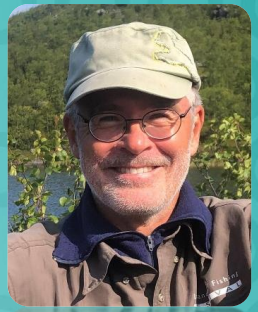
Microbial diversity of plankton and its response to browning in aquatic systems - MiDAS









Kristiina Vuorio

Marko Järvinen

Sanni Aalto

Sami Taipale

Ann-Kristin Bergström

Isolde Puts

Pär Byström

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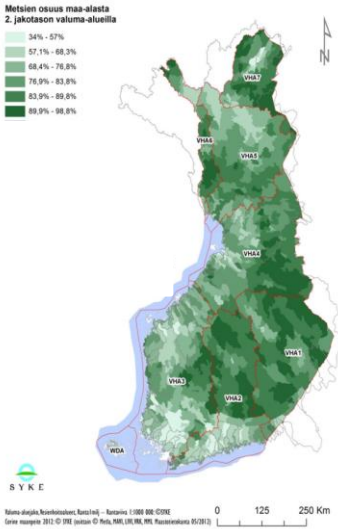
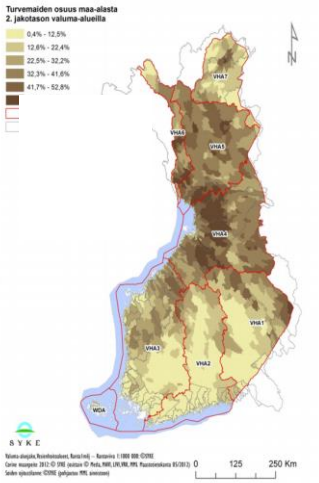
Forested areas



Peatland areas



Tattari et al. 2015

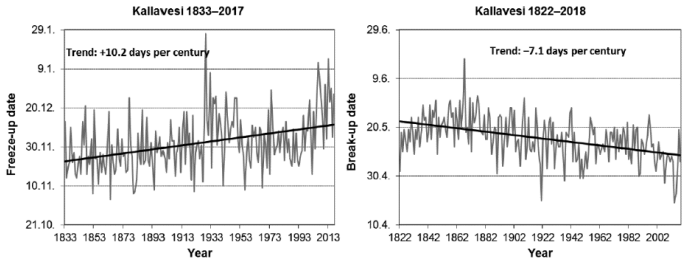
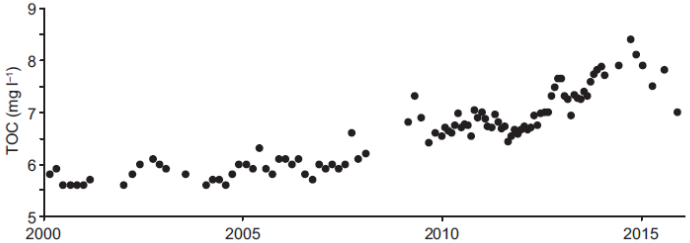


Figure 21. Lake Kallavesi freeze-up and break-up time series updated until the winter 2017–2018.

