

Note

Resident perceptions of human–beaver conflict in a rural landscape in Alberta, Canada

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Abstract: The North American beaver (*Castor canadensis*) plays a key ecological role in wetland systems, yet their activities can result in costly damage to human infrastructure. Although qualitative research on human perceptions of beavers is rare, studies on human–beaver conflict in the United States identified generally positive attitudes toward beavers and opposition to lethal management, yet in Alberta, Canada, 79% of municipalities that managed beavers reported using trapping and shooting to remove problem beavers. Given the important ecological contributions of beavers and their potential conflict with humans, qualitative research is needed to assess perspectives of stakeholders who directly experience beaver-related impacts. To address this need, from August to September 2014, we conducted semi-structured, in-person interviews with 9 residents who lived in rural areas of Beaver County, Alberta, Canada, where the potential for human–beaver conflict was high. This pilot study involved purposive sampling to select a sample of county residents who had direct interactions with beavers on or adjacent to their properties. We found that perceptions of beaver-related impacts varied across individuals, although many respondents emphasized negative impacts to agricultural production. There were also conflicts concerning local government management actions, including both support for and opposition to lethal control. This lack of consensus among the public poses a challenge to management agencies that lack time and resources to consult with all stakeholders on a multitude of issues related to human–wildlife interactions. However, our results suggest that consultation with landowners by the government is necessary to fully understand the negative impacts residents experience, the positive impacts they desire, and the socially acceptable means for managing them.

Key words: adaptive management, Canada, *Castor canadensis*, human dimensions, human–wildlife conflict, North American beaver, qualitative interviews, wildlife management

CONFLICTS BETWEEN humans and wildlife occur across the globe in a variety of social and ecological contexts (Dickman 2010, Nyhus 2016). Human–wildlife conflicts may pose threats to human safety and impede wildlife conservation efforts, and mitigating these conflicts is rarely simple (Madden 2004, Messmer 2009, Madden and McQuinn 2014). Past research on human dimensions of wildlife has shown people’s willingness to coexist with wildlife varies across groups depending on social factors, such as deeply held values about wildlife, attitudes toward a particular species, and the degree to which people are impacted by wildlife (Carpenter et al. 2000; Organ and Ellingwood 2000; Riley et al. 2002; Lischka et al. 2008, 2018). Therefore, understanding these

human dimensions is critical for developing innovative management solutions that facilitate coexistence between humans and wildlife (Goedeke and Herda-Rapp 2005, Baruch-Mordo 2009).

Wildlife managers are responsible for minimizing negative impacts and maximizing positive impacts associated with wildlife for a broader public (Riley et al. 2002). The adaptive impact management framework (Riley et al. 2002), which includes stakeholder participation and multidisciplinary, provides a useful lens for analyzing human–wildlife conflicts. Adaptive impact management is a value-based system that targets wildlife-related impacts that stakeholders perceive as important. These impacts can vary in magnitude (i.e., impor-



Figure 1. (A) North American beavers (*Castor canadensis*) in Alberta, Canada, and (B) Eurasian beaver (*C. fiber*) humanely captured in Bavaria, Germany to aid translocation efforts elsewhere in Europe (photos courtesy of G. Hood).

tance) and direction (i.e., positive or negative) depending on a stakeholder’s subjective evaluation. Consequently, the goal of management is to maximize the benefits and minimize the detriments that result from human–wildlife interactions, as defined by the stakeholders themselves.

The Eurasian and North America beaver (*Castor fiber* and *C. canadensis*, respectively; Figure 1) are examples of wildlife species that are often at the center of human–wildlife conflict management debate. When humans and beavers interact, as they often do when people live in close proximity to streams and wetlands, negative impacts can result. Beavers fell trees, dig burrows and channels, build dams, and flood land, which are instinctive species survival behaviors (Jenkins and Busher 1979). However, these instinctive survival behaviors can cause significant damage and management problems (McKinstry and Anderson 1999).

