ICP Waters –
Effects of air pollution on rivers and lakes

Report of the International Cooperative Programme on Assessment and Monitoring of Acidification of Rivers and Lakes

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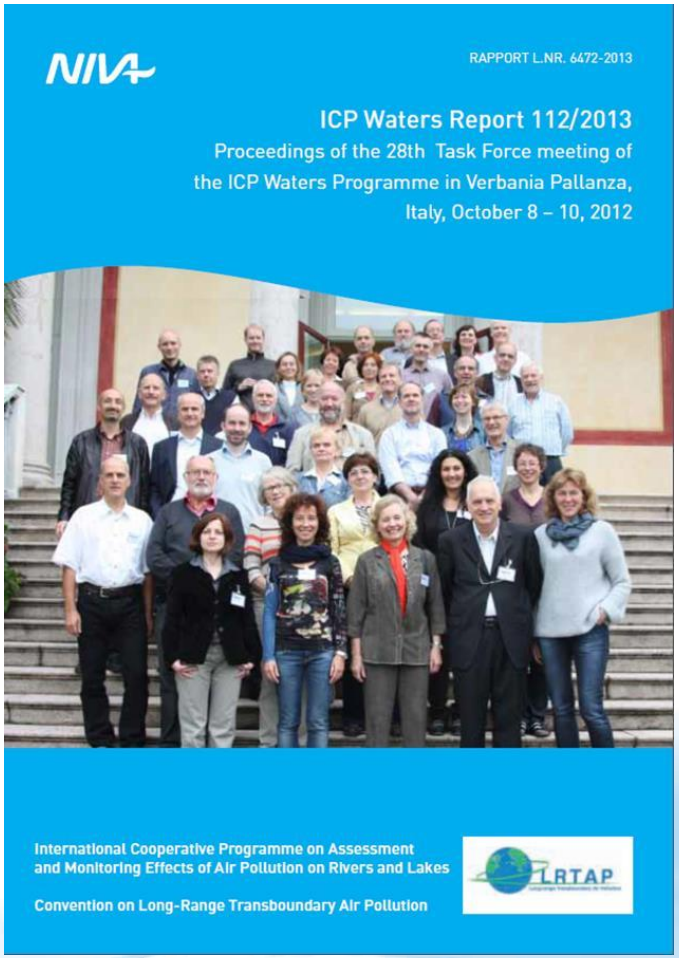
Task Force meeting 2012

- October 8-10, Pallanza, Italy
- 38 experts from 15 countries
- 23 countries participate regularly in ICP Waters activities
  - 29 when counting the chemical intercomparison



	Chemical data	Biological data	Participation in TF meetings 2010-2012	Participating in chemical intercomparison	Participating in biological intercalibration
Armenia			●		
Austria	2012		●	●	
Belarus	2011				
Canada	2012		●	●	
Croatia			●		●
Czech Rep.	2012	●	●	●	●
Estonia	2012		●	●	●
Finland	2012	●	●	●	●
France			●	●	
Germany	2012	●	●	●	●
Ireland	2012		●	●	
Italy	2012		●	●	
Latvia	2012	●	●	●	●
Montenegro	2012				
Netherlands			●		
Norway	2012	●	●	●	●
Poland	2012	●	●	●	
Russia			●	●	
Spain	2012		●	●	
Sweden	2012	●	●	●	●
Switzerland	2012	●	●	●	●
UK	2011	●	●	●	●
USA	2012		●	●	
Total	**18**	**9**	**21**	**18**	**10**

