ICP Waters

International Cooperative Programme on Assessment and Monitoring Effects of Air Pollution on Rivers and Lakes

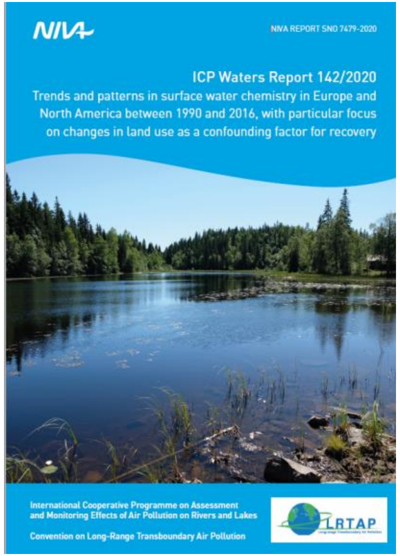
Status report ICP Waters

- Recent, ongoing, planned activities
- Work plan 2022-2023
- Task Force meeting 2021

Kari Austnes 21.04.2021

Recent and ongoing reports

- ICP Waters report 142/2020: Trends in surface water chemistry
- Ongoing: Nitrogen – trends and biological responses
- Planned for 2022: Biological responses to recovery



2020-2021 Nitrogen report

1 Trends and spatial patterns

ICP waters database

Spatial variation in nitrate trends

Trends in organic nitrogen and C/N ratio of organic matter

Spatial patterns in concentration levels and N retention capacity

2 Biological responses to N

Analysis of existing datasets

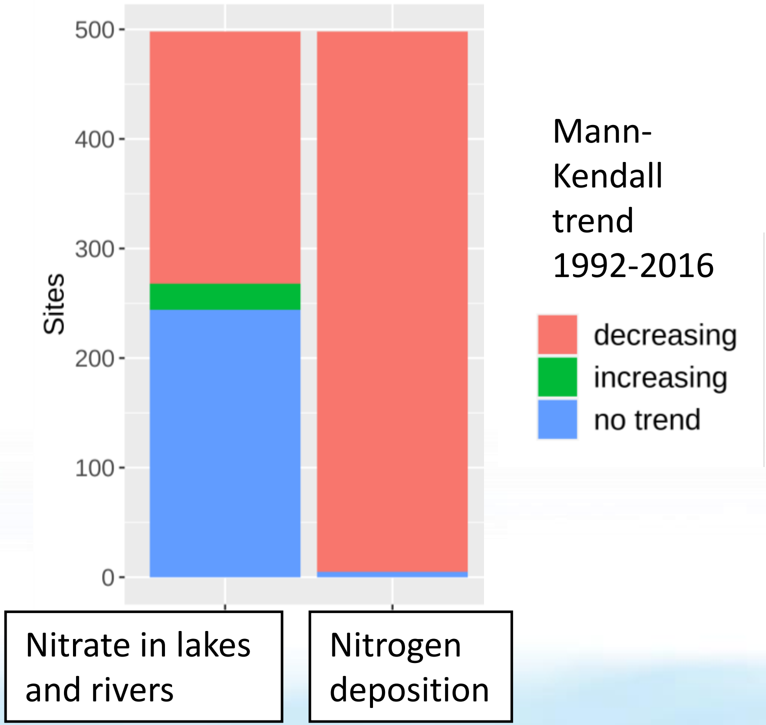
- Nordic lake dataset
- Norwegian reference rivers

Literature review

- Update of ICP Waters report 101/2010: Nutrient enrichment effects of atmospheric N deposition on biology in oligotrophic surface waters - a review

