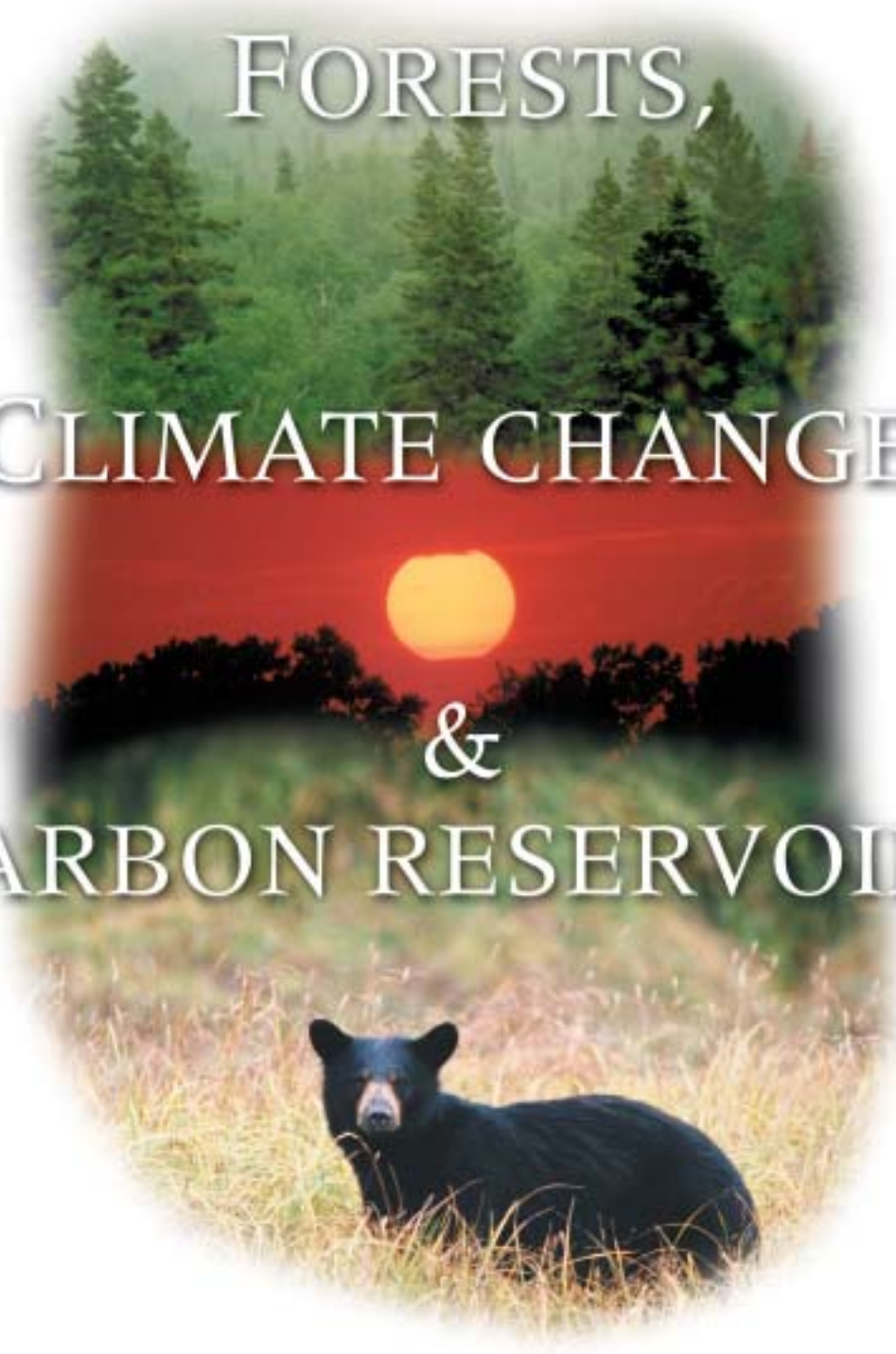
FORESTS, CLIMATE CHANGE & CARBON RESERVOIRS



OPPORTUNITIES FOR FOREST CONSERVATION

SUMMARY

of a Sierra Club of Canada Discussion Paper

September 2003

Sierra Club of Canada / du Canada

Long recognized for their rich biodiversity, Canada's forests cover more than four hundred million hectares, sweeping across the land from Newfoundland and Labrador to the Yukon. Canada's vast boreal forests include some of the most precious large-scale intact forest landscapes that remain on the planet.

