A European national river continuity restoration policies review

The network for best practices of river restoration in Greater Europe

ECRR

European Centre for River Restoration

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C. (Clara) Schmidt, B. (Bart) Fokkens

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ECRR
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OFB
OFFICE FRANÇAIS DE LA BIODIVERSITÉ

ICPDR IKSD
International Commission for the Protection of the Danube River
Internationale Kommission zum Schutz der Donau

Wetlands INTERNATIONAL

Radboud University

The James Hutton Institute

Swedish Agency for Marine and Water Management

Colophon

COLOPHON

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Design	Shapeshifter.nl | Utrecht
Photography	Jukka Jormola, ECRR

ISBN/EAN	978.90.903.7359.1
ECRR publication number	3
STOWA report number	2023-14
STOWA project code	443.330

Cite as

Schmidt, C., Fokkens, B. (2023). A European National River Continuity Restoration Policies Review European Centre for River Restoration (ECRR). ECRR publication number: 3, STOWA report number: 2023-14

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1 Introduction

Rivers are beneficial to society by the biodiversity and ecosystem goods and services that they provide. They enable us to drink clean water, harvest plants and animals, travel, and transport, remove waste and generate renewable energy (Richter et al., 2010). Besides, the mitigation of floods and droughts, maintenance of food webs, and delivery of nutrients and sediments to coastal estuaries are some of the ecosystem services that rivers provide (Richter et al., 2010). There are many more recreational, aesthetic, cultural, and spiritual direct and indirect benefits from rivers that are hard to express monetarily. Nevertheless, the economic value of rivers has been estimated by a team of ecologists and economists in the mid-nineties. They estimated rivers and lakes together to be worth $8,500 (or more than €7,000) per hectare per year, mostly due to the regulation of the hydrological cycle and the provision of water supplies (Costanza et al., 1997). This shows that rivers are valuable and therefore, should be protected from factors that affect their goods and services.

Barrier construction is identified as one of the factors that threaten the values provided by rivers (Brevé et al., 2014). River barriers, including dams, weirs, culverts, fords, sluices, and ramps or bed sills, are artificial obstacles that are installed in rivers for specific, mostly provisional, ecosystem services such as flow regulation, hydropower generation, water level control or erosion reduction (AMBER Consortium, 2022). Other functions include transport (navigation), recreation, water storage for agriculture (irrigation) and drinking water, flood protection, and cultural heritage. However, they obstruct a river, disrupting the longitudinal flow of the water, sediment, and aquatic biota, preventing the existence of river continuity. Next to the longitudinal continuity, there exists three other dimensions of river continuity: the lateral, the vertical, and the temporal. The lateral continuity describes the connection of the riverbed to its floodplains and riparian areas, the vertical continuity the connection of the river to the groundwater and the atmosphere, and the temporal continuity the seasonality of flows (Datry, Fritz, & Leigh, 2016). However, this study concentrates on the longitudinal river continuity (connectivity between up- and downstream) in the light of fish migration, sediment transport, and habitat connectivity within rivers.

The many placements of artificial barriers in rivers worldwide in the twentieth century have disconnected the upstream freshwater habitats from the oceanic habitats (Dynesius & Nilsson, 1994). Obstructing a river can vastly alter ecosystem properties such as water depth, flow regimes, channel morphology, sediment loads, chemical properties, and thermal conditions (Dynesius & Nilsson, 1994). The disruption of river continuity has been shown to result in a major decrease in species diversity, as well as population declines and even extirpation of freshwater fishes and mammals (Morita & Yamamoto, 2002). Comparing pre- and post-impounded systems has revealed that substantial reductions in the number of species within these systems across the basin occur (O'Hanley et al., 2020). Migratory fish and other aquatic fauna can often not pass river barriers and are thus confined to the parts of the river that are situated in between the barriers (Morita & Yamamoto, 2002). Salmonids and anguillids have a great cultural and economic value, with the latter being of great importance due to the high market value of glass eels (Drouineau et al., 2018). However, due to barriers in the rivers, the populations of these fish species have declined, and so has their economic revenue (Kruse & Scholz, 2006). Barriers detain fish from reaching their spawning grounds and turbines in barriers can result in direct mortality (Drouineau et al., 2018). On top of that, many indirect impacts by barriers are mentioned by Drouineau et al. (2018), such as over-predation, overfishing, stress, diseases, and selective pressure. The Living Planet Index reports that the global migratory freshwater fish populations have declined by 76%, and specifically in Europe there has been a decline of 93% over the past five decades (Deinet et al., 2020).Only 37% of rivers around the world that are longer than 1,000 kilometers are still free flowing (with a connectivity status index (CSI) ≥ 95%) and only 23% flow into the ocean without interruptions (Grill et al., 2019). Equipping river barriers with efficient fish passes, such as fish ladders or lifts, and installing bypass channels improves connectivity mainly for fish migration, whilst removing the barrier completely restores the entire river continuity. River continuity restoration will help to prevent the extinction of diadromous fish species and to achieve the relevant water legislation targets and UN Sustainable Development Goals. However, to reach the goals of the respective legislations, it is of importance how they are translated into actions in practice. Therefore, the current situation in different countries must be understood. National legislations can differ among countries, even within a collaboration overarching various countries, such as the European Union.

For EU member states the **Water Framework Directive (WFD)** is an essential driver to restore river continuity. It is an EU water legislation which commits European Union member states to achieve qualitatively and quantitatively good ecological and chemical status of all water bodies in the EU, or good ecological potential for heavily modified or artificial water bodies. The ecological and chemical status of water bodies are assessed according to their biological, hydromorphological, and chemical quality. Undisturbed river continuity is an important hydromorphological element that determines the ecological status or potential of a river (Mader & Maier, 2008). The WFD also states that because some River Basin Districts (RBDs) exceed national borders, management based on the natural geographical and hydrological unit (river basin) is essential instead of an orientation on the administrative and political boundaries (EC, 2000a). Therefore, each RBD needs to have a River Basin Management Plan (RBMP) for every six years. They are a means of achieving the protection, improvement, and sustainable use of the water environment across Europe. The WFD was adopted on the 23rd of October 2000 and came to force on the 22nd of December in that same year. Although the original plan aimed to achieve the goals by 2015, the goals starting from 2002 after three planning and implementing cycles remain unchanged for 2027.

The **Floods Directive** of the 23rd of October 2007 on the assessment and management of flood risks requires Member states to assess if their water courses and coast lines are at risk from flooding, to map the flood extent as well as assets and humans at risk in these areas, and to take adequate and coordinated measures to reduce this flood risk (EC, 2007). The Floods Directive foresees six-yearly cycles aiming to reduce the risk of flood damage in the EU. The first cycle of implementation was 2010- 2015. The second cycle of implementation covered the period 2016-2021 and the third cycle covers 2022-2027.

Besides the WFD for EU member states, any UN member state can ratify the **United Nations Economic Commission for Europe (UNECE) Water Convention on the Protection and Use of Transboundary Watercourses and International Lakes** (UNECE, 1992). This is an international legal instrument and intergovernmental platform which aims to ensure the sustainable use of transboundary water resources by facilitating cooperation between parties that border the same waters (UNECE, 2020). The Water Convention works towards achieving the **Sustainable Development Goals (SDGs)** of the 2030 Agenda for Sustainable Development. The agenda commits to a worldwide elimination of poverty and achievement of sustainable development by 2030 by among other things directly supporting the implementation of target 6.5 which requests all countries to implement integrated water resource management with appropriate transboundary collaborations. The adoption of the 2030 Agenda was a milestone providing a shared global vision of sustainable development for all (UNECE, 2020).

The **EU Biodiversity Strategy for 2030** has been published on the 20th of May 2020. It is a long-term plan that will be used to protect nature and change the course of ecosystem deterioration by recovering Europe's biodiversity (EC, 2020b). Since the Biodiversity Strategy has been accepted recently, it already includes plans for the international negotiations regarding the global post-2020 biodiversity framework in the post-pandemic context. It aims to improve the resilience of the society to future threats that we see today: climate change impacts, forest fires, food insecurity and disease outbreaks (EC, 2020c). One of the goals that the Biodiversity Strategy commits to is restoring 25,000 kilometers of rivers to be free-flowing rivers by 2030. This is planned to be done primarily by removing obsolete barriers and restoring floodplains and wetlands.

Natura2000 is the largest coordinated network of protected areas around the world, stretching over 18% of the land in the 27 countries of the European Union and 8% of their marine area (EC, 2020d). Europe's most valuable and threatened species and habitats (listed under the Birds Directive and the Habitats Directive) are protected with this network, ensuring their long-term survival (EC, 2020d). The Member States are required to protect the designated sites and ensure that they are managed ecologically and economically sustainable. Some free-flowing river stretches, but also some wetlands and lakes resulting from dam constructions are classified by Natura2000, due to their value for birds or other animals or plants (Drouineau et al., 2018).

The **EU Taxonomy Regulation** was published in the Official Journal of the European Union on 22 June 2020 and entered into force on 12 July 2020. It establishes the basis for the EU taxonomy by setting out 4 overarching conditions that an economic activity has to meet in order to qualify as environmentally sustainable. The Taxonomy Regulation establishes six environmental objectives

1. Climate change mitigation
2. Climate change adaptation
3. The sustainable use and protection of water and marine resources
4. The transition to a circular economy
5. Pollution prevention and control
6. The protection and restoration of biodiversity and ecosystems

Different means can be required for an activity to make a substantial contribution to each objective.
Under the Taxonomy Regulation, the Commission had to come up with the actual list of environmentally sustainable activities by defining technical screening criteria for each environmental objective through delegated acts. A first delegated act on sustainable activities for climate change adaptation and mitigation objectives is published on 9 December 2021 and is applicable since January 2022. A second delegated act for the remaining objectives will be published in 2022, while others will follow.

Although river continuity restoration is specifically mentioned in the Water Framework Directive, it is just one part of Fresh Water Ecosystem Restoration. River biota restoration encompasses habitat restoration in the four dimensions and not only longitudinal, but also lateral, vertical and temporal. Because the EU Directives do not yet prescribe and support this, it is not yet included in the national water and restoration laws and is not part of this review.

The ECRR is a supporting partner of the **UN Decade on Ecosystem Restoration** and wants to use the movement to promote its plan and supporting activities, especially concerning the longitudinal hydro-morphological continuity. The ECRR's view is that whilst there is a considerable body of evidence and a range of benefits, there is in most countries still no integrated programmed approach to river continuity restoration. However, there are many ongoing and finished projects concerning restoration of river continuity, but the (best) practices part of river continuity restoration and the dissemination of such restoration measures is still underexposed. Therefore, the ECRR has chosen river continuity restoration as a guiding theme for its promotion plans and supporting activities as part of the support to the UN Ecological Restoration Decade movement.

In 2021, the Dutch Foundation for Applied Water Research (STOWA) conducted a study commissioned by the European Centre for River Restoration (ECRR). The study was a pan-European survey to investigate the current situation regarding the policies and strategic planning of river continuity restoration in the Greater Europe. The aim of the ECRR/STOWA survey was to create an overview on the status and potential of longitudinal river continuity restoration within Europe including the availability and use of national policies (Verheij, Fokkens, & Buijse, 2021).

The present, also STOWA/ECRR study, has the goal to investigate selected ***national European river continuity restoration policies in-depth*** *providing various country organisations information and knowledge for making, improving and updating concerning new requirements, the laws and regulations for river continuity restoration. Similarities and differences as well as the completeness and effectiveness of the single policies were identified to determine if it is possible and useful to create a general policy framework for river continuity restoration. Existing issues as well as successful functions of the river (continuity) restoration policies of the single countries are analysed, discussed and recommendations on what an effective and complete policy should entail are given.*

STOWA is a knowledge center of the regional water managers in the Netherlands - the Dutch Water Authorities. STOWA develops, gathers, distributes, and implements applied knowledge that water managers need to properly carry out their profession. The ECRR is an association forming a European collaboration network that encourages and supports best practices in ecological river restoration. They do so by collecting and disseminating information on the ecological restoration of rivers and their floodplains across Europe, which influences decision making and the perspectives of researchers, NGOs, practitioners, and policymakers. They support the implementation of the EU Water Framework Directive, Flood Directive, UN Sustainable Development Goals, UNECE Water Convention, the Convention on Biodiversity, as well as national policies. Moreover, the ECRR has chosen for several years river continuity restoration as a guiding theme for its promotion plans and supporting activities.

This study was also enabled by STOWA and ECRR.

2 Method

2.1 LITERATURE AND POLICY REVIEW

Several European country representative water professionals were contacted and asked if they could provide the national river restoration policy of their country or the path to locate it. Not all contacted countries replied but most of them did and out of them 10 provided their national policy. Literature research on river continuity restoration policies in Europe and on what makes a good policy in general was conducted. The platforms *ResearchGate, Science-Direct, Web of Science*, and *Google Scholar* were used for the search. Based on the result of this literature research as well as on the results of the 2021 survey by the ECRR/STOWA, a list of categories and sub-categories that a complete policy should contain was created and used to perform a detailed investigation of the received national policies.

Policies were received from the following countries:

- Austria
- Finland
- France
- Germany
- Lithuania
- The Netherlands
- North Macedonia
- Norway
- Slovakia
- Spain

The policies as well as additional material on them which was provided by the country contact persons were translated into English by utilising the Google Document Translate tool. Subsequently, all the material was read and information on the single categories and sub-categories for each country collected in an Excel sheet. Even though the obtained information was verified by the country contact person through a presentation of the first findings in a country group meeting, subsequent email contact, and in the interviews for the selected countries, it cannot be denied that a certain language barrier remained.

From the 2021 ECRR/STOWA study, survey conclusions and recommendations were drawn for three different stakeholder target groups; those who are dealing with policies and planning, the implementers, and the researchers. The recommendation for the policymakers and planners is to use the following outlines to check the status and development of their existing national policy framework regarding river continuity restoration:

a. The barrier database
b. The prioritisation of basins, catchments, waterbodies, and barriers
c. The prioritisation of one or more barrier removals in river basins, catchments, or waterbodies
d. The country-specific available plans and measures to be used
e. Funding and financial instruments
f. Technical knowledge and expertise
g. Technical guidance and support
h. Monitoring and evaluation
i. Public participation
j. Awareness raising

These categories (a - j) were used as the starting point from which a list of categories and sub-categories was created which was then used to investigate the national policies. During the literature search on policy analysis, the "Australian policy cycle" created by (Althause, Ball, Bridgman, Davis, & Threfall, 2022) was discovered and found useful due to its descriptive and prescriptive nature. The Australian policy cycle entails the following stages:

1. **Identifying issues**-recognising a problem and defining it as an agenda for public policy;
2. **Policy analysis**-gathering information to frame the issue and help decisionmakers understand the problem;
3. **Policy instruments**-identifying appropriate tools and approaches to address the problem;
4. **Consultation**-discussions and interaction with relevant agencies and interest groups to test ideas and gather support;
5. **Co-ordination**-ensuring funding can be made available to implement the policy, and coherence and consistency exists with the overall government direction and other existing and planned policies;
6. **Decision**-confirmation of policy by government, usually via Cabinet consideration;
7. **Implementation**-giving expression to the decision through legislation or a programme designed to achieve goals agreed by Cabinet;
8. **Evaluation**-reviewing the effects of a policy and adjusting or rethinking its design.

It is descriptive in the sense that it explains distinct activities involved in policy development. At the same time, it encourages an orderly routine to help define the roles and respective responsibilities of all parties involved in a prescriptive manner. However, it is difficult if not impossible to determine when one stage of the policy cycle is complete and the next ought to commence. It is better to think of some stages, particularly gathering information and consultation, as ongoing processes that run through all the other stages. Furthermore, a staged model over-simplifies complex problem-solving processes that policy practitioners often describe as iterative. In general, policy making is to a certain part the craft of social problem-solving rather than a science of rational, empirical utility maximisation. Often, it is an incremental process since policy advising in democratic states aims at iterative change and continuous improvement rather than radical innovation and disruption of the status quo. The goal is evolution rather than revolution. (Althause et al., 2022)

Models such as the Australian policy cycle tend to focus on decision-making within government structures and examine in this sense a top-down approach. They do not capture well the influence of non-state actors on public policymaking or modes of engagement with citizens and communities other than consultation (bottom-up). Therefore, models of policy cycles serve a useful purpose but are not a whole portrayal of the policy making process.

Nevertheless, the following categories and sub-categories have been used for the analysis of each national river restoration policy:

(1) ***Issues identified*** *- recognising a problem and defining it as an agenda for public policy*
   - *a. Goal definition*
   - *b. River (continuity) restoration definition*

(2) ***Policy prerequisite*** *- gathering information to frame the issue and help decision-makers understand the problem*

(3) ***Policy instruments*** *- identifying appropriate tools and approaches to address the problem*
   - *a. Planning of measures*
   - *b. Barrier data base (existing, planned, removed, function, equipment)*
   - *c. Prioritisation method catchment (protected site, natural diversity and ecological condition, other social benefits)*
   - *d. Prioritisation of one or more barriers (largest environmental or ecological impact, easy to implement measures, lacking an operative fish passage, obsolete structures, relatively small barriers)*
   - *e. Available plans and measures to be used (adding a fish passage, barrier bypass channel, barrier removal, structural modification)*
   - *f. Technical knowledge and expertise*

(4) ***Consultation*** *- discussions and interactions with relevant agencies and interest groups to test ideas and gather support*
   - *a. Public participation*
   - *b. Awareness raising*
   - *c. Stakeholder forum*

(5) ***Financing*** *- ensuring funding is available to implement policy*
   - *a. Private funds*
   - *b. Regional/local government budget allocations*
   - *c. National government budget allocations*
   - *d. (Special) National funds*
   - *e. European funds*
   - *f. Principles and tools (e.g., Cost-benefit-analysis (CBA), Multi-criteria decision analysis (MCDA), polluter-pays-principle)*

(6) ***Decision*** *- confirmation of policy by government*

(7) ***Implementation*** *- legislation and/or a programme designed to achieve the goals agreed on by the government*
   - *a. Technical guidance and support*
   - *b. Top-down; Bottom-up; synthesis*

(8) ***Evaluation*** *- reviewing the effects of the policy and adjusting or rethinking its design*
   - *a. Monitoring*
   - *b. Evaluation*
   - *c. Adjustment*

(9) ***Linkage to EU WFD*** *- and other EU directives*

(10) ***Policy effectiveness*** *- ensuring that mechanisms, calibrations, and objectives display coherence, consistency, and congruence with each other*

2.2 INTERVIEWS

To get a better insight into the single river restoration policy situations of the participating countries, interviews with representatives of the water management sectors were organised. Preferably, at least one representative from the stakeholder group of policymakers and planners and one representative from the policy implementers group for each participating country was interviewed concerning the existing national river continuity restoration policy. The main aim of the interviews was to gather information as a basis for a discussion on the process of designing a

complete and comprehensive policy and what mechanisms are necessary for it to be effective. Furthermore, the interviews had the purpose to investigate how the policies work in practice. Each interview followed the same schema and contained the same main topics but the specific questions for each topic were tailored to the respective country.

(1) The opening question of the interview asks the interviewee to introduce themselves; in which institution and department they work, what their responsibilities are, and how their work is connected to river (continuity) restoration?
(2) Subsequently, the interviewee is asked how effective they rate their national river restoration policy and how they measure this effectiveness. For example, do targets exists and if so, are they met?
(3) The third topic regards the process of the policy design and the design itself; how was the policy created, who was involved and how, what were drivers and circumstances, was there a precursor of the policy?
(4) The fourth topic concerns the WFD; how is the national policy connected to the WFD?
(5) The fifth topic which is about the policy instruments, consist of sub-topics such as:
    - barrier data base - does it exists, which attributes does it contain, how was it created and how is it maintained?
    - prioritisation methods - how any by whom are rivers or river reaches and/or barriers prioritised?
    - restoration measures - which measures are mainly applied and why?
    - construction of new barriers - are new barriers being constructed and if so, why?
    - gathering and sharing of technical and ecological knowledge and project experience - does some kind of platform or network exist, are annual seminars and conferences organised, are there guiding publications?
    - Permits - for how long are they granted, do they come with requirements, how easy are they changeable; are they considered a tool or an obstacle for river restoration?
(6) The sixth topic deals with the stakeholder involvement; to what extend were stakeholders involved in the policy design, how was the policy introduced, does a general awareness of the topic exist, how and when are stakeholders involved in restoration projects?
(7) The seventh topic considers the financing; how are river restoration projects financed, does a governmental budget exists or are mainly EU subsidies used, (what is the amount) of financing, and how is the private sector involved?
(8) The eight and second to last topic regards the monitoring, evaluation, and adjustment; how is it done and in which frequency?
(9) The final question to the interviewee was to ask for their personal opinion; anything that they would like to add, what could be done better, what works well, any discrepancies between the theoretical policy and the practical implementation of river restoration projects, any general recommendations?

A time span of two hours was planned for each interview. The interviews were not expected to last that long but extra time was included in case an interesting aspect came up that needed elaboration. Due to time constraints, it was not possible to interview representatives of all the ten countries. The following countries were selected for interviews based on the result of the first findings of reading the national policies and the results of the 2021 study which are partly depicted in Figure 1:

- Austria
- Finland
- France
- Norway
- Slovakia

The four-quadrant matrix chart in Figure 1 shows the extent to which river continuity restoration in national policies is driven by political, ecological, and environmental drivers, and the extent to which river continuity restoration in

national policies is not conflicted by the barrier functions. Figure 1 is a result of the survey conducted by the ECRR/STOWA in 2021. To obtain a broad overview of the policy situation in countries with different circumstances, the aim was to interview countries from all four quadrants. The selection of countries which were chosen for interviews is based on the list of countries that provided their national river restoration policy and on the distribution of the countries in the four-quadrant matrix in Figure 1. The obtained information in the interviews in respect to the overall strategy and the different topics and items of the policy framework in use, was analysed and compared in its functioning and effectivity.