Basis for contributions to the revision of the empirical critical loads

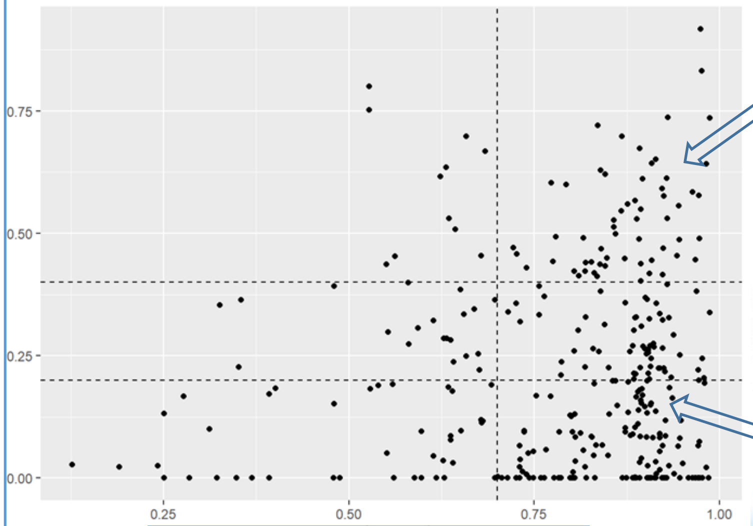
Nitrogen trends



- Nitrogen deposition declines significantly
- Nitrate in surface waters does not show a simple response to deposition
    - Explained by different climate, land cover and different N deposition history?

What separates sites with little/strong effect of N deposition on NO_3 trends?

R^2 of GAMM models per site



Relationship NO_3 conc and N dep (R^2)

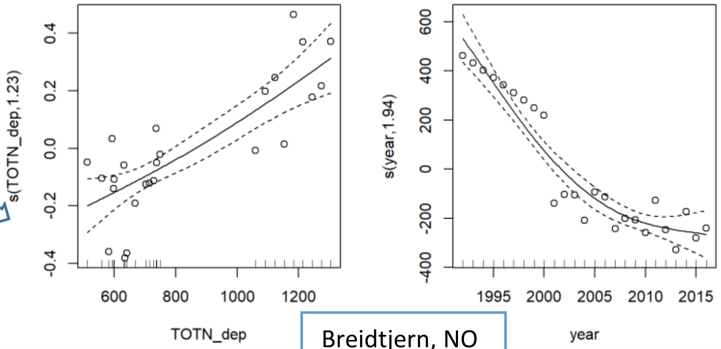
Trend in N deposition (R^2)

Strong time trend in dep and strong effect of dep on NO_3

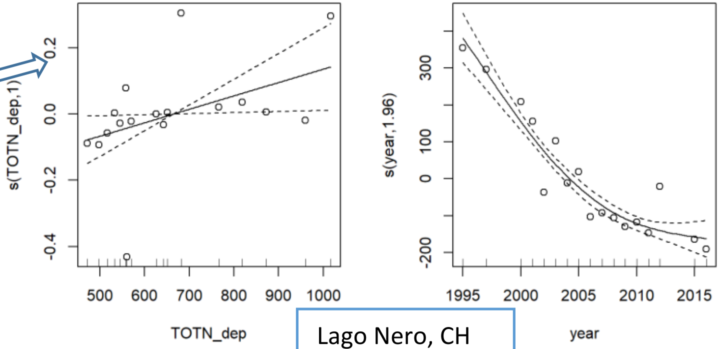
Strong time trend in dep but small effect of dep on NO_3