In North America, common approaches to mitigating these impacts include removing beavers by trapping or shooting, removing beaver dams, and fencing trees (Jonker et al. 2006, Hood et al. 2018). Depending on the type and scale of damage, beaver removal and damage repair can be costly. For example, beaver-caused damage to timber resources in Mississippi, USA cost industry nearly \$7 million in 2008 (Shwiff et al. 2011). In New York, USA, culvert damage by beavers cost municipal governments an average

of \$2,200 per incident (Purdy and Decker 1985), which is a significant concern for management agencies (Jensen et al. 2001).

In Europe, the conservation status of Eurasian beavers is considered “least concern”; however, their successful reintroduction into many areas is causing increased conflict with the agricultural and forestry industry (Wróbel and Krysztofiak-Kaniewska 2020). Despite their protected or partially protected status in many countries, governments can grant special permissions for hunting, live trapping and translocation, and dam removals to mitigate damage caused by beavers (Wróbel and Krysztofiak-Kaniewska 2020).

In addition to economic costs, traditional forms of beaver management may also result in ecological harm. Beaver-created wetlands provide important ecosystem goods and services including wildlife habitat (Hood and Larson 2014, Law et al. 2016), drought resistance (Hood and Bayley 2008), and water storage (Hood and Larson 2015). With 30–90% of wetlands already lost globally, it is critical to conserve these ecosystems (Junk et al. 2013). In light of benefits provided by beaver-created wetlands, management is needed to mitigate human–beaver conflicts while preserving ecosystem function. Killing beavers and draining beaver-created wetlands might provide short-term relief of problems but are not biologically sustainable or economically efficient (Hood et al. 2018).

