
Punkaharju Experimental Area



The Finnish Forest Research Institute

Welcome

to the Punkaharju Experimental Area of the Finnish Forest Research Institute.

The Punkaharju Experimental Area has a lot to offer the visitor. Many of Finland's oldest forest regeneration experiments, as well as plantations of exotic tree species, are to be found close to the esker. Both domestic and exotic tree species can be admired in the arboretum. The Punkaharju Research Station of the FFRI is also situated in the area. A national forest museum will be built at Punkaharju in the middle of the 90's.

The esker area proper is a nature conservation reserve where the visitor can enjoy the forest and lake scenery of Finland at its most beautiful. The Kokonharju primeval forest reserve, located in the northern corner of the esker area, shows how forests develop naturally in this region.

This guide provides general information about the Punkaharju area. More detailed information about the experiments and points of interest along the forest trails can be found in separate booklets. The Punkaharju Research Station and the Finnish Forest Research Institute will also provide more information.

The Finnish Forest Research Institute hopes that Punkaharju will provide you with a wide range of interesting forest experiences. Welcome again.



Teijo Nikkanen

Good-quality tree individuals, so-called plus trees, are selected as the starting material for tree breeding. The seed collected from these trees are used in breeding transplants. A total of 25 000 plus trees have been selected in Finland, the first of them in Punkaharju in 1947. The Kanerva Pine (plus tree N:o E1101) has been named after its discoverer, the long-standing forest officer in the area, Yrjö Kanerva.

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Formation of the Esker and Natural Conditions

The Punkaharju esker was formed about 8 400 years ago towards the end of the last ice age. As the continental ice sheet melted, retreating to the north west at a rate of about 260 m a year, the material carried by the meltwater was deposited along the edge of the glacier. The esker is believed to have taken about 30 years to form.

At the end of the ice age the esker was covered by an inland sea, but became gradually exposed as a result of land uplift in the direction of Lake Puruvesi and Lake Pihlajavesi. The water level has varied since the ice age. At its lowest, Lake Puruvesi appears to have been about 10 m lower than the present; the tree stumps of the “submerged forests” found in places at the bottom of the lake are evidence of this. At its highest Lake Puruvesi was about 10 m higher than at present. Signs of the old shorelines can still be seen on the slopes of the esker. Puruvesi attained its present level about 4 000 years ago.

Nowadays Punkaharju Esker extends for about 7 kilometres from Punkasalmi to the tip of Kokonniemi. At its highest it is about 25 m above the waters of Puruvesi, and at its narrowest only the width of the highway. Its blue waters and green forests, islands and headlands, make it one of Finland’s most beautiful and undoubtedly most famous landscapes.

CLIMATE

The Punkaharju area has a rather continental climate. The mean annual temperature during 1951–1980 was 3.1°C, and the mean annual precipitation 582 mm. The monthly mean temperatures and precipitation were as follows:

	I	II	III	IV	V	VI
Temperature, °C	-10.0	-10.0	-5.2	1.3	8.3	14.5
Precipitation, mm	38	29	28	32	35	50
	VII	VIII	IX	X	XI	XII
Temperature, °C	16.5	14.8	9.5	3.9	-1.6	-6.7
Precipitation, mm	69	76	62	63	54	46



Jouko Lehto

SOIL AND SITE TYPES

The soil and elevation in Punkaharju are very variable. In places the edges of the esker area consist of relatively flat, sandy and gravelly soils. There is also plenty of till and fine sand soils. The bedrock is exposed in only a few places.

Geobotanically, Punkaharju belongs to the eastern Finland grove zone, which extends from the shores of Lake Ladoga up to the outskirts of Savonlinna and Joensuu. The soil in the experimental area is rather fertile: almost 2/3 of the forest sites are moist or grovelike mineral soils or groves. The fertility of these site types is reflected in both the structure and growth of the tree stands and in the vegetation of the area.

