Excavation of Red Squirrel (*Tamiasciurus hudsonicus*) Middens by Bears (*Ursus* spp.) in Limber Pine (*Pinus flexilis*) Habitat in Banff National Park, Alberta

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Hamer, David. 2016. Excavation of Red Squirrel (*Tamiasciurus hudsonicus*) middens by bears (*Ursus* spp.) in Limber Pine (*Pinus flexilis*) habitat in Banff National Park, Alberta. Canadian Field-Naturalist 130(4): 281–288.

Bears (*Ursus* spp.) in North America eat the seeds of several pines (*Pinus* spp.), including Limber Pine (*P. flexilis* E. James). Information on use of Limber Pine in Canada is limited to a report of three bear scats containing pine seeds found in Limber Pine stands of southwestern Alberta. After my preliminary fieldwork in Banff National Park revealed that bears were eating seeds of Limber Pine there, I conducted a field study in 2014–2015 to assess this use. Because bears typically obtain pine seeds from cone caches (middens) made by Red Squirrels (*Tamiasciurus hudsonicus*), I described the abundance, habitat characteristics, and use by bears of Red Squirrel middens in and adjacent to Limber Pine stands at six study sites. On Bow River escarpments, I found abundant Limber Pines (basal area 1–9 m^2/ha) and middens (0.8 middens/ha, standard deviation [SD] 0.2). Of 24 middens, 13 (54%) had been excavated by bears, and three bear scats composed of pine seeds were found beside middens. Although Limber Pines occurred on steep, xeric, windswept slopes (mean 28°, SD 3), middens occurred on moderate slopes (mean 12°, SD 3) in escarpment gullies and at the toe of slopes in forests of other species, particularly Douglas-fir (*Pseudotsuga menziesii*). At the five other study sites, I found little or no use of Limber Pine seeds by bears, suggesting that Limber Pine habitat may be little used by bears unless the pines are interspersed with (non-Limber Pine) habitat with greater forest cover and less-steep slopes where squirrels establish middens. These observations provide managers with an additional piece of information regarding potential drivers of bear activity in the human-dominated landscape of Banff National Park's lower Bow Valley.

Key Words: American Black Bear; Banff National Park; Grizzly Bear; Limber Pine; midden; *Pinus flexilis*; Red Squirrel; seeds; *Tamiasciurus hudsonicus*; *Ursus americanus*; *Ursus arctos*

Introduction

Seeds of the genus *Pinus* (Pinaceae) are eaten by Asiatic Black Bears (*Ursus thibetanus*), American Black Bears (*U. americanus*), and Grizzly-Brown Bears (*U. arctos*; Mattson and Jonkel 1990). Pine seeds range in weight from < 5 mg for Jack Pine (*P. banksiana* Lambert) and Lodgepole Pine (*P. contorta* Douglas ex Loudon) to the 900-mg seed of Torrey Pine (*P. torreyana* Parry ex Carrière; Tomback and Linhart 1990). However, only large pine seeds (≥ 90 mg) are known to be eaten by bears. In North America, bears eat the 240-mg seeds of Colorado Pinyon (*P. edulis* (Engelm.); Costello *et al.* 2001, 2003), the 175-mg seeds of Whitebark Pine (*P. albicaulis* (Engelm.); Kendall 1983), the 170-mg seeds of Southwestern White Pine (*P. strobiformis* (Engelm.); Mattson and Arundel 2013), the 120-mg seeds of Jeffrey Pine (*P. jeffreyi* (Balf.); Kuhn and Vander Wall 2007), and the 90-mg seeds of Limber Pine (*P. flexilis* E. James; McCutchen 1996; seed sizes from Tomback and Linhart 1990). Of these, only Whitebark Pine and Limber Pine extend into the northern United States and Canada; the other three species occur in the southwestern United States.

