

Survey of Badger Burrow Damage to Machinery and Livestock



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Executive Summary

The *jeffersonii* subspecies of North American badger (*Taxidea taxus jeffersonii*) is an endangered species in the southern interior of British Columbia. Its habitat overlaps with many agricultural operations, particularly cattle ranches, horse farms and hay farms. Badgers are often cited as sources of damage to livestock and agricultural machinery. In an effort to document the actual frequency and extent of this damage, a telephone survey was conducted of 131 randomly selected cattle ranchers within the range of badgers in British Columbia. One-third of ranchers surveyed reported having badgers occur on their ranches within the previous five years. The occurrence of other burrowing animals was also recorded: Columbian ground squirrel occurrence was reported on 64% of surveyed ranches, pocket gophers on 59% and yellow-bellied marmots on 56%.

Of the ranchers who reported badgers, 66% felt they were either beneficial or had no effect on their agricultural operations; 21% felt they were detrimental and the rest (13%) had no opinion. Although damage to farm machinery by other burrowing animals was frequently reported, badger burrows were not conclusively linked to any of the damage occurrences. Injury to livestock as a result of animal burrows was less frequently reported than damage to machinery, of which one case was attributed to a badger burrow (1 of 131 respondents; <1%).

A separate telephone survey was conducted of large animal and mixed practice veterinarians in British Columbia, Alberta and Saskatchewan to solicit rates of occurrence of badger injury to livestock. Of the 95 veterinarians surveyed, 11 reported treating animals injured in badger burrows within the past 5 years. Only 1 of 27 veterinarians from British Columbia reported encountering an injury due to badger burrows. Recommendations for future research and extension are proposed.

Introduction

North American badgers (*Taxidea taxus*) are large-sized members of the Mustelidae family that are highly specialized for digging. The badger's propensity for burrowing, either when foraging for prey or creating shelter, occasionally puts them in conflict with humans. Because of these burrowing habits, badgers are considered a minor pest to agricultural operations throughout many portions of their range (Minta and Marsh 1988).

Badgers can cause several types of damage in agricultural settings. They can damage crops, primarily by foraging for prey in crop fields. Badgers have also been reported to damage water storage areas by burrowing into and destabilizing earthen dams, dykes, and levees (Minta and Marsh 1988). Similarly, badgers can damage building foundations and roads by burrowing under them. Occasionally, badgers also prey on livestock, mostly on poultry, but occasionally newborn lambs (Minta and Marsh 1988). Badgers occasionally injure domestic dogs during confrontations (H. Davis, personal observation). Most significantly, badger burrows may create hazards to livestock such as horses and cows, which may step into burrows and become injured.

Damage to farm machinery and injuries to livestock are widely believed to be a source of conflict between badgers and agriculturists. Researchers have cited this type of damage as the primary sources of conflict arising from badger burrows (e.g., Lindzey 1982, Minta and Marsh 1988, Lindzey 1994). Many land and livestock owners view badgers and their prey as "pests" because of their burrows. The Wildlife Service of the Animal and Plant Health Inspection Service of the US Department of Agriculture performs routine culls of "problem badgers" in many states (e.g. Colorado; Wildlife Services 1997, Wildlife Services 1999). The fear of injury to livestock was the most frequently lodged complaint about badgers filed by landowners to the California Animal Damage Control agency between 1978 and 1987, despite these injuries being very rare (Minta and Marsh 1988).

Although often cited as a source of damage, no comprehensive survey has been completed, to our knowledge, assessing the frequency or extent of damage from badger burrows. Minta and Marsh (1988) summarized the management of badger damage in California from 1978 to 1987. During this 10-year period, over 1,700 badgers were destroyed by the Animal Damage Control service because of concerns about damage, although injuries to livestock from badger burrows were "uncommon". Unfortunately, they were unable to assess the frequency with which this type of damage occurred.

The *jeffersonii* subspecies of badger that is found in British Columbia is ranked as endangered (Committee on the Status of Endangered Wildlife in Canada 2000) and a federal Recovery Team is in place to help recover the species. Negative perceptions by landowners about the effects of badger burrows, which may hamper support for recovery, have been a concern of the *jeffersonii* Recovery Team. Due to the lack of data about the effects of badger burrows on livestock and machinery, it was necessary to

determine how much of a threat badger burrows actually pose to agricultural operations.

This project will determine if badger burrows are a significant cause of damage to farm machinery or livestock injury by interviewing livestock managers, farmers, and veterinarians in badger habitat to assess the frequency and extent of these types of damage. In the long term, the results of this project may result in decreased persecution of badgers through education, examination of the actual threats posed by burrows, and working with landowners and land managers to develop strategies to minimize problems and reduce persecution. Overall, the results of this project will help raise awareness of badgers and their status and will discourage the persecution of this endangered species in British Columbia.

Methods

We identified 2 different groups whose perceptions and experiences with badgers and badger burrows we wanted to assess.

The first target group for survey was ranchers with livestock operations. We were unable to obtain contact information for all livestock operators living within the range of badgers in British Columbia because of privacy constraints. However, we obtained mailing addresses for 590 individuals that held Crown range tenures on public lands for 2002 within the distribution of badgers in British Columbia (Figure 1). Since the majority of larger cattle ranches likely also hold range tenures, we assumed that the sample of range tenure holders represented a more-or-less unbiased sample of cattle operators within the range of badgers in British Columbia. Starting with a random number between 1 and 5, we selected the first name from our sample population, and then chose every fifth name thereafter. Telephone numbers were then obtained by a manual search using directory services.

The second target group was veterinarians who work on farm animals. We obtained addresses and telephone numbers of large animal and equine veterinarians operating within the range of badgers in British Columbia, Alberta, and Saskatchewan from each jurisdiction's veterinary association. Our survey population included 37 veterinarians from British Columbia, 361 from Alberta, and 55 from Saskatchewan (total 453). We attempted to contact all veterinarians from British Columbia population, 1 in 2 from the Saskatchewan, and 1 in 4 from the Alberta population. For the Alberta sample, we selected a random start number between 1 and 4 and then every fourth name on the list thereafter. For the Saskatchewan sample, we selected a random start number between 1 and 2 and then every second name on the list thereafter.

We deemed it appropriate to ask questions about all burrowing animals so that we could gauge the rates of damage caused by badgers relative to that of other burrowing species. Accordingly, the survey tool contained separate questions for badgers, Columbian ground squirrels (*Spermophilus columbianus*), northern pocket gophers (*Thomomys talpoides*) and yellow-bellied marmots (*Marmota flaviventris*). The questions

