SUCCESS OR FAILURE OF RIVER RESTORATION PROJECTS

A multi-factorial analysis in the BSR

A study report under Project RETROUT for the Development, Promotion and Sustainable Management of the Baltic Sea Region as a Coastal Fishing Tourism Destination

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Lead Author:
Nandita Singh, Phd, Docent
Water Cente for Innovation, Campus Roslagen (UCV-CR)
Norrtälje, Sweden

Co-authors and Contributing Partners :
Didzis Ustups, Institute of Food Safety, Animal Health and Environment - BIOR, Riga, Latvia
Henri Jokinen, Baltic Marine Environment Protection Commission HELCOM, Helsinki, Finland
Håkan Häggström, Project Lead RETROUT, County Administrative Board in Stockholm, Sweden
Jakub Piotrowicz, Gdynia Maritime University, Gdansk, Poland
Kaspars Abersons, Institute of Food Safety, Animal Health and Environment - BIOR, Riga, Latvia
Marcin Kalinowski, Gdynia Maritime University, Gdansk, Poland
Martin Kesler, Estonian Marine Institute, University of Tartu, Tartu, Estonia
Nerijus Nika, Open Access Center for Marine Research, Klaipeda University, Klaipeda, Lithuania

Other Contributors:
Baltic Nature Fund, St. Petersburg, Russia
Ministry of Environment and Food, Government of Denmark, Copenhagen, Denmark
SKES, the society for the promotion of Finnish fishing tourism industry, Helsinki, Finland

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Cover photo

A restored stretch of Skeboån river in Häverödal, Norrtälje Municipality, Sweden

Photo credit: Skeboåns Sportfiske (URL: https://skeboanssportfiske.blogspot.com/p/fore-efter.html)

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INTRODUCTION

The coastal fishing tourism industry in the Baltic Sea Region (BSR) has been identified as a sector with great potential for growth and sustainable jobs. However, despite the economic potential, the industry fails to be fully exploited because of certain key challenges that currently limit its development. One of these is suboptimal conditions of habitats essential for migratory fish species which underpins this industry. Breeding and rearing habitats are among the most important ones for sustaining viable fish populations. As anadromous fish rely on running fresh water for completing their life cycle, the condition of rivers and streams are crucial for these fish and, on their part, key for maintaining viable fish stocks in the sea. This, in turn, constitutes the prerequisite for developing sustainable fisheries in the Baltic Sea. Among the common sport fish species in the Baltic Sea, sea trout (*Salmo trutta*) is one of the most desired. The anadromous sea trout stays for 1-6 years in running fresh water where it is born, until it migrates to the sea for foraging before again migrating back to the river for spawning (usually 2 years in the river and 4 years in the ocean).

In order to achieve sustainable sea trout populations, it is essential that their freshwater habitats are accessible and in good condition. River condition is assessed on the basis of the European Union (EU) Water Framework Directive (WFD), where 'good ecological status' is defined in terms of the quality of the biological community, the hydrological characteristics and the chemical characteristics (EEA, 2018). To achieve good ecological status of rivers and other freshwater bodies has been found to be a challenge in the EU and BSR, which poses obvious negative consequences for river-dependent fish stocks (Halleraker et al., 2016). River restoration has been put forward as a solution in such situations, and in the recent decades, several river restoration projects have been designed and implemented in the BSR. However, not many restoration projects are argued to have delivered goods sufficiently (Geist and Hawkins, 2016; Haase et al., 2013).

RETROUT is a flagship project supported under the EU INTERREG-Baltic Sea Program. The overarching goal of the project is to develop and promote sustainable coastal fishing tourism in the BSR. The project has partners from Estonia, Latvia, Lithuania, Poland, and Sweden, as well as HELCOM as an intergovernmental organization. One of the sub-projects under RETROUT addresses the challenge of improving the ecological status of river courses in the BSR, potentially leading to larger fish stocks which is a prerequisite for a growing fishing tourism industry. This sub-project aims to propose "Best Practice Solutions" for efficient and sustainable restoration measures for such rivers with a focus on the sea trout. These solutions are aimed to be disseminated through a number of demonstration projects and the "Baltic Toolbox on River Restoration", which will provide guidance to national and regional authorities on best practices and restoration solutions that enhance ecosystem health, are economically viable and efficient for production of fish stocks.

The above goal was addressed through a number of activities. One of these aimed to evaluate the implementation of river restoration measures (mainly habitat restoration and addressing migration barriers) in selected rivers, mainly in accordance with priority rivers identified by HELCOM as having the greatest potential to increase the production of sea trout and salmon[1]. In this context, stakeholder engagement and communication were seen as an important implementation tool in need of innovative approaches, the study and recommendations on which constitute an important aspect of this group of activities.

[1] As listed in HELCOM BSEP 126A and Recommendation 32-33/1.

Background

Setting the Context: River Restoration for Improving Aquatic Ecosystems

Rivers are running freshwater bodies that serve as important aquatic ecosystems, but are increasingly exposed to anthropogenic pressures, causing their degradation and deterioration. Important pathways include rampant hydro-morphological and physico-chemical quality changes in river courses (Lin et al., 2018). In Europe, the history of altering river courses and other surface water bodies is very old. Common examples include straightening and channelization, disconnection of flood plains, land reclamation, dams, weirs, and bank reinforcements to facilitate agriculture, produce energy or protect against flooding. Seen as beneficial to mankind, these activities have however caused serious damage to the morphology, hydrology and ecology of water bodies. If the morphology is degraded or the water flow is markedly changed, despite good water quality, a river or any other water body will not reach its full potential as an aquatic ecosystem (EEA, 2018).

Hydro-morphological elements support the biological elements. Fish are particularly susceptible to hydro-morphological pressures, particularly impacts such as interruptions in longitudinal continuity, riverbank constructions, large flow fluctuations and water abstraction. Resultant habitat alterations affect fish abundance and diversity. Especially, sea trout, salmon and many other fish species that migrate from the sea to river headwaters to spawn are dependent on accessible migration routes. Hence, lost river continuity often leads to changes in fish composition and abundance (EEA, 2018; Lin et al., 2018). Physico-chemical quality elements similarly support the biological quality elements. These generally comprise the following aspects: light and thermal conditions, oxygenation conditions, salinity, nutrient conditions, pollutants, and acidification condition. Fish are very sensitive to changes in these conditions, affecting their survival (EEA, 2018).

Hydro-morphological and physico-chemical changes in rivers and other freshwater bodies as well as other forms of degradation of aquatic ecosystems are a significant concern in the European Union and the BSR and policy frameworks have been developed to initiate appropriate action. Protecting and enhancing the status of aquatic ecosystems has been laid down as the primary objective under the EU Water Framework Directive (WFD) (2000/60/EC) which is the corner-stone of the region's water policy. Ecological status of surface water bodies is an important parameter through which achievement of this objective is to be assessed (European Commission, 2000). According to the framework, ecosystem health is expressed by biological quality elements — phytoplankton, macrophytes, phytobenthos, benthic invertebrate fauna and fish — supported by hydro-morphological and physico-chemical parameters: nutrients, oxygen condition, temperature, transparency, salinity and river basin-specific pollutants. The Directive specifies which elements are to be assessed for each water category and requires that biological and supporting quality elements achieve at least good status (European Commission, 2000; Carvalho et al., 2019).

Assessment of the ecological status of surface water bodies in the EU carried out within the scope of the WFD reveal that the picture is not very bright. As much as about 60% of these freshwater bodies fail to reach good ecological status (EEA, 2018). The situations specifically encountered in the RETROUT partner countries and in other EU member states of the BSR is summarized in Table 1.

For improving the hydro-morphological and physico-chemical quality changes in river courses — and consequently the biological quality elements as well — river restoration is an important tool. Restoration is conceptualized as the process of "reestablishment of the structure, functions, and natural diversity of an area that has been altered from its natural state" (Pess et al., 2003). It denotes an "intentional activity that initiates or accelerates the recovery of an ecosystem with respect to its health, integrity and sustainability" (SER, 2004). A primary goal of restoration is thus said to be re-

establishment of interactions among ecosystem components and environmental disturbances (SER, 2004). Seen in this light, river restoration should encompass measures for restoring the hydro-morphological and physico-chemical parameters that, in turn, have great potential to enhance the biological component in these aquatic ecosystems.

Table 1: The ecological status of rivers in the participating EU countries of the BSR according to the WFD

Country	**Rivers with 'Good' or 'High' ecological status (2018)**
Denmark	39.3%
Estonia	60.4%
Finland	64.7%
Latvia	20.7%
Lithuania	48.9%
Poland	30.7%
Sweden	31.8%

(Source: EEA, 2018)

The restoration of hydro-morphological conditions includes a variety of measures. Examples include removing obstacles and installing fish passes to ensure river continuity, improving physical habitats, restoring the natural water flow regime through setting of minimum flow and ecological flow requirements, and developing master or conservation plans for restoring the population of threatened fish species (EEA, 2018).

Apart from the EU WFD, the Baltic Sea Action Plan (BSAP) of the Helsinki Commission (HELCOM) is an important policy instrument that guides action towards enhancing the status of the Baltic Sea in part by promoting ecological restorations in the Baltic Sea Area. BSAP was adopted by all the coastal countries of the Baltic Sea and by the European Community in November 2007 (HELCOM, 2007). Under the biodiversity and nature conservation segment of the BSAP, there is commitment to the development of restoration plans (including restoration of spawning sites and migration routes) in suitable rivers to reinstate migratory fish species (HELCOM, 2007).

A wide range of restoration actions has been undertaken in the different EU countries in general and the BSR in particular since the operationalization of programs of measures under the EU WFD. Also, restoration projects aiming at improved river habitats have been undertaken under HELCOM BSAP and other sustainability frameworks, many starting even before the implementation of action under the EU WFD in 2000. This is revealed by previous studies as well as the data collected under this project.

River restoration: Theory and Practice

River restoration is a process guided by a theoretical body of knowledge rooted in the notion of ecological restoration. As a sub-type within this wider concept, it can be seen as representing "a solutions-based approach that engages communities, scientists, policymakers, and land managers to repair ecological damage and rebuild a healthier relationship between people and the rest of nature" (Gann et al., 2019).

According to the "International Principles and Standards for the Practice of Ecological Restoration" (the Standards) developed by the Society for Ecological Restoration (SER), eight principles essentially underpin ecological restoration. Principles 1 and 2 articulate important foundations that guide ecological restoration: effectively engaging a wide range of stakeholders, and fully utilizing available scientific, traditional, and local knowledge, respectively. Principles 3 and 4 summarize the central

approach to ecological restoration, by highlighting ecologically appropriate reference ecosystems as the target of restoration and clarifying the imperative for restoration activities to support ecosystem recovery processes. Principle 5 underscores the use of measurable indicators to assess progress toward restoration objectives. Principle 6 lays out the mandate for ecological restoration to seek the highest attainable recovery. Tools are provided to identify the levels of recovery aspired to and to track progress. Principle 7 highlights the importance of restoration at large spatial scales for cumulative gains. Finally, since ecological restoration is one of several approaches that address damage to ecosystems, Principle 8 clarifies its relationships to allied approaches on a "Restorative Continuum" (Gann et al., 2019).

The above principles are holistic, and their adoption can go a long way in supporting river restoration efforts. However, certain dimensions are additionally considered in relation to restoration of aquatic ecosystems in general and rivers in particular. These include, for example, considering aquatic restoration as a process comprising ecological aspects, technical feasibility and socioeconomic context (Pander and Geist, 2013). The ecological dimension can include the rehabilitation of the physical-structural properties (e.g., restoring connectivity), chemical properties (e.g., reduction of excessive amounts of contaminants), or focus directly on biodiversity itself (e.g., reintroduction of freshwater fish populations that have become extinct in a certain area usually as a result of overexploitation) (Geist and Hawkins, 2016). Technical feasibility is seen to include required skills, availability of standards guiding restoration, as well as the time needed for implementation. To this could also be added factors like choice of materials (where relevant), physical/hydro-morphological realities setting limits to what is possible to construct or modify, and accessibility to the restorable area/site by workers/machinery. Socio-economic factors include the cost and acceptance by stakeholder groups, feasibility, desired target states and chances of success (Geist and Hawkins, 2016).

More specifically, eight 'golden rules' of strategic river restoration have been defined (Speed et al., 2016). The first rule is to identify, understand and work with the catchment and riverine processes, understanding the physical, chemical and biological processes that drive river health. Second is to establish linkage to socio-economic values and integrate restoration with broader planning and development activities. Third is to restore ecosystem structure and function by working at the appropriate scale to address limiting factors to river health. Fourth is to set clear, achievable and measurable goals. Fifth is to build resilience to future change by considering likely changes in the landscape over time, including to the climate, land use, hydrology, pollutant loads and the river corridor. Sixth is to ensure the sustainability of restoration outcomes over the long term. Seventh is to involve all relevant stakeholders, involving interagency and community collaboration. Finally, the eighth rule is to monitor, evaluate, adapt and provide evidence of restoration outcomes, with the purpose of guiding adaptive management.

The theory, principles and rules of ecological restoration and river restoration represent an integrated conceptual framework against which effective river restoration practices can be designed and implemented. These are further reinforced through practical guidelines to support implementation of effective and efficient restoration. For example, according to one set of guidelines, a restoration action should start with a good restoration planning process. This, in turn, should have four distinct steps: (1) identifying the restoration goal, (2) selecting a project prioritization approach that is consistent with the goal, (3) using watershed assessments to identify restoration actions, and (4) prioritizing the list of actions. A well-crafted restoration goal should identify the biological objective of restoration, address underlying causes of habitat change, and recognize that social, economic, and land use objectives may constrain restoration options (Beechie et al., 2008).

