22

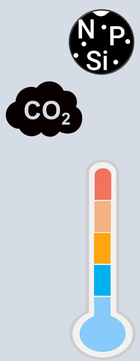
Microbial Meltdown

Concurrent global change and heatwaves disturb phototrophic more than heterotrophic protist diversity

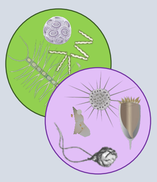
Antonia Ahme*, Inga Kirstein°, Cedric Meunier°, Sylke Wohlrab*, Uwe John*

*Alfred-Wegener-Institut, Helmholtz-Zentrum für Polar- und Meeresforschung, Bremerhaven, Germany
°Alfred-Wegener-Institut, Helmholtz-Zentrum für Polar- und Meeresforschung, Biologische Anstalt Helgoland, Germany

BACKGROUND



- Anthropogenic activities increase the mean temperature, carbon dioxide partial pressure and dissolved N:P ratio in the coastal North Sea and thereby affect unicellular eukaryotes[1]
- At the same time, heatwaves are getting more intense, frequent and long-lasting, especially affecting summer communities[2]

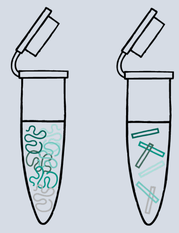


- The sensitivity to these multiple stressors might vary between organisms with different primary metabolisms (photo- vs. heterotrophs)[3]

How is the diversity of hetero- vs. phototrophic protists affected by concurrent global change and heatwaves?

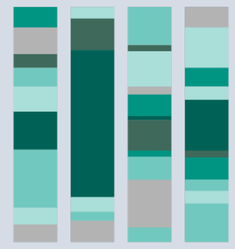
METHODS

Sampling 3-150 µm fraction over time



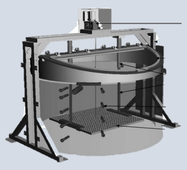
DNA Extraction & V4 18S rRNA PCR

Sequencing



Species/trophic mode annotation

Calculate log response ratios of Hill numbers (q = 0, 1) and Pielou's Evenness and model generalized additive models (GAMs) of the LRRs over time before identifying periods of significant in- or decrease[4]



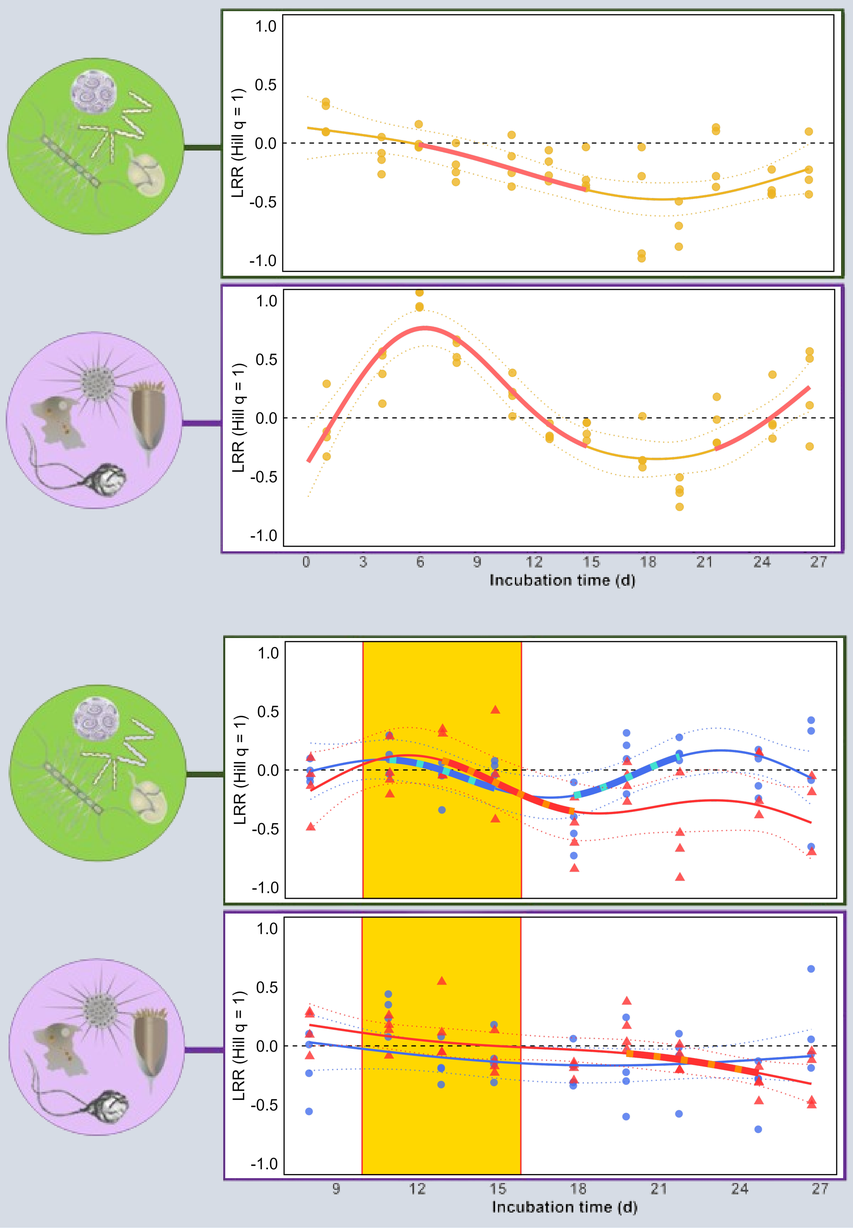
Mesocosm incubation of North Sea summer plankton community

