Forest Structure Twenty Years After the First Whitebark Pine Prescribed Burn in Banff National Park

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ABSTRACT

Following a reconnaissance level survey of blister rust infection in the Canadian Rockies, Parks Canada started a conservation program for whitebark pine in 1998. With the recognition that fire suppression had reduced the amount of available early seral subalpine forest in the Parks system, the initial action was to assess the use of prescribed fire in creating suitable recruitment habitat for this species. Permanent monitoring plots were established in control and burn treatment units on the southern flank of Observation Peak in Banff National Park. After the initial pre-burn measurement of the treatment units, a high intensity fire was applied to the burn treatment in late August of 1998. The treatments were remeasured the following summer. Twenty years later, we found substantial recruitment of whitebark pine, compared to the spruce and fir species that previously dominated the burn treatment area. No blister rust was evident on whitebark pine in either treatment. Understory shrub layers were dominated by huckleberry and grouseberry in the burn treatment, whereas, the control was dominated by a more diverse mixture subalpine fir, common juniper, Engelmann spruce, and grouseberry.

Keywords: BACI design; prescribed fire; restoration; tree regeneration; understory response; permanent plots

INTRODUCTION

Whitebark pine (*Pinus albicaulis*) is an essential part of subalpine ecosystems in the Canadian Mountain National Parks. This high-elevation keystone species' seeds provide an important food source for a number of animals including squirrels, bears, and in particular, the bird species Clark's nutcracker (*Nucifraga columbiana*) (Smith et al. 2008). Following a reconnaissance level survey of whitebark pine blister rust infection in the Canadian Rockies (Stuart-Smith 1998), Parks Canada started a conservation program for whitebark pine (Wilson and Stuart-Smith 2002). Recognizing that fire suppression had reduced the amount of available early seral subalpine forest in the ecosystem, the initial action was to assess the use of prescribed fire in creating suitable recruitment habitat for this species, and quantitatively document the successional patterns over time.

METHODS

Forty100 m^2 permanent monitoring plots were established in control and burn treatment units on the southern flank of Observation Peak (Helen Ridge) in Banff National Park to create a Before and After Controlled Impact study

design (figure 1). Initial pre-burn measurements of the treatment units recorded foliage cover, height, and vascular plant species composition of four forest structure layers (table 1). Standard tree species demographic records were also recorded including height, diameter at breast height, vigour, and disease status (B.C. Ministry of Forests and Range and BC Ministry of Environment 2010).

Table 1. Forest stratification layers and their respective height ranges.

Forest Layer	Height Range (cm)
Canopy (A)	>=10 m
Tall Shrub (B1)	>=2 m and <10 m
Low Shrub (B2)	>=15 cm and <2 m
Herb Layer (C)	Forbs, grasses, dwarf woody <15 cm

After the initial pre-burn measurement of the treatment units, a high intensity fire was applied to the burn treatment in late August of 1998. The treatment units were remeasured the following summer and the results confirmed that the fire had achieved almost 100% mortality of all size classes of the tree and shrub species present (Wilson et al. 2002).

RESULTS AND DISCUSSION

Twenty years later, we remeasured both the treatment and control plots and found substantial recruitment of whitebark pine, compared to the spruce and fir species that previously dominated the burn treatment plots (figure 2-3). The density of all tree species combined was 2200 stems/hectare in the burn treatment, with whitebark accounting for just under half of this value. Greater that 99% of all tree species were seedlings or saplings less than 1.5m tall. No blister rust was evident on whitebark pine in either treatment in the past or at this latest measurement time.

The dominant vegetation in the canopy layer in the unburned control unit remained overwhelmingly Englemann spruce (*Picea englemannii*) (~0.75) with subalpine fir (*Abies lasiocarpa*) making up the rest of the measured cover (figure 4). The remaining standing dead trees in the burned plots provided approximately 5% canopy cover in that treatment. Subalpine fir was the dominant species in the unburned control tall shrub layer (2 to 10 m), with some spruce and whitebark pine.