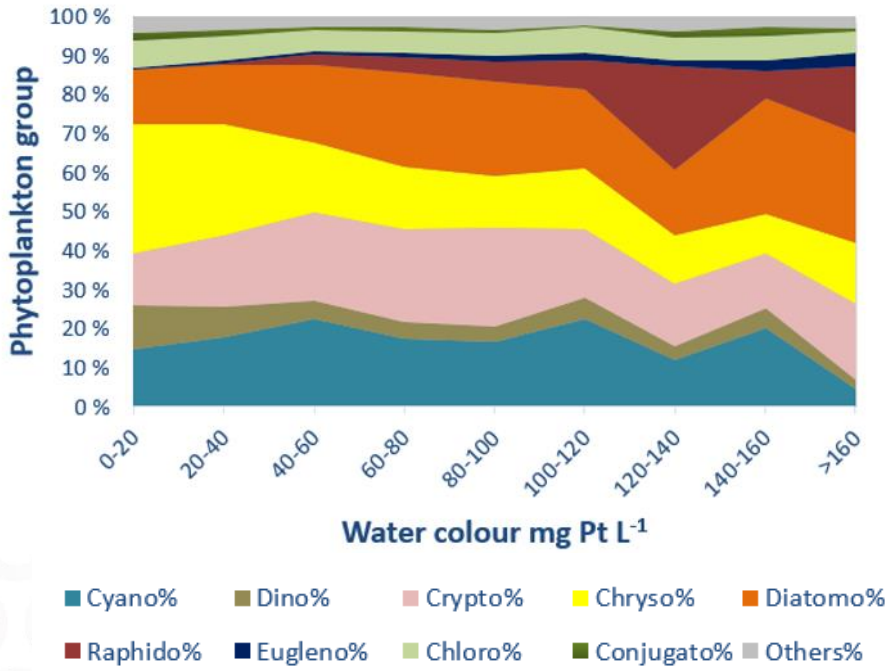
Korhonen 2019



Forsius et al. 2017

S Y K E

Impacts of browning and eutrophication on phytoplankton



Gonyostomum semen (Ehrenberg) Diesing 1866

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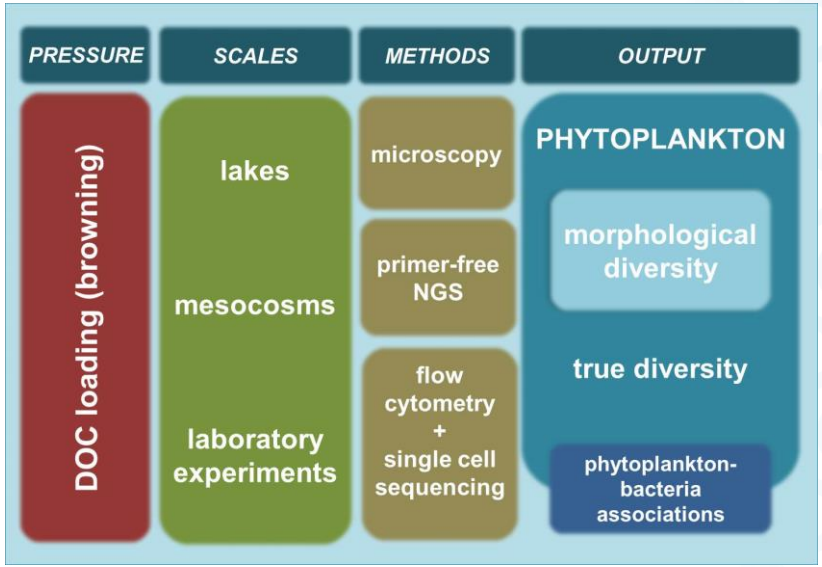
Vuorio et al. unpublished

Objectives

1. **Describe aquatic microbial diversity response to increasing allochthonous dissolved organic carbon (DOC) input (browning)**
2. Describe total diversity of planktonic aquatic microbes (phytoplankton + bacteria) in lakes
3. Describe and study changes in bacteria-phytoplankton associations caused by browning



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Funded by the Academy of Finland, grant 311229 (MiDAS)

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Laboratory experiments

Experiment 1 in 2020

- Lake water (Lake Valkjärvi)
- Illumination 16:8 h
- Temperature 20 °C
- Duration 12 days
- Volume 2 L, 4 replicates
- Treatments (HuminFeed addition):
  - 20 mg Pt L^{-1} (control)
  - 25 mg Pt L^{-1} (HF2.5)
  - 30 mg Pt L^{-1} (HF10)
  - 50 mg Pt L^{-1} (HF40)

