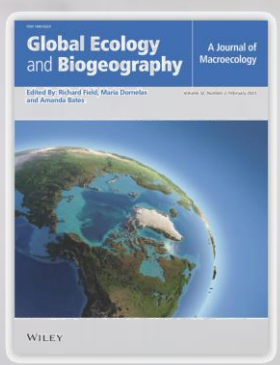
Macrosystem community change in lake phytoplankton and its implication for diversity and function

Benjamin Weigel, Niina Kotamäki, Olli Malve, Kristiina Vuorio, Otso Ovaskainen



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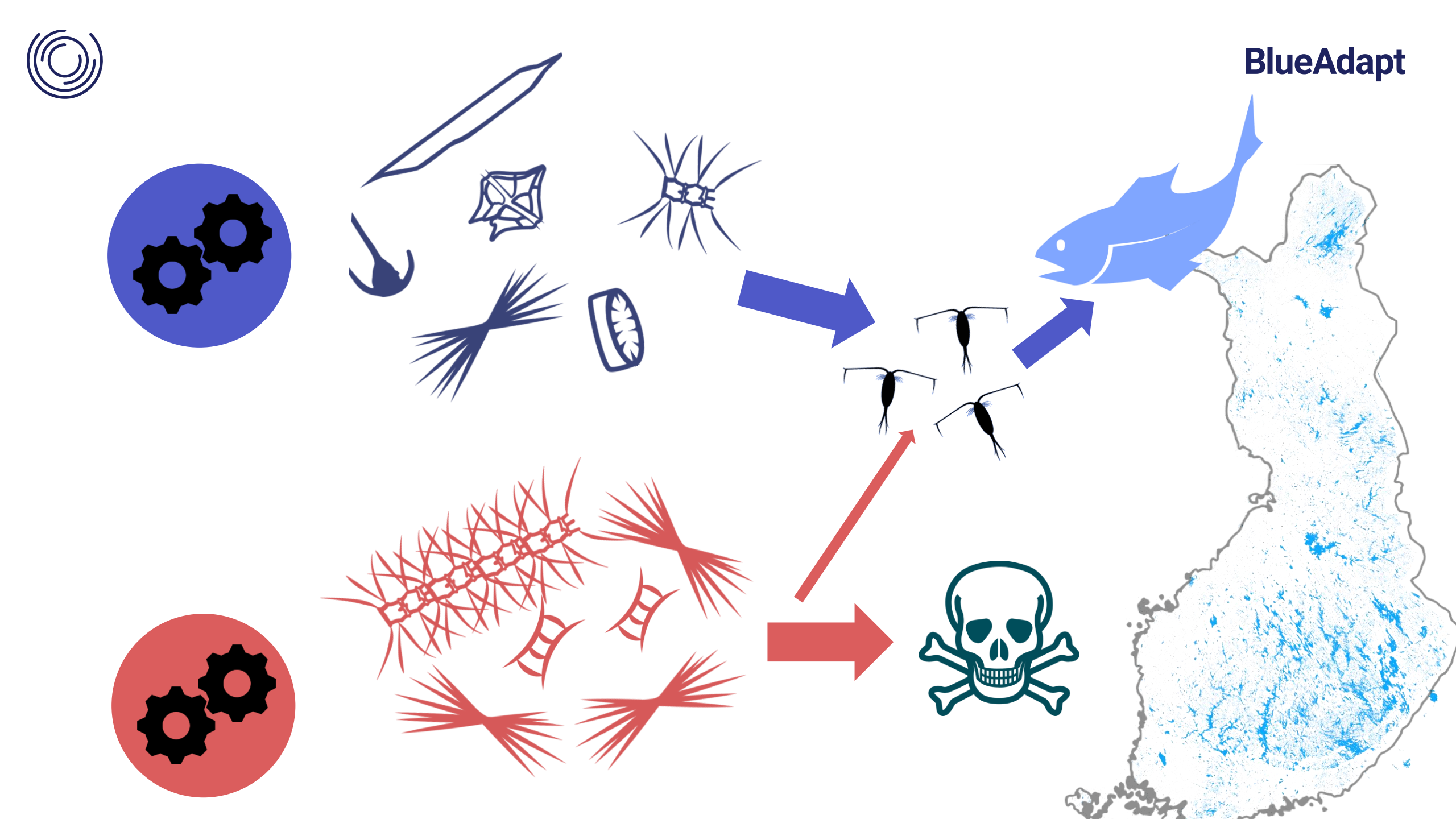

