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## SUBMISSION BY THE GOVERNMENT OF FINLAND ON FORESTS AND BIOLOGICAL DIVERSITY

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**Maintaining, Conserving and Enhancing Biological Diversity of Forests in Finland**

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Preface

At its second meeting (Jakarta, 6–17 November 1995) the Conference of the Parties to the Convention of Biological Diversity

1. Decided to invite its president to transmit the Statement (UNEP/CBD/COP/"/CW/L.18) to the Intergovernmental Panel on Forests

2. Requested the Executive Secretary:

(a) to provide advice and information pertaining to the relationships between indigeneous and local communities and forests, as invited by the Inter-Agency Task Force of the Intergovernmental Panel on Forests;

(b) to commission and carry out work on forests and biological diversity, with a view to producing a background document on the links between forests and biological diversity in order to consider, at its third meeting, whether further input to the Intergovernmental Panel on Forests is required, and to transmit this document to the Intergovernmental Panel on Forests for information;

(c) to invite all Parties, relevant to intergovernmental agencies and bodies to contribute to the preparation of the documents on forests and biological diversity to be prepared by the Executive Secretary, and to welcome the input of other Governments, non-governmental organizations and indigeneous and local communities;

3. invited all Parties to include expertise on forest biological diversity in their delegations to the Intergovernmental Panel on Forests; and

4. invited the Secreteriat of the Intergovernmental Panel on Forests to communicate progress on issues relevant to forests and biological diversity to its third meeting.

Finland has earlier (6 March 1996) given her contribution on forests, indigenous people and local communities (2a).

The present contribution is Finland's response to the request of 2b.

**Maintaining, Conserving and Enhancing Biological Diversity of Forests in Finland**

Summary

This paper will concentrate on the maintenance, conservation and appropriate enhancement of biological diversity in Finnish forests. The paper represents characteristics of Finnish forest landscapes and forest ecosystems, human-caused effects on forests and species, and steering mechanisms to maintain biological diversity in forests.

Finland is situated in northern Europe, in the boreal coniferous zone between the temperate deciduous (nemoral) and the arctic zone. About 75 % (234 000 km$^2$) of Finland's land area (305 000 km$^2$) is covered by forests and other wooded lands. Almost 90 % of the forests in Finland are dominated by coniferous tree species (82 % of the growing stock), either the Scots pine (*Pinus sylvestris*) or the Norway spruce (*Picea abies*), the rest are forests dominated by deciduous trees, mainly birches (*Betula pendula, B. pubescens*). About 63 % of the forests are privately owned (440 000 forest holdings), 25 % owned by the state, and about 9 % by companies. Private forests largely predominate in the southern part and state-owned forests in northern Finland. Forests have been used in Finland for multiple purposes for centuries, but large-scale industrial use of forests started only in the late 19th and early 20th centuries. At present the forest industry is highly important in the economy of Finland. The management of forests in Finland for wood production is both extensive and intensive. Almost all forest land outside protected areas is subject to silvicultural practices. However, native, indigenous tree species with local provenances have been used almost exclusively in regenerating stands. The small-scale forest ownership has led to variety in the regularity of forest management, and the aims of forest owners managing their forests are diverse.

Several specie groups of organisms have declined owing to the effects of forestry. Particularly species of old-growth coniferous forests, species of mature deciduous forests, species of nutrient-rich peatlands, and species requiring decaying wood have decreased.

The new alignments in the Finnish forest policy were enhanced by the principles accepted in UNCED and in the Second Ministerial Conference on the Protection of Forests in Europe in Helsinki 1993. The Ministry of Agriculture and Forestry and the Ministry of the Environment together have adopted (1994) 'The New Environmental Programme for Forestry in Finland', in which sustainable forest management is emphasized. The concept of sustainable forest management has gradually evolved, especially during the last two decades, to cover not only the wood production, but also the ecological and socio-economic sustainability of forests.

The following steering mechanisms are considered to be important in relation to the maintenance of biological diversity of forests: (1) reformation of legislation, (2) compiling national and regional forest plans, (3) developing criteria and indicators of sustainable forest management, (4) developing a reserve network, (5) developing forest management practices, (6) research and monitoring.

In general, preserving biological diversity of forests should be carried out both by establishing nature reserves and by taking biological diversity into account in managed (production) forests. These issues are interconnected, the way forests are managed affects the needs of establishing protected areas. There is, however, a minimum level for the protection of forests which should be pursued to maintain biodiversity of forests. Viable populations of species having specific habitat and area requirements, such as those preferring decaying trees and contiguous, old-growth forests, can be maintained only by an adequate reserve network.

1 Introduction

The Statement (UNEP/CBD/COP/2/CW/L.18) on biological diversity and forests, given by the second Conference of the Parties (COP) of the Convention of the Biological Diversity (CBD) to the Intergovernmental Panel on Forests (IPF), points out the main issues of forests and biological diversity, and identifies the most relevant areas in terms of references to the Intergovernmental Panel on Forests.

Finland fully agrees with the Statement's principle in paragraph 3, "Keeping in mind the crucial role of forests in maintaining global biodiversity, the COP wishes to establish a dialogue with the IPF on issues related to forests and biological diversity".

Finland regards the foundation of the IPF as very important and will support the work of the IPF in many ways. The views emphasized by Finland, and in particular, the criteria and indicators of sustainable forest management were included in the work of the IPF.

Issues on biological diversity and conservation are thoroughly integrating into the IPF programme. Biological diversity is an important priority of the IPF, and its successful implementation requires its addition to all forest policy, legislation and research. These issues are also essential in the context of this paper, which concentrates on the maintenance, conservation and appropriate enhancement of biological diversity in Finnish forests. The significance of scientifically valid information should be emphasized when managing forests and conserving biological diversity.

Forest ecosystems represent different evolutionary histories and various ecological processes. Consequently, maintenance, conservation and appropriate enhancement of biological diversity in forest ecosystems from a global perspective should be based on the relevant scientific information recognizing ecological characteristics of various forest biomes. This paper will present characteristics of Finnish forest landscapes and forest ecosystems, and the steering mechanisms to maintain biological diversity in forests. However, some aspects of the Finnish experience dealing with forests and biological diversity can be applied also in other countries and regions, especially in the boreal coniferous forest zone.

## 2 Forests and forest use

### 2.1 Forests are the main ecosystem

Finland is situated in northern Europe, in the boreal coniferous zone (Annex 1) between the temperate deciduous (nemoral) and the arctic zone. About 75 % (234 000 km$^2$) of Finland's land area (305 000 km$^2$) is covered by forests and other wooded lands. Agricultural land and built-up areas cover together about 14 % of the land area. Originally, about one third of the land area was covered by peatlands, both open fens and wooded mires. Due to draining, the proportion of natural peatlands has been considerably been reduced and covers nowadays 14 % of the total land area (see chapter 2.5). In addition to the land area, inland watercourses, mainly lakes, cover about 33 000 km$^2$ in Finland.

There are two native dominant coniferous tree species in Finland, the Scots pine (*Pinus sylvestris*) and the Norway spruce (*Picea abies*). Over 60 % of the forests are dominated by Scots pine (46 % of the growing stock) and about 25 % by Norway spruce (36 % of the growing stock), the rest being forests dominated by deciduous trees, mainly birches (*Betula pendula, B. pubescens*), and to small extent by aspen (*Populus tremula*) and alders (*Alnus glutinosa, A. incana*). The northernmost part of the country is covered by the mountain birch (*B. pubescens* subsp. *czerepanovii*), which also forms the northern border of tree growth. In addition, there are about ten other deciduous tree species in Finland (e.g., oak *Quercus robur*, linden *Tilia cordata*, ash *Fraxinus excelsior*, maple *Acer platanoides*, rowan *Sorbus aucuparia*), which, however, are rarer and distributed mainly in southern Finland (Annex 2). Since forests cover so high a proportion of the landscape in Finland, forests play a significant role in the overall biological diversity in Finland.