Experiment 2 in 2021

- Lake water (Lake Valkjärvi)
- Illumination 16:8 h
- Temperature 20 °C
- Duration 8 days
- Volume 1 L, 3 replicates
- Treatments:
  - Control
  - Glucose +1 mg L^{-1}
  - Light intensity -50%
  - Glucose +1 mg L^{-1} and light intensity -50%

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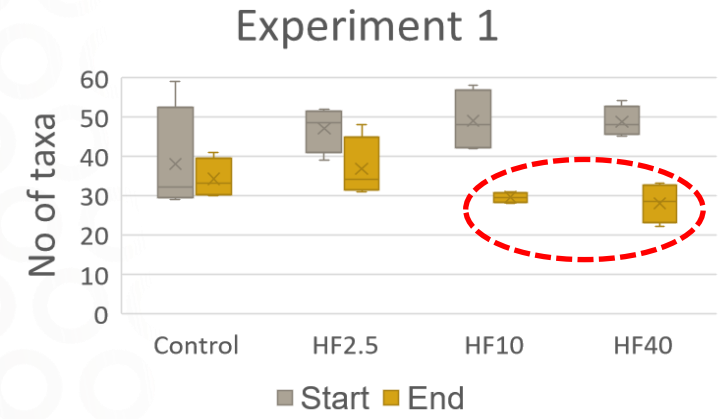
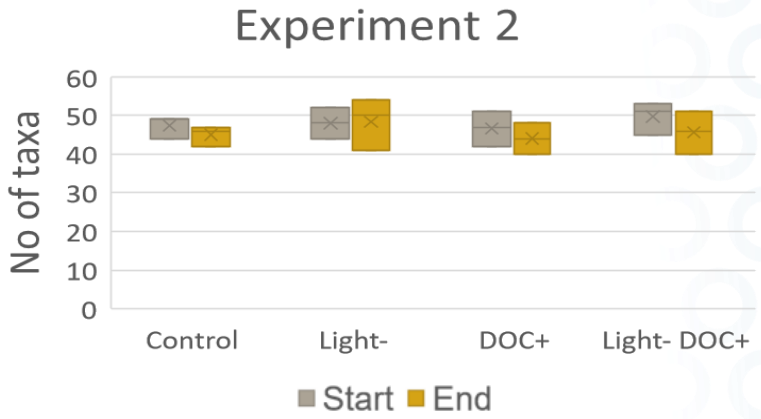
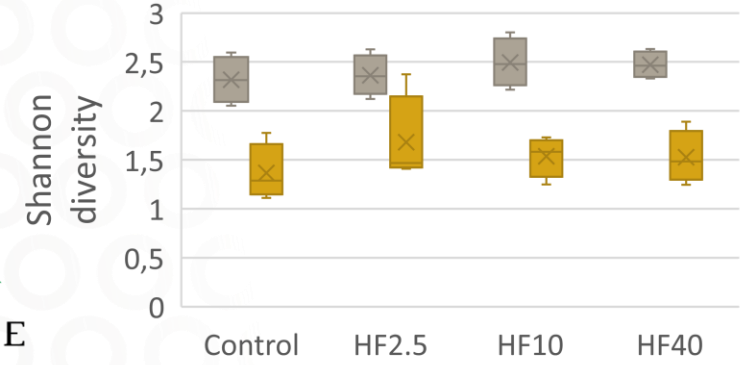
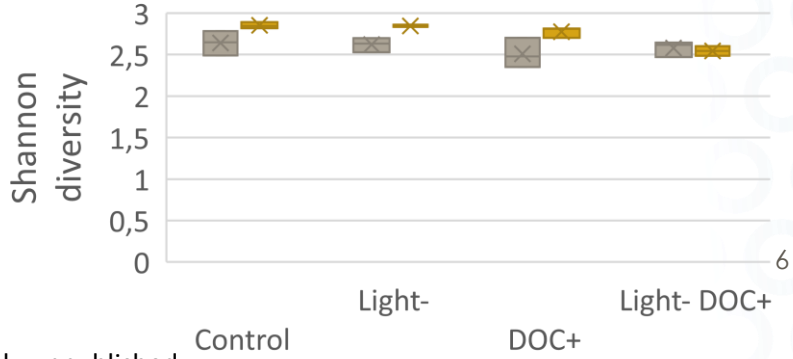
Laboratory experiments









