Facing future temperature extremes and changes: How do ecosystems under chemical stress respond to reoccurring heatwaves and increased temperatures?

First insights and results

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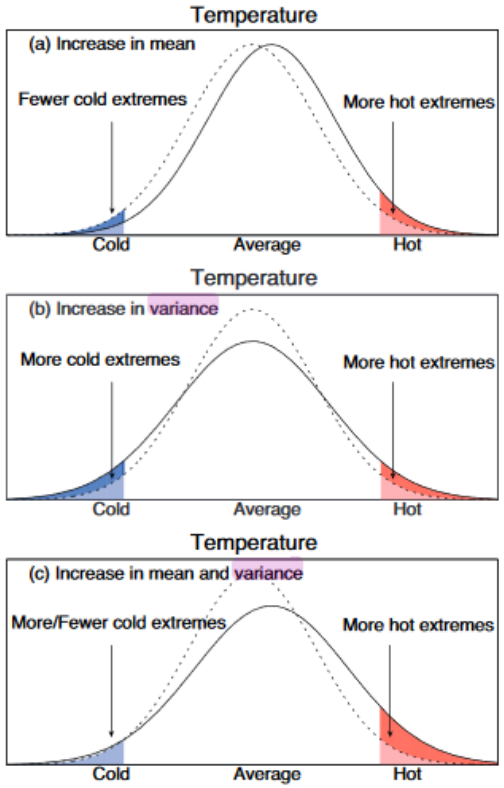
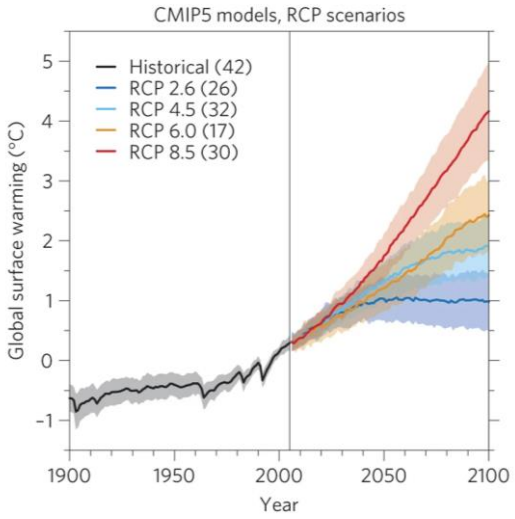
Climate Change affecting freshwater ecosystems

