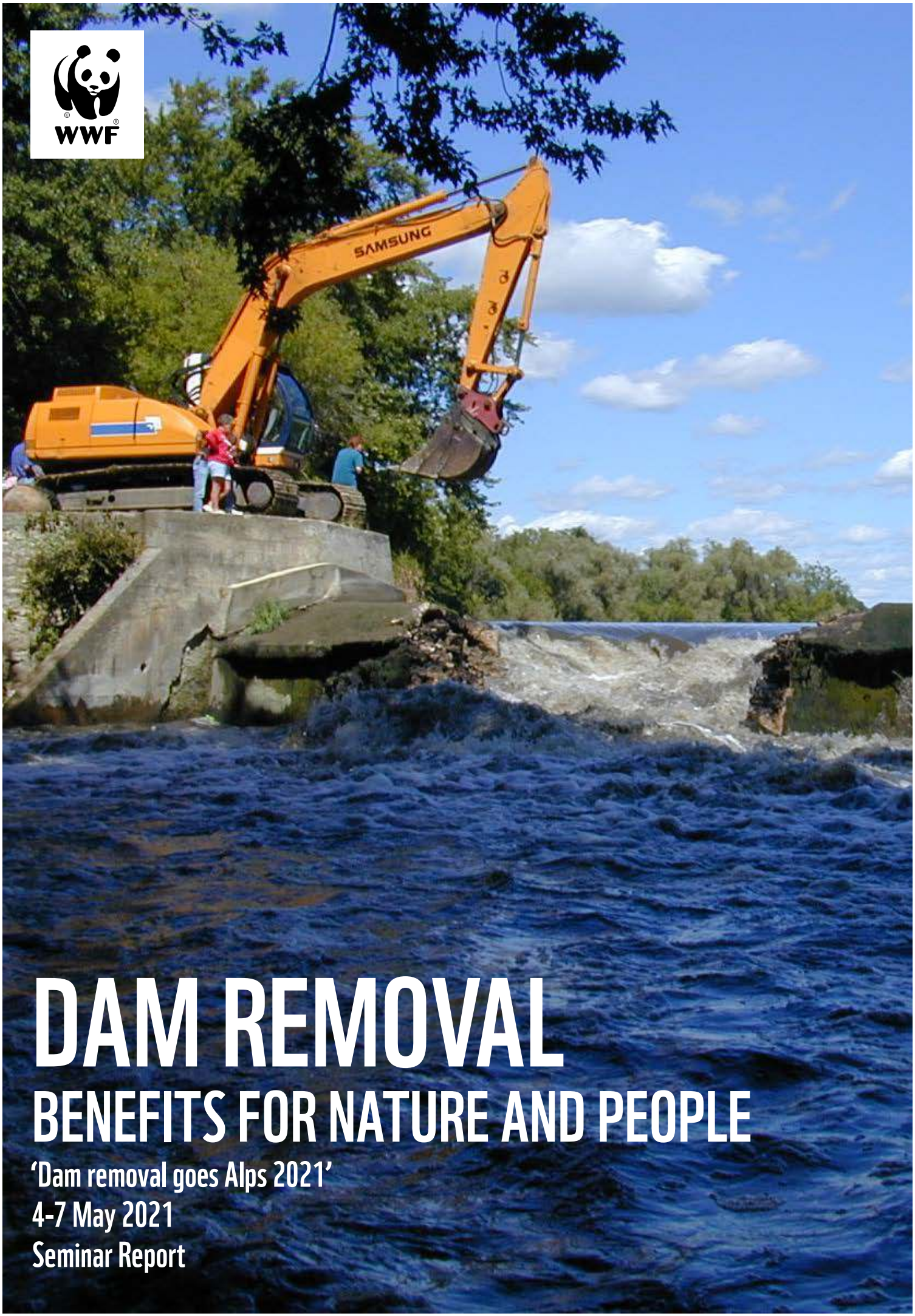

DAM REMOVAL

BENEFITS FOR NATURE AND PEOPLE

'Dam removal goes Alps 2021'
4-7 May 2021
Seminar Report

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Preface

'Panta rhei', taught Heraclitus, the Greek philosopher: everything is constantly flowing, everything is changing. However, most of our rivers do not flow freely anymore. Over 1.2 million barriers are blocking European rivers, which means an average density of 0.74 barriers per every kilometre of river. This is a disaster, not only for fish, who depend on free waterways to reach their feeding or spawning grounds, but also for humankind. People rely on healthy rivers in many ways, and it is not surprising that Siddhartha, a young Brahmin in Herman Hesse's novel, found enlightenment at the bank of a river. He was taught to listen to and observe the river, which was constantly changing and yet always remained the same river.

So, let's listen to the rivers and free them from obsolete barriers. 'Concentrate on the opportunities, not the obstacles', was the advice given to us by Kim Aarestrup after showing how the removal of the Vilholt dam in Denmark led to an overwhelming increase in the population of the iconic brown trout. We need stories like this to motivate the public, the water managers, the dam owners and everybody involved to take the big steps needed to give life back to our rivers. The Scandinavian countries, the US, Spain and France are the leaders in dam removal across the world. They were invited to Bavaria in 2020 to spread the word on how and why to promote dam removal. After Spain (2016), the UK (2017), Sweden (2018), Estonia (May 2019) and France (September 2019), we wanted dam removal to go to the Alps, the region with probably the highest density of river barriers in central Europe. After shifting the dam removal seminar to 2021 due to the Covid-19 pandemic, it was still necessary to conduct it as an online event – a challenge that we took on and which we did not regret. More than 900 experts and river lovers from more than 60 countries came together over the four seminar days and shared experiences, visions and new concepts that will build capacity not only in the Alpine region but across the world to remove even more dams, support aquatic wildlife and retrieve what is probably an intrinsic part of the human identity: the experience of flow, an element that is inherent to all healthy rivers.

Overview

Part	Presented by	Date
Keynote 1	Klement Tockner (General Director of the Senckenberg Society): "Importance and threats to river ecosystems – with a focus on Europe and the Alpine Space"	4.5.2021
Showcase Austria	Gerhard Egger (WWF Austria): Removal of the "Hornbachsperre", Showcase from the Lech River in Tyrol (Austria)	
Session 11	Overview on dams in Europe Extent of river fragmentation in Europe: Results and recommendations from the AMBER Project (Carlos Garcia de Leaniz, Swansea University, UK) Status of barriers in Bavarian rivers (Stefan Ossyssek, WWF Germany)	
Session 12	Critical status of European rivers Opportunities for dam removal under the EU Biodiversity Strategy (Claire Baffert, WWF EPO, Belgium) A pan-Alpine overview on the status of rivers (Pablo Rauch, BOKU, Austria)	
Session 13	Effects of barriers on fish populations Effects of barriers on fish and outcome of barrier removal in Switzerland (Armin Peter, FishConsulting, Switzerland) Scientific program to understand the mechanisms of restoration of the Selune River (France) following the removal of two large dams (Laura Soissons, INRAE, France)	
Session 14	Decline of land ecosystems Decline of gravel banks and related species (Myricaria) due to river degradation (Gregory Egger, KIT, Germany) Modelling the impact of dams and exotic vegetation in New Zealand braided rivers (Guglielmo Stecca, NIWA, New Zealand)	

Keynote 2	Teppo Säkkinen, Special Advisor at the Ministry of Economic Affairs and Employment: “Government programme to restore migratory fish populations in Finland”	5.5.2021
Showcase Switzerland	Christian Hossli (Aqua Viva): Removal of a small powerplant in Schöftland (Switzerland)	
Session 21	Approaches to prioritize dam removal Swiss methodology for identification and prioritization of obsolete dams (Christian Hossli, Aqua Viva & Cathy Hutchings, WWF Switzerland) Prioritization concept in North Rhine-Westphalia, Germany (Andreas Müller, Chromgruen)	
Session 22	Highlighting negative effects of dams Did the publication of the AMBER map change opinions and push removals? (Carlos Garcia de Leaniz, Swansea University, UK) Significance of river continuity to fish population (David Bittner, SFV, Switzerland)	
Session 23	Pointing to the chances Managing dam removal in Slovenia (Leon Kebe, WWF Adria) Finnish campaign for dam removal (Sampsa Vilhunen, WWF Finland)	
Session 24	Innovative communication strategies Free flowing Salzach: The power of images and visions (Christine Margraf, BUND Naturschutz, Germany) Lessons learned from the World Fish Migration Day (Pao Fernández Garrido, WFMF)	

Keynote 3	Beth Lambert, Director of Division of Ecological Restoration at the Massachusetts Department of Fish and Game (USA): "The economic effects of ecological restoration and dam removal in Massachusetts"	6.5.2021
Showcase Bavaria	Johannes Schnell (Bavarian Fishery Association): Removal of three small hydropower plants along the Mitternacher Ohe, Germany	
Session 31	Ecological benefits of dam removal Removal and reconstruction of a weir at the Ammer river (Bernhard Müller, Water Management Office Weilheim, Germany) Dam removal is the Holy Grail of river restoration: Ecological benefits of dam removal in Denmark (Kim Aarestrup, DTU Aqua, Denmark)	
Session 32	Economic benefits of dam removal Dam Removal – Exploring Investable Projects (Wouter Helmer, Rewilding Europe) Assessing the economic rationale of small-scale dam removal (Antti Iho, Luke, Finland) Lessons learned from the removal of the Krebsbach Dam, Germany (Ercan Ayboga, Environmentalist, Germany)	
Session 33	Social benefits of dam removal Dismanteling of a longitudinal dam right in the middle of Zurich (Christian Hossli, Aqua Viva, Switzerland) The Altenau Story, one of the most remarkable river restorations in Germany (Ulrich Eichelmann, Riverwatch)	
Session 34	Removals in the view of climate change Global warming induced fish die-off in the Rhein 2018 and mitigation measures taken (Samuel Gründler, Swiss Fishery Association) Methan production in large and small reservoirs in Bavaria and Rhineland-Palatinate (Andreas Lorke, University Koblenz-Landau)	

Keynote 4	Christophe Poupard, Director for Water Planning, Agence de l'Eau Seine-Normandie: "Selune, the biggest dam removal in Europe"	7.5.2021
Showcase Lithuania	Karolina Gurjazkaitė: Dam removal in a country, where dam removal used to be impossible (Lithuania)	
Session 41	Exemplary political frameworks A truthful bidding mechanism for micro-hydropower plant removals (Iho Atti, Luke, Finland) Restoring the Snake River through dam removal (David Moryc, American Rivers) Comparing dam removal policies in Europe – a short overview (speakers from Austria, Spain, France and England)	
Session 42	Financing dam removal Crowd funding for dam removal (Carmen Arufe, WWF Netherlands) Subsidising and leading the removal of small dams in Northern France (Stéphane Jourdan & Jean-Luc Carpentier, Water Agency Artoise-Picardie)	
Session 43	Expiring concessions as new chances How removing "eternal rights" of water use might lead to dam removals (Ruedi Bösiger, WWF Switzerland) Dam removal at the Duero River in Spain (Carlos Marcos Primo, NAIAD Coordinator) Selune example: Why the concession was not prolonged (Roberto Epple, ERN, France)	
Session 44	Legal cases and law enforcement Weir today, gone tomorrow? An approach to understanding and managing historic weirs in England (Steve Dean, Environmental Agency, UK) Removal of a small weir in the Windach (Markus Brandtner, Water Management Agency Weilheim, Germany)	

All presentations and videos can be downloaded and viewed here:
https://dam-removal-goes-alps.de/downloads.html

Chapter 1: Examples of dam removal in Europe

Message: Dam removal is feasible and already happening, not only in Europe, but also in the Alpine Space

Dam removal is a new idea and assumed to be the most effective measure in river restoration. It might sound radical, but radical changes are needed to stop the ongoing decline in natural freshwater ecosystems and halt the extinction of freshwater species. Most European countries have at least one successful story of barrier removal. Case studies in Bavaria, Switzerland and the river Sélune in France show how fast the fish population, in particular, recovers once it has regained its natural habitat after the removal of barriers or dams.

