Primaeval forests along the Finnish-Russian border: natural pattern, present situation and protection prospects

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Introduction
The last westernmost huge primeval forest areas in the Eurasian taiga zone have survived only in the Republic of Karelia and in the Murmansk region. There are no such areas in other parts of Fennoscandia. Similar forests occur as very small fragments in northern Finland and Sweden in low-mountain landscapes. However, they have suffered a few selective cuttings in the past. These primeval communities are highly significant for North Europe as “biotic” and recreational resources.

Location and main natural patterns of forests
The territory along the Karelian part of the Finnish-Russian border has several types of landscapes: 1) low-mountain north-taiga landscape dominated by spruce forests, 2) hilly-ridge denudation-tectonic landscape dominated by pine stands (in the north- and mid-taiga subzones), 3) hilly-ridge denudation-tectonic and morainic landscape dominated by spruce stands and 4) pine-dominated rocky landscape. At least two highly contrasting forest areas are located near the Karelian part of the Finnish-Russian border (Fig. 1).

1. Unique uneven-aged spruce low-mountain taiga (in and near the Paanajärvi National Park (NP).
Spruce stands account for about 85% of the forested area, rupicolous blueberry and fresh blueberry spruce stands clearly dominating. Forest cenoses were formed in a large burned-out area at least 350-400 years ago. The uneven-aged structure of stands is now being formed. The average age of stands varies from 160 to 200 years. It is the main spruce generation in terms of wood stock. However, the trees that build up the upper storey vary substantially in age from 80 to over 270 years (maximum age reported so far from mineral soils). This evidence shows that the formation of the absolutely uneven-aged structure of stands, a basic indication of climax forest communities, is gradually coming to an end. The forests are poorly productive (average quality class is V, 6 and wood stock at the age of 120-140 years are 115 m³/ha.
Spruce stands are practically unaffected by selective cutting. In Karelia, these spruce forests, including spruce-birch forest-tundra communities, are unique. They grow in extreme low-mountain environments with thin soils in the coldest part of Karelia. They are floristically specific, highly sensitive to human activities (or atmospheric pollution), capable of regenerating naturally after clear cutting and are resistant to recreational impacts.

Fig. 1. Left: High density coniferous forests along Finnish - Russian border (According to satellite image data). Right: Nature reserves.
2. Typical even-aged pine taiga in a denudation-tectonic landscape (Kostomuksha Strict Nature Reserve and Kalevala National Park to be established).

Pine stands cover about 85% of the forested area. Large pine stands with small spruce fragments, growing dominantly along the hydrographic network, are common. The forest communities that occur in this territory represent almost all forest types known in Karelia. Generally speaking, the territory has a topo-ecological chain of forest phytocenoses most characteristic of East Fennoscandia. Phytocenotically, the forest communities discussed are typical of the north-taiga subzone of East Fennoscandia. The composition of their stands (absolute dominance of conifers) and the living ground cover (occurrence of common plant species) are typical. Abundant spruce undergrowth, or a second spruce storey, is present beneath the canopy in about 1/2 of rupicolous blueberry and fresh pine stands. There, pine does not regenerate. As a result, pine is being gradually replaced by spruce. In nature, stable dynamic equilibrium between pine and spruce formations has been maintained by periodical fires.

Age of forests

Stands growing on most mineral soils vary in age from less then 100 to 220 and more years. The maximum age reported for some trees growing on the periphery of paludified habitats is estimated at 450 years. The age structure of stands varies considerably from one habitat type to another. For example, rupicolous pine stands commonly display at least 2-3 and more tree generations with ages ranging from 80 to over 300 years and wood stock varying substantially. Fresh blueberry pine stands are normally from 120 to 160 years, but some pine-trees are over 300 years old. In ravine spruce stands, some trees vary markedly in age, and several age groups are formed in terms of the number of trunks. The oldest age reported for ravine spruce stands is 270 years. However, 160 to 200 year-old trees dominate clearly in terms of wood stock. The forests discussed are productive for north-taiga conditions (average quality class is IV.5 and wood stock at the age of 120 to 140 years are 140 cubic metres/ha). Generally speaking, the territory displays a complete natural spectrum of forest cenoses ranging from unclosed plant groups growing in burnt-out areas to climax spruce stands existing in ravine habitats that can hardly be affected by fires.

