## Comings and Goings

We welcome Dr. Amanda Roe, research scientist. Dr. Roe joined GLFC to conduct research on population genetics and genomics of invasive and domestic forest insect pests, and to provide scientific oversight to GLFC's Insect Production and Quarantine Laboratory.

Dr. Roe obtained her PhD in systematics and evolution from the University of Alberta in 2006. Since then she has held several postdoctoral fellowship positions and was an NSERC Visiting Fellow with the CFS from 2010-2013. Her work has covered a wide range of forestry-related topics, including mountain pine beetle, spread of exotic genes from poplar hybrids, and species delineation in forest Lepidoptera. She has published widely in high-profile scientific journals.

We also welcome Dr. Taylor Scarr, as Director of the Integrated Pest Management Division at the Great Lakes Forestry Centre. He comes to us from the Ontario Ministry of Natural Resources and Forestry (OMNRF) where he was the Provincial Forest Entomologist.

Dr. Scarr earned a PhD in forest entomology and a Bachelor of Science degree in forestry from the University of Toronto. He also previously worked with the CFS as a student and term research scientist. He later moved on to the OMNRF, where for 24 years he led the forest health monitoring program, worked with many Canadian and US researchers, planned and conducted research projects in forest entomology, and provided provincial leadership to pest management programs. During this time he also worked as Acting Science Management Leader at the Ontario Forest Research Institute, leading a team of Scientists from Sault Ste. Marie, North Bay, Timmins and Kenora on forest ecology, vegetation management, landscape ecology, forest pathology and growth and yield.

Throughout his career, Dr. Scarr has also been a member of many committees including the chair of the forestry subcommittee of the Operations and Advisory Committee of the Invasive Species Centre, the board of directors of the TRIA-Net Mountain Pine Beetle NSERC research network and OMNRF's representative on the emerald ash borer research subcommittee and Asian long-horned beetle science sub-committee, SERG International (SERG-I), National Forest Pest Strategy Technical Committee, and hemlock woolly adelgid task force.

## GLFC fire researcher flies high over Alberta

*Overview*
*GLFC fire analyst Dr. Josh Johnston provided his expertise to fire managers during the devastating Fort McMurray wildfire in May and gained valuable research data along the way.*

After a mild winter followed by record-setting warm temperatures in early May, the forests of northern Alberta were tinder dry, creating ideal conditions for wildfires. On May 1st, 2016 a small wildfire was discovered southwest of Fort McMurray and despite concerted efforts from firefighting crews, it grew quickly in size and intensity. When first detected it was two hectares in size, but grew to over 2,600 hectares in just two days and to over 10,000 hectares by day four, according to estimates by Alberta Agriculture and Forestry. The fire displayed extreme behaviour and intensity and surpassed the devastating fires that occurred in



*Dr. Joshua Johnston waits to board the fixed wing infrared sensor aircraft in Edmonton, bound for Fort McMurray, Alberta, May 2016*

Natural Resources  Ressources naturelles
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The Great Lakes
Forestry Centre
(GLFC)

*e*-Bulletin

**Issue 29, Fall 2016**

Canada

Slave Lake, Alberta in 2011. The mandatory evacuation of tens of thousands of residents in and around Fort McMurray prompted a state of emergency in the area and gained international attention.

Because the quickly spreading fire could not be contained, smoke began to settle and remain low in the atmosphere, creating further problems for fire managers. The thickness of the smoke prevented helicopters and small aircraft from flying near the fire at times to observe and map its behaviour. An aircraft equipped with infrared scanning was needed to see through the smoke to map out the hotspots and fire perimeter. A compounding issue was that it was so early in the season, none of the contract aircraft had yet been hired.

Fortunately, Transport Canada (TC) offered the services of a fixed-winged aircraft that was being used by Environment Canada and Climate Change (ECCC) crews for mapping sea ice conditions and conducting maritime surveillance. The aircraft was fitted with infrared equipment and other sensors that could be adapted for use in mapping the fire. Dr. Joshua Johnston, a forest fire analyst with GLFC, was called in to assess the plane's ability to provide fire managers in Alberta the information they needed and to share his knowledge and expertise in fire behaviour and remote sensing.