France is the European pioneer and champion of dam removal. The first large dam was removed on the river Allier (Saint-Etienne-du-Vigan dam) in 1998; since then, over 100 small barriers and almost 10 large dams have been removed. France possesses a lot of technical know-how on dam removal and leads by good example in the area of river restoration in Europe. Scandinavian countries are following rapidly, as they have recognised the need for the restoration of migratory fish species populations. Alpine regions with extremely fragmented rivers are following as well. Austria, Germany and Switzerland have successfully removed barriers in their rivers.

How it's done: France – biggest dam removal in Europe on the river Sélune

The Sélune is a 90 km long river in Normandy, France. It is one of four 'salmon rivers' flowing into Mont-Saint-Michel Bay. A watershed of 1,051 km² is mostly agricultural land with villages that are home to approximately 57,000 inhabitants. Two large-scale hydroelectric dams, La Roche-Qui-Boit and Vezins, were built on the Sélune in 1914 and 1927, respectively. With a height of 16 m and 36 m they constituted an impassable hindrance for the migratory fish that frequent this coastal river. Reports concluded that it would be technically impossible to rearrange the dams and bring them up to minimum ecological standards for fish waterways. They also generated water quality problems, such as cyanobacteria blooms. Given the negative impact of the dams and their low energetic productivity, their removal was requested by NGO campaigners and state representatives at the end of the concession period in 2007. In 2014, local opposition by citizens stopped the removal process. Finally, between 2019 and 2020, the Vezins dam was dismantled. Work on the La Roche-Qui-Boit dam is planned for 2021/2022. A broad scientific monitoring programme has been supporting this project since 2012.

See: vimeo.com/546711100

Lesson learned by Roberto Epple (ERN): Top-down decisions might provoke stronger opposition, therefore early and clear communication with all parties involved is crucial.

How it's done:
Switzerland – removal of a small and relatively new power plant on the river Suhre near Schöftland

In Switzerland, a small hydropower plant on the river Suhre (Suhr in German), which rises in Sempachersee, was removed in 2018, less than a decade after its construction in 2009. The plant in Schöftland was a 'water vortex power plant', a new type of power plant that raised very high expectations and was even considered for potential export to India. However, it produced only a small amount of electricity and the owner, a cooperative, was not able to ensure river connectivity. Financial difficulties, unprofitable operation and unfulfilled connectivity requirements led to the decision to remove the obstacle. The various species returned quickly and the river is now in a near natural state.

See:
youtube.com/watch?v=eUDVNkAOzUo

flussfrei.ch

Lesson learned by Christian Hossli (Aqua Viva): No matter what age a power plant is, if it does not serve a purpose and does not meet connectivity requirements, it should be taken out.

How it's done:
Lithuania – dam removal in a country where dam removal was previously impossible

In July 2020, an obsolete barrier on the river Bražuolė was removed in order to restore river connectivity. The removal resulted in an improved habitat and water quality and helped to achieve environmental targets. Money for the removal was collected by crowdfunding and the barrier was removed in just two days. A 'low hanging fruit', the cheap, quick and easy removal initiated wider discussions on barrier removal and opened up new scientific research opportunities. Dam removal thus became part of the country's strategic plans, as the relevant ministry ordered a study with a priority list of dams to be removed in the future.

See:
youtube.com/watch?v=DRtsZy05C90&feature=youtu.be

Lesson learned by Karolina Gurjazkaite (Lithuanian Fund for Nature): Even small and – from a global perspective – insignificant removals can snowball and pave the way for much bigger projects and policy changes and a significant mindset switch.

How it's done:
Austria – removal of the 'Hornbachsperre' at a tributary of the river Lech in Tyrol

The river Lech is a braided, multi-channel Alpine river in Tyrol. With its distinct morphology, it is home to many rare species, such as the little ringed plover, the common sandpiper, the distinct species of wolf spider, the speckled buzzing grasshopper, the German tamarisk and Alpine cartilage lettuce. In one of its tributaries, the river Hornbach, a sediment control dam was removed in order to release bedload into the Lech river to stop further riverbed degradation and reconnect habitats. The dam was obsolete and the lack of sediment trapped behind it caused problems downstream (decline in groundwater table, stability of bridges). Decisions had to be made between further regulating the river or turning back time and restoring it by releasing sediment. Removing the dam turned out to be an economic decision and a nature-based solution created by a synergy of water management and conservation management.

See:
youtube.com/watch?v=Vc48dgJPFJw

Lesson learned by Toni Vorauer (WWF Austria): The removal of a dam is often much more delicate and time-consuming than its construction.

Following the dam's removal, the sediment was subject to the natural succession processes. Release of the sediment improved flood protection and the groundwater level went up by 1.5 m. The river Lech is designated a natural park and a protected Natura 2000 site, so restoration activities were financed by two LIFE+ projects: 'Wild River Landscape of the Tyrolean Lech, 2001 to 2006' and 'LIFE Lech – Dynamic River System Lech, 2016 to 2021'.

Figure 1: The lowering of the former sediment trap at the Hornbach. © Toni Vorauer, WWF Austria

How it's done: Germany – removal of three small hydropower plants along the river Mitternacher Ohe

The Mitternacher Ohe, a river in eastern Bavaria, is home to many endangered fish species, such as the Danube salmon and the lamprey. Water from the river was once used to run mills and later to operate three small hydropower plants. Transverse structures diverting water into mill channels were removed in 2001, 2007 and 2013 by the Bavarian Fisheries Association. Water has returned to the riverbed and the Mitternacher Ohe is once again flowing freely and unhindered along its total length of around 17 km. As a result, brook trout, Danube salmon, lampreys and river pearl mussels can once again migrate freely. The complete passability of the river and the improvement of the habitat on the Mitternacher Ohe ecologically outweigh the lost contribution to climate protection and energy transition many times over. In any case, the former owners of the plants opted to abandon and sell their water rights and infrastructure due to increasing low water and floodwater phases, which made operation unprofitable. The larger and diverse habitat is more resilient and allows fish species to migrate in times of low water and higher temperatures and to reach spawning grounds. The removal resulted in the change of fish status from 'moderate' to 'very good' according to Water Framework Directive criteria.

Lesson learned by Thomas Funke (Bavarian Fisheries Association): First of all, the importance of stakeholder communication should never be underestimated. You will be surprised how many different parties are involved in a public project. However, including them right from the beginning will certainly help to achieve your goals. What we really miscalculated was the workload regarding funding applications. So if your organisation does not have the capacity and expertise for this workload, try to find a partner that does. You also have to take into account the long-term commitments of your project. We had to buy some land along the river and to this day we are still responsible for taking care of it.

See:
youtube.com/watch?v=8TrFR5iEvXE

and "Der Rückbau einer Kleinwasserkraftanlage. Untersuchungen über die ökologischen Auswirkungen auf das Gewässer" from 2006

Nature reserve "Mitternacher Ohe", Freyung-Grafenau. © Wikipedia

How it's done:
Great Britain – weir removal planned in the Lake District

The river Kent in the Lake District supports Atlantic salmon, sea trout, eel, white cloak crayfish and some relic populations of white pearl mussel. It is a designated riverine site of special scientific interest and a Special Area of Conservation. It is a high-energy river; currently, there are 14 weirs on the river Kent and the river is in unfavourable condition due to the impact of human modification. The Bowston weir was constructed in 1875 during Britain's industrial revolution as part of a complex of mills involved in or supporting paper production. It became redundant in the 1960s. The Environment Agency established the Cumbria River Restoration Strategy to restore rivers and help to improve their ecological condition. The sluice gate of the Bowston river failed in 2016 and the then owners were approached to discuss the removal of the weir. Permission was granted in 2020 and the proposal for removal is awaiting a green light from the local planning authority. The removal works are planned for summer 2021. All information about the removal proposal, presented in question and answer form, has been made available to the interested public, and a local community engagement plan was made with members of the local community. The designer prepared a non-technical explanation of how the removal would be designed and a vision of the restored river after the removal of the weir in order to help people embrace the change happening in their environment.

See:
youtube.com/watch?v=l2FkTml9n2o

Chapter 2: What is at stake?

Message: There are very few free-flowing rivers left

Globally, there are very few free-flowing rivers left; they are mostly located in Central Africa, Amazonia and the Arctic Circle, places of rich freshwater mega-fauna. Unfortunately, these places are also under tremendous pressure due to the construction of new large hydropower plants and the planning of even more dams, as reported by Klement Tockner, General Director of the Senckenberg Society.

Rivers in Europe are heavily modified and in many cases blocked with barriers of different sizes that were constructed for a variety of purposes. Many of these barriers do not serve their initial purpose and stand obsolete and forgotten by humans but nevertheless continue to block migratory fish species from reaching upstream spawning habitats. Carlos Garcia de Leaniz (Swansea University, UK) reported that there are over 1.2 million barriers on European rivers, which means an average density of 0.74 barriers for every kilometre of river. Some 68 % of these barriers are lower than 2 m high, therefore hard to detect and poorly mapped. While large dams get most of the attention, it is in fact the small ones that do most of the damage. Furthermore, when talking about dams, one instantly thinks about hydropower dams, but there are many varieties of barriers that negatively affect the integrity of the river: dams, ramps, fords, weirs, culverts and sluice gates (Figure 2).

