HYDROLOGY LIFE

Towards flourishing wetlands in Finland

Project activities and results 2017–2023

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Hydrology LIFE

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A pristine mire in Kauhaneva. Photo: Terttu Hermansson.

Restoring peatlands and wetlands all over Finland

While mires once accounted for one third of Finland's surface area, over time as much as one half of them have been drained for agricultural and forestry purposes. It has been estimated that due to the drainage of peatlands, around one half of our mire habitats are endangered.

Each mire is a unique site. Mires have developed over thousands of years and store significant volumes of carbon and water. The hydrology of the mire ecosystem determines its structure and species. Thriving mires provide habitats for many species adapted to wet conditions. When a mire is restored, its plant and animal species can start reverting to their natural state.

The goal of the Hydrology LIFE project was to improve the status of endangered wetland habitats on more than 100 sites around Finland. Nine partners were involved in the project. Together we completed numerous actions to improve mire habitats and increase environmental awareness.

The project had a budget of almost EUR 9 million, of which the EU's co-financing share was 60%.

Years ago, the mires restored in the project were drained for forestry purposes. Drainage ditches served to dry out the mires and encourage tree growth on drained sites and peatlands nearby. We restored mires across nearly 6,000 hectares. We also restored degraded streams and bird lakes. These actions improved the potential for using the habitats for recreational purposes, such as picking berries and hunting.

We developed a cost-effective method for reconciling ditch maintenance and restoration measures in commercial forests and produced research evidence relating to restoration. The restoration projects provided work for entrepreneurs around the country. We published a wetland game, videos and other communication material to increase environmental awareness.

Returning wetlands to their natural state

Fostering natural values

To support the planning of restoration measures, a huge volume of data was collected on species in protected areas. More than 150 days of field work produced data on species that included mosses, vascular plants, birds, fungi, butterflies and molluscs on the sites to be restored. These inventories helped to target restoration efforts at areas where they were the most beneficial for endangered or otherwise valuable species. We also made inventories of cultural heritage values on five sites.

Based on the inventories and field visits, planners drew up a detailed, site-specific plan for the restoration actions. As part of the project, we prepared nearly 90 restoration plans which ensured that the actions could be carried out smoothly and cost-effectively. The plans described the current state of the mire to be restored and the objectives of the actions.

The planner and excavator contractor check the plan together before starting the work.
Photo: Marko Haapalehto.

An excavator blocking a ditch in a mire.
Photo: Maarit Similä.

Restoring mires

Well planned is half done! Before the actual restoration work begins, trees are often removed from the mire to be restored. This may be necessary for a number of reasons. Trees growing along ditch lines prevent the blocking of ditches, and the removal of trees additionally helps restore the original open mire landscape and reduce transpiration from trees. In the best-case scenario, income from the removed trees pays for the blocking of ditches.

The framework for a dam made of birch trunks has been covered with peat. Photo: Henri Jokinen.

Once the trees have been removed, an excavator is often used to block the ditches. Mire restoration usually takes place in winter, as a frozen mire bears the weight of the excavator better. If necessary, peat and wood dams are used to slow down the flow of water. Peat is used to build embankments, which direct the water away from the ditches to the mire surface. Once the ditches have been blocked, the natural water level of the mire begins to recover. More than one million metres of ditches were filled in on mire restoration sites during the project!

Restoration may initially leave unsightly marks in a mire, but in a few years, the rising water level and mire vegetation will cover the excavator tracks.

We have more than 30 years of experience of restoring mires in Finland!

The finished dam camouflaged by covering it with pine branches. Photo: Henri Jokinen.

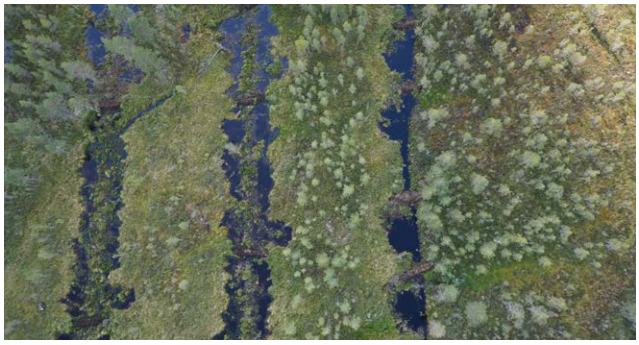


Photo: Jari Ilmonen.

