Convention on Long-range Transboundary Air Pollution

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

ICP-WATERS REPORT

Intercalibration 9804: Invertebrate fauna

NIVA Norwegian Institute for Water Research

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REPORT

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Abstract

The 4th intercalibration of invertebrates in the ICP-Water programme had contribution from 6 laboratories. 5 of the laboratories identified a high portion (>85%) of the total number of species in the test samples. Short-coming identification was consequently relatively low. Of the identified species only few falts were made. The results for these laboratories were therefor regarded as good and well within the limit of good identification proposed for intercalibration of biological material. Due to lack of identification litearture, one laboratory showed very low identification and also to some extent higher misidentifications both on species and genus level for some invertebrate groups. However, for other groups the laboratory had relevant literature and in these cases the faults were within the limits for what is acceptable. Faults resulting in a wrong acidification index, was not recorded in 1997/98. The results of the biological intercalibration in 1997/98 are the best of all tests performed so far.

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1. Interkalibrering	1. Intercalibration
2. Invertebrater	2. Invertebrates
3. Akvatisk fauna	3. Aquatic fauna
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CONVENTION ON LONG-RANGE
TRANSBOUNDARY AIR POLLUTION

INTERNATIONAL COOPERATIVE PROGRAMME ON
ASSESSMENT AND MONITORING OF ACIDIFICATION
OF RIVERS AND LAKES

Intercalibration 9804:
Invertebrate fauna

ICP-Waters Programme Subcentre
Laboratory of Freshwater Ecology and Inland Fisheries
University of Bergen, June 1998

Preface

The International Cooperative Programme on Assessment and Monitoring of Acidification of Rivers and Lakes (ICP-Waters) was established under the Executive Body of the Convention on Long-Range Transboundary Air Pollution at its third session in Helsinki in July 1985. The Executive Body has also accepted Norway's offer to provide facilities for the Programme Centre, which has been established at the Norwegian Institute for Water Research, NIVA. A programme subcentre is established at the Laboratory of Freshwater Ecology and Inland Fisheries at University of Bergen. The ICP-Waters programme has been lead by Berit Kvæven, Norwegian Pollution Control Authority.

The Programme objective is to establish an international network of surface water monitoring sites and promote international harmonization of monitoring practices. One of the tools in this work is inter-laboratory quality assurance tests. The bias between analyses carried out by the individual participants of the Programme has to be clearly identified and controlled.

We here report the results from the 4th intercalibration on invertebrate fauna.

Bergen, July, 1998

Gunnar G.Raddum

Contents

1. Introduction

The purpose of the biological intercalibration is to evaluate the quality of the biological material delivered to the Programme centre. The quality can influence on the evaluation of the acidification index, which is based on the species and their tolerance (Raddum *et al.* 1988, Fjellheim and Raddum 1990). The control is therefore important for evaluation of the significance of trends in the acidification index both for a specific site/watershed, as well as for comparisons of trends between different regions and countries. During the last years the material is also used for multivariate statistical analysis (Larsen *et al.* 1996). This type of data treatment is especially sensitive to the quality of the species identification. The intercalibration of biological material will in general put focus on the taxonomic work and through this be a basis for improving the quality and detect weak fields at the different laboratories.

The methods for intercalibration of biological material were outlined in 1991 at the 7th task force meeting of the International Co-operative Programme on Assessment and Monitoring of Acidification of Rivers and Lakes in Galway, Ireland. The different countries/laboratories have to know, first of all, their home fauna. Since the fauna in different geographical regions vary, it is necessary to prepare specific samples for each participating laboratory, based on their home fauna. It is a problem for the exercise of the intercalibration that it is not possible to use standardized samples for all participants. To solve this problem each laboratory send samples of invertebrates from their own monitoring sites to the Programme centre. Based on this material each laboratory receive individual test samples composed of the fauna from their own monitoring region. One problem with this procedure is that the Programme centre needs material from the different areas in the ICP-Water region. This material have to be collected, identified and send by the participating laboratories to the centre for making test samples.

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2. Methods

2.1 Preparation of test-samples

The participating laboratories have delivered samples from their own region for the intercalibration in 1997. Between 250 and 300 identified invertebrates have been received. In addition we had some surplus material from earlier exercises, which also was used. All together the material make up a diverse pool of organisms on which the test-samples have been prepared. Species living in the home country of the laboratory have mainly been used in the test material, but in some cases species from other regions have been included in need of species.

Identification
When preparing the biological test-samples we try to be so accurate as possible when composing the samples, concerning the species put in the sample as well as the number of individuals. To minimise possible fault the following procedure have been used:

The species have first been identified by the participating country. Two of us have verified the identification of the species as far as possible.

The content of the test samples for each laboratory, with respect to species and numbers, is listed in a table. Two persons control that the right number and species is placed in the samples according to the list.

Each laboratory has received two samples with different content.

Damages of the material
When handling invertebrates there is a risk of reducing the quality of the material with respect to taxonomic work. Important taxonomically parts as gills, legs etc. can be lost during handling connected with identification, sample composition and transportation. Contamination of larvae can also happened during these processes as well as during the identification work at the participating laboratories. All mentioned possibilities for faults can influence on the results of the identifications and disturb the results in a negative way.

3. Results and discussion

Six laboratories participated in the fifth intercalibration of invertebrates in 1997/98. Three of the laboratories number 1 - 3, came from the same country. Almost identical test samples were sent to these laboratories, while the three other participants received quite different samples. The test samples delivered - and the results of the identification by the different laboratories are shown in Appendix Tables 1 - 6.

For calculation of faults (in percent), we must take into account possible destructions of the material as mentioned above. Further, a wrong identification of a species is one fault even if the sample contain many individuals of the species. For some species, in the same genus, the time of sampling is important for discrimination between them. Faults made on species where time of sampling is important for determination have been neglected. Misidentification of species where important taxonomic characters easily disappear during handling, are also neglected.

We have discriminated between "short coming" identification, probably due to damaged material, and virtual fault (wrong species - or genus name).

From the factors mentioned above some subjective evaluation of the results have to be made when evaluating the quality of the determinations.

For the evaluation it is also of interest to know the fraction of "short coming" identification. "Short coming" identification is given in percent of the number of individuals, and is named *% identified.*

Mayflies

The identification of mayflies (Ephemeroptera) was generally good and few misidentifications were made (Figure 1). The percent of identified species was between 85 and 95 % for laboratory 1 - 5. Laboratory 6 mostly stopped identification at the genus level. Only a very low portion of the larvae was identified to species level. This laboratory made on the other side few faults. The reason for the low identification percent was lack of relevant taxonomic literature. On genus level no faults were made by laboratory 1 - 5, while laboratory 6 also made some faults on this level. In conclusion laboratory 1 - 5 identified a high portion of the mayfly material and made few or non-faults. Laboratory 6 was not able to do proper identification due to lack of literature for identification.