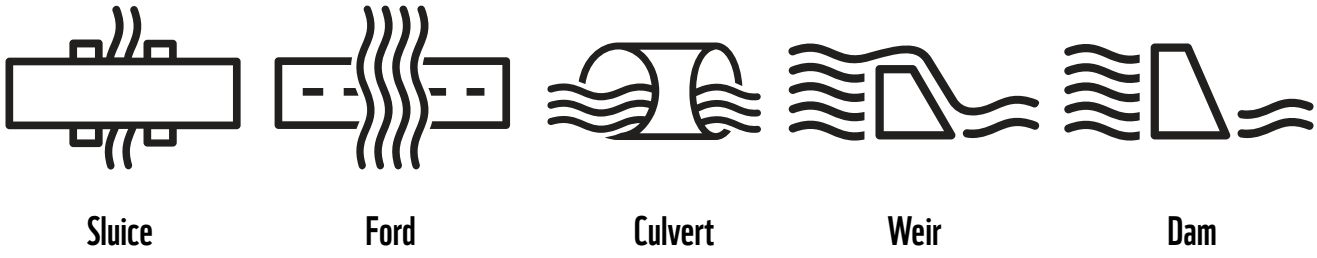


Figure 2: There are various types of river barriers, each of them cuts a river section into two parts (taken from Amber barrier ID guide portal.amber.international/barriers/)

Rivers in the Alps are among the most fragmented in Europe. All large valleys along the Alpine ridge are densely populated areas, making usable space a scarce and highly sought-after resource. The rivers flowing through these valleys have suffered major deterioration since the beginning of the 20th century due to intensified land use, flood protection measures and increased exploitation of the hydropower potential. In contrast to most other European river systems, Alpine rivers are more severely impacted by hydromorphological stressors than water quality issues. In Bavaria, very few small creeks remain completely free flowing; one example is the Schwarzbach near Unterjettenberg. Since the removal of three weirs from the Mitternacher Ohe in the Bavarian Forest, this river flows freely for 17 km.

Message: Most of our rivers have an insufficient ecological status

The dense river network in the Alpine Space is under pressure from intensified land use, flood protection measures and hydropower development, all of which lead to disturbed hydrological regimes, an altered morphology and disturbed sediment regimes. All the above-mentioned changes resulted in habitat degradation and loss of freshwater biodiversity. Most of the river network in the Alps consists of headwaters and small rivers, large rivers account for only 10 % of the network. Due to the high percentage of headwaters, 45 % of rivers are in a good hydromorphological state. However, according to Water Framework Directive assessments, only 5 % of large rivers are in a good state. Large braided rivers in the Alps are truly exotic features these days; 60 % of them have been severely altered. According to Pablo Rauch (BOKU, Austria), hydrological pressure also affects 70 % of large rivers with impoundments, water abstractions and hydropeaking. In Europe as a whole, an average of about 4 out of 10 rivers are ecologically intact. However, there are countries such as Germany where only 8 % of the rivers correlate with the goals of the Water Framework Directive. By 2027, more than 90 % of German rivers need to be restored in order to achieve the required ecological standards. This is a tremendous task, which requires the resolute cooperation of different stakeholders and a high political priority for freshwater protection.

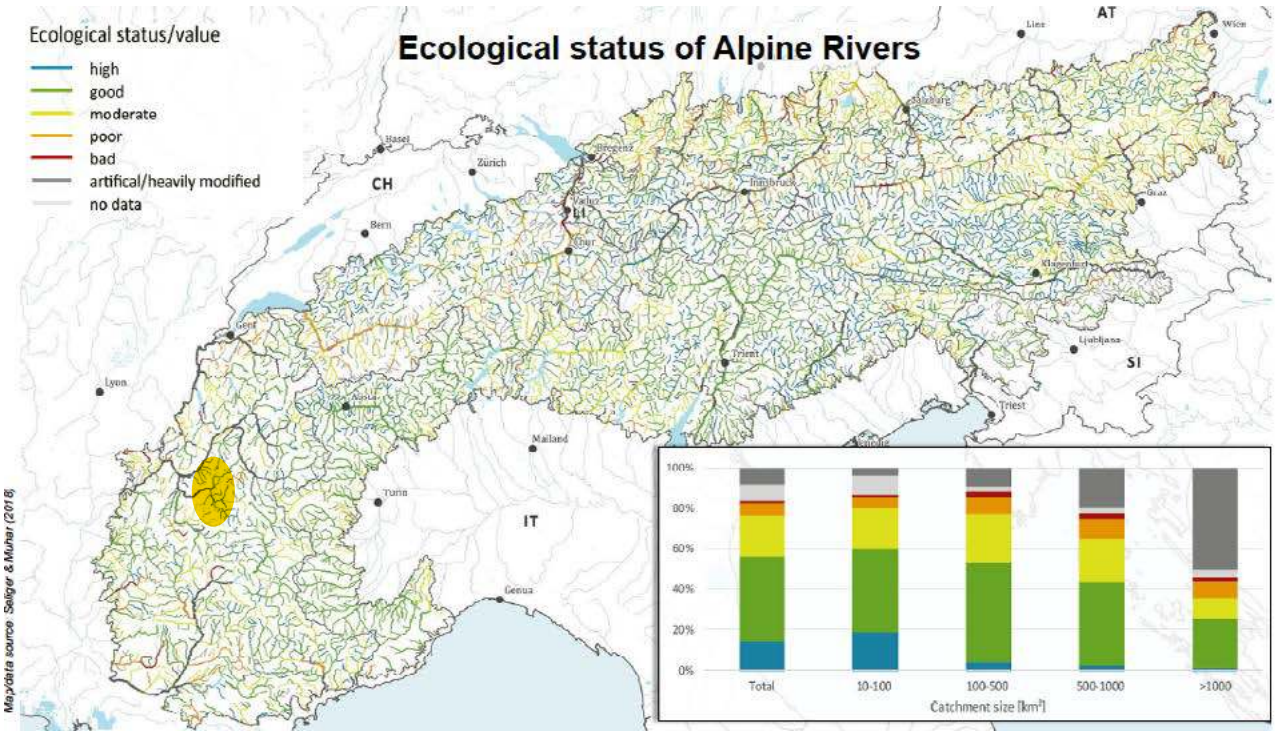


Figure 3: Less than half of the alpine rivers are only in moderate or worse ecological status. (© Carina Seliger & Susanne Muhar)

Message: Fragmentation is the problem – reconnection is the solution

Claire Baffert (European Policy Office, WWF) explained that barriers are among the main causes of failure in achieving the targets set by the Water Framework Directive. One-third of European rivers suffer from hydromorphological changes, and, of those, 20 % fail to achieve a good ecological status because of barriers. Over 1.2 million barriers are blocking European rivers, and it is important to acknowledge that 68 % of them are less than 2 m in height (and thus often overlooked). Most of the barriers in Europe's rivers are structures built to control and divert water flow or to raise water levels, such as weirs, dams and sluice gates; to stabilise riverbeds, such as ramps and bed sills; or to accommodate road crossings, such as culverts and fords. Armin Peter (FishConsulting) provided the example of Switzerland, where fragmentation is mostly caused by several hundred thousand artificial barriers less than 0.5 m in height, such as bed sills built to compensate for bed incision caused by channel straightening. Moreover, more than 100,000 barriers are higher than 0.5 m. Christian Hossli (Aqua Viva) reported that, on average, there is a barrier every 650 metres and many tributaries are disconnected from the main river. With almost 57,000 barriers, Bavarian rivers are also highly fragmented; 95 % of them are lower than 2 m in height. Stefan Ossyssek (WWF Germany) stated that only a minority of these obstacles in rivers are freely passable for fish (roughly 10 %), not to mention other aquatic species. Until recently, barrier mitigation (achieved with the help of fish ladders or bypassing) was the main concept in ensuring connectivity. Carlos Garcia de Leaniz complained that large dams get the attention, whereas the plurality of small barriers do most of the damage. Out of 4,614 barriers surveyed in detail within Europe, 13 % have been identified as obsolete. There is a great opportunity to remove the useless obstacles as a first step.

A unique citizen science project was launched in 2016 to track and map barriers on European rivers: the AMBER project seeks to apply adaptive management to the operation of dams and barriers on European rivers to achieve a more efficient restoration of stream connectivity and address impacts caused by river fragmentation. Everyone can contribute to the data collection via a smartphone app, which guides users to mark barrier location, helps identify the type of barrier and collects photo material of the barrier (see the barrier atlas https://amber.international; and also the Nature article: https://www.nature.com/articles/s41586-020-3005-2). Such a detailed inventory of obstacles on rivers is a helpful tool when prioritising barriers for removal. It is estimated that 5 % of barriers cause 50 % of connectivity loss. The goal is to initially target the least fragmented rivers where one removal opens a longer stretch of river.

The dam removal opportunity score developed within the AMBER project – DAMROS – uses a multi-scale spatial approach and highlights the greatest benefits and opportunities for barrier removal. Results show that the benefits of removal differ widely across Europe, making the Scandinavian Peninsula and the Balkans hotspots for dam removal while the Alps score very low due to high fragmentation.

Message: Fish populations are in decline and species are endangered due to river fragmentation

Dams change water flow and sediment transport, they alter thermal and chemical regimes. Flow velocity decreases. The loss of system connectivity has genetic consequences. Fish assemblages are altered.

Freshwater fish species are facing massive decline. The tiger of continental rivers, the Danube salmon (Hucho hucho), is rapidly losing its habitat as free-flowing stretches of big rivers become rare. Pablo Rauch demonstrated that the species was previously distributed in about 2,700 river kilometres. Nowadays, it is distributed in about 1,300 river kilometres, while only 240 river kilometres sustain the vital population of this magnificent fish (merely 10 % of its former distribution).

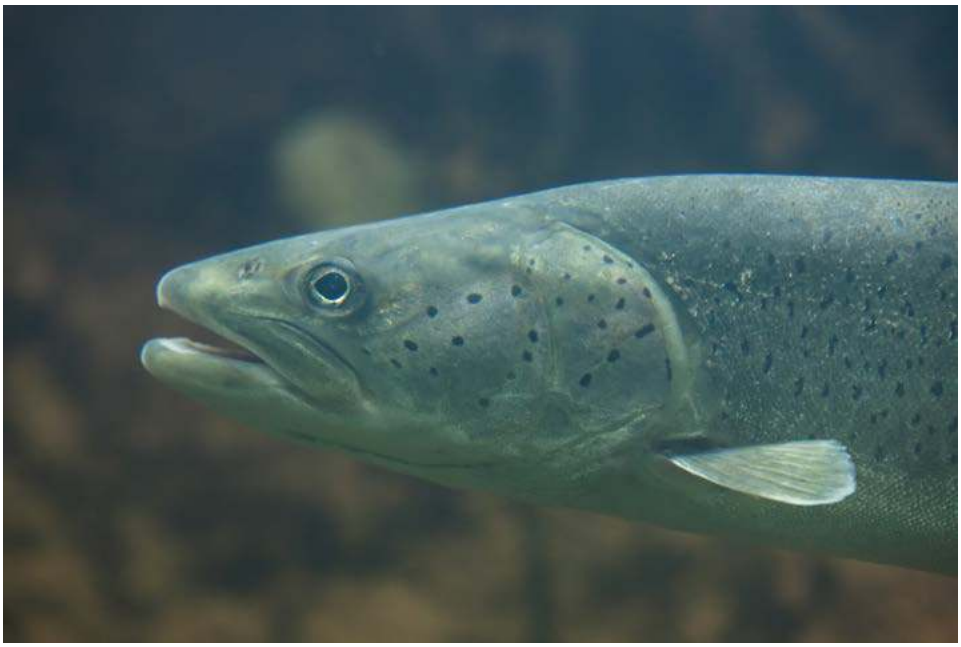


Figure 4: The Danube salmon (Hucho hucho) is one of the iconic fish species in the Danube river system. (© Getty Images)

Fish species in Bavaria are facing decline as well. By 1990, 21 of the 69 original species had disappeared and the distribution area for 27 out of 51 species had been reduced by over 50 %. Some 35 fish species out of 66 currently occurring species are on the Red List of Threatened Species. Impoundments are among the main stressors. Dam removal is a very cost-effective way to restore river continuity. It has the potential to restore fish populations and hydromorphological conditions in a relatively short period of time. Armin Peter explained that fish passes are not always the solution to the problems faced by migratory fish species. The Bannwil hydropower plant on the Aare river in Switzerland was observed for downstream fish migration using a telemetry process. There were three possible ways of passing the dam: turbine corridor, spillway corridor and fish pass. Almost half (43 %) of tagged individuals passed the hydropower plant; the majority used the turbine, one used the spillway and none used the fish pass as a downstream corridor.