Important ICP Waters reports

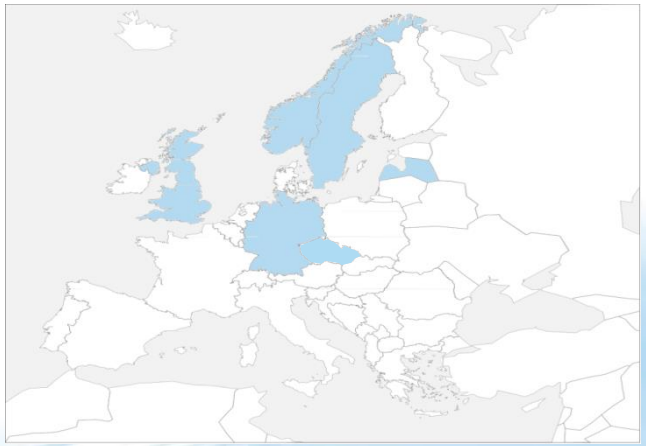
- ICPW 115/2013: Effects of long range transported air pollution (LRTAP) on freshwater **ecosystem services**
- ICPW 114/2013: **Biodiversity** in freshwaters: temporal trends and response to water chemistry
- ICPW 108/2011: Impacts of air pollution on freshwater acidification under **future emission reduction scenarios**; ICP Waters contribution to WGE report.
- ICPW 106/2011: **Trends** in **precipitation** chemistry, surface water **chemistry** and aquatic **biota** in acidified areas in Europe and North America from 1990 to 2008.
- ICPW 101/2010: **Nutrient enrichment** effects of atmospheric N deposition on biology in oligotrophic surface waters – a review.
- ICPW 97/2009: An assessment of **Mercury** in the freshwater aquatic environment related to long-range transported air pollution in Europe and North America.
- ICPW 89/2007: **Review** of the **Gothenburg Protocol**: Chemical and biological responses in surface waters and soils.
- ICPW 83/2006: **Critical Loads,** Target Load Functions and **Dynamic Modelling** for Surface Waters and ICP Waters Sites.
- ICPW 79/2005: An assessment of **Persistent Organic Pollutants** related to long-range air pollution in the aquatic environment.

New findings of particular interest to Convention

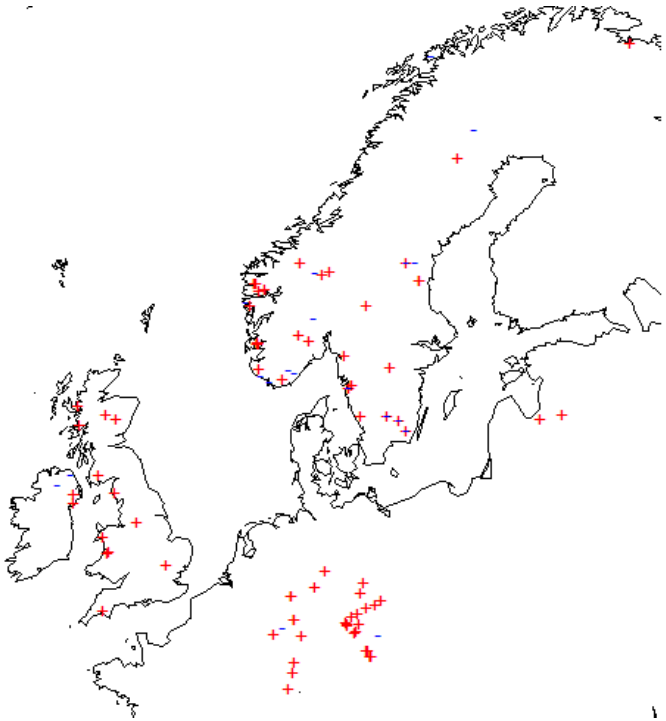
- Biodiversity report
- Ecosystem services report

30 years of biodiversity trends in European freshwaters

- Benthic invertebrates from streams and lakes between 1981 and 2011
- 1.6 million animals in 5000 samples
- Water chemistry measured for the same sites and periods
- Biodiversity indices include ALL species.
- Acidification indices include ONLY acid-sensitive species



