

EXPERIMENT AREAS
OF THE FINNISH FOREST RESEARCH INSTITUTE 3

Punkaharju



The primary task of the Finnish Forest Research Institute is to study by investigations and experiments forestry and the bases for the purposeful development of Finland's forestry (Statute 385/1953). For this work there are experimental areas under the administration of the Finnish Forest Research Institute. There are fourteen such areas, about 60 000 hectares in all. The map on the inside back cover shows the location of these areas. They represent different natural and forestry conditions. The experimental areas are supplemented by the nature reserves in Lapland, four in number and also totalling about 60 000 hectares. These State-owned lands which are under the administration and management of the Finnish Forest Research Institute have been grouped into three supervisory districts, each with its own district forest officer. There is in the majority of the experimental areas a forest technician as local supervisor and work foreman.

Permanent sample stands and other investigation projects are sited in the experimental areas. They have been established to clarify the practical value of various logging, forest regeneration, and forest drainage methods. The usefulness of the results can be checked further in the experimental areas by applying them to larger scale projects.

**Front cover: Slope of Punkaharju ridge and Lake Puruvesi.
Photo by R. Saarnio, 1957.**

The Experimental Area of Punkaharju

Preliminary phases and establishment of the experimental area.

Punkaharju is one of the few areas where the State took special action in an early phase. The reasons were the importance of the ridge as a general traffic route and its exceptional scenic value. Consequently, Czar Alexander I who in 1802 travelled along Punkaharju ridge which at that time belonged to Russia urged the authorities to ensure that the forest lining the road were not cut. The Czar had all the more reason for this as the ridge was almost treeless just then on account of burn-beating and possibly also because of war preparations. More or less the same arguments are expressed in a letter of protest from the State representative appointed for consolidation of farm lands in 1837. He pleaded that the division of the area between the adjacent private farms should be rescinded. As a result of this appeal, the then Senate of Finland ordered in 1840 that the »entire ridge in question must be demarcated with boundary marks and be maintained at State expense». This solution may have been influenced by J. L. Runeberg's, Finland's national poet's, description in a newspaper article in 1838: »the beautiful Punkaharju the equal of which can be sought in vain both south and north».

The ridge area which thus came into the possession of the State and was declared a State park in 1843 was 136 hectares. Two private farms were incorporated in it by purchase in 1874 and one more was included in 1880 in payment for arrears of taxes. The State-owned land in 1924 when Punkaharju experimental area was established was about 500 hectares. Most of this was on Laukansaari island from which Punkaharju proper juts out as a tongue of land.

The experimental area has been enlarged subsequently through purchase and exchange of farms. Areas bought in 1929 and 1930 totalled 120 hectares. Of this total, 60 hectares are in the commune of Punkaharju and the rest in that of Kerimäki.



Punkaharju at Tuunansalmi strait, near the present Holiday Village, 1837. The slopes of the ridge were denuded of forest in those days: burn-beaten lands and abandoned burn-beaten fields. Photo from lithography by P. A. Kruskopf.

The larch forest in the commune of Kitee, area 26 hectares, was bought in 1932, and the Kotila estate on Laukansaari, where Hotel Finlandia is situated, in 1935. The biggest territorial expansion, 357 hectares, dates from 1932; Enso-Gutzeit Oy exchanged areas that it owned on the islands of Mäkrä, Patasalo, and Vasattari, commune of Kerimäki, for crown estate lands. In 1942, the 39 hectare nature reserve of Hytermä in the commune of Kerimäki was donated to the experimental area by Mr and Mrs Heikki Häyrynen, and the State-owned property of Laikko (40 hectares) in the commune of Rautjärvi was incorporated into the experimental area. In 1953, the Kalkunsaari islands (4 hectares) owned by the State in the commune of Punkaharju were added to it.

