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Solböle Research Area

**Hiking Trails  
in Solböle**

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The Finnish Forest Research Institute

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## **Welcome to Solböle!**

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The Finnish Forest Research Institute wishes all visitors welcome to the Solböle Experimental Area. Solböle offers a good chance to get familiar with forest nature and research, the special features of the forests in the southernmost part of Finland and the natural scenic beauty of coastal landscape.

This guide book introduces the visitor to the forests in the Solböle area, the exotic tree species cultivated and research carried out here. It contains information on two hiking trails, the Lövsveden trail (1.5 km) and the Storsveden trail (3.5 km). The trails start from the yard of the office building and lead through the arboretum. Most of the exotic tree species cultivated here can be seen along these trails.

Enjoy Your visit in Solböle!

*The Finnish Forest Research Institute (Metla)*

## The Finnish Forest Research Institute (Metla)

Metla is an impartial state-owned research institute whose task is to solve forest-related questions through scientific research.

Metla was established in 1917. It has research centres in Helsinki and Vantaa, and there are eight research stations in different parts of Finland. Metla's target areas are research, research forests, marketing and sales, and administrative services. The expertise of the more than 200 researchers at the institute ranges from traditional forestry to the natural, social and economic sciences. The total number of employees is ca 700; half of them work at the research centres, half at the research stations.

Metla has about 150 000 ha of research forest, which facilitate versatile long-term field tests. Nature conservation areas cover 68 000 ha and teaching forests 4 500 ha of Metla's forests. Metla has long traditions in managing nature conservation areas. Besides the Pallas-Ounastunturi, Pyhäntunturi and Koli national parks, the institute manages five strict nature reserves and several other protected areas. The nature conservation areas serve not only research and conservation but also recreation.

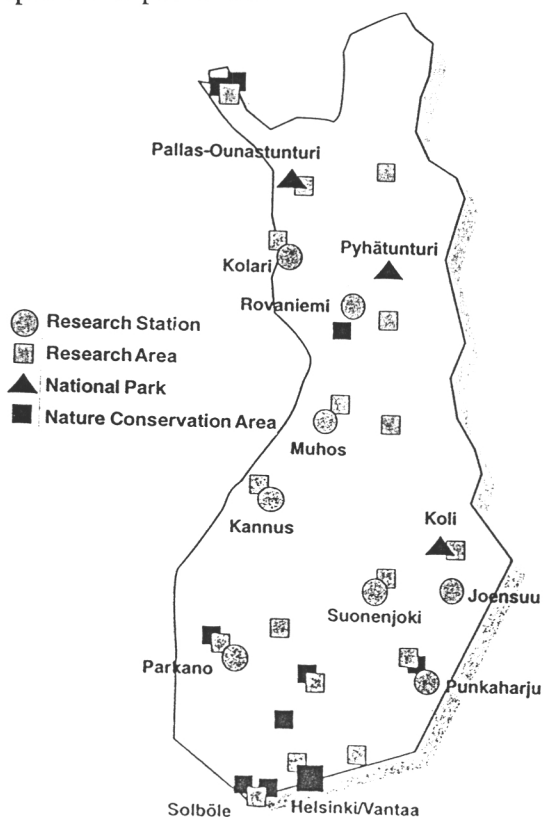
The research work is carried out as multidisciplinary projects focusing on specific questions. Each project is evaluated every three years. The research projects carried out by Metla emphasize the following topics: sustainable use and management of forests; forest health; the impact of social change on both forest economy and forestry-based economy; databases and information systems describing natural resources and the state and development of forests. Emphasis is also focused on the diversity of forest nature, timber resources, the effects of forest economy on the envi-

ronment and the co-ordination of the different uses of forest. Major research projects are being carried out on these topics.

The national forest inventory produces versatile, updated information about the changes in the state, resources and biodiversity of the Finnish forests. The inventories started in 1921; the 9th inventory is going on at the moment.

The services produced by Metla include forest statistics information service, forest damage service, laboratory and library services and, additionally, guiding and advisory services in national parks and strict nature reserves.

In addition to research work, Metla is also responsible for producing national forest statistics, calculating the norms of forest taxation, maintaining the main register for tree breeding material, and the inspection of pesticides.



## Solböle Experimental Area

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The Solböle Experimental Area was established in 1926. The area covers 1470 ha of land and 327 ha of waters in six archipelagic and coastal municipalities – Tammisaari, Särkisalo, Dragsfjärd, Paimio, Halikko and Turku. The majority of the area is in Bromarv in Tammisaari, where the office is also located.

With respect to botany, Solböle belongs to the northernmost part of the central European oak zone. The area is characterised by herb-rich forest sites with their valuable broad-leaved trees and lush vegetation. These conditions uncommon in Finland have brought about the establishment of the experimental area – they offer a good possibility for the cultivation of and trials with valuable domestic broad-leaved trees and exotic tree species. Moreover, studies on forests on rocky outcrops and mineral soil forest types have shed light on the development of coastal and archipelagic forests.

The area taken up by different experiments amounts to 220 ha at the moment. Conservation areas and different special areas add up to 100 ha; these include the

arboretum, the Vaisakko nature conservation area and also areas included in the national herb-rich forest and peatland protection programme.

The forests in the area are managed primarily for the needs of research. Research plots and growth trials with exotic tree species are managed according to special plans. Areas outside the research plots are managed as research reserves; their management aims at providing as diverse material as possible for the needs of present and future research. This material often differs from the ordinary commercial forests. Forests on rocky outcrops are preserved in a natural state, whereas landscape management is applied to coastal and herb-rich forests. Nature conservation areas are managed according to their own management plans.

The forests of the experimental area comprise a tree stock of 140 000 m<sup>3</sup>, mean volume being 128 m<sup>3</sup>/ha and annual average growth appr. 5 m<sup>3</sup>/ha. Each year appr. 3,100 m<sup>3</sup> is cut down in connection with research and other management.

## Cultivation of Exotic Tree Species in Solböle

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The Solböle Experimental Area was primarily established for the study of valuable broad-leaved trees and other domestic as well as exotic tree species. The area is characterised by trial plantations of exotic tree species, the first of which was established in the 1920's. The trials investigate how trees from climatically corresponding parts of Europe, Asia and North America perform in Finland: how well they adapt to the Finnish climate; the amount and quality of wood they produce; and to what extent they regenerate naturally in Finland. Nearly all stands with exotic tree species have died. At the moment, there are altogether 50 different exotic conifer species that grow in stands in the experimental area (12 spruces, 15 firs, 6 pines, 6 larches, 11 other conifers). Moreover, several other tree species grow as solitary trees or groups of trees in different parts of the area. Naturally regenerated plants of exotic tree species have spread to other stands as well, giving new expression to the forests.

In these experiments, which have been going on for decades, only a few exotic spe-

cies – such as Siberian larch (object L16), Contorta pine (object S36) and Douglas-fir (objects S23,S35) have proved to be competitive with domestic tree species as concerns timber production. The success of other exotic tree species has often been prevented by fungal or insect damage. For many tree species the Finnish winter has proved fateful; exceptionally cold winters and spring frosts have often damaged the trees. Firs are especially sensitive to spring frost as their growth starts early in the spring. However, many exotic tree species are cultivated as ornamental trees.

Provenance (origin) trials with spruce and pine have been carried out since the 1920's. They investigate, for instance, how Scots pine from Rovaniemi or Punkaharju perform in coastal areas or how trees from different geographical areas or altitudes perform in changed conditions.

Provenance trials and other experiments with different tree species are nowadays important in studying the effects of climatic change on Finnish forests and the range of tree species.

## Valuable Broad-Leaved Trees

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Valuable broad-leaved trees spread into Finland in the course of a long period of time: first the elm about 9 000 years ago, then lime tree and oak. About 8 000 - 5 000 years ago, birch, common alder, lime tree, elms, common hazel, ash and oak were the main tree species in southern Finland. Soon after this, the Norway spruce started to spread into Finland and the climate cooled down at the same time; this weakened the conditions for valuable broad-leaved trees and they could only hold out on the best sites of the southernmost parts of the country. Agriculture soon took most of the habitats from these tree species.

The wood of these tree species has always been highly valued. Oak and ash wood

are suitable for purposes that require toughness, hardness and rot-resistance, i.e. for parquets and boat building. Maple wood has traditionally been used as sounding boards in instruments and in fine woodwork. Valuable broad-leaved trees growing solitarily are a part of the Finnish cultural heritage; they are regarded as real landmarks and monuments. Moreover, they offer habitats for several moss, lichen and fungus as well as insect and bird species. Nowadays the cultivation of these trees is almost completely restricted to parks and gardens. Due to the possible warming of climate these species might, however, become common in Finland again.

## The Surroundings of the Office Building

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The main building of the Solböle Experimental Area was built in 1937. The office is located in this building besides a flat and the guest rooms of the experimental area. The other buildings remind of the time when the officer of the experimental area used to cultivate land and raise cattle as well. At the time, the easiest way to get to Solböle

was by water, so agriculture was an important prerequisite for the officer.