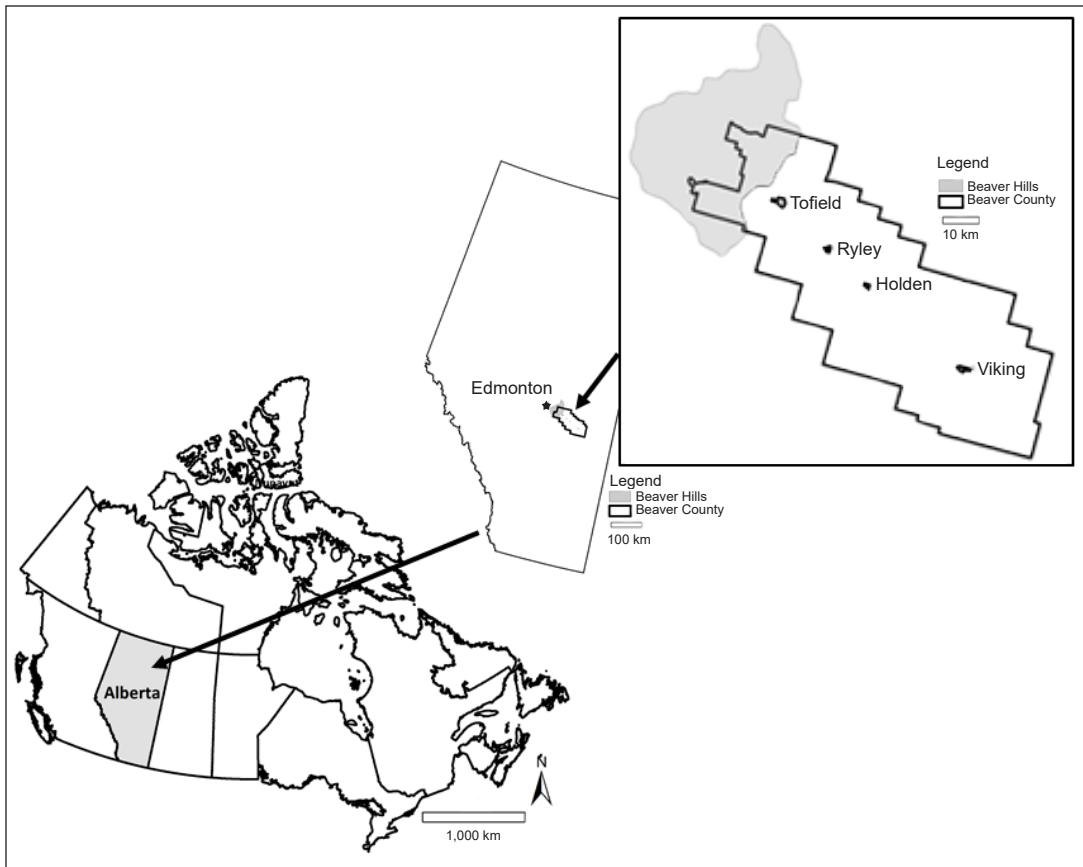


Figure 2. Residents of Beaver County, Alberta, Canada, were interviewed in 2014 regarding their perceptions of beavers (*Castor canadensis*) and human–beaver conflict.

Qualitative research on human perceptions of beavers is rare. Kloskowski (2011) examined the perceived impacts of Eurasian beavers on aquaculture operations in Poland. Schüttler et al. (2011) reported on stakeholder attitudes toward invasive North American beavers in Cape Horn, Chile. To our knowledge, the only peer-reviewed study using qualitative methods to understand perceptions of beavers in North America was conducted with livestock ranchers in the western United States (Charnley et al. 2020). Charnley et al. (2020) found that beavers both hindered and facilitated productive ranching, but that generally ranchers perceived the benefits to outweigh the drawbacks.

Quantitative survey research on human–beaver conflicts in the United States identified generally positive attitudes toward beavers and opposition to lethal management (Jonker et al. 2006, Morzillo and Needham 2015). In Alberta, Canada, 79% of municipalities that managed beavers reported using trapping and shooting

to remove problem beavers (Hood et al. 2018). Given the important ecological contributions of beavers and their potential for conflict with humans, qualitative research is needed to assess perspectives of stakeholders who directly experience beaver-related impacts. With this knowledge, managers can adapt their management actions to address concerned stakeholders by using multidisciplinary approaches to foster human–beaver coexistence. The objectives of this study were to: (1) document stakeholder-defined impacts associated with human–beaver interactions, and (2) understand the barriers to and opportunities for coexisting with beavers at high interface areas in Alberta, Canada.

Study area

Our study was based in the rural municipality of Beaver County (3,544 km²) in east-central Alberta, Canada (Figure 2). The population of the county is 5,905 and 86% of the county is classified as farmland, most of which pro-



Figure 3. Installation of a pond-leveling device used to maintain water in beaver (*Castor canadensis*) ponds at constant levels. The pipe is placed in the beaver dam at the same level as the desired level of the pond, while the cage protects the end of the pipe from beavers. When water levels rise, water automatically draws through the pipe until reaching the level of the pipe through the beaver dam (photo courtesy of G. Hood).

duces annual crops, such as alfalfa (*Medicago sativa* L.) hay for cattle (*Bos taurus*) feed (Alberta Agriculture and Rural Development 2014, Statistics Canada 2016). The northwestern reaches of the county include part of the Cooking Lake Moraine (CLM), an isolated area of mixed-wood boreal forest dominated by kettle wetlands, small streams, and glacially formed hills (Hood and Bayley 2008). With several rural-residential subdivisions adjacent to 3 provincial protected areas within the CLM, the study area is characterized by a mixture of resource use and protection. As in many parts of Alberta, beavers recolonized the area after their near-extirpation by the mid-1800s due to over-harvesting (Hood and Bayley 2008). Today, there are approximately 2 beaver lodges per square kilometer within the CLM, with the highest density of lodges occurring in the same area as many rural-residential subdivisions (Hood and Yarmey 2015). Throughout the rest of the study area, the interface of roads and private lands with beaver-inhabited wetlands and streams has resulted in numerous human–beaver conflicts.

