CANADA WILDFIRE
ANNUAL REPORT 2022-2023

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Cover photo supplied by Ellen Whitman/NRCan taken in N.W.T.

In the 2022-2023 fiscal year, our organization made significant progress in conducting research and studies in various fields. Our team of experts utilized advanced techniques and methodologies to explore and understand critical aspects of different ecosystems. Through our dedicated efforts, we aimed to enhance our knowledge and contribute valuable insights to the scientific community and society as a whole. This annual report highlights some of our key accomplishments and findings during the year.

EXECUTIVE COMMITTEE

- Nadir Erbilgin (University of Alberta - Department of Renewable Resources)
- Troy Fuller (Thompson Rivers University)
- Nick Grimshaw (Alberta Forestry, Parks and Tourism)
- Ian Meier (BC Wildfire Service) - Chair
- Mike Norton (Canadian Forest Service - Northern Forestry Centre)

MANAGEMENT TEAM

- Jen Beverly (University of Alberta - Department of Renewable Resources)
- Matthew Coyle (Government of Northwest Territories)
- Chris Dallyn (Saskatchewan Public Safety Agency)
- Mike Flannigan (Thompson Rivers University - Emergency Management and Fire Science, Faculty of Science) - Science Director
- Howard Georgeson (Saskatchewan Public Safety Agency)
- Dustin Guedo (Parks Canada)
- Jill Harvey (Thompson Rivers University - Fire Ecology, Natural Resource Sciences)
- Mike McCulley (BC Wildfire Service) - Chair
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- Oleg Melnik (Government of Northwest Territories)
- Aaron Pawlick (BC Wildfire Service)
- Dave Schroeder (Alberta Forestry, Parks and Tourism)
- Dan Thompson (Canadian Forest Service - Northern Forestry Centre)
- Gregg Walker (Parks Canada)

STAFF MEMBERS

- Renee Beaulac - Program Coordinator
- Karen Blouin - Research Coordinator
- Sandra Kinash - Knowledge Translation and Mobilization Coordinator
- Brian Wiens - Managing Director
- Wankui Zhou - Administrator

Research Highlights

Live Fuel Flammability in the Boreal Forest

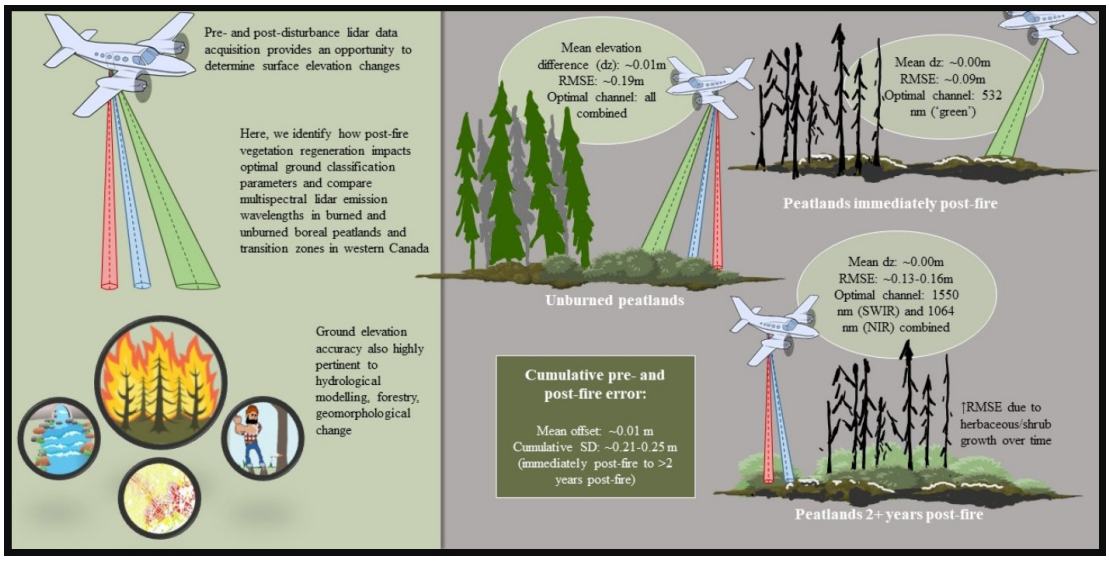
We conducted an in-depth examination of the flammability of jack pine needles in different seasons and age groups. Our study revealed that needle form and chemical composition significantly influence ignitability and energy release. This understanding has implications for assessing fire behaviour at stand and landscape scales. Full publication here