Several tree and shrub species have been planted in the surroundings either in groups or as individuals. The map shows the most important trees and shrubs that grow in the yard.

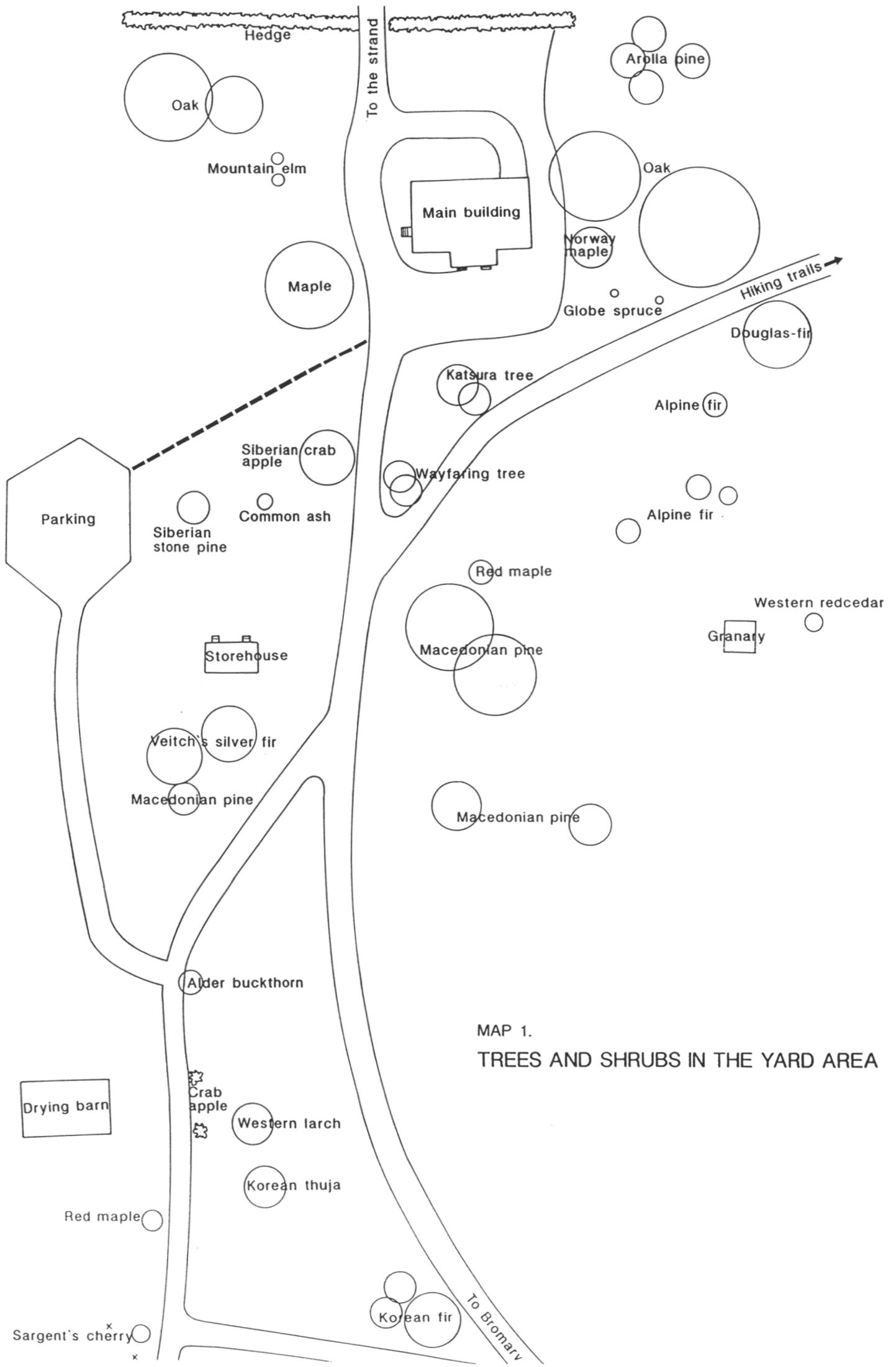
### Conifers

1. Siberian stone pine (*Pinus cembra*)
2. Colorado white fir (*Abies concolor*)
3. Douglas-fir (*Pseudotsuga menziesii*)
4. Alpine fir (*Abies lasiocarpa*)
5. Macedonian pine (*Pinus peuce*)
6. Veitch's silver fir (*Abies veitchii*)
7. Western redcedar (*Thuja plicata*)
8. Colorado spruce (*Picea pungens*)
9. Western larch (*Larix occidentalis*)
10. Korean thuja (*Thuja koraiensis*)
11. Korean fir (*Abies koreana*)
12. Globe spruce (*Picea abies* 'Globosa')

### Broad-leaved trees

13. English oak (*Quercus robur*)
14. Norway maple (*Acer platanoides*)
15. Katsura tree (*Cercidiphyllum japonicum*)
16. Wayfaring tree (*Viburnum lantana*)
17. Siberian crab apple (*Malus baccata*)
18. Common ash (*Fraxinus excelsior*)
19. Red maple (*Acer rubrum*)
20. Alder buckthorn (*Rhamnus frangula*)
21. Crab apple (*Malus toringo*)
22. Sargent's cherry (*Prunus sargentii*)





MAP 1.  
TREES AND SHRUBS IN THE YARD AREA

## Hiking trails

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The two hiking trails, which start from the office yard, give a good overview of the experimental area and the trees that are grown there. They both lead across the arboretum. The terrain is old slash-and-burn area where the last burning was done at the end of the 19th century. Stands of both domestic and exotic tree species have later been established in the area.

**The Lövsveden trail** follows at first the road running eastwards along the shore. It turns off the road after less than a kilometre, joins the road from Bromarv and follows this road back to the office yard. The trail is about 1.5 km long and it takes about one and a half hours.

**The Storsveden trail** shares objects 1–19 with the Lövsveden trail. When the Lövsveden trail turns off the road running along the shore, the Storsveden trail still goes on along the same road. Its length is 3.5 km.

Most objects have a sign showing the tree species and the year the stand has been established.

## The Lövsveden Trail

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After the office there is a cabin made of round timber, Koivula, on the left-hand side of the road. It is primarily used for the accommodation of field workers. Once the cabin is passed, the first forest objects can be seen on both sides of the road.

### L1. English oak

■ On the left-hand side of the road there grows a rather big **English oak** tree (*Quercus robur*). The tree appears to be old but it has been planted in the mid-30's.

In Finland, English oak grows naturally in the province of Ahvenanmaa, in south-western parts and certain coastal areas. Cultivated English oak trees can also succeed farther north; solitary oak trees grow in Oulu and Tornio regions. Usually, English oak grows here as solitary trees or in small stands, larger stands can only be found in southwestern Finland.

With respect to growth site, English oak is the least demanding species of the valuable broad-leaved trees that grow in Finland. It can reach the height of nearly 50 metres. In Finland,

however, it seldom exceeds 20 metres but can develop an especially thick trunk. It is a very long-lived species; it is said to be able to reach the age of 2 000 years. In central Europe, 400-600 years old English oak individuals have been found.

English oak flowers in the spring at the time of bud-burst. Its acorns ripen in the autumn and fall during October. The ground cover in an oak stand is rather rich during the spring. In summer, many light-demanding species thrive there as oak leaves do not spread themselves horizontally but remain in bunches. Most oak trees in Solböle have been regenerated naturally.

After the English oaks on the left-hand side of the road there can be seen a couple of Douglas-firs (S23) and a Macedonian pine (S32). Some mountain elms (*Ulmus glabra*) and European white elms (*Ulmus laevis*) have also been planted in the area in 1970.

## L2. Norway spruce; standard spruce stand

■ A ca 55-year-old Norway spruce (*Picea abies*) stand grows on the right-hand side of the road. It has been chosen as a **standard Norway spruce stand** in 1992. A country-wide network of standard tree stands was established in Finland ca 30 years ago. They represent the average genetic level of their region. A large number of seed collection trees (ca 500) are marked within each stand. In good years, cones are collected from at least 30 trees and the seeds are extracted. The seeds are mixed to get a representative sample from the stand. Plants grown from these seeds are used as standard (reference) lots in cultivation trials used in forest tree breeding, for example provenance trials. As seed from the same stand is used for many decades, the reference level remains stable.

This standard tree stand No 17 replaces an old stand located 1 km away, which was chosen in 1960. There is still enough seed from the old stand for the next ten years. Standard tree stands are managed with ordinary thinnings. Seed collection trees are not felled before the stand is given up.

Our native spruce has spread nearly all over the north European coniferous forest zone, over large areas in western and north-western Russia, mountain areas in central Europe, the Alps, most parts in the mountains of Balkan and the Siberian coniferous forest zone.

Spruce often grows in mixed stands with pine, larch, birch or aspen. These four species show up as pioneer species especially

in the succession after a storm, forest fire etc. Under the nurse crop of these trees, spruce gradually gains ground; in the final stage of the succession the forest often comes close a pure spruce stand. Object S28 gives a good picture of the development in a natural forest stand.

