The 2014 NWT Fires – Developing a Research Framework

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Explorer Hotel, Yellowknife, NWT

Photo credit: Environment and Natural Resources – Government of the Northwest Territories

Prepared by: Jennifer Baltzer (jbaltzer@wlu.ca) and Jill Johnstone (jill.johnstone@usask.ca)

Workshop Summary: Background, Objectives, and Outcomes

The fire season of 2014 saw 3.4 million ha of forested lands impacted by wildfires in the Northwest Territories (NWT), which made this the largest fire season in the NWT's history. The fires were concentrated in the region around Great Slave Lake (Figure 1) and thus affected the majority of NWT residents. Direct impacts to people living in the NWT included dramatic reductions in air quality, closures and damage to roads and power transmission infrastructure, and risks to community safety. In addition, the fires impacted a wide range of ecosystems across several distinct ecoregions and over large wildland areas. The 2014 fire season was long and intense and the impacts of this event will have long-lasting but uncertain impacts for the communities and ecosystems of this region. Climate change is predicted to increase the frequency of these extreme fire years and as such, governments and communities must build the knowledge and capacity to adapt to these changing conditions. Presently predictions about the behavior of fires and their impacts on the affected ecosystems are based upon our understanding of more southerly boreal forests; there is thus a pressing need to improve our understanding of the response of high latitude boreal ecosystems to fire. The 2014 fires present a unique opportunity to address important knowledge gaps across a diverse range of ecological conditions and levels of burn severity in the southern NWT. The aim of this workshop was to bring together local and outside practitioners and researchers to prioritize knowledge gaps and envision a research agenda to address those gaps with new research starting in 2015.

