Pyhäjärven suojeluohjelma
30 vuotta vesiensuojelua

Euroopan unionin osarahoittama

Pyhäjärvi-instituutti

Puhdas vesi, paremmat eväät

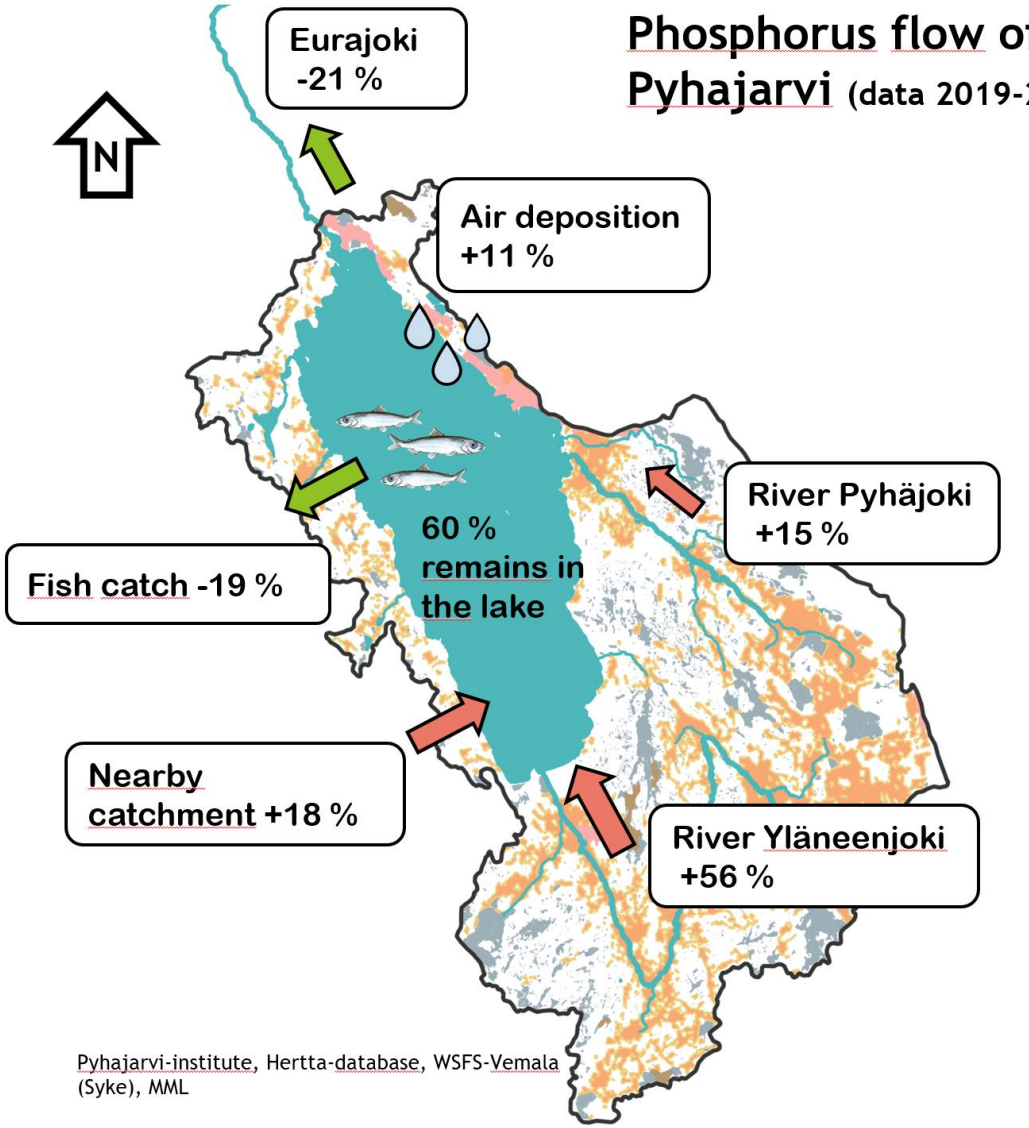
Perspective on the impacts of climate change – experiences from Lake Pyhäjärvi southwest Finland



Kallavesimalli-webinaari 30.9.2026

Lauri Anttila
Pyhäjärvi-instituutti

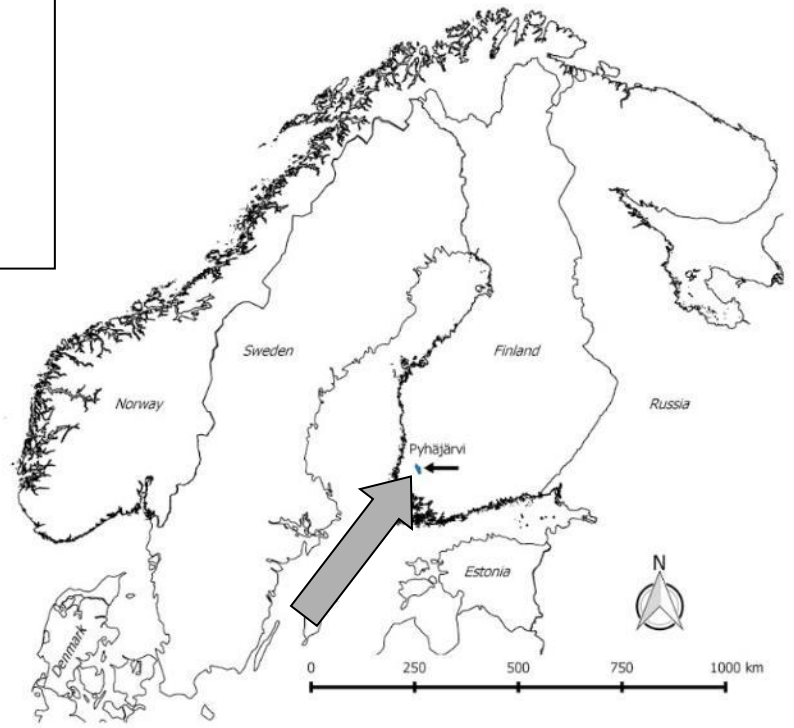
Phosphorus flow of lake Pyhajarvi (data 2019-2023)