Figure 5: Grayling die-off in Rhein (© Samuel Gründler, Swiss Fishery Association)

Climate change affects water temperature in rivers and lakes, and as temperatures rise, fish need to migrate to places with cooler water, tributaries, deeper pools and shaded areas. The grayling stock depends on free-flowing rivers and is sensitive to increases in temperature. Heatwaves in 2003 and 2018 contributed to a massive die-off in the Rhine, between Lake Constance and Schaffhausen, as reported by Samuel Gründler (Swiss Fishery Association). This area hosts one of the largest and most productive grayling populations in Europe. Fish have limited choices when temperatures rise to up to 28°C in the main river. If migration to Lake Constance is possible, fish can hope to find cooler and oxygenated water there; if not, migrating back to the river poses a high risk due to predation. Tributaries can only be reached by some fish species and certain size classes. Due to hydromorphological changes in habitats and limited migration, fish are trapped. There are some emergency measures that can be taken in such a situation, for example, shading the river (only doable for small creeks), creating artificial shelters by covering rivers with nets (predatory birds), oxygenation (using sprinklers) and improving migration routes; evacuation is a last resort. Removing migration barriers and improving habitat diversity increases the population's resilience to climate change.

Figure 6: Grayling die-off in Rhein (© Samuel Gründler, Swiss Fishery Association)

David Bittner (Swiss Fishery Association) stressed that, while river continuity is important for the fish population, caution must also be exercised when removing dams. A thoughtful evaluation of small dam removal with broad local assessment is needed. Planners need to address the trade-off between river continuity and loss of habitat. The loss of deep pool habitats due to dam removal, with no replacement habitats, can negatively affect the fish population.

Figure 7: There are various natural replacements for deep pools that may get lost due to dam removal. (© David Bittner, Swiss Fishery Association)

When removing dams, another aspect that needs some attention in the planning phase is the presence of invasive species. In some cases, removing a migration obstacle would allow invasive species to spread further upstream or downstream and even enter tributaries. Invasive species would not stand a chance in stable, mature ecosystems, but in a fragile, heavily modified riverine ecosystem, the chances of filling an empty niche are high. In that regard, special attention is needed in protected areas like Natura 2000 sites. The Habitats Directive safeguards important habitats that are needed to protect key European flora and fauna. Removing an obstacle can greatly modify a habitat and can act against the protection measures.

People love near-natural rivers for recreational use

The saying 'water is life' is sometimes over-used. People in Europe, and especially in the Alpine region, take water for granted and are not really aware of its true value. While this tends to be pushed into the background, newly established values and the needs of the population for recreation spaces and places to recharge the energy required for busy lifestyles puts the spotlight on the recreational use of near-natural rivers. People are attracted to water and many tourist destinations are being developed along the riverbanks of natural, near-natural or even restored streams.

The story of the Altenau river begins after a huge flood in July 1964. Altenau is a 28 km long stream in the North-Rhine Westphalia region of Germany, south of Paderborn. After the flood, measures were taken to control the river and prevent such events happening in the future. As the safety of people and property was the main focus, 'nature' was left out. Over the following 20 years, the river was regulated and straightened, and several flood retention basins were built. One of the flood retention basins near Atteln was constructed with a permanent reservoir lake to attract tourists. While it seemed a good idea at the time, the planners ignored the geological data input and built it on karstic ground, so the water just disappeared. A sudden change in the landscape shocked locals and they campaigned to get their river back. So far, 13 km have been restored and the Altenau renaturation is ongoing to this day as more and more parts of the river are being restored. In 2021, the Water Management Association for the Upper Lippe area (Wasserverband für das Obere Lippegebiet) started a major restoration of Gellinghauser Quellbach which also included removing an old mill weir. Ulrich Eichelmann (Riverwatch) concluded that Altenau is now in a better situation than it has been over the last 300 years. However, he warned that global warming is affecting stream discharge, which will decrease in the future, and dry riverbeds are becoming increasingly common. He also stated that rivers need strong advocates who will address any concerns, as, if this support is not available, the topic of renaturation and the dismantling of transverse structures is quickly exhausted in a region and a much larger communication campaign is needed to compensate for the lack of strong advocacy.

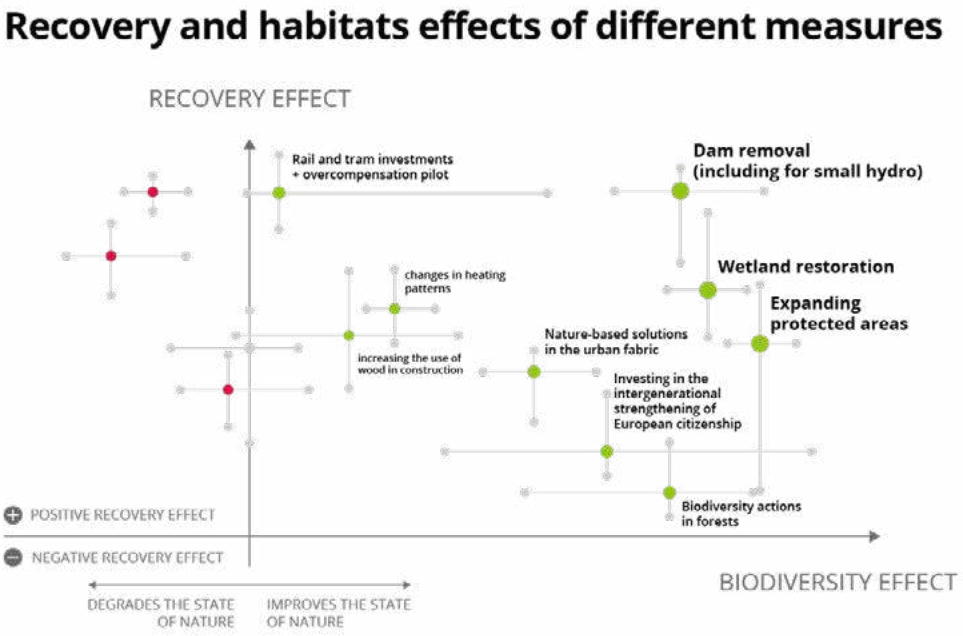
Figure 8: The renaturation and removal of barriers in the Altenau mobilized the local public already in the 90's in Germany. (© Uli Eichelmann)

Chapter 3: How can dam removal be promoted?

European law is crucial to promote dam removal

Barriers are a major reason for the failure to meet Water Framework Directive targets. Only 40 % of Europe's surface water bodies have a good ecological status. Pressure caused by hydromorphological alterations is the first reason for failing to achieve a good ecological status. This acts as a significant pressure on 34 % of the surface water bodies; of this 34 %, 20 % fail to achieve a good ecological status due to barriers, where hydropower and flood protection barriers are the most common ones.

There has been a drastic collapse in migratory freshwater fish populations in Europe since 1970 (-93 %). Barrier removal is the solution with the highest impact on biodiversity and recovery. In its Biodiversity Strategy, the European Commission has committed to restoring freshwater ecosystems and the natural functions of rivers by removing or adjusting barriers that prevent the passage of migrating fish and improving the flow of water and sediment. The goal is to restore at least 25,000 km of free-flowing rivers by 2030 by removing obsolete barriers and restoring floodplains and wetlands. Although 25,000 km might sound ambitious at first, that number corresponds to only 2 % of European rivers. Some countries, like France, have adopted higher targets in their national plans, and the Living European Rivers Initiative, a coalition of NGOs, recommends raising the EU target to 15 % of rivers (178,000 km) to be restored to a free-flowing state by 2030.



Recovery and habitat effects of different measures. The higher up in the figure the measure is located, the greater its employment impact, and the further to the right the measure is located, the more positive its impact on biodiversity. The measures with the highest employment and nature effects are in the top right-hand corner of the graph, while the measures with the lowest employment and nature effects are in the bottom left-hand corner. The measures are numbered in order of the highest nature impact. The whiskers represent the estimated ranges of impacts. The position of a measure between the extremes of the range depends on how the measure is implemented.

Source: Suomen Luontopaneeli. 2021. Luonnon monimuotoisuus ja vihreä elvytys. Suomen Luontopaneelin julkaisuja 1/2021.

Figure 9: Barrier removal is the "green" measure with the highest impact on biodiversity and recovery. (© WWF Finland)

See:
wwfeu.awsassets.panda.org/downloads/wwf_potential_of_barrier_removal_report.pdf

WWF analysed 30,000 barriers in large and medium-sized rivers in Europe. The analysis showed that nearly 50,000 km of rivers have a high and good potential to be made free flowing again by removing 7,360 barriers.

Challenges remain for policy makers to uphold common principles, such as defining what is meant by free-flowing rivers, which include longitudinal, vertical and lateral barriers, and incorporating their removal into river basin management plans.

Spain has taken river restoration seriously. Carlos Marcos Primo explained that river basin authorities are responsible for managing compliance with water rights conditions, implementing water policy, monitoring and controlling water ecological flows and improving the ecological state of the water bodies. They are also required to promote respect for the longitudinal and lateral continuity of the rivers. The authorities promote the elimination of infrastructure that is abandoned without fulfilling any function related to the use of water while taking into consideration the safety of people and property and assessing the environmental and economic aspects of the removal. The preferred option is always dam demolition, since it is the best alternative to restoring the original conditions. However, many aspects are considered when assessing the final option (e.g. heritage, environmental obligations, safety, presence of invasive species, economic and technical issues, social aspects). In the Duero river basin, the authorities are actively removing barriers that do not serve a purpose or meet regulations. So far, 176 barriers have been removed and 225 by-passes have been constructed on the river basin's 4,000 barriers.