Understory shrub and herb layers were dominated by huckleberry (*Vaccinium membranaceum*) and grouseberry (*V. scoparium*) in the burn plots, whereas, the control plots were dominated by a more diverse mixture of subalpine fir, common juniper (*Juniperus communis*), Engelmann spruce, and grouse-

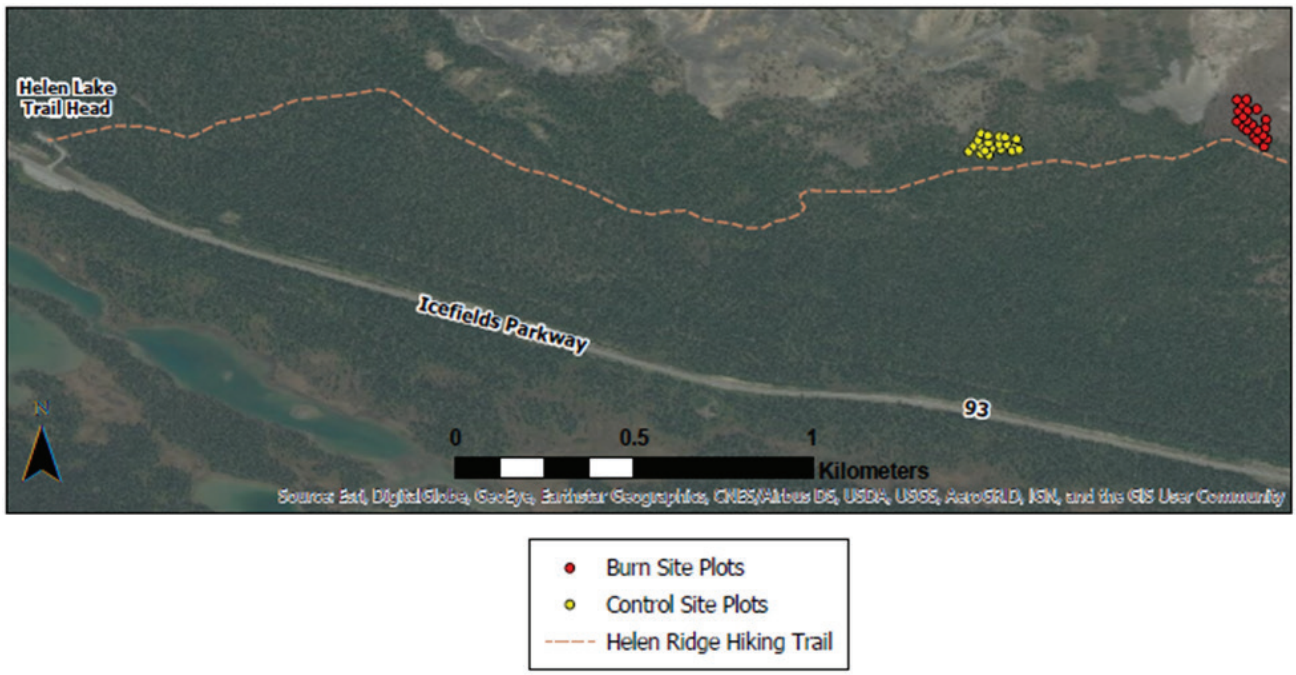

Figure 1. Study site location along the Helen Lake Hiking Trail, Banff National Park, AB, Canada.