Vuorio et al., unpublished

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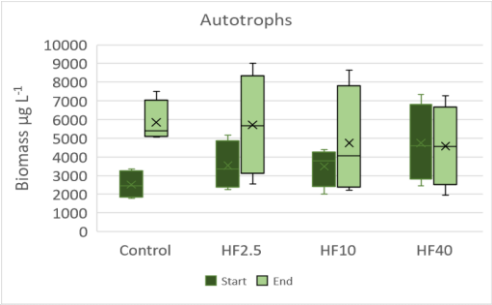
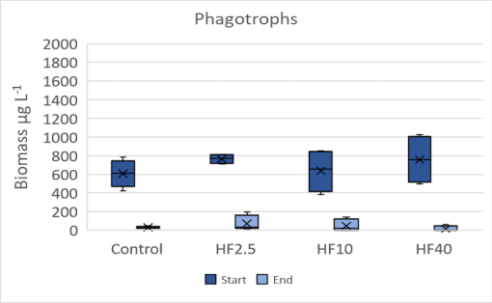
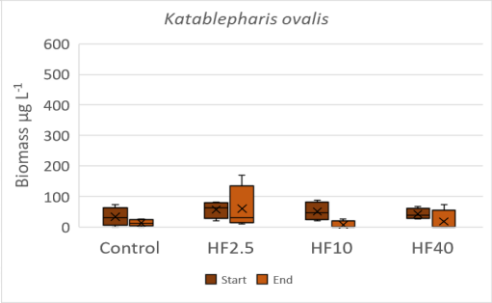
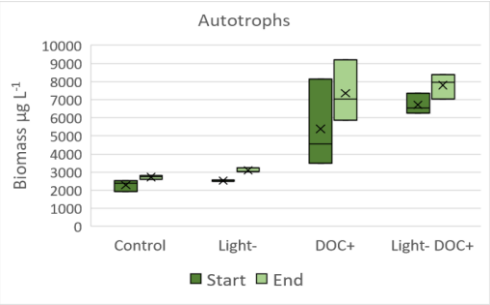
Experiment 1