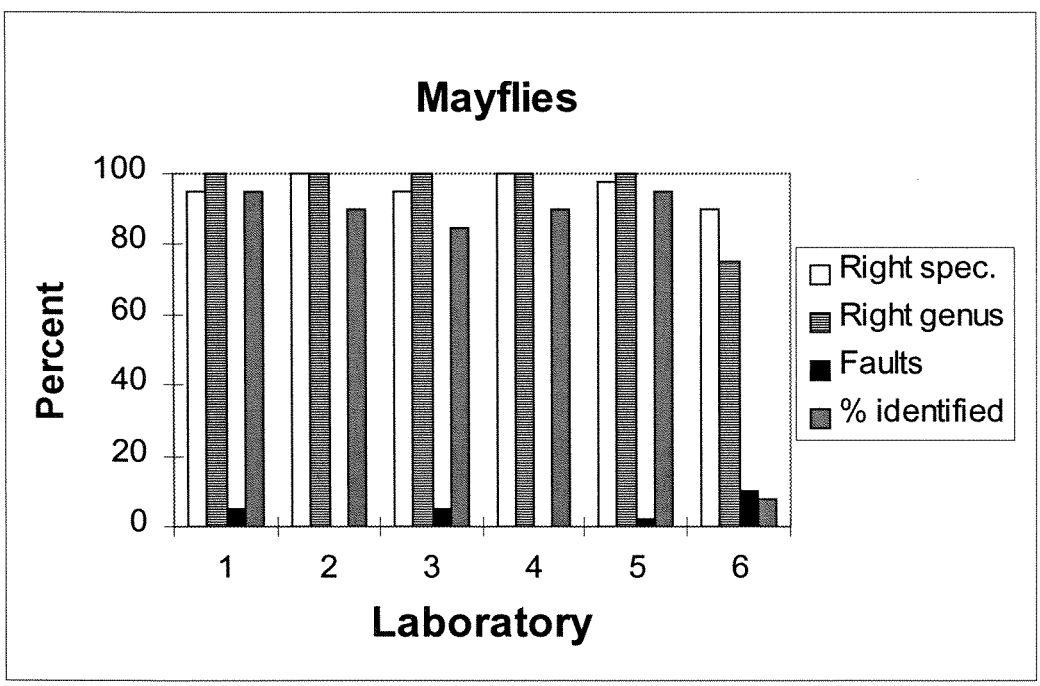

Figure 1. Results of the identification of mayflies.

Stoneflies

Laboratory 2, 3 and 4 made no real misidentifications with respect to stoneflies (Plecopera), while laboratory 1 and 5 had one discrepancy on species level compared with what we put in the testsamples. For laboratory 6 few larvae were identified to species levels and consequently had relatively few faults (Figure 2). The faults in percent on species level were 5 and 15 for laboratory 1 and 6, respectively. On the genus level laboratory 1 - 5 made no faults, while laboratory 6 also made some misidentifications on this level.

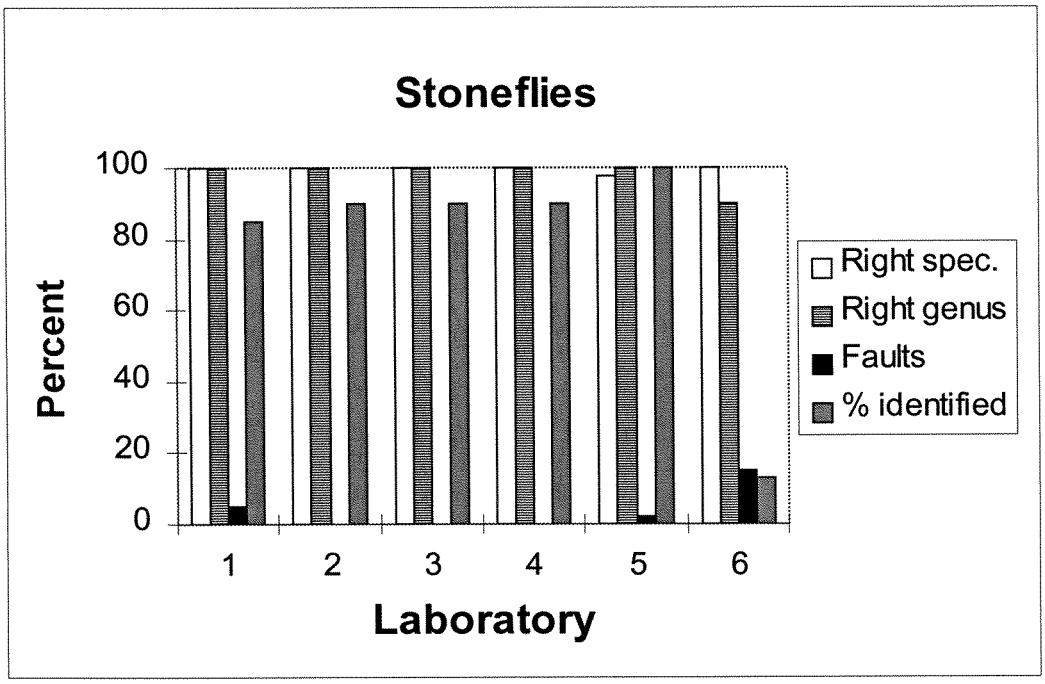

Figure 2. The results of the identification of stoneflies

In conclusion the identification of stoneflies was in general improved compared with earlier exercises. Short coming identifications were low for laboratory 1 - 5, while laboratory 6 mostly stopped at genus level for the same reason as mentioned for mayflies.

Caddis flies

The identification of caddisflies (Trichoptera) was good with almost negligible faults for laboratory 1 and 5 (Figure 3). Laboratory 6 made 15 % faults. The identification percent was between 85 and 95 % for all participants. On genus level no faults were made at all. Compared with earlier intercalibrations this is the best result ever obtained on caddisflies for laboratory 1 - 5. For laboratory 6 the result is within the limit for acceptable identifications.

