Impact of Wildlife to Beef Producers in Alberta

Starting the Conversation

April 2015

Prepared by Tracy Lee and Kim Good

MIISTAKIS INSTITUTE

Prepared for:

Alberta Beef Producers

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“I enjoy having the wildlife around. They are a big part of the reason I live in the country, and have a ranching style of life.”

“Much akin to building a house in the floodplain you should expect floods, if you farm cattle you should expect them to interact with wildlife.”

“I, like most people, appreciate and want to protect wildlife. I think it should be a shared cost with all of society. Farmers are the most connected with land and wildlife, and many have an interest in protecting them, and I feel that all taxpayers should compensate them (share the cost) for doing so.”

“shoot shovel and shut up”

Quotes excerpted from ABP survey responses.

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EXECUTIVE SUMMARY

This research was developed to improve the understanding of the interactions between beef producers and wildlife and the financial losses due to the impact because of wildlife (ungulates, carnivores and birds) on beef producers in Alberta. Wildlife impacts include financial losses such as depredation events, forage competition, stored feed loss, property damage, and prevention and management activities. The data was gathered through an online survey for beef producers and was promoted by ABP representatives, local media and word-of-mouth efforts across Alberta. Because it was not possible to randomly select a sub-section of producers, results are at risk of voluntary response bias, whereby the survey may have attracted more individuals who have strong opinions on the issue.

There were 672 survey responses, enough to statistically analyze the results from a provincial perspective but not enough to assess results per ABP zone to better understand regional differences. In addition, the number of responses where producers provided economic values was low, reducing the reliability of the data and the ability to provide a provincial perspective on the total costs of wildlife to producers. Despite these limitations, the survey results provide valuable contextual information about the impact of wildlife on beef producers, and are a good starting point for understanding losses and costs associated with the different types of impacts. In addition, given a total population of 20,000 beef producers in Alberta, 672 responses provide a 99% confidence level with a 5% margin of error, indicating these results (with noted limitations above) are representative of the entire producer population in Alberta.

Understanding the Issue

The majority of producers in Alberta experience impacts from wildlife, with 81% of survey respondents reporting impacts from ungulates, 74% from carnivores and 44% from birds. Six percent (6%) of producers reported having no issues with wildlife. Although producers experience impacts from wildlife, the majority value and want to see healthy populations of ungulates (83%) and carnivores (75%) on the landscape. In addition, 80% of beef producers feel living with wildlife is a part of doing business. However, a majority of producers (88%) agree that wildlife living amongst and moving through beef operations results in economic impacts to the landowner. When these costs are judged to be too high most producers (81%) feel they need to deal with problem wildlife themselves. Ultimately, 71% of respondents felt that the responsibilities for ensuring healthy wildlife populations are borne unevenly by agricultural landowners.

There was very little agreement amongst producers on whether the current level of economic loss due to wildlife was tolerable with 40% reporting losses as tolerable, 10%

reporting losses as neutral and 50% reporting losses are not tolerable. This likely has to do with a multitude of factors impacting individual experiences, personal values, costs of impacts, and species causing the damage.

A further analysis on the total annual percentage of economic loss full-time producers were willing to accept found that half of the producers were willing to accept between 1-5% in financial losses in any given year because of wildlife, while the other half were willing to accept less than 1% in losses. However, it should be noted that within the category of willing to accept less than 1% in financial losses, a number of individuals (25% of respondents) reported they would not accept any economic loss.

The main concerns relating to wildlife reported by beef producers in Alberta were economic losses (81%), livestock safety (66%) and increases in time required for management (62%). Producers were asked to report wildlife attractants associated with their operations; the top five attractants reported were hay yards (83%), swath grazing (60%), grain bins (38%), dead livestock piles (28%) and silage pits (22%).

To evaluate the key impacts from different wildlife types, we asked producers to identify and quantify impacts from carnivores, ungulates and birds. Each was assessed in separate sections through a series of survey questions specific to the impacts from these species classes.

Carnivores

Seventy-four percent (74%) of beef producers reported impacts from carnivore species. The species of primary concern was coyote, as 65% of all producers in Alberta experienced impacts from this species specifically. Other species of concern for all producers in Alberta were wolves (31%), cougars (21%) and black bears (19%). Grizzly bears were reported by 14% of producers in Alberta as having an impact.

In Alberta, 64% of beef producers reported experiencing a depredation event. The majority for all beef producers were calf depredation events (60%), cow depredation events (20%), feeder/yearling depredation events (14%) and bull depredation events (4%).

The value of these losses can be cumulative. For example, of the producers who reported depredation events (a subset of all producers in Alberta) the average rate of calf depredation was 2% resulting in an average value loss of $1,742 per 100 calves annually or the equivalent of $17 per calf annually. The average rate of depredation for feeders and yearlings for those producers who reported experiencing depredation was 1.5%, equating to an individual producer feeder/yearling value loss of $1,664 per 100

feeders/yearlings annually or the equivalent of $17 per feeder/yearling annually. The average rate of depredation for cows for those producers who reported experiencing depredation was 0.5%, equating to an individual producer cow value loss of $535 per 100 cows annually or the equivalent of $5 per cow annually.

The total value lost from depredation annually reported only by survey respondents (3.5% of beef producers in Alberta) based on the total number of cattle they reported and the average percent depredation rate equates to just over $2 million in losses annually. This value significantly underrepresents losses due to carnivore depredation (including coyotes) in Alberta as it is limited to survey respondents only and has not been extrapolated to the provincial level. In addition, indirect impacts associated with sharing the landscape with carnivore species are not accounted for.

Beef producers also reported losses due to property damage (e.g., fencing, shed and building damage) and forage competition (e.g., barley, oat and hay losses) although to a much lesser extent than depredation.

The following were reported as concerns producers in Alberta have about the indirect impacts from carnivore species: increased time management (49%), decreased weaning weights (24%), reduced conception rates (24%), and increased rates of disease (15%).

A common finding in this study is the notion that costs are borne unevenly amongst producers, with a small percentage of producers reporting extreme losses. For example, seven percent of individuals who reported experiencing calf depredation reported losses higher than 5% while the average producer in this subset experienced 2% in losses in a given year due to depredation. These cases of extreme loss are important to understand for development of programs that are designed to help maintain tolerance towards wildlife and support coexistence.

