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Proceedings of the 32nd Task Force meeting of the ICP Waters Programme in Asker, Oslo, May 24-26, 2016

The international Cooperative Programme on Assessment and Monitoring Effects of Air Pollution on Rivers and Lakes (ICP Waters)
Convention on Long-Range Transboundary Air Pollution

Norwegian Institute for Water Research
– an institute in the Environmental Research Alliance of Norway

REPORT

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Abstract

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CONVENTION ON LONG-RANGE TRANSBOUNDARY AIR POLLUTION

INTERNATIONAL COOPERATIVE PROGRAMME ON ASSESSMENT AND MONITORING EFFECTS OF AIR POLLUTION ON RIVERS AND LAKES

Proceedings of the 32nd Task Force meeting of the ICP Waters Programme in Asker, Oslo, May 24-26, 2016

Prepared at the ICP Waters Programme Centre
Norwegian Institute for Water Research
Oslo, November 2016

Preface

The international cooperative programme on assessment and monitoring of air pollution on rivers and lakes (ICP Waters) was established under the Executive Body of the UNECE Convention on Long-range Transboundary Air Pollution (LRTAP) in July 1985. Since then ICP Waters has been an important contributor to document the effects of implementing the Protocols under the Convention. Numerous assessments, workshops, reports and publications covering the effects of long-range transported air pollution has been published over the years.

The ICP Waters Programme Centre is hosted by the Norwegian Institute for Water Research (NIVA), while the Norwegian Environment Agency leads the programme. The Programme Centre's work is supported financially by the Norwegian Environment Agency.

The main aim of the ICP Waters Programme is to assess, on a regional basis, the degree and geographical extent of the impact of atmospheric pollution, in particular acidification, on surface waters. More than 20 countries in Europe and North America participate in the programme on a regular basis.

ICP Waters is based on existing surface water monitoring programmes in the participating countries, implemented by voluntary contributions. The ICP Waters site network is geographically extensive and includes long-term data series (more than 25 years) for many sites. The programme yearly conducts chemical and biological intercalibrations.

At the annual Programme Task Force, national ongoing activities in many countries are presented. This report presents national contributions from the 32st Task Force meeting of the ICP Waters programme, held in Asker, Norway, May 24-26, 2016.

Heleen de Wit
ICP Waters Programme Centre

Oslo, November 2016

Contents

1. Introduction

The International Cooperative Programme on Assessment and Monitoring of Rivers and Lakes (ICP Waters) is a programme under the Executive Body of the Convention on Long-Range Transboundary Air Pollution. The main aims of the programme are:

- To assess the degree and geographic extent of the impact of atmospheric pollution, in particular acidification, on surface waters;
- To collect information to evaluate dose/response relationships;
- To describe and evaluate long-term trends and variation in aquatic chemistry and biota attributable to atmospheric pollution.

The national contributions on ongoing activities that were presented during the ICP Waters Task Force meeting in Asker, Norway, May 24-26, 2016 were grouped thematically. A short summary of each presentation is given in the Minutes (Chapter 4). Selected presentations are reported more extensively in the Proceedings.

List of presentations:

<u>Acidification and recovery</u>

- Long-term sulphate and inorganic nitrogen mass balance budgets in European ICP Integrated Monitoring catchments, Jussi Vuorenmaa, Programme Centre ICP IM.

- Monitoring recovery of acidification and effects of climatic change in shallow soft water lakes in The Netherlands: Temperature, hydrology, chemistry, diatoms Herman van Dam, the Netherlands.

- Features of Recovery of the Kola North lakes in reducing atmospheric deposition (1990-2014) Tatiana Moiseenko and Marina Dinu, Russian Federation.

- Cold, dark and lifeless: the future of northern lakes? Jens Fölster, Sweden.

- Phosphorus trends John Stoddard, US.

<u>Heavy metals and POPs</u>

- Evaluating the temporal trends of mercury concentrations in Norwegian freshwater fish - a study of 25 years of data (common ICP Waters and ICP IM report: Mercury), Hans Fredrik Braaten, Programme centre ICP Waters.

- Progress report of Hg and heavy metals in terrestrial and aquatic ecosystems in Nordic countries, Staffan Åkerblom, Programme centre ICP IM.

- Increased mercury concentrations of perch in Finnish lakes recovering from acidification, Martti Rask, Finland.

<u>Critical loads/Dynamic modelling</u>

- Dynamic modelling (VSD+) at selected ICP IM sites, Maria Holmberg, Programme Centre ICP IM.

- MAGIC library in Sweden - consequences of new forestry scenario's and impacts on critical loads calculations, Filip Moldan, Sweden.

<u>Critical thresholds and biology recovery</u>

- The 2015 ICP Waters report: An attempt to tweeze out the effect of climate change as driver of biodiversity in acidified waters, Gaute Velle, Programme subcentre ICP Waters.

- Monitoring of acid sensitive lakes in Norway: comparison of ecological status based on water chemistry and biology, Ann-Kristin Schartau, Norway.

- Critical loads and critical limits - a Swedish-Norwegian comparison, Kari Austnes, Norway

<u>Climate change.</u>

- Drought induced chemistry changes in stream waters recovering from acidification. Jakub Hruska, Czech Republic.

- Lago Nero - a new site to assess the effects of environmental change on high-alpine lakes and their catchments. Andreas Bruder, Switzerland.

- DOC trends explained by climate? Heleen de Wit, ICP Waters.

2. Assessment of acid sensitive lakes in Norway: ecological status based on water chemistry and biology

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Introduction

The Norwegian monitoring program on ecological effects of long-range transported air-pollutants includes chemical and biological monitoring of both rivers and lakes. Integrated lake monitoring, covering both anthropogenic acidified lakes and reference lakes, started in 1996, at a time when southern parts of Norway was severely affected by acidification in spite of decreasing deposition of acidifying compounds since the late 1980s (Aas et al. 2016). For several of the lakes we have data on water chemistry and/or fish populations back to the 1970-ies. From 2015 onwards, the lake program has been organized as a part of the surveillance monitoring in Norway (c.f. The Water Framework Directive), financed by the Norwegian Environment Agency and conducted by the Norwegian Institute for Nature Research (NINA), Norwegian Institute for Water Research (NIVA) and Uni Research Environment.

The Water Framework Directive (WFD; European Commission 2000) was incorporated into Norwegian legislation in 2006 as a part of the EEA agreement between EU and Norway. The aim of the directive is to develop sustainable management of European surface- and groundwater with the purpose to prevent further deterioration and to protect and enhance the status of aquatic ecosystems. The environmental goal is good ecological status for all surface waters in Europe by 2027. Assessment of ecological status, which is an expression of the quality of the structure and functioning of aquatic systems, shall be based on the deviation from a type-specific or site-specific reference conditions. Such assessment are necessary to evaluate whether environmental objectives are met, to determine what measures need to be taken, and to evaluate whether programs of measures are effective. Ecological status and changes therein shall be assessed using information on relevant biological (i.e. phytoplankton, aquatic flora, benthic invertebrate fauna and fish), physicochemical and hydro-morphological quality elements. A national classification system for assessment of acidified lakes and rivers in Norway was published in 2013 as a part of the Guidance document no 2 from the Direktivsgruppa for Vanndirektivet (Anon 2013). For lake acidification, pH, Acid Neutralizing Capacity (ANC) and Labile aluminium (LAL) are included, as well as indices derived from littoral zoobenthos and fish species composition, respectively. An assessment tool based on zooplankton and littoral microcrustaceans is under development and will be implemented in 2017.

The aim of this study was to assess the trends and current acidification status for Norwegian acid sensitive lakes using the newly developed WFD classification system. In this study, we compare ecological status based on chemical and biological parameters, respectively, with the aim to answer the following questions: Do chemical and biological quality elements and parameters assign the same ecological status? If not, which quality elements indicate respectively the worst and the best status? What may be the reasons for such differences?

Study sites and methods

The monitoring program

The study includes data from 43 lakes which have been monitored either yearly (19 lakes; up to 19 years of data) or every fourth year during the period 1996-2014. In this monitoring program, we have defined 10 geographical regions (see Figure 1) based on differences in deposition of acidifying compounds, geology and biogeographical pattern. Although the monitoring represents all regions, most of the lakes are found in the acidified regions of Norway; that means Southern Norway, and in the north, the eastern part of Finnmark, close to the Russian border.

All lakes have been studied with respect to water chemistry, microcrustaceans (pelagic and littoral), and littoral macroinvertebrates, either yearly (19 lakes) or every fourth year (24 lakes). Fish populations have been studied in 28 of the lakes every fourth year (Figure 1). Additionally, from some lakes, we have conducted fish studies irregularly since the 1970s and water chemistry yearly since late 1980s. We have used standard methods for sampling and data processing, including hand-net and kick-sampling for littoral macroinvertebrates, vertical and horizontal plankton-net hauling for microcrustaceans and gill-netting by Nordic multi-mesh gillnets for fish.

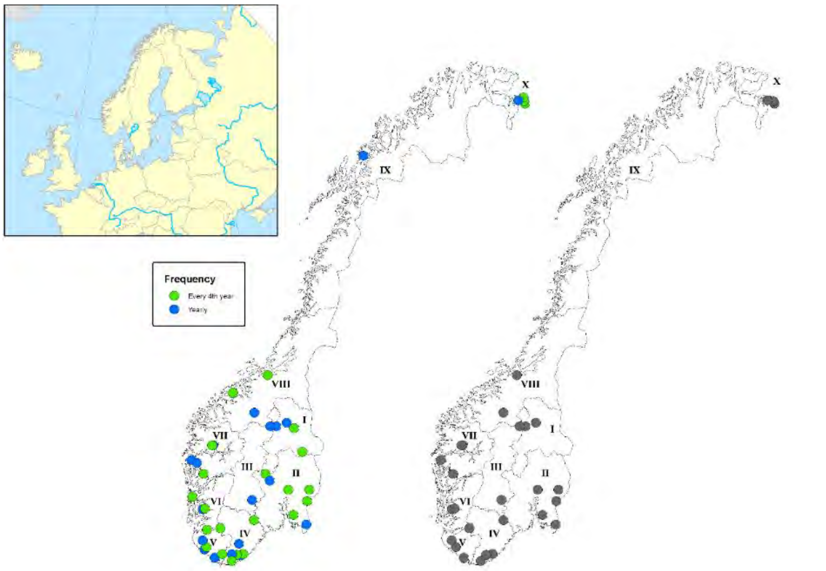

Figure 1. Lakes included in the Norwegian monitoring program on ecological effects on long-range transboundary air pollutants (surveillance monitoring of acid-sensitive lakes c.f. the WFD). Left: Lakes monitored for chemistry, microcrustaceans (pelagic and littoral), and littoral macroinvertebrates, either yearly (blue dots) or every fourth year (green dots). Right: Lakes monitored for fish populations (grey dots). Lines indicate boundaries between the 10 different acidification regions (I-X) in Norway.

Assessment of acidification status

We have assessed the ecological status with respect to acidification for all lakes based on the national classification system for lakes (Anon 2013) using data on littoral macroinvertebrates (Acidification Index 1, MultiClear, LAMI), fish (Cpue of brown trout, % reduction in fish population, NEFI-index) and supporting water chemistry (pH, ANC and LAl). Parameters and indices selected for the classification varies between lakes, taking both lake-type and available data into account (see information in Table 1). We have also tested a preliminary classification system based on microcrustaceans, although not used in the overall status assessment of the lakes. The combination of quality elements to an overall ecological status for each lake, follows the one-out, all-out principle, after excluding the most uncertain quality elements/indices/ parameters. We have not assessed the ecological status of four lakes due to missing data on suitable biological parameters for the lake type to which these lakes belong (humic lakes). For pH, ANC and LAl, we have established reference value and boundaries for 15 different acid sensitive lake types representing differences in concentrations of calcium and humic substances (TOC). For benthic invertebrates, data are, so far, not sufficient to establish type-specific boundaries. Experiences indicate, however, that the classification system is more uncertain for humic lakes than for clear lakes, and for lakes with very low alkalinity (Ca < 1 mg/L) compared to low alkalinity lakes (Ca: 1-4 mg/L).

In the ecological status assessment we have used mean values based on data from a four year period (2011-2014), meaning that for some lakes we have included data from only one year, whereas for others we have data from all four years.

Table 1. Overview of which quality elements and parameters/indices included in the Norwegian classification system for acidification of lakes (Anon 2013). LAMI: Lake Acidification Macroinvertebrate Index; MultiClear: Multimetric index for assessment of acidification of clear lakes; Acid Index 1: Acidification Index 1 = formerly Norwegian Acidification Index (Raddum & Fjellheim 1984, Raddum 1999); Krepsdyrindeks2: Microcrustacean multimetric index; % pop reduction: % reduction in (dominating) fish population; NEFI: Norwegian Fish Index; Cpue-brown trout: number of brown trout per 100 m2 gillnet; OR: ratio of spawning and rearing area (relative to lake area).

Quality element	Index	Metric types included	Lake types
Physico-chemical1	pH ANC LAl		15 different acid sensitive types based on combinations of Ca- and TOC-content
Benthic invertebrates1	MultiClear	Taxonomic richness, scoring of indicator species, relative abundances	1 type: Low alkalinity, clear lakes
	LAMI	Scoring of indicator species	
	Acid. Index 1	Scoring of indicator species	1 type: Very low/Low alkalinity, clear lakes
Microcrustaceans	Krepsdyrindeks2	Species richness, scoring of indicator species	1 type: Low alkalinity, clear/humic lakes (preliminary classification system)
Fish2	NEFI	Species composition	Site specific reference values
	% pop reduction	Changes in abundance	
	Cpue brown trout	Abundance	3 types: low, medium and high OR

Note to the classification: 1In cases where more than one parameter/index is applicable for the same pressure and water-body type (e.g. MultiClear, LAMI and Acidification index 1 for low alkalinity, clear lakes), assessment is based on the mean value after rescaling and normalization (mean nEQR-value). 2For each lake, the most applicable fish index, given the fish community in the lake and the data quality, is selected for assessment of ecological status.

