Nitrogen in Estonian lakes – the trends and impacts on Cyanobacteria

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TREIC LAKE

Introduction

- The relative role of N&P to control eutrophication in lakes is continuously debated (*Schindler et al. 2008*).
- Estonian limnologists have been P-believers as the post-socialist sharp reduction of N loading brought back cyanobacterial blooms in Lake Peipsi (*Nõges et al. 2005*)
- The long debate has not discredited the importance of P-Control, but displayed evidence on the significance of N reduction to recover lake ecosystems (*Paerl et al. 2016*)
- Chemically reduced N forms, such as NH_4^+ and urea favour non-N-fixing cyanobacteria (*McCarthy et al. 2009*)

In this presentation

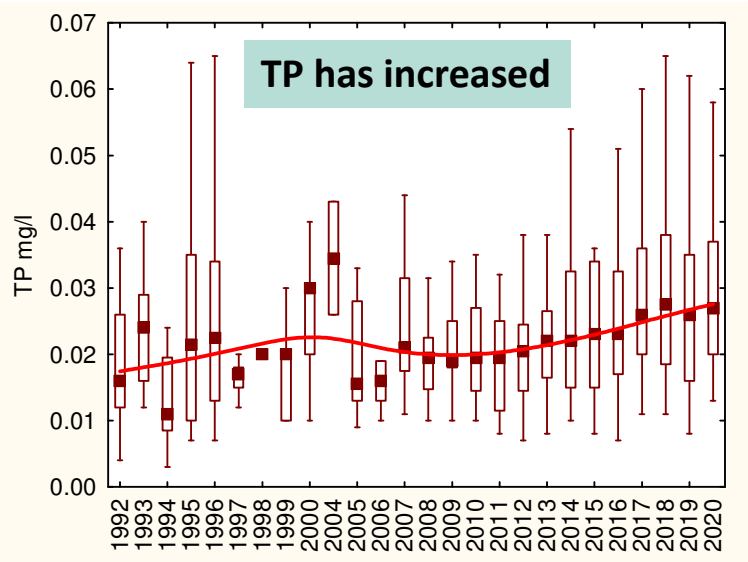
- we show N and P trends in 15 Estonian lakes and
- analyse the connections of N-forms with cyanobacteria.

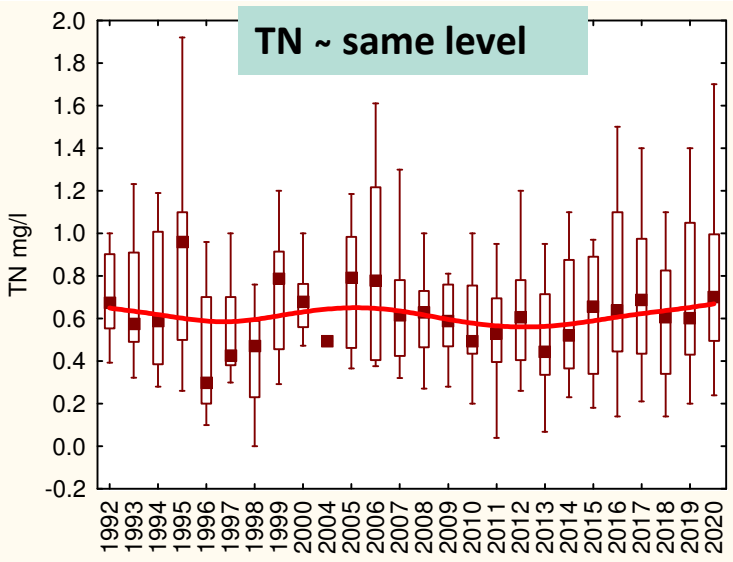
We hypothesized that

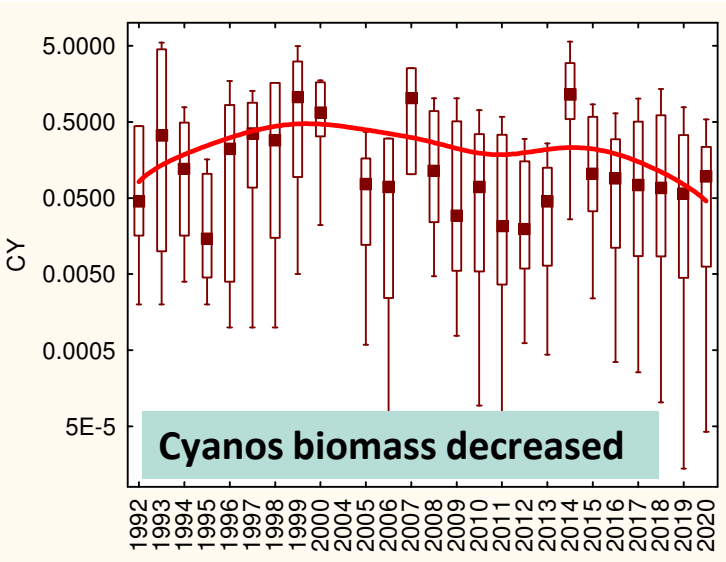
- both N and P have increased in recent decades due to the intensification of the agriculture
- it has stimulated phytoplankton development, including cyanobacteria.