Figure 10: Demolition of La Gotera dam, Spain (© Carlos Marcos Primo, River Duero Basin Authority)

In Bavaria, restoration of the Ammer river is a long-term visionary project aiming to restore river connectivity and connect the river and its tributaries. Bernhard Müller (Water Management Authority, Weilheim) explained that the focus is mainly on achieving connectivity for fish species, but once the goal is achieved, the ecological status of the river will improve accordingly. It is important to note that the Ammer has lost a lot of its length due to melioration work and straightening, and therefore has a steeper slope than it had in its natural state. With decades of development on the riverbanks, it is hard to return the river to its completely natural state and some artificial structures will have to stay in order to provide security for people and property.

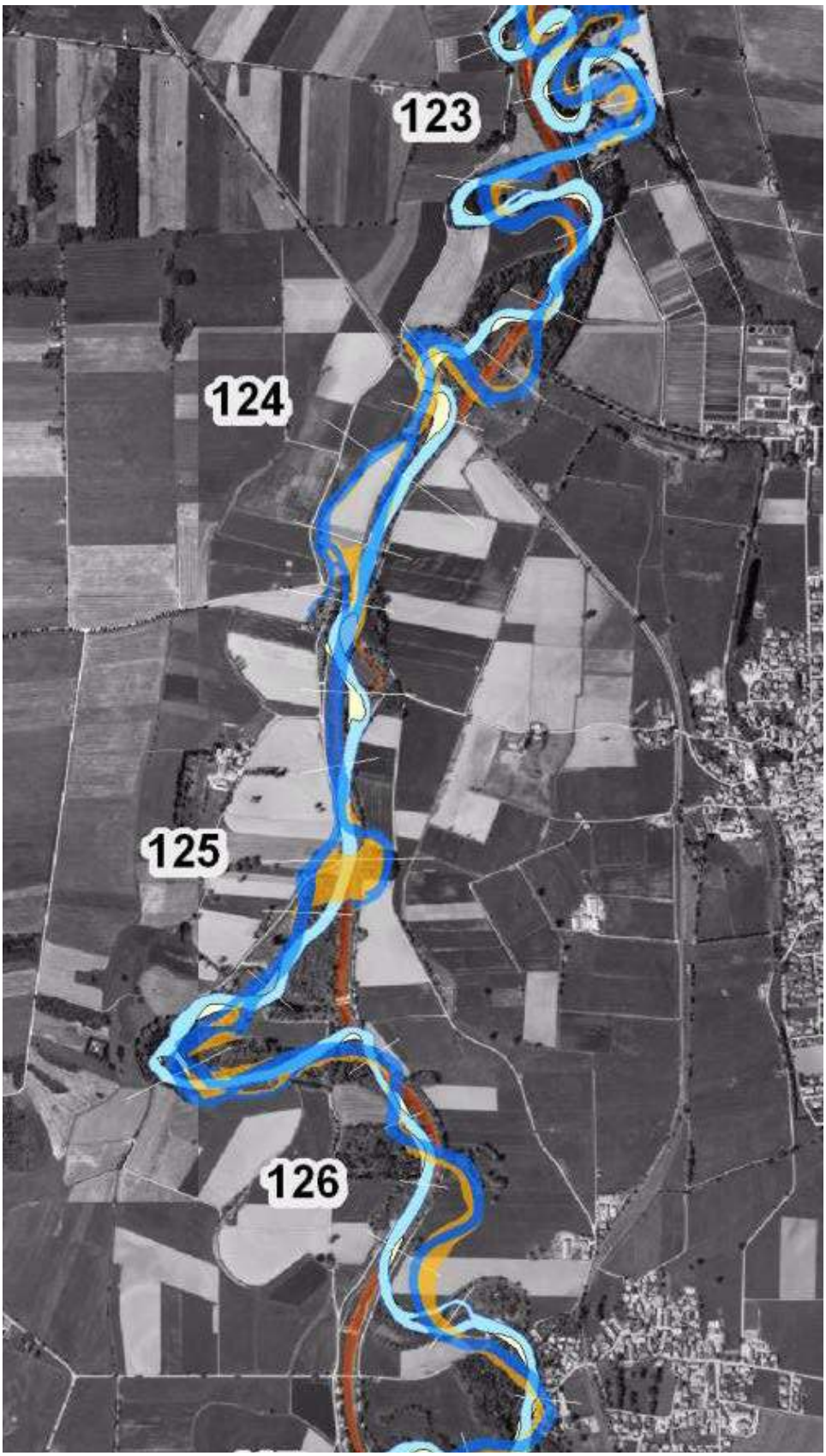


Figure 11: The riverbed of the lower Ammer river was heavily modified so that the current river (red line) is much shorter than the original one (blue line). (© René Heinrich)

National regulations are often quite good, they just need to be implemented

Finland has a unique and very progressive government programme to restore migratory fish species. However, according to Teppo Säkkinen (Ministry of Economic Affairs and Employment) this did not occur overnight but is a result of 10 years of policy steps. The challenges faced in relation to dam removal are similar to those experienced elsewhere in the world, for example, multiple dam owners, landowners, fundraising. Hydropower represents 19 % of overall electricity production, and plays an important role in adjusting power input. Only a small number of existing hydropower plants are vital to electricity production and many more obstacles are just insignificant contributors. The authorities therefore decided to balance power production and migration paths. Public debate on migratory fish species started roughly 10 years ago, with NGOs, media, public personalities and fishermen voicing strong opinions on the topic. It is important to note that, in a population of 5.5 million, Finland has 1.5 million fishermen, meaning that one in five Finns has a personal interest in the topic. A number of policies were adopted in an effort to systematically improve migration routes: the National Fishway Strategy in 2014, a government Spearhead Project in 2015–2019 and the National Migratory Fish Programme Nousu in 2019. The aim of the latter is not just to make a dam passable for fish but where possible to completely remove it. These obligations also extend to small hydropower plants, which so far have 'zero obligations'. Dam removal in Finland has strong public and political (both government and opposition) support. The government advocates for cooperation and open participatory processes, inviting NGOs, hydro businesses, Natural Resources Institute Finland, local landowners and universities to get involved.

In Spain, the public water domain includes all surface and groundwater bodies, including the surface or space on which the water flows or by which it is contained. The state therefore never loses ownership of the water and has dedicated river basin management authorities to enforce legislation. Infrastructure in the rivers is the responsibility of the owner and if it is not used (for over three years) or if it does not comply with authorisation conditions, the river basin authorities can revoke authorisation. If a dam is not being used, the owner is obliged to restore the river and recover its original features (barrier demolition). If the owner is unknown, the state can assume ownership and remove the barrier. In this way, Spain has established excellent grounds for removing obsolete barriers.

Figure 12: Effects of dam removal in the Tajo River Basin are impressing. (© Lidia Arenilla Girola, Tajo River Basin Authority)

France's Law on Water and Aquatic Environments defines water rights for transversal structures (public or privately owned) based on the year in which the structures were built and the height of the barrier. Structures built before the start of the 20th century have permanent water rights; those built later have water rights lasting up to 75 years. If the structure has no water abstraction purpose and is lower than 50 cm in height, then water rights do not apply. If water rights are not renewed, the structure must be removed. With the adoption of the Water Framework Directive in national legislation, the construction of new barriers in high ecological status rivers, migratory fish rivers and rivers acting as biological reservoirs has been banned.

Chapter 4: Several approaches may accelerate dam removal

Approaches to accelerate dam removal

Various approaches can be taken to accelerate dam removal. On the one hand, it might be a good idea to go for the 'low hanging fruit': opting for easy and cheap removals in order to start somewhere, to show the positive effects and to allay public fears. On the other hand, strategic approaches – identifying the most harmful barriers and removing those with the highest ecological gains – might be more effective in terms of biodiversity conservation.

Christian Hossli (Aqua Viva) presented a prioritisation strategy. Swiss rivers are extremely fragmented and there is a need, therefore, to prioritise barriers whose removal leads to the highest biodiversity gains in order to allocate funds wisely. A high level of fragmentation has led to a decline in fish populations: 60 % of fish species are threatened or are already extinct. In the *Flussfrei* project, a barrier assessment tool to help prioritise barriers was developed. All barriers were taken into account and were first filtered according to catchment size, bed width and ecomorphology. A secondary filter was applied to selected barriers, depending on the length of reconnected river stretches. Selection of the barriers took into account the potential implications of a removal and the costs associated with the removal. Results were collected in two groups: barriers with high potential and low costs ('low hanging fruit') and barriers selected and highlighted by experts. Removal of the latter would ensure higher ecological potential, but might be complex and demanding in terms of technical feasibility and financial input.

Another strategic approach adopted by the federal state of North-Rhine Westphalia in Germany uses GIS to determine the habitat gains that can be achieved by dismantling transverse constructions. The consortium of experts defined attributes for prioritisation based on type of barrier, backwater length, ecological status, target species, etc. Andreas Müller (chromgruen) explained that prioritisation was based on three main river basins and 26 sub-basins using a priority index calculation. Results were presented as fact sheets for each migration barrier and are used by local authorities to help in decision-making processes.

The economist Antti Iho (Natural Resources Institute Finland) presented another approach, which involves establishing a bidding mechanism to prioritise unprofitable hydropower plants to be purchased and removed. In Finland, reverse auctions are held to try to locate and remove the cheapest and the most harmful dams at once. Plant owners are invited to submit bids indicating the compensation they wish to receive in return for allowing the authorities to remove the dam and restore the river.

When dam removal is in its early stages in a country, the approach of picking the low hanging fruit is probably the easiest to start with. Picking obsolete barriers with the fewest conflicts of interest and focusing on the procedure, legal grounds for removal and funding might be easier than technically demanding removals in the face of strong opposition. In Lithuania, the authorities began by using such tactics, removing a dam in just two days, and yet it snowballed to strategic barrier removal plans and bigger removals in future.

Expiring concessions offer a good opportunity to discuss removals

Concessions for water use are a widely used practice in managing water resources. Contracts usually last between 30 and 50 years, they are rarely awarded for a 100-year period. The holder of a concession is usually obliged to pay an annual contribution to a special water fund. While policies and practices vary between countries, especially in regard to the use of the funds that have been collected, expired concessions offer an excellent opportunity to revise infrastructure, its compliance with regulations and profitability. It is important that managing authorities and concession holders understand that, in some cases, removing the dam might bring more benefits than keeping it. River basin authorities in Spain have successfully removed several hundred dams that no longer served the purpose for which they were constructed.

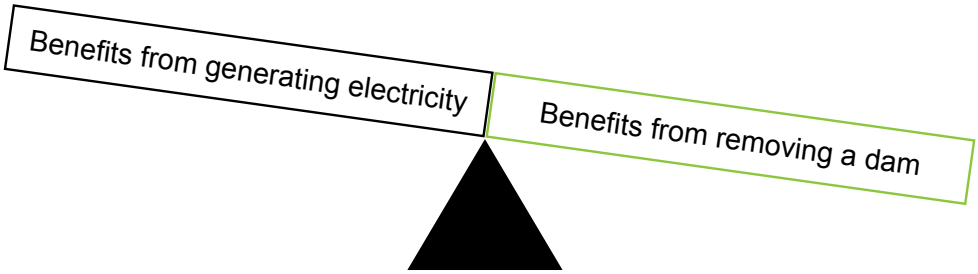


Figure 13: When concessions expire, in many cases the benefits of removing a dam will be higher than relicensing the hydropower plant under more strict legal obligations. (© Antti Iho, LUKE).