NO_3 vs N dep

Dep vs time



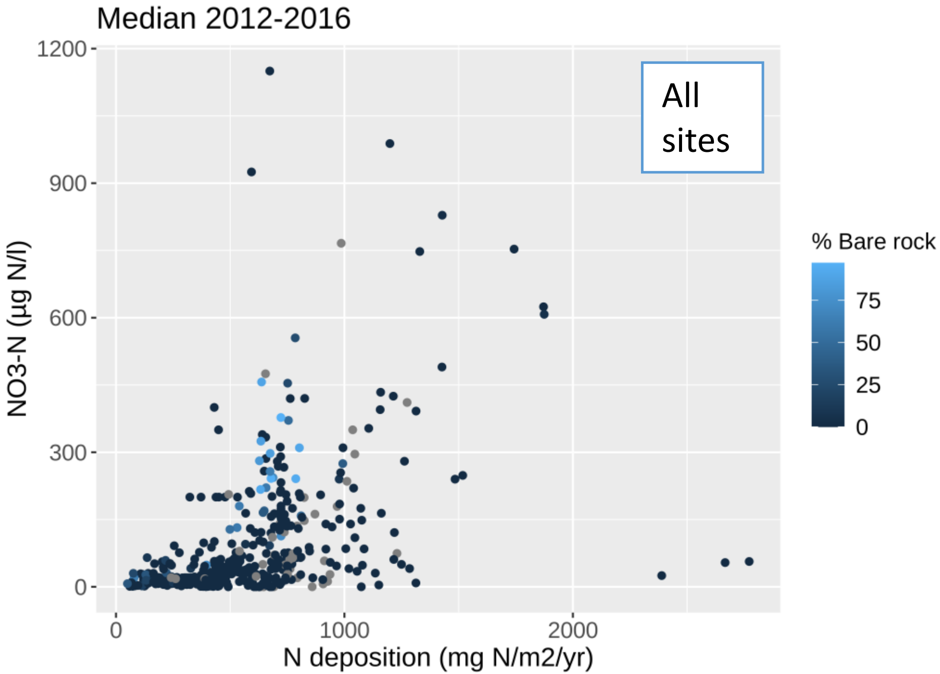
Breidtjern, NO

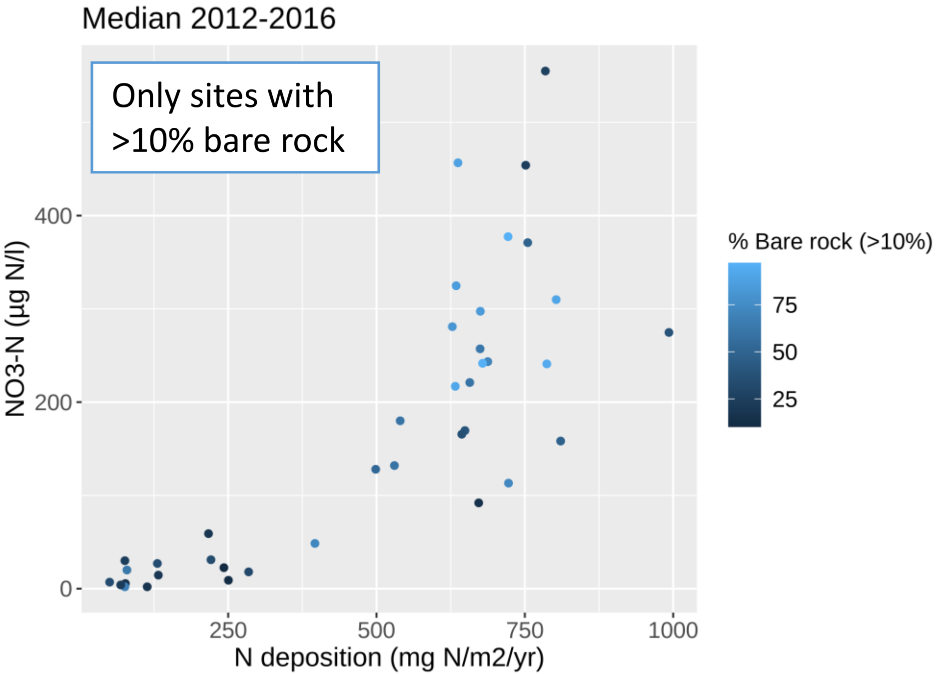


Lago Nero, CH

Lower N retention in mountainous sites

ICP waters sites cover a wide range in catchment characteristics (mountaint, forest, peatlands)