References

- *McCarthy et al. 2009. Nutrient ratios and phytoplankton community structure in the large, shallow, eutrophic, subtropical Lakes Okeechobee and Taihu. Limnology 10, 215–227.*
- *Nõges et al. 2005. Is the destabilisation of Lake Peipsi ecosystem caused by increased phosphorus loading or decreased nitrogen loading? Water Sci. Tech., 2005, 51, 3-4: 267-274.*
- *Paerl et al. 2016. It takes two to tango: When and where dual nutrient (N & P) reductions are needed to protect lakes and downstream ecosystems. Env. Sci. Technol., 50, 10805-10813.*
- *Schindler et al. 2008. Eutrophication of lakes cannot be controlled by reducing nitrogen input: results of a 37-year whole-ecosystem experiment. PNAS, 105, 11254-11258.*



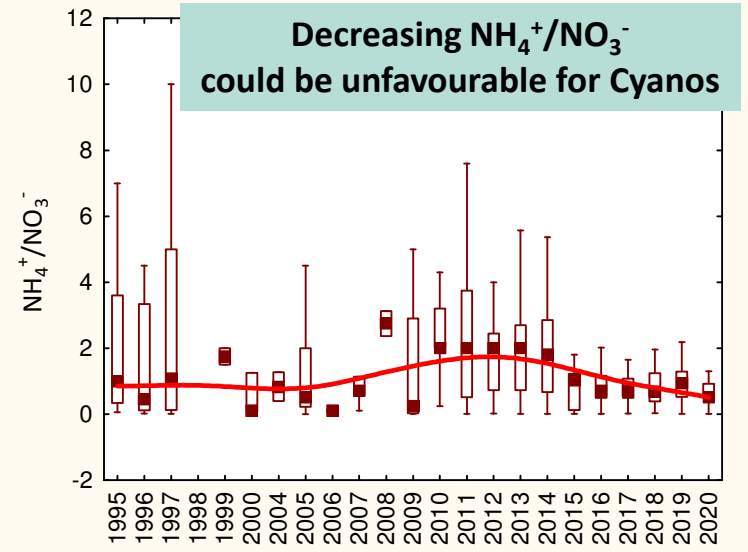


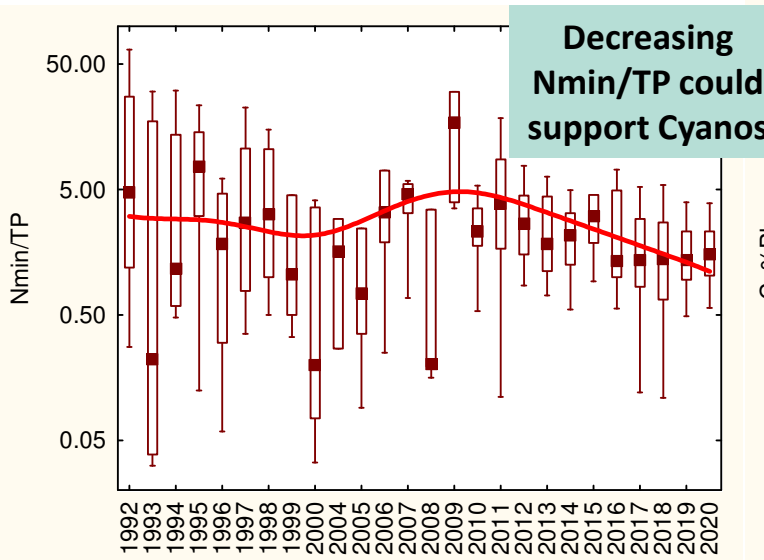


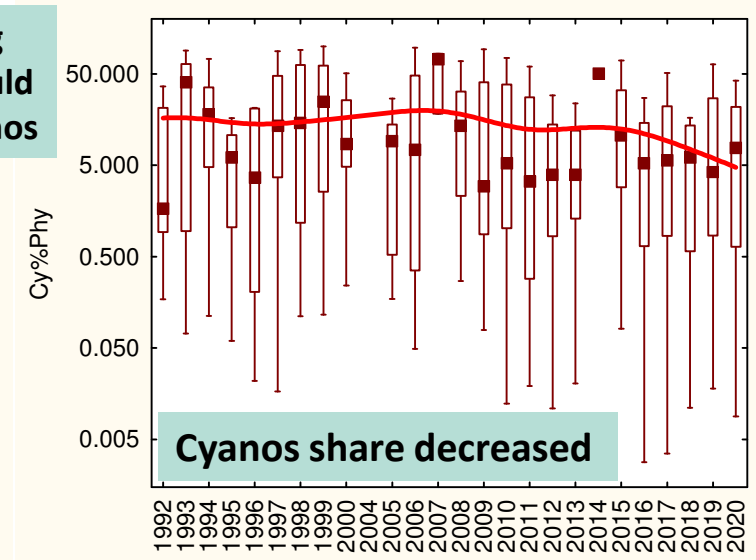
Median
25%-75%
Non-Outlier Range

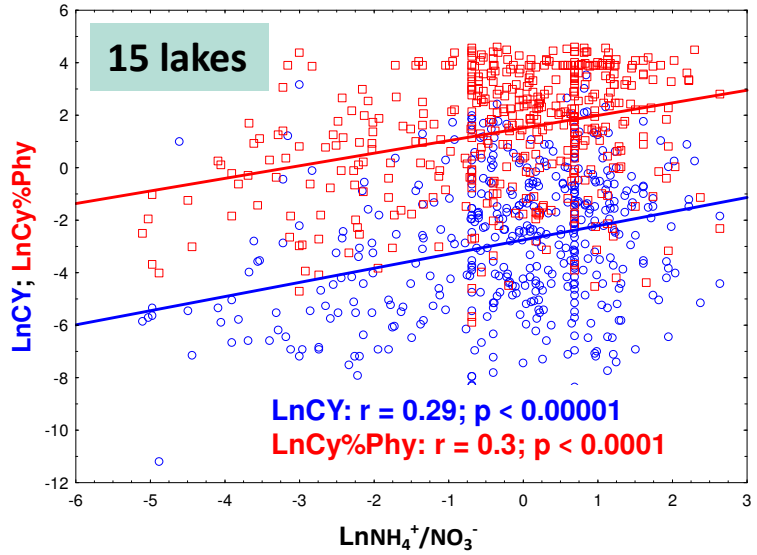
In the surface layer of 15 Estonian lakes, total P (TP) has increased, mineral N to TP (Nmin/TP) and NH_4^+/NO_3^- decreased in last decade

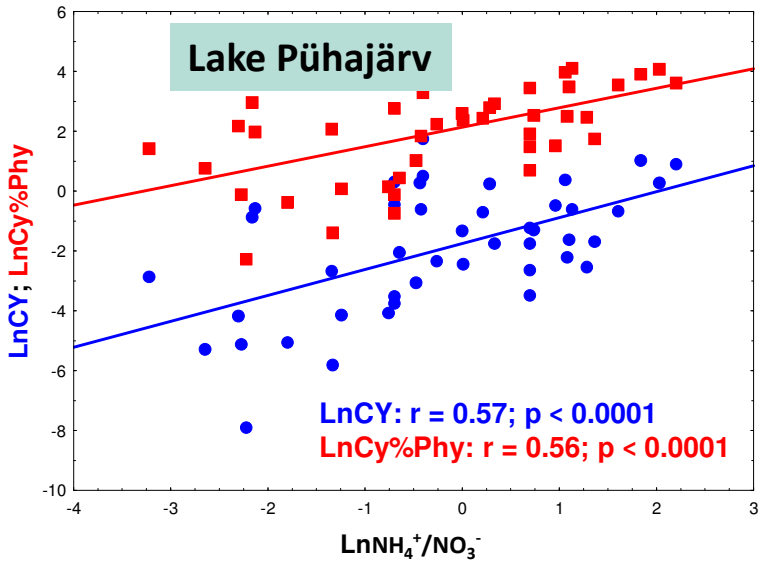
Biomass (CY) and share of Cyanos in phytoplankton biomass (Cy%Phy) decreased



