ΙΘΑΒΒΥΚ

Session: Ecological Responses to Climate Change

1 July 2025 | 08:30-10:30



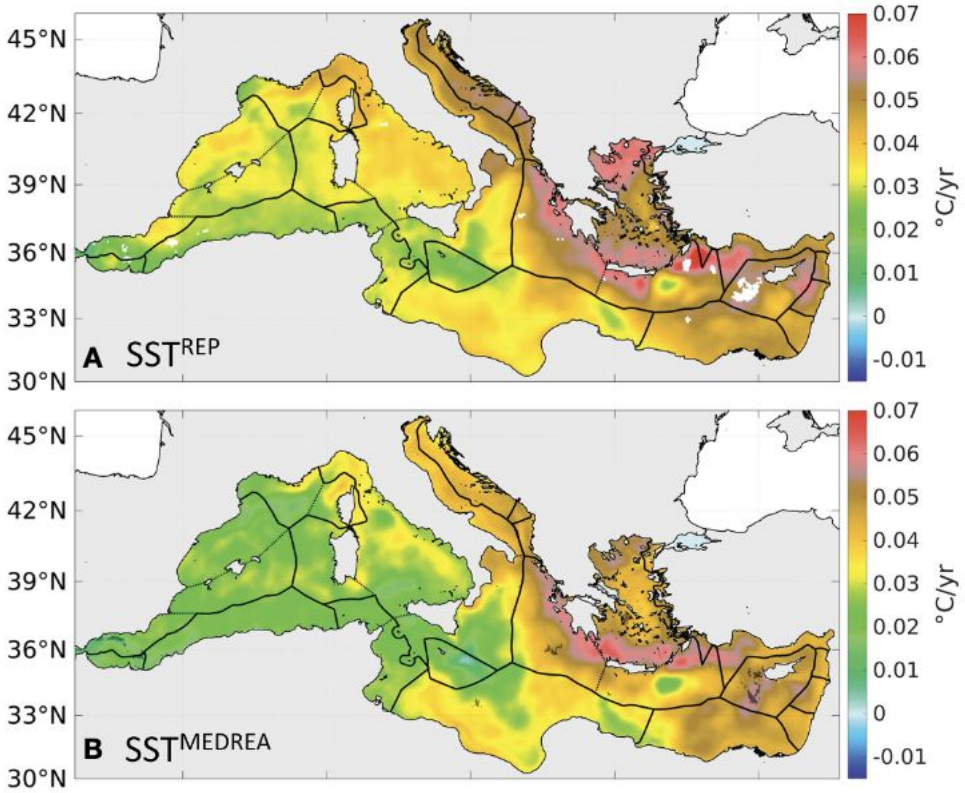
Climate change stress in benthic marine invertebrates: insights from multidimensional analysis

Presenter: Thanos Dailianis, IMBBC-HCMR

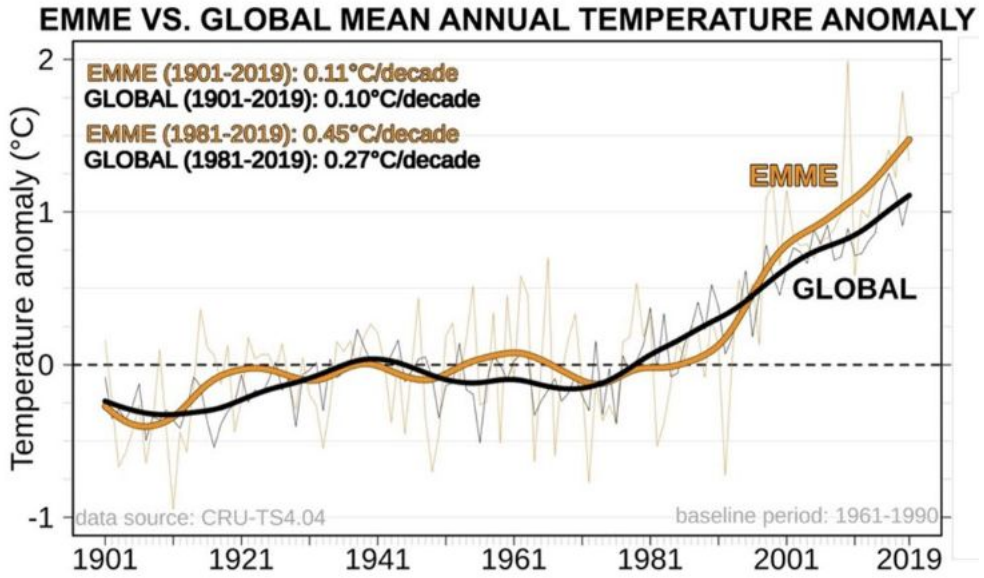
Eva Chatzinikolaou, Kleoniki Keklikoglou, Emmanouela Vernadou, Panagiotis Grigoriou, Nikos Papandroulakis, Athanasios Anastasiadis, Elisavet Kaitetzidou, Harris Markomanolaki, Anastasia Gioti, Georgia Tarifa, Jon Bent Kristoffersen

Underlying concept

- Seawater temperature and acidity in the Mediterranean are expected to increase fast in the next 10 years



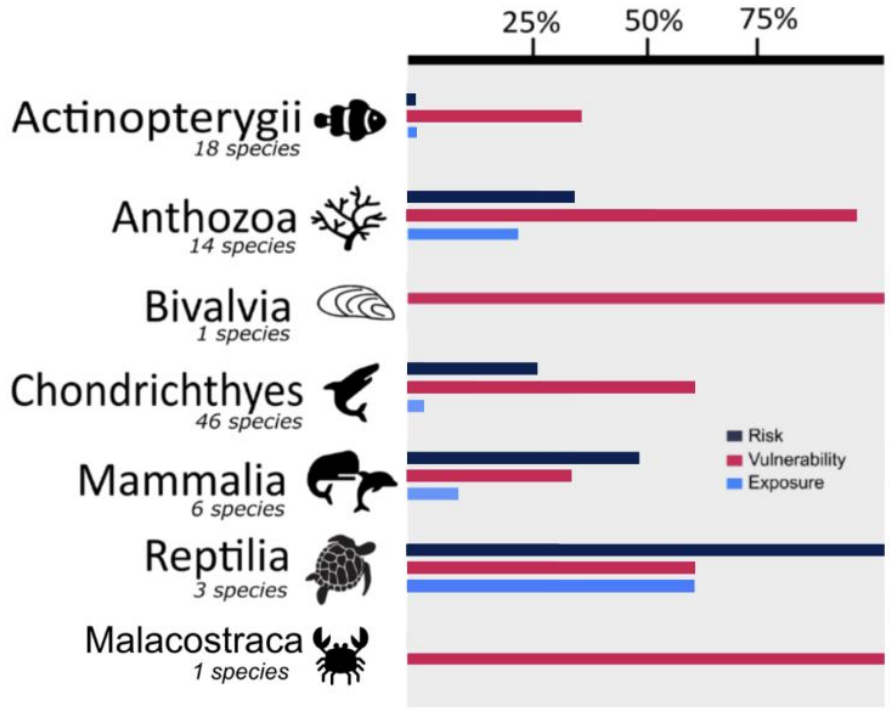
Dayan et al. 2023 *Frontiers in Marine Science*



Zittis et al. 2022 *Reviews of Geophysics*

Underlying concept

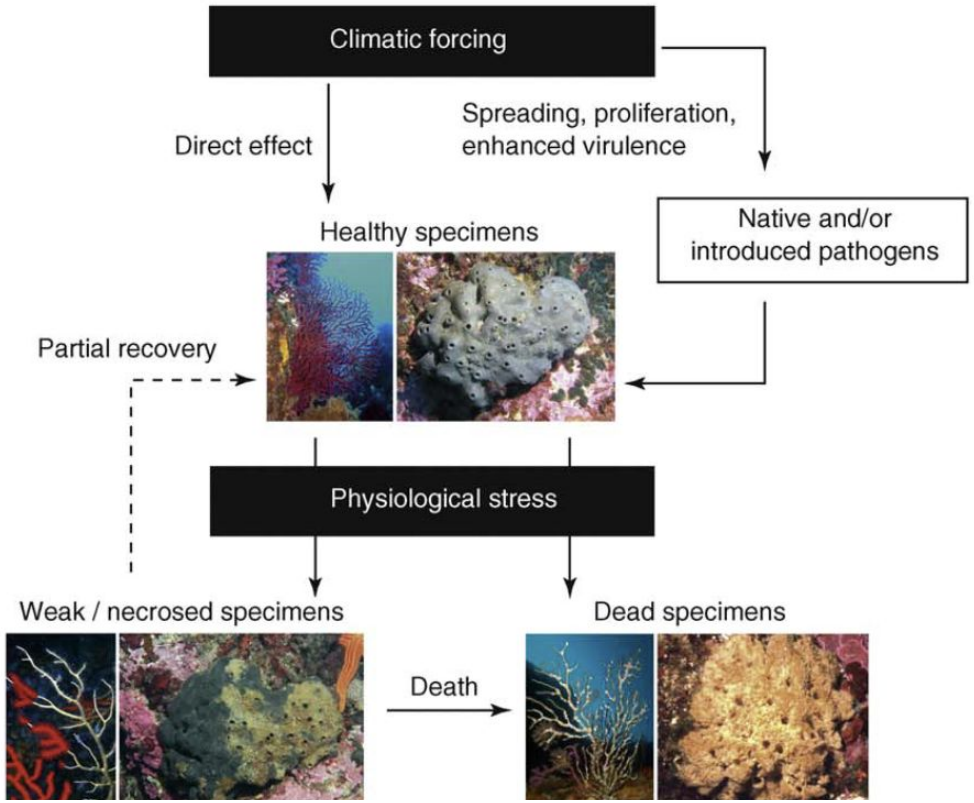
- Ongoing climate change is predominantly affecting sessile organisms, since they cannot escape stressors