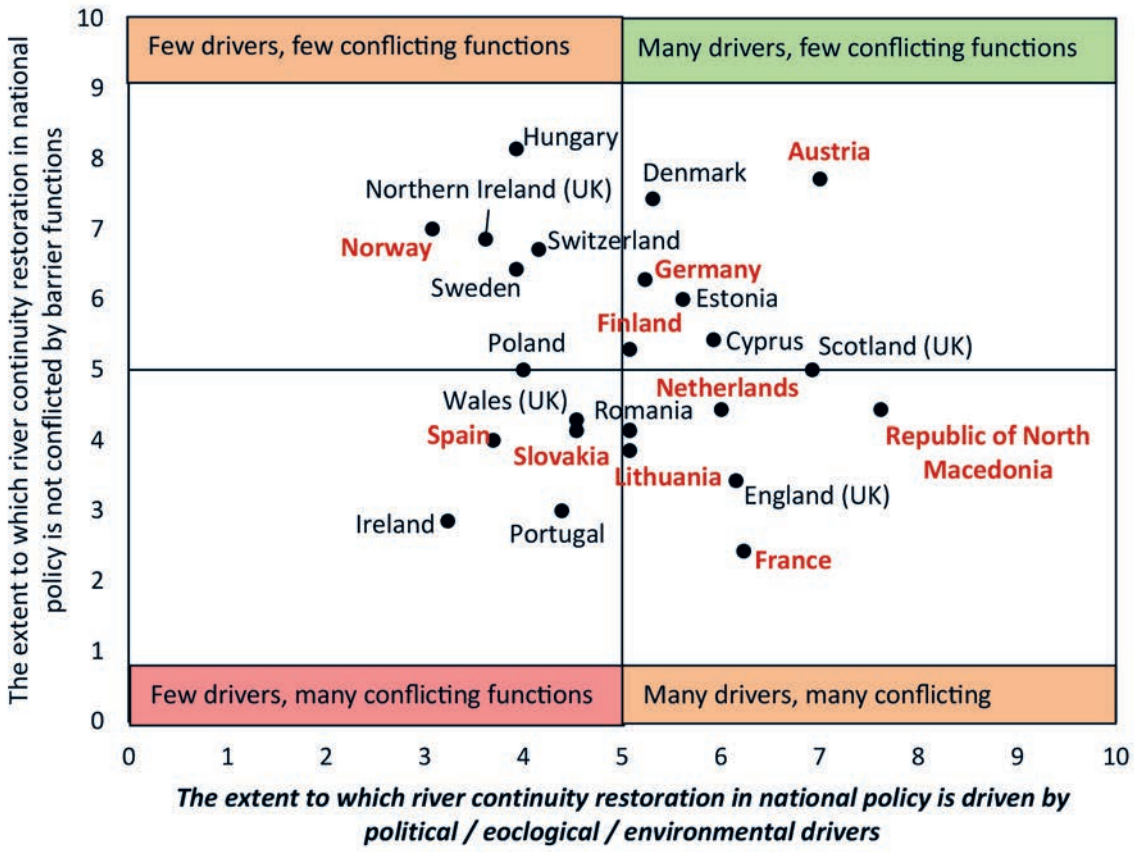

FIGURE 1

Four-quadrant matrix chart from 2021 study by ECRR/STOWA (Verheij, Fokkens, & Buijse, 2021), with in red the countries considered in this study as well.

2.3 COUNTRY REPRESENTATIVES MEETING

The first findings after reading the material on the national river restoration policies of the ten participating countries were presented in a country representative group meeting. This meeting was held online and had the goal not only to share the first findings but also to check if the obtained information was correct and to discuss questions on several topics that arose from these findings to gather more information and help structure the succeeding interviews. The topics on the agenda of the meeting were policy instruments, policy implementation, and policy

evaluation. Furthermore, the meeting provided a platform for water professionals from different countries to meet and exchange information and opinions on river restoration policies in general.

After the interviews with the water professionals of the five selected countries were completed, a summary for each country entailing the information obtained from reading the national policies and from conducting the interviews was compiled and sent to the respective country contact persons to give them the opportunity to fact-check but also comment on the summaries. The sent summaries also contained several questions at the end to collect the last missing information on each country as well as a list of EU policies and directives and the request to tick off the documents that played a role for the creation of the national river restoration policy. All country contact persons replied with their comments on the summaries and answers to the questions.

2.4 ADVISORY GROUP MEETING

An advisory group was created to discuss the findings and support the process of formulating recommendations. The first meeting with the advisory group occurred before the post-processing of the interviews was completed and therefore, the meeting concerned itself with the results of reading the national policies and helped to set priorities, to emphasise and to give new perspectives.

The second advisory group meeting took place after all interviews and their post-processing had been completed. The findings of the interviews were presented to the group, summarised under the categories of:

- Policy background and design
- Policy effectiveness
- Restoration tools
- Stakeholder involvement
- Financing
- Monitoring and evaluation

Subsequently, a discussion on possible recommendations this study could provide developed. The remarks and discussion results of both advisory group meetings were fundamental for determining the recommendations this study gives.

3 Results

3.1 EU POLICIES ON RIVER CONTINUITY RESTORATION

Directives are EU legal acts which set binding objectives to be achieved by the EU Member States to which they are addressed (Article 288 of the Treaty on the Functioning of the European Union). Member States can choose the form and methods for transposing directives into national law. However, they are bound by the terms of the directive as to the result to be achieved and the deadline by which the transposition should take place. National authorities must notify the European Commission of the measures they have adopted. The European Commission verifies the completeness and correctness of transposition of EU law into national law. (EU, 2023)

The European water policy was fundamentally reformed by the EU Water Framework Directive (WFD) in 2000. The WFD has the aim to improve the condition of aquatic ecosystems step by step and to avoid further deterioration. The Sustainable water use based on long-term protection of existing resources is to be promoted. The WFD defines ecological status as "an expression of the quality of the structure and functioning of aquatic ecosystems". Ecological status is further specified in Annex V of the WFD, with a set of quality elements to be used as indicators to classify high, good, and moderate status. For river water bodies, these include, besides biological quality elements and physicochemical supporting quality elements, hydromorphological supporting quality elements, namely: hydrological regime, river continuity, and morphological conditions. (EC, 2021)

The hydromorphological supporting quality elements are expressly defined for assigning a river water body to 'high' ecological status, and directly refer to totally (or nearly totally) undisturbed conditions. When it comes to river continuity in particular, the high-status definition explicitly refers to the absence of anthropogenic activities and to the undisturbed migration of aquatic organisms and sediments. This definition broadly corresponds to what could be generally understood as a free-flowing river. The WFD does not require the achievement of high ecological status, but rather of good ecological status. When it comes to hydromorphological quality elements, the WFD requires that the water body be in a condition that is consistent with the achievement of slightly impacted biological values. (EC, 2021)

In short, for a water body to be classified as in good ecological status, its hydromorphological condition must be such that the biological quality elements deviate only slightly from reference conditions that are derived from high status conditions. This implies the removal of all barriers that hinder the possibility for the river to achieve good status. However, the WFD also recognises the need to maintain some barriers that serve specific purposes (Article 4(3)), including inland navigation, flood defense, electricity generation or agriculture. If certain conditions are fulfilled, the concerned water bodies can be designated as 'heavily modified water bodies', and the alternative objective of 'good ecological potential' is set, which requires achieving a condition that is close to the "best approximation to ecological continuum". For these water bodies, it is not legally required to remove barriers, but it is mandatory to put in place mitigation measures to restore continuity as much as possible. Typical measures will include bypasses for fish and sediment, fish ladders, adaptation of the operation of infrastructures, in particular to ensure ecological flows, installations to prevent fish mortality, and similar measures. (EC, 2021)

To summarise, the WFD requires continuity for all EU river water bodies insofar as necessary to support the achievement of good ecological status, but not necessarily the complete absence of barriers. In fact, river continuity is already a key aspect of good ecological status. Removal or adaptation of barriers is part of the measures necessary to fulfil the legal obligations under the WFD. River continuity is also necessary to achieve the objectives of other EU legislation. For example, the Habitats Directive protects the European sea sturgeon Acipenser sturio, which needs to migrate between the sea and freshwater. The European eel, protected by the Eel Regulation15, also needs river continuity to survive. (EC, 2021)

Finally, the Biodiversity Strategy calls for a focus primarily on obsolete barriers. This term refers to barriers that no longer fulfil their original purpose or that are no longer needed. This could be, for example, a dam that is no longer useful for hydropower generation, water supply or flood protection, or a weir that no longer acts as a riverbed stabiliser because it is damaged or because the river has changed its geomorphological configuration and such infrastructure is no longer useful. When prioritising barriers for their possible removal, it will indeed be important to evaluate the role they might still be playing (although in this case the possible benefit of such future use needs to be assessed against the benefits of removing it for the sake of nature restoration), or the otherwise beneficial effect that such barriers may have (e.g., for biodiversity). This is to consider the need to maintain different important uses such as inland navigation, renewable energy generation or agriculture. The WFD already integrates provisions for such uses and sets rules to ensure the integration of different objectives. (EC, 2021)

3.2 AUSTRIA

Policy Background and Design

There exists a long tradition of water management in Austria. The viability of the ecology of aquatic ecosystems was for the first time mentioned in the Water Rights Act 1959 (WRG 1959). The WFD was transposed into national law in Austria with the Water Law Amendment 2003, Federal Law Gazette I No. 112/2003, which came into force on the 22nd of December 2003 (Federal Ministry Republic of Austria, 2023). Large parts were equally worded, e.g., Annex 5 of the WFD which describes the conditions for the ecological monitoring is congruent adopted. River basins are assigned to RBDs, which serve as an administrative framework for coordinated water body management. The river catchment areas in Austria were assigned to the three (international) river basin units Danube, Rhine, and Elbe. To make the processing manageable, Austria was divided into eight hydrologically defined (national) planning areas for coordination and processing. However, the practical significance of these planning areas has remained low because the basic water management issues and challenges are similar in all planning areas despite topographical, climatic, and other differences.

To achieve the goals and principles of the WFD, the responsible Ministry of Agriculture, Forestry, Regions, and Water Management must draw up and publish a National Water Management Plan (NGP) every six years in accordance with § 55c and § 55hWRG 1959 in cooperation with the water management plans of the federal states (Federal Ministry Republic of Austria, 2023). The NGP is a river basin-related plan in which the management goals to be achieved and the measures required for this are defined based on a comprehensive analysis of the current state of water use and pollution. After 2009 and 2015, the third NGP is now available, in which the management goals and the program of measures for the planning period 2022 to 2027 are updated (BMLRT, 2022). Since it is not clear how the European Commission (EC) will progress after 2027 by which all EU member states should have reached the goals set by the WFD, Austria decided to include all measures which were not implemented by the two previous NGPs, but which are necessary to theoretically meet the goals of the WFD, in the third NGP until 2027 to prevent an infringement proceeding. Therefore, the current NGP is all-encompassing but at the same time Austria is aware that it will be immensely difficult to complete all listed measures by 2027.

For the transposition of the WFD in Austria, several working groups were established. These working groups dealt with the different thematical topics as a preparation for the WFD implementation. All in all, there are five working groups with the topics of miscellaneous, ecology, chemical emissions and measurements, chemical surveillance and targets, and groundwater. They also issued the analysis of the current state of water use and pollution in 2006 (a first national report) and the first NGP in 2009. All of this happened in cooperation with the nine federal states of Austria since the execution of the NGP occurs on the federal state level. The working groups still exist today and meet up regularly to discuss the progress of the NGP. The working groups consist of representatives of ministries and federal states ("Bundesländer"), while experts from universities and other research institutions are invited depending on the topics dealt with. The NGP is legally not binding but the essential part (especially the tables with the planned measures) is published as an Act and thereby the federal states are obliged to realise these measures. Not all federal states, but in the last cycle five out of nine, published their own Restoration Acts that contain in detail which measures must be executed (e.g., where river continuity must be established inform of a fish passage). The federal state Acts can be enforced with legal instruments.

Policy Effectiveness

The third NGP identifies the issue of lacking river continuity by recognising that the disruption of the water course continuum results in habitat fragmentation and isolation (BMLRT, 2022). Furthermore, it states that migration obstacles can have a local adverse effect in form of missing target species but also a supra-regional effect on other water bodies since transverse structures limit the natural transport of sediment in water bodies (BMLRT, 2022). This entails long-term negative developments, such as e.g., deepening of the riverbed which can lead to a hydrological

decoupling of floodplain areas. The change in the sediment transport balance can affect the water body morphology and thus lead to the loss of suitable habitats. The current NGP expresses further that the interconnection of habitats is a prerequisite for the establishment and long-term security of self-sustaining, stable populations (BMLRT, 2022). Therefore, the goal is to maintain and restore river continuity with the tool of awarding and re-awarding permits. In addition to maintaining and restoring continuity in this way, the targeted creation of upstream fish passability by renovating existing migration obstacles is to be continued in the third NGP (BMLRT, 2022).

Restoration Tools

Austria maintains a barrier data base as part of a hydromorphological data base which also contains other parameters next to these connected to transversal barriers. The data base is usually up to date because it is maintained through a daily use by the water professionals of the federal states. The data base entails the following attributes of a barrier: the location (coordinates), the type and function (hydropower, flood protection, etc.), the equipment (fish passability), and if it is a natural or artificial barrier. A total of 28,435 impassable artificial transverse structures, longitudinal elements and residual water stretches were surveyed in the watercourses. 95% of these obstacles to migration are due to transverse structures, only a few to non-passable longitudinal elements (e.g., shooting sections, piping). Approx. 80% of all migration obstacles are in catchment areas < 100 km^2 and mostly in the headwaters since they are mainly used for flood protection and sediment retention (BMLRT, 2022). A total of 9,722 km of watercourses were rated as "significantly structurally altered", which corresponds to 30.3% of the entire river network (BMLRT, 2022). The overall length of the structurally modified routes is slightly higher compared to 2015. However, this does not result from new interventions, but is methodologically due to new or more detailed surveys. In Austria, catchments are separated by their size in two groups of areas > 100 km^2 and < 100 km^2. In the first NGP from 2009, it was decided that measures in catchment areas > 100 km^2 or in the water bodies of the Hyporhithral and Epipotamal fish regions will be prioritised in the first cycle, as these areas are home to an increased number of fish species that are dependent on migration. In general, there exists a prioritisation from big to small in terms of catchment size and from down to upstream in terms of river stretches. There are no long-distance migratory fish species present in Austria, but the middle-distance migratory fish species that do exist shall have the possibility to migrate within the big catchments. Many measures from the first NGP were completed in the first cycle. In the second NGP, the remaining measures from the first NGP as well as additional measures were planned. However, during the period of the second NGP not many measures were completed due to financial reasons. Therefore, the current and third NGP contains many measures from the previous one as well as measures on smaller streams.

Due to the high number of migration obstacles in the watercourses, it was necessary to set priorities for the restoration of continuity. The prioritisation of barriers is based on ecological criteria, with the focus being on the distribution of particularly endangered fish species (medium-distance migratory fish), followed by the willingness of the local community and the situation of ownership. Furthermore, the ecological effect of the measure depending on the length of the to be restored continuity stretch of water and the accessibility of suitable habitats upstream in tributaries are considered. Remediation was started on the lower reaches of the watercourses, specifically where improvements were expected to have a particularly high ecological impact on endangered fish species such as nase, barbel and huchen. If possible, joint implementation with other measures in the field of morphology and hydrology according to higher-level planning (e.g., use of synergies with flood protection projects) are sought for. When it comes to prioritisation, synergies with flood protection are especially being considered. On the one hand, this has financial reasons since there exists a sufficient budget for flood protection. On the other hand, there has been a development in flood protection approaches over the last years which makes it possible to unite river (continuity) restoration and flood protection measures. When talking about river continuity restoration in Austria, fish migration is usually the focal point. However, sediment transport is gaining more importance and will be a big issue in the coming years.

The proportion of obstacles to migration caused by hydropower generation is 11%. There are also obstacles to migration due to fishing (1.4%) and agriculture and forestry (1.3%) (BMLRT, 2022). Leisure use/tourism as well as

industry and commerce and other causes each make up less than 1% of all obstacles to migration (BMLRT, 2022). All other migration barriers exist because of river engineering measures due to flood protection (approx. 85%). So far, hydropower generating dams are not being removed. However, the urban flood protection dams are being deconstructed or modified where possible (e.g., ramps which were constructed for energy removal). To create continuity in the water bodies, fish ladders were built at existing and new hydropower plants, fall structures were converted into ramps and rivers were reconnected to their tributaries. In connection with increasing residual water levels to create passability for fish, these measures increased the chance of meeting all targets. In the large rivers in particular, bypass channels were often built to ensure continuity, which at the same time also bring about significant improvements in the habitat.

In general, river continuity is playing a role for the allocation of water permits. Water permits allocated before 1990 were granted for 100 years but they are rare these days. Now, permits are usually granted for 30 years but sometimes for shorter periods, also. They can entail requirements to maintain or restore the impeding structure according to the state of the art. However, the state of the art is not something that is officially decided upon, but which falls into the scope of discretion of the local experts. In 2012, the BMLFUW (Federal Ministry of Agriculture and Forestry, Regions, and Water Management) published guidelines for the planning and construction of state-of-the-art fish passage structures as well as promising new structures which are not state of the art (yet). The guide is intended to support the planning of fish passages. It contains criteria which regulate the operation and maintenance, ensure that the fish passages are functional, and that the upstream fish migration is largely (re)established. The guide contains essential planning and dimensioning criteria without detailed technical instructions for the construction. A revised and updated new edition of the guide was published by the BMLRT in June 2021. The exchange of other relevant information such a project experiences are shared in the NGP working groups.

Stakeholder Involvement

The NGPs were published in the realm of a public participating program as demanded by Art. 14 of the WFD which provides for public participation in the implementation of the directive and the preparation of management plans. According to this, hearing phases, each lasting 6 months, are to be carried out at various points in the planning process. In addition, to promote the active participation of all interested parties, the Ministry creates a first draft version of the NGP and sends it to the federal states which comment on it and send it back. In this way the NGP is being modified until a final version is drafted which is then made public one year before it is supposed to become effective. Intensive public participation was already carried out with the first two NGPs, in the course of which 379 and 78 statements were submitted (BMLRT, 2022). The draft of the 3rd NGP was published on March 22, 2021. The draft of the NGP was followed by an environmental report for the strategic environmental assessment, which describes the likely effects of the planning and contains an assessment of alternatives. On the day the NGP draft was published, it was presented to the public in an online event, thus starting the six-month phase of public participation. About 700 people followed the live stream on YouTube, numerous other interested people via www.wasseraktiv (BMLRT, 2022).

To involve the public also in the implementation phase of the planning period up to 2027, further public communication is planned. For example, based on the experiences of so-called "river dialogues" that have already taken place in some federal states, a new concept for a "river dialogue 2.0" was developed with a focus on the main targets of the third NGP, which shall primarily take place on social media, which are used more and more intensively for regional topics (BMLRT, 2022). The stakeholders and the interested public are to be networked via online channels for the respective priority projects and informed and questioned about them. In the first pilot phase, such river dialogues will be carried out on the rivers Salzach, Krems and Raab. Since 2005, the "Water Round Table" has been an important tool for public participation. Representatives of nationwide organisations and associations from the fields of business, agriculture, municipalities, fisheries, environmental organisations, water supply and water protection take part in the round table. The aim of the round table is the active participation of the representatives of

relevant social sectors in the development of national water management and the improvement of mutual understanding even with different interests. The draft of the third NGP was discussed on September 15th (2021) as part of the Round Table on Water in the BMLRT (BMLRT, 2022). In general, the Ministry of Agriculture and Forestry initiates public relations activities that aim to place the topic of water management and river restoration in the media.

Financing

There is a national budget for hydromorphological restoration of water bodies which is approved by the government for the six years of the river basin management plans. The third and current NGP has a budget of €200 million. In the previous two NGPs the total budget was €270 million which was to 2/3 utilised by hydropower owners and to 1/3 by municipalities and associations (BMLRT, 2022). As part of the Environmental Promotion Act, almost 900 measures to ensure continuity were funded in the first two planning periods (BMLRT, 2022).

Monitoring and Evaluation

According to Article 8 of the WFD, water status monitoring programs must be established to obtain a coherent and comprehensive view of the water status in each river basin district. The national legal implementation of these requirements took place in 2003 in the seventh chapter of the WRG 1959. Regarding the objectives, 3 types of monitoring programs are distinguished (BMLRT, 2022).

Overview monitoring (§ 59e WRG 1959):

- Completion and validation of the impact analysis (risk assessment)
- Efficient design of future monitoring programs
- Assessment of long-term changes in natural conditions
- Assessment of long-term changes due to extensive human activities

Operational monitoring (§ 59f WRG 1959):

- Status assessment of those water bodies that may not achieve the applicable environmental objectives based on the results of the as-built analysis
- Evaluation of all changes resulting from programs of measures
- Determination of water status regarding bilateral obligations

Monitoring for investigative purposes (§ 59g WRG 1959):

- Information compression, e.g., for the creation of programs of measures

There exist about 100 monitoring stations where all parameters a measured for the overview-monitoring. The EC criticises that the number of monitoring station is too small and does not include standing water bodies. The operative monitoring occurs on locations where only once or twice and only certain parameters are measured either as a prerequisite for planned projects or for the evaluation of completed projects. The investigative monitoring is being conducted by the federal states as an investigative tool for occurring problems. The national government finances monitoring to 2/3 and the federal states to 1/3.

In general, the federal state in cooperation with the Ministry of Agriculture and Forestry are the initiators of restoration projects. Local communities often initiate projects where a synergy of flood protection and river restoration measures are being implemented. According to the country contact person, the Austrian water policy is very effective. The obstacle is mainly the political implementation and the financing. Most projects are being financed by subsidies which are limited. The document itself is very comprehensive and effective. The current NGP is the third and last since it is planned to complete all measures by 2027.

Summary of the main characteristics

Goal: *maintaining and restoring continuity; creation of upstream fish passability by renovating existing migration obstacles*

Instruments:

- *Barrier data base (total of 28,435 barriers, approx.. 80% in catchment areas < 100 km²*

existing	planned	removed	function	obsolete	equipped
X	-	-	X	-	-

- *Prioritisation Water Body*
  - *Larger catchment areas (>100km²) and Hyporhithral and Epipotamal fish regions of high priority*
  - *Catchment areas (<100km²), where cost-effective continuity with high impact on fish biocenoses can be implemented*
- *Prioritisation barrier*
  - *On lower reaches of water courses, specifically where improvements are expected to have high ecological impact (accessibilityof habitats and spowning grounds)*
  - *Joint implementation with other measures (e.g., use of synergies with flood protection projects*
- *Plans and measures*
  - *Fish pass construction at existing and new hydropower plants*
  - *Conversion of weirs into ramps, build bypass channels*

Implementation:

River basins are assigned to the three (international) river basin districts Danube, Rhine and Elbe, which serve as an administrative body for coordinated water management

- *Austria divided into eight hydrological defined (national) planning areas*
- *Implementation of measures ranked according to ecological criteria*
- *A pro-active planning of river restoration including river continuity restoration measures with limiting resources (finances)*
- *Effective pragmatic bottom-up (planning) approach with limited funds and a strong focus on fishmigration and spawning and a call for eco-labelled electricity*

Evaluation: *distinction between overview-, operational-, and investigative-monitoring*

3.3 FINLAND

Policy Background and Design

Finland has a long history of water management legislation. The first Water Act was published in 1902, the second one in 1961 and the third and current on in 2011 (Allan, 2011). Although Finland's general compliance with the reporting requirements of the Water Framework Directive (WFD) has been good, it has been criticised by the European Commission (EC) for failings in the substantive transposition of the WFD, especially during the first years after its coming into effect. This situation has changed over the last years. The goal of the Water Restoration Strategy from 2013 is to strengthen and align actions to promote water restoration, describe good procedures and clarify the role of different actors (Ministry of the Environemnt, 2013). Albeit the Water Act from 2011 and the Water Restoration Strategy from 2013 are national plans based on the WFD, Finland has had problems implementing the environmental objectives of the WFD partly because of transposing legislation but also because of a lack of official monitoring. The Ministry of the Environment and the Ministry of Agriculture and Forestry are the two superior responsible authorities for the water management in Finland. Members of both ministries form the National Coordination Group which is accountable for the coordination of the 7+1 River Basin Districts (RBD) of Finland (Markku, 2016). There exist five national, two international and one independent RBD. The two international RBD are coordinated by a joint border water commission with Sweden, Norway, and Russia. The National Cooperation Group finances the Finnish Environment Institute (SYKE) and the Ministry of Agriculture and Forestry funds the Natural Resource Institute Finland (Luke), both institutes conduct research in water management and provide guidance for the coordination of the RBD (Markku, 2016). For example, SYKE maintains its basic expertise in collecting and maintaining national and international restoration data, national guidance on water restoration, maintenance of information systems, expert support, and development of restoration methods (Finnish Environemntal Institute, 2023). The Luke is a research and expert organisation that is responsible for the monitoring of fisheries, data collection, and the production of information and alternative solutions for society's decision-makers, businesses, and other operators (Natural Resource Institute Finland, 2023).

