

Post-fire conifer regrowth in upper subalpine Grouseberry (*Vaccinium scoparium*) habitat used by Grizzly Bear (*Ursus arctos*) in Banff National Park, Alberta

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Abstract

Grouseberry (*Vaccinium scoparium*) communities in many open, upper subalpine sites within Banff National Park have abundant conifer seedlings, saplings, and small trees. Because fruit production typically decreases with increasing forest canopy cover, we predict that infilling by conifers will lead to reduced Grouseberry fruit availability for wildlife, including Grizzly Bear (*Ursus arctos*), a Threatened species in Alberta. We studied conifer recruitment in Grouseberry communities within recent (2001 prescribed fire) and old (1920 and 1889) burns in Banff National Park during 2008–2022. Most (55%) of the conifers in our plots were Engelmann Spruce (*Picea engelmannii*); an additional 34% were Subalpine Fir (*Abies lasiocarpa*), 11%, Lodgepole Pine (*Pinus contorta*), and <1%, Subalpine Larch (*Larix lyallii*). The density of small conifers (height >30 cm, diameter <10 cm) did not vary in communities that were 21, 102, and 133 years post-fire, but was lower in the 2001 burn 6–7 years post-fire. The mean density of small conifers in the 2001 prescribed burn increased from 15 ± 18 (SD) stems/100 m² in 2007–2008 (6–7 years post-fire) to 73 ± 67 stems/100 m² in 2022 (21 years post-fire). Conifer ingrowth has the potential to overgrow and shade Grouseberry habitat, with declining fruit production a predicted consequence. However, in Banff National Park, where lightning-caused fires are rare, managers have the option of applying prescribed fire to create openings in the upper subalpine forest and thus enhance fruit production in Grouseberry and other fruiting shrubs important to wildlife.

Key words: Forest fire; forest succession; forest understorey; prescribed fire; tree regeneration; wildfire

Introduction

Vaccinium fruits are important food for North American Grizzly (Brown) Bear (*Ursus arctos*; McLellan 2011). For some bears, the fruits of *Vaccinium* and other shrubby plants likely provide the dietary energy necessary for reproduction and winter hibernation, especially when salmon (*Oncorhynchus*) or hard mast (e.g., Whitebark Pine [*Pinus albicaulis* Engelmann], Limber Pine [*Pinus flexilis* E. James] seeds) are unavailable (Welch *et al.* 1997).

Banff National Park, Alberta, Canada, lies east of the Continental Divide, in a rain shadow of prevailing westerly weather systems that become increasingly arid with distance east of the divide, culminating in the dry prairies of central Alberta. Because of this moisture gradient, Tall Huckleberry (*Vaccinium membranaceum* Douglas ex Torrey, syn. *Vaccinium globulare* Rydberg) and Oval-leaf Blueberry (*Vaccinium ovalifolium* Smith)—important food for Grizzly Bears in the moister Columbia Mountains (Mundy

and Flook 1973; Hamer 1974), the northern Canadian Rocky Mountains (Munro *et al.* 2006; Ciarniello *et al.* 2007), and the Rocky Mountains of southern Alberta, southern British Columbia, and Montana (Martin 1983; Hamer *et al.* 1991; McLellan and Hovey 1995)—are uncommon in Banff National Park. However, two short-statured (10–30 cm high) *Vaccinium* species, Grouseberry (*Vaccinium scoparium* Leiberg ex Coville) and Myrtle Whortleberry (*Vaccinium myrtillus* L.), are abundant and known food for Grizzly Bears in the park (Hamer and Herrero 1987a,b).

Because *Vaccinium* fruit production typically correlates negatively with forest canopy cover (Martin 1983; Hamer 1996; Nielsen *et al.* 2004; Pengelly and Hamer 2014; McLellan 2018), conifer infilling in *Vaccinium* habitat is predicted to have a negative impact on fruit production. During 2008–2022 we conducted field studies in Banff National Park to assess the extent of conifer recruitment in *Vaccinium* habitat. We studied four sites in a 2001 prescribed

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burn and two sites in communities >70 years post-fire, in habitat where Grouseberry was abundant and Myrtle Whortleberry varied from absent to present in low abundance.