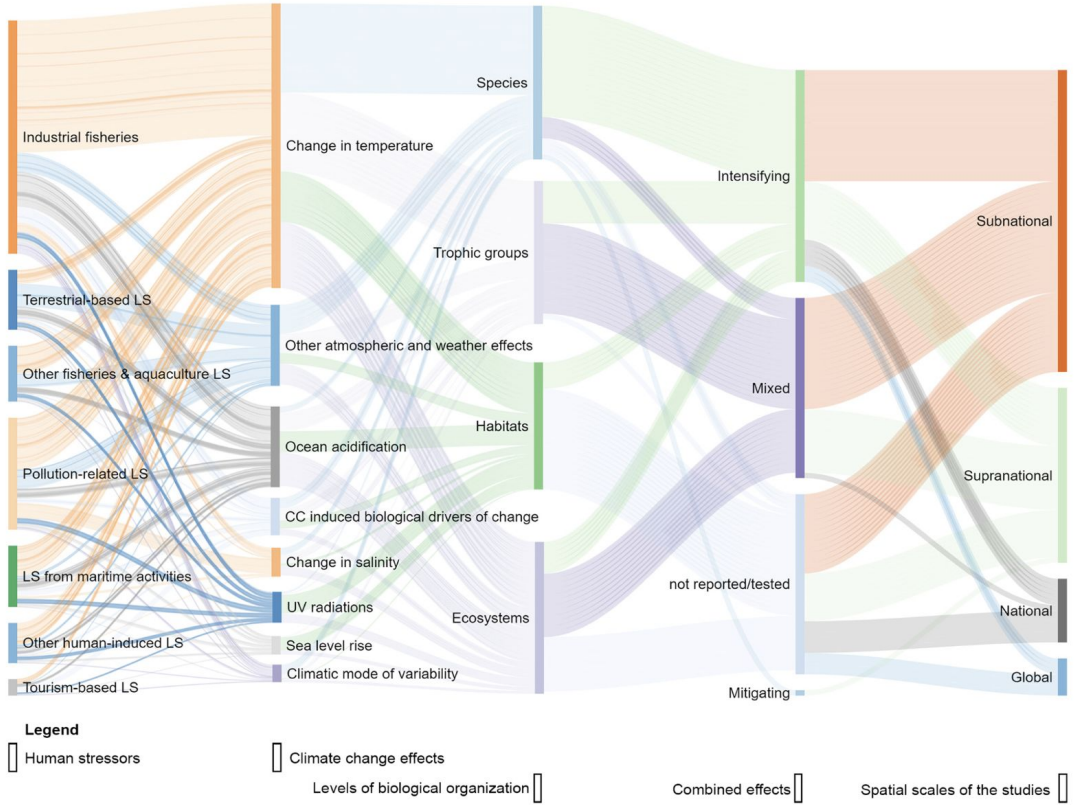
Chatzimentor et al. 2022 *Global Change Biology*

Underlying concept

- Organism holobionts respond to shifting conditions with changes in their morphology, physiology, and functions



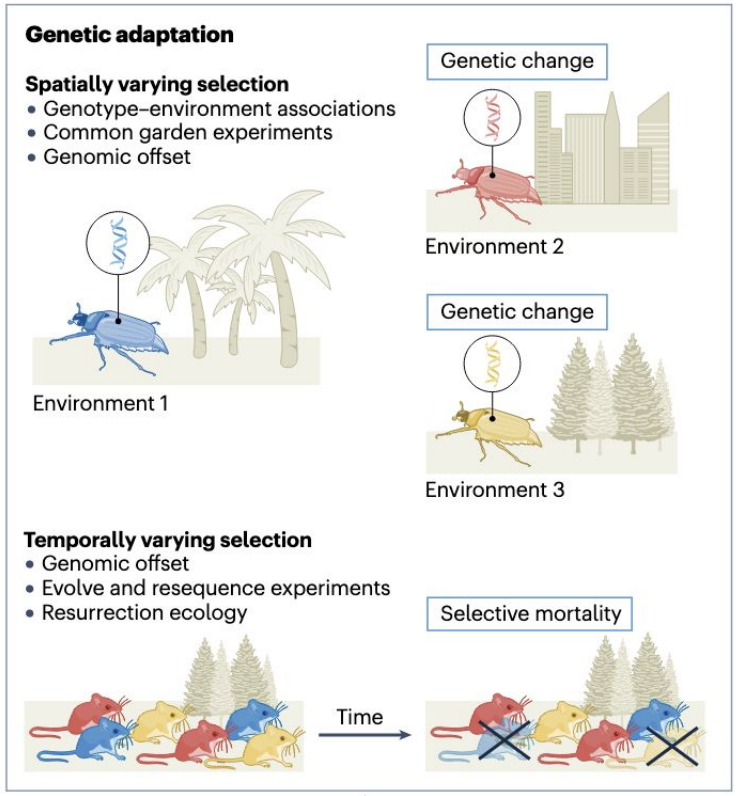
Lejeusne et al. 2010 *Trends in Ecology & Evolution*

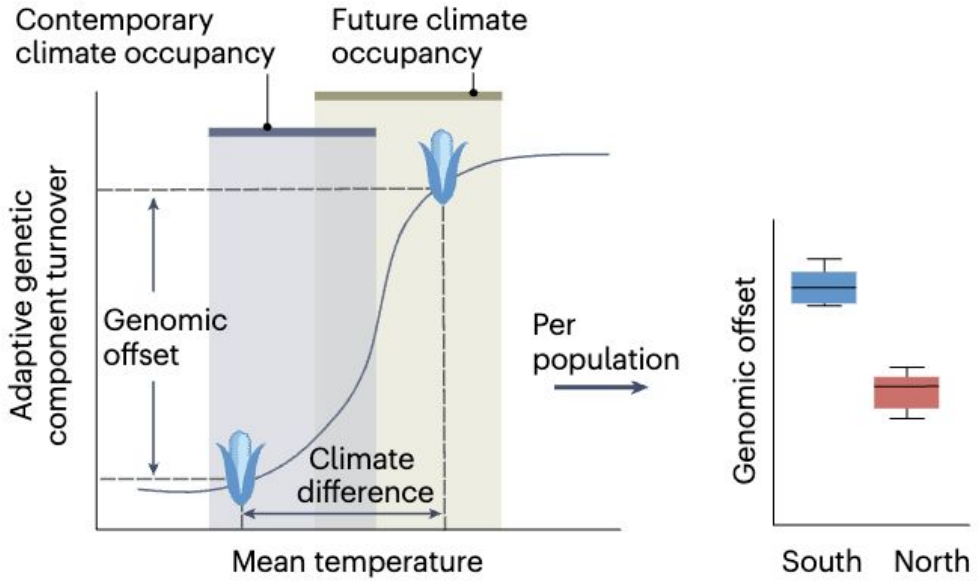


Gissi et al. 2021 *Science of the Total Environment*

Underlying concept

- Local adaptation and varying resilience among geographically distinct populations shape organismal responses





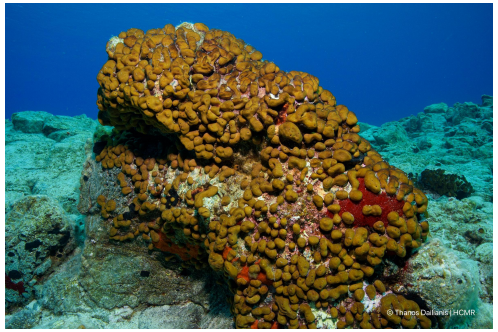
Bernatschez et al. 2023 *Nature Reviews Genetics*

Project scope

Multi-level Approaches to assess Climate Change Impact to Marine Organisms

The overall objectives of the proposed research project are:

- To implement an integrative approach for the estimation of climate change impact on different marine invertebrate taxa with partial or low motility.
- To examine the different mechanisms – molecular and physiological– activated to cope with the imposed stress factors, as well as to investigate the alterations in structural morphology and associated microsymbiotic communities.
- To study intra-species variation in response to thermal and oxidative challenges, in order to unravel the potential diversity of adaptations in geographically distinct populations.