Nex to the RBD, Finland is divided into water management regions, which are governed by the Centers for Economic Development, Transport, and the Environment (ELY centers). The ELY centers form regional cooperation groups and subgroups with municipalities, enterprises, local authorities, citizens, Universities, and other local actors. To reach the Finnish water management goals, the River Basin Management Plans (RBMPs) were created in RBD steering groups with representatives from all stakeholder groups. On the 10th of December 2009, the State Council approved the RBMPs for the seven RBD covering the whole of mainland Finland for the first time and issued a statement regarding the decision, in which it required a water management implementation program and later a monitoring system for measures to be drawn up as a broad-based collaboration (EC, 2023). The current RBMP covering the years 2022-2027 was approved on the 16th of December 2021. The implementation of the RBMPs is expected of the municipalities, enterprises, local authorities, citizens, and other local actors (e.g., water and landowners) as well as of government organisations. The goal is to carry out the renovations mentioned in the RBMPs with multiple objectives so that a good ecological and chemical state is achieved in rivers, lakes and coastal waters, the usability of the waters is improved, and biodiversity is supported.

Members from the economic development department and from the environment department of the ELY centers as well as a member from the Ministry of Agriculture and Forestry were interviewed within the scope of this study. The ELY centers mainly provide the funding for restoration projects and try to initiate them, but they are generally not the executers. There are overall 15 ELY centers in Finland of which 13 ELY centers have an environmental department. The environmental departments have the regional authority task to supervise the adherence of the Water Act from 2011 which regulates the use of the water resource as well as restoration activities (Finish Government, 2023). The economic development department of the ELY centers is among other things responsible for the fishery sector. The responsible ELY centers are divided into three groups regarding the Fishery sector: the southwest region,

the northern region, and the inland lake districts. Therefore, the NOUSU programme which has been established in 2020 and is financed by the Ministry of Agriculture and Forestry has three sub-programme coordinators. The NOUSU programme is continuing until 2024 and has the goal to improve environmental conditions and the natural reproduction cycle of endangered migratory fish species, mainly salmonid species. The programme aims at solving the migration barrier problem by the construction of up and down stream fish passages or by barrier removal. This includes small obsolete barriers but also bigger dams which are used for hydropower generation. It does not include restoration work on the river catchment area itself, but only focuses on the barriers.

In terms of the organisational structure, the Ministry of Agriculture and Forestry and the Ministry of Environment have similar tasks but different interests. The environmental departments of the ELY centers are mainly financed by the Ministry of Environment and concentrate on the implementation of the WFD. The Ministry of Environment funds projects addressing the riverine ecology in general, not only fish. The environmental departments pay attention to small streams and catchment areas less than 100 square kilometers as well as obsolete barriers. The Ministry of Agriculture and Forestry which funds the NOUSU programme concentrates on projects with focus on fish migration.

Policy Effectiveness

The publication of the WFD in 2000, started a discussion in Finland about the fishery sector which falls under the responsibility of the Ministry of Agriculture and Forestry. The National Fishway Strategy to evaluate the different catchment areas to determine where measures to improve migratory passability should be implemented to meet the goals of the WFD was published in 2012 and the Water Restoration Strategy was finalised and published in 2013 (Finish Government, 2011). At the beginning of the next planning period which started in 2015, there was for the first time a budget for river restoration of about €8 million. Now, in the third planning period (2022-2027), the budget has doubled, and the focus of projects has shifted towards barrier removal as a river restoration tool. Still, fish upstream migration restoration is being implemented but also downstream migration has gained attention recently. The distinction of the NOUSU programme to the Fishery Strategy from 2012 is mainly that it includes funding. This gives new possibilities to restoration projects to buy land or even hydropower plants, for example. The NOUSU project can be seen as a tool to implement the Fishway Strategy from 2012.

A big obstacle for the effectiveness of the Water Act from 2011 is the very permanent nature of water permits in Finland. If a water use permit was granted in the beginning of the 19th century, the permit holder is still often entitled to make use of it today. Due to the legal situation, it is very difficult to change the conditions of a permit at a later point in time if it was granted without any requirements for compensation measures. However, current legislation does allow a re-evaluation of fisheries obligation if there is one in the water permit. This kind of re-evaluation is usually a quite slow process due to disagreement between hydropower companies and other stakeholders. These proceedings can be rather quick if there exists an agreement between permit holder and other stakeholders, but it can also take up to 10 or 15 years and there are often not sufficient personnel available to handle all the required paperwork to start the process. Even if a permit is obtained today, it is permanent, but it usually entails more environmental requirements than in the past. Furthermore, the licensing authority are not the ELY centers but regional administrative agencies. The environmental permit responsibility area of regional administrative agencies handles permit application matters according to the Environmental Protection Act and the Water Act. There are six regional administrative agencies in mainland Finland. Even though the RBMPs are drawn up every six years and point out which barriers obstruct continuity and what suitable solutions are, the legislation hinders to some extent the implementation of the necessary measures. Therefore, it can be argued that the aim of WFD is not sufficiently enough integrated into the national water legislation in Finland which acts as on obstacle for the effective implementation of the WFD in general, river restoration measures included.

One reason why Finland is still implementing measures on a voluntary basis when it comes to river restoration and why there have not been any legislative changes has been the positive feedback of the EC to the RBMPs which are being submitted every six years. However, the EC has noticed that many Finish hydropower plant owners have problematic permits. Four years ago in 2019, Finland got the feedback from the EC that all existing hydropower permits should be revised to guarantee the achievement of the WFD objectives particularly in relation to ecological flow, fish passes and other mitigation measures. However, with the current situation of inflation and energy prices in Finland but also all of Europe, even owners of small hydropower plants try to shift the public attention to the importance of their existence. Sweden has a similar but even worse situation in terms of water-use permits which is why the EC strongly advised that they must change the legislation. Sweden is now in the process of updating their water management policy which entails to check every hydropower permit. It could provide political pressure if Finland receives the same strong advice from the EC to change the legislation.

Although, the stakeholders are involved on voluntary basis and the time horizon is rather short-term, the NOUSU project has brought some positive results because restoration projects are being conducted with its support. On the one hand, it is valued as a handy and flexible program which is working well. On the other hand, it has certain constrains since it is planned for a four-year period which is too short for some projects to be implemented. It would be more efficient if it was a permanent tool or at least a programme with a long-term perspective.

Restoration Tools

For a long time, there has not existed a comprehensive national data base on water restoration projects in Finland. Research information related to water restoration has been scattered in different places (e.g., the Environmental Administration's Water Works information system (VESTY) and Vesimodostumat information system (VEMU)) (Ministry of the Environemnt, 2013). However, efforts have been made to improve the information base with the help of VESTY. The ELY centers have voluntarily stored information on the projects they have implemented or are aware of in the system. Today, the data base includes the estimation of the migratory phase connectivity and contains about 5.800 dams, the number of barriers is higher. The data base also contains removed barriers which can be an issue because barriers that have been built during a construction work in or next to the water body are listed as removed barriers even though they were never meant to be permanent. The underlying problem with the system is, that it has been used for different purposes in different parts of Finland. Still, it is a system with hardly any limitations on what kind of data can be enter. It lists barriers of all sizes, some of them not even or only partly blocking the water-

way. A specific region and/or ELY center can be chosen where the output is a list of all barriers and their status. For example, its condition; if it is in use, if it is demolished or still in the planning phase. Now, there exists 1,360 barriers in Finland that are completely blocking the waterway according to the data base. The disadvantage of the data base is that it does not show all barriers per catchment area which is something that must be determined manually. In general, there exist a good knowledge where barriers are located, who owns them, what their size and status are, and what the effect of restoration on the ecosystem would be. All ELY staff members have access to this data base and the administrative rights to change and maintain the data base. There was the task in 2019 to update the whole data base and now it is part of the daily job basis to keep it updated.

In February 2011, the fisheries authorities of the ELY centers were asked, as part of the preparatory work for the Fishway Strategy, to name top destinations in their area for restoring the possibility of fish migration, including salmon rivers, sea trout rivers, lake trout rivers and lake salmon rivers (Finish Government, 2011). The respondents' attention was emphatically directed to salmon fish due to the way the questions were phrased. After additional comments from the fisheries authorities received during the fishery strategy consultation round, approximately 55 dams on 20 rivers were named as top targets (Finish Government, 2011). Measures to facilitate fish passage have also been planned for these top destinations in the environmental administration's water management planning. It is noted that in addition to these top destinations, there are numerous other regionally important destinations for which the construction of a fish passage could be recommended, therefore list is not exhaustive. For example, the background of the restoration of migratory fish in the Oulu River is a strong regional will based on socio-economic and image factors (municipalities, fishery industry operators, citizens) and there are already a lot of ready-made plans for fish passages and a gradually advancing implementation and operating model (Finish Government, 2011). The Fishway Strategy from 2012 demands that barriers obstructing fish migration that may have lost their purpose, such as mills or small old hydropower plants, should be removed. Derelict dams should be mapped and follow-up measures to remove or change them should be determined using the means made possible by the Water Act from 2011. Important barriers such as hydropower generating dams are considered in the RBMP but not all migration obstacles. Therefore, an obstacle mapping project was started a few years ago to provide a new basis for the prioritisation process. However, the mapping has been performed to a different level of detail in different parts of the country and the final results of the project are still being awaited.

The longitudinal river continuity restoration projects are evaluated and prioritised using biological, technical-economic, and socio-economic criteria. However, there is no official prioritisation procedure in place, rather the prioritisation is done subjectively by the responsible water professionals. Additionally, the common will of the area's municipalities and other actors, possible conflicting factors, the readiness of the hydropower owner to cooperate in the construction of the fish passage on a voluntary basis, the readiness of fishing right holders to commit to possible fishing restrictions in the river if a fish passage is built, and legal aspects are considered.

Stakeholder Involvement

In recent years, many changes have taken place in the Finnish water management sector due to the organisational change of the state regional administration and thus weakening human resources. The state had often been partly or completely the designer, implementer, or financier of restoration projects in the past. However, the human resources of ELY centers have been decreasing and their role has changed towards the funding and coordination of restoration projects. There has been a shift from governmental organised restoration projects to projects being conducted by the private sector. As the resources of the state and municipalities decrease, the importance of private sector and citizens' own conditional renovations increases. The projects where the community or any other private entity is very active and willing to conduct a restoration project will get a high prioritisation and hence funding even though the restoration may be more pressing at other locations from an ecologically point of view. However, in cases where there is an active community but the ecological benefit from the restoration measure is very small in proportion to the estimated costs, other projects will be prioritised in terms of financing.

According to the Water Restoration Strategy from 2013, the waterway restoration network was launched in January 2012 and is supposed to be an extensive electronic information bank and communication forum related to the restoration of lakes, streams, sea bays and small bodies of water maintained by SYKE (Ministry of the Environemnt, 2013). The goal of the network is to offer up-to-date information related to water restoration and the most current instructions available, to act as a meeting place for authorities, restoration workers and citizens related to water restoration, and to act as a window for Finnish renovation know-how for international forums (part of the content to be translated into both Swedish and English). However, according to the interviewees, there is no official network or programme in place to collect and share technical knowledge or to exchange project experience. Nevertheless, they state that Finland is a rather small country with not too many staff working in the water sector and therefore, the information is often only a phone call away for the professionals.

One way to promote fish passage construction is the use of an environmental label for the electricity generated in the hydropower plants. The idea is, that as environmental awareness grows, the demand for eco-labelled electricity is constantly increasing, which increases the interest of energy companies in building fish passages. The criteria for the "Ekoenergia" label of the Finnish Nature Conservation Association for Hydropower require the construction of a fish passage when it is considered necessary to protect the life cycle of migratory fish. In addition, the energy company funds part of the electricity produced by hydropower and sold under the "Ekoenergia" label into an environmental fund, from which finances are directed to measures that reduce the environmental harm of hydropower. Such measures can be, for example, the construction of fish passages, the dismantling of migration barriers, or the establishment of spawning grounds. However, for the strategy of such a label to work properly, it should be officially awarded by a government authority instead of a hydropower association make it transparent and to avoid the accusation of greenwashing.

The ELY centers do not have the capacity (the personnel or the strategy) to spent energy on raising awareness for river restoration, but the public interest has grown over the last couple of years due to the work of NGOs. There does exist a cooperation of the ELY centers with NGOs in the form of shared projects. Restoration projects have mainly been a bottom-up approach. The ELY centers try to find local initiatives who are interested in environmental restoration and then they provide the information and funding necessary for the projects. Sometimes it can be a

bit top-down as well if some persuasion of the local community is needed. The into English translated version of the Water Act from 2011 states in Chapter 2, Section 9 (Maintenance and removal of a structure): "The owner of a structure built in a water body shall maintain the structure in such a condition that it does not pose a danger or result in adverse or harmful consequences that violate a public or private interest." (Finish Government, 2023). This paragraph can act as a tool to compel structure owners of barrier removal. However, already the first Water Act from 1902 appointed the owner of a structure to be responsible to maintain it. Often, it is a question of finding a window of opportunity to convince the structure owner that it is more beneficial to remove than to maintain the barrier. An incentive for structure owners to demolish a barrier rather than to keep it up to technical state of the art can be the costs of maintaining a structure compared to the subsidies which are available for the removal.

Financing

There are different government budgets for the several sectors of water management. According to the Water Restoration Strategy from 2013, the funding for water restoration is €7-8 million per year (Ministry of the Environemnt, 2013). Of this, €4-5 million are spend on lakes restoration and about €3 million per year on river restoration. The Finnish government is currently the main financier of water restoration. The Water Restoration Strategy further states, that the number of river restoration projects should be doubled. Additionally, water restoration can be financed from several programs partially financed by the EU. Such programs and financial instruments include e.g. The EU's environmental financing system Life+, the rural development program Leader, the European Regional Development Fund ERDF, the European Social Fund ESF, the European Maritime and Fisheries Fund EMKR, the Rural Development Fund and the regional development funds (Ministry of the Environemnt, 2013). According to the interviewees, now there exists a €750,000 annual budget for river restoration additionally to the NOUSU budget of €15 million for a four-year period (following the political system with elections every four years) and EU Life funding. The private sector's interest in participating in projects that support environmental protection, such as water restoration, has increased in recent years. Participating in a project that improves the state of the waters can offer the company a significant image benefit. However, the increase in interest varies greatly from region to region. In addition to companies, private citizens are increasingly interested in water protection and the condition of their nearby waters. For example, willingness-to-pay surveys have shown that people are ready to pay for the improvement of the condition of their nearby waters.

Governmental funding in form of subsidies is only available for projects which are being implemented on a voluntary basis. The subsidies are used as an incentive to start restoration projects before the implementation can be enforced. In general, restoration projects receive a funding of 50% of the project costs if they are voluntary. The NOUSU programme budget is also used for a 50% funding of restoration projects. Again, the funding is only available for projects whose implementation is not required by permits or similar. Since there are many water users with permits without any requirements and it is very difficult to change the permit conditions once it has been granted, the NOUSU programme tries to set an incentive for the private sector to support the restoration or river continuity even though they are legally not obliged to do so.

Monitoring and Evaluation

The forestry industry has been very strong in Finland since the beginning of the 19th century. Therefore, alterations have been made even to the smaller streams in form of removal of rocks from the riverbeds to allow the transport of timber. This practice has been applied everywhere, even in the northern parts of Lapland. Since the 1970s and 80s this process has been reversed and rocks have been added to the riverbeds. However, there is no information on how well these measures work or how to conduct them in the best way because there has not been a lot of monitoring. In general, there are some single monitoring sites where data has been collected for a long time, but they are not the standard. Monitoring can be a requirement of the water use permits in which case it is usually self-monitoring. It can also be required or at least recommended by the ELY centers, but there is no funding for it, especially when it comes to long-term monitoring. In general, it is possible to apply for monitoring funding, but the

focus lies on the implementation of the restoration project itself and not the monitoring of it. Since there is a limited restoration budget, monitoring is often not included in project funding. Therefore, an extra monitoring budget would be needed to improve the monitoring situation. More monitoring data is needed to evaluate the efficiency and effectiveness of restoration projects. Monitoring information should be easily available in e.g., environmental management information systems such as VESTY. Thereby, information related to restoration projects could be offered to target groups.

Summary of the main characteristics

Goal: *Strengthening and align actions to promote water restoration, describe good procedures and clarify the role of different actors*

Instruments:

- *Barrier data base, no comprehensive national data base on water restoration projects (or barriers); information scattered in different places*

existing	planned	removed	function	obsolete	equipped
X	-	-	X	-	-

- *Prioritisation Water Body, ELY centers and fisheries authorities named top targets (part of fish road strategy)*
- *Prioritisation barrier*
  - *Identify derelict dams, determine follow-up measures to remove or change them according to the Water Act (587/2011)*
  - *Barriers with largest environmental impact and easy to impelement measures*
- *Plans and measures, adding fish passess, removing obsolete barriers, structural modigfication to improve migration*

Implementation:

- *Highly institutionalised and complete river (continuity) restoration policy defined and coordinated at the national level, planning organised at the river basin level and implementation on the department level*
- *Policy is controversial in relation to the high degree of everlasting water rights; and the interdiction to remove any barrier associated with watermills*
- *Other types of river restoration often implemented in combination with floodprotection and practical hydromorphological measures*

Evaluation: *Significant renovation projects, the financing of which the state participates in, are accompanied by a sufficient obligation to monitor effectiveness*

3.4 FRANCE

Policy Background and Design

The French water legislation is constantly evolving. The first French Water Act (No. 64-1245) relating to the distribution and pollution surveillance of water resources was published in 1964. It created basin-level bodies such as basin financial agencies and basin committees. The second French Water Act (No. 92-3) came out in 1992 and contained water development and management master plans for hydrological basins and sub-basins. Furthermore, it established the principles of integrated water management with an aim at preserving and protecting aquatic ecosystems. The third French Water Act (No. 2004-338) transposed the European Water Framework Directive (WFD) from 2000 into French law and established a framework for community action in the field of water policy. The current Law on Water and Aquatic Environments (LEMA No. 2006-1772) from 2006 is an update of the third French Water Act providing financial tools for achieving the objectives of the WFD. Furthermore, it created the National Office for Water and Aquatic Environments (ONEMA). The French Biodiversity, Nature, and Landscapes Recovery Act (No. 2016-1087) from 2016 broadened the missions of the regional Water Agencies. Additionally, it created the French Biodiversity Agency (AFB) which incorporated ONEMA. In 2020, the National Hunting and Wildlife Agency merged with the AFB and became the "Office français de la biodiversité" (OFB). (Cohesian, Partnership, & Water, 2019)

The WFD transposition through the Water Act from 2006 introduced a legal obligation to preserve and/or restore longitudinal continuity on some rivers (art. L 214-17 of environmental code). In 2009, the French Secretary of State for Sustainable Development announced the launch of a national action plan for the restoration of river continuity (mainly focused on the longitudinal dimension) with five main thrusts including greater knowledge of weirs and dams, definition of priorities of action for each river basin, and assessment of the environmental benefits of the measures carried out. A national strategy towards the management of migratory fish has been adopted in December 2010. It focuses on preserving and restoring populations and habitats, renovating the governance of the migratory fish management policy, enhancing the acquisition of knowledge, monitoring and evaluation, and developing the sharing of experience, communication, and training about migratory fish issues. The French approach regarding the restoration of longitudinal river continuity entails the legal obligation to restore the ecological continuity on ~11% of the rivers (through management, equipment, or removal of barriers) and to preserve the current continuity status on ~30% of the rivers. French and EU regulations thus make it mandatory to restore the river continuity of aquatic environments. They collectively require that water stakeholders increase their efforts and projects in favour of restoration.

In France, hydrological basins are delimited by the catchment area of surface waters. There are six RBD on the mainland (Artois-Picardy, Seine-Normandy, Rhine-Meuse, Loire-Brittany, Rhone-Mediterranean and Corsica, Adour-Garonne) and five hydrological basins overseas (Reunion, Guadeloupe, Martinique, Mayotte, French Guiana). The National Water Committee (CNE) consist of representatives of the Parliament, of the administrative regions, of Basin Committees, of Water Agencies, and local water committees. At the RBD level, the composition of the Basin Committee is 40% of local authority representatives, 40% representatives of users and water user associations, and 20% state representatives. The CNE is consulted about the broad outlines of water policy, and on development and water allocation projects, and informed about developments in European legislation or regulations regarding water. It is the national body for consultation on water policy and brings together the various categories of users to incorporate the different components of society.

The French water policy is defined and coordinated at the national level. But its planning is organised at the level of the RBDs, the unit of water management which follows the geographical territory of the resource and not the administrative boundaries of the country. A local implementation of the water policy is also ensured by territorial communities. For each level of water management, different organisations have specific roles to play in implementing the river restoration policy. Several other stakeholders may participate in restoration projects for aquatic

environments. The French policy for the management of water resources and aquatic environments is mainly in the hands of public stakeholders. They exercise their responsibilities on various levels within the administrative and institutional structure of the country. French legislation assigns different and complementary roles to three broad types of stakeholders:

- **The Government:** negotiates at European and international level, prepares national legislation and regulation, and ensures that they are implemented correctly.
- **Basin-level bodies:** help to collect data, plan at the hydrological basins level, collect fees and allocate financial aid.
- **Local decision-makers and project managers**: local authorities, businesses, farmers, and associations that decide to make investments.

