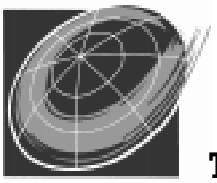

Taiga Rescue Network

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THE LAST OF THE LAST:
The Old-growth Forests of Boreal Europe

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The Taiga Rescue Network (TRN) is an international network of non-governmental organizations and indigenous peoples working for the protection and sustainable use of the world's boreal forests. TRN was established in 1992 to give a voice to those wanting to see sensitive development in the boreal region. Today more than 180 organizations are participants of the network.

Foreword

This publication is about the last old-growth forests of boreal Europe. The maps of the last old-growth forests of the region and this accompanying report are a result of extensive international cooperation between ten non-governmental organizations participating in the Taiga Rescue Network. Since 1992, the Taiga Rescue Network has been addressing forest degradation, and especially old-growth forest destruction, all around the boreal world by raising awareness about the global importance of boreal old-growth forests and the root causes of their disappearance.

The forests of Fennoscandia (Norway, Sweden, Finland) and Northern European Russia are parts of the same bio-geographical region and have great similarities – especially in their nature stage. In Fennoscandia, where only small fragments of old-growth forest remain, state and non-state actors have been conducting extensive forest inventories to identify the location of the last old-growth forests. Despite this effort, old-growth forests continue to be logged throughout the region.

Although old-growth forests in Northern European Russia are disappearing at an alarming rate, these areas still represent the largest expanse of unfragmented old-growth forests in the whole of Europe. Forestry operations and illegal activities coupled with a tremendous lack of information on old-growth forests contribute to the increasing degradation of the Russian forests. Non-governmental organizations have been trying to fill this gap of information by taking the lead in identifying large remaining tracts of old-growth forests in Russia.

Participant organizations of the Taiga Rescue Network first expressed the need to compile existing information on European and Russian old-growth forests in 1995. The report aims at ringing the alarm bell about the destruction of the last old-growth forests on the European continent. Another goal is to give policy makers, industry and local communities in the boreal countries the necessary information to take better-informed forest conservation and management decisions. Ultimately, we hope that the report will be a useful tool to dramatically increase old-growth forest protection throughout the region in order to ensure biodiversity conservation.

The non-governmental organizations involved in the project are demanding that the remaining old-growth forests identified in the report be not subjected to any human activity damaging the biodiversity, structure and ecological function of these forests. Measures should also be undertaken by forest authorities to identify the forest areas with high conservation value that are not covered in this report. The surveys and management decisions on such forests should be made with the participation of all interested parties. Eventually, forest management across the region should move towards integrating biodiversity conservation in those areas that are being used for timber production.

Wood products originating from the boreal forests of Fennoscandia and Northern European Russia are primarily exported to the Western European market, where there clearly is an expanding market for products from well managed forests certified by independent, performance based certification, such as the approach promoted by the Forest Stewardship Council (FSC), as well as old-growth free wood and wood products. We hope that the forest sector will be able to meet this demand, thereby contributing to biodiversity conservation.

Governments in Fennoscandia and Russia have indicated a commitment to global biodiversity conservation by joining several international agreements – such as the United Nations Convention on Biodiversity and the Helsinki Ministerial Conference on the Protection of Forests in Europe. We also hope that the governments will be able to implement these commitments soon.

We recommend that policy makers and the forest sector consider the report carefully, and incorporate its findings into their forest management and conservation plans. The Taiga Rescue Network will continue to engage in a dialogue with governmental and private actors to ensure adequate old-growth forest protection and socially beneficial, economically viable and ecologically sound management of the boreal forests.

Elisa Peter and Ola Larsson,
TRN International Coordination Center

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Executive Summary

The boreal forest, or *taiga*, stretches around the Northern hemisphere of the earth across Alaska, Canada, Scotland, Fennoscandia, and Russia. The European boreal region is a specific subset of the *taiga* found in Norway, Sweden, Finland and Northern European Russia and historically found in Scotland. This report investigates the status of the boreal forests in Fennoscandia and the Karelia Republic, Murmansk Oblast, Arkhangelsk Oblast, and the Komi Republic in Northern European Russia. This report is a complement to maps of the last remaining old-growth forests of this region. The maps and this report serve as an alert to the urgency needed in ensuring the protection of the last remaining old-growth areas of boreal Europe.

Natural boreal forests in Europe are conifer-dominated forests. The structure of the boreal forest is determined by disturbance regimes, such as wildfire, insect infestation, and fallen trees creating local gaps in the canopy. This disturbance regime forms the important structural components of a thriving boreal forest ecosystem. These components, such as very old coniferous and deciduous trees, trees with a heavy load of epiphytic lichens, broken top, stag-headed, and leaning trees, trees with holes and cavities, snags, fire-scarred trees, snags and stumps, stumps with uneven surfaces, and large-sized logs in various stages of decomposition create ecological niches essential for the survival of a range of boreal species.

Modern forestry methods as practiced in the region has removed natural disturbances and many of the natural structural components from the forest. This has resulted in a biodiversity crisis in Fennoscandia with large numbers of forest-dwelling species on the national red data lists for threatened and endangered species. Use of timber resources is not a problem for ecological viability in itself. It is the level, type, and intensity of use, which matters. The region has experienced several phases of forest use and exploitation. Hunter-gatherers used forests for subsistence for thousands of years. Forest use has evolved throughout the last three centuries with increasing industrialization. The stage most detrimental to biodiversity and ecosystems is the phase of large scale rotation forestry, as witnessed in Fennoscandia, which basically converts the forest from natural diversity to a high-yield mono-crop of export timber.

Fennoscandian forests have been almost totally affected by large scale industrial rotation forestry leading to the almost complete conversion of natural ecosystems with only small areas of old-growth forest remaining. Although Northern European Russian forests have been heavily exploited, they have not experienced the systematic intensity of modern forestry practices. Relative to the forests of Fennoscandia, the forests of Northern European Russia are considered more viable from an ecological perspective. It is because of this relative ecological viability that Russian old-growth forests are of great international concern. These forests

represent the largest remaining areas of intact natural forest in all of Europe. Other threats to the forests of the European boreal include pollution, illegal logging, mining and mineral prospecting, and climate change.

The last remaining old-growth forest areas in Fennoscandia are few in number, small in area, and threatened. In Northern European Russia these old-growth forests, although relatively large when compared to Fennoscandia, are also threatened. Some valuable areas remaining are protected by national governmental initiatives and protection regimes. Industry and private forest owners also have protected some old-growth forest areas. But it must be noted that many areas are still not under any form of protection.

In Norway only 0.84% of forests are protected legally. In Sweden only 3.7% is protected and only 0.8% of the productive forests below the montane regions are protected. And in Finland the level of protected productive forests is 3.6% although this is concentrated in the north of the country. The system of protection mechanisms in Russia is extremely complex. The economic and political uncertainties affecting the region currently add to this complexity and make it difficult to ensure the security of old-growth forests currently under protection. Presently, the share of the remaining old-growth forests in European Russia in general can be estimated to 5-7% of all forests, with most of them having a large proportion of bogs and being located in the very north. Only 3-4% of all forests are protected against forest operations, and the protected areas are very unevenly distributed. Old-growth areas are also under threat from logging by Russian and foreign enterprises wishing to cash in on the relatively large volumes of timber still available. In both Fennoscandia and Northern European Russia there are many key biotope types, which are underrepresented in the current protection systems.

In all areas of boreal Europe there is a lack of inventory data available on the qualities, quantities, and locations of old-growth and high conservation value forests remaining. There is also no comprehensive plan nor the means available for strategic old-growth protection in the individual countries and the region as a whole. Scientists from the region have made statements on how much should be protected; however, there is currently an alarming gap between the scientific view on what must be protected to ensure biodiversity and the actions governments and industry have actually taken in the name of ecosystem viability.

The maps presented with this report are by no means complete. The maps attempt to fill a void of information about the valuable forest areas of boreal Europe. Protection is not the end of the story. Maintenance of biodiversity also depends on the kind of forest management present in those areas, which are in use and not set aside in protection schemes. Until forest management truly reaches ecologically sustainable forest management the overall importance of protection of these last areas and other forests of high conservation value is tantamount. The urgent need for wide reaching and efficiently implemented protection and sustainable management plans is at the heart of NGO demands for the protection of the old-growth forests of the European boreal region.

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It should be emphasized that this work would not have been possible without the major effort carried out by dedicated people and NGOs. Taiga Rescue Network carried out the international coordination of the national mapping efforts, aiming at a harmonization of the mapping criteria and methodology. The four country maps were compiled and digitized at the Biodiversity Conservation Center and Socio-Ecological Union in Moscow in December 1999. Remote sensing materials for the Russian maps were provided by ScanEx Research and Development Center, SPOT Image Inc. and Data+ Company.

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- Greenpeace Russia
- Natur och Miljö
- WWF Finland
- Greenpeace Nordic
- Birdlife Finland

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1. Introduction

Over the last five years NGOs from Norway, Sweden, Finland, and Russia have joined together to undertake the important task of mapping the last remaining areas of old-growth forest in Fennoscandia and Northern European Russia in an effort to call attention to their importance and vulnerability. Leading scientists in the region have indicated the level of protection needed; however, governments, in large part, have been slow to respond adequately to ensure the protection of the most valuable and vulnerable areas. The maps complemented by this report are a compilation of existing inventory data and field studies of new primary data. They are by no means complete. The maps hope to partly fill the void of information existing on the location and qualities of old-growth forest areas in the region. This void of information can be eliminated with increased attention and resources from states and industry acting responsibly to safeguard vital biological resources.

The last remaining old-growth forests and those with high conservation value support biodiversity in the forests. They also provide an essential resource for understanding biodiversity structures and needs. Efforts to mimic landscape patterns, natural structures, and dynamics cannot be furthered without reference areas for scientists, managers, and the public to study. Relevant, correct management guidelines can only be arrived at through observance of these reference areas. It is essential for this purpose to save the last remaining patches of old-growth and those complex valuable areas which may develop into old-growth like areas in the future (Östlund et al. 1997 and Angelstam 1999).

This report serves to provide background to understand the context of the maps of the last old-growth areas of boreal Europe. This report starts off with presentation of the methodology and definitions of old-growth forests used in the development of the maps. A background on the ecological structures and dynamics of the natural boreal forest is detailed. From this background one can better understand the impacts of the historical forest use, which are presented in the next section of the report. This section also details other impacts on forests, such as pollution, mining, climate change, and illegal logging. The conservation status in each country is presented, touching the issues of current level and means of protection, status of inventories, certification, targets for protection, and mechanisms for protection. Information available on current protection status and issues affecting protection was quite various in the different countries, which led to slightly different coverage in the country sections of the report. In the conclusion of this report NGOs express their vision and demands for old-growth forest protection in Fennoscandia and Northern European Russia.

The last remaining old-growth forest areas of Fennoscandia and Northern European Russia represent a wide array of important values: ecological, economic, social, cultural, and spiritual. In this document the arguments for protection are framed in quantitative terms of number of species, currency units for compensation,

hectares of protected areas, etc. These defining terms give a picture of the forest and set parameters for necessary immediate action that must be taken by the state, the industry, and the society as a whole. However, it is important to keep in mind that these numbers can in no way sufficiently represent the breadth of important values of these forests for the environment of the region and the world and for future generations which are intrinsic and often difficult to count and record on paper.

Forest near the Lake Pyaozero (Karelia Republic, Russia).
Photo: Mikhail Karpachevskiy.

2. Fennoscandian and Northern European Russian Old-growth Forests

The definition of old-growth forests used in the compilation of the maps and this report is based on the following understanding. Old-growth forests are characterized by stands originating through natural successions with a significant contribution of old trees and dead wood, often with a multi-layered tree structure. History of human disturbance does not necessarily exclude forests from being defined as old-growth, especially in case of the Fennoscandian forests. These forests contain globally, regionally or nationally significant concentrations of biodiversity values (e.g., endemism, endangered or threatened species, endangered or threatened ecosystems, refugia), or are large landscape level forests, where viable populations of most if not all naturally occurring species exist in natural patterns of distribution and abundance. (See Appendix I for complete definitions used in this inquiry).

The forests covered in this investigation are the boreal forests of Fennoscandia in the countries of Norway, Sweden, and Finland as well as the boreal forests of Northern European Russia. The focus of the report is on issues affecting the boreal region of Europe but it should be noted from an ecological level that some hemiboreal forest areas are also included in the maps. The Russian areas of the investigation include the territories of four Russian administrative units: Murmansk Oblast, the Karelia Republic, Arkhangelsk Oblast, and the Komi Republic. To complete the picture some forested areas in the southwest of the Nenets Autonomous Okrug have also been included in the analysis. In Russia, the area of investigation covers in large part the entire north of European Russia (roughly north of 60 degrees north latitude), including the northern limit of the taiga up to its transition to tundra.

3. Methodology

The research of this project started in 1995 and was finished in 1999. The mapping, which forms the basis of this report, has been conducted at a national level. Olli Turunen (Finland), Rein Midteng (Norway), Dmitry Aksenov, Mikhail Karpachevskiy and Alexei Yaroshenko (Russia), and Fredrik Wilde (Sweden) have coordinated the national mapping efforts. The national map coordinators have been responsible for gathering relevant information and compiling it into country maps.

