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e-Bulletin

The Great Lakes Forestry Centre (GLFC)

Comings and Goings

We welcome Fire Research Scientist Dr. François Robinne to GLFC for a two-year term. He began his new duties on February 24, 2021 and is working remotely from Edmonton, Alberta.

François will be working on the wildfire risk project where it intersects with water resources. He was most recently a Postdoctoral fellow working for the Canadian Partnership for Wildland Fire Science at the University of Alberta. While working for the university, he published several scientific papers on the risks to Canadian watersheds from wildfires. He also raised awareness of existing wildfire-related issues on our national water supply. His research contributed to Global Water Futures.

GLFC's female scientists recognized on International Women's Day

In 1977, the United Nations adopted a resolution designating March 8th as International Women's Day, an idea that arose around the turn of the 20th century out of a long-standing movement for women to participate equally in society.

Statistics Canada data from 2017 reveals that women make up about 17% of the natural resources workforce. To improve the representation of women in the forest sector, the Federal Government contributed close to half a million dollars towards a three-year "Gender Equality in Forestry National Action Plan", which was launched by the Canadian Institute of Forestry in November 2018, in collaboration with the Centre for Social Intelligence. A steering committee has since been working collaboratively across the sector to engage, attract, retain and advance women.

At GLFC, women work in a variety of positions including research directors, research scientists, chemists, biologists, physical scientists, computer analysts, as well as lab and field technicians. In this article, we introduce you to five of our women scientists.

Dr. Isabelle Aubin

Isabelle is a research scientist in forest ecology. She has a B.A. in human sciences and a M.Sc. in biological sciences from the Université du Québec à Montréal. She completed her Ph.D. in Biology in 2008 at the Université de Montréal. Her research focuses on the impacts of human-mediated disturbances on forest ecosystems, with a focus on the application of ecological theory to practical problems in forest management. Her research program includes research on the restoration of urban forests and industrial landscapes as well as the assessment of forest management sustainability and pest risks and impacts. She also developed an integrative approach to better assess, predict and adapt to climate change impacts on forests.

Dr. Sandy Erni

Sandy is a fire research scientist. She received her M.Sc. in Geology and Natural Hazards from the Institut de Physique du Globe in Paris, France, and her Ph.D. in Earth Sciences from the Institut National de la Recherche Scientifique in Quebec City. Her main research interests focus on forest fire risk and impacts on communities, including hazard and vulnerability assessment methods. Her recent work has mapped the probability of fire on a national scale and provided a first estimate of fire risk for built-up areas and communities in Canada.

Dr. Amanda Roe

Amanda is a research scientist for the Insect Production and Quarantine facility at GLFC and a part-time faculty member at Algoma University. Thanks to her important work, Algoma's maple and other hardwood trees are better protected against invasive insect species. She earned her Bachelor's degree in Environmental Biology and Ph.D. in Ecology, Evolution, Systematics, and Population Biology from the University of Alberta. She completed a post-doctoral fellowship with the University of Minnesota, undertaking research in pyralid moth systematics. Amanda then went on to complete a second post-doc at the University of Alberta, where she developed molecular markers for diagnostics, population genetics, and genomics for multiple interacting organisms.

Dr. Lisa Venier

Lisa has been a research scientist at GLFC since she completed her Ph.D. in Landscape Ecology in 1996 at Carleton University in Ottawa. Her primary focus has been on biodiversity response to forest management and natural disturbances to support sustainable forest management. She works on a variety of taxa including birds, mammals, salamanders, ground dwelling arthropods and soil fauna, and at multiple scales from stand and landscape levels to provincial and national levels. Most recently, she has been studying the stand-level effects of forest harvest on soil fauna, the landscape-level effects of forest harvest and natural disturbance on birds and caribou, and the environmental sustainability of biomass harvest and wood ash amelioration.