The responsible governmental entity is the Ministry for the Ecological and Solidary Transition commonly just referred to as Ministry of Ecology. The Ministry of Ecology prepares and implements the water policy with regards to sustainable development, the environment (protection and promotion of nature and biodiversity), green technologies, and energy transition. It has the task to define the water policy in compliance with European directives and the laws passed by the parliament. The OFB is the State's central operator for terrestrial, aquatic, and marine biodiversity in France. It carries out awareness-raising actions and provides technical advice to state services at the regional and departmental levels on the potential impact of new installations, works and development of activities on rivers. It also ensures compliance with regulations governing use of water and aquatic environments and reports any observed offences. The OFB is involved in the implementation and the monitoring of European framework directives related to the good ecological status of aquatic environments (WFD), in the protection of species and habitats of community interest (Natura 2000), and in research to support knowledge development on aquatic ecosystems and innovative solutions for river management and restoration.

The basin-level bodies are the Basin Committees and the Water Agencies. They are responsible for planning and implementing the integrated water policy in the basins in a concerted manner. The Basin Committee defines the objectives to be achieved and actions to be undertaken. It votes on the financial charges to be put in place by the Water Agency. The Basin Committees draw up a River Basin Management Plan (RBMP or "SDAGE" - Schéma Directeur d'Aménagement et de Gestion des Eaux) for six-year periods. It is a long-term approach which is based on three fundamental pillars: governance that considers the various uses and the different regional issues while promoting a concerted approach, integrated management of water data, and mutualist financing of actions. The RBMP are a planning documents intended to ensure the balanced, responsible management of water resources and aquatic environments on the scale of a large hydrological basin, including four main documents:

- a characterisation of the various water uses and their impacts in the RBD,
- a monitoring programme to assess the status of water bodies,
- management plans to set the environmental objectives,
- programs of measures which list the measures designed to reach the objectives.

The Water Agencies are public institutions supervised by the Ministry of Ecology and responsible for implementing the RBMP within the RBD. To meet the objectives of the RBMP, they draw up a program of interventions every six years which is approved by the government following consultation with the Basin Committee. This program defines the fee rates and the funding for the actions to be implemented. The Water agencies provide funding and technical assistance to public and private owners of structures in carrying out works foreseen by the agencies' program of interventions, including efforts against water pollution and protection and restoration of water resources and aquatic environments. They may also manage projects to restore river continuity following agreement with the owners, thus avoiding lengthy administrative procedures. (Cohesian, Partnership, & Water, 2019)

At catchment area level, a Local Water Commission, made up of representatives of the various stakeholders, can

be created depending on local issues to draw up and implement a Sub-basin Management Plan (SBMP or "SAGE" - Schéma d'Aménagement et de Gestion des Eaux), the local version of the RBMP. It relies on a voluntary process of consultation between the stakeholders in the area. It is adapted to the area and to specific local issues. The local authorities' public institutions for cooperation have the status of joint unions. They implement the policy decided on by the Local Water Commission and can, if necessary, be involved in drawing up and monitoring the SBMP. They also provide any technical support needed to fulfill the tasks pertaining to the management of aquatic environments and flood prevention. River restoration represents a central part of the SBMPs, it is also one of the five key priorities of the 11th Water Agencies planning programs, for the period 2019 to 2024 (GEST EAU, 2023). Operational implementation of the SBMP requires appointing managers and funding studies and projects. That may include signing local or regional environmental contracts and establishing voluntary and negotiated action programs requiring financial commitments over several years on the part of the participants.

Representatives from the department of Water and Biodiversity of the Ministry of Ecology and from one of the regional offices of the OFB were interviewed for this study, and a person as well of the regional office of OFB based in the Rhone Mediterranean basin. The OFB is dependent from the Ministry for Ecological Transition and Territorial Cohesion, as well as the Ministry of Agriculture and Forestry and receives directives and guidelines from both ministries which can be contradicting to each other due to different interests. This tension is solved by compromises which are found in discussions during internal meetings. If no solution can be found during this process, the higher authority (the ministry, one of the ministers, or the prime minister) must decide. In general, the OFB tries to find solutions, that comply with the environmental law but that do not disadvantage farmers too much to prevent any big resistance movements.

The OFB regional offices are responsible for a RBD which is divided into departments. For each department there is a team of 12 to 25 persons, the so-called field agents. The regional offices of the OFB manage the department units and implement the French Water Act. One task is to provide technical counsel for the Directorate. For example, if a new dam construction is planned, they will provide technical knowledge on how to include continuity. Next to this advisory role, the implementation of the environmental policy is part of the work which is mostly done by the field agents of the department units. The regional offices are responsible for the surveillance of the policy, they have the power to impose fines on stakeholders who do not follow the policy which represents about 50% of the work of the OFB regional offices.

Policy Effectiveness

The updated Water Act from 2006 was mainly written by the Ministry of Ecology with the support of the predecessor of the OFB which at the time was called the "Higher Council for Fishery". There were several stakeholder-consultation rounds in which the hydropower plant lobby was very active. The fishery representatives at that time (beginning of the 1990s) did not have the resources for the fight against the hydropower lobby. Therefore, it was mainly scientist and experts from the OFB predecessor that pushed for environmental benefits in the policy. Nevertheless, an advantage of the updated river restoration policy of 2006 is that it is applicable for all fish species while the previous one mainly aimed at migratory fish species such as salmon and eel. Furthermore, sediment transport is also considered in the policy.

Even though the updated French Water Act has been in effect since 2006, the implementation of river longitudinal continuity restoration projects only really started in 2012/13 depending on the RBD, after the prioritisation was completed. The policy has been very effective in terms of river continuity restoration during the first few years because of the legal obligation to improve the continuity of rivers. Each RBD has their own RBMP and SBMPs which differ in the foreseen subsidies for longitudinal river continuity restoration projects. While in some RBD, the subsidy for adding a fish pass or removing a barrier used to be 80% of the project costs, the subsidies were only 50% in other RBDs because they did not have comparable financial resources. In most RBD exists a distinction in subsidy rates between removing a barrier and adding a fish pass. In general, the restoration results differ in the single RBD depending on the financial aspects of the policies.

Especially good results were achieved for the Rhone-Mediterranean RBD when the river restoration process started in 2009. In the beginning, the regulations were still in the making and not published yet but the OFB announced that regulations were under preparation and that owners would be obliged to restore river continuity according to them. Therefore, a lot of owners started the restoration before the regulations were published in 2013 because the subsidy rate was high (80%) and expected to decrease with the publication of the regulations. In fact, after a few years the subsidies decreased and are now at a rate of 40-50% depending on the ownership situation. Hence, the number of longitudinal river continuity restoration projects has decreased over the last couple of years, also because many projects have been completed and only the difficult ones are left. About half of all planned projects have been implemented in the Rhone-Mediterranean RBD. The implementation has been a bit more difficult in the southeastern part of the RBD than in the northern parts close to Germany and Switzerland due to different mentalities of the stakeholders.

Another reason why the number of longitudinal continuity restoration projects has been declining is the growing influence of the Watermill Associations in the last 10 years. The policy became controversial because some parties (local associations and the hydropower sector) criticised the policy itself and the way it was implemented. The national policy is controversial and poorly accepted by some private owners for several reasons. Disagreements exist regarding the benefits of restoring ecological continuity due to arguments in favor of "anthropic ecosystems". Conflicts arise with patrimonial water-use permits (everlasting "water rights" inherited from the feudal system and thus exempted from environmental permit) and/or hydropower issues as well as regarding the fact that removal measures are generally more subsidised than equipment measures. More generally, removal of barriers is poorly accepted, because even "obsolete" barriers are seen by some people as having many (optional) uses. Their argument is that the water mills have a historic background which should be acknowledged, and the small hydropower plants could produce clean green energy with already existing barriers which in their view means no additional environmental impact would occur. Although, hydropower development does add environmental impact to an existing structure.

Therefore, the French law was modified in August 2021, in the way that river restoration measures underlie the necessity to preserve the "actual and potential use" of the barriers when restoring the ecological continuity. Further-

more, an interdiction to remove barriers associated with watermills when complying with the legal obligation of restoring river continuity was introduced. The Watermill Association also tried to use the media for their agenda by spreading the rumor that the French government plans to demolish all dams. Of course, this is not true since river continuity can also be established by the construction of a fish passage with the consent of the structure owner, for example. Besides, any river continuity restoration measure is carried out with the owner's permission and many owners favour the removal option because the maintenance of a barrier is often costly and time-consuming (and even more so if the barrier is equipped with a fish pass). The Watermill Association and the Association of Hydropower Plant owners are different entities, but it is presumed that they have connections since their objectives overlap. After the legal alteration was adopted, legal conflicts were anticipated. The outcome of these conflicts would clarify the scope of the potential use for a barrier but until now, no attempt to test the new legislation has occurred. The assumption is that everyone is too scared of the unclear legal terms. Therefore, few river continuity restoration projects have been started since 2021. Other river restoration projects have been commenced that aim at flood management or other safety reasons but if river continuity is the only motivation, projects tend to no longer being initiated.

In sum, river continuity has been addressed at about 5,500 barriers either by removing them or adding a fish pass or any other measure to improve continuity since 2012. The river continuity restoration process worked well before the policy was altered in 2021 and now the question is how to proceed. There is the possibility to try and get the law changed again in favour of environmental restoration or to convince stakeholders that it is still a good and viable policy even though it is no longer legally binding.

The very old water-use permits in France are permanent while the newer ones usually have a duration 30-40 years depending on the RBD. The state ministry of the local branches of the ministry has the authority to assign water permits and they usually ask for the advice of the OFB. After the permit expires, the user must apply for a new permit which is a window of opportunity to demand certain improvements so that the structure is conform to the state of the art. There are still new barriers and dams being constructed every year.

Restoration Tools

When addressing longitudinal continuity restoration, all possible options (fish pass, bypass-channels, removal, etc.) used to be considered to choose the one most suitable for each barrier but after the law and therewith the policy was changed in 2021, now equipping is the most applied solution. Roughly 90% of all continuity restoration projects in the Rhone-Mediterranean RBD are fish passages. Furthermore, there has also been an evolution of fish passage options from highly technical and artificial to more nature-like fish passes. One reason is, that it has become knowledge that technical fish passes need more maintenance than nature-like fish passes. Within the context of management of aquatic ecosystems, ecological engineering, which may be defined as environmental management through the design of sustainable, adaptive, and multi-functional systems, based on the natural mechanisms governing ecological systems, stands out as an important concept.

The French resource center aims at collection and sharing experience on river restoration projects and animates a national network of practitioners whose priority is to share information and experience on certain topic such as continuity, the OFB is very active on this topic and provides a lot of information on their website (OFB, 2023). Furthermore, there exists a specialised unit of technicians and engineers that work in the field of river restoration in Toulouse that develop new techniques. Additionally, there are symposiums and conferences with professionals in the field of river restoration being organised.

The French Water Information System (SIE), a mechanism created by the Government, brings together all the available data relating to water, aquatic environments and public drinking water and sanitation services. Its objectives are to collect, share and make data on water bodies available. It supports public action, including facilitating as-

sessment of the effectiveness and efficiency of public policies. After the adoption of the new environmental law in 2006 it took six years to list and prioritise all rivers where restoration measures are needed. In 2009, when the launch of a national action plan for river continuity restoration including greater knowledge of existing barriers was announced, the OFB started to create a barrier data base. They sent their agents from the department units into the field to walk along the rivers that had been prioritised for restoration to gather information on existing barriers. The river stretches that were investigated for the creation of the barrier data base were chosen depending on ecological criteria. The concept of biodiversity reservoirs was applied where locations with a (potentially) high biodiversity gained a special attention because it was expected that the biodiversity would expand from these stretches to others with not so good conditions. The OFB personnel collected attributes about the barriers (e.g., the height), described and photographed them. Most of the data was collected in the first three years but the data base is still increasing. In 2010, a national inventory of longitudinal barriers in rivers was established by the OFB by harmonising and centralising existing data. The data base is constantly growing and contained 103 758 barriers in December 2021. Main attributes of entries to the data base are: Geographical position (X, Y coordinates), National code (ROEXXXXX), Type of barrier (dam, weir, dykes, bridge, groynes, fish-farming grids), Status of the barrier (project, under construction, existing, damaged, ruined). Complementary attributes are the name, use, height, existing fish pass, and other geographical information. The data base includes removed barriers; therefore, it is always growing but never shrinking. Information on barriers is also being collected in the process of project funding. When one of the Water Agencies funds a restoration project through subsidies, the implementing party is asked for information on any barriers on the project site. So, the information for maintaining the data base either comes from private stakeholders due to legal obligations in subsidy contracts or from governmental personnel. The barrier data base is an inventory of all existing barriers, it is public and can be freely accessed and downloaded from the SIE.

The renewed Water Act from 2006 provides a legal obligation to preserve and restore the longitudinal continuity on some but not on all French rivers. Therefore, rivers were classified in:

- List 1: rivers to preserve which includes high ecological status rivers and acting as biological reservoirs and migration routes (no new barriers can be constructed).
- List 2: rivers to restore continuity where sediment transportation and fish migration must be ensured which can be done by managing, removing, equipping, or modifying the barrier.

About 30% of the total length of French rivers belong to List 1. Most of the river reaches which are on List 2 are also on List 1, meaning that continuity needs to be improved and at the same time no new barriers can be constructed since that would be counterproductive. The prioritisation of river sections takes place before the prioritisation of barriers. The methodology to prioritise river sections from "List 2" for restoration measures follows an approach through which river sections where all barriers must be treated rather than individual barriers are prioritised.

There are mainly two prioritisation criteria for the river sections. The first criterion is the hydromorphological state that prioritises water bodies where the hydromorphology is a major cause of non-achievement of good ecological status according to the WFD. The second criterion are the migratory fish criteria which prioritises migratory routes for diadromous and/or potamodromous fish (atlantic salmon, eel, sea trout, lamprey, allis shad, zingel asper, etc.) so that these species can reach their spawning grounds. Usually, the priority areas from the eel management plan (convergence with the Eel regulation 2007/1100) are used for this criterion. Among those migratory routes, the ones with the greatest ecological potential (spawning areas and areas where other types of impact (physico-chemical, physical) are low) are targeted first. The list of river sections was finalised in 2012-2013 in mainland France, it was a lengthy and complex process.

The methodology to prioritise among all the barriers of the prioritised river sections includes several aspects. In 2019-2020 it was acknowledged that not all "List 2" barriers will be treated in time and that a prioritisation of barriers is necessary. The aim is to tackle the list of priority barriers by 2027 with one list per river basin and about 5 000

barriers at the national scale. The prioritisation process entails the consultation of stakeholders at the department level (fishing federations, environmental NGOs, hydropower producers, owners, inland waterways managers, etc.). The prioritisation at RBD level is based on the proposals from the departments. The first aspect is the migratory fish aspect where barriers with the strongest impact on migration (based on a methos to assess the upstream passage of fish) and barriers that will "free" the greatest length of river for fish are determined. If there is little knowledge, a pragmatic approach on migratory routs is taken; from downstream to upstream, starting with the barriers disrupting the continuity between the sea and the river. The second is the hydromorphology aspect where water bodies with a 2015 good ecological status objective according to the WFD are identified. The third is the practical aspect where barriers with a relatively simple administrative situation and barriers in areas with a clear project leader and/or with already existing local dynamics regarding hydromorphological restoration are detected. The final process step is the impact assessment of the restoration measure on the water resource use. A restoration project will result in profound environmental modifications that will disturb the relations that local inhabitants and people familiar with the area have developed over time with the river and its territory.

Stakeholder Involvement

In 2007, the "Grenelle for the Environment", a debate with all stakeholders involved in environment and sustainable development was organised. The commitments contained in this Grenelle were integrated into the national action plan of 2009 and completed by the national migratory fish strategy in 2010. It entails the rehabilitation and maintenance of a network of migration corridors within France so that animal and plant species can communicate, circulate, find food, reproduce, and rest.

France is divided into different regions which are subdivided into 96 departments. The RBMPs and SBMPs are implemented at the department scale. The first contact with a landowner when it comes to a restoration project is through one or several letters, followed by a discussion between all stakeholders which can last up to a few years. If there is no big opposition to the project, research will be conducted to investigate different scenarios to determine which solution would be the most beneficial one and what the estimated costs are. After more discussions on the results, a choice will be made. This is the process if there is a legal obligation for the implementation of the restoration project. If there is no legal obligation and the initiative comes from a private owner or a municipality or any other stakeholder, they will conduct or delegate the necessary studies and afterwards contact the state service for authorisation.

The main institutional actors involved in the project implementation are:

- The French Biodiversity Agency (OFB) at the regional or departmental level
- The Water Agency of the RBD
- The Regional Directorate for Environment, Development and Housing (DREAL)
- The Departmental Territorial Directorate (DDT)

The Ministry of Ecology is involved in regulation and the OFB provides technical information. The Water Agencies are responsible for the financing and are always involved in the decision-making process but from a responsibility point of view, the state services which are the DREAL and the DDT oversee the on-site implementation. The DDT inform and assist water users in the preliminary stages of projects and encourage local governments to undertake operations to restore river continuity and hydromorphology. The Water Agencies and the state services are also responsible for creation of the RBMPs as mentioned earlier.

An important tool for stakeholder involvement is the participatory approach with the advisory boards of the local public services. One objective is to involve citizens in the management of public services in communes or groups of communes of more than 10,000 inhabitants. They are consulted about plans to set up governance or to delegate public services, and about partnership projects and research and development projects in which the service might take part. To manage water issues in their area, local governments may group together and form intermunicipal boards grouping several towns (e.g., a river board) or joint boards that include at least one public entity or a department or a region. These boards can be relevant managers for river restoration projects because they cover areas that are often congruent with hydrographic units. Boards can initiate studies and projects when no other suitable local structures exist. They are authorised to intervene on both public and private land. (Cohesian, Partnership, & Water, 2019)

Public or private structure and landowners may initiate projects on their property and at their own cost. They may also group together to form an authorised board association (ASA - Association Syndicale Autorisée) to carry out work in the general interest defined in the association charter within a specified area and based on a joint budget. The ASA may receive public subsidies and may delegate project management to other public entities. Though poorly suited for larger operations spanning an entire river basin, an ASA may be brought into a project as a relay for consultations with owners. An alternative to the ASA is the EPAGE. The Environment Code establishes that an EPAGE is a grouping of local authorities formed into a joint syndicate on the scale of a watershed or of a hydrographic sub-basin of a large river with a view to ensuring the prevention of flooding as well as the management of non-state watercourses (French Governemnt, 2023). This establishment includes in particular local authorities and public organisations for inter-municipal cooperation with their own taxation, competent in terms of the management of aquatic environments and the prevention of floods pursuant to 1bis of article L211-7 of this code. The EPAGEs are joint syndicates whose purpose is to provide project management for "aquatic environments" and "flood prevention" actions: a structure exercising only one of the two aspects of this competence cannot be an EPAGE.
Associations for migratory fish, fishing federations and certified associations for fishing and the protection of aquatic environments may manage projects or undertake work in the framework of their mission to protect fish and aquatic environments, e.g., restoration of fish habitats, creation and monitoring of fish passes, protection, and restoration of spawning grounds. Networks of stakeholders involved in overall management of aquatic environments have been progressively set up around the country to encourage the emergence of local projects and to facilitate the dissemination of information, know-how and experience. Special technical management and technical assistance and monitoring groups (CATER - Cellule d'Assistance Technique à l'Entretien des Rivières and ASTER - Assistance et Suivi Technique à l'Entretien des Rivières) have also been set up in certain departments to provide technical support to local governments implementing river restoration and maintenance projects.

According to the interviewees, rising public awareness and providing education on riverine ecosystems before starting any river restoration projects is highly recommended because often the local community is not so much against a project but rather, they do not understand its importance. The social aspects of river restoration should not be underestimated. It is better to anticipate resistance and to try to get people on board before any other planning is done. The Ministry of Ecology as well as the Water Agencies do have communication services, but it seems that it is rather difficult to reach the broad public because social media accounts or similar devices are often only followed by people who are already interested in the topic. Nevertheless, the awareness for river restoration is growing especially in connection with climate change resilience.

Financing

The Water Agencies collect fees (a fee is a tax) from users and redistribute them in the form of aid (grants, advances, or loans) in line with the RBMPs. Therefore, all users are acting in solidarity. Fees are also important levers for financial incentive. For example, the average impact of the Artois-Picardy Water Agency's fees is of the order of 16% of the price per m3 of water throughout the basin. In 2017, the overall amount of fees (all water uses combined) received by the Artois-Picardy Water Agency was €166.355 million, including €135.1 million from water bills. The compositions of contributors to the received fees in 2017 were domestic water users with 81,2%, distributers of phytosanitary products with 10,7%, manufacturers and economic activities with 7,7%, and fishery and livestock farmers with 0,4%. (Cohesian, Partnership, & Water, 2019)

The Water Agencies use these fees to provide, as part of their intervention programs, financial aid (grants, loans) to public bodies (regional authorities etc.) or private ones (manufacturers, farmers, community associations, etc.) which carry out actions or projects of common interest to the basin with the aim of the balanced management of water resources. The rates of fees are governed by the law and set by each Water Agency's Board of Directors following consultation with the Basin Committees. The rates vary according to the type of fee and the geographical area. A large proportion of the fees is collected from households through the water bill. The water services manager collects the fees on behalf of the Water Agency. In France, the fees are based on the "user pays" principle: each user pays an amount pro rata to their use (user-payer) and/or to their water pollution (polluter-payer). (Cohesian, Partnership, & Water, 2019)

All types of restoration measures were subsidised through the Water Agencies until 2021 when the law was modified. The rate depended on the ecological efficiency of the measure. The Water Agencies subsidised barrier removal of list 2 rivers but also outside of these with usually 70 to 80 % of the project costs. Additionally, further subsidies from the department or the region are sometimes available. Subsidies for fish passes are with 40-60 % a bit lower because their ecological efficiency is lower while their cost is usually much higher than other continuity restoration measures. That barrier removals received a higher subsidy than fish pass construction was one of the controversial points of the policy. Furthermore, it was decided to subsidise all restoration project, even the ones that are compulsory to accelerate and support the river restoration endeavor as much as possible.

Monitoring and Evaluation

Monitoring is always required if the implemented measure of a restoration project deviates from the standard solution. In this case, the responsible implementer must prove that their solution is working through a two-year monitoring period, sometimes a longer (six year) monitoring period is also requested. The OFB has defined a standardised monitoring method for barrier removal and sometimes conducts studies entailing project monitoring. However, the monitoring programme developed by the OFB cannot be applied for every restoration project because it requires a lot of effort. Therefore, only a selection of projects is monitored since the monitoring of all projects would be too resource demanding.

There are two important aspects of evaluation. On the one hand, the evaluation of the ecological result of the restoration project at a local scale. On the other hand, the evaluation of the policy implementation. For instance, in France, that second evaluation aspect is quite important since the watermill association created headwind which led to the legal adjustment of the restoration policy against the advice of the Ministry of Ecology. Monitoring results are a valuable tool in the struggle for the alteration of the law since they can proof that the policy is good and working. At the same time, often it is difficult enough to persuade stakeholders of restoration projects without adding further constrains like monitoring obligations.