Results and discussion

In all except five of the lakes reduced deposition of acidifying compounds (sulphur and nitrogen) is followed by a significant reduction in concentration of non-marine sulphate. For nitrate, we registered a significant reduction in nearly half of the 43 lakes. In most of the lakes, pH and ANC have increased. Increased levels of TOC are also observed in many lakes, especially in the South-Eastern Norway (Region II, c.f. Fig. 1) and in the eastern part of the southernmost region (Region IV). The combination of increased pH and TOC has resulted in reduced concentrations of LAl. Further, educed levels of acidifying compounds are followed by reduced concentrations of calcium and magnesium, especially in lakes in the southernmost part of Norway (Regions II and IV). Calcium is an important component in many biological processes, and in the future, we therefore expect shifts in the composition of freshwater flora and fauna.

Some of the lakes also show a biological recovery, especially in the acidified regions of Southern Norway (Regions II, IV, V and VI). The number of acid-sensitive species of both microcrustaceans and macroinvertebrates has increased, as well as the abundance of the brown trout (Salmo trutta), and in several lakes there have been successful reintroductions of previously extinct fish populations. However, positive changes are weak and unstable and the biological recovery is ambiguous for most of the lakes. Schartau et al. (2016) gives a more thorough presentation of these results.

In general, the supporting chemical quality elements (pH, ANC, LAl) indicated better status than littoral macroinvertebrates and fish. In 34 out of 43 lakes (79 %), the water chemistry indicated "good" or better status (Figure 2). These lakes are probably not facing problems from acidification today. The most acidified lakes are located in the Southern Norway. Nevertheless, the water chemistry in most lakes here indicated "good" or "high" ecological status. In contrast, only 10 (23 %) of the lakes had sufficiently "good" status according to their biology. In 24 of 29 lakes which were in moderate status or poorer, the macroinvertebrates indicated the worst status, whereas fish and water chemistry indicated the worst status for four and one lake, respectively (Figure 2). For low alkalinity lakes (16 lakes), we also assessed ecological status based on microcrustaceans which for half of the lakes correlated quite well with the status based on macroinvertebrates. For the remaining lakes, microcrustaceans mainly indicated somewhat better status. Generally, we found good accordance between ecological status based on water chemistry, respectively biology, in non-acidified lakes with calcium concentration of 1 mg/L or higher (i.e. low alkalinity lakes). Contrary, the most pronounced differences was found for lakes with very low calcium- and TOC concentrations (Ca < 1 mg/L; TOC < 2 mg/L), lakes with low water temperatures and short growing season, and lakes in regions with the most sever acidification,

Whereas the assessment of ecological status for supporting chemical parameters take natural variation in calcium and TOC content into account, this is not the case for the assessment of littoral macroinvertebrates. Therefore, we may expect that macroinvertebrates are less accurate in assigning ecological status than chemical parameters indicative for acidification. However, there might be several other explanations for the weak and ambiguous response of the biology. Time lags between chemical and biological recovery are often observed (see for instance Schartau et al. 2007; Hesthagen et al. 2011). Such time lags can be a result of acidic episodes not detected in the chemical monitoring. Distances to potential refuges and dispersal barriers may hinder the biological recovery. Furthermore, biological interactions with more acid tolerant species established in the lake in the absence of the native species, negative effects of increased TOC and/or reduced calcium content, as well as interactions with other environmental factors may affect the biological recovery process (see also Schartau et al 2007, Linløkken et al. 2011). Re-establishing of extinct fish-populations most often require help from human. Such reintroduction is common for brown trout, but not so for other fish species.

In some cases, the biology indicated that the ecological status is poorer than what we could expect according to the actual acidification (present and past). This may be due to other human-induced pressures, for instance physical encroachments in the littoral zone, changes in the water level, or heavy metals. The latter is exemplified in Eastern Finnmark (Region X) where the monitoring of small lakes close to the Russian border has documented an increased concentration of heavy metals like nickel and copper from 2004 onwards (Berglen et al. 2015). Increased fish abundances or reintroduction of previously extinct populations, may also influence other species negatively.

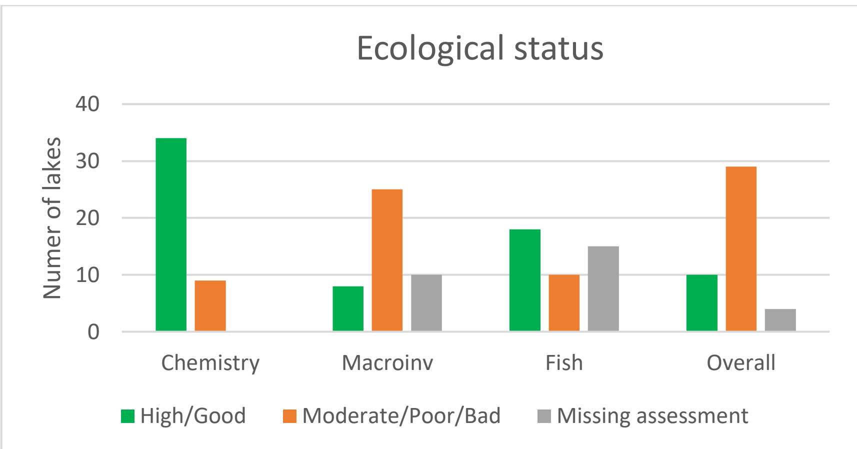

Figure 2. Ecological status for 43 acid sensitive lakes monitored for the quality elements water chemistry, littoral macroinvertebrates and fish. Overall ecological status for each lake (water chemistry + minimum one biological quality element) is based on the one-out, all-out principle.

Biological interactions may also be of importance and include both predation as well as competition between species with similar ecological niches. The acid-sensitive cladocerans Daphnia spp. are for instance sensitive to fish predation. Species richness and presence of acid-sensitive species can also be related to factors not directly associated with acidification, e.g. climatic/environmental conditions. Mountain and Arctic lakes, as well as lakes with very low content of calcium and TOC are characterized by low species richness. Apparent low species richness and low abundances of acid-sensitive species may also have methodological reasons. Especially in lakes with low species richness, small samples may not reflect the real species composition. Furthermore, our experience to use indices/parameters to assess ecological status are limited. Some are developed for other lake types, ecoregions and habitats than the lakes included in this study. Limitations in biological data for some lakes may be another reason. Data from our monitoring program will, however contribute with important information for future evaluation and revision of the classification system for freshwaters in Norway.

The long time series (up to 19 years) from the monitoring program on acid sensitive lakes in Norway show that reduced deposition of acidifying compounds are followed by chemical and biological recovery. Without these series, it would have been difficult to document positive responses in many former severely acidified lakes

References

Aas, W., Fiebig, M., Platt, S., Solberg, S. & Yttri, K.E. 2016. Monitoring of long-range transported air pollutants in Norway, annual report 2015. Miljødirektoratet rapport M-562|2016, 119 pp.
Anon. 2013. Veileder 02:2013. Klassifisering av miljøtilstand i vann. Økologisk og kjemisk klassifiseringssystem for kystvann, grunnvann, innsjøer og elver. - Direktoratsgruppa for gjennomføring av vanndirektivet, 261 pp. (In Norwegian).
Berglen, T.F., Dauge, F., Andersen, E., Nilsson, L.O., Tønnesen, D., Vadset, M. & Våler, R.L. 2015. Grenseområdene Norge-Russland. Luft- og nedbørkvalitet, april 2014-mars 2015. Miljødirektoratet rapport M-384|2015, 116 pp.
European Commission. 2000. Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 of establishing a framework for community action in the field of water policy. Official Journal of the European Communities 22-12-2000.
European Commission. 2011. Guidance document on the intercalibration process 2008–2011. Guidance Document No. 14. Implementation strategy for the Water Framework Directive (2000/60/EC). Technical report-2011-045.
Hesthagen, T., Fiske, P. & Skjelkvåle, B.L. 2008. Critical limits for acid neutralizing capacity of brown trout (Salmo trutta) in Norwegian lakes differing in organic carbon concentrations. – Aquat. Ecol. 42: 307–316.
Hesthagen, T. Fjellheim, A., Schartau, A.K., Wright, R.F., Saksgård, R & Rosseland, B.O. 2011. Chemical and biological recovery of Lake Saudlandsvatn, a formerly highly acidified lake in southernmost Norway, in response to decreased acid deposition. - Sci. Tot. Environ. 409: 2908-2916.
Linløkken, A. & Hesthagen, T. 2011.The interactions of abiotic and biotic factors influencing perch Perca fluviatilis and roach Rutilus rutilus populations in small acidified boreal lakes. - J Fish Biol. 79: 431-438.
Raddum, G.G. 1999. Large scale monitoring of invertebrates: Aims, possibilities and acidification indexes. pp. 7-16 I: Raddum, G.G., Rosseland, B.O. & Bowman, J. (eds.). Workshop on biological assessment and monitoring; evaluation of models. - ICP-Waters Rapp. 50/99. NIVA, Oslo. http://www.niva.no/symfoni/RappArkiv5.nsf/URL/C125730900463888C1256FB80053D538/$FILE/4091_72dpi.pdf
Raddum, G.G. og Fjellheim, A. 1984. Acidification and early warning organisms in freshwater in western Norway. - Verh. Internat. Verein. Limnol. 22: 1973-1980.Schartau, A.K., Halvorsen, G. & Walseng, B. 2007. Northern Lakes Recovery Study (NLRS) – microcrustaceans. Reference conditions, acidification and biological recovery. - NINA Report 235, 66 pp.
Schartau, A.K., Fjellheim, A., Garmo, Ø., Halvorsen, G.A., Hesthagen, T., Saksgård, R., Skancke, L.B., Walseng, B. 2016. Effects of long-range transported pollutants in Norwegian lakes – acidification status and trends. Including new monitoring data from 2012-2014. Miljødirektoratet rapport M-503|2016, 182 pp. (In Norwegian with English summary).

3. Features of recovery of the Kola north lakes in reducing atmospheric deposition (1990-2014)

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Introduction

Enrichment of surface water by metals is a result of both natural processes and human activities. The anthropogenic impact on the environment has increased dramatically over the last century, which is associated with the increasing volumes of extracted metals and their dispersal with atmospheric precipitation. Forms of binding metals in natural waters provides important information about the level of toxicity to biota and are directly reflecting the amount of atmospheric deposition. According to previously published results the most dangerous form of migration of heavy metals (except mercury) is in ionic form. However, the study of metals distribution forms in each water object is a task that requires a huge physical-chemical work.

Understanding the nature of element distributions in surface water and the reasons for the increase in their concentrations at the regional and global level is one of the most urgent problems of science. The aim of research was to investigate the metals distribution forms in lakes of the Kola Peninsula under different anthropogenic pressures and different time periods, 1990 to 2014.

Materials and Methods

Water samples were collected in non-sorbing plastic bottles. In the field, the bottles were rinsed twice with lake water, then filled and placed in dark containers and kept at 4°C. The scheme of the sampling points, the principles of research and the methods of water sampling, as well as chemical analyses, are described by Moiseenko et. al. (2013). The total content of elements and dissolved forms, suspension and complexes with organic ligands forms were determined in sample (ion exchange resins, ICP-MS).
We use the following gradation of lakes: firstly, location lakes on the distance from the pollution source: 1. lakes without the direct source of pollution; 2. lakes near the source of pollution; 3. lakes on excision from the source of pollution (Figure 1).

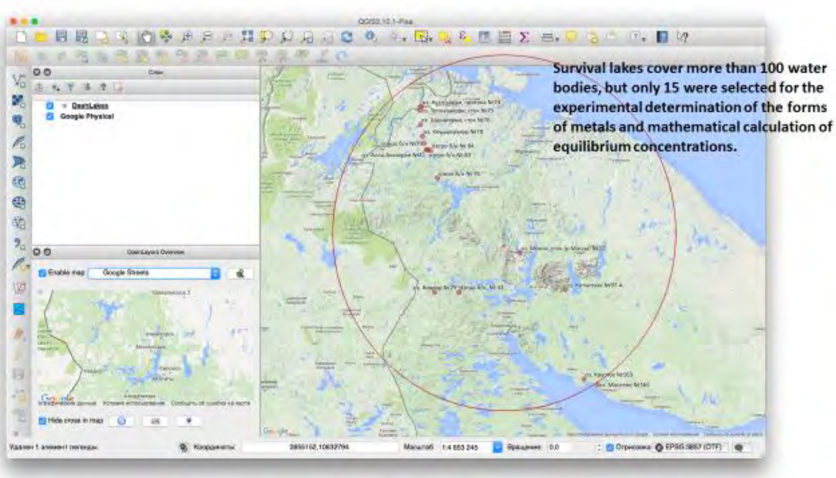

Figure 1. Spatial location of the lakes presented in this study.

We separate all chemical elements according their chemical properties: 1. alkali, alkaline earth metals; 2. subgroup of chrome; 3. subgroup of lanthanides, actinides; 4. ions of iron and aluminum; 5. subgroup of stanium

The calculation was performed in MathCAD and based on:

1.Material balance;
2.Constant of equilibrium/ acid/based properties;
3.Electrical neutrality;
4.Proton equilibria.
5.Also consider competing reactions.

Comparison of measurement forms of metals and calculation of metal forms was performed according to the data in 2014. So, we use measuring methods and checked following components: sediments and non-organic forms, complex and we used calculation technique: non-organic forms, organic complex.
Shout be noted the calculations used information about the total metal content (sample without filtration and acidification) and we cannot say exactly how many hetero-phase in the sample. However, information on inorganic equilibrium constants, degree of precipitation makes possible to separate the organic component of the other form. Results of measuring methods and calculation methods did not differ not more than 20%.

Results and Discussion

Lakes without direct source of pollution

The results of the distribution of iron and aluminum (fig. 2) forms showed an increase in the degree of binding to organic materials in water under the pH below 6 and color than 100. This is, firstly reduction and hydrolysis processes and secondly, different ratios of concentrations of iron and aluminum in system.