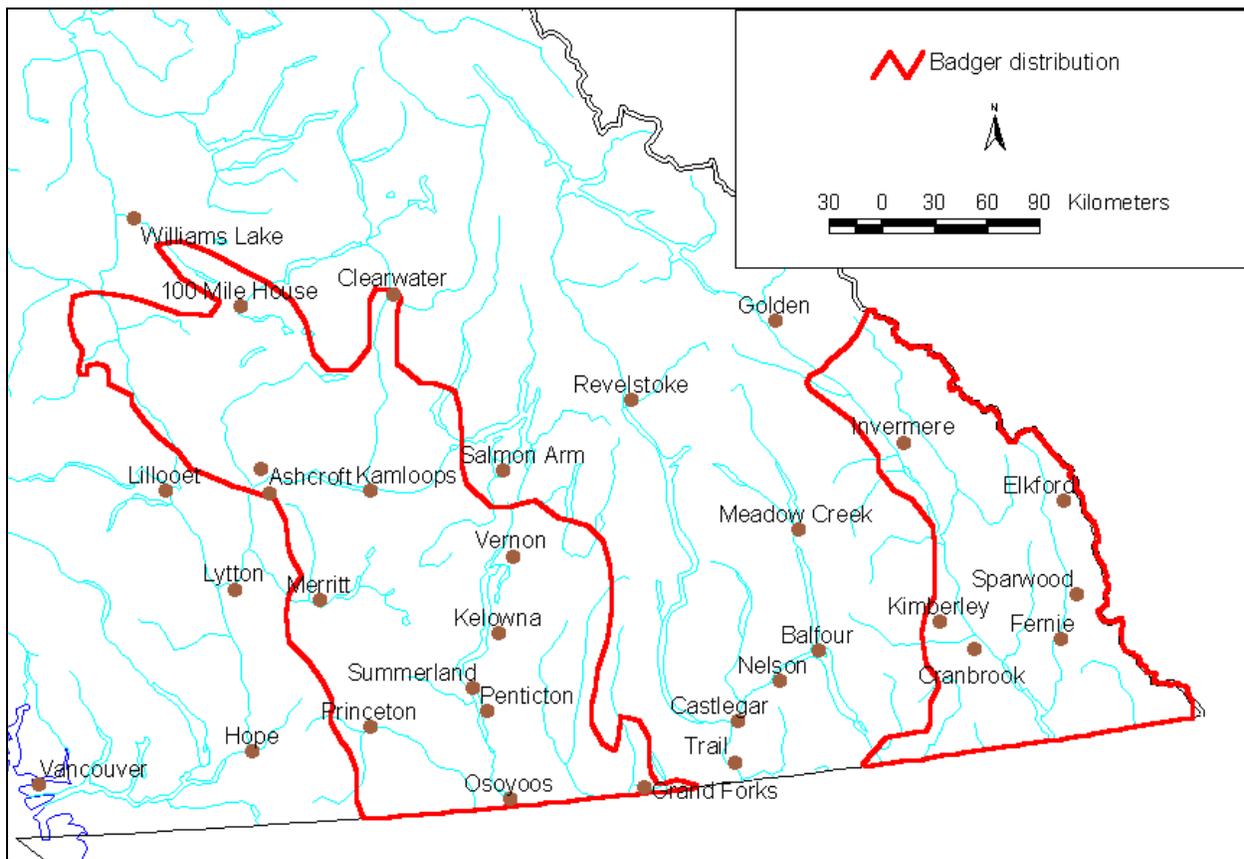


Figure 1. Distribution of badgers in British Columbia from which a random systematic sample of Crown range tenure holders were selected for survey.

for ranchers focused on lands that they owned or leased during the past 5 years and excluded Crown range tenures. Specific sections of the survey determined the prevalence of each species of burrowing animal, the types and extent of damage to equipment and livestock caused by burrowing animals, methods by which the rancher managed burrowing damage, and information about the size and type of operation. A complete survey can be found in Appendix A.

A separate survey was developed for veterinarians. They were asked to provide information on their type of practice (large animal or mixed) and specifics about any injuries caused by badger burrows that they had treated during the past 5 years (Appendix B). Both telephone surveys were conducted between 29 February and 13 March 2004.

Results

Rancher Survey

We contacted 174 ranchers from throughout the range of badgers in British Columbia. Of these, 131 ranchers (75%) participated in the study, which represented approximately 22% of the range tenure holder population in this area. The geographic distribution of the respondents was as follows: 30 tenure holders from the Kootenay, 25 from the Cariboo, 24 from the Thompson, 18 from the Okanagan, 14 from the Boundary, 12 from the Nicola, and 8 from the Similkameen regions. The ranches varied greatly in the area ranched and number of livestock (Figure 2). Most ranches were at least 50 acres in size and had more than 30 head of cattle. The number of years that ranches had been operating under the current ownership ranged between 2 and 150 years, with 50% of respondents having been in operation between 20 and 55 years (median = 30 years).

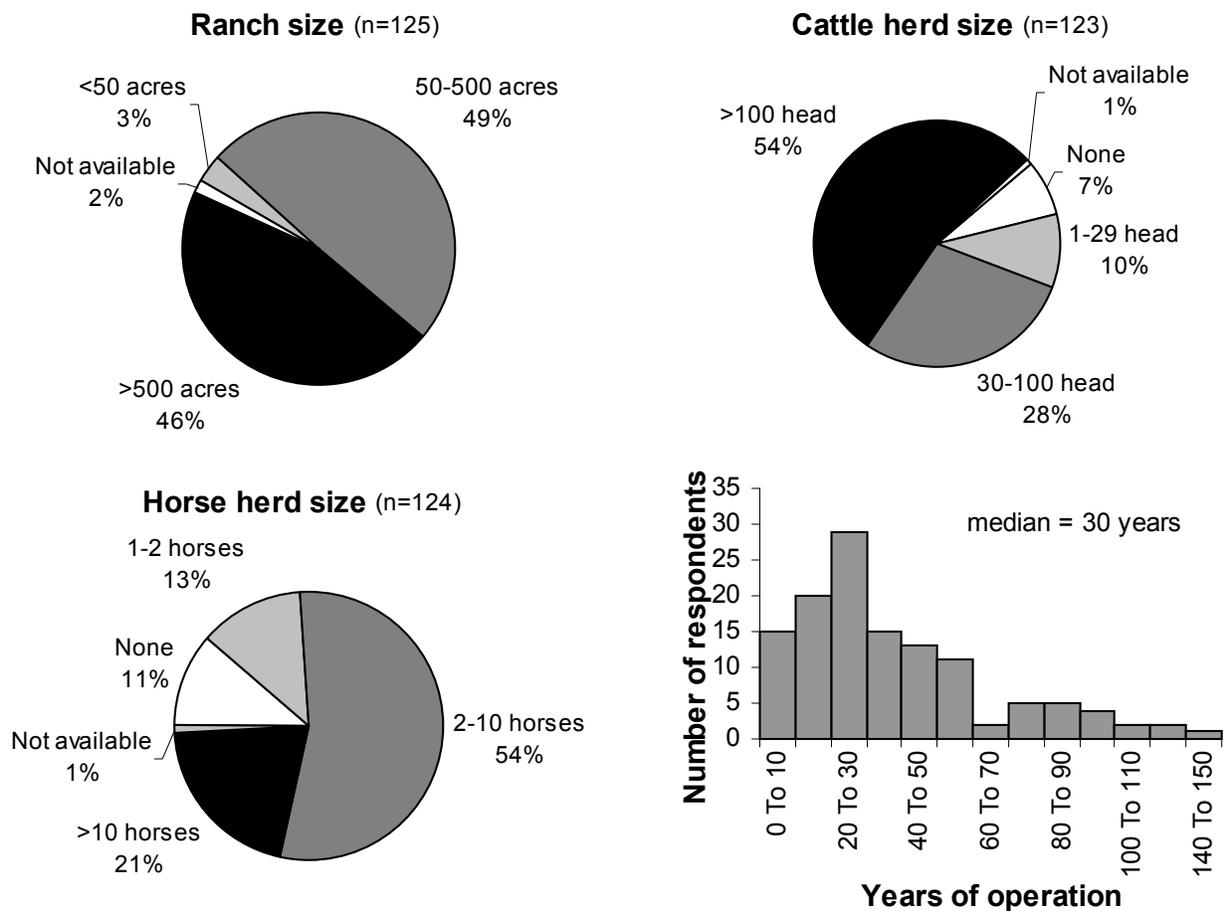


Figure 2. Characteristics of ranches surveyed.

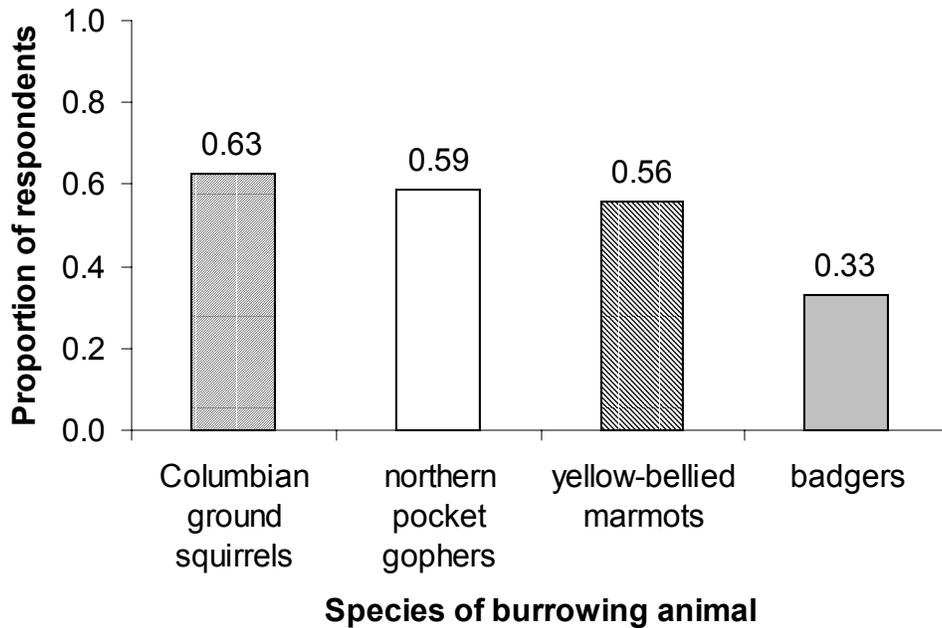


Figure 3. Proportion of respondents that reported having burrowing animals present on their property during the past 5 years. N = 131 respondents.

