Seminar on Restoration of Rivers
Modified by Hydropower and Dredging

SEMINAR REPORT






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1. Opening and overview of the ECRR by Bart Fokkens

Bart Fokkens opened the ECRR seminar day (see the full programme in annex 1) and welcomed the participants (see annex 2). Bart introduced the ECRR network and activities briefly.

Bart Fokkens, being the present chairman of the ECRR, presented an overview of the ECRR developments in the last years. The present vision of the ECRR " Enhance river restoration as an integral part of sustainable water management throughout Europe, by connecting people and organisations working on river restoration" is still valid. The important definition in the vision is that ECRR focuses on the development of ecological restoration. River restoration is being understood as a part of sustainable water management.

⇨ ECRR is a network provider to exchange information and experiences on river restoration.

What are the essential activities of the ECRR? Promotion of the network and functions are important. The dissemination of river restoration information by e-mail, website and the events in which people can meet each other.

The Member countries in Europe are quite well distributed. The Management Board represents a good variation of countries from the different regions in Europe. The major problems are the same over whole Europe, but certain areas for example the South of Europe faces bigger problems due to the water shortage and the number of reservoirs/dams. The ECRR Management Board members discussed already the existing strategy and they came to the following conclusions:

- the ECRR should improve the role of network provider better. Emphasis should be put on the national networks, conferences and workshops as well as the on the observers role which is more about the (global) representation;
- the role of the ECRR as a provider of river restoration information should be enlarged by giving examples of best practices, the role of river restoration in relation to the IWRM and the WFD implementation, examples of cost-benefit analyses and good examples of awareness rising.

The legal framework of the ECRR work is diverse. All the restoration work falls under the umbrella of three main conventions (Convention on Biological Diversity, Ramsar Convention, and the Helsinki Convention as well as some specific Basin Convention. Furthermore, there are many EU Directives which are important for river restoration issues (e.g. the Water Framework Directive, the Bird and Habitat Directive, the Nitrate Directive. The WFD is the most important directive in relation to river restoration; this creates perspectives to create more diversity in riverine habitats, to enlarge the ecological network along rivers, to contribute to a better flood management and to improve spatial
Quality.

Bart is grateful to SYKE and especially Jukka Jormola for the organisation of this seminar.

2. Welcome and introduction to SYKE by Markku Maunula

Markku Maunula welcomed the seminar participants at the SYKE institute and wished the whole group a successful day.