The areas in the commune of Punkaharju and Kerimäki comprise islands in Lake Puruvesi; the Kitee and Rautjärvi lands are on the mainland. The location of the experimental area

is illustrated by the maps on the inner and outer back covers. The experimental station of the experimental area, near Punkaharju railway station, is at $61^{\circ} 46' 51''$ lat. N. and $29^{\circ} 18' 38''$ long. E.

Area. After some surrenders of land the experimental area at the end of 1957 totalled 1 135 hectares of which 1 010 was productive forest land 31 was poorly productive forest land, 24 waste land, 67 land outside forestry, and 3 hectares inland waterways.

Communications. Laukansaari is strategically placed for communications, on the main highway and the railway line. The roads in the actual forest area, Lehtisalo, have been improved in recent years and are traffickable by car. The larch forest of Kitee is at an old crossroad and the Laikko plot is alongside the railway and close to the Imatra—Simpele road. The Kerimäki islands are reachable by water only, except for Mäkrä island to which it is possible to drive. The shortest route by boat to Hytermä nature reserve is from Kerimäki church (main) village.

Old store houses in the nature reserve of Hytermä. The lady in the picture is one of the donators of the area, Mrs Pikku-Julia Häyrynen. Photo by O. Heikinheimo, 1942.



Accommodation at Punkaharju is available at the Finlandia Hotel owned by the Finnish Tourist Association and, in summer time, the Punkaharju holiday village which is managed by the Holiday Association (Lomaliitto) and includes e.g. the former State Hotel (Valtionhotelli). The camping areas of Mustaniemi and Kuikonniemi have been even more popular than the former in recent summers.

Climate. The monthly records of the weather observations made at the observation station of the Finnish Meteorological Institute near Punkaharju railway station in 1945—1954 were as follows:

Temperature, C°												
I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	year
—8.7	—9.8	—5.3	2.8	8.3	14.1	16.1	14.9	10.3	3.7	—1.3	—3.3	3.5
Precipitation, mm												
39	28	24	31	38	59	64	74	52	52	49	43	553

Compared with the Ruotsinkylä experimental area in the commune of Tuusula, some 170 km further south, the climate of the Punkaharju district is more continental: the mean temperature of the actual summer season, June—August, during the above period was 15.0°C, that of January—March —7.9°C, while the corresponding figures in Ruotsinkylä were 13.9 and —6.2°C.

Topography and soil. The greatest variety in the terrain of the experimental area is imparted by the esker formations. The most unusual of them is, naturally, Punkaharju. Its length from Tuunaansalmi strait to the tip of Kokonniemi peninsula is about 7 km, its maximum height above Lake Puruvesi about 30 m, and at its narrowest it is only the width of the road. Parallel ridges are Takaharju and Lammasharju; Mustaniemi and Kuikonniemi are sandy and gravelly heaths on its edges. They have funnel-shaped esker pits typical of this type of terrain, like those on the edge of Runeberg's hill. Scientists estimate that about



The seed crop have been studied at this site. The use of different methods of thinning are now compared in it. Excursion point A 8 a. Photo by R. Saarnio, 1958.

8 000 years have elapsed from the geological phase when the strata of ice covering the present area of Finland melted. At that time, only the highest parts of the esker were above water level. The esker and nearby terrain have subsequently experienced many changes due to the great variation in the water level of the Saimaa lake system. When the warm post-glacial period began the water level was some 10 m below the present height judging by the tree stumps encountered at this depth, «sunken forests». From this level it rose again some 20 m, to the shore line of the former «Greater Saimaa» which can still be seen today on the slopes of Punkaharju ridge. The water dropped to its present

level when the Outermost Salpausselkä ridge emerged at Vuoksenniska, that is when Imatra came into being, in 2000 B.C.

More like Punkaharju than anything else is the esker on the Suuri Hytermä island which belongs to the nature reserve of Hytermä. There is esker terrain also on Mäkrä island and on Pieni Patasalo, connected with flatter sand and gravelly heaths. Lands of this type are to be found also on Vasattari island.