Summary of the main characteristics

Goal: *Legal obligation to restore the ecological continuity on ca. 11% of the rivers and to preserve the current continuity status on ca. 30% 0f the rivers*

Instruments:

- *Barrier data base (103,758 barriers in December 2021*

existing	planned	removed	function	obsolete	equipped
X	X	X	X	X	X

- *Prioritisation Water Body criteria based on WFD hydromorphology aspects, migratory fish preservation objectives, and practical aspects*
- *Prioritisation barrier, migratory fish, hydromorphology, and practical aspects*
- *Plans and measures 5,500 barriers treated since 2012/13, but policy poorly accepted by many private owners (law modified in 2021: continuity restoration measures need to preserve the "actual and potential use"of barriers and interdiction to remove barriers associated with watermills)*

Implementation:

- *Highly institutionalised and complete river (continuity) restoration policy defined and coordinated at the national level, planning organised at the river basin level and implementation on the department level*
- *Policy is controversial in relation to the high degree of everlasting water rights; and the interdiction to remove any barrier associated with watermills*
- *Other types of river restoration often implemented in combination with floodprotection and practical hydromorphological measures*

Evaluation: *A selection of projects is monitored since the monitoring of all projects would be too resource demanding.*

3.5 GERMANY

Policy Background and Design

Regulatory law stipulates that water bodies in Germany are subject to federate state management. The most important federal law regarding water management is the Federal Water Act (Wasserhaushaltsgesetz, WHG), originally adopted in 1957. A substantially revised version entered into force in March 2010. This amendment completed the transposition of the EU Water Framework Directive (WFD) into German national law and allowed the German federate states to adapt their respective water acts to the European provisions. The amendment created the legal basis for transboundary, sustainable water management. The goal is to achieve good status for all water bodies by 2027 at the latest. To this end, management plans are drawn up. River basin communities have been established among the federate states sharing joint responsibility for the catchment areas of large rivers to coordinate this process. (Bundesministerium der Justiz, 2009)

According to the distribution of competences under Germany's Basic Law, the German federal government has concurrent legislative competence around water protection. The federate states can deviate from federal provisions, except for substance-specific, installation-specific and EU regulations. Deviations are, however, relatively few and far between. Many federate states have passed supplementary provisions. The execution of federal and federate legislation is exclusively the responsibility of the federate states. The federal government has no supervisory powers in this regard. In most of the federate states, except for the city states and very small states, water management follows the typical three-level structure of administrative bodies in general:

- **Supreme authority:** ministry with competence for water management, typically the environment ministry (guidance and overarching administrative procedures)
- **Intermediate authority:** district authorities, regional commissioners, state offices (regional water management planning, administrative procedures)
- **Lower authority:** lower water authorities in counties and non-county municipalities, technical authorities (expert advice, monitoring of water bodies and discharges).

The federate states and the federal government have formed the German Working Group on Water Issues of the Federate States and the Federal Government (Bund/Länderarbeitsgemeinschaft Wasser, LAWA, in German). In the working group, the states coordinate administrative implementation with one another and coordinate legislation with the federal government. (LAWA, 2020)

The WFD was transposed into German national law via amendments to the WHG in June 2002 for the first time. However, a comprehensive implementation of the WFD in the WHG was not possible at that time, since the federal government's powers were limited to passing framework legislation (Article 75 of the German Basic Law) (BMUV, 2023). Only the general intent of the WFD was incorporated into the 2002 version of the WHG, while regulatory tasks were assigned to the federate states for implementation. The Act amending the WHG of 31 July 2009 introduced a fundamental reorganisation of German water legislation. Its origins lay in the Federalism Reform of 2006, which reorganised legislative powers of the Federal Government and the Federate States (BMUV, 2023). The environmental protection sector was particularly affected by the shift in legislative competency. One reason for the federal government to make use of its new powers were the problems that had arisen in transposing European Commission (EC) law into German law under the existing framework legislation. Consequently, one of the aims of the water legislation reform was to adjust German environmental legislation by creating the requirements for the uniform, nationwide implementation of European provisions on water. The two-tier implementation of EC water legislation at Federal and Federate level was to be discontinued (BMUV, 2023). The new WHG entered into force on the 1st of March 2010. Essentially it builds on the preceding Act and incorporates the following aspects of the WFD (BMUV, 2023):

- expansion of scope to include sustainable waterbody management and the protection of ecosystems that depend directly on waterbodies; priority of local water supply
- adoption of some definitions from the WFD (e.g., river basin district, river basin)
- the principle of river basin management and the mandatory requirement for national and international coordination
- inclusion of management objectives for waterbodies in accordance with the WHG
- regulation of exemptions and deadline extension options under the WFD under certain circumstances (e.g., opposing overriding public interests, proportionality considerations)

The new WHG replaced the federal government's former framework legislation in the water management sector with directly applicable provisions and transferred the regulation of details, necessitated by the extensive provisions of EC law, as far as possible to the level of ordinances. In accordance with Article 72 of the German Basic Law, the federate states may adopt ordinances that deviate from national law, provided these do not relate to substances or facilities. (BMUV, 2023)

The WFD calls for a coherent river basin management concept. Coordination needs to transcend federate state and national borders, which in turn possessed new organisational challenges. It was generally possible to make use of the existing structures and authorities for the implementation of the WFD at both national and international level, but some adaptation was needed, especially in the international sector. Furthermore, coordination bodies and levels had to be set up to meet the WFD's requirements for harmonisation. At national level, coordination committees have been set up in the relevant river basins which operate on either an informal or a formalised basis (e.g., treaty, administrative agreement), involving the competent administrations. Each river basin adopts a different approach to coordination depending on its size and the participating federate states and/or countries. The big river basin districts (RBD) that are completely or partially located in Germany are the Elbe and the Oder in eastern Germany, the Danube in southern Germany, the Rhine in western and southern Germany, the Weser in northern and central Germany and the Ems in north-western Germany. Furthermore, there exist the three small RBD of Eider, Schlei/Trave, and Warnow/Peene in the north of Germany. (BMUV, 2023)

In the Federal Republic of Germany, the federal states are responsible water management enforcement. This includes the concrete implementation of river restoration measures. Since this study was conducted under limited time resources, the river restoration policy of one federate state (Thuringia) was exemplarily examined. The Thuringian Ministry for the Environment, Energy and Nature Conservation (TMUEN) is responsible for the overall coordination of water management in the federate state including the internal coordination of the river management plans with other departments, authorities, institutions, and associations as well as the representation of Thuringia in the committees of the river basin communities. In addition, TMUEN heads the Thuringian Water Advisory Board and sets up the state program for water protection. The Thuringian State Office for the Environment, Mining and Nature Conservation (TLUBN) provides the technical basis for the implementation of the Thuringian state program. They are responsible for data storage and provision. The list of measures, including the participation of various user groups and stakeholders, e.g., in the thematic areas of water body structure and continuity, is the responsibility of the TLUBN. Furthermore, the TLUBN reviews and updates the water framework plans every six years. (TMUEN, 2022)

Policy Effectiveness

Coordinated management within river basins pursuant to Article 3 of the WFD is a central element of the Directive, and the German water management has adapted to this principle. Previously, management had been based primarily on the political boundaries of regional and local authorities. Prior to the WFD entry into force, there was very little uniform management of river basins apart from the work carried out by the water associations and river basin-related planning of certain sub-tasks, such as wastewater disposal. The preparation of management plans and programmes of measures entails a wide range of work activities, from data collection and assessment to the

setting of targets, and finally, the execution of measures. It is in the Federal Republic of Germany's interest to ensure the identical, comparable, nationwide implementation of the obligations arising from the WFD, despite the river basin-related approach. For this reason, uniform national provisions e.g., on the designation of heavily modified waterbodies, significance criteria for pressures, ecological assessment, and data preparation, need to be agreed within Germany, following the principle that the criteria and principles are drafted and specified at national level and then implemented in the river basin. Article 34 of the WHG regards the continuity of surface waters. It states that the construction, significant modification, and operation of barriers may only be permitted if the continuity of the water body is maintained or restored by suitable facilities and operating methods. If existing barriers do not meet these requirements, the competent authority shall issue the orders to restore continuity.

The Thuringian water policy identifies the issue of limited river continuity by recognising that "the migration of aquatic living organisms can be impeded by transverse structures. Fish do no longer reach their spawning habitats, so that reproduction is restricted. Sediment can also be held back by transverse structures. Sediment removal and redeployment in the riverbed are important structure-forming processes that are disturbed by transverse structures.". The federate state has the goal to restore the ecological continuity, primarily through dismantling or alternatively through conversion of all transverse structures, where this is necessary to achieve the goals of the WFD. Thereby, the connection of important spawning grounds and fish regions is to be considered as a priority. At the end of the first cycle of the RBMP, in 2015, eleven surface water bodies were assessed as "good" in terms of continuity. No further measures are necessary in these water bodies. Another 30 surface water bodies should be added by 2027. In relation to the length of the river, this affects 31% of the surface water bodies. However, river continuity is not a management goal for reservoir dams. Therefore, no management goals are formulated for dams, analogous to the water body structure. (TMUEN, 2022)

Restoration Tools

Numerous measures are planned to protect water bodies. The Thuringian state program for water protection comprises a total of 3,100 measures. Of these, 1,400 measures are to be implemented for the continuity of water bodies and 460 for near-natural water body development. A total of 970 km of watercourses are to be made more natural. Before being included in the state program, each measure goes through a preliminary examination. The basic compatibility with the conservation goals of the Natura 2000 areas, which include the Flora-Fauna-Habitat and the EC bird protection areas, is checked. The Habitats Directive requires "favourable conservation status" for habitat types and species. As a result of the planning process, the measures for inclusion in the Thuringian state water protection program were proposed, which:

- are technically suitable
- are economically reasonable
- are fundamentally compatible with nature conservation and
- have no significant negative effects on the specified uses in the water reach. (TMUEN, 2022)

Comprehensive information on the planning process for the measures around water body structure and continuity is comprehensively documented in the "Working Paper Hydromorphology on Key Water Bodies in Thuringia" (Annex 9 of Thuringian state programme water protection 2022-2027). The federate state of Thuringia usually engages external planning offices for the preparation of the planning documents and the implementation of the structural work of the state's own measures. The preparation of the planning documents takes place in four phases. In addition to general technical basics, the specific location situation is analysed in particular. This also includes property rights issues for buildings in and on the water body as well as the use of land by the planned measure. Any existing ownership and leasing relationships as well as existing area subsidies are also included in the further considerations. All stakeholders are involved in this process. According to the agreements made, the various variants of the implementation of the measures are developed. Only variants of the measures that do not conflict with the property rights issues can be carried out. (TMUEN, 2022)

By dismantling transverse structures or converting them into passable structures, sections of flowing water can be designed to be continuous for aquatic life and sediment. Fish ladders are one way of creating continuity for the fish fauna on transverse structures. Since in most cases it is not possible or necessary to restore the entire course of the watercourse, the German Council for Land Conservation developed the steppingstone concept. This concept envisages that structural improvement measures are only carried out in individual stretches of water, the effect of which radiates over the entire body of water. Elements of this concept have already been considered in the guidelines for drawing up water body development plans in the federate state of Thuringia. In the third RBMP period from 2022-2027, the creation of continuity at 1,372 transverse structures is planned. Supplementary studies are planned to determine suitable measures on various transverse structures. In addition to assessing the fish fauna, information on the presence of transverse structures as part of the water body structure mapping was also included to assess continuity. (TMUEN, 2022)

Numerous measures have already been implemented at the municipal level. Nevertheless, it can be stated that the implementation of measures by the municipalities in recent years has been slow, especially on water bodies of the second order. This was often because smaller municipalities could not muster the necessary human and financial resources to implement the measures and often did not have the necessary specialist knowledge.

Stakeholder Involvement

Article 14 of the WFD calls on Member States to promote the active involvement of all interested parties and to inform and consult the public. This applies, firstly, to the preparation and subsequent updating of management plans in the respective river basins. To this end, the timetables and work programs for the preparation of management plans and an overview of the key water management issues in the river basins must be published in due time. The public should be given an opportunity to submit written opinions at all three stages. Upon request, background information and documents must also be made available. The WFD further states that the early, active involvement of the public prior to this three-stage consultation on the management plan is to be encouraged. This makes the entire planning process transparent, allows conflicts to be identified and potentially resolved early on, enhances acceptance of the plans, and creates a basis of trust between the authorities and those affected by the measures. A wide range of successful activities in this connection have been initiated in the federate states.

According to Article 85 of the WHG which deals with the active involvement of interested parties, the competent authorities must promote the active participation of all interested parties in the preparation, review and updating of the programs of measures and management plans. These measures were developed in numerous workshops, discussions and consultations with many citizens, associations, companies, and authorities. The management plans and programs of measures for the Elbe, Weser and Rhine River basins, in which Thuringian waters are part, are also based on the data and measures developed in this way.

As early as 2008, the "RIVER ACTION - jointly developing Thuringian waters" was launched as an initiative of the TMUEN for the promotion of lively and attractive waters in Thuringia. In addition to improving surface water and protecting groundwater, the further development of water body maintenance is another priority. All in all, 20 associations were founded with the amendment of the Thuringian law on the formation of water body maintenance associations. Since the 1st of January 2020, these have been responsible for maintenance and improvement of the water body structure and continuity in water bodies. With the reorientation of water body maintenance, the ecological functionality of water bodies, in particular as a habitat for wild plants and animals, should be preserved and better promoted.

Financing

Article 40 of the WHG regards the regulation of costs. The maintenance of surface waters is the responsibility of the owners of the waters, insofar as it is not the task of regional authorities, water and soil associations, municipal special-purpose associations, or other bodies under public law according to state law. If the water body owner bears the burden of maintenance, the residents and those owners of land and facilities who benefit from maintenance or make maintenance difficult are obliged to contribute to the costs of maintenance. If a corporation is obliged to maintain a water body, the federal state can determine to what extent the water body owners and/or other persons who benefit from the maintenance, or other owners of property in the catchment area are obliged to bear the costs of the maintenance to participate. Furthermore, the burden of maintenance can be transferred to a third party with the consent of the competent authority.

By 2027, Thuringia will invest €367 million in the implementation of state measures and in the promotion of projects. In addition to the measures implemented directly by the federate state of Thuringia, numerous measures have also been implemented by the municipalities since 2009. To support this process, the municipalities were supported by the federate state through the regional water advisors and through funding programs with a funding share of up to 90%. The federate state of Thuringia has provided the municipalities with around 19 million euros in funding since 2016. (TMUEN, 2022)

Monitoring and Evaluation

In principle, the monitoring results of the macro zoobenthos and the fish fauna allow conclusions to be drawn about deficits in the water body structure and continuity. However, the surveys of these groups of organisms at specific measuring points are not sufficient to pinpoint the structural deficits or to draw conclusions about the measures to be taken. For this reason, the results of the water structure mapping were used as auxiliary parameters to localise the deficits in the water body structure and to derive more effective measures on a river. For some of the Thuringian watercourses, the water body structure has been recorded using the detailed procedure in recent years. Various individual parameters are recorded for each section of water body (about 100 m each of the watercourse). Based on these individual parameters, the indices of the main parameters course development, longitudinal profile, cross profile, bed structure, bank structure and water environment are determined. All information taken together result in the structural quality of the stretch of water. These values can be determined for the entire watercourse and summarised for the surface water body as an average structural quality. (TMUEN, 2022)

Summary of the main characteristics

Goal: *restore continuity through removal or equipment of all transverse structures*

Instruments:

- *Barrier data base (creation of continuity at 1,372 barriers is planned)*

existing	planned	removed	function	obsolete	equipped
X	-	-	-	-	-

- *Prioritisation Water Body and barrier connection of important spawning grounds and fish regions is to be considered as a priority. Sediment transport is seen important for building desired hydromorpholical structures*
- *Plans and measures*
  - *Stepping stone concept: structural improvement measures are only carried out in individual stretches, but the effect radiates over the entire water body*
  - *Building fish passes or bypass channels and lowering or removal of barrier*

Implementation:

- *Federal states are responsible for water management enforcement*
- *Thuringian State Office for the Environment Mining and Nature Conservation carries out restoration measures*
- *By 2027 high investments will be made for measures made by the State and for the promotion for river (continuity) restoration projects*
- *Numerous measures have been implemented by the municipalities since 2009*

Evaluation: *waterbody structure recorded using detailed procedure; indices of the main parameters (course development, longitudinal profile, cross profile, bed structure, bank structure and water environment) are determined*

3.6 LITHUANIA

Policy Background and Design

Lithuania is a decentralised unitary state comprising 60 municipalities. The water management of the country is based on the national Water Law from 1997. The central government is responsible for the legislation and regulation of water management, the coordination and administration of the River Basin Districts (RBD), the development and approval of the RBMPs, the negotiation of agreements for international RBD, the coordination of public consultation, the monitoring, pressure analysis, and classification of surface water bodies, and the issuing of permits. The involved and responsible ministries and institutions are the Ministry of Environment of the Republic of Lithuania, the Environmental Protection Agency (EPA), the Lithuanian Hydrometeorological Service, the Regional Environmental Protection Departments, as well as the local authorities of the municipalities which are responsible for water management at the local level. (Republic of Lithuania, 1997)

Lithuania is divided into four RBD and comprises 1185 surface water bodies (approximately 2/3 of which are rivers). It shares the three river basins Dauguvos, Ventos and Lielupės with Latvia and the Nemuno river basin with Belarus, Poland, and Russia. According to the water status classification criteria derived in accordance with the requirements of the WFD, 47% of the water bodies in Lithuania's largest river basin, the Nemuno Basin, fall within the group at risk. Lithuania has over 80 operating hydropower plants, built by damming 50 rivers which has made approximately 80% of the country's territory inaccessible for fish migration. (National Water Area Development Plan, 2022)

The WFD is implemented in Lithuania through the RBMP. The public consultation process for the third and current RBMP (2022-2027) has been concluded. The National Water Area Development Plan 2022-2027 identifies issues regarding river continuity through the fact that the condition of surface water bodies is negatively affected by hydromorphological changes, which have occurred due to land reclamation, hydroelectric power plants and river damming. Fish protection measures are insufficient in or near hydroelectric power plants. Other hydrotechnical structures (dams, sluices, rapids) also affect the ecological condition of rivers due to the changed hydrological regime of rivers and disruption of fish migration. Dams in the main fish migration corridors, which prevent fish from reaching spawning grounds and spawning, have a particularly significant negative impact.

One priority of the current RBMP is the reduction of hydromorphological impact. It is planned to improve the legal framework to reduce the negative impact of hydrotechnical structures or facilities on water bodies, to tighten the responsibility of the owners of hydrotechnical structures, to free up the migration routes of fish, to limit the fluctuation of the water level, to reduce the negative impact of the regulation of riverbeds. It is planned to restore and stabilise the ecosystems of water bodies by internal means, to partially restore the natural hydromorphological characteristics of the lake or pond, to prepare and carry out research programs, to tighten fishing control.

Restoration Tools

In 2021, barriers to fish migration were studied. Due to the significant impact of hydroelectric power plants, 41 surface water bodies have been classified as risk water bodies, due to the disruption of the river continuity. Of all 301 obstacles to fish migration located, 151 barriers without hydroelectric power stations and 97 dams with hydroelectric power stations, 48 rapids or their remains, and 4 dams impounding lakes were identified. Furthermore, 30 barriers to fish migration were classified as cultural heritage. All in all, 258 fish migration obstacles (86%) which are completely impassible are encountered. (National Water Area Development Plan, 2022)

Stakeholder Involvement

There exists a synthesis of top-down and bottom-up approach for river restoration in Lithuania. In the last years, most restoration projects such as fish pass constructions were implemented top-down in areas were no or hardly opposition to restoration projects was found. However, this was mostly the case in small river and less ecological significant locations. In recent years, the demands of the angler community have increased, and their voice has grown stronger, shifting the focus of river restoration towards more significant barriers, and gaining more political attention. This movement has not translated into actions yet, but the political pressure is raising.

Monitoring and Evaluation

According to the current RBMP, it is planned to continue international cooperation, update monitoring programs, review and, if necessary, update planning and implementation plans to better implement river basin-based management. The aim is to strengthen the state control of environmental protection in the field of water by reviewing the legal framework and make the necessary changes, to ensure effective compliance with the requirements. However, there is no effective monitoring and evaluation system in place now. It is one point of criticism of the current RBMP, that there was no reflection of the previous RBMP for the improvement of the new one. While the Ministry of Agriculture purchases evaluations for their management plans from research institutes or consultancy firms, the Ministry of Environment does not.

3.7 THE NETHERLANDS

River continuity restoration could not be identified as an essential part of the National Water Plan 2016-2021, nor of the National Water Plan 2022-2027 of the Netherlands. The topic is not mentioned in the documents. However, the Netherlands have a Fish Migration Strategy which entails the equipment of barrier with fish passes and the reconnecting the waterway network, but since it seems not to play a big role on the national planning and policy level, the Netherlands were not further investigated for the purpose of this study.

3.8 NORTH MACEDONIA

The Water Strategy for the Republic of Macedonia (2010) does not include longitudinal river continuity restoration. However, the strategy stats that there exist numerous large dams which are causing significant environmental impacts, i.e., interruption of fish migration (where dams are not equipped with fish passages), interruption of the flow of sediment downstream of the dams, loss of in-channel habitats, etc.). Beside large dams there are also over 120 small dams constructed as part of small hydropower plants and fish farms. The documents also declares that the competent authorities of Water Management conduct all national water policy in professional, administrative, regulatory, and supervisory sense. Water management is achieved within the jurisdiction of state administrative and professional institutions, as well as cooperation with other authorities, regional administration and local self-government, economic sectors, scientific and professional institutions. Regardless, North Macedonia was no further investigated for this study. However, they are very interested in the topic of river continuity restoration since the country is a candidate for accession to the EU which if they are accepted would require the transposition of the WFD into national law. A water professional from the Ministry of Environment and Physical Planning joined the country group meeting carried out in the context of this study. During the country group meeting it became clear that especially the topic of sediment transport is a very important issue in North Macedonia.