There is growing awareness of the need to preserve this rapidly dwindling global treasure. At the same time, the threat of climate change has focused new attention on the world's forests. The global climate is being affected by human activities resulting from the emission into the atmosphere of certain greenhouse gases (GHG), especially carbon compounds such as carbon dioxide (CO_2) and methane (CH_4). The prime source of anthropogenic GHG emissions is the burning of various fossil fuels, although deforestation is also a significant factor.

Forests contribute to climate regulation because of the absorption of carbon from the atmosphere through photosynthesis. When carbon is stored in forests — in living trees, in dead organic matter or in soils and peat lands — it is not in the atmosphere. The circumboreal forests are estimated to hold about half of the planet's terrestrial carbon; more than a third of that is in the Canadian boreal forest. There is an urgent need to explore ways to conserve this huge reservoir of carbon, to enhance it where appropriate, and at the same time to conserve forest biodiversity and intact forest ecosystems.

The discusion paper:

a) Provides an overview of how forests affect and are affected by climate change;

b) Describes how the Kyoto Protocol relates to forests, forest carbon "sinks" and forest management activities;

c) Outlines possible ways that forest carbon can be affected by management activities as a climate change mitigation strategy;

d) Discusses the implications of these measures on forest biodiversity; and

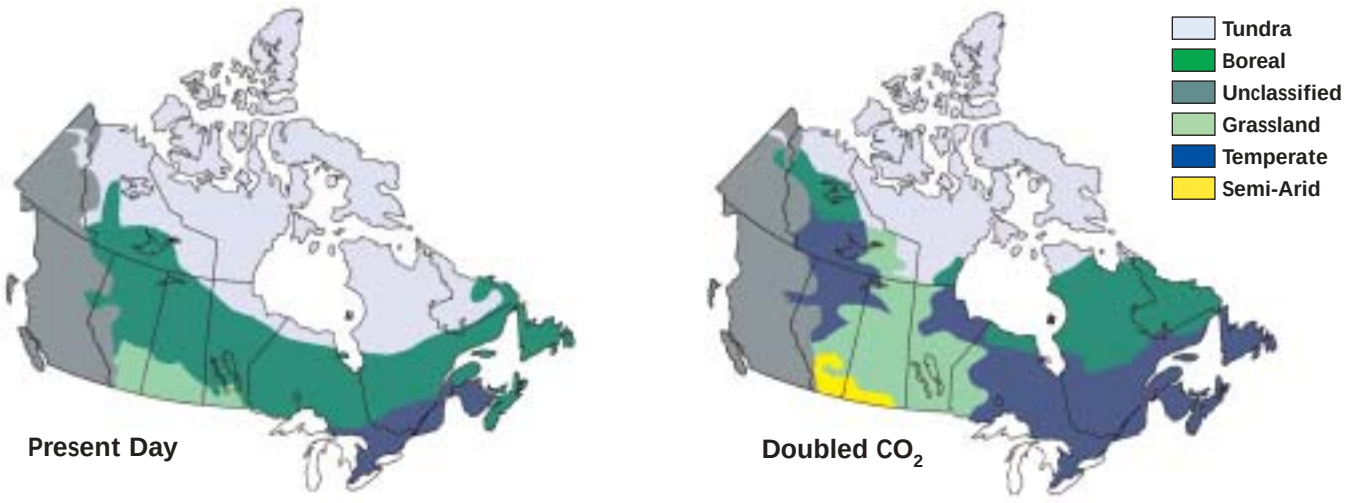
e) Explores opportunities for forest carbon management to benefit forest conservation.

