ACHIEVING LANDSCAPE FIRE MANAGEMENT GOALS IN THE SOUTHERN CANADIAN ROCKY MOUNTAINS: THE MOUNT SHANKS FIRE

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ABSTRACT

Kootenay National Park, British Columbia, has a landscape fire management target to maintain or restore 50% of the long-term average fire cycle. Because the park experiences frequent lightning fires it has adopted a strategy to use both management-ignited prescribed burns and the management of lightning-ignited fires to achieve its fire management goals. The Mount Shanks Fire, ignited by lightning in July 2001, grew to 3,807 ha by the end of August. A combination of facility-protection activities, tactical burn-outs, and a temporary road closure allowed the fire to make a significant contribution to landscape fire management goals while protecting facilities and safety of public and staff. This fire represents the first time that significant area burned has resulted from managing a lightning-ignited fire in a national park in the southern Canadian Rocky Mountains.

keywords: British Columbia, fire management, fire restoration, Kootenay National Park, lightning fire, national parks, Rocky Mountains.

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INTRODUCTION

The Kootenay National Park (KNP) Management Plan contains a target to maintain or restore 50% of the "long-term, historical average fire cycle" over time (Parks Canada 2000*a*). There has been a dramatic reduction in the area burned by fire during most of the last century, relative to the previous several hundred years (Masters 1990). Several possible causal factors for the lack of fire are known: climate change, lack of aboriginal fire, and fire suppression. While the dominant causal factor varies considerably over the landscape, the lack of fire is creating increasingly large fuel loads and putting various fire-maintained ecosystem components at risk. Based on a fire history study (Masters 1990), the 50% target translates into approximately 350 hectares per year, on average, over the 880 km^2 of forest in the park.

The Lake Louise and Yoho and Kootenay National Park Field Unit Fire Management Plan (Walker and Irons 1998) provides a "mixed fire restoration" approach to achieve the management plan target. The essence of this approach is 1) aggressive fire suppression where no reasonable alternative exists; 2) indirect fire suppression in areas where there are moderate risks to values-at-risk, public safety, or neighboring lands; 3) meet specific ecological restoration and fuel management objectives by employing management-ignited prescribed fires; and 4) designate as much area of the park as possible for management of lightning-ignited fires.

Canadian national parks have made little use of managing lightning-ignited fire to achieve landscape fire management goals, focusing instead on management-ignited prescribed fire. The majority of both lightning-caused ignitions and area burned in the southern Canadian Rockies occur between the start of July and mid-August (Wierzchowski et al. 2002). Management-ignited fires are typically ignited outside of this period (Wierzchowski 1995), either during the late spring (May–June) or early fall (September–October) (Parks Canada, unpublished data) when a variety of seasonal factors contribute to significant risk management benefits. However, the ecological costs incurred through burning outside of the ecological fire season are largely unknown for the southern Canadian Rocky Mountains.

Canadian national parks that regularly manage lightning-ignited fires include Glacier National Park in

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southern British Columbia, and northern parks such as Wood Buffalo and Nahanni national parks (Parks Canada, unpublished data). Canada's Glacier National Park usually manages one or two lightning-ignited fires per year, but these have been less than 50 ha (M. Peterson, Parks Canada, personal communication). Northern parks frequently manage lightning fires over 5,000 ha in areas with little or no values-at-risk. The use of lightning-ignited fires in the United States has been a significant part of wilderness fire management for decades, first as "Natural Prescribed Fires" and more recently as "Wildland Fire Use" (Interagency Federal Wildland Fire Policy Review Working Group 2001). In the United States, 31 Wildland Fire Use fires had burned 1,867 ha by 30 August 2002 (National Interagency Fire Center 2002).