The mapping of the Fennoscandian old-growth forests has mainly used previously published inventories, unpublished NGO inventories and field visits as sources of information. The Russian mapping work has mainly relied on satellite images and field inventories. The Fennoscandian maps represent the first time existing information on old-growth forests compiled for the region as a whole. The Russian maps represent the collection of existing data as well as the presentation of new primary data on old-growth forests in the region.

Due to national differences of old-growth forest status and available data the criteria and methodology differ between the mapped countries. (For detailed information on the methodology and criteria see Appendix II.)

It is essential to note that the areas presented in the maps do not cover the complete range of old-growth forests and forests of high conservation value. Only those forests meeting the regional definitions of old-growth forests are included on the maps. There are certainly some areas, which meet these definitions, which were missed in collecting the inventory data. Smaller areas of natural forest, many with old-growth characteristics, were not included in the analysis due to their insufficient size. This in no way means that these forests of smaller size and other areas of high conservation value not demarcated on these maps are not valuable and that adequate conservation measures should not be taken for these areas.

4. Ecology and History of Forest Use

4.1 European Boreal Forest Ecology

The boreal forest, or *taiga*, is the world's largest forest biome stretching around the Northern hemisphere in Alaska, Canada, Russia, Fennoscandia, and Scotland. What can be characterized as the European boreal forest is found in Norway, Sweden, Finland, and Russia west of the Ural mountains. Scotland also falls in this boreal zone; however, the vast majority of forests have been converted to agriculture and planted with exotic species and thus has not been included in this inquiry into the European boreal forests. The focus of this inquiry is on Fennoscandia and Northern European Russia. The following section presents a brief background into those unique ecological characteristics of the European taiga, including natural disturbance dynamics, dominant species, and structure, which are important for the existence and maintenance of biodiversity. The changes to the natural forest, in the context of the history of land use, are also presented.

The natural boreal forest can generally be described as a mosaic of upland forests and wetlands with lakes and rivers interspersed. The boreal forests in Fennoscandia and European Russia can be categorized as one distinct subgroup of the European boreal based on the mix of dominant species. This subgroup is characterized by dominant natural coniferous tree species Norway spruce (*Picea abies*) and Scots pine (*Pinus sylvestris*) and deciduous species European aspen (*Populus tremula*) and birch (*Betula* spp.) (Angelstam 1998). Goat willow (*Salix caprea*), alder (*Alnus* spp.), and rowan (*Sorbus aucuparia*) are also found in the region. Boreal forests are also characterized by a large diversity of dwarf-shrubs, grasses, herbs, mosses, fungi, and lichens (Esseen et al. 1992).

The northernmost part of the boreal region can be characterized as forest-tundra made up of stunted, sparse and swampy forests among tundra and bogs. The main species are Norway spruce (and/or Siberian spruce, *Picea obovata*, sometimes recognized as a separate species), Scots pine and white birches. To the east, in Arkhangelsk Oblast, vegetation becomes enriched with so-called Siberian species such as Sukaczev larch (*Larix sukaczevii*), sometimes distinguished from Siberian larch (*Larix sibirica*) that occurs on the western foothills of the Urals, Siberian fir (*Abies sibirica*), and Siberian stone pine (*Pinus sibirica*) (The Forest Encyclopaedia 1986).

The hemiboreal zone, some of which is included in the southwest of the Fennoscandian maps, can be characterized by the presence of temperate broad-leaf species, such as Small-leaved linden (*Tilia cordata*), ash (*Fraxinus excelsior*), Wych elm (*Ulmus glabra*), and Pedunculate oak (*Quercus robur*) in addition to coniferous trees. Within the region as a whole the boreal zone can be divided into the northern, middle, and southern boreal subsections. In the southern zone

scattered presence of the broad-leaf species of the hemiboreal are found. The middle and northern boreal zones are dominated by coniferous trees with birch as the primary broad-leaf species found (Esseen et al. 1992).

Large disturbances created by fires and to a lesser extent insect infestations, as well as gap-phase dynamics found in areas not effected by fire are integral to forest composition, structure, and species composition in the boreal forest. Wildfire is a major natural disturbance factor in the western European boreal forests (Angelstam 1998) as well as in Karelia and Murmansk Oblast. In Arkhangelsk Oblast and Komi the gap-mosaic disturbance pattern is more common.

The disturbance regime of fire creates succession patterns responsible for the mosaic of age classes and species types unique to the boreal forest. Natural wildfire patterns are dependent on a variety of variables. This complexity of variables leads to a wide diversity of impacts, which can be seen in the stand and landscape level diversity of the boreal forest.

The impacts of wildfire on the forest depend on several primary factors: frequency and intensity of the fire, severity, and characteristics of the vegetation. Site factors such as vegetation, slope, elevation, time of the day and year, stand composition, tree species, age class, basal area tree morphology, stand structure, and fire

Old-growth forest in Panskie Tundry Area (Murmansk Oblast, Russia).
Photo: Konstantin Kobyakov.

behavior such as fuel moisture, rate of spread, intensity are also vital to understanding the impacts of fire. It is important to note that fire refuges exist in some parts of the forest on moist sites with local humidity, in which fire may be absent for several hundred years (Angelstam 1998). Fire refuges are vital to the forest because many species may survive only in this area to later recolonize in burned areas of the forest.

In forests, in which fire is absent on an ecological time scale of more than 300 years, a gap-phase dynamic pattern is found (Anglestam 1998). In Arkhangelsk Oblast and Komi the gap-phase dynamic is dominant over large areas where fire is not as frequent. The main mechanism providing alternation of generations of trees in these forests is fall of individual trees or their groups because of natural mortality, insects and fungi outbreaks and windfall. Fallen trees create breaks in the canopy allowing light to reach the forest floor and new trees and plant species to grow. The fallen trees also give the forest a supply of dead and decaying wood. New and younger trees in the gap change the environment around them and the composition of plants and wildlife. The appearance of gaps in the forest cover is a random, unpredictable event creating forests of uneven age class and structure (Smirnova et al. 1995; Zakharov et al. 1997; and Yaroshenko 1999).

Certain boreal species of, for example, certain birds, lichens, and fungi, have particular habitat requirements. The fire regime and gap-phase dynamics of the

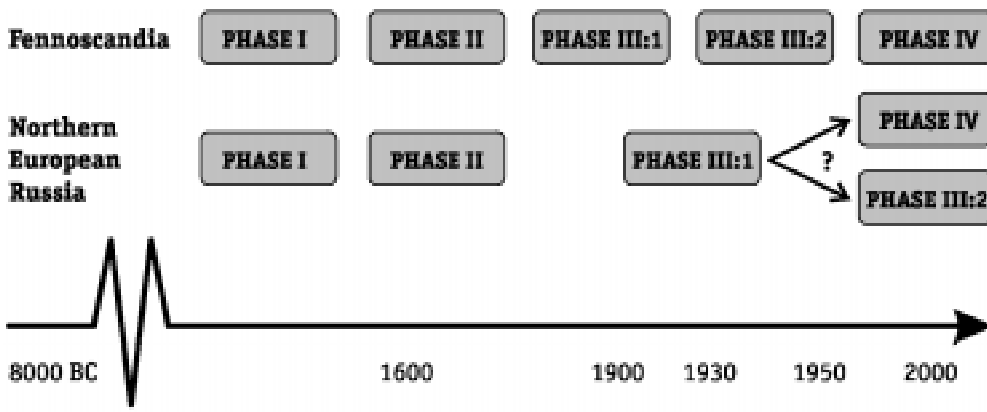
Tree regeneration on dead wood in an old-growth forest (Russia).
Photo: Alexei Yaroshenko.

forest creates a certain set of characteristics on the stand and landscape level creating habitat diversity in the forest, which allows for biodiversity (Angelstam 1998). Important structural components of a natural boreal forest from a species biodiversity standpoint are: very old coniferous and deciduous trees, trees with heavy load of epiphytic lichens, broken top, stag-headed, and leaning trees, trees with holes and cavities, snags, fire-scarred trees, snags and stumps, stumps with uneven surfaces, and large-sized logs in various stages of decomposition (Esseen et al. 1992). Gaps and specific mound-and-depression topography made by windfalls are also important aspects on the landscape level (Smirnova et al. 1995; Zakharov et al. 1997; Yaroshenko 1999).

4.2 Historical Land Use and Its Impacts on the Natural Forest

The history of land use in the European boreal region tells the story of the transformation of natural forest with multiple uses to a forest with decreased ecological viability and a very dominant narrow set of uses. The land use histories impacting the forests of Fennoscandia and Northern European Russia are slightly different because of the different political and economic histories of the region. Human effects on boreal forests of both Fennoscandia and Northern European Russia can in general be separated into three distinct phases (See Figure 1). The first stage is that of subsistence and agricultural use. Next, an intermediate stage evolved is characterized by diverse forest use, including both pre-industrial use, such as the production of tar, salt, and potash, as well as subsistence and agricultural use. This stage includes localized selective logging of forests, removing primarily large, old trees. The third stage in forest use of the region is the industrial era of forest exploitation implementing modern silvicultural methods (Östlund 1998). What is significant in the different stages is the extent of the impact on the forest ecosystem.

Figure 1: Phases of Forest Use



PHASE I – Subsistence Use

The forests of the European boreal have been in use for thousands of years. Hunter-gatherer tribes and indigenous nomadic peoples lived from the goods of the forest. Reindeer and cattle grazing, firewood collection and selective logging for subsistence use, and shelter building have gone on for centuries. As the forest areas were settled by humans, agricultural use of the forest lands gained prominence. This use of the forest can be labeled the first stage of forest exploitation. All products people extracted from forests were used for subsistence local needs.

PHASE II – Pre-industrial Forestry

The next phase includes this multiple subsistence use of the forests but sees the growing impact of pre-industrial forestry and forest exploitation for export from the local region and for commodity production. Production of tar, charcoal, salt, and potash in the whole of the European boreal dates back hundreds of years. In Sweden in the 17th and 18th century the location of iron works moved slowly north along the coast of the Gulf of Bothnia to make use of the abundant forest for charcoal production (Östlund et al. 1997). In the early 18th century forests in Northern European Russia were impacted by selective logging of large diameter trees to supply Peter the Great's shipbuilding in St. Petersburg. From the late 18th to early 20th century strong demand for high quality timber from western European markets drove the forest industry of Northern European Russia as well as in Fennoscandia.

This second phase of forest use developed in Fennoscandia and Northern European Russia for the most part simultaneously. Of course, the populated areas and those areas near ports and navigable rivers were affected first. It can generally be said that the timber frontier in the region moved from the south to the north, although coastal areas, even in the north, were affected before inland regions. The Northern European Russian port of Arkhangelsk was an important «window to Europe» for timber exports during this phase and even further back in history. It is important to note that, although these activities altered the forests locally and created local shortages of certain wood products around production and transport centers, vast areas of forest wilderness were still intact, only being impacted by selective logging and some areas untouched. The main ecological features of these forests were still intact.

PHASE III, STAGE 1 – Timber Mining

The third phase of forest use in the region brings industrial forestry. It is the development and intensity of the third phase of forest use in the whole region, which differ most between Fennoscandia and Northern European Russia. The first stage of this phase of forest use in the European boreal can be described as timber mining. Timber mining is the one time, intensive extraction of the resource until depletion followed by a shift to a new area to repeat this process (Lindahl 1998). This stage starts with selective logging practices and develops into clearcut logging. In

Fennoscandia timber mining moved from south to north in the 1800s reaching the north of the region after the 1850s (Östlund 1993). In Northern European Russia intensive selective logging was concentrated around transport and production centers. Large-scale clearcutting only began in Russia in the 1930s when pulp and papermaking began to demand trees of various sizes and export of forest products to Europe increased due to high demand for hard currency revenues.
One aspect of the third phase witnessed in Northern European Russia is that the introduction of new logging machine technology led to intensive clearcuts in accessible areas. Large scale clearcuts of 1000 ha and logging over the official allowable cut levels were common. There was wide use of penal labor to realize this increased harvest. As a result, extensive cutovers were left in accessible areas and there were many temporary logging settlements founded and soon deserted as the logging machines moved onward. On the flip side, remote areas and those difficult to reach with the new technologies were not impacted by the intensive clearcutting. These areas were also not as impacted by selective logging as in the past because this type of forestry disappeared as the new mechanized forestry practices spread in the region. These more remote areas experienced regeneration and many of these areas today are regarded as old-growth or high conservation value forests.

Fifteen-year-old unregenerated clearcut in subtundra forests near the Lake Chunozero (Murmansk Oblast, Russia). *Photo: Konstantin Kobyakov*.