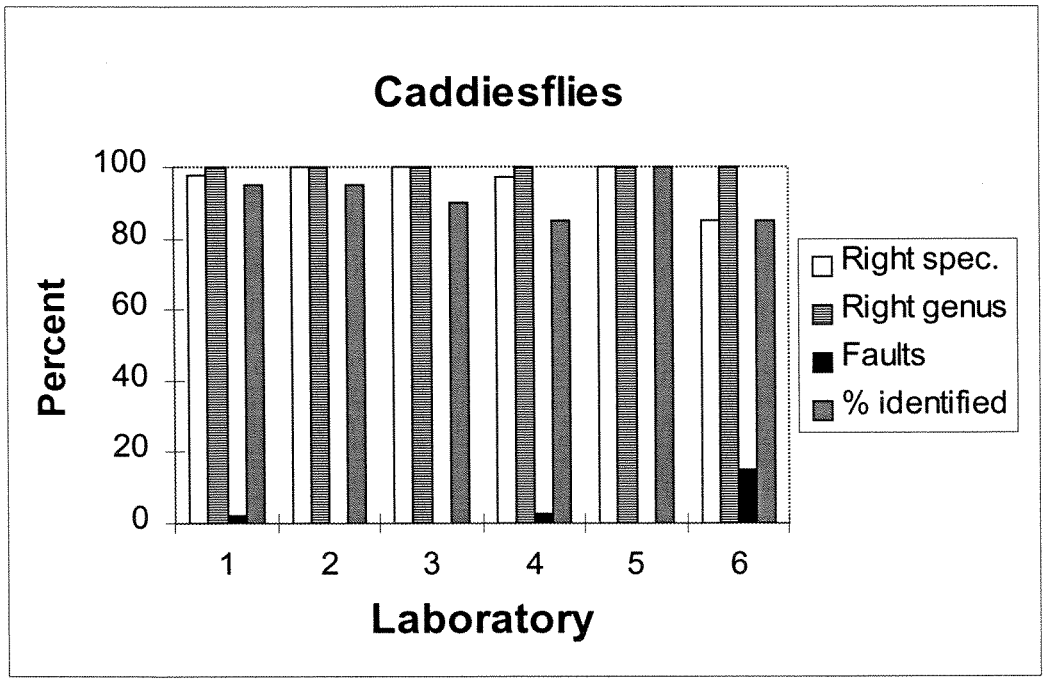

Figure 3. Results of the identification of caddis flies.

Other groups

In this intercalibration we have included Coleopta (water beetles), larger crustaceans, oligochaets, molluscs, chironomids etc. Both larvae and imagos have been included for some of the groups. Besides the molluscs and larger crustaceans, which are sensitive to acid water, we lack still information about the tolerance of many of the other invertebrates like oligochaets and coleaopterans. Due to this the species in these groups is treated as tolerant to acid water and consequently they have low importance for evaluation of the acidification index. However, all species will be important for community analysis independent of their tolerance to acid water. The results of the identification of these groups are shown in Figure 4. One of the laboratories (6) made misidentifications on the species level, while the five others made no faults. These 5 laboratories identified in practice all the specimens in the testsamples, while laboratory 6 identified about 60% of the different larvae.

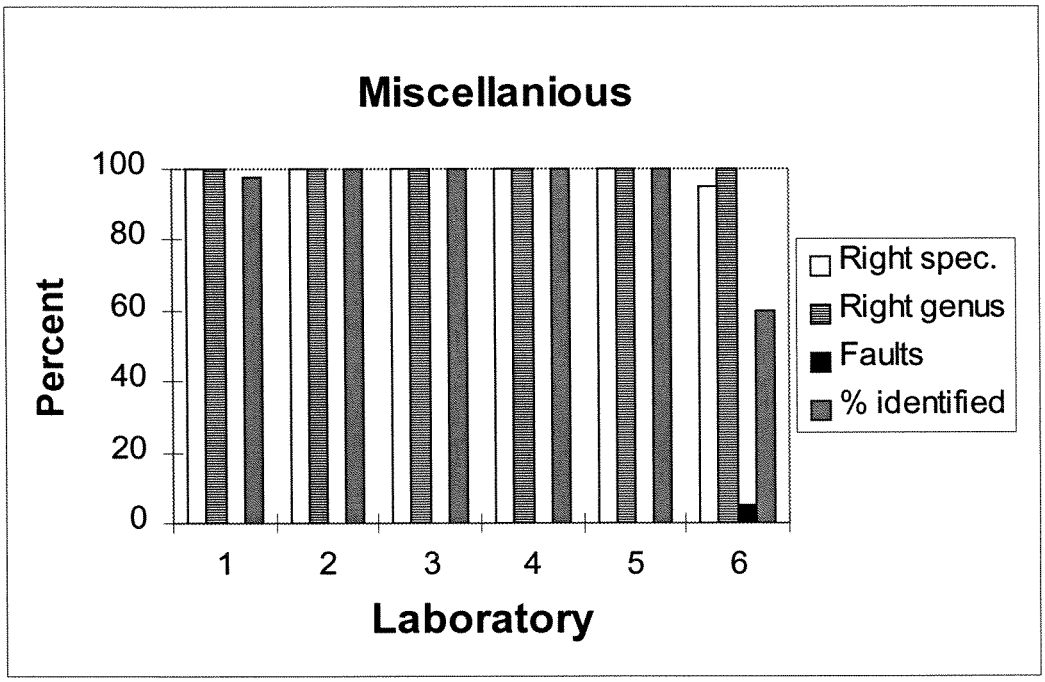

Figure 4. The results of the identification of miscellaneous groups

Total number of Species in the sample
It was low discrepancy between the number of individuals put into the samples and the reported number of larvae.

4. Evaluation/conclusion

All together the laboratories 1 - 5 identified a high portion (>85%) of the total number of species in the test samples. Shortcoming identification was consequently relatively low. The misidentifications were low and can probably in some cases be questioned. The results for these laboratories is therefor regarded as good and well below the limit of faults, 10 %, proposed for intercalibration of biological material (Raddum 1993).

Laboratory 6 was lacking relevant key literature for proper identification of some of the groups. This led to very low identification percent and also to some extent higher misidentifications both on species and genus level. However, for other groups the laboratory had relevant literature and in these cases the faults were within the limits of acceptance.

Faults resulting in a wrong acidification index was not recorded in 1997/98. Also laboratory 6, which for some groups had a very low identification percent, come out with the right acidification score for both samples. By this the score of delivered and identified samples was the same (Figure 5). Except from laboratory 6, the results for the biological

intercalibration in 1997/98 are the best of all tests performed so far in the ICP-Waters Programme.

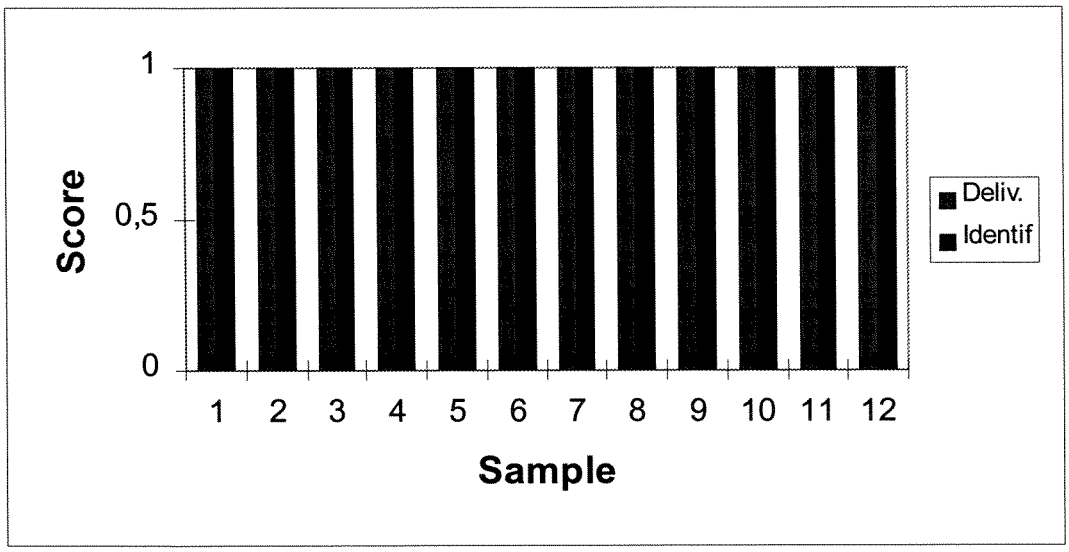

Fig. 6. Acidification score in delivered and identified samples.

