Convention on Long-Range Transboundary Air Pollution

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

91/2008

Biological intercalibration: Invertebrates 1107

NIVA Norwegian Institute for Water Research

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REPORT

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Abstract

The 11th intercalibration of invertebrates in the ICP Waters programme had contributions from 5 laboratories. The laboratories identified a high portion of the individuals in the test samples; usually > 95% of the total number of species, but shortcoming identifications below this limit was also noted. Misidentifications and low % identified were in general made on material coming from regions outside the home region of the laboratory. Few faults were recorded on genus level. The taxonomic quality was sufficient for stating the acidity index. The mean Quality assurance index was > 80 for all the laboratories, indicating good taxonomic work.

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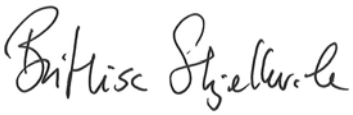
1. Interkalibrering	1. Intercalibration
2. Invertebrater	2. Invertebrates
3. Akvatisk fauna	3. Aquatic fauna
4. Overvåking	4. Monitoring



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CONVENTION ON LONG-RANGE TRANSBOUNDARY AIR POLLUTION

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

Biological intercalibration: Invertebrates 1107

Prepared by the ICP Waters Programme Subcentre
Laboratory of Freshwater Ecology and Inland Fisheries
University of Bergen, February 2008

Preface

The International Cooperative Programme on Assessment and Monitoring 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 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 the University of Bergen. Berit Kvæven, Norwegian Pollution Control Authority (SFT), has led the ICP Waters programme. SFT provides financial support to the work of the Programme Centre.

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. Twenty 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 monitoring sites are generally acid sensitive and representative of low acid neutralising capacity (ANC) and low critical load levels of the distributions for all the waters surveyed in the region. The ICP site network is geographically extensive and includes long-term data series (more than 25 years) for some sites.

The Programme objective is to establish an international network of surface water monitoring sites and promote international harmonisation of monitoring practices. One of the tools in this work is an inter-laboratory quality assurance test. The bias between analyses carried out by the individual participants of the Programme has to be identified and controlled. The test will also be a valuable tool in improve the taxonomic skill of the participating laboratories.

We here report the results from the 11th intercalibration on invertebrate fauna.

Bergen, January 2008

Arne Fjellheim and Gunnar G. Raddum

Contents

1. Introduction

The purpose of the biological intercalibration is to evaluate the quality of the taxonomic work on the biological material delivered to the Programme centre. The quality can influence on the evaluation of the samples, which is based on the species and their tolerance (Raddum *et al.* 1988, Fjellheim and Raddum 1990, Raddum 1999). The control is therefore important for evaluation of the significance of trends in acidification indexes both for a specific site/watershed, as well as for comparisons of trends between different regions and countries. The material is also used for multivariate statistical analysis (Larsen *et al.* 1996, Skjelkvåle *et al.* 2000, Halvorsen *et al.* 2002). This type of data treatment is especially sensitive to the quality of the species identification. The intercalibration of biological material will in general have focus on the taxonomic work and through this be a basis for improving the quality, detect weak fields at the different laboratories as well as harmonisation of the biological database.

The methods for intercalibration of biological material were outlined in 1991 at the 7th ICP Waters Task Force meeting 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 standardised samples for all participants. To solve this problem each laboratory send samples of invertebrates from their own monitoring sites to the Programme centre. The Programme centre may additionally add species known to be present in the region of the specific laboratory. Based on this, each laboratory receives individual test samples composed of species representing their own monitoring region. One problem with this procedure is that the Programme centre needs material from the different areas in the ICP Waters region. This material has to be collected, identified and sent by the participating laboratories to the centre for making test samples. For the tests carried out in 2007 three laboratories got test material mainly composed of fauna from their home region, while two participants received material where more than half of the animals were sampled outside their region.

In this report we have calculated the quality assurance index for the participants, see Raddum (2005). This index evaluates the skill of identifying the species as well as the genus. It also takes into account the effort of identifying all specimens in the sample. The highest index score is 100, while a value of 80 is set as the limit of good taxonomic work.

2. Methods

Preparation of test-samples

Samples of identified invertebrates were received from three of the participating laboratories. These samples were used to compose test samples, with the addition of some specimens from earlier exercises. For two laboratories we did not receive material. In these cases the test samples were based on surplus material from the home region of the laboratories (< 50%) and on material from Scandinavia and Balticum regarded as relevant for the participant.

Identification

To minimise possible faults the following procedure have been used in preparing the test samples:

- The participating country has first identified the source material for the test samples. Two of us have verified the identification of the species/taxa as far as possible without damaging the individuals.
- The content of the two test samples for each laboratory, with respect to species and numbers, is listed in a table. Two persons control that the correct number and species is placed in the samples according to the list.

For the present test two participants received samples were more than 50% of the material were collected outside the faunistic region of the laboratory. Due to this the content of the test samples will partly relay on the skill of the Programme centre. This is not an ideal situation. Apart from this, the same procedure as mentioned for the other laboratories was followed.

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, cerci, mouthparts etc. can be lost or destroyed during handling connected with identification, sample composition and transportation. Contamination of larvae can also occur 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.

Evaluation

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 contains 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 when this is pointed out by the participant.