Each of the over one hundred wetlands restored in the project had its own story to tell. Restoration work in Lake Pinkjärvi received unexpected help from the largest rodent in Finland, the European beaver.

Beavers are famous for building dams and lodges. The location of the beaver dam was ideal for restoration work! The plan was to restore a stream by reverting its waters to its old channel and recreating its meanders, in which the beaver dam was a great help.

The beaver dam had already caused the water level in the pine mire to rise, jumpstarting the mire's recovery towards its natural state.

A beaver has built its dam in an ideal place. The dam directs water into an old stream channel and raises the water level in the nearby mire. Photo: Eerika Tapio.

New rewetting method helps wetland habitats and benefits forest owners

In commercial forests a ditch network is normally used to lead water away from drained peatland forests. Sometimes these ditches interfere with the natural hydrology of a nearby protected undrained mire. Could a mire be rewetted?

The method developed for rewetting a mire recreates a more natural hydrology in a protected mire. Even if the central area of the mire had not been drained, it often dries out due to ditches that lead water past the mire. The water that would naturally be flowing into the drying mire is redirected to it by excavating feeder ditches, which recreate the natural water flow into the mire.

The method was piloted on five protected mires. The success of the operating model developed for rewetting mires was monitored in practical situations on the sites.

Water protection must be addressed when ditch network maintenance is carried out in commercial forests. Rewetting a mire is a good way of doing this, as the mire vegetation binds nitrogen and phosphorus found in run-off water. Rather than loading rivers and lakes, peat particles and other soil materials carried by the water are also retained in the mire.

Rewetting a mire that is drying out safeguards wetland biodiversity. In recent decades, most of the species that thrive in wet mires have declined due to peatland drainage. By being able to absorb large volumes of water, mires also control flooding.

During the project, this specific rewetting approach became an established method of mire restoration. New sites are being inventoried and restored around Finland!