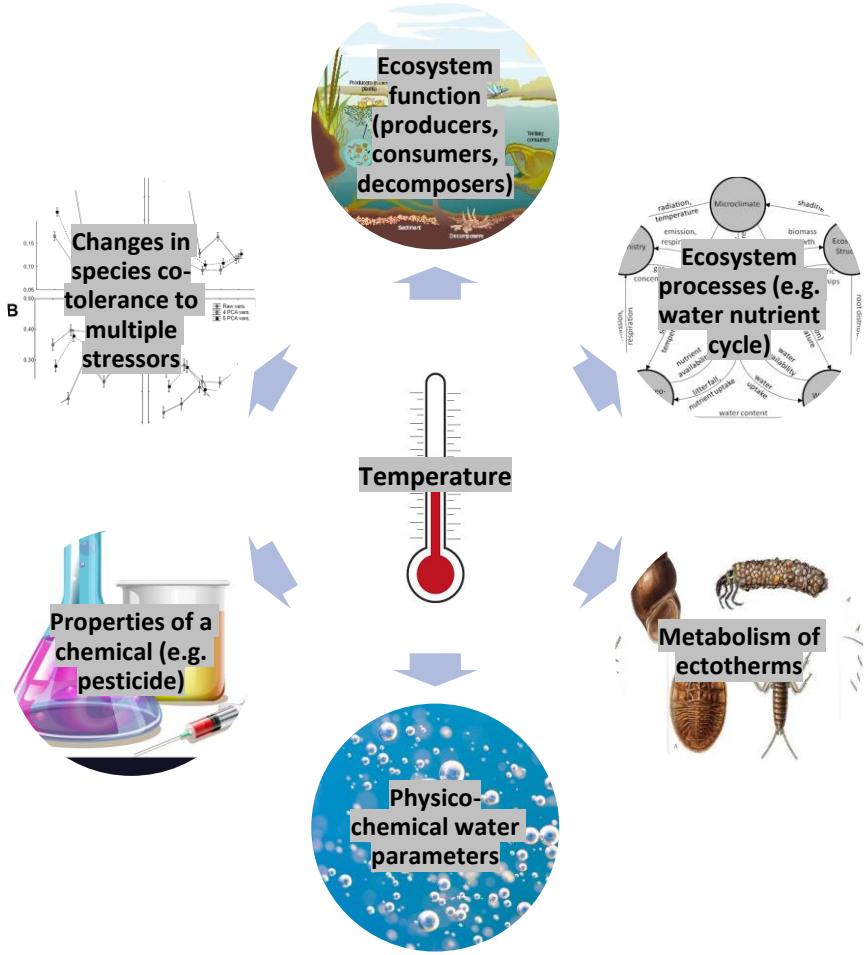
"Master" variable Temperature



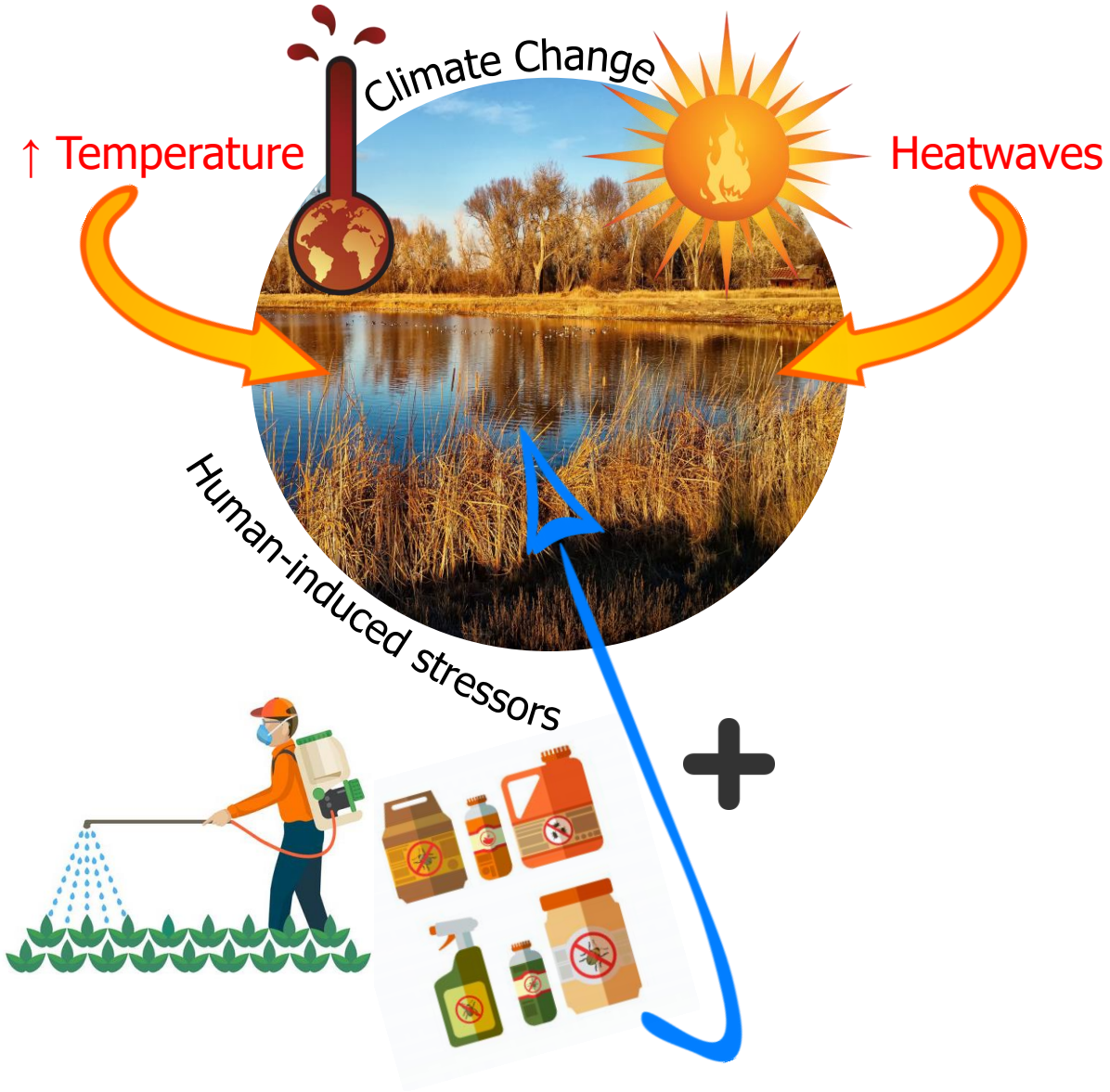


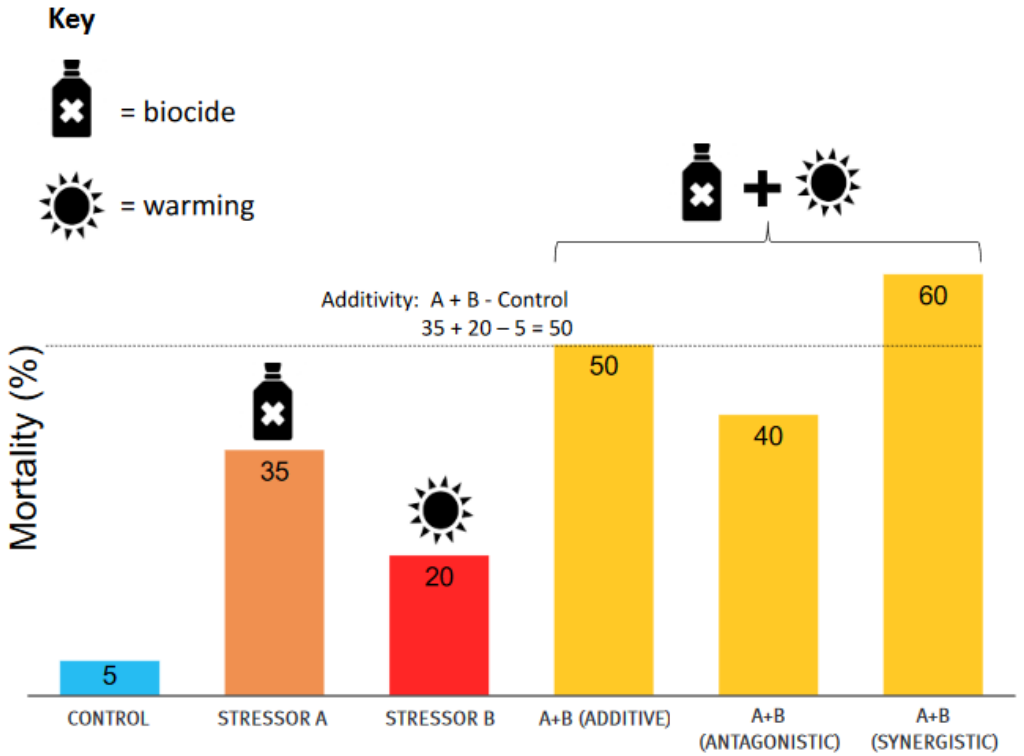
Knutti and Sedláček (2013), *Nature Climate Change*
Data based on IPCC-AR5 (2013)