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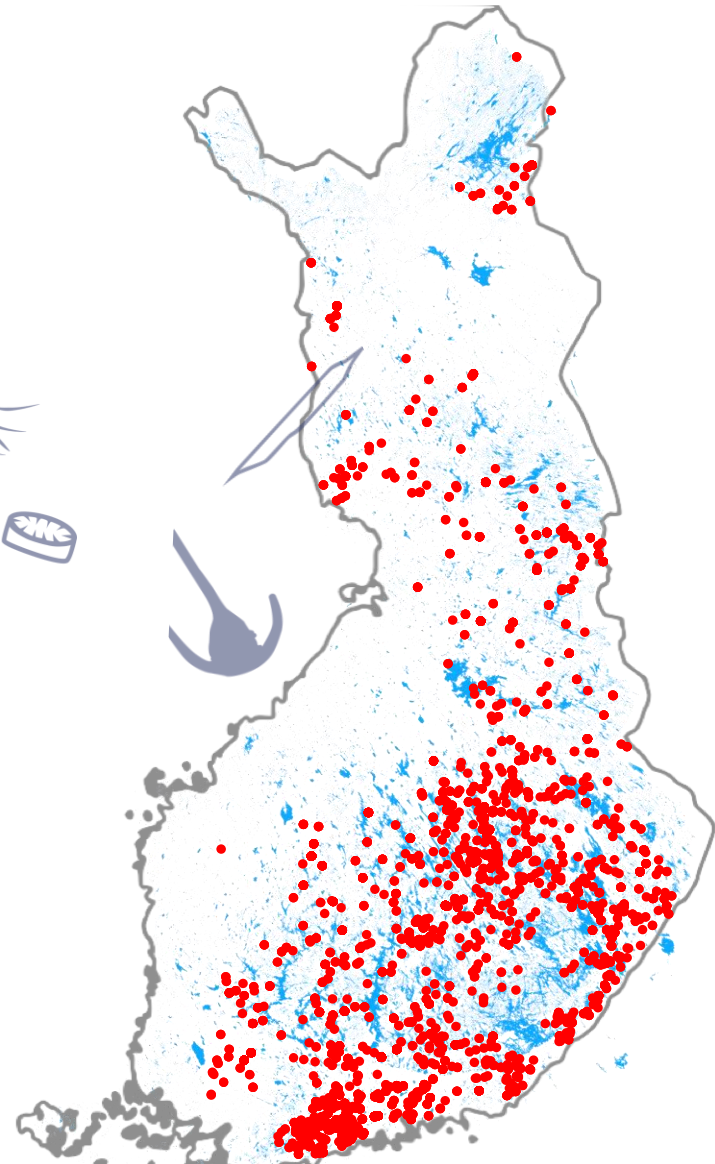
Quantify long-term community change and associated functional characteristics of lake phytoplankton in Finland

853 lakes

40 years

1977-2017



Suomen ympäristökeskus
Finlands miljöcentral
Finnish Environment Institute

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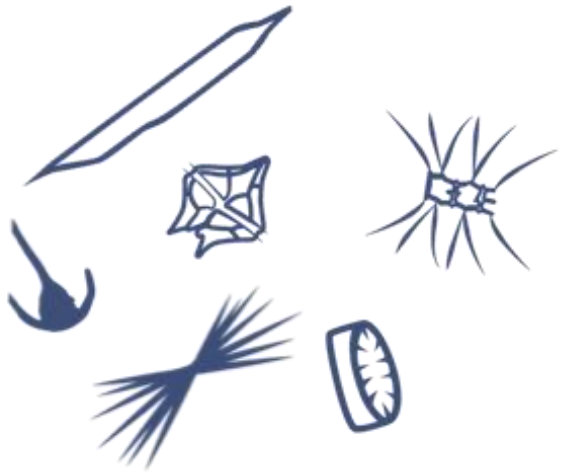
Joint Species Distribution Modelling framework

Hierarchical Modelling of Species Communities (HMSC)*

Jointly modelling …



165 species

Presence - absence

* Ovaskainen & Abrego (2020) *Joint Species Distribution Modelling*. Cambridge University Press.
Tikhonov et al. (2020) *Methods Ecol Evol,* 2020; 00:1–6.
Tikhonov et al. (2019) *Hierarchical Model of Species Communities. R package version 3.0-12.*
Ovaskainen et al. (2017) *Ecology Letters,* 20, 561– 576.