However, despite the conceptual framework, practical guidelines, and massive capital investments, river restoration is claimed to have underachieved — with many restoration projects failing to deliver the anticipated hydrological, morphological, ecological, and societal benefits (Geist and Hawkins, 2016; Haase et al., 2013; Johnson et al., 2020). This may be a result of inadequate or faulty translation of the theory into practice or lack of integrated approaches. Here, it is important to note that notwithstanding the socio-economically rooted principles stated earlier, the ecological and technological aspects tend to get precedence in practice, that could lead to internal imbalance in the projects, ultimately impacting the project implementation and functioning. Furthermore, while river restoration is almost always organized in the 'project' mode[2], what is notably conspicuous by its absence is the 'project management approach' in the planning and implementation of the efforts, which has great potential to impart sustainability to restoration projects.

To reach restoration objectives that often (ultimately) are hydro-morphological or/and ecological, the techno-ecological type of solutions/aspects need to be well implemented and functioning, otherwise the goal cannot be reached. But on the project's process level, a firm anchoring to relevant socio-economic factors is often crucial to be able to carry out the project, i.e., to get to the point where practical implementation of the restoration work can start, and to resource-wise be able to implement all those techno-ecological solutions that are optimally needed. Perhaps it can be seen as a two-level thing or a subsequent process: first the socio-economic acceptance, support and prerequisites need to be in place, then the right, optimally needed ecological and technical solutions can be implemented. Thus, it can be said that socio-economic aspects are important, but even if the socio-economic aspects are in place, but the techno-ecological implementation is poor, even then the restoration could still fail.

In this light, the body of knowledge connecting project management with sustainability is relevant. The notion of sustainability derives from the concept of sustainable development and usually seen as referring to the different approaches and connections that project management can have with environmental, social, and economic dimensions and problems (Whiteman et al., 2013; Sabini et al., 2019). This perspective is important because river restoration projects by their basic nature are 'temporary' in duration, while their purpose of restoring hydro-morphological, physico-chemical quality and biological elements in running freshwater is aligned to sustainable development, with an inherent focus on long-term horizon. Further, being temporary projects, they need to be capable of planning, designing, and organizing the activities most efficiently and effectively in terms of resources, manpower, skills, techniques and other necessary inputs.

Delivering 'success' in river restorations in a long-term perspective thus relates to two significant inter-connected dimensions, namely, 'sustainability *by* the project' and 'sustainability *of* the project'. The former implies that the project delivers a sustainable good or service while the latter implies that the project is delivered following sustainable processes (Huemann and Silvius, 2017). The intersection between project management and sustainability is conceptualized as 'sustainable project management', further defined as "the planning, monitoring and controlling of project delivery and support processes, with consideration of the environmental, economical and social aspects of the life-cycle of the project's resources, processes, deliverables and effects, aimed at realizing benefits for

[2] A project can be conceptualized as 'a series of actions aligned according to a specific goal' or as 'a concrete and organized effort that leads to the realization of a unique and innovative deliverable'. Projects have an intrinsic time element — with a beginning and an end, which can sometimes serve as a new bedrock for a new project. It involves a plan, some processes, people and a line of authority or leadership (Mesly, 2016).

stakeholders, and performed in a transparent, fair and ethical way that includes proactive stakeholder participation" (Silvius and Schipper, 2014, p. 79).

Based on the above literature, the following sustainability dimensions of project management processes and practices could be considered as important for river restoration projects: context of the project that integrates ecological, economic and social aspects, identification of stakeholders, project specifications/quality criteria, costs/benefits, criteria for measuring project success, selection and organization of the project team, project activities/sequencing and schedule, availability of financial and other resources, risk identification and management, stakeholder involvement, and project communication (Silvius and Schipper, 2014; Sabini et al., 2019).

Literature indicates that sustainability dimensions such as noted above are not widely followed in river restoration practice. A study based on feedbacks from local water managers showed that often restoration measures are prioritized, in part, based on limited finances from annual budgets and expert judgement on what may be the most cost-effective solution, or the less conflicting towards other sectors of activity. Also, water managers sometimes favor simple measures leading to quick improvements in order to demonstrate progress, but more complex situations where multiple stressors act on a larger scale, and where multiple stakeholders need to be involved, tend to be avoided (Kuijper et al., 2017).

At the core of the concept of sustainable project management, integrating the perspectives of a broad group of stakeholders, in turn leading to co-creation of project benefits with them is repeatedly highlighted (Sabini et al., 2019). A stakeholder is defined as an actor who under certain circumstances has interest for the matter, has influence on a problem, and has positive or negative impact by policy decision and its enforcement (Tanaka, 2006; Varvasovszky and Brugha, 2000). The role of stakeholders is considered important at various stages, including planning, implementation and post-project maintenance (Carr, 2015; Druschke and Hychka, 2015; Reilly and Adamowski, 2016). Consequently, stakeholder analysis can be helpful for understanding differences and commonalities of interests between stakeholders, and for proposing practical mediation for more effective outcomes (Tanaka, 2006).

With respect to river basin management in general and river restoration in particular, it is argued that stakeholder participation helps enhance through the following mechanisms: (1) providing space for deliberation and consensus building for better quality decisions, (2) mobilizing and developing human and social capital for better quality decisions and their implementation, and (3) raising the legitimacy of decisions to facilitate their implementation (Carr, 2015). Further, it is also contended that appreciation and integration of local communities and their local ecological knowledge can greatly enhance progress in addressing challenges to river restoration (Szałkiewicz et al., 2020). In relation to ecological restoration, one study advises managers to consider their desired social-ecological outcomes and work from the outset to deliberately design mechanisms for communication and public engagement that weave community stakeholders into all phases of restoration projects in sustained and consequential ways (Druschke and Hychka, 2015). Considering the importance of stakeholder participation in river restoration, best practices guidance on how to ensure that citizens and other stakeholders are fully engaged in urban river restoration projects have been prepared. One such detailed guidance document is the one prepared under "Urban River Basin Enhancement Methods" (URBEM) project, an EU 5th Framework Project (URBEM, 2005).

Further, river restoration projects can be essentially seen as causing change in the appearance as well as the social, ecological and economic function of a public environment. Since the river can represent (1) a "physical place"; (2) a "social and cultural locus" and (3) a "symbol for the total environment",

this can lead to conflicts related to values, stakeholder relations and coordination, and opposing interests with regard to e.g., flood protection, leisure usage, policy and economy. Thus, the planning and implementation of river restoration projects has to live up to expectations of multiple stakeholders, and hence an inclusive approach involving different interest groups and individuals is important (Heldt et al., 2016).

Evaluation of River Restoration Projects: Need and Status

In light of the theory and practice that can guide efficient, effective and sustainable river restoration projects, it is important to evaluate their status, processes, outcomes and impacts. From process perspective, an evaluation can help in detecting flaws such as in project design or implementation, and while from outcome/impact perspective, an important concern can be to assess if the ecological objective was reached or not. In case of shortcomings, evaluation can enable additional actions required if the objectives are not achieved (Bash and Ryan, 2002; Woolsey et al., 2007). Lessons learnt from both restoration failures and successes are valuable in order to identify any barriers that may require corrective action or positive actions that may be replicated in future projects. In fact, project evaluation can help offer important food for thought for future projects in the same or different rivers. This is desirable for sustainable development in general or water sustainability in particular, as well as for assessing the progress towards reaching the specific policy goals, such as that of the EU WFD or the HELCOM BSAP.

Despite the importance, evaluation and feedback on outcomes of river restoration projects appear to be seldom performed (Morandi et al., 2014). Several reasons are commonly advanced such as insufficient funding, time constraints and labor shortage (Bash and Ryan, 2002; Woolsey et al., 2007). Lack of evaluation guidelines and failure to set clearly defined project objectives at the outset are additional reasons (Woolsey et al., 2007).

Examples of surveys of river restoration projects aiming at sharing experience about evaluation of restoration are few, with examples including those from the European Centre for River Restoration (http://www.ecrr.org/); the National River Restoration Science Synthesis in the USA (Bernhardt et al., 2007), and the Asian River Restoration Network (http://www.a-rr.net/). In France, Onema, the French National Agency for Water and Aquatic Environments has developed a database documenting the realization of actions for river restoration and published a number of documents, including guidebooks on the subject, including one on assessing the passage of obstacles by fish (Baudoin et al., 2014).

A few comprehensive studies have been carried out to understand and analyze the success and failures of river restoration projects within EU and other regional contexts. One such study was based on evaluation of success in 44 French pilot projects. The study emphasized the importance of a good evaluation strategy based on clearly defined objectives so as to effectively assess the success or failure of a restoration project. It found that the quality of an evaluation strategy often remains too poor to understand well the link between a restoration project and ecological changes and that in many cases, the conclusions drawn are contradictory, making it difficult to determine the project's success or failure (Morandi et al., 2014).

A baseline question underlying the evaluation of a river restoration project as 'success' (or 'failure') is the criteria for making any such judgement. These criteria should be seen as closely connected to sustainability criteria along the 3 axes — ecological, social and economic. Depending on the original purpose underlying the restoration activity, which could be ecological (e.g., restoring fish populations) or socio-economic (e.g., promoting tourism), the criteria could be laid down. Also, the project processes and impacts can be seen as inter-connected in a cause-and-effect relationship, and

accordingly evaluated. The existing evaluation frameworks concerning restoration projects fail to make clear presentation along these different yet comprehensive lines.

Combining different criteria along the 3 sustainability axes, the key questions concerning restoration projects could be: Did the restoration effort help in reaching the ecological goal(s)? Were the stakeholders involved in the process of designing and implementing the project? Are they satisfied with the outcome? Was the project accomplished cost-effectively? Was the final product aesthetically pleasing? Did the project protect important infrastructure near the river? Did the project result in increased recreational opportunities and community education about rivers? (Morandi et al., 2014; Palmer et al., 2005). While some of these questions relate to the overall project goal — essentially ecological, others like those connected to stakeholders' interest and their participation are more connected to the project processes.

Notwithstanding such limitations as noted above, several different kinds of frameworks, guidelines and standards for evaluating the success or failure of river restoration projects have been suggested over the years. Among detailed guidelines is the one developed by Woolsey et al. (2005, 2007), which is based on a total of 49 indicators and 13 specific objectives elaborated for the restoration of low- to mid-order rivers in Switzerland. Most of these objectives concern ecological goals, but some socio-economic aspects are also included. There is need to develop more comprehensive evaluation frameworks that can holistically assess the success or failure of river restoration projects by linking them with the notion of sustainability and considering criteria along all the three axes of sustainability.

Aim and Objectives

As stated at the outset, the overall aim of the study reported here was to undertake an evaluation of implementation of river restoration measures (mainly habitat restoration and addressing migration barriers) in selected rivers in the BSR. While there has been a substantial attention to the question of 'what' in river restoration efforts, the question of 'how' to carry out restoration sustainably so that expected results are obtained and retained over a longer term seems to be little investigated. Considering this knowledge gap, this study focused mainly on the 'how' question, by laying down two specific but inter-connected objectives. First, to understand the differences between successful and failed/non-realized projects and identify the underlying factors. Second, to synthesize recommendations for best practices across the BSR, with a view to strengthen river restoration efforts supporting sea trout and other migratory fish species. This is also important because healthy and viable migratory fish stocks to their part underpins the coastal fishing tourism industry. This report aims to present the key findings of the study.

Conceptual Framework

An in-depth literature review was conducted in the project to explore the theory and practice of river restoration in the international, European and BSR contexts. A synopsis of the major findings of the review were presented in the preceding section on the theory and practice of river restoration. On the basis of the findings of the review, the following hypothesis was drawn for this study:

1. There exists deep interconnection between the criterion of 'success' of a river restoration effort and sustainable management of the restoration project
2. Sustainable project management, in turn, encompasses the parameters of 'sustainability *by* the project' as well as 'sustainability *of* the project'
3. Sustainability *by* the project would primarily refer to the ecological impact (such as restoration of habitats, environmental flow or fish populations) but desired social impacts (such as community benefit from greater access to recreational space or protection of a culturally or

naturally significant site) and economic benefits (such as increased property values due to the increasing demand for more natural surroundings) are also important

4. Sustainability *of* the project encompasses the resources available, and processes adopted for planning, designing, implementation, and monitoring adopted for carrying out the project and undertaking the journey to reach the desired goals – could be seen as comprising aspects like the human capital (team capacities, coordination, leadership, etc.), financial resources, and the governance structures in place
5. Both the above dimensions of sustainability of a river restoration project are rooted in the 'context' which may encompass the environmental/ecological, historical, political, economic and/or socio-cultural dimensions that directly or indirectly act as 'drivers' of the project
6. For ensuring sustainability *by* as well as *of* a river restoration project, stakeholder engagement is a key priority, and their involvement at different stages from the beginning till the end cannot be overlooked
7. Evaluation of a river restoration project as 'success' or 'failure' and identification of any underlying factors must be based on a holistic assessment of all the different aspects or criteria mentioned above

Based on this working hypothesis, the literature review, and previous knowledge of the lead author and the project team, a conceptual framework was developed which was used for comparative qualitative assessment of the river restoration case studies selected for the study. This framework is presented in Table 2.

Methodology

This study is based on a qualitative analysis of data collected from river restoration projects planned and/or implemented in the BSR. Considering that the evaluation involves a comparison of different restoration projects, considered from perspectives of policy and practice, the 'comparative case study approach' was adopted as the basic methodology. Thus, each river restoration project was regarded as an independent case study, and these were compared to reach the goals of the study.