We have discriminated between "short coming" identification, probably due to damaged material, and virtual fault (wrong species - or genus name). Due to this, some subjective evaluations of the results have to be made. The percent of faults is therefore not always the

exact calculated percent of faults, but can be a modified value where some "expert judgement" is taken into account.

It is also of interest to know how many individuals that have been identified to species level of the total number in the sample. This is named *% identified*. A low percent means that many individuals are not brought to the species level and will consequently reduce the value of the taxonomic work.

Available material for making test samples varies. The number of individuals and number of species delivered will therefore differ between the laboratories. Samples with low diversity will be easier to handle than samples with high diversity, see Appendix tables. This should also be kept in mind when the results are evaluated. On the other hand, small samples should be avoided as only a few misidentifications could result in a low score.

We have calculated the quality assurance index, Qi, for important groups of invertebrates as well as the mean index for each participant. The Qi integrates the separate levels of the identifications as follows:

Qi = % correct species/10 * % correct genus/10 * % identified individuals/100

Qi will be a number between 0 and 100. 100 are the highest score that can be obtained. A score ≥80 is regarded as good taxonomical work.

3. Results and discussion

Five laboratories participated in the intercalibration of invertebrates in 2007. The content of species in the test samples delivered - and the results of the identification by the different laboratories are shown in Appendix Tables 1 - 5.

Mayflies

The identification of mayflies was generally good. Laboratory 1 and 3 identified the mayflies (Ephemeroptera) with only minor faults (Figure 1). The results from the other laboratories were also acceptable. The genus level was 100% correctly identified by the laboratories 2 - 4. With one exeption the Qi index was > 80, indicating high quality of the work. The reason for the low Qi index in Laboratory 5 was caused by the misidentification to wrong genus of a single specimen. Normally this would not have been enough to bring the Qi below 80, but due to a mistake made by the programme centre, the total amount of mayflies in the two samples was too low.

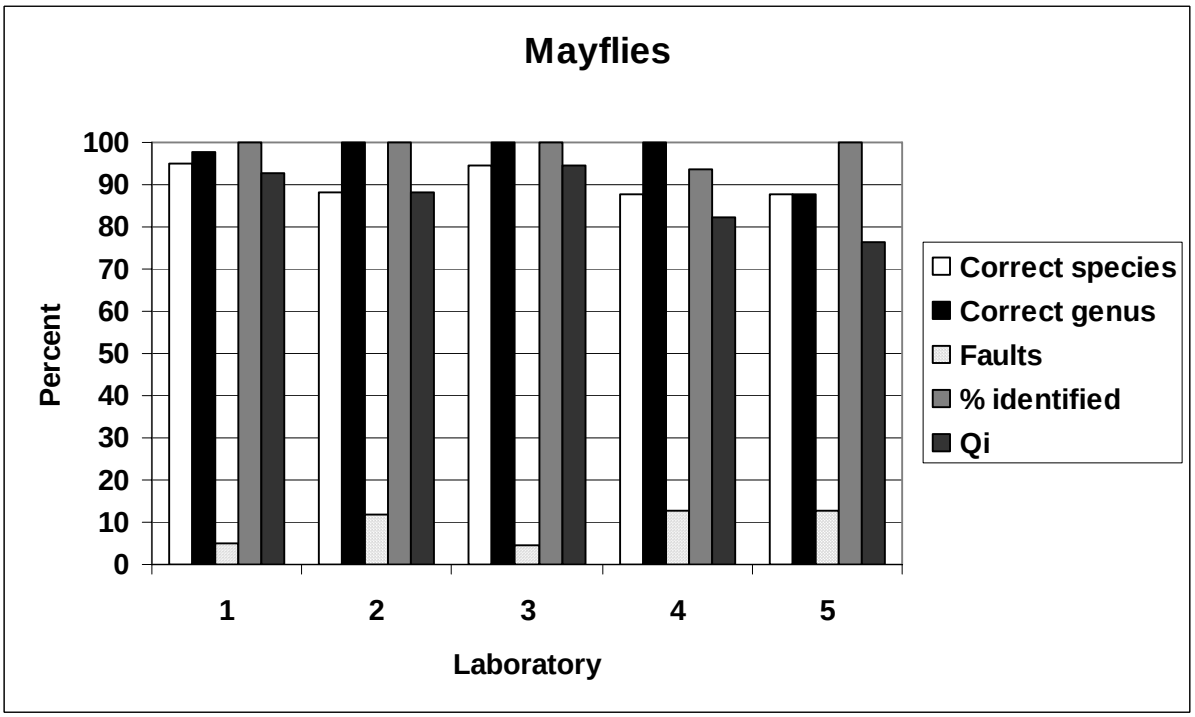

Figure 1. *Results of the identification of mayflies.*

Stoneflies

The identification of stoneflies (Plecoptera) was very good. The laboratories 1 and 3 were faultless, while the rest of the participants were acceptable (Figure 2). All larvae were identified to correct genus. Laboratory 3 correctly pointed out that a speciemen of *Diura* identified as *D. bicaudata* could be *D. nanseni*, (Figure 3) which is uncommon in the home region of this laboratory. We therefore did not recognize this identification as a fault. The Qi was calculated to 96, 95, 97, 85 and 92 for laboratories 1, 2, 3, 4 and 5, respectively.