VEGETATION

The variable soil and elevation in Punkaharju, in addition to the presence of fertile sites, offer a diverse environment for plants and animals. The long-term management of the forests and landscape, as well as the experimental activities, have also increased the diversity of the landscape.

Plants characteristic of the ridge of the esker include yellow oxytropis (*Oxytropis campestris*), alpine milk-vetch (*Astragalus alpinus*) and umbellate wintergreen (*Chimaphila umbellata*). Bog myrtle (*Myrica gale*) is common along the shores, which is easily recognised by its sawtooth edged leaf tips. Hemp agrimony (*Eupatorium cannabinum*) is more rare.

The vegetation becomes more lush on moving down from the ridges and hillocks. Plants typical of fertile sites are spring pea (*Lathyrus vernus*), ostrich fern (*Matteuccia struthiopteris*), wild balsam (*Impatiens noli-tangere*) and hedge woundwort (*Stachys sylvatica*).

Site type distribution

• Groves and grovelike mineral soil sites	23 %
• Fresh mineral soils	39 %
• Dryish mineral soils	27 %
• Dry and infertile mineral soils	1 %
• Spruce swamps	6 %
• Pine bogs	4 %

The forests of Punkaharju abound with wild berries and edible mushrooms. Blueberry, wild strawberry and wild raspberry are an added bonus to the berry-picker's harvest. A diverse mushroom flora thrives in the stands of different development stage. Mushroom pickers will find the false morel in the spring, chanterelle in mid summer, and a wide range of ceps, milk caps and other edible mushrooms in the autumn.

ANIMALS

Foxes and badgers nest in the Punkaharju area, and an early evening visitor may even see a raccoon dog. Beavers have been living right next to the research station already for many years. Elks often visit the park forest. Roe deer have been sighted a number of times in the area.

A large number of birds nest in the area – the raucous call of the capercaillie can be heard at its regular spot every spring, nutcrackers dart busily among the Siberian stone pines, and many species of woodpecker and other species that nest in hollow trees thrive in the old forests. The clear notes of the nightingale and chirping of the loriote can be heard in the spring and early summer. There is also a diverse range of waterbirds, the red-necked grebe being one of the rare sights.



Jouko Lehto

Wild balsam (*Impatiens noli-tangere*).



Jouko Lehto

Broad helleborine (*Epipactis helleborine*).



Jouko Lehto

Ostrich fern (*Mattheuccia struthopteris*).



Jouko Lehto

Rosa acicularis.

History of the Area

Punkaharju, located in the part of eastern Savo fragmented by watercourses, stands on an earlier important traffic route running east-west between the provinces of Savo and Karelia. Signs of the first inhabitants date back to the Iron Age (the 12th century): a stone-age settlement has been found in the Mustaniemi area.

The bountiful waters of Lake Puruvesi made the Punkaharju area a popular settlement area, and in the olden days

there were frequent fights about fishing rights between the Savonians and Karelians. For hundreds of years the area was a subject of border disputes between Sweden and Russia. The Swedes built the castle of Olavinlinna at Savonlinna in the 15th century. During the Finnish War (1808–09), after which Finland was an autonomous Grand Duchy under Russia until 1917, earthworks and entrenchments were built at Punkaharju, of which traces can still be seen.

A road to Punkaharju was constructed in the latter half of the 18th cen-



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tury and, by halfway through the 19th century, the road was partly fitted with stone kerbs. However, most of the road that nowadays runs along the esker was not built until the 20th century. Construction of the road made Punkaharju more accessible and it gradually became a famous natural sight.

PUNKAHARJU TO STATE OWNERSHIP – THE START OF NATURE CONSERVATION

The landscape value and natural beauty of Punkaharju was recognised already during the last century by the imperial authorities. Czar Alexander I is said to have travelled along the Punkaharju esker, which then belonged to Russia, in 1803 and been captured by the beauty of the area. He urged the state authorities to ensure that the forests running along the road would not be cut down.