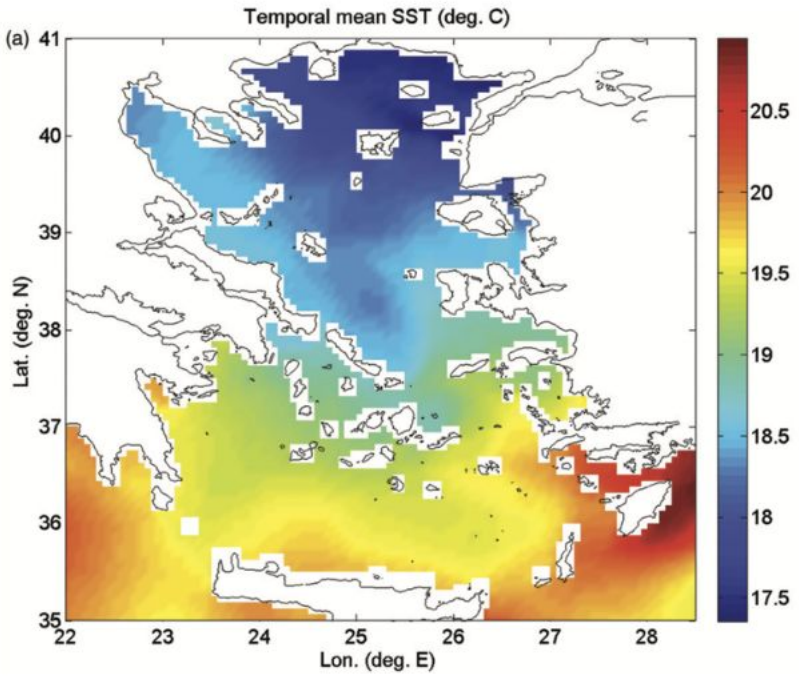


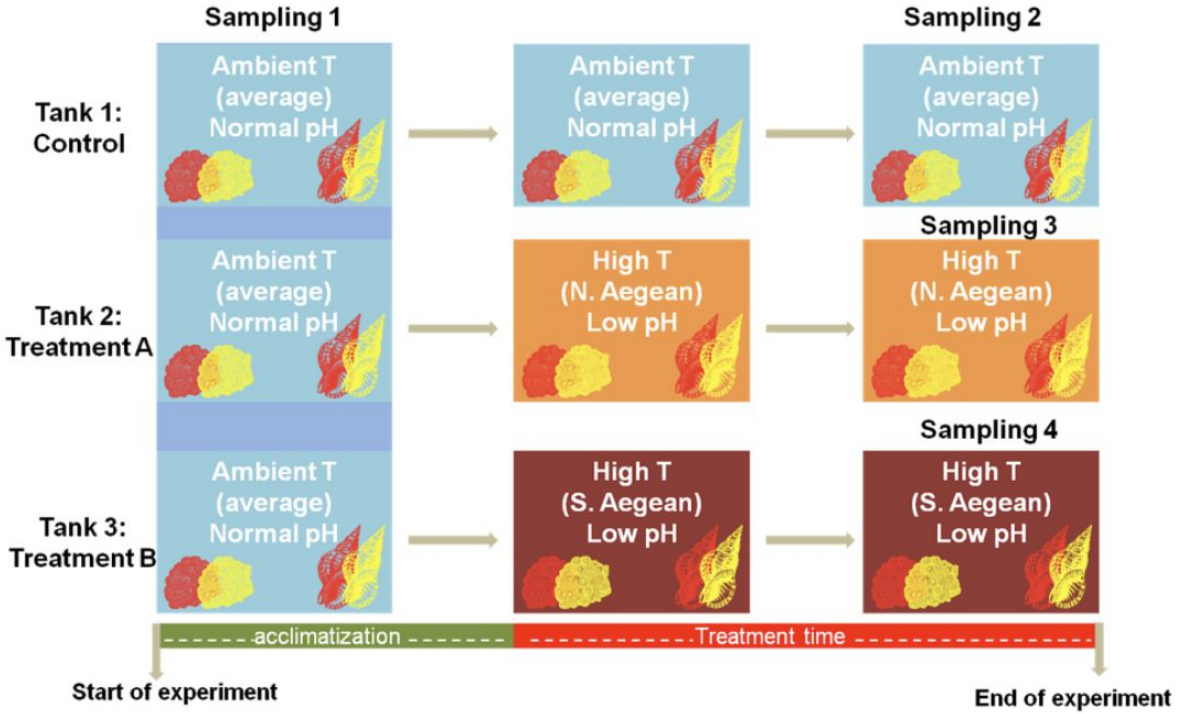
Chondrilla nucula

Hexaplex trunculus

Experimental approach

- Multi-level Approaches to assess Climate Change Impact to Marine Organisms (MACCIMO)





Experimental approach

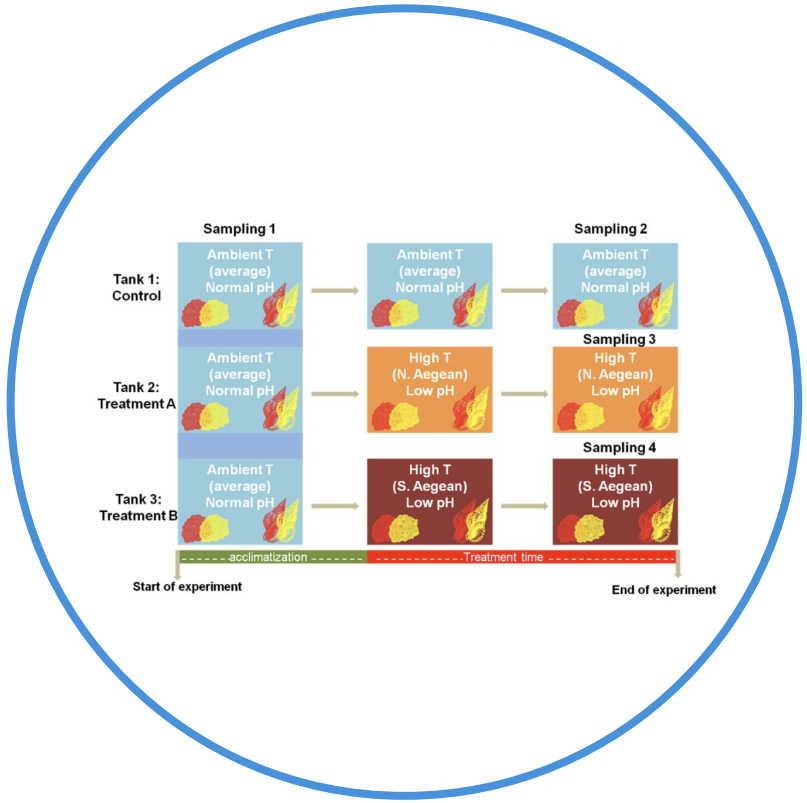
- Multi-level Approaches to assess Climate Change Impact to Marine Organisms (MACCIMO)

WP3 Assessment of morphological characters

- Scanning of organisms using microCT and creation of digital 3-dimensional models
- Analysis of morphological changes as a result of experimental treatment

WP5 Assessment of gene expression

- Assessment of the expression of selected reference and target genes through qPCR
- Analysis of the differences in gene expression as a result of experimental treatment



WP4 Assessment of physiological traits

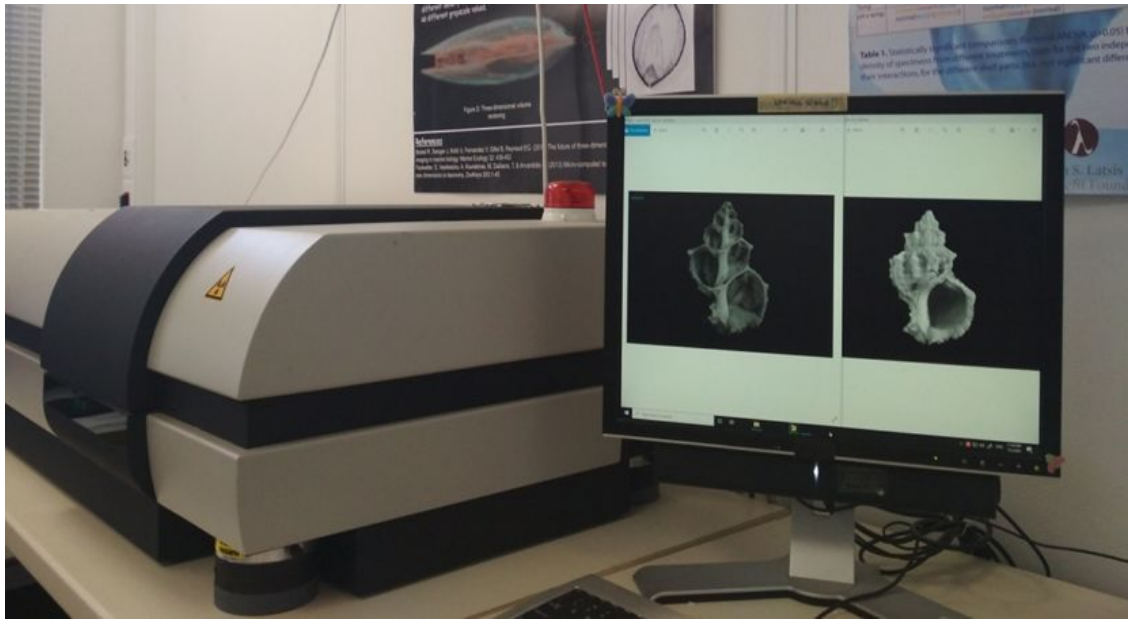
- Evaluation of metabolic rate as expressed by O_2 consumption in metabolic chambers
- Analysis of differences in metabolic rate as a result of experimental treatment

WP6 Assessment of microsymbionts

- Characterisation of the symbiotic bacterial and fungal communities via metabarcoding
- Assessment of microsymbiont community shifts as a result of experimental treatment

3D Analysis using micro-CT

X Ray based 3D imaging technique allowing measurements of specific parameters (e.g. density, thickness, porosity) on the specimens microstructure.



Density = the relative density of the specimen (i.e. grey scale values) to ensure comparability between scans

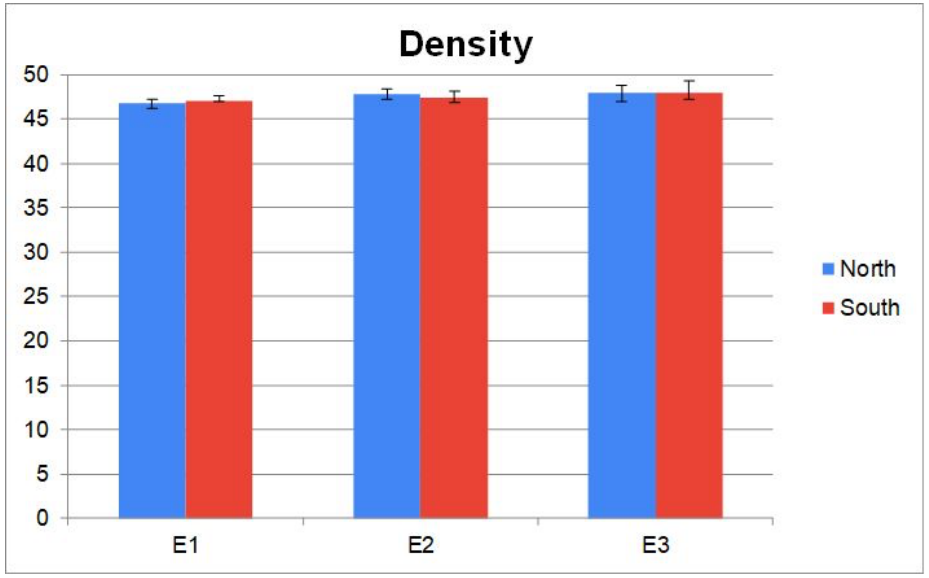
Structure thickness = average diameter of the largest spheres which can be “fitted” in each point of the specimen structure

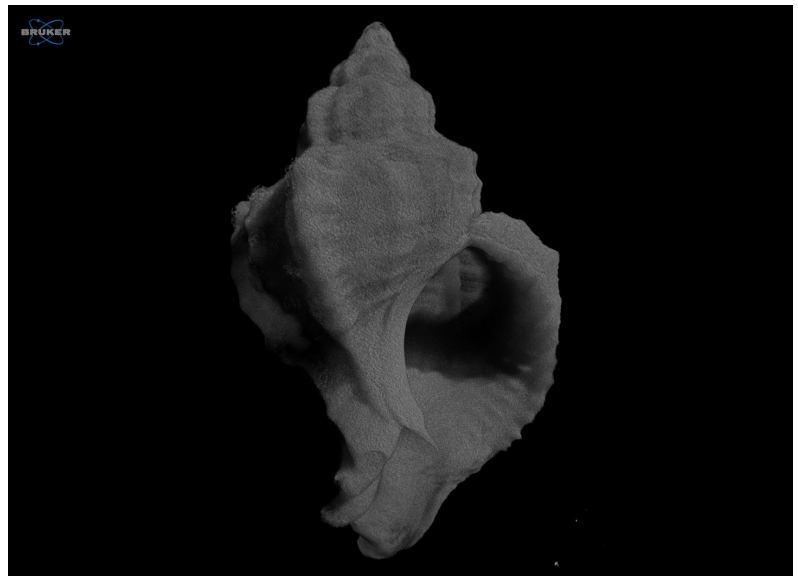
Porosity = the % volume of the closed, open and total pores