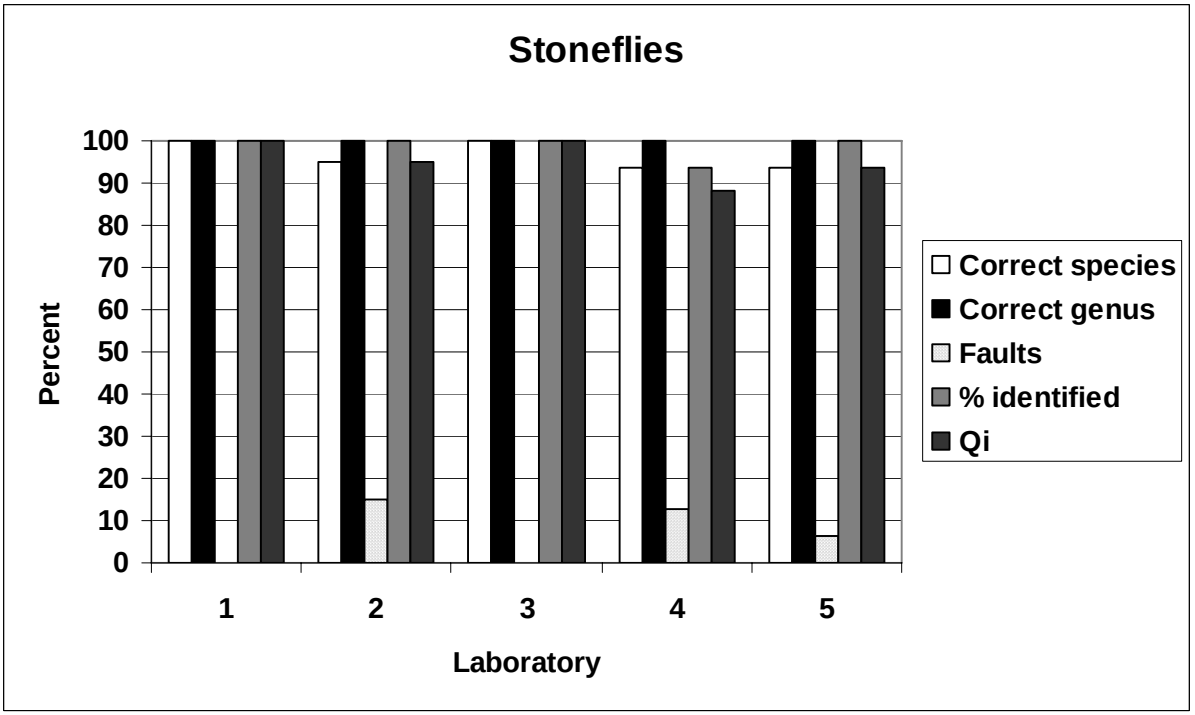

Figure 2. *Results of the identification of stoneflies.*

Figure 2. *The stonefly Diura nanseni. This species reaches its southernmost Europaean distribution limit in Fennoscandia (Lillehammer, 1988). Additionally the species is found in North America.*
Photo: Arne Fjellheim.

Caddisflies

The identification of caddis flies (Trichoptera) was also generally good (Figure 3). Laboratory 1 and 2 identified all specimens correctly. Laboratory 3, 4 and 5 did 6, 11 and 3 % faults, respectively. On genus level four of the laboratories were faultless. The *% identified* was 100% for all participants. The taxonomic work on caddisflies was also regarded as good with Qi values of 100, 100, 94, 84 and 97, for participants 1, 2, 3, 4 and 5, respectively.