Punkaharju became state property in 1840 when the Senate ordered that

“– What a lucky thought sent the road through this wonderful pleasure garden! – It is difficult to say when Punkaharju is at its most beautiful: when the sunrise sparkles over Puruvesi, over the shining lakes and light green groves, or when the moon shines over Pihlajavesi and casts a dark shadow down the steep slopes on the opposite side of the esker. What is certain, however, be it the brightness of day or the moonlight of night, there is no place more wonderful throughout the length and breadth of beautiful Finland, no district worthy of more love and admiration than Punkaharju.” (Sakari Topelius 1847).

“the whole esker in question is to be demarcated and managed appropriately at state expense”. The esker area was declared a crown park, which was initially supervised by the Governor of Mikkeli Province, but subsequently transferred to the National Board of Forestry in 1880. Responsibility for Punkaharju passed to the Finnish Forest Research Institute in 1924.

The Punkaharju Experimental Area

The Punkaharju Experimental Area was established in 1924 and, at the time, covered an area of 550 ha. Since then the experimental area has been expanded through land acquisitions and bequeathments, and now totals 1 830 ha of land and 814 ha of waters in the municipalities of Punkaharju, Kerimäki, Kesälahti, Kitee, Rautjärvi, Savonlinna and Värtsilä.

Of the land area, about 650 ha are at present being used for research purposes and almost 200 ha are protected by law, or by decision of the provincial government or the FFRI. The rest of the area forms a reserve for future research purposes.

The Punkaharju Experimental Area

Total land area	1 830 ha
Number of experiments	200
• Commercial forest	1 525 ha
• Conservation areas	236 ha
• Punkaharju Nature Conservation Area	192 ha
• Hytermä Nature Conservation Area	37 ha
• Other protected areas	7 ha
• Other land area (roads, built-up areas etc.)	72 ha

MANAGEMENT OF THE FORESTS

Punkaharju appears to be one of the first areas in Finland where the state has taken a stand concerning forest management. Alexander I expressed his concern about the state of the forests already at the beginning of the 19th century. In 1840 the esker area was decreed a state park; at the same time an order was issued that its forests were to be managed appropriately. The forests in the esker area had decreased considerably during the last century, and their condition had deteriorated owing to the practice of slash and burn agriculture and the removal of large trees for rearmament purposes. The forests were full of openings, burnt-over pasture, alder thickets or hardwood stands with an admixture of Scots pine. In order to improve the condition of the forests, A.G. Blomqvist, rector of the Evo Forestry College, was commissioned to prepare the first forest management plan for the area in the 1870's. Since then the forests have been managed systematically.

Nowadays the forests in the area are inventoried and management plans drawn up at ten-year intervals. The forests are neither fertilized nor ditched, but cuttings, young stand treatment and other silvicultural measures are carried out from time to time. Particular attention is paid

to the landscape and multiple forest use aspects.

The forests in the esker area are managed according to a special plan. No forestry measures are carried out at all in the other protected areas.

FOREST RESERVES

The systematic forest management practiced for more than a century has brought results. The forests in the experimental area are nowadays in good condition, there are few over-aged commercial stands, and



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Masur birch (*Betula pendula* var. *carelica*) is a special form of silver birch. The wood is exceptionally hard, often brown with a decorative grain. The external appearance of the tree is often very unusual: the trunk frequently has furrows, grooves or ringlike swellings. Masur birch is the most valuable tree species in Finland. It is used in inlay and veneer work in the carpentry industry. Masur birch and its genetics have been studied at Punkaharju.



Erkki Oksanen

A lot of tree breeding, timber production, silvicultural and soil experiments have been established in the Punkaharju area. People walking in the forest will recognise the experiments from the painted marks on trees, plot corner posts or litter and seed funnels. There are notice boards giving information about the experiment in many of the experiments.

the annual mean growth and mean stand volume are greater than the average for the surrounding area of the Eastern Savo area. About 5 700 m³ of timber are cut annually in connection with the research

activities and normal forest management and treatment.