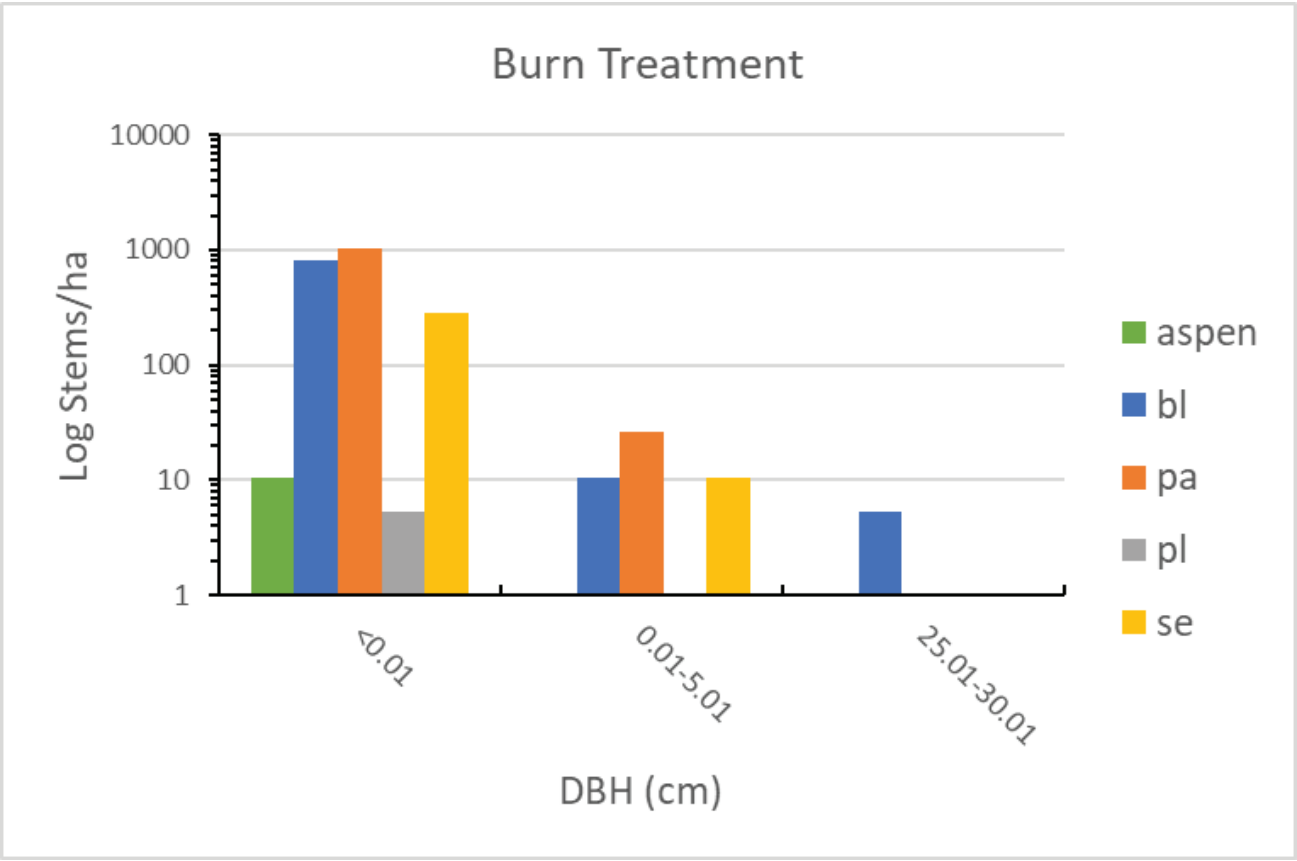

Figure 2. Helen Ridge burn treatment stem frequency distribution for tree species, Banff National Park, AB, Canada. bl = subalpine fir, pa = whitebark pine, pl = lodgepole pine, se = Engelmann spruce.

berry (figure 4). This mixture provided for significantly greater low shrub cover in these control plots, however, the strong abundance of grouseberry in these plots appeared to make up that difference in the dwarf shrub/herb layer.

MANAGEMENT IMPLICATIONS

Based on this 20-year remeasurement we conclude that this first Canadian whitebark prescribed burn was very successful in generating an increase in young healthy whitebark trees well above the levels found in adjacent undisturbed forest. We suggest that other efforts to reintroduce fire disturbance into these habitats for whitebark restoration continue with planned monitoring

The early successional floristic patterns indicate that the burn treatment was also less diverse, favouring *Vaccinium spp*. However, field observations indicate that there may be some small-scale association between a combination of understory species, micro-topography and regenerating whitebark vigor. Further analysis of these data will be explored.

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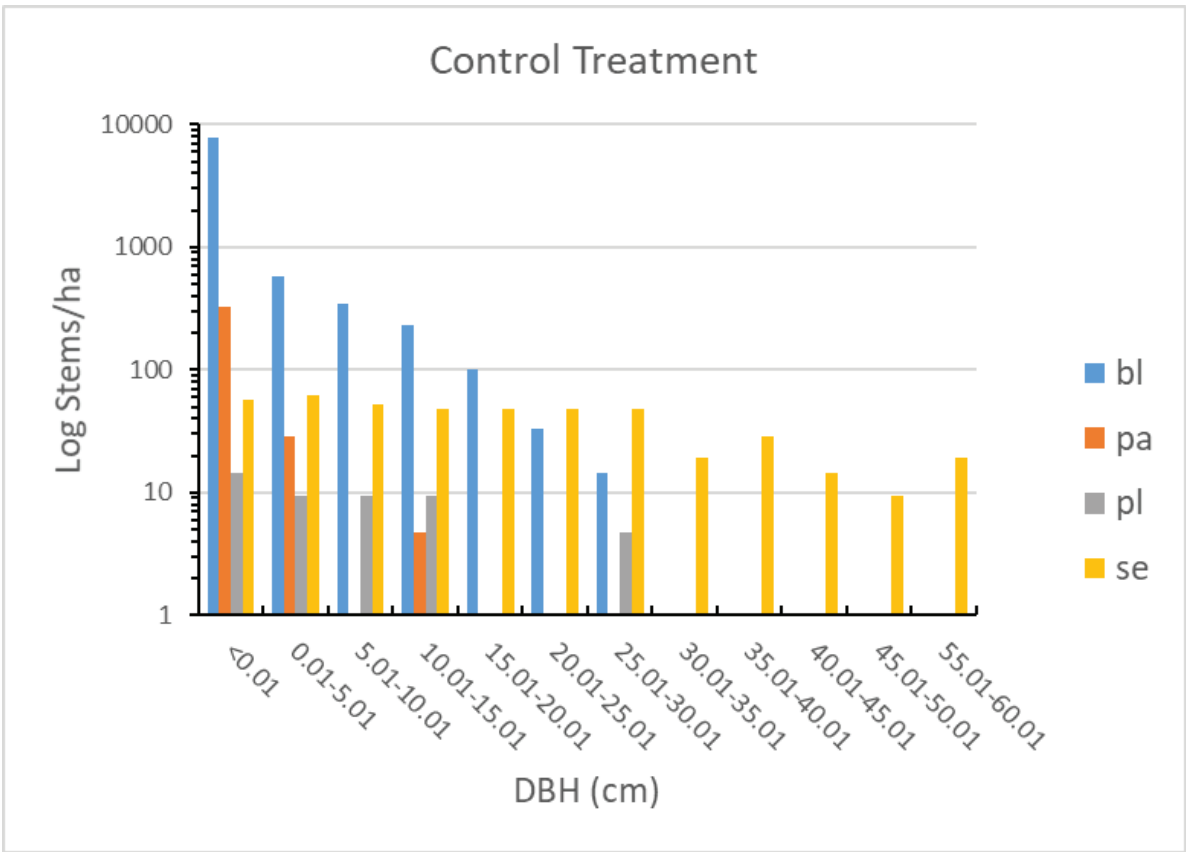