The discussion paper (32 pages including references) is available from the Sierra Club of Canada. It can be downloaded at www.sierraclub.ca. Hard copies are available at a cost of $15 per copy postpaid (foreign orders should submit payment in US dollars), from the Sierra Club of Canada, 1-412 Nicholas Street, Ottawa, Ontario, Canada, K1N-7B7.

A young growing forest is a good carbon sink, but an old forest (with a higher average volume of carbon) is a better carbon reservoir.

Impacts of climate change on forests

The figure below shows the results of one climate change model based on a doubling of atmospheric CO_2. The projected changes show the vegetation types that would be ideally suited to the new climatic conditions. Existing forest types may not necessarily be replaced by land cover better suited to the changed local climate conditions. However shifting climatic zones will cause increased environmental stress that may result in forest loss and even desertification in some regions. Changing climatic conditions are expected to provide new opportunities for insects and diseases that can migrate into new habitat much more rapidly than forests and trees can adapt to them. Many predicted impacts such as drought and extreme weather events may increase the frequency and scale of disturbances such as fire, insects and storm damage.



Projected land cover changes after carbon dioxide doubling (Source: Environment Canada)

Helping forest ecosystems adapt to a changing climate

Forests can't simply pick up and move when the climate moves northward. Over the long term, effective adaptation to climate change will require some plant and animal species to migrate and relocate to more suitable habitat. Since industrial developments and forest fragmentation create barriers that restrict this migration, it will be especially important to establish large intact protected areas in the boreal forest. These protected areas must offer broad opportunities for migration, not simply narrow "corridors." North-south alignment will be crucial, of course, since much of the migration will be northward. But hilly areas are also important, since many species will adapt to the climate crisis by migrating "up-slope" to offset the effects of rising temperature.

SINKS AND RESERVOIRS

A *sink* is a process that absorbs carbon from the atmosphere, such as the growth of a young tree. A *reservoir* is the actual pool of carbon stored in a solid state in forest biomass, dead organic matter or in forest soils and peat lands. A young growing forest is a good carbon sink, but an old forest (with a higher average volume of carbon) is a better carbon reservoir. While the Kyoto Protocol allows for crediting of forest sinks, carbon reservoirs are more important in the long run.

Sinks are only temporary – the trees will eventually be logged or will die from natural causes, resulting in significant emissions. Over the long term an intact and/or carefully managed forested landscape can maintain a significant reservoir of carbon, with growth and losses in approximate equilibrium and the size of the reservoir determined by factors such as the average age of the forest and the scale and intensity of any disturbances.

The Framework Convention on Climate Change and the Kyoto Protocol

The Framework Convention on Climate Change (FCCC) calls for the conservation and enhancement of forest sinks and reservoirs. The Kyoto Protocol, a subsidiary agreement to the FCCC, has among its provisions several that relate to forests: a) a requirement to account for any changes to carbon stocks as a result of afforestation, reforestation and deforestation; b) the option for countries to include in their accounting the positive and negative changes in carbon stocks in the managed forest; and c) provisions to obtain credit for afforestation projects in developing countries. This report is focused on management implications in Canada, and therefore considers only (a) and (b).