To address economic impacts of coexisting with wildlife, the Government of Alberta has developed compensation programs. To address depredation losses, Alberta Environment and Sustainable Resource Development (ESRD) paid out approximately $200,000 annually to beef producers. However, survey results indicate the majority of producers who report impacts from depredation (62%) don’t report to the Wildlife Predator Compensation Program.

Some of the key reasons for not reporting included the burden of proof being too great, the investment in time not being worth the return, losses not considered high enough to report, impacts not eligible (e.g., coyote depredation event) and a perception that

nothing will be done based on past experience. These are areas in current compensation programs where improvements may need to be considered. For example, other programs have addressed issues with verification and underreporting by applying a multiplier to confirmed depredation events.

Beef producers identified a number of management actions they have implemented to reduce access to attractants and improve coexistence with wildlife. The majority of beef producers who reported impacts from carnivores have implemented some form of prevention or attractant management including (in order of highest number of producers): increased time checking on livestock, removal of dead livestock from the landscape, dealing with the problem animals themselves and moving calving grounds closer to home. Interestingly, less than a half of producers had implemented management actions to address impacts from ungulates, such as fencing off stored feed, avoiding use of silage bags and pits, providing an alternative feed source and changing business practices.

Ungulates

Beef producers reported that ungulate species were of greater concern than carnivore species in Alberta, with 81% of beef producers reporting impacts associated with ungulates species. Seventy percent (70%) of beef producers in Alberta reported forage competition and 70% reported stored feed loss from ungulates. The primary species of concern for producers impacted by ungulates was white-tailed deer as impacting 60% of beef producers through forage competition and 54% of beef producers through stored feed loss, followed by mule deer impacting 53% of beef producers through forage competition and 48% of beef producers through stored feed loss and elk reported by 39% of beef producers with respect to forage competition and stored feed loss.

Beef producers identified forage crops of concern: in Alberta 62% reported losses of hay crops, 40% reported losses of oat crops and 30% reported losses of barley crops due to forage competition with ungulates. The value of these losses can be cumulative. For example, of the producers who reported losses of hay from forage competition, the average hay value lost for an individual producer was $3,355 on an average of 450 acres grown annually. For producers who reported losses of oats from forage competition, the average oat value lost for an individual producer was $3,647 on an average of 154 acres grown annually. For producers who reported losses of barley from forage competition, the average barley value lost for an individual producer was $5,460 on an average of 256 acres grown annually. The total value lost from forage competition annually reported only by survey respondents (3.5% of beef producers) in Alberta based on the total number of acres reported and the average percent forage competition rate equates to just over $1.9 million in losses annually. This value significantly

underrepresents the loss due to forage competition in Alberta as it is limited to survey respondents only and has not been extrapolated to the provincial level

Seventy percent (70%) of Alberta beef producers were impacted by ungulates consuming or damaging stored feed with 62% of those producers reporting stored hay loss or damage, 21% of those producers reporting oat loss or damage, 18% of those producers reporting barley loss or damage, and 17% of those producers reporting silage loss or damage. Producers who reported losses or damage of stored hay lost an average of $2,021 annually. Producers who reported losses or damage of stored oats lost an average of $1,994 annually. Producers who reported losses or damage of stored barley lost an average of $2,262 annually. Producers who reported losses or damage of silage lost an average of $3,113 annually.

The total value of stored feed lost or damaged reported only by survey respondents (representing 3.5% of beef producers) in Alberta and based on the total number of acres reported and the rate of stored feed reported lost or damaged equates to $621,000 in losses annually. This value significantly underrepresents the loss of stored feed due to ungulates in Alberta as it is limited to survey respondents only and has not been extrapolated to the provincial level.

To address the challenge of losses due to forage competition and stored feed losses with ungulates, the AFSC offers a wildlife compensation for crops and stored feed loss program. Of the 70% of survey respondents who reported experiencing losses due to forage competition or stored feed losses, 80% did not apply for compensation through AFSC. The top four reasons beef producers said they did not report included: a perception the return was not worth the investment in time, losses were deemed acceptable, a perception they needed to be insured to apply for the program, and/or they were not aware of the program.

Despite this low level of reporting, the AFSC paid out over $5 million dollars due to wildlife damage on crops in Alberta in 2012. This value represents all crops (cereal, forage, and fruit; not just those belonging to identified beef producers) but this study was primarily interested in damages to, and losses of, forage crops grown and feed stored by beef producers. A ten year summary provided by AFSC indicates that approximately $10 million was paid out to farmers reporting forage crop damage, suggesting approximately $1 million annually was paid out for forage crop loss.

Another concern expressed by the beef producers in Alberta who had identified they were experiencing ungulate impacts (55% of producers) was disease transmission from wildlife to livestock. The main diseases of concern to Alberta beef producers were:

chronic wasting disease (17%), brucellosis (7%), tuberculosis (4%), and diseases caused by ticks (3%). One of the main data gaps for understanding the impacts of ungulates is the cost associated with preventing and managing these diseases.

To address the impacts caused by ungulates (including forage competition, stored feed damage and loss, and disease transmission), 85% of producers reported managing to reduce ungulate impacts. There were a number of strategies these producers reported implementing to reduce impacts, but none of the listed suggestions were implemented at a high rate. The most common management practices implemented by these producers were installing electric fencing around stored feed (37%) and avoidance of silage bags or pits (38%). These producers also reported putting out alternative feed sources to draw wildlife away from stored feed (30%) and have changed their business practices to reduce impacts (22%). Some less commonly mentioned strategies included fencing off stored feed, allowing hunters onto land to reduce herd size and using deterrents (e.g., light or sound) or dogs to scare animals away.

Birds

Of less overall concern compared to ungulates and carnivores, 44% of producers in Alberta report experiencing impacts associated with birds. The top three species causing impacts to beef producers in the province were ravens (27%), geese (25%), and ducks (17%).

The primary impacts reported by producers in Alberta were depredation events on calves (24%), loss of barley forage (15%) and losses of oat forage (14%). Less than 10% of producers in Alberta reported impacts of losses of hay forage, silage crop, stored barley, oats, silage and straw damage. The number of responses associated with the percent of forage loss from birds was low and highly skewed, with a small percentage reporting extremely high percentage losses.

