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e-Bulletin

The Great Lakes Forestry Centre (GLFC)

Comings and Goings

Guy Smith retires.

After a 36-year career with the CFS, we wish Guy Smith all the best in his retirement. Most recently, Guy was the Regional Coordinator for the Canadian Wood Fibre Centre. Before his retirement, Guy gave a seminar entitled "Everyday Innovation – 36 years with the Canadian Forest Service", which is available to watch on GLFC's Facebook page.

Floods, Droughts and the 2 Billion Trees Program

Dr. Jason Leach, research scientist in forest ecohydrology at GLFC, gave a presentation as part of the CIF-IFC national e-lecture series 'Sharing Research Knowledge to Support the 2 Billion Trees Program'.

The presentation highlighted work conducted by Jason and his colleague, Danielle Hudson (GLFC), that synthesizes our understanding on how large-scale tree planting programs can modify the water cycle and alter flood and drought risks. Trees play a critical role in the global hydrologic cycle by regulating how much rainfall and snowmelt is evaporated and transpired back to the atmospheric or delivered as runoff to streams and rivers. Numerous studies have suggested that large-scale tree planting programs can threaten water resources by reducing the amount of water in streams and rivers; however, much of this research is from arid environments, such as China and Australia. In contrast, we know little about how afforestation might impact water resources in wetter environments, such as Canada, where snow is an important part of the water cycle. Jason presented some hypotheses on how planting two billion trees throughout Canada might affect our water resources, but stressed that we need more scientific investigations to help inform tree planting efforts so that they benefit our fight against climate change, as well as ensuring water security for Canadians, now and in the future. He ended his presentation by highlighting some new CFS research projects that help address these questions.

A video and pdf of the lecture is available on the CIF website. For more information contact Jason Leach.

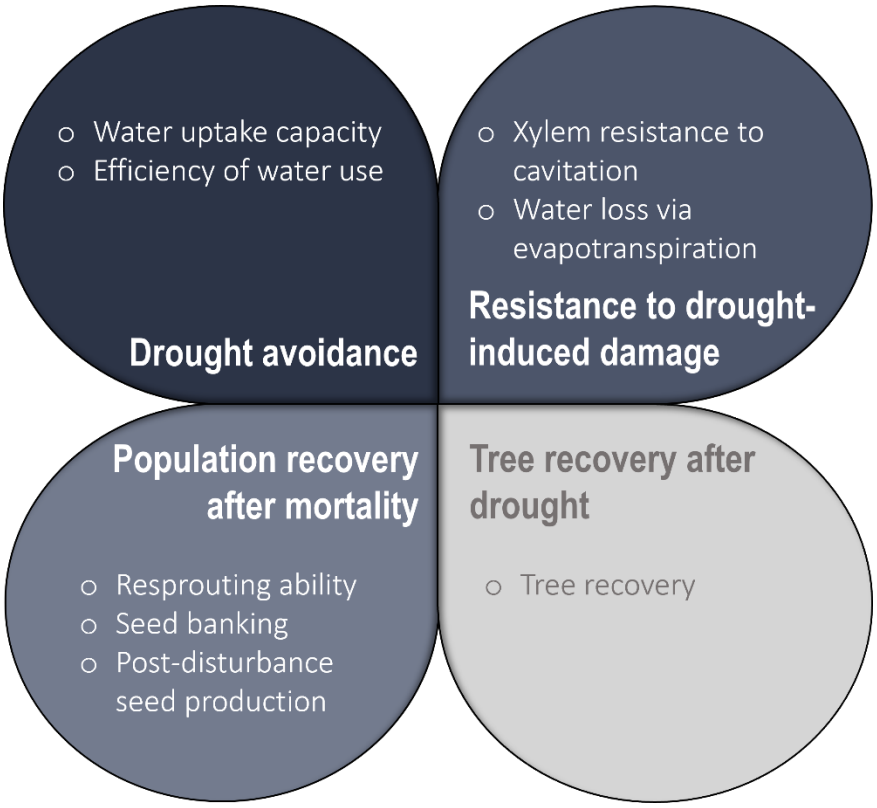
New tool provides insight into Canadian tree species' sensitivities to climate change

Drs. Isabelle Aubin and Laura Boisvert-Marsh have developed a data visualization tool to assist forest practitioners with climate change adaptation decision-making.

Projected changes in climate conditions over the next century vary widely across Canada, and so does the capacity of tree species to cope. However, not all species will react equally in the face of rapid environmental change. As part of a research project within the Forest Change program led by Drs. Isabelle Aubin and Laura Boisvert-Marsh, a data visualization tool was developed in collaboration with the Forest Gene Conservation Association (FGCA, https://fgca.net) to present a series of indices on Canadian tree species' sensitivity to climate change in an interactive way. These ten indices on tree sensitivity to drought, shifts in climatically suitable habitat and increased intensity and frequency of fire were developed based on the various strategies a species can employ, including the ability to tolerate stress, avoid damage or recover after stressor-related impacts.