Carbon credits

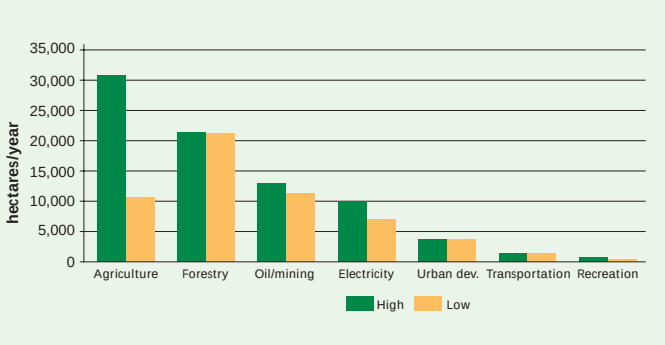
There is keen interest in the trading of carbon credits, or "offsets." The Government of Canada has indicated that it intends to allow for the domestic trading of carbon offsets that are additional to "business as usual." The question is whether it is possible to develop a trading scheme that is credible, fair, politically acceptable and cost-effective. The thorniest questions arise around accounting for the impermanence of forest sinks, the difficulty in establishing a credible baseline against which changes can be measured, assigning liability for debits, and developing practical but credible methods for measuring, monitoring and accounting for carbon stock changes. Potential buyers and sellers of credits want an easily accessible system in which credits are a privately traded commodity while debits remain a public liability; however this system is unlikely to be in the best public interest.

The conversion of intact primary forests to managed secondary forests usually results in a significant loss of carbon.

Can forests and forest management help to mitigate climate change?

A number of forest management activities have been proposed to mitigate climate change. These have associated opportunities, risks and drawbacks, and should be pursued only if they provide long-term benefits both for climate change mitigation as well as the conservation of forest biodiversity. They include:

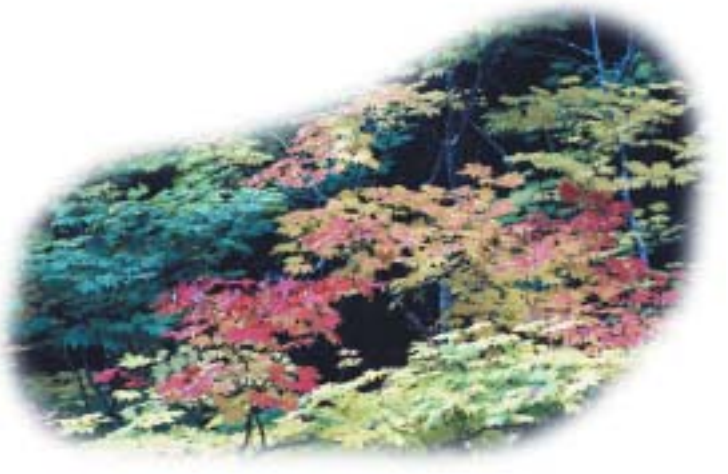
- **Establishing reserves and set-asides.** By avoiding logging in Canada's intact boreal forests it will be possible to avoid the significant losses of carbon that occur as a result of forestry, mining, agriculture and hydroelectric development.
- **Lengthening the rotation age.** In managed secondary forests one of the most effective ways to increase carbon storage is to lengthen the rotation age. This increases the average age of the forest, thereby increasing the size of the carbon reservoir. It also provides significant benefits for biodiversity, since species dependent on old forests are most typically at risk in Canada's forests.
- **Selection logging.** Partial cutting and other careful logging methods can help to increase the amount of biomass left on the site following logging, and can minimize carbon losses due to post-logging soil exposure.
- **Forest restoration and urban forestry.** These activities establish new trees that are typically relatively long-lived and well cared for.
- **Reduce deforestation.** Development activities (agricultural conversion, forestry access, mining and petroleum exploration and development, hydroelectricity projects, etc) deforest approximately 55,000-80,000 hectares annually in Canada. Measures to reduce the extent of deforestation in Canada would have enormous benefit in mitigating climate change as well as conserving forest biodiversity.



