



WWF World Wide Fund  
For Nature

**IUCN**  
The World Conservation Union

# arborvitæ

Supplement

January 1998

This Supplement has been edited by Nigel Dudley and Sue Stolton of Equilibrium Consultants. Managing editors Jean-Paul Jeanrenaud of WWF International and Bill Jackson of IUCN, the World Conservation Union. Design by WWF-UK Design Team.

Reprints: Permission is granted to reproduce news stories from this supplement providing full credit is given. The editors and authors are responsible for their own articles. The opinions do not necessarily always express the views of WWF or IUCN.

## Boreal forests: policy challenges for the future

by Nigel Dudley, Don Gilmour and Jean-Paul Jeanrenaud



M Wägeus, WWF

*Pechora Illych*

*This paper has been compiled with the active participation of many people within IUCN and WWF, including Andrew Deutz, Bill Jackson, Harri Karjalainen, Andrei Laletin, Anders Lindhe, Vladimir Moshkalo and Per Rosenberg.*

WWF International  
Avenue du Mont-Blanc  
1196 Gland, Switzerland  
Tel: +41 22 364 91 11  
Fax: +41 22 364 53 58

IUCN, 28 rue de Mauverney  
1196 Gland, Switzerland  
Tel: + 41 22 999 00 01  
Fax: + 41 22 999 00 25

**As IUCN launches an important new temperate and boreal forest programme, this arborvitæ 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.

# 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<sup>o</sup> and 18<sup>o</sup>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*

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

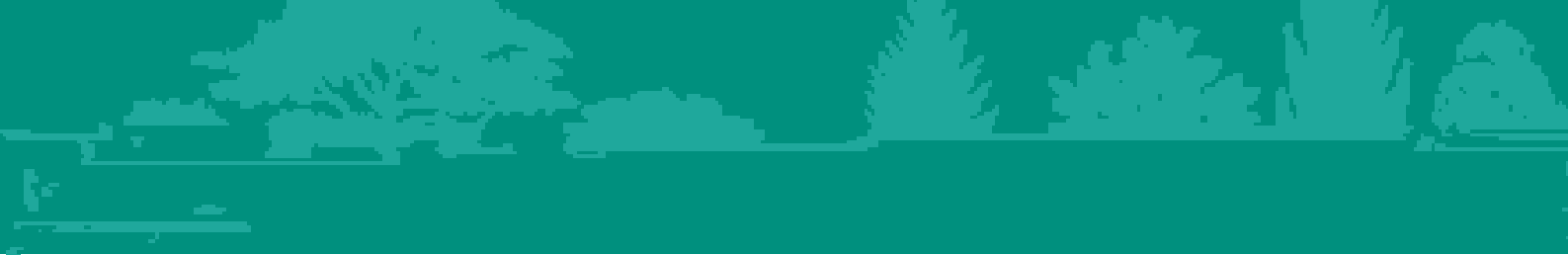
Boreal forests are usually dominated by conifers, including spruce (*Picea*), pine (*Pinus*), fir (*Abies*) and larch (*Larix*). Most deciduous trees are pioneer species which dominate early successional stages and include willow (*Salix*), poplar and aspen (*Populus*), alder (*Alnus*) and birch (*Betula*). 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.

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



**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.

For further information please contact: Andrew Deutz, Programme Coordinator, Temperate and boreal Forests, IUCN-Canada, 380 St Antoine Quest, Bureau 3200, Montreal, Quebec, Canada H2Y 3X7  
Tel: +1 514 287 9704 Fax: +1 514 287 9057 E-mail: adeutz@iucn.ca