In southern Finland, spruce flowers at the turn of May and June. Seeds ripen during the same year and fall either in the autumn or late in the following winter. The interval of large seed crops is appr. ten years.

Spruce is a rather long-lived species; it lives about 250-300 years. It tolerates shade better than pine but does not belong to true shade species. It needs a fresh soil rich in nutrients. It is the tallest of European tree species, over 50 metres on best sites. The tallest Norway spruce found in Finland was 42 metres. Older spruces are especially susceptible to rot fungi, which can penetrate the trunk if the roots or trunk is in some way damaged.

About 37 % of the volume of Finland's tree stock is spruce. It is used both for sawn goods and as raw material for paper.

### L3. Northern Japanese hemlock and Eastern/Canadian hemlock

■ On the left-hand side of the road there are bushlike trees with dark green leaves, **Northern Japanese hemlocks** (*Tsuga diversifolia*). It is a mountain species native of Japan; it forms pure stands in the sacred Fuji mountain. There it sometimes reaches the height of 20 metres and above; already in central Europe, however, it resembles a bush. It has a weak frost tolerance and has not performed very well in our country; these bushes are over 60 years old.

**Eastern hemlock** (also called Canadian hemlock) (*Tsuga canadensis*) is native of the eastern parts of North America, where it occupies large areas. It grows usually in mixed stands whereas pure Eastern hemlock stands are more rare.

In its natural habitats Eastern hemlock reaches the height of 18-21 metres and the diameter of 60-90 cm. Young trees are graceful in form; on open growth sites they taper beautifully. The top of the crown droops attractively. These trees had reached the height of 16 m at the age of 60.

Eastern hemlock produces lots of cones (of ca 1.5–2 cm). It tolerates shade and is rather long-lived; in its native habitats it often forms the last stage in the cycle of tree species, as Norway spruce does in Finland.

The Eastern hemlock bark rich in tannin was previously used as a raw material for the tannin industry. Due to its weak weather-

resistance, hemlock wood is used as pulp wood and in interior constructions; it is not very durable, however. As an ornamental it succeeds only in the south-western parts of Finland – only just.

#### L4. Japanese yew

■ Opposite to the hemlocks on the right-hand side of the road there grows **Japanese yew** (*Taxus cuspidata*). In central Europe it is popular as an ornamental tree because it has a better frost tolerance than the European yew (*Taxus baccata*). The stand has suffered from frost; in Finland the species performs satisfactorily below the Imatra–Jyväskylä–Vaasa line and up to Kemi along the western coast.

#### L5. Sawara cypress, Hiba and Korean thuja

■ On the left-hand side of the road, right after the hemlocks, grows a **Sawara cypress** (*Chamaecyparis pisifera*), native of central Japan. In its homeland the species is of great commercial significance. The wood has a pleasant fragrance. A species belonging to the same family has been used in building temples and pagodas in Japan.

Two poorly growing **Hiba** (*Thujopsis dolabrata*) trees grow next to the Sawara cypress. The scale-like leaves in the fan-formed branches give a peculiar expression to the tree. Hiba is a decorative species of Japanese mountain forests with lush vegetation. It does not tolerate frost very well – these 60-year-old trees have not grown above the snow level.

Rare **Korean thuja** (*Thuja koraiensis*) grows on the left. It is easily distinguished from other thuja species by the shining white underside of the branches.

#### L6. Curly-birch

■ **Curly-birch** (*Betula pendula* var. *carelica*) has been planted on the meadow sloping towards the shore (after the Korean thuja).

Curly-birch is a special form of European white birch (also called silver birch). In downy birch or other species this form occurs much more seldom. Curl-formation is considered to be a hereditary disease in which the development of the annual rings is disturbed and, as a result, the wood becomes harder and browner than normal, having decorative patterns. The appearance also differs from normal; the trunk often has protuberances,

stripes, rings or necks. Curly-birch grows slowly and is normally forked and bush-like. It is well suited to parks and gardens.

There are not many natural habitats of curly-birch. These are located in southern Finland, Karelia, southern Sweden, south-eastern Norway, St Petersburg region, Baltic countries and Belorussia. In southern Finland the natural habitats are primarily restricted to old slash and burn cultivation areas.

Despite its slow growth and peculiar appearance, curly-birch produces valuable raw material for the carpentry industry. The price of unseasoned, unbarked curly-birch wood can rise to 10 000 FIM/m<sup>3</sup>. It is the only wood sold by the kilo in Finland. Curly-birch wood is used for art and craft, and thin veneers in furniture, for instance.

This stand was planted in 1975. Curly-birch stands grown for commercial purposes reach the age of final felling at about 50. When grown in parks and gardens or for research purposes it can be grown for a longer time.

There is an old folktale that describes how curly-birch came into being: The devil asked a peasant if he could take some timber from the peasant's forest. The peasant allowed the devil to do so on one condition: the tree should neither be straight nor crooked. The devil spent the whole day roaming hills and valleys – in vain! At dusk he was so filled with anger that he grabbed a birch trunk and squeezed it with his fingernails so that the outside turned knobby and the inside curlicued – neither straight nor crooked! The devil got his timber.

## L7 Common hazel

■ There is a lush naturally regenerated herb-rich forest sites dominated by **common hazel** (*Corylus avellana*) on the left after the curly-birch. As a heat-loving species that thrives in calcareous soil, hazel is common only in the province of Ahvenanmaa and southern Finland, occasionally in herb-rich forests in the province of Häme.

Common hazel spread into Finland at an early stage soon after the ice age. Nuts and pollen found in peat layers show that it used to grow up to the central Ostrobothnia. Once the climate cooled down it started to decline in inland habitats. Since nuts with germination capacity are produced in few summers only, common hazel would be even more rare in inland areas if it did not reproduce strongly from root shoots. Herb-rich forests with hazel require intensive management; otherwise spruce becomes dominant and the valuable herb-rich vegetation is destroyed.

Common hazel flowers early in the spring: flowers appear in April before budburst. In the leafless bushes, the long male catkins are visible from far away. Tasty and nutritious hazel nuts ripen in September. Previously they were picked for human nourishment, nowadays birds and squirrels take care of the harvesting.

This area is included in the national herb-rich forest protection programme.

## L8. European silver fir

■ Young **European silver fir** stand (*Abies alba*) grows opposite to the common hazel. The trees are of Romanian origin. The 5-year-old saplings were planted on former agricultural land in 1967.

European silver fir is a species of temperate and maritime climate zone. It grows naturally in the mountains of central and southern Europe. Its trunk is straight, branchless up to 20 metres, and in favourable conditions it can reach the height of 50 metres. It tolerates shade, grows rather slowly when young but the growth improves at a later age and stays at a good level up to old age.

European silver fir has been cultivated a lot outside its native areas. It is used for sawn goods and paper, even though it is not considered to be as good for these purposes as Norway spruce. It has also been a popular ornamental tree. In Finland it has not performed well, due to harsh winters and spring frosts. This stand, too, has repeatedly suffered from spring frosts.

Altogether **15 different fir** (*Abies*) **species** grow in the Solböle Experimental Area, so it is perhaps necessary to give some general information about the species. Firs grow in most parts of the cool zone and in the mountains of temperate and subtropical zones. Firs are species of cool and humid climate but they do not usually grow near the boreal timber line. About 35-40 fir species are known. None of these grow naturally in the Nordic countries; probably they have not had enough time after the latest ice age to spread back onto their old growth sites and other, more competitive and adaptive species have occupied the areas instead.

Flat fir needles remain in the tree for 3–8 years. When they come loose, they leave a round scar but no knob on the shoot, so the needleless shoot is smooth. The needles have a strong fragrance when rubbed.

The bark is rather thin even in old firs; young and middle-aged trees have a smooth and old trees often a fissured bark. There are often rather big resin blisters in the bark. Thin branches, which do not self-prune easily are arranged in regular branch whorls. The crown is usually long and tapered.

Female fir flowers are grouped at the top of the crown, most male flowers underneath them. An erect position is typical for the flowering female flower as well as the cone, which makes firs easy to recognize. Seeds mature during one season. When the seeds are extracted, the scales come loose as well and the central spike of the cone remains in the tree, sometimes for several years.

The Siberian fir is the only fir species which might have commercial significance in Finland (L14). It produces good-quality wood but the wood yield cannot compete with that of Norway spruce or Siberian larch.

## L9. Common yew (English yew)

■ After the European silver firs on the right-hand side there grow dark green **Common yew** shrubs (*Taxus baccata*). The only native habitats of this Finland's most uncommon conifer are in the herb-rich forest sites in the province of Ahvenanmaa, where seafarers brought it during the Viking age. Occasionally it even forms small stands there. It is protected under the Nature Conservation Act.