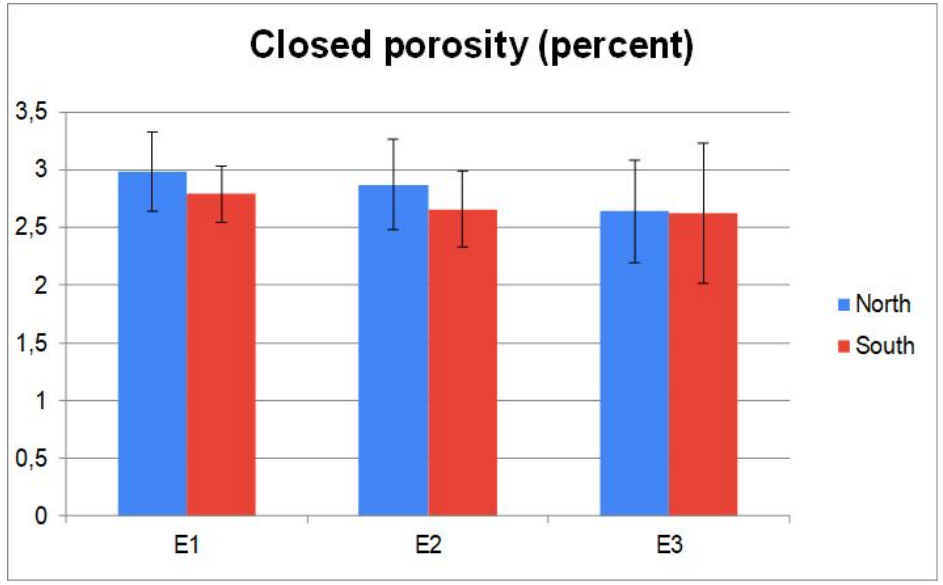
Structure separation = the average pore diameter (um)