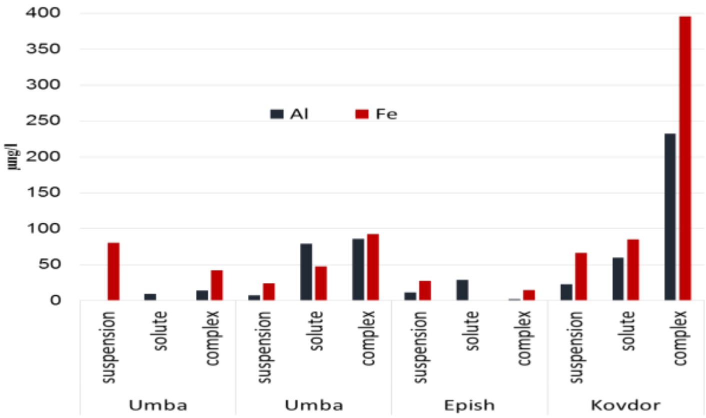

Fig. 2 The distribution of iron and aluminum by forms

The data have allowed constructing the following series of activity of metal in complexation: pH< 6 Fe>=Al>Y>Pb>Zn>Cu>Sc>Ni>Co>Cd and pH>6 Cu>Fe>Al>Sc>Co>Ni>Zn>Pb>Y>Cd
The results of calculation technique (to show by Fig. 3) to allow concluded that difference chemical group of metals in some period are characterized by different degree of complexes forms. As can see, Ca and Mg in the most degree to contact with organic matter in 2005 and in a few degrees in 2009.

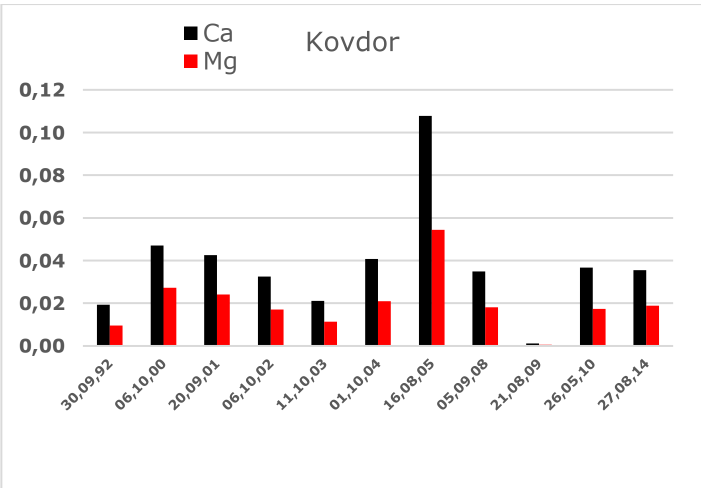

Fig. 3 Percent of complexing form by metals with organic matter in lakes water

Iron and aluminum ions interact with the organic matter in the water to varying degrees. Complex formation of iron always the maximum and the connecting of aluminum ions with organic matter is the greatest in 2014. This may be due to the increase in organic matter in 2014 (recovery) and high stability constants of organic complexes of iron (fig. 4).

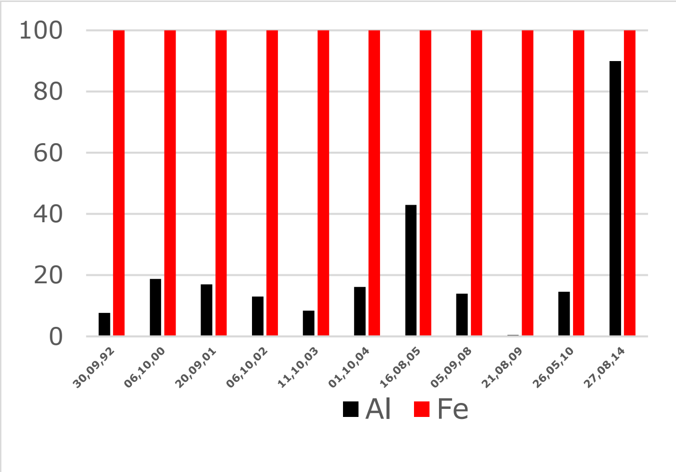

Fig. 4 Percent of complexing form by metals with organic matter in lakes water

Such elements as Cu, Ni (Fig. 5) are characterized of enough complexation especially in 2005, it is due to change in chemical composition of lakes water and decreased of Fe and Al concentration in this years.

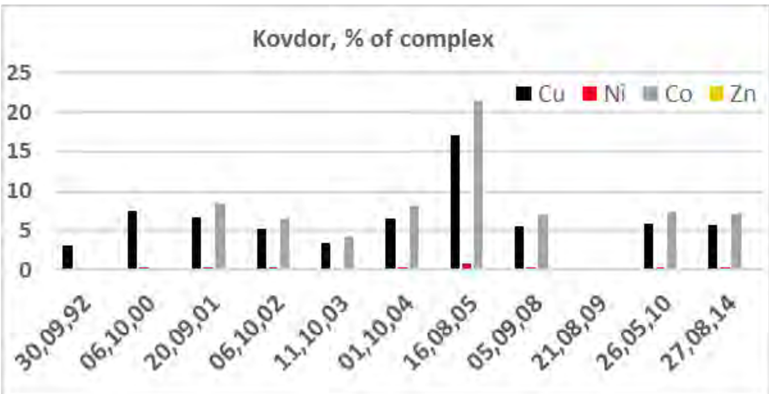

Fig. 5 Percent of complexing form by metals with organic matter in lakes water

Lakes with direct source of pollution

Chromium ions are characterized by sufficient complexing capacity (pH>6.5) under high anthropogenic load due to an increase in their concentration as compared with lakes without direct source. Manganese in such conditions has a high capacity to form suspensions. The complexation of heavy metals is modified as follows: zinc is complexed by more than 50% in lakes, copper actively forms complexes with organic matter due to a significant increase in their concentration. The affinity of these elements to an organic substance as follows: Fe>Al>Zn>Ni>Cu>Pb>La>Ce>Co

The complexation of such elements as Cu, Ni, Zn, Pb (important anthropogenic elements) are presented in Fig. 6. Cu is characterized by a maximum degree of complex forms, Pb behaves very similarly. The complexing possibility of Ni is no more than 20% in the year 1997. It is linked to the material balances of water system (a lot of concentration of Ni in 1997) and low constant of complexation.

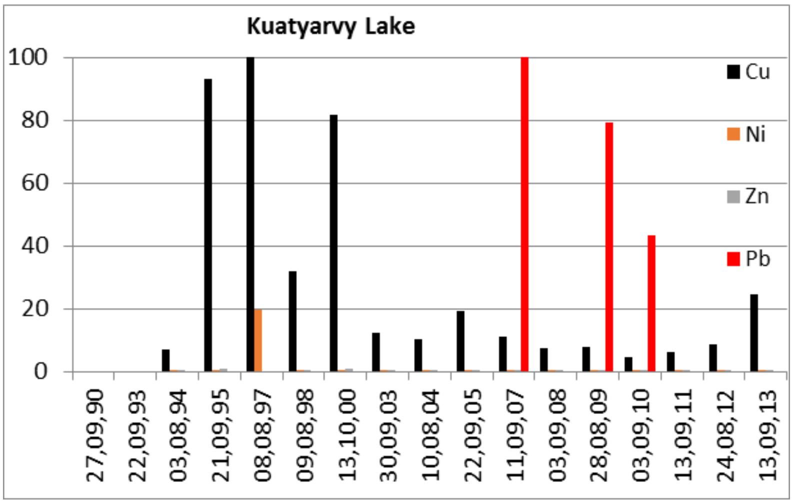

Fig. 6. Changing forms of finding metals with increasing distance from the source of pollution – Cu-Ni smelter (% of complex form)

Significant reduction of complexing forms of nickel and copper, as well as their total contents are indicating a decrease in aerobic pollution on some distances of source of pollution. But, the lower nickel ability to form complexes compared to copper is a consequence of greater affinity of copper to organic ligands. The distribution of metal affinity for organic substances should be Fe>Al>Cu>Ni>Y.
The complexing capacity of Al and Fe (Fig. 7) in longer distance from source of pollution following: decrease in complex forms of Fe and some increase of complex forms of Al.

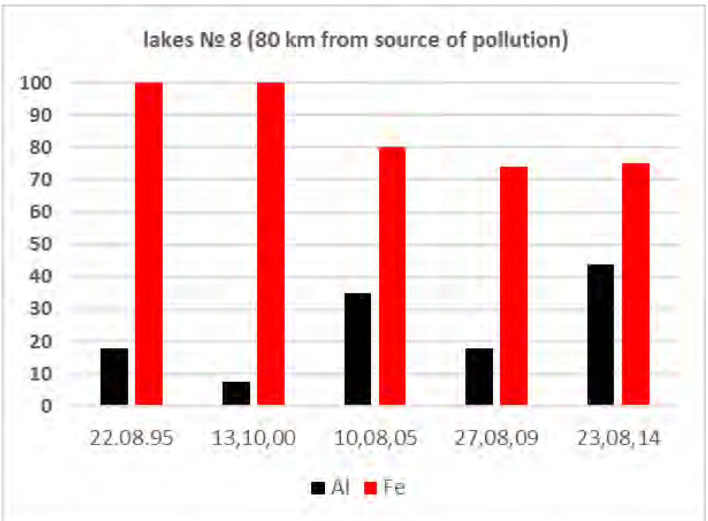

Fig. 7. Percent of complexing form by metals with organic matter in lakes water

Such elements as Cu, Ni and Co are characterized of different tendency in complexation. Degree of complex forms of Co is lower than Cu and Ni. complexing capacity of Ni is increasing along the time gradient.

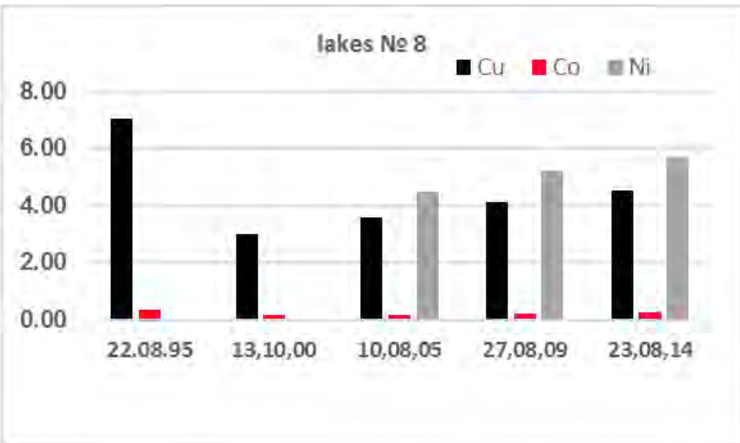

Fig. 8. Percent of complexing form by metals with organic matter in lakes water

Should be noted that change of complexation potential of elements from year to year is determined a lot of factors: concentration of organic matter, metals dispersals, air pollution and other.

Conclusions

1. In lakes without a direct source of pollution complex forms of the elements are determined primarily by the content of organic matter. Suspended substances forms are determined geological characteristics of the territory.

2. The increase in the content of elements in the lakes near the sources of pollution determines a material balance impact on complexation with organic ligands: Al content greater in the lake near the source of pollution than the natural acidification lakes and the content of Cu and Ni complex forms are dominated in lakes near source of pollution.

3. Theoretical calculation of metal forms may be used as an indirect indicator of restoration of lakes. Although the criterion is directly dependent on parameters such as color, organic matter content, pH
4. According to the data, in polluted lakes (direct source) change of complexing for the alkaline earth metals, transition metals are uneven. And to a greater extent are determined by incoming wastewater

5. Lake without a direct source of contamination are characterized by a gradual change in the degree complexing of metals: especially zinc, cobalt, lead. High degree binding of iron and aluminum with an organic material in water on the one hand, creates competition for other metals; on the other hand, can be indicate of stability systems.

4. Minutes of the 32nd Task Force meeting of the ICP Waters programme held in Asker, Norway, May 24-26 2016

CONVENTION ON LONG-RANGE TRANSBOUNDARY AIR POLLUTION

Working Group on Effects

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

MINUTES

of the 32nd meeting of the Programme Task Force held in Asker, Norway, May 24-26, 2016

KEY MESSAGES OF ICP WATERS 2016 TASK FORCE MEETING

Biodiversity Long-term records (12 to 29 years) of aquatic invertebrates (bottom-dwelling aquatic organisms) from circa 100 acid-sensitive sites from 6 European countries, with associated water chemistry and climate parameters, were analysed for trends and correlations between biological, chemical and climate variables. Increases in species diversity were found at a majority of the sites, while sulfate concentrations declined almost without exception. Few trends in climate were found to be significant. Increasing diversity correlated best with water chemical parameters associated with chemical recovery, which indicates that reduced sulfur deposition impacts biodiversity of aquatic invertebrates positively. Fewer relations were found with climatic variables, probably because trends in climate were small compared to trends in deposition and associated water chemistry. However, future environmental change is expected to become less distinct for deposition and more distinct for climate, allowing for the possibility that biodiversity may experience stronger impacts from climate in the future. Further monitoring of acid-sensitive ecosystems remains necessary. It was concluded that biological recovery is indeed associated with increased biodiversity, and that biodiversity will continue to increase when acid deposition decreases. For the studied period, impacts from climate change appear to be secondary.

Mercury Freshwater fish in lakes in boreal regions often contain levels of mercury above limits are advised for human consumption, and even further above environmental quality standards proposed by the EU Water Framework Directive to protect ecosystem health. Long-range atmospheric transport of mercury is the primary source of mercury contamination in these fish. Recently, indications of increases of mercury in fish have been observed. An analysis of temporal and spatial patterns of mercury in freshwater fish from boreal regions is needed to contribute to understanding of factors leading to high mercury levels in fish, and thus far such an analysis is lacking. ICP Waters will collate relevant data from countries in circumpolar regions, in collaboration with ICP Integrated Monitoring and other experts, with the aim to study spatial and temporal patterns of mercury in freshwater fish, which will be presented in the spring of 2017.

Nitrogen and phosphorous While deposition of nitrogen shows widespread declines, in some sites nitrogen deposition shows increases in recent years related to increases in precipitation. Catchment nitrogen input-output budgets show that nitrogen continuous to accumulate in European catchments, while previous trend assessments of ICP Waters do not show widespread increases in inorganic nitrogen concentrations in surface waters. However, nitrogen has become a more important driver of acidification in some regions, most clearly in the Alps. Nitrogen may have impacts on freshwater productivity, especially since clear, but contrasting, trends in phosphorous concentrations in freshwaters have been observed in Sweden and the United States of America. Phosphorous is considered the principal driver of freshwater productivity. In the next call for data, phosphorous will be included to allow an overview of data availability and patterns in ICP Waters sites. The topic is suitable for between-ICP collaboration.