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Appendix A. Identified species/genus

Each participating laboratory is identified by a number which is identical with table number.

Laboratories participating in the intercalibration of invertebrates in 1996 and their code numbers are:

1. Staatliche Umweltbetriebsgesellschaft, Saxonia, Germany
2. Staatliche Umweltbetriebsgesellschaft, Radebeul, Germany
3. Laboratory III, Germany. (No identification is given)
4. Sveriges Lantbruksuniversitet, Inst. för miljöanalys, Uppsala, Sweden (1997)
5. Sveriges Lantbruksuniversitet, Inst. för miljöanalys, Uppsala, Sweden (1998)
6. Latvian Hydrometeorological Agency, Envir. Poll. Observation Centre, Latvia

Table 1. Identified species/genus in sample 1 and 2 by Laboratory 1, 1997.
Deliv = delivered, ident = identified.

		SAMPLE 1		SAMPLE 2	
		Deliv.	Ident.	Deliv.	Ident.
PLECOPTERA :	Brachyptera risi	4	2	2	0
	Brachyptera trifasciata	0	0	0	2
	Brachyptera seticornis	0	0	1	1
	Diura bicaudata	1	1	2	2
	Nemurella picteti	1	1	1ad.	1
	Nemoura marginata gr.	0	1	0	0
	Siphonoperla burmeisteri	1	0	0	0
	Siphonoperla spp.	0	1	0	0
	Cloroperla tripunctata	0	0	1	1
	Leuctra nigra	1	1	1	1
	Leuctra hippopus	2	0	3	0
	Leuctra inermis	ad 1	1	1	0
	Leuctra pseudocingulata	1ad.	1	0	0
	Leuctra spp.	0	2	0	4
	Protonemura meyeri	2	1	3	0
	Protonemura auberti	1ad	1	1ad	1
	Protonemura nimborum	1	1	0	0
	Protonemura lateralis	0	0	0	3
	Protonemura spp.	0	1	0	0
	Protonemura nimborum	1	1	0	0
	Isoperla grammatica	0	0	2	2
	Isoperla spp.	0	2	0	0
	Isoperla oxylepis	2		1	0
	Isoperla goetzi	0	0	0	1
TRICHOPTERA :	Litax niger	0	0	1	1
	Drusus discolor	1	1	0	0
	Polycentropus flavomaculatus	3	3	2	2
	Neureclipsis bimaculata	4	4	1	1
	Philopotamus ludificatus	1	1	1ad.	1
	Ryacophila tristis	0	0	2	2
	Ryacophila nubila	4	4	2	2
	Ryacophila nubila puppe	1	1		
	Hydropsyche siltalai	2	2	0	0
	Ryacophila tristis	0	0	2	2
	Sericostoma personatum	0	0	1	1
	Lepidostoma hirtum	1	1	1	1
	Hydropsyche pellucidula	1	1	0	0
	Apatania sp. (fimb./mulieb.)	3	3	5	5
	Ecclisopteryx dalecarlica	0	0	1	1
	Ecclisopteryx madida	1	1	0	0
	Drusus chrysotus	0	0	1	1
	Anomalopteryx chauviriana	1	1	0	0
	Plectrocnemia conspersa	0	0	2	0
	Plectrocnemia geniculata	0	0	0	2
	Oligoplectrum maculatum	0	0	1	1
	Odontocerum albicorne	0	1	0	0
	Limniphillidae	0	0	0	3

Table 1. cont.

		SAMPLE 1		SAMPLE 2	
		Deliv.	Ident.	Deliv.	Ident.
EPHEMEROPTERA :	Leptophlebia vespertina	1	0	1	1
	Leptophlebiidae spp.	0	1	0	0
	Centroptilum luteolum	1	0	1	1
	Ecdynorus dispar	0	0	0	1
	Ecdynorus venosus	0	0	2	1
	Rhithrogena semicolorata	2	2	0	0
	Rhithrogena loyolaea	1	1(degrangei)	0	0
	Ameletus inopinatus	0	0	1	1
	Baetis rhodani	4	4	2	2
	Baetis spp.	0	1	0	0
	Leptophlebia marginata	0	0	1	1
HIRUDINEA :	Helobdella stagnalis	0	0	1	1
	Erpobdella octoculata	2	2	0	0
	Glossiphonia complanata	0	0	1	1
COLEOPTERA :	Oreodytes sanmarki	1	1	0	0
	Platambus maculatus	1	1	0	0
	Elmis spp.	0	0	0	1
	Elmis aenea	0	0	1	0
	Limnius spp.	0	1	0	0
	Limnius volkmari	1	0	0	0
	limnius volkmari ad.	2	0	0	0
	Esolus angustatus	0	0	1	1
CORIXIDAE :	Notonecta lutea	0	0	1	1
DECAPODA (KREPS)	Gammarus pulex	2	2	0	0
MEGALPTERA :	Sialis fuliginosa	1	1	0	0

Table 2. Identified species/genus in sample 1 and 2 by Laboratory 2, 1997.
Deliv = delivered, ident = identified.

	Species	SAMPLE 1		SAMPLE 2	
		Deliv.	Ident.	Deliv.	Ident.
PLECOPTERA :	Brachyptera risi	3	3	2	2
	Brachyptera seticornis	0	0	1	1
	Diura bicaudata	1	1	2	2
	Nemurella picteti	1	1	1ad.	1
	Siphonoperla burmeisteri	1		0	0
	Siphonoperla spp.	0	1	0	0
	Cloroperla tripunctata	0	0	1	1
	Leuctra nigra	1	1	1	1
	Leuctra hippopus	2	0	4	0
	Leuctra inermis	3 imago	0	0	0
	Leuctra braueri	0	1	0	0
	Leuctra sp.	0	2	0	4
	Leuctra sp. imago	0	2	0	0
	Protonemura meyeri	3	0	3	0
	Protonemura sp	0	3	0	3
	Protonemura sp. imago	0	0	0	1
	Protonemura auberti	1 imago	0	1 imago	0
	Nemoura sp.	0	1	0	0
	Isoperla grammatica	0	0	1	1
	Isoperla oxylepis	0	0	1	1
	Isoperla goetzi	2	2	0	0
TRICHOPTERA :	Litax niger	0	0	1	1
	Drusus discolor	1	1	0	0
	Polycentropus flavomaculatus	1	1	3	1
	Neureclipsis bimaculata	5	5	1	1
	Oligoplectrum maculatum	0	0	1	1
	Philopotamus montanus	0	0	1	1
	Philopotamus ludificatus	1	1	1ad.	1
	Ryacophila nubila	4	0	0	0
	Ryacophila tristis	0	0	2	2
	Ryacophila sp	0	4	0	1
	Ryacophila pupae	1	1	0	0
	Hydropsyche siltalai	2	2	0	0
	Sericostoma personatum	1	1	1	1
	Lepidostoma hirtum	2	2	1	1
	Apatania sp	3	3	5	5
	Ecclisopteryx madida	1	1	0	0
	Drusus annulatus	0	0	1	1
	Anomalopteryx chauviriana	1	1	0	0
	Plectrocnemia conspersa	0	0	3	3
	Polycentopodidae	0	1	0	0

Table 2. cont.