In the Yellowstone ecosystem, bears obtain Whitebark Pine seeds from caches of cones (middens) made by Red Squirrels (*Tamiasciurus hudsonicus*; Kendall 1983; Schwartz *et al.* 2006; Fortin *et al.* 2013). As stated by Mattson and Reinhart (1997: 926), when Whitebark Pine seeds are abundant, Grizzly Bears in Yellowstone "eat virtually nothing else". Whitebark Pine seeds are nutrient and energy rich, containing approximately 21% protein, 21% carbohydrate, and 52% lipids, exclusive of the seed coat (Tomback *et al.* 2001).

Limber Pines are also common in the Yellowstone ecosystem, but Kendall (1983) did not find evidence that Yellowstone bears ate their seeds. Limber Pine stands appeared to support few if any Red Squirrels, and Kendall found neither claw marks nor broken branches on Limber Pine trees to suggest that bears were harvesting cones directly from trees. However, McCutchen (1996) found that some American Black Bears, in some years, fed intensively on Limber Pine seeds obtained from Red Squirrel middens in Rocky Mountain National Park, Colorado.

In Alberta, a Limber Pine survey during 1995–1996 recorded three bear scats containing pine seeds in Limber Pine stands: two in Waterton Lakes National Park and the third in the Porcupine Hills, roughly 50 km north of Waterton Lakes National Park (United States Department of the Interior and United States Geological Survey 2012). Many Limber Pines at these locations were short enough that bears could have obtained cones

A contribution towards the cost of this publication has been provided by the Thomas Manning Memorial Fund of the Ottawa Field-Naturalist's Club.

directly from trees. The species of bear was unknown; this was a brief survey as part of a study on pine stand health.

In Banff National Park, both American Black Bears and Grizzly Bears are known to eat Whitebark Pine seeds (Raine and Kansas 1990; Hamer and Pengelly 2015). However, to my knowledge, there are no records of bears eating the seeds of Limber Pine in Banff National Park. During preliminary fieldwork in 2014, I determined that bears were eating Limber Pine seeds and I therefore studied Limber Pine in and near Banff National Park during 2014–2015 to assess this use and describe the habitat where bears obtain Limber Pine seeds. Limber Pines in Banff National Park are tall, upright trees, and I assumed that if bears fed on their seeds, they likely would obtain them from Red Squirrel cone caches, as reported in Rocky Mountain National Park (McCutchen 1996) and as reported for Whitebark Pine (Mattson and Reinhart 1997; Hamer and Pengelly 2015). Thus, my principal objective was to record the abundance, habitat characteristics, and use by bears of Red Squirrel middens in and adjacent to Limber Pine stands.

Study Area

Banff National Park extends eastward from the Continental Divide and, thus, is in a rain shadow with respect to the prevailing westerly winds (Holland *et al.* 1982). The park includes Main Range and Front Range habitat of the Rocky Mountains, but does not extend eastward into the Alberta Foothills. Warm, drying adiabatic winds (Chinooks) frequently descend the east slopes of the Rocky Mountains. These winds contribute to the rain shadow effect and to the development of xeric, non-forested balds and open-forest communities below the tree line on south- and west-facing slopes (Achuff 1982; Hamer 1996).

Limber Pine grows on dry, windswept sites, often in shallow soils, and on steep, rocky sites and within cliff bands (Steele 1990; Alberta Whitebark and Limber Pine Recovery Team 2014). Limber Pine is relatively shade intolerant (Steele 1990) and is commonly found in low-density, open forests. In Banff National Park, Limber Pine occurs in the montane and lower subalpine, from valley bottom to about 2000 m elevation, in the eastern, more xeric portions of the park. It typically grows on steep, south- and west-facing slopes with high exposure to the warming, drying influence of Chinook wind and solar radiation.

In Banff, Limber Pine is often found in open forests with Douglas-fir (*Pseudotsuga menziesii* (Mirbel) Franco), a species that also tolerates warm, dry sites (Vyse *et al.* 2006). Limber Pine is also found with White Spruce (*Picea glauca* (Moench) Voss) at lower elevations, Interior Spruce (*P. engelmannii* Parry ex Engelmann var. *engelmannii* × *P. glauca*) in the subalpine, and Lodgepole Pine (*Pinus contorta* Douglas ex Loudon). Limber Pine occasionally grows in close proximity to Whitebark Pine in upper-elevation, windswept sites in the park. However, Limber Pine extends farther east into portions of the Front Ranges where Whitebark Pine is absent.

