

## Impacts of Reintroduced Bison on First Nations People in Yukon, Canada: Finding Common Ground through Participatory Research and Social Learning

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### Abstract

From 1988-1992 wood bison (*Bison bison athabascae*) were transplanted to the southwest Yukon, inadvertently creating concerns among local First Nations about their impacts on other wildlife, habitat, and their members' traditional livelihoods. To understand these concerns we conducted a participatory impact assessment based on a multistage analysis of existing and new qualitative data. We found wood bison had since become a valued food resource, though there was a socially-determined carrying capacity for this population. Study participants desire a population large enough to sustainably harvest but avoid crossing a threshold beyond which bison may alter the regional ecosystem. An alternative problem definition emerged that focuses on how wildlife and people alike are adapting to the observed long-term changes in climate and landscape; suggesting that a wider range of acceptable policy alternatives likely exists than may have previously been thought. Collective identification of this new problem definition indicates that this specific assessment acted as a social learning process in which the participants jointly discovered new perspectives on a problem at both individual and organisational levels. Subsequent regulatory changes, based on this research, demonstrate the efficacy of participatory impact assessment for ameliorating human-wildlife conflicts.

**Keywords:** Aishihik, wood bison, *Bison bison athabascae*, common interest, community-based participatory research, First Nations, qualitative analysis, socio-economic impact assessment, Yukon, Canada

### INTRODUCTION

From 1988-1992, 170 wood bison (*Bison bison athabascae*) were reintroduced to southwestern Yukon, Canada, as a part of a national recovery initiative to restore the subspecies to its former range (Government of Yukon 2012). Although this intervention was biologically successful it caused considerable concern among local First Nation peoples, largely because

of bison-human conflicts and observations of how bison were affecting the regional ecosystem. Their concerns were recognised in management plans for the population. Consequently, a socio-economic assessment of the impact of the reintroduction programme was requested by First Nations and agreed to by the territorial government (Government of Yukon 2012).

We assessed impacts from the bison reintroduction programme to understand the direct and indirect impacts of bison restoration on members of the Champagne and Aishihik First Nations (CAFN), define a suite of impact mitigation alternatives, and identify information gaps and how they might be addressed. During this process an alternative problem definition emerged that focuses on how wildlife and people alike are adapting to the observed long-term changes in climate and landscape. Collective identification of this new problem

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definition indicates that our assessment may have acted as a social learning process, in which the participants jointly discovered new perspectives on a problem at both individual and organisational levels. The objectives of this paper are twofold: first, to describe the assessment process and its findings; and second, to retrospectively examine the features of this participatory process that appear to have enabled those social learning outcomes and broaden the relevance of this work to other situations. This is necessarily a *post hoc* analysis because we simply didn't expect such developments and so did not prepare an appraisal framework in advance to examine social learning or any other similarly broad-reaching outcomes.

### Theoretical framework

Our approach is guided by the literature on socio-economic impact assessment, natural resource co-management, management of human-wildlife conflict, and the emerging paradigm of community-based participatory research. Retrospectively, we also drew on literature on adaptive governance (Brunner et al. 2002 and 2005; Steelman and Rivera 2006) and social learning in environmental management in order to appraise the significance of our work (Pushchak and Farrugia-Uhalde 2005; Doelle and Sinclair 2006; Sinclair et al. 2008; Diduck et al. 2012). This project is situated at the intersection of those fields and contributes to each. First, this work reinforces the growing understanding of how participatory institutions can be designed and operated in order to ameliorate human-wildlife conflicts (Schusler et al. 2000; Treves et al. 2006). Second, our modification and application of socio-economic impact assessment methods suggest ways to advance meaningful Aboriginal participation in environmental assessments through participatory research—an important goal for indigenous communities in Canada and worldwide (Stevenson 1996; Usher 2000). Third, the social learning outcomes provisionally identify attributes for successful co-management practices that can be fostered elsewhere.

Berkes et al. (1991) suggest a working definition of co-management as “the sharing of power and responsibility between the government and local resource users.” For consistency with the established literature we use ‘co-management’ in this broad and descriptive sense, and not as a prescriptive term with specific legal meaning. Co-management regimes usually involve the creation of institutions to bridge those systems, which are very often local or regional in scope though functioning across a range of levels of integration in terms of both their membership and influence (Pinkerton 1989). In Canada the establishment of co-management regimes over the last three decades has been driven largely by the movement to settle Aboriginal land claims (Freeman and Carbyn 1988; Simmons and Netro 1995; Treseder et al. 1999). Those settlement agreements specify the type, degree, and mechanisms of power sharing in great detail, including the co-management organisations to be developed (McMillan and Yellowhorn 2004). Co-management research has evolved from its early emphasis on articulating theories

of practice to include critique (Nadasdy 2003; Irlbacher-Fox 2009), institutional analysis (e.g., Feit 2005; Natcher et al. 2005; Stevenson 2006; Houde 2007), and most recently a focus on adaptation and learning (e.g., Armitage et al. 2007, 2009, 2011; Dale and Armitage 2011). Research into human-wildlife conflicts is not new either, but has only recently expanded to explicitly incorporate the human dimensions of such problems (e.g., Woodroffe et al. 2005; Dickman 2010; Decker et al. 2012; Treves et al. 2006). It has coalesced as a field with distinct geographic foci in the continental USA (e.g., Bath and Enck 2003; Gore et al. 2006; Conover 2010) and the global south (e.g., Hoare and duToit 1999; Treves and Karanth 2003; Packer et al. 2005; Anthony 2010). Human-wildlife conflicts are complex, multifaceted phenomena that must be addressed comprehensively in order to hope for any resolution (Bath and Enck 2003; Woodroffe et al. 2005; Dickman 2010). In particular, societal dimensions of such conflicts are crucial yet often overlooked in a search for ‘efficient’ technical solutions (Clark et al. 2005; Treves et al. 2006; Dickman 2010).

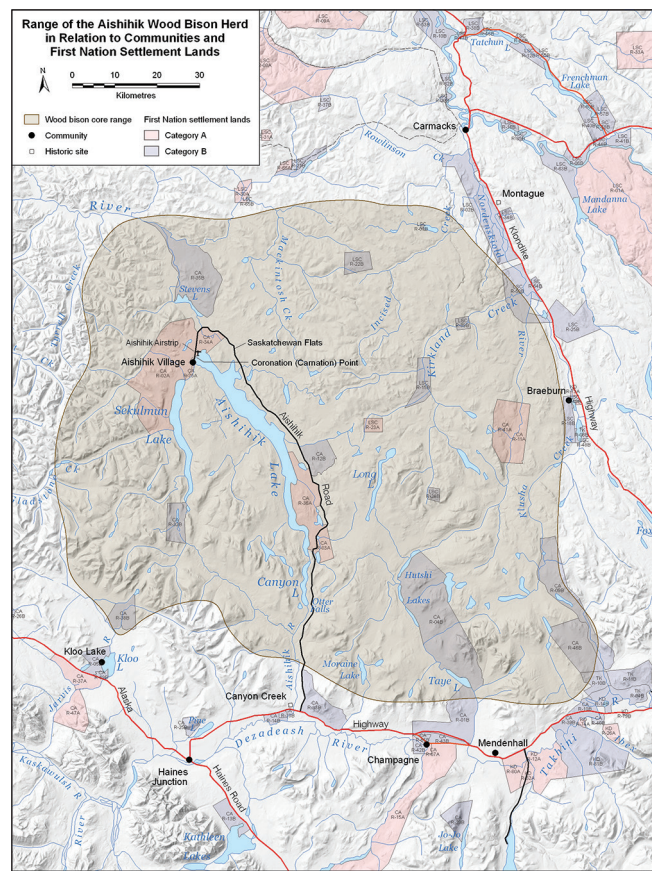
The standard approach to social impact assessment involves setting a baseline profile before any anticipated impacts take place, then comparing projected conditions with actual ones measured during ongoing monitoring once development commences (Burge 2003; Pushchak and Farrugia-Uhalde 2005; YESAB 2006). However, that methodology couldn't provide the retrospective analysis required here so to describe and investigate the range of impacts from bison reintroduction we combined a participatory assessment approach (Bradshaw et al. 2001; Pushchak and Farrugia-Uhalde 2005) with rapid appraisal (Beebe 1995). Rapid appraisal provides a flexible yet rigorous framework for documenting ‘insider’ perspectives of a complex system of interest and works well in this cultural context because it explicitly incorporates local and indigenous knowledge (Nichols et al. 2004).

