METSÄHALLITUS

Landscape Ecological Plan for State-owned Forests in

Kolari

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Abstract

The planning region includes most of the state-owned lands in the municipality of Kolari, and its total area (including waters) is 125 824 ha. According to its geobotanical location, the region belongs to the Southern Lapland sub-section of the northern-boreal coniferous zone, and within it, to the West Lapland hill area. Most of the region is 110–718 metres above sea level. Most of the forests (68% of forest land) are less than 80 years old. The forests in the eastern part of the region are slightly older than those in the western part. The forests are very pine-dominated (76% of forest land), and some of these forests have evolved after wildfires. The region includes 12 239 ha of various conservation areas, which account for 9.7% of the total area. Of these, 3 144 ha have been classified as old-growth forests, which is 4.2% of the total forest area.

Valuable habitats were inventoried using data from the geographical information system, aerial photos, various maps and participatory planning. In the field inventories, the volume of deadwood was measured for valuable habitats, and the structural features and indicator species of key biotopes were recorded. The area measured amounted to 2 481 ha, which is 3.3% of the forest land and 1.9% of the total land area. In addition, the game habitats and valuable landscapes in the region and the data from old-growth forest inventories were studied.

On the basis of the field inventories, the total area of the key biotopes identified in the region amounts to 1 860 ha (1.3% of total area), 951 ha of which is forest land (2.3% of forest area). Most of the key biotopes were banks of streams, bedrock outcrops, cliffs and old-growth forests. Ecological links were established to support the conservation areas. The total area of the ecological links is 760 ha, 310 ha of which is forest land.

The plan includes a review relating to natural forest dynamics after wildfires based on the ASIO fire susceptibility model categories. Forest and poorly productive land could be divided into the following ASIO categories: 3% almost never (A), 22% seldom (S), 70% infrequently (I) and 5% often (O). The theoretical tree species and age structure calculated according to the model was compared with the present status of the forests. On the basis of the results, the target for the proportion of birch-dominated forests was set at 8%, and the minimum limit defined for the proportion of old-growth forests was 10% (7 400 ha) of forest land. The target for prescribed burning was set at a minimum of 40 ha at intervals of three years. In forest management operations this means that the area of birch-dominated forests is to be increased (by some 40 ha/year) and the constant availability of burnt wood is to be ensured in the region. In addition, general models for forest management operations on growing sites of different categories of fire susceptibility have been presented, based on the natural forest dynamics.

In addition to combining different forms of land use, the ecological goal of the plan is to create an ecological structure that ensures the preservation of the core populations of the indigenous species and promotes their spread to other potential habitats with the help of the conservation areas, valuable habitats defined in the managed forests and the present models for forest management operations. This includes increasing the volume of deadwood. In the future, this goal will be promoted by the practice of leaving retention wood, which is an essential part of current forest management operations.

The economic impacts of the plan have been studied by the MELA model. According to the calculations, the planned cut in the region will be reduced by 11% to allow for the sites of special value and the regional goals. In the long term, the greatest impact will be caused by valuable habitats and ecological links, though at first the impacts of other sites of special value are also considerable. The impact of statutory valuable habitats on the planned cut will be minimal.

Key words

Landscape ecology, inventory, conservation area, key biotope, natural forest dynamics, ecological goal, forest management

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CONTENT

1 INTRODUCTION

The UN Conference on Environment and Development in Rio de Janeiro in 1992, adopted Forest Principles relating to the management, use, protection and sustainable development of forests. These principles acknowledge the ecological, social, cultural and psychological importance of forests. At the same time, the Convention on Biological Diversity was signed. The Convention came into force in Finland in 1994.

The Ministry of Agriculture and Forestry has set Metsähallitus the target of developing and introducing a Landscape Ecological Planning system. On this basis, Metsähallitus has defined as its own objective to draw up comprehensive Landscape Ecological Plans for the regions under its administration by the year 2000 and has incorporated Landscape Ecological Planning into its environmental management programme.

The planning work group included Planning Officers Kalervo Niku and Teuvo Kuuva, and Team Manager Kari Koivumaa from the Forestry Department, Western Lapland, and Planning Officer Jorma Paasilinna from the Natural Heritage Services of Metsähallitus. Biologist Vesa Koivunen acted as expert on plants and birds and Environment Manager Lauri Karvonen from the Forestry Department, Western Lapland, as project co-ordinator. Kalervo Niku and Teuvo Kuuva were responsible for field inventories.

Plans drawn up previously for the area of the municipality of Kolari include the Landscape Ecological Plans of Kienaja (Niku et al. 1998) and Aalistunturi (Karvonen et al. 1997) and the plan for Suntio-Haukirova (Kuuva et al. 1998), which has been included in this plan in order to facilitate its implementation and follow-up in the future.

2 OBJECTIVES OF THE PLAN

The purpose of this plan is to conduct an inventory of the different forms of use and values of the region and to harmonise the often differing ecological, social and economic objectives to form an optimal combination. The objectives also include the targets relating to the Landscape Ecological Planning of the natural resource plan for Western Lapland completed in 1999 (Sandström et al. 1999). Landscape Ecological Planning is, in fact, one of the ways in which the natural resource plan is implemented in accordance with the forest planning system of Metsähallitus.

The ecological objectives i.e. the conservation of biodiversity in the region does not only refer to the number of species, but also to the conservation of intraspecific (e.g. genetic) variation and biodiversity in the entire ecosystem. For example, biodiversity in an area can decrease, if human impacts result in a situation where original and narrow-niche species disappear and are replaced by “widespread species” that can thrive everywhere. The objective of this plan is to manage forestry and other land use in such a way as to ensure the survival of viable populations of the indigenous species typical of the region, taking into account the entire forest biodiversity of the region, both managed forests and conservation areas. In managed forests, this means conservation of valuable habitats, but also forestry operations that mimic natural forest dynamics. The aim at all levels (forest area, stand, valuable habitat) is to protect special features typical of natural forests.

In addition to forestry, tourism, recreational use and reindeer husbandry are of vital importance to the region. One aim of planning is to control the use of forests in a way that takes into account the areas and factors of importance for different forms of land use. Another objective is to support and supplement earlier land use decisions aimed at developing tourism, taking into account individual separate small sites used for recreation and conserving cultural sites in the way required by the particular site.

3 PREPARATION OF THE PLAN

3.1 Preliminary work

The objective of the preliminary work was to identify the ecological values, other special features and present land use of the region. The following sources were utilised in the work:

- stock map / forest management plan
- game management map / plan
- management and utilisation plans for fishing waters
- regional plans
- base maps
- data in the geographical information system:
    * land use category
    * restrictions on use
    * vegetation category (herb-rich forests and fertile mires in particular)
    * poorly productive forests (over 20 m^3/ha)
    * drainage situation (undrained peatlands)
    * factors reducing forest productivity
    * dominant tree species / age of stands (rotation time + 20 years)
    * proportion of broadleaves (aspen in particular)
    * broadleaves (over 100 m^3/ha)
    - data in the database of threatened species
- old-growth forest inventory data
- valuable small water bodies inventory data (Raatikainen 1995)
- records on ancient monuments (Kotivuori & Torvinen 1993)
- reindeer grazing land inventory data (Kumpula et al. 1996)
- nature and landscape analyses of areas included in shore plans
- regional plan for northernmost Lapland

These sources were used to identify valuable landscapes, game habitats and valuable forest habitats (key biotopes) in accordance with Appendix 1 and to gather information on the land use decisions and reserves made in the region.

3.2 Field inventories

Field inventories were mainly carried out on survey sites in managed and recreational forests. The work was carried out in the Suntio-Haukirova area in 1996 and elsewhere in Kolari in 1998. The fieldwork covered 4 900 ha, which is 3.9% of the planning region. The volume of deadwood was measured on 2480 ha of forest land, which is 3.3% of the forest area. Standing deadwood was measured using the relascope method (angle gauge method) (m^2/ha) and fallen trees were counted on circular sample plots of 3 ares (no./ha) in accordance with the geographical information system instructions (Metsähallitus 1997c). In addition, the amount of retention trees was recorded. Deadwood and retention trees were measured separately for each compartment.

3.3 Compiling the plan

After the field inventories, the data obtained were calculated using the MoniWin program developed by the Finnish Environment Institute (Siitonen & Tanskanen 1997) in order to define the valuable habitats. The results were entered in the geographical information system. If several ecological values were found in a compartment, they were all entered in the register using the codes described in Appendix 1. At the same time, compartments were divided, if necessary, and the data on the new compartments were updated in the system.

Key biotopes were selected mainly on the basis of structural features, nutrient level, habitats of valuable species, natural state of the site and volume of deadwood. Other valuable sites such as game habitats, valuable landscapes and cultural sites were defined on the basis of the special values of the site. The sites were recorded in the geographical information system as areas, spots or compartments.

The planning region was divided into catchment areas using an inventory by the National Board of Waters and the Environment (Ekholm 1993), and special attention was given to assessing the natural state of water bodies and peatlands in the catchment area. This was used as a basis in identifying the ecological values of the catchment areas of the streams flowing into lakes and those of the minor water bodies. All valuable minor water bodies were entered in the geographical information system using ecological codes.

In planning ecological links, the aim was to use, where possible, valuable habitats specified in managed forests, especially habitats of species typical of old-growth forests. The objective was to create a network that would optimally improve the conditions for the spread of indigenous species of the region from one habitat to another. Usually the core areas of the network are formed by fertile forests along stream banks and forests containing a high proportion of old trees and deadwood. The link between the Karhuvuoma peatland conservation area and the Kurtakkoselkä old-growth forest conservation area, which continues further on to Niesaselkä, is a good example of ecological links. It includes both stepping stones and corridors.

The plan includes the objectives set down in the natural resource plan for Western Lapland relating to this region, such as preserving and increasing the proportion of stands dominated by broadleaves and old-growth forests (see Sandström et al. 1999). In addition, at the data collecting stage the planners studied issues relating to land use in the regional plan for northernmost Lapland and the master plan for the Ylläs area (Lapin liitto 1999). Furthermore, they examined the Committee report on valuable landscapes and the report on inventories of

national heritage landscapes in Lapland (Ympäristöministeriö, 1992 and Kalpio & Bergman 1999).

3.4 Participatory planning

During the planning process, meetings were held for the general public of the region at Metsä-Ylläs in Äkäslompolo and at Vaattojärvi school, in May-June 1998. In addition feedback was collected at the public meetings held in conjunction with the preparation of the natural resource plan. The meetings were attended by 18 people, representing mainly the local hunting societies and village committees. The new site-specific information obtained in the meetings was recorded in the geographical information system where applicable. Representatives of reindeer husbandry were concerned about reindeer routes and the construction of new forest roads. Those fishing for their own use complained of the poor quality of the water in the river Naamijoki, and were informed that this is caused by drainage of the Ollinmaa pine bogs. The tourist entrepreneurs in the Ylläs area wanted a connecting road built between Äkäslompolo and Ylläsjärvi. They were informed that this kind of project is not part of landscape ecological planning and requires more comprehensive assessments and consultation with several bodies, and the question should therefore be discussed later separately with the relevant bodies. In fact, a work group has since then been appointed for the road project, including representatives of the tourist entrepreneurs, the municipality of Kolari, Metsähallitus Natural Heritage Services, the Finnish National Road Administration, the Regional Environment Centre, the Employment and Economic Development Centre, and the Provincial State Office of Lapland. If the project is realised, it will inevitably affect the landscape, ecology and recreational values of the area. A summary of the feedback received is presented in the appended table 5.

The meeting for the general public in the Suntio-Haukiorova area included in the Kolari plan was held at the beginning of August in the village of Lappea in Kolari. In addition to the representatives of Metsähallitus, a representative of the Kolari reindeer herding cooperative and ten other people interested in the plan attended the meeting. According to the representative of reindeer husbandry, the adjacent peat production areas should be fenced. In this context, however, it was stated that the question should primarily be discussed with the peat producers, as it does not concern Metsähallitus. The participants also asked for an assessment of the effects of drainage on the water level of lake Äijäjärvi. In addition, the participants asked for the location of the old corduroy road dating from the period under Swedish rule and crossing the planning region (boardwalks from Lappea to Sieppijärvi) to be marked on the map and in the terrain.

Briefings on the plan were held in Äkäslompolo and Vaattojärvi in March 2000. The contents of the plan were presented. It was emphasised that the plan will be updated, and some details were already added to the plan in the course of the meetings. Information was also given in the meetings on the focus of forest operations in the area during the next few years. Another point emphasised in the meeting held in Äkäslompolo was co-operation on the use of the future national park and the adjacent managed forests.

4 DESCRIPTION OF THE PLANNING REGION

4.1 General description

The planning region includes the state lands in the municipality of Kolari excluding the areas included in the Aalistunturi and Kienaja plans. The region covers the stock map sheets 16-30 of the Pello unit, and its total area can be divided into the following main categories (table 1, figure 1).

Table 1. Area by main category.

Main category	Area, ha	Area, %
Forest land	74 740	59
Poorly productive land	29 635	24
Non-productive land	17 245	14
Other land	2 781	2
Waters	1 423	1
Total	**125 824**	**100**

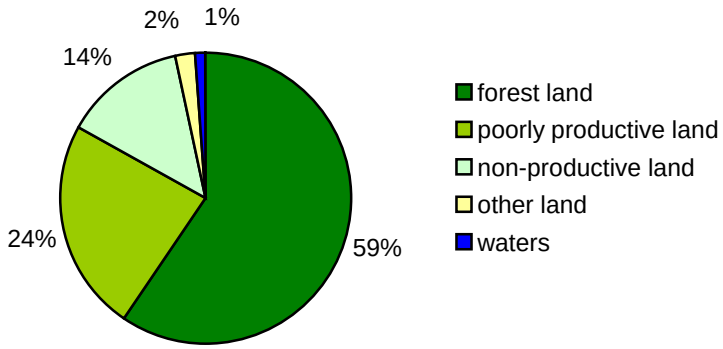

Figure 1. Area by main category.

Of all land, 41% is peatlands (51 468 ha) and of these 15.6% are forest land (8 073 ha). According to its geobotanical location, the region belongs to the Southern Lapland sub-zone of the northern-boreal coniferous zone. According to the division made for the inventory of old-growth forests, the region belongs to the hill area 4b1 of Western Lapland (Rassi et al. 1996).

4.2 Waterways

About 1% (1 423 ha) of the total area of the region is covered by water. Most of the waterways belong to the Tornion-Muonionjoki main water system and the Naamijoki water system branching from it. A small proportion of the waters in the eastern parts of the region flow into the river Ounasjoki. Valuable small water bodies are presented in appendix 4 (Raatikainen 1995).

4.3 Bedrock and topography

4.3.1 Topography

In the northern part of the municipality of Kolari, the landscape is marked by Ylläs fell (718 m above sea level). The region is characterised by considerable differences in altitude. There is a rich variety of biotopes in the area, from fertile herb-rich forests to nutrient-poor fell areas with shrubs and bare fell tops.

In the centre of the municipality, there is the extensive, varied Teuravuoma-Kivijärvenvuoma peatland, which is also protected. In summer, it forms a nesting ground for bean geese (*Anser fabalis*), whooper swans (*Cygnus cygnus*) and other species requiring quiet conditions.

South of the Teuravuoma peatlands, the landscape is dominated by high hills, such as Iso-Kelhu (381 m above sea level), Venevaara (348 m above sea level) and Muotkavaara (330 m above sea level). The area is also otherwise variable as regards its relative altitudes. In the southern part of Kolari, there is a hill area called Naalastentievat, which is included in the national conservation programme for esker formations. These hills were formed by the glacial thaw water that piled up and sorted rocks and stones.

Hikers on the slope of Ylläs fell.

4.3.2 Bedrock and soil

The region belongs to the Central Lapland Greenstone Belt, which mainly consists of quartzites, various schists and gneisses and volcanic rocks. Older (approx. 2.3–2.6 billion years old) quartzites can be found in the Niesakero and Kuertunturi sequences and younger (approx. 2.2 billion years old) quartzites in the Tapojärvi and Ylläs fell area. The surroundings of the Kolari parish village comprise volcanic rocks, and this area extends to the northeast as a continuously narrowing zone via the northern part of Ylläsjärvi to the adjacent municipality of Kittilä. Most of the region, e.g. the area covering the villages of Kurtakko, Venejärvi, Lappea,

Väylänpää, Sieppijärvi and Pasmajärvi, belongs to an area of phyllites, mica schists and mica gneisses. Some granites can be found in the Tahkovaara-Taporova area. Limestone can be found in large quantities at the mouth of the river Äkäsjoki, where there is a former limestone quarry. The Rautavaara mine contains in addition to iron ore, copper and some gold. Even though the mines have been closed as unprofitable, they contain ore supplies for decades should the need arise. (Manner & Tervo 1988).