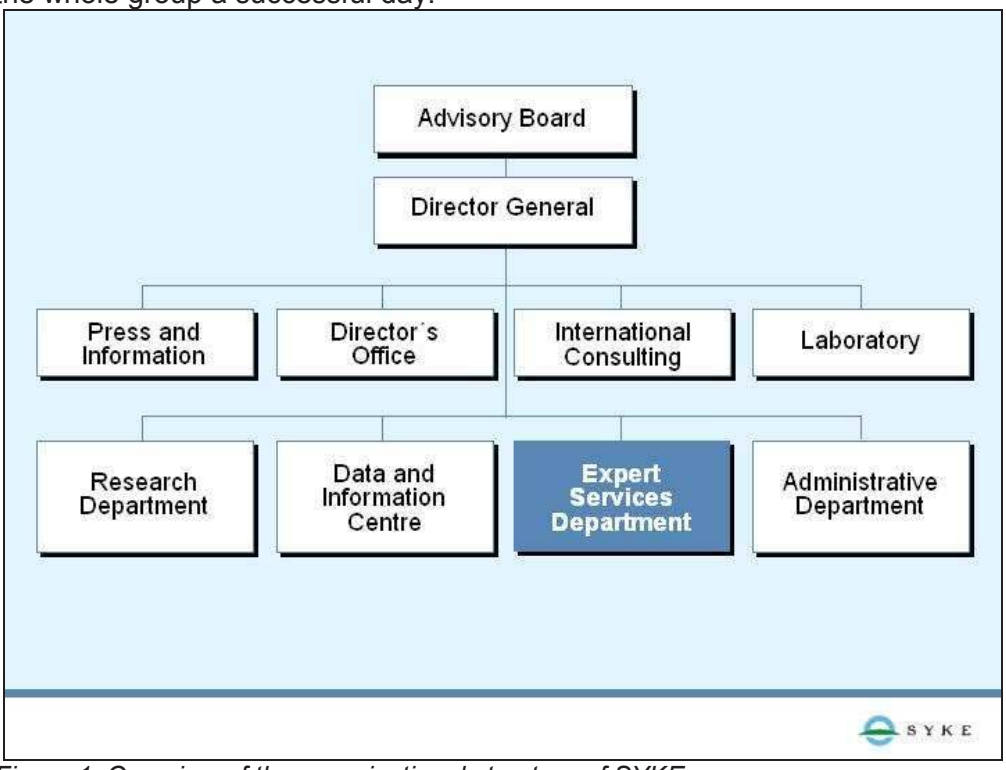

Figure 1. Overview of the organisational structure of SYKE

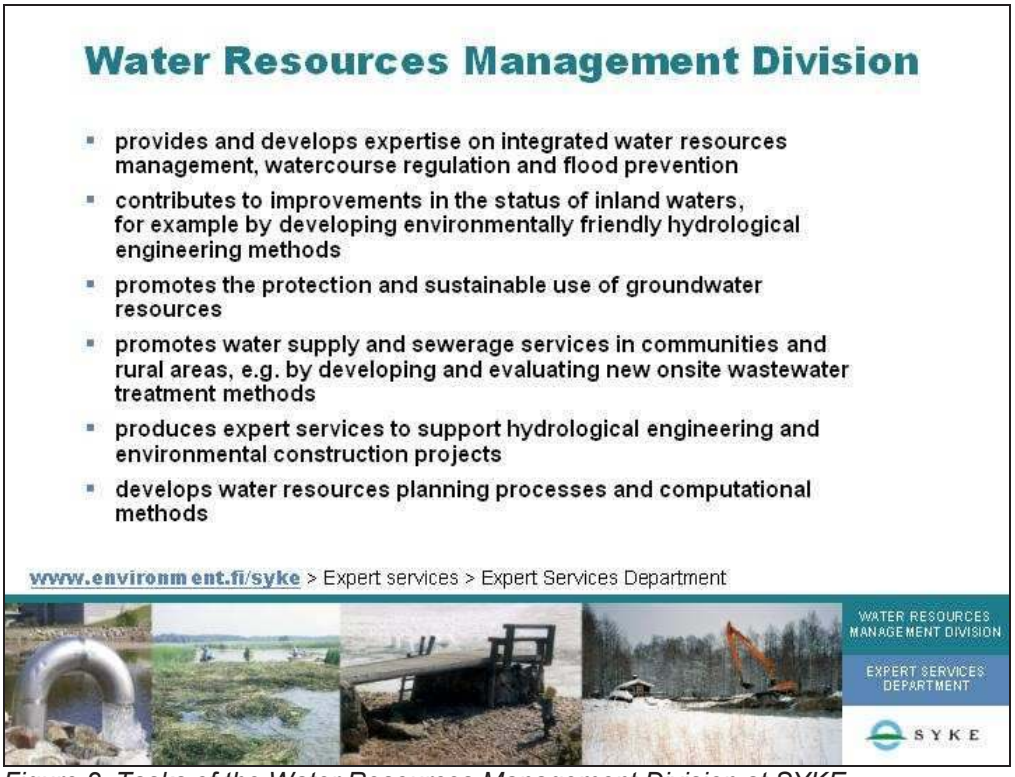

Figure 2. Tasks of the Water Resources Management Division at SYKE

The Ministry of Environment has the overall supervision of SYKE, as Finnish Environment Institute. And both bodies have the overall supervision on the Environmental Permit Authorities and the Regional Environment Centres. The Ministry of Agriculture and Forestry has the supervision of use and water management of water resources. The Water Resources Management Division is part of the Expert Services Department. An overview of the tasks is given in figure 2.

About 600 people are working at SYKE at this moment; of which 60% are academic educated employees. Finland is famous for its lakes; all big lakes are regulated

SYKE is busy with the implementation of the WFD in Finland. The aspect of Interactive Planning within planning processes is seen as a bit problematic; the fear is that these processes might be quite time consuming ones.
In the development of national guidelines for the water protection in 2015, 3 options (see figure 3) have been worked out. Which option will be finally chosen, is not known yet. Discussions are still going on.

