Documenting Wildfire Behavior: The 1988 Brereton Lake Fire, Manitoba

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Introduction

The documented behavior of free-burning wildfires can be a valuable source of information for both fire researchers and operational staff. For example, in an active fire situation, fire behavior observations provide a basis for suppression personnel to take action and advise personnel. Such information allows them to do the following:

- On a timely basis, inform and update district, regional, and provincial staff of the fire's status.
- Provide information that can be used to brief both the media and the public.
- Ensure the safety of firefighting personnel by directing them away from potentially dangerous situations.
- Make immediate comparisons between actual and predicted fire behavior.

Also, future benefits can be gained from formally recording the influences of weather, fuels, and topography on a fire's behavior. That information can then be used as an effective training tool for suppression staff since individuals relate well to recent real-life experiences in which they may have been involved.

From a fire research perspective, observations of extreme fire behavior can supplement or verify the data presently used in the development of the Canadian Forest Fire Behavior Prediction (FBP) System. The FBP System database currently consists of 245 experimental and operational prescribed fires and 45 documented wildfires (Lawson et al. 1985). Presently, most of the information regarding fire behavior under extreme fire weather conditions is collected from wildfires since it is difficult to arrange and conduct experimental fires successfully under such conditions. A detailed example of a documented wildfire in the Northwest Territories is provided by Alexander and Lanoville (1987).

This note summarizes the information needed to document wildfire spread rates and illustrates that this is not a complicated process but merely one that requires a few key observations. An example, taken from the information recorded by the suppression staff at the 1988 Brereton Lake Fire in southeastern Manitoba, has also been included.

Information Requirements

A summary of the information required to document accurately wildfire spread rates is given below. The FBP System user guide provides a more detailed account of the information needed (Alexander et al. 1984: 61–62).

Forward rates of spread. The position of the head fire at various times during a major run needs to be recorded. Observations can be made easily if landmarks such as roads, creeks, and hydro lines are used to plot the progression of the fire on a topographic map, forest inventory map, or recent aerial photograph.

Position of the flanks. Mapping or noting the positions of the fire's flanks (along with that of the head fire) permits the length-to-breadth ratio of the fire to be calculated.

Other fire behavior observations. Other observations not directly required to document the rate of spread but which can be useful in understanding other aspects of fire behavior are as follows:

- Type of fire (surface fire, torching, crown fire).
- Fire whirl development, occurrence of spot fires, and associated distances.
- Flame lengths or flame heights.
- Smoke column characteristics such as height of column and angle of tilt.
- Suppression effectiveness. (For example, hand-constructed fire guards are challenged but waterbombers are effective.)
- Depth of burn.
- Mop-up difficulty.
- Post-fire evidence such as narrow "streets" of unburned trees associated with horizontal roll vortices.

It is worth noting that a photograph can be an exceptionally useful tool in documenting many aspects of a fire's behavior. A photograph is especially valuable if the time it was taken is also recorded. This may be done manually or a camera with a "databack" attachment can be used.

Fire weather observations and fire danger indexes. The most sig-

[1] The author thanks the many Manitoba Natural Resources staff members who provided information regarding the events of the Brereton Lake Fire, with special thanks to Blair Bastian, Bob Enns, and Don Jacobs for their assistance and cooperation.

During wildfires, suppression personnel are often in the best position to make fire behavior observations.

nificant fire weather parameter to measure during a major fire run is wind speed and direction. Hourly observations of the wind, along with temperature and relative humidity, if possible, should be made at a weather station near the fire. However, if this is not possible, then estimate these parameters at the fire site by using, for instance, the Beaufort Scale to estimate wind speed. The information could also be obtained from a nearby fire weather station or Atmospheric Environment Service (AES) station. Inclusion of the daily fire weather observations that preceded the fire is important for calculating the values of the Canadian Forest Fire Weather Index (FWI) System and for possible future analysis.

Topography and fuel-type characteristics. For documentation purposes, details on the topography and fuel-type mosaic in the fire area can often be described after the fire has occurred. This may consist of information from 1:50 000 NTS topographic maps, FBP System fuel-type maps prepared from Landsat imagery or forest inventory data. However, observations of the fire's behavior in the various fuel types and on different topographic features should be noted.

The 1988 Brereton Lake Fire: A Case Study of Documentation

Observations of the fire behavior at the 1988 Brereton Lake Fire were made by a number of Manitoba Natural Resources staff members who were coordinating the fire sup-