Study Area

Our study area included sites in both the Main Ranges and Front Ranges in the Rocky Mountains of Banff National Park, 3 km east and ~30–40 km east of the Continental Divide, respectively (Figure 1; see Table S1 for coordinates). Annual precipitation is estimated as 50–100 cm and 50–125 cm in the Main Ranges and Front Ranges study sites, respectively (Janz and Storr 1977).

Elevations in Banff National Park range from 1330 m to 3610 m, with treeline at ~2300 m. The subalpine zone extends from ~1500 m to 2350 m, with the upper subalpine (generally cooler and wetter, with deeper and longer-lasting snow) beginning at ~2000

m (Achuff 1982). Because Grouseberry is more prolific in the upper subalpine, we located our plots at elevations of 2060 m to 2380 m.

The eastern slopes of the Rocky Mountains have abundant Grouseberry cover. In Hamer’s (1985) study area (which falls within our Front Ranges study area), 28% of 123 km² was mapped as Engelmann Spruce (hereafter, spruce, *Picea engelmannii* Parry ex Engelmann)–Grouseberry forest and Lodgepole Pine (*Pinus contorta* Douglas ex Laudon)–Grouseberry forest. Myrtle Whortleberry appears less abundant than Grouseberry on the eastern slopes, but Myrtle Whortleberry and Grouseberry are difficult to separate, perhaps because they likely hybridize (Szczawinski 1962; Vander Kloet and Dickinson 1999). The fruits, however, are distinct; we identified <1% of the *Vaccinium* fruits in our Grouseberry study plots as Myrtle Whortleberry (Pengelly and Hamer 2014). Neither Tall Huckleberry nor Oval-leaf Blueberry

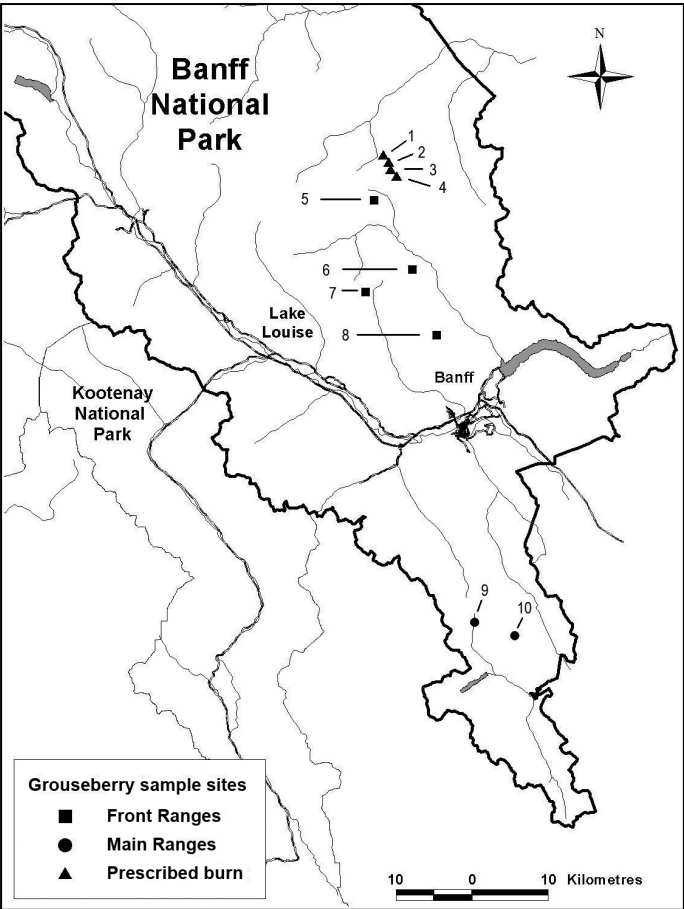


FIGURE 1. Location of Grouseberry (*Vaccinium scoparium*) study sites in Banff National Park, Alberta, 2004–2022. See Table S1 for study site coordinates.

occurs in the Front Ranges study area, to our knowledge, and neither was observed during our field work in the Main Ranges.

Forest cover in the study sites was mostly spruce. Using basal area as an index to mature trees, spruce had a relative abundance of 44%, Lodgepole Pine 21%, Subalpine Fir (*Abies lasiocarpa* (Hooker) Nuttall) 19%, and Subalpine Larch (*Larix lyallii* Parlature) 16%. Because of our sampling design, Grouseberry dominated the understorey of most plots.

