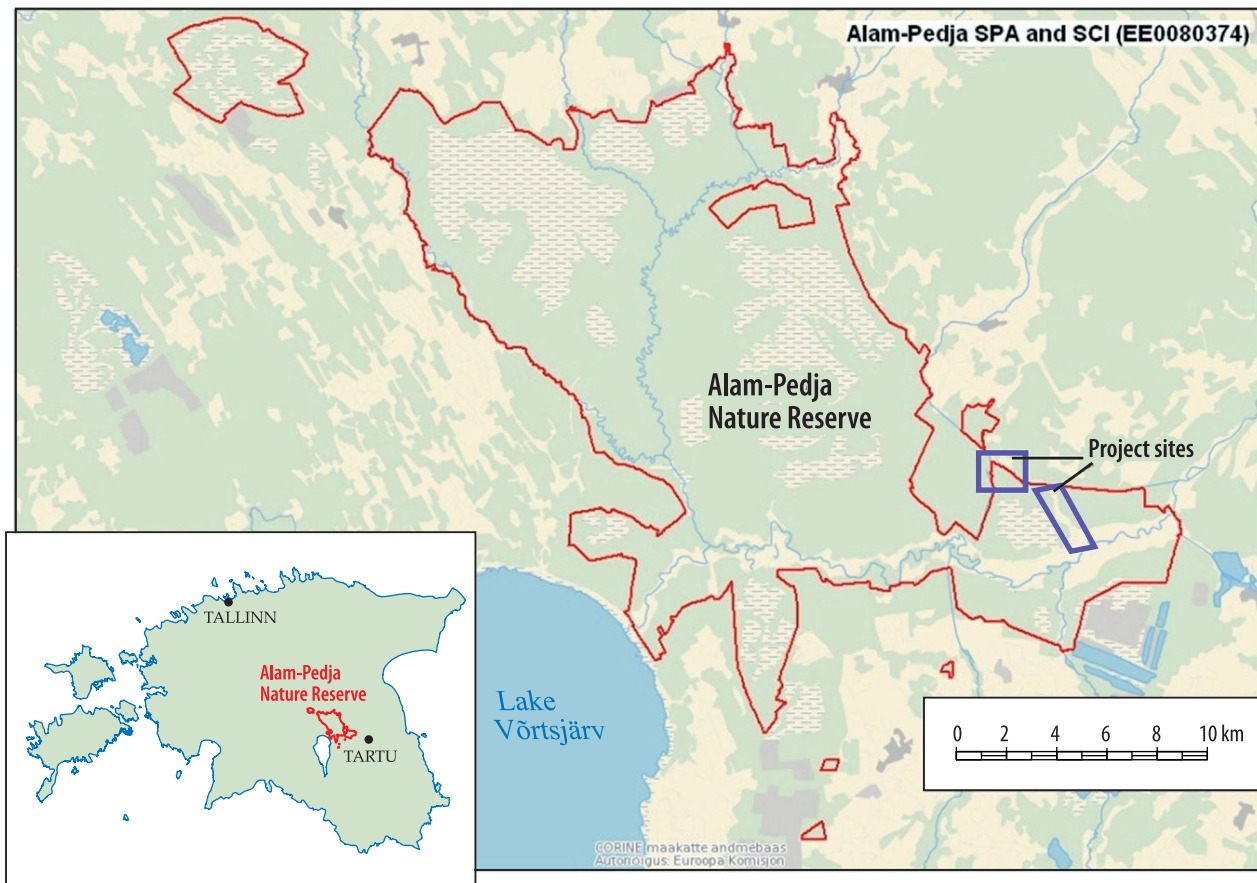


An aerial photograph of the Laeva River, a dark, winding waterway that meanders through a vast forest. The trees are in peak autumn color, displaying a rich palette of yellows, oranges, and browns. The river's path is irregular, with several sharp turns and a small, isolated island in the center. The surrounding forest is dense and continuous, with the river acting as a natural corridor through the landscape.

# Revitalisation of the Laeva River

**LIFE Happyriver Layman's Report**





## Alam-Pedja Natura 2000 site

Alam-Pedja Nature Reserve (established in 1994) is in Central Estonia, north-east of Lake Võrtsjärv, and spans an area of approximately 350 km<sup>2</sup>. The protected area is unique and valuable because it has a low human population density and the area is rich in species and habitats.