Common yew is a species of the maritime western Europe and central European mountain areas with plenty of rain. It is relatively uncommon except in Britain. It flowers early in the spring, and produces beautiful red "berries" in the autumn. The seed is surrounded by a red, fleshy seed cap; except for the seed cap, the whole plant is deadly poisonous. – Many other ornamental trees are poisonous as well; trees and bushes should be selected carefully, especially if they are planted near children's playgrounds.

Common yew wood is one of the oldest commercial timbers in Europe; it was used for bow-making in the Middle Ages already. The fine-grained, hard wood, which takes a high polish, has also been used for elaborate woodcraft. Bow-making and taking branches for decorative purposes have led to the exhaustion of the species in many places. Nowadays it is used as an ornamental.



## L10. Carolina hemlock

■ The next species to the right is **Carolina hemlock** (*Tsuga caroliniana*). Compared to Eastern hemlock (L3) it has bigger cones and its needles are not toothed. The species is native of a small area in the south-eastern United States. These trees, which come from North Carolina, have suffered from frost and grow poorly.

## L11. Yeddo spruce

■ The **Yeddo spruce** (*Picea jezoensis*) grows next on the right-hand side of the road. This species that reminds our common Norway spruce is the most important species of the coastal areas of eastern Siberia and Japan, especially Hokkaido. It grows both in pure and in mixed stands. On the continent its main habitats are in the easternmost areas of Russia, opposite to the island of Sakhalin.

Yeddo spruce can grow up to 50-60 metres. It is mainly used for sawn goods, in Hokkaido also for paper. In Finland it performs satisfactorily despite slow growth. Through crosses it might, however, be possible to create varieties which would adapt better to our climate. The large eastern Asian distribution area of the species would indicate a great genetic variation. These Yeddo spruces were 16 metres tall at the age of 60.

## L12 Cork fir

■ The next species on the right is **cork fir** (*Abies lasiocarpa* var. *arizonica*), which is a subspecies of Alpine fir (*Abies lasiocarpa*, S22). It grows in the southern parts of the Rocky Mountains and on the mountains bordered by them; it is a timber line species. The greyish colour of the needles is caused by a wax-like secretion the plant produces in order to defend itself from excessive evaporation in the mountain air. Cork fir can be distinguished by its creamy white, soft, thick, elastic bark.

Cork fir is not very significant in commercial timber production. Still, its ability to form protective forests has made it important in its native habitats.

## L13 Sakhalin fir

■ The beautifully green tree group on the right-hand side with dense branches is **Sakhalin fir** (*Abies sachalinensis*). This species with long needles is native of eastern Asia; the island of

Sakhalin, Kuriles and Hokkaido. In its native habitats it is a magnificent tree; trees with more than 40 metres' height and over a metre's diameter have been found on Hokkaido. There it is commercially significant as raw material for the paper industry and as construction timber.

In Solböle, Sakhalin fir has performed well. A fast thickening rate is typical of firs; the trees in this stand have also reached the dimensions of large-sized saw timber rather quickly. In 1990, at the age of 60, the height of the trees was 23 m and diameter 40 cm. Farther north in Finland, the species often suffers from frost and fungal diseases.

#### L14.Siberian fir

■ The next species a little further to the right is **Siberian fir** (*Abies sibirica*). It is a typical species of Russian-Siberian coniferous forest (taiga). It is a clearly continental species with a range extending from Far East near the coast of the Pacific ocean to the Northern Dvina. Siberian fir is one of the oldest exotic tree species cultivated in Finland.

Siberian fir has a beautifully tapering crown and a slim trunk. It grows up to 30–40 metres and can reach a diameter of 80–120 cm. In mountain timber line areas and in the northern parts of its range it grows as a shrub pressed against the ground. Solitarily growing Siberian fir individuals often press their lowest branches against the ground and reproduce vegetatively. The trunk of Siberian fir is smooth reminding that of rowan or alder. It has resin blisters containing colourless resin, the blisters show as swellings in the trunk. Like many other fir species, the Siberian fir is rather short-lived; it can reach the age of 150–200 years at the most. It often regenerates naturally; plantlets can be seen here and there near seed producing trees even in Finland.

Siberian fir is used as construction and saw timber and for paper production. In Russia, fir oil is distilled from its needles to produce synthetic camphore. The colour and cosmetic industries use fir oil as well.

Excluding coastal areas, the Siberian fir is more or less the only fir species which manages to grow up without any severe damage in Finland. It is susceptible to fungal diseases and spring frosts. As a forest tree, it cannot compete with Norway spruce even on best growth sites, but performs well as a solitary or park tree. It has been popular as an ornamental tree up to northern Finland. The trees in this stand were ca 21 metres tall at the age of 60.

### L15. Hybrid firs and natural regeneration: Caucasian fir

■ Some of the rather young firs that grow along the road are European silver firs planted after the especially cold winters in the 1960's, whereas some of the trees are the result of natural regeneration. The naturally regenerated plants may be hybrids, i.e., crosses between two species. Firs cross easily, especially when they grow as close to each other as they do here in the arboretum. It is difficult to define the species exactly.

Among the young firs there grow a couple of bigger trees which are not in a very good condition. They are **Caucasian fir** trees (*Abies nordmanniana*), which in the 1960's still formed a dense stand. Caucasian fir is one of the few conifers named after a Finnish scientist. The species was discovered in 1837 by A. von Nordmann in Caucasia when he held a professorship in botany in Odessa.

### L16. Siberian larch

■ The **Siberian larch** (*Larix sibirica*) stand on the left was planted in 1932 with seedlings grown from collection seed from the Raivola stand in Russia. The species grows naturally in north-eastern Russia, especially in the western and north-western parts of Siberia and the Ural Mountains. The western border of its distribution area goes on the eastern shore of Lake Äänisjärvi.

Outside its natural range, Siberian larch has primarily been cultivated in the former Soviet Union and in Finland. The most famous stand is probably the Raivola stand on the Karelian Isthmus, established to produce timber for the needs of the Russian navy. As far as is known, Czar Peter the Great himself was the initiator. In Finland, relatively close to its natural distribution area, Siberian larch has performed well.

Siberian larch demands plenty of light and a soil relatively rich in nutrients. It grows quickly and can reach the height of 45 m and the diameter of 90 cm. In trials established at Punkaharju, Siberian larch exceeded the wood yield of Scots pine with 60 % by the age of 30. However, its wood yield and growth rate do not reach those of the European larch. This stand has grown up to 27 m in 60 years; the mean diameter is 42 cm.

Siberian larch wood is extremely heavy; in Russia, for example, it is often bundled together with other species when floated to prevent the logs from sinking. Like the European larch, it has a high rot resistance and is thus suitable for constructions exposed to moisture. It cracks easily when dried and worked, which

is typical for larch wood; it is recommendable to drill holes for spikes and screws.

### L17. Sitka spruce

■ A **Sitka spruce** (*Picea sitchensis*) stand grows next to the Siberian larch. It has been named after the island of Sitka which lies in the Pacific Ocean close to the coast of Alaska. The Sitka spruce is clearly a species of a maritime climate with a long, cool and damp growth season. Its natural range covers a 2 000 km long, sometimes only 80 km wide coastal strip of land from Alaska to California.

Sitka spruce needles are stiff, long and extremely sharp. Sitka spruce is a rather long-lived species and reaches its biological maturity at the age of 500. It is the tallest of all spruce species; the biggest measured tree was 91 m tall and 4.6 m in diameter. The mean height in this stand was 22 m at the age of 57.

Sitka spruce is one of the most significant commercial timbers in North America; it is used as raw material for the sawmill and paper industries, for example. It has been successfully cultivated in the British Isles, the mountains of Germany, Denmark and southern Sweden ever since the early 19th century. The best results in Finland have been obtained here in Solböle; the climate is not maritime enough elsewhere.

### L18. European silver fir

■ On the right-hand side of the road there can be seen a **European fir** (*Abies alba*, cf L8) stand, which has many open spaces. The saplings planted in 1930 all froze in the winter of 1939/40 down to the snow level and the winter 1965/66 destroyed 80 % of the trees. This stand clearly shows the good natural regeneration ability of firs; there are lots of new seedlings within the stand, some of which may be hybrids (cf. L15).

A Siberian larch stand grows opposite to the European silver firs. It is of the same age as L16 but of different provenance: the trees in this stand come from Novosibirsk in Russia. The two stands make it possible to compare the growth and development of larches with different origins. A Sitka spruce stand can be seen after the larch stand; it is of the same age as L17 and of Alaskan origin as well.

## L19 Veitch's silver fir

■ After the cross-roads there grows a **Veitch's silver fir** (*Abies veitchii*). It is native of the mountains in central Japan. Due to its almost inaccessible growth sites it has not gained commercial significance. It is known for its good ability to regenerate naturally also outside its original distribution area. This stand, too, has plenty of new seedlings.

Veitch's silver fir is an excellent ornamental tree; solitary trees have a regular shape. Its needles are beautifully dark green on top and chalk-white – whiter than any other fir species' – beneath., which gives the tree an especially beautiful appearance. Its twigs are used in wreaths, for example. In Finland, the Veitch's silver fir has performed unevenly, best on the southern and south-eastern coast.