The most common mineral soil in northeastern Lapland is bottom moraine. Peat and bottom moraine are also the most common soil types in the planning region, and bottom moraine layers of variable thickness cover a significant part of the region. In the northern and northeastern parts of the region where the bedrock is very strong, the moraine cover is thin. In places, the bottom moraine has piled up to form streamlined drumlins, parallel to the movement of the continental ice sheet, especially in the southeastern parts of the region. Small areas of assorted soils, such as gravel and sand, can be found in low-lying rivervalleys and in esker formations. The most significant esker formation is the Haukiselkä-Naalastentievat area, which is included in the national conservation programme for esker formations. Rivervalleys with assorted soils include the surroundings of the rivers Naalastenjoki, Pasmajoki, Ylläsjoki, Luosujoki and Äkäsjoki. The centre of the region is dominated by extensive, continuous peatland areas (see. 4.3.1).

4.4 Nature conservation

The planning region belongs to the Southern Lapland sub-zone of the northern-boreal coniferous zone and to the Southern Lapland aapa mire zone in the classification according to peatland vegetation. The length of the thermal growing season is 120–135 days, and the thermal sum varies from 700 to 850 degree days. Due to the relatively nutrient-poor bedrock typical of the hill area in western Lapland (Manner & Tervo 1988), the number of fertile habitats is rather small and the number of species dependent on such habitats is small. These species can mainly be found along streams on the slopes of the hills.

After the decisions on conservation of old-growth forests, 4.6% of all the productive forest land in the planning region is protected. In the hill area of the entire western Lapland, 1.6% of the productive forest land is under statutory protection. The reason for the small proportion of conservation areas in the whole of western Lapland is not only the barrenness of the bedrock, but also the long history of settlement and forest use in the region. The conservation areas in western Lapland were established in the 1980s in the context of the conservation programmes for mires and old-growth forests. (Basic programme for mire conservation 1981 Rassi et al. 1996). The herb-rich areas in the Ylläs area are also included in the national conservation programme for herb-rich forests (1989).

Even though the threatened vascular plant species and birds of prey and their habitats in the region are fairly well known, data on other groups is very sporadic. However, it is likely that the species in the region also include threatened invertebrates and threatened fungi, mosses and lichens.

4.5 Forestry

4.5.1 History

The utilisation of the forests in the region has long traditions. Swedish sawmills extended their purchasing operations to Finland in the late 1870s, and restrictions on fellings were abolished. This period can be considered as the start of the commercial utilisation of the forest resources in the region.

In the fellings carried out at the end of the 19th century and at the beginning of the 20th century, only saw logs were used. These were floated either along the river Naamijoki or along the Äkäsjoki to the Muonion-Tornionjoki and further to Hellälä, Tornio, where the logs were sorted. At that time, a sawmill of the Kemi company established in 1883 operated in Kemi and a sawmill of the Kurt company operated in Kuusiluoto (Peura 1998). The Veitsiluoto sawmill began operations in the 1920s.

The floating of pulpwood was started when the Kemi company founded a pulp mill on the northern part of the Gulf of Bothnia in 1919, and the demand for pulpwood increased even more with the founding of a mill in Veitsiluoto in 1930. Felling, in which pulpwood was also harvested, was carried out in the 1920s and 1930s, for example in the Iso-Hevosmaa area. As the demand for pulpwood continued to increase, large areas were cut to seed-tree condition, which meant that some 5–10 trees per hectare were left as seed trees. Even small clear cuttings and some thinnings were carried out, for example in Lauttaslaki. In Venerova, some felling of trees of a minimum diameter was carried out in 1946, while in Vaatovaara and Venevaara fellings did not start until the late 1950s.

Until 1968, Metsähallitus sold some logs through standing sales, but since then only delivery contracts have been made. As the roads became better and machinery was introduced in the forests, most forest areas were affected by felling operations.

In the 1950s and 1960s, prescribed burning became the dominant method of soil preparation, which made it possible to increase the number of clear cuts considerably. These were mainly carried out in the southern parts of the region, for example, in Ritola, Kuurusenvaara, Korkealehto, Jalomaa, Alajärvenvaara, Koivurova, Saarivuomankuusikko, Haarasaajo, Limakuusikko and Välilehto. Siikamännikkö was set on fire by lightning and burned almost completely in 1962. Small areas were burned in the northern parts of the region, for example, in Kotarova and east from Hevosmaa along the river Luosujoki, but since then the use of prescribed burning has been of minor significance. In the 1990s, prescribed burning was carried out in areas such as Oravakuusikko, Oravakummut, Karhupalo, Palolovikumpu and Kierrosauttonpalo.

In forest regeneration, patch scarification and planting were introduced in the late 1950s, and the first areas were planted with bare-root seedlings in Saarijärvenkuusikko in 1956. The seedlings were wrapped in packages of 2000 seedlings. This method was very popular until the mid-60s, when dozer scarification was introduced and the hoe gave way to the new machines. When systematic regeneration of forests with poor wood yield on lands with a thick layer of raw humus was started, the need for more intensive soil preparation increased, and scarifiers were replaced by ploughs. Ploughing became the dominant method in the 1970s, but the importance of scarifying began to increase in the 1980s, when natural regeneration through seeding by seed trees became more popular and most regeneration

cuttings were carried out in pine forests. After Metsähallitus phased out ploughing in 1994, the use of scarifying increased and since then it has been the most important site preparation method. Some other methods and equipment were also used in the 1990s, such as a light scarifier attached to a farm tractor, Bräcke hummocking, furrowing-hummocking and excavator scarification.

In the first half of the 20th century, all forest work was carried out by manual labour, and logs were forwarded from the forest by horse or sometimes by reindeer. Chain saws came to the forests in the 1950s. At that time, farm tractors and trucks came into use for the forwarding of timber, and in the late 1960s, some of the logs were forwarded to the sawmills in Kemi by truck. After the Kolari railway was completed (1966), most of the timber from the region was forwarded via the Koivumaa halt and the Sieppimaa and Kolari stations to the mills in Kemi. Since floating on the river Tornionjoki ended in the early 1970s, all timber has been transported by road and rail. In the 1990s, the Pello, Sieppijärvi and Kolari railway stations have been used, through which almost all timber for Metsähallitus is transported from the Muonio and Kolari region.

Although harvesters were not introduced in western Lapland on a larger scale until the early 1990s, the mechanisation level in the area of the Kolari forest team is now over 90%. Today, 20 forest workers and 4 officials work in the area, while in the late 1970s to the early 1980s the number of forest workers was about 100 and number of officials 12.

The first ditching in the region was carried out in the early 1930s, the most significant being in the Teuravuoma area. Most of the ditching was carried out in the 1960s and 1970s. Almost all drained peatlands have been fertilised. However, fertilisation of mineral soil forests has been more limited.

4.5.2 Present status

Moderately dry or nutrient poor mineral soil forests account for 67% (50 186 ha) of the total forest land in the region, and mesic or more fertile mineral soil forests for 33% (24 553 ha). Area and growing stock by land use and main category are presented in table 2.

Overall, the age structure of the growing stock on forest land is distorted due to the fellings carried out. Classification files by age show that 68% of the stands in the region are less than 80 years old (figures 2–3). The proportion of young forests is high especially in managed forests (figure 2). In the natural resource plan for Western Lapland, the definition given for old-growth forest is a forest which is over 140 years old. These forests account for almost 20% of the total forest land. The most valuable old-growth forests are mainly situated in the Ylläs fell, Kurtakkoselkä and Paloselkä-Niesakero areas. The distribution of the tree stands by age is presented in the appended map 6.

Table 2. Area and growing stock by land use and main category.

Land use category	Area, ha	%	Growing stock, m^3	Growing stock, m^3/ha
Managed and recreational forests	71 268		4 758 400	67
- forest land				
- poorly productive land	26 608		608 220	23
- non-productive land	11 508			
Total	**109 384**	**90**	**5 366 620**	
Conserved forests				
- forest land	3 472		460 450	133
- poorly productive land	3 027		72 860	24
- non-productive land	5 737			
Total	**12 236**	**10**	**533 310**	
- forest land	**74 740**		**5 218 850**	**70**
- poorly productive land	**29 635**		**681 080**	**23**
- non-productive land	**17 245**			
Total	**121 620**	**100**	**5 899 930**	

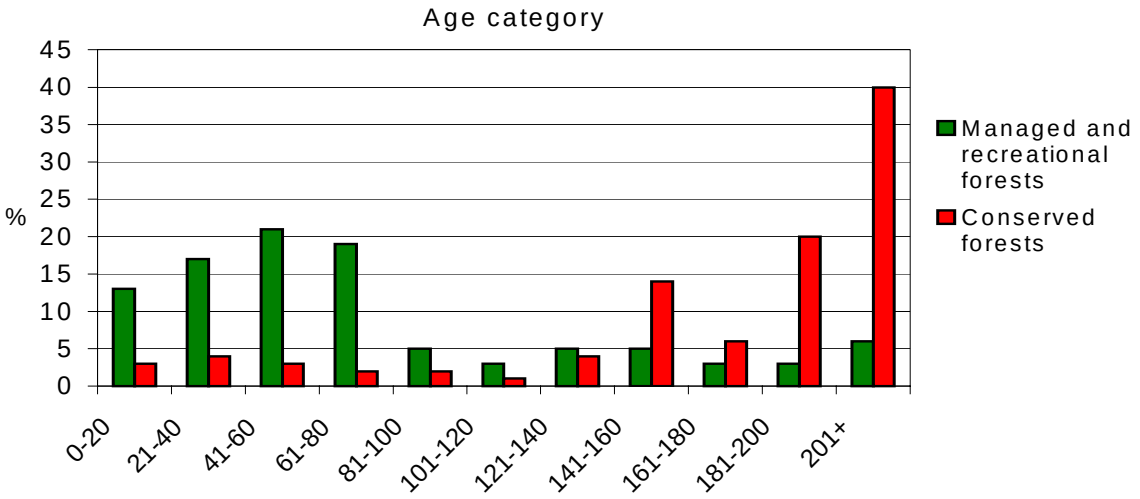

Figure 2. Managed and conserved forests by age category.

The dominant tree species are presented in figure 3 (see also appended map 5). A stand is defined as mixed forest if the proportion of the dominant tree species is less than 80% of the total volume.

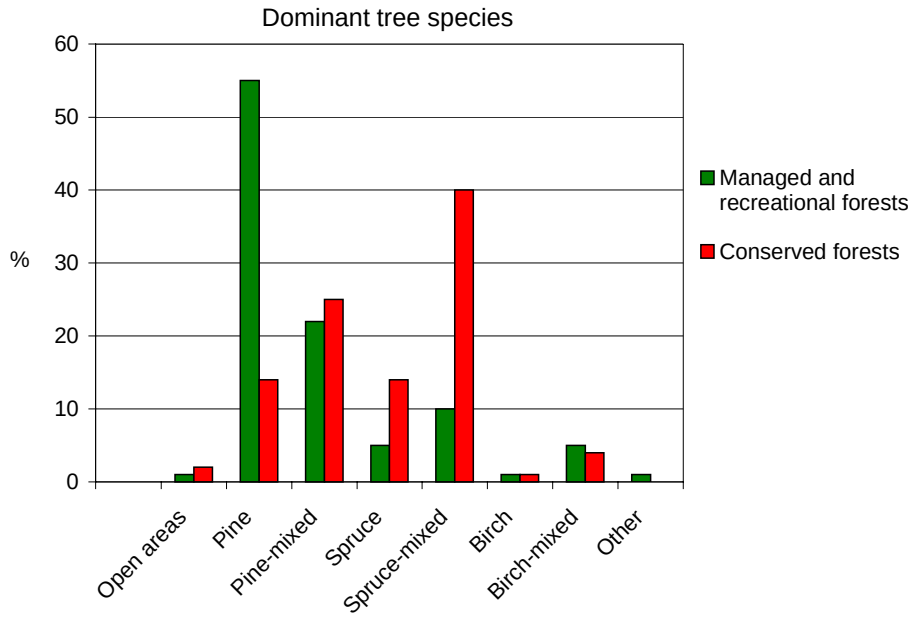

Figure 3. Dominant tree species in managed, recreational and conserved forests.

As shown in figure 3, the proportion of pine-dominated forests is high. However, in the young stands, this is also due to the fact that pine has been favoured in regeneration.

As table 3 shows, there are also some fertile areas in the region. The most significant eutrophic fen area found during the fieldwork is near Kaskisaajo north of the river Ylläsjoki. Small herb-rich forest areas were found in Niesakero, east of Tahkovaara, Honkavaara and on the southern slope of Ylläs fell. According to the Forest Act, the characteristic features of patches of herb-rich forests are to be preserved. Undrained peatlands will also be maintained in their natural state, as Metsähallitus phased out drainage in forest regeneration in 1994. The area of the region by vegetation category is also presented in appended map 4.

Table 3. Forest land and poorly productive land by vegetation category.

Vegetation category	Managed and recreational forests				Conserved forests			
	Forest land		Poorly productive land		Forest land		Poorly productive land	
Mineral soil/peatland	ha	%	ha	%	ha	%	ha	%
Herb-rich forest/eutrophic fen	104	Δ	88	Δ	11	Δ	50	1
Herb-rich mineral soil forest/herb-rich fen	2 594	4	756	3	70	2	26	1
Mesic mineral soil/tall-sedge fen	19 835	28	3 495	13	1 961	56	116	4
Moderately dry mineral soil/low-sedge fen	38 269	54	12 806	48	1 338	39	557	18
Dry mineral soil forest/dwarf-shrub pine bog	10 365	14	6 031	23	92	3	1 214	41
Nutrient-poor mineral soil/*Sphagnum fuscum* bog	101	Δ	2 047	8	-	-	20	1
Sandy patch, lichen heath	-	-	2	Δ	-	-	-	-
Rock	-	-	463	2	-	-	40	1
Fell areas	-	-	920	3	-	-	1 005	33
Total	**71 268**	**100**	**26 608**	**100**	**3 472**	**100**	**3 027**	**100**

Δ in the table means that the figure is less than 0.5.

4.6 Natural dynamics of forests

4.6.1 Defining the natural state of the forests

In the Kolari region, natural forests have mainly been regenerated by wildfires. In certain sites, storms, such as the storm Mauri in 1982, are also a significant factor in forest regeneration. Damage caused by the forces of nature often also work together, for example, a strong wind can fell trees damaged by fire.

The stands in the planning region have been indirectly classified according to the ASIO model. Compartment-specific data in the geographical information system on habitats have been used in the classification. The classification and the resultant division by habitat (table 4) are not based on the occurrences of wildfires established during fieldwork. However, the models can be used to compare the natural and the present structure of the forests, and the results can be used as a basis for defining the objectives of nature conservation and for developing forest management operations.

Half of the spruce swamps and pine bogs have been drained (20 657 ha), and the effects of drainage often extend to the adjacent mineral soil forests. This causes an error when mineral soil forests are classified according to the ASIO model, as certain forests are categorised as dryer than they actually are. For this reason drained forests are discussed below as such, and no effort is made to place them in their original categories according to the ASIO model.

Table 4. Forest land and poorly productive land according to the ASIO model categories.

Category	Peatland	Drainage situation	Area, ha	Proportion, %
A	Mineral soil forest	-	1 829	1.8
	Spruce swamp	Natural state/recently drained mire	1 527	1.4
		Transforming drained mire/transformed drained mire	-	-
	Total		**3 356**	**3.2**
S	Mineral soil forest	-	20 988	20.1
	Spruce swamp	Natural state/recently drained mire	3 105	3.0
		Transforming drained mire/transformed drained mire	1 002	1.0
	Pine bog	Natural state/recently drained mire	601	0.5
	Total		**25 696**	**24.6**
I	Mineral soil forest	-	35 086	33.6
	Spruce swamp	Natural state/recently drained mire	3 086	3.0
		Transforming drained mire/transformed drained mire	591	0.6
	Pine bog	Natural state/recently drained mire	24 012	23.0
		Transforming drained mire/transformed drained mire	448	0.4
	Total		**63 223**	**60.6**
O	Mineral soil forest	-	11 295	10.8
	Pine bog	Natural state/recently drained mire	-	-
		Transforming drained mire/transformed drained mire	805	0.8
	Total		**12 100**	**11.6**
Total			**104 375**	**100**

The natural dynamics and natural state of forests can be estimated with the help of the ASIO model and using the features presented in table 5.

Table 5. Stands by the ASIO model category.