Summary of the main characteristics

Goal: *reduce negative impact of technical facilities on water bodies, tighten responsibility of hydropower plant owners, free up fish migration routes, limit the fluctuation of water levels, reduce negative impact of riverbed regulations*

Instruments:

- *Barrier data base (301 obstacles to fish migration identified in 2021)*

existing	planned	removed	function	obsolete	equipped
X	-	-	X	-	X

- *Prioritisation Water Body not described*
- *Prioritisation barrier not described*
- *Plans and measures not described*

Implementation: *not described*

Evaluation: *monitoring and analysis of achievement of evaluation criteria for the implementation of objectives is carried out by specific institutions; these institutions submit monitoring results to the Implementation Coordinator by February 20 of each year*

3.9 NORWAY

Policy Background and Design

Norway has taken part in the Common Implementation Strategy for the WFD from the beginning and transposed the WFD into national law by the Norwegian Water Regulation in 2007 (Vannforskriften, 2007), hence the WFD implementation as part of the EEA-agreement is one planning cycle delayed compared to the rest of EU. Many physical restoration measures have been included in the Program of Measures as part of the RBMPs. Hydropower related restoration and mitigation measures have received much attention, and a national project on license revision was launched in 2013 resulting in a joint recommendation between the Norwegian Energy Regulatory Agency (NVE) and the Norwegian Environment Agency (NEA) (NVE, 2013).

However, compared to non-physical mitigation measures in the current Plan of Measures, there is still a need to further intensify the management effort on physical alteration of water bodies and hence restoration measures. In March 2022, Norway adopted its first National River Restoration Strategy (NRRS) aiming to promote physical restoration measures in the implementation of the WFD and RBMPs. The NRRS was developed as a project within the National Agency Coordination Group for WFD implementation.

There existed already other national strategies and action plans that are also partly relevant for riverine ecosystems, such as the Action Plan for Endangered Nature, action plans for riverine species (e.g., River Pearl Mussel), Action Plan for Wild Salmon and National Restoration Plan for Wetlands. Still, Norway did not have any dedicated National River Restoration Strategy before the one published in 2022. River restoration was executed in a very limited, decentralised, and fragmented way before the first RBMPs were developed according to the WFD. The RBMPs which were used from 2016 onwards gave a more structured approach to river restoration. However, at this point there still existed no NRRS. In addition, evidence based hydromorphological assessment system was also pending, so that both characterisation and classification of physical alteration of water bodies were mainly based on expert judgement (with limited monitoring data). This gave low confidence on the knowledge basis for addressing physical restoration measures.

In 2015, the Ministerial Coordination Group for Water Management agreed to ask the Agency Coordination Group for Water Management to set up two projects for the restoration of waterways and wetlands, both led by the NEA. There were three important factors that promoted the development of the NRRS. The first one was the mutual consideration in the Ministry of Climate and Environment (KLD) and the NEA that the RBMPs in the first cycle (2016 - 2021) were much more focused on pollution issues than on physical restoration measures. The second factor was the EU Biodiversity Strategy 2030 with its aim of restoring 25,000 kilometers of free-flowing rivers. The third one was the United Nations declaration of the Decade for Nature Restoration which got political attention in Norway through a conference in 2020.

In April 2020, the NEA was commissioned by the KLD to prepare a proposal for a strategy for the restoration of waterways for the period 2021 - 2030, in consultation with the National Agency Coordination Group. The NEA submitted a proposal for the NRRS to the KLD in September 2021, and presented this at a meeting of the Ministerial Coordination Group in November 2021. The NRRS includes proposals and frameworks for a follow-up Action Plan for implementation of the strategy to be drawn up. The proposal for the strategy was created with the help of an interagency working group. Participants of the working group were representatives from the NVE, the Norwegian Agriculture Agency, the Norwegian Public Roads Administration, River Basin District Authorities, County Governors Environmental Offices and Municipalities. The NVE oversees hydropower licensing and is responsible for protection and mitigation measures on watercourses. The Agriculture Agency needed to be involved due to the existing problem of agricultural runoff into fish breeding grounds. The Public Roads Administration are responsible for many culverts that prevent fish migration. The County Governors Environmental Offices, River Basin District Authorities,

as well as municipalities are all parties that were represented in the National Agency Coordination Group because they have their respective planning and implementing competency of water management. (NEA, 2022)

This diversity of interests but also of the sphere of activity on the local, the regional, and the national level led to a dynamic National Agency Coordination Group. However, there was not much disagreement about the NRRS itself, but rather about technical issues. A learning process of getting used to research based discussions was part of the work group meetings. Restoration of watercourses promotes the sustainable, multiple use of watercourses which provide many services to society. The issue of a significant loss of species diversity in freshwater as an indicator for watercourses not providing the same ecosystem services to society as when they are intact with well-functioning natural processes was agreed on. The goal of restoring at least 15% of deteriorated watercourses in the period 2021 - 2030, and to reverse the negative trend so that in 2030 watercourses are at a higher rate restored than deteriorated, was defined (NEA, 2022). The understanding of river restoration as the process to restore watercourses that have been degraded, damaged, or destroyed towards their natural state and function was shared by all participants. Therefore, the question was not where to go with the strategy but rather how. Discussions about which terms should be used to express certain ideas were part of the problem-solving process. All parties agreed that the strategy should start with an explanation why it is necessary to restore watercourses, what are the benefits of restoration, and why physical restoration should be prioritised. Some areas of action such as an improved coordination to make use of synergies between different authorities also received special attention. The idea is to have a long-term overarching strategy that enables the rivers to maintain their own functions and ecology rather than small and scattered projects that only treat the symptoms of underlying problems. The aim is to successively remove all pressures from the rivers, to create a cooperation between all important stakeholders to provide a joined strategy, and to enhance the focus on river restoration. Furthermore, the NRRS must go hand in hand with the RBMPs to encourage the river basin districts to implement more physical restoration projects. The NRRS shall facilitate increased Norwegian attention to restoration, as well as the coordination of efforts and resources. In March 2022, the Ministerial Coordination Group agreed to the proposed strategy and commissioned the preparation of a national Action Plan for the restoration of watercourses as outlined in the NRRS. A first Action Plan was planned for the first quarter of 2022, based mainly on knowledge and proposals for restoration measures in the updated regional water management plans. Preparations for the Action Plan have already been made but the work on the Action Plan itself has not started yet due to shortages and reductions in staff as well as other more pressing deadlines and priorities in the NEA.

Two representatives from the NEA were interviewed for this study. Even though the current NRRS was only published in 2021, it might already need a revision because it states the goal of restoring 15% of all rivers while with the outcome of the UN Biodiversity Conference in Montreal in December 2022, the international target is now 30% which should be reflected in the NRRS according to the interviewees. Furthermore, with the proposal of a new Nature Restoration Law in the EU and the existing EU Biodiversity Strategy 2030 which focuses very much on free-flowing rivers and the removal of barriers, the NRRS might need to align to a stronger focus on the removal of barriers to fish migration, water flow, and sediment transport. Other restoration issues (e.g., chemical pollution) will be tackled by the RBMPs, since the polluter pays principle is much easier applicable in these situations.

Policy Effectiveness

The number of applications for river restoration projects from municipalities and local environmental groups has increased a lot over the last few years. In 2022, there were three times as many applications that fulfilled the criteria for funding as the number of projects that could be financed. The interviewees also see a positive trend regarding re-licensing of hydropower, with e.g., increased environmental flow and requirement of other measures to mitigate hydropower impacts. The synergy of the WFD related RBPMs, the NRRS, enhanced focus on ecological restoration (e.g., the UN Decade of Restoration, 2021-2030), and the cooperation of different agencies has led to an increased attention of river restoration. Another sign that river restoration projects have been fruitful is the return of the salmon in some rivers in the south of Norway. Most hydropower plants in Norway are located in the headwaters of streams and rivers. Therefore, fish migration is often a smaller issue than environmental flow and sediment transport. Still, fish migration barriers are an issue in the big lowland hydropower plants. There are many good examples for up- and down-stream migration structures at hydropower plants. However, these pilot projects are not the standard yet, and they are very focused on salmon while other species such as the eel or the lamprey which are not popular for sport fishing receive less attention (Vøllestad, 2023). There are at least three main challenges when it comes to river restoration in Norway.

I) The lack of an evidence-based classification system for hydromorphological alteration of rivers following the key principles of WFD
II) No system in place to collect and secure an overview about what has been done and is going on in terms of river restoration, which limits the understanding of restoration projects on a national scale but also in general
III) The lack of a clear definition of ecological improvement as well as the monitoring of applied measures

About 25% of the Norwegian river basin catchments are protected against hydropower development, the so-called National Protection Plan for Watercourses. The regulations about what is allowed and forbidden in these catchments are quite strict but unfortunately, they are not being followed very strictly, except for larger scale hydropower development (> 1-3 MW). E.g., exceptions are being made for roads and other land use in or close to the rivers.

Restoration Tools

Part of the NRRS is to improve knowledge by collecting good examples in a data base to gain an overview about which measures were used and how well they worked. By now, several Norwegian examples have been added to the European River Wiki because until now there does not exists such a national data base. In addition, a Handbook on Physical River Measures also includes an extensive collection of good practice restoration and mitigation cases mainly from Norway (and a few from Sweden) (Pulg et al., 2018). However, the interviewees are unsure if the European River Wiki will provide the level of detail that is necessary for the Norwegian research institutes to evaluate the implemented measures. Therefore, a possible solution is to develop a national data base which is also important to be able to prove the restoration success to maintain the political goodwill. To highlight the ecosystem benefits of restoration measures for the local population and for fish migration is one beneficial aspect of a data base, another is the general importance of disseminating information, to gather knowledge and to acquire funding.

Regarding a barrier data base, there exist one for dams and abstraction points mainly for hydropower and water supply, but the Vann-Nett website collects information on all Norwegian waterbodies and the condition they are in (including mainly expert judgement of hydromorphological alterations). The Public Roads Administration started a data base of all culverts in the main roads and highways in a few regions, with field assessment of these potential barrier effect (for fish migration) of several thousand culverts. As a supplement, work has been done to translate and use the European Barrier Tracker app, which gives the public the opportunity to participate in the mapping of migration barriers. In 2022, the number of entries from Norway has been the highest number of entries in the European Barrier Tracker app, but the data is still in the AMBER Atlas and needs to be transferred to a national data base. Additionally, the quality of the data needs to be checked by the environmental authorities.

Watercourses receive a high prioritisation for river restoration measures if they are in areas protected under the Natural Diversity Act, the National Protection Plan for Watercourses against hydropower development, or the rivers designated as National Salmon Rivers. Furthermore, if they provide a living environment for highly and critically endangered species or entail habitat types according to the Norwegian Red List. Watercourses in areas valued as very important or important outdoor recreation areas in accordance with the Norwegian Environment Agency's guideline M98-2013, assessed based on frequency of use or symbolic value are also prioritised. Whereas water courses receive a medium prioritisation if they are in proposed protected areas and in world heritage areas without protection, if they are migration corridors with important function as a fish migration route in fragmented landscapes, or if they are important for climate adaptation and/or outdoor life. This includes watercourses that are important for the community's overall ability to adapt to climate change. (NEA, 2022)

The prioritisation of a barrier for restoration takes place through a two-step process. First, each sector authority maps restoration needs and prioritises within its area of responsibility (impacts for which it has sector responsibility), possibly in consultation with the County Governors' environmental departments and the NEA. Here, each sectoral authority must draw up priority criteria based, among other things, on how great the environmental damage due to physical intervention is, and how great the potential for improvement is. In the second step, the sector authorities combine their knowledge base and agree on watercourses suitable for cross-sector collaboration on larger multi-year restoration projects. These are prioritised for joint investment and comprehensive restoration. The aim is to look at a wide range of potential ecosystem services in the prioritisation, to find good win-win solutions. (NEA, 2022)

The water use permits are also an important tool when it comes to the implementation of restoration measures as a prerequisite for a renewed permit. Most of the big hydropower plants need to relicense after 30 years. The permit legal situation is less clear for the smaller barriers. There has been an increasing number of small hydropower construction sites. There are a lot of small hydropower plants who do not contribute substantially to the national power security, but rather are a source of extra income for local farmers. Furthermore, it needs to be distinguished between the old hydropower plant permits from the 1970s and 80s and the new permits from the 1990s on. The licensing from the early 90s on were much better in terms of environmental requirements at least for the big hydropower plants. When it comes to permits, it is not only hydropower which is of interest but also road construction. There are a lot of new road and railway construction projects in Norway which often entail the use of culverts, or road construction in the riparian zone along rivers. Even though the WFD states that the deterioration of aquatic ecosystems should be avoided or at least compensated, the problem remains to implement this in the approach of the land use planning system in the Norwegian municipalities and the road authorities.

The Norwegian Research Centre (NORCE) and the hydropower research center HydroCen provide knowledge compilations for public and private sectors (HydrCen, 2023). Examples are documents such as the Handbook for Environmental Design in Regulated Salmon Rivers, Handbook on Physical River Measures, or the Handbook on Investigation Methods and Measures for Restoration.

Stakeholder Involvement

Through the annual National Seminars on the Restoration of Watercourses and Wetlands since 2010, examples and experiences from Norway and Europe have been disseminated, and a restoration professional network has been built across various sectors and levels of management, research, consultants, and voluntary organisations. The NRRS was presented at the National Seminars on the Restoration in the fall of 2020 including media coverage. Hydropower related mitigation are also often in focus, with annual workshops and seminars, several arranged by HydroCen.

In the work on developing and revising the Action Plan for implementing the NRRS, it is planned to obtain input from users of the waterways, including interest groups within tourism, fishing, and other outdoor activities. Other target groups are municipalities that plan, implement, and evaluate watercourse restoration, but also consultants, politicians, contractors, and machine operators who are hired for planning and execution. Dissemination of results to the public will be important to legitimise the social benefit of watercourse restoration and inspire increased commitment. Therefore, the NRRS strives for a good media coverage of restoration work, with the intention of creating a broad and increased involvement.

In general, the are many recreational anglers in Norway, and dedicated stakeholders (e.g., Norske lakseelver) which can cause a high local attention for river restoration. If they are concerned about their local river, they will put it on the agenda of the local municipality who will then bring the topic to the regional and national agenda. It really depends on these local active groups; the implementation of restoration projects is more complicated if there does not exist a bottom-up movement. The same is true in the context of urban river restoration.

Financing of measures

Norway does not have access to any EU financing programmes. However, it can be involved in transnational projects with neighboring countries such as Sweden or Finland which receive EU subsidies. The NEA manages the grant scheme "Grants for water environmental measures", with a total allocation of approximately NOK 24 million in 2021 of which NOK 20 million went to river restoration measures. The NVE has a grant scheme (subsidies for flood and avalanche protection and environmental measures) with a particular focus on avoiding environmental degradation. The Agriculture Agency operates with the subsidy schemes SMIL (subsidy for local environmental measures in agriculture) and RMP (regional environmental subsidies in agriculture). Measures for better water environment and climate adaptation, including the improvement of hydrotechnical measures, is a priority topic in the SMIL. The Norwegian Public Roads Administration also largely finances environmental measures through budgets linked to individual projects, in addition to the fact that climate adaptation, and attention to natural diversity and the water environment are highlighted as important in the National Transport Plan. In addition to the grant scheme, the NEA annually distributes restoration funds to the county municipalities based on reported needs. The county municipalities refer to their regional water management plans, designed according to the water regulations. Some have county water environment initiative funds or a grant scheme for nature restoration from which restoration measures are funded. Municipalities can secure the financing of water environment measures using stipulations and development agreements as a means of action. In addition, funding can come from water and sewage authorities, for example in the municipality of Oslo, where the reopening of closed streams contributes to better water quality and more functioning ecosystems. The follow-up of prioritised restoration measures in the water management plans is proposed to be strengthened by NOK 19 million. (NEA, 2022)

The grant scheme for water environment measures is designed for projects where the polluter pays principle does not apply. Within the hydropower sector, river restoration or mitigation measures are also financed through the exercise of authority by the environmental and energy authorities. They can impose revision of licenses, and in some cases self-initiated projects under the auspices of power companies. The costs are covered by the power companies.

Monitoring and Evaluation

The Action Plan will be dynamic and updated regularly until 2030 with a mid-term evaluation in 2026. A thorough periodic evaluation of the work is proposed to be carried out midway and at the end of the investment period. The evaluations will focus both on the results achieved in the form of actual restoration of watercourses but also on new insights that can form the basis for proposals of how the toolbox for comprehensive restoration of watercourses can be improved and communicated better. However, there is a lack of system and funding for follow-up research at the moment. Long-term monitoring of river restoration projects is usually missing. In the private sector, big hydropower companies often hire consultancy firms who do the monitoring for them to enable decision making.

Summary of the main characteristics

Goal: *restore at least 15% of deteriorated wayercourses in the period 2021 - 2030, and to reverse the negative ternd so that in 2030 water courses are at a higher rate restored than deriorated*

Instruments:

- *Barrier data base Vann-nett website/database collects information on all WB and the condition they are they are in; as a supplement, work has started to translate and use the European Barrier Tracker app to enhance the mapping of migration barriers.*
- *Prioritisation Water Body*
  - *High: protected areas (Natural Diversity Act, Ramsar-World heritage sites), water courses with endangered species or habitats according to the Norwegian Red List, areas valued as very important (frequency of use)*
  - *Medium: proposed protected areas, watercourses with function as migration route, relevant for climate adaptation*
- *Prioritisation barrier two-step process*
  - *Each sector authority maps restoration needs and prioritises within its area of responsibility based on how great potential for potential for improvement is*
  - *Sector authorities combine their knowledge base and agree on projects suitable for collaboration (find win-win solutions)*
- *Plans and measures not described*

Implementation: *newly starting from now on*

Evaluation: *dynamic action plan; will be updated annually until 2030 with mid-term evaluation in 2026*

3.10 SLOVAKIA

Policy Background and Design

When Slovakia entered the EU in 2004, the Water Act (Law No. 364/2004 Coll.) was passed by the National Council which is the sole constitutional and legislative body of the Slovak Republic. Although, the Water Act did comply with the transposition requirements of the EU Water Framework Directive (WFD), the political mindset did not attach importance to river continuity, thus little attention was paid to river continuity restoration. Since the entry in the EU in 2004, it has been a long way to finally arrive at the conclusion to compile a new water strategy for Slovakia. The main driver for a new policy were the parliamentary elections in 2020 which resulted in a new government that had the objective to create a new policy on water management.

Slovakia is a unitary state composed of 8 self-governing regions, 79 administrative districts and 2,926 municipalities. The Ministry of Environment is responsible for:

- preparing and coordinating the implementation of River Basin Management Plans (RBMPs)
- managing River Basin Districts (identifying water planning tasks and enforcing regulations)
- carrying out analyses of sub-basin characteristics and assessing the effects of human activities
- creating and implementing monitoring programs
- ensuring public participation in the implementation of the Floods Directive and the WFD
- issuing permits and plans for water abstraction, discharge, and water use
- coordinating international cooperation on the management of transboundary RBDs

Other ministries that are involved in water related activities include the Ministry of Agriculture which oversees irrigation infrastructure, the Ministry of Economy which is responsible for hydropower facilities, and the Ministry of Health which monitors drinking water and bathing water quality. The self-governing regions do not have significant water management competencies. The Ministry of Environment operates regional and district environmental offices and enforces environmental laws through the Slovak Environmental Inspectorate (SEI) with its local inspectors. The SIE was founded in 1991 by merging two autonomous bodies, the State Water Management Inspectorate and the State Technical Air Protection Inspectorate. (European Committee, 2023)

The new national Water Strategy was adopted in 2022, the same year as the new RBMPs of the third circle of the WFD came into effect. This new Water Strategy is based on the WFD (2000/60/EC), but the EU Habitat Directive and the EU Flood Directive (2007/60/EC) are also incorporated (Ministry of Environment, 2022). The preparation of the Water Strategy concept took place in 2020-2021 with the participation of key experts from various sectors and areas. The process of creating the policy took about 220 experts working together daily. For this, the Minister of Environment decided to establish an independent advisory body to support the development of the Water strategy, in which experts from various departments, research institutes, academia, representatives of municipalities and non-governmental organisations (NGOs) were represented. In the first step, all stakeholders were identified. Next, the stakeholders were asked to state the status-quo of the current water management situation. Afterwards, a summary of all the obtained information was compiled to make it accessible. Furthermore, strategic documents such as the RBMPs or the Flood Directive which needed to be incorporated were analysed. In the second step, all analytical information was collected. The working group covered a total of eight expert groups that were created for the purpose of processing background materials, analyses and solving specific thematic areas within the framework of the creation of a water policy concept. These eight expert groups had the task to dive deeper into their specific topic to analyse existing problems. This proved to be difficult because sometimes they rather concentrated at the manifestation of a problem than its source. The approach was to follow the rivers from their source to their estuary to investigate the different functions and threats during their course. This analysing process took about eight months. Basic principles such as climate change adaption and water as a human right were agreed on to steer the direction of the solution approaches. All in all, it was agreed up on the 10 pillars of the Water Strategy:

- Water in the landscape
- Water in urban settlements
- Sustainable water use
- Water for all
- Clean waters
- Living rivers
- Danube - a European river
- Understand water
- Responsible and informed decisions about water
- Water as strategic investments - effective financing

The Danube River got special attention and a separate chapter in the Water Strategy because it represents and units all topics within its catchment. It is an international river which is used for hydropower generation and navigation, but it is also one of the last treasures of inland deltas. Furthermore, it runs through Bratislava the capital of Slovakia and therefore has a symbolic value of making water management visible. It should be added that the Slovak public society was not used to a participatory approach in designing a policy. Slovakia also made experience with the importance of linguistical terminology. They used the Slovakian word for revitalisation in the new water strategy which led to some critique. In the end, a new expression for revitalisation was established in the Slovakian language but whenever the water strategy or parts of it are translated to work with international colleagues, the term restoration instead of revitalisation is used.

The interviewees for this study were a representative of the Ministry of Environment and a representative from the Slovak Water Management Enterprise which is a governmental organisation that is subordinated by the Ministry of Environment. While the Ministry is responsible for the policy, the enterprise has the task to implement the policy. The Water Management Enterprise deals with the water management of rivers and some selected water reservoirs in the whole country of Slovakia. They are not responsible for all river basins, but they are involved in compiling the RBMPs and the flood management strategy. Regarding restoring river continuity, they conduct restoration projects which aim at an improved fish migration, the refinement of other habitat species as well as the reconnection of oxbow lakes. The Water Strategy has the goal to restore 52 km of streams by 2024 and 97 km of streams by 2026 (Ministry of Environment, 2022). The aim is to have a landscape in the basins that can retain water and mitigate the negative consequences of climate change to ensure the protection and diversification of water resources, efficient and economical use of water, fulfillment of ecosystem services, as well as the safety and protection of the health and property of the inhabitants. Sediment transport is included in the new water policy, but Slovakia does not have a big issue with sediment transport. Regarding river continuity, the Water strategy states that it is necessary to actively mitigate the negative effects of existing water structures, barriers of various types, inappropriate modifications of streams and floodplains. One of the objectives of the Water Strategy entails that projects implemented to extend the life of hydropower plants will also include the mitigation of negative impacts on water bodies by ensuring the passage of migration barriers and allowing sufficient ecological flow. Furthermore, it is planned to define sections of watercourses in which the construction of new facilities for the use of hydropower will not be permitted ("no-go" zones) and to set criteria and conditions for the construction of facilities for the use of hydropower potential with minimal impact on the state of the waters in other sections of watercourses. (Ministry of Environment, 2022)

Policy Effectiveness

The new Water Strategy aims for river restoration and flood protection measures to go hand in hand. Therefore, when river restoration is going to be implemented, it is planned to be coherent with flood protection and vice versa. Permit of the relevant state authorities is required for all activities that may have an impact on the status of surface water or groundwater. There are several authorities that grant water permits, on each level for a different purpose. While the municipality grants water permits for private water use, the district administration grants water

permits for commercial use. Bigger projects such as the construction of a reservoir need to be processed by the authority on the national level. Usually, hydropower plants receive water use permits for about 30 to 40 years.