Burrowing animals

Burrowing animals occurred on 90% of the surveyed ranches (118 of 131 respondents). Columbian ground squirrels were the most commonly occurring burrowing species, reported as being present by 63% (82 of 131) of ranchers. Pocket gophers (77 of 131; 59%) and yellow-bellied marmots (73 of 131; 56%) were also common (Figure 3). Badgers were relatively uncommon; 43 of 131 respondents (33%) reported badgers as occurring on their ranches during the past 5 years. Ranchers also reported foxes, coyotes, muskrats, skunks, beavers, black bears, and mice or voles as occurring on their lands. Ranchers had varying perspectives on the effects that each species of burrowing animal had on their operations (Figure 4). Most ranchers considered Columbian ground squirrels and northern pocket gophers to be detrimental to their ranching operations (79% and 72% of respondents, respectively), whereas half considered yellow-bellied marmots to either have no effect or be beneficial and 43% considered them to be detrimental. Almost half of the ranchers surveyed (47%) felt that badgers were beneficial to their operations, whereas 21% believed that badgers were a detriment. The abundances of these species also varied (Figure 5).

Almost half of the ranchers felt that the number of badgers that they encountered on their property in the past 5 years had not changed. Of 35 ranchers that responded to this question, 17 (49%) said that badger numbers had stayed the same, 13 (37%) said that numbers had gone down, and 5 (15%) felt that badger numbers had increased.

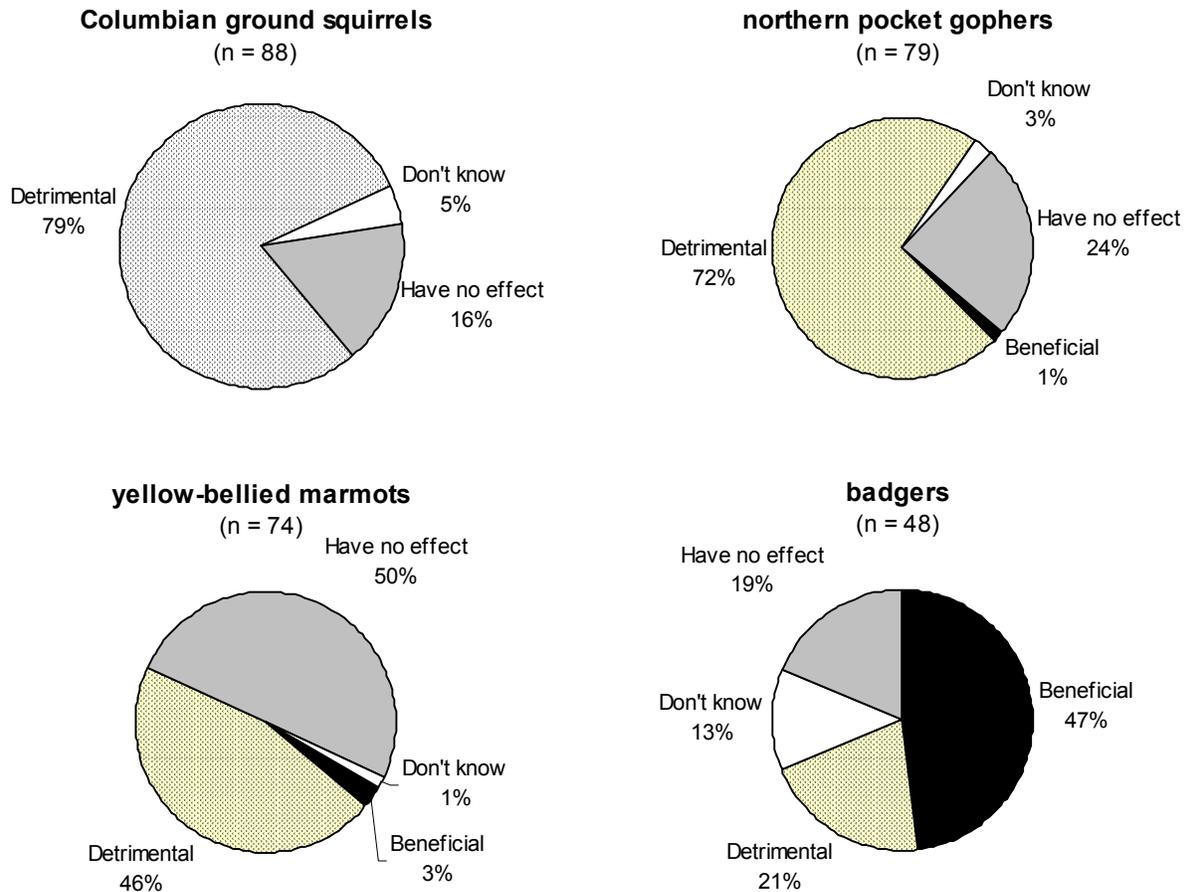


Figure 4. Perceptions of surveyed ranchers regarding the effects of Columbian ground squirrels, northern pocket gophers, yellow-bellied marmots, and badgers on their ranching operations.

Damage to machinery and livestock

Just over half of the respondents (74 of 131; 56%) experienced some sort of damage caused by burrowing animals during the past 5 years.

Machinery damage was the most common type of damage reported; 53% (70 of 131) of ranchers had farm equipment damaged by burrowing animals, although only 51 of the 70 respondents provided details (Figure 6). Of these 51 respondents, 46 reported damage to swathers, followed by damage to balers (10 incidents), miscellaneous equipment (10 incidents), tractors (3 incidents), and trucks (1 incident). Rodent burrows were the primary cause of damage to farm equipment, accounting for all but 2 instances of equipment damage (for which the respondent was unsure of the source of the burrow). Badgers were not reported to be the cause of any damage to equipment. Damage to swathers was primarily to the cutting tines, which resulted not only in monetary costs but delays in production. When operating in fields with burrows, many operators had to adjust their speed and the cutting height of the swather, thereby