Category	Time between fires, years	Area burned, % of area/year	Proportion of stands of total area, %			
			Post-fire birch stand stages of succession	Post-fire pine stand stages of succession	Spruce stand stages of succession	Pine stands older than 100 years
A (almost never)	-	-	-	-	-	100
S (seldom)	200	0.5	40	-	10	50
I (infrequently)	100	1	10	60	-	30
O (often)	50	2	-	95	-	5

The use of the ASIO model in defining the natural state of forests is discussed in detail in the Aalistunturi plan (Karvonen et al. 1997). The natural species and age distribution of stands on forest land calculated according to the ASIO model are compared with the present state. The results are presented in appended table 1.

4.6.2 Comparison between natural and present state

Table 4 gives a rough estimate of the fire susceptibility of the forests. Drained peatlands are classified as drained, not as peatlands in their natural state, as the original peatland types are not known and since the basis for future operations is the present situation.

On the basis of tables 4 and 5 and the frequencies of fires presented and the areas according to the ASIO model, the theoretical annual burned area in forests in the region can be calculated as 1 002 hectares, which can be divided into the following ASIO categories:

A category	-
S category	128 ha
I category	632 ha
O category	242 ha

The occurrence of burnt wood has therefore always been typical of the ecology of the region. When this situation is compared with the present status, where the latest prescribed burnings were carried out in 1994, it can be seen that the situation has changed considerably (cf. Saari 1923).

In a natural state, the area of post-fire birch stands, which mainly grow on wet and fertile soils, has been estimated at 12 450 ha or almost 17% of the total forest and poorly productive land (appended table 1). Today the area of birch-dominated stands is 5 100 ha or 7% of the total forest and poorly productive land, which is considerably less than would be the case in a natural state (see 5.2.4).

On the basis of the calculations according to table 4, the area of post-fire pine stands was 49 430 ha (areas of I and O categories) in forests in their natural state. In quantity the present proportion of pine-dominated forests and their age structure is comparable to forests in a natural state, as 42 100 ha of forest and poorly-productive land are exclusively pine stands. On the other hand, in structure the stands differ from a forest in its natural state, as post-fire

pine stands in a natural state usually consist of more uneven-aged trees than the present managed pine stands. The area of pine stands that could be classified as uneven-aged stands in a natural state was 7 350 ha or 10% of the total forest land (at least category O).

The proportion of stands older than 100 years presented in table 4 describes the proportion of old-growth and mature stages of succession in a natural state. These are mostly pine-dominated stands, such as the stands in Vittavaara, Paloselkä and part of the Ylläs fell area. In a natural state the total area of these forests is 27 100 ha or 36% of the total area of forest and poorly productive land. In the present state, the figure is 28% of forest land at the moment. The difference is rather small considering the history of forest management in the region.

Some of the forests on fine mineral soils and paludified mesic mineral soil forests, small forested islets surrounded by peatlands and spruce swamps along streams have never burned, or there have been hundreds of years between the fires. According to table 5, the area of these fire refugia (category A) is 3 356 ha or 3% of the total area of forest and poorly productive land.

5 SUB-SECTIONS OF THE PLAN

5.1 Nature conservation areas and valuable habitats

The core of nature conservation in the planning area is formed by statutory conservation areas, areas included in the programme for mire conservation and the areas to be established for conservation of old-growth forests. The purpose of this plan is not to increase the number of the actual conservation areas, but to address the key elements in terms of biodiversity, which include the ecological links with restrictions on use joining the conservation areas in managed forests, the key biotopes and the habitats of threatened species. In this way, special attention can be given to these valuable habitats and as many as possible can be preserved in present operations. The aim is also to control the use of managed forests so they form an ecologically functioning and sustainable entity together with the conservation areas. Hence, the inventories of valuable habitats have mainly focused on managed forests, as this has been considered the most effective way to serve both the ecology and the planning of operations in the region. The inventory of key biotopes planned for the conservation areas will supplement the already existing information concerning ecological values in the region. In this plan the impact of nature conservation areas can mainly be seen in the setting of objectives for managed forests.

5.1.1 Nature conservation areas

The nature conservation areas consist of various conservation areas and programmes. There are no conservation areas in the region established on the basis of a special separate decision by Metsähallitus. The northern part of the planning region borders on a significant conservation area north of Ylläs fell, which includes the Ylläs-Pallas old-growth forest conservation area (37 351 ha) and the National Park of Pallas-Ounastunturi (50 900 ha). The major part of these areas is situated in the municipalities of Kittilä and Muonio. The total area of the conservation areas (table 6) in the planning region is 12 236 ha, which is 10% of the land area in the region. When key biotopes, the habitats of threatened species and ecological

links are taken into account, the protected area can be considered sufficient. It has been proposed that some of the conservation areas should be included in the Natura 2000 network (n = Natura proposal). An EU Life project called Conservation of the Ylläs-Aakenus Taiga Forest Area in Lapland was started in the Ylläs-Pallas area in 1999. In this project, the conservation and recreation values of the area are being developed and aligned with each other. The area has also been proposed as a national park.

Table 6. Conservation areas in the planning region by area.

	Natura proposal	Forest land	Poorly productive land	Non-productive land	Total
Sites included in the old-growth forest conservation programme					
Ylläs-Pallas (extends into Kittilä and Muonio)	n	957	343	714	2 014
Kurtakkoselkä		273	95	35	403
Kiuaskero (extends into Muonio)		50	98	1	149
Karhujupukka		226	85	107	418
Niesaselkä	n	775	831	247	1 853
Keinosaajo		34	10	7	51
Juustovuoma		37	-	-	37
Herb-rich forest conservation sites					
Varkaankuru (Ylläs)		31	7	-	38
Mustavuoma (Ylläs)		43	2	-	45
Peatland conservation sites					
Juustovuoma	n	86	161	515	762
Karhuvuoma	n	26	80	418	524
Teuravuoma-Kivijärvenvuoma	n	707	1 031	3 237	4 975
Sieppijänkkä-Pieruvuoma	n	226	285	456	967
Total					**12 236**

There are 3 144 ha of old-growth forests, i.e. forests of over 140 years of age, in the conservation areas. The dominant tree species and the age of the stands on forest land in the conservation areas are presented in table 7.

Table 7. Conservation areas by dominant tree species and age of the stand on forest land.

Age category	Treeless		Pine-dominated		Spruce-dominated		Broadleaf-dominated		Total	
	ha	%	ha	%	ha	%	ha	%	ha	% of forest land
0	77	100							77	0.1
1–50			65	5	6	0	8	5	79	0.1
51–100			29	2	12	1	46	26	87	0.1
101–140			47	4	23	1	15	8	85	0.1
141–200			442	32	803	43	96	55	1 341	1.7
201 +			762	57	1 030	55	11	6	1 803	2.4
Total	**77**	**100**	**1 345**	**100**	**1 874**	**100**	**176**	**100**	**3 472**	**4.6**

5.1.2 Valuable habitats or key biotopes

The methods used during the planning process to inventory valuable habitats have been presented in chapters 3.1-3.3 on the preparation of the plan. The objective has been to ensure that natural habitats of the region are preserved comprehensively in their natural state, either in the conservation areas, in the ecological links or in the protected valuable habitats.

On the basis of the field inventories, compartment data, etc. the key biotopes were classified as presented in table 8. The classification is based on the most important key biotope indicator of the site, and other values have not been taken into account in the areas calculated. Habitats of valuable species are discussed in chapter 5.1.3.

Table 8. Number and area of valuable habitats in managed and recreational forests in the region

Valuable habitat (GIS code)	no.	Area, ha				Proportion, %	
		Forest land	Poorly productive land	Non-productive land	Total	of forest land	of total area
Spring	9	4	13	7	24	Δ	Δ
Stream	110	429	147	41	617	0.6	0.6
Small lake	8	9	20	11	40	Δ	Δ
Deep post-glacial hollow	1	1			63	Δ	Δ
Rock	15	25	279	49	353	Δ	0.3
Cliff, shady slope	2	4	20		24	Δ	Δ
Gorge, gully	3	4			4	Δ	Δ
Herb-rich forest	13	51	2		53	0.1	Δ
Fertile mire	23	70	52	23	145	0.1	0.1
Forest islet surrounded by peatland	33	48			48	0.1	Δ
Nutrient-poor mire	1			5	5	Δ	Δ
Old-growth forest	80	496	129		625	0.7	0.6
Old broadleaf forest	6	20			20	Δ	Δ
Early stage of succession	6	10			10	Δ	Δ
Other valuable habitat	24	9	106	37	152	Δ	0.1
Total	**335**	**1 242**	**768**	**173**	**2 183**	**1.7**	**2.0**

Δ in the table means that the figure is less than 0.05.

The key biotopes are often so small in area that it was not possible to inventory them all in this plan or to record them in the plan drawn up at the compartment level. The numbers and areas of key biotopes given in table 10 are therefore not final, but they will be supplemented when future measures are planned. The Forest Act and the Environmental Guidelines to Practical Forest Management require that valuable habitats should be protected and taken into account when carrying out felling and other measures. The number and proportion of statutory valuable habitats was defined during the field inventories as described in table 9.

Table 9. Statutory valuable habitats in managed and recreational forests.

Valuable habitat	Valuable habitat in total ha	Compartments no	Statutory valuable habitats Forest Act, ha	Nature Cons. Act, ha	Proportion, % of total area
Spring	24	1	2		Δ
Stream	617	1	3		Δ
Small lake	40				
Deep post-glacial hollow	63				
Rock	353				
Cliff, shady slope	24				
Gorge, gully	4				
Herb-rich forest	53	9	35		Δ
Fertile mire	145	4	20		Δ
Forest islet surrounded by peatland	48	11	8		Δ
Nutrient-poor mire	5				
Old-growth forest	625				
Old broadleaf forest	20				
Young succession stage	10				
Other valuable habitat	152				
Total	**2 183**	**26**	**68**		**0.1**

Δ in the table means that the figure is less than 0.05.

The volume of deadwood in the key biotopes is given in chapter 5.2.5. It must be noted that all biotopes were not measured, but, for example, a spring or a compartment considered valuable in the inventory of old-growth forests may have been recorded as a key biotope. These compartments are not included in the appended table 1.

In addition, one requirement made in the context of preparing the national conservation programme for old-growth forests (Rassi et al. 1996), was that special attention should be given to so-called a-areas in landscape ecological planning. These areas were considered to be more profitably conserved in this way on account of their lesser ecological values, location or small size or because of their fragmentation. The Otusmaa old-growth forest area also belongs to the above areas. The total area of Otusmaa is 897 ha, and it can be divided into the following main categories: forest land 288 ha, poorly productive land 233 ha and non-productive land 376 ha. The environmentally valuable sites (core areas) in these a-areas were recorded in the geographical information system as presented in table 10.

Herb-rich forest along the banks of a stream in the Varkaankuru herb-rich forest conservation area.

Table 10. Land use decisions and restrictions on use in the so-called a-areas.

	Forest land	Poorly productive land	Non-productive land	Total	Proportion, % in the a-area	
	ha	ha	ha	ha	of forest land	of total area
Game habitats	1			1	Δ	Δ
Valuable landscapes	70			70	24	8
Valuable habitats	88		27	115	40	13
Total	**159**		**27**	**186**	**65**	**21**

Δ in the table means that the figure is less than 0.5.

There are some eutrophic fens on the peatlands of the a-area, but they were not made into separate compartments due to the limited time. The peatlands in the area are in a natural state and in themselves valuable sites, which is why they will be left untouched by forest management operations. (Metsähallitus 1997a).

Furthermore, some sites have been selected that will be allowed to return to their natural state as self-restoring sites. These sites mainly include old, lightly managed forests, where restoration aims at increasing the number of old-growth forests in the region. The most important of these sites are the summit of Paloselkä, part of the Otusmaa area, the northern part of Lompolovaara, the summit of Ristimellanvaara and a compartment on the southern slope of Taporova. In addition, some sites will be allowed to develop through self-restoration to improve the value of the adjacent valuable habitats. These areas include the peatlands south of the Keinosaajat old-growth forest conservation area and around Haukijärvi. No areas that should be subject to active restoration measures have been defined in the region.

5.1.3 Habitats of threatened species

The farther north the landscape ecological planning advances, the more barren are the habitats found. For this reason special attention must be given to the conservation of the habitats of narrow-niche plant species and invertebrates. Old stands with features typical of old-growth forests on fertile mineral soils (herb-rich forests) and in fertile spruce swamps will be left outside the scope of forest management operations, and they have also been recorded in the geographical information system as old-growth forests.

All large predatory animals occurring in Finland, i.e. brown bear (*Ursus arctos*), wolf (*Canis lupus*), northern lynx (*Lynx lynx*) and wolverine (*Gulo gulo*) can occasionally be found in the Kolari planning region.

There are many known nesting territories of the golden eagle (*Aquila chrysaetos*) in the region. Some of these are in managed forests, some in the old-growth forest conservation area. The Natural Heritage Services have drawn up a nest-specific protection plan for each territory, defining the nesting areas to be left outside all operations and the surrounding impact areas in which operations are restricted. In these areas all operations disturbing nesting should be avoided during February-August. The general guidelines for the protection of the nesting areas of golden eagles and other birds of prey are provided in the Environmental Guidelines (Metsähallitus 1997a). As regards other threatened species occurring in the region, the extent of the restrictions should be decided on the basis of the species' habitat requirements.

Four nationally threatened vascular plant species have been found in the region: calypso (*Calypso bulbosa*), yellow marsh saxifrage (*Saxifraga hirculus*), *Carex heleonastes* and *Anthylis vulneraria* subsp. *lapponica*. Eleven regionally threatened (vulnerable or in need of monitoring) vascular plant species have been found in the region. Most of the habitats are in managed forests. The herb-rich forest conservation areas Varkaankuru and Mustakuru are naturally also valuable due to the rich variety of species found in them.

In inventories carried out previously in the region, three nationally threatened fungi species were found: *Bovista tomentosa*, *Calocybe onychina* and *Haploporus odorus*. Some of the habitats are in managed forests. In addition, an inventory of bracket fungi and lichen was carried out in the future Ylläs-Aakenus conservation area in 2000. This is to be continued in the year 2000. Some of the inventories were made in Kolari, e.g. in Tunturipalo, Varkaankuru and in the surroundings of Kesänkijärvi. According to the preliminary results, 92 different bracket fungi species, 19 of which are threatened species, were found in the entire Ylläs-Aakenus area. In addition, 33 species of the Thelephorales and Corticiales orders were identified in the inventories. According to the inventories, the spruce-dominant forests in the conservation area have very high conservation value. In particular, the gorge valleys in the area were very varied. The variety of bracket fungi species in pine-dominated forest was slightly poorer, but the pine-dominated forests were still classified as being of very high conservation value (Niemelä & Dai 2000).

In the Ylläs-Aakenus lichen inventory, six nationally threatened (in need of monitoring, declining) and three regionally threatened lichen species were found. In general, the variety of lichen species in the region is relatively poor (Halonen & Jääskeläinen 2000). However, only a few species inventories have been carried out, and thus the data on threatened mosses and lichens are limited at the moment. It is also assumed that threatened species can be found in the waterways in the region. The number and areas of habitats of different types of species are

presented in table 11 (the results of the above-mentioned bracket fungi and lichen inventory in the Ylläs-Aakenus area are not included in the table).

Table 11. Number and areas of habitats of different types of species in the planning region.

Habitats of valuable species	Habitats, no		Habitats, area, ha		
	Managed and recreational forests	Conserved forests	Managed and recreational forests		Conserved forests
			forest land	all land	
Species requiring special protection	8	1	233	247	5
Nationally threatened species	29	2	383	411	217
Regionally threatened species	47		316	354	
Other important species	5		12	16	
Total	**89**	**3**	**944**	**1 028**	**222**

5.1.4 Protection of waterways

Site preparation measures that would have an impact on water quality are to be avoided in the Pitkäjärvi, Naalasto, Paloselkä, Ruostevaara, Ylläs, Taporova, Ampiaislehto, Venerova, Halju and Lauttauslaki groundwater areas and in the catchment area of the river Naalastojoki, which is a spawning river for sea trout (*Salmo trutta trutta*). There are many streams in their natural state in the region, the most valuable of which have been entered in the geographical information system together with their surroundings as key biotopes. The streams in the Taporova, Kiuasselkä, Kaupinselkä and Malmivaara area in particular are such valuable minor water bodies. In addition, the minor water bodies that have been considered valuable in the inventory carried out by the Regional Environment Centre (Raatikainen 1995) have been entered in the geographical information system. The above-mentioned minor water bodies are to be taken into account in all forest management operations, and no forest management or other operations that have a significant impact on water quality should be carried out in other catchment areas of minor water bodies (Metsähallitus 1997a). There are also many springs and seepages in the region that should be taken into account in operational planning. Minor water bodies valuable in terms of the environment and fish management are listed in appendix 4.

Drainage and peat production, which are to be increased in the region, always have impacts on waterways. In the Teuravuoma peat production area managed by VAPO operations are controlled by the Lapland Regional Environment Centre. The Environmental Guidelines to Practical Forest Management (Metsähallitus 1997a) are to be followed in the planning of improvement ditching projects carried out by Metsähallitus.