A brief description of our individual roles and standpoints is important to situate this work with respect to the emerging norms and practices of community-based participatory research, especially as it relates to northern Aboriginal communities (Gearheard and Shirley 2007; Brook et al. 2009; Kwiatkowski 2011; Wolfe et al. 2011). At the time of this work the first author had a decade of experience in the study area as a community-oriented researcher and (previously) a national park warden. He was living in the Yukon and was invited to coordinate this study by the other two authors, one of whom he had previously collaborated with. The second author is a CAFN citizen who has worked as a wildlife and fisheries manager for the CAFN government for over two decades, and currently serves as co-chair of the Yukon wood bison technical team. The third author is the Yukon Government's lead biologist on bison management and serves as the other co-chair of the Yukon wood bison technical team. To summarize, this project focused on a problem identified by the community and involved community members directly and authoritatively in the design, implementation, interpretation, and dissemination of findings (McGregor et al. 2010; Castleden 2012; Mulrennan 2012), and was conducted based on indigenous principles of

relationality and respect (Battiste 2008; Wilson 2008; Kovach 2009). For clarity, this article expresses the perspectives of the CAFN people who were participants in this study and does not constitute the views or opinions of the governments that sponsored this work.

### Social and ecological context

Wood bison were once native to Yukon but were extirpated by the twentieth century (Lotenberg 1996; Stephenson et al. 2001; Hare et al. 2004). Population targets for the Aishihik bison herd vary from 500-1,000 animals, and in 2011 the population estimate was 1,230 (90% CI= 1,106-1,385, Jung and Egli 2012). The herd's current range is shown in Figure 1 and includes areas used by people from five of the six communities within CAFN's traditional territory; Aishihik, Canyon, Champagne, Haines Junction, and Mendenhall. Both First Nation and non-Aboriginal Yukon residents hunt bison in a general season that now extends from autumn through spring, and hunting is the main technique for limiting this herd's size (Government of Yukon 2012). Despite this current state of local abundance, wood bison are classified as a species at risk both nationally and globally (Gates et al. 2010; Government of Yukon 2012).



**Figure 1**

*Map of the range of the Aishihik wood bison herd in relation to communities and First Nation settlement lands*

The Aishihik herd had grown continually since establishment, despite significant population control efforts through hunting. Bison were believed to be affecting other wildlife and their habitat (thus impacting peoples' livelihoods), and the reintroduction took place without any prior consultation between the territorial or federal governments and First Nations. The political context of this situation is important. Since settlement of comprehensive Aboriginal land claims in the region in 1993—immediately following the reintroduction of bison—Yukon First Nations have played an active formal role in the decision-making process for wildlife in the Yukon (Nadasdy 2003; Clark and Slocombe 2005; Natcher et al. 2005). Management recommendations for bison in Yukon is the responsibility of two bodies: 1) the Yukon Wood Bison Technical Team, made up of territorial, First Nation, and federal wildlife managers and biologists plus representatives of the local Renewable Resource Councils; and 2) the Yukon Wood Bison Management Team, comprised of territorial and First Nation wildlife directors. The technical team makes recommendations to the management team, whose decisions are then advanced for consideration for implementation as legislation, regulations, and policy by the territorial government.

### METHODS

#### Analysis of existing data

Observations and perspectives on bison were collected by the CAFN government from 1998-2005, as follows: 1) interviews conducted with CAFN and non-aboriginal community members (handwritten interview notes,  $n = 19$ ; 1998) analysed by Fischer (2002); 2) questionnaires to CAFN and non-aboriginal community members administered by CAFN ( $n = 19$ ; 2004); and 3) records of public meetings held by CAFN ( $n = 2$ ; 2005). Interview notes and completed questionnaires were transcribed by CAFN staff. Qualitative analysis software (HyperResearch, [www.researchware.com](http://www.researchware.com)) was used to thematically code interview and questionnaire data (Miles and Huberman 1994), producing a plain-language list of community concerns for discussion.

#### Collection and analysis of new data

A two-day workshop with 15 participants was held in January 2009 in Haines Junction, Yukon, in order to verify our interpretation of concerns identified through initial qualitative analysis. Participants were purposefully recruited from the CAFN's membership, based on the following criteria: 1) familiarity with the Aishihik Valley and the behaviour, distribution, and harvest of bison and other wildlife there; and 2) participation in previous CAFN efforts to collect traditional knowledge and observations of bison. This sampling strategy follows the community's preferred practices for such work (Clark and Slocombe 2005, Clark et al. 2014). We sought to

answer the following research questions: 1) Are the impacts and concerns identified to date still what people are concerned about? 2) Have peoples' thoughts about any of these changed (for better or worse)? 3) What do these impacts mean for people? 4) Given these impacts and concerns, what should be done to improve the situation? 5) What is possible (and not possible) to do to alleviate concerns?

The workshop was run by a professional facilitator who had worked with CAFN previously (Smith and Cooley 2003). During each day the workshop participants broke out into facilitated focus groups and later reconvened to discuss each group's results and how to synthesize them. Further exploratory interviews were conducted in November 2009 with a subset of workshop participants to explore what identified impacts meant for them and their livelihoods. Interviewees were selected from among workshop participants to reflect a range of ages and experience with specific impacts. Following a semi-structured interview guide (Huntington 1998) a practice interview was performed with a CAFN staff member, then we interviewed eight of the workshop participants in their home communities. Interviews and workshop sessions were digitally recorded and transcribed in point-form, with specific illustrative quotes transcribed verbatim. We transcribed and coded data, and patterns were interpreted by the whole research team (Weston et al. 2001). Finally, findings were reviewed in detail with CAFN staff and the Yukon Wood Bison Technical Team in March 2010. Written consent to participate was given by all study participants, and their consent explicitly included use of quotes.