France decided to remove two large dams on the Sélune river after the concessions expired. The decision for the removal came from the authorities and encountered quite a lot of resistance from the local population.

Sweden has prepared the National Hydropower Relicensing Plan (Nationell Prövningsplan). Under this plan, all Swedish hydropower plants that do not have a modern operating permit need to apply for a new licence between 2022 and 2037. Owners who decide to decommission a dam can take advantage of Sweden's new Hydropower Environmental Fund, which was recently set up by eight of the country's largest hydropower companies, to recoup most of the removal costs.

In Switzerland, 'eternal rights', as they are known, were abolished by the Supreme Court. By 2030, they have to be replaced by regular concessions or decommissioned. When concessions expire and existing dams are evaluated, removals sometimes prove to be more cost-efficient and bring more benefits than maintenance combined with river restoration measures.

Provide sufficient financing for dam removal

There are many different options when it comes to financing dam removal. Depending on the situation, size of the project and capabilities of partners, removals can be funded through EU and national funding mechanisms, private investors and foundations or even crowdfunding. As one funding mechanism alone very often cannot cover 100 % of the costs related to the removal, complementary funds have to be obtained through different mechanisms. At EU level, for example, the Marine and Fisheries Fund may be used to open rivers for migratory fish species and the LIFE+ project aims to improve habitats in protected areas (e.g. the Lech project in Tyrol in Austria). Regional development funds (Interreg) and even Cohesion funds were used in the removal of the Pärnu dam on the river Sindi in Estonia.

Many European countries apply the 'polluter pays' principle. Generally, the owner who builds and uses a dam in a river is responsible for its maintenance. Once a dam has been out of use for more than three years, the water management authority may revoke the right to use the water. The owner is then obliged to restore the river and recover its original features. In theory, this is a very good regulation; in practice, however, there are many obsolete dams in rivers. Many owners are not willing or able to pay for the demolition of the infrastructure, sometimes the owners do not exist anymore. Another concept is that water users pay for the pollution and abstraction of water by contributing to a dedicated fund. This fund then provides financial aid in the form of subsidies or loans for cleaning water, conservation projects and monitoring. In Sweden, for example, the eight largest hydropower companies created the Hydroelectric Environmental Fund. The money is used to implement environmental measures in smaller hydropower plants. In Switzerland, electricity users pay CHF 0.023 (roughly EUR 0.02) per kWh into a special fund, which subsidises both the expansion of renewable energy and river restoration measures (whereas in Germany, EUR 0.065 per kWh is levied to promote renewable energy, but no restoration measures are financed by these funds).

Private funds and the company's social corporate responsibility budget can also be used for dam removal. Finally, funds may be collected by crowdfunding, which is a relatively new approach that mostly targets young people and social media users. Various crowdfunding platforms exist (e.g. https://crowdfunding.wnf.nl/) and are easy to understand and implement. However, it is important to understand the mechanisms of social crowdfunding, building a circle of followers and providing interesting content in order to keep them interested in the topic and to also involve their friends.

Reduce harmful subsidies

Many European countries decided to stop subsidising small hydropower operations, as the negative environmental impacts of such installations often outweigh the benefits of the energy produced. It is also worth mentioning that some of these installations would not even be profitable without subsidies, meaning that subsidies indirectly cause environmental degradation. Such harmful subsidies should be suspended immediately.

In 2018, a change in Finnish legislation excluded hydropower from the subsidy premium system, and since 2019 no investment aid has been given to hydropower. Lithuania discontinued hydropower subsidies in 2021. However, no dams have been built in the last 15 years (low stream gradient and therefore low profit). In 2018, Switzerland suspended subsidies for small hydropower plants below 1 MW in order to avoid negative impacts on river ecosystems.

While other European countries have ceased or reduced subsidies for small hydropower plants, the German government quite recently decided to increase these environmentally harmful subsidies (EEG amendment 2021). From 2021 onwards, owners of small hydropower plants (<500 kW) will receive EUR 0.03 per kWh in addition to the regular remuneration of about EUR 0.12 per kWh (depending on the year of start-up). This increase in subsidies, a result of political lobbying, was justified by the production losses experienced during the recent dry years. It is assumed that this regulation will cost the taxpayer about EUR 43 million per year (lasting at least until 2029, after which the amount will decrease). The need for political discussion about subsidies as a general precondition of successful river renaturation is crucial.

Inspire people

Pushing for change is never easy and it can be particularly hard if people around do not share the same vision. Many people fear change. Some want to keep familiar surroundings, such as artificial barrier lakes or mill channels; others are scared of the potential consequences of dam removal, such as flooding or changes in the groundwater levels. Change management theory suggests that there is a good chance of overcoming resistance if a critical mass is dissatisfied with the current situation, manages to agree on a shared vision and has the know-how and resources to initiate the first steps.

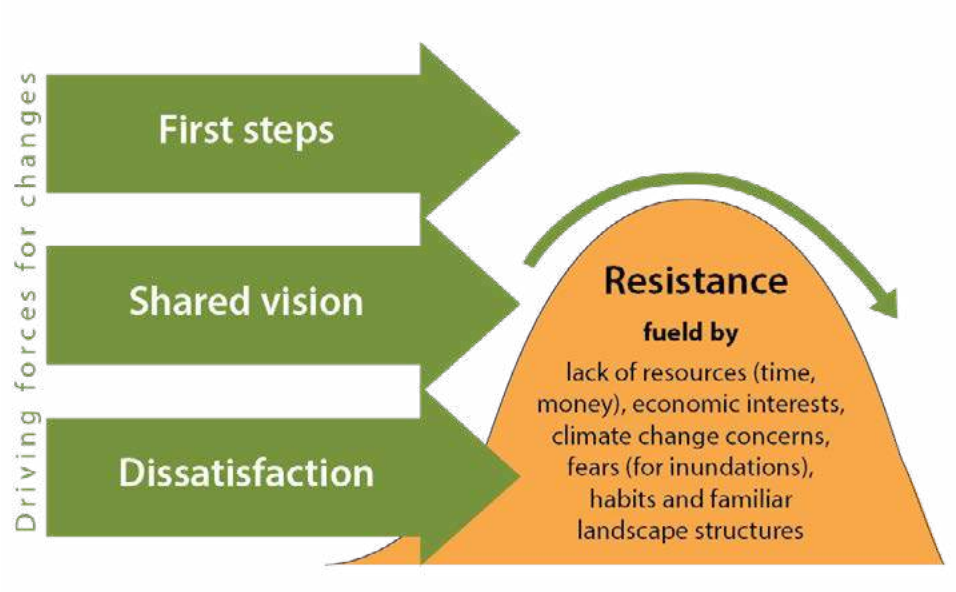


Figure 14: A process beginning with first steps, leading to a shared vision and building on dissatisfaction can lead to change. (© Sigrun Lange)

So, firstly, we have to spread the word about the catastrophic situation of our freshwater systems and species to make people dissatisfied with the current situation. Secondly, we have to pave the way for a commonly shared vision. An important precondition for that is to make people love their river, help them create positive memories around rivers and make them aware of the value of healthy rivers. In addition to rational arguments in favour of dam removal, people need to be touched emotionally. Communication of the issue is key to attracting supporters. Thirdly, people have to be enabled to take the first steps, which means they have to learn from other experiences that dam removal is feasible and worthwhile.

There are many opportunities to share experiences, address the freshwater crisis and celebrate rivers on a global scale and bring more attention to the topic. Examples include World Water Day, which takes place each year on 22 March; World Fish Migration Day (normally) in May; the Big Jump or European River Swimming Day in July; and World Rivers Day in September. The effectiveness of free-flowing rivers and dam removal as a restoration measure can be spot-

lighted on such occasions. Creating excitement, searching for river ambassadors and celebrating successes are crucial for spreading the idea and changing perspectives on the value that rivers can offer. Emotional approaches combined with best practice examples and ecological and economic facts will help to inspire people, to communicate know-how and ultimately to reduce denial among the public.

Images of restored landscapes showing the natural richness of the aquatic ecosystem and visualisations of free-flowing rivers may change public opinion in favour of renaturation, as demonstrated by Christine Margraf (BUND Naturschutz) in the case of the Salzach river, which flows through Austria and Germany.

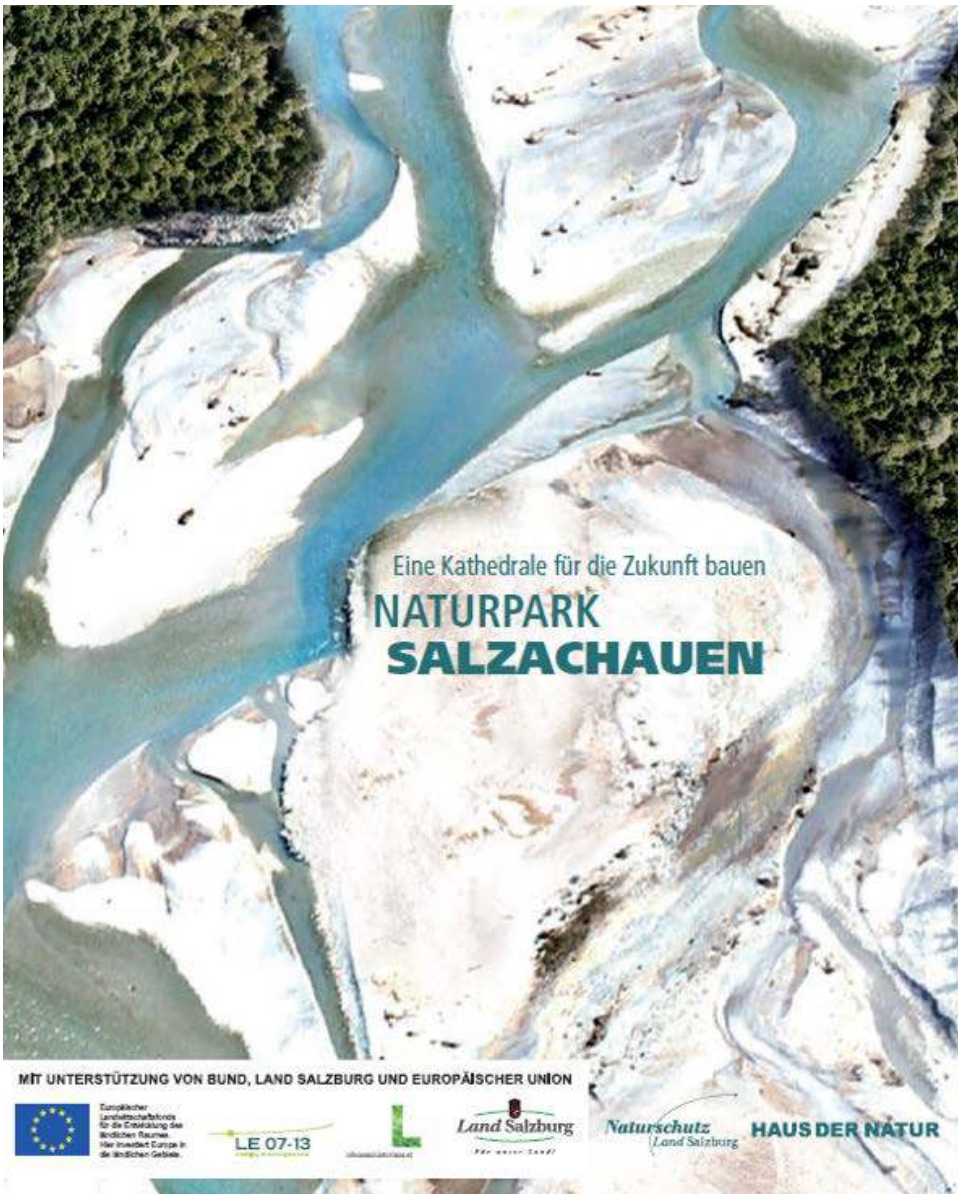


Figure 15: The vision of a free flowing Salzach as a cathedral for the future can initiate the desire to change the current situation and restore the Salzach. (© Naturpark Salzachauen)