5.1.5. Ecological network

The core of the nature conservation network is formed by the statutory conservation areas and reserves. In addition, the key biotopes complement this network. Ecological links were specified in order to connect the above-mentioned sites and thus improve the conditions for the spread of threatened species (map 3). The distribution of the ecological network by vegetation categories is presented in appended table 2.

The Ylläs area, being a large nature conservation area, serves as a home base for the core populations of threatened species. From there, the threatened species can move to other nature conservation areas. The most important corridors were formed between the Karhujupukka and Kurtakkoselkä old-growth forest conservation areas and between Kurtakkoselkä and the Teuravuoma-Kivijärvi peatland conservation area. In addition, they serve game management and increase biodiversity in the region. The banks of the streams in the region function as ecological links between islets of old-growth forests.

The total area of ecological links is 760 ha (excluding the key biotopes within them). Their areas are presented by main category in table 12.

Table 12. Ecological links in managed and recreational forests by main category.

Vegetation category	Area, ha				Proportion, % of the managed and recreational forests	
	Forest land	Poorly productive land	Non-productive land	Total	of forest land	of total area
Herb-rich forest	73	16		89	0.1	Δ
Mesic forest	114	48		162	0.2	0.1
Moderately dry forest	117	158		275	0.4	0.2
Dry forest	6	100		234	0.3	0.2
Total	**310**	**322**	**128**	**760**	**1.0**	**0.5**

Δ in the table means that the figure is less than 0.05.

5.2 Development of forest management operations

5.2.1 Forest management operations in the valuable habitats

The valuable habitats in the region have been defined (5.1.2), and they have been entered in the geographical information system using ecological codes (appendix 1). These sites are managed in accordance with the instructions given (Hallman et al. 1996) and the provisions of the Forest Act. Usually, key biotopes are either completely excluded from management operations, or the operations are aimed at retaining their special features. However, the landscape, recreation and game areas are utilised for forestry, but their special features should be taken into account. Capercaillie lekking sites must be identified and the instructions given for operations in these sites are to be followed (Metsähallitus 1997a, Helle et al. 1999).

An old-growth forest on Kesänkitunturi fell in the Ylläs-Pallas old-growth forest conservation area.

Spruce-dominated stands in the ecological corridors are excluded from forest management operations. Minor regeneration cuttings (phased regeneration) can be carried out in pine-dominated stands. In such cases 10-20 m^3/ha retention trees should be left in the cuttings. Uneven-aged stands are retained as multi-storeyd stands. Forest management operations in sites of special value should be agreed on with the Forestry Centre so that no disputes will arise concerning the application of the Forest Act. Ecological corridors can also include areas with brushwood important for game management (areas with willow). Some of the drained peatlands can be left to return to their natural state autonomously (not entered in the geographical information system).

5.2.2 Forest management models and retention trees

The basis for operations in this planning region should be forest management that emulates nature as far as possible. The ASIO model can be used as a foundation for the principles of forest regeneration. The objective is to ensure that different methods of regeneration cutting are used on the various sites so that they mimic natural regeneration methods wherever possible (size, shape and location of the regeneration site). This also makes it possible to regulate the distribution of the compartments according to size and location in the forest.

Retention trees are to be left standing in cuts (Metsähallitus 1997a). The principles for retaining trees are specified in appendix 2 with the aim of giving special attention to variety of trees and tree-groups within the forest.

5.2.3 Proportion of old-growth forests

In the natural resource plan for Western Lapland, the minimum for the proportion of old-growth forests has been set at 10% of forest land (calculation stressing ecological values, Sandström et al. 1999). At the moment, the proportion of forests over 140 years of age is 19.9% of forest land (14 921 ha) in the region. This includes all old-growth forest conservation areas. The proportion of fire refugia was 3% of forest and poorly productive land (table 5).

The region includes old-growth stands (over 140 years of age) marked as being subject to restricted use according to the plan on forest and poorly productive land (growing stock over 20 m^3/ha), as described in table 13.

Table 13. Old-growth stands with restrictions on use on forest land and poorly productive land.

	Forest land > 140 years	Poorly productive land > 20 m^3/ha	Total	Proportion, % of the managed and recreational forests	
				of forest land	of total area
1. Permanent sites					
-areas reserved for old-growth forest conservation	2 203	1 463	3 668	5	3
- peatland conservation areas	868	1 555	2 423	3	2
- herb-rich forest conservation areas	73	10	83	Δ	Δ
- habitats of valuable species	610	75	879	1	1
- valuable habitats	951	763	1 714	2	1
- areas excluded from forest management operations	241	18	259	Δ	Δ
- ecological spruce and birch corridors	271	64	335	Δ	Δ
Permanent sites in total	5 217	3 948	9 361	13	7
2. Changing sites (extended rotation time)					
- cultural sites	25		25	Δ	Δ
- game habitats	1 405	358	1 763	2	1
- valuable landscapes	1 466	331	1 797	3	1
- ecological pine corridors	100	293	393	1	Δ
Changing sites in total	2 996	982	3 978	6	3
Total, sites 1–2	**8 213**	**4 930**	**13 339**	**19**	**11**

Δ in the table means that the figure is less than 0.5.

In addition, all poorly productive forests are excluded from operations, except for drained peatlands that are suitable for improvement ditching or maintenance. This means that 5 543 ha of spruce swamps and 20 822 ha of pine bogs i.e. a total of 26 364 ha on forest and poorly productive land are left to develop naturally (25.2% of forest and poorly productive land). The area of poorly productive and non-productive land in mineral soil forests is 3 669 ha (4.9% of forest land). Taking into account the permanent and changing old-growth forests mentioned above, the proportion of old-growth forests can be considered good, this despite the fact that 75% of the old-growth forests and 39% of the conserved forests are pine-dominated. The target proportion of old-growth forest (over 140 years of age) in the forest area can be set at 10% (approx. 7 400 ha) of forest land.

Targets for the next 50 years:

- *The proportion of old-growth forests should be at least 10% of forest land or 7 400 ha. Poorly productive forests in their natural state are excluded from operations.*

5.2.4 Distribution of various tree species and fire successions in managed forests

In the natural resource plan for Western Lapland, the target set for the proportion of birch forests in the planning region in 40 years is 8% (some 4 800 ha). In this plan, the aim is to increase the proportion of birch-dominated forests (the proportion of birches 50–100%) to 8 per cent of forest land in 50 years, and some of these should be exclusively birch stands (the proportion of birches 80–100%). This means that on average 40 ha of birch-dominated stands are established yearly in regeneration and young stand management. In regeneration with silver birch (*Betula pendula*), natural regeneration by regeneration cutting or by leaving seed trees can be used in mesic forests. Peatlands and paludified mesic mineral soil forests can be regenerated with downy birch (*Betula pubescens*). When using birch, the requirements laid down in the Forest Act are to be taken into account. Birch forests usually also contain aspen, the proportion of which is minimal at the moment. Groups of aspen should be favoured during young stand improvement. However, it is not worthwhile to establish birch stands near summer grazing areas of reindeers. In future young stand improvement and intermediate cutting, the proportion of birches should be increased by 20–50 per cent, depending on the site.

The proportion of pine-dominated forests is sufficient, and it can be assumed that an increase in the proportion of birches will lower the proportion of pine. The age structure of pine stands is rather young (see appended table 1). The problem with pine stands is mainly their even-aged structure; after a wildfire some pine stands evolve into uneven-aged stands. The Aalistunturi plan presents methods that can be used to establish stands of more uneven age. These methods are used within the scope permitted by the Forest Act. The aim is to retain the structure of the present uneven-aged and multi-storeyd stands in future fellings. Such pine stands have grown naturally on dry mineral soil, and they have been established after wildfires. In dry mineral soil forests, prescribed burning should be favoured, but ancient pines and groups of retention trees should also be left standing in the wet depressions in the burned area.

As a result of natural succession, spruce-dominated forests are usually old-growth forests. In the planning region, too, the stands are old-growth forests (see appended table 1). Young spruce stands (0–40 years) account for 3.1% of forest land, and the proportion of intermediate spruce stands (40–100 years) is 3.5%. As fertile sites will be regenerated with birches, new young spruce stands will be established as undergrowth. The cultivation of spruce will also improve the age distribution in spruce stands, thus cultivation of spruce can be recommended in suitable sites. In such cases, broadleaves can also be grown as secondary species.

Targets for the next 50 years:

- *The proportion of birch-dominated stands (proportion of birches 50–100%)should be 8% of forest land, so birch-dominated stands should be established at a rate of 40 ha a year.*
- *The structure of the present uneven-aged and multi-storeyd stands will be retained.*

5.2.5 Proportion of deadwood

The volume of deadwood was measured for 436 compartments in the planning region, in a total area of 2 481 ha (see 3.2). The volume of deadwood by volume category is as follows:

	Volume of decaying wood, on average m^3/ha	Volume of deadwood m^3/ha				
		<2	2–5	5–10	10–20	20–50	> 50
		Total area of compartments				
Managed and recreational forests	17.2	203	226	763	657	502	130

The maximum volume of dead standing trees per compartment was 51 m^3/ha, and that of fallen trees 167 m^3/ha. The maximum total volume of deadwood measured was 167 m^3/ha. This compartment is located in Niesakero.

The volume of deadwood was measured in accordance with the guidelines for the geographical information system (3.2). Most inventories were carried out for potential key biotopes, thus the results do not describe the average volume of deadwood in the planning region. Only one small compartment was measured in the conservation areas due to the limited time. The average volumes for the inventoried compartments are presented in table 14. The volume of retention trees measured for living trees is also presented in the table. This describes the special features of the growing stock (e.g. sturdy aspens and ancient pines).

Table 14. The volume of decaying wood and retention trees in the inventoried compartments.

Managed and recreational forests	Decaying wood, measured		Volume of decaying wood m^3/ha			
	ha	% of area	standing trees	fallen trees	in total	retention trees
- forest land	2 257	3.2	4.0	13.9	17.9	5.7
- poorly productive land	225	0.8	1.2	11.2	12.4	18.8
Total, on average	**2 481**	**2.6**	**3.8**	**13.6**	**17.4**	**6.9**

The key biotopes and the old-growth forest conservation areas ensure that the habitats of species dependent on deadwood can be preserved in the region. The aim is to leave retention trees in managed stands, so that the amount of deadwood in managed forests will increase with time. In regeneration and intermediate cuttings, sturdy retention trees amount to 5–10 m^3/ha, so that the volume of stock in various stages of decay is at least 15 m^3/ha if the complete decaying process takes 100 years on average. In addition, some trees die naturally between fellings.

Targets for the next 50 years:

- *In regeneration and intermediate cuttings, sturdy retention trees should amount to 5–10 m^3/ha.*
- *In cuttings in the vicinity of valuable habitats and ecological links, sturdy retention trees should amount to 10–20 m^3/ha.*

5.2.6 Proportion of burnt wood (prescribed burning)

As stated earlier, the last prescribed burnings in the region were carried out in 1994. The theoretical annual burned area in natural forest in the region, according to the ASIO model, would be 970 ha. This might be an overestimation, as according to Saari (1923), for example, the average annual burned area in the region in 1911–21 was 0.10–0.25 per mille of total land area i.e. 10–25 ha a year. At the beginning of the 20th century, the small area burned by wildfire was the result of effective fire prevention. However, more relevant to the forest ecosystem is the fact that for years there has been no burnt wood, which previously played an important part in the ecology of the region. Burnt wood in recently burned areas (under three years) has been vital for many now threatened species dependent on it. For this reason the continuous availability of burnt wood should be ensured in certain areas. The burned over areas can be located far apart from each other (some 5–10 km), as the species in question spread easily.

The primary method of producing burnt wood should be prescribed burning. This method can be used on moraine soils, which can be found e.g. in Karhupalo, Kelhu and the Piimäjänkä area. Another method for increasing the volume of burnt wood is to burn the standing trees in small forest islets (2–4 ha) surrounded by peatlands e.g. in the peatland conservation areas.

According to the ASIO model, wildfires are most common in dry mineral soil forests with little raw humus; however these sites should not be burned so as not to impoverish the soil. Some 10 m^3/ha retention trees of different species should be left in burned areas. In addition, wet depressions in the site should be excluded, or if there are many of them, the economically most valuable trees can be harvested. The target for prescribed burning can be set at a minimum of 40 ha at intervals of three years. The sites to be burned over are selected in operational planning.

***Targets for the next 50 years**:*

- *Prescribed burning will be carried out at a minimum rate of 25 ha a year or 75 ha per maximum period of three years. In the areas to be burned over, sturdy retention trees should amount to 5–10 m^3/ha.*

5.2.7 Maintenance of drainage areas

In the planning region, peatlands account for 51 468 ha, 41% of which have been drained (21 177 ha). Most of the ditching was carried out in 1950–1980. As table 18 shows, a significant part of the previously drained peatlands is now assessed as undrainable. It should also be noted that most of the data in the geographical information system were collected in conjunction with the forestry inventory carried out in the late 1980s. Since the criteria for maintaining drained peatlands have been revised in recent years, the number of sustainable peatlands is currently even smaller than the figure given in the table. In the future, improvement ditching is to be carried out at an average rate of 250 ha a year.

Table 15. Drainage situation and sustainability of peatlands.

Peatland	Ha	% of all land	Drained		Drainable and sustainable	
			ha	%	ha	%
Spruce swamps	9 370	7	5 097	54	3 850	41
Pine bogs	29 800	24	15 561	52	8 991	30
Open mires	12 299	10	519	4		

The total area of undrained peatlands in the region is 30 291 ha, of which 10% is forest land (3 168 ha), 41% poorly productive land (12 397 ha) and 49% non-productive land (14 746 ha). In the geographical information system, drained peatlands have been classified into three categories according to the draining impact.

The poorest drained areas are allowed to return to their natural state, mostly without any active measures, so no areas that should be subject to active restoration measures are proposed in the plan. More information on the restoration of peatlands is available in the guide book on the subject (Heikkilä & Lindholm 1995).

No valuable habitats were found in the drained peatlands in the inventories. Valuable minor water bodies should be taken into account in improvement ditching, and water protection measures should be aimed at protecting these water bodies in particular. The valuable minor water bodies found in the region are listed in appendix 4.

5.2.8 Forest roads

The target density of the road network was set at 4.7 m/ha in the Pello unit's forest management plan drawn up in 1991. Currently the density of the road network is 5.7 m/ha. There is no need for building new trunk and district roads in the region. In the future road construction will focus on building branch roads and on the renovation of the trunk and district roads. The need for additional roads is presented in the appended table 4.

The target for areas reserved for winter-time operations only is some 35% (24 900 ha) of the forestry area. Honkavaara and the areas in the east to the river Pasmajoki should be reserved for winter-only activities, and no summer roads are built. This is the best way to ensure the conservation of the traditional forest landscape.

In planning summer and winter routes, valuable habitats such as streams, springs and fertile depressions should be taken into account (Niemelä 1995). A detailed description of the road network is presented in the appended table 4.

5.3 Landscape, recreational use and nature-based sources of livelihood

5.3.1 Reindeer husbandry

The Kolari region is divided between the Kolari and Muonio reindeer herding cooperatives. Most of the area is used by the Kolari herding cooperative. The roundup corrals of Suolakangas, Rässälehto, Pohjasenvaara, Ruostevaara, Karjalainen, Asumaa and Otusmaa are situated in the area of the Kolari herding cooperative, and the roundup corrals of Rautuvaara, Lamumaa, Sainkangas and Luosu in the area of the Muonio herding cooperative.

The grazing lands used by the cooperatives differ from each other. The best lichen sites, for example, are located north of the river Ylläsjoki in the area of the Muonio herding cooperative, while the best grazing lands for autumn food are in the central and eastern parts of the area of the Kolari herding cooperative.

The lack of winter grazing lands i.e. the physical deterioration of the lichen areas is problematic for reindeer husbandry in the region (Kumpula et al. 1996). The shortage of tree stands providing beard lichen causes problems in the late winter, although the old-growth forest conservation areas established in the region preserve some of the beard lichen areas. The area suitable for summer and autumn grazing is sufficient. The productivity of reindeer husbandry in the region is mainly based on the efficient utilisation of summer and autumn grazing lands and the provision of feed in the winter period.

Practical forestry can take allow for reindeer husbandry in many ways. Harvesting in areas where lichens are abundant is avoided during dry summer periods, and fellings in tree stands containing beard lichen are carried out in mid- and late winter. Site preparation should be as light as possible. When planning forest management operations, reindeer husbandry structures such as the corrals associated with the rotation of grazing lands and the cabins used in reindeer husbandry should be taken into account. However, the dense forest road network also facilitates reindeer husbandry operations.