*Smoke cloud shown above Fort McMurray, Alberta, May 2016*



*Image of a pyro-cumulous cloud (a thunderstorm type cloud formed by an aggressive smoke column during a wildfire). Though the smoke is thick, with infrared technology, scientists can see straight through to the fire*
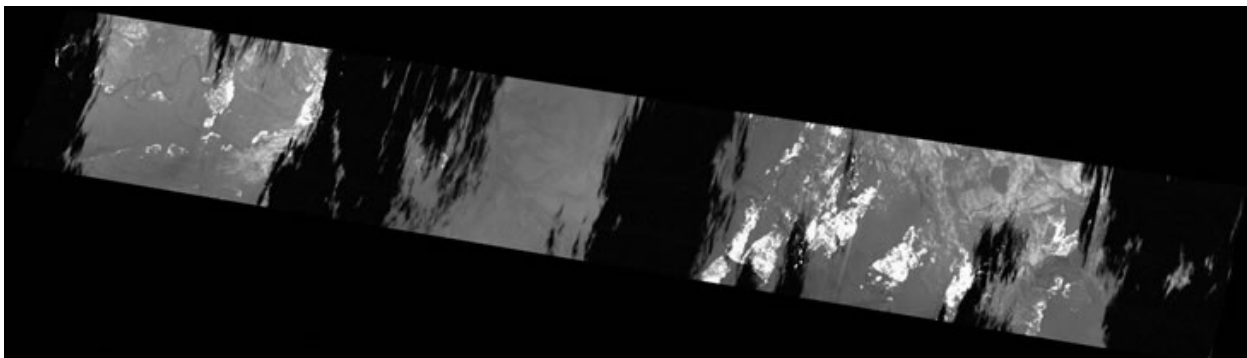


*Infrared scan imagery of the Fort McMurray wildfire. Black areas are clouds while white areas are hot spots from the fire. The image was taken during the day and the flame front was actively moving. Dr. Johnston and crew flew the same spot twice a few minutes later and they were able to map the change in the flame front location.*

**Turkish dignitaries visit the Great Lakes Forestry Centre**

In May of this year a delegation of fifteen Turkish officials visited the Great Lakes Forestry Centre to meet with the CFS fire research group to exchange ideas and information as well as build on relations and partnership opportunities. The group was composed of senior managers from the Turkey's General Directorate of Forestry (Ministry of Forestry and Water Affairs), including the General Director of Forestry and Head of the Dept. of Forest Fire Control; a forestry professor from the Black Sea Technical University, and representatives from the United Nations Development Programme.

This was a trip funded by the Global Environment Facility (GEF) which is administered by the United Nations Development Programme (UNDP). Turkish government officials and university scientists requested this tour because of CFS's leading international role in fire research, and close collaboration with Canadian fire management agencies. The GEF project is about an 'Integrated approach to management of forests in Turkey, with demonstration in high conservation value forests in the Mediterranean region' with an overall objective to demonstrate multiple environmental benefits in high conservation value forests managed in the Mediterranean forest region. Managing forest fire and carbon is a major component of the project and this study tour to Canada is an important activity of the GEF project.

Turkey is a country which has a similar climate to northern Ontario and faces similar challenges when it comes to forest fires. This visit has helped the delegation get a better understanding of the fire research that is being done by the Canadian Forest Service and opportunities for collaboration. The group was specifically interested in the Next Generation Canadian Forest Fire Danger Rating which was developed by the CFS and is instrumental in managing forest fires in Canada and abroad. Turkey's national fire danger rating system is based largely on the CFFDRS. Canada has worked with Turkish fire scientists on fire behaviour research and to assist with fire management training and this partnership will continue with visits such as this.

Other work they were interested in was fire behaviour research, modeling fire and carbon emissions, forest carbon accounting, international fire suppression resource-sharing, the International Model Forest Network (Turkey has two Model Forests), fire and remote sensing research, fire and climate change research, fire operations research (University of Toronto), as well as developing international fire danger rating and early warning systems.