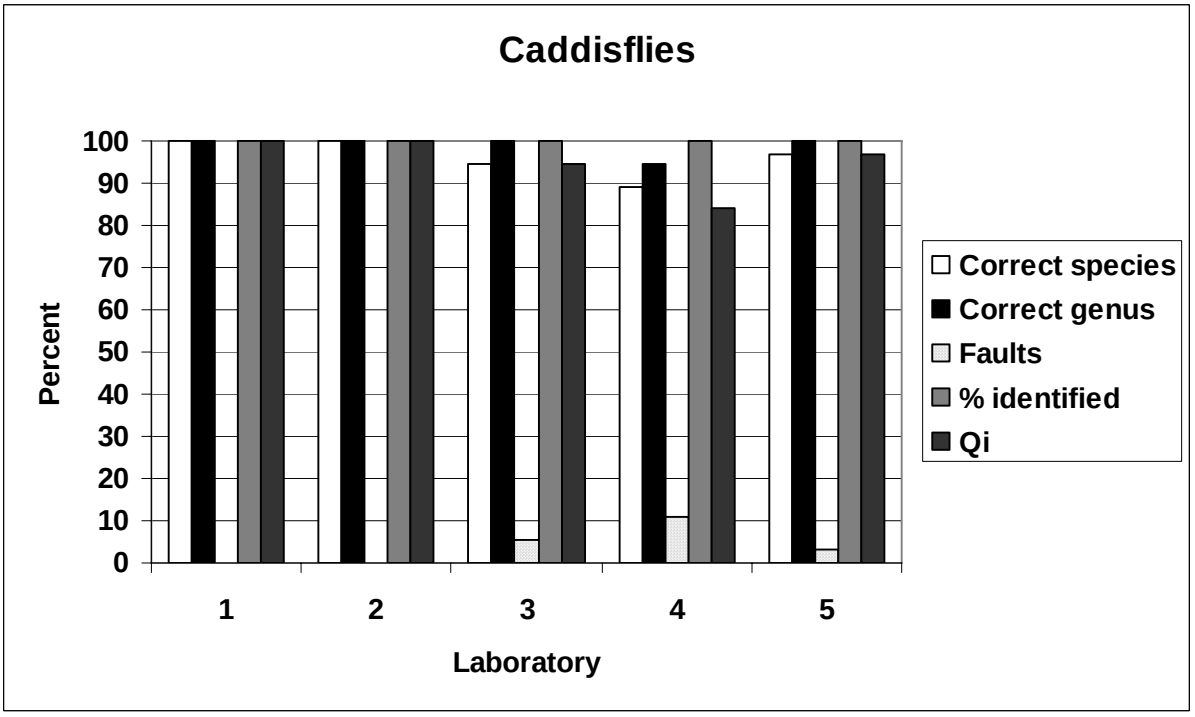

Figure 3. *Results of the identification of caddisflies.*

Other groups

In this intercalibration we have included Coleoptera (water beetles), larger crustaceans, Hirudinea, molluscs, Diptera etc. Both larvae and imagos have been included for some of the groups. Molluscs and larger crustaceans are sensitive to acid water and important for the evaluation of acidification. The tolerance of the invertebrates among Coleoptera, Diptera, Odonata etc. is little known, but generally they are regarded as tolerant to acid water and consequently have low importance for evaluation of the acidity index. However, all species will be important for statistical analysis, using the whole community. Figure 4 shows the results of the identification of these groups. The identifications made by laboratories 3 and 5 were perfect with no faults. With one exeption, all larvae were identified to correct genus. The *% identified* was 100% for all participants. The Qi score was acceptable: 92, 96, 100, 85 and 100, for participants 1, 2, 3, 4 and 5.

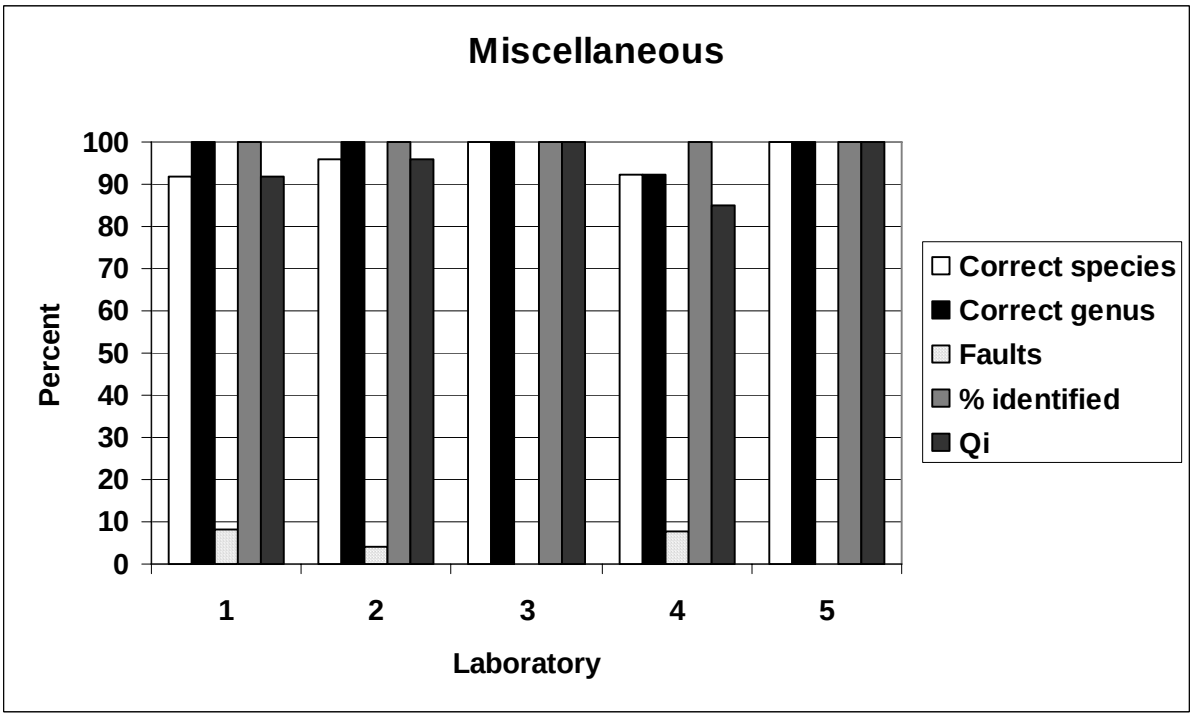

Figure 4. *Results of the identification of miscellaneous groups*

Total number of species in the sample

It was generally a low discrepancy between the number of individuals put into the samples and the reported number of larvae. However, some differences have occurred between delivered and identified numbers of individuals. More species are sometimes identified than put into the sample, but this has been neglected in this test. Some small or juvenile larvae were also put in the samples. Such larvae can be impossible to identify if origin and time of sampling is unknown. This has also been taken into account during the evaluation.