5.3.2 Game and fish management

In forestry as practised by Metsähallitus game habitat management has occupied an important position for several years. The most effective and advantageous long-term form of game management is the conservation and restoration of existing game habitats and the establishment of new ones (Metsähallitus 1997a). During the past few decades, the changing age distribution of forests has affected the habitats of capercaillie and hazel grouse in particular. This explains why it is important to manage the habitats of these species in the right way. The known habitats have been entered in the geographical information system. Active game management is mainly carried out by the local hunting societies, which establish feeding fields for game animals and provide salt licks for elks.

The most significant of the flowing waters in the region are the rivers Muonionjoki, Naamijoki, Äkäsjoki and Kuerjoki. The most important fish species are salmon (*Salmo salar*) and trout (*Salmo trutta trutta*). The river Muonionjoki has become one of the most significant recreational fishing areas nationally. In addition to the usual fish species, grayling (*Thymallus thymallus*) and brown trout (*Salmo trutta fario*) are found in several other flowing waters in

the region. Hannukaisenlammet, Kesänkijärvi and Äkäsjoki are recreational fishing areas. Fishing for household use takes place in the commercial fishing areas, and affects their natural fish stocks and sustainable use.

Game habitats with restrictions on use have been entered in the geographical information system as shown in table 16.

Table 16. Number and area of game habitats in managed and recreational forests in the region.

Game habitat	Compartments,	Area, ha				Proportion, % of the managed and recreational forests	
	no.	Forest land	Poorly productive land	Non-productive land	In total	of forest land	of total area
Capercaillie lek, in use	1	4	-	-	4	Δ	Δ
Capercaillie lek, to be developed	9	90	-	1	91	0.1	0.1
Capercaillie lek, confirmation required	33	305	2	-	307	0.4	0.3
Black grouse lek	3	16	-	-	16	Δ	Δ
Hazel grouse habitat	8	25	3	-	28	Δ	Δ
Animal burrows	1	3	-	-	3	Δ	Δ
Other game habitat	374	963	352		1 315	1.4	1.2
Total	**429**	**1 406**	**357**	**1**	**1 764**	**1.9**	**1.6**

Δ in the table means that the figure is less than 0.05.

5.3.3 Recreation and valuable landscapes

Recreational use of forests has become increasingly common as a form of land use in the region during the past few decades, concentrated on the Ylläs fell area and its surroundings in the northeastern part of the region. Ylläs fell is known for its ski slopes. The need to preserve the ecological values of the region was discussed as early as in the 1950s, and the Äkäsjoki fell area recreational forest was established in 1955. Most of this area belonged to the municipalities of Kittilä and Muonio, and it covered 14 253 hectares in the Ylläs, Kesänkitunturi, Lainiotunturi, Pyhätunturi and Aakenustunturi area and Iso-Kukasvaara with its surroundings. Later, in 1970, the area was turned into a landscape forest, and some new areas reserved for this purpose were included in it, mainly areas between the forest and the Pallas-Ounastunturi National Park. After this the total area was 41 187 ha, and the aim was to serve recreational needs and to conserve valuable habitats. The present old-growth forest conservation area covers most of the former landscape forest. Areas that are clearly affected by tourism-related building and their immediate surroundings are defined as recreational forests and excluded from the conservation area. These areas are also defined as areas serving tourism and recreation in the regional plan for northernmost Lapland. The extensive Ylläs recreational forest area includes the summits of Keskinen, Kuertunturi and Nilivaara and the areas between them. In addition to the ski slopes, popular attractions include the Varkaankuru Nature Trail on the edge of the conservation area and the numerous hiking, skiing and

snowmobile routes crossing the recreational and conservation areas, but also extending to the managed forests in the region.

In 1998, Metsähallitus proposed to the Ministry of the Environment that the Ylläs-Aakenus National Park should be established following the boundaries defined in the conservation programme for old-growth forests. However, no decision on the matter has been made so far. In February 1999 a project was started to develop further recreational use and to preserve the ecological values of the region. In this context, a management and land use plan will be drawn up for the future old-growth forest conservation area. This project, the total budget of which amounts to FIM 10 million (EUR 1.7 million), is also supported by the EU Life Nature Fund. The project will be completed in January 2003.

Significant areas in terms of recreation and landscape also include the areas defined as areas reserved for holiday cottages in the regional plan for northernmost Lapland, with their immediate surroundings, and the recreational forests established on the basis of a decision by Metsähallitus. In the master plan, a conservation area reservation has been defined in the Pitkäjärvi area, and permission is required from the municipal authority for felling in the area. The area is a groundwater area. Another separate small site for recreational use is Hannukaisenlammet with the scenic forests surrounding it.

Recreational services in Metsähallitus are divided between two business units, the Natural Heritage Services and the Wild North. The Natural Heritage Services are responsible for public services, such as the construction and maintenance of routes and the maintenance of sights and rest points. The Natural Heritage Services also administrate the Kellokas Visitor Centre in Äkäslompolo. The centre is a real multipurpose centre of ecological information, offering versatile guiding services with excellent exhibitions and slide and video presentations. The exhibition in the Kellokas Visitor Centre describes the development of the fells, forests and peatlands in the region. The centre also provides information for hiking, canoeing and fishing. The Wild North is responsible for marketing hunting, fishing and accommodation services as well as services relating to the off-road use of vehicles, products and service and activity packages.

The planning area also includes the Venejärvi village landscape, which has been classified as a nationally valuable landscape (Ympäristöministeriö 1992). The settlement and the fields of the village are located on slopes descending to the lake in a landscape surrounded by forested hills. Of the land administrated by Metsähallitus, the northeastern slopes of Muotka-Kutuvaara are included in this landscape area.

Valuable landscapes with restrictions on use have been entered in the geographical information system as presented in table 17.

The view from the popular recreational fishing area of Kesänkijärvi opens over Kellostapuli, a fell of the Ylläs fell sequence.

Table 17. The number and area of valuable landscapes in the region.

Valuable landscape	Compartments,	Area, ha				Proportion, % of the managed and recreational forests	
	no.	Forest land	Poorly productive land	Non-productive land	in total	of forest land	of total area
Riparian stand	121	312	47	18	377	0.4	0.3
Roadside stand	74	341	9	-	350	0.5	0.3
Stand close to a hiking route	13	33	5	6	44	Δ	Δ
Stand close to recreational structures	67	244	32	2	278	0.3	0.3
Other scenic forest	126	1 547	288	2	1 837	2.2	1.7
Conservation area edge	1	24			24	Δ	Δ
Total	**402**	**2 500**	**381**	**29**	**2 910**	**3.5**	**2.6**

Δ in the table means that the figure is less than 0.05.

15 culturally valuable sites have been entered in the geographical information system. These include the human dwellings dating from the Stone Age in Hannukaisenjärvenmaa and Luosukangas and the old Sami dwelling in the western part of Nilivaara near Kesänkijärvi. Remains of old logging camps can be found in several places in the region, and only the most important ones have been entered in the geographical information system. Signs of past hunting culture, such as wild reindeer pitfalls, and of old sources of livelihood, such as tar pits can still be seen in the region. Most of the cultural sites in the Kolari region are located on private land along rivers and on lakeshores, and are not included in this plan. The number and area of cultural sites are presented in table 18.

Table 18. Number and area of cultural sites in managed and recreational forests in the region

Cultural site	Compartments, no	Area, ha forest land
Tar pit	3	4
Wild reindeer pitfall, etc.	3	1
Remains of buildings	4	7
Other ancient relic, etc.	5	14
Total	**15**	**26**

As the table shows, the area of cultural sites is small, and all sites have not yet been found.

In the national heritage landscape inventory of Northern Finland, the following sites have been identified in the Kolari region: Annanniva old official residence on the river Muonionjoki, Sieppijärvi residence, Sieppijärvi seed extractory, and Niesajoki and Nilivaara reindeer roundup places (Raatikainen & Pirinen 1996). However, there are no national heritage landscapes on the land administered by Metsähallitus in the Kolari region (Kalpio & Bergman 1999).

5.3.4 Tourism

Tourism is of vital importance for the economy of the municipality of Kolari. This is illustrated by the fact that the municipality has a population of some 4 000, yet there are 120 tourist enterprises operating in the municipality. Tourists are important not only to these enterprises, but also to several service stations, shops and companies in the real estate maintenance business, etc. It should be noted that the high number of tourists affects the entire economy in general, and not only the enterprises specialising in tourism. It has been estimated that currently tourism has an employment effect equal to 240 year-round jobs in the municipality, and the income from tourism is FIM 150 million (EUR 25 million).

The most popular tourist centre area in the region includes Ylläs fell and the villages of Äkäslompolo and Ylläsjärvi beside it. This area is defined as a tourism construction area in the regional plan for northernmost Lapland. The strong development of tourism in the past was based on the popularity of the ski slopes of Ylläs fell, but today cross-country skiing, snowmobile safaris and hiking in autumn bring many tourists to the region. The seasonal peaks of tourism are late winter and autumn when the forests are glowing with autumn colours. During the past few decades, buildings for accommodation have been constructed for rental purposes and as holiday accommodation for company personnel. There are 7 hotels, with accommodation for 760 persons, and several restaurants in the region. The Ylläs area can accommodate a total of 10,000–12,000 people.

In the Ylläs area the average number of holiday buildings constructed per year has been 150 during the past few years. The most recent significant construction project was the chapel, Pyhän Laurin Kappeli, which was completed in the turn of the millennium in Äkäslompolo. There are plans to build a health resort hotel and a considerable number of holiday buildings in the area in the near future. The total budget for these projects amounts to FIM 100 million (EUR 17 million). A landscape road has been planned between Ylläsjärvi and Äkäslompolo. According to the preliminary schedule it will be completed in 2003.

Tourism has also developed in offering service packages. For example, several enterprises offering snowmobile safaris have been established during the past few years. There are also several nationally known music festivals in the region.

During the past decade the salmon stock in the river Tornion-Muonionjoki has recovered, and the increasing amount of recreational fishing has brought a new important tourist group to the region, which is seen in the economy of the riverside enterprises. In addition, various tourist enterprises have been set up all over the municipality during recent years, thanks to the attraction of Ylläs and the EU programmes supporting tourism.

6 FOLLOW-UP AND UPDATING OF THE PLAN

Landscape Ecological Planning is a continuous and constantly developing forest use planning method. This plan is not a final and comprehensive information package covering all aspects, but rather an outline and starting point for future operations. All valuable habitats have not yet been found in the field inventories carried out, and thus compartments will be divided and updated to include new sites in the plan.

The objectives of the plan are monitored yearly, for example, in connection with the follow-up inventories. This monitoring includes the implementation and management of ecological links, the preservation of valuable habitats, habitats of valuable species and game habitats, the conservation of valuable landscapes, cultural sites and ancient relics and the conditions for nature-based sources of livelihood. The feedback from stakeholders and the public is also included in the follow-up data.

The plan will be reviewed five years after its completion. This review will be held in accordance with the principles of participatory planning. In this context, the implementation status of the plan will be established together with the participants, and the necessary action will be taken to update the plan. In the assessment, attention will be paid to the proportion of stands dominated by broadleaves, the volume of growing stock on forest land in managed forests and the burned area. In addition, the proportion of old-growth forests of the total area should be assessed. The planning data will be supplemented as new sites are identified. The new data are recorded in the geographical information system. If necessary, additional inventories will be arranged to chart the implementation status.

7 IMPACTS OF THE PLAN

7.1 Ecological impacts

As a result of forestry, forests have become less diverse and younger in terms of tree species and age composition compared to forests in their natural state. The proportion of pine stands has increased, and that of spruce and birch stands have decreased. The target set in the plan for the proportion of broadleaf forests will allow a more natural structure of the forests. The conservation of old-growth forests will also promote the preservation of the species living in them in the future. According to the MELA model (MELA is a Finnish forestry model and operational decision support tool for integrated forest production and management planning), the proportion of mature forests will remain at over 10%, even though it will decrease. The proportion of stands dominated by broadleaves will on the other hand increase to 8% (see appended table 3).

The volume of burnt wood is extremely low in managed forests. The volume is to be increased by prescribed burning, which will improve the conditions for threatened species dependent on burnt wood. The volume of decaying wood is also extremely low in the region. The aim is to increase its volume by leaving groups of retention trees standing on regeneration cutting sites and in thinned stands. This will improve the living conditions for threatened species dependent on decaying wood. The impact of the retention tree groups will only be seen after a short delay, i.e. after the tree stand around them closes up.

The key biotopes identified in the region also include fertile peatlands, islets of old-growth forests, bedrock outcrops, cliffs and minor water bodies, which contribute to the preservation of threatened forest species (see table 8).

One of the aims of the plan has been to register game habitats, such as capercaillie lekking sites, and enter them in the geographical information system as separate compartments, which will ensure that they are also considered during forest operations. Field inspections of lekking sites will be continued to ensure their effectiveness and location. Young alder stands along stream banks will be left untouched. This will ensure the preservation of hazel grouse habitats. Forestry operations will improve elk habitats, as new young willows will grow in the area.

Excluding spruce stands along stream banks from forest management operations will ensure that reindeer can obtain the beard lichen they need in winter. The old-growth forest conservation areas will contribute to the preservation of lichen areas.

Drainage has had a negative impact on the status of the watercourses in the region. In time, drained areas that are left to return to their natural state autonomously and the recovery of tree stands on the sites will reduce the leaching of nutrients into the watercourses. Ditches will be cleaned in the region in the future, but care must be taken not to load watercourses. The preservation of brown trout streams is another aim of the plan and of forest utilisation in the region.

The value of regeneration sites for berry picking will decline slightly with the current forest management guidelines. As forest ploughing has been phased out, cowberry (Am. lingonberry, *Vaccinium vitis-idaea*) and bilberry (Am. blueberry, *Vaccinium myrtillus*) crops

will decline. The numerous peatlands with cloudberry (*Rubus chamaemorus*) will be preserved.

In summary, it can be stated that by preserving relatively large continuous old-growth forest areas as conservation areas (e.g. Ylläs-Pallas and Niesaselkä), it is also possible to safeguard the species living in the small islets of old forests. However, most of the region is currently covered by young or mature pine stands, the structure of which derives from the extensive regeneration cuttings and thinnings carried out in the 1960s and 1970s. Their present state is far from the natural state of a similar forest area.

7.2 Social and economic impacts

The economic impacts of the plan are a result of stand-specific operational restrictions and regional goals which aim at improving the tree species distribution and age composition of the forests in the region. The regional forest development goals do not always lead to the best results in terms of wood yield. At times, the goals may have a major impact on the yield, for example, if the goals restrict fellings in mature stands and alternative stands are not available at the time. Stand-specific operational restrictions can either result in a situation, where the stand must be left untouched, or simply reduce the intensity of forest management operations in the stand (high proportion of retention trees, limited regeneration) and/or extend the rotation time. Restrictions are due not only to the presence of valuable habitats, but also to valuable landscapes and game habitats. In the case of valuable landscapes and game habitats, the restrictions are not as strict, but the characteristic features of these sites must always be preserved. The area of sites of special value in the managed and recreational forests is shown in table 20.

Table 20. Area of sites of special value in managed and recreational forests.

Category	Compart-ments, no	Area, ha				Proportion, % of the managed and recreational forests	
		Forest land	Poorly productive land	Non-productive land	Total	of forest land	of total area
Habitats of valuable species	38	303	24	4	331	0.4	0.3
Valuable habitats	296	1 128	752	173	2 053	1.6	1.9
Ecological links, mesic or more fertile forests	59	151	64		215	0.2	0.2
Ecological links, dry or less fertile forests	84	123	258	128	509	0.2	0.5
Sites for enhancement of biodiversity	11	51	16		67	0.1	0.1
Cultural sites	13	29			29	Δ	Δ
Game habitats	431	1 052	328	1	1 381	1.5	1.3
Valuable landscapes	243	1 144	77	5	1 226	1.6	1.1
Valuable sites, total	**1 175**	**3 981**	**1 519**	**311**	**5 811**	**5.6**	**5.4**

Δ in the table means that the figure is less than 0.05.

Alternative calculations were made using the MELA model in order to obtain an overall picture of the impact of the different factors involved in the plan. The Suntio area was also included in the calculations. The basis for the calculation and the relative impacts of the plan are presented in appended table 3.

According to the calculations, the planned cut in the region will be reduced in the first 20-year period due to the key biotopes and ecological links (total 4–9%), landscape and game forests (at first 7%, but then the impact will disappear). The regional targets have no major impact on the level of the planned cut – in the second period a slight impact (2%) is to be expected. The impact of statutory valuable habitats is also minimal in economic terms. The total impact of the plan in the first and second 10-year period will be 11%. After this the impact of the different factors will decrease, and after 40 years the impact of the plan will disappear, as the young stands will become mature for regeneration. However, the reliability of the calculation will also deteriorate, as the growth of the stock is based on growth and cultivation models. The above mentioned impacts do not include the impact of the retention trees left standing in regeneration sites. These will reduce the cut by 6–7%.