The Kootenay National Park (KNP) area of British Columbia has experienced forest fires since deglaciation 10,000 years ago (Hallett and Walker 2000). Since the establishment of KNP in 1920, approximately 80% of the reported fires in the park have been lightning-caused (KNP, unpublished data). Historically, KNP has the most lightning fire occurrences of any Canadian Rocky Mountain national park, with an average of more than 2.0 lightning fires per year since 1920 (i.e., 160 lightning fires of 206 total fires) and an average of more than 5 lightning fires per year (i.e., 82 lightning fires of 103 total fires) since 1985 (Parks Canada, unpublished data). It is unknown whether the recent increase in the number of annual lightning fires is real or is merely an artifact of improvements in fire detection ability resulting from lightning location systems and aerial detection patrols.

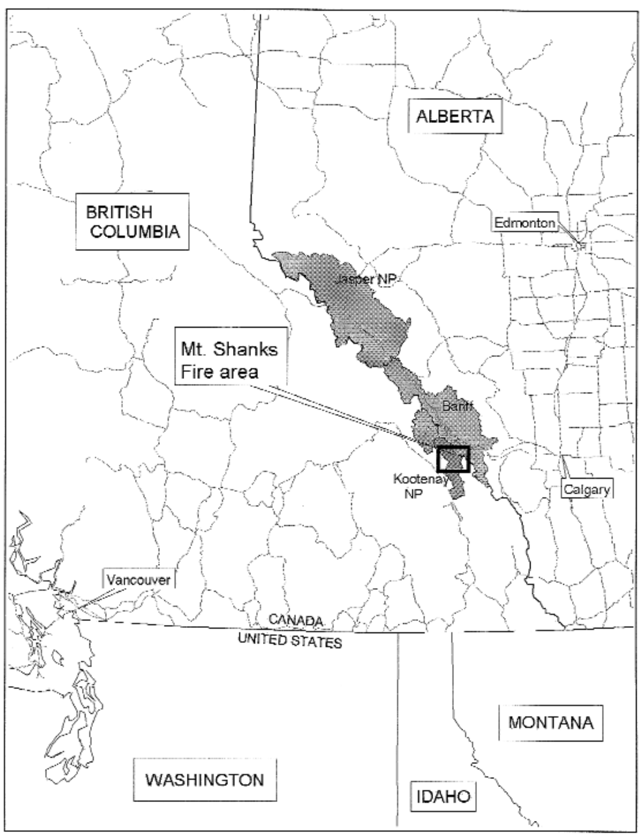

Figure 1. The geographical location of the Mount Shanks fire, Kootenay National Park, British Columbia, 2001.

Prior to the 2001 fire season, lightning fires were responsible for 16,558.6 ha burned in KNP since 1920 (i.e., an average of 204 ha/yr) and 666.7 ha burned since 1985 (i.e., an average of 44 ha/yr) (KNP, unpublished data). This represents approximately 29% of the long-term historical fire cycle (Masters 1990) since 1920 and 0.4% since 1985.

While KNP appears to have adequate lightning ignition to contribute to the area-burned target, it is also embedded in a matrix of values-at-risk that constrain the use of anything but spring and fall prescribed burns in many areas. This paper describes the chain of events, decisions, planning, and operations that allowed the Mount Shanks fire to be successfully managed within that matrix of values-at-risk.

STUDY AREA

The study area is in the Vermilion Valley of KNP in British Columbia, west of the Continental Divide (Figure 1). The elevation of the site ranges from 1,325 to 2,600 m with an average slope of 60% on a mostly southwest aspect. The forest grades from closed-canopy montane *Pinus contorta* on the lower portions of the fire area elevations, through closed-canopy subalpine *Picea engelmannii–Abies lasiocarpa* at mid-elevations to open-canopy upper subalpine *Picea engelmannii–Abies lasiocarpa–Pinus albicaulis* at treeline (Achuff et al. 1984). Stand years of origin were 1768 (1,415 ha), 1788 (1,066 ha), and 1828 (496 ha) on the lower portions of the fire area, and 1708 (743 ha) and 1994 (100 ha) on the upper elevations (A.M. Masters, Kootenay National Park, personal communication).