Methods

We studied six sites, five in the Front Ranges and one in the Main Ranges (Table 1, Figure 1). These six sites are a subset of Pengelly and Hamer’s (2014) 10 sites (details in Table 1 footnote). Sites are numbered and named (based on nearby topographic features) in Table 1. The Front and Main ranges sites included burns of varying ages and areas known from direct observation to be locations used by Grizzly Bears feeding on Grouseberries (Table 1). We chose sites where Grouseberry was abundant and where at least a portion of the area had low to absent forest cover. The burns we sampled had experienced stand-replacing

fires in 1889, 1920, and 2001.

We established 33 plots in our six sites during 2004–2008 (Table 1), with 31 retained for the current study (we excluded two of the seven Allenby plots because they were outside the boundaries of the 1920 burn). We placed these plots in micro-sites with high Grouseberry cover (Pengelly and Hamer 2014). In 2022, we placed an additional 54 plots (Table 1) using systematic random sampling. We located these additional plots along randomly selected compass bearings, separated by a fixed global positioning system (GPS) distance (i.e., a fixed horizontal map distance). We located the first plot at a randomly selected GPS starting distance from the bearing’s originating point. Originating points were one of the original plots from 2004 to 2008, or one of seven GPS waypoints we established in 2022, which normally were on the perimeters of burned patches. In 2022 we also obtained new data from 20 of the original (2004–2008) plots: 11 in the burns at the Wigmore sites, four at Scoparium, and five at Allenby. The 11 matched plots in mature forests at Wigmore were not resurveyed in 2022 because the mature forests were stable climax communities.

TABLE 1. Grouseberry (*Vaccinium scoparium*) study sites in Banff National Park, Alberta. See Table S1 for coordinates of study sites.

Site*	Number of plots†	Elevation (m)	Slope aspect‡	Habitat
Front Ranges				
1. Wigmore One	4 + 2	2060–2100	SW	2001 prescribed burn; matched plots in burn and adjacent forest; all 2022 plots in burn
2. Wigmore Two	10 + 10	2070–2160	S–W	2001 prescribed burn; matched plots in burn and adjacent forest; all 2022 plots in burn
3. Wigmore Three	4 + 7	2110–2220	SW–W	2001 prescribed burn; matched plots in burn and adjacent forest; all 2022 plots in burn
4. Wigmore East	4 + 15	2230–2300	E–SE	2001 prescribed burn on opposite mountain face to the first three Wigmore sites; matched plots in burn and adjacent forest; all 2022 plots in burn
5. Cuthead Ridges	5	2270–2310	NE–E	
6. Scoparium	4 + 10	2080–2160	NW–NE, SE–W	1889 burn; Grizzly Bear (<i>Ursus arctos</i>) feeding area (Hamer and Herrero 1987a,b)
7. Forty Mile	5	2310–2380	E	
8. Cascade	7	2230–2350	NE, W–SW	
Main Ranges				
9. Allenby	7 + 10	2110–2200	NE, E–SW, NW	1920 burn in upper valley; Grizzly Bear feeding area
10. Turbulent	6	2140–2160	NE, E, S, W, NW	

*Sites are numbered 1–10 from north to south and correspond to numbers 1–10 in Figure 1. Sites 5, 7, 8, and 10 did not contribute data to this study; they are included to maintain continuity with Pengelly and Hamer (2014).
†First number: plots established during 2004–2012 (Pengelly and Hamer 2014); second number: additional plots established in 2022.
‡Aspect proceeds in a clockwise direction through the eight cardinal directions (e.g., E–SW means east + southeast + south + southwest).

Plot analysis

Plots were 20 m linear transects. We oriented the 2022 transects on site-specific, randomly selected compass bearings. Transects established during 2004–2012 were permanently marked at the 0 m and 20 m points with iron pins (rebar).

At each plot, we recorded location and elevation using a hand-held GPS unit (Garmin GPSMap 64, Olathe, Kansas, USA); slope aspect and steepness using a compass with built-in clinometer (Ranger sighting compass, Silva, Bromma, Sweden); *Vaccinium* cover in 19, 0.04 m² quadrats placed at 1 m intervals along the transect; and conifer density in four size classes (Table 2). We facilitated visual estimates of Grouseberry cover by dividing the 0.04 m² quadrat frame into 25 equal squares using monofilament line.