Assessment of Lake-level Fluctuation as an Indicator of Fire Activity in Boreal Canada

We investigated the relationship between fuel moisture content and wildfire potential, specifically focusing on the Canadian Fire Weather Index (FWI) System. Additionally, we explored the potential of using ancillary environmental measures, such as lake levels, to complement the FWI System in assessing fire activity. Our findings suggest that lake-level fluctuation could serve as an indicator of regional fire activity, providing valuable insights for fire management. Full publication here

Mapping Organic Layer Thickness and Fuel Load of the Boreal Forest in Alberta, Canada

Our research examined the impact of fires on forest organic layers and soil carbon pools. We developed maps of organic layer thickness and fuel load using machine learning approaches, improving our understanding of fire behavior, emissions, and effects models. These findings contribute to better predictions and management of wildfires. Full publication here



Graphical abstract - Quantifying lidar elevation accuracy: Parameterization and wavelength selection for optimal ground classifications based on time since fire disturbance

Lidar Data Analysis for Peat Combustion Assessment

We explored the use of airborne lidar data to assess peat combustion and loss across large areas. By analyzing ground surface elevation data, we identified the impact of post-fire vegetation regeneration on the accuracy of lidar ground classification. Our study provides insights into the potential for improving assessment methods in hydrological modeling, forestry, and geomorphology. Full publication here

Positive Anomalies and Wildfire Activity

We investigated the link between persistent positive anomalies (PPAs) in midtropospheric geopotential heights and wildfire activity in North America. Our research highlighted the correlation between PPAs and large fire ignitions, particularly in higher latitudes. We also identified a significant expansion in the spatial extent of PPAs, which has implications for understanding wildfire patterns in a changing climate. Full publication here

Short-Interval Reburns and Soil Bacterial Communities

We studied the effects of short-interval reburns on soil bacterial communities in the boreal forest. Our findings revealed changes in bacterial composition, with specific bacteria enriched or depleted in reburn areas. We also observed relationships between soil pH and community dissimilarity. These insights contribute to understanding the ecological impacts of consecutive fires. Full publication here