There are many moraine soils in the experimental area in addition to these gravel and sand lands. The most uniform areas are Lehtisalo, Punkaharju, and the islands of Patasalo and Vasattari. The Laikko plot is almost exclusively fine-sand and silty soil, the larch forest at Kitee fine sand mixed with silt. The bedrock is visible only in rare places, e.g. in the middle of Lehtisalo and at Karjalankallio and Rakokivenniemi. But the rock is fairly close to the surface in numerous places. As open bogs are practically nil, there are very few areas completely unsuitable for the production of wood.

The changes in the water level in Lake Puruvesi also affected the value of the mineral soils as habitat for a valuable growing stock. At Lehtisalo, for instance, there are shore banks about 7.5, 5.8, and 1.7 m above the present mean water level. If the lower side of the bank was shallow and flat, the finest soil particles were washed away and the land that later appeared above the water was fairly barren. Former reefs of this kind are fairly extensive in some places.

Viewed as habitats of growing stock, the gravelly and sandy lands generally correspond to the *Vaccinum* type (VT), moraine and silt soils to the *Myrtillus* type (MT) and forest types superior to it. The distribution of the forest site types (according to Cajander's system of site classification) listed in the following thus reflects on the whole also the occurrence of these types of soil in the experimental area.

The communes of Punkaharju and Kerimäki contain 1 030 hectares of the experimental area of which 928 hectares are productive forest land, 20 hectares are poorly productive forest land, 18 hectares waste land, and 64 hectares cultivations, nurseries, roads, etc. Three per cent of the productive area consists of fern

groves (FT), 20 per cent of *Oxalis-Myrtillus* type (OMT), 36 per cent of *Myrtillus* type (MT), 35 per cent of *Vaccinum* type (VT), 3 per cent of swampy forest land with character of wet spruce-hardwoods peat-moor (KgK) and other peat-base habitats. The *Vaccinum* type includes habitats of slightly differing value; for instance, most of the area of Punkaharju ridge is of the so-called *Vaccinum-Rubus* type (VRT). The spruce stand in Kitee is also slightly poorer than the *Myrtillus* type (MT) on the whole. The fine-sand areas in the Laikko plot are considered to correspond to the *Myrtillus* type (MT).

The most common of the poorly productive lands are wet *sphagnum* moors which are to be found on the islands of Vasattari

European larch in the larch forest of Kitee (sample plot 2 a). In 1955, when the trees were 113 years old, the standing stock totalled 443 cu.m. hectare, growth 4.9 cu.m. hectare, dominant height 32 m, mean diameter 53 cm, and mean volume of the trees 2.7 cu.m. The sapling stand in the background has originated through natural seeding and includes crosses between European and Siberian larch. Photo by M. Kanerva, 1954.





Curly birch cultivation in which the trees have been planted in 1929. The tallest tree in the middle is a triploid curly birch. Excursion point B 4. Photo by R. Saarnio, 1957.

and Patasalo. A part of the peat lands originally belonging to this group have been rendered productive by drainage. Approx. 16 km of forest ditches had been dug by 1957.

Vegetation. *Oxytropis campestris* and *Astragalus alpinus* are characteristic plants of the Punkaharju ridge. *Myrica gale* is common in some places on the shores of Lake Puruvesi, and also the rare *Eupatorium cannabinum*. In the lush deciduous stands in Laukansaari there are the stately *Struthiopteris filicastrum* and *Impatiens noli-tangere* with its large flowers.

One of the valuable broad-leaved tree species in the experimental area is the linden (*Tilia cordata* L.). It grows in two fairly small natural stands, one on Vasattari and the other on Iso Niini-

saari. There are also groups of linden in six places on Vasattari and individual trees on Punkaharju ridge itself, e.g. near Runeberg's Hill.

Old natural Norway spruce stands are rare in the parts of the experimental area in the communes of Punkaharju and Kerimäki. This is a legacy of the cultivation by burn-beating which was pursued in these parts, in which the same area was burn-beaten at such frequent intervals that the spruce had no time to grow on the seed-bearing stage. On Vasattari, Mäkrä, and Patasalo which comprise 488 hectares there are only 8 hectares of natural Norway spruce stands, chiefly on wet peat-moors. Norway spruce stands proper are the result of seeding and planting.