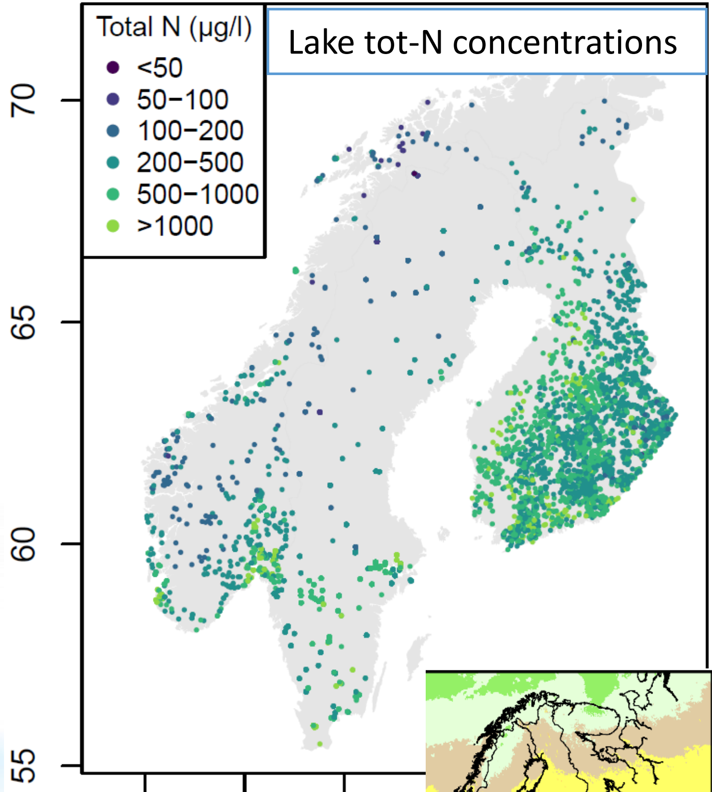


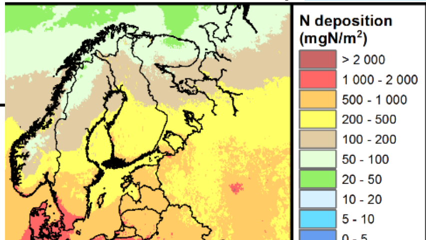
Trends – summary and way forward

- Trends
  - NO_3 mainly decreasing trends where significant
  - No clear indication of enrichment of soil N pools from TOC/TON
- Spatial
  - Tendency towards higher NO_3 in sites with high N deposition and potentially low N retention
  - TOC/TON related to land cover, but may also reflect N enrichment
- Further analyses planned
  - Different statistical approaches and time periods
  - Inclusion of most recent water chemistry data (data call 2020)

Does nitrogen affect freshwater productivity?

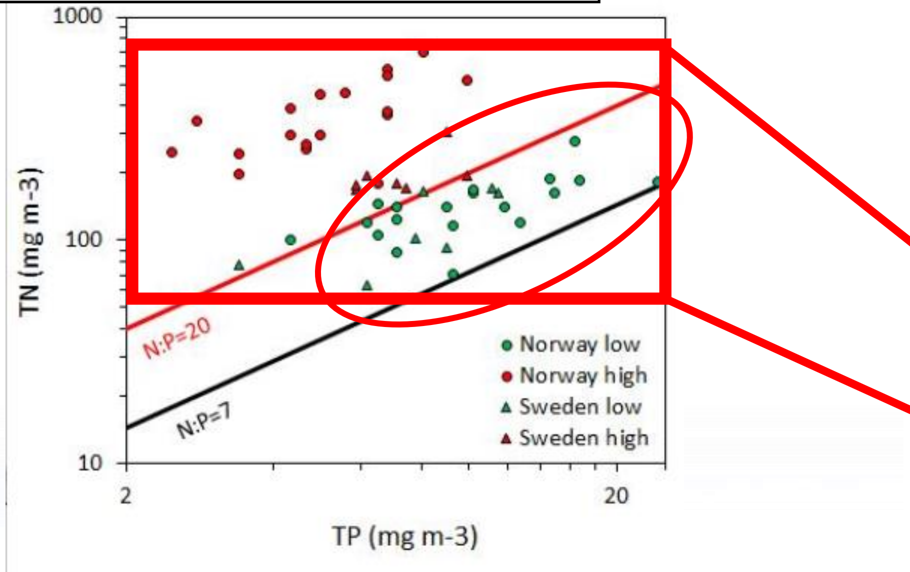
- Lake dataset from Norway, Sweden and Finland
  - Assembled for a Nordic project on Water Framework Directive
  - Algal productivity, water chemistry, land cover
  - Includes natural and agriculturally impacted lakes