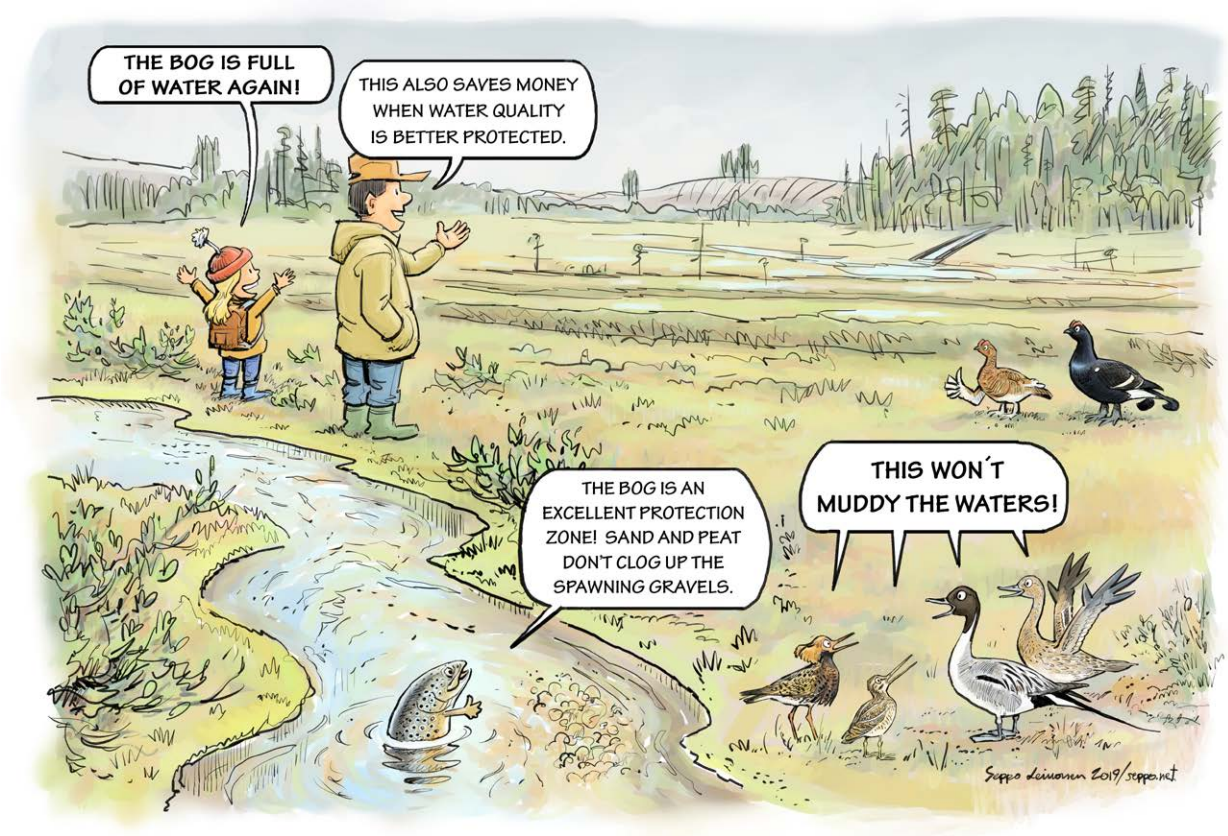


Illustration: Seppo Leinonen.

Safe nesting sites for birds were made in a lake. Photo: Antti Below.

Restoration of small water bodies and bird lakes

The drainage of peatlands has also affected streams, rivers and lakes downstream of mires. "We restored over 40 kilometres of small streams, improved the status of 5 bird lakes and raised the water level in 14 project sites.

Streams have been straightened as part of drainage, for example to speed up the removal of excess water from commercial forests. Dams and culverts have been built in streams, which may have impaired the living conditions of their original animal and plant species.

Sometimes manual labour is all that it takes to restore meanders in a stream. In this, volunteers who wish to work for nature can help: a stream can be redirected to its old channel, or stones lifted out of the stream can be rolled back into it to diversify habitats. Wedging logs into the stream bed slows its current, directs the water and provides a growing substrate for mosses. Gravel beds for spawning can be made for salmonids and sheltered places for juveniles. Sometimes, however, stream renovation requires heavier equipment, and gravel and stones need to be brought in by the truckload. Dams and culverts can be removed or replaced by new structures that facilitate the movements of species and water flow.

Many of our valuable bird wetlands are threatened by overgrowth. When a lake is taken over by aquatic vegetation, birds cannot find nesting sites and food. Predators can also reach bird nests in shallow water. Waterbird populations have declined along with habitat loss. We restored bird lakes by raising the water level, mowing water plants, dredging and building nesting islands.

A restored mire in an aerial photograph. Next to blocked ditches, water has risen to the surface of the mire. Photo: Mika Puustinen.

How does restoration affect wetlands?

Comprehensive monitoring is needed to assess the impacts of wetland restoration and to ensure that it has succeeded as planned. This work is mainly based on walking around restoration sites and making visual observations as well as systematic long-term monitoring. The Hydrology LIFE project continued the long-term monitoring initiated in previous projects and additionally developed new methods based on aerial photography.

Mire protection assisted by drones

New aerial photography methods facilitate planners' work and provide new information on the impacts of restoration. A remotely controlled drone helps assess the success of mire restoration. We monitored the impacts of restoration on more than 20 sites using aerial photographs and videos taken by drones. Mires restored in the project were photographed from drones at least once before and once after the restoration.

Based on the aerial photographs, we can evaluate the impacts of restoration on hydrology and plant life on the site. For example, the photographs show how water level has risen in the surroundings of a blocked drain has progressed, and how vegetation has changed since restoration. Aerial photography is particularly suitable for monitoring open mires.