As a starting point for discussion, we used the survey data to calculate the average annual value of barley lost per individual producer who grew barley and experienced forage competition with birds as $2,178 annually (based on an average of 350 acres grown and a reported rate of loss of 4%). Individual producers who grew oats and experienced forage competition with birdslost on average $1,679 annually, (based on an average of 195 acres grown and a reported loss rate of 6%).

Although impacts from wild birds are less than those reported for ungulates and carnivores, there appear to be cases in Alberta where beef operations experience high levels of loss from birds predating on cattle and consuming forage and stored feed. Although it appears the percentage of beef producers impacted by birds is low, there

may be cases where individuals experience more extreme impacts, and bear a significant financial burden.

How to improve coexistence?

When asked how to improve coexistence with wildlife, beef producers in Alberta identified four strategies: reducing problem wildlife populations, improved management by beef producers, changes or improvements to government planning and programming, and improved co-management opportunities. Although the top two suggestions relate to working within the current programs and approaches for addressing problems with wildlife, there were also a number of innovative suggestions, including changes to the current compensation programs, exploration of an ecosystem goods and services approach where producers are compensated for providing high quality wildlife habitat, improvements to land use planning in relation to wildlife habitat, and consideration for a new mitigation program to cost share efforts to reduce attractants.

Next Steps

The results of this study could be used to lay the foundation for the development of an ABP work plan to move wildlife and producer co-existence forward with policy makers, program designers, wildlife proponents, agricultural community and the public in an effort to create a beneficial situation for wildlife and those who are impacted by them. The work plan could include three sections: 1) Communications and Outreach, 2) Collaboration Efforts and 3) Further Research. Specific strategies are suggested for each of these theme areas as supported by the survey findings.

SUMMARY OF FINDINGS[1]

Who filled in the survey?

- 672 beef producers from around Alberta participated in the survey. This sample is representative of beef producers in Alberta with a 99% confidence interval and 5% margin of error.

- 80% of survey respondents identified themselves as full time beef producers and 17% of survey respondents identified themselves as part-time beef producers.

Perceptions and Attitudes toward Wildlife

- The majority of producers in Alberta agree it is important for them to know there are healthy populations of ungulates (83%) and carnivores (75%) in Alberta.

- 80% of producers in Alberta agree that the presence of wildlife is part of owning land, however, when the costs get too high, 80% of producers agree they need to remove problem wildlife.

- 88% of producers in Alberta agree that wildlife living amongst and moving through beef operations results in economic loss to the landowner.

- 70% of producers in Alberta agree the cost of supporting wildlife is unevenly borne by landowners in Alberta.

Tolerance Levels

- There was no level of agreement amongst beef producers about their tolerance of the current levels of economic loss as a result of wildlife where 50% agree the current loss due to wildlife is acceptable and 40% think the current level of loss is not acceptable.

- Full time producers identified a minimum acceptable percent loss of 0% to a maximum acceptable percent loss of 5%. The median amount of acceptable

[1] Black text – Alberta scale results; Green text – level one subset; Blue text – level two subset

economic loss due to wildlife was 1%. Approximately 20% of producers are not willing to accept any economic loss from living with wildlife.

Background Context

- Ungulates (81%) were the most problematic wildlife species from an Alberta beef producers' perspective, followed closely by carnivore species (74%).

- Beef producers in Alberta report a high number of wildlife attractants on the landscape, including stored feed (83% with hay yards), livestock dead piles (28%) and swath graze (60%).

- The main concern expressed about wildlife and beef operations in Alberta is the economic loss resulting from wildlife, reported by 80% of beef producers**.**

Carnivores

- 74% of beef producers in Alberta experience impacts from carnivore species that result in an economic impact to their operations and the beef industry.

- In Alberta 65% of beef producers are impacted by coyotes, 31% by wolves, 21% by cougar, 19% by black bear and 14% by grizzly bears.

- 64% of beef producers in Alberta have experienced a **depredation** event in the last three years including 61% of producers losing calves, 20% of producers losing cows, 14% of producers losing feeders and yearlings and 4% of producers losing bulls to a depredation event.

- Carnivore species also cause **property damage and loss** and 26% of beef producers in Alberta have experienced fencing damage from carnivore species, 20% of producers have experienced oat crop losses from carnivores; 14% of producers have experienced hay crop losses from carnivores; 10% of producers have experienced barley crop losses from carnivores; 7% of producers in Alberta have experienced shed /building damage from carnivores; and 7% of producers have experienced silage crop losses from carnivores.

- The survey results indicate that 54% of beef producers in Alberta were concerned about **indirect impacts** of sharing the landscape with carnivore species. The top three indirect impacts of concern to beef producers in Alberta

include 49% concerned about increases in time management due to carnivores; 24% concerned about decreased weaning rates due to indirect impacts of carnivores; and 24% concerned about decreased conception rates due to indirect impacts of carnivores.

- Producers in Alberta report implementing **preventative measures** to reduce the impact of carnivores. The most popular include: increase checking on livestock (77%), remove dead livestock from landscape (75%), remove problem carnivores themselves (64%) and move calving grounds closer to home (62%).

IMPACTS TO BEEF PRODUCERS WHO REPORTED EXPERIENCING DEPREDATION AND PROPERTY DAMAGE FROM CARNIVORES

The following results are derived from a subset of the survey data and include only those beef producers (74%) who reported experiencing impacts from carnivore species. The following percentages relate only to producers who are being impacted by carnivores and not all beef producers in Alberta.

Depredation events

- 88% of producers who experienced impacts from carnivores report impacts from coyote, 42% from wolves, 28% from cougar, 26% black bear and 19% from grizzly bear.

- 86% of the producers who experienced impacts from carnivores report experiencing a **depredation** event.

The following results are derived from a subset of the data and include only those beef producers (86%) who reported experiencing depredation events. The percentages relate only to producers who are being impacted by carnivore depredation and not all beef producers in Alberta.

- 95% of producers who reported experiencing a depredation event reported calf depredations. The mean percent loss of calves from beef producers who experience calf loss was 2%, equating to a value per 100 calves $1,742 annually or $17 per calf.

- 21% of producers who reported experiencing a depredation event reported feeder/yearling depredations. The mean percent loss of yearlings/feeders from those who experience feeder/yearling loss

was 1.5%, equating to a value per 100 feeder/yearlings of $1,664 annually or $17 per feeder/yearling.

