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Boreal forests: policy challenges for the future

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As IUCN launches an important new temperate and boreal forest programme, this arbor*vitæ* special gives an outline of key conservation issues in boreal forests.

The boreal forests of the far north make up about a third of the world's total forest area, much of it still virtual wilderness, yet they receive only a fraction of the attention given to tropical and temperate forests. Despite their vast size, boreal forests now face increasing exploitation and disturbance, with threats to both the total area of forest and to the quality of the forests that remain.

The following paper introduces the ecology and status of boreal forests, summarises some of the main threats, and proposes key elements in a conservation strategy. The text reflects a collective effort by many people within IUCN and WWF.

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The boreal forest biome

Boreal forests include most of the northern Arctic or subarctic forests and are part of the biome known as *taiga* or *tayga*. They cover an area of 1.3-1.5 million square kilometres, making up roughly a third of the world's forests and forming a circumpolar band covering Alaska, most of Canada, much of northern Russia, northern Scandinavia and parts of northern Scotland. Boreal forest was once found in southern Iceland, but was long ago destroyed. Generally, the climate in boreal regions includes long, cold winters and a high annual variation in temperature and insolation.

Definitions

There is still no agreed international definition of a *boreal forest*, although in practice most scientists recognise a boreal forest biome. The International Boreal Forest Research Association is trying to reach consensus on this issue; several definitions exist, but these vary between countries. Amongst the criteria used in definitions are:

- **temperature regimes:** eg forest lying between 13^{o} and 18^{o}C July mean temperature isotherms;
- **vegetation zones:** eg forest beyond the northernmost occurrence of maple (*Acer*) and oak (*Quercus*);
- **landscape structure:** eg forest in forest-bog patterns;
- **forest composition** including the presence or absence of certain key species (UNECE).

If vegetational characteristics are used to define the biome, "boreal forests" can occur very widely and have been identified on isolated mountain communities in temperate and even tropical regions.

For the purposes of this paper, we concur with those people who believe that no very clear boundaries can be drawn to the biome, but think that the broad geographical and ecological definition of boreal forest is useful from a management perspective. Here, *the term boreal forest is used to refer to northern Arctic forests - dominated by conifers with deciduous trees usually confined to pioneer species – found in the nationally-accepted boreal zones of Russia, Canada, the USA, Norway, Sweden, Finland and Scotland.*

People

Although the boreal region generally has a low human population, it contains many communities, including a range of indigenous peoples. Important groups include: Inuit (eskimo) people of Alaska; a range of First Nations groups in Canada such as the Innu, Cree, Metis and Blackfoot; many different indigenous peoples in Russia including Evenk, Even, Udege, Keto, Dolgan and Yakut; and the Sámi people of Lapland and European Russia. Over 50 languages are known from Alaska and Siberia, although 45 of these are in danger of extinction (Starke 1997). Newer settlers include those connected with the oil industry and other mineral mining. Settlement is not evenly spread; for example Finland has over half the global population living north of the Arctic Circle. Many people make a living from a variety of non-timber forest products – including fur trapping, hunting, reindeer herding and collection of berries and mushrooms – and in coastal regions from fishing.

Flora and fauna

Boreal forests are usually dominated by conifers, including spruce (*Picea*), pine (*Pinus*), fir (*Abies*) and larch (*Larix*). Most deciduous trees are pioneer species which dominate early successional stages and include willow (*Salix*), poplar and aspen (*Populus*), alder (*Alnus*) and birch (*Betula*). These form mixed forests with conifers in intermediate successional stages, but are later outcompeted. All plants must be able to survive extreme cold and poor soils. Although species differ, there is a marked similarity in tree genera, forest structure and wildlife throughout the biome.