### 2.2 Importance of forests to people

About 63 % of the forests are privately owned, 25 % are owned by the state, about 9 % by companies and the rest are owned by municipalities, organizations or cooperatives. Private forests largely predominate in the southern part of the country and state-owned forests in northern Finland. There are about 440 000 private forest owners in Finland with individual forest holdings; the average size of the forest holding is 27 ha. Small-scale forest ownership has led to some variety in the regularity of forest management, and the aims of forest owners managing their forests are diverse.

Throughout history, Finnish people have used their forest resources for many purposes and forests have always played a significant role in the livelihood and in the culture of the people. For instance, in Finland, as well as in other Nordic countries, there is a tradition of public right of access (Every Man's Right) which enables all citizens to move freely in forests, pick berries, mushrooms and other

vegetation not protecetd by law, and camp temporarily in the forest. This public right of access means that the multiple use of forests is made possible without reserving large forest areas for the needs of those citizens who do not own any forest land.

In the 18th and 19th century slash-and-burn cultivation was common, particularly in eastern Finland, where over half of the forest land was subject to slash-and-burn cultivation. Cattle were largely grazed in Finnish forests to reduce the use of fields and meadows as pastures for cattle in summer. This cattle grazing in forests have ended only in recent decades. There was also large-scale use of pines for tar production, particularly in central Finland. Tar was an important export product of Finland in the 18th and 19th centuries. In addition, forests have been used for firewood (as a fuel) and provided building material for centuries.

Large-scale industrial use of forests started in Finland during the 19th century. Sawtimber production began during the mid-19th century and pulp industry at the turn of the 19th and 20th centuries. At present, the forest industry is highly important in the economy of Finland; the value of the forest industry export was 34 % (52.6 billion Finnish marks) of the total export of Finland (153.9 billion FIM) in 1994. The forest industries cover some half of Finland's net foreign currency earnings. About 90 % of the trees cut in Finnish forests (55 million cubic meters in 1994) are used by the forest industry: for pulp, timber, plywood. The other 10 % is used largely for domestic purposes, such as firewood.

The total removals of wood from Finnish forests reached around 50 million $m^3$ annually already in the 1920s and exceeded the allowable cut during the 1960s. Because of intensified silvicultural practices the annual growth of wood in the forests has increased steadily from about 1970 onwards and is now about 80 million $m^3$ when measured as timber growth. The main long-term trend in wood utlilization has thus been a shift from fuelwood use to industrial use rather than an increase in the total use.

Finland is among the leading countries in the world in exporting forest industry products: among all countries, the value of the export of Finnish forest industry products was (1993) the fourth largest after Canada, USA and Sweden. The value of Finnish forestry products is about 8 % of all forestry products exported in the world, although only about 0.5 % of the world's forests are situated in Finland.

## 2.3 Forestry and environmental authorities

Forestry authorities in Finland are under the Ministry of Agriculture and Forestry (Annex 3) and environmental authorities mainly under the Ministry of the Environment (Annex 4). State-owned land in Finland is governed by the Forest and Park Service, which also oversees the protected areas. Forestry is supervised and promoted by 14 regional Forestry Centres (former Forestry Boards). In addition, there are about 300 Forest Management Associations guiding private forest owners on a local scale. At the national level, the Forestry Development Centre Tapio

provides expertise and service to the forest sector. Under the Ministry of the Environment there are 13 regional Environment Centres, which are responsible for nature conservation on a regional level.

The Forest Research Institute studies and monitors forest resources, e.g., by regular National Forest Inventories, which have been carried out since the First Inventory in 1921–24. The most recent (8th) Inventory was made in 1986–94, and the ninth Inventory began in 1996. These inventories cover the whole country and produce detailed information dealing with, e.g., age structure of forests, tree species composition, total tree volume and vegetation cover. Of the environmental authorities, the Finnish Environment Institute (former Agency) studies and monitors the effects of human-caused changes in the environment and nature conservation issues, such as threatened species and a network of nature conservation areas.

2.4 Natural history and dynamics of forests

Finland is part of the Fennoscandian (Baltic) shield which consists of an ancient bedrock area. The land area is largely covered by moraines and glacifluvial eskers and other landscape formations created by the eroding and retreating glacier. Finland and Fennoscandia were covered by ice masses during the Pleistocene period (2 million – 10 000 years before present, BP). Flora and fauna have retreated and recolonized areas during glaciation and interglaciation periods of the Pleistocene. The latest glaciation period ended about 10 000 years BP.

The forest landscape in the boreal zone was in a virgin condition modified by natural disturbances, such as forest fires, storm fells, insect outbreaks causing defoliation of needles or leaves and other biotic disturbances. Flooding of lakes and rivers affected forests along shores. Paludification was an important landscape factor, particularly on a flat terrain. Disturbances caused the natural structural variation in a boreal forest landscape. Disturbances occurred both on a small scale (within a forest stand) and on a large scale (forest landscape). Small-scale variation is, for instance, gap dynamics within a forest stand as a consequence of windthrow of individual tree(s). Large-scale disturbances consist of large fires or storms felling trees over large areas. Natural disturbances were not predictable, for example, the effects of forest fires varied grately in size and intensity.

Susceptability of tree species to forest fires is variable. In general, only some of the trees burn and die out in forest fires, particularly in pine-dominated forests. Spruce forests occur in moist or mesic sites, which burn less frequently than dry sites where pine forests are dominant. Scots pine is better adapted to more frequent forest fires in dry sites. The intensity of fires, however, varies considerably. Pines may reach the age of 600–700 years in Fennoscandia but spruces only 300–400 years.

Normal fire frequency at a given site is usually 50–200 years. It has been estimated that about 1 % of the forest land burned annually before the systematic fire suppression started in the late 19th century. Fire refugias are forests that have never

burned or burned rarely, when the fire frequency may be several hundreds of years. These forests are mainly spruce-dominated wet and moist forests.

The amount and proportion of dead and dying trees increases in the natural forest succession. Individual trees die out in natural, unmanaged forests, owing to competition between different tree individuals. The volume of dead and dying trees in natural, unmanaged old-growth forests is about one third of the total tree volume. In unmanaged old-growth coniferous forests the amount of dead and dying trees is approximately 50–100 cubic meters/ha or even more, 100–200 cubic meters/ha. About 70 % of the volume of dead trees consists of fallen trees on the ground.

As a consequence of the effects of natural disturbances the forest landscape is spatially heterogeneous both on a small scale and on a large scale. This heterogeneity, however, differs considerably from human-caused changes, such as forestry. Disturbances, forest fires and windfalls, usually affect only some of the trees in forests, and therefore, large continuous forest areas are typical in a landscape of natural forests.

Age structure within natural, unmanaged forest is highly variable: the forest consists of trees of several age classes, tree generations and tree species. This is partly a consequence of natural disturbances, because only some of the trees die out in fires, and the fires enable a new tree generation to grow within a forest of old remaining trees.

## 2.5 Effects of forestry practices on biological diversity

The management of forests in Finland is both extensive and intensive. Almost all forest land outside protected areas is subject to silvicultural practices. However, practically all Finnish forests used for wood production consist of managed natural or semi-natural forests (in contrast to man-made plantations) characterized by a mixture of indigenous tree species and other components of the original ecosystem. In production (managed) forest stands the ecological succession continues but in a different way as compared to natural, unmanaged forests.