PHASE III, STAGE 2 – Rotation Forestry

This third phase of forest use includes a second stage, which developed in Fennoscandia in the 1950s and has not developed in Russia on a full scale. This second stage of industrial forestry is characterized by rotation forestry. Instead of mining areas of timber and moving on, the forest is exploited using modern silvicultural methods, i.e., clearcutting, ditching, soil scarification, removal of deciduous trees, use of fertilizer, etc. followed by the establishment of a plantation of cash-crop coniferous trees are put in its place. This stage could also be called the conversion stage. Modern silvicultural methods and plantation forestry systematized the conversion of boreal forest ecosystems, extracting timber and the diversity of forest structures and dynamics and replacing them by equalizing all factors in the forest, species, humidity, age class, etc. on a landscape level.

It is essential to point out that it is not just exploitation alone, which jeopardizes the viability of the boreal forest ecosystem, it is the systematic implementation of modern silvicultural methods, which profoundly changes the structure and dynamics of the forest. Modern industrial forest practices in essence take the natural standing forests and completely convert them to a crop aimed at maximum yield. The key elements affected are the removal of large-diameter trees and the natural volume of dead wood snags and downed logs, fire suppression, and mono-culture replanting resulting in single-species, single-age forest stands (Linder and Östlund 1998). These aspects can be clearly seen when comparing the forests of Fennoscandia and the more remote areas of Northern European Russia. Many areas in Northern European Russia, in comparison to Fennoscandia, have to this day never been affected by a systematic implementation of modern forest management to the extent and intensity to which almost all areas of Fennoscandia have been subjected (Östlund, pers. com.).

Perhaps the most important variable for biodiversity is the number of dead trees left in the forests. Forty-seven percent of the forest species on the Swedish red data list are dependent on snags or downed logs. The disturbance of the natural structure and dynamics of the boreal forests show itself through the decrease in birds and epiphytic lichens (Linder and Östlund 1998). Modern industrial forest management has also removed fire from the ecosystem. For example, in central Sweden under natural conditions 0.6-1.9% of the forest land would burn annually. Today, the percentage of forest affected by fire is less than 0.02% annually. This is a reduction by a factor of 30–100 (Eriksen 1995).

The mono-cultural young forests are much denser and contain more trees than a natural forest with uneven age structure including large-diameter trees. This unnatural density is also seen in unmanaged, protected forests from which fire has been excluded. These unnaturally dense forests are inhibitory for light-demanding, competition-sensitive species, for example, vascular plants. Invertebrates also suffer from denser forests (Linder and Östlund 1998).

Forestry practices in the Russian forests, such as large-scale clearcuts and poor regeneration practices, all contribute to the ecological degradation of the forests.

In contrast to Fennoscandia, Russian forest management regimes in the area under consideration do not have a history of successful wide-scale use of artificial regeneration, or replanting, of coniferous tree species. Large-scale clearcutting, which began in the 1930s in Russia, brought about the spread of secondary deciduous forests dominated by birch and aspen. These Russian secondary forests, although much richer than Fennoscandian mono-cultural forests, are poor in biodiversity compared to the natural conifer-dominated old-growth forests.

While wildfires almost extinct in Fennoscandia, their presence in Russian forests is much above natural levels. Thus, over the period from 1975 to 1995, in zapovedniks in European Russia only 22.5% of fires were attributed to lightning, compared to an average of 7.6% for the rest of the region according to the statistics of the Federal Forest Service. All other fires were induced by humans or were of unclear origin (Kuleshov and Korotkov 1998). As a result of their intensity and frequency these fires destroy important fire refugia, on which many forest species intolerant to fire are dependent.

Large areas of remaining old-growth forests in Russia are reference ecosystems, representing key elements in the larger ecological network. The old-growth forest areas are attractive to the forest industry due to their relatively large area and large volume trees yielding timber. The number of large areas of old-growth forests in Northern European Russia is shrinking; however, when compared to those areas in Fennoscandia, Russian areas are quite large. Clearcutting and a system of logging roads have resulted in the fragmentation of forest areas. Fragmentation disturbs the wholeness of the populations of plants and wildlife and decreasing viability and destroying migration pathways for many animals. Fragmentation makes wilderness areas more accessible to humans, increasing the risk of unnatural disturbances, e.g., fires.

Table 1. Comparison of Swedish Forest Reserves and Forests Impacted by Forestry

Region	Forest location	Deciduous Trees %	Dead Wood %	Large Diameter Trees %	Vol m^3/ha
Northern Norrland	nature reserve	13.7	9.3	13.6	98
	outside nature reserve	11.2	2.9	3.2	134
Southern Norrland	nature reserve	14.7	5.8	9.2	127
	outside nature reserve	7.8	2.6	4.7	198
Total for Sweden	nature reserve	14.6	7.8	13.2	107
	outside nature reserve	14.6	2.3	8.1	185

Source: Fridman 1999.

The impact of the third phase of industrial forestry can be illustrated with Table 1 from the Swedish forest. The table shows the difference in key structural features in a nature reserve (protected from industrial logging) and forest areas outside of this protected area. The table highlights the marked decrease in deciduous trees, dead wood and large diameter trees and the increase in forest stand density in the managed forest.

PHASE IV – Sustainable Forestry

There is a movement towards a fourth phase of forest use in the European boreal forest. In Fennoscandia, sustainable forest management, which attempts to mimic natural process and restore system complexity, could be characterized as the next emergent phase of forest use in the region. This phase is in its infancy in Fennoscandia. A shift in attitude has taken place but the unsustainable practices are still being implemented. It remains to be seen what the result will be. In Russia the pressure of new technologies and socioeconomic difficulties threaten to bring the stage of rotation forestry to Russia in full force. There is pressure from foreign companies, primarily based in the countries of Fennoscandia, to log the relatively timber rich forests of Russia.

Many companies from Fennoscandia are involved in the development of the forest industry in Russia. However, if they were to apply the same standards for nature protection and ecologically adapted management practices demanded of them in their home country, there is some chance that the ecosystem conversion stage of industrial forest use will never arrive to Russia on a region wide level. In this case Northern European Russia could move ahead to the fourth phase. In Russia during the last several years, the official annual allowable cut levels have significantly decreased (although they are still greater than the sustainable level envisioned by NGOs) and the number and area of zapovedniks and national parks increased. This could be a step in the right direction; however, this trend seems to have slowed due to political and economic pressures.

Table 2. Red listed species in Fennoscandia

	Red Listed Species	Forest-dwelling Red Listed Species[1]	Percentage
Sweden	3501	1948	56%
Finland	1692	727	43%
Norway	3062	1405	46%

1 It is difficult to come up with an exact number due to different definitions of forest-dwelling species and forest dependent species, as well as, the complexity of the natural variables necessary to support species. This table is meant to serve as a reference point for the reader on the proportion of forest species endangered.

4.3 Biodiversity

Table 1 above gave statistics quantifying the change of the natural systems of the forest by industrial forestry. Another indicator for this change or disruption is the biodiversity crisis observed in the European boreal forests. The boreal forests are an important source of biodiversity in the world. The species included in the red data lists of the European boreal countries includes a large portion of forest-dwelling species.

Table 2 presents statistical data showing the number of forest-dwelling species on the red list of endangered species in the countries of Fennoscandia. In Norway the official red data list presented in 1998 includes 3062 species, of which 1405 (46%) are classified as forest species (Norwegian Directorate for Nature Management 1998). In Sweden there are 3501 red listed species, of which about 1948 (56%) can be said to be forest-dwelling (Artdatabanken 2000 and SSNC 2000b). In Finland there are 1692 red listed species. The large portion of them, 727 species (43%), live in the forest. Forestry practices are the primary cause for species being threatened (Committee for the Monitoring of Threatened Animals and Plants in Finland 1991).

The total number of species listed in the red data lists in Northern European Russia is presented in Table 3.

The figures presented in the table above do not fully represent the true situation. The numbers of endangered species are low because of insufficient knowledge of the diversity of arthropods and some groups of plants such as mosses and lichens. A good example of this is the relatively low number of species listed for Komi despite the fact that part of its area lies in the species rich Urals region.

Table 3. Red listed species in Northern European Russia

	Northern European Russia[1]	**Arkhangelsk Oblast[2]**	**Komi Republic[3]**	**Karelia Republic**	**Murmansk Oblast[3]**
Total number of species					
Vertebrates	530	400	248	399	350
Higher plants	1900	1300	1160	1200	1270
Number of red listed species					
Vertebrates	N/a	70	24	187	30
Lichens	N/a	N/a	N/a	N/a	6
Higher plants	N/a	215	135	205	88

1 includes Arkhangelsk Oblast, Nenets Autonomous Okrug, Komi Republic, Karelia Republic, and Murmansk Oblast;
2 includes Nenets Autonomous Okrug;
3 regions' Red Data Books are unofficial.

Despite these figures for Russia, many species listed as endangered in Sweden and Finland still exist in viable population in Northern European Russia. When looking at the area as a whole, the Russian forests serve as a mainland providing a continuous supply of some old-growth forest specialist species living in the small islands of fragmented Finnish old-growth forest (Ovaskainen et al. 1999).

4.4 Other Factors Impacting the Forests

In addition to the impact of modern forestry methods, the integrity of the European boreal forest is threatened by other factors. These include pollution – stationary and acidification, illegal logging, and destruction caused by mining and mineral prospecting. These are discussed briefly below. Other impacts to consider are overgrazing of both coniferous and deciduous seedlings by large game species such as moose. In some places in Russia overgrazing of reindeer also appears to impact the forest (Syroechkovskiy 1986).

Recreation, especially heavy around large settlements, may affect the biological diversity and the state of old-growth forests. Introduction of exotic mammal species, such as the Canadian beaver, capable of transforming the environment also can threaten the natural forest.

4.4.1 Mining and Air Pollution

The boreal forests of Fennoscandia and Northern European Russia are negatively affected by pollution from stationary sources and acidification from airborne pollution. Ninety percent of acid deposition in Sweden and Norway comes from other countries, primarily the United Kingdom, Germany, and Poland. When compared to the rest of Europe, boreal European forests and waters are especially sensitive to acid deposition (Posch et al. 1999).

Mining and extraction of oil and gas pose a serious threat to Russian forests both in terms of the physical mining of forest land, anthropogenic fires and the air pollution and acidification caused by the mining and processing industries. Some hotspots include: Kirovsk and Apatity, Pechenga and Monchhegorsk in the Murmansk Oblast. Thus, atmospheric pollution damaged 2.7% (0.2% stands have died) of all forests in the Murmansk Oblast around the Pechenga Nickel Plant at the Russian-Norwegian border and the Severonikel Plant in Monchegorsk (Zaitseva and Kobyakov 1999).

Iron mining and processing in Kostomuksha, in Karelia have caused the decline of old-growth forests at a distance of 10 km around the plant. Other large polluters are aluminum smelters in Nadvoitsy (Karelia) and Kandalaksha (Murmansk Oblast). Plesetskiy Polygon in Arkhangelsk Oblast is the site from which almost 40% of world's ballistic and space vehicles were launched. This complex is an important source of fires and pollution in the immediate vicinity. The forests of Komi and Arkhangelsk Oblast are also impacted by fire and chemical pollution caused by falling rocket stages from space launches. Also in Komi, coal mining

has destroyed soils and vegetation around the Vorkuta and Inta areas of the Pechora River basin and causes serious pollution at a distance of 100-200 km around mines. Oil extraction near Usinsk, Vozey and Ukhta, natural gas leakage near Vuktyl, potential gold mining in Yugyd Va National Park in Komi, mineral exploration in the Lapland Forest in Murmansk region and the eastern part of the Kola peninsula, diamond mining in the Arkhangelsk region, and past industrial nuclear explosions also are on the list of impacts on the forests (The State Report on… 1994; Method Development for Inventorying… 1998).

Stricter regulations on mineral extraction and processing industries may make the situation in Fennoscandia slightly less severe than in neighboring Russia; however, mining poses a potential threat to the forest are threatened by mining. Sweden has a relatively liberal mineral prospecting law, which allows prospecting in nature reserves. Although today old-growth forests may not be under direct threat of mining, it is unclear as to what would happen if valuable minerals were found under nature reserve land.

Mining presents a potential threat in the far northeast of Norway. In the Pasvik valley in Finnmark, close to the Russian border, an area with the most remaining old-growth forest in Norway, mineral exploration companies are now seeking for minerals. This is also a potential issue in the coming years in the county of Nord-Tröndelag.

Barren ground – forests killed by airborne pollution of Severonikel Plant near Monchegorsk (Murmansk Oblast, Russia). *Photo: Konstantin Kobyakov*.

4.4.2 Climate Change

Boreal forests are sensitive to climate change. Climate modeling shows that a climactic warming can lead to a northward shift of the boreal forests biome, replacing the northern edge with tundra and the southern with temperate broad-leaf forests dramatically changing the current boundaries of the boreal region (Swedish EPA 1999).

4.4.3 Illegal Logging in Russia

Illegal logging is a threat to the boreal forests in Russia (Russia's Forests: Barriers… 1999). Regarding the area of this inquiry and specifically threats to old-growth forests, perhaps, large scale illegal logging is not such a threat. Illegal logging is most widespread in more heavily populated regions with a developed road network. In these areas there are very little if any old-growth forests remaining. However, there are many various legal violations regarding logging and timber procurement, which are common in Northern European Russia. These are difficult to measure quantitatively. The most common, for example, are logging in protected areas, unmotivated salvage logging by regional forest authorities (*leskhozes*), use of improper technologies, over-harvesting, and violation of logging licenses. Despite the widespread nature of these violations they do not come close to the forest destruction caused by logging practices allowed under the current laws.