METHODS

Fire Season Context

The 2001 fire season in the Vermilion Valley followed a low-snow winter with 47% of average overwinter precipitation (British Columbia Hydro, unpublished data). The initial Drought Code (DC) value on 18 May at the Vermilion Crossing fire weather station was 250. The DC is a numerical rating of the average moisture content of deep compact organic soil layers and is an indicator of seasonal drought effects on forest fuels, and the amount of smoldering in deep duff layers and large logs (Lawson et al. 1985). The higher the DC, the more severe the drought. Previous average DC values at the Vermilion Crossing fire weather station on 18 May were 96.1 (range 15 to 217) (KNP, unpublished data).

The climate of KNP is strongly influenced by topography. The montane precipitation regime is characterized by a well-defined June maximum and a second peak in winter; annual precipitation is approximately 400 mm. The subalpine precipitation regime is characterized by a well-defined winter maximum and a weak secondary June maximum; annual precipitation is approximately 750 mm. Winds are generally light but increase with elevation. Wind direction is determined primarily by topography (Achuff et al. 1984).

KNP conducted the 311.3-ha Simpson River prescribed burn in the Vermilion Valley on 26–27 May 2001. The burn was a cooperative operation with Mount Assiniboine Provincial Park. The Simpson River prescribed burn plan included a 23,000-ha containment area within which the burn would be managed throughout the summer if the June precipitation did not extinguish the burn (Figure 1). The containment area was large enough to contain all probable estimates of fire growth based on historical fire (Masters 1990) and weather data (KNP, unpublished data). During June 2001, approximately 200 mm of precipitation fell on the Simpson River prescribed burn and it was extinguished. On 12 July, two lightning fires ignited adjacent to the prescribed burn within the containment area.

Decision Process

All decisions on managing the Mount Shanks Fire were based on the Parks Canada Fire Analysis process (Parks Canada 2000*b*). This process considers safety, socioeconomic, and ecological issues, and recommends an option to park management personnel. Safety considerations on the Mount Shanks Fire included physical risk to visitors and staff from fire, and risk from smoke for both visibility and human health reasons. Socioeconomic considerations included operational fire cost, lack of visitor opportunities, and revenue impacts on the operator of Kootenay Park Lodge and on other local and regional businesses dependant on tourism. Ecological considerations included the effects of a fire burning during the lightning season, the opportunity to achieve some area burned following a century of few fires (Masters 1990), and enhanced wildlife habitat.

Fire behavior modeling was conducted using FBP97 fire behavior prediction software (Remsoft 1997) based on the Canadian Forest Fire Behavior Prediction System (Forestry Canada Fire Danger Group 1992). Historical fire weather data were available for the Vermilion Crossing fire weather station (1983–2001) and the Kootenay Crossing climatological station (1955–2001) (KNP, unpublished data). All 2001 fire season weather data reported in this paper are from the Vermilion Crossing fire weather station.

RESULTS

Initial Assessment

The two lightning fires that ignited on 12 July 2001 were suppressed by helicopter water bucketing for approximately 45 minutes until a visual assessment of the fires was completed. The fires were each approximately 0.2 ha in area, with vigorous surface fire activity and occasional candling. Within 30 minutes of ignition, precipitation began to fall in the Vermilion Valley. All suppression efforts were suspended while a fire analysis was completed. A multi-park team was assembled on the evening of 12 July to draft the first fire analysis. Subsequent cool wet weather allowed considerable effort to be invested in the fire analysis, and it was completed on 18 July following 20 mm of precipitation on the fires.

The key issues identified in the first fire analysis were 1) facility protection at Kootenay Park Lodge, 2) smoke management, and 3) requirement for worst-case scenario planning and mitigation. The recommendation of the fire analysis was to manage the lightning fires according to the protocols established for the Simpson River prescribed burn.