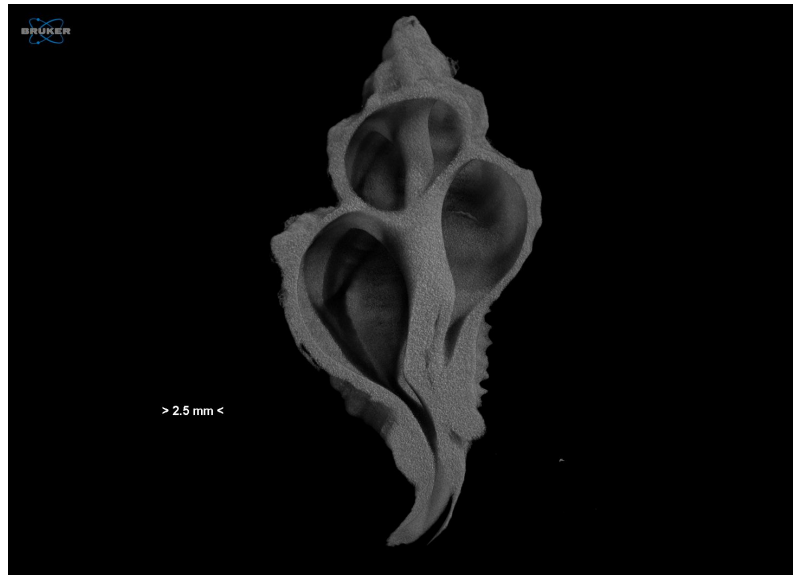
3D Analysis using micro-CT

Hexaplex trunculus



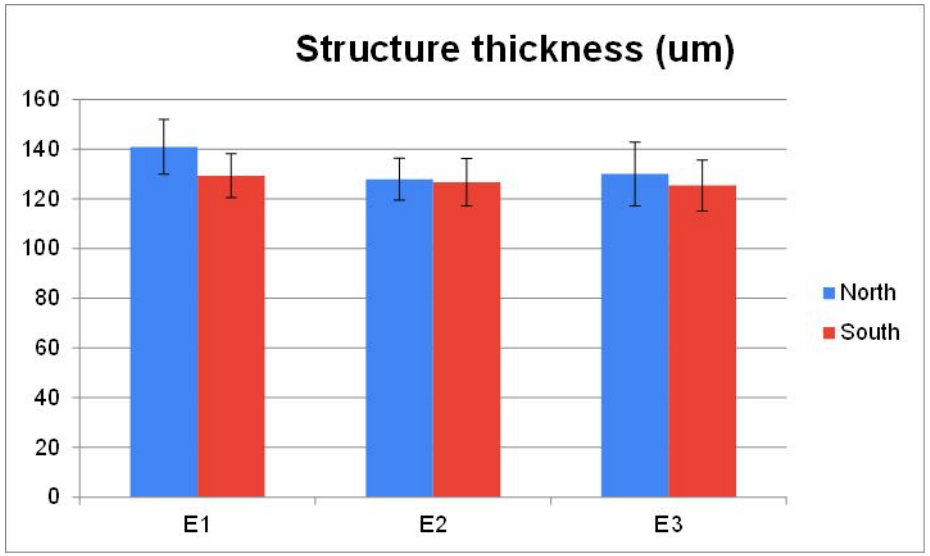


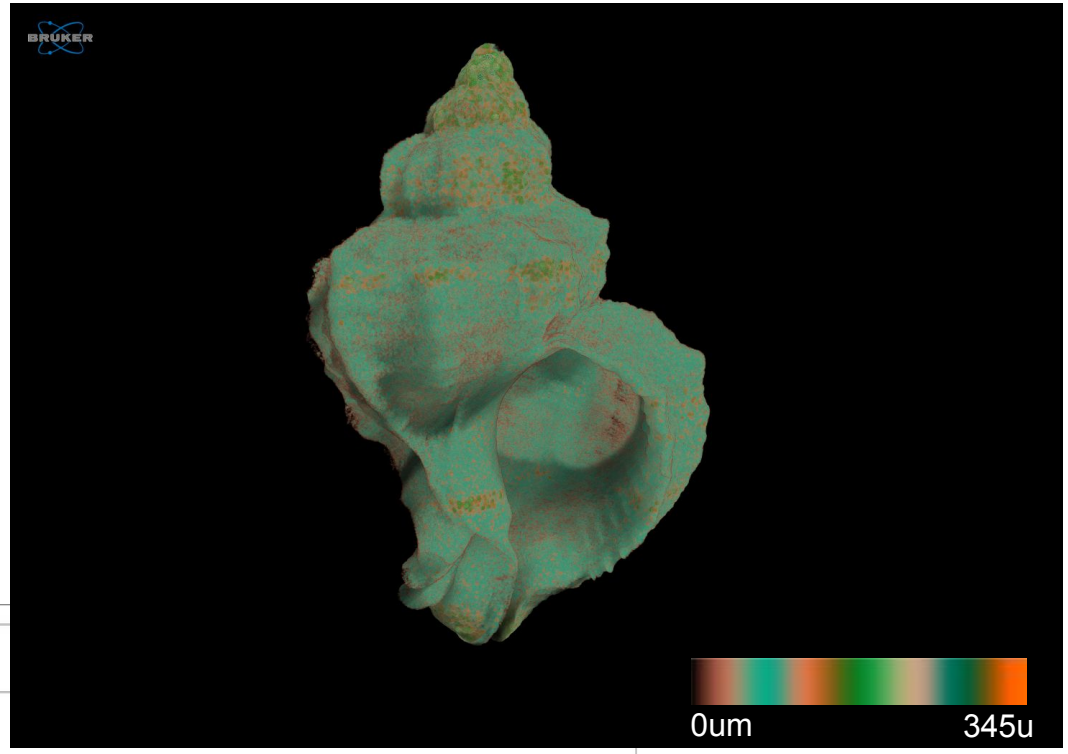


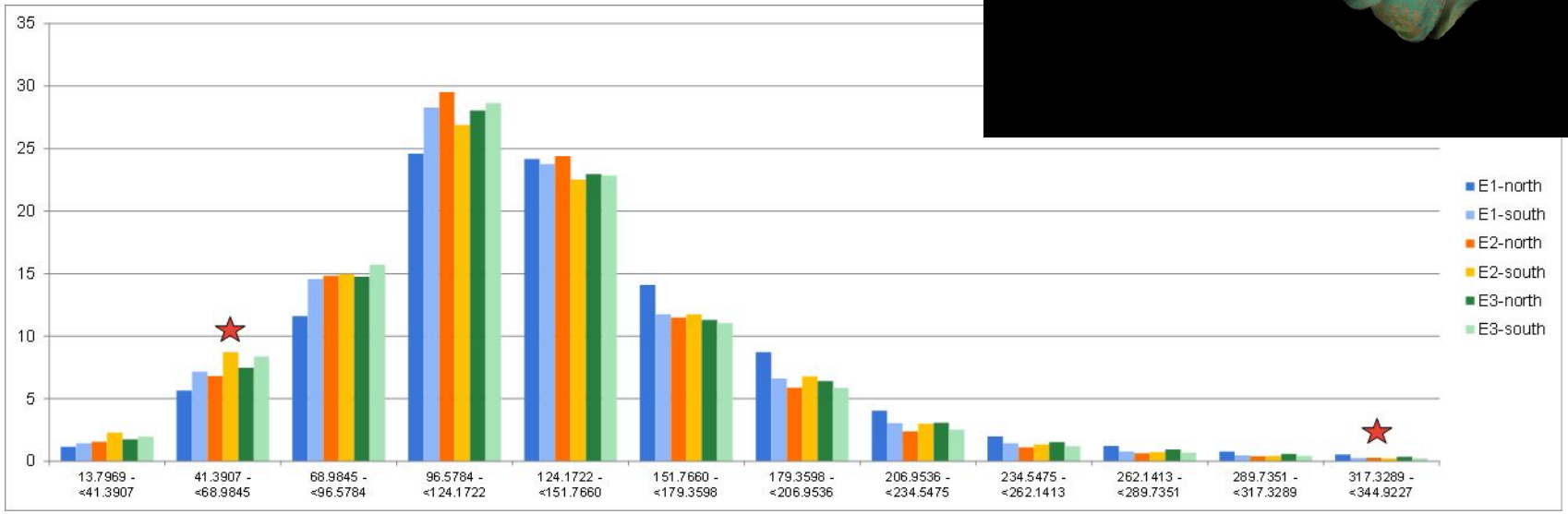


3D Analysis using micro-CT

Hexaplex trunculus

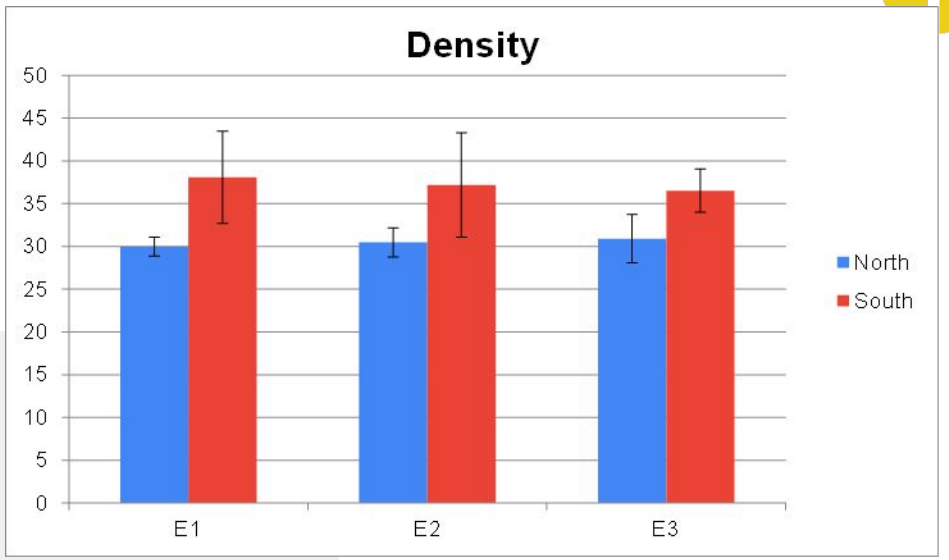


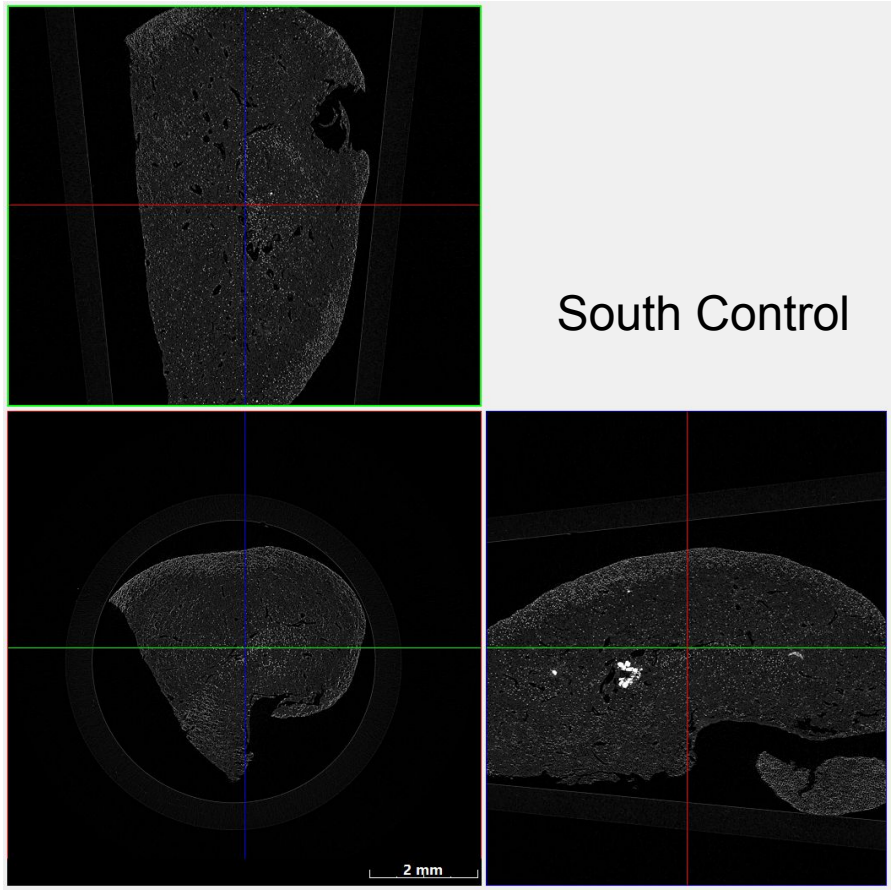


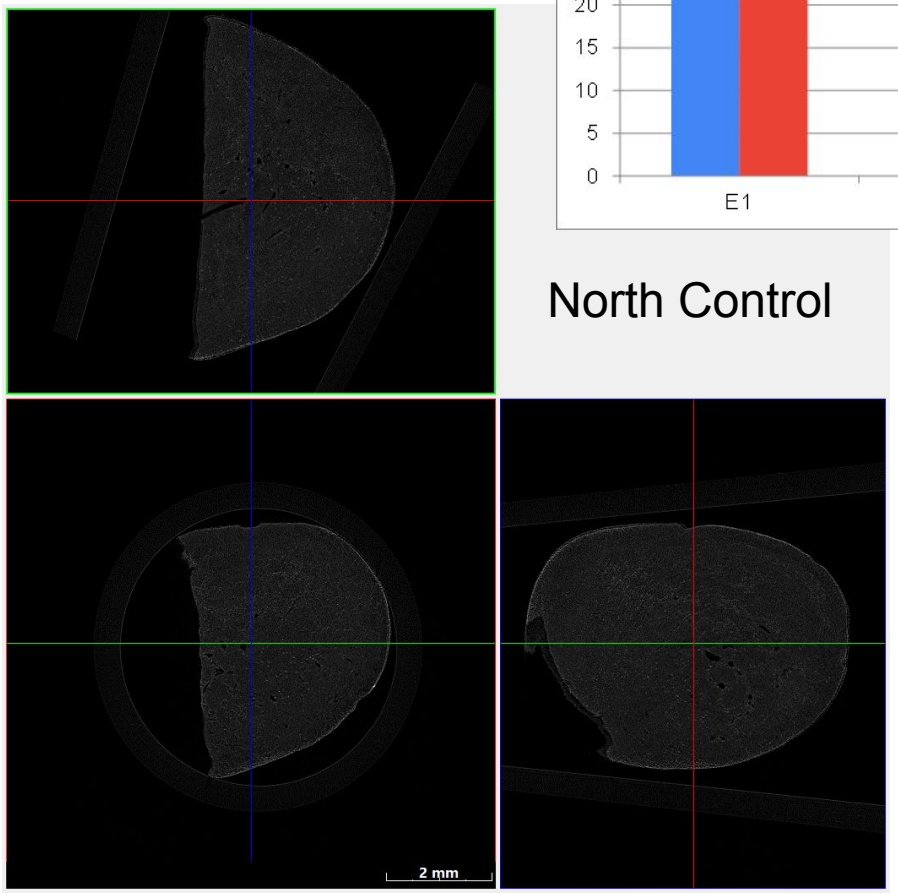


3D Analysis using micro-CT

Chondrilla nucula







3D Analysis using micro-CT

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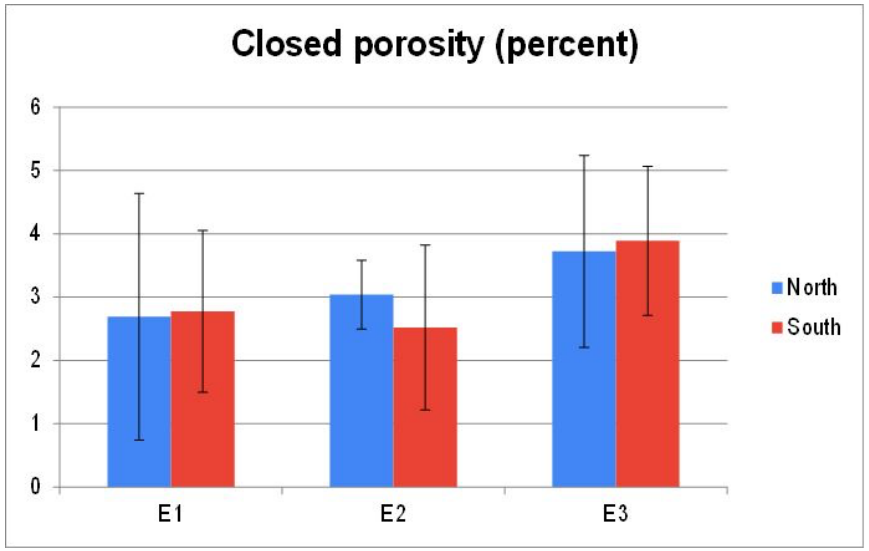