4. Evaluation/conclusion

The laboratories generally identified a high portion (≥ 95%) of the total number of species in the test samples. Shortcoming identification was low and indicated good taxonomic skills by all participants. The mean skill of identifying species and genus and Qi score per laboratory is shown in Figure 5. Laboratory 1 to 5 got a mean Qi score of 96, 95, 97, 85 and 92, respectively. Hence, all tests were characterized by good taxonomic work. The biological intercalibration is important for harmonising biological material/databases and will be of high value in programmes where community analyses is in focus or where the ecological status should be stated, like the EU Water Framework Directive.

None of the participants did misidentifications that could result in a wrong acidity index (Fjellheim and Raddum (1990) and Raddum (1999)) *w*hich is a vidly used index to evaluate damage of invertebrate fauna from acidification (Figure 6).

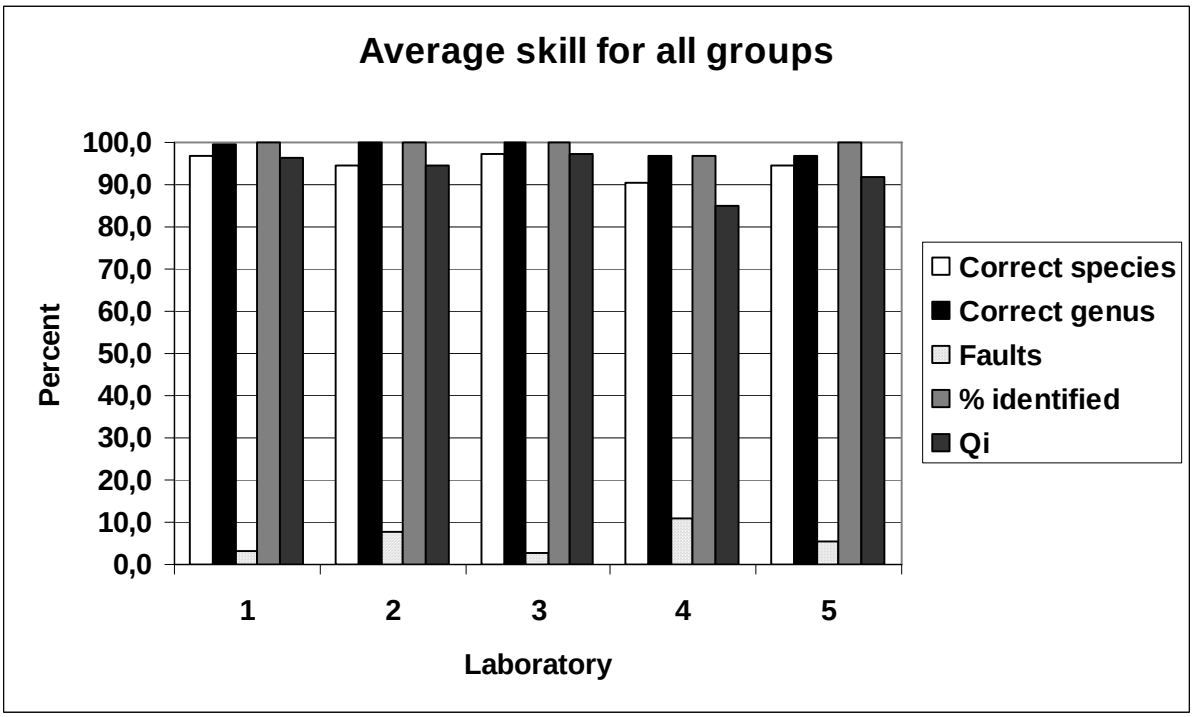

Figure 5. *Mean skill in percent of identifying species and genus and mean Qi for each laboratory.*

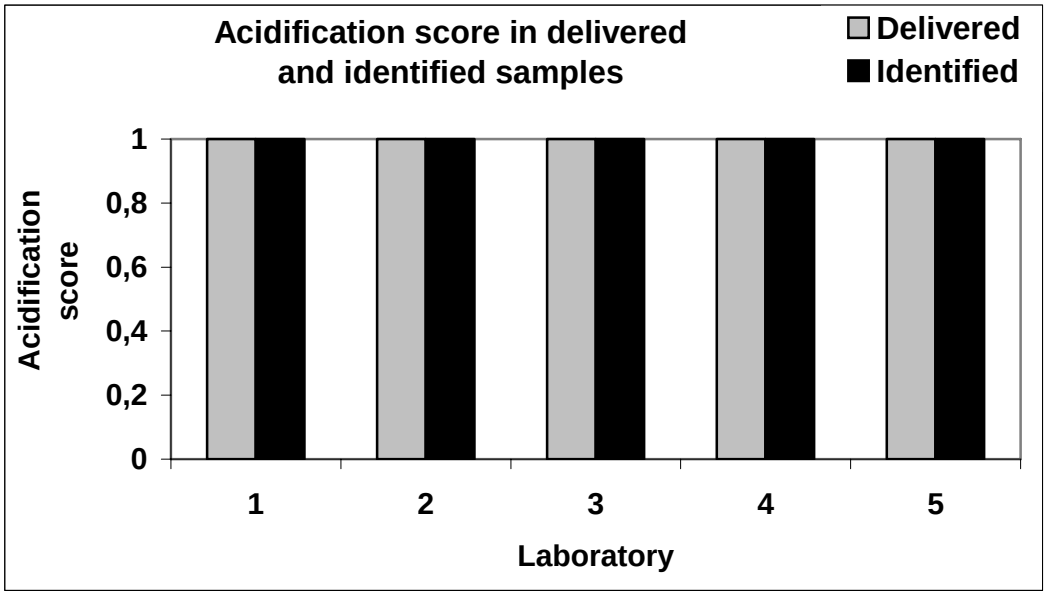

Figure 6. *Acidification score in delivered and identified samples.The calculation of the index were done according to Fjellheim and Raddum (1990) and Raddum (1999).*