- 32% of producers who reported experiencing a depredation event reported cow depredations. The mean percent loss of cows from those who experience feeder/yearling loss was 0.5%, equating to a value per 100 cows of $535 annually or $5 per cow.

- 7% of producers who reported experiencing a depredation event reported bull depredations. The mean percent loss of bulls from those who experience bull loss was 5%, equating to a value per 10 bulls of $992 annually.

- The rates of depredation do not occur evenly among producers, with some reporting losses greater than 5%. The average depredation rate is 2%, a percentage of producers (7%) report losses of calves greater than 5% due to carnivores.

- The total value lost from depredation annually reported by survey respondents (representing 3.5% of beef producers in Alberta) based on the total number of cattle they reported and the average percent depredation rates per cattle type equates to just over **$2 million in losses annually**. This value represents an extremely conservative amount of carnivore depredation in Alberta. This value is limited to survey respondents and does not extrapolate to the broader beef producer community in Alberta. In addition, the calculated loss does not include the indirect impacts associated with sharing the landscape with carnivore species.

- 62% of producers who reported experiencing a depredation event from 2011-2013 did **not** report to AESRD Wildlife Compensation program. The primary reasons for not reporting included programmatic issues such as:
    - burden of proof too great;
    - coyote depredation events are not eligible for compensation;
    - the time commitment required to process;
    - amount compensated not enough to justify time commitment;
    - impression there would likely be no action; and
    - did not know about the program.

- In Alberta, the average annual compensation payout for all claims during 2011-2013 from AESRD was $220,584, predominately for confirmed cow and feeder/yearlings depredation events, caused by mostly by wolf.

Property Damage and Loss

The following results are derived from a subset of the data and include only those beef producers (74%) who reported experiencing impacts from carnivore species. The following percentages relate to those producers who are being impacted by carnivores and not all beef producers in Alberta.

- 31% of beef producers who experience impacts from carnivores and grow oats reported an average annual loss per producer of 275 bushels of **forage oats** as a result of carnivores, this equates to an estimated value for each of those producers $1,047 of annually.

- 16% of beef producers who experience impacts from carnivores and grow barley reported an average annual loss per producer of 227 bushels of **forage barley** as a result of carnivores, at an estimated value for each of those producers of $1,121 annually.

- 21% of beef producers who experience impacts from carnivores and grow hay reported an average annual loss per producer of 37 tonnes of **forage hay** to carnivores, at an estimated value for each of those producers of $1,774 annually.

- 9% of beef producers who experience impacts from carnivores and grow silage reported an average annual loss per producer of 22 tonnes of **forage silage**, at an estimated value for each of those producers of $862 annually.

- 39% of beef producers who experience impacts from carnivores reported **fencing damage**, costing an average for each producer of $557 annually and taking approximately 59 hours of time.

- 10% of beef producers who expereience impacts from carnivores report **building and shed damage**, costing an average for each producer of $422 annually and taking approximately 18 hours of time.

Ungulates

- 81% of beef producers in Alberta report impacts from ungulates.

- 70% of beef producers in Alberta experience **forage competition** from ungulate species that result in an economic impact.

- In Alberta 60% of beef producers are impacted by white-tailed deer, 53% by mule deer, 39% by elk, 10% by moose and 4% by antelope due to forage competition.

- In Alberta 62% of beef producers report forage competition with ungulates in hay crops; 40% of beef producers report forage competition with ungulates in oat crops and 30% of beef producers report forage competition from ungulates in barley crops.

- 70% of beef producers in Alberta experience **damage or loss of stored feed** from ungulate species that result in an economic impact.

- In Alberta 62% of beef producers report damage or loss from ungulates in stored hay; 21% of report damage or loss from ungulates in stored oats; 18% report damage or loss from ungulates in stored barley; and 17% report damage or loss from ungulates in stored silage.

- 55% of producers are concerned about the economic impact of **disease transmission** from wildlife to beef cattle. The disease of greatest concern is chronic wasting disease followed by brucellosis, tuberculosis, and disease caused by ticks.

- 85% of producers reported implementing **management activities** to reduce impacts of ungulates.

IMPACTS TO BEEF PRODUCER WHO REPORTED EXPERIENCING FORAGE COMPETITION FROM UNGULATES.

The following results are derived from a subset of the data and include only those beef producers (70%) who reported experiencing **forage competition** from ungulates. The following percentages relate to those producers who are being impacted by ungulates and not all beef producers in Alberta.

- 83% of this subset of producers beef producers report experiencing **forage competition** from white-tailed deer, 74% from mule deer, 54% from elk, 14% from moose and 5% from antelope.

- 96% of this subset of producers report forage competition in **hay crops.** The mean loss of hay crops annually (2011-2013) was 6% at a value of $3,355 on an average of 451 acres.

- 89% of this subset of beef producers report forage competition in **oat crops.** The mean loss of hay crops annually (2011-2013) was 9% at a value of $3,647 on an average of 154 acres.

- 82% of this subset of producers report forage competition in **barley crops** . The mean loss of barley crops annually (2011-2013) was 6% at a value of $5,460 on an average of 356 acres.

- The total value lost from forage competition on hay, oats and barley forage crops annually reported by survey respondents (representing 3.5% of beef producers in Alberta) based on the total number of acres they reported lost equates to **$1.9 million annually**. This value represents an extremely conservative amount of forage competition losses from ungulates in Alberta. This value is limited to survey respondents and does not extrapolate to the broader beef producer community in Alberta.

- 80% of these beef producers who reported loss due to forage competition from 2011-2013, did not report to AFSC compensation programs. The primary reasons for not reporting included programmatic issues such as:
    - Return not worth the effort;
    - Losses were acceptable;
    - Not insured;
    - Unaware of potential help;
    - Losses difficult to measure; and
    - Ineligible damages.

IMPACTS TO BEEF PRODUCER WHO REPORTED EXPERIENCING STORED FEED LOSS OR DAMAGE FROM UNGULATES.

The following results are derived from a subset of the data and include only those beef producers (70%) who reported experiencing **stored feed loss or**

damage from ungulates. The following percentages relate to those producers who are being impacted by ungulates and not all beef producers in Alberta.

- 78% of these producers report experiencing damage by white-tailed deer, 69% by mule deer, 42% by elk, 15% moose and 1% by antelope.