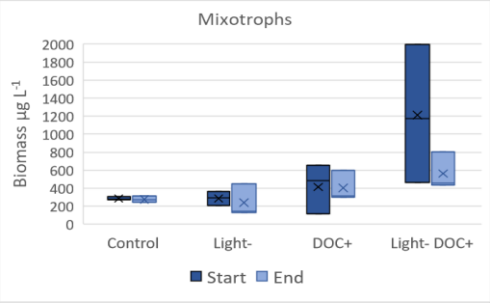


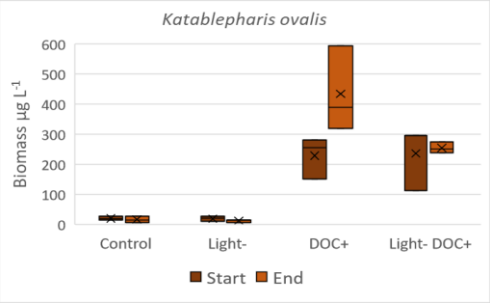




Experiment 2







Vuorio et al., unpublished

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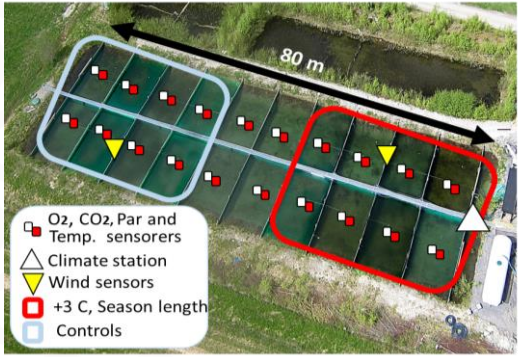
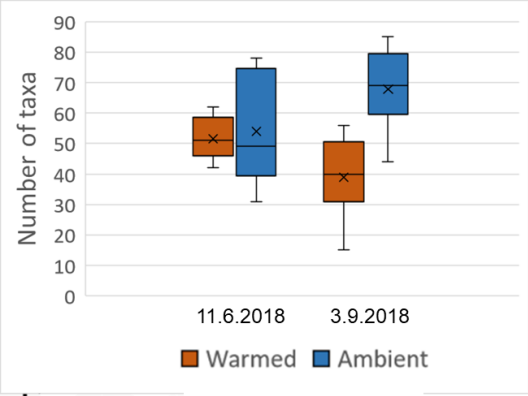
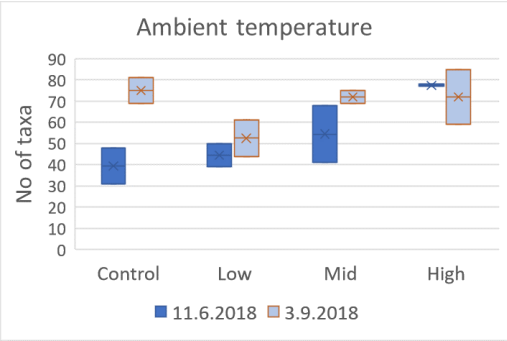
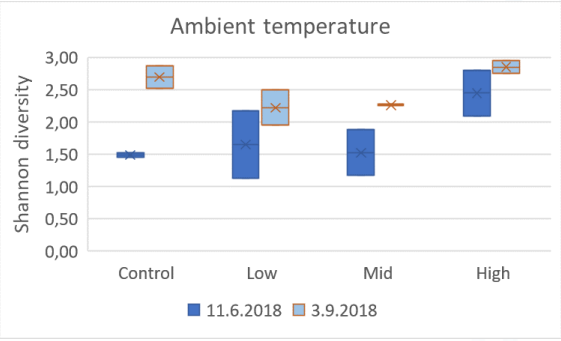
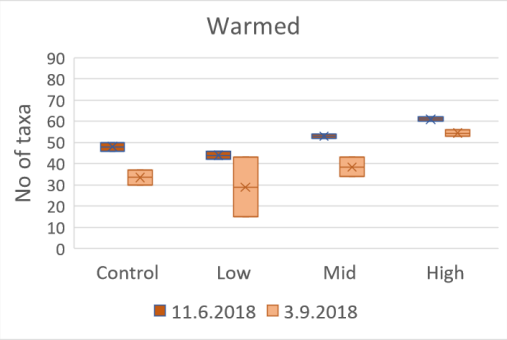
Effects of temperature and DOC