## RESULTS

### Impacts on wildlife habitat

Reduction in habitat quality and availability for moose (*Alces americanus*), caribou (*Rangifer tarandus*), Arctic ground squirrels (*Urocitellus parryii*), and muskrats (*Ondatra zibethicus*) was the most significant negative impact identified by study participants. The workshop recommendations included developing a better understanding of the nature and extent of bison damage, and what that means for other components of the regional ecosystem (Table 1). Impact on vegetation from bison hunters' snowmobiles was also a concern, and the participants suggested there should be a way to spread use of specific areas over time or even encourage use of different areas. Bison damage to trees and shrubs was widely-observed, especially in the Aishihik Valley and in the wetlands around Taye and Kloo Lakes. Study participants also commented on how bison graze, observing that horses will take a chunk of grass and leave half but that bison eat right to the dirt. Bison were also reported to trample and churn up meadows; displacing ground squirrels from meadows where they were traditionally found and trapped. There is now apparent competition for accessible ground squirrel-trapping opportunities.

Bison were observed eating muskrat push-ups—vegetation stored as winter food—apparently resulting in muskrats disappearing from certain areas. The extent and magnitude of ecological effects from bison eating muskrat push-ups are unclear, as is the question of whether bison are solely responsible for recent muskrat declines. Interviewees noted that other factors are likely involved in that decrease, such as beaver dam removal and changes in both trapping effort and mode of transport. Some workshop participants proposed removing bison from specific areas where muskrats have been heavily impacted, and also recommended further study of the bison/muskrat relationship.

### Impacts on moose and caribou

A major concern was that bison were physically displacing and/or competing for habitat with moose and caribou (Table 1). There was no discernible temporal trend, nor unanimity about the extent of competition with moose, but both species were reported to have moved from specific places where people were accustomed to seeing and hunting them in the past. Consequently some study participants reported increased effort and reduced hunting success for these species. This is particularly noticeable for elders who travel less now, and are more likely to hunt only opportunistically.

Workshop participants intensively discussed the historic high caribou abundance in the Aishihik region but a marked shift in the dialogue took place when one key participant noted that caribou declines predated the bison reintroduction. As that same participant said, “we need the big picture here” explaining that much was changing in the Aishihik Valley and we need to understand the relationships among all species. A significant spruce beetle (*Dendroctonus rufipennis*) infestation, fire suppression, and climate change were all mentioned as underlying ecosystem-scale drivers of change. Caribou have changed their timing as they come into the valley, and human distribution has also shifted. The discourse shifted from “blaming the bison”, as one participant put it, to recognition that large-scale, long-term changes in the environment were affecting moose, caribou, bison, and people. Participants then suggested that maybe thinking needs to adjust to those changes too. Examples included allowing fire to open up the landscape more, using beetle-killed wood, eating more bison, and opening the bison hunting season earlier to attract more hunters and reduce the herd.

### Impacts on berry picking and use of medicinal plants

Berry picking is an important late-summer subsistence activity for CAFN members that brings together community members—especially women—and their families (Wein and Freeman 1995; McClellan 2001). A range of species are picked and used around Aishihik Village: cranberries (*Vaccinium vitis-idaea*, *Viburnum edule*), blueberries (*Vaccinium uliginosum*), and mossberries (*Empetrum nigrum*). Bison have trampled and defecated on berry

**Table 1**  
**Summary of identified impacts and related recommendations put forward by participants**

<i>Impacts identified by participants</i>	<i>Main recommendations by participants</i>	<i>Representative quotes, with attribution</i>
Impacts on wildlife habitat and plants	Study impacts on habitat and plants	“They push over, rub on a lot of younger spruce trees. Spruce seem to be more visible, as some are leaning over road as you go to Aishihik and some trails people commonly use” (questionnaire)  “... this climate change that’s the one causing the most trouble” (workshop participant)
Competition with and/or displacement of moose and caribou	Reduce herd, study impacts on moose and caribou	“We used to have a bunch of caribou in this country here.” (workshop participant)  “I think the caribou disappeared way before the buffalo came around.” (workshop participant)
Bison eating muskrat houses, muskrat freeze and disappear from areas	Remove bison from specific areas (e.g., Taya Lake), study nature of relationship	“Bison feed on muskrat push up, so that would deplete the roots in that area” (questionnaire)  “Bison eat the muskrat push-up and tend to freeze them out even starve them (Beavers, too.)” (questionnaire)
Impacts on traditional medicines and berry picking (plant use)	Reduce herd	“The bison herds strip clean all habitat to the ground; grazing is cut to ground level, they seem to eat everything, they are like cattle” (questionnaire)
Cumulative effects on trappers from bison and bison hunters	Shift to autumn hunting season (from winter), establish compensation fund, steward, special-guide permits for trappers, education, gutpile management, renting cabins to bison hunters is a benefit	“when they extended the season it was havoc, up Aishihik road and on my line. People were leaving vehicles the other side of Mendenhall. I counted 5 vehicles alongside the road all trying to get their last minute buffalo, this spring. I didn’t even go down my [trap] line, just stayed out.” (2009 interviewee)
Bison-human conflicts, including damage to property and competition with horses	Local steward, reduce herd, aversive conditioning	“when I go rabbit snaring I always think... ‘now, what will I do if I meet a buffalo?’ Never did yet though. I think they’re scared of people now since they started hunting them.” (2009 interviewee)
Trails widened by bison and hunter traffic	Shift to autumn hunting season (from winter), reduce herd, mark trails	“I think bison hunters do much more harm out there in the land, more than bison. That is the reason I talk about changing hunting season about bison. Same as moose season. Hunter could even get their bison near road during hunting season and good meat with fat.” (questionnaire)
Damage to heritage sites and property	Inventory and monitor, Local steward, reduce herd, develop compensation programs, fencing, provide rubbing post, aversive conditioning	“... so when you see desecration happening to gravesites of your family members that really bothers you... Well, I think it hurts them spiritually and creates a lot of stress for them because in our traditions and in our culture when people were put away they were put away with respect, because the whole community puts a person away” (2009 interviewee)
Bison have become a valued food resource	Manage herd to permit some level of harvest (desired level not specified), shift season to autumn for better quality meat, use efficient and appropriate hunting methods (e.g., coordinated hunters taking >1 bison from a group)	“...to me there is a benefit that comes with them because you get meat from them but if you weren’t allowed to hunt them they’d be a total pain – wouldn’t get no benefit out of them!” (workshop participant)  “...mostly I should be satisfied with the government for bringing bison to this area ‘cause our grandchildren gonna need it” (workshop participant)  “I think you should have a group too... otherwise that one hunter will chase everything away. He’ll get his bison alright, but he’ll just make the bison wilder” (workshop participant)

patches, rendering the berries unfit to eat (Table 1). Interviewees reported that they now have to go elsewhere to pick berries. Searching out such areas requires time, effort, and money for gas, then, often picking in places where the likelihood of encountering bears (*Ursus sp.*) is greater.

Many plants are also used for traditional medicines in the southwest Yukon (McClellan 2001), and study participants consistently mentioned this in interviews, questionnaires, and the workshop. Medicine is considered a relatively private topic

by CAFN members so the study participants weren’t directly asked about it. Nonetheless, people did state that areas they usually went to pick medicinal plants had been trampled by bison, reducing the availability of those plants. Also, some elders feared walking in the bush to collect medicines because of the chance of encountering bison. McClellan (2001) pointed out that use of plants varied not only between First Nations in the southern Yukon, but also between individuals within First Nations. Access to these medicines may be more limited for

less-mobile people such as elders; probably the people who want them the most.