Methodological framework: Comparative case study approach

As case studies, the river restoration projects were empirically examined 'context-specific' events, considering their contextual conditions (Yin, 2014; Miles and Huberman, 1994, Barlett and Vavrus, 2017). Also, diverse criteria, such as ecological conditions, policy background, social and cultural factors were considered (Poulis, 2013). Further, case studies also often involve 'social actors', different kinds of actors responsible for planning, designing and implementing the projects at different levels and within different kinds of institutions, such as government, municipality, non-governmental organizations (NGOs), etc. were included. Further, another set of social actors — the stakeholders who are impacted or can impact the project processes and outcomes in diverse ways – were included.

The comparative case study approach as a heuristic — a method that aids in the process of discovery or problem-solving – helped looking at river restoration projects from the 'process' perspective. Thus, interactions between people, situations, events, and the processes that connect these were explored (Barlett and Vavrus, 2017). Further, the comparison cut across three axes: a 'horizontal' look that helped contrast one case with another and trace influences across these cases; a 'vertical' comparison of influences at different levels (for example, from the international to the national to regional and local scales); and a 'transversal' comparison over time (Barlett and Vavrus, 2017).

Table 2: Conceptual framework for comparative analysis of river restoration case studies

Nature of factor	Dimension	Suggestive criteria
Context-based	Ecological	Nature of ecological challenge(s) and the spatial scale
		Location of the proposed restoration
		Temporal and spatial scale of the proposed restoration
	Political	Relevant policy and legal frameworks at local, national and/or regional scale
		Political support vis-à-vis the proposed restoration
		Political scale involved — local, national, international
	Economic	Economic interests hampered or supported by the proposed restoration
		Financial resources available to support the restoration
	Social and cultural	Stakeholders and their interests around the proposed project
		Cultural/historical values connected to the proposed restoration site
Process-based	Technical	Selection of the restoration measure
		Technical designing
		Implementation, operation and maintenance of technology
	Project processes	Preparatory work — e.g., based on hydrological, environmental or other scientific assessment
		Nature of the plan — e.g., long/short term, site-specific or watershed-based, specific or multiple goals; also planning process adopted
		Post-implementation phases included in the project — monitoring and evaluation
	Social	Project team/actors — composition, roles, skills, personal attributes, leadership, coordination, etc.
		Decision-making process
		Stakeholder management and engagement
		Institutional factors
		Project communication within team and with stakeholders
	Financial planning and resources	Allocation of funds for every project phase

Data collection and analyses

For this study data on past river restoration project was used. The data explicitly concerned potential sea trout rivers flowing to the Baltic Sea and included two kinds of river restoration projects, namely:

1. 'Completed' projects that were planned and implemented in the past
2. 'Non-realized' projects that were planned but failed to be executed or completed

Data collection was organized in two successive rounds. In Round 1, data based on secondary sources was requested to be compiled in a comprehensive survey template that was circulated to the five RETROUT partner countries, namely, Estonia, Latvia, Lithuania, Poland and Sweden and also other HELCOM contracting parties, notably, Denmark, Finland, Germany and Russia. Of these, input was received from all the RETROUT partners as well as Denmark and Russia. All participants were requested to include in the survey as many river restoration projects as possible.

In order to identify success factors and synthesize gained lessons and experiences from completed and non-realized river restoration projects in the BSR, the evaluation framework proposed by Woolsey et al. (2005, 2007) was taken as a starting point. A detailed survey template was developed using the indicators and objectives considered there. The framework was suitably modified in order to reflect the specific needs of project RETROUT. The completed projects were further asked to be classified as 'success' or 'failure' primarily on the basis of fulfilment of the restoration project's primary goals. A third category of 'partial success' was included for completed projects to indicate cases that failed to fully attain the restoration objectives. The templates used in the project for the completed and the planned but non-realized projects are provided in Annexures 1 and 2 respectively.

In Round 2, out of the larger survey-based data sets, a 'purposeful' (or 'purposive') sampling of 2-3 restoration projects per country was carried out. The purpose was to identify and select information-rich cases for in-depth exploration (Patton, 2002). In this study, a 'stratified' purposeful sample was drawn in order to capture the diversity across river restoration projects rather than to identify a common core (Palinkas et al., 2015). The following criteria were primarily applied in the stratified purposeful sampling process:

i. A wide array of restoration activities
ii. Examples from all the above stated project categories
iii. Long as well as short term solutions
iv. Cases including different spatial scales, ranging from longer to shorter river stretches

In this round, all the RETROUT partner participated. Russia continued its participation while data from Finland was directly procured in this round. For data collection in this round, an interview guide was prepared that contained questions addressed to three kinds of stakeholders in the selected restoration projects:

1. The implementing agency
2. A stakeholder that supported the project and finally drew benefits from it
3. A stakeholder that opposed the project and was negatively affected by it

A total of 38 interviews were conducted in the different countries. In case of Russia, written answers to the interview guide were procured from the implementing agency. The interview guide used in Round 2 is provided in Annexure 3. The data procured was subject to qualitative analysis for drawing results related primarily to the following dimensions:

a. Background /context of the restoration project
b. Overall aim, and temporal and spatial scale of the project
c. Evaluation of the project as a success or failure
d. Role of stakeholders external to the implementing agency
e. Problems encountered in implementing the restoration project/activities
f. Lessons learned
g. Factors behind success or failure of the project

The data sets procured from the case studies were analyzed using 'grounded theory' (Strauss and Corbin, 1994), where the repeated elements emerging from the above dimensions were separated, subsequently grouped under data categories emerging from the conceptual framework presented earlier. A comparative case study analysis was then carried out for drawing conclusions. Though data from the first round was not explicitly analyzed in this phase, supporting data was drawn from that dataset where relevant.

The study was carried out jointly by the project team from the different partner countries. The lead in designing and executing the study was taken by UCV-CR, Sweden, supported closely by the Work package 4 leader HELCOM. Data collection was coordinated by specific partners in each participating country, namely, the University of Tartu in Estonia, HELCOM in Finland, BIOR in Latvia, Klaipeda University in Lithuania, Gdynia Maritime University in Gdansk, Poland, and County Administrative Board (CAB) of Stockholm and UCV-CR in Sweden. Data from other HELCOM countries was contributed by the Ministry of Environment and Food, Government of Denmark and Baltic Nature Fund in Russia. Finally, the collected data was systematically analyzed applying the conceptual framework presented earlier to draw the conclusions of the study by UCV-CR, Sweden.

Limitations of this Study

This study presents some limitations. First, a large number of river restoration projects have been implemented in the RETROUT and HELCOM partner countries in the recent decades, but the old data regarding the project implementation have not been systematically preserved. As a result, it was not possible to include all the river restoration projects implemented in each partner country in the study. Also, it did not become possible to maintain a general parity in terms of the number of cases examined from each country. Second, the implementation of these projects has been undertaken by diverse agencies because of which unified datasets at country-level are missing in some cases. Thus, acquiring relevant implementation data presented problems. Third, outcomes of the projects completed in the past have been poorly monitored in many cases, which made access to data regarding project impact difficult. Finally, since records of old (and even sometimes new) river restoration projects are just not available, detailed data on specific case studies was difficult to trace in some instances. Had it not been for the above limitations, the process of this evaluation study could have been much easier and the outcomes more comprehensive.

RESULTS

Findings from the survey in Round 1

In this study, data pertaining to a total of 96 river restoration projects located in 75 rivers in the project partner countries and some additional HELCOM countries were collected in the survey undertaken in the Round 1. The country-wise distribution of these restoration projects and the rivers is presented in Figures 1 and 2. On the whole, the projects were divided into two categories: 'completed' and 'non-realized'. The completed projects imply those that were implemented and completed at any point of time in the past while the non-realized referred to those that were planned but never came to be implemented or completed.

Figure 1: Distribution of all river restoration projects surveyed in Round 1

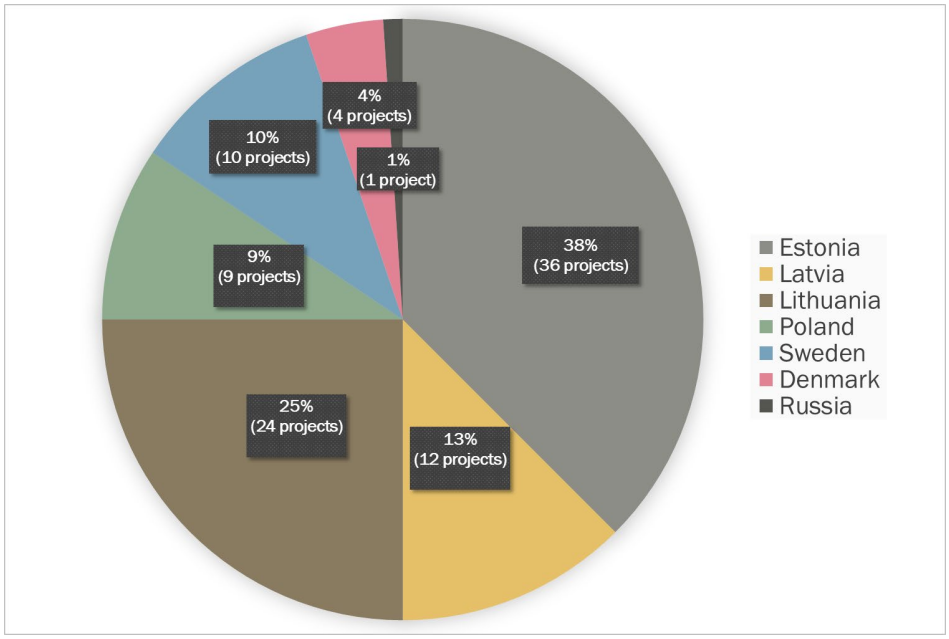
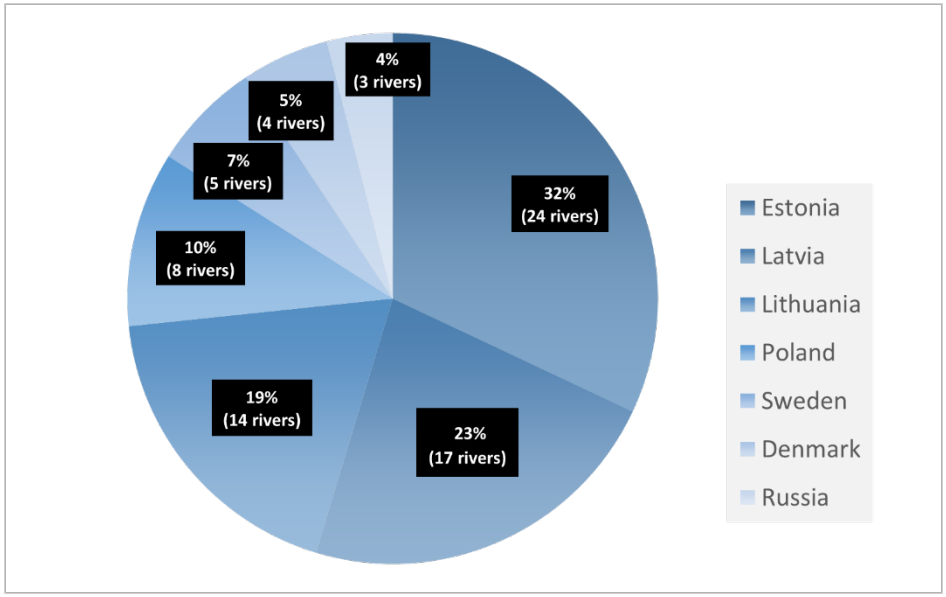


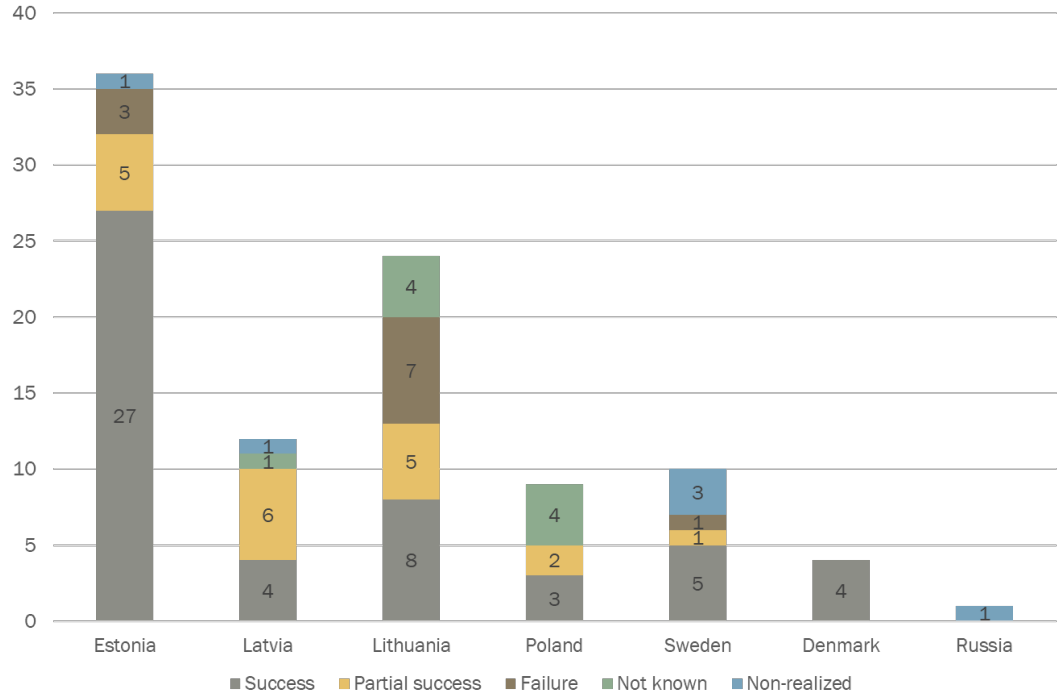
Figure 2: Distribution of rivers included in the study in Round 1



As noted, the completed projects were further classified as 'success', 'failure' and 'partial success'. Of all the river restoration projects included in the study, an overwhelming majority of 90 were

'completed' while only 6 were 'non-realized'. A good majority of the completed projects were classified as 'success' (51/90), while 19 were classified as 'partial success, and 11 as 'failure'. The status of 9 projects could not be determined based on the available data and were classified under the label 'not known'. The country-wise distribution of river restoration projects in terms of their status is presented in Figure 3.

