

Preparing for Climate Change: **Adapting to Impacts on British Columbia's Forest and Range Resources**

Executive Summary



Ministry of Forests and Range



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Purpose

The Ministry of Forests and Range (MoFR) Climate Change Task Team was established by the Forests Stewardship Division (FSD) Management Team in June 2005. The Task Team was requested to prepare a report for the Chief Forester on how the MoFR should strategically position itself with respect to the potential impacts of climate change on the province's forest and range resources

The mandate of the Task Team emphasized the need to understand and plan for the potential impacts of climate change. The team focused on identifying potential risks and opportunities, knowledge and research gaps, and some short- and long-term adaptive responses to climate change that the MoFR and others could undertake. This report therefore primarily addresses “adaptation” to climate change as opposed to “mitigation”, which is aimed at reducing greenhouse gases (GHG) in the earth's atmosphere.

The MoFR has a key role to play in mitigating the risks of future climate change by managing forests and soils to remove and store GHG, such as carbon dioxide, from the atmosphere and by developing opportunities for biofuels as alternative energy sources to fossil fuels. These “mitigation” strategies, which are largely subject to federal government direction, were outside the scope of the Task Team's assignment and are not addressed in this report. However, opportunities for reducing GHG emissions from MoFR operations were examined.

This report has been prepared for both MoFR and public review and comment. Most of the recommendations in this report have also been amalgamated with those derived from the Future Forest Ecosystems symposium held in December 2005 (MoFR 2005), the report on species management in mountain pine beetle impacted timber supply areas (Martin et al. 2005), and other MoFR activities into a Future Forests Ecosystems Initiative, which will explore opportunities to adjust approaches to forest management in response to rapidly changing conditions. Through this initiative the chief forester will seek additional input from stakeholders, communities and First Nations.

Climate Change

The global climate has always been subject to natural, sometimes dramatic, variation and species and ecosystems have adapted accordingly. However, climate scientists have concluded that much of the global climate warming observed during the latter half of the 20th century is due to anthropogenic factors, and that the rate of warming is likely to accelerate significantly during the 21st century (IPCC 2001). This projected rate of increase is faster than has likely occurred in the last 2000 years (Moberg et al. 2005). This rapid rate of climate change will drive significant changes in natural systems, and challenge the ability of natural resource managers and resource-based communities to adapt.

Implications of Climate Change for BC's Forest and Range Resources

By the end of the 21st Century, the mean annual temperature for western North America could be 2-5 °C above the mean annual temperatures of the last 1000 years (IPCC 2001). An increase in winter precipitation and a decrease in summer precipitation may also occur (AIRG 2005), although precipitation scenarios vary considerably.

These changes will significantly affect forest and range ecosystems and the sectors and communities that rely on them. Projected changes include migration of some species northward and up in elevation, new assemblages of species occurring in space and time, overall loss of biodiversity, and changes in disturbance regimes, forest productivity and hydrology. These changes are expected to have a number of adverse, and in some cases, positive effects on British Columbia's forest and range resources. Forest and range productivity may increase in some areas. However:

- As climate changes, trees may become poorly adapted to the sites they currently occupy, adversely affecting overall forest health and productivity. Climate change may make new geographical locations more suitable for individual tree species. However, seedlings may not become established on newly suitable sites if the sites are too far from the species' current range, or if the seedlings are unable to compete successfully with other species.
- Climate change is also expected to increase the incidence of insect and disease outbreaks, and spread of invasive species. The current mountain pine beetle (MPB) epidemic in British Columbia is caused, in part, by warmer winters (CCIAD 2004). Another possible indicator of climate change is the increased incidence of *Dothistroma* needle blight in lodgepole pine forests (Woods et al 2005).
- Warmer temperatures are expected to increase the frequency and severity of forest-damaging events such as, fires, ice storms, floods and droughts – varying from year-to-year and region-to-region. The large catastrophic fires which occurred in BC's southern interior in 2003 and 2004 have also been attributed, in part, to warmer than usual summer temperatures and extended drought (CCIAD 2004)
- Warmer winters may reduce the length of the winter logging season, and forests could be closed in summer more often due to drought and fire risk. Roads, bridges and culverts will also be affected due to changes in precipitation and soil hydrology, increased storm frequency, earlier snow melt, and the melting of permafrost in northern regions (Spittlehouse and Stewart 2003).

While the potential risks of a changing climate may significantly outweigh the benefits, there are a number of opportunities available that could minimize the impacts and improve results if we act now. These include, for example:

- facilitated migration of species and populations to capitalize on the warmer climates anticipated;
- managing for diversity to increase resilience to biotic and abiotic influences; and,
- reducing costs and exposure through wiser and more efficient investment.

The ratio of risks to opportunities may be influenced by the rate and degree of climate change. The IPCC Third Assessment Report (2001) and the report from the recent Exeter conference on Avoiding Dangerous Climate Change noted that a global temperature increase of 1 degree C may benefit a few regions (e.g. high latitude areas) and sectors (e.g. agriculture). The Exeter conference also noted that the literature suggests increasing damage if the globe warms about 1 to 3 degrees C above current levels, and that "the world will, in the absence of urgent and strenuous mitigation actions in the next 20 years, almost certainly be committed to a temperature rise of between about 0.5 degrees and 2 degrees C relative to today by 2050."