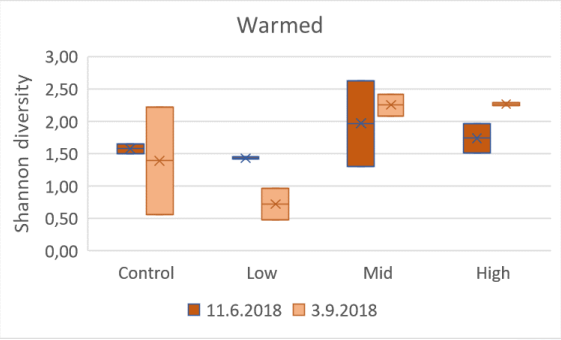












Vuorio et al., unpublished

EXEF bonds

11.6.2018 3.9.2018

Vuorio et al., unpublished

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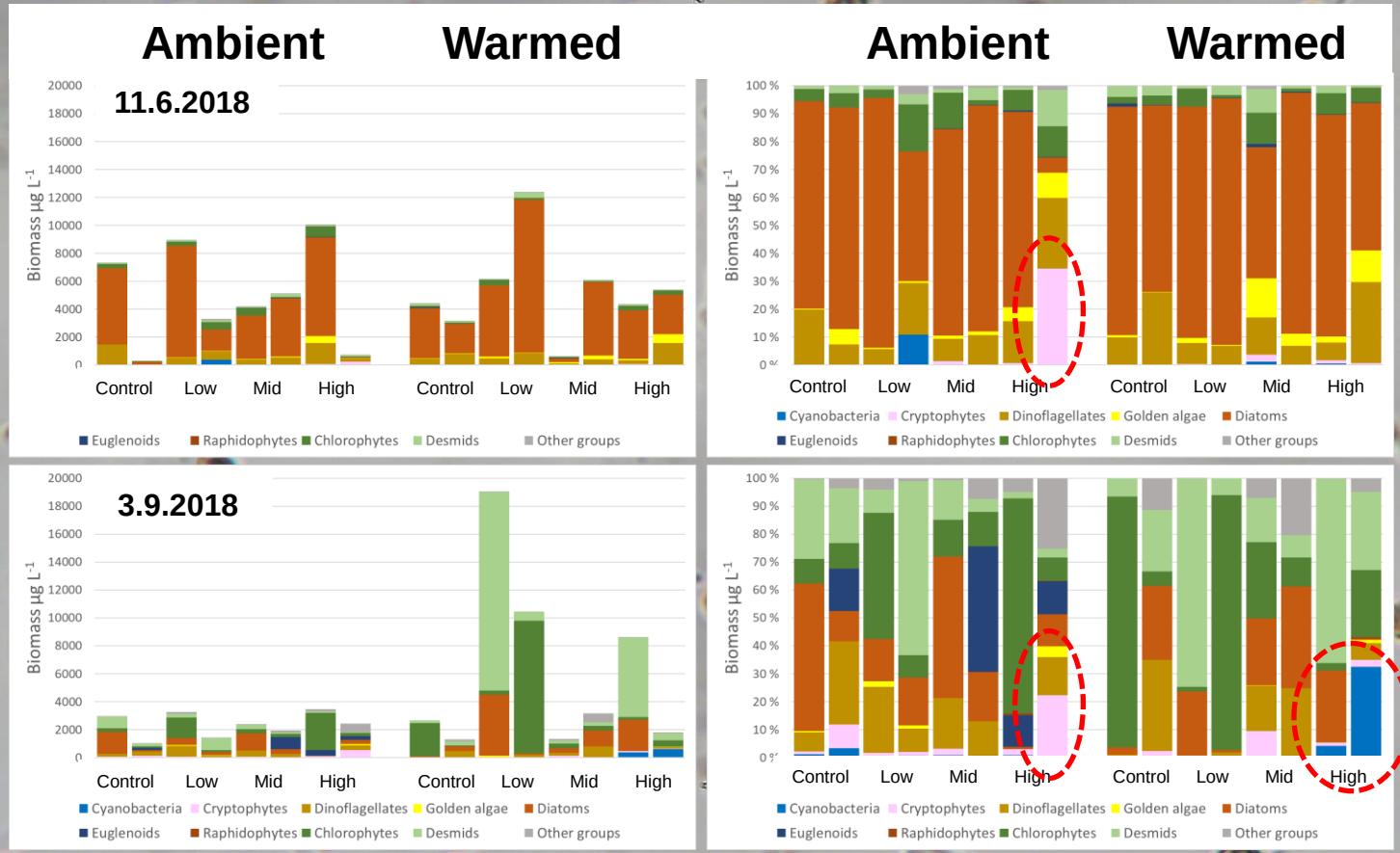
EXEF ponds, phytoplankton composition