At the crossroads, the Lövsveden trail turns right towards the main road to Solböle. The Storsveden trail continues along the road following the shore. Its description continues on page 24.

## L20. Serbian spruce

■ The European silver fir stand on the right has already been introduced (L18).

The tree species with a pointed crown on the left is **Serbian spruce** (*Picea omorika*). Before the Ice Age, this beautiful spruce species used to grow in most parts of central Europe and in parts of Asia and North America. The amber found on the shores of the Baltic Sea is fossilized resin of either Serbian spruce or its relatives. The Ice Age pushed the Serbian spruce towards south and finally the species clung to a narrow (1–1.5 km wide) stretch of land in the mountains of Serbia. It was discovered as late as 1877. Only about 30 unbroken stands of Serbian spruce are left, which totals less than 100 hectares. The natural habitats are almost without exception protected; they can only be used for seed collection.

Serbian spruce is short and has slender branches. The spire-shaped crown remains narrow even in thin stands. The branches usually curve upwards at the ends, which shows the beautiful silver-white colour of the underside. The tree is the symbol of slenderness and toughness in Serbian folklore.

Serbian spruce grows slowly and cannot compete with other tree species. It has no commercial significance, but is one of the most popular ornamental trees in central and northern Europe. It adapts quickly to new climatic conditions and tolerates urban

pollution better than most other conifers. Because of its regular shape it is popular as Christmas tree; during the last couple of years it has appeared on the Finnish Christmas tree market as well.

On the left, Sitka spruce (L17) and Balsam fir (S24) grow after the Serbian fir. Opposite to them grows a Manchurian fir stand.

### L21. Manchurian fir

■ **Manchurian fir** (*Abies holophylla*) on the right-hand side of the road, after the young European silver fir trees, is native of Korea, eastern Manchuria and the Amur area. In its native habitats it grows in mixed stands with local maple, lime, ash and elm species. Attempts have been made to grow it in southern Finland; it has performed reasonably well even though it has suffered from frosts.

### L22. Colorado white fir

■ On both sides of the road there grows a North American fir species, **Colorado white fir** (*Abies concolor*). The scientific name of the species refers to the needles, which have the same colour on both sides. The natural habitats of the species are located in the Californian mountains and the southern parts of the Rocky Mountains. Depending on the growth site, it reaches the height of 25–40 metres. It is short-lived; by the age of 125 years it is usually decayed. In the United States it is considered commercially insignificant or even harmful as it hinders the regeneration of more valuable species in cutting areas.

The species has been cultivated with success in central Europe. It has been popular as an ornamental tree for its densely arranged, horizontal branch whorls and long, crescent-shaped needles of greyish green, which make it look very decorative. It has proved to be hardy but slow in growth. It tolerates spring frost rather well as the bud-burst takes place late in the spring, but suffers from cold winters.

In Finland, the species has been grown as an ornamental up to the Oulu region. Cultivation in stands produces rather shabby-looking trees. An elegant individual grows in the office yard next to the hedge along the road leading to the shore.

### L23. Colorado spruce

■ **Colorado spruce** (*Picea pungens*) grows on the right after the Colorado white fir. This species, which is a fairly popular ornamental in Finland, comes from the North American Rocky Mountains where it grows at altitudes of 2 000–3 000 metres. Usually it does not form pure stands but grows solitarily or in small groups among other species.

The scientific name refers to the stiff, extremely sharp needles. The needles have a disagreeable smell when rubbed. The branches are horizontal and whorls arranged at long intervals, which makes decorative layers in the crown. The silver grey colour is typical of mountain species.

Colorado spruce reaches heights of 24–30 metres. It tolerates dry air and also storms because of its rather deep-going roots. It is a long-lived species, reaching ages of 400–600 years. It has no commercial significance but is cultivated as an ornamental tree throughout the boreal and temperate zones. In Finland, the crown of Colorado spruce usually turns shabby in middle age already. In this stand, the trees have reached the height of 16 metres at the age of 60.

### L24. Korean fir and Red fir

■ **Korean fir** (*Abies koreana*) grows on the left opposite to L23. It is native of the highest altitudes of mountains on the Korean continent. In Finland it suffers from frosts but has grown reasonably well in Solböle.

**Red fir** (*Abies amabilis*) grows next to the Korean fir. Its natural habitats are in the western parts of the United States, Canada and Alaska, where it thrives on western mountain-sides in a maritime climate. It is a conical, stately tree reaching heights of 60 m. In solitarily growing trees the lowest branches reach the ground. The needles turn purple with age.

Even though red fir can be used as construction timber, in mines and in the paper industry, it has so far been commercially insignificant. It has been successfully cultivated in western Europe, southern Scotland and Germany in parks and gardens. In Finland, attempts to grow it have been disappointing. All except one tree in this stand have died.

## L25. Norway spruce stand damaged by root-rot fungus

■ A Norway spruce stand grows on both sides of the road. This stand is extensively infected by a root-rot fungus (*Heterobasidion annosum*): the butts are clearly swollen. The same fungus causes root rot in pine.

The fungus enters trunks through root or trunk damage and rots them from inside. It can also colonize the surfaces of freshly cut stumps by means of airborne spores, and by root contact then invade other trees. The rot extends upwards along the trunk one metre a year at worst. The growth and vitality of infected trees deteriorate. Ill forests are also more vulnerable to winds and diseases. Moreover, rotten butts cannot be used industrially. *H. annosum* is particularly common in old, over-aged spruce stands. It has been estimated that as much as 10 % of southern Finnish spruce is infected by *H. annosum*, which causes a loss of millions of marks every year.

*H. annosum* can be controlled by avoiding cuttings in summer and by being careful so as not to damage trees during the cutting and harvesting work. In extensively infected forests the tree species should be changed as root contacts may spread the disease into new seedlings. Controlled burning has been shown to restrict the spread of the fungus; newly cut stumps can also be treated with fungicides.

## L26. Common ash

■ **Common ash** (*Fraxinus excelsior*) is the most uncommon of our valuable broad-leaved trees. With respect to growth sites, it is the most demanding of our tree species. It grows in lush, preferably chalky herb-rich forests, therefore it occurs in greater numbers only in the province of Ahvenanmaa, the coastal and archipelagic areas near Turku, in Lohja region and the southern coast of Finland. Its range extends farther north than that of English oak but it occurs rather uncommonly. The species has roots that go deep in the ground; it pumps minerals from the soil and thus improves it as the minerals are in time released from decaying ash leaves and used by other plants.

Common ash flowers early in the spring before budburst. It is the last of our deciduous trees to come into leaf, and the first to drop its leaves in the autumn. In the summer it has a distinctively light green foliage. A distinctive feature of a naked ash is the broad buds of a dull black colour. Common ash suffers easily from spring frosts and can be damaged by winter colds, too.



This ash stand was established on former agricultural land in 1935 using 6-year old seedlings. The soil is not rich enough in nutrients; the trees are small and look poorly developed even though they are over 60 years old. On good growth sites common ash grows astonishingly quickly; it reaches the measurements of valuable timber at the age of 60–70 at best. It develops a straight and branchless trunk especially within stands; in open places the trees are often forked. It often regenerates naturally, especially if the soil contains enough nutrients.

The wood of common ash is hard and heavy. It is used in parquet floors, hockey sticks, tennis rackets and furniture.

### **L27. Feeding field for game animals**

■ Opposite to common ash on the right-hand side of the road there is a feeding field for game animals. Fodder and food plants (rye, oats, turnip and cabbage etc.) are grown on the field as autumn and winter nourishment for wild reindeer, moose and hare. This is done to keep the animals away from young birch and pine stands, which they would otherwise use as a source of nourishment. Small feeding areas in the middle of forest areas have turned out to be particularly effective in this respect. At the same time, the feeding areas serve game stock management.

### **L28. Engelmann spruce**

■ The last species on the left before the main road to Solböle is **Engelmann spruce** (*Picea engelmannii*). This species, which is very similar to our common Norway spruce, is a characteristic species of the North American Rocky Mountains with a great commercial significance. It can be distinguished from Norway spruce by smaller cones and a curious, disagreeable smell (reminds blackcurrant) its needles give off when they are rubbed.

In its natural habitats Engelmann spruce often lives up to 400 years, on favourable soils it reaches the height of 35 m and the diameter of 80 cm. It is used in the sawmill and paper industry. It has been grown as an ornamental tree outside its natural range, but it is not very recommendable for that purpose as its crown starts to look shabby at an early age already. In Finland this species has not performed very well even though the seed has been collected from the northernmost parts of its range. The bad performance is probably due to a lack of light. This stand has reached the height of 18 metres at the age of 53 years.

## L29. Provenance trial with pine

■ It is easy to follow the main road back to the office yard. On the slope on the right there is a **provenance trial with pine**. It was established in 1969. Provenance trials study the adaptability and performance of different races and provenances from different growth areas and conditions. Provenance trials have been established by Metla also in Ruotsinkylä (Tuusula), Punkaharju, Rovaniemi, Kivalo and Puolanka. These trials are significant with respect to study on the effects of a possible climatic change on Finnish forests and plant species.