Figure 3. Helen Ridge control treatment stem frequency distribution for tree species, Banff National Park, AB, Canada. bl = subalpine fir, pa = whitebark pine, pl = lodgepole pine, se = Engelmann spruce.

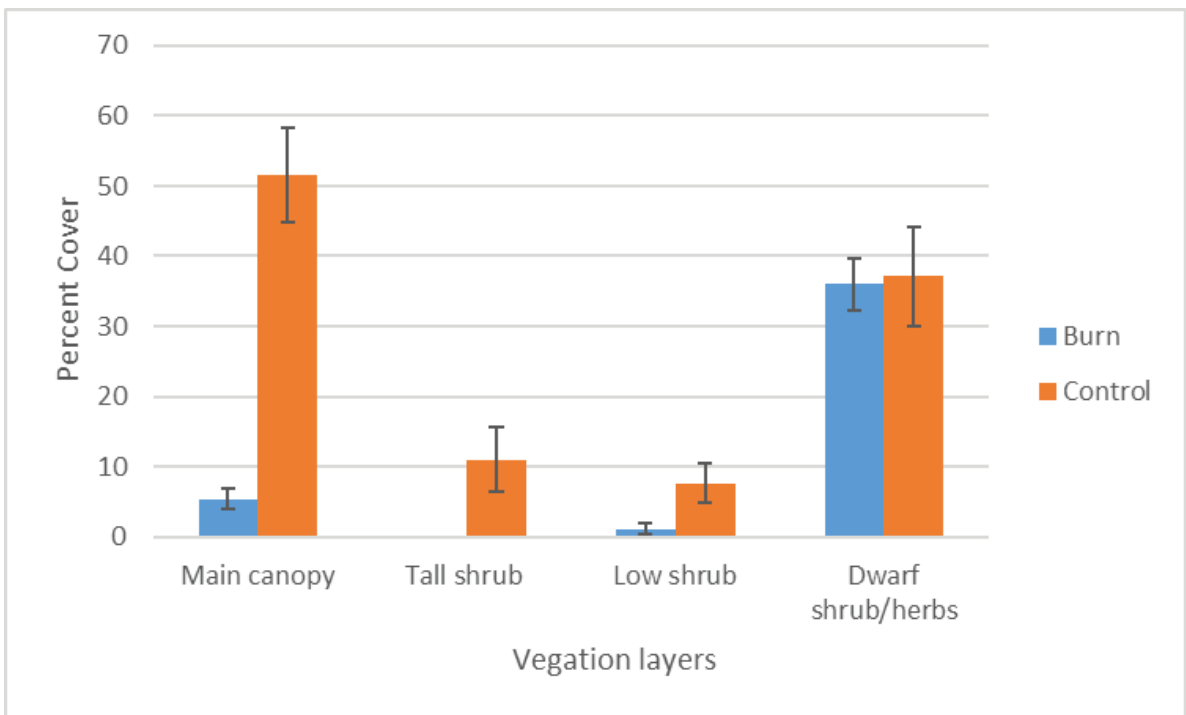

Figure 4. Vegetation cover values for Helen Ridge treatment units. Error bars are 95% confidence intervals.

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