As a result of the plan, the volume of regeneration cutting will decrease 28% in the first 10-year period, 25% in the second and 16% in the third 10-year period. The volume of thinnings will have to be increased significantly, especially in the first 10-year period, to ensure that the total impact will remain at the above-mentioned 11%. The increase in thinnings also means that the structure of timber will change as the relative proportion of robust trees will decrease. The net forestry income will decrease proportionally more than the planned cut. Finding suitable sites for thinnings may also cause problems, and this may result in thinnings being carried out in areas where the yield is low. The low volume cut will also increase the harvesting costs, and will indirectly increase the cost impacts of the plan. The volume of growing stock on sites of special value in the managed and recreational forests is presented in table 21.

Table 21. Volume of growing stock on sites of special value in the managed and recreational forests.

Category	Compartments, no	Stock volume on forest land m^3/ha	Stock volume on forest land m^3	Proportion of growing stock on forest land, %
Habitats of valuable species	38	85	25 679	0.6
Valuable habitats	296	107	120 185	3.0
Ecological links, mesic or more fertile forests	59	79	12 030	0.3
Ecological links, dry or less fertile forests	84	69	8 449	0.2
Sites for enhancement of biodiversity	11	61	3 096	0.1
Cultural sites	13	109	3 120	0.1
Game habitats	431	71	83 309	2.1
Valuable landscapes	243	95	108 886	2.7
Valuable sites, total	**1 175**	**93**	**364 754**	**9.1**

The plan will also have an impact on other means of livelihood in the region. Tourism in the Ylläs area, in particular, is based on the surrounding state forests. The area itself is extending to cover an increasingly large area in accordance with the shore plans. The plan includes many scenic forests in the vicinity of the Ylläs area – in addition to the existing recreational forest – and the aim is to preserve the special features of the landscape in the area. There are also several valuable habitats in the Ylläs area, which will require preservation of the landscape.

It is difficult to define the impact of the plan on tourism. This would require a separate survey, and it is not possible to carry out such a survey in this context. However, land use in the Ylläs area is also controlled by a master plan, which aims at ensuring the conditions for tourism. However, many comments received from tourist entrepreneurs have also been taken into account in the Landscape Ecological Plan. These represent not only the entrepreneurs' own goals, but also the wishes of their clients. In addition to the sites of special value, the operations in the normally managed forests in the Ylläs area will have a significant impact on the landscape in the area. If successful in combining interests, the region has excellent possibilities to ensure the conditions for the survival of the different means of livelihood in the area.

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Appendix 1.

LANDSCAPE ECOLOGICAL PLANNING: SITE DATA

	GIS CODE
A. LAND USE DECISIONS	
* land use category (other than actual managed forests)	
-land use categories 10-99, especially nature conservation areas and reserves	
80-89 (restrictions on use)	
B. VALUABLE LANDSCAPES, CULTURAL SITES AND RECREATION AREAS	
	Ecological code
* valuable landscape	311-322
* recreational use	61-62 (restrictions on use)
* national heritage landscapes and ancient relics	111-119
* reindeer corral or other site relating to nature-based sources of livelihood	121-129
C. GAME HABITATS	
* grouse leks and habitats	211-213
* geese peatlands, waterfowl lakes	222-223
* reindeer grazing and wintering areas	224
* beaver habitats, animal burrows	225-226
* other game management sites	214-239
D. HABITATS OF VALUABLE SPECIES	
* species requiring special conservation	411-419
* nationally threatened species	421-429
* regionally threatened species	431-439
* other species requiring special attention	442-449
E. KEY BIOTOPES	
1. Waterways	
* valuable minor water bodies	
- springs, spring fens, seepage areas	511
- streams, rivulets	512
- small lakes	513
2. Bedrock and soil	
* south-facing slopes and deep post-glacial hollows	521-522
* bedrock outcrops, cliffs and gorge valleys	531-533
3. Soil and its fertility	
* herb-rich forests	541
* eutrophic fens, eutrophic swamps, herb-rich fens, alluvial forests	543
4. Growing stock and its succession stages	
* old-growth coniferous stands	551
- fire refugia	
* old broadleaf stands	552
* early stages of succession	553
* burned areas	554
5. Ecological links	
* corridors and stepping stones	611-612

Appendix 2. 1(2)

RETENTION WOOD AND FOREST MANAGEMENT OPERATIONS

Retention trees are trees that are left standing on the site in the course of forest management operations, since their retention is more important than their removal or other treatment for wood production purposes for the reasons presented below. Retention trees are left on the site permanently. Generally, retention trees are living trees fit for sale retained in the regeneration site. However, retention trees may also be smaller trees retained during clearing and young stand improvement that are not yet fit for sale, but will become such with time (but will also later be left standing). Deadwood consists of either dead standing trees or fallen trees.

Retention trees and deadwood (to be jointly designated retention wood) refer to such trees that are left (decaying) in the forests and primarily serve the needs of biodiversity but also those of game and landscape management.

In addition, groups of growing seedlings, young trees and seed trees can be left in a regeneration site for wood production purposes. These are not actually classified as retention trees, as they will be cut later and will not produce any decaying wood on the site. However, they serve game and landscape management objectives. Trees left on the site due to temporary marketing or other such reasons are not retention trees.

If there are valuable small compartments (over 0.5 ha) on the site, other than those valuable for forestry, they should be formed into separate compartments. This applies particularly to large compartments including environmentally valuable smaller compartments, such as stands along streams and moist areas. If the area of a site of special value is smaller than 0.5 ha, it should be taken into account by leaving retention wood, for example, a sufficiently large area of retention wood should be left around a spring. Retention wood areas are included in the surrounding compartment. If necessary, they can be entered in the geographical information system as spots.

The volume and location of the retention wood to be left depends on the location, size and growing stock of the stand to be managed. In stands which have become very uniform in structure due to previous forest management operations, it is difficult to establish a good combination of retention wood. In such cases, achieving a certain minimum level of retention wood is enough. If the stand is located in the vicinity of nature conservation areas, key biotopes or ecological corridors, or if the growing stock of the stand is such that a variety of retention wood can be left, this should be done carefully. In areas surrounding valuable habitats and nature conservation areas, retention trees are left in small clusters. The volume of wood retained should be over 10 m^3/ha. The longer the distance to the core area, the smaller the volume of retention wood can be left.

During forest management operations, retention trees can be left standing for the following reasons:

- game management
    - food for game (rowan, aspen, goat willow, juniper, feeding pines, birches with catkins)
    - game shelters (spaces under spruce, dense stands, clumps of alders)
    - game nesting (breeding) and lekking sites
- landscape management (landscape spots, near landscape)
    - individual ancient pines, standing dead trees, weeping birches and other special tree individuals
    - groups of trees break and reduce the impression of open space, and the visibility over the cut area is reduced.
- nature conservation
    - protection of threatened fauna and flora species, preservation of the present habitats of the species or leaving retention wood so that these will develop in such habitats as the stand closes up (decayed and decaying wood, dead and living broadleaves/conifers – a continuum of decaying wood at stand and area level; large aspens, nest trees and their surroundings in particular).
    - water protection; buffer zones to watercourses, management of moist areas, springs and their surroundings.

Appendix 2. 2(2)

Retention trees should primarily be left in groups for the following reasons:
- Disadvantages for wood production are minimised if retention trees are in groups. Groups of trees are less of a hindrance to site preparation and the growth of the new stand than the same number of individual trees.
- In valuable habitats retention trees are naturally left standing in groups, and they will create a cooler and moister microclimate for organisms dependent on decaying wood when they grow. For this same reason, retention trees should be left in groups on other sites than valuable habitats too.
- Retention trees are best placed in the landscape as groups. In groups they also reduce the impression of open space (visibility) most effectively and improve the near landscape.

The volume and location of retention wood varies considerably, depending on the stand in question, the amount of trees that are suitable for retention, the effects on the landscape, etc. Alternative ways of leaving retention wood include the following:
- single trees
    - pine or birch individually (special individuals)
    - can be used as the primary form on regeneration sites of under 1 ha
- groups of trees
    - the primary form of retention trees in regeneration sites of over 1 ha
    - the groups can be placed in valuable habitats, for example, as groups of 2–5 ares, at a maximum distance of 100 m from each other (or other trees).
    - groups of spruces should be bound together by other tree species
    - near valuable habitats as clusters
- tree stand areas (valuable habitats)
    - large regeneration areas, which usually include valuable habitats
    - untouched areas of 5–50 ares (but not yet separate compartments), which are placed primarily in valuable habitats
    - especially for landscape management purposes
    - near valuable habitats as clusters
- tree stands on the edges of forests
    - retention trees can also be placed so that the boundary of a stand marked for cutting is moved towards the forest, for example on the border between a forest and a peatland.

The best results in terms of nature conservation and landscape management can probably be achieved by combining several forms of tree retention on each site.

The following average quantity and quality targets can be set for retention wood:
- The amount of **sturdy living** trees (over 20 cm in diameter) should be **at least** 5–10 per hectare (=3–5 m^3/ha) (trees under 20 cm in diameter are retained in the groups of retention trees)
- Retention trees should primarily be left on buffer zones of watercourses and as groups in small valuable habitats (small peatland areas, moist areas, boulder fields, bedrock outcrops, springs, etc.) e.g. 1–2 groups of 2–5 ares per hectare
- Broadleaves should be favoured (retention tree groups are established in e.g. aspen and goat willow stands)
- The site under retention trees and groups of trees must not be cleared or prepared
- The volume of **sturdy dead standing and fallen trees** on the site should be **at least** 3–5 m^3/ha (retention tree groups can be established in the concentrations of fallen and windblown trees and dead standing trees)
- In addition individual standing decaying trees, hollow trees with nests and (depending on the site) snags and special individuals (e.g. ancient pines, over-sturdy stems) are retained.
- Sturdy fallen trees should be preserved during harvesting so that no machines are driven over them.

By leaving fallen trees and standing dead trees, decaying wood is left on each site, and more decaying wood will be formed in time by living retention trees. Retention wood should also include sturdy trees, as e.g. many threatened bracket fungi require decaying stems over 20 cm in diameter. These stems remain moist thanks to their sturdy structure. For the same reason, the present sturdy fallen trees are important and they should be spared during harvesting. To ensure the availability of decaying wood on the compartment in the future, retention trees should also be left during young stand improvement and future intermediate fellings in accordance with the above principles. This ensures that decaying wood in different stages of decay and of different tree species (continuum of decaying wood) can be found in the compartment throughout the rotation of the forest, thus imitating the situation in natural forests. When leaving retention wood the effects should be considered throughout the entire rotation, as the concentrations of decaying wood developing from retention trees change the microclimate and make it favourable for certain species only after the stand has closed up.

Appendix 3.

THREATENED SPECIES IDENTIFIED IN THE KOLARI PLANNING REGION BY ORGANISM GROUP

	Threatened [1)]	Protected
Vascular plants		
dwarf scouring-rush, *Equisetum scirpoides*	+/Mr	
great spurred violet, *Viola selkirkii*	+/V	
rigid hornwort, *Ceratophyllum demersum*	+/Mr	
ostrich fern, *Matteuccia struthiopteris*	+/Md	
*Ranunculus lapponicus**	Dir	x
Chrysosplenium tetrandrum	+/Md	
Elymus mutabilis	+/Md	
sweet-scented bedstraw, *Galium triflorum*	+/V	
marsh saxifrage, *Saxifraga hirculus* *	Md/Md	x
Carex heleonastes	Md/Md	
calypso, *Calypso bulbosa**	Md/E	x
capitate sedge, *Carex capitata var.capitata*	+/Mr	
mezeron, *Daphne mezereum*	+/Md	x
Anthylis vulneraria subsp. *lapponica*	Mr/Mr	
Juncus x *inundatus*	+/E	
alpine gentian, *Gentiana nivalis*	+/Md	
Fungi		
Bovista tomentosa	V/V	
Calocybe onychina	V/V	
Haploporus odorus	V/V	

[1)] Categories of threatened species, nationally/regionally (1991 categories).

+	not threatened
E	endangered
V	vulnerable
Mr	in need of monitoring, rare
Md	in need of monitoring, declining
Mp	in need of monitoring, poorly known

*Species protected under the Nature Conservation Act.

Appendix 4.

VALUABLE MINOR WATER BODIES IN THE KOLARI PLANNING REGION

Name	Class	N.B.
Halijoki springs	4	
Haukirova springs	3	
Isolaki springs in Haukirova	3	
Lake Jänkäjärvi	2	
Hirvaslompolo pool	3	
Järvikäinen pool	4	
Kenttäoja brook	2	
Lake Kesänkijärvi	-	Recreational fishing area
River Kuerjoki	3	
Kuruvuomanoja spring	3	
Kutuoja brook	1	
Majavalantot pool	3	
Mäntyoja spring	5	
Lake Oravajärvi	3	
Pumpulijänkänoja springs	-	
Saukkokaltio springs	4	
Lake Tunturijärvi	4	
River Valkeajoki	3	
River Vuorkajoki	4	

Ecological value, classes:

0-2	Altered, but restoration possible
3	Almost natural state or returning to natural state
4-5	Valuable habitats

Source:Raatikainen, H 1995. Luonnonsuojelullisesti ja kalataloudellisesti arvokkaiden pienvesien inventointi Lapissa. Vesi- ja ympäristöhallituksen monisteita N:o 638. (In Finnish).

AGE DISTRIBUTION BY TREE SPECIES. KOLARI REGION
-Theoretical distribution derived from the ASIO model (categories (A-S-I-O) compared with present status on <u>forest land</u>

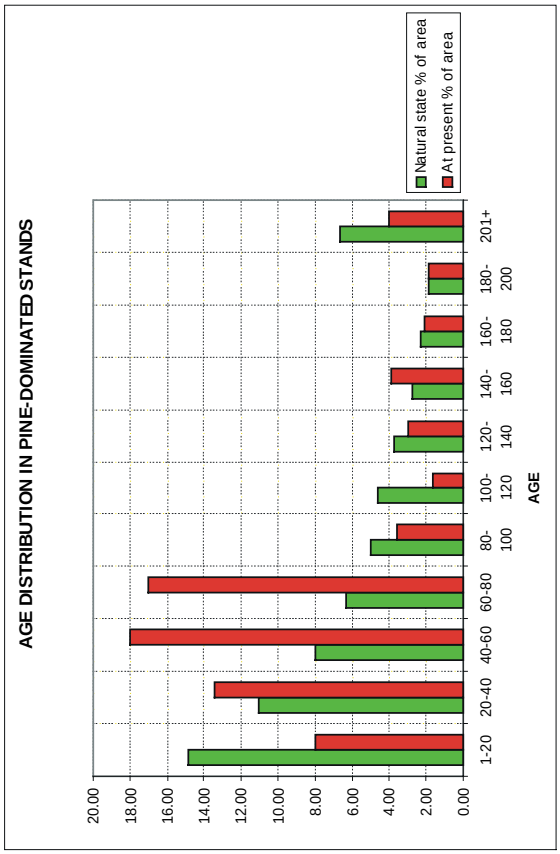
STAND	BIRCH-DOMINATED		FORESTS (50+ %)				PINE-DOMINATED		FORESTS (50+ %)			
AGE	Natural state			Natural state		At present	Natural state			Natural state		At present
years	Cat. S. ha	Cat. I. ha	Total. ha	% of area	Area. ha	% of area	Cat. I. ha	Cat. O. ha	Total. ha	% of area	Area. ha	% of area
1-20	1769	1300	3069	4.16	346	0.47	7987	2948	10935	14.84	5862	7.95
20-40	1600	1063	2664	3.61	1813	2.46	6532	1608	8140	11.04	9905	13.44
40-60	1377	787	2163	2.94	1414	1.92	4832	1074	5906	8.01	13234	17.96
60-80	1245	643	1889	2.56	371	0.50	3952	717	4669	6.33	12520	16.99
80-100	1127	526	1653	2.24	228	0.31	3232	479	3711	5.03	2663	3.61
100-120	1019		1019	1.38	228	0.31	3074	319	3394	4.60	1219	1.65
120-140					374	0.51	2514	213	2728	3.70	2184	2.96
140-160					169	0.23	2057	0	2057	2.79	2843	3.86
160-180					107	0.15	1682		1682	2.28	1549	2.10
180-200					39	0.05	1376		1376	1.87	1382	1.88
201+					15	0.02	4876		4876	6.62	2968	4.03
Total	8137	4320	12457	16.90	5104	6.92	42114	7358	49472	67.12	56329	76.43

