"Connecting diverse wildland fire, emissions, air quality and modelling communities."

Canadian Partnership for Wildland Fire Science

This is a revised extract from the Canadian Partnership for Wildland Fire Science Strategic Plan.

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Wildland fire is an important and frequent disturbance in Canadian forests. Fire management agencies must understand the fundamentals of this process, as solutions to today's major wildland fire issues require integrated and multidisciplinary scientific approaches. We can no longer treat smoke emissions, climate change, biodiversity and wildland-urban interface issues independently. For wildland fire managers to effectively use fire as a tool to achieve land management objectives while protecting values-at-risks, they need to understand the full suite of consequences of their management decisions. The Canadian Partnership for Wildland Fire Science has a mandate to conduct basic and applied research, as well as education at the public, undergraduate, graduate, and professional development levels. The Partnership positively influences wildfire policy through science and evidence, but does not undertake advocacy activities.

The early growth of the Western Partnership for Wildland Science (WPWFS) had a western Canadian focus, however, the vision of the founding partners (Alberta Agriculture and Forestry; Natural Resources Canada, Canadian Forest Service, Northern Forestry Centre; and University of Alberta, Department of Renewable Resources) was, and continues to be, to foster and support a pan-Canadian collaborative. The new branding of Canadian Partnership for Wildland Fire Science ('the Partnership') conveys building an expanded collaboration that includes new partners from across Canada. The Partnership continues to take leadership in Canada's fire science community.

Canadian Partnership for Wildland Fire Science

The new five-year plan (2016-2021) provides strategic direction for managing and conducting wildland fire research and education through the Partnership. This plan reflects recommendations made by the Formal Review Committee of the 2010-2015 WPWFS Strategic Plan. This is the first plan as the Canadian Partnership for Wildland Fire Science as we seek to team up with new partners across Canada to combine knowledge and resources.

The guiding principles ensure the development of science-informed policies, practices and decision support tools that support the Strategic Directions. Teaching and mentoring the next generation of scientists and practitioners will allow Canada to maintain its position as a world leader in wildland fire science and management. The Partnership governance model integrates an Executive Committee to provide strategic direction, guidance and approval of operating plans with a Management Team to develop and oversee the five-year implementation plan as well as the annual operating plans. Quantifiable performance measures are an essential component of this strategic plan.

IN THIS ISSUE

"Connecting diverse wildland fire, emissions, air quality and modelling communities."

Vision	The Canadian Partnership for Wildland Fire Science (CPWFS) will be an international leader in wildland fire science, shaping wildland fire management in Canada and around the world.
Mission	To provide excellence in wildland fire research, education, and knowledge exchange for the development of innovative policies and practices while teaching and mentoring generations of scientists and practitioners.
Guiding Principles	▪ Excellence ▪ Collaboration ▪ Strategic Alignment ▪ Adaptation ▪ Innovation ▪ Open Science
Strategic Directions	▪ Research ▪ Education ▪ Partnerships and Collaborations ▪ Applications and Communications

Disclaimer: This informal newsletter is produced on behalf of the wildland fire and smoke communities. Articles from government, industry and academia, whether Canadian or international, are welcome. Please visit our website or send an email to cwfsn@ualberta.com for author guidelines. Views and comments in these articles are those of the authors or the organizations they represent, and do not necessarily reflect the views of the Canadian Wildland Fire and Smoke Newsletter.

2017 Conference on Fire Prediction across Scales

October 23-25, 2017.
Columbia University Morningside Campus, USA
more info:
http://extremeweather.columbia.edu/2017-conference-on-fire-prediction-across-scales/