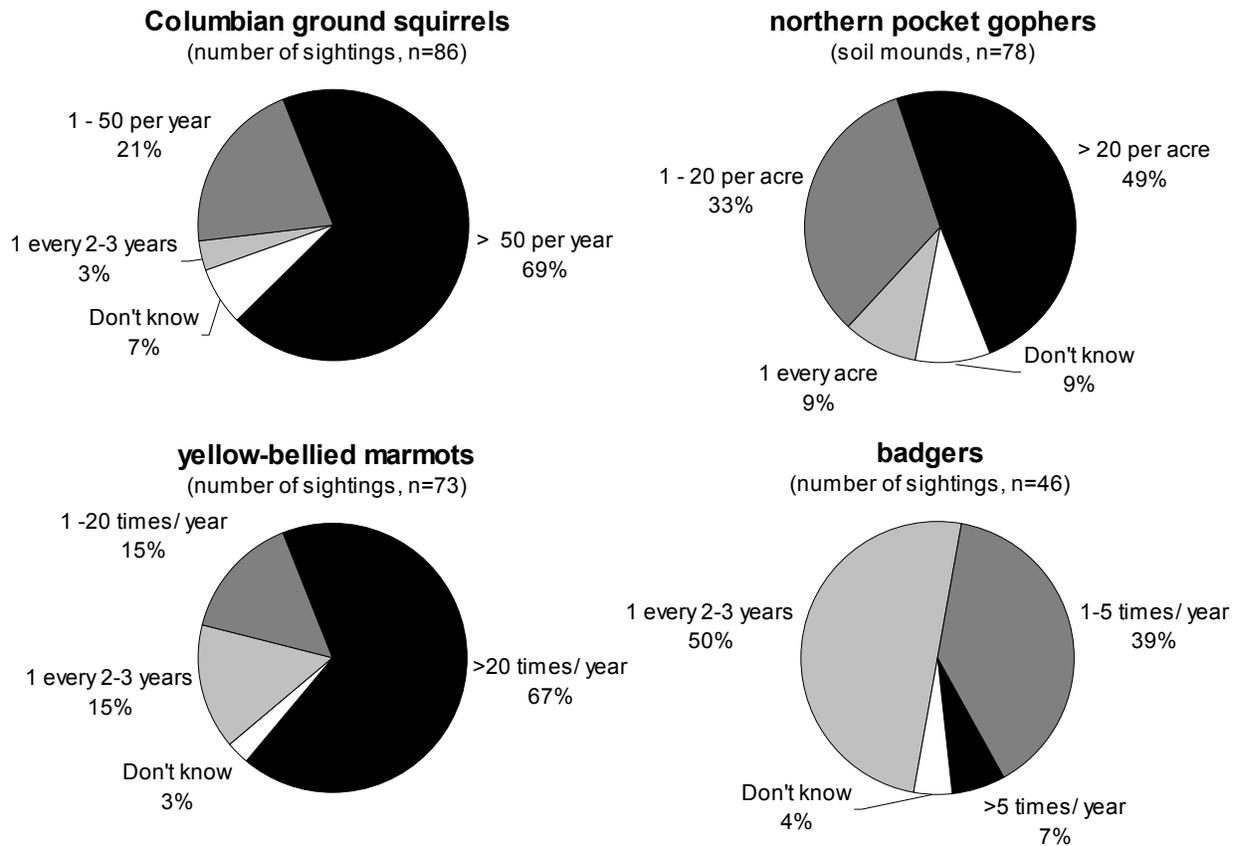


Figure 5. Approximate abundances of Columbian ground squirrels, northern pocket gophers, yellow-bellied marmots, and badgers estimated by ranchers on their lands.

reducing productivity. Damage to balers was primarily through soil being mixed in with hay and dulling the cutter knives. Soil in the hay also negatively affected the hay quality. Damage to vehicles (i.e., tractors and trucks) was primarily through increased wear and tear.

Livestock injuries were much less commonly reported than damage to machinery, with 21 of 131 respondents (16%) reporting injuries resulting from burrows during the past 5 years. Details were available for 24 cases of livestock injury, 19 of which (79%) were the result of rodent burrows (Figure 7). Fourteen of the 24 cases of animal injury involved horses, 9 cases involved cattle, and 1 case involved damage to unidentified livestock. Four respondents were unsure of the cause of their respective livestock injuries. Among 131 respondents, badger burrows caused 1 livestock injury (0.76% of respondents).

Injuries to horses from all types of burrows usually occurred when they were being ridden, but injuries also occurred during unmonitored activities. Treatment of the horse injuries involved letting the injury heal on its own (7 cases), treatment by veterinarian (1 case), and euthanasia (3 cases). The one incident of a horse being injured in a badger burrow resulted in euthanasia. Aside from the cases of euthanasia and unreported outcomes, 3 horses made a full recovery and 2 horses made partial recoveries.

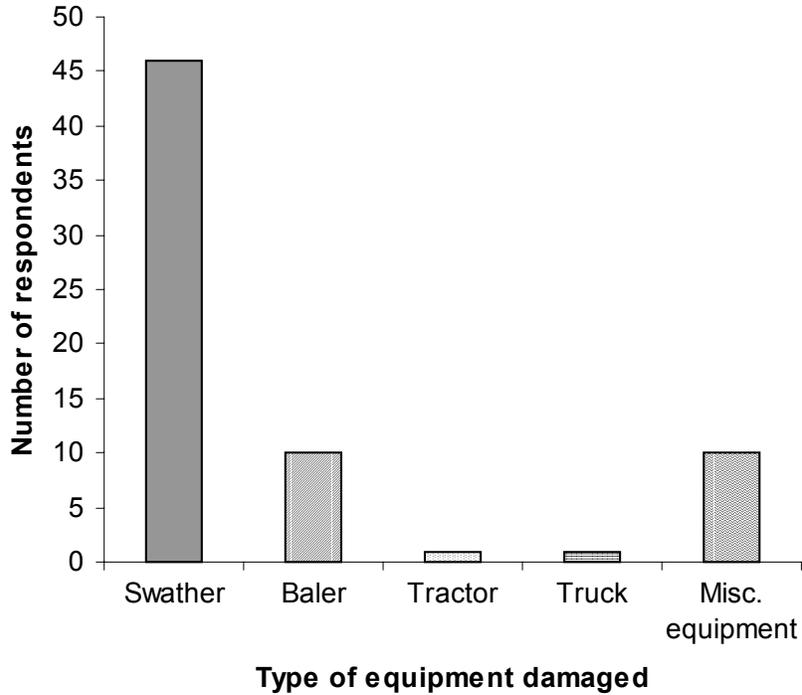


Figure 6. Frequencies of damage to various types of farm equipment caused by burrowing animals. N = 51 respondents.

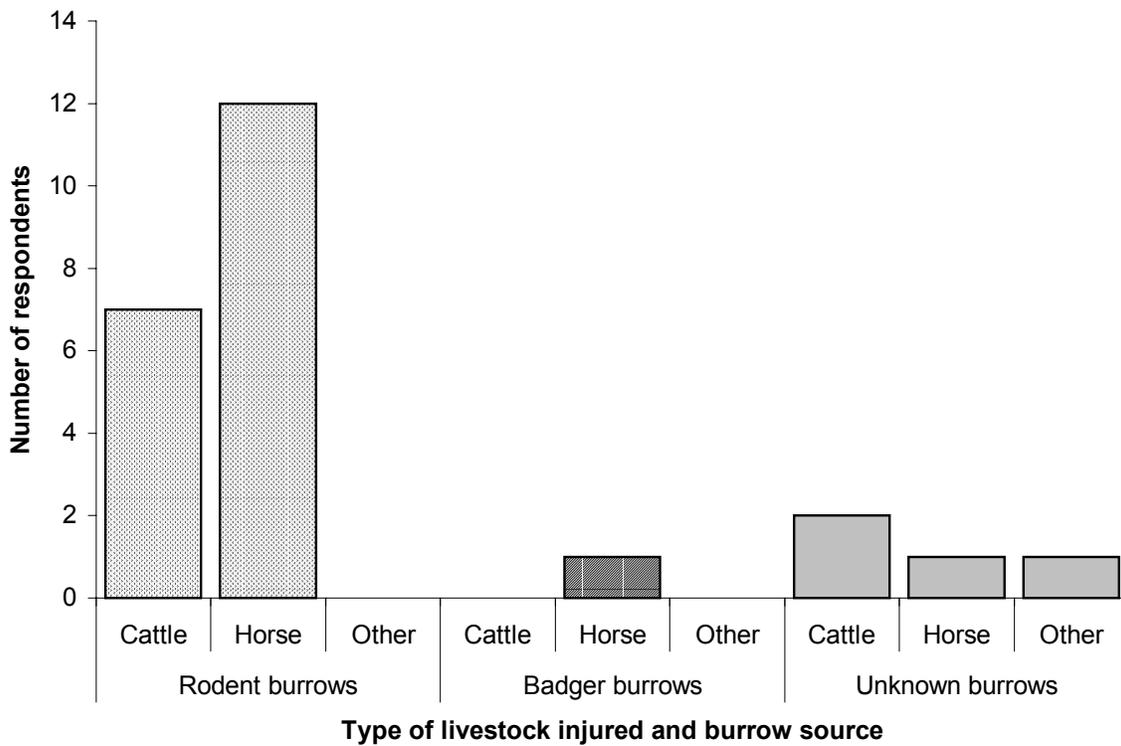


Figure 7. Number of respondents that experienced injury to livestock from burrows during the past 5 years. N = 24 respondents.

Injury to cattle occurred when they were grazing (5 cases), travelling between areas (1 case), or on pasture (1 case). Of the 9 cases of injury to cattle, treatment included letting the injury heal on its own (5 cases), treatment by the rancher (2 cases), and euthanasia (2 cases).

Few of the respondents had heard of other ranchers experiencing damage to livestock or machinery from badger burrows. Only 9 of 131 respondents reported this situation. Of 6 positive responses for which additional data was available, 2 ranchers had heard of machinery damage, 3 had heard of livestock damage, and 1 rancher had heard of both types of damage.

Perceptions about badgers

Concern among ranchers about damage caused by badger burrows was generally not high (Figure 8). Many respondents were “not concerned” about damage to either machinery or livestock caused by badger burrows (71% and 72%, respectively). Only 14% of respondents were either “concerned” or “very concerned” about damage to machinery and 16% were “concerned” or “very concerned” about damage to livestock.