The boreal forest also provides habitat for many animals along with rare or endemic species of fungi, lichens and flowering plants. Important mammals include the brown or grizzly bear (*Ursus arctos*) throughout the region, the Siberian flying squirrel (*Pteromys volans*), the wolverine (*Gulo gulo*), sable (*Martes zibellina*), stout (*Mustela erminea*) and ungulates such as the reindeer or caribou (*Rangifer tarandus*), moose or elk (*Alces alces*) and various deer species. There are also a range of birds associated with boreal forest, either as residents or migrant breeders, including the gyrfalcon (*Falco rusticolus*), hawk owl (*Surnia ulula*), Siberian jay (*Perisoreus infaustus*), Siberian tit (*Parus cinctus*), Arctic redpoll (*Carduelis hornamanni*), pine grosbeak (*Pinicola enucleator*) and Cape May warbler (*Dendroica tigrina*). Although there is low species diversity, many of these species have a wide genetic differentiation amongst populations.

Ecology

The boreal forest ecosystem is subject to regular *disturbance*. Fire is common and was long thought to be the dominant disturbance factor, with many species dependent on fire to create suitable habitat, conditions for seed germination etc. Boreal forests may be divided into those which burn regularly and fire refugia – such as wetlands and valleys – which burn seldom, if ever. In fire refugia, old-growth forests can form, with regeneration taking place when old trees die and fall, opening the canopy (Angelstam and Rosenberg 1993). Fire often occurs in small, localised and relatively cool blazes; for example, in Scandinavia the average boreal forest fire rarely exceeds 20 hectares and fires almost never kill all the trees. Recent research in Russia suggests that the role of fire may have been exaggerated and simplified (Haila *et al* 1994), and that defoliating insects, pathogenic fungi, storms and snow are more important than once thought. The variety of disturbance creates a *mosaic pattern* on a landscape level, although individual stands may be predominantly single age and monospecific.

The harsh and changeable landscape also means that dead wood is usually abundant, both as standing dead trees (snags) and down logs, and many plants and animals have adapted to the range of habitats that this creates. Succession follows a regular pattern. In Europe, for

example, on rich soils the pioneer stage is dominated by deciduous trees and it takes around a century before spruce forms a mixed stand, and then 200-300 years before the forest reaches a spruce-dominated climax. On poorer soils the early succession is dominated by pine, although some deciduous trees will also be found.

Policy context

The last few decades have been a time of many changes within the boreal region which could increase pressure on forests. Developments include the opening of interior Alaska, the reconstruction of Fennoscandia following the Second World War, the continuing settlement of First Nation land claims in North America and the break up of the Soviet Union. Changes in world trade patterns have expanded the timber market and strengthened the role of transnational companies (TNCs). Growing demand for pulp, as opposed to timber, has increased the value of the generally poor-quality wood from boreal forests. Technical developments in wood utilisation allow the use of some boreal species which previously had no commercial value, such as aspen. These changes have contributed to the development of inconsistent national strategies towards boreal forests and a rapid escalation of environmental and social problems.

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Environmental issues

Most environmental debates centre on approaches to natural resource management and on impacts of pollution.

The timber trade

Timber resources are critical to the economic development of many boreal communities. By far the most important factor currently affecting boreal forests is commercial logging. The potentially rich pickings for timber companies are balanced by harsh conditions, poor access and low-quality timber. In practice, governments have often supported logging in boreal forests to promote exports and local jobs through subsidies for logging, below-cost timber sales and by confining protected areas to places with little valuable timber. In some of the more accessible areas, there has also been a growth in illegal logging.

Subsidies have been particularly common in North America. For example, an Alaska Legislative Research Agency study showed that for every dollar invested in timber in 1988, the state only received one cent in revenue, or 2.5 cents if costs of fire fighting were excluded. This compares with 77 cents for investment in fish, 57 cents for wildlife and 25 cents for minerals (Olsen 1992) and was caused in large part by "sweetheart" deals for two pulp mills in the state, which sold subsidised timber to Japan for almost fifty years. Expenditure has exceeded revenue in some Canadian forests as well. Subsidies reportedly cost British Columbian citizens Can$0.65 for every cubic metre of timber felled in 1989 (Dudley *et al* 1995). Environmental groups also accuse governments in Fennoscandia of supporting uneconomic logging in the boreal regions.