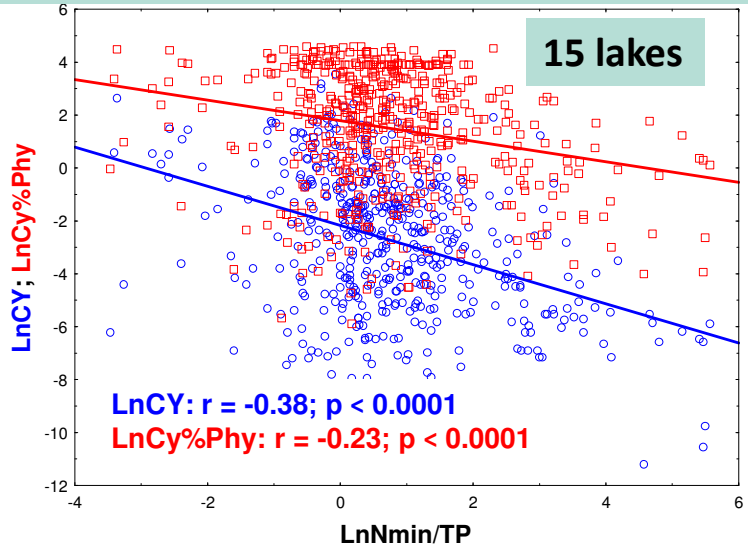


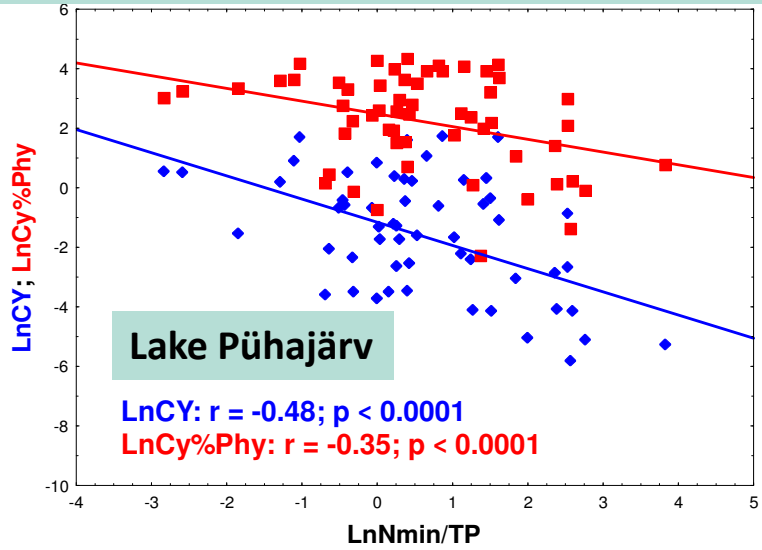


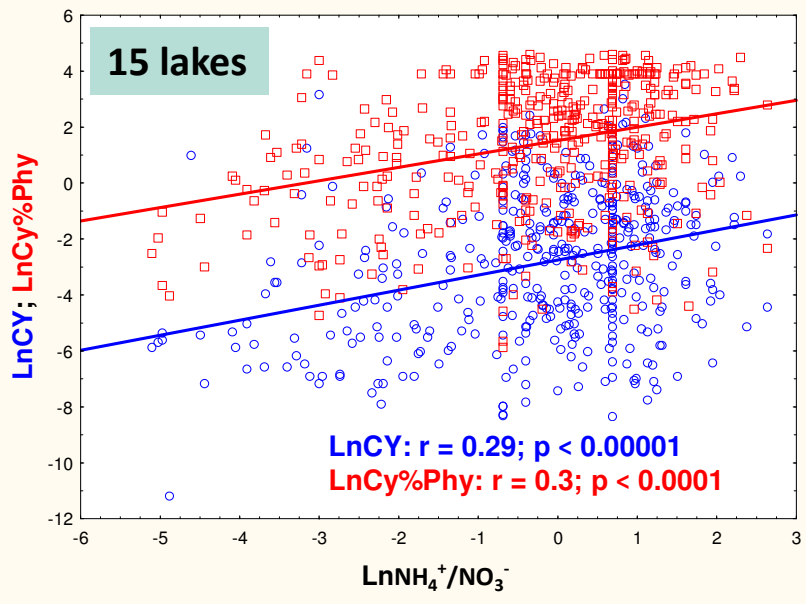


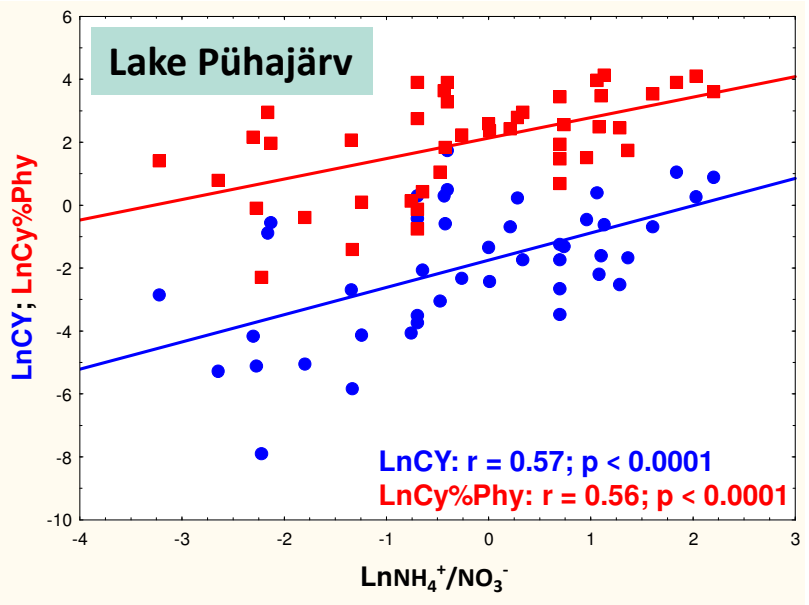


Biomass and share of Cyanos in phytoplankton biomass was positively correlated to NH_4^+/NO_3^- and negatively to Nmin/TP in all 15 lakes and more strongly in some individual lakes









