Selective Removal of a Natural Bear Attractant (Soapberry) from the Kathleen Lake Campground, Kluane National Park – 2012 Update

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Front cover photographs:
Top (L and R): Students removing soapberry bushes from Kathleen Lake campground – August 26, 2010. Photos courtesy of Daniel Jolkowski.

Bottom: RRM students take a break after removing female soapberry bushes from the group tenting area. The pile of shrubs in the centre was removed from about 0.5 ha - August 22, 2012. Photo courtesy of Josie O'Brien.

Introduction

One of the main visitor facilities in Kluane National Park (KNP) is the Kathleen Lake campground and day use area located about 30 k south of Haines Junction. Parks Canada staff manage a variety of visitor experiences at this site while trying to maintain conservation values. One of the ongoing public safety concerns has been human-bear interactions and a number of successful approaches have been employed to reduce conflicts between visitors and bears (Resource Conservation 2011). The Kathleen Lake area provides good habitat for grizzly bears (*Ursus arctos*) and Park managers consider the species an indicator of ecosystem health (Henry et al. 2008). Soapberry or buffaloberry (*Shepherdia canadensis*) fruit, are an important diet item for bears during July and August and the Kathleen Lake campground has a moderately dense cover of this plant.

Soapberry is a medium sized (under 1 m tall) shrub that can appear early in succession after fire or disturbance and remain as an understory component of open forests. It occurs across North America and is found in a variety of habitat types in the Yukon. It is dioecious, that is, male and female flowers are produced on separate plants. The bright red berries form on the female plants and the soapberry crops in the Klunae area are known to vary between years (Krebs et al. 2009).

In 2010 a small group of students from the Renewable Resources Management Program at Yukon College worked with KNP staff on a bear habitat management project at the Kathleen Lake campground. At the suggestion of Lloyd Freese and Kevin McLaughlin, students and I initiated a pilot study to assess the efficacy of removing female soapberry bushes (*S. canadensis*) to reduce natural bear attractants in the overnight campground area. This report provides an update on the work that was carried out between 2010 and 2012 and outlines some suggestions for further work.

Methods: The Kathleen Lake campground, in Kluane National Park, is located about 30 k south of Haines Junction, YT. The overnight camping area provides 39 campsites located along a 750 m gravel loop road (Figure 1). The campground is located in an open spruce (*Picea* glauca) forest with an abundant understory of soapberry (*S. canadensis*).

In late August of 2010 and 2012, students took part in a field course exercise to reduce the number of berry producing bushes of *S. canadensis* in proximity to the campground. Female plants were identified by the presence of ripe berries and were pulled out of the ground by hand or with the aid of shovels in 2010 or pulaskis in 2012. The size of the work crew varied from six in 2010 to 20 in 2012 and in both years we removed the entire plant including the roots and hauled them to the nearest roadway where they were piled and picked up by Parks Canada staff for composting offsite. We made estimates of the biomass weight of bushes we removed each year by tallying independent observer estimates of each pile. The areas treated were mapped using handheld GPS units and the time required to treat each area was recorded.

Results and Discussion

During a two day period in August, 2012 we were able to complete the initial project goal of removing all female soapberry plants within the central campground loop (Figure 1). In 2010 the student volunteers had raised concerns about the large number of ripe soapberries in the vicinity of the group camping area where they were tenting so this area was also treated in 2012. The total area treated over the two years was 3.4 ha and we removed approximately 675 kg of bushes (including branches, stems and roots) using 45.3 hours of labour (Table 1). The actual on site labour required to treat one hectare varied from 12.1 to 15.0 person-hours and the overall average was 13.3 person-hours per hectare. Much of the labour was spent looking for female bushes or carrying them out to a collection point; the time to remove most bushes, which were shallow rooted, was minimal. These estimates should be taken as a first approximation because the area treated has been overestimated by including pathways and outbuildings inside the polygon and in 2012 students spent some time double checking the areas that had been cleared in 2010.

Table 1. Summary of the work carried out to remove female soapberry plants (*S. canadensis*) in 2010 and 2012.

	Biomass removed	Area treated	Biomass removed	Labour / ha
	kg	ha	kg / ha	person-hours/ha
2010 - Portion of campground loop	193	0.7	276	12.1
2012 - Group camping area	136	0.5	272	15.0
2012 - Campground loop	277	2.2	126	13.3

This type of habitat manipulation is not new. Davis et al. (2002) outlined the various considerations to give to bear habitat management in green space areas near communities. They suggested (p. 32) that human-bear conflicts could be reduced by brushing vegetation adjacent to communities to "*reduce the habitat potential in natural feeding areas that are commonly used by humans by removing natural bear foods*".