The group also visited Ontario Ministry of Natural Resources and Forestry (OMNRF) Aviation, Fire and Flood Emergency Services for a tour of the operations centre and presentation on Ontario's fire management program, the OMNRF hangar and air tanker base and new CL415 flight simulator for pilot training. They also toured Sault Ste. Marie's Bushplane Heritage Museum. Another tour was taken in Toronto where they visited the University of Toronto's Faculty of Forestry for presentations on climate change, fire danger rating, and fire operations research.

The Canadian Forest Service will continue this engagement with Turkey as they are a wildland fire leader in the Mediterranean region, and host an International Fire Management Training Centre in Antalya. Canada will be invited to assist presenting fire danger rating, fire behaviour and other research at the training centre. Canada and Turkey are also planning to collaborate on development of new fire behaviour models, and to provide operational training on fire research applications designed for fire managers in in both countries. These collaborations will occur through government agencies and universities.

**New advances in remote sensing for near real-time fire behaviour monitoring**

Tim Lynham (CFS), Josh Johnston (CFS), and Marleen van Mierlo (Canadian Space Agency) presented a webinar on March 22, 2016 that gave an overview of the progress in characterizing fire behaviour using remote sensing as well as new developments in the Canadian space program to support wildland fire monitoring. The Canadian Space Agency recently conducted a feasibility study on a proto-operational Canadian Wildland Fire Monitoring System (CWFMS) microsatellite mission. The three also presented a summary of the capabilities of the CWFMS and the results of the feasibility study.

By 1999, there was a single civilian polar orbiting satellite available for monitoring wildland fires: the Advanced Very High Resolution Radiometer (AVHRR) satellite from the USA. AVHRR demonstrated the value of thermal infrared for detecting and monitoring wildland fires.

For the last 15 years, remote sensing specialists and fire researchers have teamed up to use thermal infrared (TIR) to characterize wildfires. They have been aided by space agencies that have rapidly developed TIR satellite platforms, even though most missions have been experimental or short-term. Fire characterization has included burned area mapping, rate of spread, fire line intensity and fuel consumption. All of these measures of fire behaviour can now be monitored by remote sensing and Canada has a plan to move forward in this area.

Space-based remote sensing is becoming an increasingly cost-effective tool for fire management and research. However, none of the currently existing, planned or investigated remote sensing satellites used for wildfire monitoring and detection, fulfil the specific needs for wildfire monitoring in Canada. Canada's geographic location limits the use of geostationary satellites (e.g. GOES). For the satellites that reach the northern latitudes (Low Earth Orbit (LEO), polar orbiting satellites) the existing infrared detectors require cooling which, due to their demanding power and weight requirements, provide limited capability at a high cost. Designers of these polar orbiting satellites are usually forced to choose between either high spatial resolution (detailed) data (e.g. TET-1) or high temporal resolution (frequent revisit) (e.g. MODIS).

For the past 15 years, the Canadian Space Agency has invested in the development of a novel infrared sensor called a microbolometer in the Canadian industry. Contrary to infrared sensors used in other missions, the microbolometer does not require cooling, which allows for a relatively low-cost mission with both high spatial resolution as well as high temporal resolution. A constellation of nine such microsatellites would provide fire monitoring data of all points within Canada at least four times daily during the burning period (09:00 – 21:00 local time).

The first step to implement this space-based fire monitoring infrastructure would be to launch a technology demonstration (proto-operational) microsatellite either in Canada or in collaboration with another space agency. This could serve as a stepping stone towards a fully operational Canadian Wildland Fire Monitoring System (CWFMS). A proto-operational bolometer-based microsatellite mission would serve to: 1) prove the functionality of the new technology in space; 2) provide fire researchers with the data they need to develop the appropriate products and applications; 3) enable commercial initiatives; 4) prepare the end-user community for using near-real-time fire behaviour observations; and 5) create global interest, since the use of this system would not be limited to Canada. These three presenters provided an overview of the efforts to implement a space-based wildland fire monitoring system which has the potential to increase the information available to wildland fire managers, reduce the costs of delivery and reduce delivery times for this information.

View the video presentation on New advances in remote sensing for near real-time fire behaviour monitoring.  Please note that you will need to download the file onto your computer and play it from there.