Production forests are usually thinned twice or three times before they are regenerated at the age of 80–150 years. The purpose of thinning is to produce high-quality timber and to increase tree volume and tree growth. In natural, unmanaged forests many trees die out as a consequence of competition between tree individuals, whereas in production forests thinnings prevent the formation of decaying trees. In addition, fallen trees are usually removed from production forests.

As a consequence of forest management the amount and proportion of decaying trees is at present very low. In the Eight National Forest Inventory in 1986–94 it was calculated that the amount of dead trees in the southern half of Finland was 0.9 cubic meters/ha, which was 0.8 % of the total tree volume (average 115 $m^3$/ha).

In the early 20th century (and the late 19th century) cutting of forests was mainly selective so that commercially valuable individual trees were removed from forests. In the 1940s and 1950s the silvicultural practices changed. Clear-cutting of a stand and replanting or natural regeneration from seed trees was adopted largely as a forest management practice. However, during the past years the average size of the regenerated areas has been small. In the privately owned forests the average size of a cutting area has been less than two hectares. This is largely due to small-scale ownership of forests in Finland (see chapter 2.2.) Native, indigenous tree species with local provenances have been used almost exclusively in regenerating stands. The change in silvicultural practice has increased the growing tree volume, but it has had considerable effects on forest landscapes.

Habitat fragmentation is the process of subdividing a continuous habitat into smaller pieces. Earlier contiguous forest areas have been fragmented due to clear-cuts, and the structure of forest stands has become more homogeneous. Intensively managed, 'cultivated' forests comprise largely stands of one age class.

Contiguous forest areas are also fragmented owing to forest roads built during the past 40 years: the amount of forest roads increased by over 20-fold between 1960 and 1994. At present there are over 100 000 km of forest roads in Finland.

Forest fires have been systematically suppressed in Finland during the past 100 years.

Natural mires have been largely drained, earlier for agricultural purposes, but from the late 1950s onwards for forestry purposes. About 7 000 $km^2$ of mires have been cleared for agricultural land and over 50 000 $km^2$ drained to increase tree growth. Drainage of mires for silvicultural purposes peaked in the 1960s and early 1970s, but the drainage continued to a lesser extent until the early 1990s. Seventy-five percent of all mires in the southern half of Finland have been drained for wood production, 62 % in the southern part of northern Finland and 24 % in the northern part (Lapland) of northern Finland.

In southern Finland no large areas of old-growth forests were left by the early 20th century, due to cuttings and slash-and-burn cultivation carried out particularly in eastern Finland, in the 18th and 19th centuries. In contrast, in northern Finland large areas of old-growth forests were still left in the mid-20th century. In northern Finland, large-scale forestry started after the Second World War in the late 1940s and early 1950s, when clear-cutting or natural regeneration from seed trees was adopted as a common silvicultural practice. Consequently, the proportion of old-growth forests has continuously decreased. The proportion of forests over 120 years old was 55 % of the whole forest land in northern Finland in 1921–24 (1st National Forest Inventory), 44 % in 1951–53 (3rd Inventory) and 25 % in 1992–94 (8th Inventory). In southern Finland, the proportion of forests over 120 years has increased: there were 2.5 % of forests over 120 year old in 1921–24, 1.3 % in 1951–53 and 4.8 % in 1986–92. In contrast to forests in northern Finland, these forests in southern Finland have been intensively managed (e.g. the amount of

decaying wood is low), so they are of minor significance to species preferring natural, unmanaged old-growth forests.

Forest management and other human uses of forest resources change the structure of forests and regional composition of forests in a way to which all species can not adapt. Although a significant number of species in boreal forests are habitat generalists, some of the species have such specific habitat requirements that they cannot survive in an intensively managed forest landscape.

Several specie groups of organisms have declined owing to the effects of forestry. Particularly species of old-growth coniferous forests, species of mature deciduous forests, species of nutrient-rich peatlands, and species requiring decaying wood have decreased. According to the Committee for the Monitoring of Threatened Animals and Plants, 41 % (692 out of 1692 endangered species in Finland) of all endangered animals, plants and fungi in Finland are threatened predominantly by forest management. Species benefitting from silvicultural practices, such as increased fragmentation, are largely habitat generalists, that is, species occurring in several habitat types. In particulary numerically dominant species tend to be generalists, distributed broadly across different forest types and across successional gradients. For instance, some bird species in Finland benefit from bushes caused by clear-cuttings, thinnings, mire drainage and fragmentation of contiguous forest areas and increase, their population. Other species that are declining (like many birds, beetles, mosses, lichens and decomposing fungi) are mainly habitat specialists, they are dependent on particular habitat components which decrease in managed forests.

Decaying trees comprise an important feature of natural, unmanaged forests. In natural, unmanaged stands there is a continuation of trees in different stages of decay. The specie groups particularly dependent on decaying trees are beetles and decomposing fungi. For instance, in Finland, about 25 % of all beetle species (900 out of 3600 species) are dependent on decaying trees. The great majority (over 90 %) of all decomposing fungi (altogether about 500 species in Finland, polypores and Corticiaceae) require decaying wood. About 20 % (104 species) of all these species are regarded as threatened due to forest management. Decomposing fungi are specialised to specific decaying stages of a dead tree. They operate based on the stage of decay in trees, in other words, the occurrence of one fungi species is dependent on the decomposition of a tree caused by another species. The occurrence of decomposition communities demands a continuation of dead trees of different decaying stages, and also the continuation of living trees on a specific site.

Several species of lichens and mosses also require the continuation of living trees, this means that there has been a permanent forest cover on a site for a very long period. For example, in a particular study it was observed that the numbers of invertebrates (insects, spiders) on the branches of spruces were five times greater in natural, unmanaged forests where spruces were 200 years old than on spruce branches of 100-year old managed forests. The higher number of invertebrates in the older trees from natural, unmanaged forests was due to the abundance of

slow-growing lichens these trees. Bird species in the foliage-gleaning guild (e.g., tits *Parus* spp) forage branches on invertebrates. Several resident species of the foliage-gleaning guild have considerably decreased in Finland during the past 50 years. These species suffer, e.g., from the effects of forest fragmentation, but probably also from the lower food resources available in managed forests. This example shows that there are complex interactions in an old-growth forest: high age and slow growth of trees increases the amount of lichens, and the more lichens the more invertebrates on branches, and the more invertebrates the more foliage-gleaning birds.

The quality of habitats varies among the habitat patches of a forest landscape. According to the source-sink model, sources are subpopulations which are demographically viable, whereas sinks are subpopulations of demographical inviability for a particular species. Sinks will ultimately become extinct unless they receive immigrants from another (source) subpopulation. Preserving source populations is of utmost importantance in boreal forests. Several species and specie groups (e.g., resident bird species) prefer large, old-growth forest areas (e.g., in size over 10 $km^2$), although the species may also occur in small patches of old-growth forests or in managed forests. However, for these species small patches of old-growth forests and managed forests most probably are sink habitats, and thus these populations are dependent on source populations in large, old-growth forest areas. Small patches of old-growth forests will most likely not maintain species preferring old-growth forests, unless source populations in large old-growth forest areas are preserved.

## 3 The new approach in sustaining biological diversity

### 3.1 General guidelines

The traditions of Finnish forest legislation date back to over a hundred years. The first significant law, passed in 1886, was aimed at preventing the devastation of forests. Other early laws connected with forests and biological diversity include the Protection Forest Act, which limits the use of forests in the northern forest line and which came into force in 1922, and the Nature Conservation Act which was passed in 1923.

Forest policy in Finland has evolved towards emphasizing the economic, social and ecological features of environmentally sound and sustainable management of forests. The importance of forests to the well-being of the Finnish nation is a key reason for the wide acknowledgement of the multiple roles of forests.