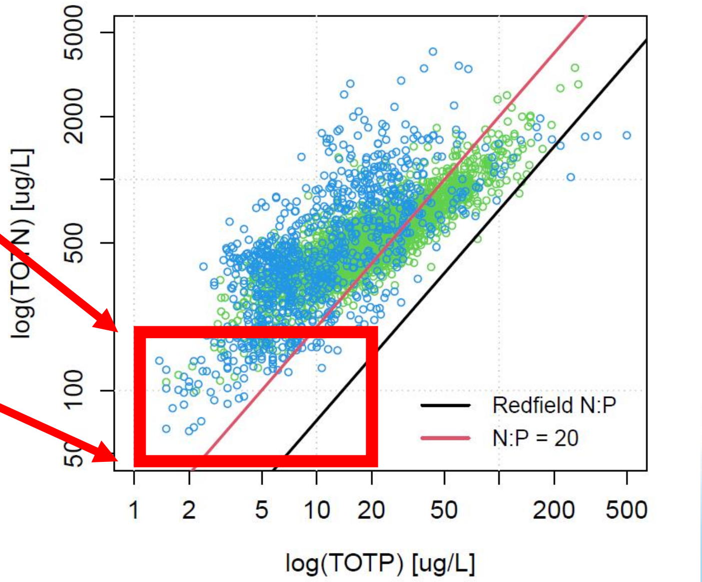


N:P < 20 in natural lakes indicates N-limitation?

Elser ea 2009: combination of monitoring and bioassays

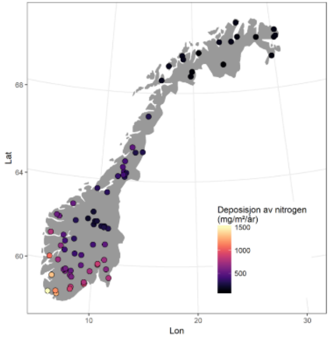


ICP Waters 2021: monitoring data Nordic countries



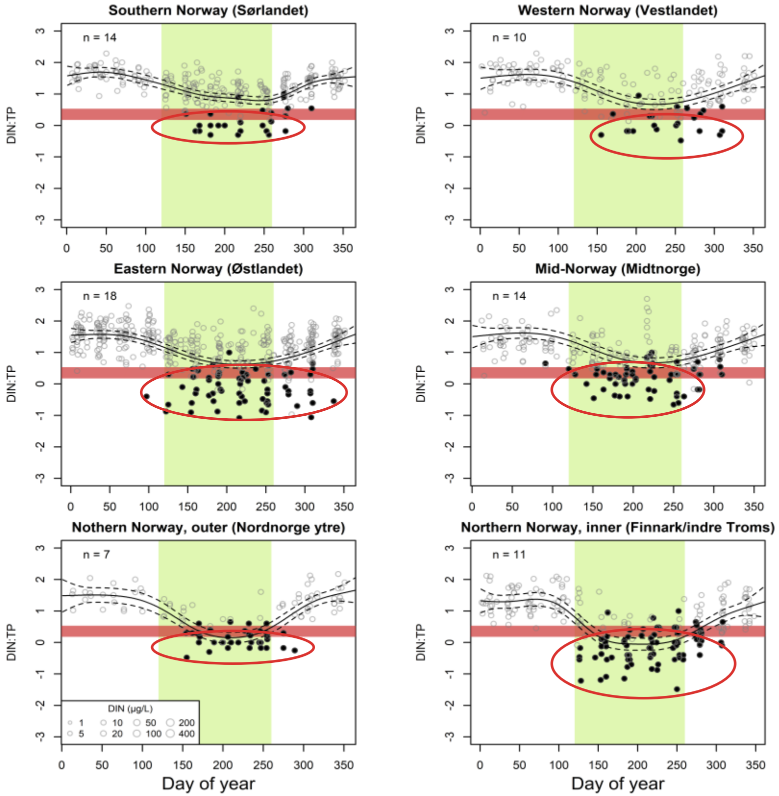
N-limitation or co-limitation in lakes with low N:P and low TP and TN