The Punkaharju Nature Conservation Area

The Punkaharju Nature Conservation Area was established in 1991. It includes the whole of the esker area proper, stretching from close to the town of Punkasalmi in the south east right up to the Kokonharju primeval forest area in the north west. The headland surrounding the Finlandia Hotel and the surroundings of the Convalescent Hospital belong to the nature conservation area. The total area of the conservation area is about 680 ha, of which 192 ha are land.

MANAGEMENT OF THE ESKER FORESTS

Systematic management of the esker forests was started already in the 1800's when they were part of the crown park. Landscape management has been the main concern in managing the forests. The systematic management was continued when Punkaharju passed to the FFRI.

In 1951 the board of FFRI passed the decision to protect the esker area by managing the tree stands as park forest. The treatment was defined as follows:

The fertility of the soil and the long tradition of forest management are also visible in the volume, growth, and tree species composition of the forests in the experimental area. Both the mean volume and annual growth increment are greater than the average for the surrounding Eastern Savo area (in parentheses).

Forest resources

Total growing stock	315 600 m ³
Mean volume of growing stock	180 m ³ /ha (134 m ³ /ha)
Total growth	11 400 m ³
Mean growth	6,5 m ³ /ha (5,8 m ³ /ha)
Annual cut	5 700 m ³

Tree species composition

Scots pine	64 %
Norway spruce	22 %
Birch	10 %
Other conifers	3 %
Other hardwoods	1 %

“Park forests are areas where the development of the forest is guided by light thinnings in accordance with the principle that the oldest viable trees are to be allowed to reach as large a size as possible, and that a new tree generation is to be formed and allowed to develop”.

Landscape management cuttings have been carried out along the lines of this directive at intervals of about ten years. Since both silvicultural and scenic aspects are taken into account in the cuttings, the fate of each tree is decided individually.

The esker stands consist primarily of Scots pine (*Pinus sylvestris*) with a small admixture of birch (*Betula* spp.) and rowan (*Sorbus aucuparia*). The trees are

very old, in places over 200 years old even. Without cuttings the esker would become overgrown within a few decades. The landscape would become closed and the tree density would increase the risk of fungal diseases.

In 1979 a management plan was drawn up for the esker area for the period 1979–2060. The aim of the plan is to ensure that the present landscape and appearance of Punkaharju is retained in the future, too. The tree stands will be gradually regenerated by careful cuttings over a period of 80–100 years. Cuttings will be done in three successive years, after which the area is left to rest for five years. This eight-year rotation will be repeated continuously.



Erkki Oksanen

The forests in the Punkaharju esker area are managed by careful cutting designed to retain the natural beauty of the area.



Teijo Nikkanen

The forests in the Kokonharju Primeval Forest Area are allowed to develop naturally without any interference from man.

In 1991 the Punkaharju esker area was designated a nature conservation area. According to the management and operating plan drawn up for the area, the forests in the esker area are to be managed in such a way that the beauty of the area and the health of the tree stands are maintained.

THE KOKONHARJU PRIMEVAL FOREST AREA

About 40 ha of the nature conservation area is completely untouched, primeval forest. A 15-ha virgin forest area in Kokonharju was conserved by decision of the FFRI in 1924. The lifecycle of northern coniferous forests can be followed in the Kokonharju Primeval Forest Area: Norway spruce have spread below the pines and are rapidly occupying the growing space, especially on eastern slopes. The primeval forest area is gradually becoming dominated by spruce, as is normally the case in the final stage of

succession in forests developing in a natural state.