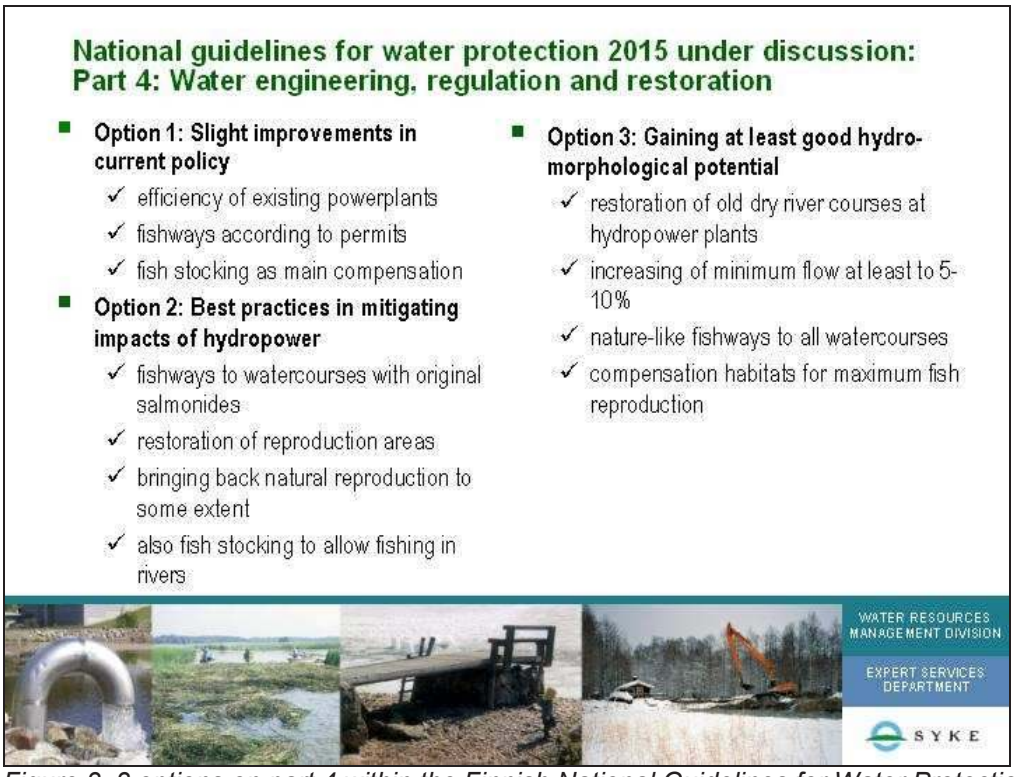

Figure 3. 3 options on part 4 within the Finnish National Guidelines for Water Protection

3. Restoration needs for heavily modified rivers and brooks in Finland by Jukka Jormola

Jukka Jormola emphasised the wish to fulfil the reduction the CO_2 emission ratified in Kyoto-protocol through hydropower. But river restoration, and the functioning of migration routes for certain fish species in relation to the development of hydropower along rivers are often conflicting. Most of the rivers that are assigned as being Heavily Modified Water Bodies in Finland are those rivers that are used for waterpower

generation. Nowadays, increasing the efficiency of the big power plants is discussed. Smaller power plants are more and more under renovation in the last years.
A local initiative has brought the salmon back into the lower section of the Oulujoki River. There is an initiative for fish passes also for the Kemijoki River. Nature-like fish passes function well in several southern rivers. The implemented fish passes in these rivers function already with a relative small amount of water, which is about 100l/s.
A good advice from the Finnish experience is to make the bypass for fishes as long as possible. The average costs for such a fish pass in Finland are ranging between 10,000 and 20,000 € per one metre in height. A major problem in the Finnish (but also other Scandinavian rivers and also in the alpine countries) is how to keep the spawning areas free of silt sediments, and there is still a shortage of spawning areas, too.
Nature-like by passes have shown good results e.g. in Denmark, where good reproduction rates where gotten with trouts. Another successful site is the area of Freudenau near Vienna along the Danube River. The idea of spawning channels and compensation of habitats was derived from Canadian experiences.

Figure 4. Nature-like bypass (left) and restoration of agricultural stream (right)

Experiences in West-Finland were made with flood retention. Provisory floods were used in the case that settlements were endangered. Besides this, environmental subsidies were paid in order to create large buffer zones in agricultural areas and the enlargement of wetland areas. New drainage practices were introduced; silt transport was reduced in forest streams and restoration measures to initiate natural recovery in agricultural streams were implemented.
Urban brooks can be seen as “new political power in urban planning” nowadays. This is due to their value for the sea trout migration from the Baltic Sea. But other important aspects of urban brooks are their importance in water purification, flood prevention in cities, green planning, and change of the hydrologic cycle in urban environment.
Another range of rivers to be restored is the former timber floating rivers. Restoration works on these rivers were carried out since the 1980’s until now; mainly involving putting stones and gravel back to the riverbed.

4. River restoration in Sweden by Erik Degerman

Erik Degerman represents the Swedish Board of Fisheries. He presented an overview about the budgets that are spent in Sweden every year for the “liming” of acidified lakes and rivers, which is 19 million € annually. For river restoration activities and lake

restoration together about 7 million € are spent per year. The Board of Fisheries gives the main financial support with 4,2 million €.
Due to the relatively limited budget, the role of volunteers in restoring small streams and brooks is very important. About 92,000 people that is about 1 % of the Swedish population is involved in restoration projects. A database has been set-up describing 500 objects.
Nowadays, the installation of new hydropower plants is not so easy anymore and issues go to the court at first. In the case of rebuilding hydropower plants very often fish passes are constructed.