Dr. Kara Webster

Kara has a B.Sc. in Ecology from the University of Guelph, a M.Sc. in Ecology from the University of Calgary and a Ph.D. in Biology and Environmental Science from Western University. She investigates carbon and nutrient cycling in forest and peatland soils to improve policies for forest sustainability in a changing climate. Her research interests are focused on understanding the microbial, physical and chemical controls on the fate of forest soil carbon, either to the atmosphere (originating from below-ground microbial and root respiration), sequestered in the soil, or exported to waterways (as dissolved organic and inorganic carbon) and how that fate is linked to other nutrient cycles and hydrologic fluxes. She combines field monitoring, empirical and ecosystem modelling, and GIS mapping to investigate soil processes across various spatial scales, from plot to landscape.

Forty year of studies at the Turkey Lakes Watershed

A summary of the current status and future direction of studies at the Turkey Lakes Watershed was outlined during a recent webinar.

Dr. Kara Webster recently gave a very well received talk as part of the CUAHSI Winter 2021 Cyberseminar Series. CUAHSI is a Consortium of Universities for the Advancement of Hydrologic Science, Inc., based in the US. The goal of this non-profit organization is to support and strengthen interdisciplinary collaboration in the water sciences. The theme of the seminar series was "Research and observatory catchments: the legacy and the future". This particular week the talks focussed on catchments in colder temperate landscapes, where snowmelt is a big driver of hydrology and biogeochemical cycling. Kara's talk was entitled: "The Turkey Lakes Watershed: 40 years of whole-ecosystem monitoring and research". The seminar is available for viewing on YouTube. To learn more about the Turkey Lakes Watershed, visit the website.

Tracing the North American longhorned beetle invasion through genomics

Dr. Amanda Roe presented this topic at the 63rd Annual Forest Pest Management Forum and as a keynote speaker at the inaugural Research Week at Algoma University in Sault Ste. Marie.

Asian longhorned beetle (*Anoplophora glabripennis* Motschulsky, ALB) is an invasive forest pest in the temperate forests of North America and Europe. It was first detected in North America in 1996 and in Europe in 2000, and since then numerous infestations have been found, including in Toronto. This species poses a threat to a wide range of broad-leaf trees, particularly maples. While Canada's ALB populations were declared eradicated in June 2020 by the Canadian Food Inspection Agency, continued surveillance is needed to protect Canada's forests from this invasive pest.

Tracing sources of new introductions or interceptions is critical to identifying pathways of invasion, as well as assessing the risk of establishment and spread. In this study, genome-wide markers were used to characterize the population structure in the native range of ALB. Results showed that populations had a

sharp genetic discontinuity between northern and southern populations, with regional substructuring among populations. The same genome-wide markers were then used to describe the variation among invasion populations in North America and detected several unique invasion stories. First, the 2003 and 2013 populations in Toronto and Mississauga, respectively, showed similar genetic signatures, verifying that the 2013 find was a missed satellite population of the original introduction and not a new invasion. Second, there were several distinct genomic signatures among the North American populations; US populations from New York, New Jersey, Massachusetts, and Illinois associated with native ALB populations in northwest China, while Ohio and Toronto populations were similar to those in eastern China. Both Ohio and Toronto populations showed unique genomic signatures that may reflect a loss of genetic diversity or selection during the invasion process.

Continued interceptions of ALB plus a new invasive population in South Carolina highlight the importance of continued vigilance for this invader. The general public plays a critical role in our ability to detect and respond to new ALB invasions. Nearly all detections of ALB came from a private citizen, rather than a trained professional. Success of this citizen surveillance was due to effective science communication and clear messaging from partner organizations. Genomic tools, when combined with an engaged public, will provide the response framework needed to prevent future ALB invasions in Canada. For more information please contact Amanda.

This work was a collaborative effort with Mingming Cui and it was central to her Ph.D. thesis with Dr. Ilga Porth at the University of Laval. The study was conducted in partnership with USDA-APHIS, the National Research Institute for Agriculture, Food and the Environment (INRAE), and the Beijing Forestry University. It is part of a larger Genome Canada Large-Scale Applied Research Project called BioSAFE (BioSurveillance of Alien Forest Enemies) aimed at developing genomic tools to improve Canada's early detection and rapid response framework for high-risk invasive species.