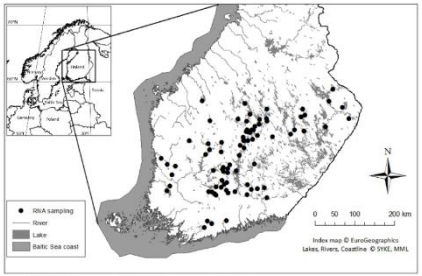


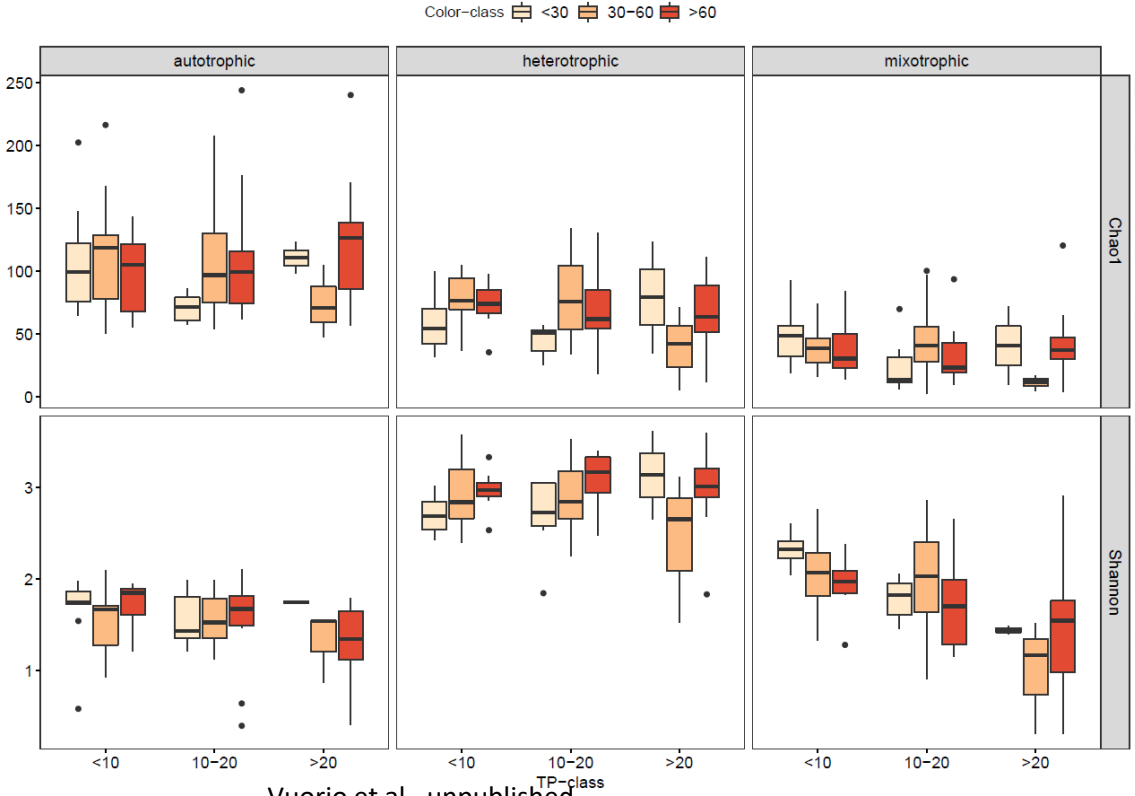
Vuorio et al., unpublished

10µm

40X

Genetic of bacteria and funtional diversity of eukaryotic phytoplankton and protists





Vuorio et al., unpublished

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Overall conclusions

- Browning favours bacteria grazing mixotrophic (phagotrophic) phytoplankton
- Browning in warmer climate can increase the abundance of bloom forming cyanobacteria
- Browning changes phytoplankton composition and favours the ”slimy alga” *Gonystomum semen*
- Changes in functionality can be greater than changes in diversity
- Changes in phytoplankton community composition can lead to reduction in the production of essential fatty acids