Just before the office there are three Korean firs on the left. One of them is rather peculiar: its needles curve funnily upwards. The trees and shrubs in the office yard have been introduced on page 6.

## The Storsveden Trail

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The objects S1–S19 along this route are the same as those of the Lövsveden trail. When the Lövsveden trail turns right at L19, the Storsveden trail still follows the road along the shore.

## S20. Sitka spruce and Sakhalin spruce

■ At the crossroads, on the left-hand side, there grows **Sitka spruce** (*Picea sitchensis* cf. L17) and after it **Sakhalin spruce** (*Picea glehnii*). Sakhalin spruce is native of southern Hokkaido, southern Sakhalin and the Kurile islands. There it reaches the height of 20–40 metres and even has commercial value. In this cultivation, saplings died in the 1930's from drought; they have been replaced by Colorado spruce (cf. L23) and Engelmann spruce (cf. L28).

## S21. Sakhalin fir

■ Probably the most magnificent fir stand in Solböle grows on the right. The species, **Sakhalin fir** (*Abies sachalinensis*) has been introduced in L13. In 1990, when the stand was 61 years old, its average height was 22 m and diameter 46 cm.

## S22. Alpine fir

■ The fir species on the right, **Alpine fir** (*Abies lasiocarpa*), has not grown nearly as well as the Sakhalin fir. Its natural habitats are at high altitudes in the mountains of the western parts of North America. It is a typical timber line species. There are stomata on both sides of the needles, which form a mat band on the top side of the needle and two silvery white bands on the underside. The crown is narrow and conical; it often tapers into a very narrow-shaped top, and the lowest branches often reach the ground if the tree grows solitarily or in thin stands.

Alpine fir does not have commercial significance as the stands are often thin and difficult to reach and, moreover, the trees are in many cases short and damaged by diseases and pests. In Europe, however, the species has been used to some extent as an ornamental.

Cork fir, a subspecies of Alpine fir, has been introduced in L12.

## S23. Douglas-fir

■ Three Douglas-fir cultivations of Canadian origin grow on the right. The first two are from British Columbia and have performed reasonably well in Solböle. One of them is 55 years, the other 65 years. The third cultivation from Alberta has not adapted nearly as well in the conditions in Solböle.

**Douglas-fir** (*Pseudotsuga menziesii*) is the most important tree species of the western parts of North America: it covers ca 60 % of the timber resources in the area. It has a wide natural range extending from Canada to Mexico. It grows rapidly as young already, and keeps up a rapid growth rate up to the age of 200 years and above. It can reach the age of 1000 years, the height of nearly 100 metres and the diameter of over 3 metres. The three-forked bracts protruding from the hanging cones are a distinctive feature of the species.

Douglas-fir demands plenty of light; in natural conditions it is able to spread efficiently only after a forest fire. Without a fire, species with better shade tolerance soon occupy the space. The wood of Douglas-fir turns reddish brown soon after cutting. It has a high rot resistance and is an excellent saw timber: sawn Douglas-fir is often called "Oregon pine." Douglas-fir veneer is used in interior finishing and furniture.

Douglas-fir has been cultivated from the early 19th century outside its natural range. In Finland it has been grown from the early 20th century. In its natural habitats, Douglas-fir is not threat-

ened by damage caused by insects or fungi, but in new cultivated stands there has been lots of damage caused by the Douglas-fir needle blight. Douglas-fir seems to be a hardy species with respect to storms and heavy burdens of snow. – Here fungal diseases have destroyed or badly damaged one of the grown races. Canadian provenances – interior British Columbia – have performed best in Finland.

## S24. Balsam fir

■ Opposite to the last Douglas-fir cultivation is a stand with many open spaces; **Balsam fir** (*Abies balsamea*) was planted there in 1935. Fungal diseases have killed most of the trees. European silver fir (*Abies alba* cf. L8) has been planted to fill the gaps, they are clearly smaller compared to the Balsam fir trees.

Balsam fir grows in the large forest area of Canada and the north-eastern parts of North America. It has the widest range of North American fir species. However, it is not valued commercially; usually it grows in mixed stands with other species regarded as more valuable.

The main use of Balsam fir is in the paper industry. Pure Balsam fir cannot compete with Norway spruce in quality, but it gives good qualities to printing paper when mixed with other species. The trunk of Balsam fir has resin blisters which contain colourless, liquid resin. It has been used in the manufacture of glues, as a fixative in soaps and perfumery, and in the optical industry as a cement for microscopes and slides - nowadays it is being replaced by synthetic materials

In Finland Balsam fir has been successfully grown in parks up to the Oulu region.

## S25. Special form of Norway spruce

■ After the Balsam fir on the left, close to the road, can be seen a special form of our native spruce. Its needles are exceptionally short and grow thickly, and the cone scales curve backwards.

A couple of shabby Siberian firs (*Abies sibirica* cf. L14) grow after the spruce.

## S26. A stand of young trees

■ The road continues across a young tree stand. Seedlings of several conifer and broad-leaf species have been planted in the area as sample plots. Only few of them can be seen from the road. A species of alder (*Alnus kamtschatca* var. *mandshurica*) spreads its branches across the road. Among the coppice there grow a couple of *Juglans mandshurica* seedlings and three different maple species, namely *Acer ukurundese*, *Acer tegmentosum* and red maple (*Acer rubrum*).

A curly-birch (cf. L6) cultivation trial is on the right after the maples.

## S27. Scots pine; flowering and seed crop trial

■ The road leads into a pleasant pine forest growing on a slope. On the left there are trees with black painted numbers. These trees have been included in a study on the flowering and seed crop of Scots pine. The study deals with the variation in the flowering and seed crop of pine. The inflorescences and cones are counted annually, which gives information about the frequency of good seed production years and the number of seeds the trees produce. This information is needed in the planning of natural regeneration, for example.

**Scots pine** (*Pinus sylvestris*) has the largest distribution area within the pine family. Its natural range includes most of Siberia and Europe except for the easternmost and southernmost areas. The main distribution area is in the continental east. Scots pine has several geographical races which differ from each other in physiology and, to some extent, in appearance.

In southern Finland, Scots pine usually flowers during the 2nd week of June. The seeds ripen in the autumn of the following year and fall late in the winter. Scots pine grows rapidly when young but the growth rate slows down with age faster than spruce's, for example. Scots pine does not grow as tall as Norway spruce. In southern Finland, where soils are reasonably rich in nutrients, Scots pine can live up to 250 years, sometimes even 500-600 years. In commercial forests, the succession of Scots pine is 80-120 years, depending on the growth site and geographical location.

Scots pine is a light-demanding species. In the natural succession it follows broad-leaf species; spruce, which has a better shade tolerance, appears later under the pine. It succeeds on poorer soils, too, but does best on soils with a reasonably good

nutrient content (mesic and semidry mineral soil forest site types; *vaccinium* or *myrtillus* site type forests ). In Finnish Lapland it is a timber line species.

Scots pine is the most important commercial tree species in Finland: ca 45 % of our tree stock is Scots pine. It is used by the paper and sawmill industries and as poles and railway blocks. There is also demand for high-quality pine timber as construction and interior decoration material.

The trail turns right at the crossroads following the strikingly straight road which rises from the seashore towards the road to Solböle. The road was built in 1941 when the Hankoniemi area was under the lease of the Soviet Union. The plot of land in Nitlax which belongs to the Solböle Axperimental Area burned down when the Soviets fired from Hanko at the Finnish positions in Nitlax. The village of Bromarv laid only 12 kilometres from the Soviet positions in Hankoniemi. To avoid encirclement, the villagers decided to build an evacuation road from Bromarv via Knopkägra to the mainland. The road continues across Skepparströmmen – a ferry was used during wartime. In the second half of the 40's, the ferry served a more peaceful purpose as an open-air dance floor.

The trail turns right at the first crossroads and leads through a pine stand, cut in seed-tree position.

## S28. A stand in natural state

■ The stand has been left in seed-tree position for natural regeneration. The stand was earlier used in an experiment on the wood production and development of pine. The trees marked with a white spot were included in this test, which has already been completed.

The area where no management measures were carried out has been left as a sample plot to show how our forests would develop without cuttings and other management measures. This stand is easy to recognize on the right-hand side of the road. Under the dense pine stand spruce, which has a better shade tolerance, has started to occupy the land. In natural succession, forests gradually undergo this kind of development: pine grows old and dies and is replaced by spruce, the species of the final stage of succession.

After the pine stand the trail turns right and continues along the Solböle main road back to the office. Larches are the next species along the trail, then five different pine species.

### S29. Kurile larch

■ **Kurile larch** (*Larix gmelini* var. *japonica*) grows on the left immediately after the crossing. It is a subspecies of Dahurian larch growing on the southern Kuriles and in the Sakhalin area.