Photo: Katja Sandgren.

A data logger for monitoring water level fluctuations in restored mires. Photo: Lauri Ikkala.

An expert examining plants on a square of a restored mire. Photo: Maarit Similä.

Globally unique mire monitoring network

Finland has a monitoring network of restored mires that is unique by global standards. Its main objective is to determine if restoration has been successful in reverting habitats closer to their natural conditions. This monitoring network established in 2008 provides highly valuable information on water quality and vegetation recovery after restoration. The project studied the impacts of restoration actions taken ten years ago on mires.

Hydrological monitoring

Among other things, the water level, nutrient balance and conditions for oxidation-reduction in the mire are examined as part of hydrological monitoring. These factors determine the type of biotic communities that develop in a mire after restoration. We used automated water level recorders and collected water samples for chemical analysis on more than 40 sites. We also continued monitoring the quality and quantity of runoff waters on nine sites and collected peat samples to understand the impacts of restoration on water bodies. Key parameters to be monitored include concentrations of phosphorus, nitrogen and dissolved organic carbon in waters.

The monitoring results indicate that while restoration actions return the water level close to its natural state and reduce its fluctuations, they also create a temporary disturbance in the quality of mire water and run-off water. After restoration, nutrient concentrations in runoff water are high, but this disturbance disappears in the years following restoration. The duration of its impact depends on such factors as the scale of the restoration actions and the nutrient content of the mire. The monitoring results help us understand the real impacts of restoration, ensure the success of restoration actions, and facilitate the planning of future restoration projects.

Monitoring of vegetation

We monitored the change in mire vegetation on a total of 151 sites around Finland as part of the project. These sites included restored, natural and drained mires alike, enabling us to separate the impact of restoration from other environmental changes. Ten years after restoration, mire vegetation had clearly started to return to its natural state.

The scale of the change caused by restoration varied from site to site. Restoration had major impacts especially in nutrient-rich pine mires and fens, whereas in nutrient-poor pine mires and fens the impacts were considerably smaller. Peat-forming sphagnum mosses proliferated in the years following restoration and were the most obvious winners, whereas woodland floor mosses, which had become abundant as a result of drainage, declined.

How does restoration affect wetland species

The objective of restoration is to improve the habitats of protected and endangered species. In the Hydrology LIFE project, we monitored the impacts of restoration actions on bats and waterbirds. Information on species is an essential tool for the management, use and monitoring of protected areas.

Insect buffet for bats

While bats are included in mire species, the impacts of mire restoration on protected bat species have not been studied before. During the project, the University of Turku conducted a study that compared bat activity in restored and unrestored mires before and after restoration. Bat sounds were recorded on 21 sites in total, and researchers analysed more than 10,000 hours of recordings. The study found that bat activity in mires increased after restoration, presumably because the restoration actions boosted insect numbers. Consequently, research has found that rather than harming bats, mire restoration benefits them!

Restored bird wetlands attract residents

We had the pleasure of witnessing great results on bird wetland restoration sites while the project was still in progress. Based on bird counts carried out before and after the work, a positive trend in the number of species and pairs of waterbirds was observed on several sites immediately following the restoration. Later counts have found, however, that annual fluctuations in the number of species may be high, which makes long-term impact monitoring necessary.

The northern bat is the most common bat species in Finland. Photo: Ville Vasko

A wood sandpiper is wading in shallow water. Photo: Jaakko Vähämäki.

The ruff is a critically endangered wader of the wetlands. Photo: Raimo Rajamäki.

Illustration: Seppo Leinonen.

Spreading awareness of the benefits of wetlands

Protecting wetlands also brings many types of benefits for us humans. Natural Resources Institute Finland analysed the costs of restoration and regional economic impacts. More than 100 contractors were employed throughout Finland during the project. Natural Resources Institute Finland also studied the extent to which restoration of biodiversity can improve the recreational and tourism value of an area. According to surveys, citizens value restoration work and find that its benefits outweigh the costs.