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Publications

1. Weigel B, Kotamäki N, Malve O, Vuorio K, Ovaskainen O: Macrosystem community change in lake phytoplankton and its implications for diversity and function. Submitted to Global Ecology and Biogeography
2. Antão L, Weigel B, Strona G, Hällfors M, Kaarlejärvi E, Dallas T, Opedal Ø, Heliölä J, Huitu O, Korpimäki E, Kuussaari M, Lehikoinen A, Leinonen R, Lindén A, Merilä P, Pietiäinen H, Pöyry J, Salemaa M, Tonteri T, Vuorio K, Ovaskainen O, Saastamoinen M, Vanhatalo J, Roslin T, Laine A-L (2022): Shifting climatic imprints reshuffle northern communities. Submitted 22.11.2021 to Science Climate Change 12: 587–592. https://doi.org/10.1038/s41558-022-01381-x
3. Salmi P, Mäki A, Mikkonen A, Puupponen V-M, Vuorio K, Tiirola M (2021): Comparison of epifluorescence microscopy and flow cytometry in counting freshwater picophytoplankton. Boreal Environmental Research 26: 17–27
4. Taipale S, Kuoppamäki K, Strandberg , Peltomaa E, Vuorio K (2020): Lake restoration influence nutritional quality of algae and (consequently) *Daphnia* biomass, Hydrobiologia 847: 4539-4557. https://doi.org/10.1007/s10750-020-04398-5
5. Vuorio K, Järvinen M, Kotamäki N (2020): Phoshorus thresholds for bloom-forming cyanobacterial taxa in northern European lakes, Hydrobiologia 847: 4389-4400. https://doi.org/10.1007/s10750-019-04161-5
6. Vuorio K, Mäki A, Salmi P, Aalto S, Tiirola M (2019): Consistency of targeted metatranscriptomics and morphological characterization of phytoplankton communities, submitted to Frontiers in Microbiology 11: 96. https://doi.org/10.3389/fmicb.2020.00096
7. Taipale S, Vuorio K, Aalto S, Peltomaa E, Tiirola M (2019): Eutrophication reduces the nutritional value of phytoplankton in boreal lakes, Enviromental Research 179: 156-166. https://doi.org/10.1016/j.envres.2019.108836
8. Vuorio K, Kanninen A, Mitikka S, Sarkkinen M, Hämäläinen H (2018): Invasion of Finnish inland waters by the alien moss animal *Pectinatella magnifica* Leidy, 1851 and associated potential risks, Management of Biological Invasions 1: 1-10. https://doi.org/10.3391/mbi.2018.9.1.01

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Warm thanks to

Marja Tiirola

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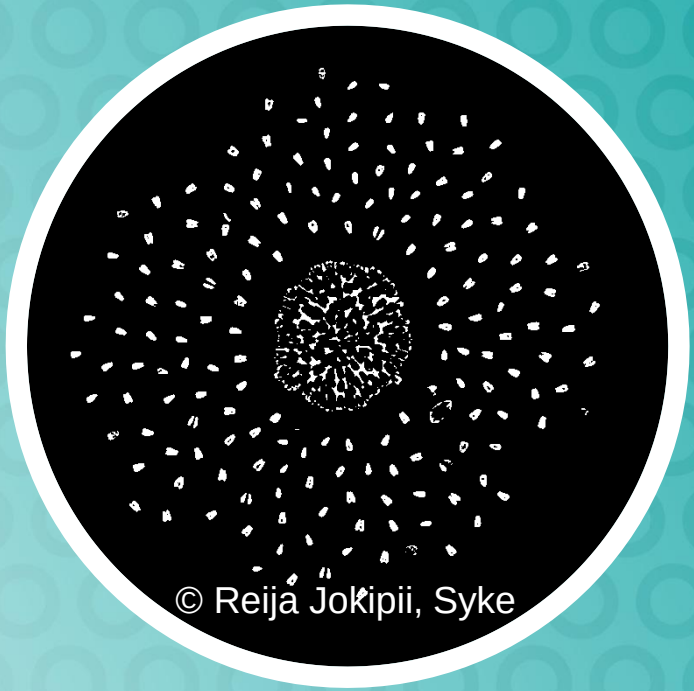

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