### **Cumulative impacts on trappers from both bison and hunters**

At least half of the workshop participants noted that they did or do still trap, and for many those traplines have been in their families for generations. Bison, plus hunters pursuing them, are seen as just one more burden on trappers alongside low fur prices and high operating costs (Table 1). One interviewee reported approximately half his traps were disturbed by bison and the other half by bison hunters, with no successful catches as a result. Another interviewee switched from trail sets to cubby-sets on trees, recounting an instance where a single bison walked along his trail and damaged six or seven traps in a row. He now needs to set twice as many traps to maintain harvest levels. Interviewees reported that trails throughout the bison herd's range had been widened and dug up by both bison and bison hunters, in all habitats and elevations. This improved access enables bison hunters to travel through areas more quickly and traverse them more thoroughly on snowmobiles, which reportedly 'washboards' the trail and damages vegetation. At some access points, specifically the Mendenhall River, wider trails are reported to be increasingly used by non-hunters, magnifying all these concerns for trapline holders.

Though study participants acknowledged that most bison hunters are respectful, hunters were reported to have run over traps or sprung them deliberately, damaged signs marking active traplines, shot at trees and signs at trail entrances, and left garbage on the trail. Bison gutpiles can attract larger furbearers such as wolverine (*Gulo gulo*), and some trappers have adopted this strategy. However, a gutpile left on the trail is an unwelcome obstacle, and—once frozen—a hazard. Several trappers interviewed in 2009 now rent out their cabins to bison hunters and view this opportunity as a benefit, though one that doesn't completely compensate for the other impacts. Shifting the bison-hunting season from mid-winter to autumn in order to give trappers a break was a suggestion widely endorsed by workshop participants. Compensation to trappers for impacts on their lines was also suggested.

### **Bison-human conflicts**

Direct conflicts between bison and people are a long-standing concern for CAFN members. Nearly every study participant recounted stories of such conflicts, most first-hand. Associated with those conflicts are the risk of human injury by bison—something that only apparently happened once in this region—and property damage. Much damage was seen simply as a nuisance (e.g., wallows in driveways that require filling, nets or fences damaged), but at least one house at Aishihik Village is apparently "tilted" because of bison rubbing against it. Methods used for protecting cabin sites include putting up wind chimes or flagging tape, identifying problem trails and providing alternate routes, placing screening on the ground, or

hanging pots and pans on a cabin. Workshop participants also suggested that a local steward be hired to prevent and mitigate bison-human conflicts. Interestingly, some elders now see this risk abating as bison are responding to hunting pressure and not frequenting the village as often (Table 1). Participants acknowledged that responses by First Nation and territorial governments were timely and sufficient. They felt that their concerns about conflicts were being heard and addressed, and clearly hoped this would continue. For example, fencing grave sites to protect them from damage by bison appeared to have worked, and fences should be further strengthened with metal posts in concrete since bison sometimes use these as rubbing posts. Participants noted that bison wallowing areas near these sites could be identified and a rubbing post put in for bison to use. They also remarked that individual bison "troublemakers" should be identified and removed, instead of the whole group.

CAFN members have habitually free-ranged their horses during winter. Bison damaged fences, displacing horses from their usual wintering ranges, and may even compete with them for forage. One interviewee who was looking after between 10–15 horses detailed the costs he incurred. Last winter bison moved his horses off their wintering range and he spent CDN 3,000 on hay, oats, and gas, the most he's spent in 20 years. This impact directly affects only those CAFN members who own horses, however it has broader implications. That interviewee uses his outfit for summer travel and moose hunts. Since he's an experienced hunter who shares his meat with other community members, anything that impacts his hunting success would have the secondary effect of reducing the net amount of meat available for the community at large.

### **Bison have become a valued food resource**

The value of bison as a resource is the only positive impact documented by this study; however, this is a significant change in value over time since bison were reintroduced. The 1998 interviews showed a common distaste for bison meat and relatively little interest in hunting them, with only two mentions of their meat as "good" (Fischer 2002). In 2004 there was similar ambivalence: three questionnaire respondents spoke negatively about bison meat, two mentioned meat in neutral terms, and three described bison meat and/or hunting opportunities positively. However, during the 2009, workshop five participants clearly indicated that they value bison meat and negative comments were absent. There was no mention at the workshop of either eradication or removal of the entire bison herd, a sentiment that was heard earlier when bison were newly released. Interviewees who had harvested a young bison in the newly-opened fall 2009 season said that the meat was "better than beef". One elder stated that he was glad the bison were reintroduced, and saw bison as a resource that people would depend on in the future (Table 1).

The realized value of the meat from any harvested bison depends on a series of individual choices. In November 2010, lean ground beef prices varied between CDN 7.03/kg and CDN 8.80/kg in local grocery stores. The *Yukon Bison Hunt*

*Information Workshop Handbook* (Government of Yukon 2008) estimates that a bull bison can yield 534 kg of meat (bone-in), so the equivalent value of meat could range from CDN 3754.00 to CDN 4699.00 per bison. This is a coarse estimate affected by a series of positive and negative biases whose magnitudes may not compensate for each other; biased high by the large size of bulls and a bone-in weight, but also biased low because the quality of much of the meat from a harvested animal would probably be higher than store-bought ground meat.

Bison meat is shared between hunters, then among their immediate and extended families, and finally to community members at large; much as moose and other large animals are. There is a clear element of reciprocity in that sharing. One interviewee who had assisted with a recent hunt said that he received half of that bison but also held a bison tag himself, and the mutual understanding was that once the meat from that first bison was gone a second bison would be hunted and split the same way. Bison appeared to be a complement to other hunted species rather than substitute for them. There was much discussion about whether hunting bison reduced pressure on moose and caribou, but no consensus judgement emerged. For example, one 2009 interviewee said that after he got a bison he did reduce his moose hunting efforts, but then was asked to get a moose for a funeral potlatch. Moreover, hunters are increasingly selecting younger bison in order to obtain better quality meat. The trade-off is that the meat doesn't go as far when it's shared, nor does it provision households for as long as a larger animal would.

## DISCUSSION

The Aishihik bison herd has a socially-determined size limit. A strong and consistently-expressed need is to keep the bison population below a threshold where they may impact the viability of other locally valued species. There are differing perceptions of what this threshold population level is, and whether it has been reached. Combining this upper threshold with the above-noted desire to harvest bison establishes functional upper and lower bounds for managing the population. Interviewees from Champagne described what might be the ideal situation; having the benefit of an easy hunt but relatively few of the negative impacts associated with the high numbers of bison. One 2009 interviewee estimated that there were three groups of 30-50 around Champagne currently and felt this was acceptable, though group sizes over 100 would be problematic. He was happy with bison living in smaller groups and thought that three or four bison per year would be enough to meet the needs of Champagne's population (20 people).