Although registered logging in the Russian Federation is well down on that during the Soviet era, there is a huge and growing illegal trade in timber. For example, a 1997 report from the Leningrad region's Forestry Industry Inspection Commission "paints a picture of utter lawlessness" according to the *St Petersberg Times*. In some areas the illegal trade now almost certainly exceeds "official" timber harvesting. Timber poachers vary from local people desperate for fuel or money to large companies prepared to operate at the edge of, or outside, the law. Russia has also attracted a series of barter deals, particularly with Japan. For example, in 1991, KS Industries – a consortium of 10 Japanese trading and heavy machinery companies – agreed to exchange US$700 m worth of lumbering machinery, saw mill equipment and heavy road building equipment for 6 million m^3 of raw timber and 400,000 m^3 of processed wood (*Yomiuri 1*991).

From a conservation perspective, one important result of this situation is that old-growth forest continues to be logged in many boreal forests. Key issues include:

- the impact of TNCs and the illegal timber trade on natural forests in Siberia and the Russian Far East (Newell and Wilson 1995);
- opening up boreal forests of Canada, including for example leasing 17 per cent of Alberta's forests to two Japanese TNCs (Pratt and Urquhart 1994);
- increased rates of logging in Alaska's boreal region;
- continued logging of old-growth forests in Finland, Sweden and Norway, despite Fennoscandia retaining at most 5 per cent of its original boreal forest (Bryant *et al* 1997).

Even where sufficient areas of old-growth remain to allow sustainable harvesting, much of this is still carried out by large-scale clear felling. This can lead to severe disruption of soil and water regimes, and threats to wildlife. It can increase the risk of torrent debris and sheet erosion and reduce the amount of coarse woody debris in watercourses, which is necessary for fish spawning. Tree loss can cause an increase in albedo, through greater snow cover, and

consequent climate disruption including changes to permafrost (Markham *et al* 1993). Large scale boreal forest logging also impoverishes native hunting, fishing and trapping grounds. Many indigenous peoples have legal battles and sometimes blockades aimed against logging. The Saami people of Norway, Finland and Sweden, have been in conflict with timber companies over old-growth logging in reindeer grazing areas, because felling leads to loss of lichen species important for winter livestock feeding.

Other industrial and social impacts

As the boreal region is opened up to exploitation, other factors alter the biome, including mineral mining, oil drilling and tourism.

Exploitation of valuable oil reserves has already transformed some boreal communities. In Alaska, oil drilling has had negative impacts on boreal forest through pipeline construction and occasional spills (Wilderness Society, undated). Serious problems are reported from Siberia, including major spills and cultural disruption of the Khanty, Mansi and Komi peoples. According to government sources, the massive oil fields of western Siberia suffered over 1,300 leaks to oil and gas pipelines in one year during the late 1980s, losing 80-100 million barrels of oil, the equivalent to 300-400 Exxon Valdez spills (Olsen 1993). Oil development has been a major focus of World Bank lending to the Russian Federation during the mid-1990s and the rich reserves have attracted companies such as Shell and Amoco. Environmental problems continue; for example in 1994 a major spill occurred in the Komi region, in an operation which included Gulf Canada and British Gas (Grigoriev 1995).

Mining is also increasing, partly because new technology allows the use of lower grade ores. However, badly managed mines cause deforestation (particularly with strip mines) and pollution of hydrological systems from tailings and chemicals used in extraction. Mining causes social tensions; some inhabitants welcome the potential income while others fear the environmental and social side-effects. Gold mining has been significant in the region since the Yukon "gold rush" of the nineteenth century and Stalin's use of political prisoners to mine Siberian gold. It is increasing rapidly in Russia, attracting transnational mining companies, and is occurring in or near several protected areas, including the Yugyd Va National Nature Park in the Kozhim River where mining is reported to have virtually eliminated *Rhodiola rosea*, a red-listed medicinal plant. Mining controversies also occur in North America; for example in Labrador, Canada, Innu and Inuit groups are campaigning against a nickel mine (Taiga Rescue Network 1997).