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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 2007 and their code numbers are:

1. Div. Ambiente Canton Ticino, Laboratorio Studi Ambientali, Sez. Protezione Aria AcquaRiva Paradiso 15, CH-6900 Lugano Paradiso, **Switzerland**
2. Swedish University of Agricultural Sciences, Dept. of Environmental Assessment, P.O. Box 7050, S-75007 Uppsala**, Sweden**
3. EcoRing, Lange Str. 9, D-37181 Hardegsen, **Germany**
4. Bayerisches Landesamt für Wasserwirtschaft, Demollstr. 31, D-82407 Wielenbach, **Germany**
5. School of Biological Sciences Queen Mary, University of London London E1 4NS, **UK**

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Table 1. Identified species/genus in sample 1 and 2 by Laboratory 1

	Sample 1		Sample 2	
Taxa:	**Delivered**	**Identified**	**Delivered**	**Identified**
Ephemeroptera				
Baetis rhodani	5	5	3	3
Baetis fuscatus	2	2	2	2
Baetis lapponicus			1	
Baetis vernus	1	1	2	2
Baetidae ind.				1
Caenis luctuosa	1	1	2	2
Caenis horaria	1	1	1	1
Leptophlebia marginata	2			
Paraleptophlebia cincta		2		
Habrophlebia lauta			2	2
Cloeon sp.	1		1	1
Centrophilium luteolum		1	1	1
Ephemera danica	1	1		
Ephemerella aurivilli			2	2
Ephemerella ignita	2	2		
Heptagenia sulphurea	2	3	1	2
Heptagenia fuscogrisea	1	1	1	1
Siphlonurus aestivalis		1		1
Heptagenia dalecarlica	1		1	
Metropus borealis	1		1	
Plecoptera				
Amphinemura borealis	2	2	1	1
Amphinemura sulcicollis	1	1	2	2
Nemoura cinerea	2	2		
Nemoura avicularis			2	2
Nemurella pictetii	1	1	1	1
Leuctra hippopus	2	2	2	2
Leuctra fusca	1	1	1	1
Capnia pygmaea	1	1	1	1
Protonemura sp.	1	1	1	1
Taenopteryx nebulosa	1	1	1	1
Siphonoperla burmeisteri	1	1	1	2
Brachyptera risi	2	2	3	3
Diura nanseni			2	1
Diura bicaudata	1	1		
Isoperla sp.	1	1	1	1
Dinocras cephalotes	1	1	1	1
Trichoptera				
Tinodes waeneri	1	1	1	1
Rhyacophila nubila	1	1		
Polycentropus flavomaculatus	1	1	2	2
Wormaldia sp.	2	2	2	2
Neureclipsis bimaculatus	3	3	1	1
Chimarra marginata	1	1	2	2
Phryganea cf. bipunctata			1	1

Hydropsyche siltalai	2	2	1	1
Hydropsyche pellucidula			1	1
Ithytrichia lamellaris	2	2	3	3
Glossosoma sp.	1	1	1	1
Lepidostoma hirtum	2	2	3	3
Sericostoma personatum	1	1	1	1
Agrypnia obsoleta	1	1		
Crunoecia irrorata	1	1	1	1
Micrasema sp.	1	1		
Adicella reducta	1	1	1	1
Megaloptera				
Sialis fuliginosa	1	1		1
Sialis lutaria			1	
Hirudinea				
Helobdella stagnalis	1	1		
Erpobdella octoculata			1	1
Gastropoda				
Platambus maculatus	1	1	1	1
Elmis aenea	1	1	1	1
Diptera				
Atherix ibis	3	3	1	1

Table 2. Identified species/genus in sample 1 and 2 by Laboratory 2

	Sample 1		Sample 2	
Taxa:	**Delivered**	**Identified**	**Delivered**	**Identified**
Ephemeroptera				
Baetis rhodani	1	2	1	2
Baetis fuscatus	1		1	
Baetis niger	1	1		
Ephemerella aurivilli	1	1	1	1
Ephemerella mucronata	1	1	1	1
Centroptilum luteolum	1	1		
Ephemera danica			1	1
Cloeon dipterum			1	1
Caenis luctuosa	1	1		1
Caenis horaria	1	1	1	
Heptagenia dalecarlica	1	1		
Heptagenia fuscogrisea			1	1
Plecoptera				
Isoperla sp.cf.*difformis*	1		1	
Isoperla grammatica		1		1
Isoperla obscura	1	1	1	1
Arcynopteryx compacta	1	1	1	1
Diura nanseni	1		1	
Diura bicaudata		1		1
Dinocras cephalotes			1	1
Amphinemura sulcicollis	1	1		
Amphinemura borealis			1	1
Nemoura cinera	1	1		
Nemoura avicularis	1	1	1	1
Taeniopteryx nebulosa	1	1	1	1
Brachyptera risi	1	1	1	1
Leuctra hippopus	1	1	1	1
Trichoptera				
Rhyacophila nubila	1	1	1	1
Rhyacophila fasciata			1	1
Hydropsyche angustipennis	1	1		
Hydropsyche siltalai			1	1
Cheumatopsyche lepida	1	1		
Agapetus ochripes	1	1	1	1
Anabolia nervosa	1	1	1	1
Silo pallipes			1	1
Polycentropus irroratus	1	1		
Oecetis notata	1	1		
Oecetis testacea			1	1
Mystacides azurea	1	1	1	1
Philopotamus montanus	1	1	1	1
Wormaldia sp.	1	1		
Chimarra marginata			1	1
Malacostraca				
Asellus aquaticus	1	1	1	1