Intensive intermediate logging in the first group forests
(Karelian Isthmus, Leningrad Oblast, Russia). *Photo: Alexei Morozov*

5. Conservation Status

The following section attempts to assess the current conservation status of old-growth forests and valuable areas in each of the countries of the region. This analysis looks at legally protected areas as well as voluntary protected areas and other legal mechanisms for protection. This section also offers recommendations from the scientific community for the level of protection needed. The information included for each country differs slightly because of the availability and breadth of recent analyses on the subject. Due to the complexity of the situation in Russia and the emerging nature of the protection mechanisms, the information presented for Northern European Russia is a bit more in depth than that presented for Fennoscandia.

The government structures and mechanisms available for forest protection in the Fennoscandian countries are quite similar. However, the ownership structure in the countries of Norway, Sweden and Finland is quite different (see Table 4). Obviously the owner of the forest area is in the position to decide whether or not to protect a valuable area and which mechanisms to implement. For this reason it is important to note the breakdown of forest owners in the different countries.

Table 4. Ownership of forest resources, in millions of hectares

	Norway	**Sweden**	**Finland**	**Northern European Russia**[1]
State-owned	0.83	2.1	5.0	68.7
Private companies	0.28	9	1.7	0
Private landowners	5.6	11.5	12.4	0
Other	0.33	0	1.0	0
TOTAL	**7.04**	**22.6**	**20.1**	**68.7**

1 This number includes only forest lands of the State Forest Fund (FF).

Sources: Swedish Yearbook of Forest Statistics 1999; Finnish Statistical Yearbook of Forestry 1998; Norwegian Institute for Statistic Studies (SST) 1999; and Strakhov et al. 1996.

5.1 Norway

The Norwegian forests make up 12 million ha, which is equal to 37% of the country's land surface. This is both productive and non-productive forest land. Seven million hectares is counted as productive forest (Norwegian Forest Owner Association 2000). More than 80% of the forest is privately owned (Norwegian Department of

Agriculture 2000). Only 0.84% of forest in Norway is legally protected in the form of national parks and nature reserves (Norwegian Ministry of Environment 1995). The Norwegian Parliament recently passed a new protection plan, which dictates the protection of an additional 0.22% of productive forest over that, which is already protected. Sixty-six percent of the old-growth forest areas, which are currently protected in Norway have less than 100 ha productive forest in the specific protected area (Framstad et al. 1995). This is significant because it shows the very small areas of productive old-growth forests under protection.

Inventory Status

Old-growth forest inventories were carried out as part of the Verneplan from 1984-1997. The results of these inventories are included on the Norwegian maps presented with this report. There is no systematic, transparent initiative to inventory and register key habitats and biotopes in Norway (WWF 2000). The state owned Statskog SF has begun a process of key biotope inventories as well as privately owned Borregaards skoger and Norske Skog. Also some municipalities have begun registering key biotopes; however, there is a lack of transparency and uneven quality of the work. Very few of the smaller forest owners have identified key biotopes on their property. There are still major gaps in the information available on forests today in Norway.

Spruce with epiphytic lichens and trace of black woodpecker (Holmvassdalen, Norway).
Photo: Bettina Heilmann

Certification

There are no FSC-certified forests in Norway today. The Pan European Forest Certification (PEFC) initiative is supported by the Norwegian Forest Owner Association (Norges Skogeierforbund). Large portions of the forests will be ISO 14001 certified during 2000. Both these schemes are not accepted by Norwegian NGOs. ISO 14001 is not set up to protect biodiversity. The PEFC initiative is not a performance based standard and is not considered acceptable as a mechanism for forest and biodiversity protection. NGOs and some forest sector representatives have just started the process of setting up a FSC standard for forest management in Norway. The Living Forest plan launched in 1995, was not set up to develop certification but started a process of developing guidelines and standards for Norwegian forest management. The Living Forest mandates no specific protection for old-growth forests.

Protection Targets

The Norwegian Institute for Nature Research (NINA) recommends that 5% of productive forests should be protected. This 5% is sufficient if certain ecologically adapted logging practices are implemented and enforced. If these are not present NINA recommends a higher level of protection. According to NINA scientists there is a lack of large forest wilderness areas and there are big holes in the coverage of protection of several valuable forest types especially coastal forests and coastal rain forests in western and central Norway, forests in lowland areas and highly productive forests (Framstad et al. 1995).

In a recent quote, one scientist from NINA states that the amount of protected forests is far from adequate from a biodiversity standpoint. He called for the halt of industrial forestry practices, which continue to drive species to extinction (Bendiksen, pers. com.).

Monetary Compensation for Protection

Officially in Norway monetary compensation is available to landowners for the protection of forest land. Compensation levels are set at the estimated value of the land and ownership remains in the hands of the original landowner. Until quite recently, the agriculture department has not been willing to compensate landowners for protection of key biotopes. In the year 2000 the parliament has decided that compensation will be allocated. However, the government has not yet decided on this amount.

5.2 Sweden

Productive forests in Sweden account for 22.6 million ha. According to official statistics released in 1997, 830,000 ha or 3.7% of the productive forest is under strict protection in the form of national park and nature reserves. It is important to note that of this only 173,000 ha or 0.8% lies outside of forests designated as

montane forests (*fjällnära*). In the southern boreal and hemiboreal regions in Sweden less than 1% of the productive forests are protected (Statens Offentliga Utredningar 1997). The high percentage of montane forests protected relative to other productive forests is important to note because despite their unique conservation value these forests are not representative of the diverse ecological and biological values of the productive forests of Sweden as a whole. Montane forests are considered low productivity forests. They have historically not been impacted by forestry as other forests of the country.

In addition to the 1997 figures presented above, 35,000 ha have been protected between 1997-1999 as nature reserves except for approximately 1000 ha, which has been deemed national park (Rolf Löfgren, pers. com.). In addition to national parks and nature reserves approximately 2000 ha are protected, divided equally between biotope protection (*biotopskydd*) and nature protection agreements (*naturvårdavtal*). These two forms of protection are designed to protect smaller areas of valuable forest. Biotope protection agreements on average cover areas of 2 ha each. Nature protection agreements are on average 6 ha in area (Statens Offentliga Utredningar 1997). With these two forms of protection and the protection of the last two years the percentage of protected productive forests in Sweden is 3.8%. (See Tables 5 for a summary of protected area.)

Table 5. Protected Productive Forest Areas in Sweden as of December 1999

Type of protection	Area (ha)
National Park	37000
Nature Reserve	830000
Biotope Protection	1000
Nature Conservation Agreement	1000
Total	**869000**

Inventory Status

The last nation wide inventory of old-growth forests was compiled in the 1980s. This inventory had very strict criteria excluding forests with any considerable evidence of human impact, which resulted in the exclusion of many valuable forests. Regional inventories have been performed and there is an ongoing nation wide key habitats inventory (WWF 2000). An inventory of forests currently under legal protection has been collected by the National Forest Inventory. This inventory concluded that the information available on the actual area and the qualities present in existing nature reserves was of varying quality and depth (Fridman 1999). A 1997 government report found that availability of sufficient data covering all areas must be improved in order to identify protection needs and areas (Statens Offentliga Utredningar 1997).

Certification in Sweden

There is no clear overview of the amount of old-growth forest protected by third party verified certification of forest management. Sweden was the first country in the world to have a national standard for sustainable forest management agreed upon by industry and NGOs under the Forest Stewardship Council (FSC) principles and criteria. Currently 40% of Swedish forests are certified under the FSC system. Under the Swedish Forest Stewardship Council standard certified forest owners must set aside at least 5% of ecologically valuable forest land or representative habitats from productive forest land. This five percent is above and beyond already protected areas. The set aside is to take place within the first 5 years of certification and be documented in an overall landscape plan or forest management plan. A simplified calculation of the amount of forest that will be protected in this way would amount to more than 450,000 ha. However, this 5% is not necessarily of high conservation value, it may simply be the most ecologically valuable, relatively to that the forest owner has.

The old-growth forest Jelka-Rimakåbbå – a TRN hotspot (Sweden). *Photo: Ola Larsson*

Protection Targets

In 1994 new forest legislation in Sweden was passed which officially put production and environmental goals on the same priority level. In 1997 the government published a gap analysis carried out for the Ministry of the Environment by two leading Swedish conservation biologists. The report recommended that from a 40-year perspective ("the long run") 9-16%, 2.2 million ha of forest below the montane forests must be protected to ensure biodiversity. From a 10-20-year

perspective approximately 900,000 ha or 4.2% more than is protected today should be protected (Angelstam and Andersson 1997).

Subsequent government reports by the environmental protection agency recognize that there are 900,000 ha of high conservation value forest that fall outside of national parks and nature reserve boundaries (Skogsvårdstyrelsen 1999). According to the Swedish Environmental Protection Agency and Forestry Board (Skogstyrelsen) prognoses two-thirds of this area, 600,000 ha, is expected to be protected by industry's voluntary measures (Statens Offentliga Utredningar 1997).

In 1998 the Swedish government officially set a goal of creating an additional 250,000 ha of nature reserves in the next 10 years and that further 25,000 ha of forest should be protected as biotope protection or nature protection agreement (Skogsvårdstyrelsen 1999). However, other published reports from the forest management agencies state the pace of the creation of nature reserves is not sufficient to secure the naturally valuable areas (Skogsvårdstyrelsen 1998).

The trend in Sweden is to rely heavily on voluntary actions by forest industry and private owners to protect valuable forests. A recent governmental report recommended that the government takes a more proactive role and that this concentration on voluntary measures be made more precise. The report recommended that long-term quantitative goals of the amount of forest that should be classified in the different categories be set by the state forest management agencies (Riksrevisionsverket 1999).

Monetary Compensation for Protection

To reach protection goals the Swedish Parliament allocated funds in the fall of 1998 to make monetary compensation available for the creation of nature reserves and protected areas. During the early 1990s funding for the creation of nature reserves has been around 190 million SEK/year (22.4 million EUR). Pressure from environmental organizations resulted in additional funding to aid in reserve building. The 1999 budget added an additional 150 million SEK (17.7 million EUR) and the 2000 budget gives an additional 50 million SEK (5.9 million EUR) to reach a level of 500 million SEK/year (58.8 million EUR) by 2001. This money is specifically for the purchase of forest land to be put under protection, it does not cover the administrative or initiative costs. Despite this increase in funds a recent report by the Swedish Society for Nature Conservation claims that county government programs to use this money to purchase valuable forest areas are moving too slowly. Many people working within the county governments highlight the lack of personnel and training necessary to implement the policy and funding for the creation of new nature reserves (SSNC, 2000).

5.3 Finland

Productive forest land in Finland totals 20 million ha. A total of 714 274 ha (3.6%) of these lands is under strict protection in Finland (See Table 6). Additionally 170,130 ha of forest are protected under a restricted forest management scheme. This protection status is not recognized by many Finnish NGOs as logging is allowed in some areas. Protected forests are concentrated in the north of Finland. Only 1% of productive forest land in the south of the country is protected (Ministry of Agriculture and Forestry and Ministry of the Environment 1999).

Table 6. Protected productive forest areas in Finland

Strict nature reserves	33,578 ha
National Parks	232,886 ha
Old-growth protection program	181,113 ha
Peatland protection program	98,938 ha
Herb-rich forests protection program	2,866 ha
Special protected areas	26,806 ha
Protected wilderness areas	97,600 ha
Other	40,487 ha
TOTAL	**714,274 ha**

Source: Ministry of Agriculture and Forestry and Ministry of the Environment 1999.

The areas detailed in Table 6 include 204,120 ha, in which an official decision for protection has been made but has not yet been enacted. However, no logging can take place on these areas during this phase. This area falls into the following categories:

- old-growth protection program 173,000 ha,
- peatland protection program 30,000 ha,
- herb-rich forests protection program 1,120 ha.

(Ministry of Agriculture and Forestry and Ministry of the Environment 1999).

Inventory Status

In the 1990s as part of the Old-Growth Conservation Program, the government carried out old-growth forest inventories (thorough mapping of more than 1300 sites on 0.5 million ha). The resulting inventories in the north of the country were systematic and extensive; however, the inventories carried out in southern Finland were less systematic and some old-growth forests may have been excluded. Key

biotope inventories were started in the mid-1990s and by 1999 forests covering about 5 million ha of private forests have been inventoried. It is planned that all private forests will be inventoried by 2002. The Forest and Park Service has carried out similar inventories on approximately 5 million ha of state-owned productive forest land. These inventories are to be finished in the year 2000. Private forest companies reportedly have their own inventories on-going (WWF 2000).