PyroCb: A Volcano-like Firestorm Sending Smoke into the Stratosphere

By Mike Fromm

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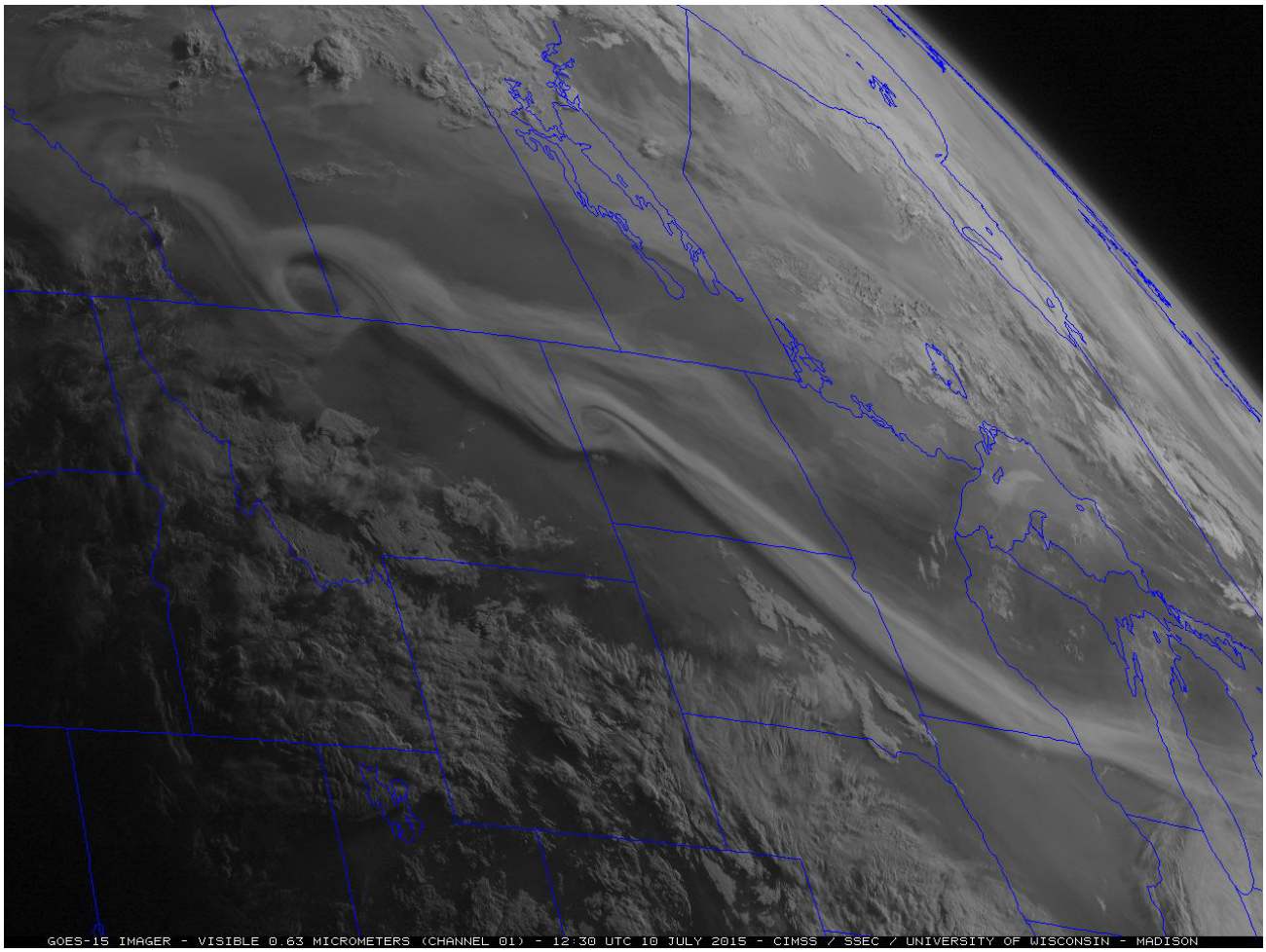
In anticipation of 2017's fire season, a large contingent of scientists (~200 strong, diverse in expertise and interests) is poised to share observations of a remarkable manifestation of wildfire behavior. The pyroCb (short for pyrocumulonimbus), is a thunderstorm on steroids caused by the enormous heat from a wildfire, has attracted the attention of these scientists. The "pyroCb" online discussion group (https://groups.yahoo.com/neo/groups/pyrocb) is a social medium devoted to watching and understanding one of nature's extreme weather phenomena.