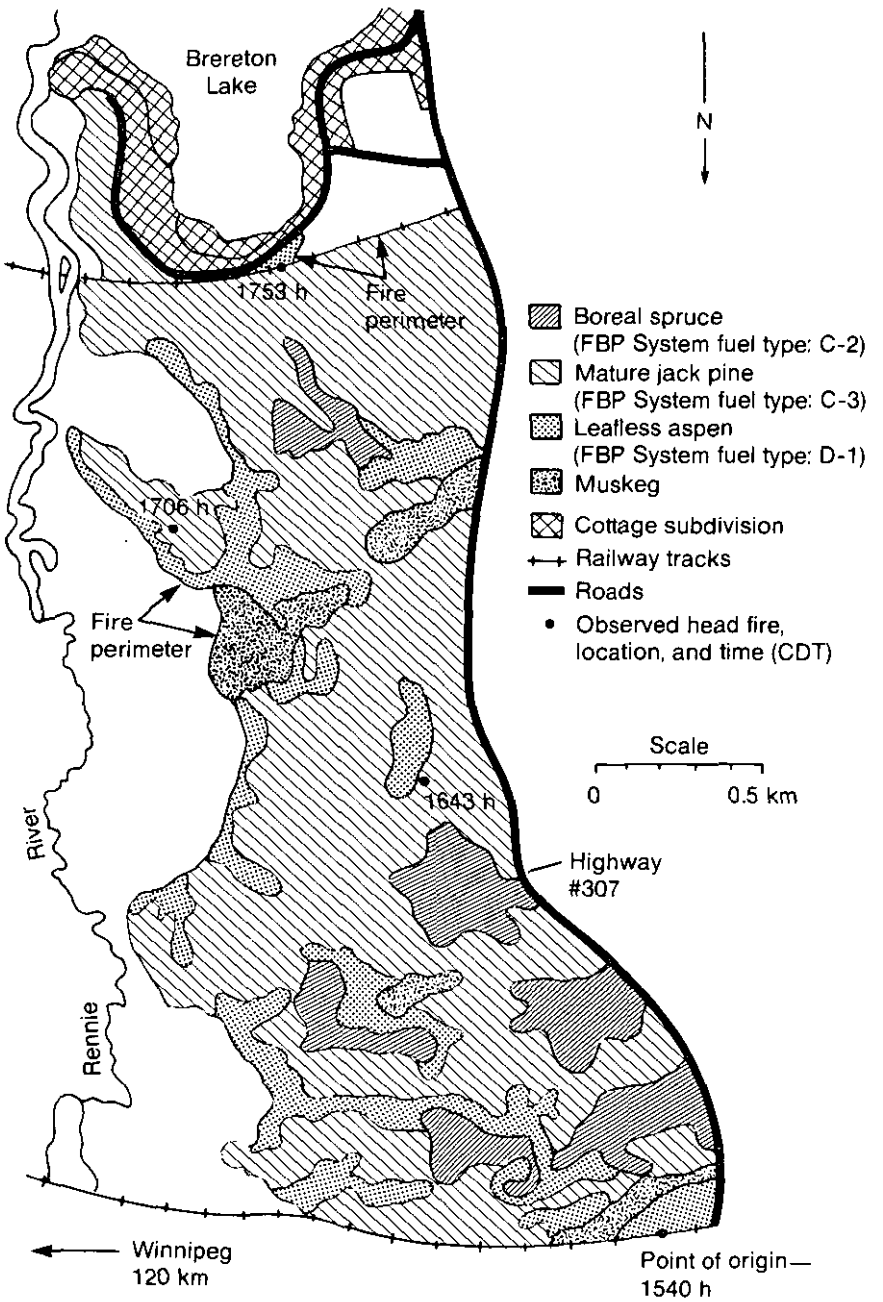

Figure 1—*Fire Behavior Prediction System fuel-type and fire-progress map for the Brereton Lake Fire, May 1, 1988.*

pression activities and positioned primarily in helicopters. This information was recorded verbally on tape and also onto the district radio logs. Given below is a summary of the recorded fire behavior at various times during the major run on May 1 (fig. 1) and how it relates to the information required for documentation.[2]

Forward rates of spread.

- 1540 hours—The fire was detected and reported to the Manitoba Natural Resources office in Rennie. It was located just west of the south railway crossing on Highway No. 307 and was less than 0.25 acres (0.1 ha) in size.
- 1550 hours—The fire crowned almost immediately and was heading northward towards the Brereton Lake subdivision.
- 1634 hours—The head fire was estimated to be approximately halfway to Brereton Lake, a distance of 0.9 miles (1.5 km) from the point of ignition.
- 1706 hours—The fire was on the last ridge before the swamp, a distance of 1.5 miles (2.4 km) from the point of ignition.
- 1753 hours—The head fire crossed the north tracks near the subdivision, approximately 1.9 miles (3.1 km) from the point of ignition.

In summary, the fire spread 1.9 miles (3.1 km) in 2 hours and 13 minutes (133 minutes) for a rate of spread of 76.4 feet per minute (23.3 m/min) or 0.88 miles per hour (1.4 km/h).

[2] Time is central daylight time (c.d.t.).

Position of the flanks.

- 1746 hours—The fire is now spreading at the back.
- 1806 hours—The west side of fire is crowning in black spruce and spreading rapidly.
- 1924 hours—A small spot fire is just east of Highway No. 307.

Other fire behavior observations.

- 1734 hours—The head fire is too intense for crews to work in front of fire so suppression efforts are restricted to the flanks.
- 1920 hours—The first cottage is lost to the fire.