Racially the best Scots pine stands are on the island of Mäkrä and on Mustanniemi headland (sample plot 24). The old Scots pine stands on the ridge are of poorer quality. Especially the stands alongside the road were pruned at the end of the 19th century and at the beginning of the 20th.

Common birch (right) and white birch (left) cultivations, of exactly the same age, excursion point B 42. The growth of these tree species is compared in the experiment. Photo by M. Kanerva, 1957.



Curly birch has grown widely in the experimental area. The first known triploid curly birch is also growing there.

The foreign tree species grown in the experimental area, especially larch, have a special interest. The larch forest at Kitee, the oldest section of which dates from 1842, is the largest of the old larch stands in Finland today and is worthy of note also because it readily regenerates naturally. As there are two larch species, Siberian (*Larix sibirica* Ledeb.) and European (*Larix decidua* Mill.), side by side in the stand, the area also contains natural cross-breeds. The best-known of the old larch stands in Lehtisalo is the Montell larch stand which was established in 1877. Larch regenerates naturally here, too, and forms many kind of cross-breeds. The extensively cultivated Siberian fir (*Abies sibirica* Ledeb.) also regenerates spontaneously in the experimental area, likewise the Stone pine (*Pinus Cembra* L.). Some of the best individual trees of the foreign species and Scots pine have been selected for forest tree breeding purposes.

Forests and their development. The present forest of Punkaharju proper originated in areas laid bare by the war of 1808/1809 or in places where burn-beating had been practised. An example of the latter is Kaarnaniemi, below the Holiday Village. As late as the end of the 1920s, there still lived at Punkaharju an old man who had cut rye at the site. The drawing on page 4 dates from this period.

The Lehtisalo areas were true burn-beating cultivation land before they were taken over by the State. The majority of them are shown on the oldest maps as burn-beating ground. The forest there were burnt-land forest in poor condition: grey-alder (*Alnus incana*) stands, small birch and pine stands, and mixed forests of these species. There were also newly felled, burn-beating or cultivated burnt fields and abandoned burnt upland areas. The islands of Mäkrä and Patasalo have also been heavily burn-beaten. There is the foundation of a well-built tar-burning pit at the north-western end of Patasalo (on Tölkää shore). However, it is not known whether only rootstocks or pien trees barked on the stump for resin gathering were used here for tar-making. The



Artificial hybridization of Sitka spruce with pollen of Norway spruce.
Photo by T. Nieminen, 1955.

growing stock of the present nature reserve of Hytermä, especially that of Suuri Hytermä, was heavily cut in the 1920s for pitprops and pulpwood.

The principal of Evo Forest Institute, A. G. Blomqvist, drew up a plan in 1877 for the improvement of Punkaharju forests, especially those of Lehtisalo. The first real management plan for the forest was approved in 1882, and the next in 1909. All these plans recommended the use of burn-beating for forest regeneration and the planting of foreign species. These instructions have been

followed. A couple of burn-beating operations have even been carried out during the time of the Forest Research Institute, the last in 1949.

The procedure applied in burn-beating cultivation was as follows: The growing stock of the area to be burnt was felled around Midsummer. It was left to dry until the following spring when the stems were pruned. The land was burned in July. After that it was ploughed by a special plough, rye was sown and covered by harrowing. The tree seeds, usually Scots pine (earlier 3—4 kg per hectare, in experiments of the Forest Research Institute roughly a half of this), were sown in the following spring among the rye shoots, later on already during the period of snow. If oats were grown on the burn-beaten land, conifer seeds were sown in the spring immediately after the oats seeds. Spruce was not sown among grain on burn-beaten land; it was sown on burn-beaten upland areas in the ploughed furrows. If planting was

An experiment with the geographical races of Norway spruce (excursion point B 45). On the right, Norway spruces from Switzerland suffering from frost and fungi. The trees were 32 years old in 1957 (forest cultivation No. 173). In 1957 its yield was 96 cu.m. hectare. On the left, 28-year-old Norway spruces from the Karelian Isthmus which have grown undamaged (forest cultivation No. 255) and yielded 175 cu.m.