Pyhajarvi-institute, Hertta-database, WSFS-Vemala (Syke), MML

Säkylän Pyhäjärvi

Surface area 155 km^2
Mean depth 5.4 m
Maximum depth 26 m
Coastline 80 km (47.71 mile)
Water residence time 3-5 y
Moderate ecological status

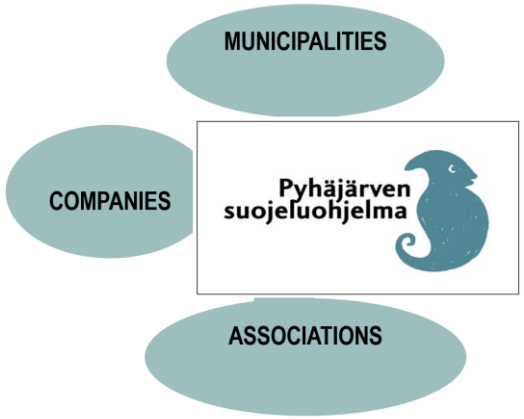


Drainage basin area

Total 615 km^2
River Yläneenjoki 23,400 ha
River Pyhäjoki 7,750 ha
Remaining area (small sub-basins) 14,950 ha

PYHÄJÄRVI PROTECTION FUND

Basic funding + project funding
(150 000 € / year)



The entire catchment of Lake Pyhäjärvi have been under voluntary water protection funding since 1995

Increasing winter time runoff, rising temperatures, shortenin ice-cover period…

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February 2020



November 2024



January 2025



July 2021

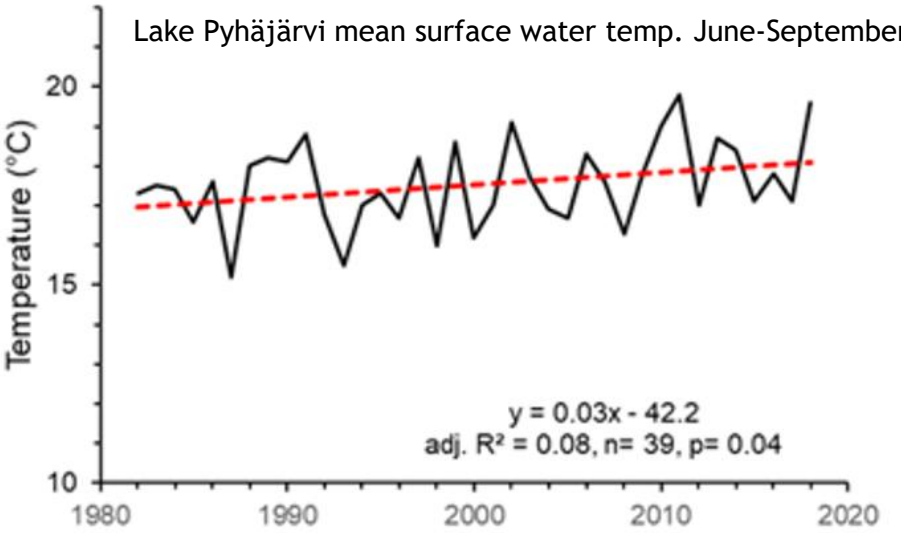
Kalakuolemat

Säkylän Pyhäjärven kiiskien joukkokuolemaan löytyi ainakin kolme syytä – helteillä rannoille ajautui massoittain kalanraatoja

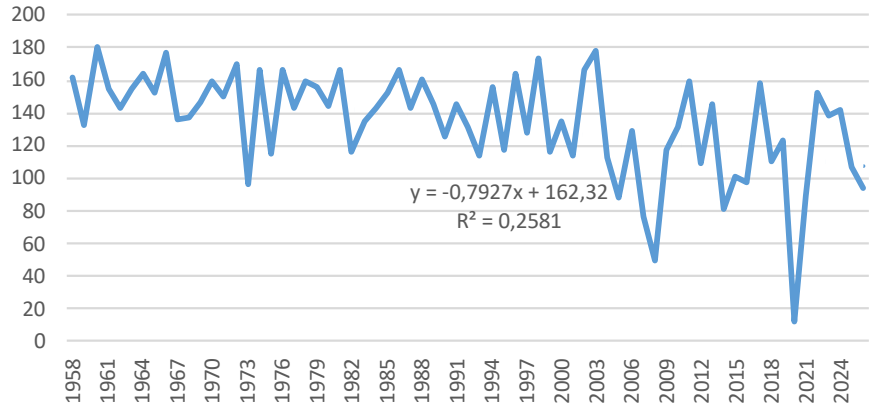
Tutkimuksissa on varmistunut, että monen tekijän summa koitui kalojen kohtaloksi. Ruokaviraston tutkimuksissa kiiskistä löytyi bakteerien aiheuttamaa tulehdusta ja sisäloisia. Kalat olivat myös kärsineet hapenpuutteesta.

Sarvala et al. 2024

Lake Pyhäjärvi mean surface water temp. June-September



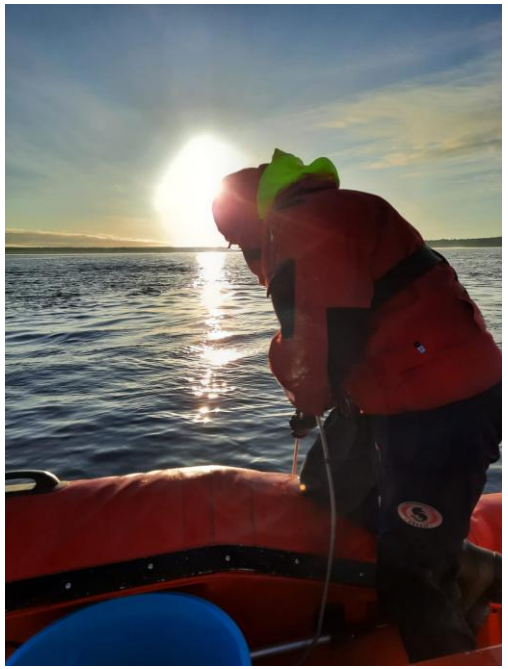
Lake Pyhäjärvi duration of ice-cover period
1985-2026 Säkylän Pyhäjärvi