### S30. Siberian larch and Dahurian larch

■ Two nearly 70-year-old larch stands grow on the left: **Siberian larch** (*Larix sibirica*; cf. L16) and after it **Dahurian larch** (*Larix gmelinii*).

Dahurian larch grows in large areas in the eastern parts of Siberia and forms the northern timber line. It grows in the most continental areas (with the coldest winters) of the Eurasian coniferous zone or taiga. The summers in eastern Siberia are so warm, however, that the northern coniferous timber line extends farther north than elsewhere. Within its large distribution area, Dahurian larch has several subspecies, which differ greatly from each other.

These two species can be best distinguished from each other by the cones: Dahurian larch cones are small, oval or round and the scales which turn outwards give the ripened cone a pretty rose-like appearance.

On favourable soils Dahurian larch reaches the height of 30 metres. In large parts of its range it remains short and crooked. The wood reminds that of Siberian larch but is harder and more resinous. In southern Finland the species has performed reasonably well. The trees in Solböle have reached the height of 24 metres at the age of 65 years.

### S31. European larch

■ The **European larch** (*Larix decidua*) stand on the right has been planted with 4-year-old seedlings in 1931.

The natural range of European larch covers large areas in Central Europe, particularly in mountain areas: the Alps, the Tatra Mountains, the Carpathians and southern Poland. It grows up to the altitude of 2 000 metres, where it forms the timber line together with Mountain pine (S34) and *Pinus cembra* (S33). It adapts well to different growing conditions and has been cultivated in many countries. It is not very vulnerable to snow, storm or harvesting damage, but is very susceptible to larch canker fungus. – This stand has been damaged by sawflies and storms, for instance.

In favourable conditions European larch can reach a height of 40 metres and a diameter of 120 cm. It is a long-lived species; over 1 000 years old individuals have been found. The trees develop a thick bark with age: over a quarter of the volume may be bark in large trunks. In dense stands the trunk is usually rather straight and branchless, but in open places the tree can develop a crooked trunk with lots of branches.

The wood of European larch varies in quality, a typical feature is high rot resistance. In constructions exposed to moisture, larch wood turns extremely hard and nearly undecaying. It is often used in this kind of construction, for example, the underwater wooden poles built to reinforce the basement in the medieval Venetian dwellings were made of larch.

These trees have grown to ca 25 metres in 65 years.

### S32. Macedonian pine

■ A dense **Macedonian pine** (*Pinus peuce*) stand grows on the left after the larches.

Macedonian pine has several separate natural habitats in the Balkan Peninsula in the border areas of Albania, Greece, former Yugoslavia and in the mountains of Bulgaria. It is a mountain species and still forms pure stand at altitudes of 1 600–2 000 metres. At higher altitudes it grows in mixed stands with Mountain pine (S 34); in the lowest parts of the mountainsides it typically forms mixed stands with Scots pine.

Macedonian pine grows slowly, so it does not pay off to grow it for the sake of its wood. Instead, it is an excellent ornamental and park tree due to its surprising hardiness, health and adaptability. The Macedonian pines in Solböle have regenerated surprisingly well also naturally.

### S33 Siberian stone pine

■ **Siberian stone pine** (*Pinus cembra* var. *sibirica*) grows on the left after the Macedonian pine. It is one of the two variations of *Pinus cembra* which grows naturally in two areas at a 2 000 kilometres' distance from each other: the European Alps and north-eastern Russia, western and central Siberia. A distinction is often made between the two variations, namely Swiss stone pine and Siberian stone pine, even though they look very much the same.

The nearest natural habitat of the Siberian stone pine is in the



Dvina river region. It grows well in Finland and is one of the oldest exotic species cultivated in our country.

Young Siberian stone pine trees are vital and densely branched but with age the branches become thick and lifeless. When cultivated as an ornamental tree it ought to be regenerated young enough. It has also been used in fencing in nurseries. Besides Shore pine and Macedonian pine, Siberian stone pine is more or less the only exotic pine species with large trees in Finland. However, to grow well it needs an especially good soil.

During the early winter of the second year after flowering, Siberian stone pine drops its big cones whole, and the seeds are released when the cone decays. The seeds are big and nutritious, peeled seeds contain 60 % fat at best. It is no wonder that the seeds are used as nourishment not only by many animals but by people as well. Still in the late 19th century, the seeds were considered so valuable for food economy that the Russians took action in order to spread the species into Finland in case of famine.

The wood of Siberian and Swiss stone pine has a strong fragrance, it is soft and light but has a high rot resistance. The beautiful branch patterns have made it popular in Switzerland and Austria as interior paneling material. In Siberia it is used to make wardrobes and clothes chests as the fragrance is believed to repel moths.

Both of these species, together with Macedonian pine, have needles in tufts of five. The stone pines can, however, be easily distinguished from the Macedonian pine by the cones. Their cones are big, upright, rounded and resinous; Macedonian pine cones are big, longish (8–15 cm) and hanging. Another distinctive feature is that young stone pine shoots have a fine coating of soft hairs whereas the shoots of Macedonian pine are bald.

### S34. Mountain pine

■ The third species on the left is **mountain pine** (*Pinus mugo*). It has many subspecies, most of them shrub-like; some of the grow into a small tree as does mountain pine .

Native of the mountain areas of central and southern Europe, the Alps in particular, mountain pine forms large thickets in the timber line area. Mountain pine is a valuable shelter forest species. Due to its adaptability it has been used in the establishment of cultivated shelter forests, to tie up moving sand dunes or as a pioneer species before other tree species in dry, sandy mineral soil forest sites. Outside its natural range, the shrub-like form of

mountain pine in particular has been grown as an ornamental although it often turns thin and shabby with age.

Mountain pine wood is very resinous, tough and rot-resistant. The species is not grown for the sake of its wood to any great extent; it is used as firewood, railway sleepers and in coal production. The resinous quality of the wood has also been utilized in torch making.

The trees in this stand are dying one after another. The climate is probably too maritime.

### S35. Douglas-fir

■ Before the next pine species on the right there grow three 70-year-old Douglas-fir stands (cf. S23). These stands are of British Columbian provenance. They have been used to study the wood yield of Douglas-fir, for instance.

### S36. Shore pine

■ The next two stands on the right have been planted with **Shore pine** (*Pinus contorta*). The natural range of Shore pine extends in the north-south direction from Alaska to southern California and in the east-west direction from the border of the prairie to the Pacific coast. It has one of the largest distribution areas among the North American conifers.

Shore pine does not demand quite as much light as our native pine, and it grows well on poorer soils, too. It does not, however, grow on extremely dry soils. Natural shore pine forests achieve maturity at the age of 150 already.

Shore pine regenerates naturally in burnt areas and grows in very dense stands. It has to be planted more densely than Scots pine to produce well-shaped trees. Shore pine resists competition from herbaceous plants better than Scots pine and its growth rate is also faster up to the age of 50. Its wood yield can be 20–50 % better compared to Scots pine. Both Shore and Scots pine produce good-quality fibre but Scots pine is clearly better as saw timber.

Shore pine has been cultivated commercially from the beginning of this century outside its natural range, particularly in central Europe and Sweden. Besides larch it is the only exotic species cultivated as an actual forest tree in Finland. Shore pine of suitable provenance can be grown up to the farthest corners of Lapland. It is, however, vulnerable to storm and snow damage. Occasionally, it suffers from insects (pine sawfly) and root rot.

### S37. Jack pine

■ Our fifth pine species along the road is **Jack pine** (*Pinus banksiana*), which grows on the right. It has been named after a British botanist, Sir Joseph Banks. This species of low-lying land grows in the Canadian forest zone covering most of the eastern parts of the Rocky Mountains, the Great Lakes district and northern New England.

Jack pine grows well on the most barren, sandy mineral soil forest sites, on rocky terrain and paludifying forest land. It demands plenty of light. It grows quickly as young, the growth declines at the age of ca. 70–80 years and the trees become biologically over-aged at 100 years already.

Some of the Jack pine's curved cones arranged in pairs open right after the seeds have ripened; some are serotine, i.e., they require intense heat, e.g. a forest fire, before they open and release the seeds. Inside the cones, the seeds keep their germinative capacity for long periods of time. In forest fires, the thin-barked Jack pines are often destroyed completely but the forest regenerates efficiently from the serotine cones. If a young stand is destroyed before it has reached seed-bearing age, other tree species soon occupy the area.

Jack pine is largely used for pulp production in the Great Lakes area. It has also been cultivated outside its natural range, especially in central Europe, at the end of the 18th century already. After the Second World War its cultivation has ceased since its size and form are not good enough to make the cultivation profitable. In Finland, Jack pine cultivations have performed well enough up to the age of 20–30 years, after which the growth has started to retard. They have also suffered snow damage.

### S38. Column-shaped common juniper

■ At the bend of the road on the left there grows column-shaped **Common juniper** (*Juniperus communis*). Juniper has the widest range of all conifers; it grows in the whole Europe, in the northern parts of Africa, Asia and America on sites that differ greatly from each other. In most cases it grows in shrub-form but the less common inheritably tree-like forms can grow up to 10–15 metres. Commercial use of natural column-shaped juniper is prohibited in Finland; in the province of Ahvenanmaa this rule is applied to trees over 7 metres. Juniper grows extremely slowly and can reach the age of 1 000 years.