Photo by M. Kanerva, 1957.



used — as always with foreign species — it was almost always done on burn-beaten upland areas cultivated earlier and on the felling sites proper.

In 1948 the predominant tree species in the productive forest land in Punkaharju and the commune of Kerimäki was Scots pine (60 per cent of the area), followed by domestic deciduous species (17 per cent) and foreign tree species (11 per cent). The mean volume for this forest area was 155 cu.m./hectare of unbarked wood, and the annual mean increment was 4.3 cu.m./hectare of barked wood. There will be changes in the post-1948 figures, especially in the mean increment values.

Demand for timber. As most of the experimental area is alongside an extensive lake system and close to the railway, the markets for timber have been relatively good. The sale of firewood earlier benefited from local consumption (hotels and Takaharju Tuberculosis Sanatorium), more recently from the motor roads built to Lehtisalo and Mäkrä. In some winters timber can be trucked across the ice from remote islands.

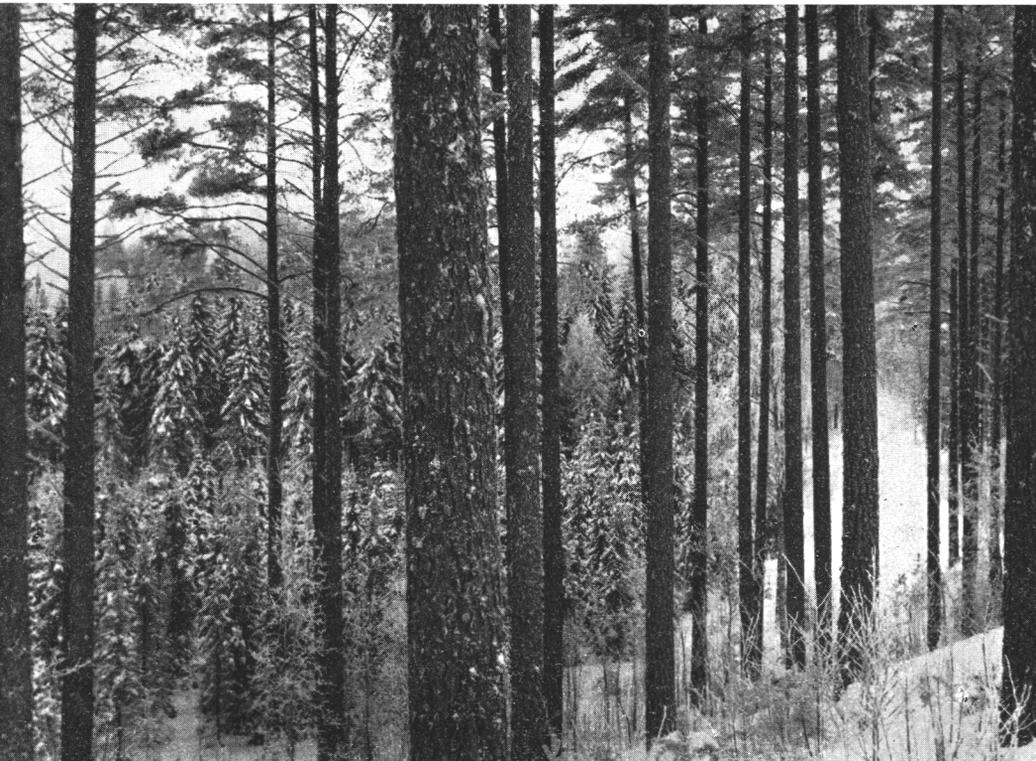
Experimental and research activities. The first experiments in the Punkaharju region were concerned with the seeding and planting of forests, especially with foreign tree species. Before the establishment of the experimental area, 76 trial plots totalling 62 hectares had been established in Lehtisalo between 1877 and 1915. By the end of 1957 their number was 504 plots and their area was 290 hectares. Before the year of damage, 1955/1956, the area of the foreign tree cultivations was 112 hectares and the number of species in them 55, in 188 trials. The Department of Silviculture of the Forest Research Institute has 41 and The Department of Forest Mensuration and Survey 12 permanent sample plots in these cultivations. They are used to study the biology and yield of foreign tree species in Finnish conditions.