Lakes and rivers in 5 countries



Trends of biodiversity

Conclusions on biodiversity

- Unique data-analysis with regard to
  - Length of dataseries
  - Regional distribution
  - Combination of chemical and biological data
- The overall biodiversity for most sites has increased since the 1980s
- Biodiversity in rivers has improved more than in lakes
- Biodiversity trends are related to changes in water chemistry
  - Reduced sulphate concentrations, which drive the most important water chemical indicators of acidity: pH, acid-neutralizing capacity, labile aluminium
- Strategies to reduce long-range transported atmospheric pollution have been effective
- BUT
  - No data from pre-industrial conditions
  - Regional variations in responses not investigated – relations to climate?
- Long-term monitoring data are extremely valuable

Ecosystem services

Effects of long range transported air pollution (LRTAP) on freshwater ecosystem services

A report for ICP Waters

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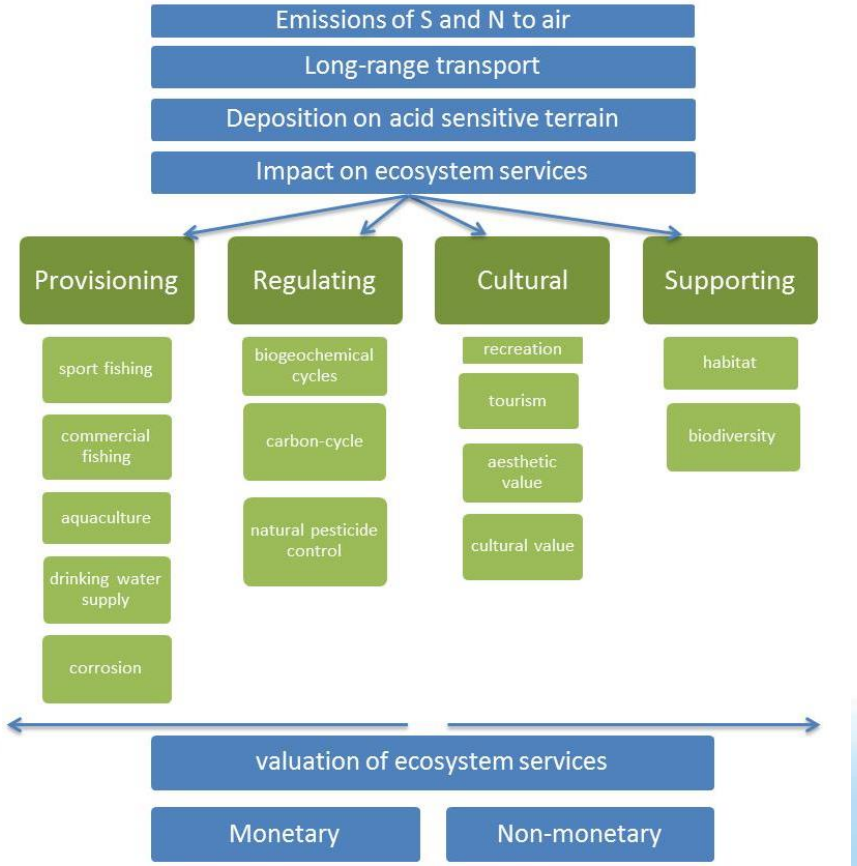
The «good old days» at the Tovdal River. Mr William Radcliffe at the Boen waterfall in the 1920's. In 1924 he and this companion Mr Harold Wilson caught 1352 salmon with two rods during 51 days of fishing. Source: Haraldstad and Hesthagen (2003).



Ecosystem services in oligotrophic lakes and rivers at risk from acidification

An **oligotrophic lake** is a lake with low nutrient content, low primary productivity, low algal production,, often clear waters, with high drinking-water quality – **and they are very sensitive to air pollution**

Ecosystem services (ES) approach to link biogeochemical impacts and the impacts on human welfare.

