Improving administrative effectiveness of lake management in the frames of River Basin Management Plans

Implementation Plan

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1. Introduction

Fresh waters make only 3% of the global water resources. Freshwater lakes, including reservoirs and ponds, are important elements for communities and their relevance is increasing. Lake ecosystems and their catchments have provided several societally valuable benefits and ecosystem services like shelter, drinking water, bathing water, food, a means of travel and wealth in a number of ways and allowed whole cultures to develop. Lakes have values associated with well-being and relaxation, their proximity has catalyzed rural development and been important in the regional socio-economic development. Lake districts are often very popular destinations for domestic and foreign tourism and visitors.

Eutrophication and its ecological consequences, pollution, over abstraction and invasive species are serious threats and increase the need for restoration and management to prevent the potential adverse economic and social impacts. There is increasing evidence that lakes are affected by climate change. Lake management is for these reasons an important part of sustainable regional development as set by Lisbon and Gothenburg agreements.

However, the most significant piece of legislation in response to the increasing threat of pollution and the increasing demand from the public for cleaner lakes, rivers and beaches and freshwater biodiversity, is the EU Water Framework Directive (WFD). This Directive is unique in that it sets out an established framework for the protection of all water bodies (including lakes) and for all EU member states to achieve good water ecological status by December 2015. This objective is likely to be achieved in slightly over half (53 %) of EU waters (A blueprint…, 2013) and, therefore, more effort need to be scheduled for the following 6-year periods of WFD.

The economic values of attractive, clean lakes are well established. There is a rising appreciation of good quality lakes across Europe. More intensive lake protection through sharing good practices with European lake managers and the regional influencing bodies is critical if we want to improve the current quality of lakes in Europe and to build long term capacity for sustainable use of lakes.

2. Project description

LakeAdmin project (Interreg IVC) consists of ten partners from nine countries (Table 1, Figure 1).
The Lake Admin project aims at an exchange of good water management practices to support the implementation of the Water Framework Directive in each of the partner regions and producing case study collection on restoration and management experiences and water quality data from the relevant lakes in each partner region covering the last 30 years.

Fig. 1. Location of partner organisations in LakeAdmin.

All participating regions have identified lakes as important elements in their regional development policies. LakeAdmin aims to improve the effectiveness of regional development policies related to water management and restoration of lakes, ponds and reservoirs by:

1. Sharing and transfer of good water management practices (Table1)
2. Mainstreaming of programs in participating regions, each participating region defining how the selected and adopted good practices will be implemented.
3. Compiling good practices and examples into guidance material ready to be disseminated to other regions in the EU, recognizing the European dimension and expanding values of the project beyond the partner regions.
4. Expanding the results of the LakeAdmin to a wider partner-network to have a long term impact.

Table 1: Lake Admin Project Partners and Good Practices Identified (Estonian ones highlighted)

Preparation, planning and procedures of restoration of lakes
Integration of shoreline management and spatial planning in the Balaton (HU) Stakeholder participation and feedback (FI) Lake restoration guidance material in a native language (EE) A flexible education-model to help management planning for stakeholders (FI) Multi-criteria assessment in comparison of options in lake restoration planning (FI) Mapping for presenting eutrophication pressures of lakes (FI) A practical tool for evaluation of reductions of diffuse phosphorus loading (FI)Multipurpose use of small urban lakes (DK)
Surveillance of needs, initiatives and operations of lake restoration
Monitoring for investigation and surveillance of lake restoration cases (FI and EE) Integrated regional on-line monitoring system (HU) Evaluation of the secondary losses caused by a protected piscivorous bird – the great cormorant (CZ)
Novel approaches for evaluation of ecological quality for restoration efforts
Assessment of contamination with passive samplers and juvenile fish analyses (CZ)
Measures to reduce external loading and other pressures
Efficient and environmentally good use of manure for protection of watercourses (FI) Waste water treatment of small villages by on-site household units (HU)
Restoration for wide response in ecological quality and for complex needs of use
Restoration of eutrophic temperate lakes by biomanipulation (DK and FI) Control of aquatic invasive species in Ireland, CAISIE (IE) Re-watering of a drained large lake in Greece (GR) Planning the multi-purpose use of a reservoir (GR)

Most partners have identified good practices including models for collaborative planning, lake restoration methods, experiences in public participation and lake management partnership and have evaluated the needs of knowledge and effectiveness of the good practice actions.

By exchange of experience between partner regions, Good Practices will be transferred into regional Implementation Plans to be implemented within the operational programs of Water Framework Directive or/and Structural Funds in the participating regions. LakeAdmin will improve the knowledge of local and regional actors in lake management issues and give better tools to enhance the ecosystem services provided by lakes and reservoirs in line with the Lisbon and Gothenburg strategies.

The overall objective of the LakeAdmin is to improve goal setting through an integrated catchment management approach and quality of lake restoration outcomes and results in regions which have acknowledged the importance of lakes in their economic development. In more detail the objectives are:

- To capitalise the identified good lake management practices by transferring them to Implementation Plans.
- To share good practices beyond partner regions by establishing open access guidance material available to lake managers, regional authorities and stakeholders also in other regions.
- To increase the use of collaborative planning methods and understanding in line with WFD principles.

The main outputs of Lake Admin are:

1. European database of lake restoration case studies called LakeAdmin Archive.
2. Good Practice Guideline material to be disseminated also widely beyond the partnership.
3. Implementation Plans for each participating region to mainstream good practices in lake management.
4. A network of different stakeholders across regions involved in water management.
5. An increase in the capacity of individuals across the EU states in policy creation and implementation.

3. The importance of lakes

3.1. The current state of European waters

There are 14755 lakes classified for their ecological status in Water Framework Directive. Almost 6500 of them (44 %) are in less than good ecological status or potential (EEA 2012; Fig. 1). If lakes in Finland and Sweden are excluded, the picture is even worse and e.g. in parts of Central Europe more than 90 % of all water bodies (including rivers) are in less than good ecological status or potential. On the other hand, no significant pressures were reported for 48 % of the lake water bodies. Lakes are clearly in better status than transitional waters and rivers and also slightly better than coastal waters (Fig. 2).

From lake restoration or management point of view it is noteworthy that in the EU scale the state of water bodies (Fig. 3, left) is not as good as it could possibly be based on the identified pressures (Fig. 3, right). This difference may be seen as a potential sign that the less than good status of some lakes, ponds or reservoirs, if they are not heavily affected by pressures of diffuse or point source loading, may call for management and/or restoration measures especially in the water body.

Diffuse loading from agriculture is a major pressure in one third of the water bodies in lakes and transitional waters especially in north-western Europe in the regions with high fertiliser input and high river nitrate concentration (EEA 2012). Since all smaller water bodies have not been included in the classification, the real percentage of lakes influenced by diffuse loading from agriculture may be even higher. Moreover, discharges from wastewater treatment plants and industries and the overflow of wastewater from sewage systems is still a significant pressure for 22 % of water bodies in Europe (EEA 2012).

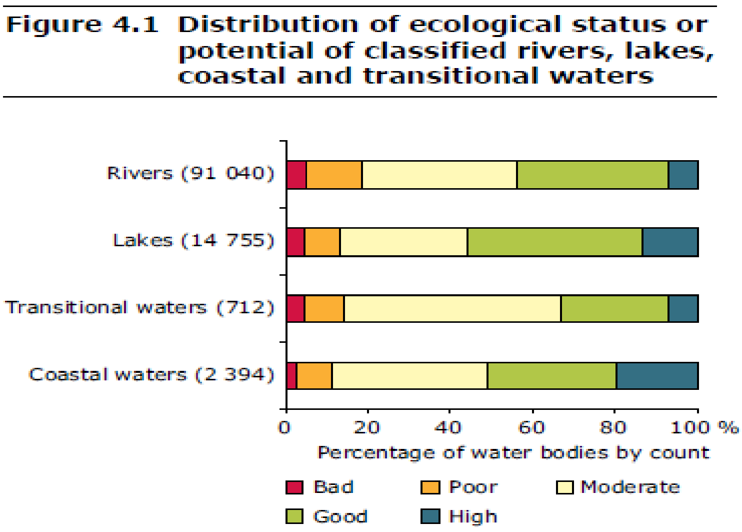


Fig. 2. The distribution of ecological status or potential of classified rivers, lakes, coastal and transitional waters (EEA 2012).

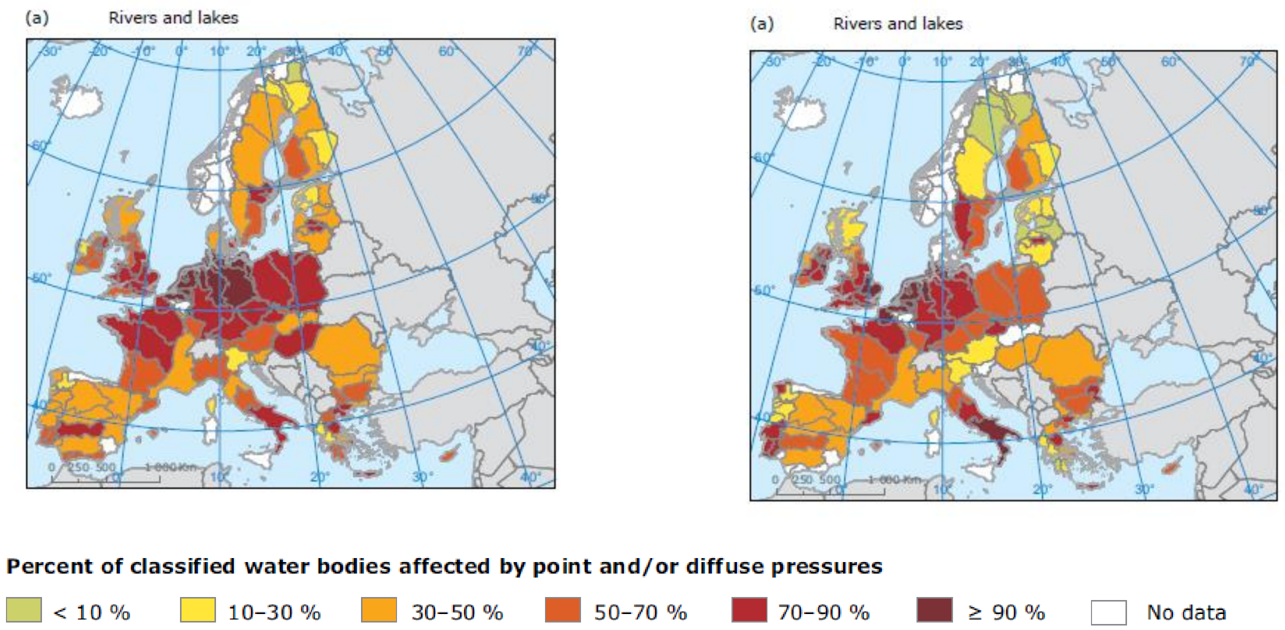


Fig. 3 : The percentage of water bodies with less than good ecological status in river basin districts in Europe (left) and the percentage of classified waters affected by point and/or diffuse pressures (right) (EEA Report 9/2012).