The biophysical effects of climate change will have numerous corresponding and inter-related socio-economic effects. Throughout Canadian forests, many communities are heavily reliant on the forest sector market economy. Increased fire and pests, along with inability of trees to adapt to the new climate regime may result in a reduction in timber supply, which would have wide-ranging effects on local industries and communities. Effects will also extend to the provincial and federal government levels, where the revenues from taxes and resource rents provide the basis of program and service provision. In addition to those benefits captured by the market system, non-market forest values, including aesthetic, cultural, and heritage values, will also be affected. (Ohlson et al 2005).

Parks and protected areas, which provide valued recreation opportunities and serve important conservation and heritage aims, may face particular challenges if the maintenance of native species and ecosystems is not possible in their current locations (Scott et al. 2002). Perhaps most overlooked are the potential effects on the ecosystem services provided by Canada's forests, including air and water purification, wildlife habitat, medicinal plants, nutrient cycling, and erosion control.

Preparing for Climate Change

Given the reality of climate change and the apparent vulnerability of forests, forest resource users, and communities, it is prudent that forest managers and forest-based community leaders begin to develop adaptive strategies to minimize the risks and maximize the benefits of climate change (Spittlehouse and Stewart 2003, Standing Committee on Agriculture and Forestry 2003).

Adaptation to climate change can be either reactive (responding after the fact to climate change) or proactive (preparing in advance). In many cases, it will be acceptable to 'react' to climate change through ongoing small adjustments (adaptive management). In other cases (e.g. species and seed selection) there will likely be benefits in taking a proactive approach. Because of the uncertainty about many aspects of future climate and its impacts, adaptation measures should ideally convey benefits now as well as (potentially) in the future. For example, the "fire smart" initiative addresses existing as well as potential future risks of forest fire to communities.

The large scale of B.C.'s forested land base means that much of the forest will have to adjust autonomously to climate change without human intervention. Human adaptation efforts will have to focus on the major commercial tree species and perhaps a few animal

species, while the majority of forest plants and animals will adjust on their own (Spittlehouse 2005).

The MoFR is charged with managing, protecting and conserving the forest and range resources of the province. Climate change adds another layer of complexity to these management responsibilities. There are two broad challenges for the MoFR: how to manage standing forests to ensure they continue to provide during the decades of change to come the goods and services that BC relies on; and how to design and manage future forests that are suited to the climate and other conditions of the future.

The MoFR participated in the development of the provincial plan, Weather, Climate and the Future: BC's Plan, and is the lead agency for implementation of seven forest-related climate change actions. These actions include: incorporating carbon management into forest management objectives, modelling and protecting incremental forest sinks, developing mitigation strategies and limiting the socio-economic costs of the mountain pine beetle, and improving fire protection for communities.

The provincial plan also sets out a number of foundation actions to be implemented across government, including MoFR. These actions are designed to increase overall provincial capacity to prepare for climate change and its impacts, and include: addressing climate change in planning and operations, implementing effective monitoring and reporting procedures, developing climate models and other tools for assessing risks and adaptation options, supporting applied research and developing capacity throughout B.C. to respond to extreme weather and climate change.

In addition to the actions identified in the provincial climate plan, the MoFR is undertaking other initiatives to prepare for the potential impacts of climate change. These activities include the development of fuel management strategies, climate based seed planning zones, climate profiles for provenances and species, and high spatial resolution climate data for climate change analysis. MoFR is also working with BIOCAP Canada Foundation to support a wide range of university research projects dealing with climate change, carbon sequestration and alternatives to fossil fuels

Conclusions and Recommendations

Climate change represents a very significant risk to B.C.'s forest and range resources. Preparing for this risk will require a long-term, sustained response that includes:

- (1) a comprehensive assessment of the potential impacts of climate change on MoFR and BC's forest and range resources and operations, and the vulnerability of forest- and range-based communities to these changes;
- (2) further research on the impacts of climate change in key risk areas, in cooperation with universities and the federal government,
- (3) the development of tools to support adaptation strategies, including climate scenarios, case studies, and decision-making frameworks,

- (4) communication, consultation and awareness raising to ensure that forest and range managers, industry and communities have the information and tools to enable them to prepare for climate change, and
- (5) program-specific management strategies to address key vulnerabilities and program areas – including both short and long-term actions.

While long-term efforts are required in many areas, a number of short-term actions could be undertaken that will allow the MoFR to proactively respond to the potential risks and opportunities of climate change, and support the development of an overall ‘future focused’ forest and range strategy. Such short-term actions should be low risk options that would provide benefits to British Columbians irrespective of magnitude and timing of climate change.

These short-term actions should also serve to:

- complement the Future Forest Ecosystem initiative,
- build on work initiated from the recently completed review of tree species management in mountain pine beetle impacted TSAs,
- increase understanding of climate change and its potential impacts as the basis for undertaking further analysis, strategy development and action, and
- build capacity within the MoFR to respond proactively to the risk of climate change.