Figure 5. Pristine Swedish river in 1937 (left) and a "cleaned one" (right)

Most of the restoration measures that are implemented in Sweden are in stream measures and improvement or development of spawning areas. About 10% of the stream length was used as a float way to transport timber and were therefore affected negatively in the past (see Figure 5). 47% of the Swedish stream length is considered in a physical pristine state, but taking into account also chemical and biological influences only 55 of the stream length is considered to have high ecological status.
Figure 6 gives an overview on the various measures that were implemented in Swedish rivers. A monitoring of the in-stream measures has shown that 65% of the measures worked good to sufficient and of 10% the results were uncertain and the rest unknown.

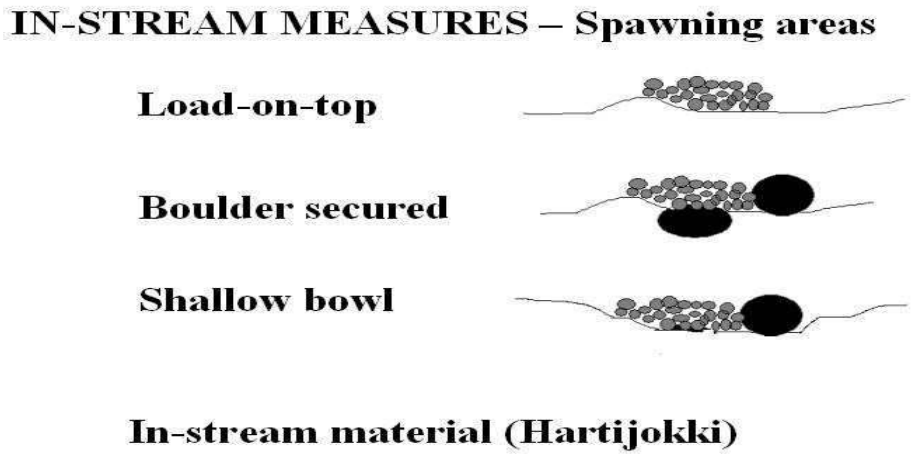

Figure 6. Overview of in-stream measures to create spawning areas

Fish passages were constructed in the last decennia in different ways – varying from very technical to nature like ones. The design depends of course on the height difference to cope with, the available space to implement the fish pass and the slope that should be reached. A few example are shown in figure 7.

Figure 7. Fish pass in Söderhamn, 4 m drop, 80 m bypass and Gullspangsälven, steep pool

The efficiency of the fish passes was “judged or evaluated” in the office of the Board of Fisheries on the one hand and on the other hand Mr. Andersson of the County of Västa Götaland carried out quantitative analysis by electro fishing in 2005. The results showed a big difference between the expected functioning (74% good to sufficient and only 3% bad) versus the real monitoring results (more than 50% in the various types are bad to doubtful). The best results were gotten in the pool and weir variants. (Hydropower and float way) dam removal sites are increasing the last years. In the case of hydropower dam restoration the initiative takers buy the dams as well as the hydropower rights. Prices varied between 10,000€ up to 1 million €. The float way restoration in the catchment of the rivers Pite and Vindelälv is running from 2004-2007 and will cost about 2 million € with watersheds bigger than 10,000 square kilometres. River restoration as such is quite new and recently only some work have been done by now; important would be to initiate follow-up projects and to carry out monitoring along the restored stretches, e.g. in the re-meandering projects like the river Laxbäcken and Klingavälsan. Most of the research work is done by the universities Umea and Karlsstad as well as the Board of Fisheries.

5. Restoration of water courses modified by hydropower en dredging by Arne T. Hamarsland

Arne Hamarsland (senior advisor) represents the Norwegian Resources and Energy Directorate NVE. He presented an overview about the hydropower plants in Norwegian rivers, of which only small water plants have been build recently. Due to the often quite

big dams in the rivers; these water bodies belong to the so-called “heavy modified water bodies” of the Water Framework Directive, but the hydropower company would put it to: heavenly modified. Talking about Water Resources Management in Norway means most of the time talking of hydropower. Figure 8 shows only the larger hydropower plants in Norway.