Figure 3: Distribution of river restoration projects surveyed in Round 1 in terms of their status



The data collected from the different countries shows that the major kinds of restoration measures carried out in the various projects were as follows: removal of migration obstacles, construction of fish pass, river habitat improvement, facilitating fish transport, improved fishing rules, and stocking. In some cases, a combination of these restoration measures was observed. Each of these categories of restoration measures can be further sub-classified as shown in Table 3.

With regard to the classification of restoration measures, however, three important points must be noted. First, 'removal of wood debris' as a river restoration measure is debated (Roni et al. 2015). In some places as in Latvia, fishing NGOs consider removal of dead wood from rivers as a restoration measure, whereas according to best available science, adding dead wood is a good restoration measure. This is because logs, branches, twigs and leaves increase structural diversity in the river and benefit invertebrates (=food for fish), which also increase biological diversity. Thus, it can be argued that those studies should be regarded as failures, even though the original purpose was fulfilled, since the river environment has deteriorated as result of the "restoration". The failure is then due to lack of knowledge. Similar reflections exist on "removal of vegetation" as a restoration measure, though there could be special cases, e.g., removal of invasive species.

The second observation regards 'beaver dam removal' as a restoration measure. Instead of removing beaver dams, a good number of restoration practitioners are said to be using beaver to accomplish stream, wetland, and floodplain restoration by constructing dams that impound water (Pollock et al., 2015). A comparative study on the positive and negative impacts of beaver dams on fish populations (Kemp et al., 2012) found that while many of the positive effects cited (51.5%) were supported by data, many more of the negative impacts (71.4%) were speculative and not supported by data

collected in the field. Furthermore, the most commonly cited negative impact of beaver dams — as barriers to fish movement — was highly speculative, as 78.4% percent of the studies did not support this claim with data. Beaver ponds are said to serve as important rearing grounds for juvenile salmonids and serve as good overwintering grounds for fish (Kemp et al., 2012).

Table 3: Classification of restoration activities carried out in the studied projects

S. No.	Main category	Sub-category
1.	Removal of migration obstacles	Dam removal
		Reconstructing culvert
		Removal of beaver dam
		Removal of culvert
		Removal of other man-made obstacles
		Removal of vegetation
		Removal of wood debris
2.	Fish pass	Nature-like fish pass
		Technical fish pass
		Fish lift
3.	River habitat improvement	Changing hydrology
		Improving water quality
		River habitat restoration, including spawning grounds
		Wetland
		Afforestation
4.	Fish transport	Fish transport
5.	Fishing rules	Fishing rules
6.	Stocking	Stocking

The third point regards 'stocking' as a restoration measure which again is debated (Uusi-Heikkilä 2018). Sea trout return to the same river where they were hatched, and thus each river has a trout population that is adapted to that particular river. By stocking, this advantage is weakened since the original population gets genetically contaminated by the imported stock. In addition, survival of stocked trout is much lower than of wild trout.

Regarding overall aim of the restoration projects studied, the following were prominent: Improvement of fish populations by facilitating upstream and downstream migrations for improved natural reproduction, restoration of other biological diversity, enhancing recreational value, revival of cultural heritage, and other kinds of stakeholder interests. The temporal scale of the restoration activities varied between short (up to one year) and long-term (more than one year), while their spatial scale ranged between short stretch to entire river or large part of the catchment. The various agencies responsible for designing and implementing the restoration projects included local authorities, regional authorities, national authorities, non-governmental organizations (NGOs), citizens and the private sector. The financial expenditure for these projects ranged from as low as < €30 000 to as high as > €5 000 000.

An important column in the survey template was the 'lessons learned'. In Estonia, good fishway design was highlighted as an important factor for achieving project goals. In Poland, adoption of a comprehensive project approach was reported as playing an important role in creating sustainable fish populations in the area. In Latvia, importance of monitoring of results and the necessity of more careful targeting of actions were highlighted as important factors. From Lithuania, important factors

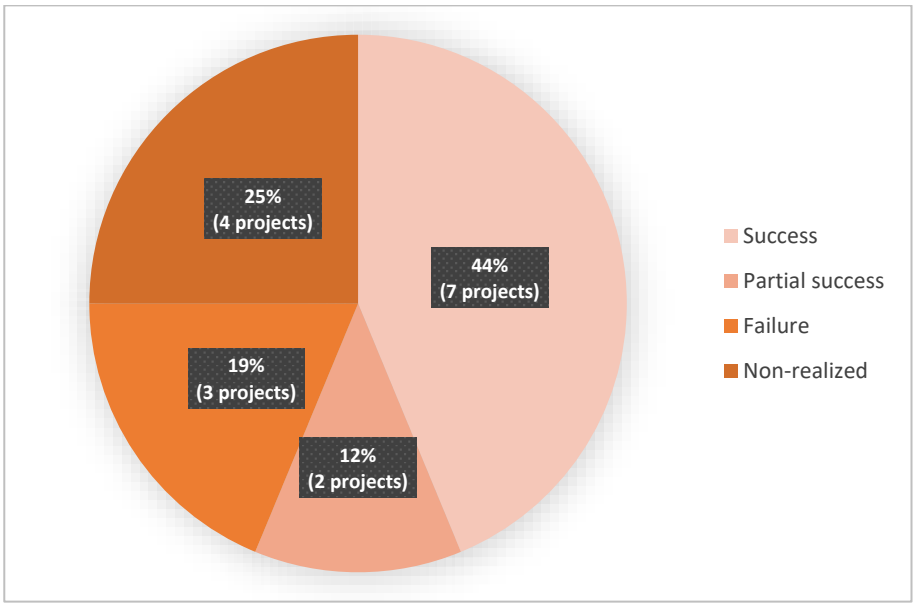
noted as thwarting achievement of restoration goals were complicated conflicts of interests among stakeholders and resultant difficulty in stakeholder acceptance especially in situations with multiple interests. Also, wrong technical design and implementation were seen as hindrances. From Sweden, two important lessons emerged. First, that maintenance of water quality is important for achieving the restoration goal of improved fish stock, which can be achieved through setting up nature reserves along watercourses. Second, simple measures that maximize positive effects on the river nature but minimize negative effects on stakeholders should be preferred. In general, stakeholder acceptance appears to have played a positive role in achievement of the restoration goal in a number of projects.

Findings from detailed case studies in Round 2

Based on the findings in round 1, a smaller stratified purposeful sample of 15 river restoration projects was selected for detailed interview-based case studies in Round 2. Apart from including projects from all the four basic categories, namely, 'success', 'failure', 'partial success' and 'non-realized', attempt was made to have representation of a wide variety of restoration activities, long as well as short-term solutions, and involving shorter as well as longer stretches of the river. Of the 15 selected cases, 6 were success, 2 were partial success, 3 were failure, and 4 were non-realized. In addition, one restoration project was directly added in this round from Finland, increasing the total number of detailed case studies to 16 and the total number of river restoration projects studied to 97. This was classified as a 'success' case by the project team. An overview of the river restoration projects included in Round 2 by 'type' is presented below in Figure 4.

First, a country-wise analysis of the case studies was conducted to identify the most important factors contributing to success or failure of the projects or affecting their implementation. While in case of the 'success' projects, the factors contributing to success of the project were primarily analyzed, in case of the 'failure' and 'non-realized' projects, factors leading to failure were of primary concern. In case of those classified as 'partial success, the factors contributing to success as well as failure of the project were analyzed. Thereafter, the data were compared across countries using the conceptual framework to compile the most important factors. In the rest of this section, the country-wise findings are summarized.

Figure 4: Overview of the types of detailed case studies in Round 2



ESTONIA

In Estonia, three different restoration projects were investigated in detail. The findings from these case studies are summarized in Table 4. The first of these was a project in river Pada. With the aim to allow upstream and downstream migrations of sea trout, the restoration comprised replacement of an old mill dam with a nature-like fishway in the original riverbed. In addition, new spawning grounds were established. It was a long-term project targeted to a great part of the river catchment. The project was rated as a success in terms of restoring the abundance and diversity of sea trout and other fauna, and also had high acceptance by stakeholders. Interviews with the implementing agency and other stakeholders showed that a number of factors within the implementation process probably led the way to the success. These included absence of conflicting stakeholder interests, a positive legal/policy framework following Natura 2000 regulations that made fish passage in rivers compulsory, good technical design and its effective implementation, good stakeholder communication, and support from key actors primarily at the Environmental Board (national level) and the local municipality. Also, adequate funds were available to support the project.

Table 4: Factors contributing to success, failure or non-realization of restoration project in Estonia

No.	River	Outcome	Restoration activity	Factors contributing to the outcome
1	Pada	Success	Dam removal, construction of nature-like fish pass, and river habitat improvement through new spawning grounds	• No conflicting stakeholder interests • Change in law, following Natura 2000 regulations, that made fish passage in rivers compulsory • A good technical design, also effectively implemented • Adequacy of funds • Good stakeholder communication • Support from Environmental Board (national level) and local municipality
2	Kunda	Failure	Construction of fish lift at dam	• Poor quality technical solution • Confinement to a particular river stretch, without consideration of obstacles downstream which ultimately obstructed fish migration • Lack of assessment of purposefulness of the project by Environmental Board
3	Narva	Non-realized	Changing hydrology and river habitat restoration (spawning ground)	• Political - Estonia accepted the project, but Russia asking for further studies and data • Lack of coordination between key stakeholders

On the contrary the restoration project implemented in river Kunda became a failure. This project comprised the construction of a fish lift over a dam. This was a poor technical solution with no evidence of ever working. Also, represented a limited vision with confinement in just one isolated river stretch, while there also existed obstacles downstream which were not considered. The latter could have continued to prevent fish migration even if the lift was better designed and working, preventing achievement of the project goal. A planned restoration project in the transboundary river Narva became non-realized because of political reasons characterized by lack of consensus and coordination between the key actors based in Estonia and Russia.

FINLAND

From Finland, an outstanding example of success through a local voluntary restoration effort was recorded. This project in the form of ongoing restoration activities was implemented on Longinoja, a tributary of Vantaa River that flows past Helsinki. This brook has been renovated since 2001 by the Finnish Fishing Tourism Promotion Association *Taimentiimi* and the Stream Water Management Association. The restoration activities began with the aim of enabling the natural reproduction of trout by establishing lost breeding and rearing habitats in different areas along the brook. The ongoing efforts continue to produce results even after 19 years. The project was deemed successful, as the living conditions for the sea trout along with a more natural state of the brook was restored. Also, the recreational value of the brook area has been improved as a side product of the spawning site restorations.

According to the interview with Juha Salonen, the leader of this voluntary restoration effort, some of the significant factors contributing to the positive results include consistency of effort and interest, good leadership with genuine passion, effective communication with local stakeholders that created trust and turned the restoration work a collective responsibility for the community, adequacy of resources in cash and kind, and appropriate knowledge and experimental temperament. The findings from this case study are summarized in Table 5.

Table 5: Factors contributing to success of restoration project in Finland

No.	River	Outcome	Restoration activity	Factors contributing to the outcome
1	Longinoja urban brook	Success	Dam removal, river habitat improve-ment (spawning sites and stony nursery areas for parr), readjusting culvert areas	• Consistency of effort and interest since the start in 2001, restoring new areas or improving old ones every autumn • Good leadership with genuine passion for the work • Effective communication with local stakeholders, leading to creation of inspiration and trust, making the restoration work a collective responsibility for the community • Adequacy of resources in cash and kind due to growing voluntary contributions • Appropriate knowledge as well as continuous observation and experimental temperament on a long-term basis

LATVIA

In Latvia, 3 case studies were examined in detail under 3 categories: one success, one partial success and one non-realized. The restoration project in Norina involved removal of migration obstacles, and according to the implementing agency and stakeholders, the major factors contributing to its success were: stakeholder consensus, agreement with landowner, good planning, adequate funds, dedicated implementation team with previous experience. However, another project on river Rakupe which principally involved river habitat restoration and improvement, particularly spawning ground, was found to be partial success despite presence of the above factors in general. It was said to be a success in terms of use of the created spawning ground, as spawning of lampreys and salmonids was observed. However, absence of systematic monitoring or survey of fish populations thwarted a real assessment of the project outcome, leading to it being considered as ‘partial success’.

In the third project on river Salaca, the restoration activity was removal of former dam remains, but it failed to be realized. Among the factors responsible for the situation were: opposition from landowner along with legal hurdle in transferring the land rights for implementing the project, conflict of stakeholder interests (economic versus nature conservation), and ineffective communication among stakeholders. An overview of the factors leading to the different outcomes in the 3 different river restoration case studies in Latvia are presented in Table 6.