Honeyman (2007) recommended the use of habitat modification techniques to reduce the amount of natural bear attractants in the Bow Valley, Alberta where bear-human interactions were a concern. Honeyman (2007, p. 55) reported that buffaloberry removal had been used successfully in Kananaskis Village and at tenting areas in Peter Lougheed Provincial Park to reduce bear activity. The habitat modification described in his report used mechanical removal of berry-producing bushes and speculated that repeated treatments may be needed as the *Shepherdia* bushes grow back. A recent assessment of bear hazards in the Kluane area by Homstol et al. (2011) also recommended targeting soapberry bushes for removal in areas such as the Kathleen Lake campground and residential areas in Haines Junction where bear-human conflicts were a concern. Vassal et al. (2003) described work proposed for campgrounds in Banff National Park that specifically targeted female soapberry plants for removal by hand.

Will the treatment be effective in reducing the number of bear-human conflicts in the campground area? Bears are under considerable time pressure to acquire food during the short northern growing season (MacHutchon and Wellwood 2003) and their nutritional budget

has consequences for current and future reproduction. Soapberries are an important part of the diet of grizzly bears in the Kluane area and Pearson (1975) suggested that weight gain in late summer was associated with soapberry consumption. Pearson (1975, p. 34) estimated that grizzly bears were consuming tens of thousands of berries per day based on a small sample (n=24) of faeces collected during the peak soapberry feeding period. One could use optimal foraging theory to predict that bears will try to choose foraging habitats during the summer berry season where they can maximize energy intake. It seems reasonable to assume bears will spend less time in the treated areas because the density of soapberries has been reduced but Timko and Innes (2009) point out the importance of monitoring and collecting empirical data to help evaluate whether management actions are actually meeting ecological integrity goals.

Is there some empirical evidence that could be collected to show that reducing berry density translates into fewer bear-human conflicts? It may be difficult to detect a change over time in bear activity around the Kathleen Lake campground specifically. Homstol et al. (2011, p. 23) described the number of bear-human conflicts there as "currently quite low" and attributed this to the long standing efforts by Parks Canada staff to educate campers about bear safety and reduce anthropogenic attractants. The authors provide a summary of the number of bear observations collected by Parks Canada at the Kathleen Lake campground and day use area over a 23 year period (Homstol et al. 2011, Figure 10 on p. 25) and it shows less than 50 entries. Therefore it is unlikely one could detect a significant decrease in sightings in future given the low starting baseline.

Future Work

There are several ways to follow up this initial project and I lay out four suggestions.

1. Extend the soapberry treatment area. Homstol et al.'s (2011, p. 42) first recommendation for the Kathleen Lake campground was to:

Remove all soapberry shrubs within 100 m of campsites, especially in fire smarted areas. If this is not possible, we recommend removing all female shrubs within 100 m of campsites. The male shrubs may produce female parts in the future so monitoring is also recommended, but berry densities should be lower than if no removal occurred.

The choice of a 100 m buffer was also used at the Two Jack Lake campgrounds in Banff National Park as noted by Vassal et al. (2003, p. 4),

A buffer zone of up to 100m-wide has been identified by Human-Wildlife Conflict wardens as an acceptable distance within which to remove berry bushes. This 100m distance is based upon the irregular shape of campground perimeters…. The buffer zone is required both for public safety reasons and for preventing habituation of bears to humans and human facilities.

There are 20 campsites on the outer perimeter of the Kathleen Lake campground loop that have not been assessed and, if there is extra help available, these areas could be treated in future. The recommendation to remove soapberry bushes within 100 m of the campground would require additional work as the group tenting area was only cleared to a distance of about 30 m. Figure 2 shows the approximate limits of a 100m buffer around the entire campground encompassing 8.0 ha. About half of this area has already been treated (3.4 ha) so there would be about 4.6 ha left to treat and the labour estimate, using the results from this study, would be between 56 and 69 person-hours depending on the density of soapberry plants.