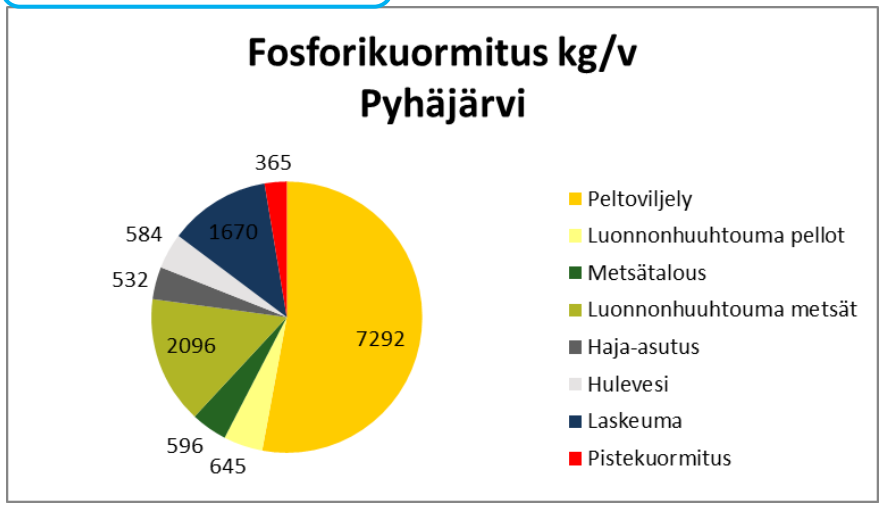
Data: Pyhajarvi institute

Changing Pyhäjärvi: modeled near future

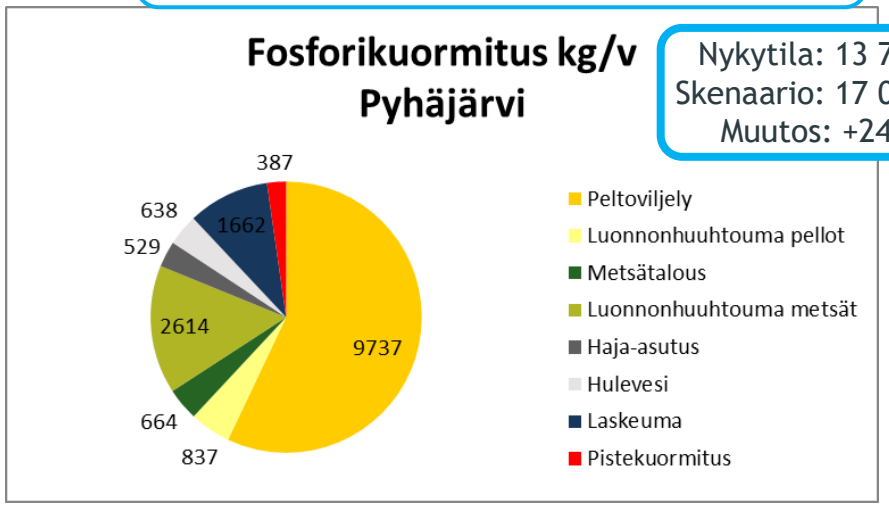
Pyhäjärvi, phosphorus & solids



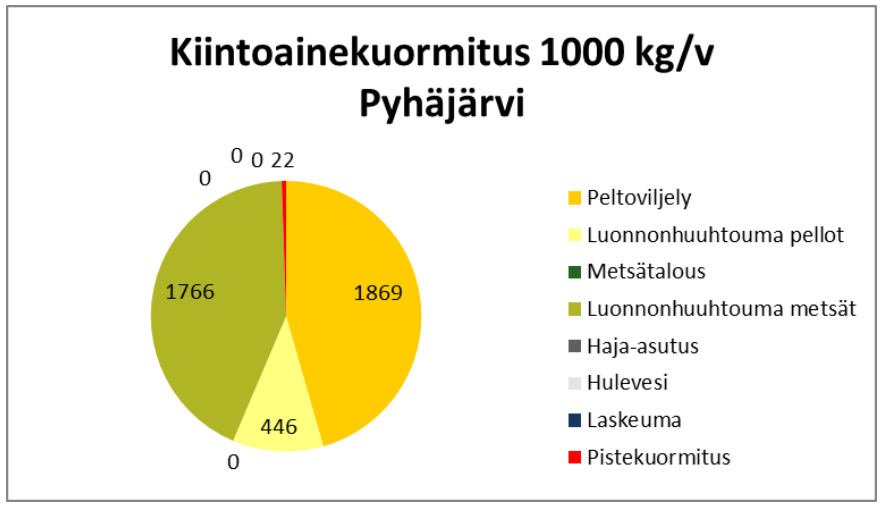
Current

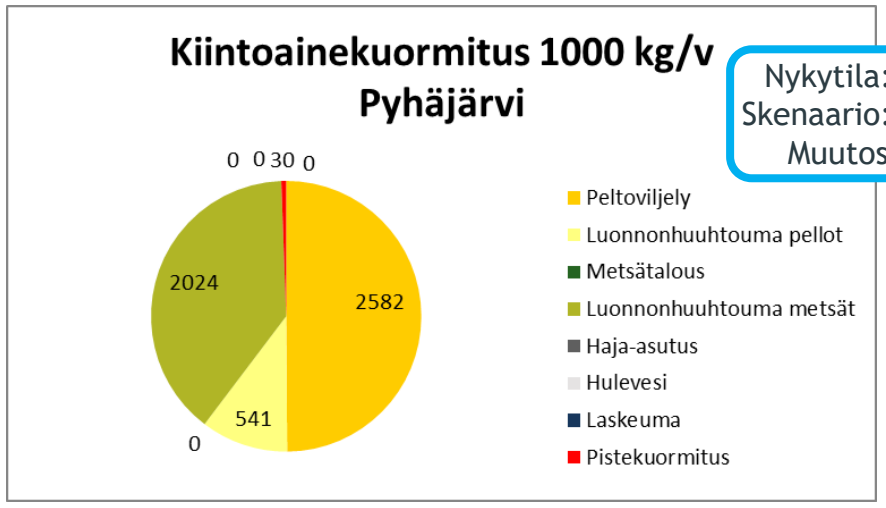


Climate change Had-SMHI + current methods



Nykytila: 13 779 kg
Skenaario: 17 068 kg
Muutos: +24 %





Nykytila: 4 357 tn
Skenaario: 5 177 tn
Muutos: +19 %

Lähde: WSFS-Vemala (sVemala)/Syke 11/2025

VESIVARA
virteaamaskenaariot
juoma- ja talousvesi
tiedifsuus
ekosysteemipalvelut

Euroopan unionin osarahoittama

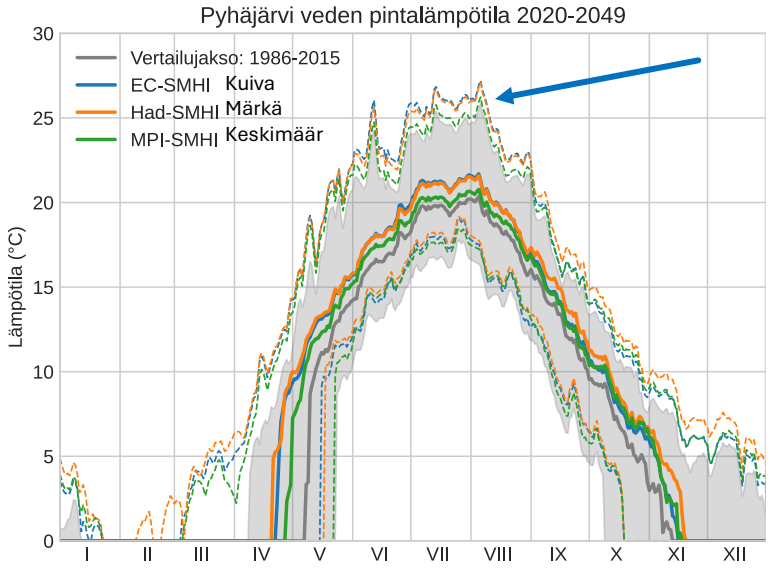
Changing Pyhäjärvi: modeled near future