Corns and Achuff (1982: 105) described a specific Limber Pine–Douglas-fir/Juniper (*Juniperus* spp.)/Common Bearberry (*Arctostaphylos uva-ursi*) open-forest vegetation type (type O2) in Banff National Park. It is found on rapidly drained, moderately to steeply sloped, south-facing erosional escarpments along the lower Bow and North Saskatchewan rivers, in habitat that is among the warmest and driest in the park. These escarpments are composed of glacial till, unconsolidated material that is frequently eroded, resulting in exposed till and substantial gullying.

Methods

I searched Limber Pine habitat to determine the density and use by bears of Red Squirrel middens, i.e., locations where squirrels cache large numbers of conifer cones, shred these cones to obtain seeds, and create conspicuous deposits of organic material (Gurnell 1984). I also examined Limber Pine trees for broken branches, claw marks, or crushed cones on the ground that could indicate that bears were obtaining cones directly from trees.

I established six study sites based on local knowledge of Limber Pine stands. Four (A, B, D, E) were in Banff National Park: three (A, D, E) in the main Bow Valley between the east park boundary and the beginning of the Bow Valley Parkway and one (B) near the Icefields Parkway crossing of the North Saskatchewan River. The Red Deer River site (C) was less than 1 km east of the park boundary; and F was 21 km east of the park in a narrow portion of the Bow Valley that is subject to strong Chinook wind. Some Limber Pine trees at site F were wind stunted and had cones within 0–2 m of the ground.

Methods differed among the six sites (Table 1). On river escarpments (sites A and B, Table 1), Limber Pines occurred in confined bands above the rivers. Thus, I established 5–12 ha blocks in this linear habitat and made total searches for Red Squirrel middens by walking on elevational contours at regular intervals within these blocks, such that my sightlines overlapped. When the topography was complex, I used the tracks function of a handheld Global Positioning System (GPS) unit to ensure complete visual coverage.

On the Bow River escarpment, I established four blocks of habitat where Limber Pines were abundant (site A.1, Table 1). I fixed the four corners of each block on a handheld GPS unit. The two upper corners were on the escarpment rim, separated by 300 m or 500 m (horizontal map distances); the two lower corners were located at the toe of the slope, similarly separated by 300 m or 500 m. Thus, block boundaries from rim to toe of slope were straight lines of variable length, whereas upper and lower boundaries were fixed hori-

TABLE 1. Limber Pine (*Pinus flexilis*) study sites in and near Banff National Park, Alberta, 2014–2015.

Site	Watershed	Topography	Range of elevation, m	(Co-)dominant tree species	(Co-)dominant indicator species	Field method
A.1	Bow	River escarpment	1360–1470	Douglas-fir	Juniper	Four 5–10-ha blocks, total search
A.2	Bow	Adjacent upland forest	1440–1460	White Spruce, Lodgepole Pine	feathermoss	Three 1.8-ha blocks, total search
B	North Saskatchewan	River escarpment	1400–1440	White Spruce	Bearberry	One 12-ha block, total search
C	Red Deer	Alluvial fan	1670–1800	Limber Pine, White Spruce	Bearberry	7-ha area surveyed in 5 h
D	Bow	Mountain side	1520–1690	Douglas-fir	Juniper	6 ha of belt transects
E	Bow	Mountain side	1460–1600	Douglas-fir, Lodgepole Pine	Juniper, Bearberry	6 ha of belt transects
F	Bow	Mountain side	1380–1570	Douglas-fir, Limber Pine	Juniper, Bearberry	6 ha of belt transects

zontal map distances, but followed the rim and toe of slope, respectively, and, hence, were irregular in shape. Blocks covered 5.2–9.7 ha. The mean horizontal distance from rim to toe of slope was 226 m (standard deviation [SD] 7, $n = 4$ blocks).