Nearly 500 species of vascular plants, 180 species of mosses, 230 lichen species and more than 700 mushroom species have been recorded in the Alam-Pedja Nature Reserve. It is estimated that at least 50% of all insect species recorded in Estonia are present in the protected area. 32 dragonfly species, 410 macrolepidoptera species and 59 butterfly species have been found in the protected area. And when it comes to beetles, there are more than 100 species of ground beetles present. 35 fish species live in the waterbodies located in the protected area, and 6 species of amphibians have been found. There are 196 species of birds, of which 153 species breed here. 43 mammal species are known from the area.

To preserve the high species and habitat richness, the site has been protected under the most important international conventions and directives: it is a Ramsar Site





(June 17, 1997), meaning it is a wetland site of international importance under the Ramsar Convention, it is also a bird site and a special area of conservation of the Natura 2000 network (August 5, 2004), and a bird area of international importance (IBA , BirdLife). The aim of the Alam-Pedja Nature and Bird Area is to protect 48 of the species in Annex I of the Birds Directive or migratory species absent from it, and the protection of the species in Annex II of the Habitats Directive, most of which are associated with waterbodies (Table 1). About 30,700 hectares (20 habitat types) of the reserve have been designated as Annex I habitat types of the Habitats Directive.

**Table 1.** The species associated with waterbodies listed in Annex II to the Habitats Directive that are present in the Alam-Pedja Nature Reserve:

Thick shelled river mussel (*Unio crassus*)  
Large white-faced darter (*Leucorrhinia pectoralis*)  
Water beetle (*Dytiscus latissimus*)  
Water beetle (*Graphoderus bilineatus*)  
European brook lamprey (*Lampetra planeri*)  
Asp (*Leuciscus aspius*)  
Spined loach (*Cobitis taenia*)  
Bullhead (*Cottus gobio*)  
Weatherfish (*Misgurnus fossilis*)  
Pond bat (*Myotis dasycneme*)  
Eurasian otter (*Lutra lutra*)  
Eurasian beaver (*Castor fiber*)

An important part in the development and preservation of diversity is played by the network of different waterbodies covering the area, of which Emajõgi River with its tributaries and oxbow lakes is central. The protected area has 12 watercourses and 57 oxbow lakes.





## Emajõgi River

Emajõgi is 100 km long and it is 35 m wide at its upper reach and up to 145 m at the mouth, its depth fluctuates mostly between 2–3.5 m. Emajõgi has a stream gradient of 3.6 cm/km, which makes it the river with the lowest stream gradient in Estonia. Low stream gradient and ground characteristics have led to the strong meandering of the riverbed, which has resulted in the formation of many oxbow lakes – previous parts of the riverbed that have been cut off from the “real river” that now form separate waterbodies.

Emajõgi links the two largest lakes in Estonia – Lake Peipus and Lake Võrtsjärv – which are the most important lakes for the fishing industry. The main importance of Emajõgi for the fishing industry is that it is an important migration route and spawning ground for the fish of the whole basin. The most important spawning areas are the oxbow lakes and alluvial meadows within the Alam-Pedja Nature Reserve. Thanks to the extensive area of alluvial meadows and the large number of oxbow lakes, a lot of the fish from Lake Peipus and Lake Võrtsjärv migrate here to spawn. By using the tributaries of Emajõgi (Pedja, Põltsamaa, Elva, Laeva), fish also have access to spawning and feeding grounds further away. Some species of fish (e.g asp) find stretches of rivers with rapids as suitable habitats and spawning grounds, while

oxbow lakes are important feeding grounds and “resting areas”.

**Estonian people value fish and fishing. So, what can we do to make fish happy and to have plenty of them?**

Studies have shown that a fish that has once spawned in one of the waterbodies in the Emajõgi river system, will also return to spawn in the same area the next year after wintering in other waterbodies. Recent data show that spawning ground fidelity is also oxbow lake specific, which means that fish always spawn in the same oxbow lake. Thus, the fish fauna of each oxbow lake is unique, and the destruction of each oxbow lake means that a unique fish community is also lost.



*Asps (Leuciscus aspius) are weighing up to 8 kg here.*







Rivers also differ from each other, providing fish with suitable opportunities for moving between different habitats and spawning grounds. Of the tributaries of the Emajõgi River, Laeva River was in poor condition. Laeva River used to be the most fish-rich river in the area, but in its lower reach, water had been diverted from its natural riverbed into Emajõgi through a straight channel. This destroyed around ten kilometres of diverse meandering river that had been a suitable habitat for fish and other aquatic biota. To preserve the fish resources of the Emajõgi river basin district and to strengthen the populations, it was also necessary to restore this missing part of the aquatic system.