The foreign species can be seen in the *arboretum* near Punkaharju *laboratory building* where in 1956 there were 47 foreign and 9 domestic tree species. Initially, a separate stand of 0.04—0.13 hectares was established for each species. A guidebook to the park is obtainable at the experimental station.

1939/40, 1940/41, and 1955/56 were exceptionally unfavourable winters for foreign tree species. The greatest damage was caused by winter 1955/56: its immediate consequences and the resultant fungal diseases caused by them will be seen in the experimental area for years to come. It was a rather unique winter: the early onset of the cold period came on the trees that were still continuing their growth exceptionally late on account of the cold early summer and warm autumn of 1955. The mean temperature in December 1955, according to observations made in Punkaharju, was in fact -17.7°C against the respective average value of -3.3°C for ten previous years.

The foreign tree species in the experimental area are also used for the collection of seeds and for tree breeding purposes. A great many natural cross-breeds also originate in the area, especially between the numerous larch species.

Old Scots pine stand close to the junction of Punkaharju railway station road and the main highway. Behind it 25-year-old Serbian spruce (excursion point A 8) and 67-year-old Siberian fir (excursion point A 7). Photo by R. Saarnio, 1958.





Old Scots pines in Kukonniemi, Punkaharju, former sample plot No. 23 of The Department of Forest Mensuration and Survey. Photo by R. Saarnio, 1958.

For comparison of the geographical races of Scots pine and Norway spruce there is one experimental series of the former and two of the latter. The Department of Silviculture has 13 and 29 sample plots, respectively, in them. The oldest experiments date from 1926 and 1927. The parallel experiments with common birch (*Betula verrucosa*) and white birch (*Betula pubescens*) and the raising of curly birch are also interesting. Especially valuable are the experimental series of the geographical races of some larch species (particularly European and Siberian) and Lodgepole pine (*Pinus contorta* Loud.).

The nursery of the experimental area comprised 12 hectares when at its largest. Various silvicultural measures such as the treatment of seeds, sowing and transplanting, fertilisation and weed control have been tried out there. Seedlings grown in the

nursery have exceeded the requirements of the area. In the year 1968, the nursery was closed and the research in nursery techniques was transferred to the new Experimental Station for Forest Cultivation at Suonenjoki, about 150 km north of Punkaharju.

The forests of the ridge itself have provided a very good opportunity for tending stands that are of exceptional scenic value. The same is true for the forests of Hytermä nature reserve, especially as it started with the poorest residual forests of the district. The nature protection area of Kokonharju (15 hectares) which is preserved in a completely natural state also offers many opportunities for the continuous study of forest-biological questions.

For forest management studies there is a separate economic unit within the experimental area of Punkaharju. It consists of the forests in Patasalo, Kerimäki. The area of this unit is 224 hectares, 210 hectares of which are productive forest land. Scots pine is the dominant tree species. In 1948, the estimated mean volume was 128 cu.m./hectare and mean increment 5.0 cu.m./hectare.