Ground truth - the importance of long-term monitoring Small (lake) catchments with intensive monitoring of deposition, hydrology and chemistry catchments are highly suitable to detect rapid response to changes in environmental change, and provide ground truth data for policy and modelling applications. Additional high frequency monitoring of climatic variables will be valuable to monitor climatic events in addition to long term changes. Examples of such sites exist in many national monitoring networks.

KEY MESSAGES OF ICP WATERS 2016 TASK FORCE MEETING

Dissolved organic carbon A large water chemistry database for Europe and North America shows that concentrations of dissolved organic carbon (DOC) continue to rise, with hardly any signs of levelling off. The primary driver appears to be the reduction in sulfur deposition, while seasalt deposition also add to changes in surface water DOC. Climatic drivers, in particular precipitation strongly affect interannual variation of DOC. More DOC in surface waters leads to higher expenses in providing clear drinking water in regions that depend on surface waters as raw water source. Also, surface water productivity and mercury contamination of aquatic foodwebs may be impacted.

Land use and critical loads A modelling exercise with MAGIC in Sweden showed that exceedance of critical loads for surface waters in Sweden may be affected by forestry, which is predicted to become more intensive in the future as the need for forest-based biofuels may increase as a climate mitigation measure. Forestry and critical loads are linked through uptake of base cations in biomass. Future forest management may impact critical loads exceedances in countries with acid-sensitive surface waters where biofuels are considered as an option to mitigate climate change.

Assessment of surface water acidification under the Water Framework Directive Under the European Water Framework Directive, ecological status of surface waters is assessed with respect to pressures that potentially affect individual water bodies. In Norway, acidification is currently the second-most important pressure for surface water quality. Detailed criteria for assessment of ecological status, using biology and chemistry, have been developed as the result of a fruitful collaboration between monitoring networks, where monitoring data and research under the LRTAP Convention proved highly valuable. There is significant added value in combining data and methods from monitoring networks designed for monitoring air pollution effects and for the Water Framework Directive.

Critical loads Differences in critical limits for critical load calculations may lead to discontinuities in critical load maps across national borders. The background for choice of critical limits is political with regard to which organisms countries choose to protect, while scientific work provides the basis for the critical limits. Further study of differences in national approaches for critical load maps calculations could lead to more consistency in international calculations of critical loads.

Acidification of surface waters is still a concern in acid-sensitive ecosystems Substantial decreases in sulphur deposition have occurred in large parts of world as a result of international cooperation on emission reductions. Sulphur reduction has led to a widespread chemical recovery in surface waters, but many waters have not returned to a pre-industrial reference condition. The subsequent biological recovery is dependent good chemical conditions and has therefore has not been as strong as the chemical. Surface water acidification is an important reason why surface water bodies do not reach 'Good Ecological Status' in accordance with the European Water Framework Directive. In acid sensitive areas, the deposition of nitrogen has become more important than sulphur for surface water acidification, and delays chemical and biological recovery. Further reduction of deposition of sulphur and nitrogen are important to further enhance protection of acid-sensitive aquatic ecosystems.

1. The meeting of the International Cooperative Programme on Assessment and Monitoring of the Effects of Air Pollution on Rivers and Lakes (ICP Waters) organized jointly with

International Cooperative Programme on Assessment and Monitoring of the Effects of Air Pollution Ecosystems (ICP Integrated Monitoring) was attended by 49 experts from the following Parties to the Convention on Long-range Transboundary Air Pollution (CLRTAP): Austria, the Czech Republic, Finland, Germany, Italy, the Netherlands, Norway, Poland, Russian Federation, Sweden, Switzerland, the United Kingdom of Great Britain and the United States of America. In addition a representative of the Working group on effects (WGE), ICP Modelling and Mapping and Joint Expert Group on Dynamic Modelling participated. The list of participants is attached as **Annex I.**

Introductions

2. Ms. Eli-Marie Åsen, Ministry of Climate and Environment welcomed all participants to the joint ICP Waters and ICP IM meeting in Asker, Norway. Ms. Åsen thanked both ICPs for their important work by providing expertise to the convention work in Europe. She described how the scientific expertise of ICP Waters and ICP Integrated Monitoring (ICP IM) has helped develop environmental legislation under the convention. Ms. Åsen gave a description of the historical convention work and presented the new LRTAP assessment report that will be presented in Brussels 31st of May, "Towards Cleaner Air" and gave a short summary of this report. Ms. Åsen explained that acidification of surface waters is still important driver of environmental change, and in Norway acidification is the second most important factor for why water courses do not achieve "good water quality" status in accordance with the Water Framework Directive. Ms. Åsen stated that future challenges will include linking effects on water quality and human health. Calls for an interdisciplinary approach to mitigate climate change are asked for on policy levels. Ms. Åsen wished all participants a productive meeting.
3. Ms. Greta Bentzen, Administrative director of the Norwegian Institute for Water Research (NIVA) opened the meeting by welcoming all participants to Norway and Asker. Ms. Bentzen described the importance of long term monitoring, scientific collaboration and numerous scientific reports that ICP waters has produced over the years. Ms. Bentzen presented the history of Norwegian acidification research and what role acidification has had historically. Ms. Bentzen highlighted how the international collaboration reduced the effects on acidification and how this is an example of effective policy and how this could be translated to climate change research. Ms. Bentzen thanked the organisers of this meeting and the Norwegian Environmental Agency.
4. Mr. Gunnar Skotte, the Chair of ICP Waters and Mr. Lars Lundin, the Chair of ICP IM, welcomed all participants to the ICP Waters meeting in Asker Norway and thanked Norway for hosting the meeting.
5. Mr. Gunnar Skotte (Chair ICP Waters), Chair of the ICP Waters Programme Task Force, thanked Ms. de Wit, the local organizer, for hosting the meeting and the introductory speakers for their presentations and warm welcoming words. Then Mr. Skotte welcomed all participants to the 32nd Task Force Meeting of ICP Waters and ICP IM in Asker, especially as this is the first joint meeting of both ICPs. He welcomed the Chair of the Working Group on Effects (WGE), ICP Modelling and Mapping, and the Joint Export Group on Dynamic Modelling (JEG DM) to the meeting.

6. The Task Force adopted the agenda of the meeting (**Annex II**).
7. Ms. de Wit (ICP Waters Programme Centre) gave some general information about the meeting and on the excursion.
8. Mr. Kaste (ICP Waters Programme Centre, Norway) gave a presentation with the title "Small calibrated catchments - important response units for environmental change". Mr. Kaste showed the importance of long-term monitoring on calibrated catchments in Norway. Norway has six calibrated catchments in the Norwegian national monitoring programme and they cover gradients in climate, deposition, land cover and water chemistry. Mr. Kaste presented how the calibrated catchments provide rapid response to changes in environmental change, and how high frequency monitoring can provide opportunities to capture climate events and long term changes. Mr. Kaste presented long term monitoring data for all six sites. All sites show recovery from acidification but remain acidified. The ANC levels are at levels in which mobilization of toxic elements to fish are occurring in most sites and the steady decline in base cations is a concern for surface water biota. The high frequency monitoring helps capture events and Mr. Kaste exemplified this with nitrogen and raised the importance and transformation to organic nitrogen. Mr. Kaste finished the presentation with showing the importance of long term monitoring for research in the future and gave important examples of large projects based on long-term monitoring. Mr. Hruska asked why nitrogen deposition has increased the last few years, Mr. Kaste answered that the precipitation increase is the reason for this. Mr. Grennfelt pointed out that this is an important question and that N deposition is not going down and urged that others too look at this. Mr. Forsius said that the ICP waters data is extremely important data for future climate change. Ms. de Wit, said that nitrogen is potentially a future topic for ICPs, and asked the focal centre to think about this during the meeting.
9. Mr. Peringe Grennfelt (Chair of the WGE) presented news and emerging issues from the WGE. Mr. Grennfelt gave an overview of the organization of the Convention, and recent changes therein. Mr. Grennfelt highlighted that there is a need for more collaboration between the ICPs. Mr. Grennfelt presented the LTRAP Assessment Report "Towards Cleaner Air". Mr. Grennfelt thanked Ms. de Wit for coordinating the WGE trend report as a background document for the Assessment Report. Mr. Grennfelt reported the key messages from the recent Extended Bureau Meeting of EMEP and WGE: 1) Air pollution still causes serious damage to health and ecosystems. 2) Air pollution remains an international problem. 3) Solutions are available to meet for instance the WHO PM 2.5 guideline levels, but this has to be addressed on all spatial levels with combined measures. The success is of pollution reductions are dependent on collaboration. 4) Results are dependent on successful policy arena. 5) There are synergies with other policy areas, such as pollution and climate. 6) Ozone requires northern hemispheric cooperating including methane abatement.

   Mr. Grennfelt gave highlights from the Executive Body meeting in Geneva, and gave a description of the Executive Body work plan. WGE is exploring other types of collaboration, for instance with Copernicus, a European Programme for monitoring the earth. Also, AMAP and EMEP find results of work done by ICP Waters and ICP IM on mercury interesting and important. Mr. Grennfelt gave a description of the financial issues of WGE. The Netherlands have announced a severe reduction in budget in the funding to the CCE, which is worrying because of the synthesizing role that CCE has under the WGE. No funding is available after 2017. Mr. Grennfelt highlighted the importance of long term monitoring data and suggests closer collaboration between ICPs. Mr. Grennfelt highlighted the unique database for ICP Waters and the importance to make data increasingly visible. Mr. Grennfelt concluded with highlighting that acidification of surface waters is still a problem.

10. Mr. Max Posch (CCE, Netherlands) reported from the ICP Mapping and Modelling Programme. Mr. Posch described the ICP M&M activities and the call for data. He described the purpose and gave information on the updated Critical Loads maps and the different Critical Loads calculations, showing the exceedance of N as a eutrophying substance across Europe. Mr. Posch gave a detailed description on the critical loads for biodiversity. He also mentioned the problems finding funding to continue to support the CCE.

11. Mr. Filip Moldan (Sweden) reported from the JEG DM. He described the history of the programme, purpose, extent and priorities of the programme. Mr. Moldan highlighted the importance of climate change scenarios in the dynamic models for ecosystem effects from air pollution. He welcomed participants to join the next meeting on 26-28 of October in Sitges, Spain.

Reports from the ICP Waters Programme activities 2016/2017

12. Ms. Heleen de Wit (ICP Waters Programme Centre) from the Programme Centre reported on the status of the ICP Waters programme and on common work under the WGE for effect-based approach. She emphasised that ICP Waters should produce policy-relevant results. She further presented the ICP Waters programme aims, main area of activities and recent reports. The state of the water chemistry and biology data base and number of participants at the TF meeting was presented (Annex III). Current work includes mercury assessment done jointly by ICP Waters and ICP IM. Biological trend analysis by Mr. Velle. Ms. de Wit was responsible for the coordination of the WGE trend assessment report. Ms. de Wit presented discussion points for Thursday,

13. Ms. Heleen de Wit (ICP Waters Programme Centre) reported on representation of ICP Waters in other bodies/meetings under the Convention. ICP Waters was represented at the following meetings:

- April 15: TF Materials, Oslo, Norway - Mr. Skotte
- May 15: ICP IM, Minsk, Belarus - Ms. de Wit
- Sept 15: Joint meeting EMEP & WGE, Geneva, Switzerland - Mr. Skotte, Ms. de Wit
- Oct 15: Acid Rain, Rochester NY - Ms. de Wit and many others
- March 16: WGE and EMEP meeting, Geneva, Switzerland - Mr. Skotte
- April 16: ICP M&M, Dessau, Germany - Mr. Valinia

14. Ms. Heleen de Wit (ICP Waters Programme Centre) presented new reports and papers from ICP Waters. These are

- ICP Waters report 126/2016 Proceedings Task Force meeting 2015. Proceedings of the Task Force meeting of the ICP Waters Programme in Monte Verita, Norway 6th - 8th October, 2015. de Wit, H.A.; Valinia, S. and Steingruber S.
- WGE trend report 125/2015 Trends in ecosystem and health responses to long-range transported atmospheric pollutants. Coordinated by ICP Waters
- ICP Waters report 124/2015 Biological intercalibration 1915. Fjellheim, Arne; Johannessen, Arne; Landås, Torunn Svanevik
- ICP Waters report 123/2015 Chemical intercomparison 1529. Carlos Escudero

15. Ms. Heleen de Wit (ICP Waters Programme Centre) outlined current work. This can be summarized as follows:
    - The trend assessment of biodiversity and climate
    - The CLTRAP EMEP/WGE Assessment Report
    - Mercury report (collaboration between ICP Waters and ICP IM)

16. Mr. Lars Lundin (Chair, ICP IM) presented status of the ICP Integrated Monitoring programme and on common work under the WGE. He emphasised that ICP IM contribute to develop and validate models in pristine sites. The focus is on catchment approaches, including budget calculations. He further presented the ICP IM programme aims, main area of activities and recent reports. The state of the catchments and number of participants at the TF meeting was presented. Mr. Lundin presented on going work and priority for the ICP IM projects. Mr. Lundin thanked the ICP Waters for the invitation to organize a common meeting with ICP IM. Mr. Wright asked how stable the funding is for ICP IM. Mr. Lundin answered that the trust fund is stable the last few years and it is up to each country to fund the IM-sites.

Acidification and recovery

17. Mr. Jussi Vuorenmaa (ICP IM Programme centre) gave a presentation titled "Long-term sulphate and inorganic nitrogen mass balance budgets in European ICP Integrated Monitoring catchments". A total of 17 sites across Europe were analysed and he showed key results on the mass balance in the different catchments. A key message was that catchments have a net loss sulfate from soils to surface waters due to the high amount of sulfur stored in the soils from the legacy of acid deposition. This suggests recovery of acid soils but more sulfur in the surface waters. Total inorganic nitrogen was still accumulating in the catchment. He suggested that N saturation could be a future problem, as retention and release of S and N are sensitive to climate change. Mr. Wright asked if excess sulfate was stored in the soils, Mr. Vuorenmaa stated that there are two main processes, absorption/desorption and mineralization, but which process is key is not analysed in this study. Mr Moldan asked why the net release of sulfur started 10 years later than the decrease of acid deposition? No answer could be given as more research is needed. Mr. Kaste asked if climatic factors can be important driver in the future. Mr. Vuorenmaa answered the climate has been identified as an important driver of nitrogen dynamics in the recent years. More research in needed to address these questions.