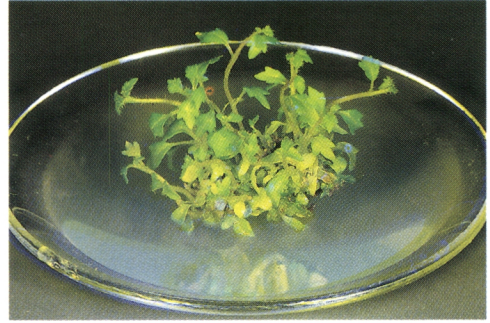
Forestry Research at Punkaharju

One of the main functions of the Punkaharju Experimental Area has been to study the success of exotic tree species, and their different varieties and origins, under Finnish conditions. There are also a number of forest tree breeding, forest soil, silviculture and forest growth and production experiments at Punkaharju. The topics being investigated in these experiments include the effect of fertilization or thinnings of different severity on the development of the tree stand. The silvicultural experiments are being used to investigate the differences between natural and artificial regeneration and the seed crops of trees.

THE GROWING OF EXOTIC TREE SPECIES

Punkaharju is one of the oldest artificial forestation experimental areas in Finland. The growing of exotic tree species was started here in 1877 when Forest Officer R. Montell established a Siberian larch (*Larix sibirica*) stand of Raivola origin in the area. In addition to Siberian larch, European larch (*Larix decidua*), Siberian fir (*Abies sibirica*) and Siberian stone pine (*Pinus cembra*) were planted in the area in the 19th century. In addition to exotic tree species, domestic tree species were also planted.

When Punkaharju was transferred to the FFRI in 1924, a start was made on continuing the trial plantations of exotic tree species that had been neglected for half a century. In the 1920's and 1930's about 150 ha of tree species trials comprising over 50 exotic species were established at Laukansaari, Punkaharju. The



Cell culture of Masur birch.

Jouko Lehto



Douglas fir (*Pseudotsuga menziesii*).

Teijo Nikkanen



The most extensive clone collection in Finland is to be found at Punkaharju. Plus trees with good properties have been propagated by grafting. Thousands of crossings are made each year in the collections in order to find progeny with properties useful for forestry.

Teijo Nikkanen

trials have been used to investigate how trees from parts of Europe, Asia and North America with a corresponding climate to that in Finland thrive here in Finland.

Since the 1920's provenance (i.e. origin) trials have been established with pine and spruce for studies on forest genetics. The provenance trials are used to study, for instance, the success of Scots pine from Lapland in southern Finland, and vice versa, or the success of provenances of the same tree species but from different geographical areas or altitudes when the growing conditions are changed.

In these experiments which have been continuing for decades, only a few tree species – e.g. larch and Douglas fir (*Pseudotsuga menziesii*) – have proved to be competitive with domestic tree species as regards their timber production. The success of other exotic tree species in Finland has often been prevented by fungal or insect damage, and for many tree species the Finnish winter has proved

to be fateful; exceptionally cold winters especially have damaged the trees. However, many exotic tree species are cultivated as ornamental trees. Tree species and provenance trials are nowadays also a valuable tool when investigating the effects of climatic change on the forests.

There is also a 5-ha **arboretum** in Punkaharju. All the tree species growing in the experimental forests of Punkaharju can be found there, as well as those tree species not growing elsewhere in Punkaharju. The arboretum was established during 1929–1938. The maintenance and regeneration of the arboretum was started in 1990. Nowadays there are 40 coniferous species and about 20 hardwood species growing there. The area reserved for each tree species in the arboretum is so small that it cannot be used for real research purposes; the primary purpose of the arboretum is for teaching, recreational and observation uses.



Teijo Nikkanen

Montell's Larch Stand is well known as the first artificially established stand in the Laukansaari area. This Siberian larch (*Larix sibirica*) stand, planted in 1877, is well worth seeing at any time of the year. The tallest tree at Punkaharju is to be found in this stand, its crown reaching up to a height of almost 42 m.



Teijo Nikkanen

Trees of the same species but derived from different areas are compared in provenance trials. The spruce on the left is from Romania and on the right from Rautjärvi, Finland. There is a clear difference in the annual growth rhythm of the trees: the tree from Rautjärvi has started to grow, the one from Romania not.