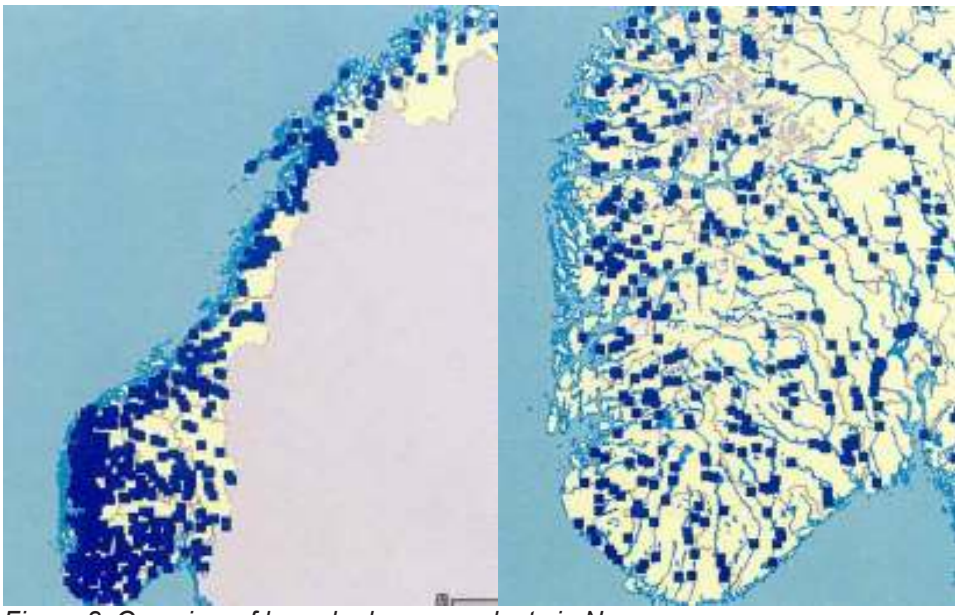

Figure 8. Overview of large hydropower plants in Norway

Why does a need for river restoration exist? As shown in figure 8 it is obvious that the problems/functions affecting rivers in Norway are hydropower, log driving, agriculture, and flood & erosion control. Hydropower plants reduce and alter the flow in a river system whereas in the case of the other functions changes of the riverbed are important. The responsibility is clear in the first case, these are the hydropower companies and in the other cases, no one or the government is responsible.
Norway is not a member of the EU, but due to the EEA-agreement, Norway implements all EU-directives – including the Water Framework Directive. Due to the importance of hydropower in developing the modern Norway the responsibility for watercourse management has been and still is under the ministry of Petroleum and Energy. NVE is one of two directorates under this ministry. After some years of “intense discussions, the main responsibility to lead the implementation the WFD in Norway was given to the Ministry for the Environment, whereas the NVE has most of the tools available that are needed for implementation.

At the moment it is important to link some processes together, e.g. the WFD work – especially on heavily modified water bodies. Because many of the old hydropower regulations end up as heavily modified. And when it comes to a renewal in terms of these old licenses (not only hydropower but also other water uses), NVE wants to use this opportunity to achieve a good ecological potential in future.

Beside the work of NVE in the “environmental flows programme”, NVE is testing different methods of restoration, rehabilitation, and biotope adjustments to gain knowledge on design(s), effects and costs.

Some examples are fish ladders or redesign of weirs, re-meandering, connection of old side channels to increase the biodiversity, etc. In recent projects woody debris were

brought into the rivers in order to have some shade and hiding in pool areas (figures 9 and 10).

Figure 9. Woody debris in a Norwegian river

Figure 10. Small agricultural river (recent situation and future image)

In agricultural areas, measures comprise the development of pools and riffles in the "river channel" and the removal of concrete weirs. Giving space to the river versus the agricultural land use is a hot political item.

In rivers with hydropower plants main problems are the low or even no flow and also the temperature.

6. Restoring Rivers in Denmark – The Houting project by Hans Ole Hansen

Hans Ole Hansen works at the Danish Forest and Nature Agency – the State Forest District of Lindet and he is the project manager of the Houting project, an EU-LIFE project.

Figure 11. River Skjern in 1999

Figure 12. River Skjern in 2002 - after restoration

River restoration in Denmark started due to the same problems in Europe such as pollution of rivers, eutrophication of lakes and rivers, and the channelization/river straightening in agricultural areas. Fish ladders were constructed close to weirs and dams. A special sheet pile construction was used in the case of a former millpond. Re-meandering projects were carried out in river stretches of the river Guden A and the river Skjern. The biggest project was the Skjern restoration project with a budget of 25 million € (see figures 11 to 13).

Figure 13. River Skjern after restoration and flood situation

Restoration activities in Denmark also include the implementation of fish ladders of all kinds (old and new styles). New style means to install passes as long as possible and to keep the maintenance low – at a minimum level. Drops of 5 m height in rivers are quite big in Denmark; at this moment the largest fish pass in Denmark was implemented in Silkeborg with 2m of height difference.