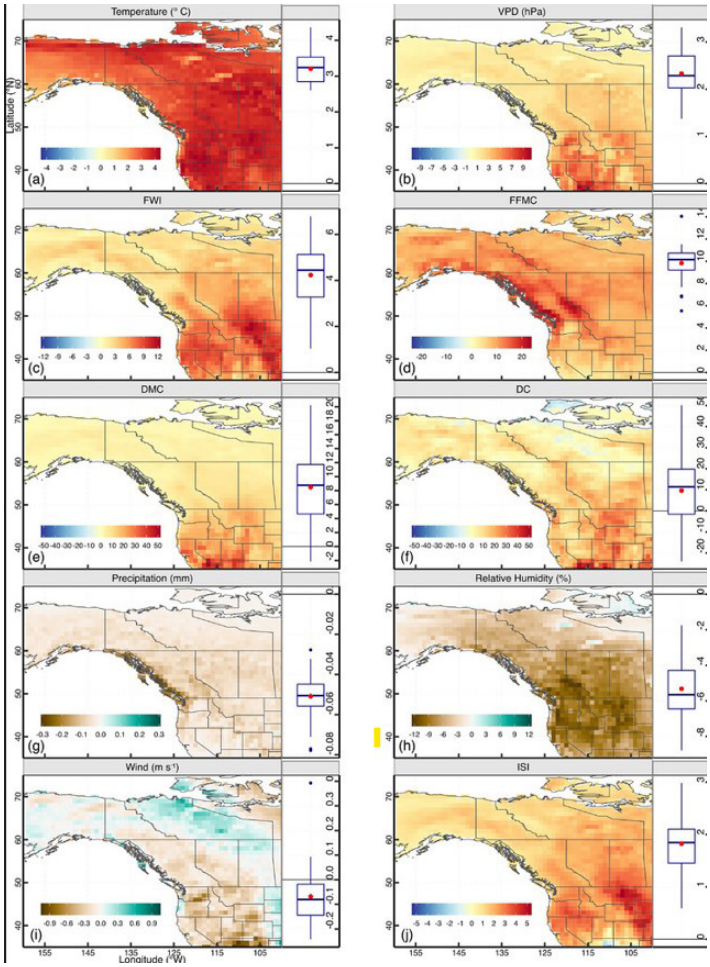


Fig. 8. Fire-related surface variables (temperature, precipitation, RH, VPD, and wind) and fire weather indices (FWI, FFMC, DMC, DC, and ISI) anomalies and the distribution of anomalies averaged over 1979–2020 during PPA days. The box-and-whisker plots show the distribution of anomalies during PPA days. The blue horizontal lines indicate median anomalies; red dots show mean anomalies; vertical lines present the range of PPA and non-PPA day anomalies within the 1.5 interquartile range. The black dots indicate outliers of the anomalies.
Citation: Journal of Climate 35, 19; 10.1175/JCLI-D-21-0926.1

Study on Lightning-Caused Wildfires in Western Canada

This research studied the risk of lightning-caused wildfires in Western Canada from 1981 to 2018. The findings showed that these wildfires tend to cluster together within a certain distance, with northeastern Alberta, central Saskatchewan, and southeastern British Columbia being the most affected areas. The results help us understand where wildfires are likely to occur and can assist in planning and preparation efforts to protect communities and resources. Full publication here

Optimal Cross-Validation Strategies for Selection of Spatial Interpolation Models for the Canadian Forest Fire Weather Index System

Accurate weather data is crucial for the Canadian Forest Fire Weather Index (FWI) System, which helps ensure community, resource, and ecosystem safety. This study compared different methods for evaluating weather data interpolation models used in the FWI system and found that several cross-validation methods identified the same models with the lowest error. This research contributes to improving the quality of historical FWI maps for better fire risk assessment. Full publication here

How Does Cultural Burning Impact Biodiversity?

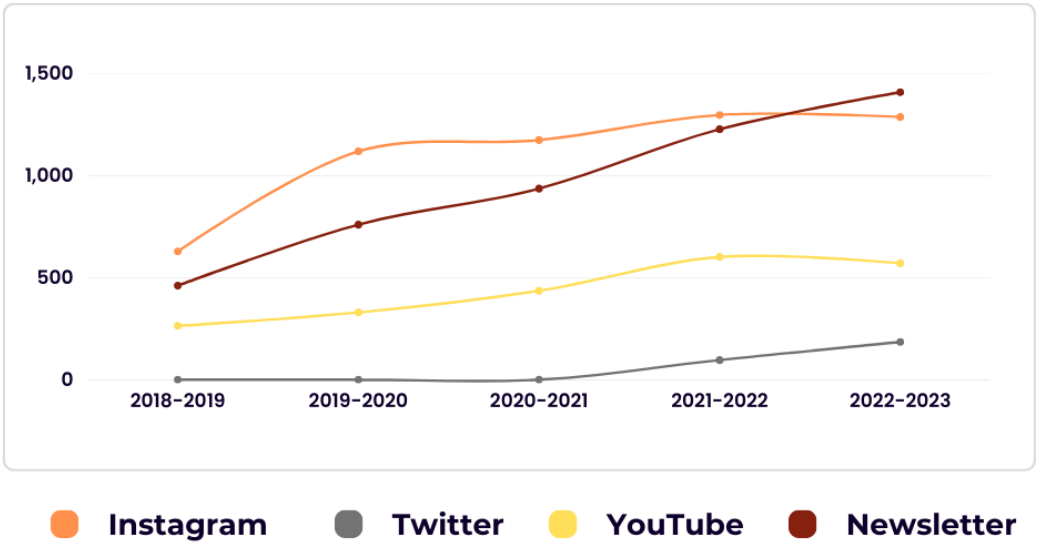
Biodiversity, the variety of life in an area, is essential for healthy ecosystems. However, it is declining globally. Some plants and animals, which are crucial for maintaining biodiversity, depend on natural disturbances like fire. Indigenous peoples have practiced cultural burning for generations to manage ecosystems. Our research reviewed over 1,000 scientific papers spanning 120 years to understand how cultural burning affects biodiversity. We found that when used appropriately and regularly, cultural burning can enhance biodiversity and promote ecosystem health worldwide. Full publication here