Very few lakes with low N and P concentrations and low N:P ratios



Norwegian rivers (undisturbed catchments) along N deposition gradient

- NO_3 to tot-P ratio below critical limit for N-limitation during growing season
- Most frequent and severe in areas with low deposition (north) and in regions with the largest areas of productive forest (east, middle)
    - Suggests N limitation during growing season is the natural state
- Some data on benthic algae available



J.E. Thrane (ICP W report, in prep). Black dots DIN < 10 µg/L

Next: revisit Nordic dataset, analyse algal biomass vs water chemistry and N deposition

Bergström et al. 2005:

Swedish lakes along N deposition gradient show *more algal biomass per unit P* where N deposition is higher

Current ICP Waters analysis on Nordic lakes: not yet tested similar to Bergström ea 2005

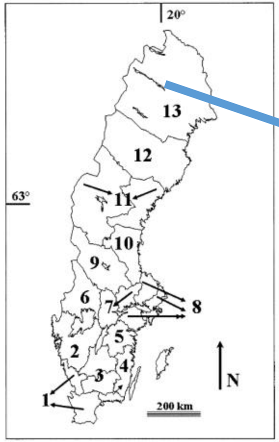
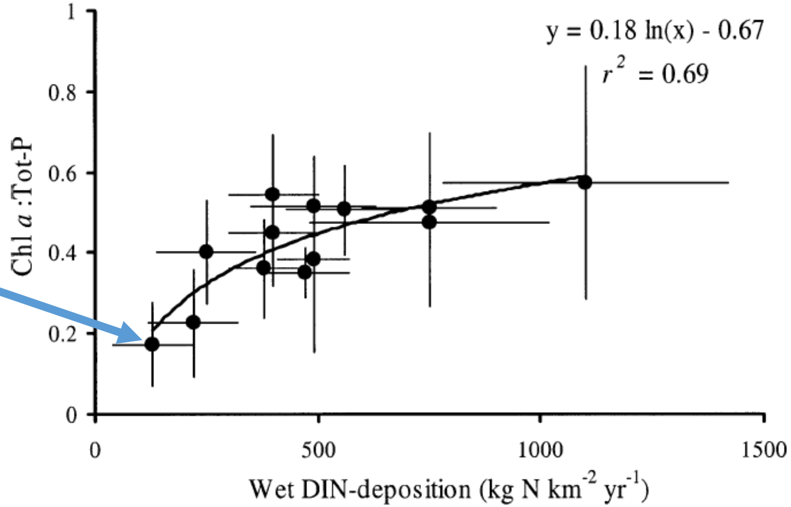
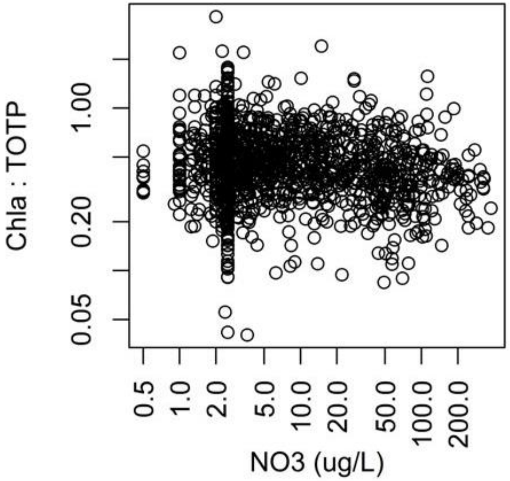


Fig. 1. The different Swedish regions used in this study.