- 94% of this subset of producers who report loss or damage to **stored hay**. The mean loss or damage to stored hay annually (2011-2013) was 4% with a range of loss between 0 and100% and an average loss of $2021.

- 64% of this subset of producers report loss or damage to **stored silage**. The mean loss or damage to stored silage annually (2011-2013) was 4% who report experiencing damage to stored feed with a range of loss between 0 and 100% and an average loss of $3,113.

- 57% of this subset of producers who report loss or damage to **stored oats**. The mean loss or damage to stored oats annually (2011-2013) was 8% with a range of loss between 0 and 63% and an average a loss of $1,994.

- 54% of this subset of producers report loss or damage to **stored barley**. The mean loss or damage to stored barley annually (2011-2013) was 1% with a range of loss between 0 and 35% and an average loss of $2,262.

- The total value lost from stored feed on stored hay, oats, barley and silage annually reported by survey respondents (representing 3.5% of beef producers in Alberta) based on the total number of acres or tonnes they reported lost equates to **$621,000 annually**. This value represents an extremely conservative amount of forage competition losses from ungulates in Alberta. This value is limited to survey respondents and does not extrapolate to the broader beef producer community in Alberta.

- 80% of these beef producers who reported loss or damage to stored feed from 2011-2013 did not report to AFSC compensation programs. The primary reasons for not reporting included programmatic issues such as:
    - Return not worth the effort;
    - Losses were acceptable;
    - Unaware of potential help;
    - Not insured;

- Ineligible damages;
- Implemented management actions to reduce impacts; and,
- Losses were too difficult to measure.

Birds

- 44% of beef producers in Alberta experience impacts from bird species that result in an economic impact.

- In Alberta 27% of beef producers are impacted by ravens, 25% by geese, 17% by ducks, 6% by eagles and 3% by hawks and less than 1% by swans.

- In Alberta 24% of beef producers in Alberta experience calf depredation from birds; 15% of producers who grow barley experience losses from forage competition from birds; 14% of producers who grow oats experience losses from forage competition from birds; 7% of producers who have silage experience silage loss from bird damage; 6% of producers who have stored oats experience stored feed loss from birds; 5% of producers who grow hay experience forage competition with bird; and less than 5% of producers experience losses of hay forage, silage crop, stored feed hay and straw damage from birds.

IMPACTS TO BEEF PRODUCER WHO REPORTED EXPERIENCING IMPACTS FROM BIRDS.

The following results are derived from a subset of the data and include only those beef producers (44%) who reported experiencing impacts from birds. The following percentages relate to those producers who are being impacted by birds and not all beef producers in Alberta.

- 62% of this subset of producers reported experiencing impacts from ravens, 59% from geese, 38% from ducks, 17% from magpie and 13% from eagles.

- 80% of this subset of producers reported **injury or losses of calves** due to birds at a rate of 1%.

- 66% of this subset of producers reported losses of **barley forage** due to birds. On average these producers reported an annual loss of 606 bushels of barley at a value of $2178 annually.

- 60% of this subset of producers reported losses of **oat forage** due to birds. On average these producers reported an annual loss of 573 bushels at a value of $1679.

- 27%of this subset of producers reported losses of **hay forage** due to birds. On average these producers reported an annual loss of 6 tonnes at a value of $423.

- 42% of this subset of producers reported an average loss of **stored silage.** On average these producers reported an annual loss of 1.5% due to birds, equating to a value of $1,263 annually.

- 31% of this subset of producers reported average loss of **stored barley.** On average these producers reported an annual loss of1.4% due to birds, equating to a value of $1,567 annually.

- 18% of this subset of producers, who have stored hay, reported an average loss of **stored hay.** On average these producers reported an annual loss of 2% due to birds, equating to a value of $998 annually.

- 23% of this subset of producers, reported losses of **straw.** On average these producers reported an annual replacement value of $54 due to bird damage.

INTRODUCTION

Alberta leads all other Canadian provinces in the production of beef with over 20,000 farms (AARG 2014) supporting approximately 5.4 million cattle (AARG 2014). Beef producers share the landscape with many species of wildlife. Wildlife is an important component of Alberta's natural heritage, providing a wide array of values for Albertans. However, sharing the landscape with wildlife often results in a burden to livestock producers in the form of economic loss, property damage/loss, and prevention and management activities (Conover 2002).

Economic losses occur from forage competition and stored feed loss from, and damage by, wildlife, such as geese, ducks, elk, deer and moose as well as livestock losses from predation by carnivore species such as bears, cougar, wolf, or coyote. There are also indirect economic losses associated with wildlife. While less understood, *stress to livestock* living in the presence of carnivores has been linked to reduced weaning rates, lower weight gain and reduced conception rates. Economic loss is also experienced through *property damage* caused by wildlife. This may include damage to fencing, beehives, grain bins, grain bags, silage bags and hay yards. *Prevention and management activities* include projects and/or activities to prevent the above losses, such as fence installation, replacing old grain bins and/or increased time spent on the landscape. There are costs and resources associated with these activities.

While the majority of beef producers value wildlife on their property and will tolerate some damage from wildlife, research indicates that once associated costs pass a personal threshold producers will take action to prevent further damages and loss to their operation from wildlife (Conover 1994, 1998; Rollins et al. 2004; Hegel et al. 2009). Therefore, it is important to understand how wildlife impacts the financial health of producers because ultimately healthy wildlife populations are dependent on the tolerance of human communities to maintain habitat and encourage wildlife to persist.

This study was developed in partnership with the Alberta Beef Producers (ABP) to:

- provide context on how wildlife affect the financial health and stability of beef producers;
- inform policy and programs earmarked to reduce conflicts or address the economic burden to beef producers; and
- identify higher risk communities in Alberta where prevention, management and compensation programs may need to be modified.

The objectives of this report are to:

- identify the species involved in conflict with beef producers;
- estimate economic losses to beef producers in Alberta and within ABP zones from carnivores, ungulates and birds coexisting on agricultural lands; and
- develop comprehensive lists of costs associated with economic loss, property damage, and prevention and management activities, including both direct and indirect costs.

Understanding the economic loss to the producer is important for developing effective mitigation strategies to promote coexistence of wildlife. It is also important to understand that wildlife provides immense value to society but that value is not calculated in this study. This study also does not estimate the value of government programming developed to support promoting coexistence and building tolerance.