	Species	SAMPLE 1		SAMPLE 2	
		Deliv.	Result	Deliv.	Result
EPHEMEROPTERA :	Centroptilum luteolum	1	1	1	1
	Ecdynorus venosus	0	0	2	1
	Ecdynorus sp	0	0	0	1
	Rhithrogena semicolorata	2	0	0	0
	Rhithrogena germanica	0	2	0	0
	Ameletus inopinatus	0	0	1	1
	Baetis rhodani	4	3	2	0
	Baetis spp.	0	0	0	2
	Leptophlebia marginata	0	0	1	0
	Ephemeroptera	0	1	0	1
HIRUDINEA :	Helobdella stagnalis	0	0	1	1
	Erpobdella octoculata	2	2	0	0
	Glossiphonia complanata	0	0	1	1
COLEOPTERA :	Oreodytes septentrionalis	1	1	0	0
	Platambus maculatus	1	1	0	0
	Elmis aenea	0	0	1	1
	Limnius volkmari	1	0	0	0
	Limnius sp	0	1	0	0
	Esolus angustatus	0	0	1	1
CORIXIDAE :	Notonecta lutea	0	0	1	1
DECAPODA (KREPS)	Gammarus pulex	2	2	0	0
MEGALPTERA :	Sialis fuliginosa	1	1	0	0

Table 3. Identified species/genus in sample 1 and 2 by Laboratory 3, 1997.
Deliv = delivered, ident = identified.

	Species	SAMPLE 1		SAMPLE 2	
		Deliv.	Ident.	Deliv.	Ident.
PLECOPTERA :	Brachyptera risi	4	4	0	0
	Brachyptera seticornis	0	0	2	2
	Diura bicaudata	1	1	2	2
	Nemurella picteti	1	1	1 imago	1. imago
	Siphonoperla burmeisteri	1	0	0	0
	Siphonoperla spp.	0	1	0	0
	Cloroperla tripunctata	0	0	1	0
	Cloroperla sp.	0	0	0	1
	Leuctra nigra	1	1	1	1
	Leuctra hippopus	2	0	3	0
	Leuctra inermis	2 imago	0	0	0
	Leuctra spp. larv.	0	2	0	3
	Leuctra spp. imago	0	2 imago	0	0
	Nemoura flexuosa	1	0	0	0
	Nemoura sp.	0	1	0	2
	Protonemura meyeri	2	0	3	0
	Protonemura nimborum	1	0	0	0
	Protonemura lateralis ad.	0	1	0	1
	Protonemura auberti ad.	1	0	1	0
	Protonemura spp.	0	3	0	3
	Isoperla spp.	0	2	0	3
	Isoperla gramatica	0	0	2	0
	Isoperla oxylepis	2	0	1	0
TRICHOPTERA :	Litax niger	0	0	1	1
	Drusus discolor	1	1	0	0
	Polycentropus flavomaculatus	2	2	2	2
	Neureclipsis bimaculata	4	5	1	1
	Philopotamus montanus	0	0	1	1
	Philopotamus ludificatus	1	1	1ad.	1
	Ryacophila nubila	4	3	2	0
	Ryacophila sp.puppe	1	1	0	0
	Ryacophila sp.	0	0	0	2
	Ryacophila tristis	0	0	2	2
	Hydropsyche pellucidula	1	0	0	0
	Hydropsyche sp.	0	1	0	0
	Hydropsyche siltalai	2	2	0	0
	Sericostoma personatum	1	1	1	1
	Lepidostoma hirtum	2	2	1	1
	Apatania sp.	3	0	5	0
	Apatania fimbriata/muliebris	0	3	0	5
	Ecclisopteryx dalecarlica	1	1	1	1
	Drusus chrysotus	0	0	1	1
	Anomalopteryx chauviriana	1	1	0	0
	Plectrocnemia conspersa	0	0	3	4
	Oligoplectrum maculatum	0	0	1	1

Table 3. cont.

	Species	SAMPLE 1		SAMPLE 2	
		Deliv.	Ident,	Deliv.	Ident.
EPHEMEROPTERA :	Leptophlebia vespertina	1	0	1	1
	Leptophlebiidae	0	1	0	0
	Centroptilum luteolum	1	1	2	2
	Ecdynorus venosus	0	0	2	2
	Rhithrogena semicolorata	2	0	0	0
	Rhithrogena sp.	0	2		
	Rhithrogena loyolaea	1	0	0	0
	Rhithrogena germanica	0	1		
	Ameletus inopinatus	0	0	1	1
	Baetis rhodani	4	0	2	2
	Baetis spp.	0	5	0	0
	Ameletus inopinatus	1	0	0	0
HIRUDINEA :	Helobdella stagnalis	0	0	1	1
	Erpobdella octoculata	2	2	0	0
	Glossiphonia complanata	0	0	1	1
COLEOPTERA :	Oreodytes sanmarki	1	1	0	0
	Platambus maculatus	1	1	0	0
	Elmis aenea	0	0	1	1
	Limnius volkmari ad.	1	1	0	0
	Esolus angustatus	0	0	1	1
CORIXIDAE :	Notonecta lutea	0	0	1	1
DECAPODA (KREPS)	Gammarus pulex	2	2	0	0
MEGALPTERA :	Sialis fuliginosa	1	1	0	0

Table 4. Identified species/genus in sample 1 and 2 by Laboratory 4, 1997. Deliv = delivered, ident = identified.