By 30 July, 52 mm of precipitation had fallen in the Vermilion Valley since ignition and no smoke or fire behavior was observed, although periodic ground assessments confirmed that one of the fires still smoldered. By the beginning of August, a stable high-pressure system was beginning to dominate regional weather patterns and no further precipitation fell until 23 August. On 5 August, smoke was observed from one of the fires. On 7 August, that fire covered an area of approximately 0.5 ha, smoldering with occasional surface flame and sporadic candling.

Facility Protection

Kootenay Park Lodge was the only constructed facility considered to be immediately at risk from the fire. This large log lodge was constructed by the Canadian Pacific Railroad in 1908 as accommodation for tourist horse trips and is the oldest standing building in

KNP (Canadian Parks Service 1989). In addition to the lodge building, there are rental bungalows built in the 1920s, and a combined retail store and visitor information center. These buildings are all enclosed within a 10-ha stand of trees. Successful facility protection required incorporating public and staff safety, structural protection, evacuation planning, and leaseholder support.

The facilities protection methods employed were to construct an array of sprinklers throughout the forest stand; thin and brush the area immediately adjacent to the buildings according to the FireSmart standards (Partners in Protection 1999); develop an evacuation plan for lodge staff, lodge guests, and firefighters; and have a Compressed Air Foam System on site. The sprinkler array was operated for 18 to 20 hours per day. By the fourth day of sprinkling, relative humidity at the lodge was consistently 40 to 55 points higher than at the Vermilion Crossing fire weather station. By 16 August, the overhead team was confident that the facility was adequately protected from wildfire.

Smoke Management

Smoke management was considered the most critical issue in managing the Mount Shanks Fire. Once the decision was made not to suppress the fire, there was no effective way to manage the smoke. As a result, all efforts were targeted at managing the potential negative effects of smoke. Smoke effects included reduced visibility on highways, impacts on human health, reduced visibility in backcountry hiking areas, and the negative public perception of the fire.

Risk to the public was managed through communication. A communications team was assembled early in the fire, and the team developed daily media and public advisories, health advice messages, a toll-free number, and a fire information website. Stakeholder sessions were held with residents, business, local governments, health authorities, and others in both Alberta and British Columbia. In addition, extensive signage was deployed along the highway in the Vermilion Valley.

Worst-Case Scenario Planning

Fire behavior modeling, historical weather data, and long-range weather forecasts were used to predict probable worst-case scenarios to direct preparedness planning. Modeling predicted that the fire front could spread 5 km with sustained winds over 3 to 4 hours. In order to evacuate Kootenay Park Lodge safely, protocols needed to provide for more rapid response than this time frame. As early as 10 August, a cold front passage was forecast for 17 August to follow a week dominated by the high pressure ridge.

