

Conservation in Boreal Forests under Conditions of Climate Change

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1 Introduction

Addressing the potential impact of climate change on boreal forest ecosystems will require a range of new conservation techniques. This offers opportunities for WWF (the World Wide Fund for Nature) to combine a number of its specialised field and policy activities into an integrated strategy.

During the early 1990s, the scope of WWF's forest policy work has broadened from a focus on tropical moist forests to a more general consideration of all the world's forests (Dudley 1992). Several major new projects, in Scandinavia, Alaska and more recently in Russia, mean that the organisation has given boreal forest issues a much higher priority than has been the case in the past. More recently, WWF's Forest Advisory Group agreed a Global Forest Strategy and several National Organisations have drawn up and published complementary forest strategies for their own countries. At the same time, WWF has been active in conservation planning aimed at reducing the impact of climate change on biodiversity (Peters and Lovejoy 1992) and in funding research into global warming and the impacts on biodiversity. Confronting the problems raised by climate change within boreal forests also allows WWF to combine policy work

with a range of new and existing field programmes. The existence of WWF national organisations or project offices in most of the countries possessing boreal forests ensures that policies and programmes can be directly related to regional conditions.

Climate change is only one of a series of threats currently facing boreal forests. Four key impacts can be identified:

- forest management and particularly timber extraction
- other industrial sectors, including mineral mining
- tropospheric pollution from wet acid deposition, gases and particulates
- stratospheric changes, including ozone depletion and global warming.

Any management systems designed to reduce the impacts of climate change therefore have to be integrated with other conservation strategies and with broader management priorities.

The following paper looks at some of the conservation issues raised by climate change in boreal ecosystems, and at some preliminary conservation strategies for reducing harmful impacts on biodiversity. A concluding section discusses potential conflicts between management for climate change and other conservation priorities.

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2 Climate Change and Conservation

Climate change poses a number of problems for conservation organisations, from the perspective of both strategy and allocation of resources. While

the evidence for the existence of climate change continues to grow, ecological impacts are still uncertain and unpredictable. There is not much to suggest that this will change in the short term. Planning conservation strategies that take account of global warming is not easy when there are many computer models of climate change, sometimes predicting very different ecological effects. Whilst conservation organisations can learn a great deal from climate models, in practice staff often have to take an educated guess at what might happen in the future from the best available evidence, and stay flexible enough to modify plans as better information becomes available.

Prediction of global warming also adds significant new pressures to organisations and institutions that are often already stretched to their limits dealing with current environmental problems. The fact that the threats from climate change remain imperfectly quantified, and are at least to some extent still in the future, can make it difficult to argue for the diversion of time and funds from other projects that are considered to be more pressing. Yet failure to include climate change impacts in current conservation planning might lead to decisions being made that will soon be out of date. There has been a lively debate about how much time and resources should be devoted to climate change work.

In addition, climate change generates some philosophical problems for many non governmental organisations (NGOs). On the whole, conservation groups have argued that environmental problems should be tackled at source rather than by attempting to reduce impacts. For example, in the acid rain debate, NGOs have been virtually unanimous in proposing cuts to sulphur and nitrogen oxide emissions rather than supporting liming programmes on freshwaters and soils. Conservation planning for climate change implies a tacit admission that pollution from greenhouse gases, mainly from the rich countries, will remain at high enough levels to continue affecting the climate. Many organisations feel more at ease with campaigning for a reduction in pollution emissions than with assuming that impacts will occur and making plans accordingly.

3 Climate Change in the Boreal Forest

Climate change could result in some particularly extreme problems for the boreal forest biome. However, conservation biologists also have opportunities in boreal regions that are denied to them in many other parts of the world. If decisive action is taken now, there is a good chance of developing policies that could, in time, avoid many of the worst impacts of climate change in this region. This could also help us to gain knowledge that would have relevance in other ecosystems as well. A summary of the problems and opportunities in boreal forests is presented below, and expanded in the following section:

Boreal forests – problems:

- acute changes are predicted
- a lack of expertise exists in international conservation organisations
- political problems in some areas.

Boreal forests – opportunities:

- conservation issues are relatively simple
- biodiversity in the region is relatively limited in terms of number of species
- boreal forests are in relatively good condition
- forest management strategies in boreal regions are currently in a state of flux.