18. Mr. Herman van Dam (the Netherlands) gave a presentation titled "Monitoring recovery of acidification and effects of climatic change in shallow soft water lakes in The Netherlands: Temperature, hydrology, chemistry, diatoms". The dataset Mr. van Dam presented started in 1978, with four samples annually. The shallow Dutch small lakes (referred as pools) showed substantial reduced acidification and lead to increases in pH in all sites. Monitoring data from 1975 to 2015 showed the importance of lake hydromorpology as the lakes responded differently to reduced atmospheric deposition. Mr. van Dam presented long term data of diatoms, already sampling started in 1920 and was resampled in 1978. The comparison showed that the community went from multiple species (1920) to single acid sensitive specie in 1978. Mr. van Dam highlights that there is a substantial need to continue with intensive and standardized monitoring to understand what drives environmental change. Studies similar to this are crucial for restoration projects as they provide important background data. Mr. Forsius asked if these pools are stratified, Mr. van Dam answered that there are not stratified as the pools are very shallow. Mr. Velle asked if the diatoms move to a new steady state and if it is possible to separate the effects of eutrophication and warming. Mr. van Dam answered that it is not possible to separate these two effects. Ms. de Wit complements Mr. van Dam on the hard work to maintain the data series and thanked Mr. van Dam that he provided this important dataset to the ICP water database.

19. Ms. Marina Dinu (Russian Federation) gave a presentation titled "Features of Recovery of the Kola North lakes in reducing atmospheric deposition (1990-2014)". Ms. Dinu presented metal composition and distribution of 15 lakes across the Kola North. Some of the lakes were located near the source of pollution and a few sites were chosen as reference sites. Multiple metals and their complexation were analysed with two different methods and provided similar results. Ms. Dinu concluded that both methods could be used to assess metal complexation in lakes. Mr. Wright asked how the deposition has changed over time? Ms. Dinu said that the deposition is changed over time and during the last years it has been stable.

20. Mr. Jens Fölster, (Sweden), gave a presentation titled "Cold, dark and lifeless: the future of northern lakes?" 81 Swedish lakes were analysed with long term monitoring data, and about 50 % of the lakes had declining Tot-P concentrations, Mr. Fölster showed that many lakes across the climatic gradients are changing state to more oligotrophic and gave multiple possible explanations on drivers of the recent decrease of Tot-P. Mr. Fölster suggested that the increase of organic matter is slowing down the oligotrophication in Swedish lakes as decreases in Tot-P is higher in lakes with no increasing trend in organic matter. A simple model was developed and TOC, Al/P and pH explained 74% of the variation. The data presented by Mr. Fölster found mostly catchment drivers but he highlighted that there are multiple in lake processes that can affect the Tot-P concentrations. Mr. Fölster explained that the many regions in the northern hemisphere are experiencing declines in phosphorous and it is likely the legacy of acid deposition that has direct and indirect effect. Mr. Moldan asked what Mr. Fölster thinks about the "lifeless state". Ms. de Wit asked about the aluminum/phosphorous dynamics and it would be interesting to look at this on a wider perspective together with nitrogen.

21. Mr. John Stoddard (United States) gave a presentation titled "Phosphorus trends". This study was recently published in ES&T and the dataset includes about 1300 sites that are sampled every 5 years. Between 2004, 2009 and 2015, the concentrations of total phosphorus substantially increased in streams across the US. Similar trends were identified for lakes across the US. Further analysis was made on reference sites without human disturbance, and phosphorus concentrations increased for the reference sites as well. No change in nitrogen was identified in the surveys indicating that there is not a co-variance with agriculture practices. Changes in hydrology, forest dieback, and recovery from acidification have not occurred across the whole continent, so they cannot be used as single explanations for the observed trends. Atmospheric deposition might a common driver, related to phosphorus in dust and storms and extreme hydrologic events. Mr. Forsius asked whether increased weathering rates due to temperature could be a driver. Mr. Stoddard answered that there is no increase temperature. Ms. de Wit suggested that particulate matter (PMs) in air may provide relevant data. Mr. Stoddard answered that the trends of PM_{10} are going in the opposite direction.

Heavy metals and POPs

22. Mr. Hans Fredrik Braaten (ICP Waters Programme Centre) gave a presentation titled "Evaluating the temporal trends of mercury concentrations in Norwegian freshwater fish - a study of 25 years of data (common ICP Waters and ICP IM report: Mercury)". Mr. Braaten gave rich background information on the historical development of mercury in fresh water fish. The aim of this report is to analyse mercury trends in freshwater fish on a larger spatial scale to include multiple areas and compare climatic, deposition and water chemical parameters. Mr. Braaten gave a description of the selection criteria of the sites, species and time periods that was used to collect preliminary data for the study. Mr. Braaten used UN/ECE transfer function to allow comparison of different fish species and age classes. The results indicate that all lakes exceed 0.02 mg/kg (EU EQS threshold) and 21% of the lakes exceed the 0.5 mg/kg WHO recommendation. There is a strong, well-documented link between high DOC in surface waters and total mercury concentrations in fish. Next steps in the analysis are to consider other water chemical compounds and climatic factors on mercury in fish. Mr. Hruska enquired after the possible mechanisms behind recovery from acidification and the mercury concentrations? Mr. Braaten suggested that the mechanism could be browning of surface waters. Mr. Åkerblom asked if there are any efforts in putting all these data in a Norwegian database? Mr. Skotte answered that most of these data can be found in a national data portal (data can be found at <http://vannmiljo.miljodirektoratet.no/>). Ms. de Wit invited all participants and focal centres to contribute with data for this report, so a common portal for Europe can be built up.

23. Mr. Staffan Åkerblom (ICP IM Programme Centre) gave a presentation titled "Progress report of Hg and heavy metals in terrestrial and aquatic ecosystems in Nordic countries". Mr. Åkerbloom started with giving a history of the different conventions on mercury as a pollutant. Accumulation of heavy metals in forest soils across European IM sites has been found, which can potentially act as a source of heavy metals to surface waters. Mr. Åkerbloom explained that long term monitoring is very important to evaluate effects of reduction in atmospheric emissions of heavy metals. Based on the fish survey data,

mercury concentrations and deposition trends do not follow each other well and more explanatory parameters are needed to describe the discrepancy. Mr. Åkerblom expressed the need for more data on a larger spatial scale to improve the regional assessments and evaluate what effects the reductions have on mercury concentrations. Mr. Åkerblom expressed that mercury and heavy metals are an important area for possible collaboration between ICP IM and ICP Waters. Mr. Grennfelt suggested that the soil data collected by ICP IM could be compared with the moss surveys done by ICP Vegetation. Mr. Grennfelt also expressed that it is important to discuss possible management options with regarding to accumulating mercury in the soils and leaching to surface waters.

24. Mr. Martti Rask (Finland) gave a presentation titled "Increased mercury concentrations of perch in Finnish lakes recovering from acidification". The study is based on mercury sampling in perch, and associated water chemistry, from 2013, in particular acid sensitive areas in southern Finland. Some lakes were also sampled in 1980 that allowed for comparison between the time periods. In some lakes, there was strong increase in Hg in fish. Mr. Rask did not identify any correlation between fish Hg increases and surface water browning, while strong relation to increases in pH and alkalinity where identified. In Finland, no effect of forestry has been identified on the mercury concentrations in perch. There was a clear connection between growth and dilution of mercury concentrations in perch in Finnish sites. Mr. Rask evaluated various mechanisms explaining the increase of mercury in perch but concluded that DOC increases, forestry and growth patterns, single or in combination, could not explain the increase. Mr. Rosseland enquired if any measurements of selenium were done. Mr. Rask answered that selenium would indeed be relevant to analyse. Mr Forsius asked if Sweden and Norway are showing the same trends. Mr Rask replied that it is possible that recovery of acidified lakes could cause increases in fish mercury. Ms. de Wit asked if Mr Rask could elucidate the possible connection between pH and mercury. Mr Rask answered that he does not know, but it might be connected to the mobility in mercury.

Critical loads and dynamic modelling

25. Ms. Maria Holmberg (ICP IM Programme Centre) gave a presentation titled "Dynamic modelling (VSD+) at selected ICP IM sites". Ms. Holmberg started the presentation with presenting the background of the effects of nitrogen deposition, and the potential effects on biodiversity across Europe. Ms. Holmberg gave a description of the VSD+ model chain that was used in the current study. The model chain is used to assess the habitat suitability index for each site to assess the future effects of nitrogen deposition. In total, 27 sites are in the study and she showed the results between modelled and measured water chemical parameters and output from the PROPS vegetation model. The next step will be continued the modelling exercise and test all sites including new deposition scenarios.

26. Mr. Filip Moldan (Sweden) gave a presentation titled "MAGIC library in Sweden – consequences of new forestry scenario's and impacts on critical loads calculations". Mr. Moldan gave information on Swedish environmental objectives and how the classification is done. Mr. Moldan gave a description of the MAGIC library which is used to assess historical changes based on basic water chemistry and a matching function. The new

MAGIC run has a more detailed forestry scenario and with less uptake compared to previous calibrations. Today there are still 10 % acidified lakes and future runs predictions suggested that about 7 % acidification was predicted for the year 2100. Mr. Moldan showed that 12 % of Sweden's area has exceeded the critical loads. Mr. Fölster mentioned that there is discrepancy between acidification and critical load maps. Mr. Moldan expressed that the accuracy of the predictions were highly dependent on actual forest management, which in its turn depends strongly on the societal need for biofuel. The need for biofuel is also guided by the availability of other sources for renewable energy, such as waste from households.

Critical thresholds and biology recovery

27. Mr. Gaute Velle (ICP Waters Programme sub-centre) presented results for the 2015 ICP waters report. The aim of the analysis was to tease out effects climate change on biodiversity on acidified lakes, i.e. the effects of increased temperature and precipitation on biodiversity. He gave a background of the project and the surface waters sampling data available. Mr. Velle discussed uncertainties in the dataset and how these have been addressed. Benthic invertebrate data were available for the period 1981 to 2014, and in some sites the time period was shorter. Both rivers and lakes showed had significant positive trends in EPT taxa, about 30 % of them were significant trends. Based on suggestions from the Task Force meeting in 2015, the sites were now grouped according to pH. The most sensitive sites (pH <5.5) had the highest increase in biodiversity. Mr. Velle showed trends in climate, and identified that most sites did not show significant increases in temperature, while a few had significant increases in precipitation. The results with the new EPT taxa showed increases in diversity in lake and river systems with decreases in sulphur as the most important driver for diversity changes. Mr. Velle analysed dose-related change in biodiversity, which means a change in driver and how that is linked to the biodiversity. When divided into pH classes significant results were identified between EPT taxa and precipitation, as biodiversity responds differently based on pH characteristics. Similar results were identified with temperature. The results indicated that biodiversity will continue to increase when acid deposition decreases. Mr Velle concluded that reductions in atmospheric acid deposition will increase biodiversity.
28. The presentation inspired a long discussion on methodology and interpretation of the preliminary results. Mr. Forsius asked why some sites have negative trends in biodiversity? Mr. Stoddard complemented the work done by Mr. Velle work, and that these are very interesting results. He also asked if other chemical parameters were tested as sulfur has so strong statistical power, is there are any first principal reasons why we have picked these parameters. Mr. Velle said no. Mr. Monteith asked if the analysis becomes "clouded" when divided into quarters? Mr. Velle stated that the resolution is not high enough for it to be affected as most sites are sampled during the spring. Mr. Monteith further asked if multiple interactions of for instance BC and pH can be used. Mr. Velle answered that it has been tested, but it becomes very complicated statistics with the Bayesian modelling. The Task Force expressed its satisfaction with the progress made by Mr. Velle.
29. Ms. Ann Kristin Schartau (Norway) gave a presentation titled "Assessment of acid sensitive lakes in Norway: comparison of ecological status based on water chemistry and

biology". Ms. Schartau described the history of the European Water Framework Directive and the classification system. She gave a detailed description of the supporting chemical data used in the analysis for biota and examples of the link between chemistry and fish and what type specific reference conditions are used in Norway. Ms. Schartau gave a detailed description of the surface water monitoring program including different parameters and temporal patterns. The spatial water chemistry pattern followed the recovery from acidification. The macroinvertebrates data showed that some regions have reached the environmental objectives, while the other area the recovery is slower. Like the macroinvertebrates, fish species have returned in some areas to reach the environmental objectives but there are substantial variations in recovery rates. Most lakes (80%) have reached good chemical status with respect to chemical parameters, whereas only 23% lakes have reached good ecological status with regard to biology recovery. Mr. van Dam asked about the macrophytes, but this was not included in the national monitoring program in Norway.

30. Ms. Kari Austnes (Norway) gave a presentation titled "Critical loads and critical limits - a Swedish-Norwegian comparison". Ms. Austnes provided a description of the background of the comparison. In general, the Swedish method gave much lower critical load than the Norwegian. This is linked to the parameter chosen for estimating reference condition and to the classification of reference conditions. Ms. Austnes presented the relationship between ANC and biota for both countries. She highlighted that choice of method is a political question linked to what species we want to protect. Mr. Fölster welcomed future collaboration and revisiting the pH and ANC calculations and their relationship to biota between Norway and Sweden.

Climate change

31. Mr. Jakub Hruska (Czech Republic) gave a presentation titled "Drought induced chemistry changes in stream waters recovering from acidification". The Lysina site is part of both ICP Waters and ICP IM. In the Czech Republic, a substantial increase in temperature and higher storm frequency has been recorded during the last few years. Data presented by Mr. Hruska showed substantial droughts the last two years. The drought period did not affect the sulfate, chloride or nitrate concentrations in the streams. The base cations and DOC were not affected either during the drought period. As a result of the drought, more variation occurred during mean annual measurements of chemical parameters. Mr. Stoddard asked why pH had changed when other parameters did not? Mr. Hruska answered that this could be linked to dilution with respect to base cations. Mr. Moldan asked if the catchment is starting to accumulate sulfur. Mr. Hruska answered that this has indeed occurred.