We analyzed matched photographs taken in 1978 and 2022. They show the change in forest cover that occurred during a 44-year period (1978–2022) at two locations in the Scoparium site. There, D.H. observed an adult female Grizzly Bear feeding on Grouseberries for five hours (12 September 1978) and three hours (17 October 1978), with feeding observed in both locations on both dates. We took observations and photographs from a mountain slope 200–260 m elevation above the feeding areas, and 700–850 m map distance away. The two feeding areas measured ~6 ha and ~7 ha and were separated at their closest point by ~400 m. We matched the 1978 camera location in 2022 by carrying in the field 20 cm × 30 cm prints of two 1978 photographs. We gridded those portions of the photographs that fell within the two feeding areas as delineated in field notes and site sketches made in 1978, and we scored each intersection of grid lines as either open habitat or coniferous foliage; 3870 and 4404 intersections were scored for Feeding Areas 1 and 2, respectively.

Data analysis

Because conifer infilling is dominated by smaller individuals, particularly in the recent 2001 burn where Trees (>10 cm diameter 1.4 m above the ground [dbh]) were absent in all but one plot, our analyses emphasize Saplings (small conifers between

30 cm and 2 m high) and Staddles (height >2 m but dbh ≤10 cm; Table 2). We do not emphasize Seedlings (height ≤30 cm) given that seedling height asymptotically approaches zero, making counts difficult (and hence potentially inaccurate), particularly where herbs, shrubs, or abundant conifer Staddles and Saplings conceal the ground; furthermore, seedlings are subject to high mortality and thus may or may not contribute to subsequent infilling (Brodersen *et al.* 2019). The densities of Staddles + Saplings measured in 2022 in the 2001 burn did not differ between the 11 permanently marked, original plots and the 34 randomly placed 2022 plots (Mann-Whitney-Wilcoxon $U = 130$, $P = 0.13$), and these two 2022 samples were combined ($n = 45$) for some analyses. Data often had many zero observations and did not follow a normal distribution (Shapiro-Wilk normality test, $W = 0.78$, $P < 0.01$); we thus used nonparametric tests. We conducted the tests in R version 4.2.2 (R Core Team 2022). Values reported are means ± SD.

Results

Grouseberry cover in our plots was $39 \pm 21\%$ (range 2–86%, $n = 85$). This high cover reflects our method of selecting study sites in Grouseberry habitat (Pengelly and Hamer 2014). In the 2001 prescribed burn, Grouseberry cover was $29 \pm 17\%$ (range 2–75%, $n = 45$). We selected 11 original plots in this burn where *Vaccinium* cover was high (mean cover in 2022, 49%), but we randomly placed the 34 burn plots added in 2022 and they had lower Grouseberry cover (23%). Grouseberry cover in the mature forests adjacent to the 2001 burns was $59 \pm 15\%$ (range 36–86%, $n = 11$).

Spruce made up most of the conifers (55%) in the 85 plots and dominated the Tree (54%), Sapling (49%), and Seedling (72%) size classes. Subalpine Fir made up 34% of all conifers, Lodgepole Pine made up 11%, and Subalpine Larch <1%. Lodgepole Pine made up 66% of the Staddles in the prescribed burns 21 years post-fire (Figure 2) but otherwise was a relatively minor component in the spruce-fir forests of the cooler, upper subalpine sites (Figure 3). Subalpine

TABLE 2. Plot sizes used to measure conifer densities in four size categories at Grouseberry (*Vaccinium scoparium*) plots in Banff National Park, Alberta.

Size category	Height (m)	Diameter* (m)	Plot radius† (m)	Plot area (m ²)
Trees	>2	>0.1	5.64	100
Staddles	>2	≤0.1	4	50
Saplings	>0.3, ≤2	—	3	28
Seedlings	≤0.3	—	3	28

*Conifer diameter was measured 1.4 m above the ground.
†Density plots were centred at the 10 m mark of 20 m transects (all four plot sizes were nested at the same centre point).



FIGURE 2. Plot T10 in 2001 burn, photographed in 2022. Plot T10 tallied 153 Staddles/100 m² (all Lodgepole Pine [*Pinus contorta*]) and 92 Saplings/100 m² (42% Engelmann Spruce [*Picea engelmannii*], 42% Lodgepole Pine, and 17% Subalpine Fir [*Abies lasiocarpa*]); Grouseberry (*Vaccinium scoparium*) cover was 19%. The person in the photo is D. Hamer. Photo: D. Hamer.