# e-Bulletin

**The urban forest and health in a changing climate**

On March 31st, 2016 John Pedlar participated in a collaborative webcast that was part of the 'Cool Communities' webinar series hosted by Health Canada. The goal of this web series is to showcase community-level initiatives that help reduce the urban heat island effect – a phenomenon that is of increasing concern under ongoing climate change. This particular webinar focused on the potential role of urban forests in meeting this objective and Health Canada offered members of the Canadian Forest Service an opportunity to speak with respect to their experience and expertise in this area.

Three CFS employees spoke during the webinar. Ken Farr (Manager of Science Integration at CFS Headquarters) provided an overview of the role that CFS plays in supporting Canadian forests and forest industry through related research and programs. Laura MacKenzie (Chief of Policy at CFS Headquarters) addressed the many ecosystem services provided by forests. John presented information on a number of research activities that are ongoing at the Great Lakes Forestry Centre related to urban forests and/or climate change, including: climate modelling efforts, a citizen science-based urban tree survey, and a web application aimed at assisting homeowners in deciding whether to treat or remove EAB-infested ash trees. In particular, John's presentation focused on a web application that draws on both continent-wide climate and plant occurrence datasets to identify climatically suitable plant species for planting under climate change. This application has been used by horticulturalists, forest managers, and the general public to assist with planting decisions. Efforts are ongoing to improve this product by incorporating a wider range of climate scenarios and by including information on plant traits, which will further inform users regarding the suitability of planting certain species.

The webinar was well-attended, with over 200 people calling in. Discussions are ongoing between Health Canada and the Canadian Forest Service regarding potential avenues for collaboration with respect to urban forests and climate change.

**Neonics, honeybees, and the forestry connection: An overview of the environmental risks associated with these insecticides**

Dave Kreutzweiser presented a webinar on April 25, 2016 which gave an overview of the work that he and Taylor Scarr (formerly with Ontario Ministry of Natural Resources and Forestry) have done on the environmental risks associated with these neonicotinoid insecticides.

Neonicotinoids, a class of systemic insecticides, are the most widely-used group of insecticides in the world due to their favourable properties from a pest management point of view. They are neurotoxins that are highly effective against a broad range of insect pests while expressing relatively low toxicity to mammals. However, recent studies have shown that their broad scale use has resulted in widespread and persistent contamination in soils, plants, sediments, and water. Also, several studies linked the use of neonicotinoids in agriculture to honeybee colony collapse disorder, which caught the world's attention. Dr. Kreutzweiser and three other Canadian scientists were appointed to a 30-member advisory panel to the International Union for the Conservation of Nature (IUCN) Commission on Ecosystem Management that was assembled to review over 800 scientific studies and provide an analysis and synthesis of the environmental risks associated with the widespread use of neonicotinoids. A Worldwide Integrated Assessment (WIA) was published in a series of papers and several international press conferences were held in 2015. The assessment showed that neonicotinoids pose a serious threat of harm to a broad range of non-target organisms, well beyond honeybees.

Dave provided an overview of the findings of the WIA and showed the forestry connection to this issue. He also highlighted the similarities and differences between agricultural uses and forestry applications of neonicotinoids and their environmental risks. Agricultural applications are wide-spread and often prophylactic, while forestry applications are targeted, specific, and very limited. He did not advocate an outright ban of neonicotinoids as some forest pest management issues may require urgent action or have no immediate alternative. An example of this is the invasive Hemlock Wooly Adelgid which is killing hemlock trees in eastern United States. Neonicotinoids (imadacloprid and dinotefuran) are currently the only effective tools in managing this pest and the hemlock leaf litter, where the pesticides could be found, is not an important organic matter source for litter consumers which could be affected by the pesticide. He did however caution that the use of this or any other type of pesticide should be carefully considered and that tests must be done to ensure these risks are mitigated.

View the video presentation on [Neonics, honeybees, and the forestry connection: An overview of the environmental risks associated with these insecticides](). Please note that you will need to download the file onto your computer and play it from there.