The ecology of boreal forests can also be affected by tourism and hunting. "Wilderness tourism" is increasing in Alaska, northern Canada and Lapland, where particular threats include use of snowmobiles and other off-road vehicles, and building tourist accommodation. Sport hunting is increasing in some areas, particularly within Russia where foreign hunters are prepared to pay large sums of money for trophy hunting of species such as bear.

Impacts of climate change

A more general threat comes from predicted changes to global climate (Watson *et al* 1996), which could result in an overall shift in conditions suitable for many boreal tree species, generally towards higher latitudes and/or higher elevations. Predictions are that impacts will be particularly severe in boreal forests.

Climate change will alter regional climates, which will affect the growth and regeneration capacity of forests. In several instances, this will alter the function and composition of forests significantly. As a consequence of changes in temperature and water availability, a substantial fraction of the existing forested area of the world will undergo major changes in broad vegetation types – with the greatest changes occurring in high latitudes, ie in boreal regions. Climate change is expected to occur at a rapid rate relative to the speeds at which forest species grow, reproduce and reestablish themselves. Isotherms will effectively shift polewards at a rate that could be significantly greater than the speed at which trees are thought to be able to migrate, leading to likely changes in the species composition of boreal forests (Davis 1989). Isolated and relic populations could become extinct. Boreal forests are also likely to experience increased stress caused by more frequent outbreaks and extended ranges of pests and pathogens, and increased frequency and intensity of fires (Watson *et al* 1996).

These changes would almost certainly result in some loss of biodiversity (Korpilahti *et al* 1996). Forecasts vary greatly but one model suggests that 40 per cent of the boreal forest might disappear, to be replaced by temperate forest and woodland (28 per cent) and steppe (12 per cent) (Solomon 1993).

Implications for biodiversity

Boreal countries have, on average, protected a smaller proportion of their productive forest than many tropical countries, and important gaps remain in area networks (Hansen *et al* 1994). Scandinavia has less than 5 per cent of its original boreal forest, Alaska retains about 15 per cent and Scotland has 2-3 per cent of its boreal forest remaining, all of it strongly modified by human interference (Dudley 1992). Most of the remaining old-growth boreal forest is found in Canada and in Russia where 40-50 per cent of the forest remains uncut, but where exploitation is increasing rapidly in some areas.

Logging old-growth forests can have a dramatic impact on biodiversity. Short term effects may be an increase in numbers of species, as weed and alien species invade disturbed ground as primary colonisers. However, those species reliant on natural forest – including presence of dead timber, uneven aged stands and living trees of great age – are no longer able to survive. The species which disappear after logging are often those which are rare, endemic or otherwise threatened.

The results can be seen for example in Scandinavia, where many species are under threat. In Sweden it is estimated that 1,700 of the endangered "red list" species are associated

with forests (Naturskyddsfreningen) including many boreal species. Particular concern has been expressed for the survival of the Siberian tit (*Parus cinctus*) and the white-backed woodpecker (*Dendrocopus leucotos*). Half of Sweden's population of golden eagles (*Aquilia chrysaetos*) live in old-growth Scots pine forest, some of which is still threatened by logging (Tjernberg 1986). Even greater effects can be expected on fungi, lichens and soil flora and fauna (Ingelof *et al* 1984, Ingelof 1988) which are now used as indicators of old-growth forest in the north (Nitare 1991). According to the report of the Committee for Monitoring of Threatened Animals and Plants in Finland: "forest management still poses the main principal threat to wildlife", with 692 species endangered solely through forest management and an additional 805 species endangered at least partly through forest management (quoted in Halkka 1993).

Similar fears are expressed in Alaska and northern Canada, where forests provide habitat for some of North America's most important animal species, including the bald eagle, grizzly bear and many deer, such as the Sitka Black Tailed Deer which relies on old growth stands to provide shelter during the winter. Siberia's forests, particularly in the far east, provide unique habitat to a range of endangered species.

