Climate Change Impacts and Adaptation in **Ontario's Forestry Sector**

Introduction

Ontario's forests are feeling the effects of a warming climate. Ontario's landscape is 66 percent forested, accounting for over a quarter of Canada's forests[1]. Four broad forest regions exist in Ontario: deciduous, Great Lakes-St Lawrence, the Hudson Bay lowlands, and the Boreal[1,2].

Ontario's boreal forest is the largest forest region in Ontario and Canada (Image: Ontario Government, 2017)

Ontario's forest industry is a key component of the provincial economy. The industry contributes over $12 billion to Ontario economy and supports approximately 150,000 direct and indirect jobs.[3] In 2014, over $5.2 billion of forest products were exported from Ontario[3]. In addition to direct economic benefits, these forest ecosystems provide a myriad of social, health, and ecological benefits important for Ontarians, including recreational opportunities. Ontario's forests also play a key role in fighting climate change: forests help reduce Ontario's total greenhouse gas emissions by removing and sequestering carbon from the atmosphere, or forest products can be used as a renewable energy source.

A warming climate will have broad and far-reaching implications for Ontario's forests, including both disturbances (insects, disease, fire, and wind) and biotic responses (physiology, genetics and plant succession). Furthermore, the pace of climate change is likely to exceed the natural ability of forests to adapt, requiring changes to how forests are managed[4]. Planned forest adaptation will be needed to sustain the current level of goods and services provided by Ontario's forests, and to maintain the competitiveness of Ontario's forest sector.

Climate Change and Forests

Impacts already observed

Climate change is already having an effect on Ontario's forests. The most visible climate-related impacts are the changes in disturbance regimes, such as fire and pest outbreaks. As a result of warmer winter temperatures, shifts in the timing of insect outbreaks have been observed, such as the Emerald Ash Borer – a wood boring invasive species of insect that has spread northward from Michigan to southern Ontario, which is estimated will cost

Canadian municipalities $2 billion over a 30-year period[5]. More subtle impacts have also been observed, such as lengthening of the growing season, increased area burned by forest fires, and changes in tree species composition, phenology, and productivity[6]. Since 1963, the length of the fire season has increased by up to 8 days in many of Ontario's boreal forest ecosystems[7].

Emerald Ash Borer is an invasive species responsible for damaging ash trees in Ontario (Image: Canadian Food Inspection Agency)

Projected impacts

Increasing temperatures and changes in precipitation are expected to continue[8]. Climate models examining diverse scenarios, show that average annual air temperature in Ontario could increase between 3.0 and 4.0°C by the 2050's, and annual precipitation levels could increase by 240mm, if global emissions aren't rapidly decreased[8,9].

These projected changes in climate are expected to affect forests in many ways. Long-term changes in temperature and precipitation patterns will alter evapotranspiration rates, water availability, the length of growing season, and changes in the seasonality of wildland fire[10]. Extreme climate events such as drought will affect forest composition, with recurrent moisture deficits favouring drought-tolerant species at the expense of species such as black spruce and balsam fir. Projected warming may also aid in the spread of invasive pests; presently limited to British Columbia and Northern Alberta, warming temperatures could see potential arrival of the mountain pine beetle in Ontario by mid-century[7]. In addition to changes to the forest and species, increases in extreme rain and wind events as well as increased forest fire severity may lead to infrastructure damage, disruptions for forestry operations and related industries (e.g. mills, maple syrup production, transportation routes), and potential hazards for worker and community health and safety[11]. As a result of climate change, traditional forest management practices may become less effective at meeting future forest management objectives.