The distribution of impacts isn't equal within CAFN. As a group, elders experience substantial negative impacts but because they tend to dislike bison meat they're not sharing in the benefits that younger community members are realising. There is also the potential for women to be experiencing similar impacts on gendered activities such as berry picking, but this

wasn't clear from our data. There is a deeper implication here too. In the southwestern Yukon, the essentially social nature of the relationships First Nations people have with animals is well-documented (McClellan et al. 1987; McClellan 2001; Cruikshank 1998, 2005; Nadasdy 2003, 2007) and have been profoundly disrupted by the reintroduction of bison. Re-establishing such relations, and with a new species in the mix, is a daunting undertaking that is probably not yet complete; either for individuals or even the community as a whole. Psychological and physiological stress can result from such changes in an indigenous person's environment (Furgal et al. 2002; Gearheard et al. 2006). Such stress can reduce the state of peoples' health directly or interact with other risk factors (e.g., diet, pre-existing health issues, local economic and environmental conditions, substance abuse, lack of public health infrastructure) to produce even further and more complicated health problems (Furgal et al. 2002). More difficult to appreciate from the outside are the profound, internally-experienced emotional and spiritual impacts from bison damage to grave sites. Respect for ancestors, community, and family is a societal value of intense importance; for example, funeral and potlatch traditions involve the entire community working together in mourning with the family of the deceased (2009 interviewee). This specific impact is a very difficult one to deal with, and mitigation is probably only possible through prevention.

Despite such stress, a new relationship that includes bison in the landscape appears to be forming. Throughout interviews and workshops, ethical concerns were expressed for the bison themselves. These included the need to avoid harassment, some disapproval about hunting pregnant cows, and concern about full utilisation of meat. Taken together, this indicates an attitude of respect for bison, as shown by southwestern Yukon First Nations people to other animals (McClellan 1987; Nadasdy 2007; Clark and Slocombe 2009). Importantly, such respect does not seem to be seen as inconsistent with wanting a smaller herd, or the desire to see bison-human conflicts prevented and mitigated.

Workshop participants clarified that some of the more acute concerns they have with the bison restoration programme were not really with the bison themselves. Rather, the root of several of the identified issues was the influx and conduct of bison hunters, mostly from other communities, on their traditional territory. This main finding was largely a result of the mutual learning between First Nation participants and government wildlife managers that took place during the 2009 workshop. Since key managers were at that workshop it was straightforward for them to translate participants' recommendations about those concerns into specific regulatory changes, which were enacted that same year. These included the establishment of an autumn bison-hunting season in 2009, and a mid-winter break in the regular bison hunting season to provide respite for both wildlife and trappers (Government of Yukon 2011).

Impacts on trappers are much more profound than the loss of effort, time, money, and broken traps. One interviewee explained that a First Nation person's trapline is often their

family's traditional hunting area. He remarked, "I'm just kind of the caretaker of it for my family." Study participants reported learning many of their bush skills as children on those traplines, making them a tangible expression of their culture, a way to perpetuate that culture by educating their children, and a very real dimension of their identity. This connection to the place brings with it the responsibility to reconcile demands from two different cultures; being such a caretaker and meeting the regulatory requirements of holding a trapline, primarily by showing fur production. Impacts from bison and bison hunters make that harder.

There may be similar cultural consequences from reduced muskrat populations; fewer opportunities for women and elders to trap, or for families to use spring trapping as a means of transmitting cultural knowledge and skills to younger generations. McClellan (2001) observed that more muskrats are trapped in spring by women than by men. As with the changing distribution and availability of large mammal species, loss of this specific interaction with the environment constitutes a psychosocial disruption to familial identity and cultural transmission (Furgal et al. 2002).

## CONCLUSIONS

### Implications for wood bison management

Despite the contentious origins of the bison in southwestern Yukon, they have become a valued resource for First Nations people. Tolerance of bison was markedly low in early interviews and workshops, but had risen considerably by 2009. Collier et al. (2011) made comparable observations about how indigenous utilisation of introduced Asian buffalo (*Bubalus bubalis*) in Australia led people to attribute greater value to those animals. Another clear implication of this finding is the need to manage the population to permit some sustained level of harvest. The current management plan calls for a post-hunt population of or near 1,000 animals (Government of Yukon 2012). That target acknowledges the idea of socially-determined carrying capacity—an 'acceptance capacity' (Carpenter et al. 2000)—but the targets were defined based on generic IUCN mammal conservation criteria (Government of Yukon 2012). In the absence of sufficient contextualisation it is difficult to know whether the targets will ultimately be useful benchmarks for management. Further research will be required to determine whether this target accurately reflect the upper acceptance capacity threshold.

Reducing the population may still be required in order to achieve what most participants said they want. That said, implicit in study participants' observations is another alternative that might achieve their objectives without affecting the restoration of a species at risk. Interviewees from Champagne stated that impacts from low numbers of bison around their community were manageable, that the problems came with larger groups (defined as over 100 animals) that impacted specific places very hard. Their observations and

opinions suggest that managing the population for lower density or smaller group size in areas of concern, rather than reducing its overall size, could lead to the same objectives being achieved. Stephenson et al. (2001) proposed that such a distribution might actually have been the historical norm for wood bison in interior Alaska and the Yukon. How to bring this about, and what other issues such a course of action might inadvertently create, ought to be examined further.

There was also a desire by some study participants to reduce the uncertainty around the nature and extent of some impacts, primarily regarding the effects of bison on moose and caribou. Recent research has suggested that potential competition between bison and moose and caribou is low, based on low niche overlap (Jung and Czetwertynski 2013). However, there was also recognition that this is a dynamic system where the abundance and range of all species is changing. All participants in bison management will need to keep modest and contingent expectations about what any studies can provide, especially in terms of comprehensiveness, certainty, and predictive capability.

### Ameliorating human-wildlife conflict through social learning

Unexpectedly, an alternative problem definition arose in our assessment that focuses on observed long-term, large-scale changes in climate and landscape, with wildlife and people all interconnected and just trying to adapt. The emergence of this narrative of complexity and interconnectedness suggests that a wider range of acceptable policy alternatives likely exist than may have previously been thought. Local communities and decision-makers exploring those alternatives will have to be aware of the demanding implications of this holistic picture, which include: identifying thresholds of change, identifying and choosing between alternative stable states for the regional ecosystem, predicting the long-term costs of trying to manage for a specific state that may be expensive and/or infeasible (e.g., fewer bison, abundant caribou), and clarifying the normative choices that will have to be made about what kind of ecosystem people want to have (Peterson et al. 2001; Walker et al. 2002; Chapin et al. 2009).

The collective identification of that new problem definition suggests this assessment may have acted as a social learning process (Pushchak and Farrugia-Uhalde 2005; Sinclair et al. 2008). In such processes the participants jointly discover new perspectives on a problem at both individual and organisational levels. Now that bison have come to be seen as a valued resource, some common ground has emerged that opens up new possibilities for reconciling differences as shared interests are acknowledged. Since the issues around managing the Aishihik herd will undoubtedly continue to evolve, having such an inclusive institutional foundation in place to respond to changing conditions and new problems will be of enduring importance.

This finding has important implications for those seeking to resolve similar problems elsewhere. Based on 15 years of



empirical research into environmental assessments, Sinclair et al. (2008) found a strong link between such learning outcomes and assessment procedures that promoted interaction and dialogue among participants; something that we were able to achieve here. Their evaluation framework suggests four factors that likely played a particular role in achieving this outcome in our situation. These factors were: 1) an ongoing and open flow of information through existing institutional structures—in this case that was primarily the Yukon Wood Bison Technical Team; 2) Pre-existing adaptive management regulations that enabled the territorial government flexibility to respond quickly to workshop recommendations; 3) an assessment process designed to be open to knowledge from different sources and encourage affected CAFN members to share their concerns through a variety of mechanisms; and 4) long-standing and productive professional relationships between key personnel in CAFN and the Yukon Government, without which those first three factors likely would not have existed in sufficient form to be effective. Armitage et al. (2011) likewise point out the importance of a stable and supportive policy environment to enable co-production of knowledge in co-management regimes.