EDUCATIONAL ACTIVITIES

Canada Wildfire firmly believes in the power of knowledge and its crucial role in addressing the challenges posed by wildfires. Recognizing the dynamic nature of this field, Canada Wildfire places great emphasis on fostering a culture of continuous learning and professional development. Up until now, the NSERC Strategic Network (Network) has engaged a total of 114 trainees who will contribute to the workforce as skilled individuals. This group is comprised of undergraduate and graduate students as well as post-doctoral fellows. The Network is led by seven researchers and supported by nine co-leads.

In line with their commitment to ongoing education, Network students are expected to actively participate in various online courses to refresh their awareness of critical issues such as confirmation bias and equity, diversity, and inclusion (EDI). Additionally, Canada Wildfire has facilitated access to a range of fundamental wildfire courses available online, covering topics such as fire weather indices, fire line safety, and incident command systems. To enhance the learning experience, approximately 15 Network students had the opportunity to attend in-person sessions prior to the 2022 Wildland Fire Canada conference, fostering an interactive environment conducive to deeper understanding. It is worth noting that these training opportunities have also been extended to students outside the NSERC program upon request. We have also been working with the CIFFC Training Working Group to encourage job shadowing and mentorship opportunities for Canada Wildfire HQP with the various wildfire agencies across Canada.

KNOWLEDGE EXCHANGE ACTIVITIES



Communication efforts have been focused on building awareness around Canada Wildfire research and related wildfire science. The primary intended audiences are Canadian wildfire agencies and researchers. At the research project level, more work is needed to establish a process for agencies and researchers to develop project specific knowledge exchange plans prior to the start of each project. Our partners have agreed that implementation of research is an agency's responsibility, but also acknowledge that knowledge exchange is most successful when there is a strong researcher/agency relationship and communication is maintained throughout the project.

Canada WIldfire continues to offer its monthly webinar series as well as February Flare Up (four webinars in February taking a deep drive into one topic from multiple angles). The webinars primarily feature Canadian wildfire science researchers, but have also allowed opportunities for partner agencies to share new products, projects, and other information. Analytics show that a high proportion of attendees work in Canadian wildfire agencies. These webinars include a live Q&A session, where attendees have time to ask questions of the featured speaker. Sessions are recorded with speaker permission and posted to Canada Wildfire's YouTube channel.

Our YouTube channel was launched in August 2021 as an accessible way to view previously recorded research presentations and webinars. Playlists are based on wildfire topic or event and include but are not limited to Fuels Friday talks, February Flare up, remote sensing, wildfire and water related videos, and fire weather. Since launching, we have 199 subscribers and 1,982 views.

In November 2021, we launched The Ember, our monthly electronic bulletin that delivers quick Canadian fire science updates, academic and job opportunities, lists our latest publications, and shares original Canada Wildfire research stories. The Ember provides timely research updates to our readers. In contrast, the Canadian Wildland Fire and Smoke Newsletter is released twice a year and provides an overview of various topics in Canadian wildfire research. It covers fire management strategies, firefighting efforts, smoke impacts on air quality, and other relevant aspects of wildland fire and smoke in Canada. They provide a platform for researchers, professionals, and stakeholders to share insights, best practices and help facilitate the exchange of knowledge and expertise within the wildfire research community. Both publications feature job postings and academic opportunities related to wildfire research, and practioner communities providing readers with valuable resources for career development and educational pursuits.

CURRENT PROJECTS

Medium Range Forecast Guidance

The objective of the project is to determine the optimal utilization of ensemble weather forecasts for predicting fire weather conditions. Additionally, it aims to identify the most effective use of ensemble weather streams for modeling fire growth. Currently, numerical weather prediction (NWP) model forecasts, including ensembles, have been acquired, along with weather and fire weather observations using the Canadian Fire Weather Index (FWI) System. The analysis has commenced, and a draft report is being prepared.