WG1-IPCC-AR5 (2013)



Multiple stressors: Increased temperature, heatwaves and chemicals

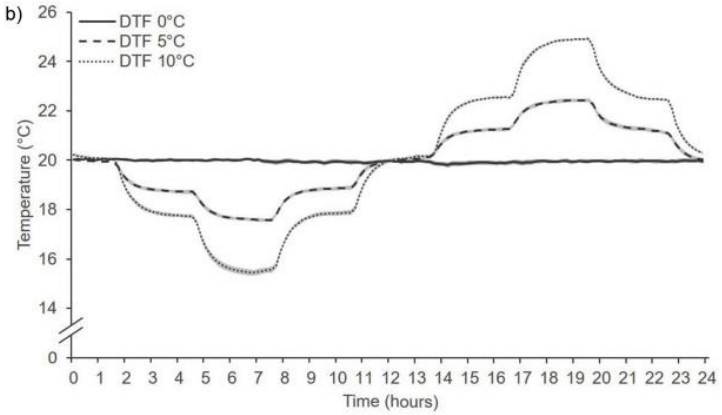


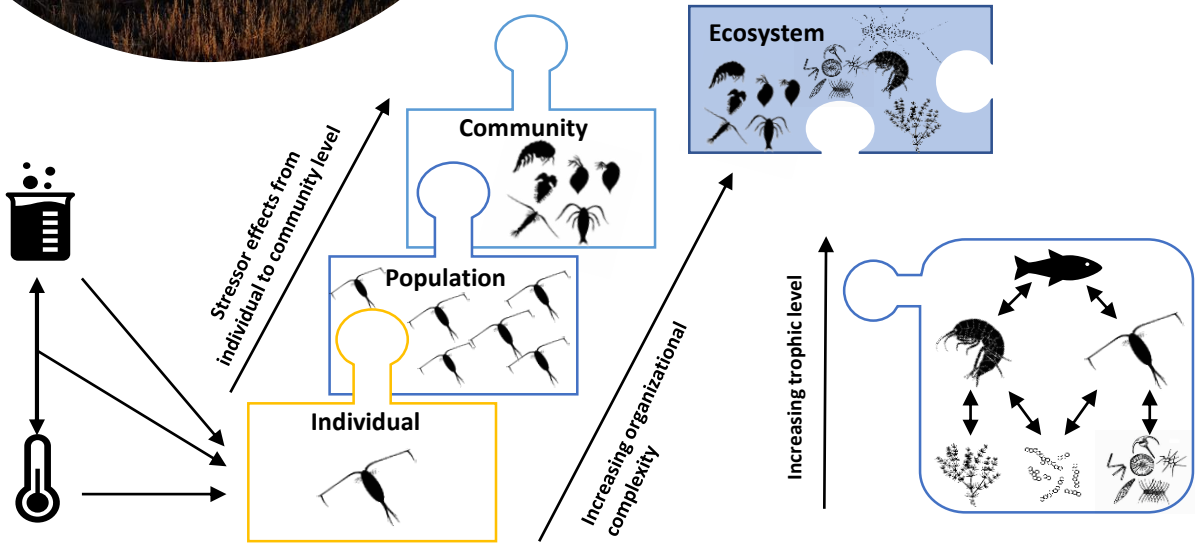


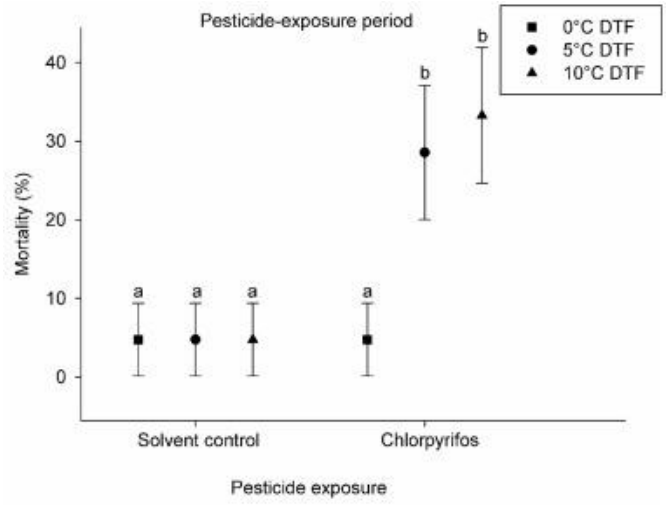
Jackson et al. (2018), *Briefing paper No.27*