## Climate-induced range shifts in boreal forest pests: A conference presentation

*Overview*

*GLFC scientist Jean-Noël Candau was one of 30 scientists from around the world who met to discuss the: "Climate-Induced Range Shifts in Boreal Forest Pests: Ecological, Economic and Social Consequences" at an International Union of Forest Research Organizations (IUFRO) conference held in Sept-Îles, Quebec in July.*

Jean-Noël Candau, quantitative ecologist, develops and applies statistical and computer simulation approaches to study the large-scale dynamics of forest insect infestations and their interactions with other disturbances and climate change. At this conference he was invited to give a keynote presentation on species-range expansion of important forest pests as a result of climate change. The world's climate is changing quickly. Since 1970, global mean annual temperatures have increased at a rate of 0.17°C per decade. In addition, the amount of greenhouse gases already present in the atmosphere and the inertia of the world's climate system commit the planet to further warming. Several authors have proposed conceptual frameworks to help predict changes in species distribution in response to climate change. In general, it is expected that insect species distributions will be affected in latitude and altitude.

While accounts of range expansions are accumulating and are generally in agreement with expectations, there is an increasing need to better understand the factors involved in these changes. Using a broad framework based on the determinants of range limits and range dynamics, Dr. Candau described the various ways by which climate change may affect species distribution, drawing examples from recent empirical studies. A review of the current literature suggests that: (1) there are still relatively few examples of expansion of forest pest distribution related to climate change; (2) there are even fewer empirical studies that document the causes of range expansion; and (3) there is a pressing need for more studies that test and measure the impacts of climate change on individual determinants of range limits in order to better understand and predict potential changes in pest distribution.

Conference delegates had the chance to visit forests in northern Quebec affected by a spruce budworm outbreak that started in 2006. Spruce budworm outbreaks occur every 30-40 years and participants were able to view stands at different defoliation levels and see the life stages of the pest and the damage it causes. This epidemic of spruce budworm has affected almost five million hectares of forest to date in Quebec and New Brunswick.

**Field trials testing parasitic wasp for control of emerald ash borer (EAB) continue**

GLFC scientist Krista Ryall is continuing with research efforts begun by now retired entomologist Barry Lyons to test the effectiveness of parasitic wasps against EAB. When EAB was accidentally introduced to North America two decades ago, likely through unsecured shipping crates, it came with no natural enemies and typically kills 99% of ash trees after it invades an area. The idea of using parasitoids (a parasite that kills its host) from EAB's native range is part of an integrated pest management strategy that also includes development of lures for trapping insects, branch sampling for early detection and injection of the botanical pesticide TreeAzin into individual high value trees.

Field trials with parasitic wasps were initiated in 2013, using insects imported into Canada from a special US Department of Agriculture, Animal Plant Health Inspection Service rearing facility in Brighton, Michigan. With approval from the Canadian Food Inspection Agency, tens of thousands of wasps have been released since 2013, while 1600 of the wasps were released this field season.

Testing with two different species of wasps has been undertaken to date. Oobius agrili lays its eggs inside the eggs of the emerald ash borer and consume the larva from the inside, eventually emerging from the egg as an adult wasp. Tetrastichus planipennisi inserts its ovipositor through a tree's the bark and lays its eggs on the EAB larvae. The wasp larvae then consume and kill the EAB larvae.

To measure success, specialized traps are set out to catch the parasitoids and determine an index of population density. Select trees are also felled to observe adult emergence in the laboratory. In the US, where trials have been underway for longer, a buildup of parasitized EAB has been reported, but no major impacts on EAB populations have been observed. It is hoped that parasitoids could become one of the tools available to help mitigate the spread of this devastating pest. Ash trees in over 246,000 hectares of Ontario's forests have been killed and trees in Quebec are also being attacked. It will be several years before we will be able to measure whether these parasitoid releases are reducing the emerald ash borer populations enough to effectively protect ash trees.

## Publications of interest

- To order copies of these publications, please contact the Great Lakes Forestry Centre publications assistant.
- Publications are available in English unless otherwise indicated.

## Wildfire suppression costs for Canada under a changing climate

This journal article examines the cost implications of climate-influenced changes in fire regimes in northern and boreal regions, which will have both ecological and economic ramifications. Where other researchers have predicted that the intensity and frequency of fires will increase only a few have quantified these relations. Utilizing four different General Circulation Models, the authors project that fires suppression costs in Canada will increase to $1 – 1.4 billion dollars which is a significant increase from current costs.

## Recent Publications

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