A serious problem for the fish breeding in the Alam-Pedja is the overgrowing of the alluvial meadows. As overgrown alluvial meadows are not suitable for spawning, the area of spawning grounds is constantly shrinking. This results in decreased fish stocks in the entire large system of waterbodies that is connected with the Emajõgi River and which depends on offspring from Alam-Pedja. The solution to the problem is simple in itself, the breeding grounds need to be cleared from overgrowth.

The need for the described work has been recognised for a long time, and there has been an intense effort to

*Part of the flood plain was overgrown before  
the restoration work started.* ►





find resources. In 2009, the LIFE+ project, code-named Happyfish (Õnnelik kala), was launched on the initiative of Wildlife Estonia. Using the project's funds and funds from the Cohesion Fund, 18 of the most valuable oxbow lakes were reconnected with Emajõgi between 2010 and 2013.

The LIFE Happyfish project was acknowledged in 2011 with the "Estonian Environmental Action of the Year" award and the project was also awarded the pan-European "Best of the Best" LIFE project award. LIFE programme once again helped to restore Laeva River's natural riverbed and to clear the alluvial meadows. In 2013, a project called LIFE Happyriver (Õnnelik jõgi) began, during which 8 km of the lower reaches of the Laeva River and 13 hectares of alluvial meadows suitable as breeding grounds for fish were restored. Stocking the river with 12,000 asp summerlings helps to restore the asp population.



*Asp*

### **Project LIFE Happyriver – Restoration of the natural streambed of the lower reaches of the Laeva River**

#### **Project objectives:**

- Continue to improve the status of waterbodies of Alam-Pedja that are associated with Emajõgi River and increase connectivity, which started under the LIFE Happyfish project.
- Restore 5 km of natural streambed in the lower reaches of the Laeva River.
- Restore 12 hectares of alluvial meadows that are suitable as spawning grounds.
- Strengthen the population of asp, a protected fish species, in the Emajõgi system. Stock the rivers with 10,000 summerlings.
- Increase people's awareness.
- Improve the conditions for the sustainable management of alluvial meadows.

## The objectives of the project were fulfilled and exceeded!

As the water from the Laeva River had been directed to a straight ditch, the water did not reach the natural riverbed. As a result, the riverbed filled with sediments and vegetation, and over time, a series of ponds with standing water formed instead of the river. A river that had been rich in fish disappeared. Comprehensive measurements were done in the course of the project and excavation sites, riverbed profiles and necessary structures were determined. Sediments that had collected between the existing river sections were removed with excavation work, and connections with Laeva River and Emajõgi River were restored. A total of 8 km of meandering river with flowing water was restored.

Restoring the overgrown alluvial meadow was a long process. First, trees and shrubs were removed, stumps were crushed, and before regular mowing began, thin scrub that started to grow was crushed in the first few years. During the project, 13 hectares of alluvial meadows were restored, which serve as breeding grounds for many fish in the spring.

Marko Kohv

*Line of ponds marked  
the historic river bed.*







One of the objectives of the project was to strengthen the asp population in the Emajõgi system. Asp is one of the four protected fish species listed in Annex II of the Habitats Directive whose habitats are protected in the Alam-Pedja Natura 2000 area. Asp needs a variety of habitats for its population to persist – it spawns in fast-flowing sections of the river, feeds in rivers, oxbow lakes and lakes, and winters in lakes or in deep depressions in the rivers. Asps travel a lot in search of suitable habitats. Telemetry studies and otolith microchemistry analyzes show that each individual repeats regularly its migration patterns.

In order to facilitate and give the first push to the asp population recovery in the Laeva River, the artificial breeding and rearing of asp in the Haaslava fish hatchery that had started during the LIFE Happyfish project continued and resulted in the release of 12,000 juvenile asp into the Laeva River.

*Juvenile asps* ►

◀ *Laeva River  
shortly after  
restoration*



## Public awareness

Informing the public is important for promoting nature conservation and Natura 2000 principles and for ensuring the sustainability of the project. Teaching camps organised for children and youth during the project deserve a special mention. Over 100 young people received both theoretical knowledge and practical skills whilst carrying out activities in the biodiverse Alam-Pedja Nature Reserve under the guidance of experts.