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Hierarchical Modelling of Species Communities (HMSC)

Considering …

STUDY DESIGN

853 lakes

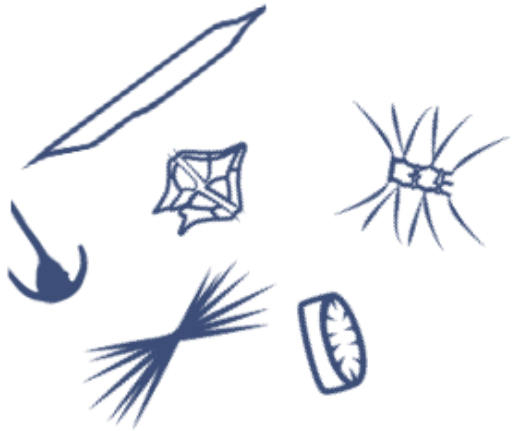
Hierarchical spatial structure

1057 spatially explicit sites

666 watersheds (catchment areas)

54 river basins (draining to coastal areas)

165 species



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Hierarchical Modelling of Species Communities (HMSC)

Including …

EXPLANATORY COVARIATES

Physico-chemical water variables

Temperature
Phosphorous concertation
Nitrogen : phosphorous
Water colour

Lake bathymetry

Lake size (surface area)
Mean depth
Retention days
(residence time of water)

Land use proxies

Urban area
Agricultural area
Mineral forest area
Peat forest area

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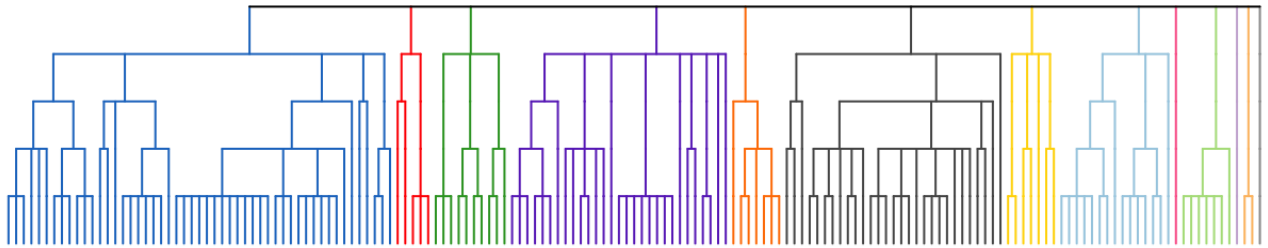
Hierarchical Modelling of Species Communities (HMSC)

Accounting for ...

PHYLOGENY AND TRAITS



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Hierarchical Modelling of Species Communities (HMSC)