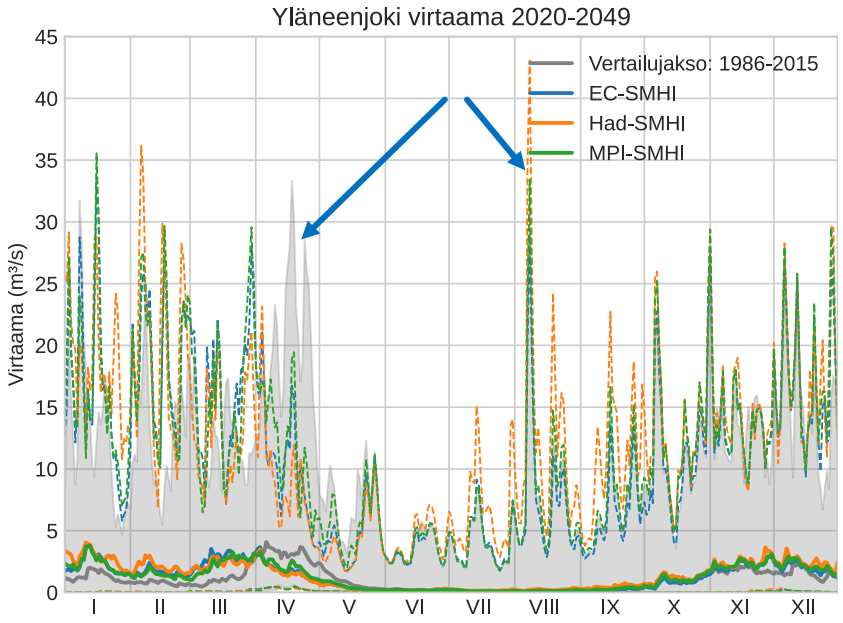
Suomen ympäristökeskus
Finlands miljöcentral
Finnish Environment Institute

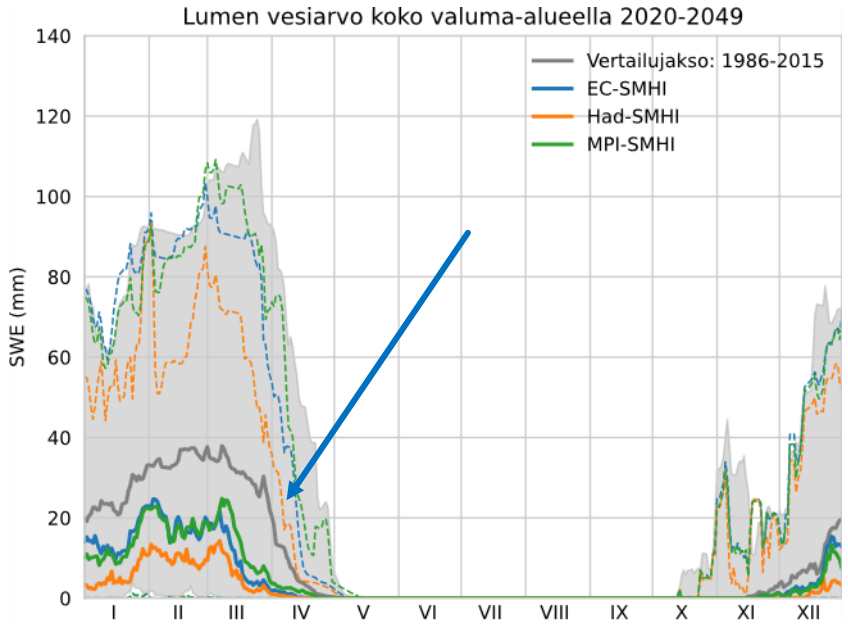
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osarahoittama

Lake Pyhäjärvi and river Yläneenjoki

Discharge winter ↑ and spring↓. The spring flood peak is occurring earlier. Annual flood peaks can occur at any time; caused by heavy rain in summer, and by melting snow + rain in winter. The highest flood peaks are comparable to those of the reference period. The duration of the open-water season is increasing, and average and maximum water temperatures are rising.