The following are recommendations for possible short-term actions the MoFR could undertake. These recommendations should be considered in the context of other ministry initiatives, priorities and resource commitments.

The recommendations are grouped into three main strategies:

- A. Improving knowledge through analysis and research
- B. Reviewing operational policies and practices
- C. Building awareness and capacity within and outside the ministry

A. Improving knowledge through analysis and research

Recommendation 1. Undertake comprehensive assessments of the potential impacts of climate change on BC’s forest and range resources and operations, forest- and range-based communities, and the MoFR. These analyses will identify those resources, regions, and sectors most at risk, which will then help to prioritize further research, analysis, and action.

Recommendation 2. Evaluate various climate and biogeoclimatic (BEC) unit models for projecting future climate and its impacts. This analysis would determine

which models and methods are the most appropriate for projecting the range of plausible changes to BC's ecosystems and climate zones based on data from various global circulation and regional climate models. These maps, with appropriate policies, guidance documents and training, could then be used to inform forest and range management decisions, such as species selection choices, forest health and protection strategies, road and bridge design, and timber supply.

Recommendation 3. Evaluate the adequacy of existing environmental and biological monitoring networks for tracking the impacts of climate change on forest ecosystems, identify inadequacies and gaps in these networks and identify options to address them. This work should be undertaken in cooperation with other provincial agencies involved in monitoring, such as the Ministry of Environment (MoE).

Recommendation 4. Range - Undertake further research, analysis and monitoring related to range management in BC to increase understanding of species shifts in response to climate change. This could include a gap analysis for the range reference program to identify areas or BEC zones that require range reference sites to monitor species shifts, and a gap analysis correlating climate data with the movement of invasive species.

Recommendation 5. Design and establish a long-term multi-species/seedlot trial to test improved genotypes across a diverse array of climatic and latitudinal environments. This study will assist in identifying which species and seedlots will maintain or enhance forest productivity and health under a range of future climates.

Recommendation 6. Undertake an analysis of the potential impacts of climate change on timber supply under alternative species choices. This is a short-term action that will facilitate the longer-term development of a conceptual model for assessing the impacts of climate change on forest values more broadly, and of policy and management options for responding to climate change.

B. Reviewing operational policies and practices

Recommendation 7. Examine opportunities and barriers for increasing species and genetic diversity in plantations. Increased species and genetic (seedlot) diversity in plantations and across the landscape can serve to increase the resilience of forests to changes to climate, forest pests and diseases. This recommendation should be explored further under the auspices of the Future Forests Ecosystem initiative.

Recommendation 8. Examine options for modifying seed transfer limits and systems. Adjustments to the elevational and latitudinal transfer limits of tree species may be warranted to help ensure that planted trees are adapted to future climates. A range of seed transfer systems should be explored with attention to the biological risks and benefits, and policy, operational and cost implications.

Recommendation 9. Examine alternative systems for species selection to ensure that trees will be adapted to future climate. Planting species adapted to future climate

projections may significantly reduce the risk of trees being poorly adapted to the changing climate in the last 2 or 3 decades of their rotation. Future climate maps could be used to facilitate the migration of tree species to areas, but policy and operational issues will require significant consideration and discussion.

Recommendation 10. Conduct an assessment of greenhouse gas emissions produced by the MoFR’s internal operations, and work with other agencies to create incentives and remove barriers to reducing MoFR emissions. This analysis could be undertaken in collaboration with MoE and the Ministry of Finance.

C. Building awareness and capacity within and outside the ministry

Recommendation 11. Fire Protection – Inform the public, industry and other agencies of the potential impact of climate change on the fire regime in the province and continue to encourage pro-active actions in regard to fuels management and community protection. These actions can in time be incorporated into the new provincial fire management strategy that is currently under development. This recommendation encompasses the ongoing fuels management initiative guided by the Protection Program and involving the active participation of other agencies (e.g. UBCM). Activity around the information component has been limited to date, but will increase as more knowledge of the potential changes and their impacts is acquired.

Recommendation 12. Increase awareness and understanding of climate change impacts and issues by developing and implementing a climate change communications strategy. Increased awareness of climate change is a pre-requisite for engaging MoFR staff, stakeholders and communities in assessing risks and vulnerabilities to climate change, and, eventually, incorporating these considerations into policies, plans and practices. The strategy should be developed and implemented in collaboration with MoE.

Recommendation 13. Support the implementation and coordination of climate change initiatives across the MoFR and the development of a community of practice. Climate change issues cut across the MoFR. Proper resourcing and coordination are required to ensure that the approved recommendations from this report are implemented and that networks are developed and sustained. This structure should include an executive sponsor, FTE(s) and resources, with appropriate reporting relationships and links to relevant MoFR business areas.

These recommendations do not cover the full range of options presented in the report. Further analysis and discussion of the other possible short- and long-term actions identified in the report should take place, in association with the Future Forest Ecosystems initiative and other MoFR and provincial programs. These actions should be examined through environmental, social and economic lenses, in consultation and cooperation with other government agencies, industry, communities and First Nations.