It was also noted that the fire was not continuously crowning; that is, some torching was occurring but spread was not sustained through the tree crowns. The fire spread primarily on the jack pine ridges and only occasionally burned through the black spruce stands. Also, some mop-up difficulty was experienced in areas with a southern exposure; however, this was not the case on north-facing sites due to the presence of ground frost at or near the surface.

By the evening of May 1, crews were able to secure a fireline completely around the fire using both natural fuelbreaks and constructed fireguards. A major suppression effort on May 2, which included the use of three CL-215 waterbombers, prevented any further flare-ups from occurring and effectively brought the fire under control.

Fire weather observations and fire danger indexes. Fire weather information was not available from the Manitoba Natural Resources office at Rennie but a number of other sources were used to establish the conditions that existed before (table 1) and during the fire run on May 1. This included the 1300-hour observations from the fire weather stations at West Hawk Lake and Nutimik Lake; the hourly readings on May 1 from the AES stations at Kenora, Winnipeg, and Sprague, MB; and estimates of the conditions by the suppression staff at the fire. At 1700 hours, during a major fire run at the Brereton Lake Fire on May 1, 1988, the fire-weather and fire-danger condition observations provided in table 2 were made by fire suppression personnel and substantiated with data from the AES weather stations.

Topography and fuel-type characteristics. The fire area is situated at an elevation of 1,082 feet (330 m) above mean sea level (m.s.l.). The terrain is gently undulating and had a minimal effect on the fire's behavior.

The fuel types in this area were primarily mature jack pine (FBP System Fuel Type: C-3) with some small stands of boreal spruce (C-2) and trembling aspen prior to leaf flush (D-1). The forest inventory information for the area within the perimeter of the fire has been broadly categorized according to the FBP System fuel-type classification. A map depicting these fuel types is shown in figure 1.

Concluding Remarks

During wildfires, suppression personnel are often in the best

Table 1—*Fire weather and fire danger conditions which preceded the occurrence of the 1988 Brereton Lake Fire*

Date	1300 hr weather observations [1]							FWI System components [2]					
	Temperature		Relative humidity	Wind		Rain		FFMC	DMC	DC	ISI	BUI	FWI
	(°C)	(°F)	(%)	(km/h)	(mph)	(mm)	(in)						
04/21	2.0	36	73	12.5	7.8	0	0	83	30	236	3.1	46	9
04/22	3.5	38	72	1.5	0.9	0	0	83	31	238	1.7	46	5
04/23	6.0	43	49	7.0	4.3	0	0	84	31	240	2.7	47	8
04/24	9.5	49	47	12.5	7.8	0	0	86	33	243	4.3	49	12
04/25	3.5	38	86	13.0	8.1	4.7	0.19	44	22	235	0.1	35	0
04/26	5.5	42	45	9.0	5.6	0.1	0.01	65	23	237	0.8	36	1
04/27	10.0	50	33	14.5	9.0	0	0	81	24	239	2.5	39	6
04/28	18.0	64	19	16.5	10.3	0	0	91	28	244	11.3	44	23
04/29	22.0	72	18	12.5	7.8	0	0	94	33	249	13.6	49	27
04/30	22.0	72	32	16.0	9.9	0	0	93	36	254	14.4	54	30
05/01	22.5	73	40	27.5	17.1	0	0	91	40	260	20.9	58	39

[1] Observations from the West Hawk Lake (1,085 ft or 331 m m.s.l.) and Nutimik Lake (991 ft or 302 m m.s.l.) fire weather stations were averaged to obtain the values for the Brereton Lake area. Note: these stations are operated by Manitoba Natural Resources and located approximately 19 miles (30 km) southeast and north of the fire area, respectively.
[2] FWI System calculations began on April 21 with the following moisture-code starting values: FFMC–85, DMC–30, and DC–235. Key to acronyms: Fine Fuel Moisture Code (FFMC), Duff Moisture Code (DMC), Drought Code (DC), Initial Spread Index (ISI), Buildup Index (BUI), and Fire Weather Index (FWI).

Table 2—*Fire-weather and fire-danger conditions during a major fire run at the Brereton Lake Fire on May 1, 1988*

1700 hr fire weather observations [1]	
Temperature	79°F (26.0°C)
Relative humidity	21%
Wind	SSE 19 mi/h (30 km/h)
Days since rain [2]	6
Adjusted Fire Weather Index System values	
Fire Fuel Moisture Code	91
Initial Spread Index	22.4
Fire Weather Index	42

[1] Estimates were made by fire suppression personnel and substantiated with data from the AES weather stations at Kenora, 47 mi (75 km) east, 1,348 ft (411 m) m.s.l.; Winnipeg, 75 miles (120 km) west, 784 ft (239 m) m.s.l.; and Sprague, 56 mi (90 km) south, 1,079 ft (329 m) m.s.l.
[2] Greater than 0.6 mm (0.02 in.).

position to make fire behavior observations. This was true at the Brereton Lake Fire. The efforts of the suppression staff resulted in the collection of useful data. Information of this type serves many purposes such as use at post-fire boards of review and verification of the FBP System relationships. Operational staff should be encouraged to make similar observations in the future. ■

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