The characteristics of ranchers who had negative perceptions about badgers (i.e., either considered badgers “detrimental” or were “concerned” or “very concerned” about damage) were not easily identified. In comparison to respondents who were either positive (i.e., “beneficial”, “not concerned”) or neutral (i.e., “have no effect”, “mildly concerned”, “somewhat concerned”), ranchers with negative views about badgers were generally individuals with mid-sized ranches (i.e., 50-500 acres) and sizable horse herds (i.e., >10 horses; Figure 9). There were no substantial differences in the median number of years ranching for those respondents with negative views of badgers (median = 37 years, n = 16) compared to those who had positive views (median = 40

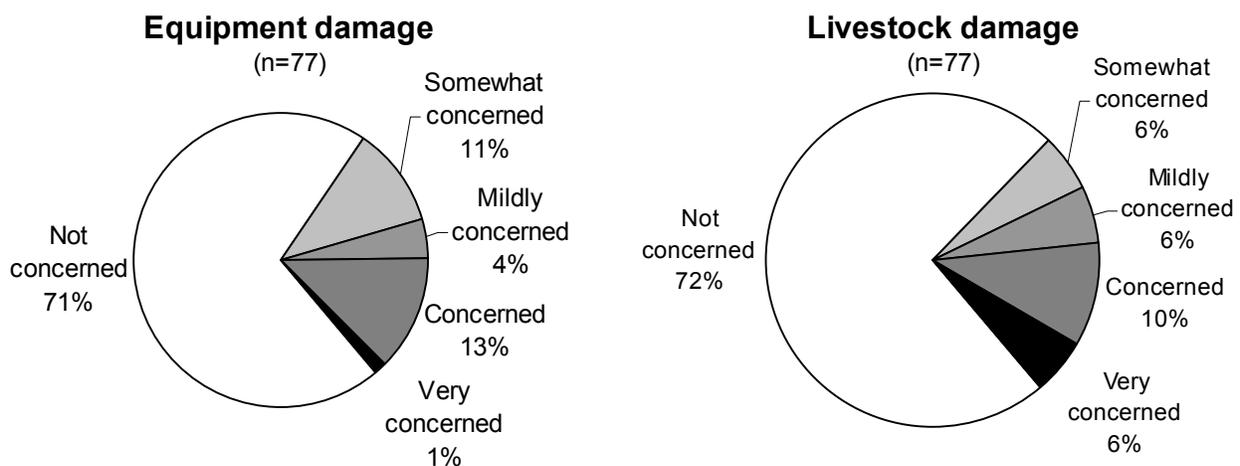


Figure 8. Levels of concern about damage from badger burrows to farm equipment and livestock, as expressed by respondents.

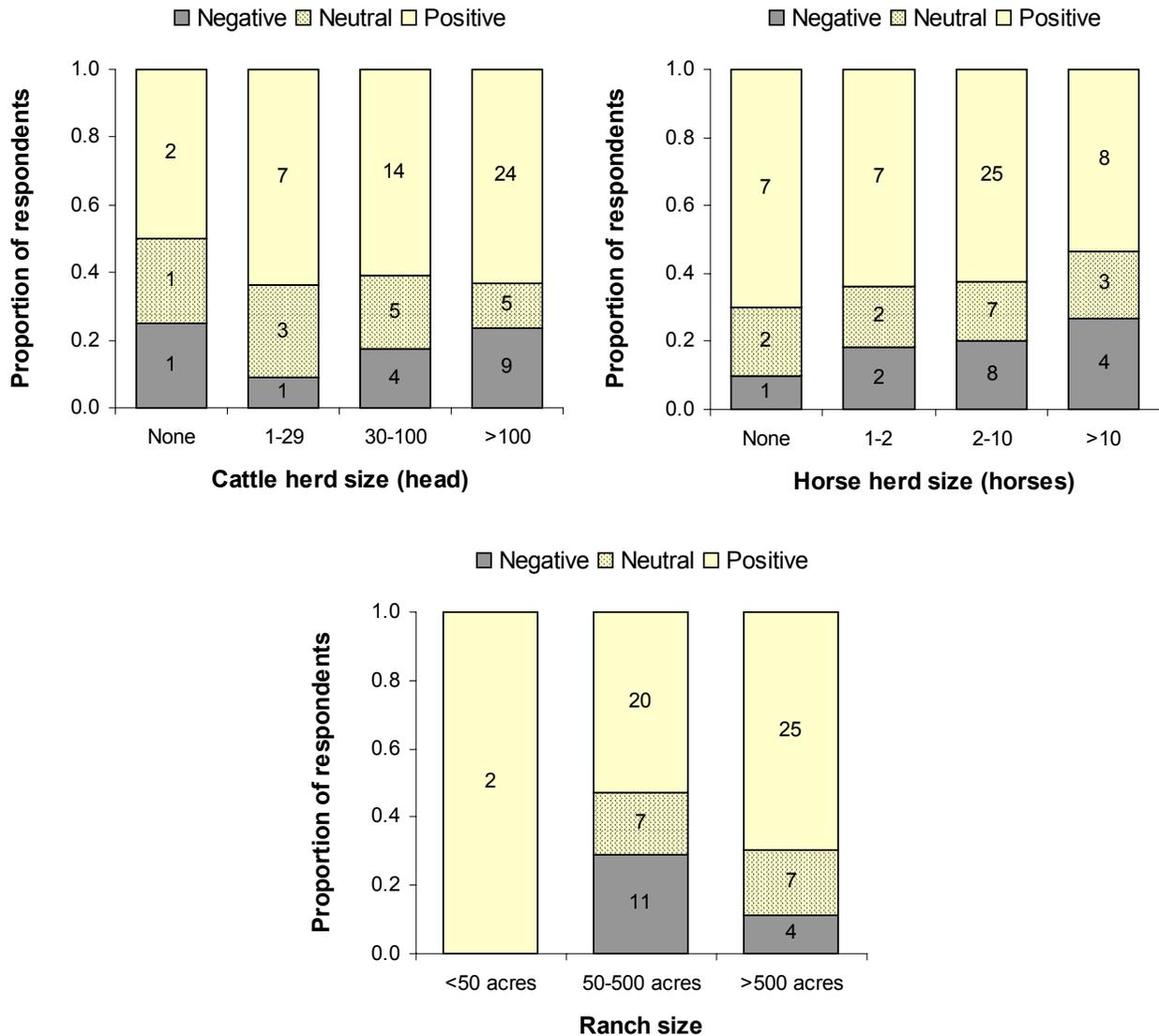


Figure 9. Comparison between characteristics of ranchers with negative views towards badgers (i.e., “detrimental”, or were “concerned” or “very concerned”) and those who had positive (i.e., “beneficial”, “not concerned”) or neutral (i.e., “have no effect”, “mildly concerned”, “somewhat concerned”) views of the species. Sample sizes for each type of respondent are noted.

years, n = 47). Respondents with neutral views of badgers had generally been ranching for shorter periods (median = 23.5 years, n = 14). Of those 16 respondents that were concerned about damage to either equipment or livestock from badger burrows, 7 reported badgers on their property during the past 5 years.