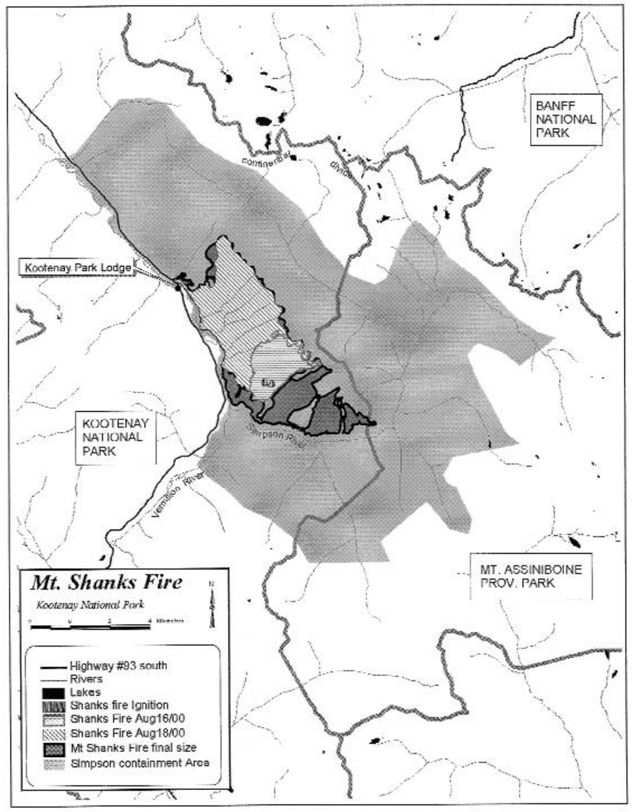

Figure 2. Containment area and significant daily growth perimeters for the Mount Shanks fire, Kootenay National Park, British Columbia, 2001.

A second fire analysis was completed on 12 August that forecast potential fire behavior associated with the forecast cold front passage. In response to the predicted fire behavior, protocols were established for burnout operations using an aerial drip torch, evacuation and protection of the lodge, closure of the highway, and evacuation of the fire base.

Cold Front Passage

On 17 August, after 18 days with no precipitation, the forecast for the Mount Shanks Fire predicted extreme fire behavior with a rate of spread of 18 m/min and a head fire intensity of 19,000 kW/m (Heathcott and Weir 2001). The cold front passage occurred beginning that afternoon and the first significant winds (>12 km/h) in August were recorded during the day. A thunderstorm cell associated with the cold front passage crossed to the southeast of the fire at 18:36. An initial downdraft from the cell hit the fire from the southwest that was measured at 45 km/h at the fire base. The cell passed over Mount Shanks and a second downdraft hit the fire from the southeast that was measured at 74 km/h at a ridge-top weather station across the Vermilion Valley.

In 2.5 hours the fire grew from 600 ha to approximately 2,400 ha (Figure 2) and the fire front spread 4 km towards the northwest and the lodge. Kootenay Park Lodge was evacuated, the highway was closed, and a burn-out operation was conducted parallel to the moving fire front in order to prevent the fire from crossing the containment line at the Vermilion River. Fire foam was applied to all buildings at Kootenay Park Lodge. A small fire crew remained at Kootenay Park Lodge through the night but the fire spread stopped approximately 0.7 km from the lodge. The burn-out operation was continued past the lodge to further protect the facility.

An evacuation of adjacent backcountry hiking areas in both KNP and Banff National Park was implemented on 18 August as a precautionary measure. The highway was reopened on the morning of 19 August. Additional burn-outs were conducted on 19 and 21 August to burn out the existing fire perimeter to the Vermilion and Simpson Rivers. These burn-outs increased the area burned to approximately 3,807 ha. Once the burn-outs were completed, the fire was contained to the Mount Shanks ridge on the east, the Simpson River on the south, and the Vermilion River on the west. The north perimeter was unanchored and helicopter bucketing of hot spots restricted further fire spread.

Additional fire analyses were completed on 20 and 27 August. On 23 August, 11.8 mm of precipitation fell at Vermilion Crossing, the first precipitation since 30 July. The remainder of August and September was relatively cool with occasional precipitation and no additional fire spread occurred.

DISCUSSION

The Mount Shanks Fire was the first managed lightning fire of its magnitude in the Southern Canadian national parks. It also represents the largest area burned by a managed fire, either lightning- or management-ignited, in the Southern Canadian Rocky Mountains. The fire was successfully contained within the prescribed containment area through the use of tactical burn-outs. All preparedness protocols, based on an evaluation of probable worst-case scenarios, were implemented successfully and there was no compromise of safety to humans or facilities.

Prior to the 2001 fire season, lightning fires were responsible for an average of 204 ha/yr burned in KNP since 1920 and an average of 44 ha/yr from 1985 to 2000. These averages have now increased to 251 ha/yr and 280 ha/yr, respectively. This represents an increase from approximately 29% of the long-term historical fire cycle (Masters 1990) since 1920 and 0.4% since 1985 to approximately 40% for both time periods.