The importance of high environmental realism in (cosm) experiments

- Cosm experiments consider different trophic levels and high organizational complexity
- Chemical effects under constant (elevated) temperature regimes vs. natural variability







Verheyen and Stocks (2019), *Environmental Pollution*

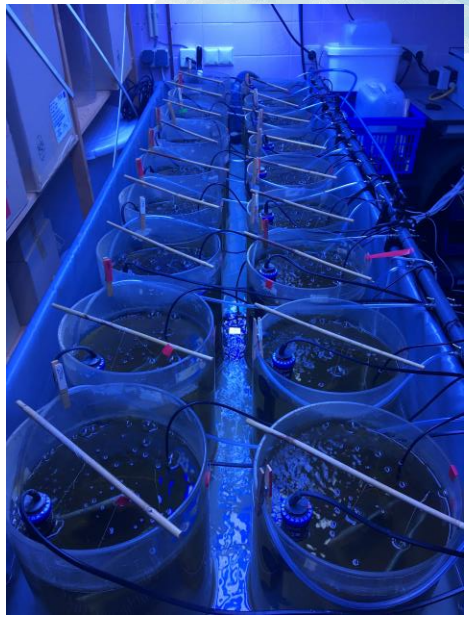
Experimental design

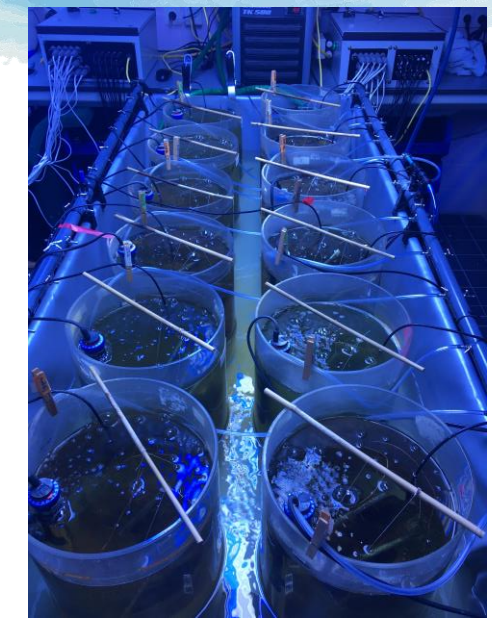
- Ambient and two future climate scenarios
3 T treatments (ambient, elevated, HW)

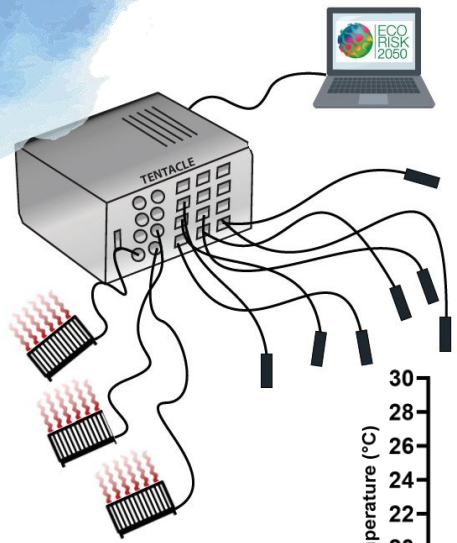
- Fungicide carbendazim solved with DMF
2 chemical treatments (solvent control, 100 ug/L)

- Indoor microcosm test systems
12 L, plankton community, 3 benthic organisms,
2 macrophytes, sediment, 10 endpoints, aerated

- 5 replicates = 30 controlled test systems

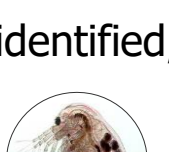






(Macro-) zooplankton species, macroinvertebrates and mollusc

12 species identified, incl.


