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The Great Lakes Forestry Centre (GLFC)

Comings and Goings

We say farewell to Maureen McIlwrick.

Maureen McIlwrick is retiring from her role as Regional Liaison Officer. Maureen has been with CFS-GLFC for approximately 23 years. Her career began with the Tree Plan Canada Program and then evolved into working with Indigenous communities across Ontario delivering, leading and at times, managing a variety of Federal Forestry Economic Development Programs until 2021. We wish her all the best in her retirement.

Summary of over 40 years of research on the Turkey Lakes Watershed

A compendium of experimental sites and scientific Investigations in the Turkey Lakes Watershed was recently published in the form of a GLFC Information Report. The report was compiled by Dr. Kara Webster, Dr. Paul Hazlett (retired) and colleagues.

The Turkey Lakes Watershed (TLW) study is a federal, interdepartmental study established in 1979 to investigate the effects of acid rain on terrestrial and aquatic ecosystems. The 10.5 km^2 watershed, located in the Eastern Temperate Mixed Forest on the Canadian Shield, has been the site of multidisciplinary studies on biogeochemical and ecological processes conducted across plot to catchment scales. The whole-ecosystem investigative approach was adopted from the outset and has allowed research to evolve from its original (and continuing) acidification focus to include investigations on the effects of climate change, forest harvesting and other forest ecosystem perturbations. The extensive scientific and support infrastructure allows for collection of a comprehensive data record essential for understanding long-term environmental trends. These data have contributed to over 400 published research papers and graduate theses. The watershed has also figured prominently in many continent-wide comparisons advancing fundamental watershed theory, as well the importance of "uniqueness of place". The knowledge gained at TLW has influenced pollutant emission and natural resource management policies provincially, nationally and internationally. This compendium provides a summary of those investigations, listing publications in 12 different categories: Site Overview, Atmospheric/Meteorology, Vegetation - Forest/Understory, Soils, Hydrology – Soil Water/Ground Water, Hydrology – Streams, Hydrology – Lakes, Water Birds, Fish and Aquatic Communities, Modelling and Remote Sensing, Internal Reports.

Read the full article “A Compendium of Experimental Sites and Scientific Investigations in the Turkey Lakes Watershed” or contact Kara Webster.

Expanding the portfolio of climate change adaptation options

GLFC's Dr. Isabelle Aubin, Dr. Samuel Royer-Tardif and collaborators recently published an article that presents a portfolio of forest management options that considers both forest management objectives with assessments of forest vulnerability to climate change.

Forests are important for the Canadian economy and for society, but climate change is affecting our ability to manage forest ecosystems sustainably. Direct impacts, such as changing temperature and precipitation patterns, and indirect effects, such as increased frequency and severity of climate-related disturbances like fires, drought, pests and pathogens, can all interact to affect the growth, health and survival of forests. These factors and the uncertainty associated with their timing and impacts make it difficult for forest managers to evaluate and select which management options achieve their desired goals while maintaining biological and ecological integrity of the forests they manage.

In this paper, Drs. Aubin and Royer-Tardif and their collaborators propose a framework that expands the possible forest adaptation actions when faced with climate change and its impacts. Following a functional zoning approach, an approach that employs adaptation actions of varying intensity in different areas of the forest, they argue that selecting which actions are appropriate should be based on the management objective (e.g., conservation, multifunctional forestry vs. high yield plantations) and forest vulnerability to climate change. Such actions could include low intervention scenarios where forests are expected to be less impacted by climate change, such as establishing ecological reserves in climate refugia. On the other hand, high-yield, short rotation plantations, such as plantations of fast-growing hybrid poplar, could be established in areas where climate-related loss of forest ecosystems is projected. In between these two extremes, ecosystem-based forestry integrating recent advances in sustainable forestry and ecosystem functioning could be applied depending on forest vulnerability. This work highlights that managing forests sustainably under climate change is a challenge and that implementation of adaptation actions across the landscape requires good communication among stakeholders and with the public.

Read the full article: "Revisiting the Functional Zoning Concept under Climate Change to Expand the Portfolio of Adaptation Options" or contact Isabelle Aubin.

Using simulation modelling to estimate the probability of fire spread

Dr. Denys Yemshanov and colleagues developed an optimization model to plan wildfire fuel treatments to minimize the risk of fire spread in forested landscapes.