Public interest in the status of rivers and fish is high. The project presented the role and opportunities of the Natura 2000 network and the LIFE program in various publications and in radio and television. The biggest television coverage was given to the formal celebration event held to celebrate Laeva River's restoration and Natura 2000 day in May of 2018. The event was featured by all the major television channels in Estonia. One of the most viewed programs on the national television "Osoon" made several episodes about the Alam-Pedja Nature Reserve. Information boards and printed leaflets are a necessary source of information for people visiting the Alam-Pedja Nature Reserve. It is important to communicate and cooperate with professional and recreational fishermen and to carry out



*Releasing of juvenile asps into the Laeva River with the Minister of Environment.*

activities to raise their awareness. The transfer of information to experts, practitioners, officials and politicians has been comprehensive in both the events held in Estonia and at several international conferences.

LIFE Happyriver hosted LIFE programme's riverine habitats thematic conference in September 2014. Representatives from 14 countries presented and planned for the conservation of riverine habitats and species. An overview of the conference was published in the LIFE News environment in January 2015, and it was one of the most read news stories of the year.





In the course of the project, in co-operation with RMK, the road leading to Emajõgi River's alluvial meadow along with a bridge were reconstructed (300 m). Thousands of hectares of alluvial meadows are regularly managed in the area, and the access road is necessary for carrying out management work and for transporting the collected hay away from the area. Alam-Pedja managed alluvial meadows are one of the most representative ones in the whole boreal region of Europe.

Restoration of the Laeva River (habitat type 3260) is a good example of the importance of rivers in the functioning of ecosystems. They are like the circulatory system of the body, where local obstacles and clogs lead to bad consequences for the whole system. The removal of each obstacle connects different parts of the river and increases the chances of maintaining diversity even hundreds of kilometres away. The restoration of alluvial meadows (habitat type 6450) greatly increases the area of spawning grounds and the value of the area in ensuring the preservation of fish stocks.

At the same time as the natural riverbed of the Laeva River was reopened, barriers limiting fish migration were removed from the middle reaches of the Laeva River in the Laeva village using the resources of the EU Cohesion Fund. This will increase the area that the activities influence and the results of the Happyfish and Happyriver project activities will be consolidated and enhanced.

In addition to humans, healthy fish stocks are also important to many birds and animals. They are of particular importance to white-tailed eagles (*Haliaeetus albicilla*), for whom fish are an easy prey during the spawning period, and thus these fish constitute an important source of nutrition for the rearing of their chicks. Carlin-type plastic tags used by Wildlife Estonia for tagging common bream have been found in white-tailed eagle's nests up to 4 km from oxbow lakes. Common tern (*Sterna hirundo*), great crested grebe (*Podiceps cristatus*), grey heron (*Ardea cinerea*) and great egret (*Ardea alba*) all feed on fish. The area may also be suitable for the black stork (*Ciconia nigra*) that avoids humans; white-tailed eagle and black stork are listed in Annex I to the Birds Directive.

The large otter population of the Alam-Pedja Nature Reserve also feeds on fish. Eurasian otter (*Lutra lutra*) is included in Annexes II and IV to the Habitats Directive. Pond bat (*Myotis dasycneme*), a species included in Annex II, whose population in the area is one of Europe's largest, feeds, among other things, on invertebrates (for example, caddis flies) that spend part of their life cycle in waterbodies.

## Monitoring of biota

Lea Saar

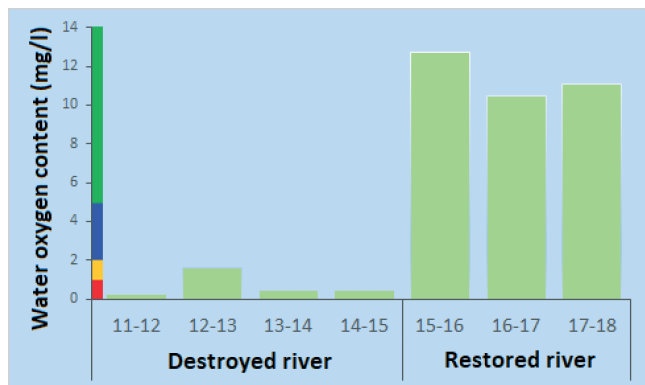


For monitoring project results, we have used most novel research methods. We studied the migration and introduction success using biotelemetry. In 2018, we also used a particularly innovative method of otolith microchemical fingerprinting. Project studies show the return of a characteristic fish fauna, rapid colonisation of reopened river section by fish and other aquatic biota, and that it is being used as a migratory route.