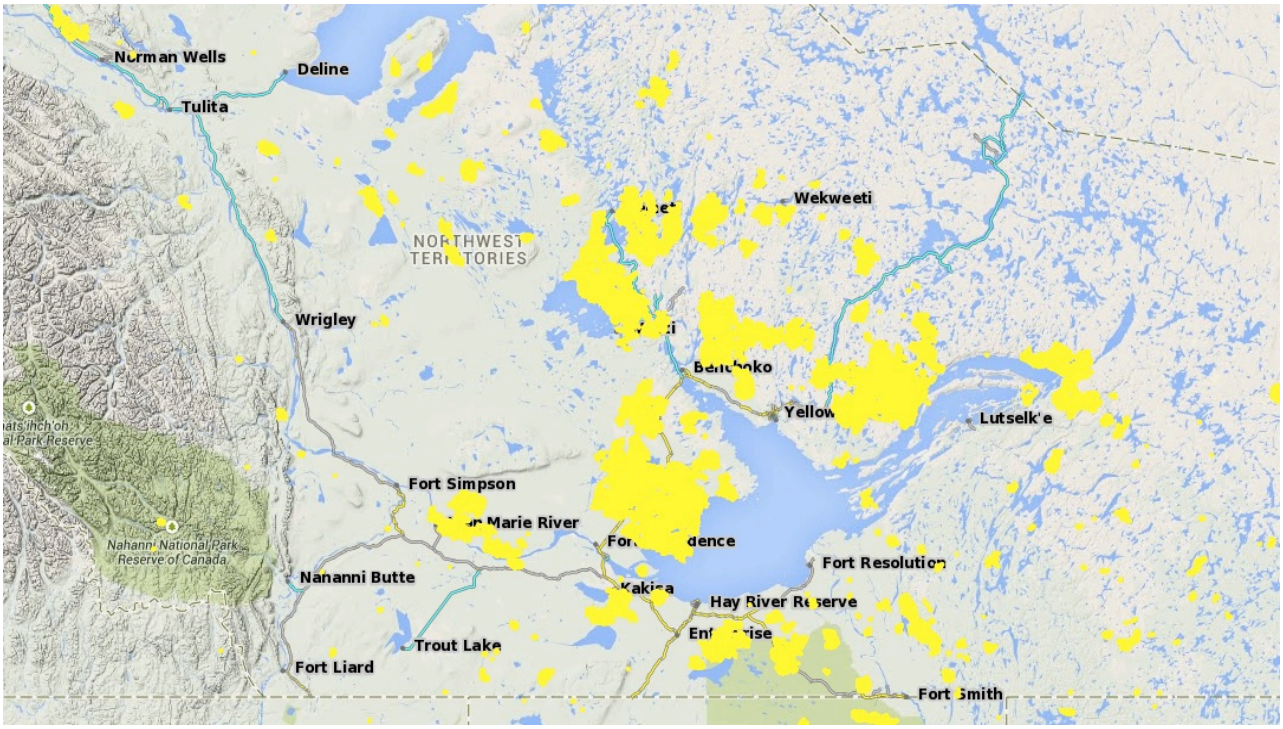

Figure 1: Distribution of wildfires (shown in yellow) in the NWT in 2014.

Participants from the Government of Northwest Territories (GNWT) gathered with researchers from universities and federal government agencies from across Canada and USA to discuss the research needs arising from the 2014 fire. Initial discussions on Day 1 included over 100 participants and focused on summaries of the 2014 fires and their impacts, and identification of key research needs perceived by GNWT representatives. A set of six smaller working groups focused on thematic areas to further identify research priorities and both immediate and longer-term data needs. Day 2 of the workshop saw thematic working groups developing ideas for an initial plan of integrative research

activities to target short, medium, and long term goals, and discussing opportunities to initiate research programs through internal and external funding sources. Importantly, working groups identified a set of immediate data needs that were high priorities to address in the coming 2015 year to characterize initial conditions and immediate post-fire impacts. These critical next steps included a need for developing a field sampling design based on initial assessment of pre-fire conditions and fire characteristics, and implementation of field studies in 2015 to gather field data on initial aquatic, permafrost, and vegetation responses.

Summary of Research Needs presented by the GNWT

The workshop opened with several presentations from representatives of the GNWT, who summarized the events and outcomes of the 2014 fire season that influenced operations and issues of concern for different government departments. **Richard Olsen** (Forest Management) presented an **overview of the 2014 fire season**, noting that 2014 presented a record in terms of annual area burned, and was characterized by extreme wildfire burning conditions and fire behavior. There were substantial impacts on residents and infrastructure caused by the 2014 fires, including impacts on air quality (smoke), transportation, power line infrastructure, and land use impacts caused by fighting fires to secure values at risk. The GNWT faced a number of issues during the fire season that related to concerns about the health and safety of people, protection of values at risk, and wildlife impacts. **Terry Hall** (Department of Lands) further discussed how **land use management**, policies, and procedures are affected by wildland fire both during and after the fire season. **Michael Conway** (Department of Transportation) described some of the **transportation issues** that arose due to the 2014 wildfires, including road closures and health and safety considerations caused by fires intersecting major road networks and extreme low visibility conditions arising from smoke. Now that the immediate impacts of the fires are over, there remain concerns about the long-term impacts of fires on permanent and winter roads that could be caused by falling trees, permafrost thaw, changes to hydrology, and patterns of winter snow accumulation and melt. **Matt Seaboyer** (Air Quality Programs) used data from the NWT air quality monitoring stations to describe some of the large impacts the 2014 fires had on **air quality**, particularly around Yellowknife, when air quality routinely exceeded health guidelines. His presentation was followed by **Courtney Howard** and **Katherine Kohle** (Health and Social Services) who summarized some of the **human health impacts** caused by smoke from the 2014 fires. Initial health observations suggest an increase in respiratory problems, as well as negative impacts of decreased physical activity during periods of poor air quality.