The Houting project is a big nature restoration project in Denmark with a total budget of 13,5 million € within the EU-LIFE programme. Nowadays the amount of Houting is decreased to about 7,000. The Houting is a priority species in the EU Habitat Directive – therefore it is an obligation to ensure its survival. To do so, restoration of rivers and an open connection to the North Sea is necessary due to the life cycle of a Houting. Spawning takes place in streams, fries drift to static waters, fries of 3-4 cm swim to the North Sea, adults of 3-4 years old return to the streams for spawning.
The Houting project will remove 13 obstacles and will give access to additional 130 km of river habitats, create spawning grounds and nursery areas.

More detailed information can be found at: www.houting.dk

Figure 14. The Houting and its distribution in former times in the whole Wadden Sea and nowadays (small map) in Danish rivers and Wadden Sea area

7. The ecological management of Estonian rivers by Toomas Timmusk and Illmar Tupits

Toomas Timmusk represents the Institute of Forestry and Rural Engineering at the Estonian University of Life Sciences. Illmar Tupits represents the Jõgeva Bureau of Land Improvement of Estonia.
Estonia has 4 main drainage basins: Lake Peipsi, Gulf of Finland, Gulf of Riga, and the islands of Western Estonia. 7,308 watercourses with a total length of about 31,000 km exist. Most of these rivers are quite small ones (see figure 15).

The watercourses of Estonia divided by length

Length, km	Number of watercourses	%
< 10	6389	94,3
10 - 25	315	4,3
26 - 50	66	0,9
51 – 100	32	0,4
101 - 200	6	0,1

Figure 15. Division of Watercourses by length

As a EU member state, Estonia must implement the WFD by 2015 and should ensure a good water status by that time or at least in 2027.

The human impacts on the rivers and catchments are:
- Pollution coming from point and diffuse sources,
- Drainage and dredging of rivers for agricultural use, and
- Modifications of rivers by construction of reservoirs, hydropower plants, weirs and mills.

The political changes in Estonia have led to a decrease in the surface of agricultural land between 1939 and 2001, a reduction from 2.8 to 0.9 million hectares. The same development can be seen in the number of the total cattle (from 700,000 in 1939, highest values of 850,000 in 1985, and about 290,000 in 2001. The results on pollution load in surface water bodies are shown in figure 16. The decrease in nitrogen and phosphorus loads as well as reduction in organic substances is obvious.

POLLUTION LOAD TO SURFACE WATER BODIES, 1990–2000 tons

Year	Organic substances	Suspended solids	Total nitrogen	Total phosphorus
1990	...	27 900	8 170	917
1992	...	19 294	5 635	673
1993	11 250	13 743	4 241	445
1995	4 481	7 490	3 503	321
1996	4 174	6 330	3 200	304
1998	3 122	4 856	2 976	279
1999	2 308	4 071	2 739	256
2000	2 051	3 142	2 810	230
2005	1399		1771	146

Figure 16. Pollution Load of Surface Water Bodies between 1990 and 2005

The reduction of nutrients can be seen clearly in the monitoring data of the river systems, for example in the case of the river Amme (see figure 17).

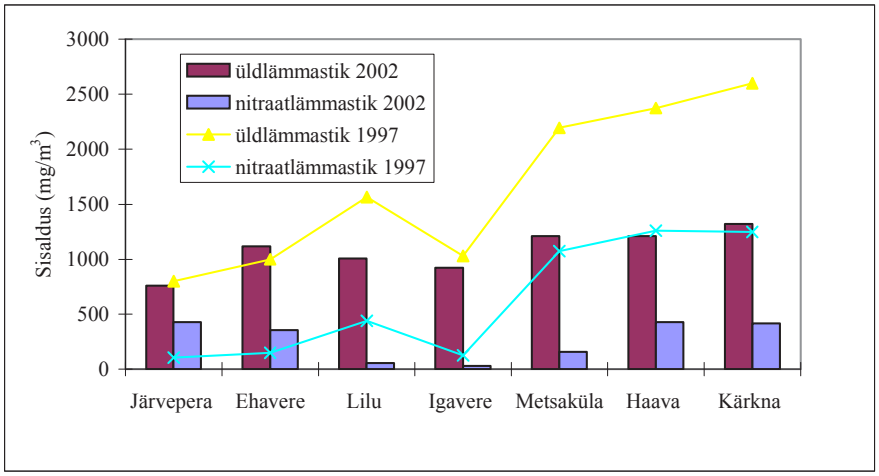

Figure 17. Data on nitrogen and phosphorus load in the Amme River (1997, 2002)

In Estonia, many rivers are also modified by dredging activities for agricultural and forestry drainage, and modifications in river by dams and weirs exist. At this moment river restoration activities mainly take place in smaller rivers. The objectives differ. The measures comprise the construction of fish ladder along weirs and smaller dams. The first works (9 projects) were carried out between 2002 and 2006. The Estonian Ministry of Environment started a project on “Technical assistance for improvement of ecological quality of watercourses” within the EU funded ISPA programme. This Estonian ISPA project aims on design solutions to allow fish migration through 36 dams in future. Examples of the works can be seen in figure 18.