Although wildfires are an important ecological process in forested regions worldwide, they can cause significant economic damage and frequently create widespread health impacts. Land management agencies invest significant resources into the prevention and suppression of wildfires and the costs are increasing. One way to reduce these costs is through the effective implementation of prescribed burns and other wildfire fuel treatments, which can help reduce the size and intensity of forest fires, as well as the spread of large wildfires. However, fuel treatments are costly and can be difficult to plan effectively in complex (e.g., mountainous) landscapes.

In this study, the researchers used fire behavior simulation modelling to estimate the probability of fire spread between all pairs of forest sites and formulated a modified Critical Node Detection (CND) model to find a pattern of fuel reduction treatments that minimizes the likely spread of fires across a landscape. The approach was demonstrated with a case study in Kootenay National Park, British Columbia, where prescribed burn options for reducing the risk of wildfire spread in the park area were investigated. The results provide new insights into cost-effective planning to mitigate wildfire risk in forest landscapes. The approach should be applicable to other ecosystems with frequent wildfires.

Read the full article on "Detecting critical nodes in forest landscape networks to reduce wildfire spread" or contact Denys Yemshanov.

New Information Reports on fire to update approach to fire danger rating

GLFC recently published two information reports on fire. Report 26: "An overview of the next generation of the Canadian Forest Fire Danger Rating System", was written by the Canadian Forest Service Fire Danger Group, which includes fire researchers from across the Canadian Forest Service (CFS) including GLFC. The principal author of Report 29: "An approach for defining physically based fire weather index system classes for Ontario" is Chelene Hanes. The work was conducted in collaboration with the Ontario Ministry of Northern Development, Mines, Natural Resources and Forestry and colleagues from GLFC.

Every day of the fire season across Canada wildland fire managers rely on the Canadian Forest Fire Danger Rating System (CFFDRS) to provide them with an understanding of the potential for fires to start and spread. This system has evolved over more than eight decades through a comprehensive research program aimed at developing models that can be used to inform decision-making needs of wildland fire management operations in Canada. The core parts of the CFFDRS have not been updated in decades, while the complexity of fire management decision-making is increasing. This document provides a high-level overview of the CFS research and development program focused on producing the next generation of the CFFDRS. This new CFFDRS represents only the next evolutionary step for the system and is not an end point in its development. Furthermore, what is described is a vision for what we hope to complete, document and to begin implementing with fire management agencies by 2025. Read the full Overview of the next generation of the Canadian Forest Fire Danger Rating System.

The Canadian Fire Weather Index (FWI) was introduced nationally in 1969 as a system of codes and indices based on four weather observations (temperature, relative humidity, wind speed, precipitation). These codes and indices are commonly interpreted and communicated using a classification system (e.g., Low, Moderate, High, Extreme) by fire management agencies. The original classes for the FWI system were determined assuming a small number of the "worst" days in the fire season should be classified as Extreme and most of the days classified as Low. Using Ontario as an example, this information report introduces an approach to update the way FWI system classes are determined by associating one important characteristic of wildland fire (for example, rate of spread) to each code and index. The report compares these two approaches using twenty-eight years of historical weather and fire records. Read the report: An approach for defining physically based Fire Weather Index System classes for Ontario.

Plant traits as indicators of recovery of reclaimed well sites in boreal forest and grasslands habitats

In two recent journal articles, GLFC's Isabelle Aubin and Kierann Santala explored the use of plant functional traits as a way to track the recovery of reclaimed well pad sites in Grassland and Boreal Forest Ecosystems of Alberta.

Oil and gas well pads established during the development of energy resources are estimated to have a footprint that covers over 630,000 ha of Alberta's landscape. Reclamation of these sites is a critical step in alleviating impacts of the industrial human footprint. Approximately 130,000 well pads representing over 130,000 ha of land have been certified as reclaimed since 1963 in Alberta. However, there is a concern that resource development will have long-lasting legacy effects on soil, biological, and spatial characteristics of ecosystems.