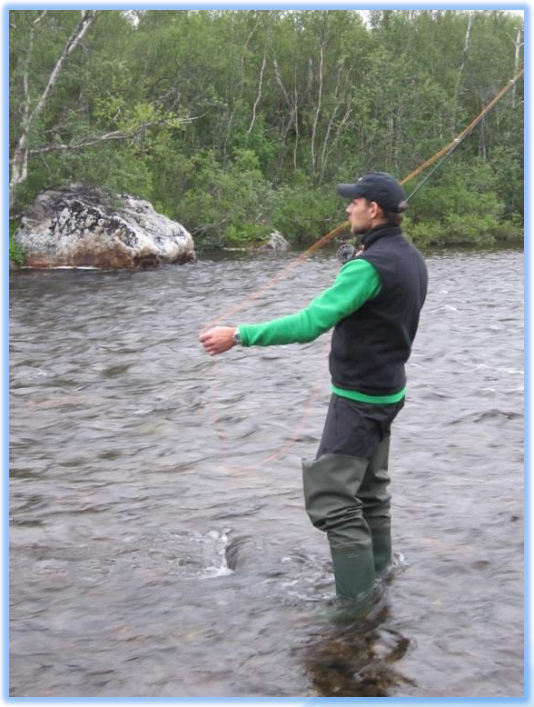
- Provisioning services:
  - Drinking water (water purification)
  - Food supply (fish)
- Regulating services:
  - Retention of nitrogen
- Cultural services:
  - Recreation, sport fishing, tourism
- Supporting services (feeding into the three other types of services):
  - Biodiversity

Monetised impacts

- Lost (decreased) fish stocks
- Reduced tourism
- Increased drinking water treatment
- Adaptive measures such as liming, preservation of biological diversity in gene-banks

Economic impact of freshwater acidification - recreational fishing

- In Scandinavia, large fish populations became extinct because of acid rain
- Policy: liming of rivers to promote fish (salmon!) populations
  - Stimulates recreational fishing
  - Economical gain locally related to tourism
  - Benefit to the general public
- National liming activities (public money) in Norway
  - 14 million Euro in 2011
  - 17 million Euro in 2015



Economic impacts of the salmon fishery in Trondheimsfjorden

- 20 000 – 100 000 adult salmon migrate into fjord and up the river to spawn
- 25 000- 30 000 recreational fishers in rivers and fjords
- 83 full-time jobs associated with this activity
- Total annual revenues of salmon fishing in the Trondheim region is 45 million EURO

Main conclusions

- Main ecosystem service affected by acidification of freshwaters:
  - Loss of sport fisheries
    - Brown trout
    - Atlantic salmon
  - Economic impacts, tourism, biodiversity, aesthetic and cultural values
- Difficult to value in monetary terms
- Need to aggregate costs over long time periods
- Costs and benefits of adaptation may occur in the distant future
- A thorough analysis of costs and benefits of reducing acid deposition in terms of ecosystem services has not been done

Other items

- Cooperation between ICP Waters and the European Long-Term Ecosystem Research Network
  - Workshop
  - Common interest in monitoring networks and quality assurance
- Nitrogen
  - Several countries noted recent decreases in surface water nitrate related to N deposition and climate change
- Sulphur
  - Long timeseries document relations between S deposition, S in surface waters and biological status

Other items - 2

- Dynamic modelling/critical loads
  - Empirical indicators of acidification agree with modelled indicators
- EECCA
  - Continued activity to involve EECCA countries
  - Armenia now has a focal centre
- Chemical intercomparison
  - Sixty-eight laboratories from 26 countries participated
  - Valuable tool for quality assurance of laboratory analyses
- Biological intercalibration
  - Three laboratories from three countries participated

Other items - 3

- Participation in other groups under the Working Group on Effects
  - ICP Modelling and Mapping
  - ICP Integrated Monitoring
  - Joint Expert Group on Dynamic modeling
- Publication in scientific journal
  - Trends in water chemistry (based on report 106/2011)

WP 2013 – future reports

- **New items (will be discussed at TF meeting in October):**
  - **2013:** Start a new trend assessment (chemistry and biology) up to 2012 picking up some of the threads from the work on the biodiversity report.
  - **2014:** What is happening with Nitrogen in the waters and the catchments?

  or

  - A review of old and new policy relevant indicators?