Beaver conflict management is under the jurisdiction of municipal governments (i.e., Beaver County). During the time of this study (2014–2016), the county relied on its own staff, a contract trapper, or our research team to mitigate conflicts. Ongoing strategies to mitigate

or prevent conflicts included beaver removal through shooting or trapping, breaking beaver dams, and installing pond leveling devices, which cost the county an average of \$82,000 per year (Hood and Yarmey 2015). Pond leveling devices are a nonlethal option to alleviate beaver-caused flooding, whereby a culvert pipe is installed through the dam, allowing water to flow freely from upstream to downstream, thus bypassing the dam (Simon 2006, Hood et al. 2018). When appropriately implemented, pond leveling devices reduce flooding to a level acceptable to humans while maintaining enough water in the wetland to meet ecological goals (Figure 3).

Methods

Data collection

We completed our pilot study as part of ongoing human–beaver conflict mitigation research in Beaver County. Our study consisted of 9 semi-structured interviews conducted from August to September 2014 with key informants who had firsthand experience with beavers (i.e., lived near them, were impacted by them, or managed them). Purposive sampling was used to select a sample of county residents who had interactions with beavers and could be considered stakeholders (Patton 2002); therefore, respondents may have stronger opinions about beavers than county residents in general. Key informants who had repeated interactions with beavers were identified by county staff for inclusion in the study, as they had a stake in the issue and often represented heavy users of county services. Key informants included residents both strongly opposed to and supportive of beaver management by the county. Sample size reflects resident willingness to participate.

Our interview guide contained close- and open-ended questions to solicit information about experiences related to living with beavers, impacts from beavers, and perceptions of management. Experiences of living with beavers were explored with multiple open-ended questions: “Can you tell me about the beavers in your area? Do you feel they are valuable? Why? Do you feel they are a nuisance? How? Can you tell me about a memorable experience you’ve had with beavers?” To elucidate beaver-related impacts experienced by respondents, we asked: “Impacts are defined as interactions

that are important and affect your life – they can be positive and/or negative. What are the impacts you experience from beavers or their activities?” and then followed up with prompts as necessary (i.e., “What are the ecological impacts of beavers? What impact do they have on the natural environment? Do beaver lodges or dams impact your life?”). This list of impacts was then reviewed with the participant, who was next asked to assign a direction to each impact (i.e., positive, negative, or neutral). Themes related to human–beaver conflict and coexistence were explored by asking: “Do you think humans and beavers can successfully share the same area? Why or why not? In a perfect world, what types of interactions would you like to have with beavers? What should be done if conflicts arise between humans and beavers?” Lastly, we collected sociodemographic information from participants, including age, gender, farming background, and level of education. Interviewers used probing questions to gain more detail and explore new topics as they emerged. Interviews were audio-recorded to supplement detailed notes taken by the interviewer. Our research design and interview guide were approved in advance by the University of Alberta’s Research Ethics Office (#Pro00040715).

Data analysis

Given the focus on human perceptions of human–beaver interactions, we used deductive thematic coding (Braun and Clarke 2006) to categorize interview responses into 2 broad themes: (1) impacts from beavers and (2) conflict or coexistence with beavers. Impacts were grouped by direction assigned by the participant (i.e., positive, negative, and neutral), then a list of unique impacts was compiled by eliminating any redundancies. We grouped statements pertaining to conflict and coexistence with beavers (e.g., causes of conflicts, opinions about management, strategies for coexistence) and summarized them to represent the range of viewpoints. A team of 4 researchers reviewed the dataset to reduce bias and confirm inter-coder agreement.

Results

Demographically, most study participants were men ($n = 6$), had a background in farm-

ing ($n = 8$), lived in rural areas ($n = 8$), and had at least some post-secondary education ($n = 7$). Age of participants ranged from 21–92 years old, with a mean of 57 years old. The sample was not fully representative of Beaver County’s population overall, but rather intended to understand members of a stakeholder group of significant concern for county managers.