Daphnia magna


Daphnia longispina


Cyclopoida


Alona costata


Scapholeberis mucronata


Chydorus sphaericus

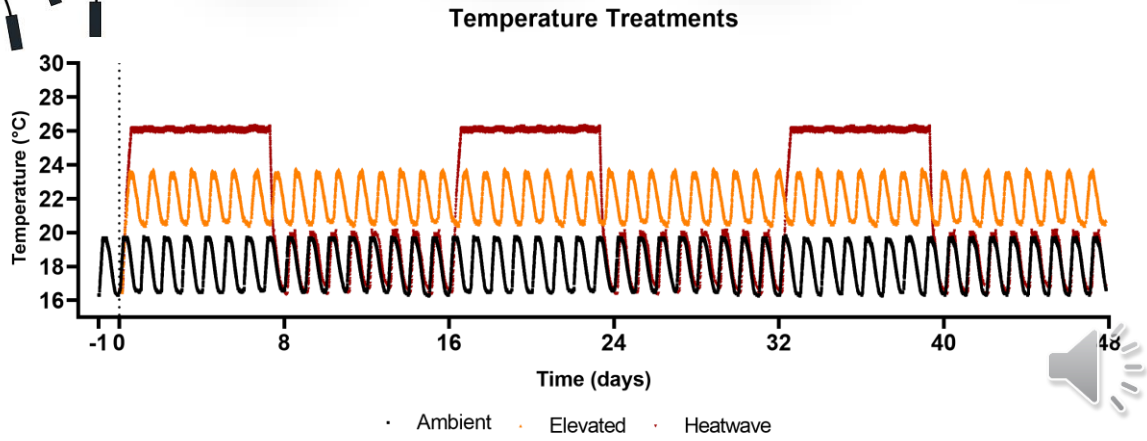

Myriophyllum spicatum


Asellus aquaticus


Gammarus pulex

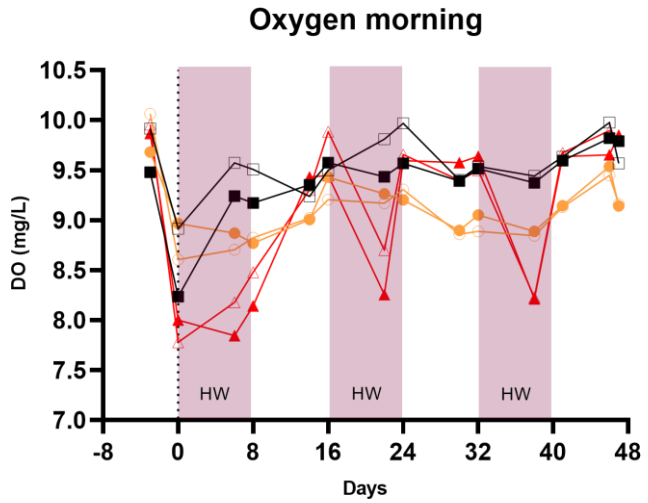

Limnea stagnalis

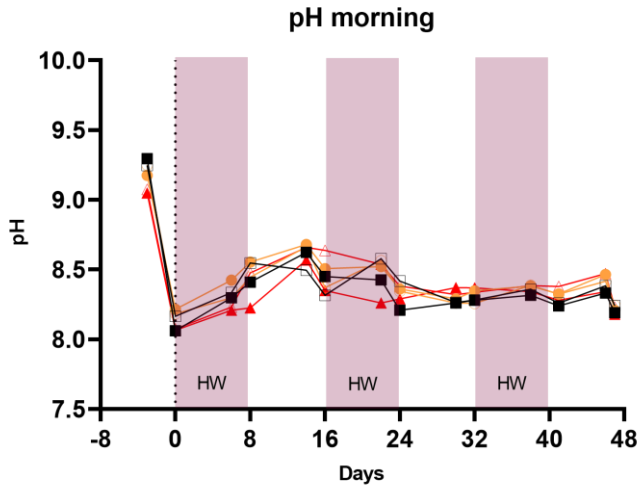

Elodea nuttallii

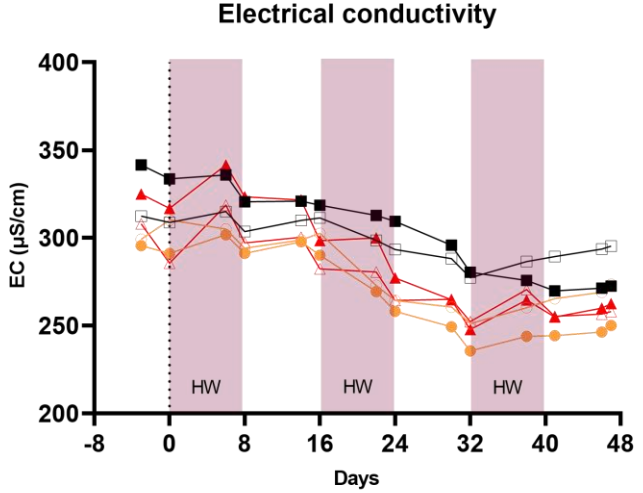


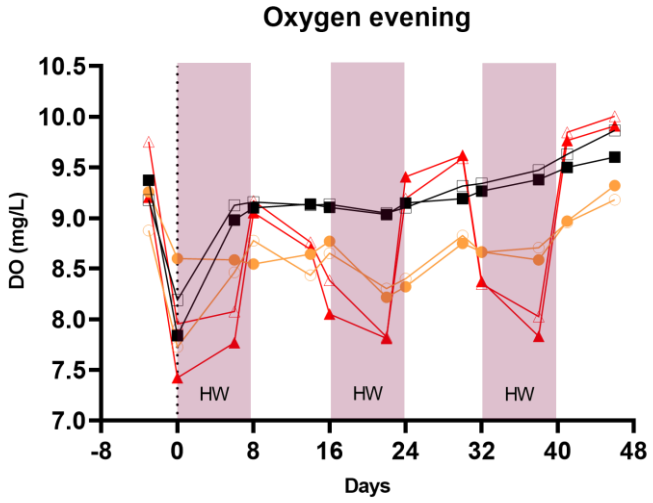
Preliminary study results

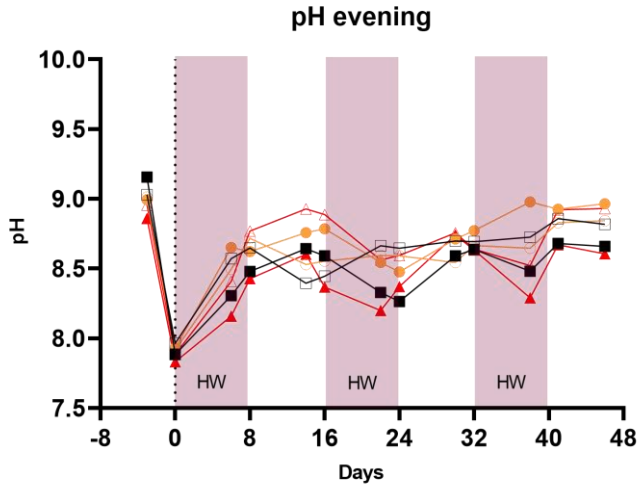
Physico-chemical properties and fate of carbendazim in water