I established a 500-m long block where Limber Pines were most abundant. I then established three additional blocks, each 300 m long, two downstream and one upstream of the 500-m long block. Each block was separated by 300 m of unsampled habitat. Blocks were numbered consecutively from upstream to downstream. Limber Pine had low density beyond these blocks and was not sampled.

I recorded coordinates for all Red Squirrel middens in each block with a handheld GPS unit to accurately locate middens near boundaries. In addition, I recorded the presence of Limber Pine cones or cone scales, slope aspect and steepness, and basal area of trees using a 2 m^2/ha prism, following the methods described by Hamer and Pengelly (2015). I examined middens for evidence of excavation by bears. Because Limber Pine cones were 25 times more abundant in 2015 than 2014 (15 cones/tree in 2015 versus 0.6 cones/tree in 2014 on 10 permanently identified trees in site A.1), I re-examined all middens in late September 2015 for evidence of excavation by bears.

Location of middens was facilitated by their large size (mean 39 m^2, range 11–92 m^2; Figure 1). All midden excavations were attributed to bears. Although few scats were found at middens in this study, those found were from bears. In addition, excavations did not differ in appearance from those found in Whitebark Pine habitat, where abundant bear scats and radio-locations from collared bears were positively linked to excavated middens (Hamer and Pengelly 2015). Thus, there appears to be no plausible alternative to bears being the source of these excavations (Figure 1). This contention is further supported by observation that middens in habitat lacking nearby Whitebark Pine or Limber Pine were not dug, including the 15 undug middens of upland site A.2 and an additional nine middens (all undug) in a block 300 m upstream of site A.1. This latter block was excluded from this report because no Limber Pines were recorded at either middens or systematic plots.

Because 79% of site A.1 middens occurred in gullies, I obtained additional information on gully characteristics. I used trigonometry to calculate gully size at the midden by measuring slope distance with a steel tape and slope angle with a clinometer, from gully bottom to crest of gully side, at right angles to the run of the gully at the midden. I averaged the heights of left and right sides to obtain gully depth.

To compare habitat characteristics at middens to characteristics in the site as a whole, I recorded habitat characteristics at 65-m intervals along linear transects on fixed elevational contours within each block (systematic plots). In each block, I ran three parallel transects spaced by 50 m of elevation. I varied starting

FIGURE 1. Red Squirrel (*Tamiasciurus hudsonicus*) cone cache or midden excavated by bears at site A.1 of the Bow River escarpment, adjacent to Limber Pine (*Pinus flexilis*) habitat, Banff National Park, Alberta, 2015. Photo: D. Hamer (10-second timer).

distances on each transect so that systematic plots would not lie directly upslope or downslope from each other.

Because site A.1 was used intensively by bears, I also obtained comparative data from the gently sloping, upland forest at the top of the escarpment (site A.2, Table 1) by establishing 300-m by 60-m irregularly shaped plots (i.e., following the lie of the escarpment rim), adjoining blocks 2–4. Middens were recorded if they were within 60 m of the rim. Upland forest plots were not established at block 1 nor along 200 m of the 500 m length of block 2 because human activity had removed or highly modified the forest at those locations.

At the North Saskatchewan River escarpment (site B, Table 1), the distance from escarpment rim to river bottom was less than half that at the Bow River escarpment, and there was little gullying. Therefore, I searched one 1300-m long, 12-ha block where Limber Pines occurred, following the procedures described for site A. Because of time constraints, I established systematic plots along only 650 m of the 1300-m block length, where Limber Pines were more abundant.

The Red Deer River site was an active alluvial fan created by a stream discharging into the valley bottom of the main Red Deer River Valley (site C, Table 1). I spent 5 h surveying 7 ha of this alluvial fan during a helicopter-assisted field day. This survey was facilitated by the gentle slope and open, immature forest of this disturbed site, which provided easy travel and high visibility. However, because time was limited, I did not collect all data at middens, and I could not confidently state that I had completed a total search. Systematic plots were established at 80-m intervals along a linear transect running through the alluvial fan.