To increase uptake of these indices amongst practitioners in forest management and conservation, the tool was developed in collaboration with the Forest Gene Conservation Association, an organization specialized in working with forest practitioners on issues such as climate change. These interactive visualizations were created using the Tableau Software, allowing the user to compare the different strategies tree species can employ in the face of climate change stressors. The visualizations are grouped by stressor, and the descriptions and pop-ups provide users with the information necessary to interpret the data provided in the visualizations. The goal of these indices is to assist forest practitioners with climate change adaptation decision-making by identifying species that may require specific management consideration under a changing climate.

These data visualizations are available through the FGCA website and Tableau Public and are based on open data available through the TOPIC network. When using the FCGA website, the user will find links that provide information on increased frequency of drought events, increased fire intensity and frequency and shifts in climatically suitable habitat . On the Tableau Public website, further information is available on drought, fire and shifts in climatically suitable habitat and migration ability.



Example of strategies trees employ to overcome drought stress.

Details on the development of these indices can be found in the scientific publication: "Using a Trait-Based Approach to Compare Tree Species Sensitivity to Climate Change Stressors in eastern Canada and Inform Adaptation Practices." For more information about the data visualization tool, contact Dr. Isabelle Aubin.

Protecting Canada's drinking water supplies from forest fires

Dr. François-Nicolas Robinne has worked on the Canada Source Watershed Polygon dataset, or Can-SWaP, which will be a useful tool for mitigating risks to water supplies during and after forest fires.

Over 80% of domestic (i.e., excluding industrial and agricultural) water use in Canada comes from streams, lakes, and reservoirs. These freshwater bodies and their catchments require adequate protection to secure drinking water supply for Canadians. Many of these catchments are forested and exposed to wildfire hazard, which can adversely affect water availability and water quality; significant changes to water supply post-fire can indeed lead to serious challenges for drinking water providers, potentially for many years. Canada, like most countries, lacks a consolidated national dataset of municipal catchments, arguably due to gaps in data availability.

Can-SWaP was created using point locations of more than 3,000 municipal water licenses defining rights to surface water withdrawal. Where possible, the resulting 1,574 catchments were assessed for accuracy in spatial coverage against provincial and local datasets. Each watershed in Can-SWaP has an estimated water volume used for municipal water purposes

derived from licensing data, and several variables from RiverATLAS for investigating the integrity of drinking water sources in Canada.

This dataset can be used for multiple purposes. The initial intent is to use it to look at changing fire regimes using other NRCan products, but there are many other ways. Before a fire, it can be added to one of the many elements of vulnerability that are essential to the wildfire risk analysis process. During a fire, it might be used to identify those source watersheds that display high fire danger, and thus help firefighters to allocate resources adequately. Finally, at the end of the fire season, Can-SWaP can be used to assess area burned and fire severity in source watersheds. For those watersheds that were heavily impacted, advanced hydrology and erosion tools can be brought in to help evaluate future challenges to downstream water treatment capabilities.

For more information, read the article: A Regional-Scale Index for Assessing the Exposure of Drinking-Water Sources to Wildfires or contact Dr. François-Nicolas Robinne, who is now at the University of Alberta. GLFC contacts include Drs. Jason Leach and Dan Thompson.

WildFireSat: the world's first purpose-built operational satellite system for monitoring wildfires

In the summer of 2022, the Water Innovation Lab held a workshop focussed on the Great Lakes and selected Sault Ste. Marie as a highlight location.

Once operational, WildFireSat will be used to detect and monitor wildland fires in near real-time, providing valuable information to management agencies when they need to make critical decisions on strategic preparedness and priorities.

Managing wildfire is becoming increasingly more complex and we have seen this play out in recent fire seasons, with extreme and less predictable fire behaviour and significant consequences for Canadians. Studies indicate these challenges will worsen with the numbers of fires, severity of burning conditions and area burned predicted to increase dramatically. WildFireSat will help in part to address some of these challenges by proving an unprecedented level of intelligence and situational awareness to the decision-makers at crucial times of the day in near-real time. The mission will also support smoke and air quality monitoring and forecasting, and carbon emission monitoring.

The WildFireSat mission is a collaboration between the Canadian Space Agency, Environment and Climate Change Canada and Natural Resources Canada, where GLFC leads the Canadian Forest Service's role in the mission as well as the User and Science Team.

The requirements for WildFireSat are uniquely driven from direct engagement with the provincial and territorial wildfire management agencies. The Canadian government has also been working with industry for over 10 years to develop the specialized infrared technologies capable of delivering this mission. Examples of the potential products that fire managers will have access to include precision maps of wildfire size, shape and location, the direction of travel and speed of various sections of the fires, estimates of fire intensity, and the likelihood of success of various firefighting methods. WildFireSat products could also help to predict the

estimated arrival time of the fire at adjacent communities, industrial installations, infrastructure, and sites of cultural value. In addition, WildFireSat will provide important data necessary to determine the rate of smoke production, its composition, how high it is travelling into the atmosphere, and where and when it will impact air quality on the ground.

Because the WildFireSat mission has been approached with the decision-makers at the forefront, from initial design to operational use, it ensures fire management agencies are ready to use WildFireSat products as soon as available and serves as an example for future satellite missions. WildFireSat is targeting to be ready for the 2029 fire season. Read the paper on Canadian Fire Management Agency Readiness for WildFireSat: Assessment and Strategies for Enhanced Preparedness or the pamphlet on WildFireSat. Contact Josh Johnston for more information.