METHODS

To calculate the economic loss of wildlife we considered three areas where economic impacts to beef producers are known: 1) economic losses associated with (a) livestock depredation from carnivores, and (b) forage loss from ungulates, birds and carnivores; 2) property damage to infrastructure from carnivores, and 3) investment in preventative measures and management activities to reduce impacts from wildlife.

Carnivore, ungulate and bird impact were assessed to determine an estimated annual cost to beef producers in Alberta for each category. Data was acquired through an online survey aimed at beef producers, reference literature and datasets provided by Alberta Environment and Sustainable Resource Development, Fish and Wildlife Division (AESRD-FW) and Agricultural Financial Services Corporation (AFSC).

To assess the impacts (e.g., predation on cattle, damage to grain bins and silage and consumption of feed) of carnivores (i.e., grizzly bear, black bear, cougar and coyote) to beef producers the following information was collected from the data sources:

1. Total depredations of cattle (mature and calves) was gathered through:
    a. online survey results;
    b. review of AESRD payouts from the Wildlife Predator Compensation Program; and
    c. literature review.
2. Total number of other types of property damage associated with carnivores (e.g., grain bins, silage bags, grain, and silage loss) was gathered through the online survey.
3. Economic value of cattle (mature and calf) in Alberta was determined using CANFAX averages.

4. Economic value of feed loss was determined using agricultural commodity prices shown in AFSC and Alberta Agriculture and Rural Development online data.
5. Indirect costs relating to stress and loss of weight gain were determined through literature review.
6. Best management practices (BMPs) employed to reduce conflicts with carnivores were gathered through the online survey and individual expertise about costs associated with BMPs.
7. Beef producers; time spent addressing cattle / predator issues was gathered through the online survey.

To assess the impacts (e.g., competition for forage on pastures and consumption of stored feed) of ungulates (e.g., deer, elk, moose, and pronghorn) to beef producers the following information was collected from the data sources:

1. Feed storage loss amounts from ungulates were gathered through the online survey.
2. Value of property damage from ungulates was gathered through the online survey.
3. Economic value of forage and feed loss was determined using commodity prices from AFSC online data.
4. Best management practices (BMPs) employed to reduce conflicts with ungulates were gathered through online survey and individual expertise about costs associated with BMPs.

The online survey was used to determine if birds are considered an economic issue for beef producers.

Methodology for Alberta Beef Producers' online survey

An online survey was developed in conjunction with representatives from ABP. The survey consisted mostly of fixed scale or close-ended questions, with a few open-ended questions. The ABP wildlife committee and five other beef producers tested the survey for clarity. Representatives from AFSC and AESRD-FW also reviewed a draft of the survey. The survey was edited and missing concepts were added based on feedback from the reviewers.

The original intention was to mail a copy of the survey to a randomly selected distribution list. Unfortunately, the mailing list of ABP members is restricted to specific objects relating to check-off dollars. Instead an online survey was developed. In addition, hard copy surveys were available to all ABP delegates and committee members and were mailed to individuals upon request.

The online survey was developed in Survey Monkey and shared via a web link as per the project outreach plan (see Appendix 1). A Mount Royal University student entered all hard copy surveys were entered into Survey Monkey.

The data was exported from Survey Monkey into Microsoft Excel and analyzed using appropriate software. All statistical analysis and graphs were developed using Sigma Plot and open-ended questions were coded using HyperResearch.

Methods: Carnivores

Survey participants who reported a loss of cattle due to carnivore depredation were asked to report their total number of calves, cows, feeders/yearlings and bulls and the number of each cattle type presumed lost due to carnivore depredation for 2011, 2012 and 2013. The data was summarized and incomplete answers (i.e., those who did not report the number of cattle or entered text instead of numbers) were removed from the analysis. The remaining data was analyzed to determine the average number of cattle type owned and the mean percent lost per cattle type. In an effort to report numbers in a manner that individuals could relate to, regardless of their personal operation size, average responses have been reported in “per 100 animal” units. This analysis does not include indirect economic impacts which are addressed in a later section, although this represents a gap in the economic analysis.

In working to understand the economic impact of these depredation losses different approaches can be taken. Two such approaches were considered. One uses *net present value (NPV)* to compare the present value of the animal today to the present value of the animal in the future, taking inflation and returns into account. The value of this approach is that when one considers a calf that was intended to be a replacement heifer or a 3 year-old cow that was likely to be a part of the herd contributing calves for the next 4-5 years, NPV calculations provide a picture of the opportunity loss (e.g., the net value of each calf that cow will no longer have) of not having that specific animal in the herd (pers. comm. Dale Kaliel, Alberta Agriculture).

Another approach is based on using the current *market value* of the cattle in a region, or at a specific auction market, and multiplying that number by the number of cattle confirmed predated. Other studies (Hoag et al 2011, Steel et al. 2013, Ashcroft et al. 2010, St Louis Federal Reserve 2011, and Pacific Analytics Inc. and Reduction Strategies 2010) have used the market value approach. This is the commonly used approach in similar research because this is generally how payouts in programs designed to compensate beef producers for animal loss are calculated.

The data collected in this survey did not include details such as: how many of these calves are replacement heifers, how old were the cows lost, and the general health of the cow prior to depredation which would make the NPV approach more accurate. Given the limited data collected about these details and the norm for this type of research, the authors used the market value system. By using this approach we were better able to compare the current Alberta compensation program to actual losses described by producers.

Market values per animal of each cattle type were calculated using CANFAX data averaged over the same time period, from 2011-2013, as displayed in Table 1. It should be noted that the value of cattle fluctuates over time, and our analysis represents a snap shot in time representing average market value of cattle from 2011-2013. In this analysis we used an average weight of 550 pounds for calves; 1,400 pounds for cows; 850 pounds for feeders and yearlings; and 2,400 pounds for bulls. The dollar value per cattle type to determine loss per animal is shown in Table 2.Using these values for each cattle type and the estimated loss per 100 animals, an annual cost was calculated.

Table 1: Canfax Data 2011-2013.