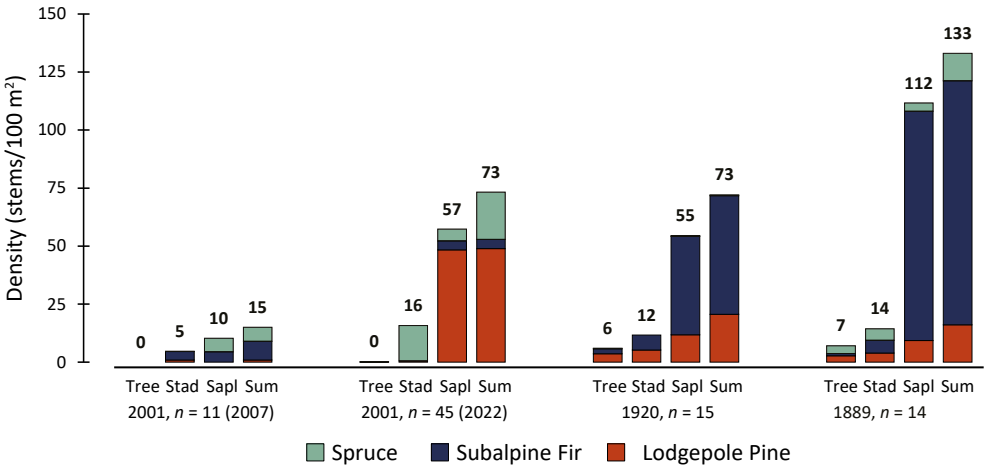


FIGURE 3. Densities (stems/100 m²) of Trees (diameter 1.4 m above the ground >10 cm), Staddles (diameter 1.4 m above the ground ≤10 cm, height >2 m), and Saplings (30 cm < height ≤ 2 m) in the 2001 Wigmore prescribed burn 6–7 years post-fire (2007–2008) and 21 years post-fire (2022), and in the 1920 Allenby burn and 1889 Scoparium burn. Spruce = Engelmann Spruce (*Picea engelmannii*). Subalpine Fir (*Abies lasiocarpa*). Lodgepole Pine (*Pinus contorta*). Stad = Staddle; Sapl = Sapling.

Fir, considered a very shade tolerant and often late-successional species (Varga and Klinka 2001), dominated in the two older burns 102 and 133 years post-fire (Figure 3).

The density of conifer ingrowth in mature forest at the Wigmore sites (where Pengelly and Hamer [2014] placed matched plots adjacent to the 2001 burns in multi-aged, old forest originating from fires

that occurred from ~1800 to 1868 [Hamer and Herero 1987a]) provides a baseline for intermediate-sized conifers present in mature, closed forest in the study area, namely, 22 ± 38 Staddles + Saplings/100 m² (range 2–134 stems/100 m², $n = 11$). Higher conifer density occurred in plots >70 years post-fire, i.e., the Scoparium and Allenby sites: 91 ± 185 Staddles + Saplings/100 m² (range 7–1040 stems/100 m², $n =$

29), given that these two sites were in regenerating post-fire communities (see Methods) with abundant post-fire conifer infilling (Figure 4).

Conifer density in the 2001 Wigmore burns increased rapidly post-fire (Figure 3). The mean density of Staddles + Saplings in the 2001 prescribed burn increased from 15 ± 18 stems/100 m² in 2007–2008 (six to seven years post-fire; $n = 11$) to $73 \pm$