When a wildfire attains sufficient instantaneous heat energy release in a favorable weather setting, the smoke column penetrates upward, pushing past the 'boundary layer' (where our air quality is important) right through the entire troposphere (where our weather is formed), into the stratosphere (where only volcanoes were known to pollute). Most of the smoke column is manifested as a water-ice cloud that like its cumulonimbus (Cb) cousin, exhibits lightning and sometimes hail or even a tornado. Unlike the severe Cb though (which generates huge precipitation), the pyroCb produces little or no rain. This is almost certainly because of the enormous concentration of smoke particles that are part and parcel of the combustion driving the firestorm. Given these unusual attributes, the pyroCb may represent a critical factor in fire dynamics and at the same time provide clues to puzzling aerosol-cloud interactions, even the role of cloud

and smoke in the Earth's radiative balance. This is why such a large group of scientists are following pyroCbs around the globe.

The pyroCb group keeps its fingers on the pulse of fire and pyroconvective activity in near real time; with some individuals monitoring fire on the ground, others monitoring via satellite, and still others running global weather models that incorporate pollutions sources such as wildfires and predict plume movement. When conditions are ripe for a pyroCb, or when one has been witnessed, the pyroCb group comes alive with posts giving observations, analyses, even predictions. The data that are shared are generally considered community property, and can take the form of photographs, satellite imagery, model output, smoke-plume maps, and innovative blends of these (and other) data. PyroCb occurrence has been aggregated since 2013. A spreadsheet format is used to catalog pyroCb occurrence with direct qualifiers (such as date, latitude/longitude, onset time) and auxiliary information (such as estimated smoke injection height). By this method, the pyroCb group has counted pyroCb occurrence per year in the dozens, surprising given that 20 years ago the concept of a pyroCb was only known to a very small group of individual eyewitnesses to this volcano-like phenomenon. As we go forward into 2017 and beyond, the pyroCb group will continue to monitor the globe, report on extreme fire and smoke, and encourage multi-disciplinary research into one of Mother Nature's particularly fascinating phenomena.



Visible satellite image of smoke in the upper atmosphere from a pyroCb in British Columbia in July 2015. This smoke plume stretched from the Pacific coast to the Great Lakes Photo Credit: CIMSS - SSEC - University of Wisconsin Madison

Canadian Wildland Fire & Smoke Newsletter

Spring 2017

"Connecting diverse wildland fire, emissions, air quality and modelling communities."

The Canadian Interagency Forest Fire Centre - Roles and Activities

By Kim G. Connors

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Canada's wildland fire management agencies rely on the cooperative support of their fellow agencies, and at times international partners, to address severe fire situations. No agency can practically maintain sufficient resources to deal with its most problematic fire situations on its own. The agencies rely on the sharing of personnel, aircraft and equipment from across Canada to protect people, property and resource values from the threats of unwanted wildfire.

The agencies – including the 10 provinces, the Yukon and Northwest Territories, and the federal government represented by the Canadian Forest Service and Parks Canada – also come together to develop and share policy, procedures, standards and best practices to improve forest fire management in Canada.

The Canadian Interagency Forest Fire Centre Inc. (CIFFC) was opened on June 2, 1982 with a mandate to provide operational forest fire management services to its member agencies, including efforts to gather, analyse and disseminate fire management information to ensure a cost effective sharing of resources, facilitate resource exchange, and to actively promote, develop, refine, standardise and provide services to its members that will improve forest fire management in Canada.

Located in Winnipeg, CIFFC operates the national coordination centre, which monitors the daily fire situation in Canada and internationally, acts as a centre for information exchange, and coordinates the sharing of resources between those agencies requiring assistance to address escalated fire situations, and those agencies with resources available to assist.

CIFFC is also the conduit for the development and sharing of information, operational improvements, and best practices across all facets of the wildland fire management business. A series of committees and working groups involving staff from CIFFC's member agencies and cooperators from academia, other stakeholders and the private sector address priority fire management issues.