3.2. The current state of waters in Estonia

3.2.1 Assessment of the Estonian water bodies in River Basin Management Plans

In Estonia, there are about 2300 lakes with a surface area of more than one hectare, 1304 of them are natural lakes (Tamre, 2006). All surface water bodies have been listed in the Regulation no. 44 of the Minister of the Environment (2009). Surface water bodies are classified into natural, heavily modified and artificial water bodies. Eight natural types of lakes were distinguished. All rivers with a river basin over 10 km^2 and lakes with an area over 50 ha were considered for the purpose of establishing and identifying surface water bodies. Smaller water bodies were designated as surface water bodies only if they were significant water bodies. There are three river basin districts in Estonia: East-Estonia river basin, West-Estonia river basin and the transboundary (Estonian-Latvian) Koiva river basin (Fig. 4).

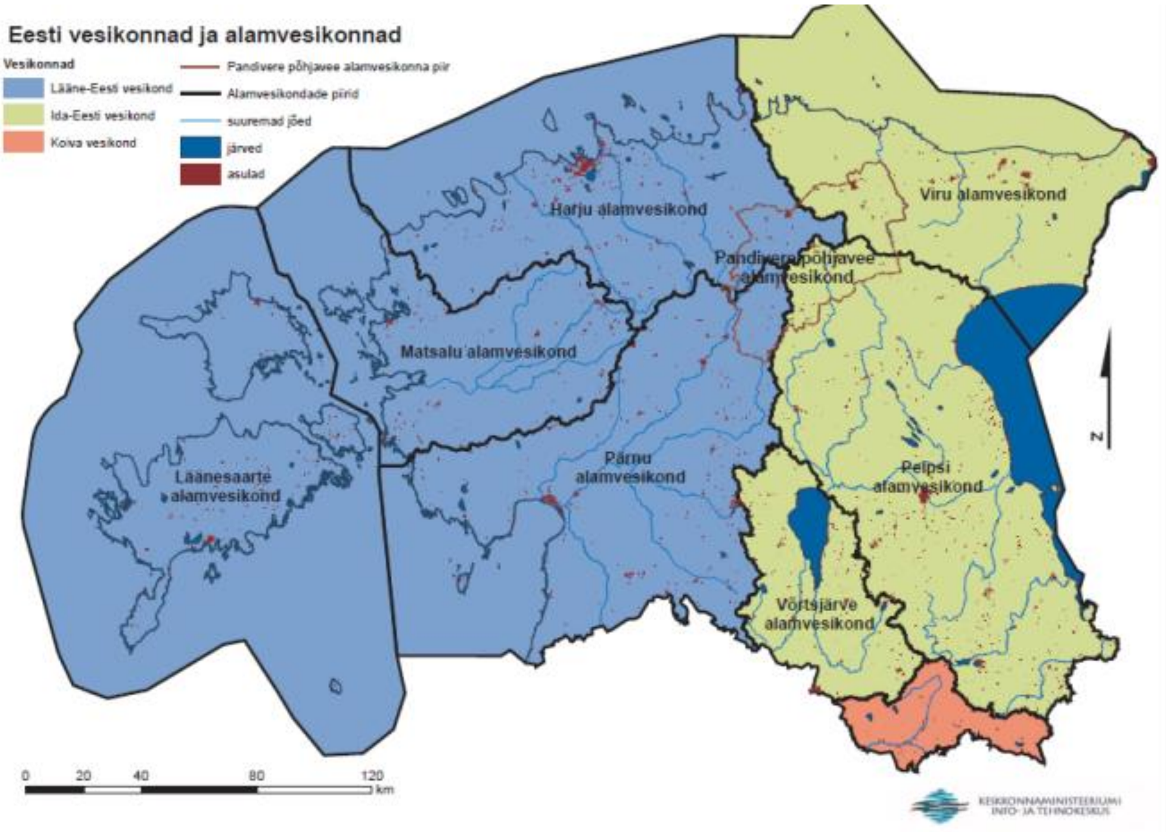


Figure 4. Estonian river basins and sub-basins.

Main problems which are required be solved or mitigated with aid of the Programme of Measures at RBMPs in Estonia are:
1. Diffuse load (agriculture, rural waste water, forestry, transport, internal load of water bodies)
2. Physical alterations of lakes (drainage, impoundments, extraction of bed soil from water bodies, dredging of waterways, dams, amelioration, road construction).
3. Point load (collection and treatment of waste water and rain water, animal husbandry, fish-breeding, waste management and polluted areas, oil shale energetics)

Implementation of the Programme of Measures is organised by the Commission for Water Management.

During the 1970s and 1980s, the use of fertilizers and farm sewage considerably impacted on the lakes of Estonia, resulting in quick eutrophication. In the early 1990s, with the crumbling of collective farms, agricultural production lie dormant, the state of lakes (especially small lakes) improved. Eutrophication process slowed down and the concentration of nitrogen in the water decreased. Eutrophication is still main problem for Estonian lakes, and human impacts amplifying it need to be reduced continually.

Quality criteria used for quality assessment of water bodies are set up according to Regulation no. 44 of the Minister of the Environment (2009). Due to intensive development of planktonic algae, the transparency of water in about half of the Estonian lakes is less than 1,5 m in summer time. Water colour is mainly yellowish-green or greenish-yellow but in many lakes also brown. The water of Estonian lakes is fresh, and most lakes are calciumhydrogencarbonatic. Mainly, the nutrient (P, N) concentration is high, and phosphorus is the limiting factor for growth of phytoplankton and macrophytes. Among the 29 monitored small lakes in 2013, 58% (17 lakes) was in good ecological status and 14% (four lakes) in high status, only one lake (Jõuga Pesujärv) had poor ecological status, according to WFD criteria (Fig. 5). Lake Harku status of which has been unsatisfactory for decades, was not monitored in 2013. Due to the location at Tallinn town, there is high human pressure to a small water volume of the lake. Though it has decreased remarkably since 1980s, the external load of nutrients is still high as well as internal load and intensive recreational activity of citizens at the lake.

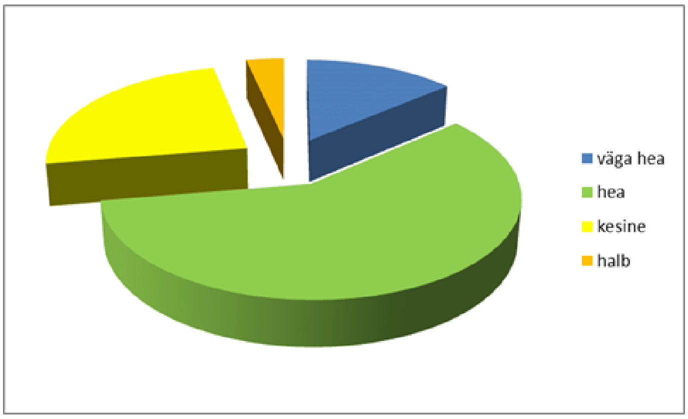


Fig. 5. Summary evaluation of ecological status of Estonian small lakes in 2013. Colours indicating ecological status: blue – high, green – good, yellow – moderate, orange – poor. (Eesti väikejärvede…, 2013).

Generally, the ecological status of Estonian lakes is statistically in good relation with co called index of catchment area, considering density of population, land use, load from domestic animals, known residual pollution and hydromorphology. The status of Estonian lakes (except Lake Harku) depends on weather conditions, which shows their relatively good condition (Eesti keskkonnaseire 2007-2010).

Table 2. Summary of evaluation of ecological status of surface water bodies on the basis of intermediate estimates in the year 2013. Info from the Estonian Environmental Board.

River Basin	East-Estonian	West-Estonian	Koiva
Number of surface water bodies	399	307	28
Status worsened during the year	40	32	3
Status improved during the year	10	14	0
Status unchanged	349	261	25
Unachieved aim of 2015	64	65	8
Achieved aim of 2015	355	242	20

3.2.2 Implementing the Water Framework Directive in Estonia

The overview of the essential water management problems (Oluliste..., 2014) which could endanger achievement of environmental goals set by WFD for water bodies by 2015 was done in 2012-2014 and it is available at: http://www.envir.ee/et/oluliste-veemajandusprobleemide-ulevaade. This was an intermediate stage for compiling of new river basin management plans (RBMPs) which included also the public exposition and discussion in 2013.
RBMPs are reviewed and updated after every six years. The process for compiling the RBMPs and the accessory Programs of Measures for the period 2015-2021, was initiated by the Minister of the Environment in 6th January 2012, and the legislative proposal will be ready by 22nd December 2015.

The following characteristic features associated with implementation of WFD in Estonia can be highlighted:

1. Estimates for the ecological status of lakes, based on the class boundaries of the indices and the rules for status assessment set up by the ministerial regulation drawn up according to WFD, do not always coincide with the expert opinions, due to several and changing factors which are not considered in these documents. Thus, the regulation is being updated periodically according to feedback from experts.

2. Monitoring system is improved continuously to be most cost-effective. In cases of important water bodies, the earlier wider long term databases are being proceeded in spite of the minimum requirements set by the WFD.

3. Once a year, changes of ecological status of water bodies according to state monitoring results, are checked by the Ministry of the Environment. The water bodies where worsening has appeared, the reasons are identified during the following year carefully. Such way, the measures to improve the situation can be undertaken promptly. This practice was also included in the Finnish-Estonian common Good Practice (GP) proposed to of LakeAdmin GP list – 'Monitoring for investigation and surveillance of lake restoration cases' (Finnish Environment Institute and Estonian University of Life Sciences).

4. Financing of management, incl. restoration and development of monitoring of water bodies is hold mainly through the Environmental Investment Centre (KIK), http://www.kik.ee/en. 2.7 million € were used for feasibility studies, cleaning or restoration of 20 lakes during 2011-2013.

5. Applied investigations to solve different water management related tasks are carried out on request of the Ministry of the Environment (reports are available at web page of the Ministry of the Environment, www.envir.ee) or, in case of too large volume, available by request.