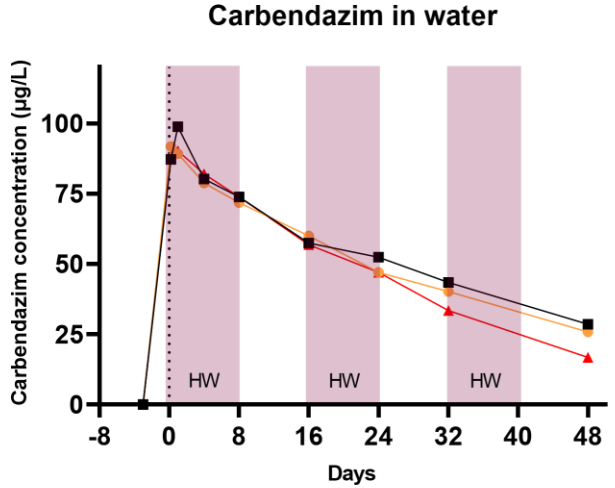








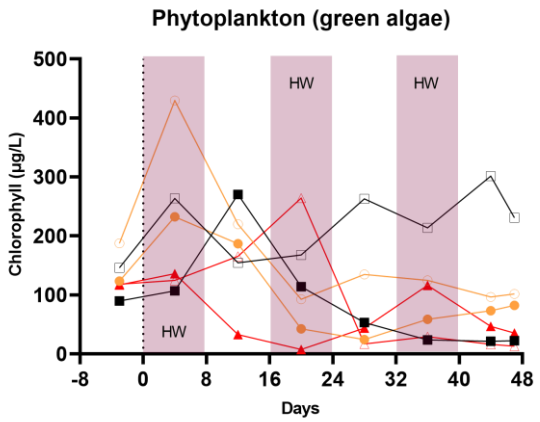


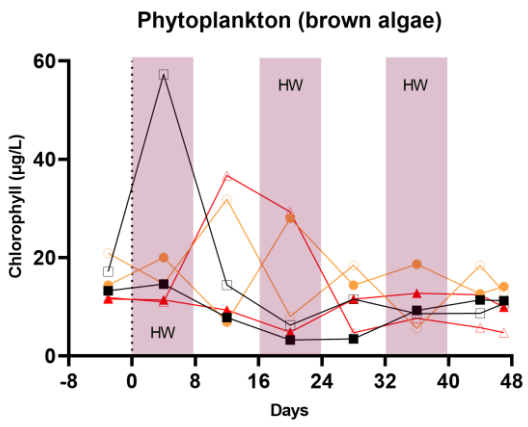


Amb/Control
Amb/100 µg/L
E/Control
E/100 µg/L
HW/Control
HW/100 µg/L

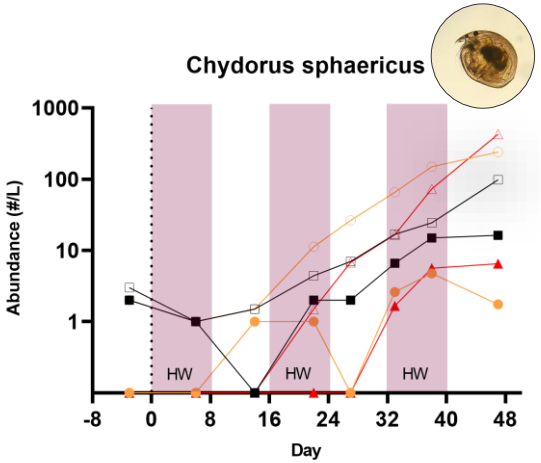
Preliminary study results

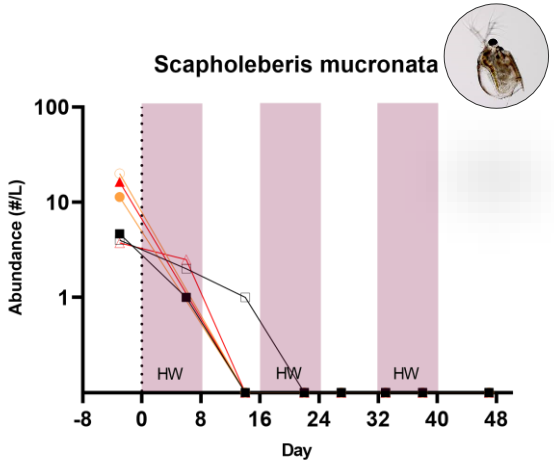
Phytoplankton

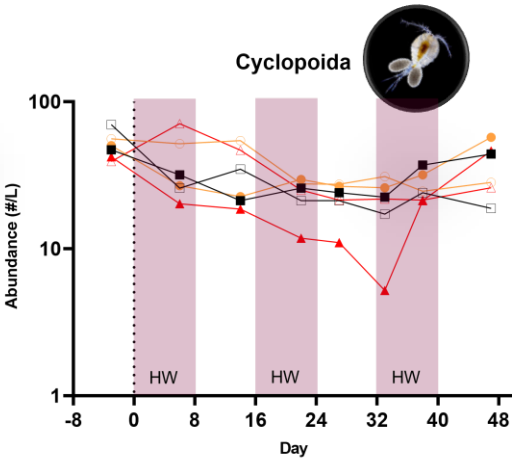