Decisions made at the United Nations Conference on Environment and Development (UNCED, Rio de Janeiro, 1992), especially the Non-legally Binding Authoritative Statement of Principles for a Global Consensus on the Management, Conservation and Sustainable Development of all Types of Forests, Protection of the Atmosphere (Agenda 21, chapter 9), Conservation of Biological Diversity (Agenda 21, chapter 15) and Combating Deforestation (Agenda 21, chapter 11) and further Convention on Biological Diversity and United Nation's Framework Convention on Climate Change and the Second Ministerial Conference on the Protection of Forests in Europe (Helsinki, 1993) have had an important impact on the development of forest policy in Finland.

The Rio and Helsinki principles consist in general of issues dealing with forest management and sustainable use, protection of forests, and sustainable development. in general. The principles of the Ministerial Conference on the Protection of Forests in Europe in Helsinki, resolution H1, *'General guidelines for the sustainable management of forests in Europe'*, and resolution H2, *'General guidelines for the conservation of the biodiversity of European forests'*, are particularly important in terms of biological diversity, but so are resolutions H3 (*'Forestry cooperation with countries with economies in transition'*) and H4 (*'Strategies for a long-term adaptation of forests in Europe to climate change'*), which should be emphasized in relation to biodiversity.

Finland committed herself to the management, conservation and sustainable development of forests both at the national and international levels by adopting the four resolutions (H1–H4) of the European Ministerial Conference. These resolutions deal with issues which require political attention and stimulation in view of the current global discussion on forests and the urgency attached to the promotion of the sustainable management of forests.

The Ministry of Agriculture and Forestry has developed 'The New Environmental Programme for Forestry in Finland', in cooperation with the Ministry of the Environment and with other authorities of environmental, nature conservation and forestry groups, and with non-governmental organisations (NGOs). In July 1994, the Ministry of Agriculture and Forestry and the Ministry of the Environment adopted this new programme which comprises the strategy for sustainable forest management in Finland in the near future. The Programme offers a basis for the current reformation of forest laws. In this Programme the principles of maintaining, conserving and appropriately enhancing biodiversity in all forest ecosystems have been integrated and specified. The role of production forests have been especially addressed from the viewpoint of biodiversity.

Maintenance, conservation and appropriate enhancement of biological diversity in forest ecosystems cannot be successful without the adoption of sustainable forest management. The concept of sustainable forest management has gradually evolved, especially during the last two decades, to cover not only the wood production, but also the ecological and socio-economic sustainability of forests. Thus, the concept of sustainable forest management also covers the maintenance of biodiversity. Based on the New Environmental Programme for Forestry in Finland, the concept of sustainable forest management implies that natural resources are used in a way that does not cause a decrease in the biodiversity of forest ecosystems, in addition, local populations of species occurring in forests should not be threatened by forestry practices.

Finland has promoted the concept of sustainable forest management by specifying the criteria and indicators of sustainable forest management (see chapter 3.2.3). The Ministry of Agriculture and Forestry (1995) has also actively developed indicators which will be used in evaluating sustainable forest management in Finland.

The Ministry of the Environment prepared (1994) a document on maintaining biodiversity in Finnish forests (In Finnish, Suomen metsäluonnon monimuotoisuuden säilyttäminen), which reviewed in detail the state of conservation of Finnish forests and the guidelines for the establishment of forest reserves.

Conserving biodiversity of forests should be carried out both by establishing nature reserves and by taking biological diversity into account in production forests. The better the specific features of forests rich in biodiversity can be maintained in production forests, the fewer protected areas are needed. There is, however, a minimum level for the protection of forests which should be pursued to maintain biodiversity of forests and the natural dynamics producing this biodiversity.

## 3.2 Specific steering mechanisms

The following key steering mechanisms, *inter alia*, are intended to be used in Finnish policy for maintaining biodiversity in forests:

- reformation of legislation (3.2.1)
- compiling national forest plans (3.2.2)
- compiling regional forest and natural resource plans (3.2.2)
- developing criteria and indicators for sustainable forest management (3.2.3)
- developing a reserve network (3.2.4)
- developing forest management practices (3.2.5)
- research and monitoring (3.2.6)

3.2.1 Legislative reform

Reform of forest legislation is important for the realization of the current demands for sustainable forest management. The present Acts undergoing revisions are the Private Forest Act and the Forest Improvement Act, which concern the funding of forestry measures. Forest legislation reforms have been carried out with due observance to the on-going overall review of the Nature Conservation Act. The Government has recently submitted its proposal for reforming the two forest Acts to the Parliament.

The proposed reforms stress the maintenance and enhancement of biological diversity in production forests, in addition to production of wood and non-wood products and services. According to the Forest Act, the Forestry Centres will prepare regional forestry programmes and use the criteria and indicators for sustainable forest managment in these target-oriented programmes.

A general guideline is included in each Act that requied in management practices the simulation of the natural dynamics of forests. For example, forest harvesting should be carried out by taking into account the specific characteristics of a given site. There is also a statement dealing with specific small-scale 'key' habitats in which special caution should be applied when managing these habitats (key habitats under discussion in the proposed forestry legislation are in Annex 5).

The new proposals for financing forestry measures make it possible to conduct inventories of important habitats for biodiversity and to restore degraded habitats.

In the Act on Forestry Centres and the Forestry Development Centre, which came into force at the beginning of March 1996, sustainable forest management and conservation of biological diversity are key elements. In the Forest and Park Service Act, which deals with state-owned forests and which came into force at the beginning of 1994, the regulations related to maintaining, conserving and enhancing biological diversity were already included in the legislation.

The Government has also recently submitted the new Nature Conservation Act to the Parliament. The goal of this Act is to maintain and enhance the level of biodiversity in Finland. The Act takes into account the demands of the European Union's Habitat and Bird Directives. The Nature Conservation Act stresses the

so-called 'favourable' level of protection, which is based on the directives of the European Union (see also chapter 3.2.4).

The conservation status of a natural habitat will be taken as 'favourable' when: (1) its natural range and areas it covers within that range are stable or increasing, (2) the specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future, (3) the conservation status of its typical species is 'favourable' (see next). The conservation status of a species will be taken as 'favourable' when: (1) population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats, (2) the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future, (3) there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.

In the Nature Conservation Act, the 'favourable' level of protection reached by creating will be reserves, protecting species and their specific sites of occurrence, by protecting specific, rare habitat types (see Annex 5) and by other regulations of land use. The most important areas in terms of biological diversity and nature conservation will be included in the Natura 2000 network of the European Union.

### 3.2.2 Compiling national and regional forest plans

The United Nation's Conference of Environment and Development (UNCED) suggested that every country should compile a national forest plan. Finland stresses the importance of compiling this kind of plan, which should be based on economic, ecological, social, cultural and spiritual sustainability.

In forestry planning different needs should be taken into account, such as wood production and forest biodiversity, as well as economic objectives and environmental values.

In the Forest and Park Service the compiling of multiple-needs plans for some state-owned forests has already begun. An essential part of multiple-needs plans is the so-called landscape ecological planning. This planning is the overall consideration of nature values in a relatively large area (50–500 $km^2$). This plan includes mapping of important 'key habitats' for biota, mapping of other nature, landscape and cultural values, maintaining ecological corridors and 'stepping stones' for the biota and structural characteristics of forests to simulate natural dynamics, and definition of areas for restoration or in terms of biodiversity improvement. The purpose of ecological corridors and stepping stones (small patches of valuable habitats, such as old-growth forests, herb-rich forests or brook surroundings) is to maintain dispersal possibilities for species between larger habitat areas.