In these studies, the long-term recovery of taxonomic and functional composition (i.e. trait values) of plant communities on reclaimed sites was studied and compared to adjacent undisturbed reference sites to determine factors controlling their recovery. Functional traits are morphological, physiological, and phenological attributes that determine an organism's functional response to a given environmental filter. Functional composition was found to change towards that observed in reference sites over time, but older reclaimed sites in both forested and grassland systems were dominated by species associated with fast-resource acquisition traits and exotic species. In the well pads study within grasslands ecosystems researchers found that sites more recently reclaimed included higher prevalence of tall, native species preferring hydric conditions, and species with low dispersal capacity. This is consistent with shifts in reclamation practices within this region, which now emphasise the use of native plant species in place of historically-used introduced agronomic species. A strong link was also found between functional composition and environment factors in both forested and grassland ecosystems. This link suggests a significant influence of time and subsequent developing site conditions (e.g., canopy cover in forested ecosystems) as well as enduring legacies of wellsite operation/reclamation (e.g., high soil bulk density and exotic species in both forested and grassland ecosystems) on functional composition of the plant communities.

The results suggest that even as practices and policies evolve, reclamation does not fully alleviate the legacy effects of this industrial disturbance and sites will be slow to recover by comparison to better known disturbances such as forest harvesting. In addition, the studies suggest a trait-based approach can provide more mechanistic understanding and generalizable framework to assess and compare successional trajectories of landscapes impacted by various natural and anthropogenic disturbances. Read the full article on Uncovering traits and recovering grasslands: A functional assessment of oil and gas well pad reclamation and on Plant traits as indicators of recovery of reclaimed wellsites in forested areas: Slow but directional succession trajectory. This work was in collaboration with Anne McIntosh from the University of Alberta and Ermias Azeria from the Alberta Biological Monitoring Institute. For more information contact Isabelle Aubin.

New fact sheets on forest pests available

GLFC has new fact sheets (our Frontline Express series) on various forest pests, including oak wilt, hemlock woolly adelgid and LD Moth *(formerly known as European gypsy moth). The new publications include information on the life cycle, appearance, signs and symptoms of damage, natural controls as well as suggestions as to what landowners can do.*

Oak wilt is a tree disease caused by the fungus *Bretziella fagacearum*. The fungus is widespread throughout the eastern United States and, as of 2021, found within 600 m of the Canadian border near Windsor, Ontario. The fungus clogs the vascular system of the tree, causing mortality within 1 year in red oaks, and in 2-15 years in white oaks. Infected trees also produce pressure pads where beetles can pick up fungal spores and move the fungus to new stands. Within stands, infections can also be transmitted by root grafting. This publication describes the biology, impact and management options for oak wilt.

The Hemlock woolly adelgid (*Adelges tsugae*) is an introduced pest of hemlock trees in eastern Canada and the eastern United States. Hemlock woolly adelgid is also present in British Columbia but is a native species there and not a significant pest. The insect causes damage by eating the contents of a tree's nutrient storage cells. This reduces the health of trees and causes buds to die and needles to turn yellow. Tree death can occur in 5-15 years after a tree is infested. This publication describes the biology, impact and management options for hemlock woolly adelgid in Canada. In addition, a technical note describing sampling techniques for detecting infestations is available.

The LD moth (*Lymantria dispar dispar*) is a naturalized non-native pest that prefers oak leaves, but it can defoliate several other tree species native to Canada. Repeated high rates of defoliation *by L. dispar* result in lowered tree growth rate, occasional tree mortality, and considerable nuisance when eggs and larvae occur at high density in places frequented by the public. This document describes the biology, impact, and management options available for *L. dispar* populations.

The Entomological Society of America is currently considering a new common name for *L. dispar*. Suggestions have been submitted and will be reviewed by a committee. A short list of possible new names will be chosen from among the over 100 or so that were submitted and released for public comment. The final name will be selected after the public comment period and that name will be submitted to the Entomological Society of America's common names committee for review. For more information about the Better Common Names Project and the renaming effort for *L. dispar* specifically, please visit the Better Common Names Project website and FAQ.

Vegetation Zones of Canada: a Biogeoclimatic Perspective

This significant body of work is the result of many years of collaboration between GLFC ecologist Ken Baldwin (now retired) and provincial and territorial collaborators.

Vegetation Zones of Canada: a Biogeoclimatic Perspective maps Canadian geography in relation to regional climate, as indicated by vegetation patterns. Compared to previous similar national-scale products, *Vegetation Zones of Canada* benefits from the work of provincial and territorial ecological classification programs over the last 30+ years, incorporating this regional knowledge into a harmonized national map. This new map, reflecting vegetation and soils adapted to climates prior to approximately 1960, can serve as a broad-scale (approximately 1:5 million to 1:10 million) reference for monitoring and modeling effects of climatic changes on Canadian ecosystems.

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