Impacts caused by beavers

Many positive impacts were identified by participants related to water quality and quantity (Table 1). Wetlands created or maintained by beaver dams were seen to provide water for agricultural and other personal uses, protect against fires, and mitigate droughts. For example, 1 participant thought beavers were “important to have the benefits with drought mitigation, especially with the droughts we keep on having.” These beaver ponds were also associated with increased habitat for other wildlife and opportunities for recreation, such as canoeing and wildlife watching. One participant expressed their enjoyment of wildlife watching: “We love [the beavers], they’re beautiful. I just hope we get some pups again because...it’s loads of fun watching them play and slapping their tail in the water.” Besides water-related impacts, participants also valued the beaver’s existence for its own sake, the opportunity to feel a connection with nature, and for its important role in the ecosystem. For some, beaver populations provided them with job opportunities as trappers and managers. Lastly, beavers were identified as having positive impacts through their tree-felling activities because they encouraged forest regeneration and provided accessible sources of firewood.

Negative impacts identified often cited conflicts with agricultural land-use, including decreased water quality for cattle, damage to cattle dugouts from burrowing, and flooded crops. Other negative impacts experienced by participants included damage to road and culvert infrastructure, cutting of valued trees (e.g., fruit trees), and blocking recreational trails. A participant explained that “at first they’re looked upon, because they’re Canada’s national animal, well it’s kind of nice to have a few beavers around, but then you suddenly realize that after a few years they’re creating an unholy mess and causing trouble in the streams.”

Table 1. Impacts of living near beavers (*Castor canadensis*) identified by residents of Beaver County, Alberta, Canada during interviews conducted in 2014.

Positive	Negative	Neutral
View beavers	Chews down trees	Damages property with felled trees
Know beavers exist	Loss of valued trees (e.g., mature trees, fruit trees)	Floods agricultural fields or other land
Connect with nature	Damages property	Eats plants
Creates wetlands	Blocks trails	
Provides water for cattle	Changes water flows	
Prevents fires	Floods roads	
Provides water for human use	Dams flood upstream agricultural land	
Creates wildlife habitat	Removing dam floods downstream agricultural land	
Recreational use of ponds	Prevents water flow into cattle dugouts	
Mitigates drought	Causes lakes to dry up	
Improves water quality	Sediment build-up in ponds	
Changes water chemistry	Damages infrastructure	
Creates jobs (clearing dams, trapping beavers)	Plugs culverts	
Encourages a healthy environment	Flooded culverts freeze and break	
Provides firewood	Infrastructure damage threatens public safety	
	Damages cattle dugouts	
	Reduces water quality	
	Changes water chemistry	
	Invades private property	

Finally, beavers were perceived to cause a negative impact through their intrusions on private property: “People don’t want them in their acreage yard, it’s kind of an invasion of your own privacy, your yard. It’d be like if you had your place and I come along with an axe and I cut down a tree there for no reason.”

Some participants were ambivalent about calling certain impacts positive or negative, and instead considered them neutral. These neutral impacts included beavers damaging property with felled trees (also considered negative by some), flooding other people’s land, and foraging on plants.

Human–beaver conflict and coexistence

Themes related to conflict and coexistence with beavers featured prominently in conversations with participants. The most frequently cited barrier to living with beavers was their negative impacts on agricultural production. Some participants viewed beavers as providing benefits to farmers in the form of water for cattle, but most active farmers interviewed considered beavers to be completely incompatible with an agricultural lifestyle. For example, 1 participant expressed that there is no place for beavers in an agricultural landscape: “I think

the only permanent solution is to keep them out.” When asked if humans and beavers can successfully share the same area, a participant who farmed responded, “I’m not going to, I’m not prepared to...we’re losing income if we let them be there.”

Besides agriculture, participants raised other concerns about human–beaver coexistence. In terms of beaver management undertaken by the county, 7 of the 9 participants were uncertain about the county’s current management practices. For example, 1 person stated, “I’ve heard they’re not doing anything—that’s what people are saying.” Disagreement over the county’s choice of beaver management actions was also prevalent in the interviews. Some participants felt that the county should not be killing beavers under any circumstances, while others felt “if they’re causing problems, I think [beavers] should be destroyed.” It wasn’t only the type of management that caused dissatisfaction for some, but also the timing of the management. In an agricultural context, removing beaver dams can have unintended downstream effects, such as the flooding of crops during key harvest periods: “I’m not happy with what happened last summer...I think [the county] could’ve waited until I was finished haying before they started opening up [dams].” Multiple participants indicated that they would like to be consulted more in the county’s management, for example, “[the county] should talk to everybody before they start shooting beavers.” Finally, the topic of developing properties in wetland areas was raised. Participants had mixed feelings about who was responsible for flooded homes or yards (e.g., the county or the homeowner), but most agreed that land use zoning was necessary to prevent building in areas prone to beaver flooding.

