# The 2014 NWT Fires – Developing a Research Framework

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

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**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.

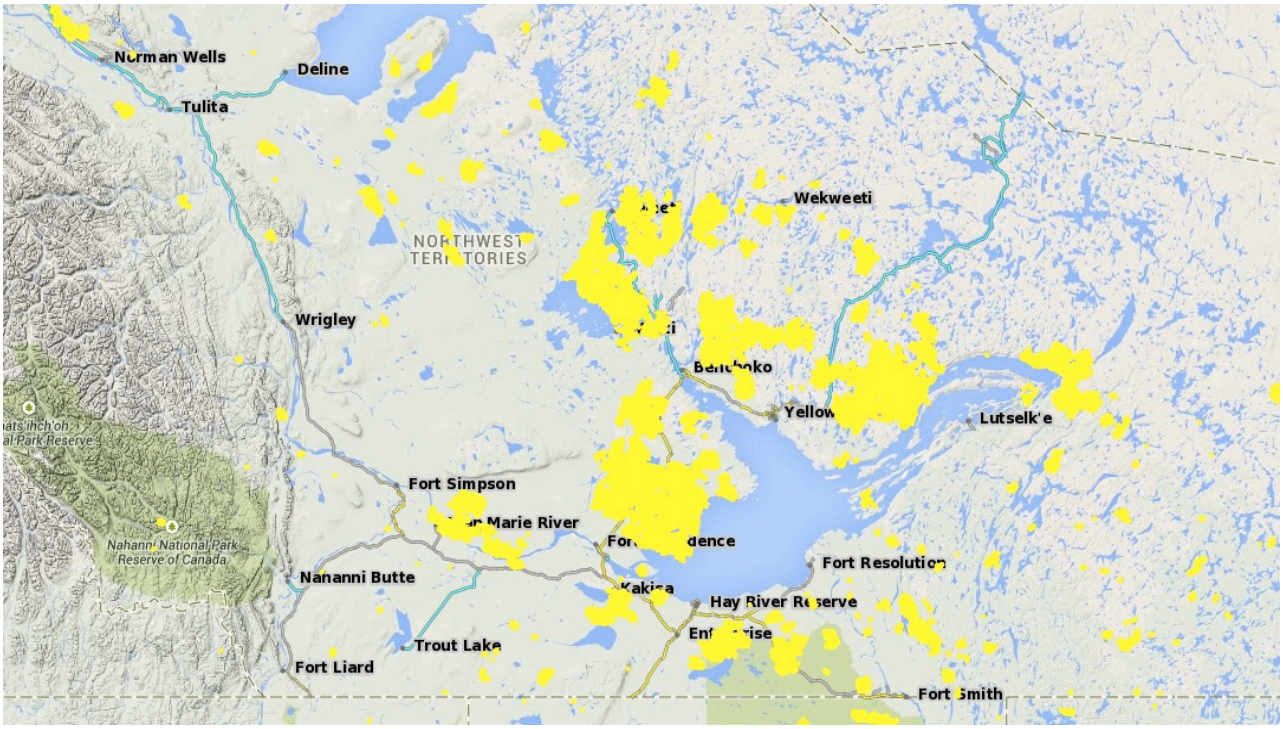


**Figure 1:** Distribution of wildfires (shown in yellow) in the NWT in 2014.

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?<br>• What are the controls on spatial and temporal variations in fire severity?<br>• How can we improve models of both flaming and smoldering combustion?<br>• Are there reliable pre-season indicators of extreme fire years? | • Remote sensing mapping of burned areas, canopy severity, and surface severity<br>• Ground-truthing data for fire severity mapping<br>• 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?<br>• How do fire effects vary with proportion of catchment burned or fire severity?<br>• How do fire effects vary across different ecological regions and permafrost conditions? | • Gauged stream basins in burned and unburned areas<br>• Initial and ongoing monitoring of water quality and particulates<br>• 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<br>• 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?<br>• Under what conditions do we see vegetation recovering to its pre-fire composition vs. shifting to a new state?<br>• What factors controlled carbon emissions to the atmosphere from the 2014 fires?<br>• How does permafrost vulnerability to thaw influence patterns of vegetation succession? | • Mapped fire conditions and pre-fire vegetation cover<br>• Intensive research basins in burned and unburned areas<br>• Immediate post-fire field surveys of fire severity and regeneration<br>• Establishment of long-term vegetation monitoring plots<br>• InSAR-based DEMs for quantifying thaw settlement following fire<br>• Installation of permafrost monitoring infrastructure |
| **Wildlife responses to fire** | • How do wildlife species change their habitat use in response to fire?<br>• What is the rate and pattern of habitat recovery after fire for different wildlife species (caribou, bison, fur-bearers, non-game species)?<br>• What are the patterns of caribou | • Information on wildlife movements before and after fire<br>• Surveys of habitat quality across different fire severities and vegetation types<br>• Surveys of habitat quality with time since fire<br>• Modelling of fire impacts on |

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| | habitat quality within burned areas?<br>• What is the natural range of variability in fire impacts on wildlife habitat based on historic conditions?<br>• 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?<br>• What are best practices for dealing with air quality problems?<br>• 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<br>• Research on best practices<br>• Centralization of decision-making resources<br>• 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

**Immediate critical data needs (Table; 0.5 page-1page)**

**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:**

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