Another challenge is to solve the acute shortage of personnel with the latest knowledge, language skills and professional skills in the field of water management. Due to the unfavorable age structure of employees at all levels, within a few years there is a risk of failure of public services in several sectors of water management. The lack of experts can lead to the absence of a quality knowledge base, necessary for proper and effective water management.

Restoration Tools

Since 2009, Slovakia is obliged to develop a RBMP according to the WFD which also provides guidance on how to identify hydromorphological alterations. According to these instructions, all barriers on Slovakian watercourses that were able to be identified were listed. The process to build a national barrier data base has been long and laborious. The whole process started in 2009 with the first RBMP but with every election the project got interrupted and/or was started in a new manner. A lot of data was collected by the Ministry of Environment, but the Ministry of Agriculture also possesses data. There is lots of information gathered in different places and in different formats which complicates the process of integrating all information into one system. Measures to restore rivers are identified in the RBMPs. The measures are prioritised, but detailed technical proposals are not part of the RBMPs. Each organisation has an obligation to include river restoration measures into their operational planning that must be in line with the RBMP. For example, the Slovak Water Management Enterprise must develop a 2-year plan with specific financial demands.

Since the Water strategy came into effect in May 2022, two barrier removal projects and between 20 to 30 barrier equipment projects in the form of fish pass construction have been achieved. It is expected in the future, that there will be more barrier modifications instead of removals to restore river continuity. Still, the approach is to systematically restore the longitudinal continuity of the streams through removing migration barriers based on a thorough evaluation of the removal impacts. The removal of barriers is preferred, and the implementation of other measures only planned for those barriers that cannot be removed. The construction of fish passages close to natural solutions (bypass channels, boulder slides) are prioritised and technical fish passages only foreseen where no other solution is possible.

The list of barriers is currently under revision in terms of feasibility of their removal, those barrier removals that result in not achieving a good ecological status must be identified. As the government started the process of creating a new water strategy in 2020, the idea was born to prioritise the very long list of migration obstacles for restoration. Therefore, prioritisation only started for the third circle of the RBMPs. The Water Research Institute which is the think tank of Slovakia regarding water management in cooperation with the Ministry of Environment created a concept of prioritisation which orientates itself on the free-flowing rivers agenda of the EU (SEI, 2023). During this process, an expert group on river restoration of about 20 persons has been established in 2020 to set up prioritisation methods at basin level and water body level. The expert group consists of members from the Water Research Institute, the Nature Conservancy Association, and the Angler Association. These representatives know the localities very well and can therefore make informed recommendations. However, additional information such as migration barrier attributes or the terrain character need to be investigated before any decisions can be made. In theory, protected areas and species have a high priority but in praxis this cannot always be factored in as much as it should be. Ecological criteria have priority, but financial factors were also considered.

There is no official network or communication tool to gather and share information and experience between water professionals. However, there are events being organised to enhance the exchange of information and opinions. Most knowledge is exchanged in organised workshops and conferences. Slovak experts are also involved in international projects which enhances the expertise at the national level. There exists also a cooperation with other countries Slovakia shares international river catchments with such as Hungary and the Danube catchment.

Stakeholder Involvement

Traditionally, stakeholder consultation processes take place when strategic impact assessment or environmental impact assessment are being conducted in the realm of developing a specific legislation or implementing a restoration project. However, it is unusual that stakeholders are invited for framing strategies of action plans. An exception was the case of drafting the new Water Strategy. Regular meetings of the expert working groups took place, at least once every week. In addition, the Slovak Environmental Agency which is an institution that arranges workshops for the Ministry of Environment, received EU funds for the promotion of the Water Strategy. They arranged five thematic workshops of which two were devoted to river restoration. The aim of these workshops was to bring people from different backgrounds and with different opinions together to start a communication process between all stakeholders. These workshops were also supported by Slovakian NGOs. The involved NGOs caused a big social media presence of the project.

One of the objectives of the Water Strategy is to create a strategy of communication, knowledge transfer and informal education for different target groups in a participatory process between experts (in the field of water, education, marketing, and communication) and representatives of target groups (Ministry of Environment, 2022). The aim is to raise public awareness of the value of water, the importance of its protection, including river protection and restoration. As soon as it is decided to realise a restoration project, the respective landowners must be contacted. Furthermore, there are regulations in the law at what stage stakeholders must be involved. According to article 47 of the national Water Law, there must be an assessment of the planned restoration project which has to be published as well.

Financing

As a result of the lack of a long-term sustainable financial policy of the state and noncompliance with the state's investment policy in development and maintenance of water management, a high financial/investment debt has arisen, which is still growing. The administrators of watercourses do not have long-term guarantees from the state for the payment of economically justified costs for the management of streams and watersheds. The transfer of the management of streams, but also of state property between departments, takes place without setting up adequate financing for its further management.

About 80% of all projects are financed by EU subsidies and about 20% from the state budget. This estimation of finances includes all water management related constructions, such as wastewater treatment plants, public water supply systems, flood protection, or monitoring systems. 100% of the state monitoring systems are financed by the EU. Some barrier removal projects are financed by the Norwegian Fund. The new Water Strategy has the target to create a long-term financial mechanism for the implementation of systematic and complex restoration of watercourses and floodplains while gradually reducing EU sources of finance, based on the analysis of financial flows, the calculation of necessary operating costs and investments, including their prioritisation.

In the last 10 to 15 years there have been attempts to change the financial system, but politicians are not very open to the idea of a water-use tax due to the low salaries in Slovakia. The money which is generated through the allocation of permits goes into the Environmental Fund and is used for water supply constructions and their maintenance but not for restoration projects. Furthermore, the tool of financial penalties is not working well. Often, the amount of the penalty is too low or there is no official guideline for it. Sometimes companies prefer to pay the penalty than to implement the necessary mitigation or restoration measures. The Ministry of Environment has made some efforts to change this uncooperative situation by organising cross-sectoral dialogues.

Monitoring and Evaluation

Until now, monitoring exists mostly for fish pass constructions. Otherwise, only for water quality but not so much hydromorphological restoration. However, the objective 9.2 of the Water Strategy has the target to improve the scope and quality of water data collection. It is planned to expand the monitoring of Slovakia's waters in such a way as to enable monitoring, analysis and evaluation of new phenomena and indicators including the fragmentation of the river network. Furthermore, the improvement of the quality of water data collection and the digitalisation of the entire data flow within the framework of water monitoring through the Water Information System is under process. The implementation of the Water Strategy will be evaluated in the second third of the planned implementation period, in 2027. The next RBMP must be submitted by 2027, therefore, monitoring for the evaluation of the WFD objectives will be conducted. Another evaluation will occur at the end of the Water Strategy's validity in 2030 when the update of the Water Policy Concept of Slovakia is planned.

Summary of the main characteristics

Goal: *revitalize 52 km of streams by 2024, and 97 km of streams by 2026; actively mitigate the negative effects of existing water structures - barriers of various types, inapproprariate modifications of streams and floodplains*

Instruments:

- *Barrier data base, it is planned to create a Water Information System by integrating existing information systems and linking data from sectors and departments to ensure an available comprehensive dta base of water bodies*
- *Prioritisation Water Body in accordance with the Biodiversity Strategy 2030*
- *Prioritisation barrier not described*
- *Plans and measures*
  - *Removal of barriers preferred, implementation of other measures only in case of that barriers cannot be removed*
  - *Priority of nature-based bypass channels; technical fish passess only where no other solution is possible*

Implementation: *by government, private sector, academic sector, or civil society; in 3 phases - inverstigation, planning and construction*

Evaluation:

- *Implementation will be monitored once a year per 31 December by the Ministry of the Interior of the Slovak Republic (Water Section)*
- *Evaluation in the second third of the implementation period (2027) and at the end (in 2030), when the update of the Water Policy Concept of Slovakia is planned*

3.11 SPAIN

Policy Background and Design

In 1939, the government of General Francisco Franco formulated a water plan according to which the responsibility for managing water resources was divided among three different ministries: the Ministry of Public Works (for hydro-electrical development and domestic supply), the Ministry of Industry (for groundwater), and the Ministry of Agriculture (for irrigation) (del Moral & Saurí, 2010). The 1939 water plan failed to meet its goals for irrigation, but the construction of dams to generate electricity went forward (González-Gómez, García-Rubio, & Guardiola, 2012). To meet the increasing levels of water demand, the Spanish government adopted a water strategy for the best part of the last century that involved building large water infrastructures to increase the availability of water resources. Most of the dams were constructed in the water-rich basins of northern Spain and were owned and managed by hydropower companies. In the water-scarce basins of the south, most of the reservoirs which were primarily used for irrigation and flood control were owned and operated by the government. The two types of reservoirs were constructed in approximately equal numbers from 1939 to 1970. Since then, however, very few dams have been built for hydroelectric purposes, while the storage capacity for irrigation and flood control has grown very rapidly, particularly in the 1970s and 1980s (Costeja et al., 2004). By 1990, Spain's hydraulic infrastructure included more than 1,000 dams (compared with 60 in 1900) with a total storage capacity of close to 54,000 cubic hectometers (i.e., some 50 percent of total natural runoff). The water policy in the 20th century was led by engineers and based primarily on the performance of reservoirs and dams, actions that clearly targeted water supply. As a result, Spain is ranked fourth in the world in terms of the number of dams (Martínez-Cortina, 2010).

Due to the extremes of drought and flood that ravaged much of the country in the early 1990s, Spain was immersed in a discussion of a new national water plan in 1993 (Costeja et al., 2004). Although this plan called for greater efficiency in water use as well as a new sensitivity to environmental issues, in the end it fell back on the old model of expansion through a massive program of new reservoirs and extensive water transfers (Costeja et al., 2004). The plan itself was required by the Water Law of 1985, which was enacted by a Socialist government to modernise the legal framework for dealing with water issues. Among other measures, this law stipulated that water policy consider both the surface and groundwater resources within river basins and that the environmental functions of those resources be formally recognised. Planning was required at two different levels, that of the individual river basins and that of the country as a whole. The plans for the former were drafted by the respective river basin authorities, either the regional governments (where the catchment area is confined to a single region) or the national government (where the catchment area includes several regions). These plans, however, had to conform to the guidelines laid down in the national plan. The backbone of the latter was the so- called "national water balance system," a very complex set of large-scale transfers of water from the northern basins to other areas of the country (González-Gómez, García-Rubio, & Guardiola, 2012). Under this system, the Duero and Ebro Rivers were to be the main donors and the Mediterranean region the principal recipient. In the end, the original national plan was shelved after the Socialist Party was defeated in the elections of 1996 and the Conservative Party came into power (González-Gómez, García-Rubio, & Guardiola, 2012). There were three main reasons for the opposition to the national water plan of 1993. First, a water policy handed down by the central government was poorly suited to the changing political and administrative structure of post-Franco Spain. After many decades of strict central control, the Constitution of 1978 granted a much larger voice, if not actual power, to 17 autonomous regions. Together with a growing regional consciousness, this led to fierce (and effective) opposition by water-rich regions to the transfer of part of their resources to water-scarce areas, even when offered compensation. The controversy over transfers has reached such proportions that the government of Catalonia, a region in the northeastern part of the country that may face water shortages in the medium term, preferred to obtain water from the Rhone River in France rather than pursue agreements with other regions in Spain. This is a striking example both of Spaniards' resistance to treating water as simply a commodity and of the shifting spatial scale of water policy. The second reason for the opposition and one of the main criticisms of the I993 plan was its disregard of the need to achieve greater efficiencies in water use by means

of demand management. The third reason for opposition to the plan was that it would spoil the last scenic rivers in Spain, particularly those in the Pyrenees and the nearby Cantabrian Mountains. Conservationists felt that these areas could be spared through the reuse of water and the adoption of water-saving technologies, both of which the plan ignored. Along with consumer groups, trade unions, and other organisations in the civil society, conservationists have taken a much stronger interest in water issues in the recent years, thus joining a "water community" that was previously largely isolated from the rest of society. (González-Gómez, García-Rubio, & Guardiola, 2012)

Today, the responsibility for water management has changed to some extent; water management is mainly in the hands of the Ministry for the Environment including the implementation of WFD guidelines, the hydropower sector is governed by the Ministry of Industry and the Ministry of Agriculture still manages water for irrigation. As noted previously, the new government that was elected in 1996 promised to make water policy more sensitive to the economic, regional, and environmental aspects of this resource (Irujo, 2009). The new Water Act from 1999 introduced the water market, with emphasis on environmental protection aspects while continuing traditional water management. Water policy has undergone a gradual shift towards more rational and sustainable management of water resources since the 1980s. Having abandoned the old policy of building large dams and reservoirs, the National Hydrological Plan from 2001 contemplated a series of actions based on saving, purification, revitalisation, and desalination and provides measures to strengthen public control over the use and quality of water (Irujo, 2009). In the context of the Water Framework Directive (WFD), the Ministry of Environment initiated a National Strategy for River Restoration (ENRR) in 2006 to introduce new river management concepts and procedures necessary to achieve the WFD environmental objectives. Theoretical concepts from Fluvial Geomorphology and Ecology, together with WFD principles and objectives have been used as a basis for this strategy. Traditional drivers of river restoration arise from European and national legislation and policy relating to environmental protection and nature conservation. The ENRR is being implemented by the Spanish Ministry of Environmental Affairs, with scientific assistance from the Universidad Politecnica of Madrid. In general, river continuity restoration measures can be implemented by the state, the local administration, autonomous entities, or other environmental organisations.

The current Water Strategy from 2022-2030 which is an update of the ENRR identifies the issue of the decrease and potential loss of autochthonous fish communities in river sections affected by hydraulic infrastructures that impede the reproductive movement of aquatic species, especially in rivers with the presence of anadromous and catadromous fish species, such as salmon or the eel (ENRR, 202). Furthermore, it recognises the goal of the restoration of the connectivity of the rivers and the objective of restoring at least 25,000 km of rivers in the European Union so that they return to being of free flow from here to 2030. The Spanish Water Strategy defines river restoration as a set of actions aimed at the integral ecological recovery of the environment, including the total recovery of processes and natural functions that conform the ecosystem, thus returning it to its original state of reference. The river restoration process, therefore, requires the elimination, modification and management of all pressures that alter and deviate from their original state, with the goal of recovering over time the set of hydrological, geomorphological processes and ecological functions of each river, as well as the services and benefits that it provides to society. Every six years, the River Basin Management Plans (RBMP) of the river basin district, and its program of measures, are published and approved. One chapter of the program of measures is dedicated to the morphological restoration and improvement of fluvial connectivity, with the associated budget. A report including all implemented measures is published every year.

Policy Effectiveness

In recent years, a lot of progress has been made regarding river continuity restoration which is proven by the fact that Spain tops the list of barrier demolitions in Europe in 2021. The distribution barrier removals within Spain are uneven, with some areas where much progress has been made and others where the process is slower. In the Catalan River Basin District, barrier removals are currently being implemented at a rate of 2-3 demolitions of small structures per year. The main obstacles to carrying out river continuity projects are administration, financing, and the fact that some structures which are targeted for restoration have historical or cultural protection.

Possible solutions to enhance river restoration that could be implemented at the national level would be to facilitate the administrative procedure for the removal of concessions and the design and execution of projects. Furthermore, to put financing mechanisms in place, to facilitate the execution of restoration projects by the private sector and public entities. Moreover, establish mechanisms so that the competent authorities for water management are consulted before cataloging a barrier as historical heritage, or that once cataloged, mechanisms can be sought to be able to act to improve connectivity throughout respecting the cultural character, if it proves to be necessary.

Definition of guidelines for river restoration framed within a national strategy has represented a relatively easy task and has always counted on a general agreement regarding river problems and the desired objectives. Difficulties have arisen in applying these guidelines, due to discrepancy in approaches among the administrative staff without enough environmental background and the small experience in participating and being involved in management of the stakeholders.

Restoration Tools

The current Water Strategy states that as far as possible, the scale of action of river restoration must be strategic and be planned at the river basin level, involving the entire length of the fluvial corridor. Riparian vegetation enhancement, weir removal and fish passes are the most frequently implemented restoration measures. In recent years, partial weir removal in combination with the construction of fish passage structures, is gaining ground as a restoration measure to increase the longitudinal connectivity in Spanish rivers. After long administrative processes, many small, obsolete weirs have been removed, especially in the northern and Basque country districts, where 74 small weirs were removed between 2007 and 2010.

For an improved river restoration management, it is necessary to increase the information available on the different hydromorphological conditions of the water bodies. Currently, in addition to the information on the fluvial hydromorphology protocols, maps showing the state of the hydromorphological quality including river continuity are published. With respect to the restoration of the natural connectivity of the rivers and the natural functions of the corresponding floodplains, the Member States elaborate an inventory of the barriers to the longitudinal and lateral connectivity of surface waters and determine the barriers that should be eliminated to contribute to the achievement of the restoration objectives established for terrestrial, coastal and freshwater ecosystems and the objective of restoring at least 25,000 km of rivers in the EU. In total, more than 18,500 transversal barriers have been inventoried in the set of water bodies that form the channels of the inter-community basins. Highlighting the majority presence of barriers formed by dams and weirs with an average height of less than 2 meters.

According to the Water strategy, the Member States will eliminate the barriers to longitudinal and lateral connectivity of superficial waters determined in accordance with the guidelines. When removing barriers, Member States should primarily address obsolete barriers that may not be necessary for renewable energy generation, inland navigation, the water supply, or other uses. For the prioritisation of barrier restoration projects, each of the following criteria are represented on maps (GIS layers) and are given certain weights. Once the maps are superimposed on each other, each barrier obtains its own prioritisation score. Criteria used for water body (WB) prioritisation are:

- WB with those barriers that were priority for removal or permeabilisation as part of the Programme of Measures (as parts of the River Basin Management Plans)
- WBs that were in protected areas (e.g., it is estimated that at least 38,290 kilometers of Spanish rivers are included in the spaces that form the Red Natura 2000 (RN2000))
- WBs with barriers whose removal or permeabilisation would maximise unfragmented river length
- WBs with significant fish populations that are threatened with invasive species
- WBs particularly sensitive to climate change

Stakeholder Involvement

In the area of education and training, a particular effort has been made since 2006 to increase the knowledge of ecological river science among managers. Two international seminars on river restoration were organised in 2006 and 2007, with the presence of the relevant international scientific community, and several publications were produced to facilitate the design and application of restoration measures (González del Tánago and García de Jalón 2007; Barreira and others 2009).

Several internal workshops with scientific experts and major official water authorities as well as open conferences to promote discussions and encourage participation were organised and later extensively referenced in regional journals. Additionally, six specific working groups addressing flow regulation, channelisation and dredging, agriculture, urbanisation, invasive species, and river conservation were created, to prepare initial reports including diagnosis and proposals. The dissemination of information and social learning about the National Strategy were also achieved by means of the creation of specific sections of the general Ministry of the Environment web site and by public participation in several radio and television programs that addressed the concepts and activities of the river restoration National Strategy.

The same specific working groups mentioned above integrating scientific and administrative experts and stakeholders' organisations prepared detailed reports on the main problems of Spanish rivers and the alternatives and constraints for ameliorating their ecological status. Flow regulation by dams and reservoirs in nearly all the major rivers for irrigation and hydro-power purposes was considered the most important stressor on Spanish rivers. Accordingly, the possibility of improving flow variability and river dynamics to achieve success with other restoration measures was extensively considered. In the context of the revision of the ENRR, the Directorate General of Water has maintained coordination meetings with the different Hydrographic Confederations and equivalent organisms of the intra-community basins, constituting the working scenarios and discussion of the main aspects related to the revision and the update of the ENRR. However, there is little social awareness of hydromorphological degradation and social demands for hydromorphological river restoration and protection in general.

Financing

The financing of river restoration measures corresponds to the general administration of the state, especially in the inter-community basins and the Autonomous Communities and Municipalities, having a framework of investment foreseen in this Strategy for the period 2022-2030 of €2,500 million.

River continuity restoration measures are financed through the general state budgets of the respective Water Authorities. In case of intra-community basins, finances are governed by the competent authority body. In Catalonia, this budget comes from collecting a fee from water users. In general, if the restoration or removal of a barrier is enforced legally, the structure owner must carry the project costs.

Monitoring and Evaluation

It is necessary to monitor indicators and technical criteria to evaluate the different restoration actions. The ENRR considers a fluvial hydromorphology protocol as a calculation tool for some metrics, a set of indicators based mainly on the recovery of the length of the river object of the restoration project, the length of the river recovered in terms of river continuity, the surface of the river corridor recovered, the number of works eliminated or adapted by the acts and the number of inhabitants protected against the risks of flooding. These metrics are used for the development of specific programs for monitoring the implementation of ecological water regimes, which allow to analyse the fulfillment of the same, as well as its effects on the fluvial environment and the aquatic and coastal ecosystems that sustain it, focusing especially on the hydromorphological conditions of the channels, the state or ecological potential of the water masses, and the fulfillment of the objectives of the protected areas.

Summary of the main characteristics

***Goal**: restore connectivity of the rivers, restoring at least 25,000 km of rivers to free flow until 2030*

Instruments:

- *Barrier data base (Member States will elaborate an inventory of the barriers to the longitudinal and lateral connectivity of surface waters)*

existing	planned	removed	function	obsolete	equipped
X	-	X	-	X	X

- *Prioritisation Water Body*
  - *Protected areas (RN2000), WBs with significant fish populations that are threatened by invasive species, WB particulary sensitive to climate change*
- *Prioritisation barrier whose removal would maximise unfragmented river length*
  -> criteria are represented on maps (GIS layers) and re given certain weights; once the maps are superimposed on each other, each barrier come out with its own prioritization score
- *Plans and measures barrier removal and fish fish pass construction*

***Implementation:** application framework designed with the aim of translating the objectives into actions through elaboration and execution of national recovery plans*

***Evaluation:** based on a set of selected indicators to assess the success of the objectives and instruments.*

4 Findings & Discussion

This chapter has the aim to analise and integrate the obtained information from the single countries on their national longitudinal river continuity restoration approach and the observations which are emerging across countries into a bigger picture. Therefore the main findings are presented first and later discussed in relation to a broader context.