We inspired everyone to participate in by providing information for experts, learning materials for teachers, and opportunities for hands-on work for volunteers.

A teacher's guide introduces wetland biodiversity and ecosystem services to children and young people and helps them understand why wetlands are important.

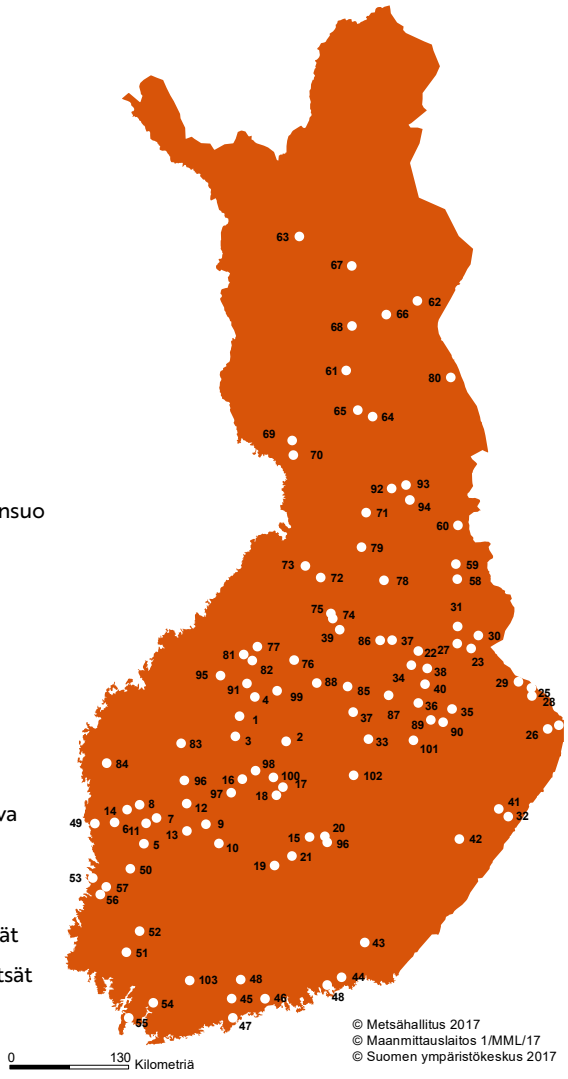
Wetland cards and short videos explain how we can restore streams and mires together and keep coastal meadows open. They provide tips for schoolchildren and fishermen as well as forest owners and livestock farmers. The videos also give a summary of Finnish know-how in improving the natural state of this peatland country of ours.

You can also learn about protecting wetlands by playing a game! in the Wetland Game, anyone can test the impacts of different land use options on biodiversity.

- **Wetland game: kosteikkopeli.jyu.fi**
- **Wetland video in English www.youtube.com**
- **Wetland cards: julkaisut.metsa.fi/**
- **Learning materials: Materials for teachers in MAPPA material bank for environmental educators mappa.fi**

In the Hydrology LIFE project we restored wetlands across Finland !