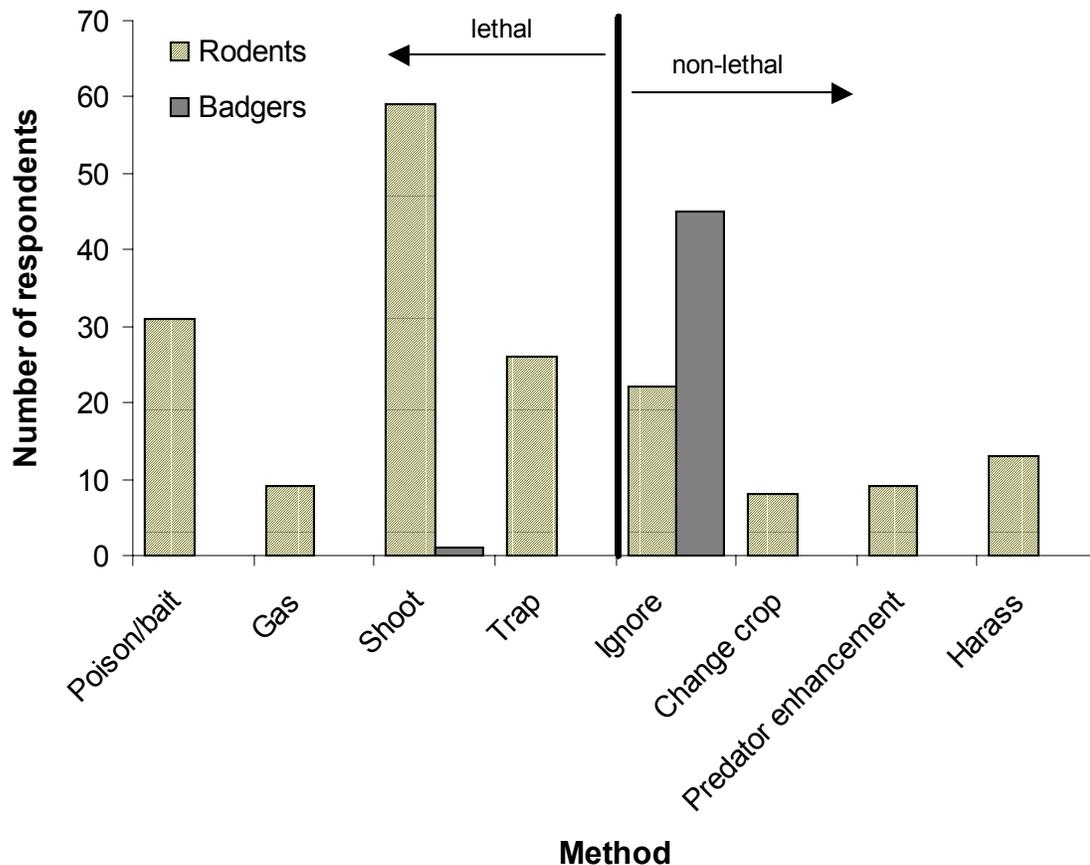


Figure 10. Lethal and non-lethal methods used by respondents to manage damage caused by burrowing rodents and badgers.

Management of burrowing animals

Respondents used a variety of lethal and non-lethal methods to manage damage caused by burrowing animals (Figure 10). Lethal management was used much more commonly than non-lethal methods for rodents. Of 114 respondents that used some form of management for rodent damage, 52% used shooting, 27% used poison baits, 23% used traps, and 8% used gas delivered to burrow systems. Non-lethal management for rodents included ignoring them (19% of respondents), harassment (11%), predator enhancement (8%), and changing crops (7%). For badgers, however, the vast majority of respondents simply ignored the species or filled in their holes (98%; 45 of 46 respondents). Only one respondent (2%) indicated that they would shoot badgers that occupied certain fields on their ranch.

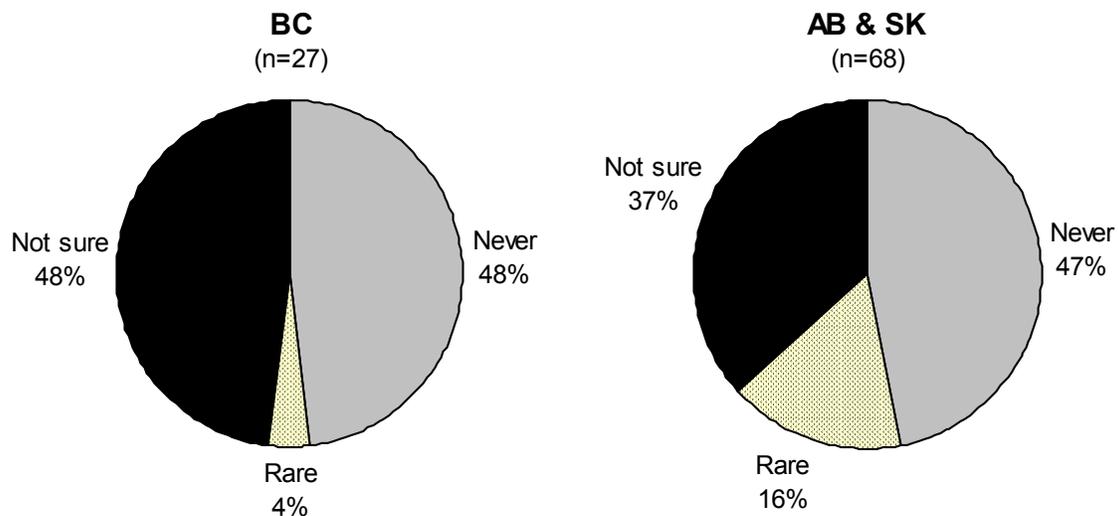


Figure 11. Frequency with which veterinarians in British Columbia (BC) and the Prairie provinces (AB & SK) reported treating animals injured in badger burrows.

Veterinarian Survey

We surveyed 26 large animal and 69 mixed practice veterinarians in British Columbia, Alberta, and Saskatchewan. We successfully contacted and surveyed 27 veterinarians from British Columbia, 43 from Alberta, and 25 from Saskatchewan. All veterinarians contacted agreed to take part in the survey. Most veterinarians had never treated an animal that had been injured in badger burrows (Figure 11). Many veterinarians had treated animals that were injured in burrows, but they were unsure of what type of animal caused the burrow. No veterinarians reported injuries from badger burrows as being “common.”

Of the 95 veterinarians that we surveyed, 11 recalled treating animals that had been injured in badger burrows during the past 5 years. Only 1 of 27 veterinarians from British Columbia reported encountering a badger-related injury; the remaining 10 veterinarians were from Alberta and Saskatchewan. The most frequently reported types of livestock injured by badger burrows were cattle (7 reports) and horses (8 reports). One veterinarian each reported injury to a dog and a bison.

The types and number of injuries that veterinarians treated varied among the different types of livestock and regions. One veterinarian from British Columbia had treated 2 soft-tissue injuries to cattle during the past 5 years. The remaining injuries were from the Prairie provinces (Table 1). The survey of 95 veterinarians from all 3 provinces indicated that they had treated approximately 35 head of cattle and 33 horses from injuries caused by badger burrows during the past 5 years.

Table 1. Details of injuries to livestock by badger burrows during the past 5 years, as documented by 17 of 69 veterinarians surveyed in Alberta and Saskatchewan.

Type of livestock	Injury - outcome	Number of veterinarians reporting this injury	Total number of animals injured
Cattle	Broken leg-destroyed	2	9
	Soft tissue injury-recovered	2	24
	Undisclosed injury	3	unknown
Horse	Broken leg-destroyed	3	13
	Broken neck-destroyed	1	1
	Soft tissue injury-recovered	2	9
	Undisclosed injury	1	10
	Undisclosed injury	1	unknown
Bison	Broken leg-destroyed	1	1
Dog	Fighting injury-recovered	1	1

Problem Wildlife Control

We contacted Jim Knight, the Problem Wildlife Specialist for Montana State University Extension Service to assess perceptions regarding damage by badgers in Montana. Mr. Knight was surprised that badger damage would be an issue in British Columbia, because it was not an issue that was “on the radar screen” of Montana ranchers and agriculturalists. He suggested that badger excavation activity, when it was encountered, was frequently in conjunction with ground squirrel burrows, so the presence of the badger was generally viewed as positive. Another US contact, Tom Brannon, recently retired Forestry and Range Coordinator, Washington State University Extension Service, Chelan County, supported the notion that badgers are not perceived as a problem by ranchers that he dealt with in East-Central Washington.

Discussion

The survey showed that damage caused by badgers to either equipment or livestock was exceedingly rare in British Columbia (< 1% of respondents). Conversely, burrowing rodents caused frequent damage (56% of respondents). Although the risk to ranchers in British Columbia from badger burrows was apparently low, 14% and 16% of respondents were “concerned” or “very concerned” about damage to equipment and livestock, respectively. Twenty-one percent of respondents also indicated that badgers were “detrimental” to their operations.

Machinery Damage

The rarity of damage to equipment from badger burrows may be due in large part to the nature of the areas in which badgers burrow in British Columbia. Weir et al. (2003) noted that 90% of badger burrows in the Thompson region occurred at sites with greater than 7% slope and that badgers rarely burrowed into flat ground. Since most machinery is used on flat ground, it is unlikely that operators would encounter badger burrows during normal activities. Thus, the risk to farm equipment from badger burrows in British Columbia appears to be minimal. Burrowing rodents, however, do cause extensive damage to farm machinery, perhaps because they are more likely to burrow in areas in which machinery is operated.

Livestock Injury

Several factors relating to the behaviour and abundance of both badgers and livestock probably contributed to the low rate of livestock injury that we observed in British Columbia.