Several presentations also addressed issues and research needs related to longer term impacts of fire on environments and ecosystems. **Erin Kelly** (Corporate and Strategic Planning) discussed some of the needs related to understanding how fires affect **water quality and aquatic ecosystems**. There are likely to be a number of pathways by which fires affect water, such as by causing changes in runoff, water temperature, water chemistry, and inputs and outputs from lakes, which in turn are likely to change aquatic productivity, fish habitat, and food web structure. The NWT has some initial data on water quality changes in response to the 2014 fires that could provide a basis for further research. **James Hodson** (Wildlife) described some of the expected impacts of wildfires on key wildlife species such as **bison and moose**, and identified research needs that would help predict long-term fire effects on wildlife habitat. Fire disturbance is likely to be particularly important in affecting habitat availability for **woodland caribou and also barren ground caribou** in winter. **Tom Lakusta** (Forest Management) gave an overview of **forest mapping and inventory** data available in the NWT, and highlighted the importance of post-fire succession research to managing and predicting forest change. **David Andison** (Healthy Landscapes Program) further identified the need to better understand **variability in fire impacts** to build our capacity to manage forest landscapes based on natural ecosystem processes and patterns. **Kumari Karunaratne** (Geoscience) discussed some of the potential impacts of fire on **permafrost**, and the key role of played by excess ground ice in determining the degree of impact. Lastly, **Tom Andrews** (Archaeology) described how the territory has relatively little information about **archaeological sites** across much of the 2014 burned areas, and encouraged researchers to get training through his group to identify possible archaeological signs in the field or to host an archaeologist with their field crews.

Presentations by government representatives highlighted a number of **key areas for additional research relevant to the NWT**:

- Best practices for emergency responses during extreme drought and fire conditions
- Predicting fire behavior under extreme burning conditions
- Ecological impacts of extreme fires that create unusual conditions (e.g. complete fuel combustion, burning of wetlands, or re-burning of recently burned vegetation)
- Interactions of fire and drought affecting aquatic and terrestrial ecosystems
- Influence of FireSmart prescriptions and variable fuel conditions on fire behavior
- Cumulative impacts of both fires and fire fighting activities on land use values
- Long-term impacts of fires on permafrost stability, hydrology, and winter conditions, and consequences for infrastructure such as permanent roads, winter roads, and power lines.
- Direct and indirect impacts of fires and smoke on human health
- Best practices for responding to human health issues during and after extreme wildfire events
- Immediate and longer term impacts of fires on water: runoff, water temperature, water chemistry, lake inputs and outputs, aquatic productivity, fish habitat, and food web structure
- Long-term impacts of fires and fire characteristics on patterns of forest succession and rates of habitat recovery for wildlife, especially caribou
- Long-term patterns of lichen recovery after fire
- Use of local knowledge to inform priority areas for wildlife habitat assessment
- Mapping of fire characteristics such as severity and patchiness from remote sensing
- Stratification of field sampling based on mappable features to improve potential to extrapolate to a larger study landscape
- Role of excess ground ice and vegetation cover in determining permafrost degradation following fires
- Scoping of burned areas for archaeological artifacts and unusual or poorly understood organisms to extract additional value from field sampling programs

Working groups: Summary

Working groups convened on the afternoon of Day 1 and for most of Day 2 to discuss priority research questions arising from the 2014 fires, and specifically identify key information needs to address those questions. The table below summarizes the main outcomes from each working group.

Working group	Priority research questions	Immediate information needs
Fire: behavior, mapping, and modelling	• What are the controls on fire size and distribution? • What are the controls on spatial and temporal variations in fire severity? • How can we improve models of both flaming and smoldering combustion? • Are there reliable pre-season indicators of extreme fire years?	• Remote sensing mapping of burned areas, canopy severity, and surface severity • Ground-truthing data for fire severity mapping • Reconstruction of fire behaviour (and suppression activities) on 2014 fires.
Hydrology and terrestrial-aquatic linkages	• What are the consequences of fire for hydrological processes and water quality? • How do fire effects vary with proportion of catchment burned or fire severity? • How do fire effects vary across different ecological regions and permafrost conditions?	• Gauged stream basins in burned and unburned areas • Initial and ongoing monitoring of water quality and particulates • Information on water flow paths before and after fire or, where this is not possible due to lack of pre-burn data, at burned and unburned sites • Monitoring of aquatic organisms and food webs
Terrestrial impacts of fire	• How do pre-existing conditions and fire severity influence patterns of vegetation succession after fire? • Under what conditions do we see vegetation recovering to its pre-fire composition vs. shifting to a new state? • What factors controlled carbon emissions to the atmosphere from the 2014 fires? • How does permafrost vulnerability to thaw influence patterns of vegetation succession?	• Mapped fire conditions and pre-fire vegetation cover • Intensive research basins in burned and unburned areas • Immediate post-fire field surveys of fire severity and regeneration • Establishment of long-term vegetation monitoring plots • InSAR-based DEMs for quantifying thaw settlement following fire • Installation of permafrost monitoring infrastructure
Wildlife responses to fire	• How do wildlife species change their habitat use in response to fire? • What is the rate and pattern of habitat recovery after fire for different wildlife species (caribou, bison, fur-bearers, non-game species)? • What are the patterns of caribou	• Information on wildlife movements before and after fire • Surveys of habitat quality across different fire severities and vegetation types • Surveys of habitat quality with time since fire • Modelling of fire impacts on