Reactions

To date, reactions to the problems in boreal regions have come from governments, through grassroots responses and as a result of international initiatives such as the Convention on Biological Diversity. In Lapland, Canada and Siberia many activities were initially organised by indigenous peoples' groups, although today a large number and variety of non-governmental organisations (NGOs) are also involved. In 1992, a group of NGOs, scientists and concerned individuals attended a conference in Jokkmokk, Sweden, and launched the Taiga Rescue Network (TRN) to facilitate communication between people interested in boreal forest conservation through a newsletter, *Taiga News*, and biannual TRN conferences.

A Ministerial Conference on the Protection of Forests in Europe took place in Helsinki in June 1993 and agreed a series of resolutions. In October 1993, the Conference on Security and Cooperation in Europe ran an experts' workshop in Montreal, looking at *Indicators for Sustainable Development of Temperate and Boreal Forests*. Both the resulting Pan-European Process and the Montreal Process have now developed criteria and indicators for sustainable management of forests in the region. The extent to which these will be implemented remains uncertain. On a global level, the United Nations has an on-going series of fora addressing development and conservation issues in all forest types, under the auspices first of the Intergovernmental Panel on Forests and latterly the Intergovernmental Forum on Forests. The World Commission on Forests and Sustainable Development, an NGO with links to the UN system, has also held an important series of public hearing around the world, including two in Canada and Russia, which attempted to identify key obstacles to sustainable forest management in the boreal regions.

Responses from IUCN and WWF

The boreal forest represents a unique opportunity to manage a biome on a sustainable basis. Huge forests, low human population and its location in some of the market countries of the world presents opportunities missing in many other key habitats. However, at present the signs are that old mistakes are being repeated in boreal forests. IUCN and WWF are not arguing against development – indeed, well-managed forests and mines have the potential to add a much needed injection of cash and jobs into impoverished communities. However, the key word here is sustainable. Rather than a resource "grab", we need to see responsible resource management, driven by local communities and considering all types of resources, for example biodiversity and non-timber forest products alongside timber and fibre. Development of such a balanced policy is a key component of the two organisations' programmes in the region.

Both IUCN and WWF have active programmes in the boreal region. They draw inspiration and a framework from the joint IUCN/WWF *Forests for Life* strategy, which has the following five key elements:

- Establishment of a network of ecologically-representative protected areas.
- Environmentally appropriate, socially beneficial and economically viable forest management outside protected areas.
- Development and implementation of ecologically and socially appropriate forest restoration programmes.
- Reduction of forest damage from global change, including a decrease of pollution below damage thresholds, as measured by critical loads.
- Use of forest goods and services at levels that do not damage the environment, including elimination of wasteful consumption.

Projects include development of protected areas, species protection, work with local communities and encouragement of sustainable forest management.

Traditional Sámi house in Sweden.

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IUCN's Temperate and Boreal Forest Programme: Over the past year and a half, IUCN has been engaged in a process of discussion and consultation with its members and with organisations working on temperate and boreal forests worldwide. To redress the relative lack of attention paid to these forests by the conservation community, it has recently established the *Temperate, Boreal and Southern Cold Temperate Forest Programme*. The Programme has three principle objectives:

- **Policy analysis** to develop cross-sectoral national and international policy frameworks supportive of conservation and sustainable management of temperate and boreal forests. Topics will include perverse economic incentives, standards and guidelines, criteria and indicators, and international trade and investment flows.
- **Information compilation and dissemination** on planning and management systems, and concerning the status and trends in both forest resources and forest policies. Various reports and studies will be supplemented by the publication of a conservation atlas of temperate and boreal forests which will be produced in both hardcover and electronic formats.
- **Stakeholder involvement** in decision-making on temperate and boreal forest management and utilisation. The programme will convene roundtable discussions of stakeholders and develop national and/or local level projects, and produce case studies and reports synthesising successful experiments in community involvement in forest management.

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