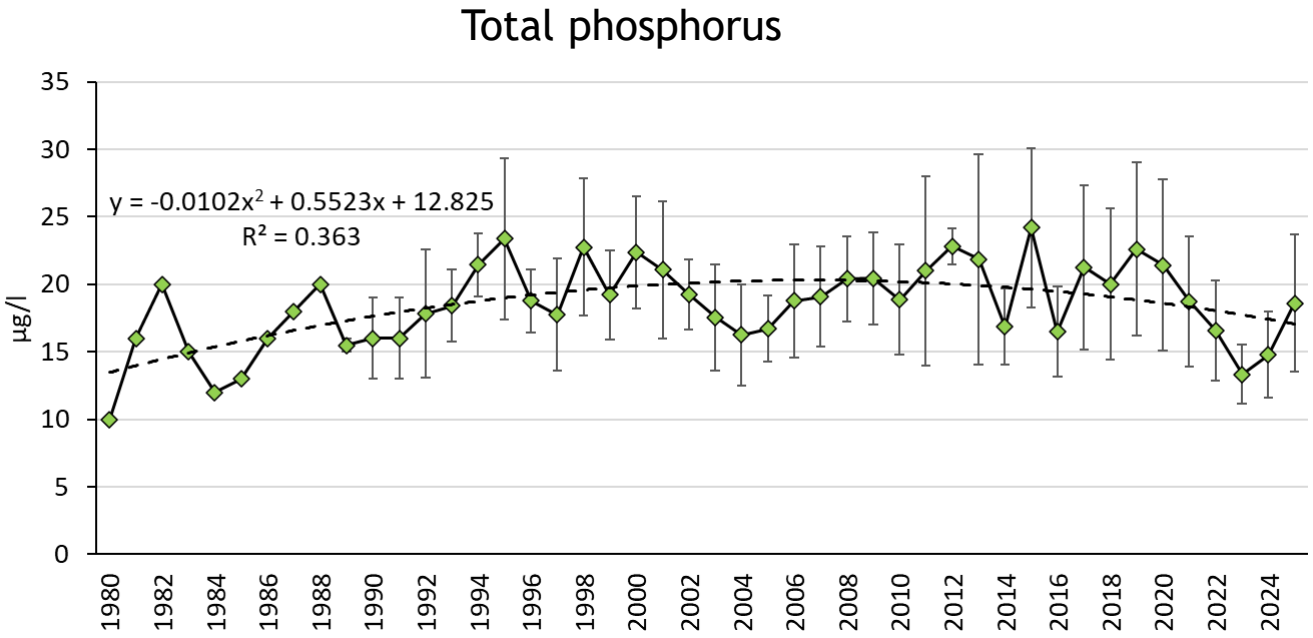




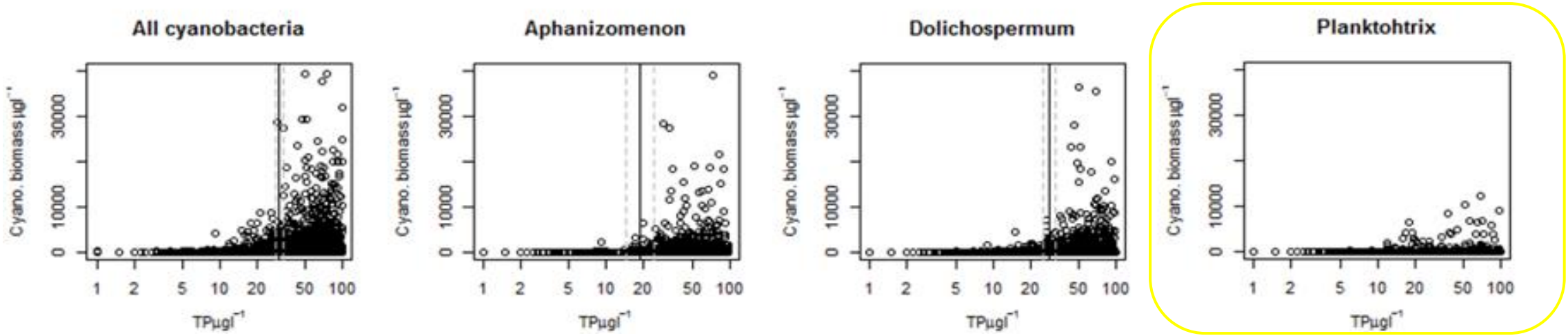
How might the lake react to increasingphosphorus concentrations?

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- Nutrient concentrations in Lake Pyhäjärvi are close to the threshold where the probability of blue-green algal blooms increases.