1. Peuralamminneva
2. Pyhä-Häkin alue
3. Haukisuo-Härkäsuo-Kukkoneva
4. Salamajärvi
5. Hämeenkangas
6. Haapakeidas
7. Häädetkeidas
8. Kauhaneva-Pohjankangas
9. Helvetinjärvi
10. Siikaneva
11. Puurokeidas-Hannankeidas
12. Närhineva-Koroluoma
13. Seitseminen
14. Lauhanvuori
15. Haapasuo-Syysniemi-Rutajärvi-Kivijärvi
16. Vesilahdensuo-Kurkisuo
17. Pohjoisjärven metsä
18. Sallistensuo
19. Kärppäjärven alue
20. Kälkäsuo-Lehmussuo
21. Onkisalo-Herjaanselkä
22. Pitkäsuo-Särkäntakanen
23. Mujejärvi
24. Koitajoen alue
25. Ukonsärkän alueen vanhat metsät
26. Jorhonkorpi
27. Paistinvaaran alueen vanhat metsät
28. Suolamminvaara-Tervasuo
29. Ruunaa
30. Jonkerinsalon alue
31. Teerisuon-Lososuon alue
32. Päätyeenlahti
33. Rahkasuo
34. Tiilikan alue
35. Polvelan luontokokonaisuus
36. Pisa-Kypäräinen
37. Laakajärven metsät ja suot
38. Löytynsuo-Maamonsuo
39. Saarisuo-Kurkisuo
40. Matalasuo-Hyvärilänsuo
41. Partiissuo
42. Savonsuo
43. Enäsuo
44. Valkmusa
45. Nuuksio
46. Sipoonkorpi
47. Finnträskin vanha metsä
48. Kalkkilammi-Sääksjärvi
49. Mankaneva
50. Rimpisuo-Siikelinsuo
51. Kurjenrahka
52. Maisaarensuo
53. Porsmusansuo
54. Teijon ylänkö
55. Stormossen
56. Pinkjärvi
57. Lastensuo
58. Isosuo-Koirasuo
59. Tulisuo-Varpusuo
60. Sydänmaanaro
61. Herankaira
62. Sieriäisten harjulammet
63. Loukisen latvasuot
64. Soppana
65. Simojärvi
66. Kemihaaran suot
67. Viiankiaapa, Sodankylä
68. Haikara-aapa – Vitsikkoaapa
69. Veittiaapa
70. Rimpijärvi-Uusijärvi
71. Olvassuo
72. Veneneva-Pelso
73. Loukkuneva-Isoneva
74. Kinkerisaarenneva
75. Kansanneva-Kurkineva-Muurainsuo
76. Tervaneva-Sivakkaneva
77. Pesäneva
78. Kivesvaaran ja Keräsenvaaran lehdot ja letot
79. Sarvisuo-Jerusaleminsuo
80. Oulanka
81. Kivinevan alue
82. Lestijoen yläjuoksu ja Paukaneva
83. Peränevanholma
84. Varisneva
85. Valkeiskylän ja Ventojoen metsät
86. Vahtisuo ja lähistön vanhat metsät
87. Kuikkasuo ja Suurisuo
88. Varisvuori - Louhukangas – Saukonlähde
89. Ruohosuo
90. Vaikkojoki, Vaikon vanhat metsät ja Aitalamminsuo
91. Linjasalmenneva
92. Sammalharju
93. Lauttasuo
94. Metsäkylä
95. Pilvineva
96. Keskisenlampi-Riionlampi
97. Pihlajavesi ja yläjuoksun pienvedet
98. Valkeisenlampi-Särkilampi-Utusuo
99. Seläntauksen suot
100. Oksalan Isosuo-Miehinkäisensuo
101. Riistaveden lintujärvet Kuopio
102. Keurunmäki-Haavikkolehto
103. Hyyppärän harjualue



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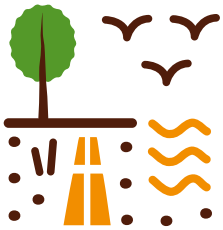
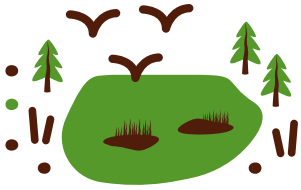
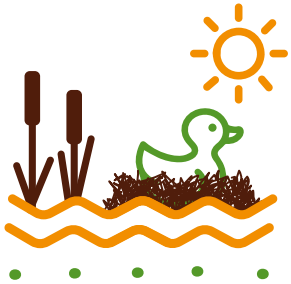
Hydrology LIFE project outcomes







Actions on
103 *Natura 2000 sites*

87 *restoration plans prepared*

Nearly
6,000 *hectares of mires restored*

Over 100
km of river and stream inventories

42 kilometres
of rivers and streams restored

Water level raised in **14** *project sites*

5 *bird lakes restored*

160 *hectares of new protected mires*

Ca. 130
volunteers participating in restoration work

More than 200
people worked on the project

EUR **5.8** *million*
spent on outsourced services