In contrast to sentiments presented above, participants discussed why and how they continued to coexist with beavers. Some held the view that humans and beavers should learn to live together: “there’s got to be some level of compromise...if we get rid of beavers—well, then we won’t be able to call it Beaver County for one thing—but other than that, we would probably throw off a whole bunch of stuff, which the scientists probably know more about than me.” A rural resident stated, “if you’ve got a problem with beavers, don’t move here!”

Most participants who wanted to live with beavers saw a role for management in achieving that goal. For example, a participant who is a trapper said that humans and beavers can share the same areas as long as the beavers are prevented from causing damage: “[coexistence is possible] only with control...they’re okay over there, but they’re not okay here.” When participants experienced damage from beaver activities, some explained that they were willing to accept some level of damage. One participant said, “[beavers] dropped two trees on the garage...but that’s a fact of living with beavers—you can’t blame them,” and another said, “they take down our nice great big poplars, but that’s how it is—they have to eat too.”

Discussion

Interactions between humans and wildlife are becoming more common, especially in contexts where formerly extirpated species are recovering and (sub)urban areas are expanding adjacent to natural areas (DeStefano and DeGraaf 2003, Lindsey and Adams 2006). We focus our results on 3 main findings: (1) experiences of beaver-related impacts varied across individuals, (2) beavers were seen as incompatible with an agricultural lifestyle, and (3) conflicts were not only about beavers, but also government management choices. Our findings are relevant to conservation efforts targeting beavers and beaver-created wetlands in human-dominated landscapes and provide tangible strategies to address these conflicts on private properties where official resource management actions are limited.

Participants of our study identified a range of ways they were personally impacted by beaver activities, and the type and direction of impacts experienced varied across participants. Given that municipalities are often managing beavers with public funds and responding directly to complaints from residents, those residents’ desired impacts are an important consideration for effective and socially acceptable management (Decker et al. 2014). Most municipalities in Alberta use trapping, shooting, and dam removal to control beaver populations, costing on average \$21,933 per year, but can range up to \$154,875 (Hood et al. 2018). Through our interviews with residents of Beaver County, Alberta, we found some participants experi-

enced positive impacts from beavers, including increased wildlife habitat and improved water quality, while others experienced negative impacts including damage to infrastructure and decreased agricultural production. Even the same beaver activity can be perceived differently depending on the individual and the context. Further, positive and negative impacts were not mutually exclusive—some participants navigated the trade-offs between the two. In Cape Horn, Chile, where beavers are an invasive species, researchers found a similar range of positive and negative impacts attributed to beavers, such as their value for trapping, enjoyment of seeing them, damage they cause to forests, and contamination of potable water (Schüttler et al. 2011). Our findings suggest that for managers to increase positive impacts and decrease negative impacts experienced by this group of stakeholders, consultation is necessary to understand which impacts are causing conflicts for which stakeholders.

A major barrier to human–beaver coexistence stated by our participants was that beavers are seen as incompatible with agriculture because of the associated damages to crops and infrastructure. This prevailing negative attitude could be due in part to the legacy of government programs designed to maximize farm productivity by draining wetlands, experiences of lost income to flooded lands, and the social (and policy-level) classification of beavers as “pests.” Additionally, landowners who grew up in the county prior to the natural recolonization of east-central Alberta by beavers in the 1950s and 1960s often see beavers as a new species that “was never in this part of the county before.” However, prior to the industrial fur trade of the seventeenth and eighteenth centuries and subsequent European settlement, beavers were very common throughout the area (Hood 2011). Similar barriers to human–wildlife coexistence were documented in pond fisheries in Poland, where uncompensated damage to fish production from beavers and otters (*Lutra lutra*) threatened livelihoods (Kloskowski 2011). The potential for conflict between beavers and farmers is high in our study area because 86% of land in Beaver County is dedicated to agricultural production (Alberta Agriculture and Rural Development 2014). Therefore, fostering coexistence between humans and beavers on or near