6. Plans of Measures for lakes of less than good quality according to RBMPs are being done yet – the first four of them were compiled in the frames of LakeAdmin project and are attached as Appendixes to the current Implementation Plan.

3.3 Relations between climate change and lake management

Climate impacts on lakes in Europe. According to the European Water Directors in 2004: What is the risk of failing to achieve good ecological status by 2015 due to climate change? Response of lakes to climate forcing is most coherent for physical parameters (rise of water temperature, especially of deep water, changes of ice regimes, floods). Anticipated changes in the chemical regime of lakes are less coherent and depend strongly on lake type and local conditions (Changes in timing and increase of P loadings, higher internal load due to higher temperature and lower O_2, increase of total annual N loss from the catchments, lower water levels or shortage of water in periods of draught). The impact of climatic factors on dissolved organic carbon production and transport is complex and includes the combined effects of both temperature and precipitation on the decomposition, solubility and hydrological transport of these compounds (Common…, 2000). Because of complex interactions, biological changes induced by climate change are inherently unpredictable (cyanobacterial blooms) and may also be related to changes in fish communities (Jeppesen et al. 2012).

Implications for Water Framework Directive implementation. Ignoring clime change by the Water Framework Directive may have strong implications for the typology and quality assessment systems used for water bodies (A blueprint…, 2013). Two most widespread pressures on ecological status of water bodies in the EU:

1. Pressures that originate from hydromorphological modifications to water bodies,
2. Pressures that stem from over-abstraction of water

According to the analysis of Adaptation strategies of 18 RBMPs 2009-2015 (Nõges et al., 2013), Estonia and Latvia fully excluded CC issues, Germany discussed the issues very modestly, Danube countries concluded that CC signals for the district are sufficient to act beyond existing scientific uncertainties, most countries described the observed CC and its impacts to water resources management, UK and Ireland dedicated a separate report on CC issues and 'climate checking' of the Programme of Measures.

Short- and long-term objectives. The application WFD and framing of RBMPs is based on the Common Implementation Strategy. The regulation on consideration of climate change effects was accomplished by 2009 - **„River Basin management in a changing climate, Guidance document No. 24** (Common…, 2009). The following features can be stressed in this document:

1. Apart from exceptional circumstances, it is not expected that, within the timeframe of WFD implementation (i.e., up to 2027), a climate change signal will become statistically distinguishable from the effects of other human pressures at a level requiring reclassification of sites. Studying reference sites does not give information on how impacted sites will respond to climate change.
2. It is likely that indirect pressures arising from human responses to climate change – both adaptation and mitigation - will have a greater impact on water bodies than the direct CC pressures. These indirect pressures include damming and elevated water abstractions for irrigation, new flood defence infrastructure, intense production of energy crops.
3. The database of specific measures, guiding principles:
   a. Critical loading limits in lakes have to be lowered in a future warmer climate as natural mechanisms that control phytoplankton development weaken
   b. Be aware of the dominant cascading effects in your lakes (Rehabilitate zooplankton in lake monitoring schemes, follow changes in fish feeding types and size structure)
   c. Consider geographic, and type-specific differences in sensitivity of lakes to pressures for selecting appropriate conservation, adaptation and restoration measures
   d. Avoid trade-offs between measures (measures which endanger water resources, biodiversity and the ecological status of lakes, energy-intensive adaptation measures based on continuous use of fossil fuels and thus contradicting to CC mitigation, energy-intensive restoration measures (e.g. sediment removal) if natural processes sustaining the achieved results are not developed).

3.4. Climate change challenges for lake management in Estonia

Likewise the Water Framework Directive 2000/60/EU does not concern climate change, also in current Estonian RBMPs or Programmes of Measures the influence of climate change on waters has not been considered. During the revision process of existing RBMPs for the period of 2015-2021, impacts of climate change on water bodies will be analysed and charted. For fulfilment of the requirements of WFD, assessment of climate change impact is now compulsory for every EU member state. The minimum expected approach is an analysis of the climate impact on estimation of pressure factors, planning of monitoring programme and selection of measures.

In 2012, Estonian Ministry of the Environment ordered a study on influence of climate changes on ecosystems of water bodies and ground water (Kliimamuutuse…, 2012), and to get respective suggestions for improving the monitoring programme. The report includes analysis of observed and predicted changes in water-attributed climate indicators, gives an overview of global and regional climate models, profound analysis of climate change on Estonian water ecosystems and ground water, and an assay on efficiency of the state monitoring programme to distinguish the human-induced influence on the ecological status of waters from the influence of climate change.

The scenarios for global climate change predict temperature rise by 1-6 °C, depending on emission, and increase of precipitation by 10-20% by the end of the Century (2100). During 1996-2010, the average annual rise of temperature in Estonia was 1.6-2.0 °C, whereby the most clear increase appeared in winter and spring seasons. The regional climate models foresee significant changes in hydrological regime of Estonian inland water bodies by the end of the 21 Century – shortening of ice-cover period at rivers, decrease of spring floods, remarkable increase of freshet infiltration into ground water.

The main climatic pressures on Estonian water bodies are rise of water temperature and changes of precipitation volume and wind regime. Climate warming increases the water level in lakes, rises the water temperature, shortens duration of ice cover and strengthens thermal stratification. Due to increasing precipitation, also nutrient load from catchments increases and blooms of cyanobacteria leading to summer fish kills can occur more frequently. From other side, the concentrations of substances may decrease in conditions of heavy precipitation. So, climate change may strengthen or weaken occurrences of eutrophication and, therefore, support or counteract the measures undertaken for improvement of the ecological status of lakes. Estonian large lakes Võrtsjärv and Peipsi are especially sensitive concerning temperature rise and changes of water level. The long-term studied shallow Lake Võrtsjärv could be, due to its natural water level fluctuation, even handled as a model lake for studies of climate changes.

The main difficulty in assessment of the ecological status of water bodies is differentiation of human impact from climatic factors. For this, monitoring of natural reference sites is foreseen by EU directives, but even this is effective only in case of comparison of long-term homogenous datasets with meteorological data. In Estonia there are present sufficiently long-time hydrological and hydrochemical data series for all types of water categories. As well there are present essential biological datasets for assessment of the ecological status of coastal sea and large lakes. Considering small lakes, the datasets since 1992 are present for six lakes of permanent monitoring programme, and these time series are supplemented yearly. Due to lacking permanent monitoring sites and the rotating monitoring system, there are present no data series of at least 1-year pace for Estonian rivers – so the climate change effect on rivers can not be identified in this stage.

Table 3. Representation of Estonian water bodies on the state monitoring program (Kliimamuutuste…, 2014)

River basin	Rivers			Lakes			Coastal lakes		
	Total number	Monitored	Reference water bodies	Total number	Monitored	Reference water bodies	Total number	Monitored	Reference water
East-Estonian	263	108	14	44	43	10	2	2	0
West-Estonian	356	125	13	43	41	5	14	14	2
Koiva	20	5	1	8	8	2			
Sum	639	238	28	95	92	17	16	16	2

Investigative monitoring of most sensitive lake types is suggested for primary identification of climate change. In Estonia, such sensitive lakes are shallow, soft water lakes of low trophy, and four of them are permanently included in surveillance monitoring program. The most climate-sensitive parameters were not included in the set of the characteristics for lake types in Estonia, therefore the current typology can be considered as a good one (Kliimamuutuste…, 2014).

The main suggestions to improve the state monitoring program for considering effects of climate change on lakes in Estonia are:

- Natural and human impact on lakes can be distinguished as clearly as possible only in the case of adequate monitoring frequency.
- Complex analysis of hydrobiological and hydrochemical data with hydrological or meteorological data should be used.
- Mapping of Estonian potential climate change focal points.

- Sustaining monitoring of lakes in level of profoundness which enables analysis of ecological mechanisms in lakes.
- In addition to surveillance and operational monitoring, monitoring programs should include investigative monitoring for preparation possible plans of measures for lake restoration.
- Permanent monitoring sites at rivers of reference water bodies should be included in the yearly ecological monitoring system.

Because of hard distinctness of anthropogenic and other origin climate change, it is suggested, as a practical solution, to define two types of interference factors for water bodies:

1) pressure factors which can be influenced with local managing methods, and

2) pressure factors which are not possible to influence with local managing methods (e.g., natural variability irrespective of climate change).

In the frames of the research and development programme up to 2020, the Estonian Ministry of the Environment has joined with three volunteer programmes of the European Research Area (ERA) to jointly plan research, the so-called joint initiatives (joint programming initiative, i.e. JPI). The intention of the Joint Initiative Climate is to increase the relations between climate change studies and societal decisions. For example, emphasis is laid on compiling reliable climate forecasts and adapting to climate change. The Joint Initiative Water focuses on ensuring a normal water circulation, developing safe water systems, protecting ecosystems, and facilitating competition in water economy and water saving in production.

3.5. Values of lake ecosystems and lake restoration

3.5.1 General background

Ecosystem services are benefits that people and society obtain from ecosystems. The term was introduced as a framework for social-ecological systems a decade ago in the Millenium Assesment which listed provisioning, regulating, cultural and supporting services. They can also be divided in two main categories, extractive and non-extractive (US EPA 2012, Fig 6).

The concept can be a useful tool in local, regional and even global policy (Carpenter et al. 2009). In regional lake or water management, valuation of the ecosystem services can pave the way for implementing management programs and participation of local stakeholders. It can demonstrate that management of the aquatic habitats is not only a cost to be covered and only for a better environment, but also an investment safeguarding the benefits of natural capital to the local society.

The original approach has been largely focused on linking scientific research with ecological properties and biodiversity (e.g. Carpenter et al. 2009). But for a preliminary assessment of lakes and their management for regional policy, a simpler and more practical approach may be needed. For this purpose we have listed the frequency different uses of lakes or reservoirs which have direct economic significance or are related to these economically significant uses.