Gammarus pulex	1	1	1	1
Gammarus pulex			1	1*
Hirudinea				
Helobdella stagnalis	1	1	1	1
Oligochaeta				
Eiseniella tetraedra	1	1	1	1
Gastropoda				
Ancylus fluviatilis	1	1	1	1
Bithynia tentaculata			1	1
Physa fontinalis	1	1		
Gyraulus sp(albus)	1	1	1	1
Megaloptera				
Sialis lutaria			1	1
Coleoptera				
Nebrioparus depressus	1	1	1	1
Oretochilus villosus	1	1	1	1
Elodes sp.	1	1		
Limnius volckmari			1	1
Heteroptera				
Hespecorixa salhbergi	1			
Hespercorixa cf linnaei		1		

* Identified to genus

Table 3. Identified species/genus in sample 1 and 2 by Laboratory 3

	Sample 1		Sample 2	
Taxa:	**Delivered**	**Identified**	**Delivered**	**Identified**
Ephemeroptera				
Baetis rhodani	1	1		
Baetis niger			1	
Baetis muticus	1		1	1
Baetis sp.		1		1
Centroptilum luteolum	1	1		
Cloeon dipterum			1	1
Caenis luctuosa	2	3		
Caenis horaria			1	1
Caenis macrura	1		1	1
Ephemera vulgata	1	1		
Ephemera danica			1	1
Heptagenia sulphurea			2	2
Ephemerella aurivilli	1	1		
Ephemerella ignita			1	1
Plecoptera				
Taeniopteryx nebulosa	1	1	1	1
Isoperla grammatica	1	1	1	1
Diura sp.	1	1		
Dinocras cephalotes	1	1		
Protonemura meyer			1	1
Capnia sp.	1	1	1	1
Nemurella pictetii			1	1
Nemoura avicularis			1	1
Nemoura cinerea	1	1		
Nemoura sp.	1	1		
Amphinemura borealis			1	1
Amphinemura sulcicollis	1	1		
Leuctra hippopus	1	1		
Leuctra nigra			1	1
Trichoptera				
Molanna angustata	1	1		
Mollanodes tinctus	1	1		
Cyrnus flavidus	1	1	1	1
Holocentropus dubius			1	1
Cyrnus trimaculatus			1	1
Polycentropus flavomaculatus	1			
Polycentropus irroratus		1		
Plectrocnemia conspersa			1	1
Neureclipsis bimaculata	1	1		
Polycentropus irroratus			1	1
Brachycentrus subnubilus	1	1		
Leptocerus tineiformis	1	1	1	1
Mystacides azurea			1	1
Athripsodes cinereus	1	1		
Hydropsyche pellucidula			1	1

	Sample 1		Sample 2	
Taxa:	**Delivered**	**Identified**	**Delivered**	**Identified**
Goera pilosa	1	1		
Lepidostoma hirtum			1	1
Malacostraca				
Asellus aquaticus	1	1	1	1
Gammarus pulex	1	1		
Gammarus lacustris			1	1
Hirudinea				
Erpobdella octoculata			1	1
Megaloptera				
Sialis sp.	1	1		
Gastropoda				
Theodoxus fluviatilis	1	1		
Bithynia tentaculata			1	1
Physa fontinalis	1	1		
Diptera				
Atherix ibis	1	1		
Coleoptera				
Elmis aenea	1	1	1	1
Limnius volckmari	1	1		

Table 4. Identified species/genus in sample 1 and 2 by Laboratory 4

	Sample 1		Sample 2	
Taxa:	**Delivered**	**Identified**	**Delivered**	**Identified**
Ephemeroptera				
Baetis rhodani	1	1		
Baetis niger			1	1*
Baetis muticus	2	1*	1	1*
Centroptilum luteolum	1	1		
Cloeon dipterum			1	1
Caenis luctuosa	1			1
Caenis horaria		1	1	1
Caenis macura	1	1	1	
Ephemera vulgata	1	1		
Ephemera danica			1	1
Heptagenia sulphurea			1	1
Ephemerella aurivilli	1			
Ephemerella mucronata		1		
Ephemerella ignita			1	1
Plecoptera				
Taeniopteryx nebulosa	1	1*	1	1*
Isoperla grammatica	1	1*	1	1*
Diura nanseni	1			
Diura bicaudata		1		
Dinocras cephalotes	1	1*		
Protonemura meyer			1	1
Nemurella pictetii			2	1
Nemoura avicularis			1	
Nemoura cinerea	1	1		1
Nemoura flexuosa	1	1*		
Amphinemura borealis			1	1*
Amphinemura sulcicollis	1	1*		
Leuctra hippopus	1	1*		
Leuctra nigra			1	1
Trichoptera				
Molanna angustata	1	1		
Mollanodea tinctus	1	1		
Cyrnus flavidus	1		1	
Holocentropus dubius		1	1	2
Cyrnus trimaculatus			1	1
Polycentropus flavomaculatus	1	1		
Plectrocnemia conspersa			1	1
Neureclipsis bimaculata	1	1		
Polycentropus irroratus			1	1
Brachycentrus subnubilus	1	1		
Leptocerus tineiformis	1		1	
Leptocerus interruptus		1		1
Mystacides azurea			1	1
Athripsodes cinereus	1	1		
Hydropsyche pellucidula			1	1