Table 6: Factors contributing to success, failure or non-realization of restoration projects in Latvia

No.	River	Outcome	Restoration activity	Factors contributing to the outcome
1	Norina	Success	Dam removal, removal of beaver dams, removal of wood debris	Success factors: • Stakeholder consensus • Agreement with the landowner • Good and precise planning • Adequacy of funds • Dedicated sizeable implementation team with high motivation for nature protection • Previous related experience of the project implementers Factor thwarting success: Though this case was classified as 'success' because the project goals were met, considering the correctness of the measure itself (refer page 14-15), the project could be (re-)classified as failure, lack of correct knowledge being the underlying factor.
2	Rakupe	Partial success	River habitat restoration and improvement (spawning ground)	Success factors: • Relevant knowledge and expertise at planning and implementation stages • Longer project period • Adequacy of funds • Multi-stakeholder effort with involvement of experts, municipality, environmental groups, anglers and citizens • Willingness and diligence of involved actors to improve the river condition Factors thwarting success: • Absence of systematic monitoring/survey of fish populations to assess the project outcome
3	Salaca	Non-realized	Removal of former dam remains	• Opposition from landowner • Lack of support from key stakeholders such as municipality • Legal - inability to transfer the land rights for implementing the project • Conflict of stakeholder interests, largely economic versus nature conservation • Ineffective communication regarding river importance for salmonids and the benefits of restoration

LITHUANIA

From Lithuania, 3 cases were examined in-depth. The first one was a success case in river Viešvilė that concerned the construction of a fish pass at a dam to re-establish fish migration to upper reaches. This fish pass was regarded as successful because the density of spawning nests has been found to be constantly high for several years after the restoration. Also, different stakeholders accepted the project very positively and the fish pass is believed to have become the symbol of Viešvilė town where the site is located. However, further improvement of spawning areas is seen as a necessity for improving fish populations. Factors contributing to success here include a good technical design, stakeholder consensus and support, effective management of resistance from local community through efficient communication, and absence of legal complications such as landownership (all rivers in Lithuania are State-owned) which simplified procedures.

The second case was about a failed technical fish pass built at a hydro-power dam in river Venta, which is one of the biggest river systems in the country, with the river starting in Lithuania, and entering the Baltic Sea in Latvia. Venta is seen as the river basin that is most severely affected by the hydropower industry. The restoration project here is regarded as a failure because the construction is faulty and normally enough water (sanitary discharge) in the fish pass is not ensured, because of which fish can hardly enter the fish pass. Moreover, the fish pass has sluice gates, and the entrance is opened only during migration periods. The dam operates in hydropeaking mode[3], accumulating water above the dam and releasing it through HPP turbines, while stopping the water flow through the dam, leading to fish casualties.

The third case concerned a non-realized project on river Šalpė where an old mill dam has been illegally built and maintained whereas originally the dam was planned to be removed or 'rearranged' so as to improve the river connectivity and restore fish migration. There has been a legal dispute between the environmental agencies and the dam-owner, with the conflict gaining ground from contradictory legal frameworks on environmental protection and cultural heritage protection. The very fact that the dam in conflict is a private property governed by another legal framework further complicates the matter. In light of the legal complexity, construction of a fish pass was proposed as an alternative, but this is more expensive, and has not been implemented either. The findings from the Lithuanian case studies are summarized in Table 7.

POLAND

In Poland, only two kinds of restoration projects were reported: success and partial success. The success project was in river Ina, where comprehensive restoration activities were undertaken including construction of fish passes, river habitat improvement and afforestation on the riverbank. The important factors for the success of the project are stakeholder consensus and active participation, effective stakeholder communication, longer time frame and larger spatial scale with integrated river basin and ecosystem-based approach, adequacy of funds, monitoring program before and after, as well as voluntary support from civil society in monitoring and supervision of the project.

However, in the second project on river Rega that shared many similarities with the previous one, change in project management due to administrative changes at state level, caused delay in project realization. This has led to classification of the project as 'partial success'. The findings from the Polish case studies are summarized in Table 8.

[3] Hydropeaking—the discontinuous release of turbined water due to peaks of energy demand—causes artificial flow fluctuations downstream of dam reservoirs

Table 7: Factors contributing to success, failure or non-realization of restoration projects in Lithuania

No.	River	Outcome	Restoration activity	Factors contributing to the outcome
1	Viešvilė	Success	Nature-like fish pass at the lower dam to re-establish fish migration to upper reaches	• Good technical design • Consensus among the major stake-holders and their continuous support • Effective management of resistance from local community through efficient communication in early stages • State-ownership of the land, which simplified procedures
2	Venta	Failure	Technical fish pass built at a hydro-power dam, as integral part of the dam	• Technical problems - faulty design and construction • Inefficient operation of fish pass – insufficient water, closed sluice gates during migration period, etc. • Conflicting stakeholder interests
3	Šalpė	Non-realized	Rearrangement/removal of ruins of an old dam or construction of fish pass	• Legal dispute • Conflicting stakeholder interests • Contradictory legal frameworks – environmental, cultural heritage, property rights etc.

SWEDEN

In Sweden, all the 3 different kinds of projects were explored in round 2. The success project was on river Muskån and involved construction of a new reach and river habitat improvement, with new spawning areas and holding spots. In this project, a new road was to be constructed across the river, which implied excavation of the riverbed for bridge foundations, and consequently, the river also had to be straightened and moved. So, a completely new stretch of the river was constructed due to the road construction requirements and the new stretch was about 150m shorter than the original. The project was implemented by the Swedish Transport Administration and the following factors can be noted as having contributed to its success: effective handling of conflicting stakeholder interests and creation of dialogue and subsequent trust, good leadership, good and creative planning along with adequacy of funds, right competence and experience within the implementing group, and post-project monitoring through external stakeholders (sport fishing association).

The second restoration project from Sweden on Moraån concerned a fish-ladder construction at a dam and ended up as a failure, though it had many success factors behind it. These included availability of requisite funds, participation of a broad-based sport fishing association who operated as consultants, a simple, cheaper and functional technology, information dissemination early in the project to minimize risk of opposition, and procedural simplicity. However, the project failed after a successful implementation, due to a planning failure. The possible obstruction to fish migrations from beaver dams downstream was ignored. Also, there was technical difficulty, with a lot of water going past the fish ladder, misguiding the fishes. Consequently, the project failed to reach its goals.

Table 8: Factors contributing to success or partial success of restoration projects in Poland

No.	River	Outcome	Restoration activity	Factors contributing to the outcome
1	Ina	Success	Fish passes, river habitat improvement (artificial spawning grounds), afforesta-tion at riverbank	• Multi-stakeholder effort with clear consensus, coordination and active participation • Effective stakeholder communication • Long-term project (67 months), dealing holistically with many complex aspects of river restoration • Holistic river basin and ecosystem-based approach vs. site-specific project approach • Voluntary support from civil society in monitoring and supervision (overpoaching) and awareness generation in local community • Adequacy of funds • Monitoring program before and after
2	Rega	Partial success	Fish passes, river habitat improvement (artificial spawning grounds), devices for directing fish behavior, afforestation of riverbanks	<u>Success factors:</u> • Involvement of diverse stakeholders in project implementation bringing in diverse perspectives, experiences and knowledge • Holistic, river basin and ecosystem-based approach • Adequacy of funds • Willingness and diligence to work on part of management group • Promotion and dissemination of project at local level by NGOs <u>Factors thwarting success:</u> • Change in project management due to administrative changes at state level, causing delay in project realization

The third Swedish restoration project represents a non-realized project which concerned facilitation of fish passage across the remains of a former paper-mill dam on Moraån. This proposed project suffered from the following core problem: conflicting stakeholder interests where environmental (fish-related) interests clashed with cultural interests. For solving the problem, the stakeholders were unable to agree on one of the possible solutions, namely, dam removal versus fish pass. There was lack of clear leadership, with each stakeholder trying to independently influence strategic decisions, in part resulting from ineffective and delayed communication regarding benefits of the restoration. The findings from the Swedish case studies are summarized in Table 9.

RUSSIA

From Russia a transboundary project on the river Seleznevka, also involving Finland, was reported. The project was classified as non-realized. It concerned removal and/or reconstruction of remains of water-gates of old dams on the Russian side, and grade-up of bottom level by rocks and stones under the dams to provide free passage of fish, and restoration of spawning sites mainly on the Finnish side. Dams on this river are impassable obstacles for migrating fish especially during low level of water.

Table 9: Factors contributing to success, failure or non-realization of restoration projects in Sweden

No.	River	Outcome	Restoration activity	Factors contributing to the outcome
1	Muskån	Success	Construction of new reach, river habitat improvement (new spawning areas and holding spots)	• Effective handling of conflicting stakeholder interests • Creation of dialogue, inspiration and trust among all involved stakeholders • Good leadership with continuous guidance to the implementing entrepreneurs • Right competence and experience within implementing group • Adequacy of funds • Good and creative planning • Dedication of implementing entrepreneurs • Post-project monitoring through external stakeholders
2	Moraån	Failure	Fish-ladder construction at a dam	<u>Factors for success:</u> • Requisite financial resources • Aid from a broad-based sport fishing association who operated as consultants • Procedural simplicity with no need of seeking permission for water-related activities • A good, simple, cheap and functional technology • Necessary knowledge and expertise within the implementing agency • Information dissemination early in the project to minimize risk of opposition <u>Factors thwarting success:</u> • Obstacle (beaver dams) downstream preventing fish from reaching the ladder • Technical difficulty - a lot of water going past the fish ladder, misguiding the fishes • A planning failure that the possible obstruction from beaver dams was ignored
3	Moraån	Non-realized	Removal of remains of former dam	• Conflicting stakeholder interests – environmental (fish-related) vs cultural • Stakeholder disagreement on a single course of action (dam removal vs fish pass) • Lack of clear leadership, with each stakeholder trying to independently influence strategic decisions • Exclusion of local stakeholders and their interest, leading to conflict • Ineffective and delayed communication regarding benefits of the restoration for nature and fish

Expected outcomes of this planned but non-realized project were improved connectivity of river habitats facilitating fish migration and overall improvement in ecological condition of the river, thus

ultimately improving the state of native populations of sea trout and salmon on the both sides of border. Among factors thwarting realization of this project were: poor communication among cross-border stakeholders, leading to critical gaps in project planning, which in turn resulted in inefficient planning and insufficiency of funds for fulfilling the mandatory legal requirements, most importantly, conducting EIA of the restoration activities on the Russian side. Table 10 summarizes the findings of the case study from Russia.

Table 10: Factors contributing to failure of a transboundary restoration project in Russia

No.	River	Outcome	Restoration activity	Factors contributing to non-realization
1	Selezne-vka	Non-realized	To remove or reconstruct remains of two old unused dams, and to restore spawning and rearing sites on the rapids downstream and upstream of the dams to provide free fish migration	• Bad insufficient planning that failed to understand and implement the necessary legal frameworks on both sides of the border • Poor communication among cross-border stakeholders, leading to critical gaps in project planning • Consequently, insufficiency of funds for the necessary EIA of restoration activities on the Russian side • Non-fulfilment of juridical requirements led to opposition from Russian federal authorities

COMPARATIVE CASE STUDY ANALYSIS

The results from the country-based case study analyses presented in the previous section were compared within the scope of the general conceptual framework developed for the project (presented on page 10). Results from the comparative case study analysis which highlight the factors important for success of the sampled restoration projects are summarized in Table 11. A short discussion on each of these factors, corroborated by evidence from the cases is presented in this section. The factors are divided into two broad categories: *context-based* and *process-based*. The former concern the context in and about which the project is designed and implemented, while the latter concerns the process adopted for planning, designing, implementing and undertaking the post-implementation phases of the project. Factors within each of these categories is described in detail below. The examples discussed are mostly drawn from the stratified samples selected in Round 2 of the study.

Context-based factors

Ecological context

The ecological context is the most important driver of a river restoration project. In the restoration projects included in this study, the two most common challenges addressed were obstacles to fish migration and fish habitat degradation. The case studies reflect that generally a good knowledge existed about the ecological challenge facing fish populations at the specific restoration sites, but the extent of holistic knowledge at a broader spatial scale is not clear. The Polish restoration projects, where an integrated basin-wide approach was adopted, and some Lithuanian and Danish projects where a larger part of the river was targeted, reported success in reaching the project goals. On the contrary, in another project in Kunda river, Estonia, even if the fish pass design had been technically correct, persistence of dams downstream could still have hindered fish migration.

It emerges from the study that holistic knowledge and understanding of the ecological conditions affecting fish populations is an important factor affecting the fate of a river restoration project. This would include knowledge about migration obstacles, quality of river habitats, water quality and quantity issues, and any other related ecological problem in the river/ basin that can impact fish populations and their migration. Knowledge on these aspects at a wider spatial scale is desirable, while neglect of the ecological status upstream or downstream can adversely impact the project outcomes.

Political context

The political context at the restoration site can play a major role in determining the sustainability and hence the eventual success of a river restoration project. Three important factors that must be considered here while designing river restoration projects are described below.