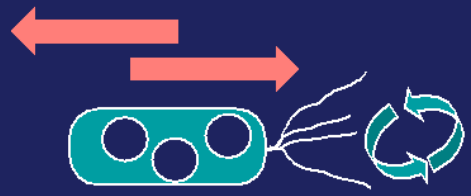
Accounting for …

TRAITS

cell volume

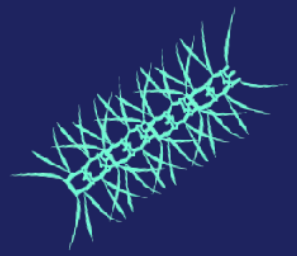
nitrogen fixation ability

motility



demand for silica

chain forming ability



ability to produce toxins

Change of community types over time

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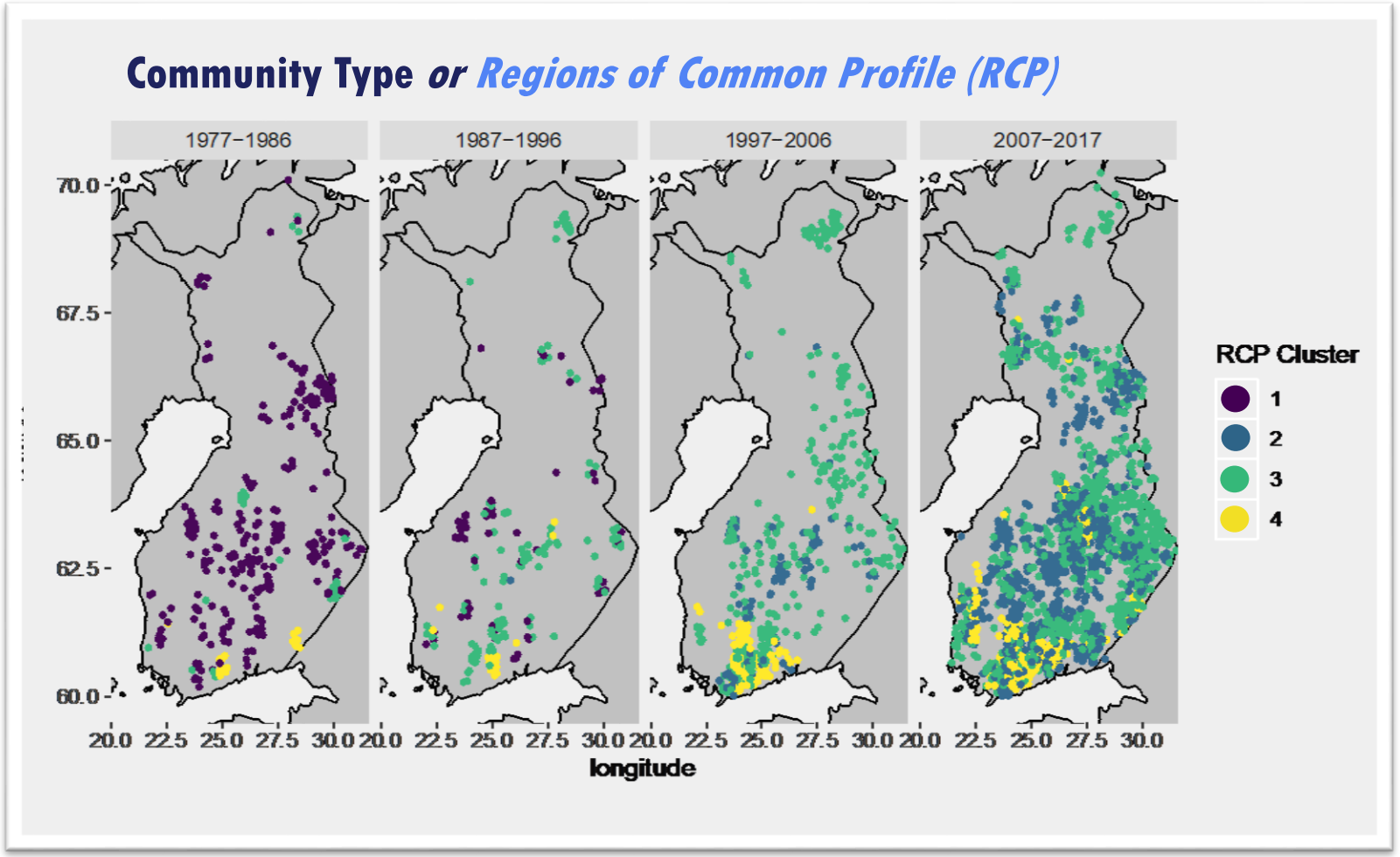

Change of community types over time

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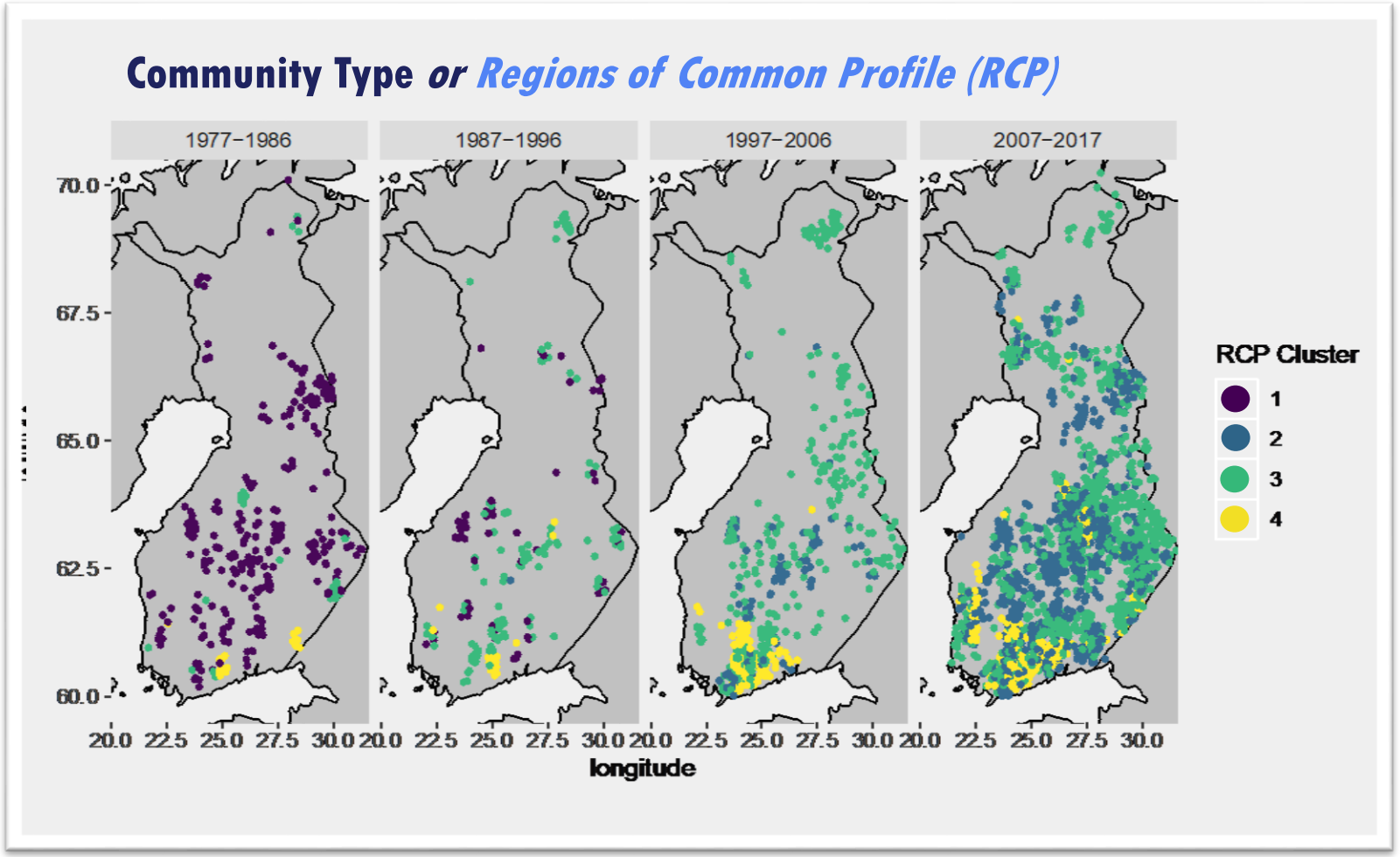