The concept of multi-objective forest management planning has been adopted, and a new forest planning database has been developed, for private forests too. The

system was put into operation in 1995, and it permits a more specific description of the forest stands and, especially, their biological diversity. In Finland, the annual planning area for private forests is some 1.1 million hectares, on which about 15 000 plans are made for single estates. A forest management plan consists of the assessment and evaluation of the forest estate by a forester and recommendations for measures to be taken. The plan is meant to support the decisionmaking of the owner of the forest holding. The acquirement of a forest management plan is voluntary and its implementation is not obligatory, even though it is recommended by forest professionals.

Landscape ecological planning should ensure the maintenance of biodiversity in a landscape of production forests. However, evaluation and development of the scientific basis of this planning should be encouraged. At present, the scientific knowledge of the effects of different silvicultural practices on biota is not well developed. (see chapter 3.2.6).

It should, however, be stated that landscape ecological planning of production forests does not exclude the need for developing a reserve network (see chapter 3.2.4), but this planning and reserve network support each other in maintaining biodiversity. Although the important areas for biota are included in landscape ecological planning, wood production is clearly the main land use in these plans.

In compiling forest plans there is a need for cooperation between forestry and environmental authorities and organizations, land owners and local communities. The Forest and Park Service has used a planning process in which different parties have had the possibility to participate.

### 3.2.3 Developing criteria and indicators of sustainable forest management

Finland is developing criteria and indicators for sustainable forest management and monitoring forest ecosystems. By using criteria and indicators one can evaluate achievements in forest management. The criteria and indicators will also be refined with the implementation and follow-up of the forthcoming forest and nature conservation laws and the Environmental Programme of Finland.

In the Expert Level Follow-up meeting of the Helsinki Ministerial Conference on the Protection of Forests in Geneva in 1994, six criteria and 27 indicators for measuring sustainable forest management were adopted. Criterion 4 'Maintenance, conservation and appropriate enhancement of biological diversity in forest ecosystems'is particularly connected with biodiversity in forests, but also other criteria have links to biological diversity.

The Ministry of Agriculture and Forestry of Finland launched a project in 1995 for developing national criteria and indicators for sustainable forest management. The six criteria developed during the follow-up of the Helsinki Ministerial Conference were adopted as such. The pan-European quantitative indicators were modified to fit the Finnish conditions and were complemented with, in particular, biological

diversity and socio-economic indicators. The pan-European decriptive (legal/regulatory, institutional, financial instruments and informational means) indicators were used for identifying the national descriptive indicators. Approximately 160 quantitative and descriptive indicators were selected for further work in Finland (Annex 7).

The Finnish indicators cover forest resources, carbon balance, forest ecosystem health and vitality, wood and non-wood forest production, biological diversity in production forests, protected forests, threatened species, protective functions of forests for soil and water, and socio-economic and cultural functions of forests.

A report on national criteria and indicators is being prepared and is scheduled to be printed in June 1996.

The next step will be to proceed from the national level criteria and indicators towards sub-national and local levels. In October 1995, a one-year participatory research project was started in the Pirkanmaa region in southern Finland. The project is aimed at developing principles for the preparation of a regional development strategy for sustainable forestry. The project will also lead to the development of a common strategy for the Forestry Centres in the preparation of regional forestry programmes, according to the forthcoming forest legislation (see chapter 3.2.1).

### 3.2.4 Developing a nature reserve network

Developing a nature reserve network should be encouraged, as it is highly important both in terms of nature conservation and sustainable forest management. The most valuable and fragile forest areas should be protected. The planning of a nature reserve network should be based on scientifically verified biogeographic criteria. The network should be planned in co-operation between environmental and forestry authorities and organizations, land owners, and local communities.

The protected forests should include all forest types, not only the non-productive ones, which has been customary in many areas. The reserve network of forests should be based on ecologically valid principles. In particular, forest areas having a unique biota, such as old-growth coniferous forests, mature deciduous forests, herb-rich forests and valuable wooded mires should be protected. It is impossible to maintain all the characteristics of natural forest landscapes and forest structures (e.g. the large amount of decaying trees) in intensively managed forests.

Of all forest land (including productive forest land, scrub land and ecologically valuable wasteland) about 10 percent is preserved or outside normal forest use (source: Finnish Forest Research Institute eight National Forest Inventory). About half of this (5.3 percent) of the productive forest land (forest- and scrub land) in the whole country and about 3 percent (530 000 hectares) of the forest land is protected by law. However, the majority of protected forest land (about two thirds) is situated in northern Finland close to the northern limits of forest growth (Annex

6). In southern Finland, less than one per cent of the forest land is protected. Although the protected forests in northern Finland are ecologically valuable, they cannot compensate for the need to protect more southern productive forest areas.

The Council of State in 1993 and 1995 made decisions-in-principle on protection of old-growth forests in southern and northern Finland. According to the decision-in-principle, Finland does not currently have sufficient forest reserves, except in northernmost Lapland. The working group on the protection of old-growth forests has drawn up proposals for protecting of old-growth forests in southern Finland (1992 and 1994). The proposal to further improve the protection and reserve network of old-growth forests in northern Finland was made in May 1996. The final decisions on the protection of old-growth forests will be made later by the Council of State.

In developing the Finnish network of nature conservation areas the Habitat and Bird Directives of the European Union must also be taken into account. The Habitat Directive stresses the so-called 'favourable' level of protection of habitats and species with a special interest. To fulfill the demands of the Directives, an ecological network of special areas of conservation shall be set up under the title Natura 2000 in each member state of the European Union.

Finland made its first proposal for the Natura 2000 network in late 1995. This proposal included 370 areas, representing more than 25 000 $km^2$ of land. It consisted of existing nature reserves on state-owned land, such as Strict Nature Reserves, National Parks, Wilderness Areas, and mire conservation areas. These areas are largely concentrated in northern Finland.

Finland will make the complementary proposal for the Natura 2000 programme. This proposal consists mostly of areas in southern Finland. Regional Environment Centres and the Forest and Park Service will make the required inventories in the summer of 1996, and the final proposal will be made in late 1996.

3.2.5 Developing forest management practices

Developing forest management practices is of utmost importance due to the great majority of production forests. One very important aspect is to identify and conserve or manage 'key' habitats, i.e. areas of particular conservation value. The maintenance and tending of these habitats, such as herb-rich woodlands and small wetlands (see Annex 5), should be embodied in the management and use of production forests.

The primary objectives in forest management will be to maintain and enhance sustainable management so that forests produce a sustainable yield of wood and biodiversity is maintained in forest ecosystems. In Finland these objectives will replace the previous emphasis on wood production activities and are included in the proposals for the new forestry legislation.

Environmental management principles pertaining to forestry practices should include all phases of forest treatment — restocking, clearing, tending of young stands, thinning of more mature stands, and timber harvesting. The same applies to operations affecting abiotic site factors, including prescribed burning, site preparation, afforestation of former agricultural land, forest drainage, and construction of forest roads. Important aspects in coniferous boreal production forests include, *inter alia*, favouring broad-leaved deciduous woods and mixed stands, landscape management, wildlife management, and sensitive harvesting on islands and in shoreline forests.

Recently, these principles and practices have been included in the management recommendations prepared by the Forest and Park Service, as well as by the forestry organizations for privately-owned forests.

In the northern tree line in the northernmost Finland there are restrictions for forestry which might cause a decline of the tree line (for details, see the Finland's report on Forests, Indigenous People and Local Communities, reply on request 2a (see preface)). Specific caution must be adopted when managing forests near the northern border zone for forests.

The effort to diversify the skills towards management of the ecosystem is visible in the new teaching programmes at all educational levels, both in the vocational schools for forestry and in forest education in universities. Service training of biodiversity issues covers a broad scale from actual forestry operations to policy formulation. In addition, the awareness of forest and land owners of biodiversity in forests has according to recent studies increased through information material concerning the new recommendations for forest management. On issues dealing with biodiversity and forest management there is cooperation between non-governmental organizations (NGOs) and authorities.