In this situation a participatory approach not only yielded insights into the nature of First Nations peoples' concerns about the Aishihik bison herd, but also created a shared ethical space where community participants and management agency personnel were able to acknowledge one another's perspectives (Barrett 2013). This permitted co-discovery of common ground (Brunner et al. 2002) in terms of the benefits First Nations people and other Yukoners are realising from having wood bison on the land. Clarifying and securing such common interests is an enduring challenge in wildlife conservation, and likely to remain so even given the many advances in theory and practice over the past decades (Brunner et al. 2005, Clark et al. 2005, Clark and Milloy 2014). In this case, we were simply intending to generate basic 'single loop' learning about the impacts of bison on livelihoods to inform existing decision processes, yet by doing so in a culturally and situationally appropriate manner we appear to have surpassed that goal and enabled substantive advances toward the common interest of bison co-management participants.

Common interests are hard to define in abstract but in specific situations this is more easily done, and such interests can be said to be served if a situation and its outcomes pass a set of three tests appraising their procedural, substantive, and practical dimensions (Steelman and Rivera 2006, Steelman and DuMond 2009). Our research and its outcomes appear to pass these three tests as follows. First, the 'procedural test' dictates that to serve the common interest an inclusive process is necessary, with responsible participation (i.e., demands are not incompatible with the needs of other participants) and accountability for actions taken. Our project, and indeed the bison co-management process as a whole, is highly inclusive. At the project level collaboration among study team members and professional workshop facilitation were key factors in maintaining responsible conduct. More broadly, responsibility

and accountability are established community norms. In southwestern Yukon, two decades of experience implementing co-management regimes has given communities, First Nation Governments, and locally-based co-management institutions enough wisdom to judge whether they like what they see and effective power to remedy situations when they don't (Clark et al. 2014). Second, the 'substantive test' requires that all valid and appropriate concerns be considered. Our research was specifically intended to empirically identify, understand, and validate the full range of concerns expressed by CAFN members impacted by bison. As such, it explicitly enabled the larger decision process to meet this criterion as well. Regulatory changes in the Yukon undergo their own public territory-wide consultation process which would, for example, have taken non-CAFN interests into account in the decision to change bison hunting seasons. Third, the 'practical test' demands that participants expressing valid and appropriate concerns have their expectations corroborated in practice. In this situation, the Yukon Government's rapid changes to hunting season dates in response to concerns identified and recommendations made during this study went a long way towards meeting the valid expectations of study participants. Completion of targeted research on bison impacts and competition with other species, also recommended by participants, likely continued to uphold those expectations as well (Jung and Czetwertynski 2013).

To be clear, we make no claims that the work described herein solved all the challenges faced in the ongoing management of bison in southwestern Yukon, or that it has redressed historical incidents of acknowledged concern. Nor do we believe that we have fallen into the trap of uncritically retelling the co-management 'success story' (Nadasdy 2003). In this situation several dimensions of the larger policy context contributed to the success of this study, giving us a structural advantage over situations that may lack a comparable degree of social capital or institutional capacity. Nonetheless, we believe that this form of participatory impact assessment approach could still be applied—with context-specific adaptations—in situations where collaborative wildlife management efforts are less established or institutionalized. Even in such situations this approach holds promise for ameliorating human-wildlife conflicts and their attendant controversies.