Certification

The development of certification in Finland has been a complicated process because of disagreements and conflicts between the different stakeholders. There are several Finnish NGOs, which are members of the Forest Stewardship Council (FSC). The process to develop a national FSC standard for sustainable forest management has been slow going and often interrupted by disagreement. Currently there is no national FSC standard in Finland. The national Finnish Forest Certification System (FFCS) is supported by the traditional forest sector, primarily by the Central Union of Agricultural Producers and Forest Owners (MTK) and the forest industry. This national standard falls under the umbrella of the Pan European Forest Certification (PEFC) system. Under this system there is only limited protection for old-growth forests or valuable areas. Altogether FFCS standard is estimated to additionally protect some 1% of the forest area (Anju Asunta, pers. com.). Finnish NGOs do not consider the FFCS standard a sufficient certification for biodiversity protection (Finnish Nature League 1999).

Finnish old-growth forest (Ahiola/Suomussalmi, Finland).
Photo: Eberhard Weckenmann.

Protection Targets

According to Finnish scientists the present reserve network should be enlarged, and in the long run the level of protection should be at least 10% of forest land protected in each biological forest zone (Toivonen 1999). There is no indication that this recommendation has been adopted into Finnish state policy or management practices.

Monetary Compensation for Protection

According to the National Forest Program as approved by the Finnish Government, 1999, the Ministry of Forestry and Agriculture will increase funding for forest nature management from FIM 15 million (EUR 2,5 million) to FIM 25 million (EUR 4,2 million) annually. This includes, e.g., financial support for private forest owners for losses due to protecting important forest sites, implementation of management plans, and completion of the mapping of extremely important habitats. The Ministry of Environment will increase funding for the management of protected areas from FIM 72 million (EUR 12,1 million) to FIM 84 million (EUR 14.1 million) in year 2000 and to FIM 96 million (EUR 16.1 million) by year 2003. Altogether FIM 3,300 million (EUR 560 million) will be used in implementation of ratified protection programs on private owned lands of which some FIM 1000 million (EUR 170 million) will be used for forest protection (The Finnish Governmental Decision on March 3 and November 18, 1999).

The total amount of money for nature protection under the National Forest Program is increasing; however, it is allocated to manage existing protection areas and to complete existing protection programs. There is no money for new forest reserves. The National Forest Program is a guideline and not binding, so it remains to be seen how much money in the end is actually put into nature conservation in general.

5.4 Russia

Current Ownership, Administration, and Use

Forest land of the State Forest Fund in Northern European Russia totals 68.7 million ha of the total forest land of the Murmansk Oblast, the Karelia Republic, Arkhangelsk Oblast, and the Komi Republic. In Russia the state owns all forest land. The Constitution dictates that forest resources (including forests) are to be managed jointly by federal and regional authorities. In practice, forest management is mostly performed by various federal governmental agencies (Federal Forest Service, Committee for Environment Protection, Ministry for Agriculture and Food, Ministry of Defense, etc.). Forests on former collective farms (now private agricultural cooperatives) are owned by the state but not managed by the state authorities. These areas are leased with no payment under a special legal status (*bezvozmezdnoe polzovanie*).

Forests and other lands designated for forestry comprise the State Forest Fund of the Russian Federation (FF). FF consists of forest lands (on which forest grows or may grow, including burns, cutovers, and tracts, where it failed to regenerate) and non-forest lands (agricultural lands, settlements, infrastructure, and "non forests", such as bogs, rock outcrops, gullies etc.). In turn, forest lands are divided in lands with stocked and unstocked forest stands. There are also some forest lands outside of the official FF, such as city forests and forests under management of the Ministry of Defense.

In Russia, forests of the FF are divided into forest management groups (Table 7). Group I forests are ecologically valuable forests mostly intended for the performance of environmental functions. Economic use in Group I forests is restricted; however, final felling is prohibited only on about one-third. The majority of Group I forest permit economic activities, such as intensive thinning and recreation. Many of these forests currently experience severe human impact, e.g., roadside forests were heavily exploited earlier. Group II forests are forests in strongly developed and densely populated areas and areas with a low degree of forest cover. Group III forests are intended for commercial forestry.

The Russian forestry and environmental legislation is quite complex and has just been undergone revision. At the federal level the relevant acts are the Forest Code (adopted in 1997), the Environmental Protection Act, the Protected Areas Act, the Animal World Act, the Environmental Expertise Act (environmental impact assessments), and a few others. In addition there exist regional adaptations of these acts such as the Karelian Forest Code. There are also a large number of norms dictating practical applications of the code adopted on the federal and regional levels.

Russian System of Protected Areas

Russian forests can be protected by several mechanisms as designated in accordance to the Environmental Protection Act (1991) and the Protected Areas Act (1995). Those, which are relevant for this inquiry, are: zapovedniks, national parks, nature parks, zakazniks, and nature monuments. A brief description of the different characteristics of these regimes is provided below. This description is much more detailed than that given for Fennoscandia due to the emerging nature of the subject and the importance in understanding the details of the overall protection regime for forests in Russia. The description of the different protection regimes is followed by an analysis of the regimes and current protection status.

A *zapovednik* is a strict nature reserve under exclusive federal ownership and management. Officially no human activity apart from some scientific research, inventories and monitoring is allowed in a zapovednik. Recently limited tourism under strict supervision is beginning to be allowed in some zapovedniks. There are currently 99 zapovedniks established in Russia, covering a total area of 33.1 million hectares, including 26.7 million hectares of lands with inland waters, which is 1.56% of the total Russian's territory (*Zapovedniks and National Parks Bulletin*, 1998-1999).

Table 7. Land management in the Forest Fund and other forests in Northern European Russia by various authorities as of 1998

Authority	All forests by management groups, thousand ha			Including the category of forest lands	
	I	II	III	thousand ha	% of region's forest lands
Arkhangelsk Oblast, total forest area of 28985 thousand ha					
Federal Forest Service[1]	6924	0	20074	20644	91,4
State Committee for Environment Protection[1]	52	52	0	45	0,2
Ministry for Agriculture and Food[1]	489	259	956	1704	7,5
Ministry of Education[1]	2	0	14	15	0,1
Ministry of Defense[2]	22	0	168	155	0,7
Urban forests[2]	19	0	8	19	0,1
Total	**7507**	**259**	**21219**	**22582**	**100,0**
Nenets Autonomous Okrug, total forest area of 447 thousand ha					
Federal Forest Service[1]	447	0	0	191	100,0
Total	**447**	**0**	**0**	**191**	**100,0**
Murmansk Oblast, total forest area of 9973 thousand ha					
Federal Forest Service[1]	5966	0	3504	5188	95,2
State Committee for Environment Protection[1]	362	0	0	176	3,2
Ministry of Defense[2]	49	0	85	80	1,5
Urban forests[2]	7	0	0	4	0,1
Total	**6384**	**0**	**3589**	**5448**	**100,0**
Karelia Republic, total forest area of 14922 thousand ha					
Federal Forest Service[1]	3156	4508	7096	9695	98,7
State Committee for Environment Protection[1]	60	0	0	40	0,4
Ministry for Agriculture and Food[1]	14	7	3	23	0,2
Ministry of Defense[2]	11	57	7	60	0,6
Urban forests[2]	4	0	0	3	0,0
Total	**3245**	**4572**	**7105**	**9821**	**100,0**
Komi Republic, total forest area of 38883 thousand ha					
Federal Forest Service[1]	16066	513	21370	29792	97,3
State Committee for Environment Protection[1]	721	0	0	629	2,1
Ministry for Agriculture and Food[1]	118	73	0	191	0,6
Ministry of Education[1]	2	0	10	10	0,0
Ministry of Defense[2]	0	0	4	4	0,0
Urban forests[2]	6	0	0	5	0,0
Total	**16913**	**586**	**21384**	**30631**	**100,0**
TOTAL for Region	**34496**	**5417**	**53297**	**68673**	

1 Lands constitute the Forest Fund of the Russian Federation
2 Forests outside of the Forest Fund of the Russian Federation
Source: The Forest Fund… 1999.

National parks are something slightly different in Russia compared to most western countries. The first national park was established in 1983. At present, Russia has 34 national parks, covering 6,8 million hectares, which is 0.39% of the total Russian territory (*Zapovedniks and National Parks Bulletin*, no. 23, 1998). National parks are exclusively federal level protected areas and established by the decision of the federal government. However, in comparison to zapovedniks, the lands inside a national park may have multiple land users and land use zones, e.g., Strict Protection Zone, Specially Protected Zone, Tourism and Recreation Zones, and Economic Zone. *Nature parks* are a new category of protected area first introduced with the Protected Areas Act in 1995. Nature parks are the analogue of the national parks on the regional level. As the national parks, nature parks may be divided into zones dictating different levels of protection and use.

Zakazniks (refuges) are probably the most flexible category of protected areas in Russia. They can be created on regional or federal level to ensure protection of certain valuable areas, or survival of particular species of plants and wildlife. Their lands may, according to the Protected Areas Act, either belong to the zakaznik or be left under the management of the original landuser. Zakaznik landusers are responsible for keeping its protection and fulfilling the protection regime. Limitations on human activity may be as strict as in zapovedniks or permit full economic activity. Zakazniks can be either permanent, or temporary. In the latter case, zakazniks are created for a certain period of time (usually 10-15 years). The Protected Areas Act does not even mention the option for establishing temporary zakazniks. However, in areas under consideration they are still common.

*Nature monument*s (pamyatniki prirody) include natural objects of special interest such as rock formations, champion trees, bird rookeries, or scenic landscapes. Traditionally they are relatively small and thus usually cannot provide an adequate degree of protection to the ecosystems. However, in the region of this inquiry there are a few rather large nature monuments with an area more than thousand hectares.

Russian forest legislation also allows another mechanism for forest conservation. A special protective area (SPA) (*osobo zashchitny uchastok*) may be established in all forest classifications. SPAs are established by the regional governments and do not need a decision by the Federal Forest Service. SPAs can be used to protect the headwaters of rivers, riverbanks, erosion sensitive sites, etc. Some of the uses of the SPA mechanism appear, at least formerly, to be oriented towards biodiversity conservation. Traditionally, a SPA is rather small – a few, tens or hundreds of hectares. However, there is precedent of putting together a number of SPAs to form one larger area of protected land.

There is another mechanism for protection of ecologically valuable forests in Russia. Through as special parliamentary decision, final logging in Siberian and Korean stone pine (*Pinus sibirica* and *P. koraiensis)* forests is prohibited. All forests with 30% and more of the stone pine trees are classified as stone pine forests. The Komi Republic has some stone pine forests.

Current Protection Status

As detailed above Russia has a number of mechanisms in place to protect forests. However, there are many limitations of the existing regime both in theory and practice. This section provides a brief analysis of the different mechanisms. Zapovedniks do not necessarily protect only old-growth or ecologically valuable forests. Secondary and disturbed forests are included in zapovedniks as well as many low-productive forests and non-forest ecosystems. In Northern European Russia zapovedniks which do protect some old-growth areas are Laplandskiy in Murmansk Oblast, Kostomukshskiy in the Karelia Republic, Pinezhskiy in Arkhangelsk Oblast and Pechoro-Ilychskiy in the Komi Republic. Kandalakshskiy Zapovednik in Murmansk Oblast protects mainly sea shores, islands, and water areas. Pasvik Zapovednik in Murmansk Oblast and Kivach Zapovednik in the Karelia Republic protect mainly secondary and disturbed forests.

The zoning system in the national park system is problematic. The economic zones and even often the recreational zones do not play a sufficient role in forest conservation, this is due to the fact that often national park administrations are pushing economic usage in general. According to the official data of the Protected Forests Department in the Federal Forest Service from spring 1999, 32% of total Russian national parks' income (not including the budget financing) originated not from visitors but from selling timber products. In four national parks this activity produces more than 70% of

Old-growth forest
(Komi Republic, Russia).
Photo: Natalia Zakharova

the parks own income (*Zapovedniks and National Parks Bulletin* 1999). These figures show the scale of the logging operations in Russian national parks.

The system of nature parks is very new and not all information is available. Currently there is no information available about the existence or status of any established nature park in the area of the mapping project. However, there are plans for establishing a few nature parks in the Karelian Republic. The most developed projects for now are the Sorokskiy Marine Nature Park, Zaonezhie Nature Park, Tulos Nature Park, Koitayoki Nature Park and Ladozhskie Shkhery Nature Park. The last one is also regarded as a candidate for a national park on the federal level.

Unfortunately, the value of these nature parks in old-growth forest conservation is limited since only the Sorokskiy Nature Park includes some areas of White Sea shore old-growth forests. Some small areas of potentially valuable forests may also remain in the projected area of the Ladozhskie Shkhery Park. However, it is too early to discuss if the restrictions of the forestry activities in these parks will be adequate to the goals of old-growth forests protection. According to the information we have, Kozhozersky Zakaznik in Arkhangelsk Oblast has been now also converted to the nature park. However, this information is not complete yet.

Table 8. Protected Areas in Northern European Russia by official categories. Overlapping areas calculated twice, as in the official sources. (All figures in thousands hectares.)