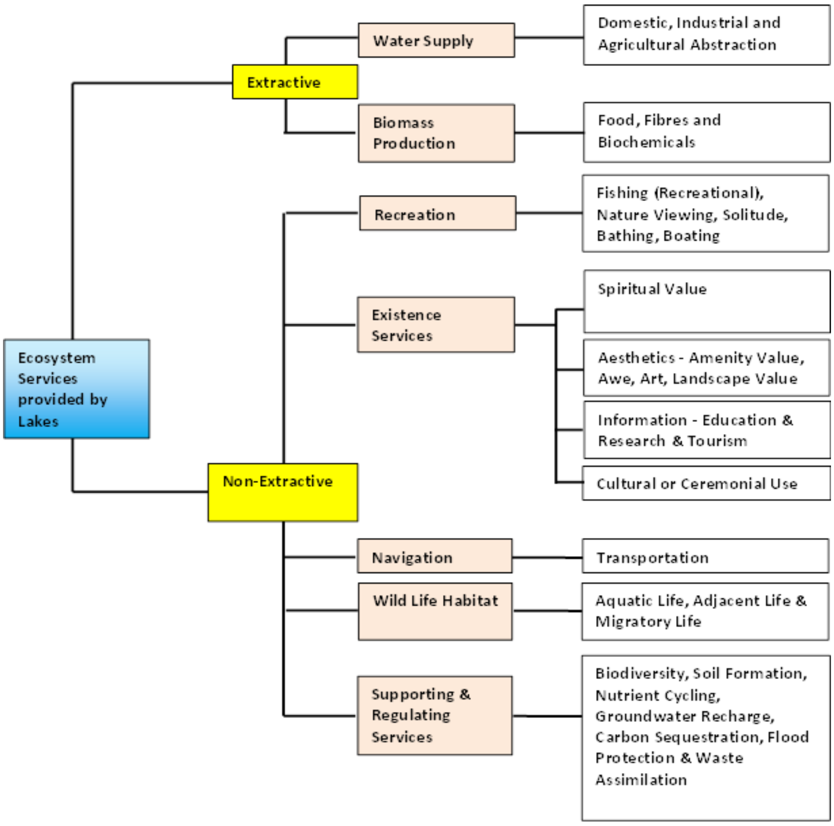


Fig. 6. Types of lake ecosystem services as defined in the US-EPA applied to Lough Corrib in the West Region of Ireland (Teresa O´Reilly, see http://www.epa.gov/aed/lakesecoservices/ecosl.html

3.5.2 Ecosystem services provided by lakes and reservoirs in LakeAdmin regions

A preliminary survey of Ecosystem services identified by partners in their regions resulted in a list of 16, mainly provisioning lacustrine ecosystem services related to some economically significant use of natural resources. These recognised ecosystem services are either directly (e.g. raw water, irrigation, aquaculture, commercial fisheries, hydropower) or indirectly (e.g. recreation, tourism, recreational and sport fishing) highly important in the local economy. Most of these ecosystem services are also dependent on a sufficiently high quality of water. Since their local economic value is high, extensive water protection or management measures have been or will be carried out to maintain them. The role of e.g. irrigation is of special importance in the southern, Mediterranean, partner regions while boating and fisheries are more specified as northern services. Recreation, biodiversity and landscape value were in high priority in all regions. We conclude that maintaining biodiversity and the economically significant Ecosystem services share a common interest. Maintaining economically valuable activities like tourism may thus also require maintenance of biodiversity and at least in LakeAdmin regions the highest income from tourism is significantly related to high biodiversity.

Table 4. Benefits gained from ecosystems of lakes, reservoirs and ponds in LakeAdmin partner regions. Abbreviations of ESS categories: P = Provisioning, R = Regulating, C = Cultural. Supporting services which are less directly policy related or measurable were not listed.

Ecosystem Services Lake use	ESS	Use of lakes in partner regions LakeAdmin countries (blue = yes, white = no)								
		Finland	Czech Rep.	Denmark	Estonia	Greece	Hungary	Ireland	Italy	Malta
Aquaculture	P	no	yes	no	yes	no	yes	no	yes	no
Bathing	C	yes	yes	yes	yes	no	yes	yes	yes	no
Biodiversity	P	yes	yes	yes	yes	yes	yes	yes	yes	yes
Boating and sailing	C	yes	yes	no	yes	yes	yes	yes	yes	no
Env. education	C	yes	yes	yes	yes	yes	yes	no	yes	yes
Fisheries commercial	P	yes	no	no	yes	no	no	no	no	no
Fisheries recreational	P	yes	yes	yes	yes	yes	yes	yes	yes	no
Fisheries sportfishing	C	yes	yes	yes	yes	no	yes	yes	no	no
Flood protection	R	yes	yes	yes	no	yes	no	no	no	no
Freetime residence	P/C	yes	yes	yes	yes	yes	yes	no	yes	no
Irrigation	P	no	yes	no	no	yes	no	no	yes	yes
Landscape value	C	yes	yes	yes	yes	yes	yes	yes	yes	yes
Raw water	P	yes	yes	no	yes	yes	yes	yes	yes	no
Tourism	P/C	yes	yes	no	yes	yes	yes	yes	yes	yes
Water sports	C	yes	yes	no	yes	yes	no	no	yes	no
Water transport	P	yes	no	no	no	no	yes	no	no	no

Valuation of the ecosystem services could pave the way for implementing management programs and participation of local stakeholders since it demonstrates that management of the aquatic habitats is not only a cost to be covered but also an investment for the local society and environment.

3.5.3. Value of lakes in Estonia

Estonia has about 2300 lakes with a surface area of more than one hectare, and half of them are smaller than three ha. The largest of them are Lake Peipsi (3511 km^2), Võrtsjärv (270 km^2) and the Narva reservoir (102 km^2). All the three are of great importance in fishery. In Tallinn, the capital, Lake Ülemiste (941 ha) is the drinking water supply, and Lake Harku (164 ha) is important for recreation activities. With reference to fishery and recreation economy, most valuable lakes are located on the Otepää and Sakala upland and Vooremaa while other regions are more rich in plant and animal rarities.

Ecosystem services of lakes in Estonia have not yet been studied or their values estimated systematically. Still, in frames of the project “Development of methods for assessment and mapping of ecosystem services of marine and inland waters” (2014-2015), funded by European Economic Area (EEA) and Norway Grants, the methodologies of mapping and assessing marine and inland water ecosystem services will be developed also for Estonian water bodies, including monetary values of pilot water bodies will be found (http://www.ctc.ee/running/ecosystem).

Here, just some examples follow.

At the largest transboundary European lake, Lake Peipsi, fishing has always been one of the main sources of subsistence and gives 95% of Estonian freshwater fish catch. 33 fish species and lamprey inhabit Peipsi and the lower courses of its tributaries; the total catch is 9-11 thousands metric tons a year, and fish export is one of the main market for local commercial fisheries. For local inhabitants and tourists, recreational fishing is even more important: during winter weekends, the maximum number of on-ice anglers reaches up to 3000 and catches amount up to 20 kg (mean ~4±2 kg) per day per angler (Orru et al., 2014). According to the cited study, a third of the anglers on Lake Peipsi are Estonian tourists and approximately half are Latvian tourists. The survey carried out among the anglers, recreation (inl. enjoying nature and company, and excitement) is the most appreciated value of winter fishing while additional food or income is not so important (Orru et al., 2014). Better organization of ice-fishing tourism infrastructure could create more local employment opportunities and would help to maintain traditional fisheries dependent lifestyles. Tourism is an intensively developing branch of economy at Peipsi. The lake has also been considered a potential source of water supply for Northeastern Estonia and the Estonian capital, Tallinn.

The second large Estonian lake, Võrtsjärv (270 km^2), offers large variety of ecosystem services. 45 professional fishermen families with total annual catch of around 200 tons and annual turnover ca 400 000 - 500 000€. 8% of 300 000 Estonian amateur fishermen prefer Võrtsjärv for fishing. In addition to 16 000 people living in the municipalities surrounding the lake, around 30 000 tourists visit it annually. Environmental education to 4000-5000 people of all age groups and level of education is given at the shores of the lake.

4. Lake restoration and WFD implementation in the partner regions

4.1. Description of Lake Restoration in Estonia

4.1.1. Feedback from the EU to the national implementation of WFD in the second RBMP period.

According to the Commission Staff Working Document COM (2012)670 final (European Commission 2012) the key strengths of the Estonian National River Basin Management Plans are as follows:

- good information on pressures
- good visualisation of geographic information on maps
- detailed annexes at water body level.

Significant gaps exist though:

- Not all biological quality elements (BQEs) have been used for assessment.
- Although there has been some international co-ordination with Russia in the East Estonia RBD, there is no reference to Latvia who also shares the basin. There are no international RBMPs for the international RBD on EE territory.
- Information on public involvement, methodologies used, and assessment of protected areas was scarce or almost missing.
- The monitoring network is relatively weak, with a low density of monitoring stations. The monitoring programme has not provided sufficient data for status assessment of water bodies. For example, it is admitted that for several water bodies the reasons for lacking good status are not fully known. Prolonged deadlines for achieving good status have been applied in order to carry out further studies. There is information provided for groundwater and surface water sample analyses showing that limit values for pollutants have been exceeded. It is not properly explained why these water bodies are considered to be good status. Current statements are not convincing.
- The assessment of chemical status is weak. The monitoring of polluting chemicals is un-satisfactory.
- The Programme of Measures includes few measures beyond basic measures, including permits and controls. Based on the RBMP, it is almost impossible to distinguish between supplementary and additional measures. References to the needs of specific plans have neither addressees nor deadlines. It is not clear from the RBMP, who should comply those plans and by what time.
- Assessment methods for the classification of ecological status are not fully developed for all biological quality elements. For example, class boundaries have not been set for phytoplankton and macrophytes in rivers and for phytobenthos and fish in lakes.
- Information on pressure-response relationships cannot be found in the RBMP or in the national guidance document.

4.1.2. Significant issues for ecological status of Estonian lakes

The Ministry of the Environment is the competent authority in all river basin districts on the Estonian territory. The competency is defined by national laws or regulations, mainly the Water Act (Veeseadus, 1994), where relevant responsibilities are described. The competent authority acts as a co-ordinating body involving other relevant authorities in the process of preparation or implementation of the river basin management plans. For co-ordination purposes, the Minister of Environment established in June 2011 a water management commission, which deals with preparation and implementation of the river basin management plans. A centrally co-ordinated national approach has been followed in WFD implementation similarly in all the three RBDs.

The methodology is mostly presented in the Ministry of the Environment Regulation No 44, 2009: "Guidance on establishment of surface water bodies and list of those water bodies for which the status has to be assessed, classification of status and values of the quality elements of that attribute those classes and guidance on establishment of the status classes"(in Estonian).

The one-out-all-out principle has been applied as the combination rule to derive the overall ecological status for rivers. For lakes the final assessment is made based on 2/3 QE compliance level. The decision on which QE to include is done by expert opinion. Ecological status assessment methods have been developed for all surface water body types in Estonia. Intercalibration has been carried out and the results have been taken into account while setting class boundaries. All relevant biological quality elements (BQEs) are used in surveillance monitoring, but not all supporting elements are used. Nutrient load from diffuse and point sources including internal load and the resulting eutrophication is by far the most dominant reason for exceedance of ecological status in 44% of cases in Estonian rivers, 86% of cases in lakes and 93% of cases in coastal water bodies. Other pressure factors, such as residual industrial pollution, mining activities or transportation, which could potentially bring about specific pollutants other than nutrients, were responsible for non-compliant ecological status in 12% of cases in rivers, 3% cases in lakes and 7% cases in coastal waters.