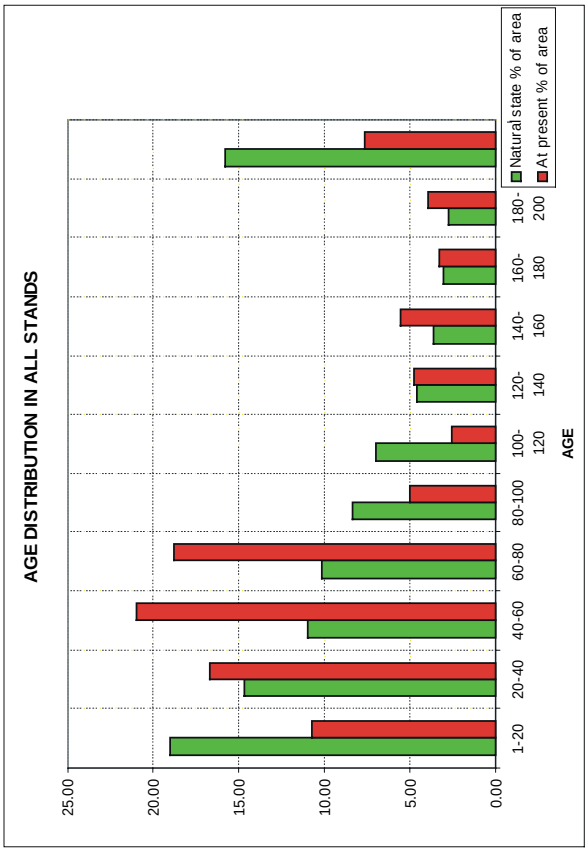
STAND	SPRUCE-DOMINATED		FORESTS (50+ %)				TOTAL	ALL STANDS						
AGE	Natural state			Natural state		At present	Natural state					Natural state		At present
years	Cat. A. ha	Cat. S. ha	Total. ha	% of area	Area. ha	% of area	Cat. A. ha	Cat. S. ha	Cat. I. ha	Cat. O. ha	Total. ha	% of area	Area. ha	% of area
1-20			0	0.00	1706	2.31	0	1769	9287	2948	14004	19.00	7914	10.74
20-40			0	0.00	559	0.76	0	1600	7596	1608	10804	14.66	12277	16.66
40-60			0	0.00	779	1.06	0	1377	5619	1074	8069	10.95	15427	20.93
60-80		922	922	1.25	969	1.31	0	2167	4595	717	7480	10.15	13860	18.80
80-100		834	834	1.13	816	1.11	0	1961	3759	479	6198	8.41	3707	5.03
100-120		754	754	1.02	446	0.61	0	1774	3074	319	5167	7.01	1893	2.57
120-140		682	682	0.93	966	1.31	0	682	2514	213	3410	4.63	3524	4.78
140-160		617	617	0.84	1087	1.47	0	617	2057	0	2674	3.63	4099	5.56
160-180		558	558	0.76	783	1.06	0	558	1682	0	2241	3.04	2439	3.31
180-200		617	617	0.84	1506	2.04	0	617	1376	0	1993	2.70	2927	3.97
201+	2211	4566	6777	9.19	2654	3.60	2211	4566	4876	0	11653	15.81	5637	7.65
Total	2211	9552	11763	15.96	12271	16.65	2211	17689	46434	7358	73692	99.98	73704	100.00

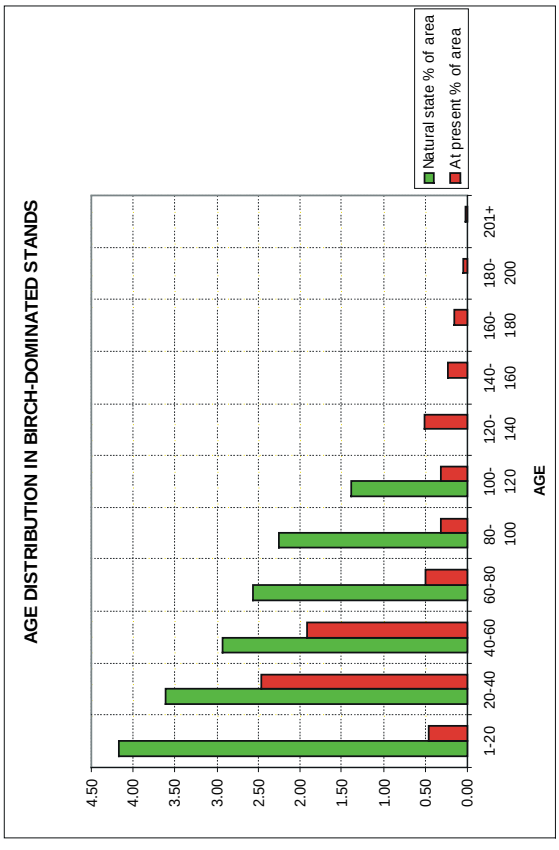
ASSUMPTIONS:
At a certain age (100 or 120 years). birch-dominated stands develop into spruce-or pine-dominated stands. Thus. the average age of spruce stands is reduced by 40 years.
- The generations have been calculated according to a geometrical progression for 20 years using the formula P=(1-p)**k*p. weighting areas 0-40 years old (in category O. 0-20 years)
In this formula. p stands for the probability of natural fire on the site (e.g. 200 years: p=0.005) and k stands for the time elapsed since the last fire.
Category assumptions in forest land:

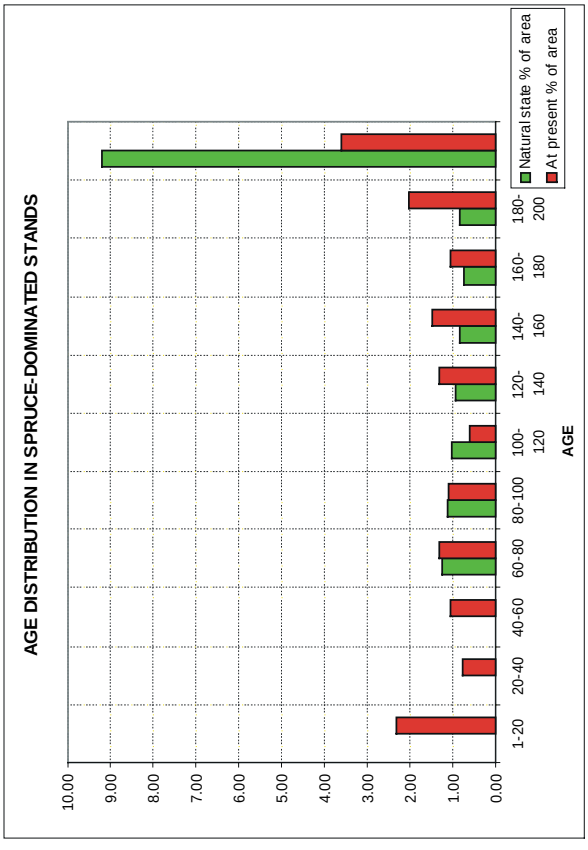
Category	%/100	area burned. % of area/a	fire interval	age distribution	birch stands <100 years	stands. % of category area post-fire pine/	spruce stands
A	0.03		---	201+	0	0	0
S	0.24	0.5	200	0-350	40	0	10
I	0.63	1	100	0-250	10	60	0
O	0.1	2	50	0-150	0	95	0

Appended table 1.2(2).





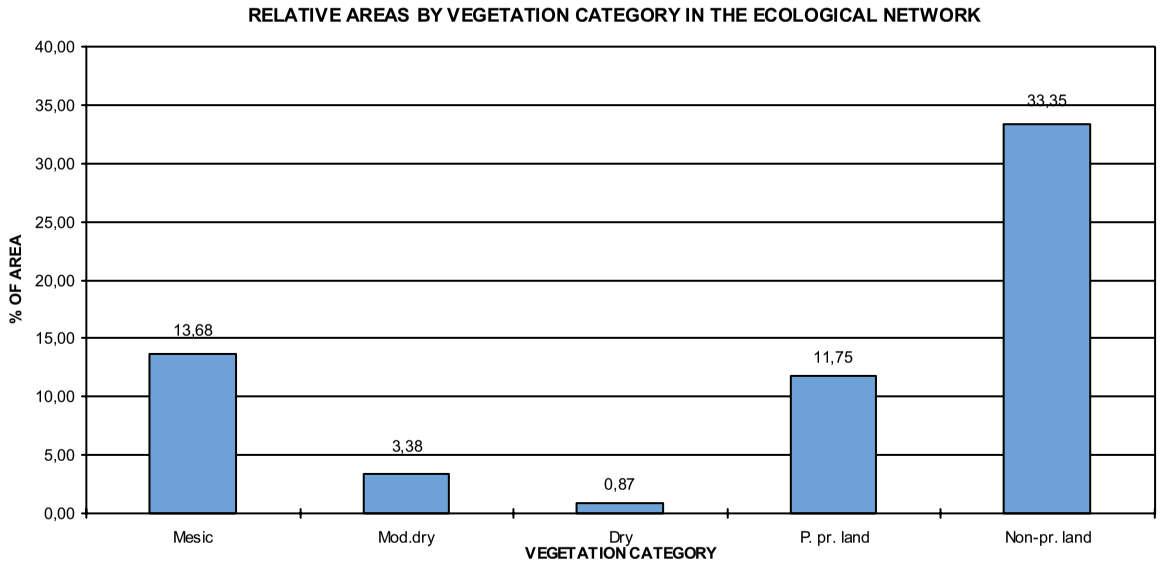




AREAL DISTRIBUTION OF ECOLOGICAL NETWORK BY VEGETATION CATEGORIES, KOLARI REGION

Ecological network includes
1) statutory nature conservation areas and reservations and old-growth forest areas
2) key biotopes, ecological links and biodiversity enhancement areas
(key biotopes include habitats of threatened species and species requiring special protection)

PEATLANDS	FOREST LAND												POORLY PRODUCTIVE LAND		
	Mesic forest /%			Moderately dry forest /%			Dry forest /%			Forest land, total			Total	Ecol.	%
	Total ha	Ecol ha	Mesic	Total ha	Ecol ha	Mod.dry	Total ha	Ecol ha	Dry	Total ha	Ecol ha	%	area, ha	area, ha	P. pr. land
MINERAL SOIL	18473	3101	16,79	37726	1039	2,75	10466	36	0,34	66665	4176	6,26	2438	1045	42,86
PEATLAND	6118	264	4,32	1881	300	15,95	75	56	74,67	8074	620	7,68	27198	2436	8,96
Total/average	24591	3365	13,68	39607	1339	3,38	10541	92	0,87	74739	4796	6,42	29636	3481	11,75



Appended table 2.

Appended tables 3. 1(5).

MELA MANAGEMENT CATEGORIES AND ALTERNATIVE MODELS

The MELA forestry model was used to calculate the effect of various factors on the planned cut and other features in the Kolari planning region. For the purpose of the assessment, each forest stand is assigned a management category according to recommended management operations in the area. The management category depends on restrictions on use imposed in the area (see Appendix 1; for more detail see Soinne 1999). The categories are:

1.0 Managed forest
1.1 Uneven-aged forest
2.0 Cuttings leaving abundant retention trees
3.0 Extended rotation
4.0 Over-extended rotation
5.0 Selective cutting
6.0 No cutting
8.0 Conservation areas and areas reserved for conservation

The following guidelines were laid down for the stands in the various categories:

1. All stands within normal forest management operations.

2. Cuttings leaving abundant retention trees
   - More retention wood is left in intermediate and regeneration cuttings than normally (20 m^3/ha). This code is also used when clusters of retention trees are left around valuable sites or when a buffer zone is left around a watercourse.

3. Extended rotation time/ limited regeneration
   - The stand is regenerated in stages (maximum regeneration area being 0.7% of total area per year) and using an extended rotation time, the normal time multiplied by 1.5. More trees are to be retained than is the normal practice (10-15 m^3/ha). Thinnings are permitted even in mature forests.

4. Over-extended rotation time/ limited regeneration
   - The stand is regenerated in stages (maximum regeneration area being 0.5% of total area per year) and using an over-extended rotation time, the normal time multiplied by 1.7. Significantly more wood are to be retained than is the normal practice (20 m^3/ha). Thinnings are permitted even in mature forests.

5. Selective cutting
   - The stand is to be cut only in selected areas. This cutting method is used in valuable habitats where the aim is to retain the characteristic features.

6. No cutting
   Survival of the habitat requires leaving the stand untouched.

The following local restrictions concerning tree species and age structure were added to the basic model:

- Broadleaf-dominated stands should cover at least 8% of the forest area, conservation areas included.
- Stands older than 140 years should cover at least 10% of the forest area, conservation areas included.

The volume of retention wood is 7 m^3/ha (in addition to natural loss) in regeneration cuttings and 3 m^3/ha in thinnings. The calculated waste percentage is 7% in regeneration cuttings, 11% in intermediate cuttings and 5% in overstorey cuttings.

The models were compiled using a 4% growth rate for a 40-year period. Forest use complying with the selected model was compared with four other forest use models. The comparison was conducted to find out the financial impacts of various factors. The alternative models were:

1. All restrictions – basic model (P)

   The forest is managed according to silvicultural and environmental guidelines. Sites of special value recorded in the GIS system are taken into account by dividing the stands into forest management categories (see Soinne 1999).

   In addition to these restrictions, the model assumed that the proportion of broadleaf-dominated stands should be at least 7% of the area throughout the assessment period, and that the proportion of old-growth forests should be at least 10%. The calculated difference between models P and M shows the impact of these local restrictions.

   The basic model includes all planned restrictions. The difference between the results of models P and E shows the total impact of the plan.

2. All sites of special value (M)

   This model evaluates the combined impact of all sites of special value. It includes cultural sites, game habitats and scenic and recreational areas. It also takes into account occurrences of species (key biotopes, ecological areas) and old-growth forests (protected areas). The calculated difference between models M and E shows the total impact of all sites of special value.

   The model also evaluates the impact of the targets set for the proportion of old-growth forests and/or broadleaf-dominated forests on the total cut. Their impact is revealed by excluding these restrictions from this model and comparing the result with model P.

3. Valuable habitats (A)

   This model evaluates the financial impact of valuable habitats and ecological sites. The difference between models A and E shows the impact of the valuable habitats on the total cut.

   The model excludes cultural sites, game habitats and scenic and recreational areas (Appendix 1). The difference between the models A and M shows the impact of the excluded sites on the total cut.

4. Statutory valuable habitats (L)

   This model evaluates the financial impact of statutory valuable habitats on the total cut. The only restrictions are the valuable habitats as defined in the Forest Act, Nature Conservation Act or in some other legal statute. The difference between this model and model E shows the impact of statutory valuable habitats on the total cut.

Appended tables 3. 3(5).

5. No restrictions (E)

This model shows the total cut when sites of special value in managed forests are not considered and/or there are no local restrictions in the area. Silvicultural operations are carried out in line with forest management guidelines.

When comparing the planned cut according to these models and other data, we get the results shown in figures 1–3 below. The change in certain regional stand data in the basic model (according to plan) is shown in figures 4–6.

RESULTS OF THE MELA ASSESSMENT

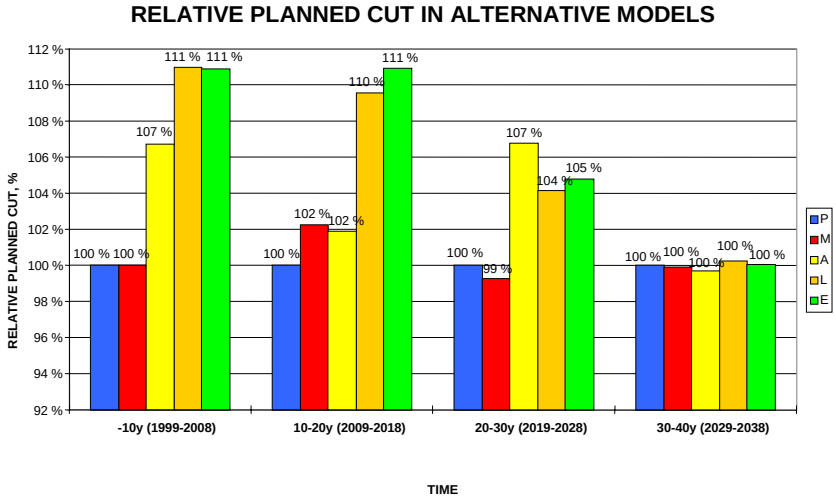


Figure 1. Planned cut in alternative models.