Full report here

Early Event Detection for Spring Wildfires

Teleconnections are recurring large-scale anomaly patterns of pressure an d circulation. The correlation of teleconnection climate patterns (Oceanic Nino Index, Pacific Decadal Oscillation and Arctic Oscillation Index) and the severity of spring wildfire seasons were be analyzed.

Full report here

Wildfire Fuels and Fire Regimes in British Columbia

This initiative consists of six separate but interconnected projects and is being carried out in concert with the 'Bulkley Valley Research Centre fire research and extension program.' The projects address the topics of fuel loading and fire severity, fuel management efficacy, disrupted fire regimes, fire suppression and fuel loads, and the effects of climate change and disrupted fire regimes on future wildfires.

Full report here

NSERC/Canada Wildfire Strategic Network

This project is a multi-year research project to address several aspects of wildland fire knowledge gaps through a combination of ground based surveys, remote sensing data, numerical analysis and modelling, and operations management studies. The research will involve a collaborative effort with probable users of results and between research agencies. The project leverages existing projects both directly linked to wildland fire and to allied areas of inquiry. The Strategic Network is expected to increase its role as a backbone of wildland fire research to support additional project investments.

Full report here

Firecast Trial

Conduct automated Fire Growth Modelling on one season of fires to evaluate the system utlity and viability. This will include development of full database of driving meteorological models and fire growth model outputs.

Full report here

Firecast Evaluation

Evaluate operational application of automted Fire Growth Modelling and potential role in operations in Alberta.

Full report here

Wildfire Detection Economics in Alberta

Feasibility of emerging detection systems will be evaluated using simulations with different technologies against cost efficiecy of detection systems.

Full report here

Data Analytics for Categorizing Historical Wildfires to Help Suppression Operations

Categorize fires into clustes based on historical resource usage and suppression outcomes to evaluate the ability to predict resources and outcomes for future fires.

Full report here

Development of an Atmospheric Instability Index for use in Alberta

Create a fire behaviour danger index based on atmospheric instability for use in Alberta. The relationship between the vertical structure of the atmosphere and wildfire activity, and in particular large wildfire growth is well known.

Atmospheric instability can have a strong influence on the rate of spread and intensity of wildfires. It supports column development and circulation, which contributes to increasing intensities. We propose to investigate various thermodynamic and severity indices (e.g. Haines Index, Lifted Index, George's K) for their potential application as a decision support tool for wildfire management in Alberta.

Full report here

Developing an Early Warning System Based on Extreme Fire Weather Forecasting

Develop machine learning approaches to wildfire prediction with a specific focus on developing an early warning system based on forecasting extreme fire weather.

Full report here

Stochastic Frontier Analysis of Wildfire Suppression in Alberta: Identifying Sources of Suppression Efficiency

This project aims to improve the efficiency and effectiveness of wildland fire operations by utilizing historical daily data from Alberta Wildfire operations to analyze the factors that impact the operational efficiency of large-scale fire suppression efforts.

Full report here

Psychological Health and Safety in Wildland Firefighting

This project aims to leverage the collective knowledge and expertise about psychological health and safety and the wildland fire intervention program development process to mobilize existing knowledge and best practices from neighbouring jurisdictions and associated industries. Audit the psychosocial climate, including assessing employee experiences and availability and evaluating existing resources, supports and structures. And work with BCWS Organizational Development, Safety and well-being, and Research and Innovation staff to determine how best to implement the findings of this project in the BCWS.

Full report here

Implications of Forest Management and Historical Fire Regimes for Wildfire Risk

This 'fire research and extension program' consists of two projects that are interconnected with and in support of the 'wildfire fuels and fire regimes in B.C.' work being carried out by UBC. These projects focus on providing information on how the implications of past forest management practices relate to the resiliency of current landscapes and on providing data on historical disturbance regimes in the Lakes Timber Supply Area of northern B.C.

Full report here

Aerial Effectiveness

Analyze aerial firefighting operations in Alberta to develop metrics for effectiveness and support decisions about the most effective and cost effective fleet utilization

Report currently unavailable - contact Jen Beverly for more information

Fuel Measurement Implementation

Pair innovative fuel measurements with other field data to improve fuel representation. Used to validate against remote sensing data.

Report currently unavailable - contact Jen Beverly for more information