4.2. Inclusion of the Lake Archive and rationale behind its preparation

LakeAdmin Archive is a case study collection which is prepared to aid the transfer of Good Practices and preparation of the regional Implementation Plans of LakeAdmin. Each partner region has participated in collecting, and dissemination of previous experiences and knowledge on lake restoration themes and actual cases from the past 10 - 30 years in partner regions and nearby areas including problems addressed, methods, good practices, approaches applied, impacts and costs of the measures.

More than a half of the Estonian lakes are in a hypertrophic, mixotrophic or eutrophic state. Most of them have been strongly influenced by the agricultural factor – fertilizers and wastes from collective farms – which accelerated their eutrophication. The status of Estonian lakes in the 1950s and 1960s could be considered still natural, not influenced remarkably by human impact. By the beginning of the 2000s typical oligotrophic lakes in Estonia had almost disappeared and the number of hypertrophic lakes increased.

4.2.1. Short history of national lake restoration

There are just few examples of properly prepared and implemented lake restoration projects in Estonia (Tuvikene et al., 2006). Lake restoration intensified in the1970s when possibilities to restore the previous state of the lakes with lowered water level were investigated and tested. During that time the purpose was largely to increase the proportion of the commercially valuable fish stock. The tested lakes were Ermistu, Lahepera, Väimela Alajärv, Vasula, Maardu, Suure-Jaani and Harku.

As another approach, rearrangements of fishery in large lakes, the composition of the fish fauna was affected favourably. The use of Danish seines damaging the stock of valuable fishes, especially pike-perch, was reduced since 1974 in Lake Peipsi. In Lake Võrtsjärv, fish trawling was gradually restricted since 1966, and finally stopped in the 1970s. As a result of these measures, the fishing mortality of pikeperch fell sharply and its stock and catches began to increase rapidly. The increased pressure of big predatory fishes has caused a significant reduction in the stock of ruffe and roach. This project can be regarded as one of the most successful project of lake management in Estonia up to now - the former ruff lake became a valuable pikeperch and eel lake.

In the 1980s, mostly for recreative purposes, attempts were made to restore lakes like, e.g. Verevi, Arbi. Although the condition of the lakes was improved for several years, persistent results were not achieved. In the Soviet period an attempt was made to improve the status of Lake Lahepera (ca 100 ha) located near Lake Peipsi, using the method of mud removal. Despite previous thorough chemical analysis and the establishment of 36 ha mud deposition fields, the work was not completed: there was found no application for mud, technically low quality pumps roiled the water and nutrient salts from mud entered the water.

A complex method was used in Lake Ermistu in Tõstamaa: mud removal after lowering water level and supplementing of the local fish community with commercially valuable fish species. However, water lowering failed and the local fish community remained unchanged. By now the lake has changed into a typical makrophyte lake.

Short description of two biomanipulation cases of Estonia.

4.2.2. Biomanipulation in Lake Harku

In Estonia, biomanipulation as restoration method was first used in Lake Harku (area 1.62 km2, mean depth 1.6 m). This project started in cooperation with Arhus county and Freshwater Centre (Denmark) in 1990 (Harku järv Lake Restoration, 1992). During 1993-1994 ca 30 tons fish was removed from lake. 20-23 in 1993 and 7.7-8 t in 1994, respectively. 20-23 tons built up 66-76% of biomass of cyprinids. Dominating fish species removed were bream and roach. The average length of main filtrator, cladoceran *Daphnia cucullata*, increased significantly.

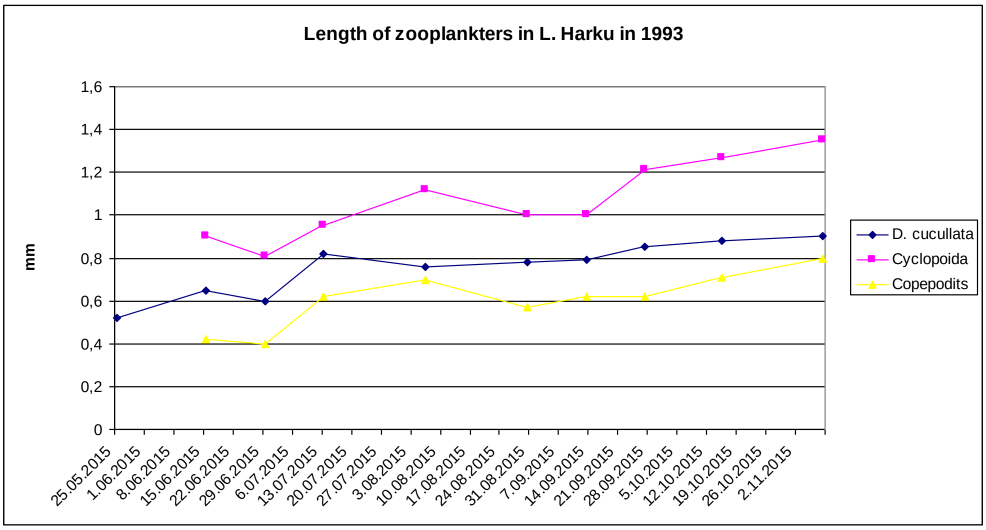


Figure 7. The average length of zooplankton

On spring 1994 the number of *D. cucullata* was twice higher in comparison with 1993 (Figure 7). After the two-year biomanipulation the phytoplankton biomass decreased mainly due to decrease of biomass of dominant species – green alga *Scenedesmus quadricauda*. The decrease of the amount of *S. quadricauda* is apparently connected with grazing by zooplankton, since small green algae are one of the main food for filtrators. Water transparency rose little after biomanipulation (Figure 8).

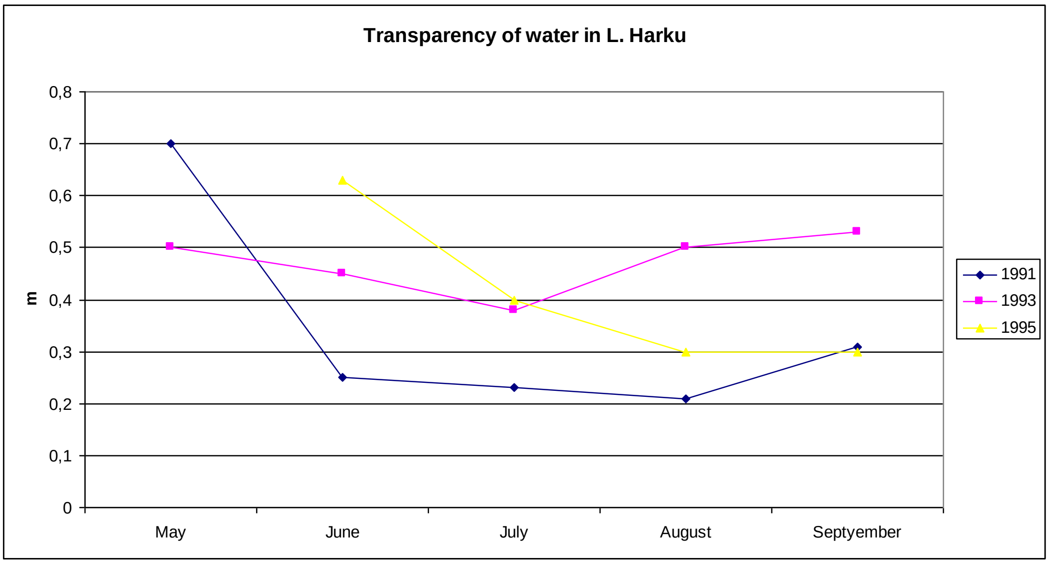
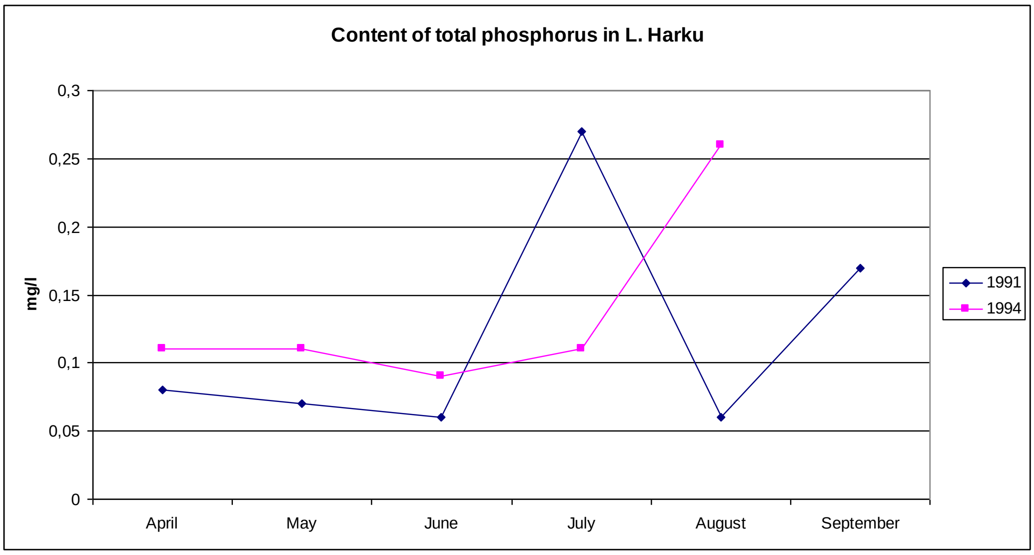


Figure 8. Water transparency (Secchi depth) in Lake Harku

After biomanipulation the content of phosphorus decreased especially during summer months (Figure 9).