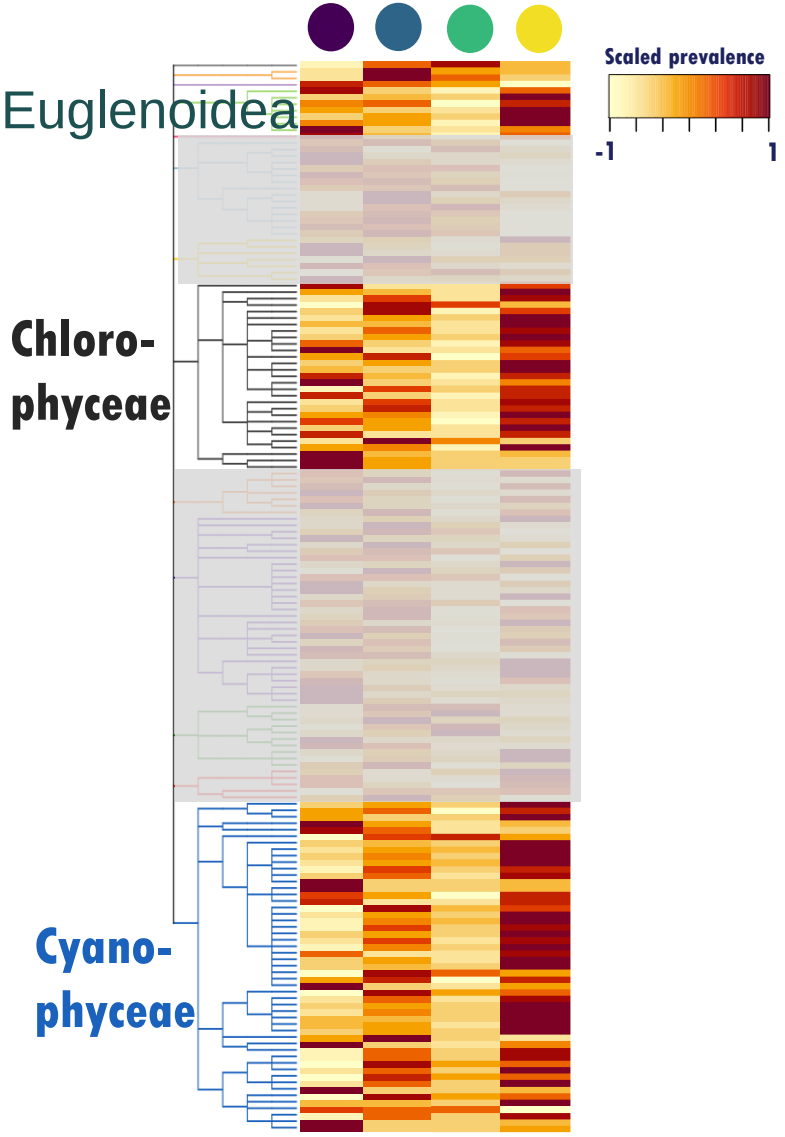

Change of community types over time

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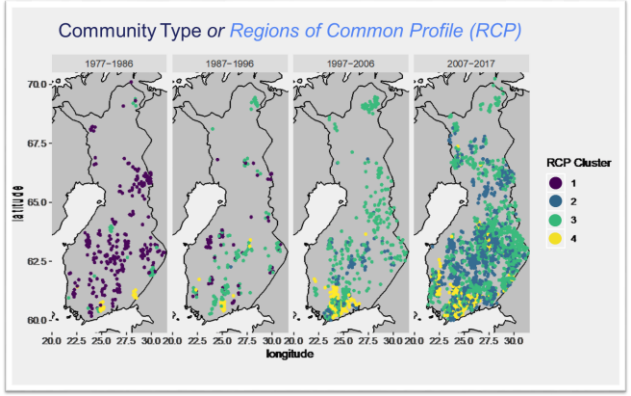
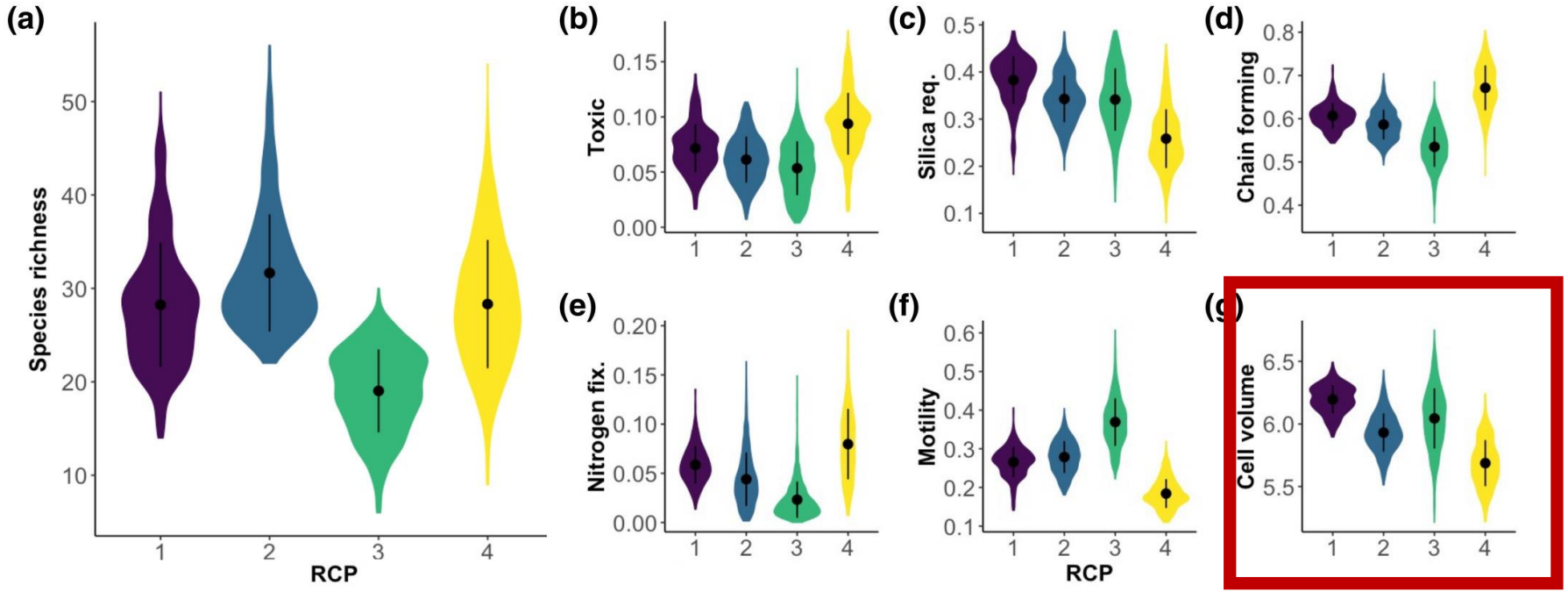


What are the characteristics of the different clusters?



