Wildfire Prevention Research Priorities and Dependencies

Balancing the potential benefits and risks of wildland fire is a complex task, one that will become more challenging as a result of climate change and increased residential and resource development in forested areas. To support strategic and tactical wildfire management decisions, wildfire managers require tools that are based on research and quantitative analyses.

This list of items identifies knowledge gaps requiring a focused literature review and subsequent gap analysis to identify new research requirements and existing research dependencies, where specific BC based research doesn't exist.

Research Priorities and Knowledge Gaps

Risk Identification and Risk Evaluation

Goal: Design a Wildfire Risk Process for BC at various temporal and spatial scales.

Defining the Wildfire Threat – Ecological and Disturbance Factors

1. Further develop tools for fire behaviour modelling used at an operational/ planning level to assist in the development of fire threat/ risk/ behaviour models for Wildfire One.
2. Fire Behavior – weather, climate (including climate change), ignition, and disturbance (wildfires, forest health, harvesting, etc.).
    a. Determining Ignition Potential theoretically or historically – Analyze BC lightning analysis to determine probability of ignition.
    b. Fuel Typing Approaches for BC that improves the spatial data set for Fire Behaviour Prediction.
        i. Research needs to inform assignment of existing and development of new fuel types or fuel type derivatives for BC ecosystems. Development of fuel type models for the non-typical forest types found in BC.
        ii. Research into how to assign fuel types and the associated implications – (e.g. typing overgrown stands and C3 vs C7).
        iii. Modeling wildfire spread rates in mountain pine beetle-affected forest stands and forest health related fuel types (MPB grey attack and increases to surface fuel loads, spruce bark beetle Swiss needle cast, etc.).
        iv. Validation of fire behaviour models in coastal fuel types.
    c. Lapse Rate tool useful for fire behaviour prediction in mountainous terrain of BC.
    d. Fire Threat and Fire Growth Modelling - Modelling tools are based on data mostly from outside BC, and adapting model outputs to BC vegetation types requires research, monitoring, and calibration.
        i. Burn P3 modeling tool research on key inputs – ignition grid development and spread event days – also research into future burn probability analysis based on climate change.

ii. Understanding methods, challenges and constraints to using Burn P3 in mountainous terrain.
iii. Evaluation of new models used by other agencies for operational use in BC.
iv. Studying and designing linkages between different modelling tools. Many existing software applications used for fire behaviour prediction and fire management are currently 'stand-alone' applications.

3. Fire Ecology and Fire Effects
    a. Understand historic fire regimes associated with various BC ecosystems and post-fire succession in BC ecosystems.
    b. Quantify current seral stage distribution in relation to the natural range of variation and implications of altered vegetation patterns to wildfire risk. Provides baseline data for the development of a business case for a managed wildfire strategy, prescribed burn program, and fuel treatment program.
    c. Understand the relationships between fire behaviour, fire effects and ecosystem response. Aids in the prediction of the wildfire impacts, which is a key input when planning and executing managed wildfires, prescribed burns, or fuel treatments.
    d. Understand Aboriginal burning practices and associated fire effects related to fire regimes and fire ecology.

Defining the Wildfire Threat– Human Factors

1. Determine Ignition Potential theoretically or historically – Analyse BC human caused fire starts to determine probability of ignition.
2. Quantifying the risk (probability x consequence) of interface fires separately.
    a. How to measure probability?
    b. How to measure consequence?
3. Quantifying risk to isolated critical infrastructure

Wildfire Risk

1. Methodologies for defining the WUI spatially and research into the impacts of different approaches for use in BC.
    a. Structure density thresholds
    b. Escape Routes: Rural areas in mountainous terrain following long winding highways
2. Quantify anticipated consequences and losses:
    a. Determining what the acceptable level of risk to BC's Values – how to define it? What methods of measuring?
        i. Relative weighting values at risk requires research into fire effects on values unique to BC and to inform subsequent weighting
        ii. Weighting elements to determine final risk ratings.
3. Quantify probability of loss:
    a. Factors that affect suppression success in BC's circumstances.