How does emerald ash borer (EAB) affect riparian forests?

In this study, researchers found that despite the structural changes to forests from EAB infestation, forest soils are fairly resistant to the devastating effects of EAB and soil buffering helps to mitigate the effect of EAB on adjacent streams.

Ash trees that grow in forested areas are especially abundant in riparian zones and thus play an important role in regulating the flow of nutrients and of particulate material into the aquatic ecosystem. In 2014 and 2015, researchers examined the effects of tree mortality caused by EAB on riparian forests and soils. Plots were established in two riparian forests in southwestern Ontario that had different infestation timelines: one that had mortality in the past 2–3 years and one that was infested 10 years previous. For both sites, plots that were not affected by ash mortality were also studied for comparison. Researchers measured five factors: canopy openness, litterfall, herbaceous vegetation, soil carbon and nitrogen, and soil nitrogen mineralization.

Plots that experienced EAB mortality had a more open forest canopy, resulting in more herbaceous ground vegetation. There was a reduction in litterfall and a lower flux of nutrients to the forest soil.

Despite the reduction in nutrient fluxes, there was no difference measured in the soil nitrogen and carbon content or soil nitrogen mineralization. Overall, despite changes to riparian forest canopy structure and litterfall, there was no significant difference in soil nutrient cycling between EAB-induced canopy gaps and closed canopy plots after 10 years, suggesting a high resilience of riparian forest soils to EAB infestation.

Read the full article on soil and nutrient cycling responses in riparian forests to the loss of ash from emerald ash borer.

A compilation of North American tree provenance trials

Dr. Dan McKenney, John Pedlar and colleagues recently published a summary of available provenance trial measurements and associated climate data for seven eastern North American tree species.

Tree provenance trials consist of a variety of seed sources (or provenances) planted at several test sites across the range of a species. The resulting plantations are typically measured periodically to investigate provenance performance in relation to abiotic conditions, particularly climate. These trials are expensive and time consuming to establish, but are an important resource for seed transfer systems, which aim to match planting sites with well-adapted (climatically suitable) seed sources. Provenance trial measurements may be underutilized because the data are scattered across publications, conference proceedings, and university theses. The article documents an effort to collect available provenance trial measurements and associated climate data for seven eastern North American tree species: white pine, jack pine, white spruce, black spruce, red oak, tamarack and yellow birch. The resulting datasets included a total of 773 provenances and 62 test sites, with 65 historical climate variables appended to each location. We hope this data will support forest managers in making seed transfer decisions, particularly in an era of rapid climate change. To read the full article: "A compilation of North American tree provenance trials and relevant historical climate data for seven species", visit our publications website.

Indeed, historical provenance trials have also been used to help develop climate-based revisions to Ontario's Seed Transfer Guidelines, published by the Ontario Ministry of Natural Resources and Forestry, and to which Dan and John contributed.

Updated precipitation models now available

Dr. Heather Macdonald and colleagues at GLFC and Environment and Climate Change Canada recently published new national precipitation models based on important adjustments to Canada's historical climate station records.

Until twenty years ago, much of Canada's historical precipitation record suffered from documented measurement shortcomings related to undercatch, wetting losses, unrealistic snow-water equivalence conversion, and trace amounts of precipitation.

Researchers from Environment and Climate Change Canada have been collaborating with researchers from NRCAN-CFS over the past 25 years to develop spatial models of historical climate. More about these customized spatial climate models for North America is available in a 2011 article published in the Bulletin of the American Meteorological Society. Now these methods have been used to develop gridded (map) products of adjusted precipitation at finer grid scales than have previously been available. In this just-out publication: "Spatial models of adjusted precipitation for Canada at varying time scales", gridded adjusted precipitation models at daily, pentad (5-day) and monthly time scales for Canada are described. Compared to unadjusted precipitation, adjusted models present evidence of more rapid increasing trends. In 2020, MacDonald and colleagues also published unadjusted precipitation spatial models for North America at the monthly time scale, as well as minimum and maximum temperature, which are available at https://www.nature.com/articles/s41597-020-00737-2?sf240169531=1.