32. Mr. Andreas Bruder (Switzerland) gave a presentation titled "Lago Nero - a new site to assess the effects of environmental change on high-alpine lakes and their catchments". He described of the Lago Nero catchment with regard to air pollution and the monitoring program of the area. The program will run for at least four year as funding has been secured. The deposition pattern show high annual and inter-annual variability which is linked to high amounts of precipitation in the catchment. High fluxes of sulfate and nitrogen are identified during the snowmelt periods and the budget calculation shows that

much of the nitrogen is retained in the catchment. Further analysis understanding the mechanism for nitrogen retention is needed and was planned as part of the monitoring programme. Mr. Bruder stressed the importance of high frequency sampling and gave an outlook for the plans for the site. Mr. Stoddard asked if there are any plans to include dry deposition. Mr. Bruder answered that this is in the pipeline. Mr. Rosseland asked if the phosphorus is measured and if it can be linked to the Sahara dust storms. Mr. Bruder answered that this monitored and will be analysed in the future.

33. Ms. Heleen de Wit (ICP waters Programme centre) gave a presentation titled "Climatic and chemical drivers of trends in DOC in Northern surface waters in Europe and North America" Ms. de Wit explained that much work has been put in to develop the database and presented the current status of the work and gave a description of the different data sources. In general, only the UK are showing weakening trends, while for most other places the lakes and rivers are getting browner at the same rate as the previous analysis. Mean annual temperature and precipitation show more variation on the trends of DOC. In the future, precipitation seems to grow more important. The data analysis is under progress and more data will be added to the database and further investigations will be done. Mr. Monteith asked if it might be inter-annual variation is what we are linking the DOC trends to. Mr. Wright asked for possible reasons why a stronger relation between trends in DOC and sulfate after 2000. Mr. Monteith suggested that the relationship between DOC and sulfate might not be linear.

Common work for all ICPs, current issues from WGE, potential for more collaboration between ICPs

34. Ms. de Wit (ICP Waters Programme Centre) gave a presentation on the common reports between ICP Waters and ICP IM and possibly new topics. She presented issues from the convention including emerged from WGE: joint meetings, data portal, open data access, Assessment Report, WGE trend Report. She also presented how ICP Waters have responded to the recommendations and gave examples what measures have been taken to address the recommendations.

35. Mr. Salar Valinia (ICP Waters Programme Centre) presented ideas for the next ICP Waters thematic report on the regional assessment of acidification. At present, the key policy instrument for presentation of the current state of surface water acidification is the map of exceedances of critical loads. This gives only a limited view on the status of acidified lakes as areas that are currently non-exceeded may still contain lakes that are acidified. In this report, the aim is to go one step further and present the actual state and regional extent of acidified lakes for as many countries as possible. The ICP Waters database is aimed to present temporal trends, and is not primarily suited to give a regionally explicit overview of surface water acidification. Mr. Valinia presented possible methodologies to do an assessment, included MAGIC modelling and/or MetaMAGIC, with the aim to produce maps and proportion of acidified lakes in countries. Ms. de Wit suggested that contributions from NFCs would be extremely welcome and useful for this ICP Waters report and invited NFCs for opinions on possibilities to contribute. Mr. Fölster (Sweden) expressed that this would be a very useful exercise, although it might be somewhat difficult to assess the number of lakes. Ms. Steingruber (Switzerland) said that

this would be interesting, but that an assessment for all of Switzerland would be a significant project. Also, she wondered how to establish a reference state. Ms. de Wit replied that it might be better to only consider the acid-sensitive part of Switzerland. Ms. Rogora (Italy) answered that Italy would be interested to contribute, both with Magic and MetaMAGIC, and that some parts of the Italian Alps are acid-sensitive. Mr. Stoddard (USA) answered that this assessment would be of large value for Europe, and said it would be relevant to also contribute for the US. Mr. Forsius (ICP IM) said that ICP IM sites could have relevant data, and that other relevant partners for this assessment would be CCE and ICP M&M. Mr. Stoddard stated that the modelling expertise of ICP IM would be relevant in this assessment. Ms. de Wit concluded with thanking all NFCs for their contribution to the discussion and that it was clear that NFCs could play a very important role in this report. She said that ICP Waters would discuss more details in the separate part of the Task Force meeting.

36. Ms. de Wit presented ideas for potential new themes for reports, and started with mentioning nitrogen. ICP Waters has produced a report on impacts of (reactive) nitrogen in surface waters earlier, while more a detailed recent analysis of trends in nitrate is lacking. The meeting so far has produced some very interesting trends in phosphorous, and to understand trends of these elements in combination would be very relevant for assessing effects of deposition on surface water productivity. Ms. de Wit asked the Task Force meeting for opinions on this suggested theme. Mr. Forsius (Finland) expressed that this theme is very important and can potentially produce very relevant results, in particular connecting deposition, nitrogen budgets and time series. He concluded that there is a good potential for joining forces between ICP IM and ICP Waters on this topic. Mr. Stoddard wondered if, since ICP waters have had previous focus on nitrogen, there were any new things to say? Ms. de Wit suggested that adding phosphorous presents something novel. Mr. Stoddard answered that it is risky to phosphorous on the list without knowing what data is available. To this, Ms. de Wit agreed. Ms. Rogora (Italy) stated that different forms of nitrogen would be interesting. Ms. Holmberg (Finland) suggested that including effects on climate and bio-economy in the nutrient assessment could be interesting. Mr. Monteith (UK) suggested that a trend analysis could be interesting and focusing on the legacy of nitrogen deposition. Ms. de Wit concluded that a first step in the analysis would be to ask for phosphorous data in the next call for data for ICP Waters, and evaluate those data before deciding if they would be included in an assessment. Mr. Forsius (ICP IM) expressed that nitrogen is a relevant topic for future collaboration between the ICPs, to which Ms. de Wit agreed. Mr. Moldan suggested that the Task Force on Reactive Nitrogen is working on similar topics and that it could be relevant to be updated on the status of their work.

37. Ms. de Wit reminded the Task Force of some highlights of the mercury report and invited Mr. Braaten to give an update on the current collaboration. Mr. Braaten explained that the collaboration includes Sweden and Finland, and that contacts have been made with potential collaborators in the Russian Federation. Mr. Braaten said that he intended to establish a common database. The planning for the final report to present it in the spring of 2017. Mr. Forsius informed the Task Force meeting that he is currently the Chair of AMAP, and that the next AMAP meeting in Russia will discuss a mercury report focusing

on pan-arctic systems. He said that the mercury report could be a very relevant contribution to the AMAP report. Mr. Braaten agreed to send some information on the ICP Waters mercury report to Mr. Forsius, for him to present at the AMAP meeting. Mr. Rask (Finland) added some cautionary words that it would require time and resources to build a database as many data are not very well organized Mr. Skotte asked if it might be possible to include work on critical exceedances of mercury critical loads in the planned report. Mr. Posch explained that it is up to individual countries to require updates of critical load maps. Mr. Forsius suggested that an empirical model for mercury could be used for the critical load assessment on a Scandinavia. Mr. Posch informed that there is a CCE report with information on the status of the delivery on critical loads for mercury. Mr. Åkerblom invited all participants of the Task Force meeting to submit data for mercury in fish.

38. Ms. de Wit reminded the Task Force of the wishes from the WGE to increase the visibility of data, and asked the focal centres to provide a link and a short description of the data portal that can be shown on the ICP Waters webpage.

39. Mr. Forsius (Programme centre ICP IM) presented how carbon cycle research can be used in policy relevant sciences and presented three examples of this: 1) Carbon stores and fluxes 2) Long-term changes in C fluxes and stores. 3) Impacts of land use changes and policies.

40. Mr. Forsius (Programme centre ICP IM) gave a presentation titled "The upcoming EU directive on National Emission Ceilings and cooperation with AMAP. The new EU-NEC directive and the proposal are currently being negotiated and the directive is linked to Natura 2000. The NEC directive would provide a strong legal basis for future monitoring. The decision will probably come quite soon. Ms. Forsius urged the focal centres to analyse annex V and contact the national water authorities as the directive will can have an effect on the national monitoring programs.

41. Mr. Forsius (Chair of Arctic Monitoring and Assessment Programme, AMAP) gave a presentation on the goals and aims of AMAP and what the role of the programme has on an international level. Mr. Forsius presented how AMAP and LRTAP cooperation functions and presented the recent report of Arctic freshwater synthesis.

Separate Task Force meeting ICP Waters

42. Ms. de Wit reminded the Task Force meeting of the previous discussion on 'regional extent of acidification of surface waters', and concluded that this will be the new thematic report for 2017. The report would benefit from contributions from the focal centres. Replies from the focal centres included both support but also warnings that a full assessment might be resource-demanding and that data availability might be challenging. Also, different countries might employ different criteria to assess acidification status. There was support for a MetaMAGIC. Ms. de Wit suggested that the best approach might be that each focal center can produce a chapter describing national approach and status of data availability.

43. The Programme Centre received support from the Task Force meeting to continue with this theme (a regional assessment of surface water acidification) as the 2017 thematic

report. In the next Task Force meeting, a workshop will be held to prepare the report. A reference group was made that consists of Mr. Valinia (Programme Centre), Mr. Stoddard (USA), Ms. Rogora (Italy), Mr. Monteith (UK), Mr. Fölster (Sweden) and Mr. Hruska (Czech Republic).

44. Ms. de Wit (ICP Waters Programme Centre) reminded the Task Force of the previous discussion on trends in phosphorous and informed that the next call for data will include water chemical data on phosphorous (all species), for assessment of trends. Mr. Fölster suggested that tot-P should be included in the chemical inter-calibration and the Task Force meeting applauded this.

45. Mr. Sample (ICP Waters Programme Centre) gave a presentation on the ICP Waters database and new ideas on how to develop the webpage. He also presented that call for data will be as previous years, in addition to phosphorous data, and it would be appreciated to use the ICP Waters template. A total of 266 sites and 18 countries are included in the database.

46. Mr. Valinia (ICP Waters Programme Centre) gave a presentation on the plans to update the ICP waters webpage and in particular focusing on data visualization and data access. The Programme Centre and the Focal Centres welcomed this.

47. Mr. Ulańczyk (Poland) gave a presentation of new candidate sites to contribute to ICP Waters from Poland. Mr. Ulańczyk gave a detailed description of the candidates. The monitoring data includes biological, chemical and organic pollutants. The ICP Waters programme centre welcomed Poland back to the programme. Mr. van Dam (the Netherlands) informed that much diatom work has been done for these lakes in early 1920s. Mr. Hruska (Czech republic) stated that Slovakia might be able to provide data to ICP Waters also, but right now a Focal Centre from Slovakia is lacking. This will examined further by the Programme Centre.

48. Ms. de Wit invited for feedback from the focal centres on the first joint Task Force meeting with ICP Integrated Monitoring. Mr. Velle suggested that the work plan sessions, together with ICP IM for common discussions, and separate for ICP Waters, could be extended to allow sufficient time. All agreed that this would be useful, also if this means that the meeting could extend to three days. In general, all feedback was positive and the benefits for collaboration on reports and databases were highlighted. The Task Force meeting was positive to future joint meetings with ICP Integrated Monitoring.

Other business

49. Mr. Fölster (Sweden) invited ICP Waters to Uppsala, Sweden, for the next Task Force meeting in 2017. The Task Force meeting will be held the 9-11th of May, 2017.

50. Mr. Gunnar Skotte (Chair ICP Waters) thanked all participants for a constructive meeting and thanked the organizers Ms. de Wit and Mr. Valinia for an excellent hosting of the meeting, including an interesting excursion and very pleasant Task Force dinner. He thanked the Programme Centre for the organization of the meeting.

51. The Task Force expressed its appreciation to the Programme Centre for its scientific and coordinating work and acknowledged its important contribution to the programme's successful implementation. Finally, the Task Force recognizes that the contributions of the National Focal Centres and cooperating institutes are essential for the high quality output from the programme.
52. Mr. Lars Lundin (Chair ICP IM) and Mr. Gunnar Skotte (Chair ICP Waters) expressed that both ICPs were content with the joint meeting. Mr. Lundin expressed his thanks to ICP Waters for the practical organization of the meeting, informed that ICP IM will consider also other ICPs for common meetings, and suggested that the decision on a future joint meeting will need some additional consideration.

Adoption of the minutes

53. The decisions in the ICP Waters meeting as written in the minutes were adopted by the Task Force.

5. Annex I: Participants at the ICP Waters 32nd Task Force meeting

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6. Annex II: Agenda for the 32nd Task Force ICP Waters May 24-26, 2016

Venue: Holmen Fjordhotell in Asker

Introductions

- Meeting welcome, *Eli-Marie Åsen, Ministry of Climate and Environment*
- Meeting welcome, *Greta Bentzen, Administrative director of NIVA*
- Opening words, *Gunnar Skotte, ICP Waters & Lars Lundin, ICP IM*
- Adoption of the agenda*, Gunnar Skotte, ICP Waters Chairperson*
- General information about the meeting and excursion, *Heleen de Wit, local host*
- Small calibrated catchments - important response units for environmental change, *Øyvind Kaste, Programme Centre ICP Waters*
- Report from the Working Group on Effects, *Peringe Grennfelt, Chair of the Working Group on Effects*
- Reports from other ICPs - (ICP M&M, JEG)

Summary of the ICP Programme activities 2015/2016

- Status of the ICP Waters programme, and report on common work for effect-oriented programmes under the Working Group on Effects, *Heleen de Wit, Programme Centre ICP Waters*
- Status of the ICP Integrated Monitoring programme, *Lars Lundin, Chair ICP IM*

Acidification and recovery

- Long-term sulphate and inorganic nitrogen mass balance budgets in European ICP Integrated Monitoring catchments, *Jussi Vuorenmaa, Programme Centre ICP IM*
- Monitoring recovery of acidification and effects of climatic change in shallow soft water lakes in The Netherlands: Temperature, hydrology, chemistry, diatoms *Herman van Dam, the Netherlands*
- Features of Recovery of the Kola North lakes in reducing atmospheric deposition (1990-2014) *Tatiana Moiseenko and Marina Dinu, Russian Federation*
- Cold, dark and lifeless: the future of northern lakes? *Jens Fölster, Sweden*
- Phosphorus trends *John Stoddard, US*

Heavy metals and POPs

- Evaluating the temporal trends of mercury concentrations in Norwegian freshwater fish - a study of 25 years of data (common ICP Waters and ICP IM report: Mercury)*, Hans Fredrik Braaten, Programme centre ICP Waters*
- Progress report of Hg and heavy metals in terrestrial and aquatic ecosystems in Nordic countries*, Staffan Åkerblom, Programme centre ICP IM*