Nitrogen report – relation to empirical CLs

- Phosphorus is the main control of lake productivity
- Challenging to document relationships between N deposition, water chemistry and biological responses
  - Nordic lake dataset will be explored further
- Based on water chemistry: natural rivers are seasonally limited by nitrogen
  - Not further substantiated by link with biological data so far
  - More N limitation where N deposition is low; possible link to vegetation cover

Potential to derive critical loads for N for *type of lakes?*

- Relationships to land cover and nitrogen retention capacity?

Table A4.1 Proposed new empirical critical loads of nutrient N for fresh waters, based on this review. N deposition in kg N ha^{-1} yr^{-1}. Table numbers refer to tables in De Wit and Lindholm (2010). In *italics*, critical loads that were suggested in other reviews.

EUNIS	Description	Catchment type	Regions	Response	Critical load
C1.1	Oligotrophic soft-water lakes	Arctic	Europe, Canada, Greenland	1. Phytoplankton community shift at N deposition <1-1.5 (Table 1)	1
		Alpine, boreal	USA, Europe	1. Phytoplankton community shift at N deposition 3-5 (Table 1) 2. Higher phytoplankton productivity at N deposition < 5 (Table 3)	3-5
		Temperate, boreal	Canada, USA, UK, Scandinavia, Netherlands	1. Phytoplankton community shift at N deposition 2-9 (Table 1) 2. Higher phytoplankton productivity at N deposition < 5 (Tables 2 and 3) 3. Shift of N to P limitation of benthic algae at N deposition 2-12 (Tables 2 and 4) 4. Productivity of benthic algae increases at N deposition 2-12 (Table 4) 5. *Macrophytes: loss of key isoetid species, increase in species such as Juncus bulbosus and Sphagnum (Bobbink and Roelofs, 1995)*	5-10
		Dunes	Netherlands	1. *Increased biomass and rate of succession (Bobbink et al., 2003)*	10-20
C1.4	Dystrophic lakes	Temperate, boreal	Sweden, Canada	1. Higher phytoplankton productivity, especially at N deposition < 5 (Table 3)	3-5

Other activities ICP Waters

- Review of the Gothenburg protocol
  - Observed and projected trends, suitability of current monitoring & expected new scientific findings
  - For surface waters:
    - water chemistry monitoring serves its purpose, but is under threat from reduction in funding. Increased focus on monitoring under the NEC Directive might counteract this trend. The data that are collected under the Water Framework Directive are often not suitable for targeted monitoring of air pollution effects on waters
    - Biological monitoring should be strengthened
  - New scientific findings:
    - E.g. thematic reports 2021+2022 (nitrogen, biological recovery)
- Mercury and the Minamata Convention
  - Input to guidance for effect-based monitoring
  - Possible collaboration with ICP IM on trends in Hg
- Biological/chemical intercalibration
- ICP Waters web page: http://www.icp-waters.no/

Workplan 2022-2023

- 2022 report on biological recovery
  - Focus on trends:
    - Regional differences
    - Potential delays in biological recovery vs chemical recovery
  - Policy and management implications:
    - Need for biological monitoring, description of different biological indices, dose-response relationships
  - Call for contributions just sent out:
    - Benthic invertebrate data: Update of ICP W database
    - National chapters: Biological trends/recovery across biota
- 2023
  - To be discussed at the Task Force meeting
  - Possible topics:
    - Climate change effects on water chemistry?
    - Joint WGE report?
    - Topics emerging from the GP review process?

Task Force meeting 2021

- Online: 28-29 April (afternoons)
- Topics: Nitrogen, biology, trends, climate, NECD, GP review
- Drop me an e-mail if you'd like to attend

- Next year in Riga and hopefully with ICP IM! 🤞