Relevant policy and legal frameworks at local, national and/or regional scale

Existence of relevant policy and legal frameworks at the municipal, national or higher levels can help provide long-term support to river restoration projects. Cohesive policies and regulatory frameworks that support integrated long-term solutions are especially important. For example, in the restoration project in Pada river in Estonia, a change in law following Natura 2000 regulations that made fish passage in rivers compulsory, is stated to be a positive factor that helped achieve project success. Similarly, State ownership of rivers and adjoining land can facilitate restoration projects, as was noted at a project on river Viešvilė in Lithuania. In another case in the Venta basin, the Environmental Impact Assessment (EIA) framework necessitated construction of fish pass as an integral part of a newly built dam. On the contrary, in a project on Salaca river in Latvia, absence of legal provisions that could have enabled transfer of private land for public good at the restoration site, prevented implementation of the project.

At a regional or even international scale, it can be said that existence of a common legal/policy/action framework, such as the EU WFD or the BSAP, can help by providing a common set of principles and practices. This can be especially important for undertaking restoration in transboundary rivers.

Nature of political support vis-à-vis the proposed restoration

In general, active long-term political support from various levels — municipal, national or regional — is a positive factor for sustainability of restoration projects. Examples of potential benefits include long-term institutional support, better coordination with different stakeholders and more stable financial resources. On the contrary, private or non-governmental efforts are always potentially exposed to higher risks. Most of the restoration projects included in this study were initiated by or with support from governmental agencies. However, a good number of these were reckoned as failures or remained unrealized due to operation of multiple other factors.

Political scale involved – local, national, international

The political scale is important in determining the fate of restoration projects. This factor is important because accordingly support can be drawn, or any existing barriers addressed. Financial, legal and administrative setups can all be defined by the political scale. Also, identification of stakeholders is determined by this factor. From this study, it emerges that integration and coordination between concerned agencies at the different political scales – such as municipal and county or ministries of national governments, etc. is important. In the case of transboundary projects, coordination and cooperation of national (and other agencies) at other relevant scales – also plays an important role in determining project success. An example comes from the restoration project in river Salaca, Latvia, where the implementing agency was the Ministry of Environmental Protection and Region Development, but lack of support from the municipality and Juridical Commission of Parliament led to non-realization of the project.

Economic factors

Understanding the economic context is very important for designing effective restoration projects. At least two factors appear to be important here:

Economic interests supported or hampered by the proposed restoration

A proposed river restoration project can affect the economic interests of stakeholders variously. Sometimes it may be seen as a cause of property depreciation or economic loss in other forms, as was seen in the case of the proposed restoration project in river Salaca, Latvia. Here, the landowner claimed that his property would lose its value if the bridge on the river was removed as a measure for restoring fish migration. He also insisted that for this reason, his entire property should be purchased by the government, which carried a high price that was, however, not acceptable to the latter. Consequently, the project could not be implemented. In the case of removal of Pagraumenė Mill Dam on Šalpė river in Lithuania too, there existed an economic angle in the interests expressed by the landowner. Existence of the old mill was connected to rural local tourism and anticipating that its removal would compromise this economic value (apart from other reasons cited), the landowner refused to agree to the proposed restoration.

Financial resources available to support the restoration

Availability of adequate funds on a long-term basis is absolutely essential for ensuring sustainability and hence, success of any river restoration project. Not only are these required for the phase of implementation, but also for any pre-project preparations and post-project activities to assess sustainability. In this study, many restoration projects reported availability of adequate funds as a factor promoting project success. Examples include projects on Pada river in Estonia, Longinoja in Finland, Norina and Rakupe rivers in Latvia, Ina and Rega rivers in Poland, and on Muskån and Moraån

(fish-ladder) in Sweden. On the contrary, in the case of the Russian transboundary project, additional hydrological study was required for EIA to fulfil a legal requirement, but due to insufficiency of funds, this could not be undertaken, and consequently, the project remained unrealized.

Social and cultural factors

Social and cultural factors are often overlooked when planning and implementing river restoration projects, but these may play a key role in their success or failure. Planners tend to take it for granted that the people — stakeholders — who will be affected by a project or who share an interest in a project will behave in certain ways to take advantage of the 'obvious' benefits to be generated (Conlin, 1986). But they forget that different stakeholders may hold different values and interests in the project. Further, they forget that river restoration is an adaptive problem which is socially and ecologically complex, and where the solution is not actually 'known'. Reaching an effective solution requires innovation, sharing of new information, and learning by engaging the stakeholders in the problem, who must then adapt their own behavior to create a solution (Naiman, 2013). All these aspects are essentially 'social' factors, that can include aspects like multiple owners, interests and interest groups, jurisdictions, values, and public involvement. In addition, 'cultural' factors are important to consider in the project context. Culture is about beliefs, values, practices and artifacts of a social group, and in the context of restoration projects, can play an important role from the stakeholders' perspective. Some social and cultural factors that can influence the fate of a river restoration project are discussed in detail below.

Stakeholders and their interests around the proposed project

This study showed that projects where stakeholders and their interests around the proposed project were included from the beginning, performed well. Especially important was early consensus, cooperation and a relationship based on trust and mutual support. Examples from the studied sample that considered stakeholder characteristics as important in success of river restoration include those in Pada river in Estonia, Longinoja in Finland, Norina and Rakupe in Latvia, Viešvilė in Lithuania, and Ina in Poland. On the contrary, projects that suffered due to conflicting stakeholder interests or lack of mutual trust included the projects in Salaca river in Latvia, those in Venta and Šalpė rivers in Lithuania, the non-realized project in Moraån in Sweden, and the transboundary projects in Narva river across Russia and Estonia and in Seleznevka river across Russia and Finland. It is important to make an assessment of conflicting or diverse interests early in the project planning process and act appropriately to resolve them and making an effective plan.

Cultural/historical/other values connected to the site of proposed restoration

Location of a proposed river restoration project may be closely conflict with the cultural, historical, recreational, environmental or other values upheld by the local stakeholders regarding that site. If the planned location has minimum possible conflict with these stakeholder interests, the project will ordinarily not face any opposition, but otherwise projects may fail to take off. An example from the case studies that strongly illustrates this factor is the dam removal project in river Moraån, Sweden. Another example is the bridge removal project on river Šalpė in Lithuania. Both these projects failed to be implemented.

Process-based factors

Technical dimension

The visible part of a river restoration project is the technical solution implemented in order to reach the ecological goals. An inventory of river restoration measures has been produced under a EU-

funded project REFORM (Ayres et al., 2014) where these are assessed from cost and benefit perspectives. Several other sources also exist on technical interventions available for river restoration. The REFORM inventory mentions the following: reducing undesired sediment input, removal of barriers that disrupt the longitudinal connectivity of a river system, installation of fish pass/bypass/side channel for upstream migration, removal of bank fixation, re-meandering water courses to natural or near-natural shape, recreating gravel bar and riffles, and removal of hard engineering structures that impede lateral connectivity. All these restoration measures are known to have positive impacts towards strengthening fish populations. While these basically answer the 'what' question, regarding the 'how' question in river restoration, this study identified at least three important process components as discussed below:

Selection of the restoration measure

Selecting the most appropriate restoration measure is a core issue that may end-up determining the failure or success of a river restoration project, and this can be a very tricky question since both the ecological and social sides may need to be balanced. As exemplified by a number of case studies in this project, and as described above, the selection should be made carefully, following a thorough assessment of the various context-based factors described above. This process is often influenced by some of the other process factors, such as the planning (e.g., preparatory work) or social factors (e.g., inclusion of stakeholders from early project stages or achieving their consensus on the selected measure). Examples related to this point will be mentioned under other relevant sections.

Technical designing

After the most appropriate measure has been selected that is ecologically and socially valid, there is need to ensure that the design is effective in operation. In a number of instances, such as in the nature-like fish pass and river habitat improvement interventions in river Pada, Estonia or the nature-like fish pass in Viešvilė river in Lithuania, a good technical design is cited as a positive factor that led the way to project success. On the contrary, in the case of the fish lift project in river Kunda, Estonia, or the technical fish pass in Venta river, Lithuania, sub-standard technical design was an important cause behind the project failure. In the fish ladder project in Moraån in Sweden, it was pointed out that a "good, simple, cheap and functional technology" are desirable technical qualities. However, this project ultimately failed, one of the reasons being a faulty design that made a lot of water flow past the fish ladder, misguiding the fishes.

Implementation, operation and maintenance of the interventions

After creating a good design, it is equally important to implement it efficiently and ensure its efficient operation as well as upkeep and maintenance in the long term. The case of nature-like fish pass and river habitat improvement interventions in river Pada, Estonia are also said to have been efficiently implemented, contributing to project success. On the contrary, inefficient operation of fish pass with insufficient water in the Venta project in Lithuania contributed to its failure. Further, river restoration efforts take time to show impacts, but lack of monitoring of the technical input and of the ecological impacts makes things obscure. Restoration in river Longinoja in Finland is a classic example where consistency of effort and interest has continued over the years since the start in 2001, with restoration of new areas or improvement old ones is carried out every autumn, making it a success.

Project processes

Planning is a key process in any project, that must be conducted with great caution. A number of important planning dimensions need to be considered while evaluating the factors underlying success or failure of a river restoration project. After a good planning, it is equally important to have efficient

and effective implementation of the project and thereafter regular follow-up. The different factors related to project processes that emerged as important from this study are described below.

Preparatory assessments

Planning of a project must be preceded by necessary preparatory exercises. These could include hydrological, environmental, social or other kinds of scientific assessments. Hydrological assessments can throw useful light on the nature of the hydrological/ecological problem and potential solutions. Environmental or social impact assessments could help gather baseline data about the environmental and socio-economic factors that local communities and other stakeholders might consider important. Planning carried out on the basis of adequate and appropriate preparatory work has higher possibilities of success. Though preparatory assessments are not explicitly mentioned in any of the case studies selected in this study, it appears that some kind of preparatory work was completed in at least some of the successful projects. On the contrary, it appears that in the fish ladder project in river Moraån in Sweden, proper ecological assessments in the area were not undertaken, and therefore the project failed after a successful implementation. One of the important reasons cited is overlooking of possible obstruction to fish migration from beaver dams downstream.

Nature of the plan and process adopted

The nature of the plan for a restoration project can be described in a number of ways. For example, the plan can be long- or short-term, site-specific or watershed-based, have specific or multiple goals, etc. A long-term integrated approach, preferably at watershed scale, combining more than one ecological goal can be a sustainable option. Among the successful case studies analyzed in this study, the restoration in Ina River in Poland, with fish passes, river habitat improvement (artificial spawning grounds), and afforestation at riverbank was a long-term project (67 months), dealing holistically with many complex aspects of river restoration. Similarly, success of the Longinoja project in Finland is based on consistency of effort and interest since the start in 2001, restoring new areas or improving old ones every autumn.

Further, regarding the planning process, important aspects include project origin in good preparatory work and rational decisions made with participation of stakeholders. Good and precise planning is highlighted as a positive factor in the successful project in the Norina project in Latvia. On the contrary, in the non-realized transboundary project in Russia, “bad, insufficient planning” that failed to understand and implement the necessary legal frameworks on both sides was cited as an important cause of failure.

Designing a project that is responsive to stakeholder interests is also an example of good planning. Incorporation of local cultural/historical/recreational/other values or preferences in the restoration plan/design can serve as a positive factor, neglect of which can lead to project failure. The dam removal project in river Moraån, Sweden is a glaring example, where there exist two conflicting stakeholder interests, namely, environmental (fish-related) versus cultural/historical, and the project plan fails to reconcile the latter, leading to its non-realization.

Post-implementation phases

A project is not only about planning and implementing an intervention. A good project must also include resources and strategies for the phases of monitoring and evaluation. This is important because after implementation, the results must be assessed, and in case of any problems, necessary correctives applied. Also, long-term impacts can be ascertained only after proper evaluation. Thus, a project that includes all the project cycle phases is more likely to be sustainable, and hence successful. In this case, the most important result is the improvement in the trout population, which must be monitored. However, as noted earlier, monitoring of river restoration projects is generally reported

to be poor, and in case of most of the projects included in this study too, data on pre- and post-project status of trout was lacking. Post-project monitoring was explicitly stated in the success case of Ina River project in Poland. Also, in the success project in Longinoja, Finland, an electrofishing monitoring program for trout parr was mentioned at certain sites of the brook.

Social factors

Social factors comprise a wide array that ranges between aspects that concern the project internally to those that connect to the external systems and processes. From this study, at least four important social factors were identified:

Project team

The project team can have members from the implementing agency alone, or also include external actors such as experts, entrepreneurs, social organizations, etc. — broadly all those who directly contribute to the different project phases. In this study, some of the case studies explicitly illustrated the value of a cohesive project team comprising an array of relevant actors possessing necessary knowledge and experience, and skills, including good leadership and coordination skills. For example, in the Longinoja case in Finland, presence of appropriate knowledge, good leadership and genuine passion for the work in the team were mentioned as success factors. Similarly, in the successful project in Norina in Latvia, a dedicated sizeable implementation team with high motivation for nature protection, together with previous related experience was mentioned as an important factor. Similar importance was noted in the partial success case of Rakupe project. Willingness and diligence to work on part of management group is mentioned as a positive factor in Rega project in Poland. In Sweden, good leadership with continuous guidance to the implementing entrepreneurs and right competence and experience within the implementing group are mentioned as positive factors in the Muskån project, while lack of clear leadership in the project management and resultant attempt by individual stakeholders to independently influence strategic decisions marred the non-realized dam removal project in Moraån.

Decision-making process

Decision-making is a process which occurs repeatedly in any project through different stages. What is important here is how are decisions made, who exercises the authority and who contributes to what an extent? Again, the case studies in this study indicate that river restoration projects having participatory decision-making, where the implementing agency consulted the stakeholders, valued their perspectives and interests, while arriving at strategic decisions have tended to succeed. Within the project team too, a participatory style of decision-making while implementing projects seems to have promoted success. The case studies mentioned under the previous point obviously included participatory decision-making elements.