- Increased mercury concentrations of perch in Finnish lakes recovering from acidification, *Martti Rask, Finland*

Critical loads/Dynamic modelling

- Dynamic modelling (VSD+) at selected ICP IM sites, *Maria Holmberg, Programme Centre ICP IM*
- MAGIC library in Sweden - consequences of new forestry scenario's and impacts on critical loads calculations, *Filip Moldan, Sweden*

Critical thresholds and biology recovery

- The 2015 ICP Waters report: An attempt to tweeze out the effect of climate change as driver of biodiversity in acidified waters, *Gaute Velle, Programme subcentre ICP Waters*
- Monitoring of acid sensitive lakes in Norway: comparison of ecological status based on water chemistry and biology, *Ann-Kristin Schartau, Norway*
- Critical loads and critical limits - a Swedish-Norwegian comparison, *Kari Austnes, Norway*

Climate change

- Drought induced chemistry changes in stream waters recovering from acidification. *Jakub Hruska, Czech republic*
- Lago Nero - a new site to assess the effects of environmental change on high-alpine lakes and their catchments. *Andreas Bruder, Switzerland*
- DOC trends explained by climate?, *Heleen de Wit, ICP Waters*

Common work for all ICPs, current issues from WGE, potential for more collaboration between ICPs

- Common reports – mercury and possible new topics, *Heleen de Wit ICP Waters, Martin Forsius ICP IM*
- The upcoming EU directive on National Emission Ceilings and cooperation with AMAP, *Martin Forsius, ICP IM*
- Current issues that have emerged from WGE: joint meetings, data portal, open data access, Assessment Report, WGE trend Report *Programme centres*
- Items for discussion from National Focal Points

Workplans (separate meetings for ICP W and ICP IM)

- Workplan, *Programme centres*
- Adoption of the minutes

Other Business

- Evaluation common meeting
- TF meeting(s) 2017

7. Annex III: Status participation in the ICP Waters programme as of November 2016

	Chemical data	Biological data	Participation in TF meetings 2014-2016	Participation in chemical intercomparison 2014-2016	Participation in biological intercalibration 2014-2016
Armenia	2012		●		
Austria	2015		●	●	
Belarus	2015				
Belgium				●	
Canada	2015			●	
Croatia					
Czech Rep.	2016	2011	●	●	
Estonia	2016		●	●	●
Finland	2016		●	●	
France				●	
Germany	2016	2015	●	●	●
Ireland	2012			●	
Italy	2016		●	●	
Latvia	2016	2014	●	●	●
Lithuania				●	
Moldova	2016				
Montenegro	2012				
Netherlands	2016		●	●	
Norway	2016	2015	●	●	●
Poland	2013		●	●	
Russia	2016		●	●	

Serbia				●	
Spain	2014			●	
Sweden	2016	2014	●	●	●
Switzerland	2016	2015	●	●	●
UK	2015	2013	●	●	●
USA	2016		●	●	
Total	**21**	**7**	**15**	**22**	**7**
Belgium				●	
Serbia				●	
Total				**24**	

8. Annex IV: ICP Waters workplan for 2016–2018

2016

- Arrange thirty-second meeting of the Programme Task Force, joint with ICP Integrated Monitoring, scheduled to be held in Oslo, Norway, on May 24 to 26 2016.
- Prepare proceedings from the 32nd Task Force meeting
  - abstracts (2-6 pages) by **Aug 1 2016** to **Salar.Valinia@niva.no**
  - Report delivered in **September 2016**
- Finalize biodiversity & climate report
  - The draft report will be ready for review by **June 15 2016**
  - Comments to draft report are expected by **August 1 2016**
  - Special reviewers? TBA TF meeting
  - The report will be finalized in **August 2016**
- Write report on mercury, in co-operation with ICP IM
  - A draft report will be presented at the Task Force meeting in **May 2016**
  - Key results will be presented on the WGE meeting in **September 2016**
  - Special reviewers? TBA TF meeting
  - Final report in print and to be presented at the **Task Force meeting 2017**
- Arrange and report chemical intercomparison 1630
  - in collaboration with all participating ICPs
  - Invitations will be sent in **March 2016**
  - Samples will be sent by **May 20 2016**
  - Report delivered in **September 2016**
  - Responsible person: Carlos Escudero
  - Laboratories that analyse samples for national monitoring programs and laboratories in EECCA countries will not pay a fee
- Arrange and report biological intercalibration 2016
  - in collaboration with participating ICPs
  - Send out invitations by **1 May 2016**
  - Report delivered in **November 2016**
  - Responsible person: Godtfred Anker Halvorsen
- Contribute to a DOC trend analyses, resulting in a submitted manuscript in **2016**
- Run the Programme Centre in Oslo and the Subcentre in Bergen, including:
  - maintenance of web-pages
  - An overview of the layout and functioning of the web page, including publication list
  - Increase visibility of activity of Focal Centres on the web-page
  - maintenance of database of chemical and biological data
  - Report to UNECE
- Submission of data to the Programme Centre by all Focal centres.

  - Responsible: James Sample
  - Call for data: **June 15 2016**
  - Submission by **August 15 2016**
- Participation in meetings of relevance for the ICP Waters programme
  - Other possible items to be announced
  - Cooperation with other bodies within and outside the Convention
- Consider availability other water databases and cooperation with other water monitoring programmes (UNEP, GEMS, EEA)
- Cooperation with ECCCA countries (East Central Caucasus and Central Asian countries)

2017

- Arrange thirty-third meeting of the Programme Task Force in spring of 2017
- Prepare proceedings from the 33rd Task Force meeting
- Finalize report on mercury, in co-operation with ICP IM
- Arrange and report chemical intercomparison 1731
- Arrange and report biological intercalibration 2117
- Write new thematic report (suggested topic: regional assessment of lake acidification)
- Run the Programme Centre in Oslo and the Subcentre in Bergen, including:
  - maintenance of web-pages
  - An overview of the layout and functioning of the web page, including publication list
  - Increase visibility of activity of Focal Centres on the web-page
  - maintenance of database of chemical and biological data
  - Report to UNECE
- Submission of data to the Programme Centre by all Focal centres**.**
- Participation in meetings of relevance for the ICP Waters programme
- Consider availability other water databases and cooperation with other water monitoring programmes (UNEP, GEMS, EEA)
- Cooperation with ECCCA countries (East Central Caucasus and Central Asian countries)

2018

- Arrange thirty-fourth meeting of the Programme Task Force in spring of 2018
- Write new thematic report (theme to be discussed at Task Force meetings 2016 and 2017)

9. Reports and publications from the ICP Waters Programme

All reports from the ICP Waters programme from 2000 up to present are listed below. Reports before year 2000 can be listed on request. All reports are available from the Programme Centre. Reports and recent publications are also accessible through the ICP Waters website; http://www.icp-waters.no/

Anker Halvorsen, G., Johannessen, A., Svanevik Landås, T. 2016. Biological intercalibration: Invertebrates 2016. **ICP Waters report 130/2016.**

Escudero-Oñate, C. 2016. Intercomparison 1630: pH, Conductivity, Alkalinity, NO3-N, Cl, SO4, Ca, Mg, Na, K, TOC, Al, Fe, Mn, Cd, Pb, Cu, Ni and Zn. **ICP Waters report 129/2016**.

De Wit, H., Valinia, S. (editors). 2016. Proceedings of the 32st Task Force meeting of the ICP Waters Programme in Asker, Oslo, May 24-26, 2016. **ICP Waters report 128/2016**.

Gaute Velle, Shad Mahlum, Don T. Monteith, Heleen de Wit, Jens Arle, Lars Eriksson, Arne Fjellheim, Marina Frolova, Jens Fölster, Natalja Grudule, Godtfred A. Halvorsen, Alan Hildrew, Jakub Hruška, Iveta Indriksone, Lenka Kamasová, Jiří Kopáček, Pavel Krám, Stuart Orton, Takaaki Senoo, Ewan M. Shilland, Evžen Stuchlík, Richard J. Telford, Lenka Ungermanová, Magda-Lena Wiklund, Richard F. Wright. 2016. Biodiversity of macro-invertebrates in acid-sensitive waters: trends and relations to water chemistry and climate. **ICP Waters report 127/2016**

De Wit, H., Valinia, S. and Steingruber, S. Proceedings of the 31st Task Force meeting of the ICP Waters Programme in Monte Verità, Switzerland 6th –8th October, 2015. **ICP Waters report 126/2015**

De Wit, H., Hettelingh, J.P. and Harmens, H. 2015. Trends in ecosystem and health responses to long-range transported atmospheric pollutants. **ICP Waters report 125/2015**

Fjellheim, A., Johannessen, A. and Landås, T.S. 2015. Biological intercalibration: Invertebrates 1915. **ICP Waters report 124/2015**

Escudero-Oñate, C. 2015 Intercomparison 1529: pH, Conductivity, Alkalinity, NO3-N, Cl, SO4, Ca, Mg, Na, K, TOC, Al, Fe, Mn, Cd, Pb, Cu, Ni, and Zn. **ICP Waters report 123/2015**

de Wit, H., Wathne, B. M. (eds) 2015. Proceedings of the 30th Task Force meeting of the ICP Waters Programme in Grimstad, Norway 14th –16th October, 2014. **ICP Waters report 122/2015**

Fjellheim, A., Johannessen, A. and Landås, T.S. 2014. Biological intercalibration: Invertebrates 1814. **ICP Waters Report 121/2014**

Escudero-Oñate. 2014. Intercom¬parison 1428: pH, Conductivity, Alkalinity, NO3-N, Cl, SO4, Ca, Mg, Na, K, TOC, Al, Fe, Mn, Cd, Pb, Cu, Ni, and Zn. **ICP Waters Report 120/2014**

De Wit, H. A., Garmo Ø. A. and Fjellheim A. Chemical and biological recovery in acid-sensitive waters: trends and prognosis. **ICP Waters Report 119/2014**

Fjellheim, A., Johannessen, A. and Landås, T.S. 2013. Biological intercalibration: Invertebrates 1713. **ICP Waters Report 118/2014**

de Wit, H., Bente M. Wathne, B. M. and Hruśka, J. (eds) 2014. Proceedings of the 29th Task Force meeting of the ICP Waters Programme in Český Krumlov, Czech Republic 1st –3rd October, 2013. **ICP Waters report 117/2014**

Escudero-Oñate, C. Intercomparison 1327: pH, Conductivity, Alkalinity, NO3-N, Cl, SO4, Ca, Mg, Na, K, TOC, Al, Fe, Mn, Cd, Pb, Cu, Ni and Zn. **ICP Waters Report 116/2013**

Holen, S., R.F. Wright, I. Seifert. 2013. - Effects of long-range transported air pollution (LTRAP) on freshwater ecosystem services. **ICP Waters Report 115/2013**

Velle, G., Telford, R.J., Curtis, C., Eriksson, L., Fjellheim, A., Frolova, M., Fölster J., Grudule N., Halvorsen G.A., Hildrew A., Hoffmann A., Indriksone I., Kamasová L., Kopáček J., Orton S., Krám P., Monteith D.T., Senoo T., Shilland E.M., Stuchlík E., Wiklund M.L., de Wit, H., Skjelkvaale B.L. 2013. Biodiversity in freshwaters. Temporal trends and response to water chemistry. **ICP Waters Report 114/2013**

Fjellheim, A., Johannessen, A. and Landås, T.S. 2013. Biological intercalibration: Invertebrates 1612. **ICP Waters Report 113/2013**

Skjelkvåle, B.L., Wathne, B.M., de Wit, H. and Michela Rogora (eds.) 2013. Proceedings of the 28th Task Force meeting of the ICP Waters Programme in Verbania Pallanza, Italy, October 8 – 10, 2012. **ICP Waters Report 112/2013**

Dahl, I. 2012. Intercomparison 1226: pH, Conductivity, Alkalinity, NO3-N, Cl, SO4, Ca, Mg, Na, K, TOC, Al, Fe, Mn, Cd, Pb, Cu, Ni and Zn. **ICP Waters report 111/2012**

Skjelkvåle, B.L., Wathne B. M. and Moiseenko, T. (eds.) 2010. Proceedings of the 27th meeting of the ICP Waters Programme Task Force in Sochi, Russia, October 19 – 21, 2011. **ICP Waters report 110/2012**

Fjellheim, A., Johannessen, A., Svanevik Landås, T. 2011. Biological intercalibration: Invertebrates 1511. NIVA-report SNO 6264-2011. **ICP Waters report 109/2011**

Wright, R.F., Helliwell, R., Hruska, J,. Larssen, T., Rogora, M., Rzychoń, D., Skjelkvåle, B.L. and Worsztynowicz, A. 2011. Impacts of Air Pollution on Freshwater Acidification under Future Emission Reduction Scenarios; ICP Waters contribution to WGE report. NIVA-report SNO 6243-2011**. ICP Waters report 108/2011**

Dahl, I and Hagebø, E. 2011. Intercomparison 1125: pH, Cond, HCO3, NO3-N, Cl, SO4, Ca, Mg, Na, K, TOC, Al, Fe, Mn, Cd, Pb, Cu, Ni, and Zn. NIVA-report SNO 6222-2011. **ICP Waters report 107/2011**

Skjelkvåle B.L. and de Wit, H. (Eds). 2011. Trends in precipitation chemistry, surface water chemistry and aquatic biota in acidified areas in Europe and North America from 1990 to 2008. NIVA-report SNO 6218-2011. **ICP Waters report 106/2011**

ICP Waters Programme Centre 2010. ICP Waters Programme manual. NIVA SNO 6074-2010. **ICP Waters report 105/2010**. 91 s. ISBN 978-82-577-5953-7,

Skjelkvåle, B.L., Wathne B. M. and Vuorenmaa J. (eds.) 2010. Proceedings of the 26th meeting of the ICP Waters Programme Task Force in Helsinki, Finland, October 4 – 6, 2010. **ICP Waters report 104/2010**

Fjellheim, A. 2010. Biological intercalibration: Invertebrates 1410. NIVA-report SNO 6087-2010, **ICP Waters report 103/2010**

Hovind, H. 2010. Intercomparison 1024: pH, Cond, HCO_3, NO_3-N, Cl, SO_4, Ca, Mg, Na, K, TOC, Al, Fe, Mn, Cd, Pb, Cu, Ni, and Zn. NIVA-report SNO 6029-2010. **ICP Waters report 102/2010**