Addressing Climate Change

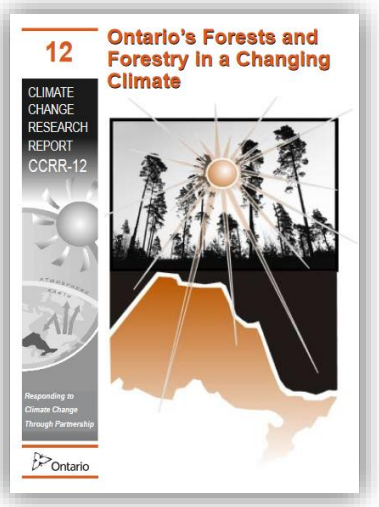
Over 40% of Ontario's forests are managed. Climate change has important implications for the management of these lands. Adaptation measures can help reduce the vulnerability of Ontario's forests and the forestry sector. Knowledge of climate change impacts can be incorporate throughout the planning cycle; early adaptation offers the potential to both minimize negative impacts, as well as maximize opportunities associated with a changing climate[12]. For example, timber management policies can be modified to make the most of tree species that are projected to experience an increase in forest growth productivity. Adaptation initiatives can also contribute to Ontario's greenhouse gas reduction goals: healthy, sustainable forests capture and sequester carbon, and urban forests reduce impact of urban heat waves and conserve energy required for building air conditioning.

"Consideration of climate change and future climatic variability is needed in all aspects of sustainable forest management."

- "A Vision for Canada's Forests: 2008 and Beyond", The Canadian Council of Forest Ministers (CCFM)

Other adaptation efforts that could reduce vulnerability include[12]:

- Integrate climate change throughout the forestry life cycle, including planning, reforestation, stand tending, and harvesting;
- Develop climate-based seed selection systems for reforestation;
- Promote inherent resilience and ecological integrity to minimize losses from climate change-induced disturbances; and
- Adopt climate-sensitive sustainable forest management best practices.



MNRF has produced over 150 reports and scientific publications related to climate change.

As the agency responsible for managing Ontario's forests, the Ministry of Natural Resources and Forestry (MNRF) collaborates with other agencies and partners (e.g., Canadian Forest Service and the Canadian Council of Forest Ministers) on research studies and projects to help understand climate change and its effect on the environment. The Ministry is helping Ontario's forests adapt to climate change by:

- Reviewing forest legislation and policy to determine if and how it can be enhanced;
- Developing methods for assessing the vulnerability of forests;
- Incorporating climate change considerations into forest management planning revising manuals, guides and plans to provide new direction as new evidence becomes available; and more.

Climate change impacts extend beyond those direct related to tree species. They can also affect direct and indirect impacts on forest landscapes, the forest sector, forest management objectives, and various forest-based communities. Therefore, a comprehensive approach through adaptation planning activities is needed to maintain and enhance the long-term health of Ontario's forested ecosystems while providing ecological, economic, cultural, and social opportunities for present and future generations[12].

Climate Change Adaptation Resources

Natural Resource Canada's Adaptation Platform is a unique online resource of tools and information that members of the forestry sector can use to support their efforts to adapt to a changing climate. Led by the Climate Change Impacts and Adaptation Division (CCIAD), the Adaptation Platform is a national forum that brings together key Working Groups to collaborate on various climate change adaptation priorities and to produce project-level research and activities. Chaired by the Canadian Forest Service at NRCan, the Forestry Working Group addresses the adaptation of sustainable forest management to changing climatic conditions.

How can the adaptation platform products help?

The following is a sample of resources available on the platform that members of the forestry sector can utilize in their efforts to prepare for a changing climate:

Product: **Compendium of Forestry Adaptation Initiatives across Canada**

Description: The Forestry Adaptation Community of Practice (FACoP) was developed to provide a centralized collection of information on current or recent forestry adaptation initiatives across Canada. The site includes projects, case studies, research papers, policy initiatives, and forestry management practices that are focused on advancing forestry adaptation to climate change. This type of knowledge will be a great resource for everyone within the area of adaptation and can help advance our understanding of forestry adaptation across Canada.

Product: **Research and Analysis of Monitoring and Evaluation Programs as Analogues for Climate Change Adaptation Measurement**

Description: With the goal of informing the development of adaptation measurement programs in Canada, this report provides insights on successful monitoring and evaluation program components that are transferable to sustainable forest management. This research includes an in-depth analysis of the Forest and Range Evaluation Program (FREP) - a provincially-run program in British Columbia designed to monitor and evaluate the implementation and effectiveness of forest and range practices throughout the province in meeting government objectives for sustainable forest management.