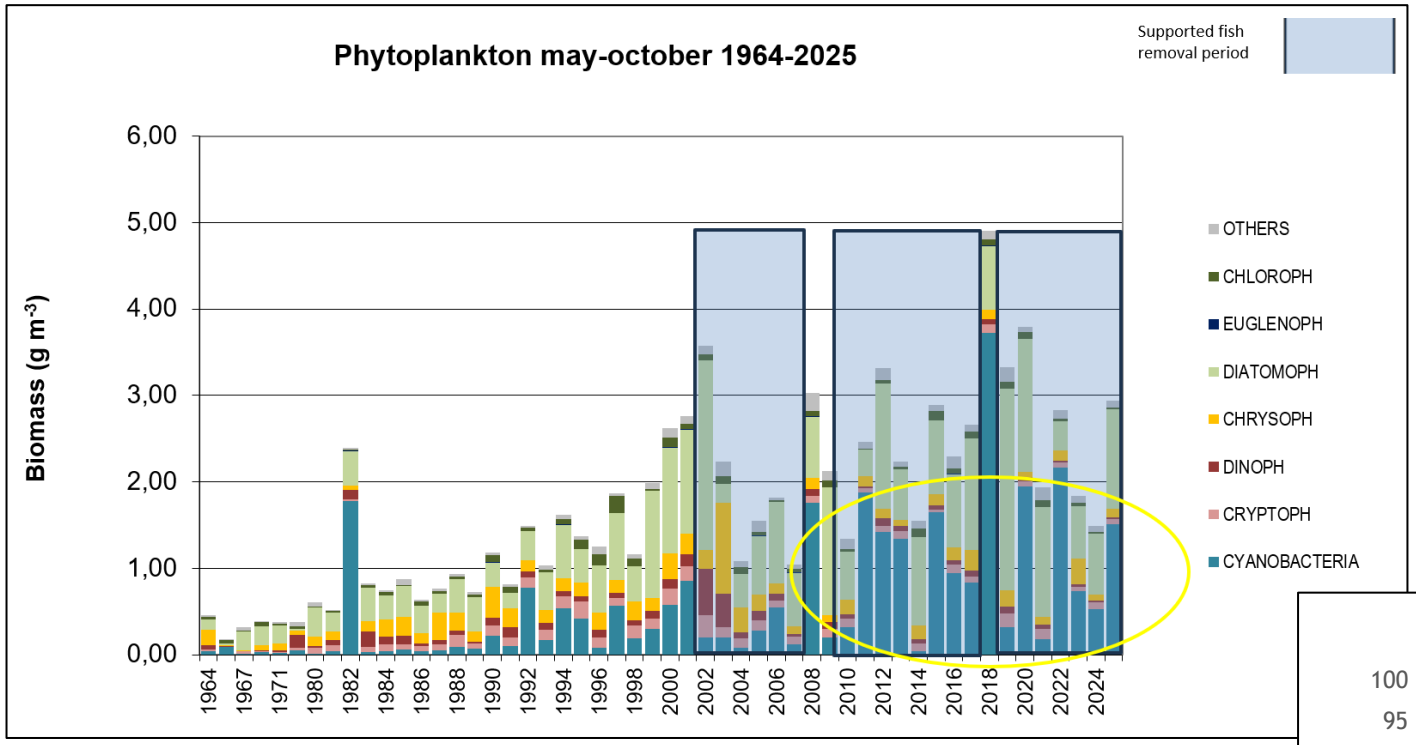


Vuorio et al. 2020



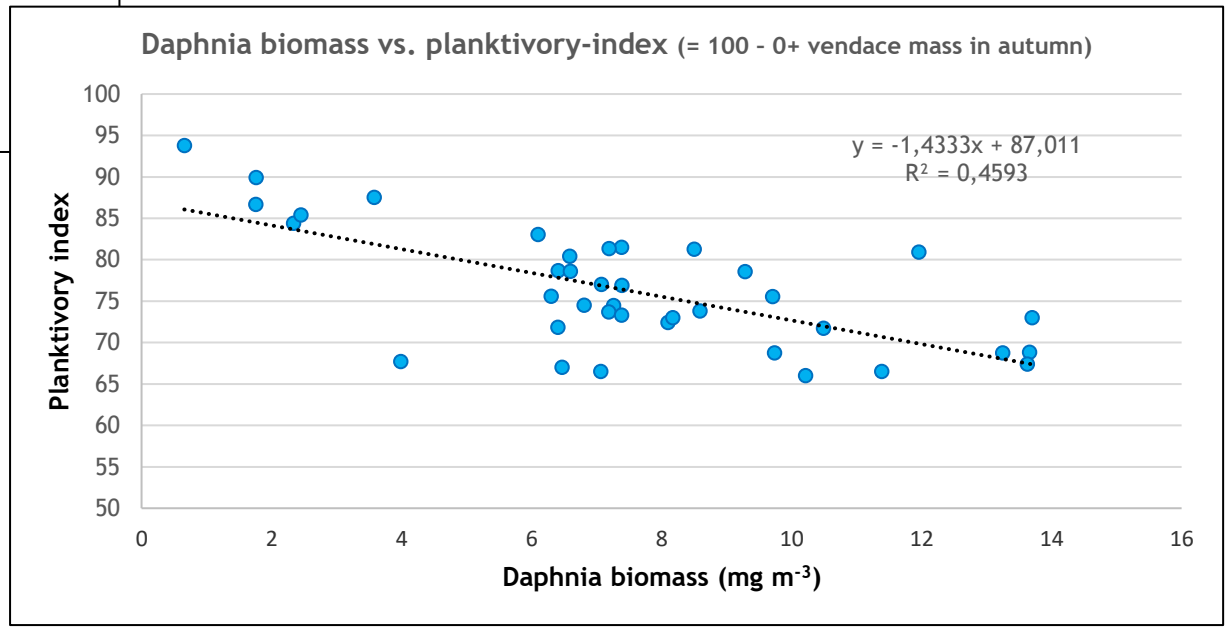
Changing phytoplankton structure and food web regulation

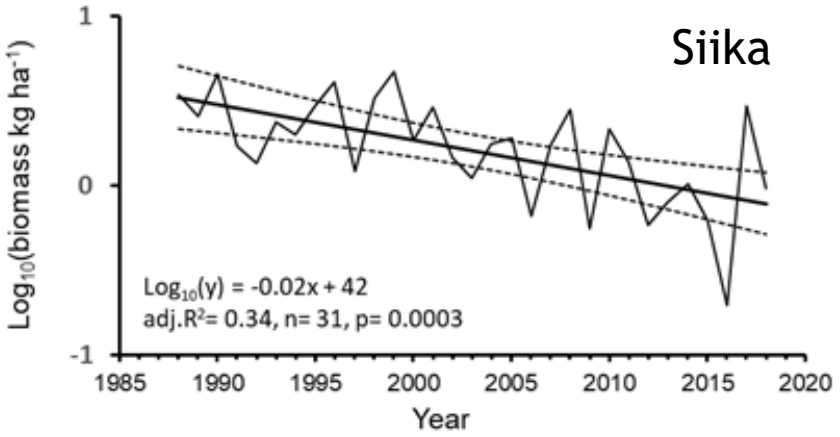
Pyhäjärvi-instituutti
Puhdas vesi, paremmat eväät