Most models of climate change predict relatively acute changes in the boreal region. Increases are expected in mean annual temperature, and in the frequency and severity of both storms and fires (Shugart et al. 1992). Some researchers suggest that 40 per cent of boreal forests could disappear and be replaced by temperate forests and/or tundra (Solomon 1993), although there are wide variations in predictions from different models. Many tree species will be unable to disperse fast enough to keep pace with changing conditions (Davies 1989) and are therefore likely to undergo a net decline.

In practice, if the predicted changes come about they will not in the short term mean that the biome will undergo abrupt changes in vegetation patterns, but rather that an increasing proportion of the boreal forest will be growing in sub-optimal conditions, and therefore under extra stress.

Changes in storm damage and fire frequency would have an important impact on ecology, and warmer conditions are also likely to allow the spread of additional pest species. The challenge for conservation biologists will be to design management systems and protected area strategies that give the boreal forest ecosystem as much resilience as possible to survive and adapt to changing conditions.

Working in boreal forests also creates a range of institutional problems for conservation organisations such as WWF. During the 1980s, international attention was focused on issues related to the loss of tropical forests to the extent that status of and threats to temperate and boreal forests were, until recently, comparatively ignored. Until the mid 1990s, WWF had no staff working specifically on boreal forest issues, even within those countries in North America and Scandinavia where there were active WWF National Organisations. Whilst this situation has now changed, expertise in boreal regions continues to lag behind that in other biomes. Lack of institutional expertise adds further blocks to progress in this area and lack of political will in some countries has allowed conservation problems to develop relatively unchallenged.

However, the boreal forest zone also has some advantages when compared with other regions. These could combine to make the region an ideal testing ground for theories of conservation biology and climate change.

Conservation issues within the boreal region are relatively simple compared with other parts of the world. The official bodies charged with management and regulation of the forest estate are well trained and equipped when compared to those in most tropical countries. Land tenure disputes, while still important particularly in parts of Canada and Russia, are less acute than in almost any sizeable tropical rainforest region. Infrastructure and the facilities for the training of foresters and conservation biologists are already well developed in most countries of the region, and many boreal countries have substantial research programmes looking at both sustainable forest management and at the impacts of climate change on the region. On a global scale, it should be noted that this stability relies heavily on what happens in the former USSR.

Future political and economic developments in the Russian Federation, which holds the largest proportion of remaining boreal forest, could reduce the comparative advantages listed above.

Biodiversity is also simple compared with the tropics and even with most temperate forests. Boreal forests are dominated by a few genera of trees and speciation is similarly limited amongst most groups of lower plants and animals, although the extent of within-species genetic variation in the biome is still relatively unknown. Boreal forest conservation strategies therefore have the advantage of being developed to protect a relatively small number of species. Boreal forests are also, on a global scale, in better condition than either tropical or temperate forests, and large tracts of semi-natural or old-growth forest remain in Russia, Canada and Alaska.

In addition, forest management and conservation policies are currently being rewritten in several boreal countries, with new laws recently introduced into Sweden and Finland, new policies being developed in the Russian Federation, and legal and management changes initiated at a provincial level in Canada. Attitudes towards forest management, and particular towards the importance of biodiversity, the role of fire in the landscape and the importance on non-wood forest products, has changed enormously in the last few years. The forest industries throughout the region have become used to a measure of change and development; it may therefore be an apt time to introduce policies aimed specifically at addressing threats from climate change.

4 A Strategy for Conservation in Boreal Forests under Conditions of Climate Change

Over the last three years, WWF has been drawing up strategies for conservation on a global, regional and national level. The *Global Forest Strategy*, which included input from 27 national organisations and 13 programme offices, draws up a detailed framework for addressing environmental and social problems in forests, within the context of five key objectives:

- Establishment of an ecologically representative network of protected areas covering at least 10 per cent of the world's forest area by the year 2000, demonstrating a range of socially and environmentally appropriate models;
- Environmentally appropriate, socially beneficial and economically viable forest management outside protected areas, to achieve sustainable management, including no net deforestation, by the year 2000;
- 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, to attain a level of use of forest goods and services within the regenerative capacity of the forest estate.

Within the context of forest management and protection in the boreal region, the first and second objectives are the most important. The existence of large tracts of biologically-rich old-growth forest means that WWF's target of setting aside 10 per cent of forest in reserves is more achievable within the boreal zone than in other areas. Canada is already committed to setting aside 12 per cent of its territory into ecologically-representative protected areas.