Longer Term

1. Assessing climate change, climate variability and wildfire in BC
    a. Improve downscaling of local weather prediction.
    b. Effects of climate change on fire occurrence in BC, the complex combination of influences makes it difficult to identify clearly whether any measurable changes in the patterns of wildland fire over the last few decades can be linked directly to climate change.
    c. Expected shifts in wildfire patterns; interpreting how climate change and climate variability may alter patterns of lightning, fuel moisture, temperature, precipitation and vegetation—all factors that can affect fire occurrence.
        i. Examine trends in local and regional key weather (wind speed and relative humidity) indices with respect to fire occurrence and behaviour e.g the length of the fire season and how the fire season length may change as a result of climate change.
    d. Ecosystem distribution (changing fuel types) examining the relationship between climate projection and areas burned.
    e. Ecological impact of large scale high severity fires.

Residual Risk Reduction

Goal: Reduce residual risk through science based mitigation activities.

Fuel Treatment

1. Fuel Treatment Design in BC's ecosystems (most research is from the US).
    a. Data Collection and Mensuration – research into the accuracy of various sampling techniques and fuel loading determinations including qualitative vs quantitative.
    b. Modelling fire behaviour potential in relation to fuel treatment dynamics – what are the best approaches to maximizing fuel treatment placements across the landbase to reduce risk to values (i.e. cap selected landscape units or target from the community/value out)?
    c. How to best evaluate effectiveness - Burn P3? What criteria average HFI? Fire size?
    d. Understanding how to design fuel treatments or prescribed burns in cool interior and forests such as pine beetle-affected and interior spruce stands that have almost never been studied. Coastal forests? (e.g .opening up stand to increase wind speed and blowdown risks).
    e. Maximizing benefits of fuel modification approaches, thresholds and targets (thinning, mulching, pruning and Rx Fire) – cost/benefit analysis.
2. Fuel Treatment Effectiveness
    a. Simulating treatments over time at stand and landscape scale in current and climate change scenarios. Continue developing TASS modeling to link stand attribute growth to fire behaviour.
    b. Research to support how to measure effectiveness of fuel treatments including prescribed fire; Post Fire: area burned, values at risk saved, suppression costs? Without Fire: How to measure/predict potential reduction in risk?
    c. Studies on duration of effectiveness of treatments, and how to best maintain benefits over time.

   d. Effectiveness of treatments to inform balancing between objectives.
      i. Identifying fuel and fire behaviour considerations of biodiversity wildlife, watershed management, and other values. How to measure?
   e. Economics of fuel treatments at multiple spatial scales from the interface to the landscape.
   f. Ecological impacts of treatments including relationship between fuel treatments (prescribed fire) and short / long term carbon equilibrium.
   g. Carbon emission and sequestration potential from different activities – understanding the relationship between short term carbon release and long term carbon sequestration.
3. How do land use practices affect wildfire risk?
   a. Evaluation of the relationship between fuel hazards associated with post-harvest debris and fire risk especially around communities – assess potential fire behaviour and threat in these areas – retroactively study existing fires and compare with waste levels and harvesting methods. Research to validate and improve hazard abatement standards.
   b. Research into the implications of including and excluding the appropriate type, location and quantity of both natural and prescribed fires on the various landscapes in consideration of resource and community values.

Firesmart

1. Relationship between FireSmart structure and home ignition zone treatments, fuel treatments and risk reduction.
2. Most effective communication methods to engage public in FireSmart principles.
3. Analysis of the FireSmart Program in BC, assessing public's reluctance to practice FireSmart principles and their reasons for applying them

Public Perceptions of Wildfire Prevention

1. Understanding public perception of risk and risk tolerance in BC and the relationship to wildfire.
2. Understanding the social, psychological and cultural factors that shape people's understanding of fire hazards and their readiness to respond to the risks in BC.
3. Public acceptance of risk reduction through fire management options.
4. The factors that influence community and household mitigation efforts.
5. Research into effective communication strategies/tactics.

Longer Term

Wildfire Fire Economics

1. Estimating the potential true costs of fire?
2. Calculating the full impacts of wildfire beyond suppression and rehabilitation costs to include environmental and social impacts?
   a. Adding the value of ecological goods and services.
   b. Loss of values/resources

c. Loss of income
d. Lost tax revenues
e. Loss of human life
f. Health problems associated with smoke, and mental health needs
g. Benefit of avoided/mitigated future fire

Remote Sensing

Studying links between various data sources used for active fire intelligence and post fire impacts. Remote sensing (mainly satellite) tools used for fire progression mapping, fire perimeter scanning, burn severity monitoring, smoke plume modelling, post wildfire natural hazards. CFS is currently doing some of this work, need to ensure we are linking into the processes and procedures.

If you have any questions please contact

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