EXPERIMENTAL DESIGN

- 4 x Ambient (control)
- 4 x Ambient + 5-day Heatwave (+ 2°C)
- 4 x ERCP 8.5 scenario (+ 3 °C, N:P of 25, pCO2 of 1000 ppm)
- 4 x ERCP 8.5 scenario + HW

RESULTS

DIVERSITY RESPONSES



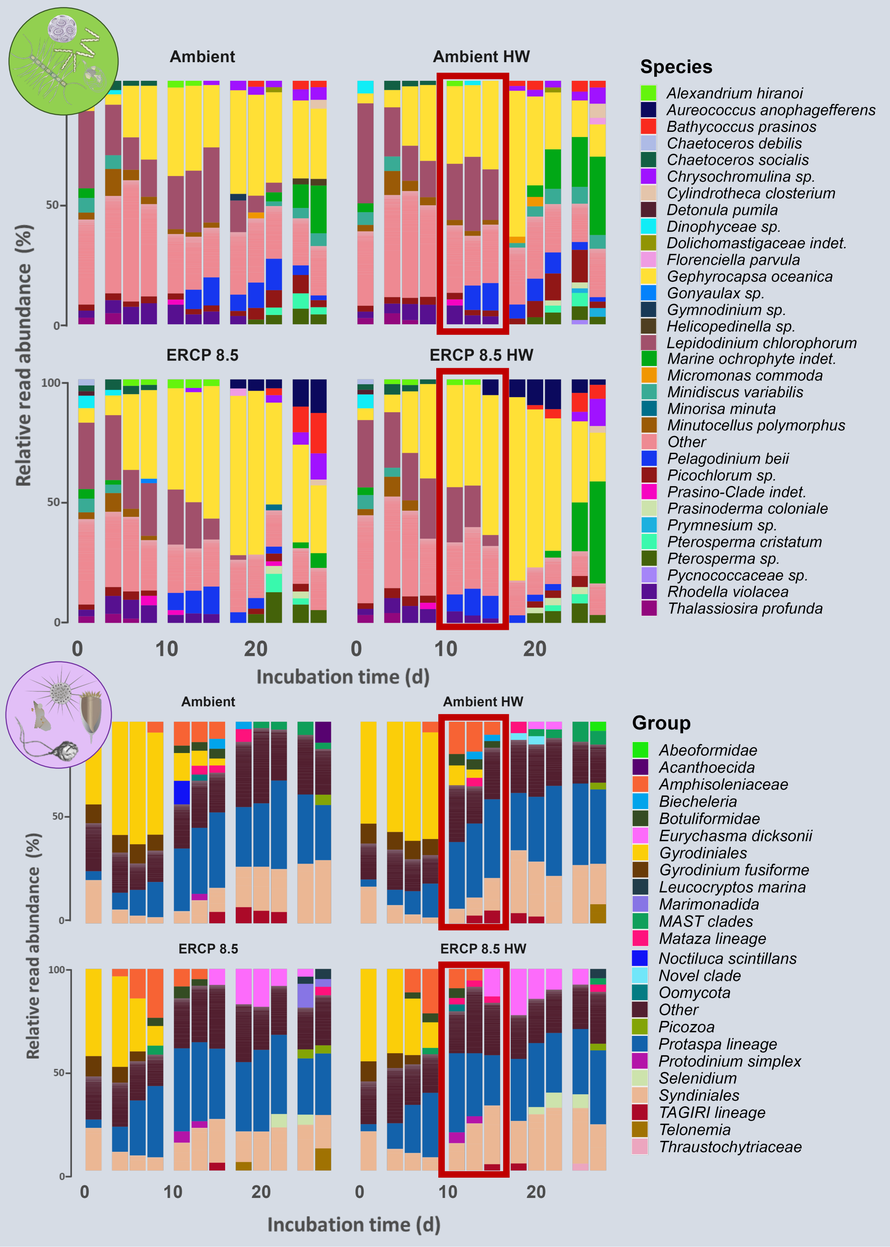
ERCP 8.5 scenario

- Both, decreases in species evenness and richness drive the diversity decline for phototrophs
- Shift towards fewer and smaller phototrophic species
- Heterotrophic diversity mainly driven by changes in evenness
- Shift from microzooplankton to parasitic heterotrophs

Heatwave scenario

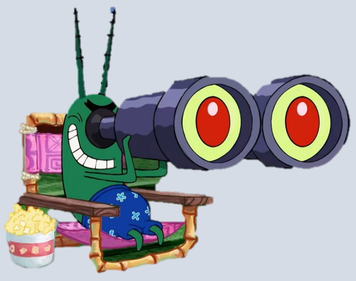
- Under ambient conditions, phototrophic diversity decreased during the heatwave but was able to recover
- Under ERCP 8.5 conditions, phototrophic diversity decreased during the cooling phase and did not recover → pre-selection for warm-tolerant species
- Heterotrophs show no clear diversity pattern

COMPOSITIONAL RESPONSES



CONCLUSIONS & OUTLOOK

- *Gephyrocapsa oceanica* profits from both global change and heatwaves
- The trophic mode determines the susceptibility towards global change and heatwaves
- Phototrophic diversity is particularly compromised by global change and the temperature drop at the end of a heatwave
- Heterotrophic diversity is resistant to heatwaves and resilient to global change