	habitat quality within burned areas? • What is the natural range of variability in fire impacts on wildlife habitat based on historic conditions? • What do we expect wildlife habitat suitability and availability to look like with increased fire activity?	wildlife habitat through time
Human responses to fire	• How should we prioritize allocation of human resources during large fire years? • What are best practices for dealing with air quality problems? • What is the effect of large fire years on food security in northern regions?	• Data on air quality and human health issues during the 2014 fire season • Research on best practices • Centralization of decision-making resources • Information on food sources, rates of depletion and recovery

Working group leaders:
Fire behavior and modeling: Mike Wotton, Nancy French, Kris Johnson
Hydrology and terrestrial-aquatic linkages: Chris Spence and Suzanne Tank
Terrestrial impacts: Jill Johnstone and Jennifer Baltzer
Wildlife responses: Fiona Schmiegelow and James Hudson
Human responses: Toddi Steelman and Ashley Mercer

Next steps
- Development of geospatial data layers for integrated site selection (mid-February)
- Coordination of teams and field data collection to address immediate critical needs (Field sampling starting in April)
- Ongoing submission of coordinated funding proposals (CHARS, ABoVE, CIMP, GNWT, NSERC)
- Developing the research community to address social needs

For further information or to get engaged in the research contact:

Workshop coordinators:
Jennifer Baltzer, Wilfrid Laurier University (jbaltzer@wlu.ca)
Jill Johnstone, University of Saskatchewan (jill.johnstone@usask.ca)
Andrew Applejohn, Government of the Northwest Territories

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List of GNWT and local participants and their affiliations