### 3.2.6 Research and monitoring

Scientifically valid reviews on the biodiversity of various forests are inadequate. The need for acquiring more knowledge applies not only to protected areas and rare or endangered species, but also to production forests, and to the impacts that forest management practices have on biodiversity.

In general, there is an urgent need to study in detail the effects of forestry practices on biota. These studies should include both a local scale, intensive research within a forest stand and stands; and a larger, regional scale, which covers extensive scientific work within a landscape perspective. The important topics to be studied include ecological and structural components of biodiversity (e.g. amount of decaying trees, old-growth trees and deciduous trees) available and needed within the production forests, and the amount of old-growth forests needed at the landscape scale.

A study of the dispersal ability of species is of utmost importance, as several species preferring old-growth forests probably have poor dispersal ability. Consequently, they are susceptible to habitat fragmentation. The effects of habitat fragmentation on different groups of biota should also be studied. This information is important for landscape ecological planning. As forest ecosystems are rather complicated systems, research on species' interactions should be encouraged.

The results dealing with criteria and indicators give new insight into the evaluation of sustainable forest management. The indicators should be completed if they do not measure all the aspects needed.

Determining and monitoring biodiversity of forests should be connected to measurable parameters. There is also a need to develop methods for assessing the conservation value of different types of habitats and areas.

The monitoring system is required to yield information on the state and changes of biodiversity in forests. Monitoring will also be applied in assessing the effectiveness of efforts to conserve biodiversity. In general, monitoring of changes both in the structure of forests and in the species and habitat diversity is essential. Monitoring of populations and forests should be carried out in areas remaining natural (protected areas) and in production forest landscapes to detect the effects of changes, both detrimental and favourable, in sustaining biological and structural diversity of forests.

The Finnish Environment Institute is mostly responsible for the monitoring of threatened species and habitats in Finland. The responsibility for monitoring biodiversity in nature conservation areas lies both within the Finnish Environment Institute and in the Forest and Park Service, whereas the Forest Research Institute is mainly responsible for monitoring biodiversity and its development in production forests. The National Forest Inventory (see chapter 2.3) will be developed into a versatile monitoring system focusing on forest and peatland ecosystems and will include a broader component of biological diversity.

There have been separate research programmes which deal with biological diversity or issues which are connected with biological diversity in Finland for the last five years. A large-scale, multidisciplinary national scientific research programme of biological diversity funded by the Academy of Finland, will begin in early 1997.

## 4 General overview of the factors dealing with biological diversity of boreal forests

In general, maintenance, conservation and appropriate enhancement of biological diversity of boreal forests should be carried out both by establishing nature reserves and by taking biodiversity into account in production forests. These issues are connected with each other, since the way forests are managed affects the needs of establishing protected areas.

Maintaining biodiversity requires a sufficient protection of forests. Preserving several species and forest ecosystems is possible only by establishing nature

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reserves where the natural dynamics of forests are allowed to proceed uninterrupted. Viable populations of species having specific habitat and area requirements, such as those preferring decaying trees and contiguous, old-growth forests, can be maintained only by an adequate reserve network. Several species of natural and old-growth forests prefer large, contiguous forest areas. It is important that the source populations of species in their optimal habitats are preserved. In addition, the protection of large forest areas is well-founded, as natural disturbances and natural dynamics of forest landscapes operate at a relatively large scale.

Creating forest reserves is not enough, however, biodiversity should also be properly taken into account also in production forests outside the protected areas. Landscape ecological planning should ensure the maintenance of biodiversity in an environment of production forests. Forest management should simulate the natural dynamics of forests. In production forests the important characteristics of biodiversity should be identified and maintained, both at the regional and local scale. At the regional scale, the representativeness of different forest types is important. At the local scale, specific characteristics of individual forest stands should be considered. In practise, these principles imply that there should be an adequate amount of decaying trees, old-aged trees and stands, and broad-leaved trees in the production forests. In addition, the key 'habitats' highly important in terms of biodiversity should either be left untouched or managed with special care.

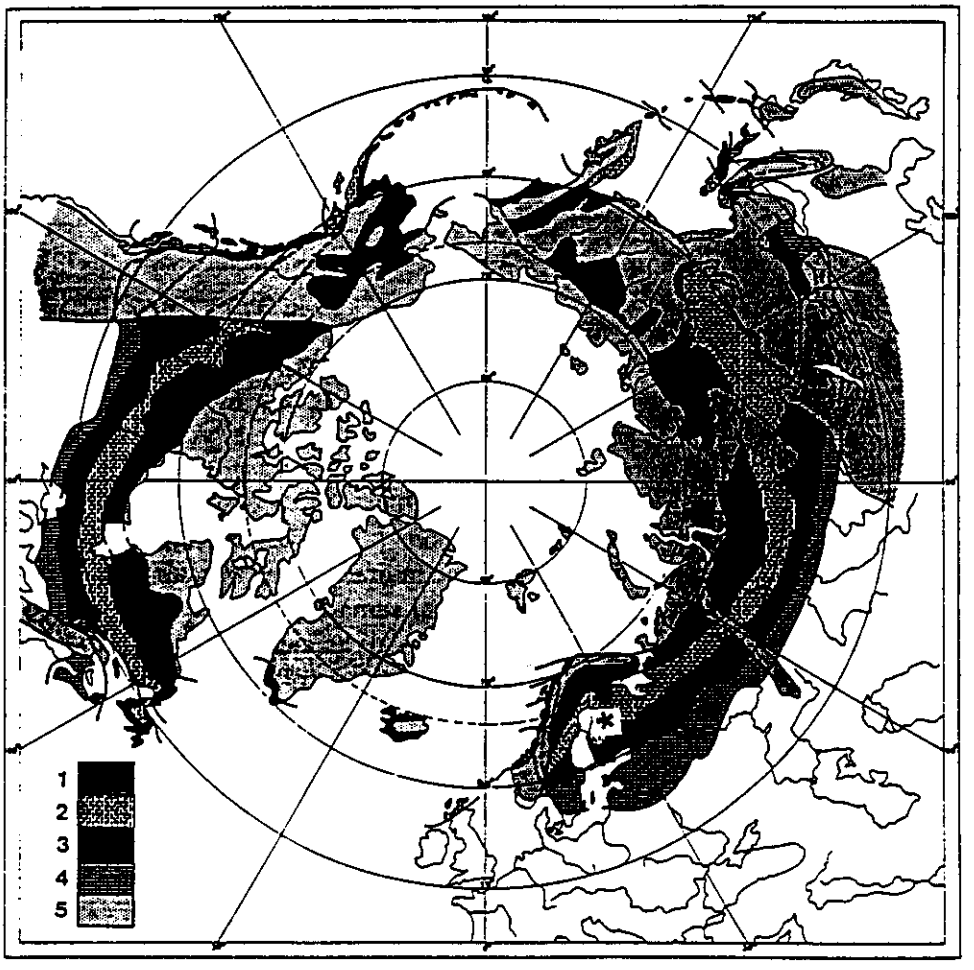
Maintaining biodiversity in forests requires national strategies, as well as regional forest plans, where biodiversity issues are included. Conserving biological diversity requires the co-ordination of legislation dealing with both nature conservation and forestry.

Scientifically verified knowledge is essential in conserving biodiversity. A good example of this scientific research is the work on the criteria and indicators of sustainable forest management, which is necessary for evaluating and monitoring the effects of forestry on biodiversity. The study of both ecological and socio-economic factors affecting the state of biological diversity is important. Both the actions of nature conservation and forest management plans should be scientifically founded. Consequently, all the people working with forests and environment issues should be appropriately educated.