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## REFERENCES

- Anthony, B. P., P. Scott, and A. Antypas. 2010. Sitting on the fence? Policies and practices in managing human-wildlife conflict in Limpopo province, South Africa. *Conservation and Society* 8(3): 225.
- Armitage, D., F. Berkes, A. Dale, E. Kocho-Schellenberg, and E. Patton. 2011. Co-management and the co-production of knowledge: learning to adapt in Canada's Arctic. *Global Environmental Change* 21: 995–1004.
- Armitage, D.R., F. Berkes, and N. Doubleday (eds). 2007. *Adaptive co-management: collaboration, learning, and multi-level governance*. Vancouver, BC: University of British Columbia Press.
- Armitage, D.R., R. Plummer, F. Berkes, R.I. Arthur, A.T. Charles, I. Davidson-Hunt, A.P. Diduck, et al. 2009. Adaptive co-management for social-ecological complexity. *Frontiers in Ecology and Environment* 7: 95–102.
- Barrett, M. J. 2013. Enabling hybrid space: epistemological diversity in socio-ecological problem-solving. *Policy Sciences* 46: 1–19.
- Bath, A. J., and J. W. Enck. 2003. Wildlife-human interactions in national parks in Canada and the USA. *NPS Social Science Research Review* 4: 1–32.
- Battiste, M. 2008. Research ethics for protecting Indigenous knowledge and heritage: institutional and researcher responsibilities. In: *Handbook of Critical and Indigenous Methodologies* (eds. Denzin, N., Y. Lincoln, and L.T. Smith). Pp. 497–510. Thousand Oaks, CA: Sage Publications.
- Beebe, J. 1995. Basic concepts and techniques of rapid appraisal. *Human Organization* 54: 42–51.
- Berkes, F., P. George, and R. J. Preston. 1991. Co-management: the evolution in theory and practice of the joint administration of living resources. *Alternatives* 18: 12–18.
- Bradshaw, M., L. Wood, and S. Williamson. 2001. Applying qualitative and quantitative research: a social impact assessment of a fishery. *Applied Geography* 21: 69–85.
- Brook, R. K., S.J. Kutz, A.M. Veitch, R.A. Popko, B.T. Elkin, and G. Guthrie. 2009. Fostering community-based wildlife health monitoring and research in the Canadian North. *EcoHealth* 6: 266–278.
- Brunner, R.D., C.H. Colburn, C.M. Cromley, R.A. Klein, and E.A. Olson. 2002. *Finding Common Ground: Governance and Natural Resources in the American West*. New Haven, CT: Yale University Press.
- Brunner, R.D., T. A. Steelman, L. Coe-Juell, C. M. Cromley, C. M. Edwards, and D. W. Tucker. 2005. *Adaptive governance: integrating science, policy, and decision-making*. New York, NY: Columbia University Press.
- Burge, R. 2003. Theory and practice of social impact assessment. *Impact Assessment and Project Appraisal* 21: 84–88.
- Carpenter, L.H., D.J. Decker, and J.F. Lipscomb. 2000. Stakeholder acceptance capacity in wildlife management. *Human Dimensions of Wildlife* 5: 5–19.
- Castleden, H., V.S. Morgan, and C. Lamb. 2012. "I spent the first year drinking tea": exploring Canadian university researchers' perspectives on community-based participatory research involving Indigenous peoples. *The Canadian Geographer* 56: 160–179.
- Chapin, F. S. III, G.P. Kofinas, and C. Folke (eds). 2009. *Principles of ecosystem stewardship: resilience-based natural resource management in a changing world*. New York, NY: Springer.
- Clark, D., and D.S. Slocombe. 2009. Respect for grizzly bears: an Aboriginal approach for co-existence and resilience. *Ecology and Society* 14: 42. [online] URL: <http://www.ecologyandsociety.org/vol14/iss1/art42/> Accessed on April 03, 2016.
- Clark, D.A., and D.S. Slocombe. 2005. Re-Negotiating science in protected areas: Grizzly bear conservation in the Southwest Yukon. In: *Presenting and Representing Environments*, (eds. Humphreys, G. and M. Williams), GeoJournal Library, 81: 33–53. Dordrecht, NL: Springer.
- Clark, D.A., L. Workman, and D.S. Slocombe. 2014. Science-based grizzly bear conservation in a co-management environment: The Kluane region case, Yukon. In: *Large Carnivore Conservation: Integrating Science and Policy in the North American West* (eds. Clark, S.G. and M.B. Rutherford). Pp. 108–139. Chicago, IL: University of Chicago Press.
- Clark, S. and C. Milloy. 2014. The North American model of wildlife conservation: an analysis of challenges and adaptive options. In: *Large Carnivore Conservation: Integrating Science and Policy in the North American West* (eds. Clark, S.G. and M.B. Rutherford). Pp. 289–324. Chicago, IL: University of Chicago Press.
- Clark, T.W., M.B. Rutherford, and D. Casey (eds.) 2005. *Coexisting with large carnivores: lessons from Greater Yellowstone*. University of Chicago Press, Chicago, IL.
- Collier, N., B.J. Austin, C.J.A. Bradshaw, and C.R. McMahon. 2011. Turning pests into profits: introduced buffalo provide multiple benefits to indigenous people of northern Australia. *Human Ecology* 39: 155–164.
- Conover, M. R. 2010. *Resolving human-wildlife conflicts: the science of wildlife damage management*. Boca Raton, FL: CRC Press.
- Cruikshank, J. 1998. *The social life of stories: narrative and knowledge in the Yukon Territory*. Lincoln, NB: University of Nebraska Press.
- Cruikshank, J. 2005. *Do glaciers listen? Local knowledge, colonial encounters, and social imagination*. Vancouver, BC: University of British Columbia Press.
- Dale, A., and D. Armitage. 2011. Marine mammal co-management in Canada's Arctic: knowledge co-production for learning and adaptive capacity. *Marine Policy* 35: 440–449.
- Decker, D. J., S.J. Riley, and W.F. Siemer (eds.). 2012. *Human dimensions of wildlife management*. Baltimore, MD: JHU Press.
- Dickman, A. J. 2010. Complexities of conflict: the importance of considering social factors for effectively resolving human-wildlife conflict. *Animal Conservation* 13: 458–466.
- Diduck, A.P., A.J. Sinclair, G. Hostetler, and P.J. Fitzpatrick. 2012. Transformative learning theory, public involvement and natural resource and environmental management. *Journal of Environmental Planning and Management* 55: 1311–1330.
- Doelle M. and J. Sinclair. 2006. Time for a new approach to environmental assessments; promoting cooperation and consensus for sustainability. *Environmental Impact Assessment Review* 26: 185–205.
- Feit, H. A. 2005. Recognising co-management as co-governance: visions and histories of conservation at James Bay. *Anthropologica* 47(2): 267–288.
- Fischer, L.A. 2002. *Late winter resource selection and the potential for competition between wood bison and woodland caribou in the Yukon*. M. Env. Des. Thesis. University of Calgary, Calgary, Alberta, Canada.
- Freeman, M.M.R., and L. Carbyn (eds.). 1988. *Traditional knowledge and renewable resource management in northern regions*. Edmonton, AB: CCI Press.
- Furgal, C., D. Martin, and P. Gosselin. 2002. Climate change and health in Nunavik and Labrador: lessons from Inuit knowledge. In: *The Earth is Faster Now: Indigenous Observations of Arctic Environmental Change*. (eds. Krupnik, I., and D. Jolly). Pp. 266–299. Fairbanks, AK: ARCUS.
- Gates, C.C., C.H. Freese, P.J.P. Grogan, and M. Kotzman (eds.) 2010. *American Bison: status survey and conservation guidelines 2010*. Gland, Switzerland, IUCN.
- Gearheard, S., W. Matumeak, I. Angutikjuaq, J. Maslanik, H.P. Huntington, J. Leavitt, D.M. Kagak, et al. 2006. "It's not that simple": a collaborative comparison of sea ice environments, their uses, observed changes, and adaptations in Barrow, Alaska, USA, and Clyde River, Nunavut, Canada. *Ambio* 35: 203–211.
- Gearheard, S. and J. Shirley. 2007. Challenges in community-research relationships: learning from natural science in Nunavut. *Arctic* 60: 62–74.
- Gore, M.L., B.A. Knuth, P.D. Curtis, and J.E. Shanahan. 2006. Stakeholder perceptions of risk associated with human-black bear conflicts in New York's Adirondack Park campgrounds: implications for theory and practice. *Wildlife Society Bulletin* 34: 36–43.