Stakeholder management and engagement

Once the stakeholders relevant to a project are identified and an analysis of their interests is carried out, it is extremely important to address any potential or existing conflicts, and to gain their confidence and participation. Thus, managing stakeholders involves resolving conflicts, promoting coordination, and attaining their active involvement. Inability to do so or ignoring the same can prove to be detrimental for a project's fate. In this study, lack of coordination between key stakeholders was stated to be an inhibitor in the transboundary Narva project in Estonia. On the contrary, in the Longinoja case in Finland, a relationship based on confidence and trust between the project team and the local stakeholders (including the community) made the restoration work a collective responsibility for all, that continues to drive the project for more than 19 years.

In the Rakupe river project, which was classified as partial success, multi-stakeholder effort with involvement of experts, municipality, environmental groups, anglers and citizens is cited as a positive factor. In the Ina project in Poland, positive factors contributing to success included a multi-stakeholder effort with clear consensus, coordination and active participation and voluntary support from civil society in monitoring and supervision (overpoaching). Also, in the partially successful Rega project, involvement of diverse stakeholders in the project implementation was said to have positively helped by bringing in diverse perspectives, experiences and knowledge. Finally, in the successful Muskån project in Sweden, effective handling of conflicting stakeholder interests and creation of dialogue, inspiration and trust among all involved stakeholders were stated to be important factors, while in the non-realized project in river Moraån, inability to balance stakeholder interests and initiate their consensus has been a key factor leading to failure. This project also showed how effective engagement of external stakeholders can even help in post-project monitoring.

Project communication

Finally, communication is an important project process that may heavily influence the project fate. Clear, regular and effective communication is essential within the project management team as well as with the external stakeholders. A number of restoration projects included in this study mentioned effective communication as a positive factor. Good coordination within project teams itself reflects effective internal communication. In the restoration project in Longinoja brook, effective communication with local stakeholders is seen as leading to creation of inspiration and trust, making the restoration work a collective responsibility for the community.

The projects on Pada river in Estonia and Ina River in Poland show similar observations. In the Moraån fish ladder project in Sweden, stakeholder communication and information dissemination early in the project was observed to help minimize the risk of opposition, though the project failed due to other factors. However, in the other non-realized (dam removal) project in the same river, ineffective and delayed communication regarding benefits of the restoration for nature and fish is said to be a major cause behind its failure. A lesson from this project is worded by one of the stakeholders as follows: “A good communication plan is vital to have, this together with identification of which interests and viewpoints there are as well as an open and transparent dialogue is a key to success.” In the Russian transboundary project in river Seleznevka, poor communication among cross-border stakeholders was identified as leading to critical gaps in project planning, finally resulting in its non-realization.

Financial planning and resources

In order to make a project run efficiently and effectively, it is important to have good financial planning. This, in turn, involves equitable allocation of funds so that there is adequacy for undertaking the different phases. A number of restoration projects examined in this study stated that adequacy of funds as a factor promoting success. However, the transboundary project in river Seleznevka involving Russia and Finland reported insufficiency of funds for undertaking an environmental impact assessment of the restoration activity which was a mandatory legal requirement in Russia. This ultimately led to non-realization of the project. In general, clear evidence of allocating funds for monitoring and evaluation phases does not exist in majority of the cases, the emphasis mainly lying on project implementation.

Table 11: Summary of factors important for success of river restoration projects

Nature of factor	Dimension	Criteria	Factors promoting project success
Context-based	Ecological	Ecological challenge(s) to address, the spatial scale and overall ecological status of the river stretch	Holistic knowledge of the ecological challenges adversely affecting fish populations, including water quality and quantity issues, and other related ecological problems in the river/ basin
	Political	Relevant policy and legal frameworks at local, national and/or regional scale	Cohesive policies and legal frameworks that support integrated long-term solutions
		Political support vis-à-vis the proposed restoration	Long-term political support
		Political level involved — local, national, international	Integration and coordination between different political scales involved
	Economic	Economic interests hampered or supported by the proposed restoration	Promotion of common economic interests
		Financial resources available for the restoration	Adequate and long-term availability of funds
	Social and cultural	Stakeholders and their interests around the proposed project	Consensus, cooperation and relationship based on trust and mutual support among stakeholders
		Cultural/historical values connected to the site of the proposed restoration	Recognition of cultural/historical values at the proposed restoration site
Process-based	Technical	Selection of the restoration measure	Choice of the most appropriate solution, based on an integrated context-analysis
		Technical designing	Ensuring effectiveness of the design
		Implementation and maintenance of technology	Effective implementation and long-term maintenance

Nature of factor	Dimension	Criteria	Factors promoting project success
Process-based	Project processes	Preparatory work — hydrological, environmental or other scientific assessments	Completion of preparatory studies or pre-assessments for baseline data, and project design
		Nature of the plan — e.g., long/short term, site-specific/watershed-based, specific/multiple goals	Long-term integrated approach, preferably at watershed scale, combining multiple ecological goals
		Post-implementation phases included in the project – monitoring and evaluation	Plan comprising all project cycle phases — implementation, monitoring, evaluation
	Social	Project team/actors — composition, roles, skills, personal attributes, leadership, coordination, etc.	Cohesive team comprising an array of relevant actors possessing necessary knowledge and skills, including good leadership and coordination skills
		Decision-making process	Participatory decision-making, inclusive of stakeholders' perspectives
		Stakeholder management and engagement	Stakeholder involvement in all project phases, and efforts at consensus building
		Project communication within team and with stakeholders	Effective and regular communication with stakeholders and within team
	Financial planning and resources	Allocation of funds for every project phase	Adequate funds allocated for supporting every project phase

Source: Results from comparative case study analysis of completed and non-realized restoration projects in the BSR under Retrout project

CONCLUSIONS

This study aimed at undertaking a qualitative evaluation of river restoration measures in selected rivers in the Baltic Sea Region. Towards this end, data from 97 restoration projects located in 76 rivers in the RETROUT project partner countries and some additional HELCOM countries were collected. Instead of focusing on the question of 'what' in river restoration efforts - which has been already somewhat widely considered - this study explored the question of 'how' to carry out restoration sustainably so that expected results are obtained and retained over a longer term. Towards this end, the study attempted to comprehend the factors that lead to success or failure of river restoration projects and to systematically present these factors within a logical framework of analysis that was outlined in Table 11.

The case study analysis reveals that success (or failure) of river restoration projects does not depend only on what kind of technical solutions are adopted, but there is need to adopt a more holistic approach. In this broader approach, the technical solutions and the way these are planned, designed and implemented are important, and these further need to be seen as connected to two sets of factors – 'context-based' and 'process-based'. The former are discernible along ecological, political, economic, and social and cultural axes. The latter similarly relate to at least four different realms, namely, technical, project processes, social, and financial. While different kinds of factors play a role under the above categories, the study clearly showed that consideration of stakeholder interests and their early engagement can play a significant role in making the river restoration successful and sustainable.

This study touches upon two discrete yet closely interconnected aspects, namely, 'sustainability' of river restoration projects and their 'success'. From the study, it can be inferred that sustainability is a comprehensive term that includes the state of the project during its tenure as well as its outcomes in the future and incorporates criteria along the three dimensions of sustainability – ecological, social and economic. As noted earlier, sustainability 'of' the project is a means to reach the goal of sustainability 'by' the project. In this light, 'success' of a river restoration project aiming at improving fish populations corresponds to a great extent to the dimension of ecological sustainability (to be) achieved by the project.

The outcomes of this study – the factors underlying success of river restoration projects, as outlined in Table 11 - can be applied to analyze the status and potential of any planned, ongoing or completed river restoration measures. The results from such analysis can be further used to delineate corrective actions for improving the situation. The findings of this study can also be used for developing a set of guidelines for planning and implementing new restoration projects so that these can be sustainable along all the three axes – ecological, social and economic - and hence have greater potential of delivering more successful river restoration.

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Annexure 1: The template for evaluation of completed river restoration projects

		Case 1	Case 2	Case 3	Case 4	Case 5	Case 6
River identification	River						
	Country						
Restoration activity and overall aim	Description of the restoration activities						
	Overall aim of the restoration project/activities						
	Temporal scale of the restoration activities						
	Spatial scale of the restoration activities						
Classification as a success or failure. Components affecting the judgement	Provision of high recreational value						
	Improving sea trout smolt production						
	Improving salmon smolt production						
	Restoring abundance and diversity of river vegetation						
	Restoring abundance and diversity of fauna						
	Project acceptance by stakeholders						
	Maintaining cultural heritage values						
	Success / failure						
Additional information	Expected lessons to learn						
	Monitoring						
	Salmon/sea trout/both						
	Sea trout population						
	Hydrology						
	Water quality						
	Fisheries management						
	Recorded outputs of the project						
	Restoration year start						
	Restoration year stop						
	Agency/agencies responsible for designing & implementing the project						
	Total budget						

Annexure 2: The template for evaluation of non-realized river restoration projects

		Case 1	Case 2	Case 3	Case 4	Case 5	Case 6
River identification	River						
	Country						
Restoration activity and overall aim	Description of the planned restoration activities						
	Overall aim of the planned restoration project/activities						
	Temporal scale of the planned restoration activities						
	Spatial scale of the planned restoration activities						
Factors leading to non-realization of the project (Suggestive list)	Insufficient funds						
	Opposition from some stakeholders						
	Conflict among different stakeholders						
	Juridical proceedings						
	High cultural heritage values that would be damaged						
	Lost hydroelectric power						
	Any other factor?						
	Success / failure						
Additional information	Expected outcomes of the planned but non-realized project in general						
	Expected outcomes of the planned but non-realized project for fish populations (sea trout/salmon)						
	Expected lessons to learn						
	Impact of non-realization of project on Salmon/sea trout/both						
	Agency/agencies responsible for designing & implementing the project						

Annexure 3: The interview guide used for conducting detailed case studies

A. FOR IMPLEMENTING AGENCY

Name of the agency interviewed:

1) Restoration activity & overall aim

a) Background of the restoration project/activities: What was the major problem/challenge in relation to the river concerned that needed to be addressed and for which this restoration project was designed? Why was this river/river stretch selected?

b) Description of restoration activity: What was the implemented restoration activity/activities? Describe in detail.
(Among the various cases already reported in the template, these include removal of a dam, construction of a fishway, transporting fish over a dam, stocking fish, restoration of spawning beds, changing hydrology or water quality, changing fishing rules, others, or their combination)

c) Overall aim of the restoration project/activities: What was the major aim & objectives of the implemented restoration project/activities for fish (trout/salmon /both) populations as well as any other purposes?
(Examples of objectives already reported in the template include: improvement of fish populations, enhanced recreational value, restoring diversity of river vegetation or fauna, revival of cultural heritage values, other stakeholder interests, etc.)

d) Temporal scale of the restoration activities: Was the activity implemented as a "short-term solution to a particular problem" or as "long term restoration project", or did it include a "combination of short- and long-term activities"? Or was the particular activity undertaken as part of a larger project?

e) Spatial scale of the restoration activities: If the activity was confined to only a "particular stretch of a river", why was such a selection made? Why wasn't greater part of a river targeted?

2) **Evaluation of the project as a success or failure**

a) Rating on the basis of specific components: Would you classify the project/activity as success or failure, in terms of the following components (as applicable): You can rate the project/ activity as "success", "partial success", "failure", "not known", "not relevant". Why do you think so?
   i) Improving habitats for sea trout /salmon juveniles
   ii) Improving sea trout smolt production
   iii) Improving salmon smolt production
   iv) Improving water quality
   v) Provision of high recreational value
   vi) Restoring abundance and diversity of river vegetation
   vii) Restoring abundance and diversity of fauna
   viii) Project acceptance by stakeholders
   ix) Maintaining cultural heritage values

b) Overall rating of the project as success / failure of the project:
   i) Has this restoration project been classified as a success or as a failure?

ii) What is your own judgement based on the above criteria? You can choose among "success", "partial success", "failure". Why do you think so?

3) Role of stakeholders external to the agency

a) Who were the other groups/individuals that shared an interest in the project, either positive or negative? Describe in detail.

b) Were there any groups/individuals external to this agency that helped in the planning and implementation of the project, or have provided support afterwards? If yes, explain in what way?

c) Were there any groups/individuals external to this agency that obstructed the planning and implementation of the project? If yes, in what way?

4) Problems in implementing the restoration project/activities

a) Problems encountered: What were the major problems/barriers that you faced in implementing the project/activities?

i) Was there resistance from one or more interest groups (such as **economic interests** like hydropower, other industry; **cultural heritage**-related NGOs, associations or agencies; **farmers and drainage associations**; **road or rail transport** authorities etc. In what form was the resistance expressed?

ii) Were there any pending /new court cases/litigations that thwarted the project initiation or progress? If yes, explain.

iii) Was there a shortage of resources, such as funds?

iv) Any other hurdles that obstructed you from undertaking the activities as planned?

b) Addressing the problems: What steps did you take to address these problems?

c) Impact on results: Do you think these problems affected the final achievement of results? If yes, how?

5) **Role of fisheries management in achieving the trout-related goals of the project**

a) Was the restoration project supported by fisheries management? If yes, in what way?

Note: Fisheries Management could be taken to include: i) Ministries/Government Agencies concerned with fisheries, ii) Law, rules and regulations in place for controlling fishing activities iii) System of 'Catch quota', limitations on fishing techniques and instruments, etc.

b) How do you think fisheries management could further support restoration projects with the aim of improving trout stocks in the river?