Figure 18. Impressions of the Pärnu River with 3m high weir (left) and the Kullavere River (right)

The objectives comprise not only the construction of fish ladders (technical ones and nature like ones) but also the demolition of weirs and the construction of bypass channels. Other objectives are the reconnection of old oxbows along the Suur-Emajõgi River, restoration of the riparian zone along the Esna River, and restoration and design of new spawning areas.
The project results will enlarge the knowledge and experiences on river restoration works in Estonia, including e.g. environmental impact assessments and developing some guidelines on the implementation as well on the process.

Figure 19. Measures in dredged rivers, stone deflectors (left) and stone weir (right)

Restoration works along dredged rivers include stone deflectors, riffles, stone weirs, and sedimentation ponds (figure 19). Even bank protection works by putting large boulders along the eroding riverbank are used.
The Amme River was selected as a case study in order to have a construction site to get publicity; to carry out research on the efficiency of the used means and constructions/solutions, and to research on the building technology.

8. Reports on river restoration and implantation of the WFD in Finland; chaired by Jukka Jormola

a) First example was about the restoration of the last timber-floating river in Finland. A stretch of 13 kilometres and a surface area of 80 hectares will be restored. A fish pass of 390 m length, accommodating a discharge of 1.2 m^3/s will be implemented. Restoration measures include the widening of the riverbed and putting back stones into the formerly cleaned riverbed.
b) Sediment control plays a major role in restoration projects in Finland. It is difficult to keep coarse spawning areas free of fine sediments. Sand traps are used as one solution. Another method is to bring woody structures into the main channel and to initiate a kind of self-cleaning process. Now an evaluation of streambed projects is undertaken and the results will be summarized in a guidebook for structural planners but also for everyman's use.
c) Brook management and restoration in agricultural areas is important due to their hydrological, ecological and landscape value. Keep brooks in a "natural state" as many of them still are. Methods to improve agricultural brooks are to support the natural recovery, to restore fisheries and to look for ways of environmentally friendly dredging. Brooks in the city area can be improved, e.g. by developing a low flow channel at the bottom and to create terraces at the banks to enough space for floods. An example was visited during the excursion; see for more information the pdf-file no. 14 on the CD-ROM.
d) The city of Helsinki has initiated a programme on restoration of small rivers and streams. These streams fulfil a very important function for trout to spawn. Riffles in the stream support the increase of the trout population; although the stream is situated close to a highway. Planned construction works are a threat to this important spawning place in the city area of Helsinki. Much of the small restoration works is carried out by volunteers; similar to the Swedish situation.
e) The creation of spawning habitats could be used as a mitigation/compensation measure to get a good ecological potential in Heavy Modified Water Bodies. The amount of wild salmon rivers in Finland decreased very much due to the dam building in rivers and the loss of connectivity and variety of habitats. Most of the dams and weirs in the Finnish streams do not have any fish pass structure yet. At this moment fish stocking can be seen as a main mitigation measure. In the period between 1999 until 2002, 13 conventional (read: technical) fish passes and 21 nature-like fish passes were built. The knowledge on the efficiency of spawning channels is not new, e.g. first experiences were made in Canada at the Seton River already in 1960 and 1967. Meanwhile, the spawning channels are getting more and more complex, e.g. by creating hiding places such as pools and shade zones by bringing in woody debris.
f) In central Finland many rivers systems were destroyed by the construction of paper mills, (timber) float ways or hydropower plants. Hundreds of these installations are nowadays low producing ones. 25 years ago the first (modern style) restoration projects were carried out, planned and implemented by the Environment Authority, paid and supervised by the Fishery Authority. In 1982, the first countywide inventory of riverine waters was done. Volunteers appeared in 1984, meanwhile more than 130 rapids and runs, many different fish passes were built. The first two doctoral theses on restoration ecology were published in 2000 and 2002. In the last years socio-economics came into the picture. Today most of the bigger rivers in Central Finland have been restored; the focus is now on the restoration of smaller stream and brooks in forest and agricultural areas.

9. Further co-operation in river restoration and role of the ECRR

- ⇨ It is still important to define good practice in river restoration works; this would sure beneficial to the new EU member states that are just getting started to undertake river restoration measures. ECRR network plays a key role to disseminate the information.

- ⇨ Nordic countries have improved their knowledge on river restoration in the last years; in 2006 the first river restoration conference was held in Sweden.

- ⇨ Hydropower is very much dominant in Nordic rivers and often the construction of fish ladders is impossible, e.g. in the western part of Norway. Nowadays, the amount of people working on river restoration is quite limited; therefore the ECRR network would be valuable to support some activities.