Estimated annual deforestation in Canada, by source

Measures in which the risks outweigh the opportunities include:

- Intensive forest management which aims to speed up forest growth usually has a negative impact on biodiversity conservation. The faster growth is generally accompanied by a shorter rotation period, which largely negates any temporary gains in carbon sequestration.
- Fires and insect protection can increases the average age of forest landscapes. However too much fire protection can lead to "fuel loading" and a risk of catastrophic fires, while the use of pesticides tends to be "addictive" since it increases the vulnerability of the stand to future attack.
- Plantations have been promoted for their contribution to carbon storage but they come with significant risks. Plantations should not be considered unless they are situated on deforested or degraded land, use native species, avoid chemical inputs and help to reduce pressure on on natural forests.



The importance of intact boreal forests

In Canada it is the vast and still substantially intact boreal forest that holds the greatest potential for innovative thinking, management strategies and actions to help mitigate climate change. In general, the conversion of primary forests to managed secondary forests results in a loss of ecosystem carbon. This happens because:

a) there is significant deforestation from the creation of a new network of more or less permanent roads;

b) secondary forests are usually managed to a rotation age that is significantly shorter than the natural disturbance interval, meaning that the average age (and volume) of the forest is reduced; and

c) even where the rotation age is similar to the natural disturbance interval (such is in a heavily fire-dominated region) there is still a loss of carbon, because logging preferentially removes high-volume stands whereas fire acts more randomly across the land base, leaving significant pockets of high-volume old growth forests intact.

Reasons to be cautious

Forest carbon management is at best a transition strategy towards permanent solutions to reducing anthropogenic impacts on the climate, and any interest in forest carbon projects must not undermine efforts to effectively address climate change by substantially reducing the consumption of fossil fuels. This will require careful attention to develop an effective policy regime that includes the right incentives and disincentives. Any offset trading regime must be free of perverse incentives if it is to be effective.

PERCENTAGE CHANGE IN CARBON AFTER CONVERTING PRIMARY FORESTS TO MANAGED SECONDARY FORESTS

(Source: Kurz *et al* 1998)

Landscape	Natural Disturbance Interval	Harvest cycle (rotation age)	Percentage change in ecosystem carbon on managed landscape after 200 years
B.C. Interior	100 years	100 years	-25.1
Boreal	120 years	120 years	-12.1
B.C. Coastal	400 years	100 years	-50.6

The above results were derived from the carbon budget model developed by the Canadian Forest Service. None of the scenarios include consideration of the carbon lost as a result of deforestation for the construction of roads and landings. Furthermore, the scenarios for the BC Interior and boreal forests presume that the rotation age is the same as the natural disturbance interval, although in practice the rotation age is usually significantly shorter. Inclusion of these considerations would increase the loss of carbon in the transition to a managed forest.

CONCLUSIONS

Forests, climate change and the need for effective action

Impacts of climate change on forests and forest health can be expected to be significant, and in some regions severe.

There is an urgent need for effective action to address climate change.

Forest carbon measures must not undermine efforts to achieve significant reductions in greenhouse gas emissions.

The importance of intact forest landscapes

The value of intact old growth and boreal forests in mitigating climate change should be adequately recognized.

Old forests store greater volumes of carbon than young forests.

Large undisturbed forests are vitally important to support forest adaptation.

Logging or other industrial activities carried out in intact forests can reduce the amount of carbon stored in forests, resulting in additional emissions of carbon into the atmosphere.

A potential role for enlightened forest management

Forest management activities aimed at enhancing carbon sequestration can have negative impacts on climate change, forest biodiversity or both.

Forest management activities can under certain circumstances have positive impacts on both climate change mitigation as well as forest biodiversity.

Strategies to manage forests to mitigate climate change should focus on the long-term benefits of carbon reservoirs.

The Kyoto Protocol and policies needed to implement it effectively in Canada

The Kyoto Protocol must enter into force.

There must be effective international as well as domestic guidelines to protect forest biodiversity.

National accounting must be rigorous, transparent and independently verifiable.

Canada must decide whether or not to include forest management in its Kyoto Protocol accounting framework.

Canada must decide on the rules governing any offset trading scheme.

There should be a review to evaluate the advisability of proceeding with an offset trading regime.

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