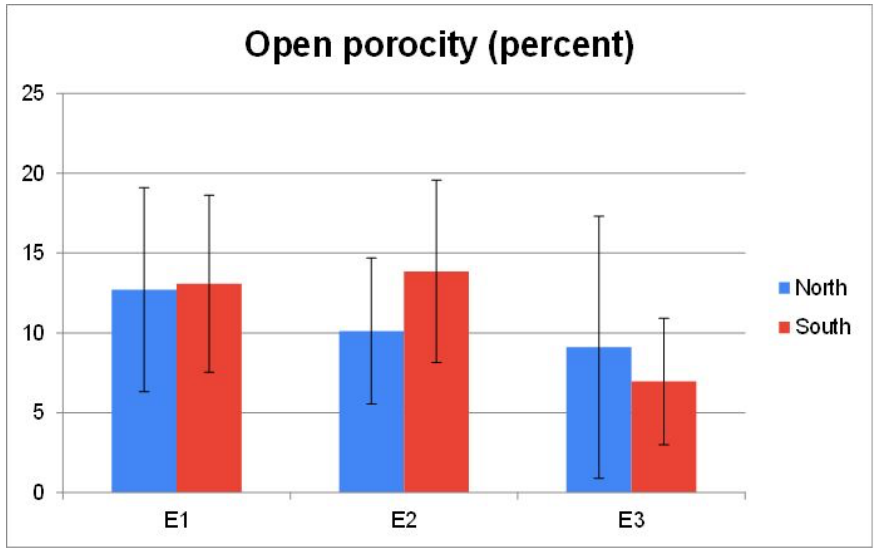

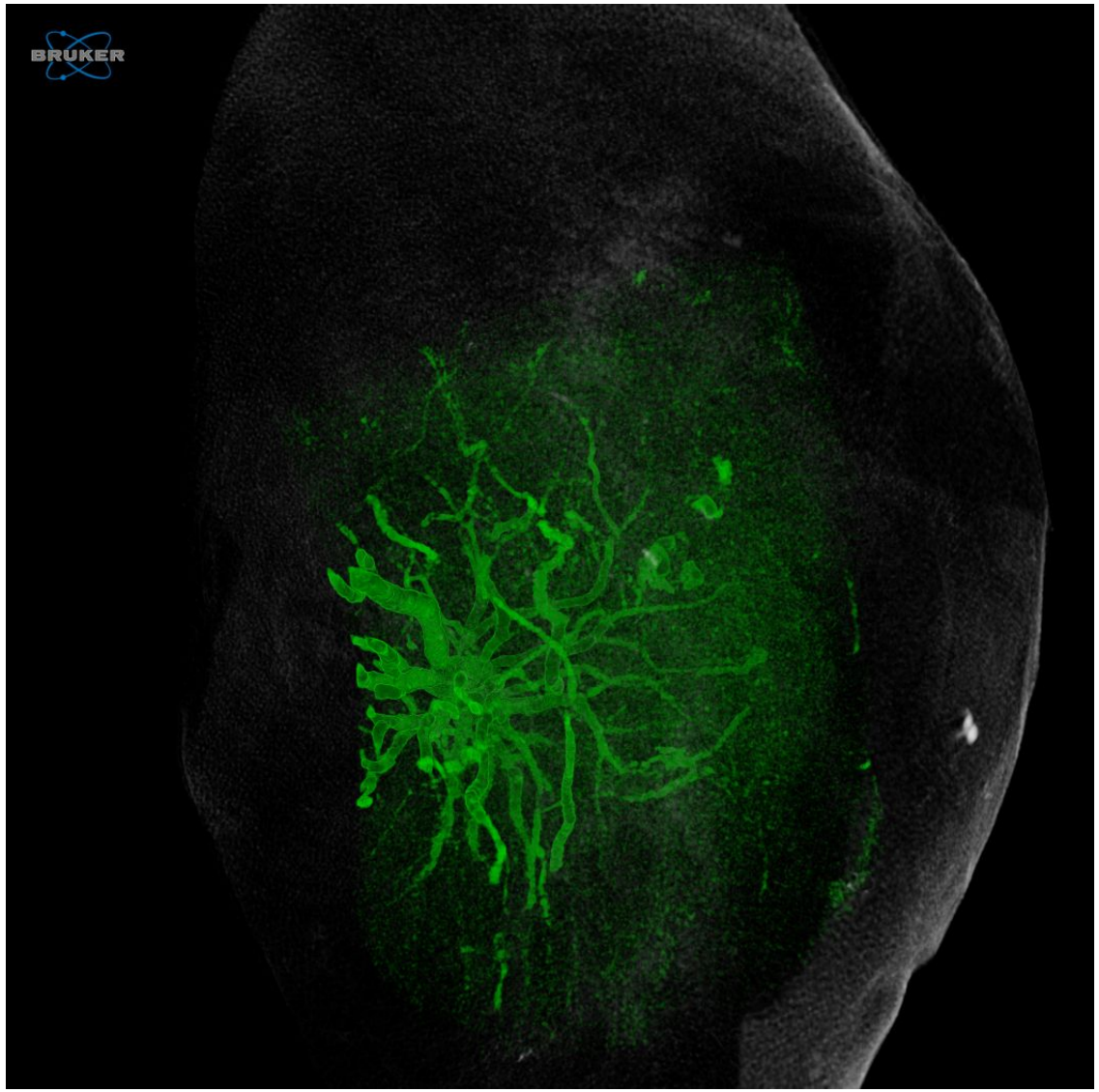

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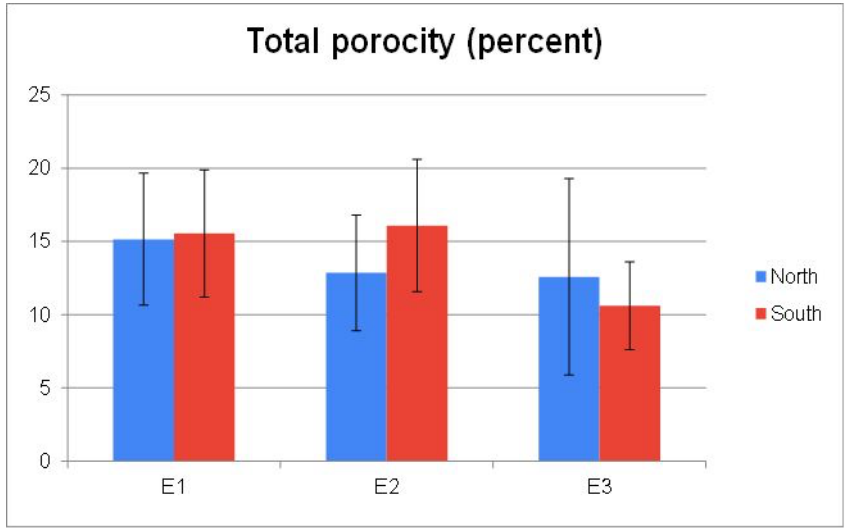
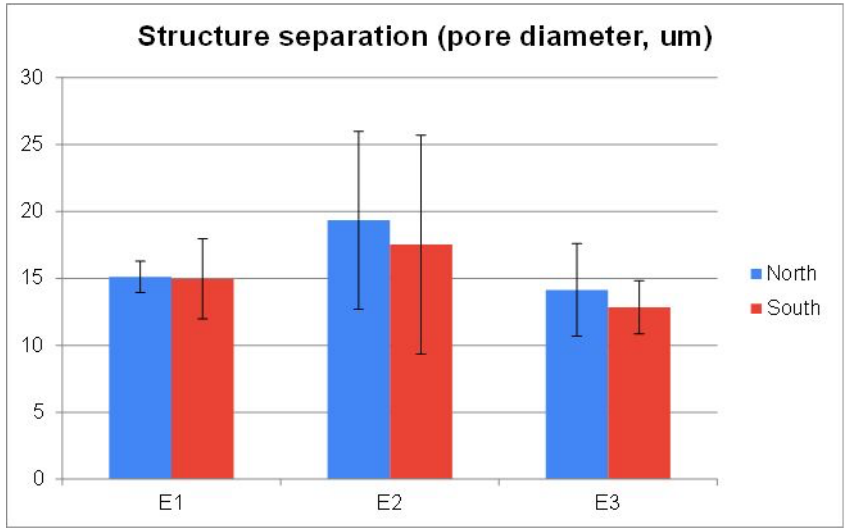
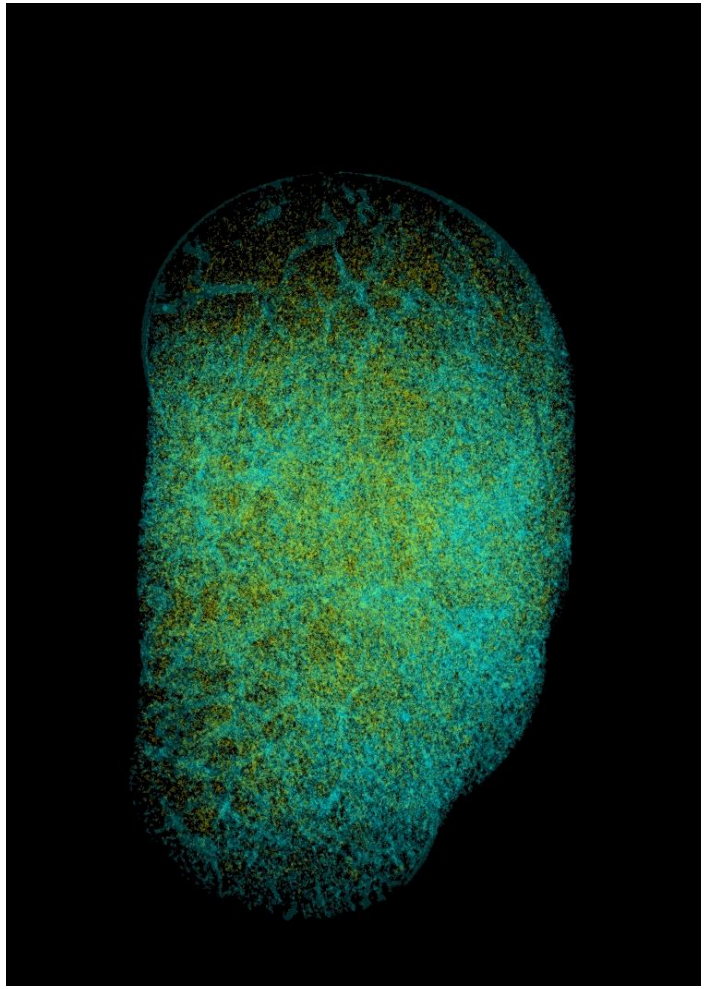
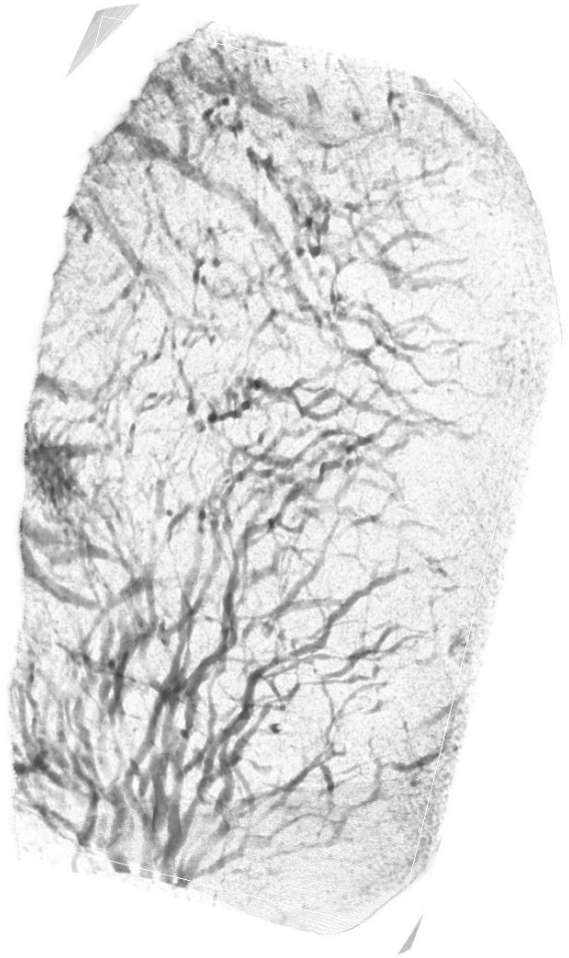