The First Public Report of the National Risk Profile recently published

This report is Canada's first strategic, national-level risk assessment. It was published to broaden public awareness of the three costliest hazards facing Canadians: earthquakes, wildland fire, and floods.

The National Risk Profile (NRP) is a federal government initiative that is being developed with provincial, territorial, and expert stakeholder input. GLFC fire researchers Daniel Thompson, Lynn Johnston, Sandy Erni, as well as Francois Robinne contributed to the section on wildfires in this first public report.

The report indicates how the impacts of climate change are causing longer and more intense fire seasons, with costs to the economy in the billions. Efforts are being made to improve Canadians' awareness on how to face wildland fires in their communities, and to help build more resilient infrastructure that can stand up to the effects of wildland fire. However, there remain gaps in public awareness of wildland fires as well as in our ability to respond to wildland fires at the national level. There is also inadequate inclusion of Indigenous knowledge in wildland fire management and response. Work is being undertaken to help identify the landscapes and communities that are at greatest fire risk, and to development operational tools to help make informed decisions on wildland fire management.

Read the full report: "The First Public Report of the National Risk Profile".

Historical review of white spruce research

The first in a series of three Information Reports about white spruce has recently been published, based on the work of the late GLFC scientist Dr. Roy Sutton.

These reports bring together a vast amount of information about white spruce and in part realize Roy's goal of publishing a monograph on this important species. When Roy completed his Ph.D. at Cornell University in 1968, his 500-page thesis focused on the ecology of young white spruce. Part of the thesis included a literature review with the heading "Botanic-Ecologic Review of White Spruce", which was also published the following year by the Federal Forestry Branch as a departmental report under the title "Silvics of White Spruce." The thesis established him as a prominent figure in Canadian silvicultural research. During his long and productive career, Roy continued to devote much of his energy to the problem of white spruce regeneration and to related topics involving root development, site preparation and vegetation management.

Several decades had passed since Roy completed his initial review, so a considerable body of white spruce research had been published in the meanwhile. However, Roy used his Ph.D. work as a foundation to incorporate the new material. In addition to the Information Reports, a considerable amount of material from Roy's review was added to the WIKI page for *Picea glauca.*

The first report: "White Spruce Taxonomy Phylogeny Biosystematics and Plant Geography. A Historical Review" includes a comprehensive review of white spruce genetic variation, population studies, preferred growing conditions, ecological succession, and current distribution. The next two reports in the series will be published at a later date. For more information contact Stan Phippen.

Recent Publications

Allison, J.D.; Marcotte, M.; Noseworthy, M.; Ramsfield, T. 2021. Forest biosecurity in Canada – An integrated multi-agency approach. Frontiers in Forests and Global Change. Volume 4.

de Jong, M.C. and McFayden, C.B. 2023. Wildfires from Space: the end of MODIS Fire Data – An update on the status of the MODIS and WildFireSat missions. Natural Resources Canada, Canadian Forest Service, Sault Ste. Marie, Ontario. Frontline Express 92. 2 p.

de Jong, M.C. and McFayden, C.B. 2023. Wildfires from Space: a synthesis of satellite missions for active fire monitoring. Natural Resources Canada, Canadian Forest Service, Sault Ste. Marie, Ontario. Frontline Express 93. 4 p.

Great Lakes Forestry Centre. 2023. WildFireSat: The world's first purpose-built operational satellite system for monitoring wildfires.

McFayden, C.B.; Hope, E.S.; Boychuk, D.; Johnston, L.M.; Richardson, A.; Coyle, M.; Sloane, M.; Cantin, A.S.; Johnston, J.M.; Lynham, T.J. 2023. Canadian fire management agency readiness for WildFireSat: Assessment and strategies for enhanced preparedness. Fire 6(2):73.

McFayden, C.B.; Wotton,B.M.; Robinson, J.W.; Johnston,J.M.; Cantin, A.; Jurko, N.M.; Boucher, J.; Wheatley, M.; Ansell, M.; Boychuk, D.; Russo B. 2023. Reference Guide to the Drop Effectiveness of Skimmer and Rotary Wing Airtankers. Natural Resources Canada, Canadian Forest Service, Great Lakes Forestry Centre. Information Report GLC-X-35. 144 p.

Sutton, R.F., Haddon, B.; Jamieson, K.B.; Jamieson, D.; Ortiz, F.M.; Phippen, S.V. (eds.) 2023. White spruce taxonomy, phylogeny, biosystematics and plant geography, a historical review. Natural Resources Canada, Canadian Forest Service, Great Lakes Forestry Centre. Information Report GLC-X-32. 144 p.

Venier, L.A.; Pedlar, J.H.; Higgins, K.; Lawrence, K.; Walton, R.; Boulanger, Y.; McKenney, D.W. 2022. Size requirements of intact forest landscapes for effective biodiversity conservation under regional fire regimes and climate change. Biological Conservation. Vol 276.