The cooperation between authorities, nongovernmental organizations, forest owners and the forest industry is important. International cooperation is essential both on a global and a regional level.

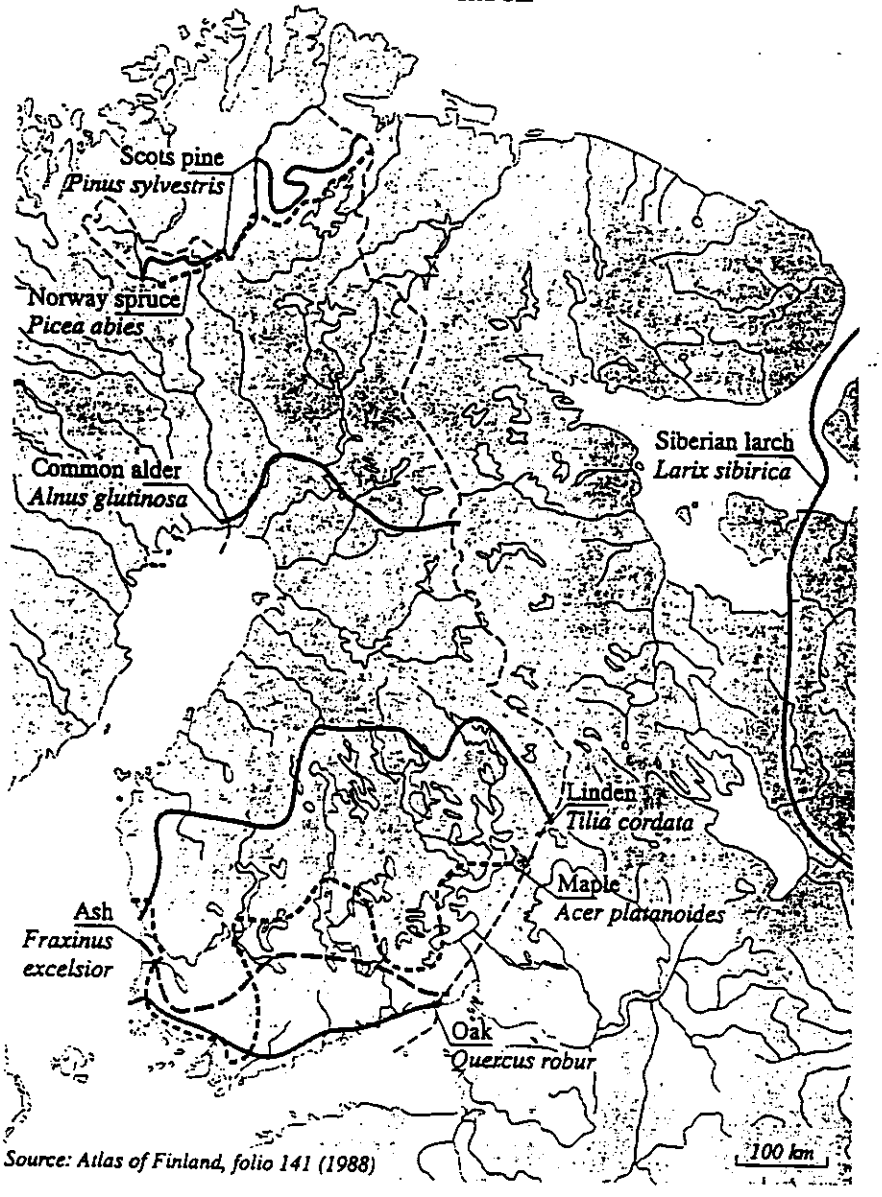
Annex 1.

The circumboreal zone and its transcontinental subzones. (1) northern boreal, (2) middle boreal, (3) southern boreal, (4) hemiboreal, (5) arctic and complex mountain oroarctic areas where the subzones are not indicated though they occur there as as an outlier, according to Hämet-Ahti (1981, Fennia 159:69–75). The location of Finland is presented as an asterisk.



Annex 2.

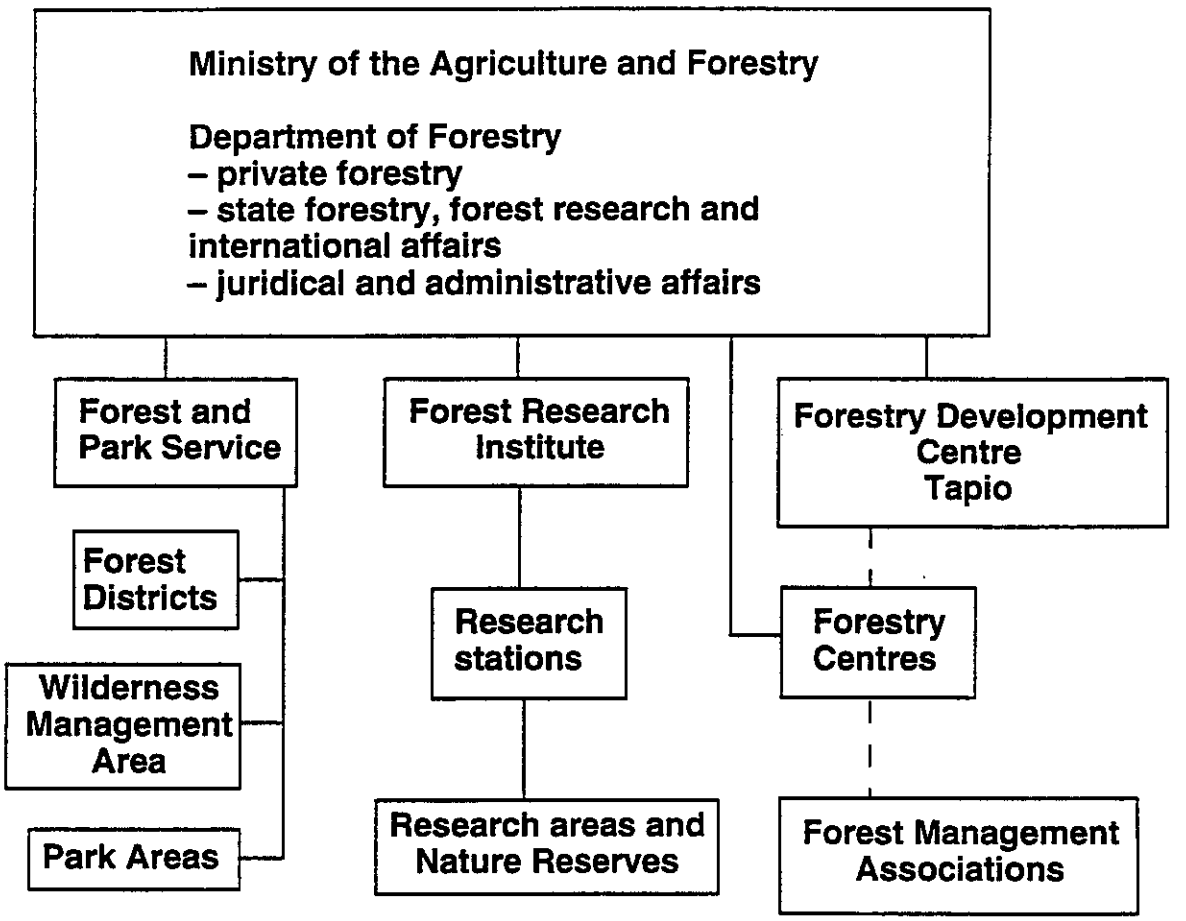
**Northern limits of selected tree species in Finland and western limit of Siberian larch**