De Wit, H. A. and Lindholm M., 2010. Nutrient enrichment effects of atmospheric N deposition on biology in oligotrophic surface waters – a review. NIVA-report SNO 6007 - 2010. **ICP Waters report 101/2010**

Skjelkvåle, B.L., De Wit, H and and Jeffries, D. (eds.) 2010. Proceedings of presentations of national activities to the 25th meeting of the ICP Waters Programme Task Force in Burlington, Canada, October 19-21 2009. NIVA-report SNO 5995 - 2010. **ICP Waters report 100/2010**

Fjellheim, A. 2009. Biological intercalibration: Invertebrates 1309. NIVA-report SNO 5883-2009, **ICP Waters report 99/2009**

Hovind, H. 2009. Intercomparison 0923: pH, Cond, HCO_3, NO_3-N, Cl, SO_4, Ca, Mg, Na, K, TOC, Al, Fe, Mn, Cd, Pb, Cu, Ni, and Zn. NIVA-report SNO 5845-2009. **ICP Waters report 98/2009**

Ranneklev, S.B., De Wit, H., Jenssen, M. T. S. and Skjelkvåle, B.L., 2009. An assessment of Hg in the freshwater aquatic environment related to long-range transported air pollution in Europe and North America. NIVA-report SNO 5844-2009. **ICP Waters report 97/2009.**

Skjelkvåle, B.L., Jenssen, M. T. S. and De Wit, H (eds.) 2009. Proceedings of the 24th meeting of the ICP Waters Programme Task Force in Budapest, Hungary, October 6 – 8, 2008. NIVA-report SNO 5770-2009. **ICP Waters report 96/2008**

Fjellheim, A and Raddum, G.G. 2008. Biological intercalibration: Invertebrates 1208. NIVA-report SNO 5706-2008. **ICP Waters report 95/2008**

Skjelkvåle, B.L., and De Wit, H. (eds.) 2008. ICP Waters 20 year with monitoring effects of long-range transboundary air pollution on surface waters in Europe and North-America. NIVA-report SNO 5684-2008. **ICP Waters report 94/2008**

Hovind, H. 2008. Intercomparison 0822: pH, Cond, HCO_3, NO_3-N, Cl, SO_4, Ca, Mg, Na, K, Fe, Mn, Cd, Pb, Cu, Ni, and Zn. NIVA-report SNO 5660-2008. **ICP Waters report 93/2008**

De Wit, H. Jenssen, M. T. S. and Skjelkvåle, B.L. (eds.) 2008. Proceedings of the 23rd meeting of the ICP Waters Programme Task Force in Nancy, France, October 8 – 10 , 2007. NIVA-report SNO 5567-2008. **ICP Waters report 92/2008**

Fjellheim, A and Raddum, G.G. 2008. Biological intercalibration: Invertebrates 1107. NIVA-report SNO 5551 – 2008. **ICP Waters report 91/2008**

Hovind, H. 2007. Intercomparison 0721: pH, Cond, HCO3, NO3-N, Cl, SO4, Ca, Mg, Na, K, Fe, Mn, Cd, Pb, Cu, Ni, and Zn. NIVA-report SNO 5486-2007. **ICP Waters report 90/2007**

Wright, R.F., Posch, M., Cosby, B. J., Forsius, M., and Skjelkvåle, B. L. 2007. Review of the Gothenburg Protocol: Chemical and biological responses in surface waters and soils. NIVA-report SNO 5475-2007. **ICP Waters report 89/2007**

Skjelkvåle, B.L., Forsius, M., Wright, R.F., de Wit, H., Raddum, G.G., and Sjøeng, A.S.M. 2006. Joint Workshop on Confounding Factors in Recovery from Acid Deposition in Surface Waters, 9-10 October 2006, Bergen, Norway; Summary and Abstracts. NIVA-report SNO 5310-2006. **ICP Waters report 88/2006**

De Wit, H. and Skjelkvåle, B.L. (eds). 2007. Trends in surface water chemistry and biota; The importance of confounding factors. NIVA-report SNO 5385-2007. **ICP Waters report 87/2007**

Hovind, H. 2006. Intercomparison 0620. pH, K25, HCO3, $NO_3 + NO_2$, Cl, SO_4, Ca, Mg, Na, K, total aluminium, aluminium - reactive and nonlabile, TOC, COD-Mn. Fe, Mn, Cd, Pb, Cu, Ni and Zn. NIVA-report SNO 5285-2006. **ICP Waters report 86/2006**

Raddum, G.G. and Fjellheim, A. 2006. Biological intercalibration 1006: Invertebrate fauna. NIVA-report SNO 5314-2006. **ICP Waters report 85/2006**

De Wit, H. and Skjelkvåle, B.L. (eds.) 2006. Proceedings of the 21th meeting of the ICP Waters Programme Task Force in Tallinn, Estonia, October 17-19, 2005. NIVA-report SNO 5204-2006. **ICP Waters report 84/2006**

Wright, R.F., Cosby, B.J., Høgåsen, T., Larssen, T., Posch, M. 2005. Critical Loads, Target Load Functions and Dynamic Modelling for Surface Waters and ICP Waters Sites. NIVA-report SNO 5166-2005. **ICP Waters report 83/2006**

Hovind, H. 2005. Intercomparison 0317. pH, K25, HCO3, NO3 + NO2, Cl, SO4, Ca, Mg, Na, K, total aluminium, aluminium - reactive and nonlabile, TOC, COD-Mn. Fe, Mn, Cd, Pb, Cu, Ni and Zn. NIVA-report SNO 5068-2005. **ICP Waters report 82/2005**

Raddum, G.G. 2005. Intercalibration 0307: Invertebrate fauna. NIVA-report SNO 5067-2005. **ICP Waters report 81/2005**

De Wit, H. and Skjelkvåle, B.L (eds.). 2005. Proceedings of the 20th meeting of the ICP Waters Programme Task Force in Falun, Sweden, October 18-20, 2004. NIVA-report SNO 5018-2005. **ICP Waters report 80/2005**

Fjeld, E., Le Gall, A.-C. and Skjelkvåle, B.L. 2005. An assessment of POPs related to long-range air pollution in the aquatic environment. NIVA-report SNO 5107-2005. **ICP Waters report 79/2005**

Skjelkvåle et al 2005. Regional scale evidence for improvements in surface water chemistry 1990-2001. *Environmental Pollution, 137: 165-176.*

Hovind, H. 2004. Intercomparison 0418. pH, K25, HCO3, NO3 + NO2, Cl, SO4, Ca, Mg, Na, K, Fe, Mn, Cd, Pb, Cu, Ni and Zn. NIVA-report SNO 4875-2004. **ICP Waters report 78/2004**

Raddum, G.G. 2004. Intercalibration: Invertebrate fauna 09/04. NIVA-report SNO 4863-2004. **ICP Waters report 77/2004**

Skjelkvåle, B.L. (ed). Proceedings of the 19th meeting of the ICP Waters Programme Task Force in Lugano, Switzerland, October 18-20, 2003. NIVA-report SNO 4858-2004. **ICP Waters report 76/2004**

Raddum, G.G, *et al.* 2004. Recovery from acidification of invertebrate fauna in ICP Water sites in Europe and North America. NIVA-report SNO 4864-2004. **ICP Waters report 75/2004**

Hovind, 2003. Intercomparison 0317. pH, K25, HCO3, NO3 + NO2, Cl, SO4, Ca, Mg, Na, K, total aluminium, aluminium - reactive and nonlabile, TOC, COD-Mn. Fe, Mn, Cd, Pb, Cu, Ni and Zn. NIVA-report SNO 4715-2003. **ICP Waters report 74/2003**

Skjelkvåle, B.L. (ed). 2003. The 15-year report: Assessment and monitoring of surface waters in Europe and North America; acidification and recovery, dynamic modelling and heavy metals. NIVA-report SNO 4716-2003. **ICP Waters report 73/2003**

Raddum.G.G. 2003. Intercalibration 0307: Invertebrate fauna. NIVA-report SNO-4659-2003. **ICP Waters report 72/2003**

Skjelkvåle, B.L. (ed.). 2003. Proceedings of the 18[th] meeting of the ICP Waters Programme Task Force in Moscow, October 7-9, 2002. NIVA-report SNO 4658-2003. **ICP Waters report 71/2002**

Wright, R.F and Lie, M.C. 2002.Workshop on models for Biological Recovery from Acidification in a Changing Climate. 9.-11. September 2002 in Grimstad, Norway. Workshop report. NIVA-report 4589-2002.

Jenkins, A. Larssen, Th., Moldan, F., Posch, M. and Wrigth R.F. 2002. Dynamic Modelling of Surface Waters: Impact of emission reduction - possibilities and limitations. NIVA-report SNO 4598-2002. **ICP Waters report 70/2002.**

Halvorsen, G.A, Heergaard, E. and Raddum, G.G. 2002. Tracing recovery from acidification - a multivariate approach. NIVA-report SNO 4564-2002. **ICP Waters report 69/2002**

Hovind. H. 2002. Intercomparison 0216. pH, K_{25}, HCO_3, NO_3 + NO_2, Cl, SO_4, Ca, Mg, Na, K, total aluminium, aluminium - reactive and nonlabile, TOC, COD-Mn. Fe, Mn, Cd, Pb, Cu, Ni and Zn. NIVA-Report SNO 4558-2002. **ICP Waters Report 68/2002**

Skjelkvåle, B.L. and Ulstein, M. (eds). 2002. Proceedings from the Workshop on Heavy Metals (Pb, Cd and Hg) in Surface Waters; Monitoring and Biological Impact. March 18-20, 2002, Lillehammer, Norway. NIVA-report SNO-4563-2002. **ICP Waters report 67/2002**

Raddum.G.G. 2002. Intercalibration 0206: Invertebrate fauna. NIVA-report SNO-4494-2002. **ICP Waters report 66/2002**

Bull, K.R. Achermann, B., Bashkin, V., Chrast, R. Fenech, G., Forsius, M., Gregor H.-D., Guardans, R., Haussmann, T., Hayes, F., Hettelingh, J.-P., Johannessen, T., Kryzanowski, M., Kucera, V., Kvaeven, B., Lorenz, M., Lundin, L., Mills, G., Posch, M., Skjelkvåle, B.L. and Ulstein, M.J. 2001. Coordinated Effects Monitoring and Modelling for Developing and Supporting International Air Pollution Control Agreements. *Water Air Soil Poll.* **130**:119-130.

Hovind, H. 2001. pH, K_{25}, HCO_3, NO_3 + NO_2, Cl, SO_4, Ca, Mg, Na, K, total aluminium, aluminium - reactive and nonlabile, TOC, COD-Mn. Fe, Mn, Cd, Pb, Cu, Ni and Zn. NIVA-Report SNO 4416-2002. **ICP Waters report 64/2001**

Lyulko, I. Berg, P. and Skjelkvåle, B.L. (eds.) 2001. National presentations from the 16[th] meeting of the ICP Waters Programme task Force in Riga, Latvia, October 18-20, 2000. NIVA-report SNO 4411-2001. **ICP Waters report 63/2001**

Raddum.G.G. 2000. Intercalibration 0005: Invertebrate fauna. NIVA-report SNO4384-2001. **ICP Waters report 62/2001**

Raddum, G.G. and Skjekvåle B.L. 2000. Critical Load of Acidifying Compounds to Invertebrates In Different Ecoregions of Europe. *Water Air Soil Poll.* **130**:825-830.

Stoddard, J. Traaen, T and Skjelkvåle, B.L. 2001. Assessment of Nitrogen leaching at ICP-Waters sites (Europe and North America). *Water Air Soil Poll.* **130**:825-830.

Skjelkvåle, B.L. Stoddard J.L. and Andersen, T. 2001. Trends in surface waters acidification in Europe and North America (1989-1998). *Water Air Soil Poll.***130:**781-786.

Kvaeven, B. Ulstein, M.J., Skjelkvåle, B.L., Raddum, G.G. and Hovind. H. 2001. ICP Waters - An international programme for surface water monitoring. *Water Air Soil Poll.***130**:775-780.

Wright, R.F. 2001. Note on: Effect of year-to-year variations in climate on trends in acidification. NIVA-report SNO 4328-2001. **ICP Waters report 57/2001**

Hovind, H. 2000. Trends in intercomparisons 8701-9812: pH, K_{25}, NO_3 + NO_2, Cl, SO_4, Ca, Mg, Na, K and aluminium - reactive and nonlabile, TOC, COD-Mn. NIVA-Report SNO 4281-2000. **ICP Waters Report 56/2000**

Hovind, H. 2000. Intercomparison 0014. pH, K_{25}, HCO_3, NO_3 + NO_2, Cl, SO_4, Ca, Mg, Na, K, total aluminium, aluminium - reactive and nonlabile, TOC, COD-Mn. Fe, Mn, Cd, Pb, Cu, Ni and Zn. NIVA-Report SNO 4281-2000. **ICP Waters Report 55/2000**

Skjelkvåle, B.L., Olendrzynski, K., Stoddard, J., Traaen, T.S, Tarrason, L., Tørseth, K., Windjusveen, S. and Wright, R.F. 2001. Assessment of trends and leaching in Nitrogen at ICP Waters Sites (Europe And North America). NIVA-report SNO 4383-2001. **ICP Waters report 54/2001**

Stoddard, J. L., Jeffries, D. S., Lükewille, A., Clair, T. A., Dillon, P. J., Driscoll, C. T., Forsius, M., Johannessen, M., Kahl, J. S., Kellogg, J. H., Kemp, A., Mannio, J., Monteith, D., Murdoch, P. S., Patrick, S., Rebsdorf, A., Skjelkvåle, B. L., Stainton, M. P., Traaen, T. S., van Dam, H., Webster, K. E., Wieting, J., and Wilander, A. 1999. Regional trends in aquatic recovery from acidification in North America and Europe 1980-95. Nature 401:575- 578.

Skjelkvåle, B. L., Andersen, T., Halvorsen, G. A., Raddum, G.G., Heegaard, E., Stoddard, J. L., and Wright, R. F. 2000. The 12-year report; Acidification of Surface Water in Europe and North America; Trends, biological recovery and heavy metals. NIVA-Report SNO 4208/2000. **ICP Waters report 52/2000**

Reports before year 2000 can be listed on request.

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