GLFC staff involved in this work recently provided hands-on training to ECCC staff for disseminating many of the spatial climate models. This involved workshop-type sessions over six days, with lectures and software training. The spatial climate models developed at GLFC are widely used by researchers and agencies across North America (either in grid form or via estimates at their specific research locations). Researchers interested in any of these models including the new adjusted precipitation models can obtain them by contacting Dan McKenney or Heather Macdonald.

GLFC researcher contributes to US Forest Service book on invasive species

Dr. Denys Yemshanov was a co-author on three chapters of the book: "Invasive Species in Forests and Rangelands of the United States: A Comprehensive Science Synthesis for the United States Forest Sector", a project that was four years in the making.

The book describes the serious threat that invasive species have caused and will continue to cause to native ecosystems, especially with ever-increasing world trade. Over 100 experts contributed to the book, which presents the latest research on a wide range of natural science and social science fields that explore the ecology, impacts, and practical tools for management of invasive species. It covers major taxonomic invasive species groups that impact a diversity of habitats in forests, rangelands and grasslands of the US. It also includes a comprehensive primary reference list for each topic. The scientific synthesis provides the cultural, economic, scientific and social context for addressing environmental challenges posed by invasive species and is intended as a resource for scholars, policy makers, natural resource managers and practitioners.

Denys was a co-author on Chapter 6: "Early Intervention Strategies for Invasive Species Management: Connections Between Risk Assessment, Prevention Efforts, Eradication, and Other Rapid Responses"; Chapter 13: "The Role of International Cooperation in Invasive Species Research"; and Chapter 14: "Economics of Invasive Species".

The book is open access and an online version is free, accessible at Treesearch.

A new watershed tool for improving our understanding of landscape influences on water resources

Dr. Brian Kielstra of GLFC's Watershed Ecology Team has developed a general-purpose watershed analysis tool: "hydroweight" R package that accounts for distances from upland features to waterbodies.

Environmental scientists often want to understand how upland features like forest cover affect downstream waterbodies, for parameters such as water quality. They characterize upland areas by calculating various landscape attributes, such as percent forest cover in the watershed. However, current approaches tend to ignore proximity to the waterbody; for example, if there was higher forest cover near the waterbody and lower forest cover farther away. The recently developed *R* statistical software package was designed to account for these patterns.

Hydroweight calculates landscape attributes based on distances to waterbodies, which is important because areas nearby have more influence on the calculated attribute than those farther away (known as inverse distance-weighting). Various weighting scenarios are implemented accounting for straight-line and flow-path distances of upland features to waterbodies. Building on previous research and tools, ***hydroweight*** provides a set of simple and flexible tools for general-purpose watershed analysis in *R*.

For more information, contact Drs. Brian Kielstra or Erik Emilson, and visit ***hydroweight*** on Github.

Recent Publications

Royer-Tardif, S.; Doyon, F.; Nolet, P.; Thiffault, N.; Aubin, I. 2021. Revisiting functional zoning under global change: Adapting forests with a diversity of management intensities. Forests. 12(3).

Thiffault, N.; Raymond, P.; Lussier, J.M.; Aubin, I.; Royer-Tardif, S.; D'Amato, A.; Doyon, F.; Lafleur, B.; Perron, M.; Bousquet, J.; Isabel, N.; Carles, S.; Lupien, P.; Malenfant, A. 2021. Adaptive silviculture for climate change: From concepts to reality. Report on a symposium held at Carrefour Forêts 2019. Forestry Chronicle. 97 (1): 13-27.