- Government of Yukon. 2008. *Yukon Bison Hunt Information Workshop Handbook*. Hunter Education and Ethics Development. Yukon, Canada: Government of Yukon.
- Government of Yukon. 2011. *Hunting Regulations Synopsis*. Yukon, Canada: Government of Yukon.
- Government of Yukon. 2012. *Management Plan for the Aishihik Wood Bison (Bison bison athabascaae) Herd in southwestern Yukon*. Yukon, Canada: Government of Yukon.
- Hare, P.G., S. Greer, R. Gotthardt, R. Farnell, V. Bowyer, C. Schweger, and D. Strand. 2004. Ethnographic and archaeological investigations of alpine ice patches in southwest Yukon, Canada. *Arctic* 57: 260–272.
- Hoare, R.E. and J.T. DuToit. 1999. Coexistence between people and elephants in African savannas. *Conservation Biology* 13: 633–639.
- Houde, N. 2007. The six faces of traditional ecological knowledge: challenges and opportunities for Canadian co-management arrangements. *Ecology and Society* 12: 34. [online] URL: <http://www.ecologyandsociety.org/vol12/iss2/art34/> Accessed on April 03, 2016.
- Huntington, H. 1998. Observations on the utility of the semi-directed interview for documenting traditional ecological knowledge. *Arctic* 51: 237–242.
- Irlbacher-Fox, S. 2009. *Finding Dahshaa: self-government, social suffering and, Aboriginal policy in Canada*. Vancouver, BC: UBC Press.
- Jung, T. S., and K. Egli. 2012. *Population inventory of the Aishihik wood bison (Bison bison athabascaae) population in southwestern Yukon, 2011*. Yukon Fish and Wildlife Branch report TR-12-19. Yukon, Canada: Government of Yukon
- Jung, T. S., and S.M. Czetwertynski. 2013. *Niche overlap and the potential for competition between reintroduced bison and other ungulates in southwestern Yukon*. Yukon Fish and Wildlife Branch report TR-13-15. Yukon, Canada: Government of Yukon.
- Kovach, M. 2009. *Indigenous methodologies: characteristics, conversations, and contexts*. Toronto, ON: University of Toronto Press.
- Kwiatkowski, R.E. 2011. Indigenous community based participatory research and health impact assessment: a Canadian example. *Environmental Impact Assessment Review* 31: 445–450.
- Lotenberg, G. 1996. *History of wood bison in the Yukon: a re-evaluation based on traditional knowledge and written records*. Yukon, Canada: Government of Yukon.
- McClellan, C. 2001. *My old people say: an ethnographic survey of southern Yukon Territory*. Mercury Series, Canadian Ethnology Service Paper 137. Canadian Museum of Civilization, Hull, PQ.
- McClellan, C., L. Birckel, R. Bringhurst, J.A. Fall, C. McCarthy, and J.R. Shephard. 1987. *Part of the land, part of the water: a history of the Yukon Indians*. Vancouver, BC: Douglas and Macintyre.
- McGregor, D., W. Bayha, and D. Simmons. 2010. Our responsibility to keep the land alive: voices of northern indigenous researchers. *Pimatisiwin: A Journal of Aboriginal and Indigenous Community Health* 8: 101–123.
- McMillan, A.D., and E. Yellowhorn. 2004. *First peoples in Canada*. Vancouver, BC: Douglas and Macintyre.
- Miles, M.B., and A.M. Huberman. 1994. *Qualitative data analysis: an expanded sourcebook 2<sup>nd</sup> edition*. Thousand Oaks, CA: Sage Publications.
- Mulrennan, M.E., R. Mark, and C.H. Scott. 2012. Revamping community-based conservation through participatory research. *The Canadian Geographer* 56: 243–259.
- Nadasdy, P. 2003. *Hunters and bureaucrats: power, knowledge, and aboriginal-state relations in the southwest Yukon*. Vancouver, BC: University of British Columbia Press.
- Nadasdy, P. 2007. The gift in the animal: the ontology of hunting and human-animal society. *American Ethnologist* 34(1): 25–43.
- Natcher, D.C., S. Davis, and C.G. Hickey. 2005. Co-management: managing relationships, not resources. *Human Organization* 64: 240–250.
- Nichols, T., F. Berkes, D. Jolly, N.B. Snow, and the community of Sachs Harbour. 2004. Climate change and sea ice: local observations from the Canadian western Arctic. *Arctic* 57: 68–79.
- Packer, C., D. Ikanda, B. Kissui, and H. Kushnir. 2005. Conservation biology: lion attacks on humans in Tanzania. *Nature* 436:927–928.
- Peterson, G.D., G.S. Cumming, and S.R. Carpenter. 2001. Scenario planning: a tool for conservation in an uncertain world. *Conservation Biology* 17: 358–366.
- Pinkerton, E. (ed.). 1989. *Cooperative management of local fisheries: new directions for improved management and community development*. Vancouver, BC: University of British Columbia Press.
- Pushchak, R. and A.M. Farrugia-Uhalde. 2005. Social impact assessment and high-level radioactive waste disposal: the Canadian concept and Aboriginal responses. IN: *Environmental Impact Assessment: Practice and Participation* (ed. Hanna, K.S.) Pp. 118-144. Don Mills, ON: Oxford University Press.
- Schusler, T.M., L.C. Chase, and D.J. Decker. 2000. Community-based co-management: sharing responsibility when tolerance for wildlife is exceeded. *Human Dimensions of Wildlife* 5: 34–49.
- Simmons, N. M., and G. Netro. 1995. Yukon land claims and wildlife management: the cutting edge. In: *Wildlife conservation policy* (eds. Geist, V. and I. McTaggart-Cowan). Pp. 161-174. Calgary, AB: Detselig Enterprises, Ltd.
- Sinclair, A.J., A. Diduck, and P. Fitzpatrick. 2008. Conceptualising learning for sustainability through environmental assessment: critical reflections on 15 years of research. *Environmental Impact Assessment Review* 28: 415–428.
- Smith, B., and D. Cooley. 2003. *Through the eyes of hunters: how hunters see caribou reacting to hunters, traffic, and snow machines near the Dempster Highway*. Yukon, Yukon, Canada: Government of Yukon.
- Steelman, T.A. and J. Rivera. 2006. Voluntary environmental programs in the United States: whose interests are served? *Organization and the Environment* 19: 505–526.
- Steelman, T.A. and M. DuMond. 2009. Serving the common interest in forest policy: lessons from the healthy forests restoration act. *Environmental Management* 43: 396-410.
- Stephenson, R.O., S.C. Gerlach, R.D. Guthrie, C.R. Harington, R.O. Mills, and G. Hare. 2001. Wood bison in late Holocene Alaska and adjacent Canada: paleontological, archaeological and historical records. In: *People and wildlife in northern North America: essays in honor of R. Dale Guthrie*. (eds. Gerlach, S.C. and M.S. Murray) Pp. 125-159. British Archaeological Reports, International Series no. 944.
- Stevenson, M. G. 1996. Indigenous knowledge in environmental assessment. *Arctic* 49: 278–291.
- Stevenson, M.G. 2006. The possibility of difference: rethinking co-management. *Human Organization* 65: 167–180.
- Treseder, L., J. Honda-Mcneil, M. Berkes, F. Berkes, J. Dragon, C. Notzke, T. Schramm, et al. 1999. Northern Eden: community-based wildlife management in Canada. Canadian Circumpolar Institute occasional paper no. 46, CCI, Edmonton, AB.
- Treves, A., and U. K. Karanth. 2003. Human-carnivore conflict and perspectives on carnivore management worldwide. *Conservation Biology* 17: 1491–1499.
- Treves, A., R.B. Wallace, L. Naughton-Treves, and A. Morales. 2006. Co-managing human-wildlife conflicts: a review. *Human Dimensions of Wildlife* 11: 383–396.
- Usher, P.J. 2000. Traditional ecological knowledge in environmental assessment and management. *Arctic* 53: 183–193.
- Walker, B., S. Carpenter, J. Anderies, N. Abel, G. Cumming, M. Janssen, L. Lebel, et al. 2002. Resilience management in social-ecological systems: a working hypothesis for a participatory approach. *Conservation Ecology* 6: 14-. [online] URL: <http://www.consecol.org/vol6/iss1/art14> Accessed on April 03, 2016.
- Wein, E.E. and M.M.R. Freeman. 1995. Frequency of traditional food use by three Yukon First Nations living in four communities. *Arctic* 48: 161–171.

- Weston, C., T. Gandell, J. Beauchamp, L. McAlpine, C. Wiseman, and C. Beauchamp. 2001. Analyzing interview data: the development and evolution of a coding system. *Qualitative Sociology* 24: 381–400.
- Wilson, S. 2008. *Research is ceremony: indigenous research methods*. Halifax, NS: Fernwood Publishing.
- Wolfe, B.B., M.M. Humphries, M.F.J. Pisaric, A.M. Balasubramanian, C.R. Burn, L. Chan, D. Cooley, et al. 2011. Environmental change and traditional use of the Old Crow Flats in northern Canada: an IPY opportunity to meet the challenges of the new northern research paradigm. *Arctic* 64: 127–135.
- Woodroffe, R., S. Thirgood, and A. Rabinowitz (eds.). 2005. *People and wildlife: conflict or coexistence?* Cambridge: Cambridge University Press.
- Yukon Environmental and Socioeconomic Assessment Board (YESAB). 2006. *Guide to socio-economic effects assessments*. Whitehorse, YT: YESAB.

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