Looking to the future, sharing experiences with events, organising volunteering opportunities, creating attractive promotional materials and visuals, involving celebrities and important public figures are just some of the tools that can be used to inspire and engage people.

Figure 16: The World Fish Migration Day brings together people to remind them on the value of natural rivers. (© World Fish Migration Foundation)

Making the topic personal to the audience is also important. The Finnish campaign 'Mating belongs to all' was rolled out before dam removal even began.

Chapter 5: Dam removal is the holy grail of river restoration; it brings many benefits

Ecological benefits

There are many case studies proving that river biodiversity can improve significantly when the habitat is healthy and undisturbed. Fish populations can be restored in a very short period. In Liechtenstein, the restoration of the Binnenkanal (inland canal) in the Alpine Rhine Valley in 2000 resulted in an increase in fish species diversity. In the first year, four new fish species were found; a year later, three more species were found. Yet another three were found 3.5 years after restoration. In 2012, the canal was home to a total of 19 fish species, which is a remarkable improvement, given that there were only six species there before the dam was removed a decade previously. However, it is important to note that the speed and success of colonisation depends on nearby species pools.

Dam removal can also improve the ecological status of the river. When a habitat improves, fish species thrive and the fish indicator component improves. Evidence of such significant improvement in the Mitternacher Ohe in Bavaria led to the status of the river being upgraded from moderate to very good with regard to the fish population, following the removal of three barriers.

Figure 17: The removal of one of the last remaining barriers in the Mitternacher Ohe. (© Landesfischereiverband Bayern e.V.)

Another successful example is the Gudenå river in Denmark's Jutland region, which flows for approximately 149 km before entering the Randers Fjord. In 1866, the Vilholt hydropower dam (Vilholt Mølle) was built. In 1987, the local authorities, along with the National Forest and Nature Agency, began discussions with stakeholders to remove the Vilholt dam in order to restore natural river conditions and fauna passage. The brown trout population has been monitored annually since 1987. After the removal of Vilholt dam in 2008 (after nearly two decades of debate), monitoring results showed an overwhelming increase in the population's density in both upstream and downstream sections of the dam.

Figure 18: Removing the Vilholt Dam lead to a significant increase in brown trout populations. (© Kim Aarestrup, Technical University of Denmark) Link to the publication: https://amber.international/wp-content/uploads/2017/12/Birnie-Gauvin-et-al.-Hydrodam-removal-JEMA.pdf

Fish populations are restored not only as a result of free passage but also because habitats, sediment transport and natural hydrological conditions are restored. Therefore, removing the barriers and improving hydrological conditions must be the first choice in river management. Barrier removal has a direct benefit on overall river health and reaches far beyond the local site.

Figure 19: The river stretch of the Gudenaa before and after the removal of the Vilholt Dam. (© Kim Aarestrup, Technical University of Denmark)

However, it must be remembered that dam removal sometimes causes conflicts in relation to nature conservation. For example, the removal of a barrier might demolish a habitat of a protected FFH (fauna/flora/habitat) species, such as the common river mussel. Markus Brandtner (Water Management Authority, Weilheim) reported that, when the barrier was removed on the Windach river in Bavaria, the river mussel population, which colonised the mill channel (drying out after the removal) was evacuated and brought to an appropriate location within the river. The host fish species are present, and the mussel population is considered to be stable in its new environment. In this case, therefore, the conflict could be resolved. In other cases, the potential dispersal of invasive species might cause conflicts with dam removal approaches.

Dam removal helps to reduce greenhouse gas emissions

Methane is the second most important greenhouse gas, with a global warming potential of 28 to 35 times that of carbon dioxide (CO_2). Its temporal dynamics (sources and sinks) are still poorly understood. Current estimates suggest that freshwater reservoirs account for between 2 and 8 % of global methane emissions (5 to 18 % of global anthropogenic emissions). However, tropical reservoirs are not the only contributors. Andreas Lorke (University of Koblenz-Landau) reported that emissions were monitored in Germany's River Saar, for example. Methane production and emission is caused mainly by sediment accumulation in impoundments. Lorke claimed that the removal of dams can be expected to result in a significant reduction in methane emissions from the impounded area. And this is not only valid for larger dams. He recommended including emission monitoring in future removal projects. Against this background, the image of hydropower as a climate-friendly (CO_2-neutral) form of energy production is at least debatable. Other scientists from the Helmholtz Centre for Environmental Research (UFZ) quite recently came to the conclusion that reservoir drawdown areas in particular, where sediment is exposed to the atmosphere due to fluctuations in water levels, are hotspots for CO_2 emissions.

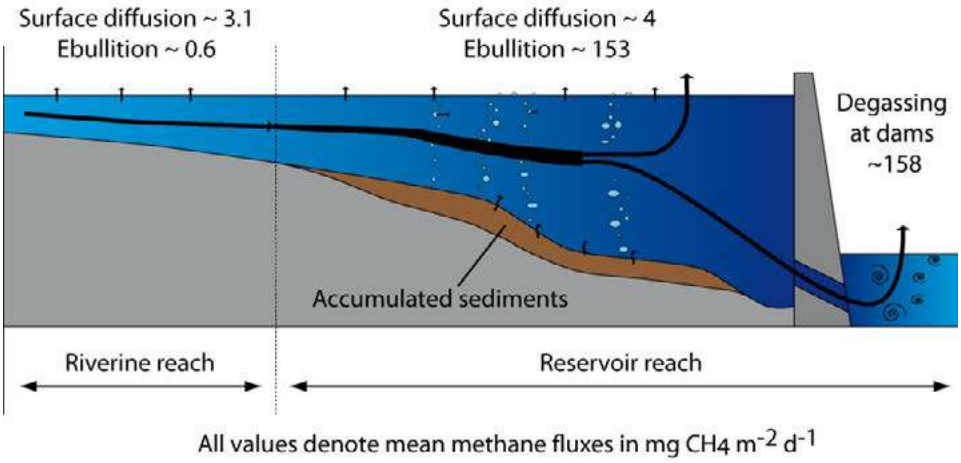


Figure 20: Methane emissions within impoundments are significantly higher than in riverine reaches. (© Andreas Lorke, University of Koblenz)

Economic benefits

Balancing benefits generated by using rivers for hydropower generation versus benefits gained by removing dams in order to create natural pathways is a challenging task. While market values (e.g. white water sports, fishing and nature tourism), increasing property values and employment effects are easier to predict, non-market values, like strengthening biodiversity, protecting endangered fish species, preserving aesthetic values and recreational opportunities, are harder and more expensive to estimate. To solve this challenge, economist Antti Iho (Natural Resources Institute Finland) presented an interesting concept: the economic value of a dam removal was assumed to be zero. This means that the benefits of hydropower generation have to be above zero in order to outweigh the effects of removal. However, in the case of less water availability (e.g. due to increasing low water phases) or higher ecological requirements (e.g. fish ladders or bypasses, higher residual flows), the net present value (NPV) of hydroelectric plants, calculated by discounting all future revenues and costs to current time and summing them up, might become negative. In these cases, the benefits of dam removal would outweigh the further operation of the plants. By applying the NPV assessment tool, the unprofitable plants were identified and a discussion was initiated with their owners. The Natural Resources Institute Finland will upload an NPV tool to its website in autumn 2021. An English version will most likely be made available as well. However, Antti Iho stressed that this tool works perfectly for cooperation with the owners of bigger, professional plants, whereas the owners of small hydro plants quite often argue more on an emotional basis than on a mere financial basis.

In the US, Beth Lambert (Massachusetts Division of Ecological Restoration) has expertise in economic studies on job creation and cost comparisons between dam removal and dam maintenance. The division's study revealed that taxpayers benefit from investing in river restoration, as barrier removals in Massachusetts created 12.5 jobs for every million dollars spent. Besides, it frees dam owners from maintenance and safety obligations. In three concrete cases examined by the study, dam removal was 60 % less expensive compared to costs for repair and maintenance over 30 years.

In the German state of Thuringia also, maintenance and rehabilitation costs were the main drivers when considering the removal of five obsolete dams: four of the dams – Roth 1 (9.5 m high), Noßbach (11 m), Wechmar (11.7 m) and Haina (7 m) – will soon be removed by Thüringer

Fernwasserversorgung (TFW). Removal of the Haina dam is planned for 2021; the removal of another dam, Engerda (11.25 m), is being actively discussed. In the next few years, around 30 dams that are more problematic could be considered for removal by Thüringer Fernwasserversorgung and private operators.

Social benefits

Dam removal and river restoration create an attractive natural environment that can serve as a place for recreation, relaxation and reconnection with nature. The latter is incredibly valuable, especially in urban environments. There are a few examples of restoring rivers in dense urban spaces. In the Swiss capital Zurich, a longitudinal barrier was removed on the river Sihl near the main train station. This redesigned concept of a more nature-oriented urban river environment goes well beyond a simple cost-benefit analysis and is of immeasurable value for the population, as many choose this spot to enjoy their lunch on a riverbank or to grab a drink with friends after work.

Figure 21: In Zurich a longitudinal barrier was removed in the river Sihl. (© WWF Switzerland)

The restoration of the river Isar in Munich started in 2000. The main goal was to create a cultural highlight and improve quality of life in the city. The 8 km long stretch was reconstructed to improve flood protection and to restore ecologically valuable habitats for flora and fauna. At the same time, the restoration met the growing demand of city dwellers for natural landscapes in central urban areas for leisure and recreational use.