THE PUNKAHARJU RESEARCH STATION

The Punkaharju Research Station of the FFRI is located right next to the old Punkaharju railway station. The research station has been gradually expanded from a tree breeding station (1964) to a research station (1987), where 6 research officers and about 40 auxiliary staff are employed. The research station building was completed in 1982.

The Punkaharju Research Station has specialised in forest tree breeding research. Traditional breeding research includes crossing breeding and progeny trials. During the past few years the research topics have been expanded to include seed orchard research, resistance breeding and biotechnological research, i.e. vegetative propagation and gene technology. The biotechnological methods are used in the laboratory to produce large number of genetically identical birch seedlings from small pieces of plant tis-

sue. In addition, ways of transferring the genes of certain desirable traits to tree individuals for further breeding are also studied. In resistance breeding, individuals are being developed that are unpalatable to hares, voles and elks.

Other Sites of Interest in the Punkaharju Area

The Hytermä Nature Conservation Area at Kerimäki also belongs to the Punkaharju Experimental Area. The conservation area comprises three islands of great natural beauty on Lake Puruvesi, with a total area of about 40 ha. With its esker formations, pine stands, pools and sandy beaches it is like a miniature copy of Punkaharju.

The district police superintendent of Kerimäki, Heikki Häyrynen, and his wife Pikku Julia Häyrynen, bought the



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Sorehouse in Hytermä.

Hytermä islands in the 1920's. They built a villa there, started landscape gardening work, and built up a collection of articles associated with rural culture on the main island. The storehouse, windmill, labour memorial, embankments and stone steps are from their period.

On Häyrynen's request, the islands were designated a nature conservation area by the provincial government in 1932; it was the first conservation area in the province of Mikkeli. In 1942 the Häyrynen's donated the islands to the FFRI. The deed of donation includes a stipulation concerning the management and use of the islands: The forests are to be managed expertly, solely from the point of view of the beauty of nature, and in accordance with a plan approved by the FFRI". In addition the income from timber sales had to be used for forestry research. The Hytermä forests have been

managed solely from the landscape point of view. Completely untouched primeval forest areas have been left on the islands.

Other sites of interest in the Punkaharju Experimental Area include the **Lönnrot Pine** in Hummovaara Village, Kesälahti. Elias Lönnrot, compiler of the Finnish national epic "Kalevala", sat at the foot of the tree and wrote about the national epic poems and traditions on his first poem collection trip. One of Finland's oldest larch stands is located at Puhos – the **Arppe Larch Stand** established in 1842. The shipowner Arppe established the stand to produce raw-materials for his shipbuilding yard. The stand is the oldest artificially regenerated stand in the Punkaharju Experimental Area.



The Finnish Forest Research Institute

The FFRI is a national, independent research institute, whose task is to promote, by producing research data, the sustainable, diverse use and protection of Finland's forests.

The FFRI was established in 1917. It has developed into a major organization with the head office in Helsinki and Vantaa, and eight research stations situated in different parts of Finland. The expertise of the more than 200 researchers at the institute ranges from traditional forestry science to the natural, social and economic sciences. The total input of the staff is about 1 000 person years.

The institute has about 140 000 ha of experimental forest and nature conservation areas available for long-term research and studies. There are over 20 000 sample plots in these forests, the oldest of which were established already during the 19th century.

The FFRI is the organization with the longest tradition of managing nature conservation areas in Finland. It manages the Pallas-Ounastunturi, Pyhätunturi and Koli national parks, as well as a large number of nature parks and other conservation areas. In addition to research work, the institute is responsible for guiding and advisory services in the areas.

The major research projects carried out by the institute have included long-term artificial regeneration and forest growing experiments on both mineral and peat soils. This work has provided a scientific basis for the silvicultural and forest improvement methods used in Finland. The national forest inventory has followed the development of Finland's forest resources since the 1920's. Important new research topics are forest health and multiple use.

In addition to research work, the institute is also responsible for the national forest statistics, calculating the norms for forest taxation, the forest genetic registers, monitoring the state of health of the forests, and the inspection of control chemicals.