## Ecosystem recovery

An important change compared to the time before restoration is that flowing water has been restored, and there is a significant increase in water oxygen concentration that is important for biota. The increase is especially evident during the winter, which is the most difficult period.

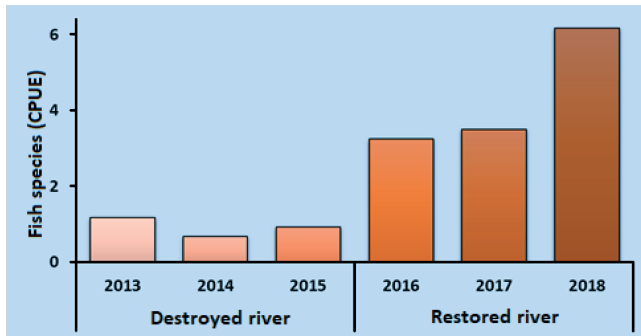


*The average oxygen concentration of the natural lower reaches of the Laeva River in the winter before and after the river was restored. On the y-axis, the oxygen concentration in yellow marks the concentration that only species with low requirements can survive in (e.g., weatherfish, tench, crucian carp), blue indicates the concentrations required by most species (including asp, spined loach), and green indicates the concentrations that are also acceptable for species that are very sensitive to water oxygen conditions (e.g., bullhead, Eurasian minnow).*

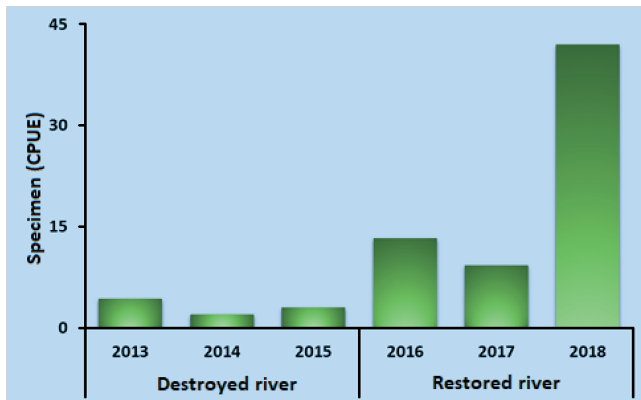
The reopened riverbeds with flowing water are acquiring characteristic features of watercourses. The species composition of the ichthyofauna has increased significantly; 11 species of fish have been added, including the asp, spined loach, and bullhead which are all protected species that had previously not even been observed in the preserved river sections. A total of 23 species of fish were caught during fishing surveys. These include several species characteristic to watercourses (e.g., spined loach, gudgeon, chub), including species that are very sensitive to water oxygen concentrations (e.g., bullhead, Eurasian minnow). The addition of these species to the ichthyofauna of the restored river suggests that the previously destroyed riverbed is becoming a normal fish-rich natural river. The appearance of different age groups is important for the protection of asp and for the stocking effort to be considered successful.

According to watercourse assessment methods, the status of large invertebrates has improved after the activities of 2015, and its characteristics show that it is in good condition.

In order to evaluate the impact of the work on ecosystem recovery, aquatic and semi-aquatic macroflora (macrophytes) were also studied. Based on flora, the state of the stretch of the river that was opened in the first stage is either good or very good. In the section that was restored later, the condition is either poor or good, but too little time has passed from digging, and the river is also expected to achieve good or very good condition in these sections.



*Average number of fish species per one multi-mesh gillnet during one night before and after the restoration.*



*Average fish catches per one multi-mesh gillnet during one night before and after the restoration.*

## Novel research methods

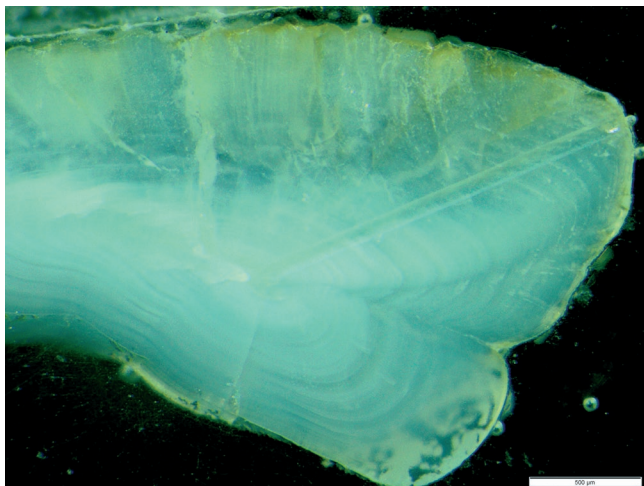
In the monitoring of project results, we have used the most novel research methods. Asp migrations and the effectiveness of its introduction were studied using biotelemetry and otolith microchemical fingerprinting.