2. Follow up the removal of female soapberry shrubs. It would be useful to re-visit the treated area during the next growing season, when berries are ripe, to ensure that all of the female shrubs were actually removed. Volunteers may have missed soapberry bushes that had ripe berries during the initial treatment or some female bushes may not have actually set fruit and were therefore not recognized and left behind on the treated area. Homostol et al. (2011, p.42) stated that, "*male shrubs may produce female parts in the future",* but I could find little support for this claim in the literature (Table 2). Vassal et al. (2003) raised the question of whether male soapberry plants could produce fruit when female plants are removed and cited . Stephens (1973) who claims the plant can be monecious as well[1]. Lewis (1990) followed 150 tagged soapberry plants that were located on three different study areas in southern Alberta and confirmed that none of the shrubs changed gender over a six year period. She concluded that gender appeared to be fixed.

[1] I contacted Dr. Craig Freeman, the Curator in Charge at the R. L. McGregor Herbarium at the University of Kansas, where H.A. Stephens worked for years. In an emailed response, on January 27, 2013, Dr. Freeman indicated that Stephens' (1973) book was never revised and there was no errata published to his knowledge. He also checked all the specimens of *S. canadensis* that were deposited in their collection by Stephens and said he did not find any notes or annotations about reproductive biology. He believes the reference to "monecious" is an error.

Virtually all authors describe *S. canadensis* as dioecious meaning that single sex flowers are borne on separate plants (Table 2). The suggestion that, "T*he male shrubs may produce female parts in the future*…" (Homostol et al. (2011, p.42) seems to imply that some soapberry plants are *subdioecious* using the terminology suggested by Sakai and Weller (1999). Subdioecious reproduction, defined by Sakai and Weller (1999, p. 5) is a *"population of plants with staminate flowers, plants with pistillate flowers, and some hermaphroditic plants (usually with staminate and perfect flowers although other combinations are possible).*"

Table 2. Literature survey of the reproduction system of *Shepherdia canadensis*

Description	Species	Source
"dioecious"	*S. canadensis* (L.) Nutt.	Moss 1959, p. 341
" unisexual flowers"	*S. canadensis* Nutt.	Graham 1964, p. 274
"dioecious"	*S. canadensis* (L.) Nutt.	Viereck and Little 1972, p. 194
"flowers sessile.. of 2 kinds - staminate..and pistillate"	*S. canadensis* (L.) Nutt.	Hulten 1968, p.684
"dioecious or monecious"	*S. canadensis* (L.) Nutt.	Stephens 1973, p. 410
"dioecious"	*S. canadensis* (L.) Nutt.	Hayes et al. 1989, p. 1870
"Plants are generally dioecious but occasionally monoecious" citing Stephens (1973)	*Shepherdia canadensis* (L.) Nutt. Elaeagnaceae	Walkup 1991 under *General Botanical Characteristics*
"dioecious"	*S. canadensis*	Pojar and MacKinnon 1994, p. 94
"dioecious"	*S. canadensis*	Johnson et al. 1995, p. 55
"dioecious"	*S. canadensis*	Parish et al. 1996, p. 71
"dioecious"	*S. canadensis* (L.) Nutt.	Magee and Ahles 1999, p. 756
"dioecious"	*S. canadensis* (L.) Nutt.	Douglas et al. 1999, p. 12
"dioecious"	*S. canadensis* (L.) Nutt.	Cody 2000, p. 440
"dioecious"	*S. canadensis* Nutt.	Keefer et al. 2010, p.37

If soapberry shrubs bearing fruit appear in a treated area in later years I think the simplest explanation would be that a female plant was missed during the initial removal operation. Verifying this could be done by marking the shrub so it could be revisited in May when the flowers are present. If only female flowers are present than the explanation is simple. If, on the other hand, both male and female flowers appear on the same plant (i.e. a hermaphrodite) then this would be a new discovery for North American *Shepherdia*.

3. Monitor the response of soapberry shrubs in areas where Firesmart thinning has opened up the canopy. The cost effectiveness of manipulating bear habitat by removing soapberry shrubs could be undermined if shrubs grow back quickly. There could also be new problems appearing in areas around communities or campgrounds where Firesmart campaigns are opening up the forest canopy through thinning operations and potentially increasing the growth rate of soapberry shrubs. Both Honeyman (2007) and Homostol et al. (2011) raised this concern and pointed out that bears would be expected to increase their activity in habitats where natural bear attractants were increasing. It may be prudent to monitor the response of Yukon soapberry shrubs to changes in canopy cover and develop a northern description of soapberry response rather than rely on southern studies.