Name	Department	Position	Email
Tom Andrews	ECE	Manager, NWT Cultural Places Program	Tom_Andrews@gov.nt.ca
Glen Mackay	ECE	Assessment Archaeologist	Glen_Mackay@gov.nt.ca
Dr. Kate Kohle	Yellowknife Health and Social Services Authority		kate.kohle@gmail.com
Dr. Courtney Howard	Yellowknife Health and Social Services Authority/ Canadian Association of Physicians for the Environment		courtghoward@gmail.com
Mike Palmer	CIMP	Environmental Monitoring Specialist	Mike_Palmer@gov.nt.ca
Claire Marchildon	CIMP	Environmental Management Scientist	Claire_Marchildon@gov.nt.ca
Pete Cott	CIMP	Environmental Scientist	Pete_Cott@gov.nt.ca
Claudia Haas	Protected Areas Strategy	Protected Areas Biologist	Claudia_Haas@gov.nt.ca
Noni Paulette	Protected Areas Strategy	G.I.S. Analyst	Noni_Paulette@gov.nt.ca
Karin Clark	Wildlife	Wildlife Biologist, Cumulative Effects	Karin_Clark@gov.nt.ca
Jan Adamczewski	Wildlife	Wildlife Biologist, Ungulates	Jan_Adamczewski@gov.nt.ca
Karl Cox	Wildlife	Wildlife tech. Fort Smith	Karl_Cox@gov.nt.ca
Terry Armstrong	Wildlife	Bison ecologist	Terry_Armstrong@gov.nt.ca
James Hodson	Wildlife	Wildlife Biologist, Environmental Assessment/Habitat	James_Hodson@gov.nt.ca
Erin Kelly	ENR	Associate ADM, Corporate & Strategic Planning	Erin_Kelly@gov.nt.ca
Meghan Beveridge	Waters	Water Stewardship Advisor	Meghan_Beverdidge@gov.nt.ca
Derek Faria	Waters	hydrologist	Derek_Faria@gov.nt.ca
Robin Staples	Waters	Aquatic Quality Scientist	Robin_Staples@gov.nt.ca
Stefan Goodman	Waters	Watershed Science Consultant	Stefan_Goodman@gov.nt.ca
Jennifer Fresque-Baxter	Waters	Watershed Management Advisor	Jennifer_Fresque-Baxter@gov.nt.ca
Jim Sparling	Environment	Manager, Climate Change Programs	Jim_Sparling@gov.nt.ca
Kris Johnson	Fire Mgmt	Manager, Fire Science	Kris_Johnson@gov.nt.ca
Colin Avey	NWT Centre for Geomatics	Geomatics Applications Specialist	Colin_Avey@gov.nt.ca
Jurjen van der Sluijs	NWT Centre for Geomatics	remote sensing	Jurjen_VanderSluijs@gov.nt.ca
Matt Fournier	DoT	transportation planner	Matt_Fournier@gov.nt.ca
Michael Conway	DoT	Regional Superintendent North Slave	Michael_Conway@gov.nt.ca
Rob Thom	DoT	transportation planner	Rob_Thom@gov.nt.ca
Daniel Zoe	DoT	Highway Maintenance Supervisor EDZO	Daniel_Zoe@gov.nt.ca
Darrel Gargan	DoT	Highway Maintenance Supervisor FORT PROVIDENCE	Darrel_Gargan@gov.nt.ca
Del Miller	DoT	Regional Manager Highways, YELLOWKNIFE	Del_Miller@gov.nt.ca

Ziaur Rehman	DoT	Design and Construction	Ziaur_Rehman@gov.nt.ca
Muhammad Abu Baker	DoT	Design and Construction	Muhammad_Abu_Bakar@gov.nt.ca
Muhammad Ferdous Ashraf	DoT	Design and Construction	MuhammadFerdous_Ashraf@gov.nt.ca
Ann Kulmatycki	DoT	Structures - Head	Ann_Kulmatycki@gov.nt.ca
Peter Praetzel	DoT	Structures - Project Manager	Peter_Praetzel@gov.nt.ca
Salim Sarwar	DoT	Structures - Senior Project Officer	Salim_Sarwar@gov.nt.ca
Pietro Debastiani	DoT	Assistant Director	Pietro_Debastiani@gov.nt.ca
Mahabub Rahman	DoT	Technical Services	Mahabub_Rahman@gov.nt.ca
Tom Lakusta	Forestry	Manager, Forest Resources	Tom_Lakusta@gov.nt.ca
Dr. David Andison	Forest Research Institute	Healthy Landscapes Program Coordinator	andison@bandaloop.ca
Andrew Applejohn	Environment	Senior Science Advisor	Andrew_Applejohn@gov.nt.ca
Matthew Seaboyer	Environment	Air Quality Programs Coordinator	Matthew_Seaboyer@gov.nt.ca
Ashley Mercer	Aurora Research Institute		amercer@auroracollege.nt.ca
Frank Lepine	Fire Mgmt	Associate Director	Frank_Lepine@gov.nt.ca
Richard Olsen	Fire Mgmt	Manager, Fire Operations	Richard_Olsen@gov.nt.ca
Larry Nixon	Fire Mgmt	A/ Manager Fire Science	Larry_Nixon@gov.nt.ca
Mathew Coyle	Fire Mgmt		Matthew_Coyle@gov.nt.ca
Mike Gravel	Fire Mgmt	Manager Forest Management Services	Mike_Gravel@gov.nt.ca
Jakub Olesinski	Fire Mgmt	Ecosystem Forester	Jakub_Olesinski@gov.nt.ca
Jeff Walker	ENR	Regional Superintendent	Jeff_Walker@gov.nt.ca
Valerie Jackson	NTGO	Project Geologist,	Valerie_Jackson@gov.nt.ca
Kumari Karunaratne	NTGO	Manager, Geoscience Information Services	Kumari_Karunaratne@gov.nt.ca
Terry Hall	Lands - Land Use and Sustainability	Director	Terry_Hall@gov.nt.ca
Lorraine Seale	Lands - Land Use and Sustainability	A/Director	Lorraine_Seale@gov.nt.ca
Gina Ridgely	Lands - Land Use and Sustainability	Manager, Sustainability	Gina_Ridgely@gov.nt.ca
Lindsay Armer	Lands - Land Use and Sustainability	Manager, Land Use Planning	Lindsay_Armer@gov.nt.ca
Sandra Bradbury	Lands - Territorial Lands	Lands Administration Team Lead	Sandra_Bradbury@gov.nt.ca
Bill Peck	Lands - Commissioner's Land	Geomatics Specialist	Bill_Peck@gov.nt.ca
Scott Stewart	Lands - North Slave Region	Regional Superintendent North Slave	Scott_Stewart@gov.nt.ca
Conrad Baetz	Lands - Beaufort Delta Region	Regional Superintendent	Conrad_Baetz@gov.nt.ca
Jamie Chambers	ENR - FSU	Head, Field Support Unit	Jamie_Chambers@gov.nt.ca
Danny Beaulieu	ENR	Renewable Resource Officer	Danny_Beaulieu@gov.nt.ca
Ivan Russell	MACA	Manager, Emergency Measures	Ivan_Russell@gov.nt.ca
Dave Fox	Environment Canada	air quality specialist	Dave.Fox@ec.gc.ca
Bruce Hanna	FSU	Regional Science Coordinator	Bruce_Hanna@gov.nt.ca