	Sample 1		Sample 2	
Species	deliv.	ident.	deliv.	ident.
Coleoptera				
Oulimnius tuberculatus	2	2	2	2
Oulimnius troglodytes	0	0	1	0
Stenelmis canaliclata	1	1	2	2
Elmis aenea	6	4	4	4
Limnius volkmari	3	3	2	2
Ephemeroptera				
Baetis rhodani	4	4	2	2
B. niger	1	1	3	3
B. subalpinus	2	2	1	1
Caenis horaria	1	1		
C. luctuosa	2	2	1	1
Cloeon dipterum	5	0	3	3
C. cf. inscriptum	0	5		
Ephemera vulgata	2	2	2	2
Heptagenia fuscogrisea	0	0	1	1
H. dalecarlica	2	2	1	1
H. suphurea			1	1
Ephemerella aurivilli	3	3	1	1
Leptophlebia vespertina	1	1	0	0
Suphlonurus aestivalis	0	1		
S. alternatus	1	0	1	1
Siphlonurus sp.	0	1		
Plecoptera				
Arcynopteryx compacta	1	1	1	2
Leuctra nigra	2	3	0	0
Nemoura avicularis	1	0	0	0
Nemoura cinerea	1	2	0	0
Leuctra fusca	3	4	3	5
Leuctra sp.	2	1	2	2
Leuctra digitata	2	4	4	7
Diura nanseni	3	3	4	3
Amphinemura borealis	2	2	4	4
A. sulcicollis	1	2	1	2
Brachyptera risi	3	3	10	10
Taeniopteryx nebulosa	2	2	2	2
Protonemura meyeri	6	6	4	4

Table 4. cont.

	Sample 1		Sample 2	
Species	deliv.	ident.	deliv.	ident.
Trichoptera				
Rhyacophila nubila	3	3	3	3
Rhyacophila fasciata	1	1	1	1
Silo pallipes			2	2
Polycentropus flavomaculatus	7	5	4	2
P. irroratus	1	0	2	2
Plectrocnemia conspersa	2	4	2	0
Plectrocnemia sp.	0	1	0	3
Neureclipsis bimaculata	4	3	4	3
Cyrnus flavidus	2	1	0	1
Holocenropus dubius	2	2	3	5
Holocentropus sp.	0	2	0	0
Philopotamus montanus	0	0	1	1
Athripsodes cinereus	3	0	1	1
Athripsodes sp.	0	3		
Hydropsyche siltalai	2	2	3	3
Oecetis testacea	1	0	0	0
Arctopsyche ladogensis	1	1	1	1
Halesus radiatus	1	0		
Halesus sp.	0	1	0	0
Agrypnia obsoleta	1	1	1	1
Phryganea bipunctata	0	0	3	3
Ecclisoperyx dalecarlica	2	2	1	1
Lepidostoma hirtum	1	1	0	0
Miscellanious				
Pisidium sp.	1	1	1	1
Ancylus fluviatilis	3	3	1	1
Physa fontinalis	2	2	1	1
Radix pergra	3	3	2	4
Theodoxux fluviatilis			2	2
Asellus aquaticus	1	1		
Gammarus lacustris			3	3
G. pulex	3	3		
Spirosperma ferox	2	2	1	1
Erpodella octoculata	2	2	1	1
Helobdella stagnalis			1	1
Lauterborniella agrayloides	2	2	2	2

Table 5. Identified species/genus in sample 1 and 2 by Laboratory 5, 1998.
Deliv = delivered, ident = identified.

Taxon	Sample 1		Sample 2	
	Deliv.	Ident.	Deliv.	Ident.
Gastropoda/Bivalvia				
Ancylus fluviatilis	1	1	1	1
Bithynia tentaculata	1	1	0	0
Theodoxux fluviatilis	0	0	3	3
Dreissena polymorpha	3	3	3	3
Oligochaeta				
Stylaria lacustris	4	3	2	2
Limnodrilus sp.	1	1	1	
Potamothrix hamoniensis	2	2	1	2
Tubifex ignotus	0	0	2	2
Tubifex tubifex	2	2		
Hirudinea				
Erpobdella octoculata	2	2	1	1
Glossiphonia complanata	0	0	1	1
Helobdella stagnalis	1	1	0	0
Crustacea				
Asellus aquaticus	2	2	3	3
Gammarus pulex		1	1	3
G. fossarum *.			2	
Ephemeroptera	0		2	
Baetis niger	2	2	1	
Baetis rhodani	3	3	2	1
Baetris subalpinus	0		1	1
Baetis cf vernus				1
Baetis sp.				1
Caenis horaria	3	3	2	2
Ephemerella aurivilli	2	2	1	1
Ephemerella ignita	2	2	1	1
Heptagenia fuscogrisea	1	1	0	0
Leptophlebia marginata	0	0	1	1
Leptophlebia vespertina	1	1	0	0
Plecoptera				
Amphinemura borealis		1		1
Amphinemura sulcicollis	2	1	1	
Brachyptera cf braueri	2	2	0	
Brachyptera risi	0		2	2
Dinocras cephalotes	0		1	1
Diura nanseni	2	2	2	2
Leuctra digitata	3	3	1	1
Leuctra fusca	2	2	2	2
Leuctra nigra	3ad.	3	2	2
Nemurella picteti	2	2	2	2
Perlodes microcephala	1	1	0	0
Taeniopteryx nebulosa	1	1	1	1

Table 5 cont.

Taxon	Sample 1		Sample 2	
	Deliv.	Ident.	Deliv.	Ident.
Coleoptera				
Elmis aenea	2	2	1	1
Limnius volkmari	4	4	1	1
Oulimnius tuberculatus	1	1	1	1
Oreodytes septentrionalis	0	0	2ad.	2
Megaloptera				
Sialis fuliginosa	2	2	0	0
Trichoptera				
Agapetus ochripes	1	1	2	2
Ecnomus tenellus	1	1	1	1
Neureclipsis bimaculata	3	3	1	1
Philopotamus montanus	0	0	2	2
Molanna angustata	1	1	2	1
Hydropsyche angustipennis	1	1	3	3
Hydropsyche pellucidula	3	3	1	1
Hudropsyche siltalai	2	1		
Hudropsyche cf siltalai		1		
Micrasema gelidum	1	1	3	3
Sericostoma personatum	1	1	1	1
Tinodes waeneri	0	0	1	1
Chironomidae				
Epoicicladius flavens	3	3	2	2
Heterotanytarsus apicalis	2	2	3	2
Zalutschia zalutschicola	1	1	5	5
Pagastiella orophila	1	1	0	0
Pseudochironomus prasinatus	1	1	1	1

*) The species do not belong to the fauna of the country

Table 6. Identified species/genus in sample 1 and 2 by Laboratory 6, 1997. Deliv = delivered, ident = identified.

	Sample 1		Sample 2	
Species	Deliv.	Ident.	Deliv.	Ident.
Mollusca				
Theodoxus fluviatilis	1	1	1	1
Ancylus fluviatilis	2	2	2	2
Physa fontinalis	0	0	1	1
Lymnea ovata	1	1	0	0
Dreissena polymorpha	1	1	1	1
Oligochaeta				
Limnodrilus claparedeanus	2	2	2	2
Limnodrilus lastockini	0	2	0	1
Peloscolex ferox	3	3	0	0
Eiseniella tetraedra	0	0	1	1
Psammcystides albicola	2		1	0
Criodrilus lacuum	0	1		
Enchytraidae	0		0	2
Hirudinea				
Glossiphonia complanata	2	2	1	1
Helobdella stagnalis	2	2	3	3
Erpodella octoculata	2	3	2	1
E. nigricollis	1	0	1	2
Haemopis sanguisuga	1	1	0	0
Ephemeroptera				
Baetis muticus	3	0	0	0
B. rhodani	4	0	3	0
B. niger	1	0	0	0
B. subalpinus	1	0	2	0
Baetidae	0	10	0	9
Ameletus inopinatus	1	0	1	0
Caenis horaria	2	0	0	0
C. luctuosa	2	0	1	0
Caenis sp.	0	4	0	1
Ephemerella ignita	1	1	0	0
Heptagenia sulphurea	1	1	0	0
Leptophlebia vespertina	3	0	1	0
Paraleptophlebia sp.	0	3	0	0
Plecoptera				
Brachyptera risi	5	1	6	0
Brachyptera sp.	0	0	0	5
Diura nanseni	3	0	2	0
Isoperla gramatica	3	0	3	0
Capniidae	0	3	0	0
Perlodidae	0	7	0	0
Cloroperlidae	0	0	0	3
Leuctra hippopus	4	0	4	0
L. nigra	0	0	1	0
L. fusca	1	0	1	0

Table 6 cont.