Differences in sites used by badgers for burrowing in the Prairie provinces, as compared to British Columbia, may help explain the greater number of reports of injury resulting from badger burrows by veterinarians in the Prairie provinces. As mentioned above, badgers in British Columbia tend to select sites with >7% slopes and these sites are less likely to be used heavily by livestock. In the Prairie provinces, however, badgers often burrow in flat ground (E. Garde, University of Saskatchewan, personal observation) perhaps because sloped sites are less common. Burrows that occur on flat ground may be more difficult for livestock to see and therefore increase the probability of injury.

The paucity of badgers in British Columbia also likely contributed to the low level of livestock injury caused by badgers. Combined badger population estimates for Alberta and Saskatchewan range between 14,700 and 38,900 individuals (Newhouse and Kinley 2000), with approximately 75% of those occurring in Saskatchewan. Comparing this with the estimate of <200 adults in British Columbia (Adams et al. 2003), we anticipate that injury rates should be lower in British Columbia than elsewhere.

Although both may be susceptible to injury in badger burrows, horses may be more prone to injury in badger burrows than cattle. Horse legs are more fragile than those of cattle, so serious injury (e.g., fractures) may occur more often to horses when they step into badger burrows. Minta and Marsh (1988), along with many veterinarians that we interviewed, speculated that cattle are much less prone to injury from badger burrows because they move slowly, whereas horses often move quickly over unfamiliar ground, which may increase their risk of injury. Horses may also be more susceptible to badger burrows when being ridden because they are distracted by the rider's aids. A cursory examination of the data suggest that horses may be 10 times more likely to be injured in badger burrows than cattle. Similarly, pasture-breeding bulls may be at higher risk due to distraction. Calves may also be at greater risk due to their small size relative to

badger burrows. However, during our survey of veterinarians, most suggested that the risk to livestock from badger burrows was minimal, particularly when compared to other sources of injury, such as fences. The disproportionate vulnerability of cattle relative to horses may explain our observation of the equivalent number of cattle and horses injuries, despite the much greater abundance of cattle on ranches.

It is useful to compare our observed rates of machinery damage and livestock injury data with equivalent European research. Although very different in many respects from North American badgers, Eurasian badgers (*Meles meles*) are a fossorial mustelid that occurs in many areas that are used for livestock ranching. In a survey of damage caused by Eurasian badgers on farms in the United Kingdom, Moore et al. (1999) determined that injuries to livestock and damage to machinery occur relatively infrequently (1.7% and 2.7% of survey respondents, respectively), considering the abundance of Eurasian badgers in their survey area. However, Eurasian badgers do not dig as many burrows as North American badgers (Long and Killingley 1983), so conflict is less likely. Nonetheless, our results suggest that damage to equipment and livestock caused by North American badgers is much less common in British Columbia than similar damage caused by Eurasian badgers in the United Kingdom.

Rancher Perceptions

The majority of respondents that we surveyed considered badgers to be either beneficial or have no effect on their ranching operations. Also, most ranchers that we surveyed dealt with badger burrows by simply ignoring them or filling them in. A minority of ranchers felt that badgers were detrimental to their operations or were a cause for concern. The types of ranchers that were concerned about badgers or considered them detrimental were generally those with more horses on smaller parcels of land.

The concern expressed by ranchers about badger burrows may be more closely linked to their concern about burrows in general, and may not actually be specific to badgers. Damage from other burrowing animals was common and ranchers may have experienced considerable amounts of this type of damage. Thus, some ranchers may perceive all burrowing animals to be a source of damage and not consider badgers to be any less of a risk to their operations than other, more damage-causing, species. Further analysis of the data could examine the source of these negative perceptions about badgers.

Survey Limitations

The voluntary nature of participation in the survey may have had implications for the responses that we collected. The 25% of ranchers that were contacted who did not participate in the survey may have had experiences and perceptions that were different from those ranchers that participated. Ranchers that are wary of any documentation of badgers on their ranches may not have wished to participate in the survey. In addition, because the survey was being conducted for the Ministry of Water, Land and Air

Protection, some ranchers were unwilling to participate because of ongoing conflicts with this agency, most notably over perceived inaction regarding wild ungulates feeding on hay and hay fields.

In some cases it was difficult to ascertain whether reported damage was attributed to the correct species of burrowing animal. As noted by Moore et al. (1999), in the absence of verification, this survey reflects the perceptions of the person being surveyed. Ground-truthing of the respondents would allow us to determine how accurate the responses are and to what extent their perceptions reflect what is occurring on-the-ground.

Unfortunately, our survey population was probably not an unbiased sample of cattle ranchers. Given the very compressed contract schedule and the time required to conduct one-on-one telephone surveys, we limited the survey to the immediately available list of range tenure holders. Not all cattle ranchers hold Crown tenure permits, so some ranches have not been included in our survey population. Large cattle operations are probably more likely to have Crown tenure permits than smaller operations, so our sample was probably biased towards these larger operations. Since the attitudes and pest management practices of smaller operations may not be the same as those of large ranchers, our results may not reflect those of all cattle ranchers or those of “hobby farmers” throughout the range of badgers in British Columbia.

Recommendations for Recovery Team

Rancher attitudes about badgers were generally positive, and when negative attitudes were encountered, they may be due to perception or lack of knowledge about badger ecology, rather than fact. We believe a carefully designed extension program, making use of the body of existing badger information, data from this survey, and rancher testimonials, could help reduce the residual negative attitudes about badgers within British Columbia’s agricultural community.

The results of this survey will be helpful to the *jeffersonii* Recovery Team in directing their education efforts at those groups that have negative views of badgers. Specifically, the recovery team should:

- Get the message to all landowners that damage caused by badger burrows is extremely rare and report the reasons why.
- Target future education at mid-size landowners (50-500 acres), as this group were more likely to perceive badgers as detrimental and to be “concerned” or “very concerned” about damage to equipment or livestock caused by badgers. Extension material should be targeted to this audience to help dispel the myth about the frequency and extent of damage caused by badgers in British Columbia.
- Future research should attempt to quantify the positive effects of badgers on controlling prey populations. Before and after prey population estimates, if

possible, would be helpful in promoting badgers as effective rodent control agents.

- Government agencies should provide ranchers with extension material that includes a key to identifying different types of burrows, to help them better identify sources of damage and allow them to better manage burrowing rodents.
- Government agencies should provide ranchers with extension material to help them reduce future conflict with badgers. Material should also indicate that personnel are available, at no cost to the rancher, to help them deal with “problem” badgers.

One of the limitations of the survey is that it did not reach the small, non-tenure holding rancher and the “hobby farmer,” as we were unable to obtain lists of these individuals. A follow-up survey could reach owners of these smaller farms if access to the list of farm status holders was possible from BC Assessment. The addition of this demographic would make the database more truly representative of the farming community.

In addition to conducting an additional survey targeting smaller ranches, hobby farms and horse farms, we believe considerable amounts of additional information can be gleaned from the current data. Specifically, cross-tabulations of the data could help identify specific demographics and issues to which extension material should be developed and targeted.

Acknowledgements

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Appendix A: Burrow Damage Survey Tool for Landowners

Hi, my name is _____. I am doing a contract for the Ministry of Water, Land and Air Protection. We are trying to determine the extent of damage that ranchers and farmers experience from burrowing animals by conducted phone interviews with farmers and ranchers in the _____ area. Your name was randomly selected for the survey. The results will help us identify ways to reduce damage caused by burrowing animals and ultimately help you reduce damage to your livestock and machinery. Your answers will be kept confidential and we will not be disclosing information about any individual landowner's responses. Can I take a few moments of your time to get your experience on this matter? The survey usually takes less than 10 minutes.

If no then

Thanks very much

If yes, then

First of all, burrowing animals includes badgers, marmots, pocket gophers (moles) and ground squirrels (gophers). We are primarily looking at the effects that 2 groups of these animals have on ranching operations: rodents (gophers, moles, and marmots) and badgers.

1) Have you had burrowing animals on your property over the past 5 years?

If yes then continue to 2), if no then proceed to 16)

2) Have you had **Columbian ground squirrels**, also known as "gophers", on your property in the past 5 years?

- yes *continue to i)*
- no *proceed to 3)*
- not sure *proceed to 3)*

i. Do you consider Columbian ground squirrels to be *[choose 1 of following]*:

- beneficial
 - detrimental
 - or have no effect
- on your operations or the environment?

ii. How often do you see them?