agricultural land requires consideration of the specific ways beavers positively and negatively impact agricultural production. For example, education campaigns that include information on the benefits of living with wildlife along with strategies to reduce conflict are more effective at increasing tolerance than focusing on conflict mitigation alone (Slagle et al. 2013).

Many participants explained that conflicts were not only related to beaver activity, but also the county’s choice of management methods, the timing of management, and lack of action. Many participants were unsure about what the county was doing to manage beavers, yet the county spent >\$82,000 per year on beaver management (Hood and Yarmey 2015). As Madden (2004) notes in the summary of recommendations from the Fifth International Union for Conservation of Nature World Parks Congress Workshop, simply showing a willingness to work on these wildlife issues can reduce short-term conflict. Additionally, a number of residents expressed a desire for greater power in decision-making in the form of consultation (Arnstein 1969). By engaging with the public, management staff could gain insights into existing problems and possible solutions. Involving local people in beaver management can help resolve problems early or prevent them altogether because public dissatisfaction with management is often associated with a lack of control over the solution (Madden 2004). Furthermore, we determined that lethal management of beavers was a particularly contentious topic that could result in conflict between humans over what management was considered appropriate. Need for citizen participation in beaver management has long been acknowledged (Enck and Brown 1996), and addressing these types of human–human conflicts is critical to successful wildlife management (Dickman 2010, Peterson et al. 2010).

Our study speaks to the specifics of living with beavers in rural Alberta and relates to the challenge of human–wildlife coexistence in other contexts. People are heterogeneous in their perceptions of wildlife-related impacts; therefore, conflicts between humans over appropriate ways to manage wildlife are likely to arise. In general, our participants viewed management as necessary for human–wildlife coexistence but disagreed over which actions should be

taken. This lack of consensus among the public poses a challenge to management agencies that lack time and resources to consult with all stakeholders on a multitude of issues they deal with day-to-day. However, our results suggest that consultation is necessary to fully understand the negative impacts residents experience, the positive impacts they desire, and the socially acceptable means for managing them, especially where agricultural livelihoods are at stake. If managers expand the scope of beaver management to include not only management of beaver populations, but also management of stakeholder-defined impacts, they will be better positioned to achieve a goal of net-positive benefits to society (Decker et al. 2006, 2014). With reintroductions and natural recolonization of beavers throughout the Northern Hemisphere, managing their potential impacts will benefit from greater insights into stakeholder perceptions and potential mitigations.

Management implications

Consideration of the human dimensions of human–beaver conflicts illuminates possibilities to mitigate these conflicts more effectively. Although this pilot study had a relatively narrow focus—perceptions of beavers in an agricultural landscape in Alberta, Canada—our findings provide insight into the complex realities of living with beavers. Based on our findings, management of human–beaver conflicts could be improved in several ways. Firstly, participants' recognition of positive impacts of living with beavers and willingness to tolerate some negative impacts provides a foundation upon which to build communication and outreach efforts. Secondly, the diversity of perceptions of human–beaver interactions suggests managers should not assume that interactions with beavers are inherently negative or positive. The same interaction might be a negative impact to 1 person and have no impact on another. Thirdly, our participants expressed the desire to be consulted about their conflicts with beavers, the management they prefer, and the appropriate timing of that management. In particular, we found strong opinions both for and against lethal management of beavers; therefore, consultation on this topic might be especially timely given that lethal management is regularly used. Finally, we recommend man-

agers openly acknowledge the negative beaver-related impacts farmers experience, especially associated economic losses. Given the predominance of agricultural land-use in this and many other parts of the beaver's range, reconciling the perceived incompatibility between beavers and agriculture will be necessary for coexistence that promotes ecological benefits and human well-being.

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