Forest growth conditions are fairly uniform and favourable for both pine and spruce over most of the area. Considering that spruce is a shade-tolerant species, the area covered by spruce stands tends to increase owing to spruce undergrowth, a second spruce storey which penetrates the upper pine canopy. Rupicolous, sedge-Sphagnum and other types of habitats that are extreme with respect to forest growth conditions are an exception. However, the present-day area distribution of pine and spruce stands is basically due to the fire regime formed in the past millenium.

Modern forest cenoses thus represent different stages of pyrogenic successions ranging from pioneer plant groups occurring in open burned-out areas to relatively stable 300 year-old phytocenoses with at least 2-3 tree generations that have survived several fires.

Not less than 1/2 of forests growing on mineral soils were affected by selective cutting, low-intensity cutting being dominant. They did not have an evident effect on the structure of cenoses, but resulted in a higher percentage of spruce in areas where pine was cut down most intensely.

Other fragments of primeval forests survived: 1) to the north from Paanaijarvi NP; 2) to the south from Kostomuksha strict reserve and 3) between Tulos lake and border - in special boundary zone with width 2-3 km only. The forests around northern part of Lake Ladoga shore are absolutely secondary.
Current situation

The total area of primeval taiga along Finish-Russian border is 500,000 ha in the least. About 25% are reserved now for national parks in accordance with government decision.

From south to north the situation is as follows:
1. In different variants, the Ladoga Skerries National / Nature Park to be established is expected to cover an area of 62 to 120 thousand hectares, about ½ being occupied by the Ladoga Lake aquatorium. Practically all the forests are secondary and are considered water-protective forests;
2. The active Tolvajarvi Landscape Reserve (44.5 thousand hectares). Half of its forests were cleared a few decades ago, and the main part of preserved forests are water-protective stands surrounding the lake-river system;
3. Koitajoki National Park to be set up (32.5 thousand hectares). Its forests were practically cleared a few decades ago.
4. Tuulos National Park to be established (38.5 thousand hectares). 2/3 of forests were cleared several decades ago. Primeval forests have survived mainly in the 2-3 km wide strip which extends along the boundary between Lake Tuulos and the border. The rest of preserved forests are water-protective stands around Lake Tuulos and on the islands.
5. Kalevala National Park (95,000 ha). It is the only large forest massif of commercial value in the protected areas to be established.

Conservation problems

After all, the only final decision on the establishment of a new park concerns Kalevala National Park.

The economic value of the last primeval forests is the main obstacle for establishment of new national parks. For example, about 7.5 mln/m³ mature and overmature wood grow in “Kalevalski” planned NP only. The forest production from this area is worth hundreds of millions of US-dollars.

In general, the cardinal problem of projecting of nature reserves network is its optimisation not only on ecological, but also on economical criteria. The establishment of parameters of this network should implement as by a principle of “ecological sufficiency”, and principle of territory “minimum”. First principle guesses that dimensions of the area must provide normal functioning of the natural-territorial complex in the natural regime. Second demands the feasibility of minimum of this area because the organisation of nature protected territories eliminates industrial utilisation of natural resources. It entails by a straight and usually very large economical damage, which one is necessary to attempt to minimise on the initial stages of organisation of protected object.

There are two alternative versions of forest use - traditional industrial development of wood resources with a large-scale clear cutting or the use of landscape as a national park. The methodical approaches to economical calculations of these scenarios of nature management have not been developed yet. Apparently, these assessments should be based on the “what we will gain and what we will lose” principle. In principle, it is easy to calculate the cost of wood resources including in money’s worth. However, detection of the economical benefits of utilisation of ecological, biotic and recreational resources (functions) of forests are integrated to principal methodical problems. These resources (functions) are difficult to evaluate in cost expression and to compare them to the effect of the use of timber.