4.1 FINDINGS

Goal

- *For almost all countries river continuity restoration is not the topic of a separate policy but part of the national water policy and are up to date from 2022*
- *The terminology used in the laws differs very much in its interpretation between the different countries.*
- *All policies identify issues regarding river fragmentation and define goals for river restoration, but differ in specification. Austria, France, Germany and Spain mention specifically river continuity / connectivity restoration*
- *All policies evolved through the years or were newly induced by the development of the implementation of the WFD*

(Barrier) data base

- *Almost all countries maintain a data base with information on water bodies / barriers / restoration projects*
- *Austria, France, Germany, Lithuania and Spain have a specific barrier data base*
- *The data base of France and Spain is also used for barrier removal / equipment / by-pass planning and progress tracking*
- *Since the data collected from the dams by the countries are not unambiguous and are also recorded in different ways, they can hardly be compared between the countries. A certain degree of harmonization is desirable for this.*

Prioritisation Water Bodies restoration

- *Half of countries prioritize Water Bodies restoration*
- *Common prioritization criteria are: Fish migration, fish biocenoses, protected areas (Natura 2000, Ramsar sites, Red List species etc.)*
- *Hydromorphological aspects , water flows and sediment transport are only sometimes mentioned*

Prioritisation of barrier removal / equipment / by-passes

- *More than half of the countries prioritize barriers*
- *(Highest) ecological impact is the main criteria*
- *Other criteria are km of river length opening, (spawning) habitats, obsolete dams, hydromorpholgical aspects, climate adaptation / mitigation*
- *Combination with implementation of other measures, floodprotection, floodplain restoration, technical construction works*
- *Sediment transport, (ecological) flow regimes, nutrients etc. are hardly mentioned*

Plans and measures

- *(Available) plans and measures (e.g. WFD implementation) to be used are included in some policies*
- *If they are mentioned they differ very much in details*
- *How to gain and share technical knowledge is only described in a few policies*

Public participation and stakeholder involvement

- *Public participation and stakeholder involvement is described in all policies*
- *In practice approaches differ from more to less top-down*

Financing

- *Sources of finance are included in all policies but to different sources the funding amounts are highly dependent on the political constellation and are not investigated.*
- *Sources only distuingished between regional, national and European funds. Private funds were not mentioned.*
- *The financing amounts are highly dependent on the political constellation and circumstances and are not investigated.*

Implementation

- *The method of implementation is determined on one hand by the policy criteria, measures and plans but at least as much by the circumstances such as property rights, administrative organisation, (government) financing, political relations, etc..*

Monitoring and evaluation

- *Monitoring and evaluation is part of all policies, however, adjustment of policy to monitoring restoration results and/ or policy performance is only mentioned in two policies*

4.2 DISCUSSION

The first point of discussion needs to be on a very generic level about the terminology. During this study it has become clear that all countries possess a legally binding document (usually in form of a water law) entailing river continuity aspects, but not all countries use the same clearly defined terms of "policy", "strategy", and "action plan" for additional guiding documents. A policy is a deliberate system of guidelines to guide decisions and achieve rational outcomes (Wikipedia, 2023a). A strategy is a general plan to achieve long-term or overall goals and generally involves setting targets and priorities, determining actions to achieve the targets, and mobilising resources to execute the actions (Wikipedia, 2023b). An action plan is a detailed plan outlining actions needed to reach one or more goals, it can be defined as a sequence of steps that must be taken, or activities that must be performed well, for a strategy to succeed (Wikipedia, 2023c). Often, the respective distinction of the investigated information is not very clear especially since some countries utilise all three document types and others only two or one of them. Sometimes a document declared as a policy is a mixture of policy and strategy and in other cases a strategy also entails components of an action plan. However, all investigated countries possess a water law and at least one additional strategic document regarding waterway restoration. In this study, legally binding documents (laws) as well as guiding documents such as policies, strategies, and action plans of the respective countries were considered if they entailed any content on longitudinal river continuity restoration to gain an overview of the situation on the topic in each country with the aim to not disregard any valuable information. However, the term "policy" was used throughout this study (if no other explicit denotation was used for a document) to facilitate the understanding of the report and to focus on the content rather on the terminology.

As mentioned in the introduction of the report, this study concentrated on the longitudinal dimension of river continuity restoration. Since there are different aspects of longitudinal continuity the overarching question is how far do policies consider all aspects of longitudinal river continuity? Fish migration is an established motivator and the main driver for longitudinal river continuity restoration in all investigated countries but not the only reason. Other aspects such as sediment transport, habitat connectivity, and environmental flow are also mentioned in some but not all policies. However, it cannot be argued against the fact that fish migration, especially of endangered species, receives special attention, sometimes even in the form of a separate Fish Migration Strategy. Furthermore, funding is often available (exclusively) for fish migration enhancing restoration measures which can be explained by direct revenues from the fishery and tourism sector. Nevertheless, other drivers such as sediment transport seem to gain more and more importance according to the interviewees.

Where opportunities exist to remove barriers alongside planned or existing restoration projects, or in connection

with protected areas, these could be prioritised. Synergies can also be sought with other EU legislation or other initiatives. For instance, improving connectivity and river habitats can greatly benefit the European eel, in line with Regulation No 1100/2007. When planning river restoration, it is important to consider possible synergies with the objectives and measures set out in the Eel Management Plans. The same goes for synergies with the objectives and measures of the Pan -European Action Plan for Sturgeons. In general, the migration routes of migratory species are taken into account when prioritising barrier removal. When prioritising barriers for removal, it is also important to consider existing uses in a river basin, including inland navigation, flood defence, energy generation or agriculture. This will help maximise the co-benefits of such operations and avoid significant adverse effects on important uses. The WFD integrates provisions for such uses and sets rules to ensure the integration of different objectives. (EC, 2021)

There exist very different historic backgrounds regarding water laws and the associated policy design in the single countries. In general, either the responsible authority, in most cases the Ministry of Environment, designs the river restoration policy which usually includes stakeholder consultation rounds, or the authority identifies stakeholder groups, states the status-quo, and creates working groups joined by stakeholder representatives which develop the policy. A couple of interviewees made the point that linguistic terms and clear definitions are sometimes a greater source of conflict than the overall steering direction of a policy in the making. To allege an example, the definition of "obsolete" barriers can be intricate since a barrier may be seen as obsolete as soon as it does not fulfill the function any longer that it was initially constructed for (e.g., hydropower generation) but has in the meantime obtained other functions (e.g., recreational use) or social value with a historic background.

The fact, that in several countries more than one governmental authority are responsible for the water management of the country, leads to the situation that often different and opposing interests are prevalent. A common situation is, that the Ministry of Environment is in charge of the maintenance and the restoration of watercourses while the Ministry of Agriculture and Forestry has an special interest in the fishery sector which can cause a fruitful cooperation in regard to river continuity restoration but also provide situations of conflict when it comes to the decision which restoration measure is suitable (e.g., decision between a barrier removal or equipment) and which locations and facilities should receive priority. The same applies for the relationship between the Ministry of Environment and the energy sector regarding hydropower dams and their function as a river continuity barrier as well as a source of energy. In other cases, the state is not conducting river continuity restoration projects itself but only provides the necessary information and advice as well as financial tools. In general, it can be said that the administrative structure of the water management sector is important for the implementation of river restoration since it determines on which level decisions are made, which stakeholders are involved, and what financial tools are available. Furthermore, the administrative structure seems to be dependent to some extent on the size of the country because rather small countries (e.g., Austria) have two administrative levels while big countries (e.g., France) can have up to four levels. However, the number of administrative levels is not important, if each level is organised in an effective way with the aim to have as less as possible administrative effort and burden. The different historically grown water management structures in each country lead to the conclusion that the development of a general policy framework might be less useful than general recommendations for effective tools and approaches under certain circumstances. This conclusion is underpinned by the fact that the various social, political, topographical, as well as climatical circumstances in the single countries all influence the approach of water management in general and the river continuity restoration in particular, respectively.

Nevertheless, country overarching guidelines and legislation such as the WFD are important to initiate progress and to provide a continent-wide steering direction of the water management sector. The WFD has had an impact on all water restoration policies to a different extent. The link to the WFD ranges from "partially congruent" to "based on" to "oriented towards". However, the WFD was the driver for an update of all national policies, most of them represent the transposition of the WFD but also other EU directives have had an impact on the respective national

policies. The Biodiversity Strategy for 2030 (2020), the Habitats Directive (1992), Natura2000, and the Floods Directive (2007/60/EC) were all important guiding legislations in most of the investigated countries. Furthermore, the European Green Deal (2019), the Environmental Impact Assessment (EIA) directive as well as the Eel regulation (2007) were influential in some countries according to the interviewees. The different EU directives, strategies, and regulations influence what is decided, implemented, and monitored (or not) regarding river continuity restoration in each country, but this study could not incorporate all of them in detail due to time limiting factors. However, it is recognised that synergies with other directives which are affecting the water management sector (e.g., Flood Directive) are explicitly sought for in some national policies but not sufficient emphasised in others.

Most countries focus on the river continuity restoration of obsolete barriers. A prerequisite for this approach is an existing and maintained **barrier data base**. All countries maintain a barrier data base to a certain extent. While some possess a quite comprehensive and detailed barrier data base, others are still in the process of completing their partial data base by integrating already existing data or collecting additional information. Austria has a decided approach when it comes to determining restoration options considering the use of the barrier. There, hydropower generating dams are not being removed but rather equipped with fish passes, while urban flood protection dams are being deconstructed or modified where possible. The Slovakian policy states that barrier removal is always the preferred option if possible but according to the implemented projects so far, barrier equipment is predominant. In France, equipping barriers is also the most applied solution after the law was changed in 2021. In general, it can be said that the choice of restoration option depends on the ecological aim of the restoration measure, the willingness of the owner as well as the available funding.

Considering the **prioritisatio**n of continuity restoration projects, the single approaches differ a little but not too much. Mostly, the prioritisation of barriers is based on the hydromorphological state and ecological criteria, with the focus being on the distribution of particularly endangered (migratory) fish species, followed by the willingness of the local community and the situation of ownership. More in detail, the ecological effect of the measure depending on the length of the to be restored continuity stretch of water and the accessibility of suitable habitats upstream in tributaries are considered. Often, the priority areas from the eel management plan (Eel regulation 2007/1100) are considered. Furthermore, some countries (e.g., Austria) prioritise from big to small in terms of catchment size and from down to upstream in terms of river stretches.

Robust prioritisation and planning of action requires robust data. In addition to mapping out the location of barriers to longitudinal and lateral connectivity, it would also be important to identify gaps in knowledge preventing the assessment of connectivity and to put in place processes to fill such gaps. It should be noted that addressing these data gaps could also support the correct implementation of other, related EU legislation. (EC, 2021)

Stakeholder involvement is widely recognised as very important but implemented in different ways. Next to stakeholder consultation rounds or their participation in working groups during the development process of a national policy, they are usually consulted and involved in individual river continuity restoration projects, also. The participatory approach with the advisory boards of local public services as well as authorised board associations of private structures and landowners is prevailing in the investigated countries. Other tools for stakeholder involvement are so-called "river dialogues" and similar activities on social media, Water Round Tables for a face to face interaction and communication, annual national conferences and workshops organised for water professionals, or an existing country-wide water restoration network. The implementation of the stakeholder involvement is in most countries organised by the responsible ministry but in a few countries also in cooperation with local NGOs.

Regarding the **financing** of restoration projects exists a wide range of approaches from mostly using EU funds (e.g., Slovakia) to almost exclusively using national funds (e.g., Austria, France). Norway is an exception since it is not an EU member and therefore only uses its national budget. In general, the aimed at result of project funding seems to determine the funding strategy to a certain extent; a fast and high number of restoration of waterways will be reached through a general funding of all restoration projects independent of them being legally enforced or conducted on a voluntary basis. On the one side, a targeted funding of voluntary based restoration projects may seem "fairer" to the public and be more practical with a very limited funding budget available. On the other side, any voluntarily based approach means that not necessarily the most effective or needed barrier restorations are targeted since the prioritisation follows not strictly criteria such as ecological impact. The separation between different barrier types in respect of their use and ownership is possible regarding continuity restoration funding rates. However, different subsidy rates depending on restoration measure or situation of ownership may lead to disagreements and resentment by the affected stakeholders. The time horizon of funding budget is also an important factor for the effectiveness of the policy and the implementation of river continuity restoration measures. Some country contact persons described difficulties to realise projects within the six-year cycles of RBMPs since budget allocation are usually planned for the same period of time. In Finland, the NOUSU programme with a time horizon of four years constitutes an even smaller and therefore more intricate planning timescale.

The **monitoring and evaluation** of implemented measures as well as of the policy implementation itself exist to some extent and at least partially in all countries. There are different monitoring levels and purposes in place. In general, monitoring funding and a standardised method are often missing. Furthermore, the lack of human resources also constitutes a constraint for monitoring. However, obstacles to the effectiveness of river restoration policies are mainly the political implementation (e.g., clear legislation or allocation of decisional power between responsible authorities), and the financing according to the interviewees. Unceasing permits without environmental requirements can be very inhibiting, also. The problem in this respect is that institutions allocating permits are often not the same responsible for river restoration management. The hydropower lobby against and the lack of public support for river restoration measures are further constraints. A bad communication and cooperation between stakeholders can be an obstacle but does not seem to be the main problem.

5 Conclusion and Recommendations

This chapter follows the same structure as the one above; starting with the situation of governance and administration, followed by the utilisation of prioritisation methods and a barrier data base, the stakeholder involvement, financing, and the monitoring and evaluation needs. The chapter closes with a conclusion on where further investigation is needed and a summary of the key messages of this study.

The **national river continuity restoration policy** of a country needs to be horizontally (synergy with other national policies and laws) and vertically (effective on all administrative levels) integrated. In general, it is necessary to combine river continuity restoration with other aspects of water management such as flood control and drought management (especially in view of climate change adaption), navigation, irrigation necessities for agriculture, hydropower generation. Furthermore, other functions that provide ecosystem services such as the maintenance of food webs and the transport of nutrients and sediments should be considered in view of financing strategies, prioritisation methods, or monitoring activities. To include all aspects of longitudinal river continuity or even all dimensions of river continuity can help to gain a holistic view and to find synergies more easily to conduct an effective restoration. Additionally, to agree on linguistic terms and their definitions will help to set clear targets shared by all stakeholders and facilitates communication processes.

In general, the **completeness of a policy**, although important, should not be overrated since circumstances can be more determining for the policy effectiveness. Rather, obstacles and drivers of river continuity restoration need to be identified and suitable and effective solutions be found. For example, unceasing water-use permits without environmental requirements need to be abolished. The allocation of permits should be used as a restoration tool and not constitute an obstacle to it. Therefore, an allocation of permits for a rather short period of time (30 to 20 years or even shorter) and with environmental requirements is beneficial. A requirement could be, to check every 10 years if the facility is still state of the art and if not so to update it accordingly. Awareness raising in and cooperation with local administrative departments is needed to explain why water-use permits should not always or at least not without environmental requirements be granted.

The investigation of the **administrative structure** of the water management sector and the interests of the responsible authorities can be helpful to improve the river continuity restoration situation. Compromises of different interests should be found on the highest level of authority (between the single ministries if there is more than one responsible for the water sector) to provide a clear steering direction and guidelines. Nevertheless, for the effective implementation of river restoration projects, tools must be in use to involve all stake holders and find specific solutions that follow the official guidelines but are somewhat tailored to the specific situation. This balance of clear objectives and adapted implementation can be expressed through the prioritisation on a national and/or regional level of necessary river continuity restoration projects and certain communication, suitable solution determining, ecological, and technical advice on the local level. Basically, this describes a synthesis of a top-down and a bottom-up approach as well as the combination of a centralised and decentralised structure. The top-down approach allows the prioritisation of restoration projects according to ecological criteria and the centralised part provides a certain overview of a whole catchment if not a whole country situation. The bottom-up and decentralised approach enhances the willingness and cooperation of all involved stakeholders.

The **prioritisation method** for river reaches as well as the single barriers within the river reaches should be standardised and include all important aspects which are of ecological, social, and economic nature. There should be an official method available to measure the ecological importance regarding the natural reproduction cycle of endangered migratory fish species, functioning ecosystems (food-webs), habitat connectivity, and the protection of other endangered species. But also, the sediment transport and the environmental flow should be considered. In general, all ecosystem functions and the ecological services need to be incorporated. The available project funding needs to be considered for prioritising purposes but preferably not be the determining factor since idealistically the funding should be regulated and be made available through the policy as well. Once the Nature Restoration Law, which

has been proposed by the EC as the first continent-wide comprehensive law of its kind and a key element of the EU Biodiversity Strategy, is finally adopted by the EU, every Member State will have to make a restoration plan not just for but also including aquatic ecosystem restorations, and thus will have to use some kind of prioritisation. This can be a good opportunity to design new and effective prioritisation methods. But for this there are also clear and practical metrics from the EU are needed with additional guidelines and tools for in this case the free-flowing rivers.

To be able to make informed decisions, the status-quo needs to be known. Regarding longitudinal river continuity restoration, a comprehensive, maintained, and accessible **barrier data base** is the prerequisite. The Adaptive Management of Barriers in European Rivers (AMBER) project can give a good orientation for building up a national data base. The Amber Barrier Atlas includes the following barrier attributes: the date of entry, a barrier ID, a picture, the location (coordinates), the barrier type (dam, weir, culvert, ford, sluice, ramp, or other) and the subtype, the height (with a range from < 0.5m to > 10m), the barrier extension (fully or partially), if the barrier is in operation or not, barrier flow conditions, river width, river name, barrier fish pass type. The structure of the AMBER atlas can be a good starting point for building a national barrier data base which can include additional information such as ownership, restored barriers, presence of endangered species or other valuable information. The barrier data base should be used for the same purpose throughout the whole country to ensure its functioning and maintenance in the foreseen way. Keeping the data base up to date through a daily use of the water professionals or an inventory with each RBPM cycle can be an option.

In general, **stakeholder involvement** is inevitable which has been widely recognised already, but also the exchange of project experiences, restoration data, and information on planned projects between the water professionals of a country can enhance the river continuity restoration process. There are several possibilities such as the implementation of a country-wide network system for water professionals, annual conferences, workshops, and field trips, or even an internal monthly newsletter.

The **financing** of river continuity restoration should be reviewed and if necessary improved to enable the implementation of all necessary measures and to ensure that the funding mechanisms act as tools to incentivise river continuity restoration. The funding regulations and processes must be transparent. A staggered funding system with a high subsidy rate in the beginning and the prospect of the restoration measure becoming legally mandatory at a defined point in the future can be an effective motivator to realise restoration projects. In general, fees for noncompliance with the policy or the law must be high enough so that to put up with it is not a viable option for (private) stakeholders.

A **monitoring and evaluation** system is necessary to be able to improve restoration measures, to keep an overview of the country-wide development, and to be able to adjust financial, legal, or technical tools. There are two aspects of monitoring that need to be considered, the ecological result of the implemented restoration projects and measures as well as the policy implementation process itself. A separate budget for monitoring is necessary. Monitoring data and evaluation services can also be purchased from consultancies if the required resources are not available to the responsible authority. To facilitate and differentiate the monitoring methods, responsibilities, and financing of it, it can be distinguished between different types of monitoring as it is the case in Austria.

The introduction of an environmental energy label for hydropower generation granted through a transparent process by an official authority could be an option to add another driver to the river continuity restoration cause. The collaboration with regional/local NGOs for the advertising of the label in the public could apply social pressure on hydropower owners to remediate their environmental impact.

Further investigation is needed of the influence of other EU directives and regulations on the national policies regarding longitudinal river continuity restoration to identify useful synergies which can be applied by the project implementers. The MERLIN project funded by the EU is already taking this approach, however, it explores social, economic, and environmental factors that shape the success of freshwater restoration in general and not for river continuity restoration in particular. Funding mechanisms also should be further investigated since funding plays a decisive role for the prioritisation and choice of measures as well as their monitoring and evaluation after implementation. The scope of different funding mechanisms and budget allocations used in the single investigate countries could only be viewed abridged within the possibilities of this study, but a more detailed investigation may provide further insight on how to enhance longitudinal river continuity restoration.

In summary, the completeness of a policy is important to ensure that all necessary components (administrative structure, a barrier data base, prioritisation methods, stakeholder involvement, funding mechanisms, monitoring and evaluation system) for the implementation of longitudinal river continuity restoration are considered but is less determining for its effectiveness than the existing circumstances. Obstacles and drivers of river continuity restoration need to be identified to recognise windows of opportunities for either implementing river continuity restoration measures or to initiate a beneficial change of the prevalent circumstances (e.g., enabling legislation). Even though the conclusion of this study is that the development of a general policy framework for river continuity restoration of European countries would not coercively enhance the river continuity restoration process, it cannot be denied that there is an evolving river continuity restoration policy process existing in the investigated countries. Water professionals in all countries that participated in this study and most probably beyond that are already striving for improvement of river continuity restoration within their means. Still, there are many problems (lack of barrier data base, prioritisation method, monitoring and evaluation system) that need to be addressed and conditions that need to be advanced (e.g., identifying synergies). Hopefully, this study will contribute and support the process.

6 Acknowledgement

This study would not have been possible without the support of all the water professionals in the participating countries who provided information on their national laws and policies regarding river continuity restoration, who took part in the country contact group meeting, who agreed to be interviewed, who provided comments and corrections for the single country summaries and who were available for further inquiries via email. Representatives from the following institutions and organisations were involved in this study: Ministry for Agriculture, Forestry, Regions, and Water Management of Austria, Ministry of Agriculture and Forestry of Finland, Finnish Environment Institute (SYKE), Economic Development Department and Environment Department of the ELY centers in Finland, Office français de la biodiversité (OFB), Department of Water and Biodiversity of the Ministry of Ecology of France, Thuringian State Office for the Environment, Mining and Nature Conservation (TLUBN), Ministry of Environment and Physical Planning of the Republic of North Macedonia, Norwegian Environment Agency (NEA), Ministry of Environment of Slovakia, Slovak Water Management Enterprise, Agència Catalana de l'Aigua. We are very grateful for the time and effort that the representatives spent for this study.

Furthermore, we thank the advisory group for the conductive discussions during the meetings, their insights, and recommendations. The advisory group had the following members:

- Josée Peress - Office français de la biodiversité (OFB)
- Christina Lindhagen - Swedish Agency for Marine and Water Management
- Edith Hödl - International Commission for the Protection of the Danube River (ICPDR)
- Kirsty Blackstock - James Hutton Institute (Scotland), Environmental Governance and Land Management Group, Department of Social, Economic and Geographical Sciences
- Paul Brotherton, Heather Bond, and Emma Cordier – Wetlands International Europe

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ISBN/EAN 978.90.903.7359.1
ECRR publication number 3
STOWA report number 2023-14
STOWA project code 443.330

The network for best practices of river restoration in Greater Europe
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ISBN 978-909037359-1