- 1 every 2-3 years
- 1-50/year
- >50/year

3) Have you had **northern pocket gophers on your property**, also known as "moles" on your property in the past 5 years?

- yes *continue to i)*

- no *proceed to 4)*
- not sure *proceed to 4)*

i. Do you consider pocket gophers (or moles) to be *[choose 1 of following]*

- beneficial
- detrimental
- or have no effect on your operations or the environment?

ii. How many soil mounds do you see per acre?

- 1 every acre
- 1-20/acre
- >20/acre

4) Have you had **yellow-bellied marmots** on your property in the past 5 years?

- yes *continue to i)*
- no *proceed to 5)*
- not sure *proceed to 5)*

i. Do you consider marmots to be *[choose 1 of following]*

- beneficial
- detrimental
- or have no effect on your operations or the environment?

ii. How often do you see them?

- 1 every 2-3 years
- 1-20 times/year
- >20 times/year

5) Have you had **badgers** or their burrows on your property in the last 5 years?

- yes *continue to i)*
- no *proceed to 8)*
- not sure *proceed to 8)*

i. Do you consider badgers to be *[choose 1 of following]*

- beneficial
- detrimental
- both beneficial and detrimental
- or have no effect

on your operations or the environment?

ii. How often do you see them?

- once every 2-3 years
- 1-5 times/year
- >5 times/year

6) How has the number of **badgers or badger burrows** that you have seen changed in your area over the past 5 years?

- Gone up
- Gone down
- No change
- Don't know

7) Have you, in your farming operations, experienced any damage to livestock or farm equipment as a result of burrowing animal activity in the last 5 years?

- Yes, *proceed to 8)*
- No, *proceed to 12)*

8) Sticking with machinery damage, have you experienced any damage caused by **burrowing rodents** to machinery during the past 5 years?

- Yes, *proceed to a)*
- No, *proceed to 10)*

a) Which equipment?

- Swather Type of damage: _____
- Bailer Type of damage: _____
- Tractor Type of damage: _____
- Truck Type of damage: _____
- ATV Type of damage: _____
- Other: _____ Type of damage: _____

9) Have you experienced any damage caused by **badgers** to machinery during the past 5 years?

- Yes, *proceed to a)*
- No, *proceed to 10)*

a) Which equipment?

- Swather Type of damage: _____
- Bailer Type of damage: _____
- Tractor Type of damage: _____
- Truck Type of damage: _____
- ATV Type of damage: _____
- Other: _____ Type of damage: _____

10) Getting back to injuries to livestock, have you had any livestock injured in rodent **burrows** during the past 5 years?

- Yes, *proceed to i)*
- No, *proceed to 12)*

i. Have you had any cattle injured in rodent burrows?

- yes *continue to a)*
- no *proceed to ii)*

a. How many? _____

b. What were animals doing at the time?

- Grazing
- Being driven between grazing areas
- Holding pen
- Feedlot
- Herding cattle
- Other _____

c. What was resultant treatment?

- Euthanasia (Bullet)
- Treatment by self
- Vet call and treatment
- Let heal on own
- Other _____

ii. Have you had any horses injured in rodent burrows in the past 5 years?

- yes *continue to a)*
- no *proceed to iii)*

a. How many? _____

b. What were animals doing at the time?

- Grazing
- Holding pen
- Playing in field Herding cattle
- Other _____

c. What was resultant treatment?

- Euthanasia (Bullet)
- Treatment by self
- Vet call and treatment
- Let heal on own
- Other _____

iii. Have you had any other animals injured?

- yes *continue to a)*
- no *proceed to 13)*

a. What kind? _____

b. How many? _____

c. What were animals doing at the time?

- Grazing
- Being driven between grazing areas

- Holding pen
- Feedlot
- Herding cattle
- Other _____

- d. What was resultant treatment?
- Euthanasia (Bullet)
 - Treatment by self
 - Vet call and treatment
 - Let heal on own
 - Other _____

11) Have you had any livestock injured by **badgers or their burrows** during the past 5 years?

- Yes, *proceed to i)*
- No, *proceed to 12)*

i. Have you had any cattle injured by badgers or their burrows?

- yes *continue to a)*
- no *proceed to ii)*

a. How many? _____

b. What were animals doing at the time?

- Grazing
- Being driven between grazing areas
- Holding pen
- Feedlot
- Herding cattle
- Other _____

c. What was resultant treatment?

- Euthanasia (Bullet)
- Treatment by self
- Vet call and treatment
- Let heal on own
- Other _____

ii. Have you had any horses injured by badgers or their burrows in the past 5 years?

- yes *continue to a)*
- no *proceed to iii)*

a. How many? _____

b. What were animals doing at the time?

- Grazing
- Holding pen
- Playing in field
- Herding cattle
- Other _____

c. What was resultant treatment?

- Euthanasia (Bullet)
- Treatment by self
- Vet call and treatment
- Let heal on own
- Other _____

iii. Have you had any other animals injured by badgers or their burrows in the past 5 years?

- yes *continue to a)*
- no *proceed to 12)*

a. What kind? _____

b. How many? _____

c. What were animals doing at the time?

- Grazing
- Being driven between grazing areas
- Holding pen
- Feedlot
- Herding cattle
- Other _____

d. What was resultant treatment?

- Euthanasia (Bullet)
- Treatment by self
- Vet call and treatment
- Let heal on own
- Other _____

12) On a scale of 1 to 5, with 1 being "not at all concerned" and 5 being "very concerned" how concerned are you about **badgers** causing the following problems to your operations?

Not concerned at all

Very concerned

1

2

3

4

5

_____ Damage to machinery

_____ Injury to livestock

_____ Other reasons _____

13) Have you ever heard of anyone else experiencing damage caused by badgers to machinery or livestock in the past 5 years?

- Yes, *proceed to a)*
- No, *proceed to 14)*

a. What was damaged?

- Machinery
- Livestock
- Other: _____

14) How do you deal with **rodents and their burrows**?

- Ignore them and live with the losses/risk
- Try to reduce population numbers
 - Poison
 - Shooting
 - Traps
 - Other
- Non-lethal control
 - Change grazing-haying regime (fallow years) or crops planted
 - Predator enhancement
 - Harassment
- Other _____

15) How do you currently deal with **badgers and their burrows**?

- Ignore them and live with the losses/risk
- Try to reduce population numbers
 - Poison
 - Shooting
 - Traps
 - Other
- Non-lethal control
 - Harassment
- Other _____

16) Can you give me an indication of the size of your operation?

- Cattle: 1-29 30-100 >100
Horses: 0-1 2-10 >10
Other: _____ 1-29 30-100 >100

17) Approximately how much land (private or leased, not including crown range) do you use in your operations?

- <50 acres 50-500 acres >500 acres Won't provide

18) Years of operation _____

Appendix B: Burrow Damage Survey Tool for Veterinarians

Hi, my name is Helen Davis. I am doing a contract for the British Columbia Ministry of Water, Land and Air Protection in conjunction with our provincial wildlife veterinarian Helen Schwantje. We are trying to determine how often farm animals get injured by badger burrows. This survey is being done to assess how much of a problem this is. If they are a significant problem, we plan to try and figure out what can be done about it. Can I take a few moments of your time to get your experience on this matter?

If no then

Thanks very much

If yes, then:

Great thanks,

How would you characterize your practice?

- Small animal only
- Large animal only
- Mixed

How common are injuries from badger burrows encountered in your practice?

This could include cows or horses stepping into burrow holes or dogs being injured by fighting with badgers or stepping into holes.

- Never
- Rare
- Common
- Animals come in injured, could be by a badger burrow, but don't know how they got injured

2. How many times have you treated the following for an injury that was reported to you as caused by a badger or badger burrow in the past 5 years?

a. Cow

Type of injury:

- Broken leg, animal destroyed
- Treated fracture, (average cost_____)
- Other _____

b. Horse

Type of injury:

- Fracture, animal destroyed
- Fracture, treated (average cost_____)
- Soft tissue injury, treated (average cost_____)

c. Dog

Type of injury:

- Hurt by fighting with badger
- Hurt by stepping into burrow, destroyed
- Hurt by stepping into burrow, treated (average cost_____)

d. Other (sheep, goat, _____)

Type of injury:

- Broken leg, animal destroyed
- Treated fracture
- Other _____