Change of community types over time

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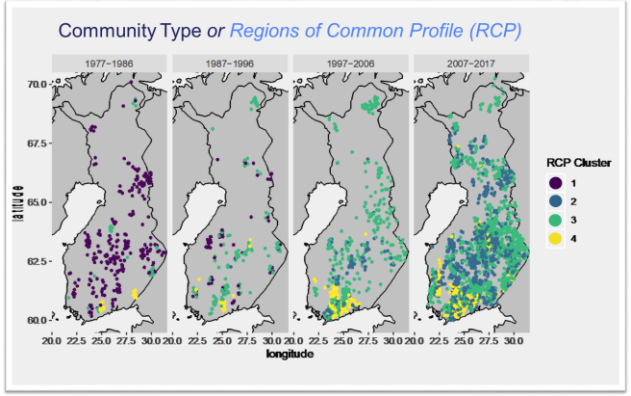
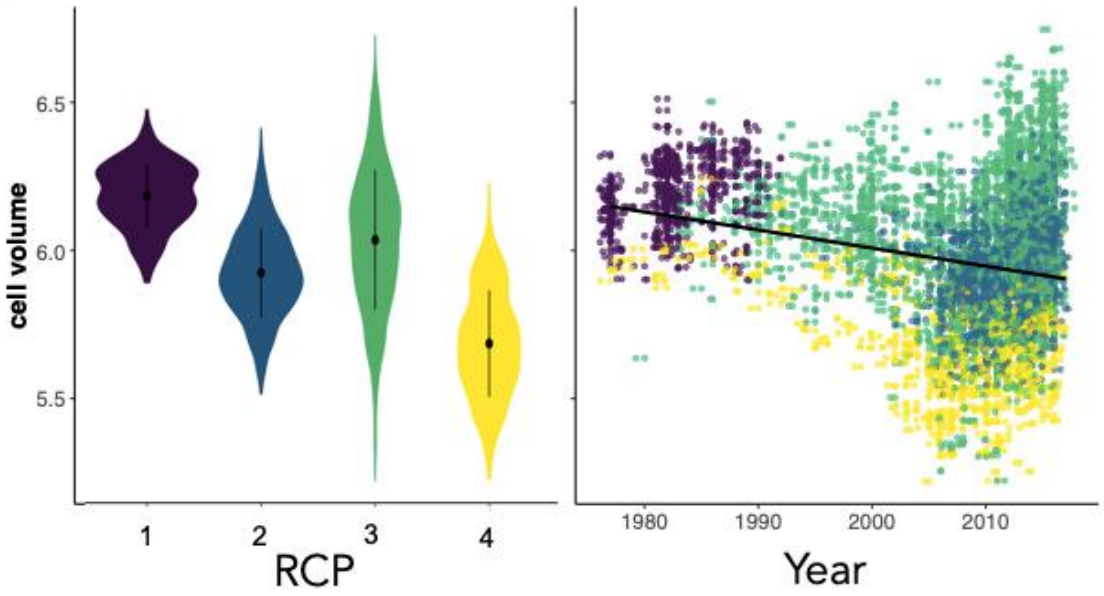
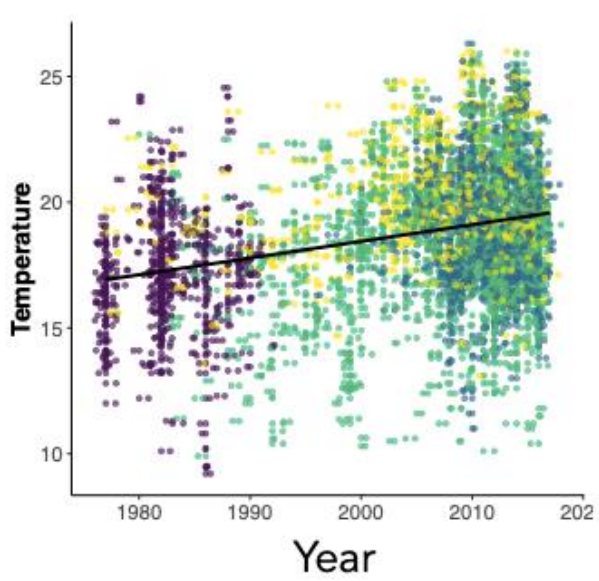
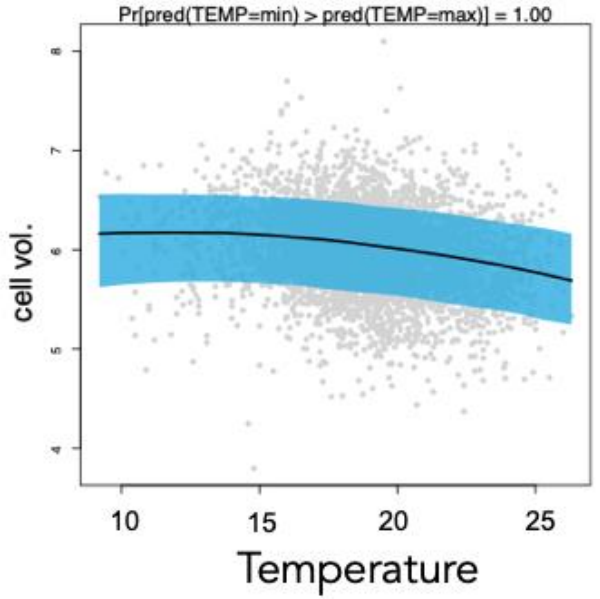