Organizational Structure

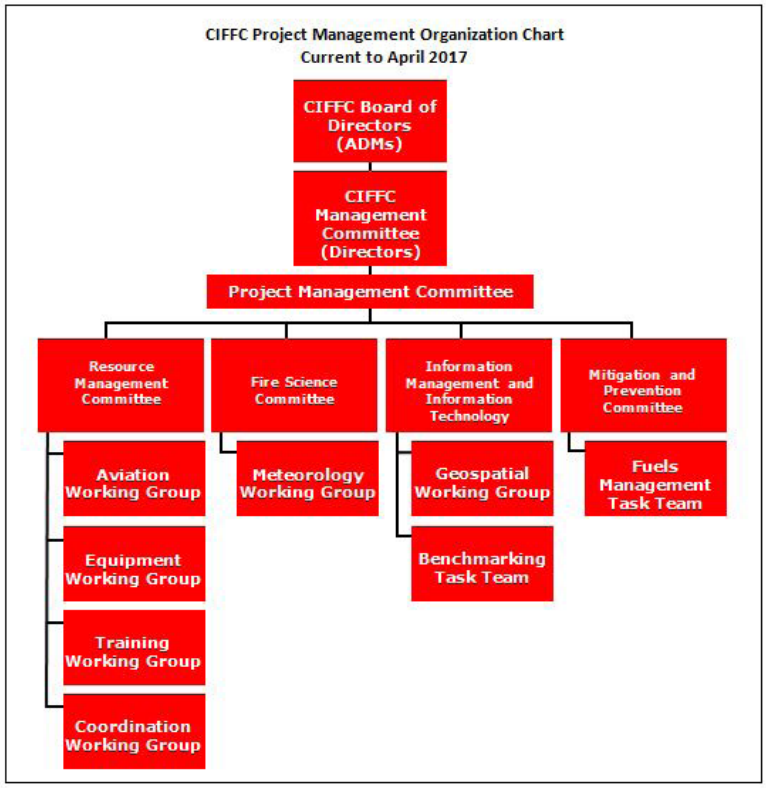
CIFFC operates as a private non-profit corporation with two levels of management which direct the operation:

(1) The Board of Directors is made up of Assistant Deputy Ministers responsible for forestry representing each of the provinces, territories and federal government. This board is responsible for the corporate oversight of CIFFC. They set policy, approve strategic directions and provide fiduciary management.

(2) The Management Committee is comprised of the Directors responsible for forest fire management for each of the Provinces, Territories and representatives of the Federal Government. This group prepares budgets and policies and controls the operation and expenditures of the CIFFC.

CIFFC is led by an Executive Director, and staffed by a small number of personnel who provide leadership in strategic planning, operations, resource and information management, training and administrative support.

CIFFC personnel operate and implement programs approved by the Management Committee and the Board of Directors. In addition, CIFFC coordinates and leads Committees, Working Groups and Task Teams assembled to address specific tasks. The current CIFFC governance structure is shown on next page.



A Modern Funding Approach

Funding for CIFFC is as unique as its management systems. An annual levy charged to CIFFC's member agencies supports the base operating costs of the Centre and its programmes. There is also a charge-back to the agencies using CIFFC's resource exchange and coordination services that support the activities of CIFFC's working committees. The Federal government contributes one-third of the CIFFC's base operating costs. The remaining two-thirds of the base costs plus one hundred percent of collaborative project costs[1] are funded by the provinces and territories on a calculated model which considers many variables relative to the size of their program and use of external resources.

Advanced Resource Sharing

Resources in Canada are shared on a formal basis under the Canadian Interagency Mutual Aid Resources Sharing (MARS) Agreement which outlines three categories of resources: equipment, personnel and aircraft. CIFFC also coordinates development of the cost-recovery formula for resource exchanges, so that there are standard costs for the use of specific resources from each agency, established prior to each fire season.

In addition to this intra-Canadian co-operative agreement, a Diplomatic Note signed with the United States authorises the sharing of resources for fire suppression across the international boundary. The Canada/United States Reciprocal Forest Fire Fighting Arrangement (CANUS) combined with several other exemptions allows for quick movement of resources across the international border, essential during an escalated fire season.

Both of these documents lay out the terms under which resources can be legally shared, how resources will be made available, what costs will be involved and the conditions for their return.

In addition to co-operating with the United States, the CIFFC and its member agencies have arrangements with Australia, Mexico, New Zealand and South Africa. Requests for assistance from and to other countries are negotiated on an as-and-when needed basis. The CIFFC also maintains membership with international organizations such as the North American Forestry Commission and the Global Fire Monitoring Centre.