	Arkhangelsk Oblast (including Nenets Autonomous Okrug)[1]	**Karelia Republic[2]**	**Komi Republic[3]**	**Murmansk Oblast[4]**	**Total area under conside-ration**
Total legally protected areas, including:	6972 (11.9%)	908 (5.3%)	6327 (15.2%)	1147 (7.9%)	15355 (11.6%)
• Zapovedniks	51 (0.1%)	60 (0.3%)	721 (1.7%)	495 (3.4%)	1327 (1.0%)
• National parks	478 (0.8%)	234 (1.4%)	1892 (4.6%)	0 (0%)	2603 (2.0%)
• Zakazniks and nature monuments[5]	6443 (11.0%)	615 (3.6%)	3714 (8.9%)	624 (4.5%)	11424 (8.7%)

1 According to Ermolin 1996; The Electronic Cadastre…; a series of the official decisions and other official documents.
2 According to Protected Nature Areas of Karelia. 1995; The Electronic Cadastre…; a series of the official decisions and other official documents.
3 According to Taskaev et al., 1996; The Cadastre of the Protected Nature Areas of the Komi Republic. 1993, 1995; The Electronic Cadastre…; a series of the official decisions and other official documents.
4 A series of the official decisions and other official documents on protected areas.
5 Including some other regional protected areas.

Zakazniks are the most widespread form of protected areas because they can be created much faster and easier than zapovedniks and national parks. There is no complete register of zakazniks for whole Russia. However, according to the different sources, Russia has currently more than 1,000 zakazniks totaling millions of hectares. Zakazniks constitute the majority of all protected areas in areas of historic industrial use. In many cases rapid designation of a zakaznik may save a valuable area, which later may be converted into a national park or zapovednik.

The Table 8 represents the figures on the total size of protected areas by regions and official categories. The total sum is very impressive: about 11.6% of the total regions area looks to be protected according to the official data. However, the more detailed analysis shows the figures of real forest protection (Table 9). Only less than 5% of the area under consideration prohibit the final felling of forests. And only about 3% do provide an adequate forest protection against all kinds of destructive logging.

Table 9. Protected Areas in Northern European Russia by protection regimes. Overlapping areas are excluded. (All figures in thousands hectares (% of area of relevant region).)

	Arkhangelsk Oblast (including Nenets Autonomous Okrug)[1]	**Karelia Republic[2]**	**Komi Republic[3]**	**Murmansk Oblast[4]**	**Total area under consideration**
Total legally protected areas (PA), including:	6972 (11.7%)	908 (5.4%)	5967 (14.3%)	1144 (7.9%)	14992 (11.4%)
PA providing some forest protection (where at least final felling is prohibited)[5], including:	1208 (2.1%)	365 (2.1%)	4018 (9.7%)	626 (4.3%)	6217 (4.7%)
PA providing relatively strict forest protection (both final and intermediate felling are prohibited)[5]	411 (0.7%)	173 (1.0%)	2898 (7.0%)	607 (4.2%)	4089 (3.1%)
PA what we could not found any data on protection regime available	208 (0.3%)	194 (1.1%)	0 (0%)	0 (0%)	402 (0.3%)

1, 2, 3, 4 see notes to Table 8.

5 Known non-forest areas and overlapping protected areas are excluded.

With regards to Special Protective Areas (SPAs), the logging limitations for this protection mechanism are usually quite weak. Article 55 of the Forest Code only states "*final felling MAY be prohibited in the SPA*". So there is some possibility to set up a strict protection regime through this mechanism but only if the SPA is set up within the category, which prohibits all forest use. It is not entirely clear how this mechanism works legally. Also it is impotant that SPAs are governed by decision-making on the regional level, which may affect the security of sites protected as a SPA.

In the case of the special legal protection for stone pine forests, this provision, unfortunately, does not manage to exclude all logging. Much logging in these forests happens under the title of "sanitary" logging. Practically all areas of Russia's stone pine forests are under great threat.

As was briefly introduced earlier in this report, forests in Russia are legally designated as Group I, Group II or Group III. The primary function of Group I forests is "protective" from an ecological standpoint. However, what is often not understood is that Group I forests are not protected simply because they fall into this category. Official forest statistics separate out forests within this group as "possible for exploitation". Areas excluded from exploitation are forests on slopes greater than 30 degrees, forests along key fish spawning rivers, and forests deemed protecting

"Selective logging" in subtundra forests, where final felling is officially prohibited in Tuliyoki Area (Murmansk Oblast, Russia). *Photo: Konstantin Kobyakov*.

waterways and at the sources of creeks and springs. According to the 1993 official data, more than half (53.5%) of the forested area designated as "protected" by Group I status was officially "possible for exploitation".

Among the first group protective categories, the subtundra forests are dominated in the area under consideration. We do not regard them as a real protected areas since the status of these forests means a relatively weak protection. The intermediate selective logging of low (10-20%) and medium (20-30%) intensity are prescribed here by forest regulations, as far as intermediate strips-shaped clearcuting (*Directions for Intermediate Logging for Plain Forests of European Russia*, article 7.7). At the same time the dominant part of the subtundra forests stay still untouched because of the low interest by timber industry. The high percentage of swamps among these lands (about 70%) and low productivity of these forests (the annual growth varies from 0.7 to 1.3 cubic meters per hectare) (Semenov et al., 1998) are probably the main reason for it.

However, in all three regions with subtundra forests the timber industry operates now close to subtundra borders. Some enterprises are facing problems with new areas for harvesting and so may threat the subtundra forests. In the Murmansk region we know the precedents of the industrial harvesting in the subtundra belt made "as an exclusion" in the Soviet times. The geological exploration and mining activities widely developed in all three regions are another big threat for subtundra forests. For example, the large area of subtundra old-growth forests have been destroyed last years by diamond mining development in the Belomorsko-Kuloyskoe Uplands, Arkhangelsk Oblast.

Inventory Status

There are no special official inventories of key biotopes and old-growth forests available from the state in Russia. The most recent inventories made by the Federal Forest Service only assess forest areas for timber volume. These inventories map the age of stands and dominant tree species, as far as many parameters mostly practical for industry. Historically any inventories looking a biodiversity and conservation value have been made regionally by scientists and NGOs.

Possibilities for Voluntary Protection

Theoretically there are several possibilities for voluntary forest protection to be enacted in Northern European Russia. The Environmental Protection Act of 1991 permits commercial enterprises to form zakazniks on land they are using without any formal decision from the state. However, the Protected Areas Act does not repeat this statement and at this time there are no known regulations or normative documents backing up this provision in the 1991 regulations.

Another possibility is to lease forest land for purposes other than timber exploitation. The new *Regulations on Leasing of the Forest Fund Plots* adopted in 1998 allow forest land to be leased for up to 49 years for purposes other than timber extraction: harvesting non-timber forest products; as a game area; as well as

cultural, health and tourism purposes. One example of voluntary forest protection is the Muravyevskiy Nature Park in Amurskaya Oblast in the Russian Far East, which has been leased since 1993 by the Socio-Ecological Union formally for game purposes. The Russian Forest Code considers scientific purposes as an official forest use (article 80).

Since 1996 a number of foreign companies active in Russia have signed on to a moratorium on purchasing timber from old-growth forests in the Karelia and Murmansk regions. This was an initiative started by NGOs working in the region. The moratorium may be regarded as a kind of voluntary forest protection. However, the companies supporting the moratorium do not own or lease the forests giving no real secure protection to the areas.

Certification

Voluntary forest certification is in the beginning stages in Russia. The Federal Forest Service appears strongly opposed to a system of voluntary certification. Two model forests areas in Russia are currently awaiting a decision on their FSC certification status. One of these areas is in Komi at the WWF Priluzie model forest.

Protection Targets

WWF Russia recommends to protect around 10% of forest areas. At this point WWF has not come with a mechanism and overall plan for how to accomplish this goal. For many NGOs in the region the percentage of protected area is not the main issue. What is an essential goal is that the integrity of a system and continuity of old-growth forest areas be maintained and protected as the backbone of an overall strategy for biodiversity and ecological viability in the region. The current complexity and confusion surrounding what the different protection schemes actually mean on paper and in practice and what protected areas might be counted as protecting old-growth forests make it almost impossible to set percentage-based protection schemes. The Biodiversity Conservation Center sees a possibility in creating an old-growth protection strategy by setting together some existing protected areas and working to change the status of other vital areas.

Monetary Compensation for Protection

The Global Environmental Facility (GEF) of the World Bank Group allocated more than 20 million USD in 1994 towards biodiversity conservation in the Russian Federation. This funding is estimated to reach 26 million USD by the year 2002 (GEF 2000). This money has been distributed to the Ministry of the Environmental Protection and Natural Resources and the Federal Forest Service. A range of national and international NGOs and Russian universities have also received funding through the GEF for projects on a Russia-wide level. This funding is not set up expressly for the purpose of creating protected areas. It remains to be seen what this funding can do towards the protection of biodiversity in the Northern European Russian forests.

5.5 International Protection Mechanisms

International and multilateral conservation conventions and initiatives also have the potential to affect the forests of Fennoscandia and Northern European Russia. Sweden, Norway, and Finland are all parties to the 1992 United Nations Convention on Biological Diversity as well as the 1979 Bern Convention on Conservation of European Wildlife and Natural Habitats. Russia has signed on to the Convention on Biological Diversity but not the Bern Convention. Sweden and Finland as members of the European Union are also party to the European Union Habitats Directive, which was adopted in 1992. The Directive requires conservation of endangered species and habitats and is working to set up and implement a network of protected areas called NATURA 2000. This European Union initiative also makes available funding for habitat protection, for the Western Taiga. This is an administrative demarcation of the European boreal within the boundaries of the European Union, thus only including Finland and Sweden.

Unevenaged old-growth pine forest in Kalevala area (Karelia Republic, Russia).
Photo: Alexei Yaroshenko.

6. Conclusions

The last old-growth forests of Fennoscandia and Northern European Russia are under threat. The threat of destruction by modern forestry practices is real. Modern silvicultural methods and plantation forestry models as practiced in Fennoscandia have removed important natural disturbance regimes and many of the structural components from the forest. This has resulted in a biodiversity crisis in Fennoscandia, which is indicated by large numbers of forest dwelling species on the national red data lists for threatened and endangered species. In Northern European Russia fragmentation of old-growth forest areas and destruction of natural systems by timber mining and road building jeopardize the largest remaining intact forests in all of Europe.

Use of timber resources is not necessarily a problem for ecological integrity in itself. It is the level, type, and intensity of use which matters. The region has experienced several phases of forest use and exploitation, starting with subsistence use by hunter-gatherer cultures and presently the domination of modern industrial forestry as the primary use of the forests. The phase of forest use most detrimental to biodiversity and ecosystems is the phase of large scale rotation forestry, witnessed in Fennoscandia, which basically converts the forest from natural diversity to a high-yield mono-crop of export timber.

The phases of exploitation seen in the region are slightly different in Fennoscandia compared to Russia. Fennoscandian forests have been almost totally affected by large scale rotation forestry leading to the conversion of natural ecosystems and only small areas of old-growth forest remaining. Although Northern European Russian forests have been heavily exploited, many areas have not experienced the systematic intensity of industrial forestry. Russian forests are under threat but slightly more viable from an ecological perspective when compared to the forests of Fennoscandia.

Russian old-growth forests are of great international concern because they are the largest remaining areas of taiga in all of Europe. These areas are pools of biodiversity providing in many instances viable populations of species. These last areas also provide key reference areas for scientific research needed for understanding ecological dynamics and structures, which are necessary for the development of sound management regimes. There is now the opportunity to steer the evolution of forest use in Northern European Russia, so that the ecologically destructive phase of large scale rotation forestry is never realized on a broad scale.

Some ecologically valuable forest areas remaining in the European boreal zone of Fennoscandia and Northern European Russia are protected by national governmental initiatives and protection regimes. Private industry and private forest owners also have protected some old-growth forest areas. Importantly, many ecologically valuable areas are still not under any form of protection. Scientists

from the region have made statements of how much should be protected; however, there is currently an alarming gap between the scientific view on what must be protected to ensure biodiversity and the actions governments and industry have actually taken in the name of ecosystem viability.

There is a need for a better overall system of protection for old-growth forests and forests of high conservation value. A comprehensive strategy for old-growth forest protection in each of the countries and the region as a whole must be developed. In order to create and enact this strategy the financial and administrative means must be secured to ensure improved inventories of old-growth and other high conservation value forests as well as to implement systems for monitoring forest status on an on-going basis.

Protection is not the end of the story. Maintenance of biodiversity also depends on the kind of forest management present in those areas, which are in use and not set aside in protection schemes. Until forest management truly reaches ecologically sustainable forest management the overall importance of protection of these last areas and areas of high conservation value is tantamount. The urgent need for wide reaching and efficiently implemented protection and sustainable management plans is at the heart of NGO demands for the protection of the old-growth forests of the European boreal region.

Pine forest in Kalevala area (Karelia Republic, Russia).
Photo: Alexei Yaroshenko.

7. NGO Demands

In response to the continued threat to the old-growth forests of Fennoscandia and Northern European Russia environmental NGOs of the region make the following demands.