For more information, and to view more products through the Adaptation Platform, visit: http://www.nrcan.gc.ca/environment/impacts-adaptation/adaptation-platform/10027

Footnotes

[1] Ontario Government, 2017
[2] Flannigan and Weber, 2000
[3] Ontario Government, 2017
[4] Colombo et al., 1998
[5] NRCan, 2016
[6] Williamson et al., 2009 and Lemmen et al. 2014
[7] Chiotti and Lavender, 2008
[8] McDermid, Fera and Hogg, 2015
[9] CCDS, 2017
[10] Murphy, Chretian and Brown, 2012
[11] Eskelin et al. 2011
[12] Johnston et al., 2009

This information sheet was developed by the Ontario Centre for Climate Impacts and Adaptation Resources (OCCIAR) with federal funding support through Natural Resources Canada's Regional Adaptation Collaboratives Program.

www.ClimateOntario.ca

Natural Resources Canada | Ressources naturelles Canada
Canada

MIRARCO/Laurentian University
935 Ramsey Lake Road
Sudbury, ON P3E 2C6
P: 705 675 1151

OCCIAR
Ontario Centre for Climate Impacts and Adaptation Resources

Full References

Chiotti, Q. and B. Lavender. 2008. Ontario; in From Impacts to Adaptation: Canada in a Changing Climate 2007, edited by D.S. Lemmen, F.J. Warren, J. Lacroix and E. Bush; Government of Canada, Ottawa, ON, p. 227-27

CCDS [Canadian Climate Data and Scenarios]. 2017. 2050s Ensemble Scenarios. RCP8.5 in 2046-2065: relative to 1986-2005, 50th percentile of the distribution of the CMIP5 ensemble. Canadian Climate Change Scenarios Network. Available at: http://www.cccsn.ec.gc.ca/?page=ensemblescenarios-2050s

Eskelin, N., Parker, W.C., Colombo, S.J. and Lu, P. 2011. Assessing assisted migration as a climate change adaptation strategy for Ontario's forests: Project overview and bibliography. Climate Change Research Report CCRR#19, Ministry of Natural Resources, Sault Ste. Marie, Ontario. 44p. Available at: http://www.climateontario.ca/MNR_Publications/stdprod_088019.pdf

Flannigan, M.D., and M.G. Weber. 2000. Influences of climate on Ontario forests. Pages 103-114 in A.H. Perera, D.L. Euler, and I.D. Thompson, editors. Ecology of a managed terrestrial landscape: patterns and processes of forest landscapes in Ontario. UBC Press, Vancouver British Columbia.

Johnston, M.H., M. Campagna, P.A. Gray, H.H. Kope, J.A. Loo, A.E. Ogden, G.A. O'Neill, D.T. Price and T.B. Williamson. 2009. Vulnerability of Canada's tree species to climate change and management options for adaptation: an overview for policy makers and practitioners. Canadian Council of Forest Ministers, Ottawa, Ontario. 44 p.

McDermid, J., S. Fera and A. Hogg. 2015. Climate change projections for Ontario: An updated synthesis for policymakers and planners. Ontario Ministry of Natural Resources and Forestry, Science and Research Branch, Peterborough, Ontario. Climate Change Research Report CCRR-44.

Murphy, B.L., A.R. Chretien and L.J. Brown. 2012. Non-timber forest products, maple syrup and climate change. The Journal of Rural and Community Development, 7(3), p. 42-64.

NRCan [Natural Resources Canada], 2016. Forests Topics: Emerald Ash Borer. Available at: http://www.nrcan.gc.ca/forests/fire-insects-disturbances/top-insects/13377

Ontario Government. 2017. Managed forests and climate change. Available at: https://www.ontario.ca/page/managed-forests-and-climate-change

Ontario Government. 2017. Forestry facts. Key facts about Ontario's forests. Available at: https://www.ontario.ca/page/forestry-facts

Williamson, T.B., Colombo, S.J., Duinker, P.N., Gray, P.A., Hennessey, R.J., Houle, D., Johnston, M., Ogden, A. and Spittlehouse, D.L. 2009. Climate change and Canada's forests: From impacts to adaptation. Sustainable Forest Management Network and Natural Resources Canada, Canadian Forest Service, Northern Forest Center, Edmonton, Alberta.

Image credits pg 3, pg 4: P.Cobb.