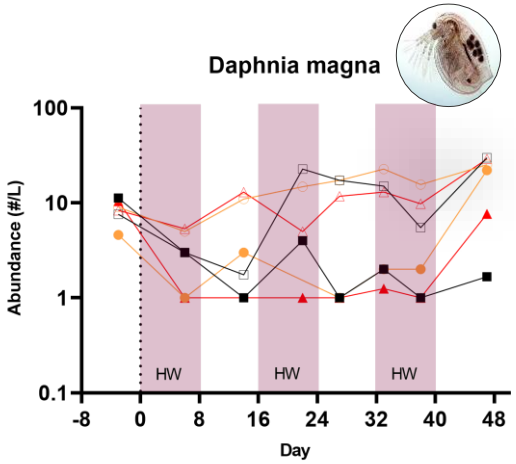


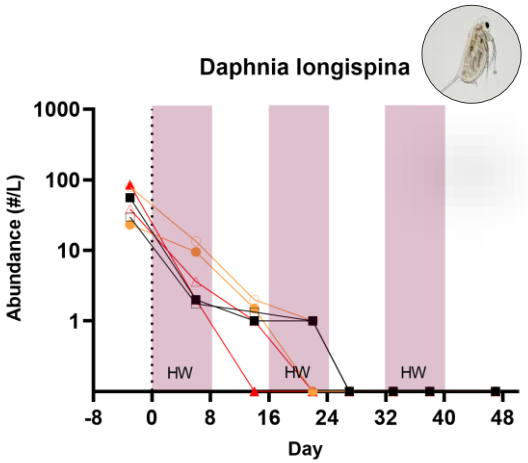
Zooplankton

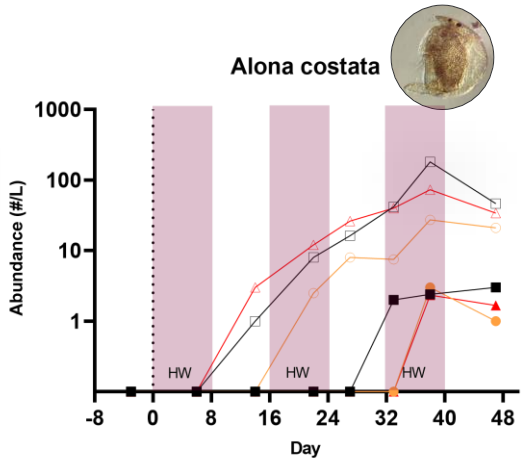










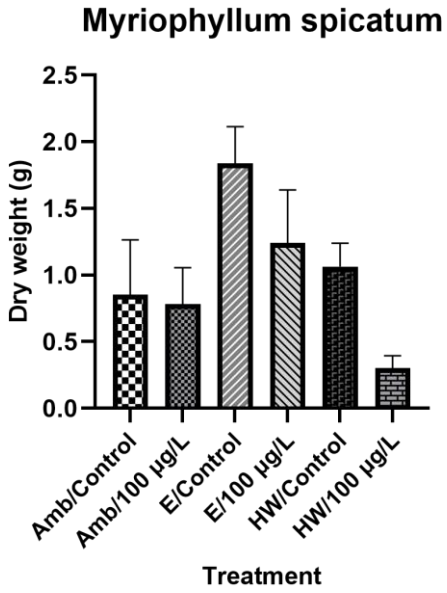


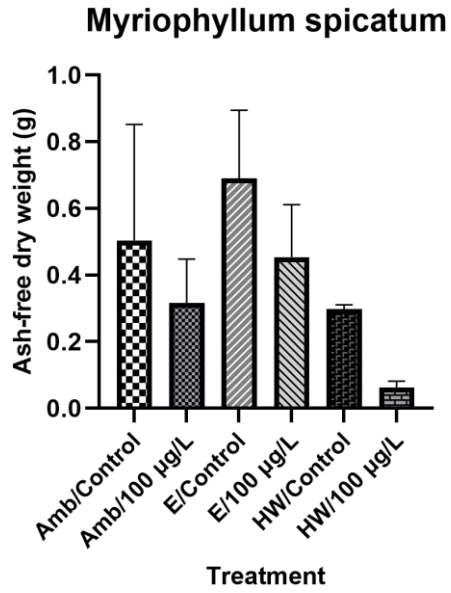
Amb/Control E/Control HW/Control
Amb/100 µg/L E/100 µg/L HW/100 µg/L

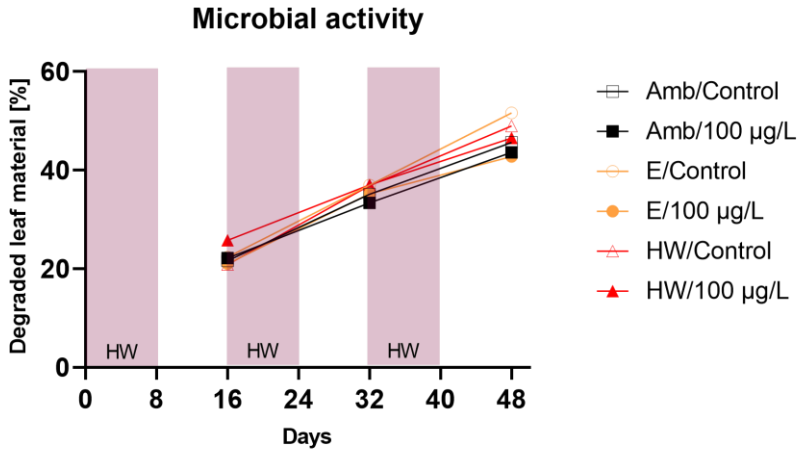
Amb/Control E/Control HW/Control
Amb/100 µg/L E/100 µg/L HW/100 µg/L