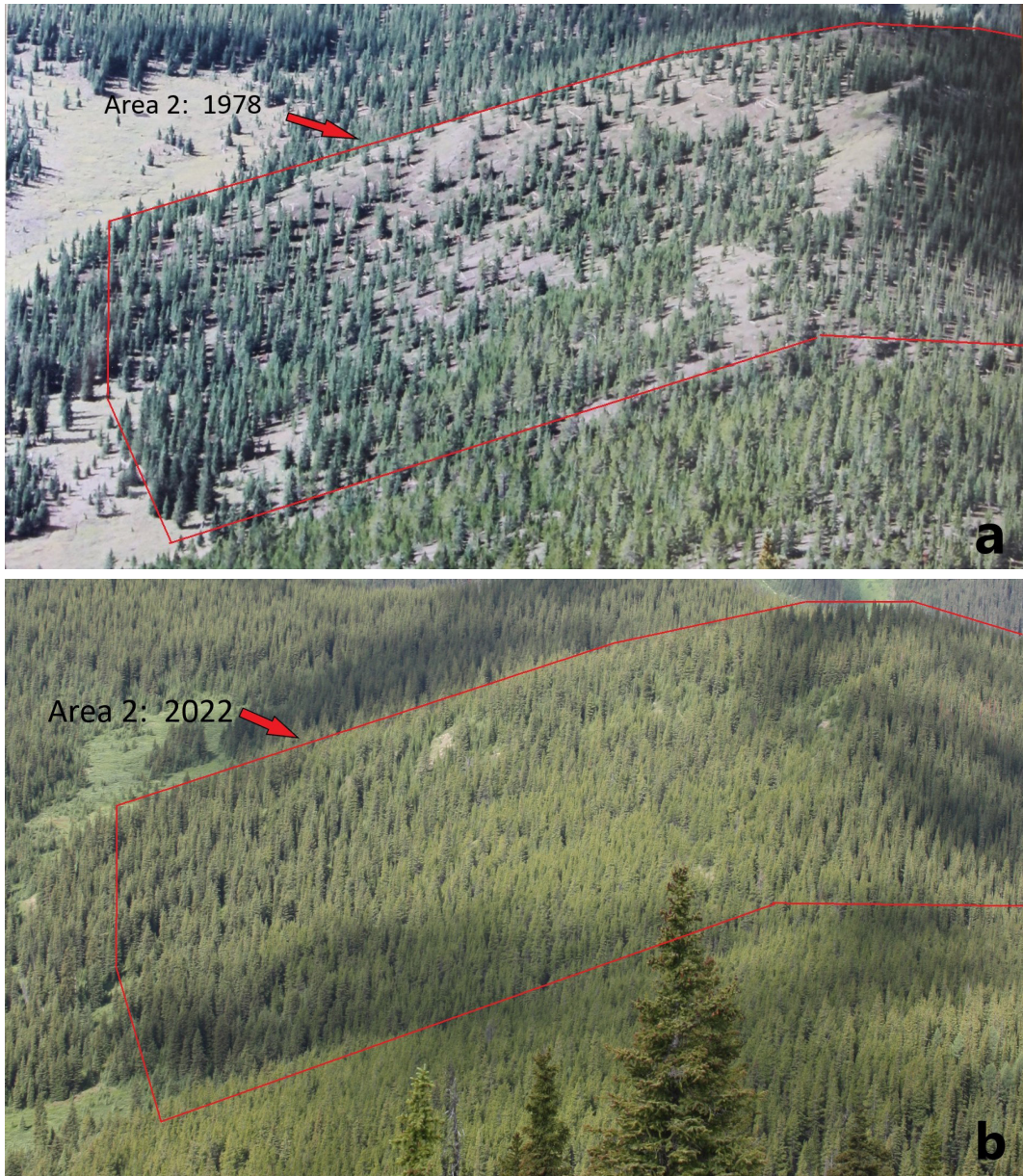


FIGURE 4. Matched photographs of Feeding Area 2, Scoparium site. a. Photograph taken on 12 September 1978, 89 years post-fire. b. Photograph taken on 22 July 2022, 133 years post-fire. Photos: D. Hamer.

67 stems/100 m² in 2022 (21 years post-fire; $n = 45$). The density of conifer infilling (Staddles + Saplings) differed among the four post-fire ages that we studied, i.e., the 2001 burn six to seven years post-fire, the 2001 burn 21 years post-fire, the 1920 burn 102 years post-fire, and the 1889 burn 133 years post-fire (Kruskal-Wallis test, $H = 17.5$, $P < 0.001$). Staddle + Sapling density did not differ among the three older post-fire samples but was lower in the 2001 burn six to seven years post-fire (Dunn multiple comparison test, adjusted $P < 0.004$). We excluded Trees from this analysis because they were essentially absent in the 2001 burn, both six to seven years post-fire and 21 years post-fire.

In 2022, living Trees (i.e., excluding fire-killed snags) occurred in just one plot in the 2001 burn. Mean Tree densities in the 1920 and 1889 burns (Figure 3) and in the old-growth forests adjacent to the 2001 burn (8.8 trees/100 m²) ranged from 6 to 9 stems/100 m² and did not differ among the three sites (Kruskal-Wallis $H = 0.69$, $P = 0.71$).