Juniper wood contains no resin and has a pleasant fragrance; it is a good handicraft material. Its twigs are used in smoking

fish and meat and the berries to spice game dishes. The plant and its berries have also been used in folk medicine to prevent scurvy and scabies and to assist digestion. The berries have been boiled to prepare cough mixture.

Stories about juniper have followed man through ages. The fragrance of juniper and the sharp needles were believed to keep away trolls and witches; alepots and other drinking vessels were made of juniper; juniper branches were hung above kitchen and barn doors. Juniper smoke was believed to expel evil spirits and epidemic diseases.

### S39. Young fir stand

■ A dense spruce stand grows on the right and after that a young stand with **Sakhalin fir** (*Abies sachaliensis*, cf L13) and **Balsam fir** (*Abies balsamea*, cf. S24), planted in 1983.

### S40. Korean pine

■ On the right there grows an ash stand introduced under L26 and an Engelmann spruce stand introduced under L28. Opposite to the ash stand, on the other side of the road, there grow a couple of **Korean pine** (*Pinus koraiensis*) trees. They are in a weak condition. Korean pine is native of Japan, north-eastern China, Korea, Amur area and Manchuria. In Japan it is a rare species, which grows in mixed mountain stands; in the Amur area and Manchuria it is one of the most important forest trees. In the shore areas of its natural range it is one of the most important saw timbers. – Korean pine has big edible seeds; they are eaten by wild boar, bear and even by people.

After the Korean pines, the trail joins the Lövsveden trail coming from the right. The road continues towards the office building; the pine provenance trial along the road has been introduced under L29.

Our hiking trails end at the yard of the office building, where they started off. The Finnish Forest Research Centre hopes You have enjoyed Your visit in Solböle and its forests; we also hope You have received new information about the Finnish forests, forest economy and research. Welcome again!

## List of objects along the trails

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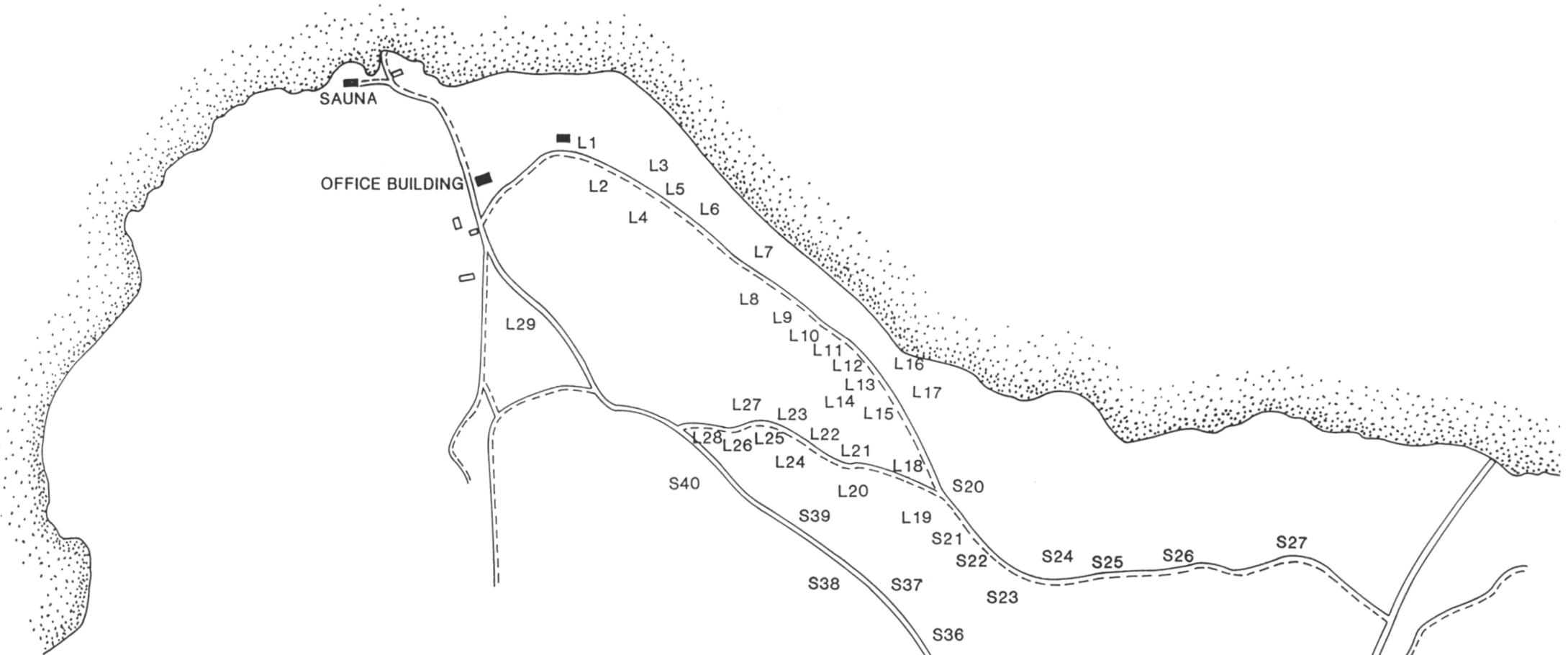
### 1. The Lövsveden trail

- L1. English oak (*Quercus robur*)
- L2. Norway spruce (*Picea abies*); stand-stand
- L3. Northern Japanese hemlock (*Tsuga diversifolia*)  
Eastern hemlock (*Tsuga canadensis*)
- L4. Japanese yew (*Taxus cuspidata*)
- L5. Sawara cypress (*Chamaecyparis pisifera*)  
Hiba (*Thujopsis dolabrata*)  
Korean thuja (*Thuja koraiensis*)
- L6. Curly-birch (*Betula pendula* var. *carelica*)
- L7. Common hazel (*Corylus avellana*)
- L8. European silver fir (*Abies alba*)
- L9. Common yew (*Taxus baccata*)
- L10. Carolina hemlock (*Tsuga caroliniana*)
- L11. Yeddo spruce (*Picea jezoensis*)
- L12. Cork fir (*Abies lasiocarpa* var. *arizonica*)
- L13. Sakhalin fir (*Abies sachalinensis*)
- L14. Siberian fir (*Abies sibirica*)
- L15. Hybrid firs and natural regeneration; Caucasian fir (*Abies nordmanniana*)
- L16. Siberian larch (*Larix sibirica*)
- L17. Sitka spruce (*Picea sitchensis*)
- L18. European silver fir
- L19. Veitch's silver fir (*Abies veitchii*)
- L20. Serbian spruce (*Picea omorika*)
- L21. Manchurian fir (*Abies holophylla*)
- L22. Colorado white fir (*Abies concolor*)
- L23. Colorado spruce (*Picea pungens*)
- L24. Korean fir (*Abies koreana*)  
Red fir (*Abies amabilis*)
- L25. Norway spruce stand damaged by root-rot fungus

- L26. Common ash (*Fraxinus excelsior*)
- L27. Feeding field for game animals
- L28. Engelmann spruce (*Picea engelmannii*)
- L29. Provenance trial with Scots pine

### 2. The Storsveden trail

- S1-S19 = L1-L19
- S20. Sitka spruce (*Picea sitchensis*)  
Sakhalin spruce (*Picea glehnii*)
- S21. Sakhalin fir (*Abies sachalinensis*)
- S22. Alpine fir (*Abies lasiocarpa*)
- S23. Douglas-fir (*Pseudotsuga menziesii*)
- S24. Balsam fir (*Abies balsamea*)
- S25. Special form of Norway spruce
- S26. A stand of young trees; trials with broad-leaf trees
- S27. Scots pine (*Pinus sylvestris*); flowering and seed crop trial
- S28. A stand in natural state
- S29. Kurile larch (*Larix gmelinii* var. *japonica*)
- S30. Siberian larch (*Larix sibirica*)  
Dahurian larch (*Larix gmelinii*)
- S31. European larch (*Larix decidua*)
- S32. Macedonian pine (*Pinus peuce*)
- S33. Siberian stone pine (*Pinus cembra*)
- S34. Mountain pine (*Pinus mugo*)
- S35. Douglas-fir
- S36. Shore pine (*Pinus contorta*)
- S37. Jack pine (*Pinus banksiana*)
- S38. Column-shaped common juniper (*Juniperus communis*)
- S39. Young fir stand
- S40. Korean pine (*Pinus koraiensis*)

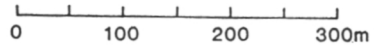


MAP 2.

### HIKING TRAILS IN SOLBÖLE

LÖVSVEDEN TRAIL, OBJECTS L1-L29

STORSVEDEN TRAIL, OBJECTS L1-L19 AND S20-S40



TO BROMARV →