However, climate change creates additional problems for reserve management, and should therefore influence decisions about the selection of reserves. Shifting geographical and climatic zones may mean that areas that were ecologically valuable when a reserve was created become less suitable over time. Extreme weather events could further weaken protected ecosystems. Damage from climate change does not respect the boundaries of protected areas. The ability of atmospheric pollution to damage reserve areas has already been demonstrated (Fry and Cooke 1984). Similar deterioration is likely to affect boreal regions in the future as a consequence of climate change.

Whilst there can be no way of avoiding all such impacts, WWF has drawn up a preliminary set of criteria for maximising the chances of selecting protected areas that will be robust

enough to preserve biodiversity during times of rapidly changing weather patterns (based on Markham et al. 1993).

Reserves should:

- be as large as possible, to give space for plants and animals to migrate within the protected area if climatic conditions change;
- have more than one protected area per habitat type, ideally at some distance apart, so as to maximise the chances that at least one area will remain in conditions suitable for its continued survival;
- have altitudinal and latitudinal variation, to maximise the potential for migration if climate changes;
- have topographic variation, including valleys and areas where microclimate is likely to remain fairly stable;
- place zones of transition between one habitat type and another within the core of reserve rather than at the edge, so that once again there is space for expansion or contraction of habitat types within the protected area;
- ideally be close to other reserves or to similar habitat outside reserves to allow migration if necessary;
- include buffer zones where management is carried out sensitively enough to protect the main core of the reserve;
- have flexible zoning of reserve boundaries if possible, such that the reserve can, through negotiation, be relocated in the future if changing conditions make this necessary.

In addition, two other factors are important:

- consideration should be given to the development of corridors of natural or semi-natural habitat between reserves to aid migration (although further study is required as to the role that these might also play in spreading pests, diseases and alien species);
- existing stresses, including air pollution, fire mismanagement and invasion by alien species, should be minimised to give the ecosystem as great a chance as possible of coping with a changing climate.

5 Discussion

WWF has concluded (Peters and Lovejoy, 1992 and Markham et al. 1993) that conservation strategies aimed at combatting climate change need not be in direct conflict with other conservation planning requirements. Two effects were possible: climate change might provide additional arguments for implementing some existing conservation strategies; and in other cases might suggest the need for additional, complementary, procedures. The ten procedures outlined above fall into this category. More recently, proposals have emerged for ways to address the impacts of climate change that would certainly have detrimental impacts on existing conservation plans. These include:

- removal of dead timber and dying trees to reduce methane emissions from decaying vegetable matter
- disturbance of forests to introduce extra dynamism into ecosystems and thus help them adapt to a changing climate
- select useful species and genotypes
- enhance available nutrients
- control stand density
- change rotations.

Most of these proposals are, in effect, arguing for a continuation, or introduction, of intensive forestry practices. At a time when these are being questioned in several boreal countries, for both social and ecological reasons, it appears that in this case climate change is being used as a justification for forest practices that fly in the face of widely accepted conservation priorities.

WWF has always been cautious in both its predictions about global warming and its approach to management for climate change. Short-term measures that risk immediate environmental damage in the cause of addressing a possible future threat are therefore in opposition to its approach. At the same time, enough evidence has emerged about the likelihood that global warming is already underway to justify taking action to alleviate some of the ecological effects. WWF therefore proposes that, in the short term, management steps taken to address climate change in the boreal region should be confined to those which have an additional conservation

effect, or at least are not in opposition to existing conservation priorities. This win-win climate scenario minimises the risks of causing secondary ecological damage in attempting to address problems of global warming.

References

- Davies, M.E. 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. 260 p.
- Fry, G. & Cooke, A.S. 1984. Acid deposition and its implications for nature conservation in Britain. Focus on Nature Conservation number 7. Nature Conservancy Council, Peterborough, UK. 48 p.
- Markham, A., Dudley, N. & Stolton, S. 1992. Some like it hot: Climate change, biodiversity and the survival of species. WWF International, Gland, Switzerland. 144 p.
- Peters, R.L. & Lovejoy, T.E. (eds.). 1992. Global warming and biological diversity. Yale University Press, New Haven–London. 372 p.
- Shugart, H.H., Leemans, R. & Bonan, G.B. 1992. A systems analysis of the global boreal forest. Cambridge University Press, Cambridge, UK.
- Solomon, A.M. 1993. Management and planning of terrestrial parks and reserves during chronic climate change. In: Pernetta, J. (ed.). Impacts of climate change on ecosystems and species: Implications for protected areas. IUCN, Gland, Switzerland.

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