List of visiting researchers and their affiliations

Name	Affiliation	Email
Jennifer Baltzer	Wilfrid Laurier University	jbaltzer@wlu.ca
Laura Bourgeau-Chavez	Michigan Tech	lchavez@mtu.edu
Michael English	Wilfrid Laurier University	menglish@wlu.ca
Mike Flannigan	University of Alberta	mike.flannigan@ualberta.ca
Nancy French	Michigan Tech	nhfrench@mtu.edu
Ron Hall	Canadian Forest Service	Ron.Hall@NRCan-RNCan.gc.ca
Ed Johnson	University of Calgary	johnsone@ucalgary.ca
Jill Johnstone	University of Saskatchewan	jill.johnstone@usask.ca
Jay Jones	University of Alaska Fairbanks	jbjonesjr@alaska.edu
Eric Kasischke	University of Maryland	ekasisch@umd.edu
Bob Kochtubajda	Environment Canada	Bob.Kochtubajda@EC.gc.ca
Sonja Leverkus		shiftingmosaicsconsulting@gmail.com
Toni Lewkowicz	University of Ottawa	alewkowi@uottawa.ca
Michelle Mack	Northern Arizona University	Michelle.Mack@nau.edu
Branda Nowell	North Carolina State University	blnowell@ncsu.edu
Marc-André Parisien	Canadian Forest Service	Marc-Andre.Parisien@NRCan-RNCan.gc.ca
Bill Quinton	Wilfrid Laurier University	wquinton@wlu.ca
Colin Robertson	Wilfrid Laurier University	crobertson@wlu.ca
Fiona Schmiegelow	University of Alberta & Yukon College	fschmieg@ualberta.ca
Chris Spence	Environment Canada	Chris.Spence@EC.GC.CA
Toddi Steelman	University of Saskatchewan	toddi.steelman@usask.ca
Ron Stewart	University of Manitoba	Ronald.Stewart@umanitoba.ca
Suzanne Tank	University of Alberta	suzanne.tank@ualberta.ca
Merritt Turetsky	University of Guelph	mrt@uoguelph.ca
Mike Wotton	University of Toronto	Mike.Wotton@NRCan-RNCan.gc.ca