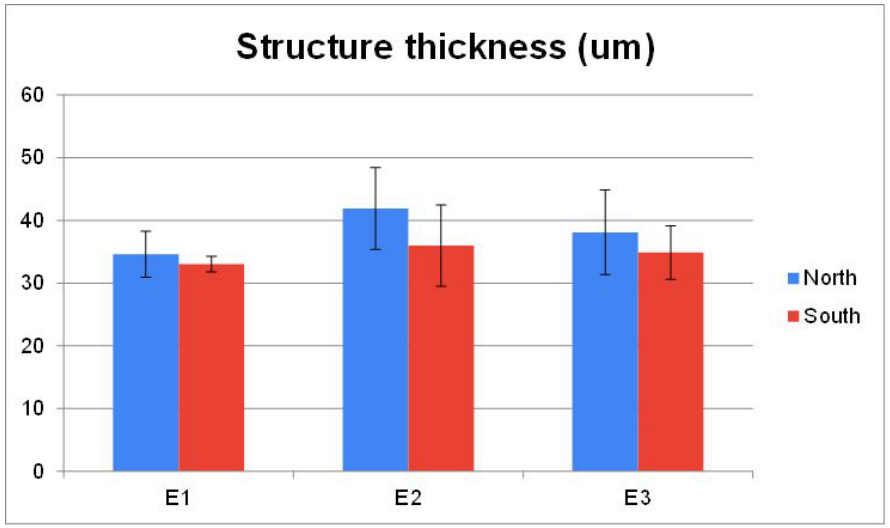


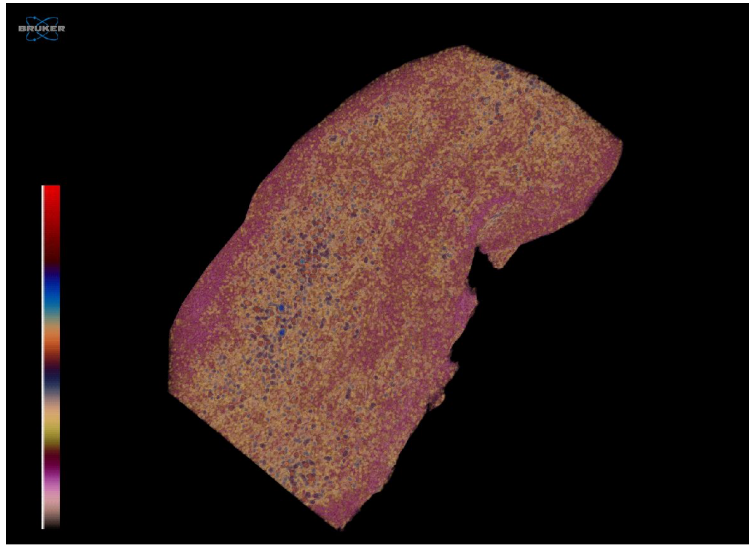


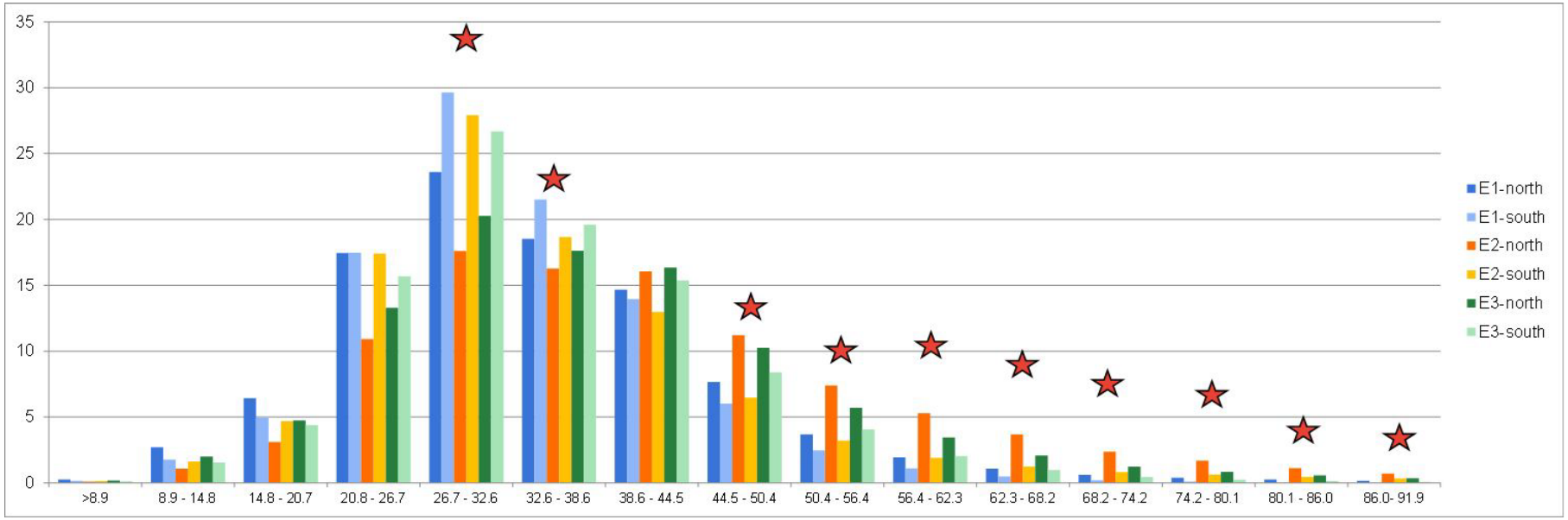


3D Analysis using micro-CT

Chondrilla nucula



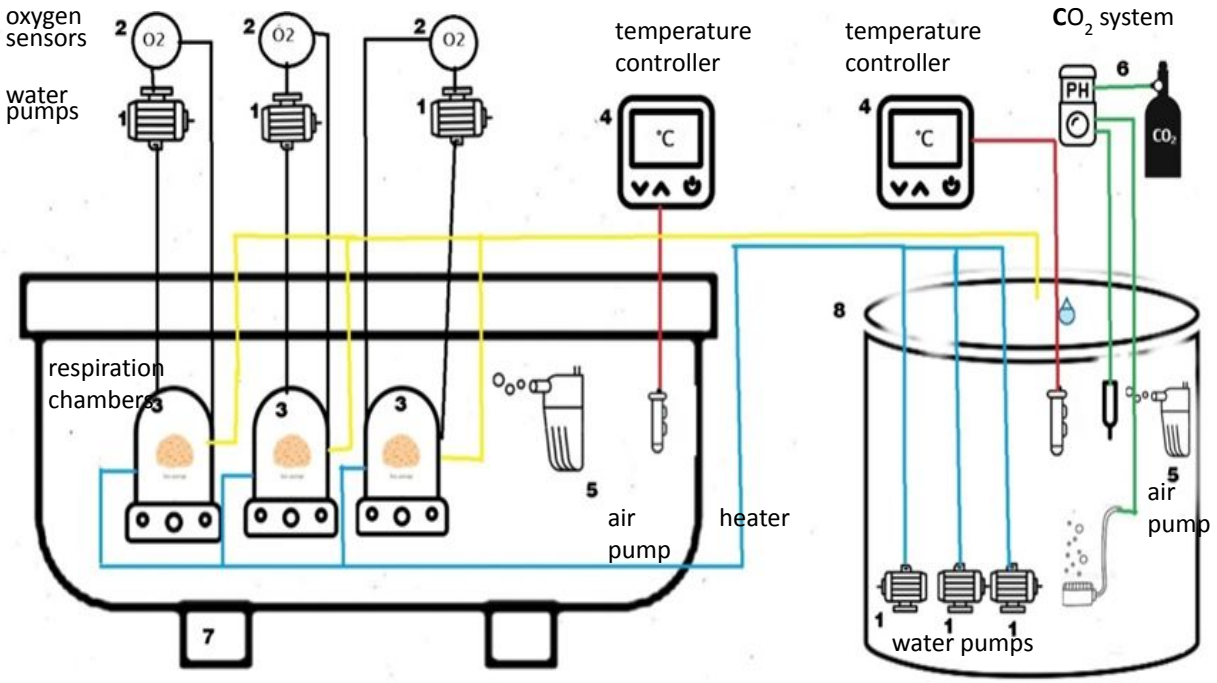


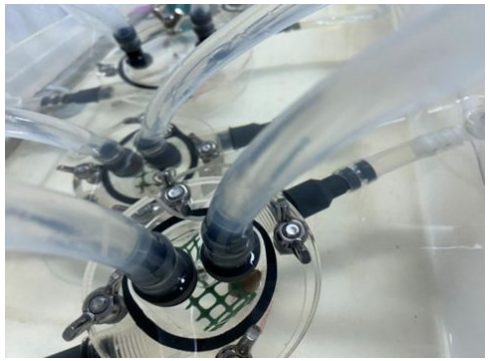


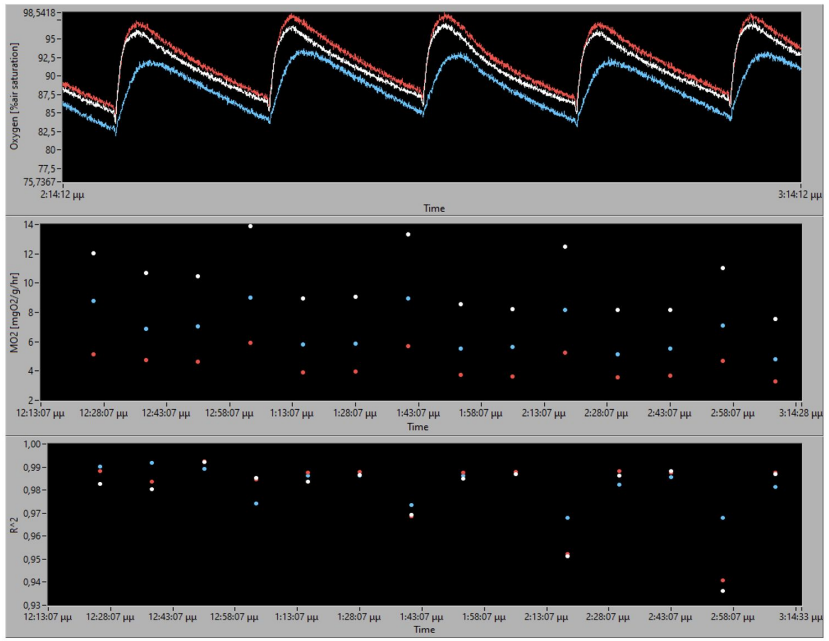
Metabolic rate - Experimental setup

water bath tank with respiration chambers

tank providing seawater at experimental conditions

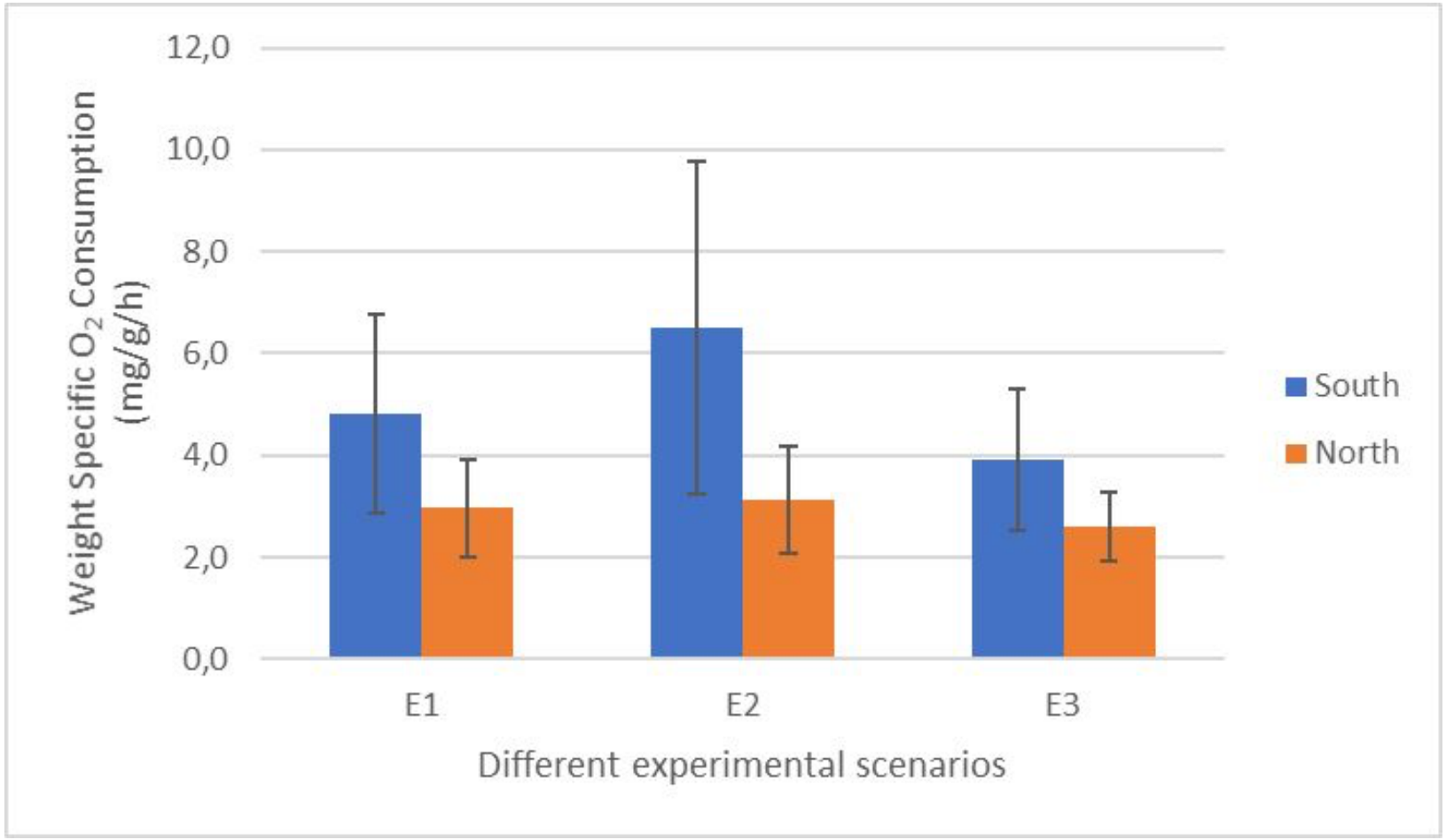




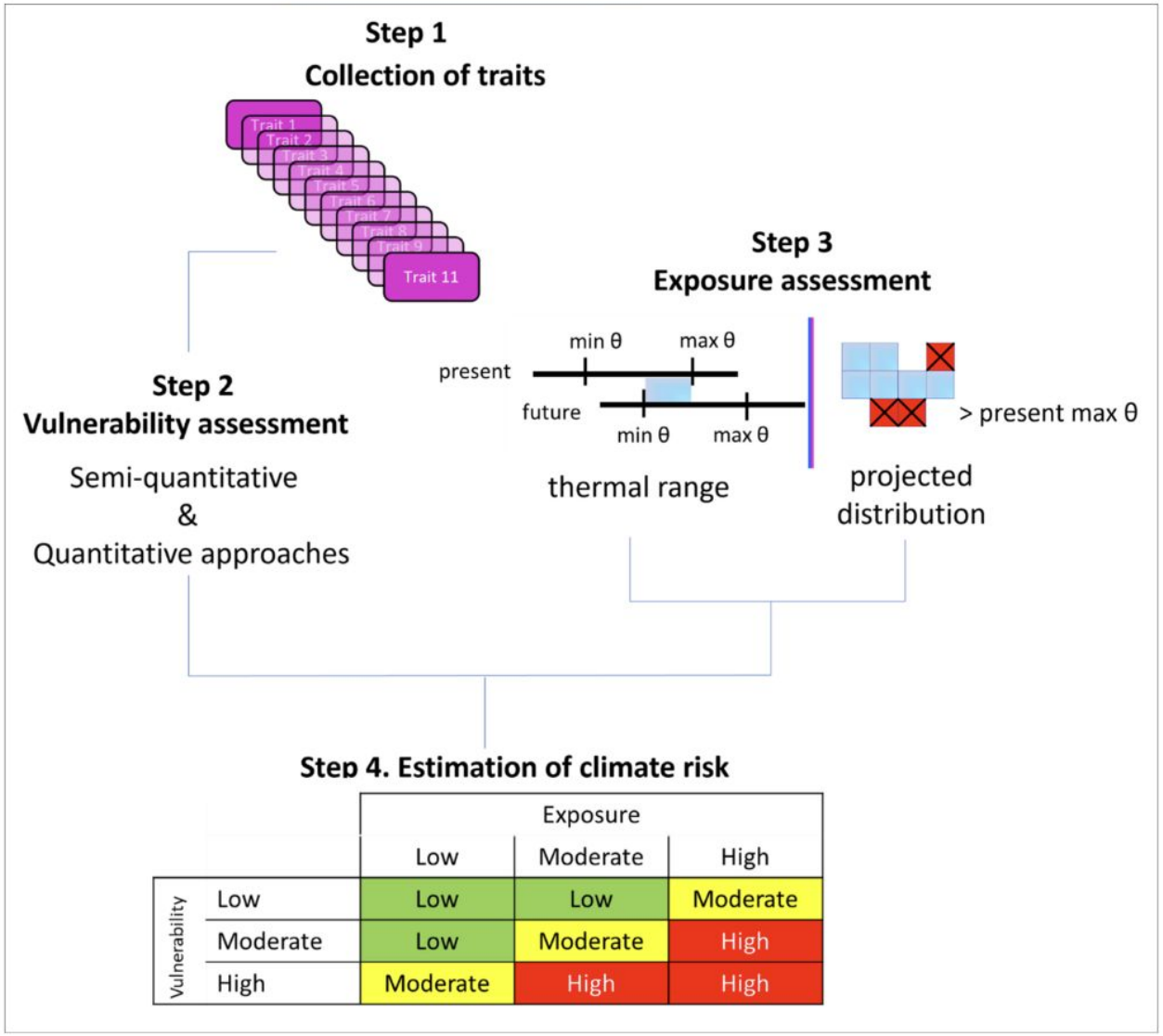


Metabolic rate as O_2 consumption

Chondrilla nucula



Climate risk – an emerging threat



Chatzimentor et al. 2022 *Global Change Biology*

A four-step process for assessing climate risk to Mediterranean marine species

- Trait-Based Vulnerability.
- Exposure Estimation
- Risk Matrix Integration

DOI: 10.1111/gcb.16577

RESEARCH ARTICLE

Global Change Biology WILEY

Are Mediterranean marine threatened species at high risk by climate change?