7.1 NGO demands concerning old-growth forests in Northern European Russia

Forests of European Russia have a long history of exploitation. However, the intensive industrial development came to northern European Russia only in the late 19th century. Destructive clearcutting became the main harvesting method in the 1930s. The intensive logging of the Soviet times was never sustainable, even in purely economical terms. The official limits of maximum allowable cutting levels were aimed to satisfy only demands of the forest industry and, in reality, had nothing to do with scientifically justified values. However, in many regions, even these weak limits were often considerably exceeded. Excessive careless exploitation of forest resources in many regions resulted in exhaustion of economically accessible timber resources and completely ruined the life of the local people. Today's social problems of temporary logging settlements are often not due to the current economic crisis in Russia but due to unsustainable forestry practices of previous time.

The industrial logging of the 20th century systematically destroyed the old-growth forests. Today less than 12-15% of old-growth forests are left in the north of European Russia (forests transitional to tundra are not included). In terms of whole European Russia, they occupy less than 6-7% of the total forested land. At the same time, Russia has saved more old-growth forests than all other European countries together. Therefore, the remaining Russian old-growth forests are the unique natural heritage, representing the main receptacles of biological diversity in European forests as a whole. The Russian forests are still inhabited by many species of plants and animals, which are extinct or endangered in other European countries. Also large tracts of European old-growth forests – more than 50 thousand hectares in size – remain today only in Russia making them sites of international importance.

The current economic model of forest use is oriented mainly towards the export of raw materials and cannot provide long term economic growth for the region. This model, although it may be represented as including ecological considerations, in reality, destroys the last old-growth forests in Russia, which have now become the most threatened natural ecosystems. If the current situation does not change, we will loose the most valuable old-growth areas in next 5-10 years. Logging the last European old-growth forests will not solve any social or economical problem in Russia. In its best light it will only postpone the social and economic crash in the forest industry and logging settlements by a matter of several years.

Based on this, Russian environmental NGOs demand:

1. Areas of old-growth forests greater than 50 thousand hectares – nature sites of international importance – and smaller areas of old-growth forests with proved high conservation value identified in European Russia should be immediately protected against any forestry operation, road construction, and mining activities.

   The aforementioned categories of old-growth forest areas should be protected through:
   - establishment of state protected areas (*specially protected nature areas* in Russian terminology) at regional or federal levels with a protection regime that directly prohibits all kinds of forestry operations, road construction, mining activities and, land reclamation and other activities that could change the hydrological regime;
   - implementation of other legal protection mechanisms, which provide the same degree of protection;
   - voluntary exemption of forestry operations and road construction on old-growth forest areas leased by private business.

2. The protection level of transitional to tundra forests (including both officially recognized subtundra forests and low productive forests adjacent to them), which are critically important for maintaining regional and global ecological balance, against forestry operations, road construction, and mining and prospecting of mineral resources shall be enhanced.

3. The Federal Forest Service of the Russian Federation shall adopt special regulations considering areas of old-growth forests as a special category of forest lands, where forestry operations and road construction should be prohibited through routine official procedures of forest surveys.

Most of the timber currently harvested in old-growth forests and even in the subtundra forest belt of European Russia is exported to Western Europe, particularly to the Nordic countries. The foreign importers and consumers share with Russian loggers and authorities the responsibility for destruction in Russia of the last European old-growth forest. Therefore, the protection of the remaining old-growth forest areas in European Russia also should become their shared responsibility.

Therefore, Russian environmental NGOs appeal to both Russian and Western European businesses and consumers using timber from Russia:
- Do not harvest timber in the aforementioned forests.
- Do not participate directly or indirectly in forestry operations, road construction or development of other kinds of transport infrastructure and other activities that threaten these forests.
- Do not use the timber and the products of its processing originated from these forests.

It is important to note:

Areas of old-growth forests shown on the map, except those listed in Items 1 and 2, are mostly located in areas long used by humans; however, they may have high

conservation value. Therefore, they shall be surveyed for their conservation value on the basis of reliable on-site verification conducted with participation of all interested parties before taking decision on their protection or sustainable use. This decision should be made jointly by all involved stakeholders, including environmental NGOs.

The appropriate measures should be undertaken to identify other forest areas in European Russia, which may have high conservation value, while not meeting the definition of old-growth forest. Particularly, this includes smaller forest areas not covered by this report and forests important for protection of rivers and streams and key habitats. Surveys and decisions on such forests should be made with participation of all interested parties.

The information on old-growth forests and other valuable forest areas in whole European Russia is still incomplete:

- Some areas of old-growth forests located in European Russia are not included in this report.
- There are also other areas of high conservation value in regions under consideration, which may have been missed by the maps with this report.

This statement is supported by:

Biodiversity Conservation Center
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Karelian Students Environmental Organization
Kola Wild Nature Conservation Center
Socio-Ecological Union
To Save the Pechora Committee

7.2 NGO Demands Concerning the Old-growth Forests of Fennoscandia

Intensive forest management has a long history in Fennoscandia. It has led to an biodiversity crisis by altering in a vast majority of the forest land natural processes like tree aging and decaying, and changes in tree species composition in different stages of succession. Today there is less than 5% of old-growth forests left in Fennoscandia where these natural processes can take place.

In recent years there have been some improvements in the forest protection and management in the region. Even though the forest industry has shown increasing consideration for nature conservation the old-growth situation remains acute. Old-growth areas continue to be logged.

The remaining old-growth forests of Fennoscandia should not be subject to any human activity (e.g., forestry) that damages their nature conservation values regarding biodiversity, structure and ecological function. The sites outlined in the maps of this report include non-protected forests, which in great extent include

high conservation values and should be used as a basis in future protection plans. The protection of old-growth forests can be achieved through a variety of means:

- areas legally protected by public authorities
- voluntarily set aside areas, verifiable by third party
- exemption of forestry operations as part of a voluntary certification scheme, such as the Forest Stewardship Council (FSC)

The protection of old-growth areas is a responsibility of both public authorities and the private sector. In this work a priority should be given to regions where current protection levels are low.

Protection of the remaining old-growth forests of Fennoscandia will not be sufficient to ensure the long-term survival of all the endangered forest species, but it is one of the vital steps. There is a great need for restoration of forests currently missing old-growth features. This goes particularly for the southern parts of Fennoscandia.

If the Nordic countries are to meet their international commitments, such as the UN Convention on Biological Diversity and the Ministerial Conference on the Protection of Forests in Europe, there must be a combination of land area protection, increased consideration of nature conservation in forestry operations and active measures for the restoration of biological diversity. We strongly encourage all involved parties to develop a joint strategy aiming at the protection of the remaining old-growth forests in Fennoscandia.

Notes:

- It should be noted that there are forest areas of high conservation value, which may not fulfill the old growth definition.
- Please note that this statement concerns all old growth forests in Fennoscandia, not only the ones covered in this report. The information on old growth forests in the region is still incomplete. The sites outlined in the maps of this report include non-protected forests, which in great extent include high conservation values and can be used as a basis in future protection plans, but there are other areas of high conservation value which are still unregistered.

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Nature and Youth Norway
The Norwegian Society for Nature Conservation
The Swedish Society for Nature Conservation
WWF Finland
WWF Norway
WWF Sweden

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Appendix I:
Definitions Used for Old-growth Forest

Russian Definition Used for Old-growth Forest

"Old-growth forests are forests originated through natural successions, unaffected by destructive human impact over a significant period of time and having the area sufficient for self-maintenance in the absence of catastrophic disturbances."

The following *human-induced impacts* were considered as significant in this study:

- clearcutting (including land clearance for agricultural purposes) or highly intensive selective logging;
- large scale human-induced fires;
- land reclamation in forests or other human-induced changes of hydrological regime;
- chemical tapping of coniferous forests;
- intensive and regular application of chemicals such as pesticides, herbicide, fertilizers, etc.;
- severe industrial pollution;
- intensive grazing in the forests that resulted in degradation of forest understory and the grass cover;
- and intensive recreation in the forests that resulted in degradation of forest understory and the grass cover, etc.

Under a *significant period of time* we understand the time sufficient for restoring the forest ecosystem characteristics corresponding to those of the primeval forests for a particular forest type under particular climate and soil conditions.

Fennoscandian Definition Used for Old-growth Forest

"Old-growth forests are characterized by stands originating through natural successions with a significant contribution of old trees and dead wood, often with a multi-layered tree structure. These forest contain globally, regionally or nationally significant concentrations of biodiversity values (e.g., endemism, endangered or threatened species, endangered or threatened ecosystems, refugia), or are large landscape level forests, where viable populations of most if not all naturally occurring species exist in natural patterns of distribution and abundance."

Appendix II: Criteria and Methodologies Used in the Mapping Process

Criteria and Methodology

Due to national differences of old-growth status and available data the criteria and methodology partly differ between the countries. Find below information on the used criteria and methodology.

This booklet does not provide the appropriate space for a detailed description on criteria and methodology. Please contact the different map coordinators if you have additional questions on the sources, specific areas, etc.

NORWAY

Criteria

Boundaries of the investigation
The map covers the whole country.

Definition used
The Fennoscandian definition stated in this report has been used:

"Old-growth forests are characterized by stands originating through natural successions with a significant contribution of old trees and dead wood, often with a multi-layered tree structure. These forest contain globally, regionally or nationally significant concentrations of biodiversity values (e.g., endemism, endangered or threatened species, endangered or threatened ecosystems, refugia), or are large landscape level forests, where viable populations of most if not all naturally occurring species exist in natural patterns of distribution and abundance."

The areas included in the Norwegian map are areas valuable for protection (conservation value) based on the fact that the areas are in a natural state that makes them valuable for species dependent on old-growth forests and/or for other reasons, which are considered valuable for protection. The areas are from official inventories done by the Norwegian Institute for Nature Research (NINA), Last Chance Group (NOA) and Miljöfaglig Utredning (MFU) on behalf of the Norwegian environmental authorities (DN). The purpose of these inventories was to find old-growth forests that could be included in the Norwegian old-growth forest protection program. The majority of these areas are presented in DN-reports. In addition some forests are from areas that are proposed as part of planned national parks. Some

other additional areas originate from local NGO mapping of high conservation value forests.

Size of areas
The minimum size has been 100 ha. Areas smaller than 1000 ha are shown as dots, while areas larger than 1000 ha are shown as polygons.

Protected areas
The areas shown as protected are areas protected by the Norwegian Nature Conservation Act. All old-growth forest areas protected until December 10th 1999 are shown.

Limitations
The map shows all publicly known areas larger than 100 ha. It is reasonable to believe that many old-growth forest areas, mainly on company land, are not publicly known because the forest sector is unwilling to reveal the information. In addition Norway lacks thorough national inventories of potential remaining old-growth forest areas. Unregistered old-growth areas do exist. Local NGOs have found such areas not registered in the national inventories.

It should be emphasized that there are around 200 areas of valuable boreal rainforest in the counties of North and South Tröndelag and Southern Nordland smaller than 100 ha.

Sources

The main source has been literature studies and field trips. The work is based on the results of state and NGO old-growth forest inventories (see below). These areas have been updated by field investigations conducted by the mapper and local forest groups of the Norwegian Society for Nature Conservation.

Main references
Reports from the Norwegian Directorate for Nature Management:

- DN-report 1991-1: Proposed protected old-growth forests – Central Norway
- DN-report 1991-5: Proposed protected old-growth forests – Eastern Norway
- DN-report 1992-9: Proposed protected old-growth forests – Western Norway
- DN-report 1996-7: Proposed protected old-growth forests – Northern Norway. ISBN 82-7072-242-1
- DN-report 1997-2: Boreal rainforests – Central Norway. Registration-report. ISBN 82-7072-276-6
- DN-report 1998-3: Proposed protected old-growth forests – Central Norway II. ISBN 82-7072-296-0

Reports from the Norwegian Institute for Nature Research:

- NINA-report 427: Conservation valuable coniferous forests in Möre og Romsdal. 1997. ISBN 82-426-0712-5

- NINA-report 306: Conservation valuable coniferous forests in Agder. 1994 ISBN 82-426-4103-5
- NINA-report 262: Conservation valuable coniferous forests in Oppland. 1993. ISBN 82-426-0448-7
- NINA-report 006: Conservation valuable coniferous forests in central Norway. 1989. ISBN 82-426-0023-6
- NINA-report 060: Conservation valuable coniferous forests in Northern Norway. 1994. ISBN 82-426-0496-7
- NINA-report 394: Supplementary registrations in central Norway. 1996. ISBN 82-426-0655-2
- Ökoforsk report 1988:8: Conservation valuable coniferous forests in South Tröndelag. ISBN 82-7216-490-6

Reports from the NGO group Last Chance:

- NOA-report 1997-2: Inventories of conservation valuable forests in Vestfold and Vest-Agder. ISBN 82-90895-10-0
- NOA-report 1998-2: Inventories of conservation valuable forests in Telemark and Aust-Agder. ISBN 82-90895-13-5
- NOA-report 1996-1: Forest areas in Eastern Norway registered by Last-Chance.

Reports from Miljøfaglig Utredning:

- MFU-report. 1998-1: Inventories of coniferous forests in central Norway and Buskerud carried out in 1997.