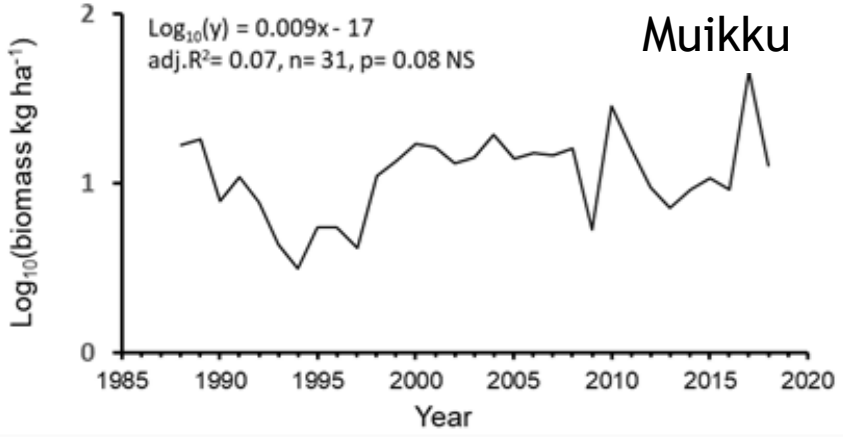


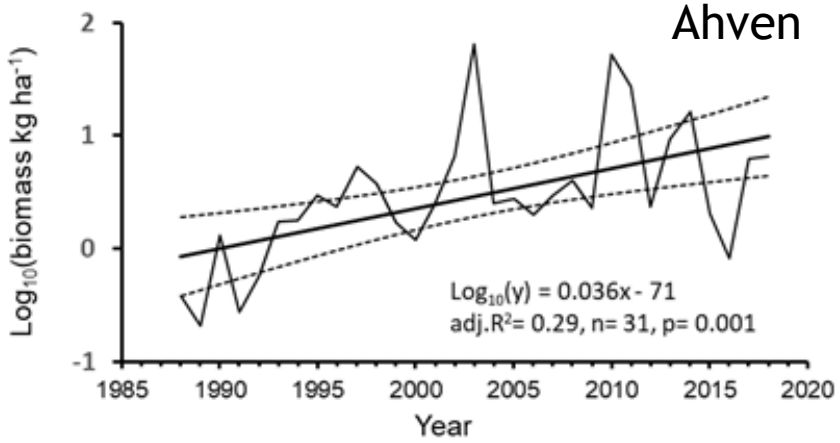
The increase in phytoplankton biomass in Lake Pyhäjärvi was explained by nutrient levels until the 1990s, and by temperature, wind, ice cover, and other climate-related variables in the 2000s. (Deng et al. 2016)

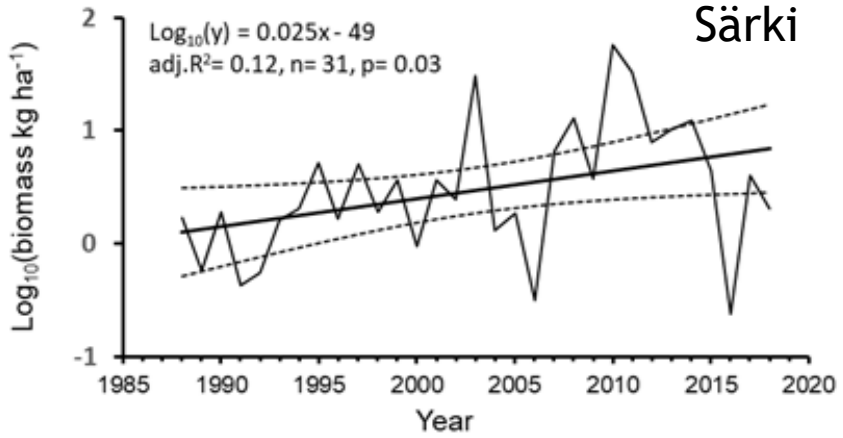
Environmental pressures increase algal biomass growth →The role of food web regulation is significant from the perspective of water quality
→ Rising biomasses and poor nutritional quality of filamentous cyanobacteria can reduce efficiency in some cases.

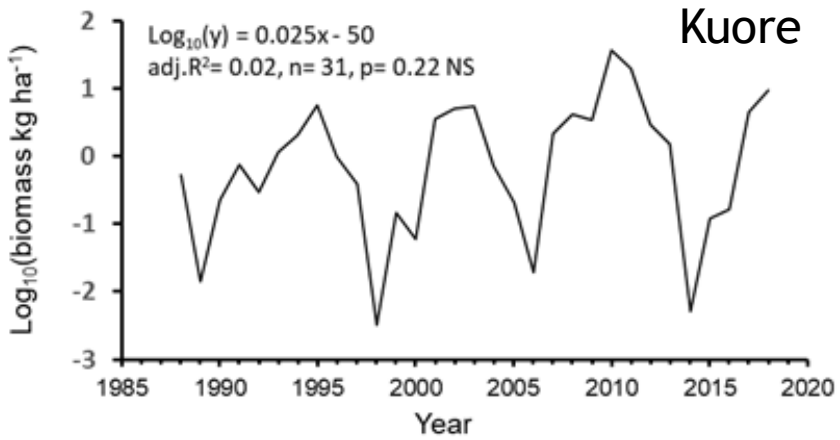


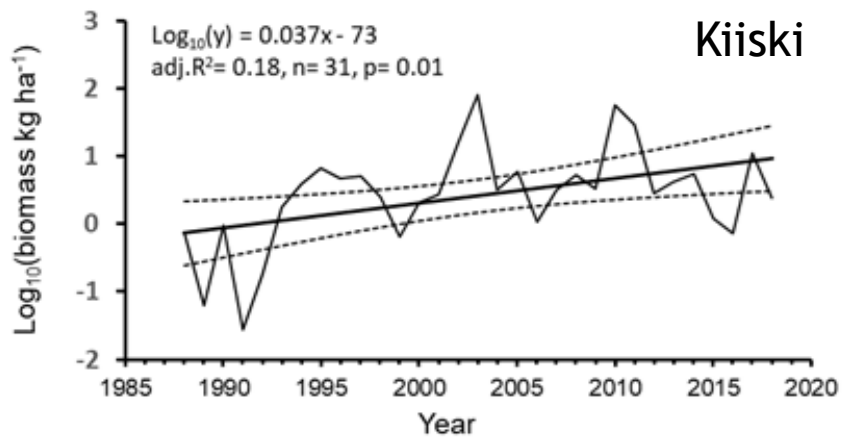












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Changing fish community

- Estimated population biomasses in autumns 1988–2018 (Sarvala et al. 2024)
  - Salmonids ↓
  - Cyprinids and percids ↑