I established three mountain sites in the Bow Valley where Limber Pines occurred on steep slopes with abundant rock outcrops (sites D–F, Table 1). These sites were too extensive for total searches, as used on the confined river banks of sites A and B and the alluvial fan of site C; thus, I sampled them by running 20-m wide belt transects following procedures described by Hamer and Pengelly (2015). I ran transects on elevational contours; 30-m belts were used in open habitat with higher visibility. I used a handheld GPS unit to locate transects at regular vertical intervals on the slopes and to measure transect lengths. I located and described all Red Squirrel middens that fell inside belt transects (Hamer and Pengelly 2015). I also established comparative systematic plots at 65–m intervals along the transects as described for escarpment blocks.

Results

Bow River escarpment (site A)

The mean basal area of Limber Pine in systematic plots at the Bow River site was 9 m^2/ha in block 2 and 1–2 m^2/ha in the remaining three blocks. Of the 24 Red Squirrel middens examined in 2014 at this site (Table 2), bears had excavated 10 (42%). Bear scats composed almost entirely of pine seed coats were found at three middens. Re-examination in 2015 revealed that bears had excavated 11 of the 24 middens (46%). Two that had been recorded as excavated during 2014 field work were not excavated in 2015, but three other middens were. Hence, 13 different middens (54% of 24 middens) were excavated when 2014 and 2015 observations are combined.

Five of the 24 middens (21%) were at the toe of the slope; one had been excavated by bears. The remaining 19 middens were at the bottoms of gullies (mean gully width 42 m [SD 15, $n = 4$]; mean depth 7 m [SD 3, $n = 4$]). Mean slope steepness at the middens was less than half that at the systematic plots (Table 2).

Only one of the 24 midden sites contained Limber Pine, resulting in a mean basal area at middens of only 0.06 m^2/ha. However, mean basal areas of Douglas-fir, White Spruce, and Lodgepole Pine were 23 (SD 11), 11 (SD 4), and 8 (SD 6, $n = 4$) m^2/ha at the middens. The total basal area for all conifers at the middens was more than double that in the systematic plots (Table 2).

Sixteen middens were located in upland White Spruce–feathermoss (e.g., *Hylocomium splendens* (Hedw.) Schimp. in B.S.G., *Pleurozium schreberi* (Brid.) Mitt.) forest on the gently sloping bench land adjacent to the escarpment (site A.2, Table 2). None was excavated by bears in 2014, but one was excavated in 2015. Eleven of the upland middens (69%) contained Limber Pine cones or cone scales. The nearest Limber Pines occurred on the rim of the escarpment.

North Saskatchewan River escarpment (site B)

The basal area of Limber Pine was 5 m^2/ha in the systematic plots on the North Saskatchewan escarpment (Table 2). One midden occurred on the open slopes of the escarpment. Two were in the single gully that dissected the block, in White Spruce–feathermoss forest (total 0.2 middens/ha). Four middens were within 60 m of the escarpment rim in adjacent upland White Spruce–Lodgepole Pine forest (0.9 middens/ha). All seven middens contained Limber Pine cones or cone scales; none was excavated by bears.

Red Deer alluvial fan (site C)

In the Red Deer site, basal areas of Limber Pine, White Spruce, and Lodgepole Pine were 7, 6, and 5 m^2/ha, respectively, at systematic plots placed in the active portion of the fan. No middens were located in this Limber Pine habitat. Four middens were located on the eastern edge of the fan in an alluvially inactive zone where successionally mature White Spruce–feathermoss forest has developed; all contained Limber Pine

TABLE 2. Habitat characteristics at Red Squirrel (*Tamiasciurus hudsonicus*) midden plots and at systematically placed plots in Limber Pine (*Pinus flexilis*) habitat at six study sites in and near Banff National Park, Alberta, 2014–2015.