Anastasia Chatzimentor[1] | Aggeliki Doxa[1,2] | Stelios Katsanevakis[3] | Antonios D. Mazaris[1]

Future outlook – gaps and necessities

Controlled experiments

In situ experiments

Testing of single stressors →

Testing of combined stressors →

Cumulative stressors (synergistic) →

Tolerance range

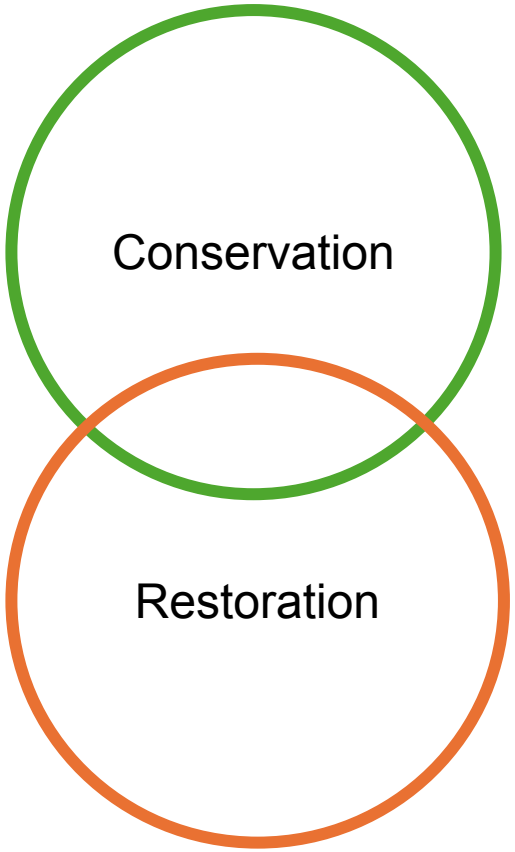
Optimal conditions

Innate (genetic) resilience

Intraspecific variability

Acquired resilience (adaptation)

Physiological response



Species < Habitats

Thank you!

Questions?
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H.F.R.I.
Hellenic Foundation for Research & Innovation

This research was supported by the Hellenic Foundation for Research and Innovation (HFRI) under the “2nd Call for HFRI Research Projects to support Faculty Members & Researchers”, Project Number 3280

BEeS

The LifeWatch ERIC Biodiversity & Ecosystem eScience Conference

Heraklion, 30 June - 3 July 2025