The Hot, Dry Season

During the fire season, CIFFC operates its national coordination centre seven days a week. An integral part of its operation is the "situation report" which provides information and intelligence on the fire situation and resource availability to all member agencies. CIFFC also identifies available resources moving to and from participating agencies including aircraft, personnel, equipment and speciality items.

The CIFFC coordination centre sets a National Planning Level from 1 (low) to 5 (most severe) each day during the fire season, as a measure of the current and forecast level of fire activity across the country, and of the current and

[1] Parks Canada contributes to the collaborative project costs

Image 1: South African firefighters imported for the Horse River (Fort McMurray) Fire in 2016.

Image 2:Inside the CIFFC Response Centre

expected level of resource exchange and availability. If the national planning level reaches level 3, there are two groups that are implemented under the CIFFC structure;

1. The Canadian Multi-Agency Coordination (CMAC) Group is made up of senior operational decision makers from each of the CIFFC member agencies. This group discusses the current and projected need for external resources and are the first level of decision making on the allocation of scarce resources.

2. The CIFFC Strategic Planning Unit is made up of CIFFC senior staff, forecasters from the Canadian Forest Service, international liaison(s) from Natural Resources Canada and various members of the Government Operations Centre in Ottawa.

The CIFFC Coordination Centre maintains daily contact with the National Interagency Coordination Center (NICC) in Boise Idaho and through the Canada/United States Reciprocal Forest Fire Fighting Arrangement, exchanges resources as needed across the international boundary.

In recent years and more frequently, the CIFFC is required to maintain regular contact with other international partners throughout the season. During escalated fire situations in Canada when significant numbers of international resources have been imported to assist the Canadian agencies, international liaison officers will be located at CIFFC to help coordinate the deployment of their agency's resources, and ensure a clear flow of information between the international agency and the host province or territory.

The resources imported and exchanged during a severe fire event can be very significant: during the 2016 Horse River Fire that had a severe impact on Fort McMurray, Alberta, international resources including personnel, aircraft and equipment were brought in from the USA, Mexico and South Africa in addition to significant resources from all agencies within Canada. Arrangements had also been made to mobilize resources from Australia and New Zealand if required. CIFFC's role included the coordination of transport, coordination of logistics with sending and receiving agencies, and communication and coordination with federal agencies including Natural Resources Canada, the Government Operations Centre, Public Safety Canada, the Canadian Border Services Agency and others.

Canadian Protection, International Attention

CIFFC has attracted international attention and delegations from various developing nations regularly visit the Centre to review its operations. Through various departments of the Government of Canada, the CIFFC has coordinated Canadian response to international requests for assistance. These requests for international assistance will continue and the CIFFC, along with member agencies and Canadian corporations will be organized to address these requests.

The Canadian Interagency Forest Fire

Centre will continue to be front and centre in forest fire management by helping our neighbours around the world.

The Future

The Canadian Council of Forest Ministers originally directed CIFFC to promote and improve fire management on a national level. The Centre continues to meet this challenge through its agreements and the development of standards and collaborative projects through various Working Groups.

Internationally, CIFFC will continue to promote Canadian fire management technology in the global market place.

These programs, in concert with existing fire management programs, will all contribute to a better organization and a more efficient fire management system for Canada.

Wildfire Remote Sensing Workshop, 20 – 22 June 2017 in Montreal, Québec

By Helena van Mierlo

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The Wildfire Remote Sensing Workshop (https://crss-sct.ca/conferences/csrs2017/wildfire-remote-sensing-workshop/) is a 2.5 day long program within the larger Earth Observation (EO) Summit 2017 (https://crss-sct.ca/conferences/csrs2017/). The workshop will bring together the Canadian and international community involved that uses remote sensing as applied to wildfire and touches as well on popular topics such as the use of drones, international collaboration and the cost of fires.

The objectives of the workshop are:

1. To provide a status on current capabilities in remote sensing applied to all phases of wildland fire management and research (pre-fire, during fire and post-fire).

2. To better understand the challenges related to implementing remote sensing and fire research into operational fire management.

3. To identify areas of collaboration between ground, air and space capabilities to strengthen wildfire management in Canada and abroad.