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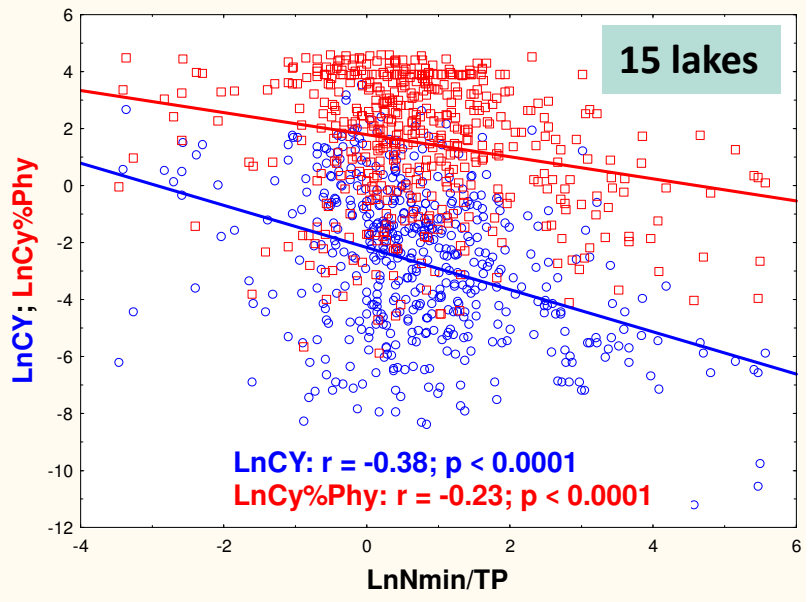
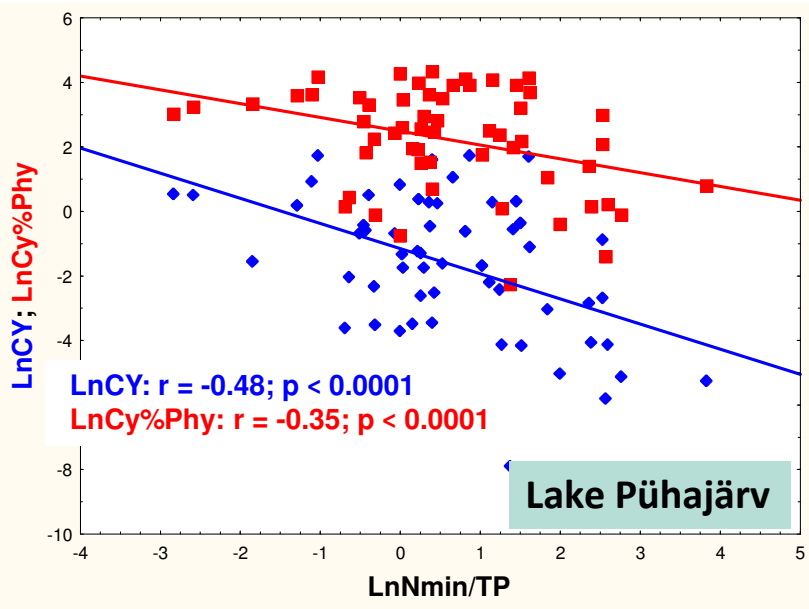
*Take home message





- **Stronger N-limitation (reduced Nmin/TP) in recent years could have enhanced Cyanobacteria in Estonian lakes**

BUT

- **biomass and share of Cyanobacteria has not increased as lower contribution of reduced N (lower NH_4^+/NO_3^-) has worsened the conditions for Cyanobacteria**