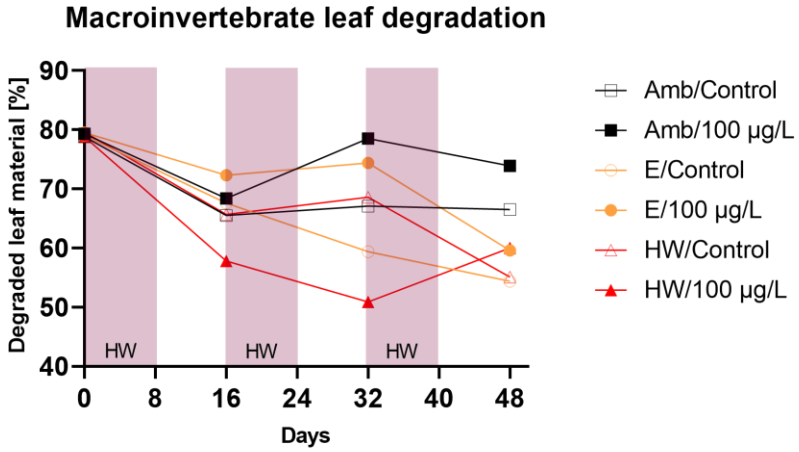
Preliminary study results

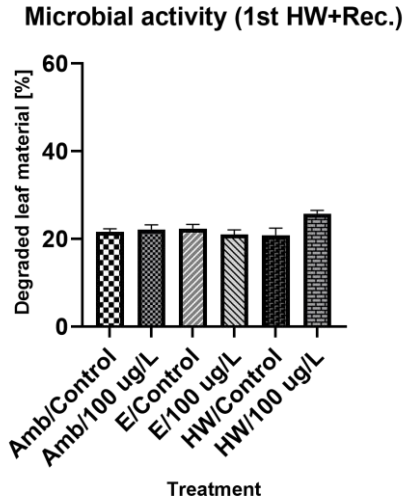
Primary production, macroinvertebrate and microbial activity

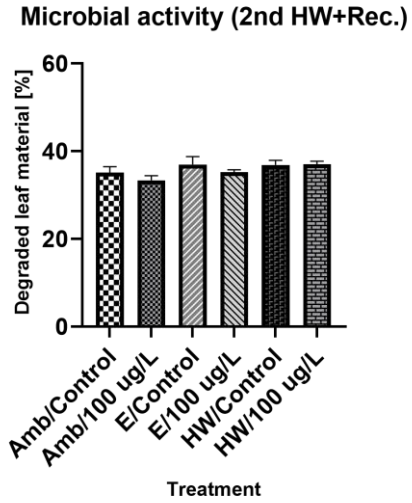


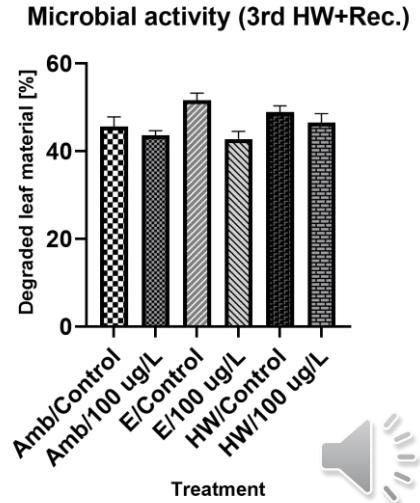










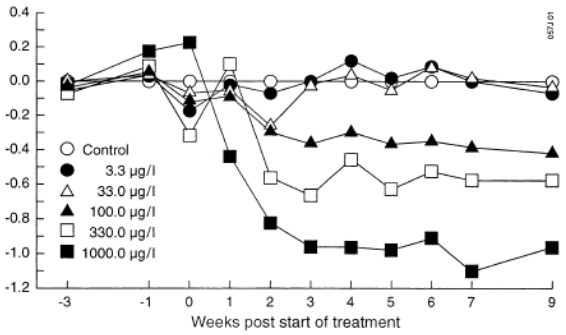


First conclusions and future research

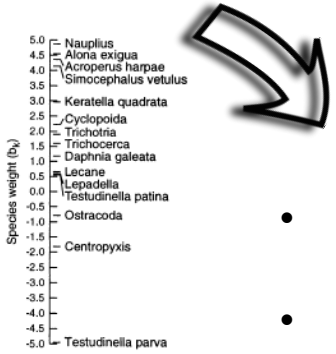
- Temperature machinery (TENTACLE) works indoors and outdoors
- Elevated T and heatwaves affect ecosystem properties
- Multiple stressor effects revealed for zooplankton species, primary production and macroinvertebrate activity

- Complete micro-zooplankton analysis, extract carbendazim from sediment samples
- Statistical (multi- and uni-) variate analyses → multiple stressor effects on zooplankton community/individuals
- Investigate multiple stressor interactions (chemical & non-chemical stressor)

<u>Other carbendazim studies</u>



Van den Brink et al. (2000), *Aquatic Toxicology*



<u>Own study</u>

- 12 macro-zooplankton species
- 16 microzooplankton species (so far)

<u>Future</u>