Our index of conifer foliage at the Scoparium Grizzly Bear feeding areas, as measured from matched, oblique photographs, increased by 54% during the 44 years from 1978 (89 years post-fire) to 2022 (133 years post-fire). In Feeding Area 1, the portion of grid intersections scoring conifer foliage increased from 58% to 96% from 1978 to 2022 (a 65% increase), and in Feeding Area 2, conifer intersections increased from 69% to 98% (a 42% increase; Figure 4).

Discussion

Conifer regeneration in the Wigmore 2001 prescribed burns increased rapidly following fire. Twenty-one years post-fire, the density of intermediate-sized conifers (height >0.3 m, diameter ≤ 10 cm, i.e., Saplings + Staddles) at Wigmore was similar to the density we recorded in the older 1920 Allenby and 1889 Scoparium burns (Figure 3). Some notable differences were evident, however. Because the 2001 fire was stand-replacing, a Tree component was still absent at Wigmore in 2022 (i.e., the diameters of the young conifers were <10 cm). The species composition of the intermediate-sized conifers also differed (mostly spruce in the 2001 burn, mostly Subalpine Fir in the two older burns). Finally, the 1889 site had twice the density of Saplings compared to the other two sites. However, statistically the three older burns had an equivalent density of intermediate-sized conifers. All three sites thus had the potential for further development of a conifer overstorey, as illustrated in Figure 4 for the 1889 burn.

Although conifer regrowth in the Wigmore prescribed burns was substantial by 21 years post-fire (Figure 2), regrowth was delayed for several decades

at the 1889 Scoparium burn (Figure 4a). The rate at which conifer ingrowth occurs is variable, with multiple explanations, from fire season and severity, to site characteristics, including the composition and age of the pre-fire community, to weather both pre- and post-fire (Little *et al.* 1994; Gill *et al.* 2021). This lag in recruitment following the 1889 fire may, in part, explain why our results indicated a comparable amount of conifer regeneration between the 133-year-old 1889 burn and the 21-year-old 2001 burn. Regardless of cause, what is important to managers is that conifer ingrowth intercepts solar radiation and shades the understorey, and this shading can substantially reduce fruit production in shrubby understorey berry-producing species (citations in Introduction). In the Wigmore sites, Grouseberry produced 7.0 times more fruit per square metre of *Vaccinium* cover in the prescribed burns than in the adjacent mature forests (Pengelly and Hamer 2014), even though Grouseberry vegetative growth was prolific under the forest canopy, with double the cover of that found in the adjacent burns.

The highest Grouseberry fruit densities recorded in the 10 study sites, 2480 and 1790 Grouseberry fruits/m² of *Vaccinium* cover, were at the Wigmore East burn (Figure 3 in Pengelly and Hamer 2014). Although Grouseberry produces the smallest of Alberta's *Vaccinium* fruits, this superabundance of fruits (in some years) ensures that Grouseberries are an important food for Grizzly Bears. In 2021, we found eight bear scats containing Grouseberries in the Wigmore burns in just two person-hours of searching (D.H. unpubl. data), twice the number found in the 1978 Scoparium feeding areas described earlier (see Methods). Because American Black Bear (*Ursus americanus*) do not occur in the Front Ranges study area (Hamer and Herrero 1987a), these scats are attributable to Grizzly Bears.

At the Wigmore sites, plots in mature forests adjacent to the 2001 burn had a mean of nine Trees/100 m², whereas in the 2001 burn 21 years post-fire, mean densities of 16 Staddles/100 m² and 57 Saplings/100 m² were recorded, indicating high potential for conifers to re-create closed-canopy forest. Conifer infilling is also restoring the forest canopy in the older 1920 and 1889 burns. A longer growing season near treeline, resulting from less snow and earlier spring melt, may accelerate infilling in the upper subalpine (Brodersen *et al.* 2019; Kummel *et al.* 2021). At the same time, the Canadian Rocky Mountain national parks are experiencing smaller amounts of forests burned, and hence much longer fire cycles have been recorded since the 1930s (White 1985). This reduction in fire activity is attributed to fire protection since the 1930s and not to climatic change; analysis

has shown no significant changes in fire climate in the mountain national parks since the 1930s (White 1985; Wierzchowski *et al.* 2002). Banff weather station data (1890 to present) indicate warmer, drier winters starting in the 1970s, with, however, no obvious trends during the fire season (M. Heathcott unpubl. analysis). At the same time, fire exclusion allows conifer regeneration to persist and hence reforest open habitat (Greene 2021). Furthermore, a multi-century analysis of fire-scarred trees by Parks *et al.* (2025) has shown that, despite increasing area burned in recent decades, a widespread fire deficit persists across a range of North American forest types and the current fire regime of high areas burned is not unprecedented.