Figure 22: The restored Isar in Munich is now a place that invites to rest and have a chat with friends. (© Sigrun Lange, WWF Germany)

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youtube.com/watch?v=PVN9P6l4yGM

Such projects are more than just restoration. The integration of the natural environment within an urban space improves quality of life and is usually seen as an investment for the future.

Chapter 6: More research is needed to demonstrate the benefits of dam removal

Dam removal projects offer extraordinary research opportunities in diverse research fields. While fish fauna might be the most obvious one, terrestrial changes, riverbank succession, changes in groundwater, interstitial fauna and the evolution of social acceptance of changes in the landscape are just as exciting to observe. In the light of global warming, research on greenhouse gas emissions and methane emission monitoring should be conducted in future removal projects.

Figure 23: The Sélune river in February 2021 after removal of the first dam. (© SMBS & University Paris Nanterre)

Sélune scientific programme

The main reason for removing dams on the Sélune river was the restoration of river connectivity for migratory fish species. The 15-year-long scientific programme was designed to understand the mechanisms of restoration of the Sélune river and its valley and to provide recommendations on river restoration to stakeholders and decision makers involved in future restoration work.
A long-term study of the riverine system is divided into three phases: evaluation of conditions with existing barriers (2012–2019); observation of short-term effects of dam removal (2019–2021); and restoration of the river post dam removal (2021–2027). A multidisciplinary approach has been adopted, focusing on territory dynamics, river dynamics, biocenosis functioning and evolution. Territory dynamics focus on societal impact, local acceptance, territorial context and changes, and the configuration of local and international collectives. River dynamics studies include chemical and sedimentary fluxes, hydrological regime,

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programme-selune.com/en/

geo-morphological changes and water quality monitoring. Biocenosis researchers observe changes in ecosystem functions, interactions between terrestrial and aquatic ecosystems and species distribution (native, invasive and returning species). There are 20 research units, several research projects and an observatory with its own information system (SISelune), which is publicly available.

Various tools and methods are used to monitor the return of diadromous fish species: an acoustic camera, eDNA, telemetry and the monitoring of abundance indices (electrofishing and sampling every two years) and spawning grounds (annually). A DIDSON acoustic camera is installed downstream of the dams and has been operating continuously since 2013, counting (per species) and measuring size distribution. Telemetry is used to study the potential for and the dynamics of (re)colonisation of upstream areas in the Sélune valley by diadromous fish, focusing on Atlantic salmon. eDNA is used in 30 sampling locations on the Sélune river and its tributaries to follow the return of diadromous fish species.

Exploring social acceptance of landscape changes

Understanding the psychological aspects of dam removal and why many people might be against renaturation is very important. People feel connected to the landscape; they have memories attached to it, and drastic changes, such as the disappearance of a lake that they grew up with, might be too much for them. People feel safer with dams, they feel that the river is controlled and managed. On the other hand, a lack of understanding of natural principles and underestimation of the dam's retention capacities means they have no trust in nature-based solutions. Dam removal is a relatively new approach and the idea is restricted to a very narrow circle of nature-minded people. Most people outside this sector do not naturally support the idea of removing structures from rivers, structures that were put there to control water. It is very important, therefore, to explain every aspect of renaturation and include a broad circle of stakeholders, including the general public, from early in the planning phase. Measuring social acceptance at various stages of a dam removal project can be very valuable, and the results can act as a useful tool for future dam removal practitioners.

Making the future desirable for people and generating positive public opinion is of utmost importance for a successful dam removal story.

CONCLUSION

There are many different approaches to tackling barrier removal in rivers. In some cases, the removals that will have the most effect are prioritised; in other cases, a decision will be made to undertake the easiest (but not necessarily the most effective) removal. There is no one right recipe to follow and no magic ingredient to guarantee the best result. All aspects of the project – policies, legal grounds, financial flows, technical feasibility, conservation targets and social acceptance –are of equal importance and should be thoughtfully incorporated into the project plan. Once the first barrier is gone, new removals will follow. The positive effects of such projects are contagious and a snowball effect is guaranteed. Let's start a new dam removal story today!

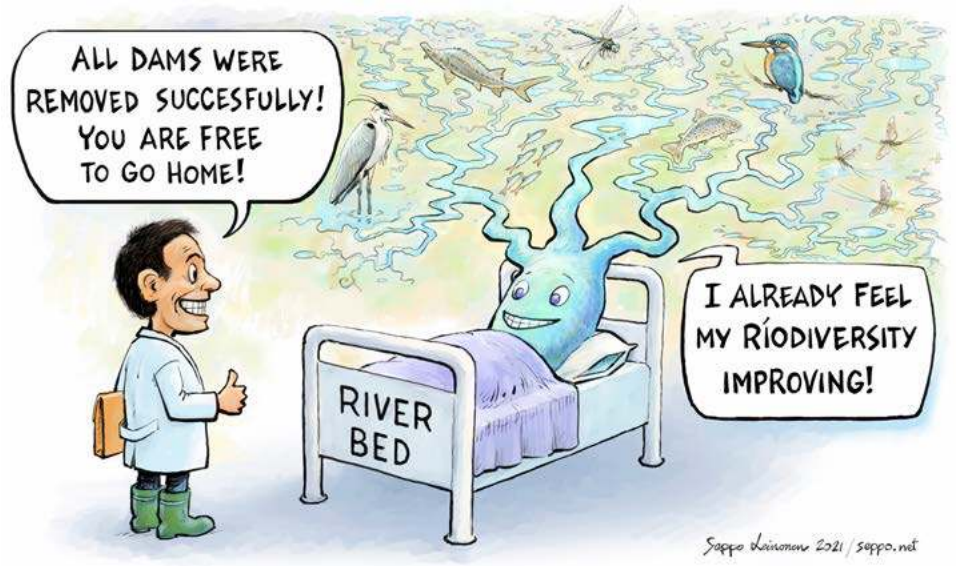

Figure 24: In his Keynote speech Klement Tockner showed how dam removal can cure biodiversity loss in freshwater ecosystems and wetlands. (© Seppo Leinonen)

This report was prepared by Neža Posnjak on behalf of WWF Germany, based on lessons learned during the four-day seminar series 'Dam removal goes Alps 2021' which was organised by

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Partners

Dam Removal Europe is a project that allows relevant specialists to connect with one another. Through DRE conferences we can all share our knowledge and inspire new visions for a free-flowing Europe. Dam Removal Europe offers a website to communicate about removals, share news and information, and upload movies: damremoval.eu

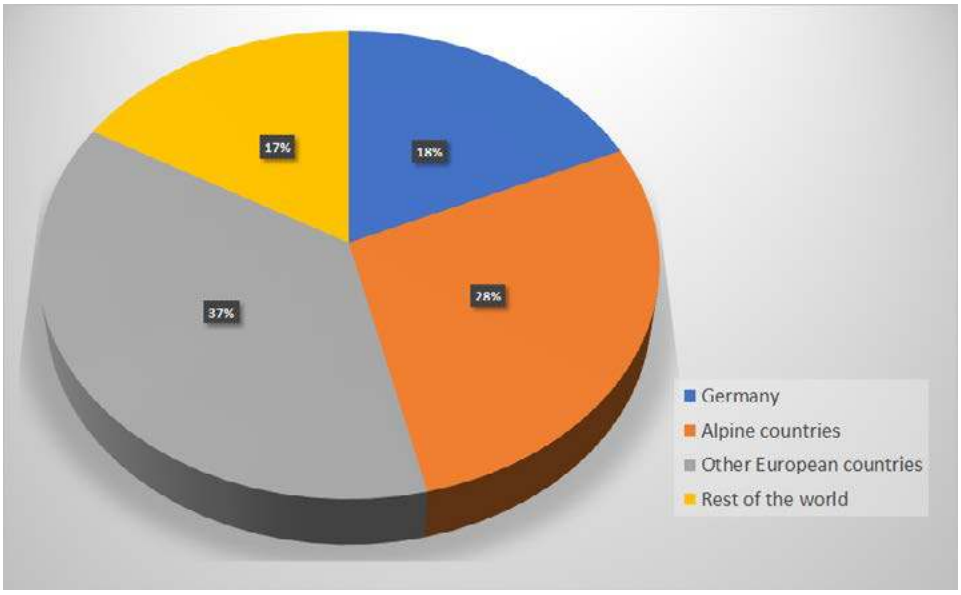
https://dam-removal-goes-alps.de/

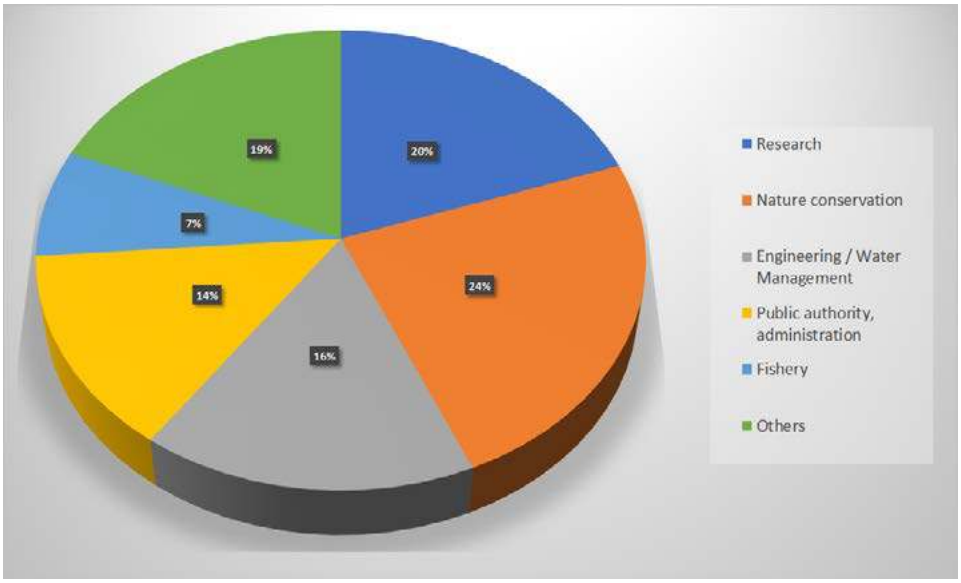
Up to 400 participants from almost 60 countries attended each of the four days of the international conference 'Dam removal goes Alps 2021'. The conference was held on a digital platform and gave a deep insight into how far the idea of removing barriers and dams in our rivers has already spread. Experts, government officials and activists from all types of organisations presented a variety of showcases and shared their learnings and key issues on successful river renaturation.

- Almost 40 speakers and presenters from all over Europe and beyond (e.g. New Zealand and the United States)

- 7 showcases (videoclips) from 6 countries (Switzerland, Austria, Germany, France, UK, Lithuania)

- Over 900 registered participants (concrete: 931) from almost 60 countries





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Why we are here
To stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature.

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