4. To bring together leaders and

experts in the remote sensing and wildland fire community from Canada and abroad to explore, discuss, establish or strengthen collaborations and partnerships to support wildland fire management and research.

Next to presentation sessions and theme discussion sessions, two panel discussions will be held on 'Bridging Research and Reality' and 'Ground, Air and Space helping each other out' with Canadian and international representatives from the federal and provincial government, industry and academic world represented in the panels. In addition we are pleased to announce that Prof. Martin Wooster of King's College London and Prof. Mike Flannigan of the University of Alberta have accepted to be keynote speakers at the EO Summit 2017.

As a general EO Summit participant your access will not only be limited to the Wildfire Remote Sensing Workshop but you will have free participation in the complete EO Summit 2017 program which includes keynotes from renowned speakers related to other Earth Observation areas, and a number of exciting training and special events.

Looking forward to meeting you at the EO Summit in June 2017!

Workshop co-leads:

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Moisture Changes from Sprinkler-watering

By Devon Barnes[1], Greg Baxter[2], and Eric Miller[3]

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Abstract

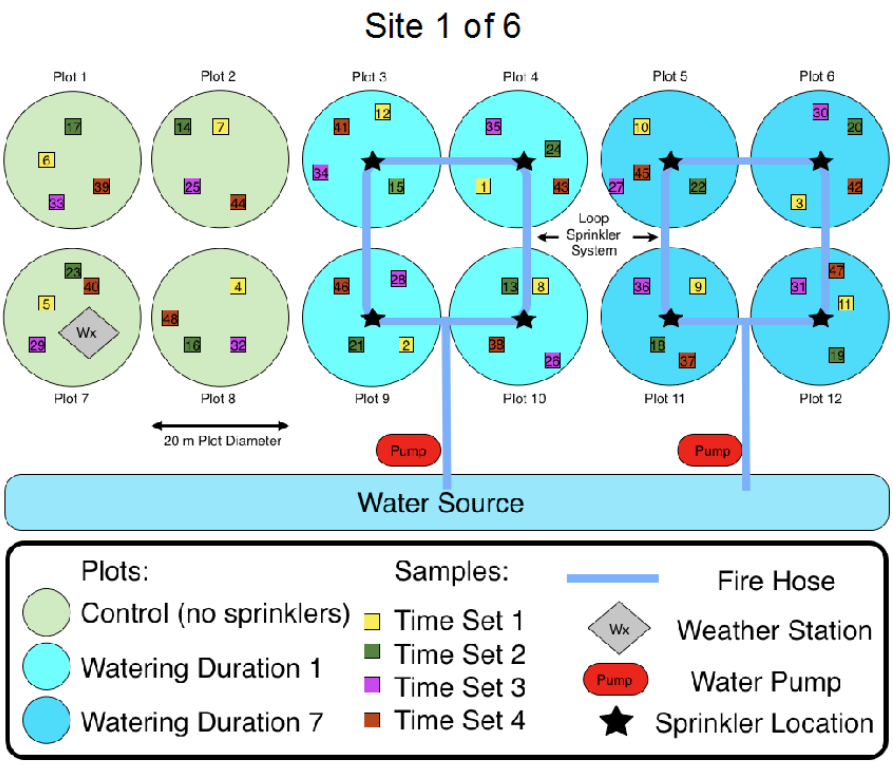
Interest in the use of sprinklers to support wildfire operations has generated questions about how they impact fuel moisture. Fuel moisture is a measure that fire managers use to assess availability of organic matter for fires to burn. This report documents the amount of water distributed and fuel moisture changes from sprinkler-watering treatments using a loop sprinkler system. It is recommended that feather moss (0-5 cm) and upper-duff (5-13 cm) in lowland boreal forests receive 10 and 20 mm of sprinkler-watering to raise moisture near saturation levels for a 24-hour period. If sprinklers were combined with fuel treatments and prescribed fire, they could help manage forest dynamics by controlling the spread and intensity of wildfires around assets.