Species	Sample 1 Deliv.	Sample 1 Ident.	Sample 2 Deliv.	Sample 2 Ident.
Leuctra sp.	0	2	0	5
Amphinemura standfussi	1	0	1	0
A. borealis	3	0	3	0
Amphinemura sp.	0	6	0	0
Nemoura cinerea	3	0	4	0
N. avicularis	1	0	0	0
Nemoura sp.	0	3	0	0
Nemurella picteti	0	3	0	0
Protonemura meyeri	2	0	4	0
Protonemura sp.	0	2	0	4
Taeniopteryx nebulosa	2	2	3	3
Trichoptera				
Philopotamus montanus	0	1	1	1
Hydropsyche pellucidula	1	0	3	4
H. angustipennis	3	5	0	1
H. siltalai	3	0	1	0
Lepidostoma hirtum	1	1	0	0
Neureclipsis bimaculata	2	2	3	4
Holocentropus dubius	1	0	1	0
Cyrnus flavidus	2	2	1	3
Polycentropus flavomaculatus	3	4	1	0
Silo pallipes	2	2	0	0
Rhyacophila obliterata	0	0	2	3
R. nubila	2	3	1	0
R. fasciata	1	0	0	0
Megaloptera				
Sialis lutaria	0	0	1	0
Sialis	0	0	0	1
Coleoptera				
Planatambus maculatus	1	0	0	0
Limnius volchmani	2	0	1	0
Stenelmis canaliculata	1	0	1	0
Elmis aenea	3	0	2	0
Olimnius tuberculatus	0	0	2	0
O. troglodytes	2	0	0	0
Coleoptera imago	5	4	2	2
Coleoptera larve	2	4	5	6

Appendix B. Reports and publications from the ICP-Waters Programme

1. Manual for Chemical and Biological Monitoring. Programme Manual. Prepared by the Programme Centre, Norwegian Institute for Water Research. NIVA, Oslo 1987.

2. Norwegian Institute for Water Research, 1987. Intercalibration 8701: pH, Ks, SO_4, Ca. Programme Centre, NIVA, Oslo.

3. Norwegian Institute for Water Research, 1988. Data Report 1987 and available Data from Previous Years. Programme Centre, NIVA, Oslo.

4. Norwegian Institute for Water Research, 1988. Intercalibration 8802: pH, K_{25}, HCO_3, NO_3, SO, Cl, Ca, Mg, Na, K. NIVA, Oslo.

5. Proceedings of the Workshop on Assessment and Monitoring of Acidification in Rivers and Lakes, Espoo, Finland, 3rd to 5th October 1988. Prepared by the Finnish Acidification Research Project, HAPRO, Ministry of Environment, October 1988.

6. Norwegian Institute for Water Research, 1989. Intercalibration 8903: Dissolved organic carbon and aluminium fractions. Programme Centre, NIVA, Oslo. NIVA Rep. 2238-89. ISBN 82-577-1534-4.

7. Note: Some reflections about the determination of pH and alkalinity. Prepared by the Programme Centre, Norwegian Institute for Water Research. Håvard Hovind, NIVA, Oslo October 1989.

8. Hovind, H. 1990. Intercalibration 9004: pH and alkalinity. Programme Centre, NIVA, Oslo. NIVA Rep. 2465-90. ISBN 82-577-1776-2.

- Skjelkvåle, B.L., and Wright, R.F. 1990. Overview of areas sensitive to acidification: Europe. Programme Centre, NIVA, Oslo. Acid Rain Research Report 20/1990. NIVA-report 2405-90. ISBN 82-577-1706-1.

9. Johannessen, M. 1990. Intercalibration in the framework of an international monitoring programme. Proceedings of the third annual Ecological Quality Assurance Workshop, Canada Centre for Inland Waters, Burlington Ontario. Programme Centre, NIVA, Oslo.

10. Norwegian Institute for Water Research, 1990. Data Report 1988. Programme Centre, NIVA, Oslo.

11. Norwegian Institute for Water Research, 1990. Data Report 1989. Programme Centre, NIVA, Oslo.

12. Proceedings for the fifth Meeting of the Programme Task Force Freiburg, Germany, October 17 -19, 1989. Prepared by the Umweltbundesamt, Berlin July 1990.

13. Hovind, H. 1991. Intercalibration 9105: pH, K_{25}, HCO_3, $NO_3 + NO_2$, Cl, SO_4, Ca, Mg, Na, K and TOC. Programme Centre, NIVA, Oslo. NIVA Rep. 2591-91. ISBN 82-577-1931-5.

14. Norwegian Institute for Water Research, 1991. The Three Year Report. Summary and results 1987 – 1989: Results from the International Co-operative Programme on Assessment and Monitoring of Acidification in Rivers and Lakes. Programme Centre, NIVA, Oslo.

15. Norwegian Institute for Water Research, 1991. Summary of The Three Year Report 1987 – 1989. Programme Centre, NIVA, Oslo.

16. Scientific papers presented at the Sixth Task Force meeting in Sweden 23 - 24 October 1990. Swedish Environmental Protection Agency, Sweden, September 1991.

17. Seventh Task Force meeting of international Co-operative Programme on Assessment and Monitoring of Acidification of Rivers and Lakes. Galway, Ireland. September 30 - October 3 1991. Proceedings.

18. Johannessen, M., Skjelkvåle, B.L. and Jeffries, D. 1992. International cooperative Programme on Assessment and Monitoring of Rivers and Lakes. In: Conference Abstracts, Intern. Conference on Acidic Deposition, Glasgow 16-21, sept. 1992, p. 449. Kluwer Academic Press.

19. Hovind, H. 1992. Intercalibration 9206: pH, K_{25}, HCO_3, NO_3 + NO_2, Cl, SO_4, Ca, Mg, Na, K, Al and DOC. Programme Centre, NIVA, Oslo. NIVA Rep. 2784-92. ISBN 82-577-2164-6.