Nigel Dudley

## References

- Angelstam, P and P Rosenberg (1993); Aldrig Sallan Ibland Ofta, *Skog & Forskning* 1/93, Sveriges skogsvarvsbund, Sweden
- Bonan, G H, H H Shughart and L U Dean (1990); The sensitivity of some high latitude boreal forests to climatic parameters, *Climatic Change* 16, 9-29
- Bryant, D et al (1997); *The Last Frontier Forests*, World Resources Institute, Washington DC
- Davis, M (1989); Lags in vegetation response to greenhouse warming, *Climatic Change* 15, 75-82
- Dudley, N (1992); *Forests in Trouble: A Review of the Status of Temperate Forests Worldwide*, WWF International, Gland, Switzerland
- Dudley, N, J-P Jeanrenaud and F Sullivan (1995); *Bad Harvest? The Timber Trade and the Degradation of the World's Forests*, Earthscan, London
- Grigoriev, A (1995); Foreign investments and the future of the oil and gas industry, *Taiga News* number 13, Taiga Rescue Network, Jokkmokk, Sweden
- Haila, Niemela and Kouki (1994); *Effects of management on the ecological diversity of boreal forests*, Finnish Forest Research Institute, Helsinki
- Halkka, A (1993); Reverse side of sustainability, in *Finland and Forest: A Success Story?*, edited by Harri Karjalainen, Helsinki, 16-17 June 1993, Helsinki
- Hansen, J-P H et al (1994); *The State of Protected Areas in the Circumpolar Arctic 1994*, Conservation of Arctic Flora and Fauna, Directorate for Nature Management of Norway, UNEP and World Conservation Monitoring Centre
- Houghton, J T, G J Jenkins and J J Ephraums (1990); *Climate Change: The IPCC Scientific Assessment*, Cambridge University Press, Cambridge
- Ingelof, T, G Thor and L Gustafsson (1984); *Florarand I Skogsbruket: Artdel*
- Ingelof, T (1988); *Florarand I Skogsbruket: Allman del*, both from Skogsstyrelsen, Jonkoping
- Korpilahti, E, S Kellomki and T Karjalainen [editors] (1996); *Climate Change, Biodiversity and Boreal Forest Ecosystems*, International Boreal Forest Research Association reprinted from *Silva Fennica* 30(2-3), 1996
- Markham, A, N Dudley and S Stolton (1993); *Some Like It Hot: Climate Change, Biodiversity and the Survival of Species*, WWF International, Gland
- Naturskyddsforeningen, the Swedish Society for Nature Conservation
- Newell, J and E Wilson (1995); *The Russian Far East*, Friends of the Earth Japan
- Nitare, J (1991); Nyckelbiotoper avsojlar skogens historia, *Skogs-Eko*, 12-13, April 1991
- Olsen, R [editor] (1993); *The Taiga: A Treasure - Or Timber and Trash?*, Taiga Rescue Network, Jokkmokk, Sweden.
- Pratt, L and I Urquhart (1994); *The Last Great Forest: Japanese Multinationals and Alberta's Northern Forests*, NeWest Press, Edmonton
- Prentice, I C, M T Sykes and W Cramer (1991); The possible dynamic response of northern forests to global warming, *Global Ecology and Biogeography Letters* 1(5)
- Solomon, A N (1993); Management and planning of terrestrial parks and reserves during chronic climate change, in J Pernetta [editor], *Impacts of Climate Change on Ecosystems and Species: Implications for Protected Areas*, IUCN, Gland, Switzerland
- Starke, L [editor] (1997); *Vital Signs 1997-1998*, Worldwatch Institute, Washington DC
- Taiga Rescue Network (1996); *Sustainable Forestry in the Boreal*, Jokkmokk, Sweden
- Taiga Rescue Network (1997); *Taiga News* issue 23, Jokkmokk, Sweden
- Tjernberg, M (1986); *The Golden Eagle and Forestry*, Swedish University of Agricultural Science, Department of Wildlife Ecology, Report number 12, Uppsala
- UNECE Timber Division: *Separation of boreal and temperate forests in International Forest Resource Assessments (Boreal and temperate zones delineation)*.
- The Wilderness Society (undated) *Tracking Arctic Oil*, Washington DC
- Watson, R T, M C Zinyowera and R H Moss [editors] (1996); *Climate Change 1995: Impacts, Adaptations and Mitigations of Climate Change: Scientific-Technical Analyses: Contributions of Working Group II to the Second Assessment Report of the Intergovernmental Panel on Climate Change*, Cambridge University Press
- Yomiuri newspaper (1991); 13th October 1991, Japan