Soapberry is present at a variety of stages of succession (Keefer et al. 2010) and is often associated with post fire plant communities (Hamer 1996). Female plants allocate resources to both growth and reproduction so we should consider how these two responses are affected by changes in light levels due to canopy changes. While bears cue in on fruit production, a shrub that has been growing vigorously for some years may be able to produce more berries eventually. Smith et al. (1988), working in the Kluane area, used a non-destructive photographic technique to follow the growth of individually tagged *S. canadensis* twigs between 1978 and 1984. The average growth of these small, terminal twigs was 34.5% a year but their study did not describe the overall growth of the complete plant. Knight (1999), working in southeastern BC, compared the density of buffaloberry bushes between control forest plots and clearcuts (where the canopy had been removed) and found higher densities in the clear cut but the difference was not statistically significant (likely as a result of a small sample size of seven). Burton et al. (1998) examined soapberry plants in a study located west of Hazelton, BC and estimated both plant growth and fruit production in plots with varying levels of light intensity. He found that standing crop, annual growth and fruit production of *S. canadensis* each had a positive correlation with light levels. Hamer (1996) found a relationship between buffaloberry fruit production and the degree of forest canopy closure in Banff National Park. Open forests (between 0 and 45% crown closure) showed high levels of fruit production but this dropped off

quickly as crown closure increased. After surveying the literature, Keefer et al. (2010) were unable to find agreement on the response of soapberry to forest removal and suggested more research was needed.

The removal technique used in this study was to uproot and take out any female soapberry plant in the treated area. In Banff National Park the proposed removal method was to cut the stems off 5 cm above the ground (Vassal et al. 2003). Soapberry are able to form adventitious buds where a stem has been cut or browsed (Hayes et al. 1990) and can also resprout after wildfire so the complete removal of the plant should provide a more lasting impact.

4. Evaluate the tradeoffs of removing only female soapberry plants versus total removal of all plants. The biology of *S. canadensis* has several aspects that may inform habitat management decisions affecting it. First of all the plant is dioecious so managers have the option of removing only the berry-producing female plants and leaving the male portion of the population intact. The soapberry habitat manipulations around Canmore and Kananaskis District used mechanical methods to remove all buffaloberry shrubs (Honeyman 2007) so this project at Kathleen Lake may be among the first to target just female plants. One unanswered question is how bears identify suitable berry habitat. Do they seek out potential berry patches based on habitat appearance or from foraging experience in previous years? If so the continued presence of male soapberry plants could be viewed as an "attractant". If bears behave as optimal foragers (given the constraint of finding secure habitat) and choose berry patches based on short term rewards, then the absence of fruiting shrubs should encourage them to keep moving and leave the treated area.

What is the overall impact of soapberry removal on the food supply for bears in the general vicinity of the treated area? At Kathleen Lake this was not a major concern because of the small size of the treated area compared with undisturbed areas nearby. However this has been raised as a consideration by Gilbert (2001) who assessed the problem created by buffaloberry crops attracting grizzly bears to the Two Jack Campground in Banff National Park (an area of

approximately 60 ha). The subsequent environmental screening report, prepared by Vassal et al. (2003), assessed the impact of removing buffaloberry plants from the Two Jack Campground and stated (p. 8), "*its removal from the campgrounds is not expected to greatly impact wildlife.*" Honeyman (2007) suggested using habitat enhancement sites to offset the food supply losses from soapberry removal operations. He gave the example of the creation of a firebreak near the Canmore Nordic Centre; buffaloberry was predicted to grow quickly in this area and improve bear habitat. Noble (1985) had also suggested the possibility of managing grizzly bear habitat by replanting soapberry in areas affected by coal mining or logging.

One of the benefits of leaving male soapberry plants behind is the contribution they make to soil fertility with their nitrogen fixing root nodules. Rhoades et al. (2008) documented the ecological service provided by soapberry in their study, in northern Alaska, where the total nitrogen levels in the soil increased annually by about 2.4 g N per m^2 over a successional period of 120 years. In the nitrogen limited soils of Kluane there could be a considerable benefit to leaving intact male plants behind to provide this ecosystem service.

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Figure 1. Google Earth image of the Kathleen Lake campground loop showing the area treated in 2012. The polygon surrounding the group tenting area at the north end of the campground is 0.5 ha and the interior of the loop (including paths, outbuildings and campsites) is 2.9 ha.

Figure 2. Google Earth Pro image of the Kathleen Lake campground loop showing the approximate 100m buffer around the campground that covers an area of 8.0 ha.