Annual Prices, Alberta ($/cwt)				
	D1/2 Cows	**Bulls**	**850 lb Steers**	**550 lb Steers**
2011	$70.21	$79.45	$123.40	$151.58
2012	$74.46	$86.12	$134.98	$167.12
2013	$75.84	$85.28	$133.84	$157.12
Average	$73.50	$83.61	$130.74	$158.60

Table 2: Total cost per cattle type.

Cattle Type	Lbs	$/cwt	Total Cost
Calf	550	$158.60	$872.32
Yearlings/Feeders	850	$130.74	$1,111
Cow	1400	$73.50	$1,029
Bulls	2400	$83.61	$2,006

To determine the cost of livestock lost in Alberta due to depredation, we used the total number of cattle per type (Table 3).

Table 3: Number of cattle per type in Alberta averaged from 2011-2013 (Statistics Canada).

Cattle Type	Total Head
Calves	1,626,000
Feeders and Yearlings	1,530,000
Cows	1,720,000
Bulls	89,000

All margins of error notifications can be assumed to be 95% confidence intervals unless otherwise noted.

Methods: Ungulates

Two main sets of questions were asked of survey participants about the impact of ungulates. The first set of questions was about losses associated with forage competition by ungulates. This refers to ungulates grazing forage crops – in particular oats, barley, and hay, as these are common forage crops for which compensation is available. The second set of questions was about the losses related to stored feed by ungulates. This refers to feed that has been removed from the field to be fed throughout the winter – in particular grain oats, grain barley, hay, and silage. Producers were asked to base their answers on their experiences in 2011, 2012, and 2013. The results were summarized using Excel spreadsheets. The first three questions in each section were tallied and presented as percentages.

Three questions were asked to help determine the financial implications of ungulates on forage crops. Respondents provided the number of acres they grew of each crop. This number (acres grown) was multiplied by the 10 year provincial yield average (Matejovsky 2014) to determine the total yield per respondent. Table 4 displays the 10 year mean yield of each forage crop grown per acre. Respondents also provided percentage of yield loss. The total calculated yield for each respondent was then multiplied by the percentage loss they reported. Respondents were asked to share the average price per bushel or tonne they received. This amount was multiplied by the calculated yield loss to determine the economic loss to that crop for each year.

Table 4: 10 year mean of forage crop grown per acre.

Forage Crop	10 Year Mean per Acre
Barley	62.2 bushels
Oats	73 bushels
Hay	1.6 tonnes

The final value calculation required each box in the online survey to be completed. Respondents who reported all zeroes (i.e., they did not grow the crop) were removed

from the data set for that year. If a respondent supplied the amount of acres grown or a total amount of stored feed and also reported the amount of loss experienced but did not provide a dollar value, the average dollar value of all the other responses was used in that column for that calculation. If the dollar value was significantly higher than others (e.g., ten to one hundred times greater), the dollar value was replaced with the average. If the respondent reported a loss but no acres that line was deleted. When acres were reported but loss has been left blank it was calculated as 0% loss. The total number of respondents that reported acres grown was used as the sample size.

Three questions were asked to help determine the financial implications of ungulates on stored feed. Respondents provided the total dollar value of their stored feed and the dollar value of the stored feed loss. The percentage loss for each respondent was then calculated. All responses were totaled and averaged.

Questions asking if producers reported losses to compensation programs were asked and responses were totaled and reported as a percentage. An open-ended question followed asking producers why they had not reported. Individual responses were grouped with similar responses.
Producers were asked what types of management activities have been undertaken to reduce ungulate impacts. Responses were totaled and reported as a percentage. Responses provided in the “other” category were analyzed with individual responses being grouped with similar responses.

Producers were also asked if they were concerned about disease transmission between ungulates and livestock. These responses were totaled and reported as a percentage. Respondents also identified the diseases of most concern.

Methods: Birds

Survey participants were asked to identify if they had impacts from birds. Those that said yes were asked to identify impacts to three areas: depredation on cattle, forage crop competition and loss of stored feed.

Those that identified cattle depredation as an issue were asked the percentage loss annually from 2011 to 2013. Responses were plotted with a box plot to identify outliers, mean, and median values. In this case the median value was used to determine percent loss of cattle from depredation, as values were highly skewed.

Producers who identified forage crop competition as an impact were asked to identify which crops they grew (barley, oats and hay) and if the crop had been foraged by birds. Additional data on the total acres grown, percent yield loss and dollar value per

appropriate unit (e.g., bushel or tonne) were also reported by producers. The number of acres grown was multiplied by the 10 year provincial yield average (Matejovsky 2014) to determine the total annual yield per respondent. Table 4 displays the 10 year mean of forage crop grown per acre. Respondents then provided percentage of yield loss. The total calculated yield for each respondent was then multiplied by the percentage loss they reported. Respondents also supplied the average price they received per bushel or tonne they received. This value was multiplied by the calculated yield loss to determine the economic loss to that crop for each producer.

The number of responses for birds was extremely limited. The results are presented in this report to provide context for discussion and to demonstrate that bird damage is an issue for some beef producers. However, the true economic impact and losses from birds needs to be better understood and researched before a provincial overall impact could be calculated.

Three questions were asked to help determine the financial implications of birds on stored feed (barley, oats, hay and silage). Respondents provided the total dollar value of their stored feed and the dollar value of the stored feed loss by birds. Response rates to the questions were low. Outliers (identified using box plots) were not included in calculations to determine the mean. All responses were totaled and averaged and the mean percent loss was determined.

Lastly, producers were asked if they had damage to straw and the value of the replacement straw.

Methods: Applying Subset Data to Whole Beef Producer Population

Much of the data collected through this survey represents a subset of Alberta's entire beef producer population. For example, the survey asked all respondents if they had experienced some kind of wildlife impact, if they answered no, the survey used skip logic to send them to the next section, if they answered yes, they were asked further questions related to that topic – this group represents a subset of the whole population.