Site	No. middens	Mean midden density, no./ha (SD)	Mean slope aspect, ° (SD)		Mean slope steepness, ° (SD)		Mean basal area of Limber Pine, m^2/ha (SD)		Mean basal area of all conifers, m^2/ha (SD)		No. middens excavated by bears
			Midden	Systematic	Midden	Systematic	Midden	Systematic	Midden	Systematic	
A.1	24	0.8 (0.2)	230 (13)	212 (21)	12 (3)	28 (3)	0.1 (0.1)	3.0 (4.0)	44 (8)	17 (5)	13
A.2	16	3.0 (0.9)	17 (55)	25 (43)	5 (1)	6 (3)	0.2 (0.3)	0.0	44 (2)	45 (12)	1
B	3	0.2	153 (65)	147 (15)	10 (4)	29 (6)	0.0	5.0 (4.0)	27 (7)	7 (4)	0
C	4	0.6	—	122 (9)	—	8 (1)	0.0	7.0 (4.0)	—	17 (4)	0
D	1	0.2	213	233 (21)	16	25 (6)	0.0	0.4 (0.7)	66	28 (8)	0
E	4	0.7	146 (23)	155 (21)	21 (5)	31 (9)	2.0 (4.0)	2.0 (4.0)	36 (19)	17 (14)	2
F	2	0.3	144	185 (30)	14	25 (8)	0.0	3.0 (5.0)	48	10 (8)	1

cones or cone scales but none was excavated by bears. The mean distance from these middens to the nearest Limber Pine was 75 m (range 46–95 m).

Mountain sites (sites D-F)

Sites D–F had low Limber Pine basal area and low midden density (Table 2). Mean slope steepness at the middens was less than that at the systematic plots (Table 2). All middens contained Limber Pine cones or cone scales; two middens in site E and one midden in site F had been excavated by bears.

(Note added in proof: One excavated midden containing 48 Limber Pine cones and 57 Whitebark Pine cones on its surface was discovered on 13 September 2016. It was located 6 m from a 16 October 2013 GPS location of a collared adult female Grizzly Bear. This midden was less than 2 km from site E, at 2120 m elevation, adjacent to a rocky ridge crest where both Limber Pine and Whitebark Pine are abundant [D. Hamer, 2016 field observations]).

Discussion

My observations at the Bow River escarpment of Red Squirrel middens excavated by bears and three bear scats composed of pine seed coats are, to my knowledge, the first record of bears in Banff National Park eating Limber Pine seeds. The species of bear responsible for these field signs could not be determined, as both Grizzly and American Black Bears are common in this portion of the park. Species identification could likely be achieved by DNA or remote camera sampling. However, only three pine seed scats were located during this study and were unsuitable for DNA analysis because of age; and use of cameras was precluded.

The steep, windswept, open escarpment at the Bow River site was not used by Red Squirrels as midden locations. Rather, all 24 middens were either in gullies or at the toe of the slope, adjacent to steeper slopes where Limber Pine trees occurred. Middens were on slopes that were less than half as steep and contained more than twice the conifer basal area as slopes where Limber Pines occurred. Limber Pines were similarly absent from midden sites elsewhere in the study area. Eighteen of the 20 middens in sites B–F were in White Spruce, Lodgepole Pine, and/or Douglas-fir forests, where Limber Pine measured zero in basal area. Kendall (1983) found a similar pattern in Yellowstone National Park: no Red Squirrel middens occurred within her three Limber Pine study areas. It appears that Limber Pine stands, typically, are not Red Squirrel habitat and, hence, are less likely to be sites where bears obtain pine seeds. On the Bow River escarpment, however, frequent small gullies provide Red Squirrel habitat in close (< 100 m) proximity to Limber Pine stands, and my observations in 2014 and 2015 suggest that bears regularly eat the seeds of Limber Pine at this location.