*Source: Atlas of Finland, folio 141 (1988)*

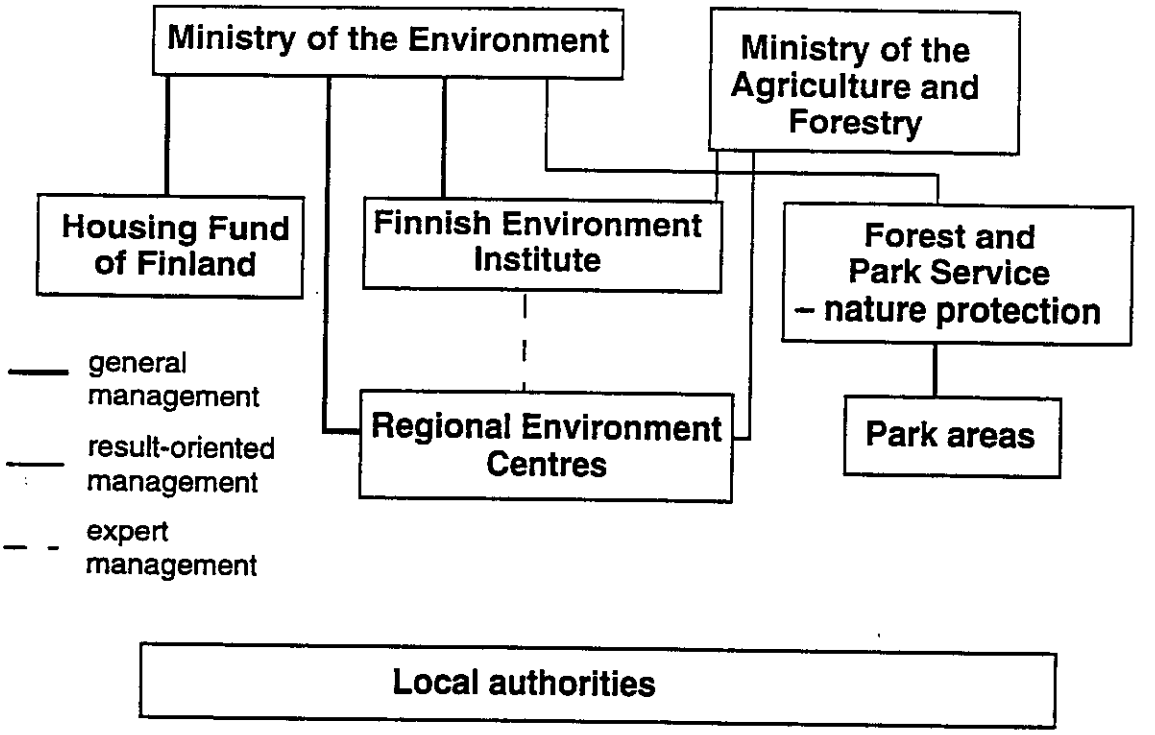
Annex 3.

## Administration of Forestry in Finland



Annex 4.

## Environmental Administration in Finland



## Annex 5.

**Key habitats (under discussion of the new General Forestry Act)**

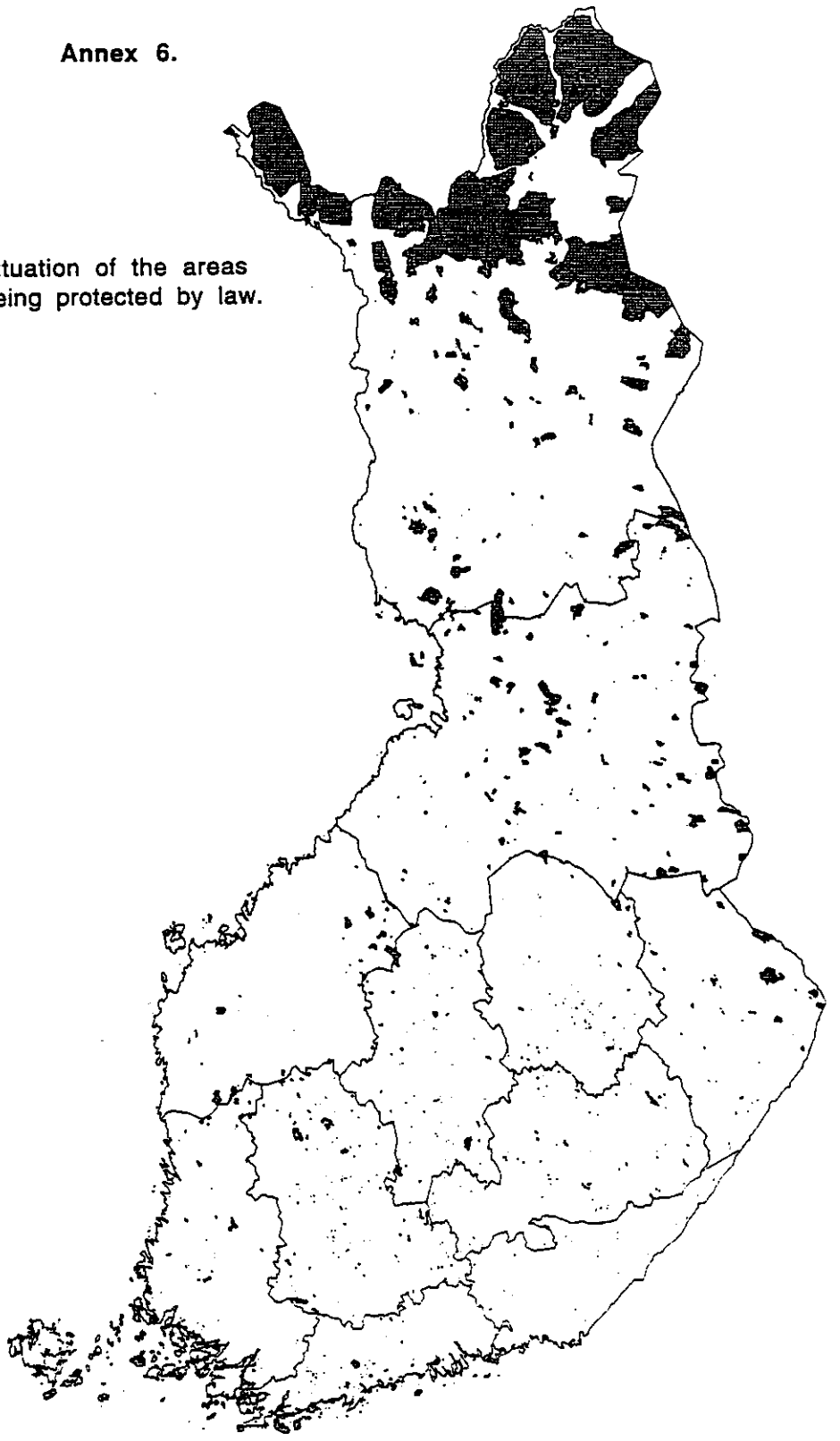
- small herb-rich woodlands
- small natural stands of valuable broad-leaved trees (oak, elm, ash, lime, hazel)
- herb-rich and fern-rich wooded peatlands and marshes
- rich fens (except Lapland)
- small wetlands in forest areas
- natural springs, brooks and small ponds with their surroundings
- small wooded mineral islands in mire areas
- exposed rocks and rock cliffs, with their basement woodlands
- rocky crevices and gorges
- shoreline and island forests
- sparsely wooded mires and shore marshes
- sparse woodlands on sands, rocky outcrops and boulder fields

**Wooded key habitats (under discussion of the new Nature Conservation Act)**

- larger natural stands of valuable broad-leaved trees (oak, elm, ash, lime)
- larger natural stands of hazel
- larger natural black elder marshes
- sparsely wooded dunes

**Annex 6.**

Situation of the areas being protected by law.



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