- ⇨ In Denmark, a good job has been done on river restoration during the last 20 years by the 13 counties. From the 1rst of January 2007, the administrations will be reorganised in that way that only municipalities and the national level will remain. It is important to try to establish a good network again.

- ⇨ In Sweden, no national network exists and there is no control on river restoration works. Main initiative takers are the sport fisher associations. Problems derive from the division of tasks. The Fishery Board is responsible for fish; the Environment Agency is responsible for water. River restoration interferes both themes, but the responsibility is not clear.

- ⇨ The WFD will (finally) force countries to deal with river restoration in the coming years, but still the risk is that those measures might be too costly to reach a good ecological potential in Heavy Modified Water bodies.

- ⇨ Good chance to discuss experiences and solutions on river restoration will be the coming 4th ECRR conference in Venice, 16-21 June, 2008. More info can be found at the website: **www.ecrr.org** and **www.cirf.org**

10. Closing of the seminar day by Bart Fokkens

Bart Fokkens thanked all the participants for their presentation and their active participation in the discussions. Specials thanks were addressed to Jukka Jormola and his colleagues from SYKE for taking care of the organisation of the seminar and other logistics.

Annex 1. Programme of the ECRR seminar

Restoration of Rivers modified by Hydropower and Dredging

November 7, 2006, at SYKE/Finnish Environment Institute in Helsinki/Finland

Meeting location: Finnish Environment Institute SYKE, Mechelininkatu 34
Helsinki, Room Merilokki, 1st floor

08.30	Reception and coffee at the entrance of Merilokki
09.00	Opening and overview of ECRR, Bart Fokkens, RWS-RIZA, The Netherlands
09.15	Welcome, Markku Maunula, Water Resources Management Division, SYKE, Finland
	Chairman: Bart Fokkens
09.30	Restoration needs for heavily modified rivers and brooks in Finland, Jukka Jormola, SYKE, Finland
09.50	River restoration in Sweden, Erik Degerman, Swedish Board of Fisheries, Sweden
10.10	Hydropower and river restoration in Norway, Arne T. Hamarsland, Norwegian Water Resources and Energy Directorate, Norway
10.30	LIFE-Houting Project, River restoration in Denmark, Hans Ole Hansen, Lindet Forest State District, Denmark
10.50	Ecological management of Estonian rivers referring to the example of Amme river solutions, Ilmar Tupits, Jõgeva Bureau of Land Improvement, Toomas Timmusk, Institute of Forestry and Rural Engineering in the Estonian University of Life Sciences, Estonia
	Questions & Discussion
11.30	Lunch at SYKE canteen

12.15 Reports of river restoration projects and views of implementation of Water Framework Directive in Finland and other countries. Comments/Experiences of the participants on difficulties and challenges concerning river restoration, hydropower and other uses of rivers and brooks.
Chairman: Jukka Jormola

Jorma Kauppinen: Restoration of timber floating river
Marita Ahola: Restoration of forest brooks
Auri Sarvilinna: Restoration of agricultural brooks
Mikko Saikku: Restoration of urban brooks
Lasse Järvenpää: Spawning habitats as mitigation
Anssi Eloranta: River restoration in Central Finland

13.45 Coffee

14.15 *Chairman: Bart Fokkens*

Further international co-operation in river restoration and the role of ECRR in this (at room Muuttohaukka, ground floor).

Bruna Gumiero: Presentation of CIRF activities and the coming 4th International River Restoration Conference in Venice 2008

Conclusions of the seminar

15.00 Closing with some snacks and drinks & talks.

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Departure of participants

Annex 3. List of power point presentations (available as pdf-files on the CD-ROM)

1. Welcome and overview of the ECRR by Bart Fokkens
2. Welcome and introduction to SYKE by Markku Maunula
3. Restoration needs for heavily modified rivers and brooks in Finland by Jukka Jormola
4. River restoration in Sweden by Erik Degerman
5. Hydropower and river restoration in Norway by Arne T. Hamarsland
6. LIFE-Houting Project, River restoration in Denmark by Hans Ole Hansen
7. The ecological management of Estonian rivers by Toomas Timmusk and Illmar Tupits
8. Restoration of timber floating river by Jorma Kauppinen
9. Restoration of forest brooks by Marita Ahola
10. Restoration of agricultural brooks by Auri Sarvilinna
11. Restoration of urban brooks Mikko Saikku
12. Spawning habitats as mitigation by Lasse Järvenpää
13. River restoration in Central Finland by Anssi Eloranta
14. CIRF mission and activities by Bruna Gumiero
15. Excursion locations of 6th November 2006