Keep your eyes open for the publication of the overview paper, dealing with multiple trophic levels and ecosystem consequences!

Acknowledgements

We thank the whole team of the AWISOM "Heatwave Now and Tomorrow" project for their help during the experiment on Sylt, in particular Josefine Schmidt, Ruben Schulte-Hillen and Katharina Berg. We also acknowledge the crew of the RV Mya for collecting the water sample. We are grateful for the help of Stefan Neuhaus with bioinformatic processing of the 18S rRNA metabarcoding data. Furthermore, we thank Klara Wolf, Nils Anthes and Anika Happe for their valuable input regarding heatwaves in general, statistics and figure design.

References

[1]IPCC (2023). "Summary for Policymakers," in *Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change,* ed. H.L.a.J. Romero. (Geneva, Switzerland: IPCC), 1-34.
[2]Laufkötter, C., Zscheischler, J., and Frölicher, T.L. (2020). High-impact marine heatwaves attributable to human-induced global warming. *Science* 369(6511). doi: 10.1126/science.aba0690.
[3]Chakraborty, S., Nielsen, L.T., and Andersen, K.H. (2017). Trophic Strategies of Unicellular Plankton. *The American Naturalist* 189(4), E77-E90. doi: 10.1086/690764.
[4]Simpson, G.L. (2018). Modelling Palaeoecological Time Series Using Generalised Additive Models. *Frontiers in Ecology and Evolution* 6. doi: 10.3389/fevo.2018.00149.

Contact

@AhmeAntonia

planktoni@posteo.de