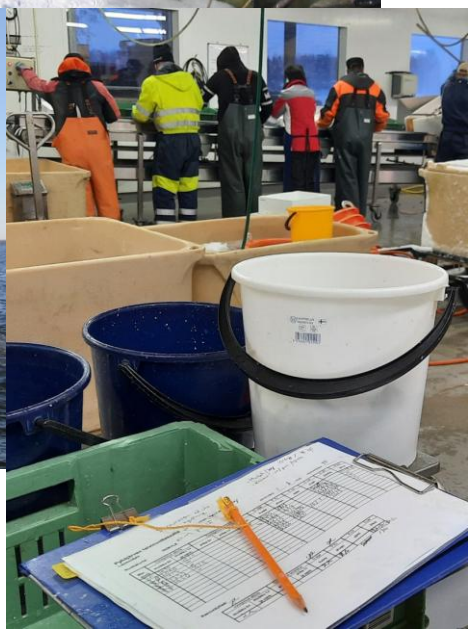
Challenges in fish community estimations

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- Nordic multimesh gillnet underestimates the abundance of vendace and pike, which are important from the perspective of water management.
- Winter seine fishing was long-time the most significant form of fishing on Lake Pyhäjärvi. The catch provided a good picture of the fish stock structure.
  - → Shortening winters and decline in the number of fishermen → only one winter seine-fishing crew still active → sparse data







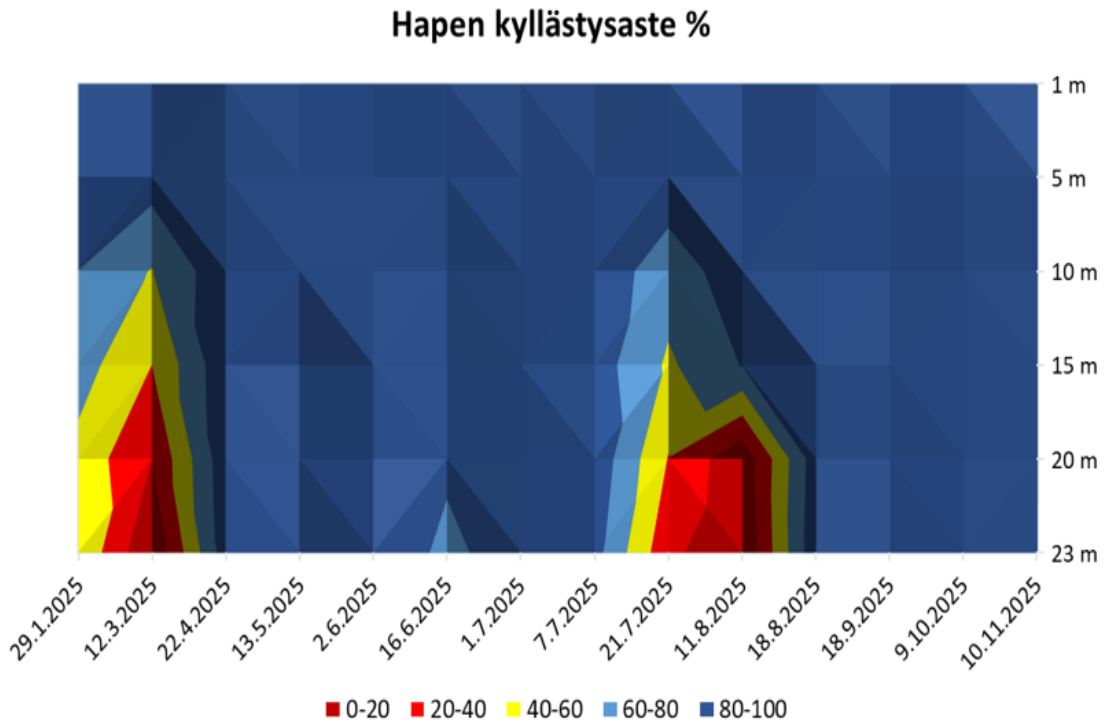
- → New methods have been considered and tested, but (…like fish stock assessment always) there are many challenges and uncertainties
  - → Echo sounding not very usefull (because Pyhäjärvi is quite shallow)
  - → Commercial open-water fishing too selective for the creating large-scale picture of all key species
  - → Many method too expensive to yearly use

The effects of climate change on lake ecosystems are still mostly mystery

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Some interesting questions regarding Lake Pyhäjärvi:

- Internal loading in winter period
  - (shorter ice-cover period → shorter anoxic period in deep areas vs. wind-induced turbulence)
- Impacts for autumn spawning salmonids
  - Ice-cover, temperatures in spawning period, hatching and food availibility in spring
- Reducing of summer time discharge → some years only minor loading in summer → reduce summer-time algal blooming?
- Changes in thermal stratification → impacts for internal load and availability of nutrient during heatwave



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References:

- Sarvala, J., Helminen, H., Karjalainen, J., Marjomäki, T. J., Forsman, T., & Anttila, L. (2024). Long-term decline of whitefish (Coregonus lavaretus) population in the boreal lake Pyhäjärvi, southwest Finland, relative to simultaneous abiotic and biotic changes. *International Journal of Limnology*, *60*, 16.
- Deng, J., Qin, B., Sarvala, J., Salmaso, N., Zhu, G., Ventelä, A. M., ... & Vuorio, K. (2016). Phytoplankton assemblages respond differently to climate warming and eutrophication: a case study from Pyhäjärvi and Taihu. *Journal of Great Lakes Research*, *42*(2), 386-396.
- Vuorio, K., Järvinen, M., & Kotamäki, N. (2020). Phosphorus thresholds for bloom-forming cyanobacterial taxa in boreal lakes. Hydrobiologia, 847(21), 4389-4400.



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Thank you!

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