20. Norwegian Institute for Water Research, 1992. Data Report 1990. Programme Centre, NIVA, Oslo.

21. Norwegian Institute for Water Research, 1992. Evaluation of the International Co-operative Programme on Assessment and Monitoring of Acidification in Rivers and Lakes. Programme Centre, NIVA, Oslo.

22. Hovind, H. 1993. Intercalibration 9307: pH, K_{25}, HCO_3, NO_3 + NO_2, Cl, SO_4, Ca, Mg, Na, K, total aluminium, reactive and non-labile aluminium, TOC and COD-Mn. Programme Centre, NIVA, Oslo. NIVA Rep. 2948-93. ISBN 82-577-2370-3.

23. Raddum, G.G. 1993. Intercalibration 9301: Invertebrate Fauna. Programme Centre, NIVA, Oslo. ISBN 82-577-2376-2.

24. Proceedings of the 9th Task Force Meeting in Oisterwijk, the Netherlands, November 1-3, 1993. Programme Centre, NIVA, Oslo.

25. Skjelkvåle, B.L., Newell, A.D, and Johannessen, M. 1993. International Cooperative Programme on Assessment and Monitoring of Rivers and lakes: Status and Results. In: BIOGEOMON - Symposium on Ecosystem Behaviour: Evaluation of Integrated Monitoring in small catchments. Prague, September 18-20, 1993. Czech Geological Survey, Prague 1993. s. 274-275.

26. Hovind, H. 1994. Intercomparison 9408: pH, K_{25}, HCO_3, NO_3 + NO_2, Cl, SO_4, Ca, Mg, Na, K, total aluminium, TOC and COD-Mn. Programme Centre, NIVA, Oslo. NIVA Rep. 3142-94. ISBN 82-577-2616-8.

27. Skjelkvåle, B.L., Newell, A.D., Raddum, G.G, Johannessen, M., Hovind, H., Tjomsland, T. and Wathne, B.M. 1994. The six year report: Acidification of surface water in Europe and North America. Dose/response relationships and long-term trend. Programme Centre NIVA Oslo. Norwegian Institute for Water Research. NIVA Report 3041-94: 135 pp. ISBN 82-577-2499-8.

28. Norwegian Institute for Water Research, 1994. Data Report 1991. Programme Centre, NIVA, Oslo. ISBN 82-577-2662-5.

29. Stoddard, J.L, and Traaen, T.S. 1994. The stages of Nitrogen Saturation: Classification of catchments included in "ICP on Waters". In: M. Hornung, M.A. Stutton and R.B. Wilson (eds.) Mapping and Modelling of Critical Loads for Nitrogen: a Workshop Report. Proceedings of a workshop held in Grange-over-Sands (UK), 24-26 October 1994. pp.69-76.

30. Hovind, H. 1995. Intercomparison 9509: pH, k_{25}, HCO_3, NO_3 + NO_2, Cl, SO_4, Ca, Mg, Na, K, total aluminium - reactive and nonlabile, TOC and COD-Mn. Programme Centre, NIVA, Oslo. NIVA Rep. 3331-95. ISBN 82-577-2849-7.

31. Traaen, T.S., and Stoddard, J.L. 1995. An assessment of nitrogen leaching from watersheds included in ICP on Waters. Norwegian Institute for Water Research, NIVA Report 86001-3201, 39 pp.

32. Norwegian Institute for Water Research, 1995. Data Report 1992-93. Draft 1994. Programme Centre, NIVA, Oslo. ISBN 82-577-2852-7.

33. Norwegian Institute for Water Research, 1995. Data Report 1992-93. Draft 1994. Part 2, Biology and Site-data. Programme Centre, NIVA, Oslo. ISBN 82-577-2852-7.

34. Raddum, G.G. 1995. Aquatic Fauna: Dose/response and long-term trends. Programme Centre, NIVA, Oslo.

35. Raddum, G.G. 1995. Intercalibration 9502: Invertebrate Fauna. Programme Centre, NIVA, Oslo.

36. Raddum, G.G., and Skjelkvåle, B.L. 1995. Critical limits to invertebrates in different regions in Europe. *Water Air and Soil Poll.* 85: 475-480.

37. Hovind, H. 1996. Intercomparison 9610: pH, K_{25}, HCO_3, NO_3 + NO_2, Cl, SO_4, Ca, Mg, Na, K, total aluminium, aluminium - reactive and nonlabile, TOC and COD-Mn. Programme Centre, NIVA, Oslo. NIVA Rep. 3550-96. ISBN 82-577-3099-8.

38. Newell, A.D, and Skjelkvåle, B.L. 1996. Acidification trends in surface waters in the International Program on Acidification of Rivers and Lakes. *Water Air Soil Poll.* 93:27-57.

39. Norwegian Institute for Water Research, 1996. Programme Manual. Programme Centre, NIVA, Oslo. NIVA Rep. 3547-96. ISBN 82-577-3094-7.

40. Raddum, G.G. 1996. Intercalibration 9603: Invertebrate Fauna. Programme Centre, NIVA, Oslo. ISBN 82-577-3095-5.

41. Lükewille, A., Jeffries, D., Johannessen, M., Raddum, G.G., Stoddard, J.L, and Traaen, T.S. 1997. The Nine Year report. Acidification of Surface Waters in Europe and North America. Long-term Development (1980s and 1990s). Programme Centre, NIVA, Oslo ISBN 82-577-3195-1. 168 pp.

42. Hovind, H. 1997. Intercomparison 9711. pH, K_{25}, HCO_3, NO_3 + NO_2, Cl, SO_4, Ca, Mg, Na, K, total aluminium, aluminium - reactive and nonlabile, TOC and COD-Mn. Programme Centre, NIVA, Oslo. NIVA-Report SNO 3716-97. ISBN 82-577-3284-2.

43. Johannessen, M., and Skjelkvåle, B.L. 1997. International Co-operative Programme on Assessment and Monitoring of Acidification of Rivers and Lakes - ICP-Waters; Programme objectives, organization and main results. In: Proceedings to "International Conference on management of Transboundary Waters in Europe" 22-25 September 1997 in Poland. Programme Centre, NIVA, Oslo. ICP-Waters Report 43/1997. ISBN 82-577-3297-4.

44. Henriksen, A., and Posch, M. 1998. Critical load and their exceedances for ICP-Waters sites. Programme Centre, NIVA, Oslo. NIVA-Report SNO 3821-98, ICP-Waters Report 44/1998. ISBN 82-577-3399-7

45. Stoddard, J.L., Traaen, T.S., Skjelkvåle B.L., and Johannessen, M. 1998 Assessment of Nitrogen Leaching at UN/ECE ICP-Waters sites. In press *Environmental Pollution.*

46. Summary of The Nine Year Report. NIVA-Report SNO 3879-98, ICP-Waters Report 44/1998. ICP-Waters report 46/1998. ISBN 82-577-3463-2

47. Raddum, G.G. 1998. Intercalibration 9804: Invertebrate fauna. NIVA-Report SNO 3912-98, ICP-Waters Report 47/1998. ISBN 82-577-3500-0

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