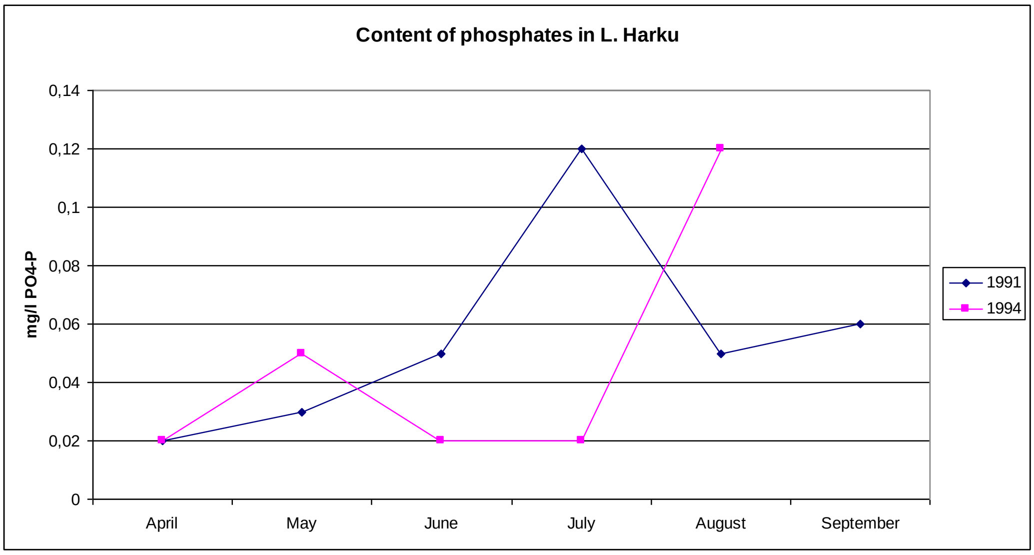


Figure 9. Content of total phosphorus and phosphates before (1991) and after (1994) biomanipulation in L. Harku.

To conclude, some positive trends in water quality (increased transparency, decreased phytoplankton biomass) were seen just after the biomanipulation. Due to the lack of funding the removal of fish was stopped and non-predatory fishes were caught in not sufficient numbers and the desired goal was not achieved.

4.2.3. Biomanipulation in Lake Ülemiste

Selective fish catch was done by Centre for Limnology of Estonian University of Life Sciences in cooperation with Finnish Environmental Institute in 2004-2006. Total of 156 tonns of fish were caught, of which bream built up 55% and roach 26%, respectively. During biomanipulation the content of nutrients, as well as phytoplankton biomass were decreased. Dominating fish species removed were bream and roach. The average length of main filtrator, cladoceran *Daphnia cucullata*, increased significantly.

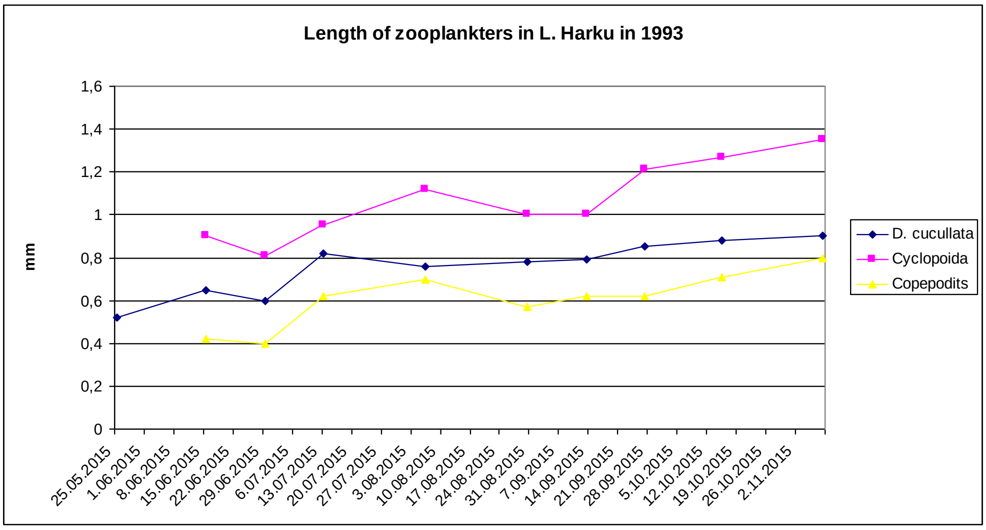


Figure 10. The average length of zooplankton

On spring 1994 the number of *D. cucullata* was twice higher in comparison with 1993 (Figure 10). After the two-year biomanipulation the phytoplankton biomass decreased mainly due to decrease of biomass of dominant species – green alga *Scenedesmus quadricauda*. The decrease of the amount of *S. quadricauda* is apparently connected with grazing by zooplankton, since small green algae are one of the main food for filtrators.
Water transparency rose a little after biomanipulation (Figure 11).

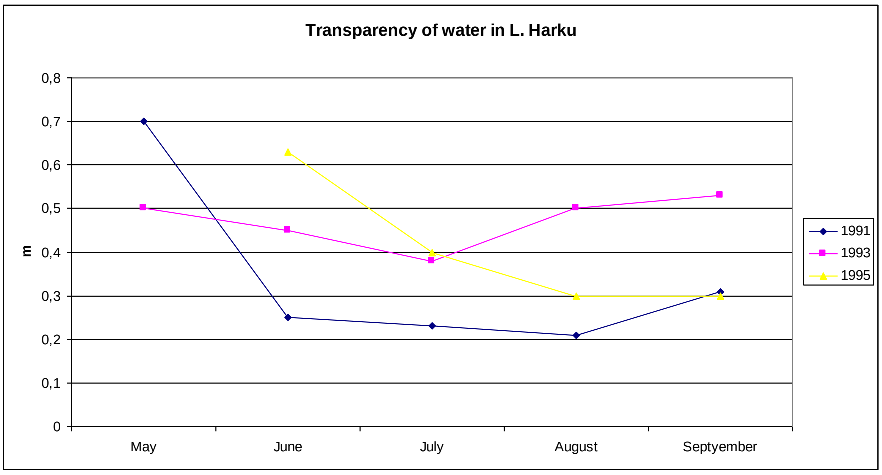


Figure 11. Water transparency (Secchi depth) in Lake Harku.

After biomanipulation the content of phosphorus had decreased especially during summer months (Figure 12).

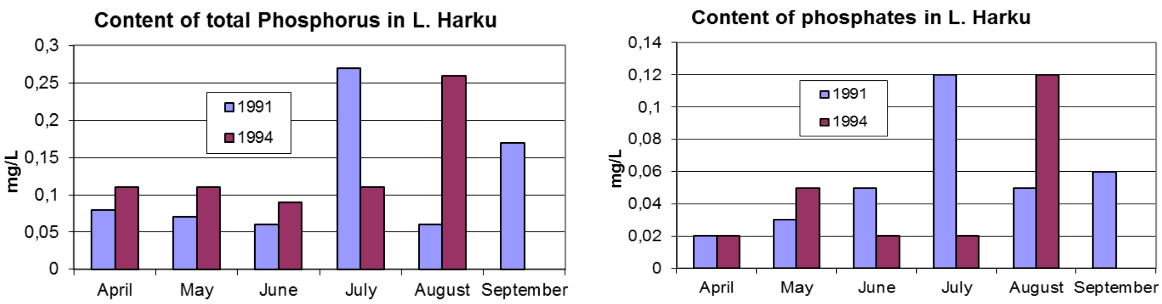


Figure 12. Content of total phosphorus and phosphates before (1991) and after (1994) biomanipulation in L. Harku.

To conclude, some positive trends in water quality (increased transparency, decreased phytoplankton biomass) were seen just after the biomanipulation. Due to the lack of funding the removal of fish was stopped and non-predatory fishes were not caught in sufficient numbers and the desired goal was not achieved.

4.2.4. Biomanipulation in Lake Ülemiste

Selective fish catch was done by Centre for Limnology of Estonian University of Life Sciences in cooperation with Finnish Environmental Institute in 2004-2006. Total of 156 tons of fish were caught, of which bream built up 55% and roach 26%, respectively. During biomanipulation the content of nutrients, as well as phytoplankton biomass were decreased. Water transparency increased, but only during spring time. Unfortunately there was no seen the increase of number and biomass of big cladocerians. Results obtained did not satisfy the company AS Tallinn Vesi and due to stopping of funding biomanipulation was stopped.

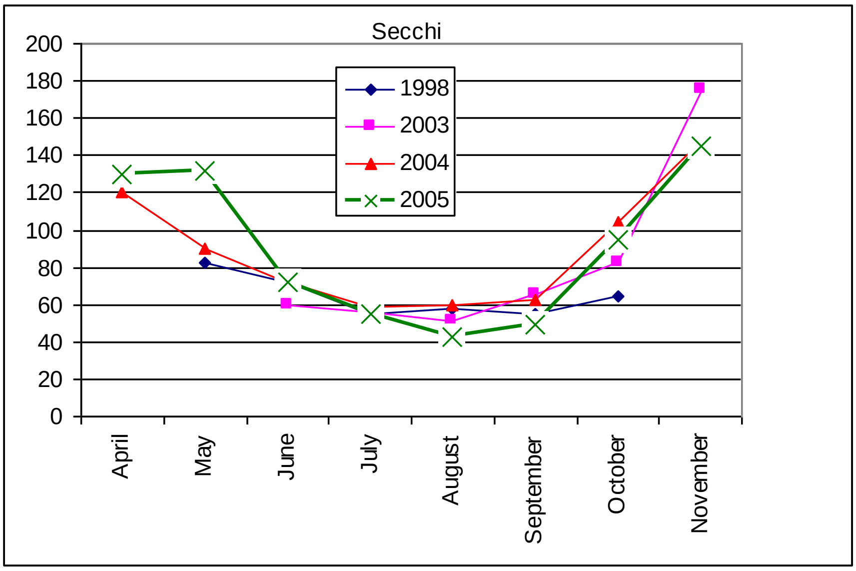


Figure 13. Seasonal changes of water transparency according Secchi depth in Lake Ülemiste, 1998-2005.

4.3. Open Access Guidance Material

LakeAdmin is dedicated to identifying, exchanging, adopting and transferring Good Practices in lake management processes. Regional and local policy is also enhanced through closer co-operation between lake restoration managers and policy makers. The compilation of the LakeArchive which includes data on previous restoration measures (including limnological, hydrological and ecological measures) spanning a time period of 30 years will no doubt increase the capacity of managing authorities to tackle environmental problems and issues associated with water body restoration. Access to the LakeAdmin Archive will be available to all relevant and appropriate stakeholders and authorities through the social networking site LakeWiki at http://www.jarviwiki.fi/wiki/Main_page?setlang=en. In the LakeWiki, each lake of over 1 ha, each drainage basin, region and river basin district has its own page. The development of the Lakewiki has followed a number of steps and can be reviewed at: www.jarviwiki.fi/wiki/LakeAdmin.