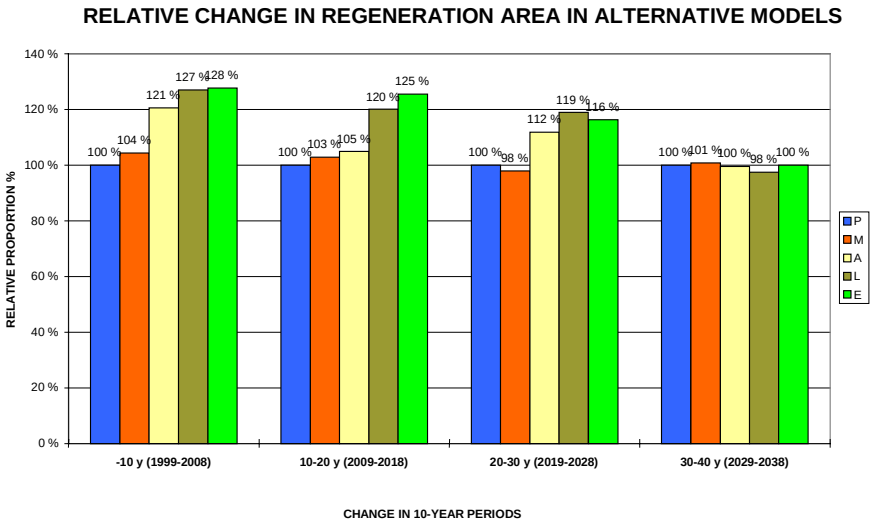


Figure 2. Relative change in regeneration cutting area in alternative models.

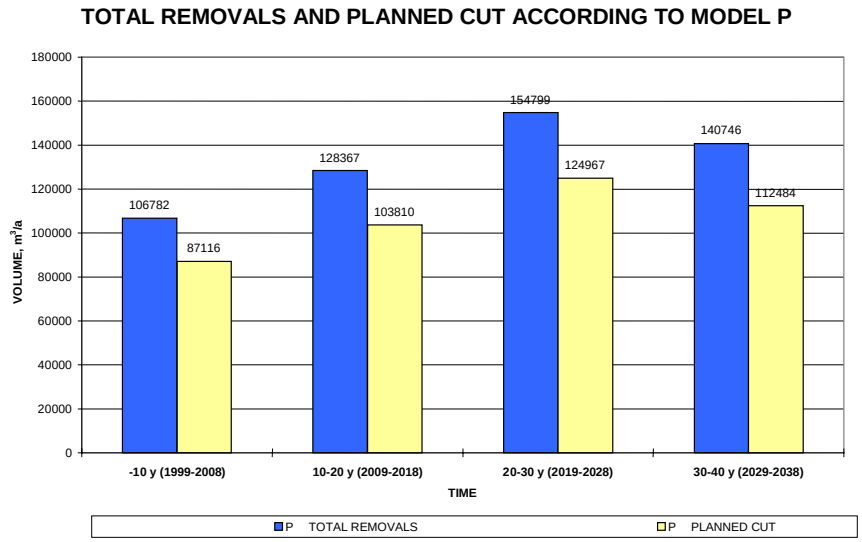


Fig 3. Total timber removals and planned cut.

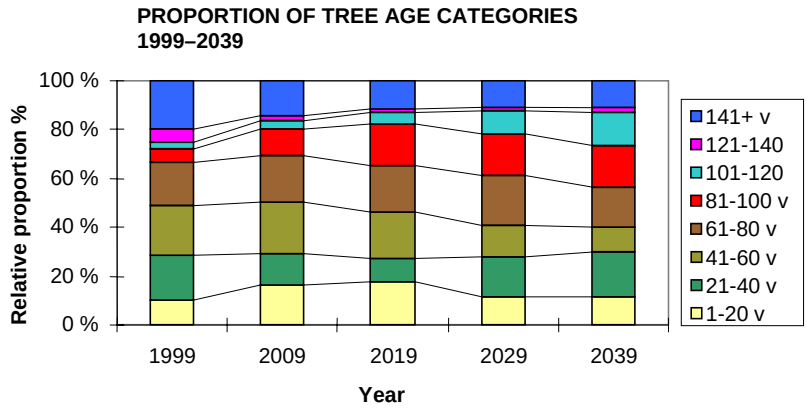


Figure 4. Relative change in tree age groups in the years 1999–2039 in the Kolari planning region. Based on model P.

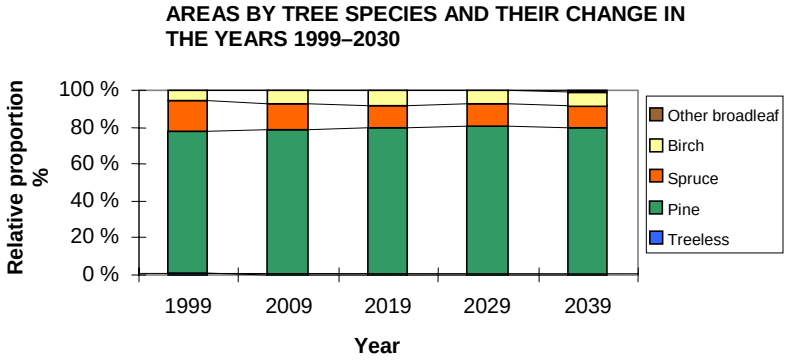


Figure 5. Areas by tree species and their change in the years 1999–2039 in the Kolari planning region. Based on model P.

Appended table 3. 5(5).

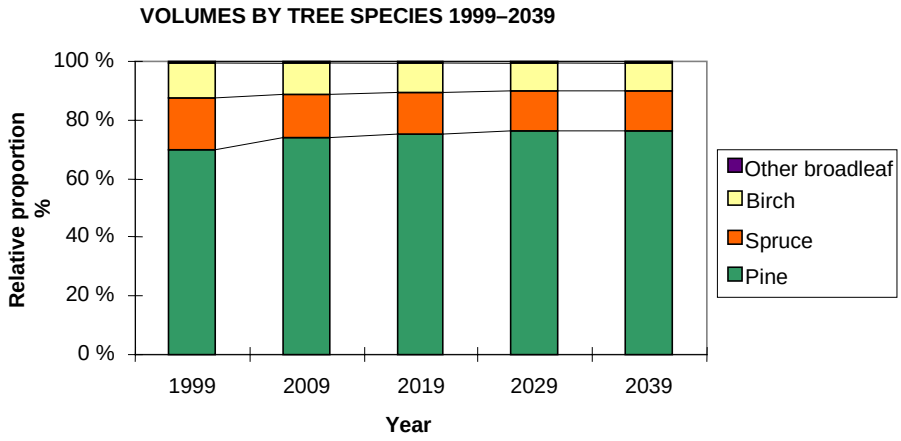


Figure 6. Volumes by tree species and their change in the years 1999–2039 in the Kolari planning region. Based on model P.

Appended table 4.1(2).

ROAD NETWORK PLAN

1. KEY FIGURES

LANDSCAPE ECOL. REGION Kolari

Team	Kolari
Map sheets	16-30
Compartm.	281-547

STATE AND PRIVATE ROADS

	ENTIRE REGION		FORESTRY REGION	
	total area. ha	forest land. ha	total area. ha	forest land. ha
	125 856	74 739	109 384	71 268
Percentage of forest land of total area %		59		65
Percentage of forest land in area served by road network [1]		85		85

District and trunk roads				
Current length. km	346.7	294.695	342.6	291.21
Present road density. m/ha	2.75	3.35	3.13	3.47
Further need. km	0	0	0	0
Target density. m/ha	2.75	3.94	3.13	4.09
Summer branch roads				
Current length. km	283.8	241.23	281.4	239.19
Present road density. m/ha	2.25	2.74	2.57	2.85
Further need. km	49	49	49	49
Target density. m/ha	2.64	3.88	3.02	4.04
Summer roads total, at present				
Length. km	630.5	535.925	624	530.4
Road density m/ha	5.01	7.17	5.70	7.44
Road service [2]	90	85	90	85
Effective road density. m/ha	4.51	6.10	5.13	6.33
Average forest haulage distance. 100m	5	5	5	5
Average road service area, ha/km [3]	90.00	85.00	90.00	85.00
Summer op.area (utility area). ha	56745	45554	56160	45084
Summer roads total, target				
Length. km	679.5	584.925	673	579.4
Road density. m/ha	5.40	7.83	6.15	8.13
Road service [2]	90	85	90	80
Effective road density. m/ha	4.86	6.65	5.54	6.50
Average forest haulage distance. 100m	5	5	5	5
Average road service area, ha/km [3]	90.00	85.00	90.00	80.00
Summer op. area (utility area). ha	61155	49719	60570	46352
Winter roads				
Winter operating area at present. ha	69111	29185	53224	26184
Winter operating area at present. %	55	39	49	37
Winter operating area target. ha	64701	25020	48814	24916
Winter operating area target. %	51	33	45	35

[1] Proportion of roads located on forest land

[2] Effective road service area/ calculational road service area

[3] (2x average forest haulage distance) x 1000 m x road service %

ROAD NETWORK PLAN

2. GENERAL FOREST ROAD PLAN

LANDSCAPE ECOL. REGION Kolari

Team 1
Map sheets 16-30
Compartments 281-547

ROAD	ROAD NAME	Impact area	ROAD CONSTRUCTION NEED				WORK TYPE		SCHEDULE			Special aspects (x)					Notes
number		Area. ha	Trunk road Length. km	District r. Length. km	Branch r. Length. km	Total Km	New roads Length. km	Renovation Length. km	- 2000 Length. km	2001-2005 Length. km	2006- Length. km	Bio-diversity	Rein-deer	Game	Scenic values	Recreation	
	Ylisenjärvenvaara				4				4								
	Mukkakoskenlaki				2					2							
	Pahkavaara				3					3							
	Pitkälehto				4					4							
	Malmivaara				3						3						
	Kiusselkä				3						3						
	Kuertunturi				4					4					x	x	
	Kaalimaanlaki				2					2							
	Honkamaa				0.8					0.8							
	Ritolaen vankka				2.5					2.5							
	Kuurusen vaara				1					1							
	Kiusaajalehto				1.2					1.2							
	Pohjoisnenä				2						2						
	Huttinen				2.5					2.5							
	Karjalainen				2				2				x				
	Peurarova				2					2							
	Haukirova				6						6						
	Peräpalo				3						3						
	Hietasen rantalehto				0.6					0.6							
	Total				48.6				6	25.6	17						

Landscape ecological plan - Summary/analysis of feedback

Region: Western Lapland
Kalervo Niku
11.6.1999
Kolari
4.6.1998 - 11.6.1999

Feedback provider
Eo = environmental organisation
Te = tourist enterprise
En = engaged in nature-based sources of livelihood
Po = public officials
Pp = private person

Feedback proposition (location and measures)	Target area	Eo	Te	Pn	Po	Pp	Implementation
Exclude the Ylläs area from cuttings	Cuttings		x				High-altitude spruce stands excluded from the cutting plan
Exclude the Kuertunturi-Äkäslompolo roadside from cuttings	Cuttings		x				Designated as scenic forest
Poor water quality in River Naamijoki	Waters		x				Environment Centre will draw up a restoration plan
Save capercaillie leks	Game sites					x	Marked in the Geographical Information System
Save cloudberry mires from cutting	Berry-picking					x	Cloudberry mires are spared as ditching is no longer carried out
Pitkäjärvi wind-fallen trees remain unharvested	Cuttings					x	Key biotope has been set up and marked in GIS
New forest roads pose a risk to the attraction of Ylläs	Forest roads		x				Road network plan has been drawn up for the entire region
Ancient stone piles in Mustasaajo	Cultural sites					x	Sites marked in the Geographical Information System
Poor water quality in River Palojoki	Waters					x	No active measures
Poor water quality in River Venejoki	Waters					x	Initiative on rehabilitation to Lapland Regional Environment Centre
Free right of hunting should be maintained	General					x	Outside the scope of Metsähallitus' power
Berry picking should remain free	Berry-picking					x	Granted by public right of access, not in Metsähallitus' power
Drained cloudberry mires to be returned to natural state	Berry-picking					x	No active measures, natural restoration
New connection road between Äkäslompolo and Ylläsjärvi	Road network		x				Project started in other instances
TOTAL			**5**			**9**	

x = Category of feedback provider

Appended table 5.

GLOSSARY

ASIO model

This model, developed in Sweden, describes the natural frequency of fires in different forest types.

Almost never (A) Areas where forest fires do not occur at all, or occur very seldom (at intervals of several hundreds of years); a fire refugium.

Seldom (S) Areas where forest fires occur seldom (at an average interval of 200 years).

Infrequently (I) Areas where forest fires occur infrequently (at an average interval of 100 years).

Often (O) Areas where forest fires occur relatively often (at an average interval of 50 years).

Biodiversity enhancement area

An area defined in Landscape Ecological Planning, where an effort is made to preserve natural values and, if possible, add to them. The site may be of special value and particularly sensitive from a conservational point of view.

Classification of drained mires:

Recently drained mire? is one in which the tree stand and ground vegetation have not significantly altered as a result of draining.

Transforming drained mire is one in which draining has resulted in clearly enhanced tree growth, even though mire vegetation remains dominant.

Transformed drained mire is one in which forest species are dominant and tree growth corresponds to that in mineral soil forest habitats.

Dominance of tree species

The proportion of a certain tree species of the total volume of a stand. If the proportion of one tree species is over 80%, this is called a single-species stand. If the proportion is 50–80%, the stand is, for instance, a spruce-dominated mixed forest. If the proportion of each tree species is less than 50%, the stand is a mixed forest.

Ecological corridor

A continuous chain of one or more habitat patches (e.g. forest compartments) that connects two areas (e.g. two old-growth forest islets, conservation areas or key biotopes) and facilitates the spread of species from one area to another.

Ecological link

A general term for individual habitat patches connecting certain areas or several patches forming a continuous chain. These patches facilitate the movement of species between the areas (see ecological corridor, stepping stone).

Fire refugium

An area which has never burned or has burned very rarely.

Forest road types

Trunk road Major road gathering traffic from district and branch roads. Trunk roads often have significance for the general public.

District road Connected with trunk road or public road. Serves several logging sites or estates.

Branch road Connected with a district road, serves one or a few logging sites or estates.

Forestry area

All land used for silvicultural purposes. Classified according to growing stock:

Forest land Average annual growth volume at least 1 m^3/ha a year. Forest land is capable of producing logs.
Poorly productive land Average annual growth volume 0.1–0.9 m^3/ha. .
Non-productive land Average annual growth volume less than 0.1 m^3/ha.

Indicator species

A species which is especially sensitive to a certain ecological factor, which means that an occurrence of the species indicates the factor in question. A good indicator species is visible, easy to recognise and provides a reliable indication.

Key biotope

Habitats where threatened and demanding species actually occur or are most likely to occur, e.g. herb-rich forests, springs, cliffs and old-growth forests. The key biotopes have some lasting features which enable the species to survive.

Landscape Ecological Planning

Long-term forest use planning with the aim of steering forest operations in a region to ensure that its native species can survive in viable populations.

MELA forestry model

A Finnish forestry model and operational decision support tool for integrated forest production and management planning. MELA is used for solving problems related to the production potentials of forests and how to manage forest stands in order to achieve the overall (usually forest level) goals for forestry in each particular decision situation.

Participatory planning

A planning method based on transparency, in which interested groups and citizens are actively involved in planning at an early stage.

Population

Number of individuals of a certain species that live in a particular area at a particular time.

Restoration

Usually a one-off measure, such as filling ditches, with the intention of speeding up the return of an area to or close to its natural state.

Retention trees

A tree or cluster of trees left on a felling site, usually for the sake of biological diversity and scenic values.

Stepping stone

An islet or habitat patch between two separate areas (for instance two conservation areas or key biotopes) which serves to facilitate the spread of species between the two areas.

Succession

The time-bound transformation of a set of organisms within a certain location. For instance, the changing conditions within a certain stand as the trees age.

Threatened species

A species which is in danger of extinction in Finland due to human intervention (rarity does not equal threatened status).

Threatened species categories (1991)

Extinct
Species whose regenerating populations have disappeared in Finland and which have not been detected since 1965 despite searching.

Critically endangered
Species whose regenerating populations are in danger of extinction in Finland unless factors threatening them are eliminated.

Endangered
Species whose regenerating populations in Finland are at risk and which will become critically endangered unless factors threatening them are eliminated.

Species in need of monitoring
Species which have to be monitored in Finland but which have not, for various reasons, been included in the above categories. These species are divided in three subcategories:

Declining
Species whose populations in Finland have significantly declined but which are not yet endangered.

Rare
Species which, due to their special biological features, live only in a limited area in Finland or only in a few locations and whose population is therefore very small.

Insufficiently known
Species which are assumed to be endangered or even extinct in Finland, but whose category cannot, due to insufficient knowledge, be specified.

Winter road Forest road which can only be used in winter, when the base is frozen and covered with snow.

Landscape-ecological Plan for State-owned Forests in Kemi

METSÄHALLITUS

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