Time

The mapping work was carried out between June 1st 1999 and December 10th 1999.

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SWEDEN

Criteria

Boundaries of the investigation

The research covers the boreal region of Sweden. The southern parts of Sweden, which are regarded as hemiboreal and nemoral, are not covered. The southernmost counties covered in the maps are Värmland, Örebro (northern half), Västmanland (northern half) and Gävleborg.

Definition used
The Fennoscandian definition stated in this report (see under Norway in this Appendix) has been used.

Size of areas
The minimum size has been 100 ha. Due to the lack of large old-growth forests in the southernmost part of boreal Sweden forests areas down to 75 ha have been included in this region. Areas smaller than 1000 ha are shown as dots while larger areas are shown as polygons.

Protected areas
Due to lack of accurate documentation of protected forest areas it has not been possible to show protected areas in the Swedish map.

It should be noted that a large proportion of the unfragmented montane or "mountain-near" (*fjällnära*) forests shown on the map are within protected areas.

Limitations
Many old-growth forest areas are missing from the Swedish map. There is no up to date national old-growth forest inventory and some forest companies were unwilling to share any company information concerning their land holdings.

Due to lack of information sources there has not been information available on the county of Västernorrland. Lack of consistent information has also forced the mapper to show old-growth forest areas bigger than 1 000 ha in the county of Norrbotten as dots.

Sources

The main source of information has been phone interviews and literature studies. The phone interviews were conducted with 45 representatives of local groups of the Swedish Society for Nature Conservation (25), municipalities (8), counties (5), the National Board of Forestry (4), and forest companies (3).
The main references were:

- Lundqvist, R. 1997: Dalarnas urskogar – en inventering av urskogsartade skogar i Dalarnas län. Länsstyrelsen, Miljövårdsenheten 1997:4.
- Sporrong, H. 1998: Skogar med höga naturvärden i Skellefteå kommun. Skellefteå kommun (ISBN 91-630-7065-0).
- Naturinventering Bjurholms kommun. 1994: Miljö- och hälsoskyddsavdelningen, Bjurholms kommun, Henrik Sporrong.
- Karström, M. 1997: Indikatorarter för identifiering av naturskogar i Norrbotten, del 2, Inventeringsrapport för Jokkmokks kommun. Rapport 4692, Naturvårdsverkets Förlag (ISBN 91-620-4692-6).
- Woodland Key Habitat identified by the National board of forestry.
- Särnaprojektet – Inventeringsrapport från en landskapsekologisk planering. Dala-natur, årgång 10, no. 5, September 1993 (ISSN 0282-8723).

- Skyddsvärd naturskog i Orsa, en inventering 1992-1993. Orsa kommun (rapport 1:95) & Länsstyrelsen i Dalarna (rapport 1995:1, ISSN 1101-3044).
- Skyddsvärd naturskog i Mora, en inventering 1991-1992. Mora kommun (rapport 1:94) & Länsstyrelsen i Dalarna (rapport 1994:4, ISSN 1101-3044).

The unfragmented mountain-near forests are based on:

- Von Sydow, U. *Gräns För Storskaligt Skogsbruk I Fjällnära Skogar – förslag till naturvårdsgräns* (Border for Large-scale Industrial Forestry in the Montane Forests – Recommendation for Nature Protection Border). Svenska Naturskyddsföreningen, 1988. (ISBN: 91-558-5201-7).

Time

The major part of the mapping work was carried out during the end of 1998. Minor additions and updates have been carried out during 1999.

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FINLAND

Criteria

Boundaries of the investigation
The map covers the whole country except Ahvenanmaa (Åland) autonomous area.

Definition used
The Fennoscandian definition stated in this report (see under Norway) has been used. Complementary criteria have been that:

- The trees or part of them are classified as "overmature"
- no logging operations conducted within the last 40 years
- the amount of dead trees exceeds 10 cubm per ha or 10 percent of the total wood volume
- the forest is situated on forest land (annual production exceeds 1 cubm per ha)

Size of areas
The minimum size has been 50 ha. All areas are shown as polygons.

Protected areas
Protected areas are shown. The decision of protection must be publicly available. The category includes areas protected by the state (nature reserves, national parks), accepted state protection programs and areas protected by the ecological landscape plans of the Forest and Park Service.

The data on protected areas shows the status on September 30th 1999.

Limitations
The map is showing all publicly known areas. It is reasonable to believe that some areas, mainly on company land, are not publicly known due to the forest sector's unwillingness to reveal these areas.

Sources

The main sources have been age class maps, reports, field trips, and personal contacts. Satellite images and age class maps have been used as base information showing potential old growth areas. This information has been refined through field trips, reports and interviews with more than 100 persons.

Main personal sources have been Jarmo Pyykko (northernmost Lapland), Keijo Savola, Matti Liimatainen, and Laura Rasanen. Published sources of particular importance are:

- Ecological landscape plans of the Forest and Park Service
- Publications of the nature conservation (Green series) by the Forest and Park Service
- Old Growth Forest Protection Programs I, II and III of the Finnish Ministry of Environment
- Proposal for the Natura 2000 network by Finnish Ministry of Environment

Time

The mapping started in 1992. The major part of the work was carried out between autumn 1998 and September 1999.

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RUSSIA

A more thorough description of the methodology and criteria used for Russia can be obtained from the Biodiversity Conservation Center, the Greenpeace Russia, and the Socio-Ecological Union.

Criteria

Boundaries of the investigation

The mapping covers the territories of four Russian administrative units (so-called subjects of the Russian Federation): Murmansk Oblast, the Karelia Republic, Arkhangelsk Oblast, and the Komi Republic. To complete the picture some forested areas in the southwestern part of Nenets Autonomous Okrug (the fifth administrative unit) have been also included in the analysis. The covered area presents practically the whole north of European Russia (roughly northern than 60 degrees north latitude). It includes the northern limit of the taiga up to its transition to tundra. Preliminary data from more southern regions show that most large tracts of old-growth forests in European Russia remain in this area.

The analysis covers all types of landowners.

Both high and low productive forest areas have been covered (including mountain areas). Within the boundaries of the mapped areas natural non-forest ecosystems (such as bogs, rocks or lakes) occur. These areas were shown separately from forested areas.

Definition used

The definition of the old-growth forests used was the following:

"Old-growth forests are forests originated through natural successions, unaffected by destructive human impact over a significant period of time, and having the area sufficient for self-maintenance in the absence of catastrophic disturbances."

The following *human-induced impacts* were considered as *significant*:

- clearcutting (including land clearance for agricultural purposes) or highly intensive selective logging;
- large scale human-induced fires;
- land reclamation in forests or other changes of hydrological regime due to human activities;
- chemical tapping of coniferous forests;
- intensive and regular application of chemicals such as pesticides, herbicides, fertilizers, etc.;
- severe industrial pollution;
- intensive grazing in the forests that resulted in degradation of forest understory and the grass cover;
- intensive recreation that resulted in degradation of forest understory and the grass cover, etc.

Under the *significant period of time* we understand the time sufficient for restoring the forest ecosystem characteristics corresponding to those of the primeval forests for a particular forest type under particular climate and soil conditions.

The old-growth forest area criteria

In practice, the old-growth forest is not simply a stand but a certain area consisting of intermingled natural ecosystems representing a unified natural complex. To delineate the area of the old-growth forests, the following criteria were used:

I. Due to peculiarities of vegetation and history of development, the total minimum size of the old-growth forest area referred to in this study varies by administrative regions and within their limits, being not less than the following:

- 3,000 hectares for Murmansk Oblast and most of the Karelia Republic (excluding its southwestern part);
- 2,000 hectares for the southwestern part of the Karelia Republic (approximately southwards of the 64 degree north latitude and westwards of the lakes Onega and Vygozero);
- 5,000 hectares for Arkhangelsk Oblast and the Komi Republic, as far as for the Nenets Autonomous Okrug.

II. At least 90% of the particular area should be covered by natural ecosystems (including both forested and non-forested) slightly if ever affected by human agency, on which there is no *reliable records* or which do not have *apparent evidences* of disturbances by humans during the 20th century according to the criteria of old-growth forests (see above):

III. The patches of old-growth forests (stands) within a defined area should occupy at least 50% of the total area of old-growth forests (or 30% for subtundra forests and forests north of the official northern limit of subtundra forests).

IV. The area does not have any permanent settlements or transport infrastructure. Some temporary trails, winter roads and hunting cabins have been regarded as exclusions.

The criteria above do not cover the complete variety of valuable forests but only those, which meet the old-growth forest definition. Particularly, smaller areas of natural forests stay outside of our analysis due to their insufficient size. But, this does not mean that forests of smaller size and other natural ecosystems within the area under study are non-valuable and do not need adequate measures for their conservation. Their identification and protection is critically important for conserving the biological diversity, especially in the southern part of the regions, where there are no large tracts of natural forests left.

Protected areas

The map shows protected forests, which have adequate protection against logging and other types of destructive human impact. This includes forests in the legally protected areas under the authority of the federal agencies – State Committee of the Russian Federation for Environment Protection (zapovedniks) and Federal Forest

Service of the Russian Federation (national parks) – as well as permanent zakazniks, which do provide sufficient level of forest protection. The borders of the subtundra forest belt are also marked in the map.

Limitations
There is a lack of on-ground information on most of areas of old-growth forests shown on the map. Some areas are poorly accessible, especially those under the authority of the Ministry of Defense and the Border Service.

Sources

The main sources of information were medium resolution satellite images and field surveys. Official forest survey data, high resolution satellite images, and topographic maps were used as supplementary information.

Official forest survey data

- maps by the Federal Forest Service of the Russian Federation (FFS) at 1:200,000 scale generalized at the level of leskhoz (local unit of the FFS) and showing dominant tree species and stand age. These maps have been used for four regions: the republics of Karelia and Komi and Murmansk and Arkhangelsk oblasts. Although some gaps remained. The information on these maps was relevant to various years, from the 1980s to the 1990s. Being important supplementary information, these maps required verification and updating.

- maps by FFS at 1:50,000 scale on the level of lesnichestvo (common name for a subdivision of the leskhoz) and showing dominant tree species and stand age. These maps are usually not generalized, therefore, show particular forest plots with a degree of detaility they were mapped during official surveys. These relatively out-of-date maps were used only for Murmansk Oblast and few areas in northern Karelia. For Murmansk Oblast, they were updated by visiting all leskhoz offices in 1995. Being a very important source of preliminary information for Murmansk Oblast, these maps were later verified and updated by satellite images.

Satellites images

Medium resolution (about 150 meter per pixel) images with four or two spectral Russian satellites Resurs-O1-3 and Resurs-O1-4. The images almost completely covered the whole target area and were the main source of the information for the map. The images were of from 1997 to 1999. For all key areas, at least one image not older then summer of 1999 was used.

High resolution (about 35 x 45 meter per pixel) images in three spectral bands from the Resurs-O1-3. These images were used for several key areas in Arkhangelsk Oblast and the republics of Komi and Karelia.

High resolution (20 meters per pixel) images in three spectral bands from SPOT satellite on August 1996. These images were available for some key areas in western part of the Karelia Republic and Murmansk Oblast.

Topographic maps

1:200,000 scale Russian topographic maps for the whole target area. The information from these maps was used mainly to identify settlements and the infrastructure as well as a supplementary material for recognition of satellite images. Besides that, they were used to show non-forest natural ecosystems inside areas of old-growth forests and the northern limits of forests.

Field data

The identified old-growth forest areas have been selectively checked through on-site field survey. A large set of criteria has been used in this field survey (can be ordered from the Biodiversity Conservation Center).

Based on the results of the surveys some areas have been excluded from the old-growth forest category. At the time of the production of this report the field survey is not completed. However, the preliminary results show that practically all large areas (larger than 50 000 ha) fulfill the old-growth forests criteria described above. The conservation value of smaller areas (2 000 to 50 000 ha) may be different and requires in the most cases field visits before the final decision.

Field data have been collected by different NGOs and research organizations. Practically all large preliminary identified areas of old-growth forests in Murmansk Oblast were surveyed during 1991–1999 by Druzhina Movement for Nature Conservation of Moscow State University, Biodiversity Conservation Center, Kola Wild Nature Conservation Center and the Institute for Industrial Ecology Problems of the North (Kola Research Center, the Russian Academy of Science).

During 1996–1999 Greenpeace Russia, Pushchino State University, Biodiversity Conservation Center, Socio-Ecological Union and the Institute of Soil Science of Moscow State University and Russian Academy of Sciences surveyed most areas of old-growth forests identified in the Karelia Republic. Data from the Finnish Nature League, Karelian Student Nature Conservation Organization (SPOK), and some specialists from the Karelian Research Center of the Russian Academy of Science were also used.

In Arkhangelsk Oblast and Komi Republic, the identified areas of old-growth forests were surveyed during 1998–1999 by Greenpeace Russia and Pushchino State University with assistance of Biodiversity Conservation Center. The surveys in these regions are not completed.

Time

The information and data included in the map was last updated December 1999.

Map coordination

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