Fig 14. LakeWiki Map

The Estonian contribution to the LakeAdmin database comprises a significant body of information regarding 18 Estonian lakes where restoration activities have been done or planned. The scientific archive includes historical data from the 1970s to the present including lake water chemistry and chlorophyll levels. The impact and effectiveness of improved wastewater treatment especially nutrient removal can be seen in the long term trends with general improvements apparent in response to the measures and investment in new sewage treatment works and better planned agricultural activities. The database also contains an overview of the principal programmes of measures that are active in the catchments of the lakes under the WFD currently and historically under earlier national and international legislation. Significant amounts of historical information are included in the database and via the LakeAdmin wiki interface it will be possible for different organisations to upload new material. Links to research projects and previous management programmes are also included. The LakeWiki and underlying database thus provides a broad overview of Estonian lake catchment management.
A long-term perspective is particularly valuable as it clearly shows that catchment management for some issues has been successful in the past and hopefully this will encourage current catchment managers to strive for further improvements in the future. The LakeWiki interface will allow current managers and those with an interest in water quality to compare Estonian lakes with each other and also with those of the other LakeAdmin partners across Europe.

4.4. Needs of knowledge

The Needs of Knowledge refers to the knowledge gaps found by the LakeAdmin partners and where regional policy makers could benefit from Good Practices adopted, implemented and monitored in LakeAdmin partner countries.

4.4.1. Needs of knowledge in LakeAdmin regions

Table 5. Needs of knowledge were identified less than Good Practices. Five LakeAdmin partners have listed 12 needs of knowledge. (Please note that the enumeration of / reference to GP´s will be updated)

NoK & Owner	Name of the Need of knowledge	Link to an identified Good Practice (and GP owning partner)
P1	Costs of lake management as regional and local investments	Chapter on Ecosystem services
P5	Economic methods for utility assessment of lake sediments	- partially linked to Chapter on Ecosystem services
P5	Application of biomarker tests into the programs for assessing the ecological status of lakes	GP 18. Biomonitoring by passive sampling and juvenile fish analysis (P3)
P6	Co-operation between stakeholders and authorities	GP 15. Stakeholder participation and feedback (P1) GP 16. Guidance of management planning for stakeholders (P2) and GP 17. Lake restoration book in native language
P8	The Negative Impacts resulting from the legacy of old Afforestation Practices on the Water Bodies of the West Region	partially linked to Chapter on Ecosystem services
P8	Potential Water Quality problems in relation to Agriculture	GP 9. RAE (P2) and GP 14 Kutova (P1)
P8	Wastewater from Unsewered Properties (Commercial and Residential)	GP 8 RENULDS (P1) and GP 13 On-site treatment of wastewater (P7)
P9	Elevating the level of environmental education	GP 16 Guidance of management planning for stakeholders (P 2) and GP 17 Lake restoration guidance material in native language (P5)
P9	Land use model for the integrated management	GP 2 Pressure maps (P1) (partial link) GP 14 Kutova (P1) (partial link)
P9	Assessment methodologies for evaluation of socio-economic values of nature	GP 25, Small lakes ecosystem service value (P4) and Chapter on Ecosystem services
P9	Management of sustainable professional and game fishing	Chapter on Ecosystem services, Biomanipulation GP
P9	Management planning of artificial lakes	GP 1 Multicriteria assessment (P1), GP 3 Monitoring as a planning tool (P1), GP 22 Multi-purpose planning of the Plastiras Dam (P6), GP 30 Planning to ensure the infrastructure of the Lake Stefaniada region (P6)

4.4.2. Needs of knowledge in Estonia

In Estonia, the Managing authorities are generally very interested to keep frequency of monitoring of water bodies at least the same level it has been shaped earlier, and to take care of our natural water bodies as well as possible. Still, the methods continuously need to be developed and the new approaches are welcomed.

During recent years, development of methods for biological assessment of the status of water bodies is one of the most actual issues. “Application of biomarker tests into the programs for assessing the ecological status of lakes” is one of the identified by Estonian University of Life Sciences need of knowledge in Estonia, and the GP - “Assessment of contamination with passive samplers and juvenile fish analyses” proposed by the University of South Bohemia has great potential to support this need of knowledge. Bilateral co-operation aiming to test and possible application of the method in Estonian state monitoring programme will reach beyond the LakeAdmin project time. In February 2015, a project application was submitted to the Estonian Environmental Investment Centre for this work, planned to perform in tight co-operation with the University of South Bohemia.

Another need of knowledge accentuated by Estonian partner was “Economic methods for utility assessment of lake sediments” which actually did not get suitable bond to any Good Practice proposed by LakeAdmin partners. Anyway, the subject needs to be handled in EU scale since cost-effective sediment removal from lakes being restored by this method is undoubtedly an issue of great interest and necessity.

5. Good Practices

A Good Practice has been defined by Interreg as follows: “In the context of the INTERREG IVC programme, a good practice is defined as an initiative (e.g. methodologies, projects, processes and techniques) undertaken in one of the programme’s thematic priorities which has already proved successful and which has the potential to be transferred to a different geographic area. Proved successful is where the good practice has already provided tangible and measurable results in achieving a specific objective.” (Interreg IVC Manual May 2012).

The LakeAdmin project identified altogether 18 good practices (GPs) of lake restoration and used several most appropriate of them in each partner’s regional or local plan implementation plans for advancement of lake restoration. The set of practices addresses many central subjects of lake restoration: for procedures and tools for restoration planning, for monitoring the status of lakes, for reducing loads and impacts of pressures and for wide restoration cases with complex needs for uses of a lake. The set of recognised GPs is divided into five categories (Table 6).

Table 6. The set of recognised GPs identified in the LakeAdmin project

Good practices identified in LakeAdmin project
Preparation, planning and procedures of restoration of lakes Integration of shoreline management and spatial planning in the Balaton (HU) Stakeholder participation and feedback (FI) Lake restoration guidance material in a native language (EE) A flexible education-model to help management planning for stakeholders (FI) Multi-criteria assessment in comparison of options in lake restoration planning (FI) Mapping for presenting eutrophication pressures of lakes (FI) A practical tool for evaluation of reductions of diffuse phosphorus loading (FI)Multipurpose use of small urban lakes (DK)
Surveillance of needs, initiatives and operations of lake restoration Monitoring for investigation and surveillance of lake restoration cases (FI and EE) Integrated regional on-line monitoring system (HU) Evaluation of the secondary losses caused by a protected piscivorous bird – the great cormorant (CZ)
Novel approaches for evaluation of ecological quality for restoration efforts Assessment of contamination with passive samplers and juvenile fish analyses (CZ)
Measures to reduce external loading and other pressures Efficient and environmentally good use of manure for protection of watercourses (FI) Waste water treatment of small villages by on-site household units (HU)
Restoration for wide response in ecological quality and for complex needs of use Restoration of eutrophic temperate lakes by biomanipulation (DK and FI) Control of aquatic invasive species in Ireland, CAISIE (IE) Re-watering of a drained large lake in Greece (GR)

Planning the multi-purpose use of a reservoir (GR)

Good practices identified in the project were prepared to become a relevant part of regional planning and water management. Partner regions have successfully adopted several GPs from each other. Most frequently adopted GPs deal with stakeholder participation, which in various approaches or tools seemed to interest several partner regions. Also monitoring practices were gathered to be important. A novel approach to use passive samplers also for assessing restoration needs is interesting, especially if load of hazardous substances is in question.
A widespread knowledge of the GPs identified in LakeAdmin should have long term benefits in the regions beyond the lifetime of the project, furthermore enhancing also capacity of project partners and regional authorities and stakeholders in the field of restoration. Identified GPs could benefit also other regions. GPs are adaptable, so other regions in Europe may tailor aspects of relevant GPs to address their own needs.

5.1 Good Practices proposed by Estonian University of Life Sciences

5.1.1. Lake restoration guidance material in native language

Interest in lake restoration in Estonia has been growing fast and diversely due to concurrent public notification of lake restoration matters. Profound information on lake restoration has been made accessible for public in an Internet Handbook in Estonian. The material has been used intensively and the feedback has been good. Since the handbook was published, 22 new lake or reservoir restoration projects have been funded by the Estonian Environmental Investment Centre. Experiences suggest that information in native language is needed to facilitate also the central idea of the Water Framework Directive to increase the participation of local stakeholders.

5.1.2. Monitoring for investigation and surveillance of lake restoration cases (GP proposed together with Finnish Environment Institute)

Monitoring before, during and after restoration and management measures is of crucial importance in safeguarding the reaching of good status of lakes. Preoperative monitoring is needed for proper identification of the causes for problems. Monitoring is also a prerequisite for selection of a right measure to improve the status of a lake and to plan correctly the efforts for the selected measure. During realisation of measures monitoring is needed to ascertain progress and to know the impacts of the measure; that is either to ascertain that a better water status is achieved - or to notice if measures have not reached desired impacts and to analyse the causes of a possible failure.

Most of the successful restoration cases in Finland regard lakes which have been monitored sufficiently. In many cases the monitoring is obligated in environmental permits and/or the lake has been included in a national, regional or local programme of intensive monitoring.

If worsening of the ecological status of water bodies has been identified in regular monitoring in Estonia, reasons for this are carefully studied during the following year and the measures to improve the situation can be undertaken promptly.

5.1.3. Biomarkers of environmental stress in fish

The original background of using biomarkers as a reference of environmental condition comes from the field of ecotoxicology. Fish that are living in the environment are concurrently affected by several factors: different type contamination, food availability etc., and their condition forms according to all the factors taking effect. Biomarkers such as fish condition factor (CF), liver somatic index (LSI), gonad somatic index (GSI), erythrocyte abnormalities, activity of biotransformation enzymes (EROD), parasites and more, are used to evaluate the condition and health of the fish living in the areas of interest, e.g. lakes that are in poor condition. The method was advanced for coastal sea waters during BONUS+ BEAST project in 2009-2011 and was suggested to use in Baltic Sea area but can be a useful tool for lakes, also. Since the practice is still in testing phase, the LakeAdmin team decided to discard it from the final list of the identified GPs.

5.2. Good Practice Guide for the practice proposed by Estonian University of Life Sciences

5.2.1. Lake restoration guidance material in native language

Summary. As a finding from previous Interreg IIIC project Lakepromo (2004-2007), the need for assembled and systemized information on lake restoration issues, available in native language to reach as large as possible range of target groups, was identified in Estonia. Though in several EU member states, especially Finland, Denmark and Sweden, publication of such guidance materials is a common practice, in several other countries including Estonia, much more attention should be paid on this.

Target groups: all official language speaking people, Ministry of Environment and the related institutions, local municipalities, engineering bureaus, environmental impact assessors, students of environmental disciplines, hydraulic construction enterprises, community groups, outdoor enthusiasts and water users, the media, etc.