Introduction

There are wildfire stories and studies that describe how sprinkler systems can be a valuable tool for managing fire behaviour. The impact of wetting fuels' surface is understood, but water absorption and retention is rarely considered. This study measures sprinkler-watering duration's effect on fuel moisture changes to quantify the efficient use of sprinkler systems for operations. More importantly, sprinkler systems remove firefighters from dangerous wildfire situations, while allowing them to introduce wildland fire proactively in a controlled manner.

Methodology

A sprinkler treatment is a combination of watering duration and intensity. To measure sprinkler watering duration's effect on fuel moisture changes, this study controlled watering intensity by attaching a 345 kPa pressure regulator to the sprinklers. As well, the water pump throttle was set to very low (step 4) to control gas consumption. Then 7 watering duration levels were tested by changing the amount of gas supplied to the water pump. Figure 1 shows each research site had a control treatment and 2 watering duration levels that were examined using 12 treatment plots containing 48 samples. Sample locations were randomly placed, and the plot sampling order was balanced into 4 time sets throughout the afternoon. Each sample measured the water distribution and fuel moisture before and after sprinkler-watering. Sprinklers were operated during the evening to maximize fuel moisture changes, and a portable weather station was also setup inside a control plot to record local weather during the experiment.



Time Set	Site Sample Order											
	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th
1	Plot 4	Plot 9	Plot 6	Plot 8	Plot 7	Plot 1	Plot 2	Plot 10	Plot 11	Plot 5	Plot 12	Plot 3
2	Plot 10	Plot 2	Plot 3	Plot 8	Plot 1	Plot 11	Plot 12	Plot 6	Plot 9	Plot 5	Plot 7	Plot 4
3	Plot 2	Plot 10	Plot 5	Plot 9	Plot 7	Plot 6	Plot 12	Plot 8	Plot 1	Plot 3	Plot 4	Plot 11
4	Plot 11	Plot 10	Plot 1	Plot 7	Plot 3	Plot 6	Plot 4	Plot 2	Plot 5	Plot 9	Plot 12	Plot 8

Figure 1. A research site map showing 2 sprinkler watering duration levels and a control treatment, containing 12 treatment plots and 48 sample locations.

Gas (L) Treatment Level	Sprinkler-watering		Feather Moss			Uppper Duff			Water Pump Operation Time (min)
	Equivalent Rainfall (mm)	Water (L) Consumed [a]	FFMC Before [b]	Moisture Changes [c]	FFMC After [b]	DMC Before [b]	Moisture Changes [c]	DMC After [b]	
0.0	0.0	0	67	-15%	78	44	-12%	50	0
1.9	6.9	2,168	86	188%	8	51	31%	38	98
3.8	10.0	3,142	68	140%	13	58	39%	39	206
4.2	12.5	3,927	47	243%	0	44	73%	20	218
7.6	21.2	6,660	75	280%	0	45	84%	18	424
11.4	28.0	8,796	73	209%	2	67	72%	33	532
15.1	35.0	10,996	51	417%	0	13	115%	0	776
17.0	32.4	10,179	69	356%	0	48	120%	12	869

[a] Assumed sprinkler's spray radius was 10 m. Volume = $(\text{radius})^2 \times \text{pi} \times \text{rain}$

[b] Conversion of mean moss and upper-duff moisture content into fuel moisture codes FFMC and DMC respectively.

[c] Mean moisture changes between before and after measures.

Table 1. Sprinkler-watering duration levels were controlled by litres of gas supplied to the water pump, which produced a sprinkler-watering treatment. The green and brown highlighted rows are the recommended sprinkler-watering treatment levels for feather moss and upper-duff soils respectively.

Results

The sprinkler-watering distribution was variable, because the spray collided with surrounding vegetation. Generally, a longer sprinkler-watering duration caused moisture to seep deeper into soils for prolonged water retention. Table 1 lists the moisture changes caused by different sprinkler-watering duration levels. Notice the sprinkler-watering effect begins to diminish as feather moss and upper-duff values approached situation levels around 10 and 20 mm of equivalent rainfall. To convey the change in fuel hazard, feather moss (0-5 cm) and upper-duff (5-13 cm) moisture was converted into Fine Fuel Moisture Code (FFMC) and Duff Moisture Code (DMC) respectively.