	Sample 1		Sample 2	
Taxa:	**Delivered**	**Identified**	**Delivered**	**Identified**
Goera pilosa	1	1		
Lepidostoma hirtum			1	1
Megaloptera				
Sialis lutaria	1	1		
Malacostraca				
Asellus aquaticus	1	1	1	1
Gammarus pulex	1			
Gammarus lacustris		1	1	1
Hirudinea				
Erpobdella octoculata			1	1
Diptera				
Atherix sp.	1	1		
Gastropoda				
Theodoxus fluviatilis	1	1		
Bithynia tentaculata			1	1
Physa fontinalis	1	1		
Coleoptera				
Elmis aenea	1		1	1*
Riolus subviolaceus		1		
Limnius volckmari	1	1*		

* Identified to genus

Table 5. Identified species/genus in sample 1 and 2 by Laboratory 5

	Sample 1		Sample 2	
Taxa:	**Delivered**	**Identified**	**Delivered**	**Identified**
Ephemeroptera				
Ecdyonurus dispar	1	1*		
Ameletus inopinatus			1	1
Rithrogena semicolorata			1	1
Baetis niger	1	1*		
Baetis rhodani			1	1
Baetis muticus	1			
Centroptilum luteolum		1		
Caenis rivulorum			1	1
Caenis luctuosa	1	1		
Plecoptera				
Brachyptera risi	1	1		
Leuctra inermis			1	1
Leuctra hippopus	1	1		
Leuctra nigra	1	1	1	1
Capnia bifrons	1	1		
Amphinemura sulcicollis	1	1		
Amphinemura sulcicollis			1	1
Amphinemura borealis			1	
Amphinemura standfussi				1
Diura bicaudata		1	1	1
Diura nanseni	1			
Isoperla obscura	1	1	1	1
Isoperla grammatica			1	1
Siphonoperla torrentium		1	1	1
Siphonoperla burmeisteri	1			
Trichoptera				
Chaetopteryx villosa	1	1		
Halesus radiatus			1	1
Potamophylax cingulatus	1			
Potamophylax rotundipennis		1		
Odontocerum albicorne			1	1
Oxyethira sp.	1	1		
Silo pallipes			1	1
Goera philosa	1	1		
Philopotamus montanus			1	1
Tinodes waeneri	1	1		
Lepidostoma hirtum			1	1
Hydropsyche siltalai	1	1		
Holocentropus dubius			1	1
Holocentropus picicornis	1	1		
Cyrnus flavidus	1	1		
Cyrnus trimaculatus			1	1
Polycentropus irroratus	1	1		
Neureclipsis bimaculata	1	1		
Plectrocnemia conspersa			1	1

	Sample 1		Sample 2	
Taxa:	**Delivered**	**Identified**	**Delivered**	**Identified**
Sericostoma personatum	1	1	1	1
Agrypnia varia			1	1
Athripsodes bilineatus			1	1
Oecetis testacea	1	1		
Oecetis ochracea			1	1
Mystacides longicornis	1	1		
Mystacides azurea			1	1
Athripsodes sp.cf.cinereus?	1	1		
Rhyacophila dorsalis	1	1		1
Rhyacophila nubila			1	
Odonata				
Cordulegaster boltoni	1	1		
Enallagma cyathigerum			1	1
Megaloptera				
Sialis lutaria			1	1
Malacostraca				
Gammarus lacustris	1	1		
Heteroptera				
Sigara scotti			1	1
Artocorisa germani	1	1		
Cymatia bonsdorfi			1	1
Glaenocorisa propinqua	1	1		
Coleoptera				
Coelambus novemlineatus	1	1		
Olimnius tuberculatus	1	1	1	1*

* Identified to genus

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

All reports from the ICP Waters programme from 1987 up to present are listed below. All reports are available from the Programme Centre. Publications from 2002 up to present can be found at http://www.iis.niva.no/icp-waters/

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

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

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

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.

Norwegian Institute for Water Research, 1989. Intercalibration 8903: Dissolved organic carbon and aluminium fractions. Programme Centre, NIVA, Oslo. NIVA-Report SNO 2238-89.

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Hovind, H. 1990. Intercalibration 9004: pH and alkalinity. Programme Centre, NIVA, Oslo. NIVA-Report SNO 2465-90.

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

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

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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-Report 2784-92.

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

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.

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-Report 2948-93.

Raddum, G.G. 1993. Intercalibration of Invertebrate Fauna 9301. Programme Centre, NIVA, Oslo. NIVA-Report SNO 2952-93.

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