**Otoliths**, also called statoconium, are located in the inner ear of fish. They record the chemical composition characteristic to the water body, which is why they can be used to determine the age of the fish and to understand the patterns of movement and origin. From otoliths, we clearly recognise the fish that we incubated and grew in our fish hatchery.



*Asp's otolith, also called the statoconium. They are in fish head and always paired.*





Mehis Rohtla

*The otolith of a 12-year-old asp prepared for analysis.*

The first results of the studies show that the stocking of asp as part of LIFE projects has been effective. A significant share of the asp living in the Emajõgi system, including fish caught from the restored Laeva River, originate from the Haaslava fish hatchery.

## Socio-economic impacts

Fishing is important for Estonians. The activities carried out during the project will help maintain the fishing potential of the Emajõgi river basin district, Lake Peipus and Lake Võrtsjärv. This will benefit both professional fishermen (120 in the region) and recreational fishermen from Estonia and neighbouring countries. While the number of professional fishermen has remained relatively stable, Emajõgi River has become more and more popular among recreational fishermen. According to the surveys, hundreds of people fish on Emajõgi each day, and fish catches are also significant, reaching up to hundred ton per year.

In addition to assessing the ecological results of the project, a study of socio-economic impacts was also carried out. Restoring the natural state of the lower reaches of Laeva River will create ecosystem services that will have a positive impact on the environment and, thus, on the well-being of individuals.

The results of the study show that only 5% of respondents prefer to spend the money from EU funds on carrying out land improvement activities, and 70% consider it necessary to restore natural waterbodies with the help of European Union projects.



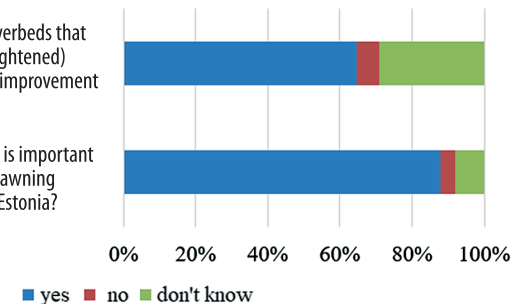
The importance of individual ecosystem services was discussed with focus groups that were put together, and “improvement of fish spawning conditions” received the highest rating.

As many as 85% of the respondents had a positive personal willingness to pay to restore the natural status of Laeva River, which is a very good result. The average individual willingness to pay was 25.5 euros, which is about 22 million euros when extrapolated to the residents of Estonia. Thus, according to the results of the study, the economic value of the ecosystem services provided by the lower reaches of Laeva River to Estonian residents is 22 million euros.

Restoration of the natural state of the river is economically a very successful project which brings a significant increase in well-being.

Should the natural riverbeds that were destroyed (straightened) during previous land improvement work be restored?

Do you believe that it is important to guarantee good spawning conditions for fish in Estonia?



*Results of a questionnaire.*



## Experience of restoration

Previously, restoration of natural river conditions has not been carried out on such a scale in Estonia. Even in Europe, the reopening of the natural riverbed and the previous linking of the oxbow lakes are unique, and the experience from these activities can be used to improve habitat conditions in all areas that have similar conditions. The experience gained from the restoration of oxbow lakes has been used to restore the connections between oxbow lakes and main riverbeds in other major rivers, such as the middle reaches of Narva and Põltsamaa rivers. The experience gained from restoring the Laeva River is helpful in planning and implementing similar activities elsewhere in Estonia. The capacity of both organisations and people has increased. Different agencies involved with nature conservation and environmental management have gained new practical knowledge on how to jointly design and implement such activities.

The experience gained from breeding and introducing asp can also be used to strengthen the populations of other protected and industrial fish species.

### **LIFE12 NAT/EE/000871 LIFE Happyriver**

Duration: July 2013 - December 2018

Total budget: 911 219 EUR

Contribution of EU LIFE financial instrument: 50%

Information: [www.loodushoid.ee](http://www.loodushoid.ee)

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