Discussion

Sprinkler systems are an affordable option to help protect assets from wildfires. In this experiment, sprinkler-watering caused a significant change in moisture content between repeated measures. Sprinklers can be used alone or combining treatments: Tree spacing and pruning, sprinkler-watering, and prescribed fire to manage wildfires proactively (Figure 2). In the wildland urban interface, property owners can install sprinkler systems to suppress falling embers and reduce radiant heat around their values. For a broader community-based approach, a sprinkler system provides a containment line for ignition operations if trained personnel are available. Sprinkler protection programs could also play a pivotal role in reclaiming fire-driven landscapes by using "water-fire" tactics that reintroduces wildland fire in a controlled manner to restore ecological resilience.

Conclusion

The use of sprinklers for protection against wildfires should grow, and widespread adoption of sprinkler protection programs will lead to further innovation. A sprinkler-watering treatment influences fire behaviour by hydrating fuels, which can improve firefighter safety by removing them from dangerous wildfire situations. Results show the majority of sprinkler-watering samples achieved moisture changes beyond their ignition threshold. If sprinkler systems were combined with fuel treatments, then wildfires would be easier to control. This research demonstrates that sprinkler systems can help protect people and their property from wildfires, while managing the biological balance between ecosystem renewal and perseveration from wildland fire.

*This article was also featured in FPinnovations Info Note.

It is recommended that feather moss (0-5 cm) or upper-duff (5-13 cm) receive 10 or 20 mm of equivalent rainfall to raise moisture near saturation levels for a 24-hour period.

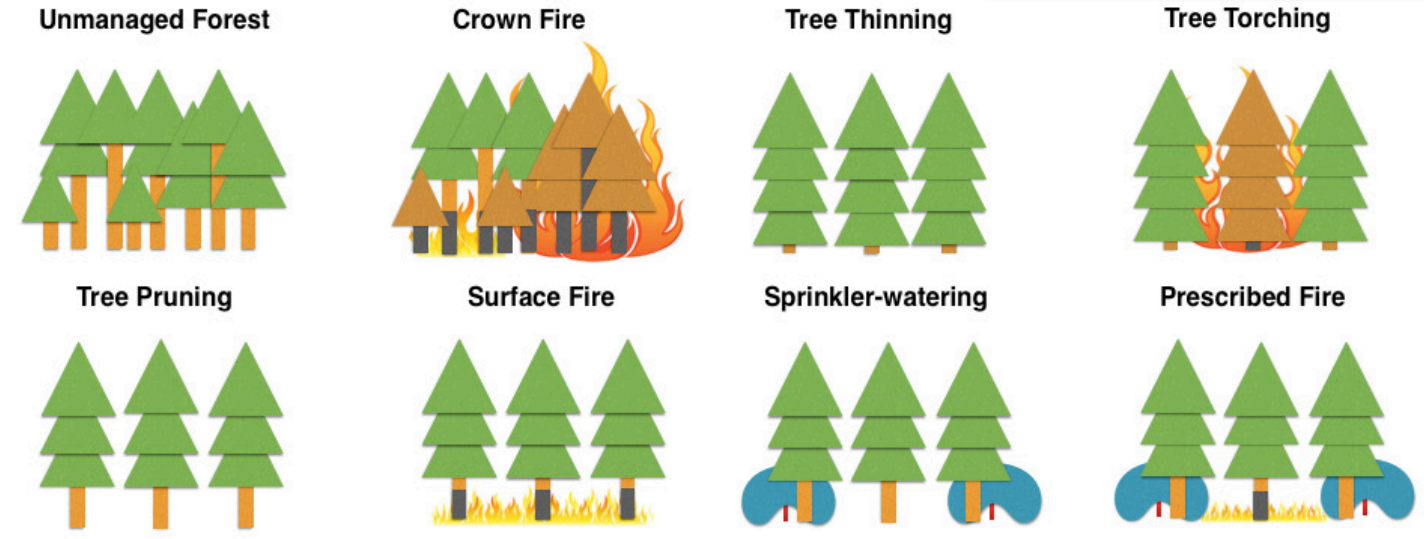


Figure 2. Thinning, pruning, sprinkler-watering, and prescribed fire fuel treatments used to control wildfires.