Decreasing size with increasing temperature

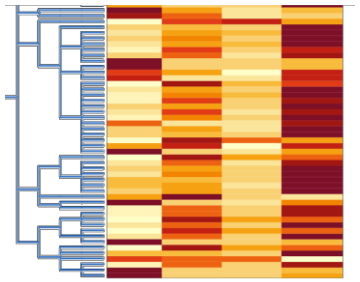




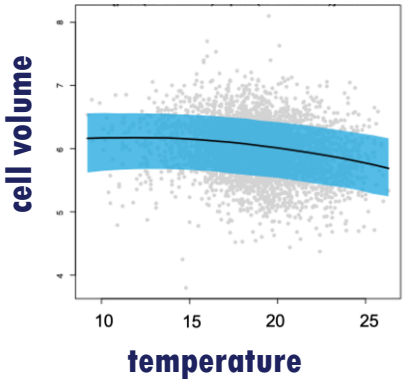


Conclusions

Nationwide restructuring of community types, displaying altered trait profiles



Higher prevalence of cyanobacterial species



Smaller phytoplankton size structure linked to higher temperatures

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Future direction/ ongoing work

Global & national drivers

RCPs
Downscaled Climate scenarios
Time: 2020-2100

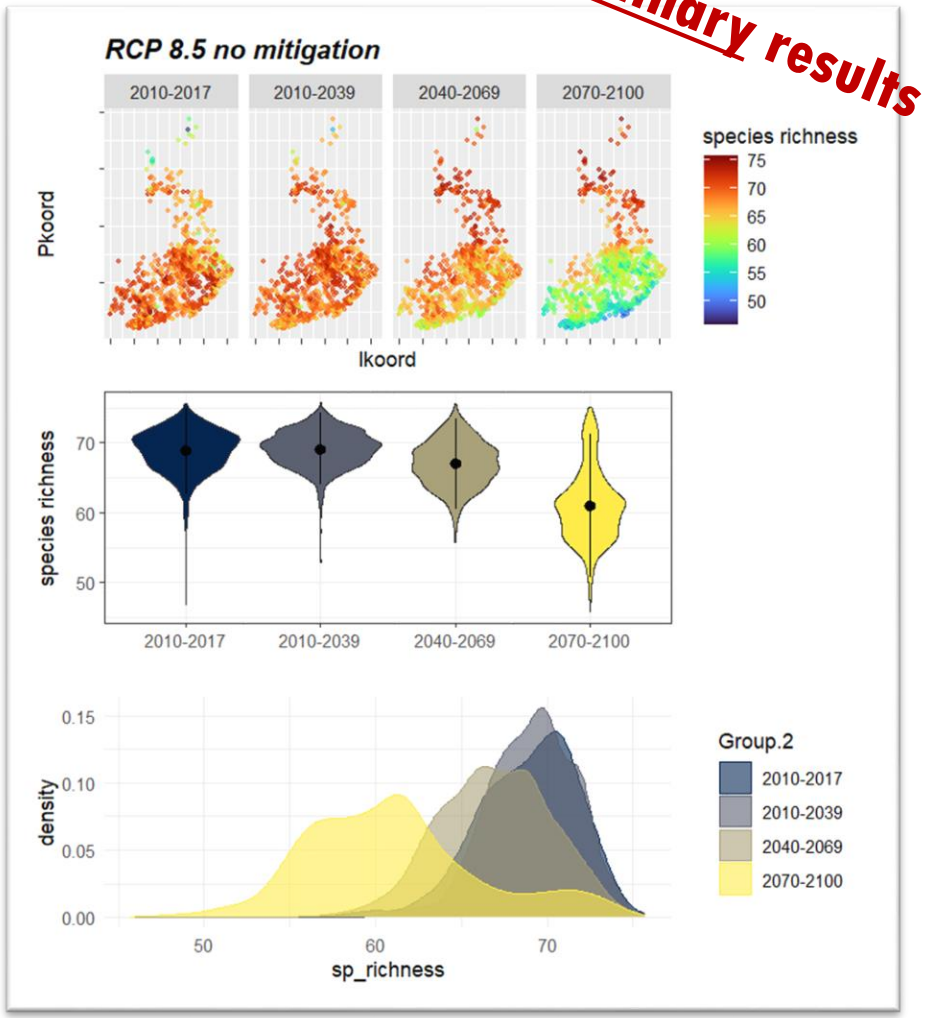
Nutrient leaching & loads entering aquatic ecosystem

VEMALA-model
All nutrient loads from land, waste water treatment and industrial outlets

Ecological outcomes

HMSC
Joint Species Distribution Model

preliminary results



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Thank you for your attention

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Acknowledgements

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