Because of the longer fire cycles in the upper subalpine forests of Banff National Park, the use of prescribed fire is warranted to maintain Grouseberry fruit production for Grizzly Bears and other species. Prescribed fire to maintain these ephemeral open habitats ideally will be consistent with historical frequency and severity, as determined by a fire history study (Greene 2021). Our study found that easterly aspect fire produced the highest density of Grouseberry fruits, similar to previous work on Buffaloberry (*Shepherdia canadensis* [L.] Nuttall), where the greatest fruit production was recorded on northeast aspects (Hamer 1996). However, many factors affect fruit production, including precipitation, drought, degree days of growing, and weather during pollination. A wide variety of burns of different ages on different aspects and elevations is needed to provide food security for Grizzly Bears and many other species.

Management implications

Vaccinium fruits are an important energy source for many populations of Grizzly Bears, a species of Special Concern in Canada (SARA Registry 2025). McLellan (2011, 2015) concluded that the high density of Grizzly Bears in his southeastern British Columbia study area was largely attributable to wildfires of the 1920s and 1930s, which created major shrub fields covering 5–12 km² where Tall Huckleberry, the main Grizzly Bear food in his study area during summer hyperphagia, was abundant. Like the upper subalpine location of our Grouseberry study sites, Tall Huckleberry fruits in McLellan's (2015) study area were produced almost exclusively in higher-elevation areas away from the concentration of human activity in valley bottoms where the risk of Grizzly Bear mortality from hunting and other human activities was higher. These circumstances permitted the Grizzly Bear population to expand despite industrial development in the study area (McLellan 2015).

In Banff National Park, it may be difficult for managers to apply prescribed fire to achieve management

goals. In 24 years of weather data from the Front Ranges of Banff National Park (1980–2003), only three springs and four autumns had burn windows exceeding three days (I.P. unpubl. data). Managers also have the option of allowing natural-ignition wild-fire to burn in upper subalpine forests (above 2000 m). But this is a high-risk option, as was discovered in Yellowstone National Park, where 36% of the park burned in 1988 after managers allowed 18 lightning strikes to continue burning (Turner *et al.* 2003), and in Glacier National Park, Montana, where the lightning-caused Canyon Creek fire in 1988, which authorities similarly did not suppress under a let-burn policy, later experienced “a rare catastrophic run” and burned 400 km², including many agricultural resources (Tall Timbers 1989).

In the Rocky Mountain national and provincial parks, few areas exist where managers permit lightning-caused fires to burn unhindered. In addition, analysis has shown that both lightning and lightning-caused fires are rare events in most of Banff and Jasper national parks compared to forests west of the Continental Divide in British Columbia (Wierzchowski *et al.* 2002). Because of both fire suppression by managers and a paucity of lightning-caused ignition, no lightning-ignited fire >10 ha has occurred in the last century in our study area (White 1985; I.P. pers. obs.). We conclude that although many opportunities exist to light fires like the 2001 Wigmore prescribed burn in our study area, the chance of a lightning fire occurring remains small. Enhanced fruit production for wildlife in Banff National Park will likely result when managers use prescribed fire to create openings in the forest canopy for Grouseberry and other *Vaccinium* species, Buffaloberry, and other fruiting shrubs important to wildlife (Hamer and Herrero 1987b; Hamer 1996; Pengelly and Hamer 2014; McLellan 2018).

Author Contributions

Writing: D.H.; Review: D.H. and I.P.; Conceptualization and Field Investigation: D.H. and I.P.

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SUPPLEMENTARY MATERIALS:

- TABLE S1.** Universal Transverse Mercator (UTM) coordinates of Sites 1–10.
- TABLE S2.** Conifer densities (stems/100 m²) by site age (years post-fire), species, and conifer size class at 85 Grouseberry (*Vaccinium scoparium*) plots in Banff National Park, Alberta.