Observations from the North Saskatchewan River escarpment and Red Deer River alluvial fan provided further evidence that Limber Pine stands do not, in themselves, support bear use of Limber Pine seeds. These two sites had the highest basal areas of Limber Pine of all sites, but I recorded only one midden and no evidence of use of Limber Pine seeds by bears. Hence I conclude that Limber Pine habitat tends to show minimal or no use by bears – unless the pines are interspersed with (non–Limber Pine) habitat with higher forest cover and lesser slope steepness where squirrels can establish middens, such as found at the Bow River escarpments.

The Red Deer alluvial fan differed from other sites in having gentle slopes of less than 10° steepness. The coarse, rocky alluvium found at the surface of the active portion of this fan may have prevented squirrels from burying and caching cones, and thus may have had an effect analogous to steep slope.

Gurnell (1984) found that Red Squirrels moved Lodgepole Pine cones as far as 185 m. However, I assume that the abundance of Limber Pine cones in middens will decrease with increasing distance from Limber Pine trees, and at some distance a lower number of Limber Pine cones and seeds presumably will not attract bears. For instance, none of the 16 middens in the upland White Spruce forest above the Bow River escarpment but within 60 m of the escarpment rim was excavated by bears in 2014, although eleven of these middens contained Limber Pine cones or cone scales. The abundance of Limber Pine cones may also explain why some middens at the Bow River escarpments were excavated while others were not. For example, Limber Pine was abundant in block 2 of this site (mean basal area at systematic plots, 9 m^2/ha), and all eight middens in this block were excavated in 2015. In contrast, Limber Pine was less abundant in the other three blocks (1–2 m^2/ha), and only three of the 16 middens at these other locations were excavated in 2015.

Although the North Saskatchewan site was identified as a Limber Pine–Douglas-fir type by Corns and Achuff (1982), I did not find Douglas-fir at this site. Elevation was the same as at the Bow River escarpment (1400 m, Table 1), but the North Saskatchewan is farther north in a glaciated region of the park that includes the Wilson Icefield 5 km north of my study area. At the North Saskatchewan site, the lack of Douglas-fir and the presence of only one forested gully to provide suitable food and shelter for Red Squirrels in close proximity to Limber Pine trees may explain why midden density was only a quarter of that found at the Bow escarpments and also why bears apparently did not eat Limber Pine seeds at the North Saskatchewan escarpment.

No field signs were found to indicate that bears were harvesting cones directly from Limber Pine trees. Although Banff National Park is subject to frequent Chinook winds, the trees are not stunted as they are in Waterton Lakes National Park or the Porcupine Hills of southwestern Alberta, where Alberta's strongest Chinook winds occur (Vickers *et al.* 2001). Thus, cones

were not within reach of bears on the ground except at site F, which also lacked evidence that bears had harvested cones from trees.

The Bow River Valley has been described as one of the most human-dominated landscapes where Grizzly Bears still survive (Gibeau *et al.* 2001). Hebblewhite *et al.* (2003) found that 82% of American Black Bear mortality in the Bow Valley is caused by humans. The Bow Valley escarpment, where I observed substantial use of Limber Pine seeds by bears, is within 3 km of a town of roughly 10 000 people, the four-lane Trans-Canada Highway, the Canadian Pacific Railway main line, and an 800-unit campground. The escarpment is also traversed by a network of walking and bicycling trails and undesignated paths.

Managers should consider use of Limber Pine seeds by bears in the Bow River escarpment if they choose to mitigate soil erosion and other impact from the profusion of paths that currently dissect the unique and fragile habitat of the Bow River escarpment. Continued evaluation of bear use of Limber Pine seeds may also benefit management of Limber Pine throughout Alberta, where this tree species is listed as endangered (Alberta Whitebark and Limber Pine Recovery Team 2014).

Acknowledgements

I thank Parks Canada's Banff National Park Resource Conservation Service, Banff Field Unit, for support. Ian Pengelly made numerous suggestions, directed me to several Limber Pine stands, and reviewed the manuscript. I also thank M. Bernauer, B. Gleig, D. Gummer, R. Osiowy, J. Park, J. Whittington, and N. Woode for assistance, and two anonymous reviewers and the editors for useful comments on the manuscript.

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Received 12 November 2015
Accepted 24 August 2016