CONCLUSIONS

The Mount Shanks Fire achieved 11 years of the KNP Park Management Plan target for area burned by fire and can be considered a success in achieving ecological and safety objectives. As a result of the highway closure, lodge closure, and backcountry evacuations, the social and economic impacts of the fire were significant for a period of time. The communication efforts successfully mitigated the potential impacts of smoke on public safety and human health.

The Mount Shanks Fire demonstrated that selected lightning fires can be managed to contribute towards targets for area burned. However, similar situations where the values-at-risk are few and easily protected will be relatively rare. Therefore, the majority of area burned by fire in the Southern Canadian Rocky Mountain national parks will continue to be achieved through spring and summer prescribed burns.

LITERATURE CITED

Achuff, P.L., W.D. Holland, G.M. Coen, and K. Van Tighem (eds.). 1984. Ecological land classification of Kootenay National Park, British Columbia. Volume I: integrated resource description. Environment Canada/Alberta Institute of Pedology, Edmonton.

Canadian Parks Service. 1989. Archaeological resource description and analysis: Kootenay National Park. Archaeological Services Unit, Western Region, Calgary, AB.

Forestry Canada Fire Danger Group. 1992. Development and structure of the Canadian Forest Fire Behaviour Prediction System. Information Report ST-X-3, Forestry Canada Science and Sustainable Development Directorate, Ottawa, ON.

Hallett, D.J., and R.C. Walker. 2000. Paleoecology and its application to fire and vegetation management in Kootenay National Park, British Columbia. Journal of Paleolimnology 24:401–414.

Heathcott, M., and J. Weir. 2001. Fire behavior forecast, Shanks fire (01KO014), valid for Thursday, August 16 to Saturday, August 18. Unpublished report prepared for the Lake Louise and Yoho and Kootenay National Parks Field Unit of Parks Canada, Radium Hot Springs, BC.

Interagency Federal Wildland Fire Policy Review Working Group. 2001. Review and update of the 1995 Federal Wildland Fire Management Policy. National Interagency Fire Center, Boise, ID. http://www.nifc.gov/fire_policy/

Lawson, B.D., B.J. Stocks, M.E. Alexander, and C.E. Van Wagner. 1985. A system for predicting fire behavior in Canadian forests. Proceedings of the Conference on Fire and Forest Meteorology 8:6–16. Society of American Foresters, Bethesda, MD.

Masters, A.M. 1990. Changes in forest fire frequency in Kootenay National Park, Canadian Rockies. Canadian Journal of Botany 68:1763–1767.

National Interagency Fire Center. 2002. Incident management situation report, August 30, 2002—0530 MDT. http://stone.cidi.org

Parks Canada. 2000*a*. Kootenay National Park Management Plan. Ministry of Public Works, Ottawa, ON.

Parks Canada. 2000*b*. Parks Canada fire operations manual. Unpublished report prepared by Parks Canada, Ottawa, ON.

Partners in Protection. 1999. FireSmart: protecting your community from wildfire. Partners in Protection, Edmonton, AB.

Remsoft. 1997. FBP by Remsoft®. Version 97.0. Remsoft Incorporated, Fredericton, NB.

Walker, R.C., and T.B. Irons. 1998. Lake Louise and Yoho and Kootenay National Parks Field Unit fire management plan. Unpublished resource management plan prepared for Resource Conservation, Lake Louise and Yoho and Kootenay National Parks Field Unit, Radium Hot Springs, BC.

Wierzchowski, J., M. Heathcott, and M.D. Flannigan. 2002. Lightning and lightning fire, central cordillera, Canada. International Journal of Wildland Fire 11:41–51.

Wierzchowski, J.L. 1995. An evaluation of prescribed burning program in Banff National Park and application of remote sensing in assessing effects of prescribed burning. M.Sc. Thesis, University of Calgary, Calgary, AB.