The objectives are to educate the Estonian target groups in large scope of lake restoration issues, to raise the awareness of all related people, institutions and enterprises to get best possible effect in lake management and restoration.
During 2009-2011, a manuscript of Lake Restoration Handbook was compiled in Estonian, and made accessible in internet. The manuscript is available at:
http://pk.emu.ee/struktuur/limnoloogiakeskus/teadustoo/publikatsioonid/jarvede-tervendamine-kogumik/

Outcomes resulting from the Good Practice:
1. Better knowledge of lake restorers let avoid mistakes in the process
2. More successful restoration cases
3. Approving relevant legislation
4. Overall raising awareness on lake management.

Activities
1. Mapping of needs and opportunities. Should be initiated and/or co-ordinated by the Ministry of the Environment
2. Planning of publication
    1. institutions/persons
    2. time table
    3. financing
    4. dissemination

Results
The material has been used intensively and the feedback has been good. The materials have been used for preparing a lake restoration chapter in a university textbook of Hydrobiology (in Estonian), and, of course, in the preparing phase of lake restoration projects in Estonia. Experiences suggest that information in native language is needed to facilitate also the central idea of the Water Framework Directive to increase the participation of local stakeholders.

5.3. Transfer of the Good Practice(s) into policy

Estonian University of Life Sciences has identified two Good Practices from other Project Partners as most likely suitable measures for transferring to the Astonian lake management in order to try to obtain similar results.

The selected Good Practices are:
1. Multi-criteria assessment in comparison of options in lake restoration planning (Finland)
2. Assessment of contamination with passive samplers and juvenile fish analyses (Czech Republic).

These two identified good practices were included in the compiled plans of measures (see Appendixes) as a part of suggested actions, and some other were suggested as of great potential for use in Estonia.

5.3.1. GP 1 Multi-criteria assessment in comparison of options in lake restoration planning (Finland)

An approach based on multiple criteria decision analyses (MCDA) has been used in Finland both locally and regionally. Main criteria defining the priority of a lake to be restored have been 1) state of the lake which defines the need for restoration or management 2) degree of recreational use and 3) potential of local participation. The basic analyses can be carried out by a straightforward method using spreadsheets weighing the criteria by their importance. Lake cases are initially prioritized based on the sums of lake specific scores and results of prioritisation are further elaborated by MCDA. The evaluation method is transparent. It may also improve a tool for initial planning for local stakeholders, when they know what kind of information is needed from the lakes and which criteria are considered for funding decisions. Elements of the approach have also included in national guidance material for implementing the Water Framework Directive in Finland.

Table 7. Evaluation criteria for lake restoration initiatives (modified from Marttunen et al. 2008, Olin 2013)
Tentative principle for ranking by priority: Very high 5 points, High, 3 points, Medium 1 point. Values of criteria which are considered most important can be weighted e.g. by 2. Ranking of initiatives is based on the sum of points.

STATE	**Very high priority (5)**	**High priority (3)**	**Medium priority (1)**	Weight
External nutrient loading	Magnitude has been estimated, main water protection measures in the catchment done	Loading estimates are in progress, main water protection measures planned and partly done		
Ecological status	Moderate or lower, or clear decline in status observed	Good or lower, or decline in status observed	High or good, and decline in status observed	
Algal blooms	Frequent heavy blooms of cyanobacteria or/and sliming of fishing gear	Frequent blooms of cyanobacteria or/and sliming of fishing gear	Occasional blooms of cyanobacteria or/and sliming of fishing gear	
Conservation value	Part of Natura 2000 or other conservation area, high national importance	A potential site for endangered species, a high regional conservation value	Some local conservation value	
Shoreline and vegetation	Severe overgrowth of shores, loss of submerged vegetation, significant changes in species composition	Increase of overgrowth and or changes in species composition have been observed	Some overgrowth or changes in species composition have been observed	
Fish stock	High dominance of cyprinids, biased age/size structure, frequent fish kills. EQR value* poor or bad (WFD survey by Nordic multimesh gillnets)	Dominance of cyprinids, biased age/size structure, occasional fish kills. EQR value moderate or lower	Some changes in species composition, EQR value good or lower	
USE				
Linkage to WFD	Nationally important in WFD	Regionally important in WFD	Locally important in WFD	
Recreational value	Regionally very important for swimming (EU beach), recreation, landscape &/ tourism Shoreline for public use	Regionally important for swimming, recreation, landscape &/ tourism, open shoreline for public use	Locally important for swimming, recreation, landscapte &/ tourism, open shoreline for public use	
Other benefits	Significant reduction in flood risk or draught risk Important for raw water use	Reduction of flood risk or draught risk in identified areas Important for raw water use	Reduction in flood risk or draught risk	
Potential amount of users	Close to town/big villare, very much settlement by the lake	Rather close to town/village, important for local settlement	Some discance to town or village, settlement nearby	
Activity in fish management	At least three criteria filled: -management of fishing or foodweb management -active recreational or subsidiary fishing -commercial fishing	At least two criteria filled: -management of fishing or foodweb management -active recreational or subsidiary fishing -commercial fishing	At least one criterion filled: -management of fishing or foodweb management -active recreational or subsidiary fishing -commercial fishing	
Socio-economic importance	National/regional priority for: - enterprises - tourism - employment - research site	Local priority for - enterprises - tourism - employment - research site	No national or regional socio-economic significance	
APPLICABILITY				
Local activity and consensus	At least three criteria found: -a lake protection association - owners of water areas joined - volunteer work in management or monitoring - wide local consensus	At least two criteria found: -a lake protection association - owners of water areas joined - volunteer work in management or monitoring - wide local consensus	At least one criterion found: -a lake protection association - owners of water areasjoined - volunteer work in management or monitoring - wide local consensus	
Phase of planning	Operationve plan ready or in preparation	General plan ready or in preparation	Preliminary monitoring and plans have been done	
Permissions	Agreement of the objectives with owners of water areas and regional authorities	Need for permissions explored and permissions applied	Owners of water areas are known and application is possible	
Self financing	Decision for own funding with a percentage > 30 % of total cost	Decision for own funding with a percentage < 30 % of total cost	Negotiations between partners have been initiated	

Table 8. An example for comparison of different lakes

Evaluation criteria for lake restoration initiatives (Marttunen et al. 2012, Olin 2013)							
Tentative principle for ranking by priority: Very high 5 points, High, 3 points, Medium 1 point.							
Values of criteria which are considered most important can be weighted by 2 or 3.							
	Initial evaluation points				**Weighed evaluation points**		
STATE	Lake 1	Lake 2	Lake 3	Weight	**Lake 1**	**Lake 2**	**Lake 3**
External loading	5	3		2	10	6	0
Ecological status	3	3		2	6	6	0
Blooms of cyanobacteria	3	5		3	9	15	0
Conservation value	3	5		1	3	5	0
Shoreline and vegetation	1	3		1	1	3	0
Fish stock	1	1		1	1	1	0
					0	0	0
USE					0	0	0
Linkage to WFD	5	3		1	5	3	0
Recreational value	3	5		3	9	15	0
Other benefits	1	3		1	1	3	0
Potential amount of users	3	5		3	9	15	0
Activity in fish management	1	3		1	1	3	0
Socio-economic importance	3	5		3	9	15	0
					0	0	0
APPLICABILITY					0	0	0
Local activity and consensus	3	5		2	6	10	0
Phase of planning	3	3		1	3	3	0
Permissions	1	1		1	1	1	0
Self financing	1	3		1	1	3	0
Total	40	56	0		75	107	0

In Estonia like in Finland, there are many lakes, and the status of many of them needs to be improved. In the situation of constrained financing, water managing authorities, above all the Ministry of the Environment and the Environmental Board, need effective methods to find out which lakes are needed to pay attention first priority and which can be treated later. The Finnish experience in using the multi-criteria assessment in comparison of options in lake restoration planning can be easily acquired and practiced in Estonia. Transfer of this good practice will serve efficient use of finances for management of water bodies. This will be also a valuable tool for the Environmental Investment Centre for evaluating the project applications for lake restoration.

5.3.2. GP 2 Assessment of contamination with passive samplers and juvenile fish analyses (Czech Republic)

These highly perspective biomonitoring techniques are potentially effective methods to estimate ecological status of coastal and inland water bodies in the frames of surveillance-, operational and/or investigative monitoring. The University of South Bohemia has a long and successful experience with these techniques, not only in the region itself, but also in other regions, mainly within Europe. Estonian University of Life Sciences and University of South Bohemia in České Budějovice, Faculty of Fisheries and Protection of Waters have planned joint actions to test in Estonian waters the method of assessment of contamination with passive samplers. For this, in February 2015, a project application was submitted to the Estonian Environmental Investment Centre for testing the method in Estonian coastal and inland waters, and elaborating a protocol for Estonian monitoring program; the project is planned to perform in tight co-operation with the University of South Bohemia. The method was suggested for using also in the plans of measures for improving the ecological status of four Estonian lakes.

Passive sampling is able to achieve enormous sampling requirements. It is sampling technique based on free flow of analyte molecules from the sampled medium to a collecting medium, as a result of difference in chemical potentials. The method can be used to detect occasional pollution over a longer time span than the typical water samples representing one moment.
Advantages of passive sampling are:

- pollutants are concentrated in the sampler
- deployment is not time consuming/labor intensive and it does not require connection to energy sources
- multi-residue sampling and relatively cheap analyses of wide spectra of pollutants, it provides time average concentration over relatively long time period.

Target groups: regulatory and monitoring bodies at both government and local council levels. Consultancy companies and analytical laboratories. Owners of the water bodies, who are interested in the pollutants in water, e. g. municipalities, regions and government bodies, as well as individual stakeholders or private companies with a nature aware approach, utilizing water sources.

7. Planning measures for improving ecological status of lakes

Requested by the Ministry of the Environment

The plans of measures were sent for comments and suggestions for improvement to the respective regions of the Environmental Board and to the water department of the Estonian Ministry of the Environment in December 2014. Depending on the feedback, the very final versions may be ready during the year 2015, latest by December when the updated Water Management plans for 2015-2021 will be ratified.

Appendixes

1. Plan of Measures for improving the ecological status of Lake Harku (abstract from Estonian version)
2. Plan of Measures for improving the ecological status of Lake Viitna Pikkjärv (complete English version)
3. Plan of Measures for improving the ecological status of Lake Verevi (abstract from Estonian version)
4. Plan of Measures for improving the ecological status of Lake Veisjärv (abstract from Estonian version).

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