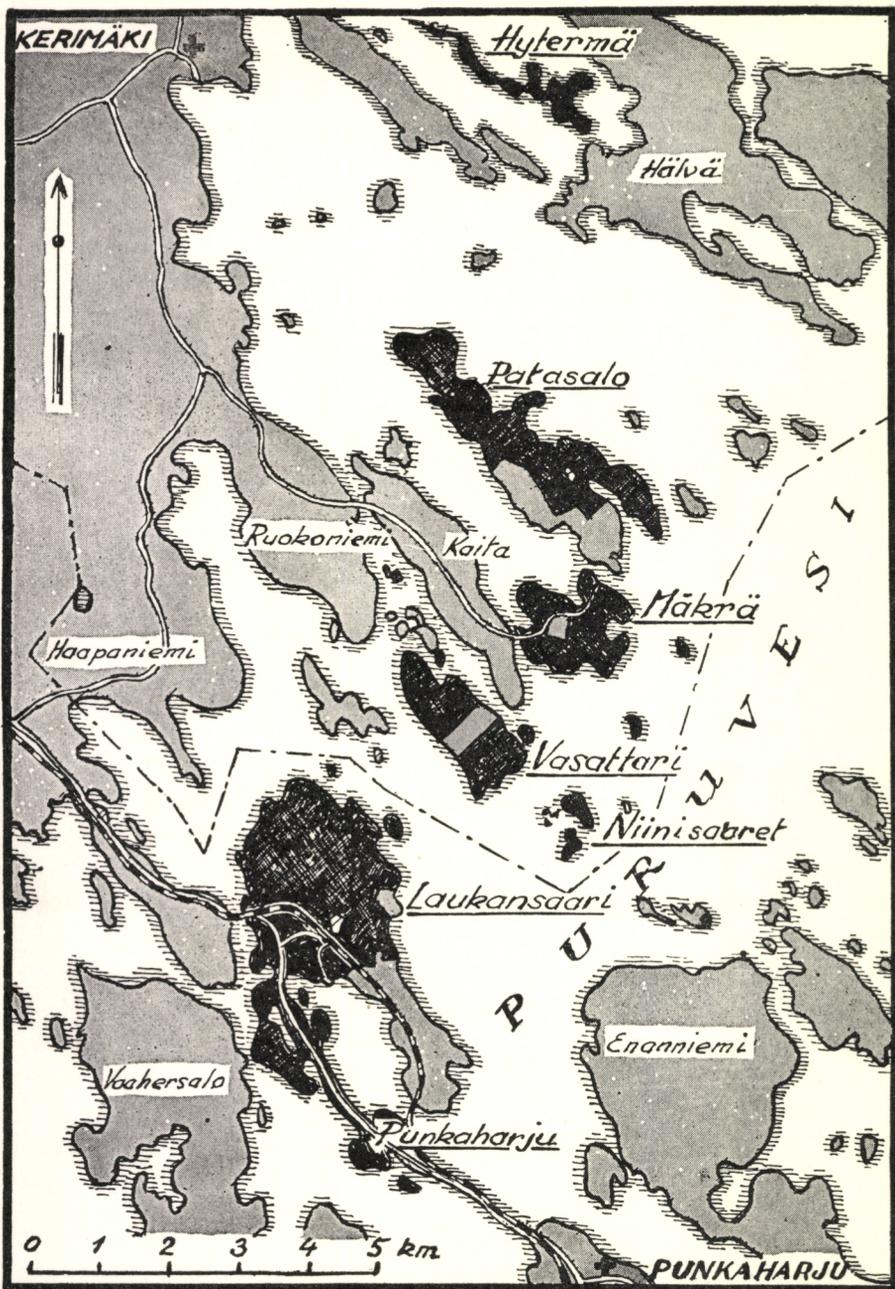
The Department of Forest Mensuration and Survey of the Forest Research Institute has 25 series with 41 sample plots in the experimental area. They are used to study the yield of the domestic and most important foreign tree species. As the first experimental areas were established in the 1920s, the results available are extremely valuable.

The cultivations of foreign tree species and races concentrated in a relatively small area have provided research material for many studies of forest damage, above all diseases caused by insects and fungi. The Department of Forest Technology has also been able to make use of the experimental area for studies on the harvesting and transport of timber.

Excursion points are listed in the appendix.

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Lands (dark) in the communes of Punkaharju and Kerimäki belonging to the experimental area of Punkaharju.