6) Additional information

a) Expected lessons to learn:

i) What lessons did you learn from this experience for implementing restoration projects in the future?

ii) Would you like to highlight any lessons that any restoration project implementing agency should be careful about?

b) Monitoring:

i) Was there monitoring program in place before, after, or both before and after the restoration project?

ii) If yes, what are the outcomes?

c) Salmon/sea trout/both: Was there a sea trout or salmon population, or both, in the river before starting the restoration project? Were they genetically original or introduced stocks?

d) Sea trout population: What is known about the sea trout (and salmon) population before and after the restoration project?

e) Hydrology:
   i) What is known about the river hydrology before and after the restoration project?
   ii) How do you think this has affected the trout/salmon populations?

f) Water quality:
   i) What is known about the river water quality before and after the restoration project?
   ii) How do you think this has affected the trout/salmon populations?

g) Factors behind success or failure of the project:
   i) What do you think were the major factors enabling the project to be successful in reaching its goals?

B. Alternately, which factors do you think thwarted the project in any way – in reaching its goals, completion within the planned project period, overall completion of the project activities, etc?

C. FOR A STAKEHOLDER THAT SUPPORTED THE PROJECT AND FINALLY DREW BENEFITS

1) Basic questions:

a) Why were you interested that the restoration project should be undertaken?

b) How did you support the planning and implementation of this river project?

c) What was the previous state of the river and how were you affected by it?

d) How has the restoration brought about a change in the previous state of the river? (For example, in terms of hydrology, water quality, sea trout stocks, flora and fauna diversity)

e) Do you think that those changes/improvements have been long-term? Do they continue at present?

f) What benefits did you get after the restoration project/activity was completed?

g) Do you think that the benefits which came to you in the beginning continue at the same level or their effectiveness is now reduced? If yes, in what way and what could be the reasons?

h) In your opinion, which were the factors that helped the project/activities the most in terms of their timely completion and achievement of results? In what way did they facilitate? (Examples - law, rules and regulations, funds, local support groups, etc)

i) Alternately, were there also factors that thwarted the project process? Which were these and in what way did they obstruct? (Examples – law suits, land ownership issues, conflict of rights etc)

2) **Additional information**

a) What do you think about project acceptance by the different stakeholders?

b) Which other groups/individuals have shared an interest in this restoration project? Explain what has been their interest - positive and negative.

c) Did any of those groups/individuals also support the process in some way? If yes, explain how?

d) What kind of benefits have come to those groups/individuals? Do you think their benefits have been long-term?

e) Are there also some groups/individuals that opposed the project? Why did they do so, and in what way? (**Note**: try to get detailed data about at least 1-2 such cases)

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D. FOR A STAKEHOLDER THAT OPPOSED THE PROJECT AND WAS NEGATIVELY AFFECTED BY THE RESTORATION PROJECT

1) Basic questions:

a) What were the reasons that made you believe that the restoration project in question was against your interest?
b) Did you try to oppose the planning and implementation of this restoration project? How?
c) What was the previous state of the river and were you affected by it?
d) Has the restoration brought about any change in the previous state of the river? (For example, in terms of hydrology, water quality, sea trout stocks, flora and fauna diversity)
e) Did you get any benefits after the restoration project/activity was completed?
f) Do you think that the improvements have been a cause of loss or disadvantage to you in any form? Please explain what and how?
g) In your opinion, which are the most important factors that prevented this project from being started / reaching its goals (Examples – law suits, land ownership issues, conflict of rights etc)

2) **Additional information**

a) Which other groups/individuals have shared an interest in this restoration project? Explain what has been their interest - positive and negative.
b) Did any of those groups/individuals also support the process in some way? If yes, explain why and how?
c) What kind of benefits have come to those groups/individuals?
d) Are there also some other groups/individuals that opposed the project? Why did they do so, and in what way? (**Note**: try to get detailed data about at least 1-2 such cases)
e) In your opinion, how has the project acceptance by the different stakeholders been?

Annexure 4: List of river restoration projects evaluated in the study

ESTONIA

1. Purtse River - Construction of new nature-like bypass fishway at Sillaoru
2. Pada River - Replacing Koila old mill dam with nature-like fishway in the original river bed
3. Pada River - Replacing Adrika old mill dam with nature-like fishway in the original river bed
4. Kunda River - Replacing AS Estonian Cell pumping station dam with nature-like fishway in the original river bed
5. Kunda River - Construction of fish lift at Kunda cement plant dam
6. Toolse River - Reconstructing one culvert to bridge and another culvert was enhanced with nature-like rapids
7. Sõmeru River - Construction of new nature-like bypass fishway at Rägavere. Removal of beaver dams. Creating new spawning areas
8. Vainupea River - Construction of new nature-like bypass fishway at Pajuveski
9. Mustoja River - Replacing Vihula old sawmill dam with nature-like fishway in the original river bed and creating new spawning areas
10. Võsu River - Replacing Sae old mill dam with nature-like fishway in the original river bed
11. Loobu River - Construction of new chamber type (pool pass) fishway at Joaveski
12. Loobu River - Construction of new nature-like bypass fishway at Loobu
13. Loobu River - Replacing Kadrina dam with nature-like fishway (rock ramp) in the original river bed
14. Loobu River - Reconstructing one culvert and replacing Neeruti dam with nature-like fishway in the original river bed
15. Valgejõgi River - Replacing Tapa dam with nature-like fishway in the original river bed
16. Valgejõgi River - Construction of new nature-like bypass fishway at Vahakulmu
17. Loo River - Construction of new chamber type (pool pass) fishway at Loo
18. Kuusalu Brook - Removal of beaver dams and four small scale man made migration obstacles
19. Valkla Brook - Creating new spawning areas and diversification of trout habitat, replacement of one small dam by nature-like fishway, and removal of one beaver dam
20. Pirita River - Reconstruction of old fish pass to fish ramp (left side of the river) at Nehatu
21. Pirita River - Creating a new spawning area at a site having limestone
22. Pirita River - Replacing old Loo dam (ruins) with nature-like fishway (rock ramp) in the original river bed, also creation of additional spawning grounds
23. Pirita River - Replacing old Paritõkke dam (ruins) with nature-like fishway (rock ramp) in the original river bed
24. Pirita River - Construction of new nature-like (rock ramp) fishway at Vaskjala
25. Pirita River - Construction of new nature-like (rock ramp) fishway at Kose
26. Vääna River - Construction of new nature-like (rock ramp) fishway at Saku
27. Vasalemma River - Replacing old Laitse dam with nature-like fishway (rock ramp) in the original river bed
28. Nuutri River - Removing one small dam and replacing another with nature-like fishway (rock ramp) in the original river bed at Kärdla
29. Punapea River - Creating new spawning areas and removing migration obstacles (wood debris)
30. Tirtsi River - Creating new spawning areas (total area 160 m2) and removing migration obstacles (wood debris)
31. Veskijõgi Brook - Construction of new nature-like bypass fishway at Pidula

32. Vesiku Brook - Opening up the overgrown (reed belts) stream mouth
33. Pärnu River - Construction of new fish ramp (left side of the river) at Kurgja
34. Pärnu River - Replacing old Türi mill dam (ruins) with nature-like fishway in the original river bed
35. Rannametsa River - Construction of new nature-like bypass fishway at Laiksaare
36. Narva River – Redirecting some water (40-50 m^3/s) to the old riverbed and to restore the scenic falls and rapid on the river from the hydropower plant located at Ivangorod town

FINLAND

1. Longinoja Brook – Restoration of the living conditions for sea trout and the natural state of the brook as well as creation of spawning spots within the city of Helsinki

LATVIA

1. Raķupe River - Adding of gravel, stones and boulders
2. Lencupe and Strikupe Rivers - Removal of beaver dams and fallen trees from rivers
3. Raķupe River - Adding of gravel, stones and boulders
4. Pitragupe and Ķikans Rivers – Removal of beaver dams and fallen trees from rivers
5. Raunas River - Restoration of river rapids habitats
6. Peterupe, Kisupe and Age Rivers - Removal of beaver dams and fallen trees from rivers
7. Kisupe River - Removal of dam
8. Noriņa River - Removal of old mill dam, removal of bever dams and fallen trees
9. Pitragupe, Mazirbe, Melnsilupe and Pilsupe Rivers - Removal of beaver dams and fallen trees from the rivers, restoration of spawning grounds
10. Līgatne River - Construction of a fishway
11. Rauza, Vecpalsa and Vizla Rivers - Removal of beaver dams and fallen trees from rivers, In Rauza also adding of stones in riverbed
12. Salaca River - Removal of remains of former paper-mill dam

LITHUANIA

1. Smiltelė River – Creation of wetland in the channel of the river for water treatment, resulting in a meandering series of bioponds, separated by shallow thresholds planted with emergent vegetation
2. Smiltelė River – Creation of spawning gravel bed in sand dominated stream stretch
3. Jūra River – Restoration of a meandering channel
4. Šventoji River - Creation of spawning gravel beds in 4 potentially suitable reaches (300-700 m in length)
5. Šventoji River – Fish pass on the Anykščiai dam (lock type)
6. Šventoji River - Fish pass on the Kavarskas dam (concrete basins type)
7. Jūra River - Fish pass on the Tauragė dam (lock type)
8. Venta River - Fish pass on the Jautakiai dam (concrete basins type)
9. Venta River – Fish pass on the Rudikiai dam (concrete basins type)
10. Venta River – Fish pass on the Viekšniai dam (cascading concrete-stone pools with stone rapids)

11. Venta River - Fish pass on the Kuodžiai dam (concrete cascading basins)
12. Minija River - Fish pass on the Grąžčiai dam (concrete-stone natural channel-like cascading pools)
13. Sausdravas River - Fish pass on the Žlibinai dam (concrete rectangular basins)
14. Agluona River - Fish pass on the Agluonėnai dam (concrete long channel with screens)
15. Šventoji River (Coastal) - Fish pass on the Laukžemė dam (concrete pools with walls)
16. Šyša River - Fish pass on the Šilutė dam
17. Viešvilė River – Fish pass on the Viešvilė dam (stone-concrete natural-like channel)
18. Viešvilė River - Fish pass on the Gulbinai dam (concrete channel with walls)
19. Vilnia River – Fish pass on the Belmontas dam
20. Vilnia River - Fish pass on the Rokantiškiai dam (concrete rectangular basins in cascade)
21. Jusinė River - Fish pass on the Jusinė dam (stony channel with stone rapids)
22. Siesartis River - Fish pass on the Valtūnai dam (cascading stone-concrete pools)
23. Kražantė River - Fish pass on the Kelmė dam (concrete rectangular pool channel)
24. Žalesa River - Fish pass on the Skirgiškis dam (stone-concrete pools)

POLAND

1. Ina River - Construction of 28 fish passes (including the modernization of two existing); construction of artificial spawning ground; forestation of 23 km of the river bank in order to improve the ecological effect of the undertaking; evaluation of the environmental resources of Ina River basin
2. Rega river - Construction of 23 fish passes; installation of fish monitoring devices; installation of devices for directing fish behavior; electro-electronic barriers; construction of artificial spawning grounds for Salmonids; afforestation of 47 km of river banks
3. Kwacza River - Restoration and protection of spawning grounds on river sections earlier drained and damaged by human activity; re-naturalization of selected regulated river sections; complete restoration patency for fish at the water node in Słupsk
4. Parseta River – Organisation of educational workshops directed at local community for protecting the river and its fishes, seen as a long-term intervention for river restoration
5. Parseta River valley - Demolition of existing water thresholds and implementation of a cascade of natural stones; active habitat protection (combating poaching, counteracting threats, limiting fishing pressure); inventory of spawning grounds
6. Płutnica River - Evaluation of the natural features and conditions of particular river sections for the needs of migrating fish species and development of methods for their revitalization
7. Biała Tarnowska River – Removal of fish migration barriers; delimiting river channel migration zone in order to increase channel retention in high-flow events; restoration of natural riparian habitats; reintroduction of Atlantic Salmon by selecting potential stocking sites
8. Gowienica River - Restoration of spawning grounds and connectivity at Widzeńsko wire
9. Drawa River - Restoration of riverine habitats

SWEDEN

1. Muskån River - Construction of new reach road 73, habitat improvement, new spawning areas and holding spots
2. Muskån River - Demolition of a dam at Hammersta farm

3. Muskån River – Conversion of culvert to a larger culvert, lowering it and creating a natural bottom; habitat improvement measures close to the culvert; restoration of a wetland upstream to make the river flow more natural
4. Vaskabäcken River - Conversion of culvert to a larger culvert, lowering it and creating a natural bottom
5. Moraån River - Fish ladder of concreate tubes constructed at the Järna dam
6. Husbyån River – Construction of concreate fish pass (fish ladder)
7. Bergshamra River - Habitat improvement measures; reintroduction of trout
8. Muskån River – Construction of fish pass (salmon ladder) at Fors mill
9. Muskån River - Construction of fish pass (salmon ladder) at Vretafors
10. Muskån River - Construction of a natural lake outlet

DENMARK

1. Villestrup River - Removal of seven barriers at fish farms
2. Gudenaa River - Removal of barrier at a former hydropower plant
3. Gudsø Møllebæk River - Removal of barrier at a former hydropower plant
4. Kolding River - Removal of barrier

RUSSIA

1. Seleznevka, Tchornaja and Gladyshevka Rivers - Removal of old dams on rapids of river Seleznevka, restoration of spawning and growing sites in rivers Tchornaja and Gladyshevka