All respondents who answered yes to a question like "have you experienced carnivore impact?" become a subset of the entire population of respondents representing the Alberta beef producer populations. Then all respondents who answered yes to that question are asked the next question "have you experienced predation by carnivores?" If they answered no they were sent to the next section, if they answered yes they become a part of a subset of the population of respondents representing those who experienced some kind of carnivore impact. Next, the respondents yes to that questions are further asked "have you experienced loss of calves to carnivores?" and become a

further subset of respondents representing those who experienced loss of calves. These are important considerations when reviewing the survey results and to understand if the results are applicable at the provincial scale (i.e., across the entire beef producer population in Alberta).
In some cases it may be more meaningful and clear to understand subset data as it applies to the broader beef producer population, as such subset data is represented as a percentage of the entire beef producer population throughout the report in blue boxes . The results in the blue boxes were determined by using survey response numbers. For example, the number of survey respondents who reported experiencing carnivore depredation (n=401) was divided by the total number of respondents who answered the question about having issues with carnivores (n=630) to determine 64% of producers in Alberta experienced depredation events. This approach was applied for a number of questions throughout the report. These subset results applied to the whole population are presented in blue boxes at the end of each section."

RESULTS

Demographics

Six hundred and eighty-seven beef producers started the survey. Five hundred and forty-nine beef producers (80% of the participants) identified themselves as full-time producers and 115 beef producers (17% of the participants) identified themselves as part-time beef producers. Twenty-four of the survey participants skipped the question, not identifying as either full-time or part-time.

Six hundred and seventy-two beef producers identified the ABP zone they live in. Not every question was applicable to every respondent dependent on their operation; therefore, to determine overall confidence levels in the results of the survey, 672 was the number of producers that completed the survey. As a result, given a total target population of 20,000 beef producers, 672 responses provide a 99% confidence level with a 5% margin of error. As every question is not applicable to every producer the confidence level per question will vary.

What is a confidence interval and margin of error?

Confidence level refers to how certain we can be of the results. It is expressed as a percentage and represents how often the population would pick an answer within a certain margin of error. A margin of error is the plus-or-minus Figure reported with survey or poll results.

For example, when 81% of producers report damage by ungulates in a survey with a 99% confidence level and 5% margin of error, we can be 99% confident that between 76% and 87% of beef producers in Alberta experience damage by ungulates.

A limitation resulting from the online survey is the possibility of *selection bias* in sampling due to the "word-of-mouth" promotion approach (compared to a random mail-out). The main limitation is the potential for **voluntary response bias**, which can occur when sample members are self-selected volunteers. The survey may attract volunteers who tend to have a strong interest in the main topic of the survey, resulting in a sample that tends to over-represent individuals who have strong opinions.

At the outset of the project the intention was to report on a regional basis using the ABP zones as the regions. In order to do that a relatively large number of responses was required in each zone. Figure 1 shows the number of responses required to report regionally with statistical confidence compared to the actual responses received for each zone.

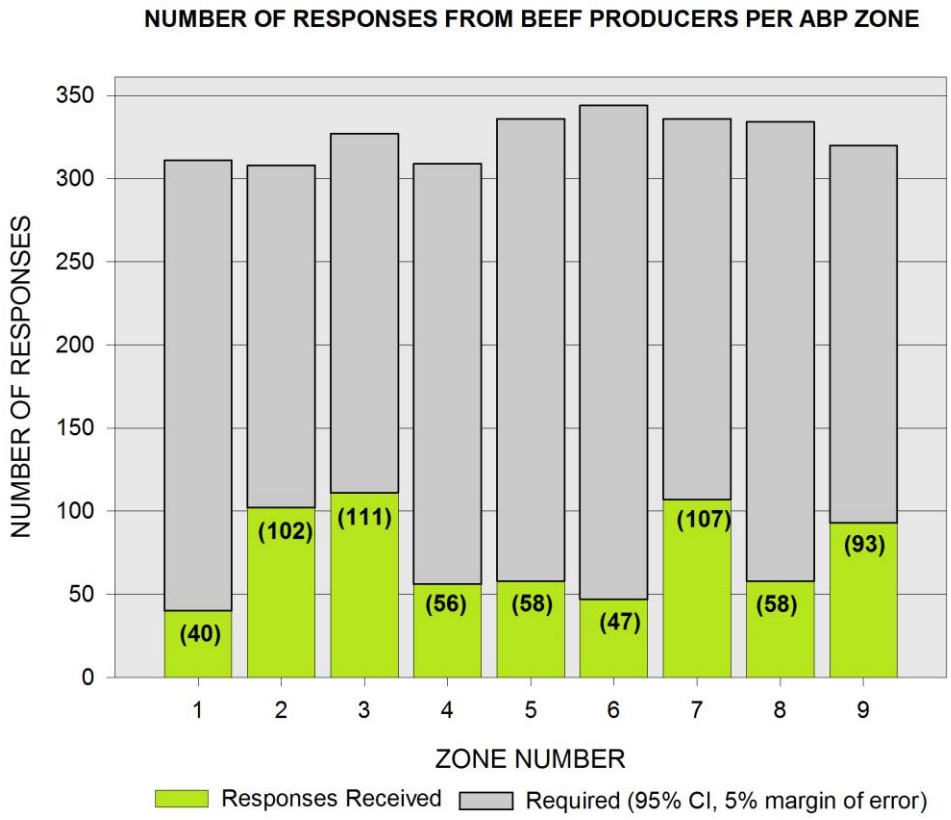

Figure 1: Survey responses per ABP zone received compared with survey responses required.

While none of the zones had enough responses to meet the goal of a 95% confidence level with a 5% margin of error, zones 2, 3, 7, and 9 had enough responses to meet a 95% confidence level and 9% margin of error. However since not all questions applied to each respondent, the questions regarding specific economic costs associated with wildlife did not have enough responses within these zones to enable a zonal comparison.

In summary, with a producer population in Alberta of 20,000, there are enough survey responses (n=672 producers) to meet a 99% confidence interval with 5% margin of error to analyze the information at a provincial scale.

Perceptions and attitudes toward wildlife

In designing this project, six assumptions were made regarding beef producers' perceptions and attitudes about wildlife. This is important information when working to inform policy and programs designed to reduce conflicts or address the economic burden to producers. An early question in the survey tested these assumptions. Producers were asked to rate (using a five point Likert scale) their level of agreement with the statements in Table 5. A Likert scale is a rating/ranking method to measure degrees of opinion or attitude. The results aligned with the main assumption that producers appreciate wildlife but are concerned about the cost of wildlife to their operations.

The results indicate there is a high level of agreement around all statements. The final statement of "The economic impacts I have experienced from wildlife to my beef operation is tolerable" did not show a level of agreement, with 50% of participants disagreeing and 40% of participants agreeing with the statement.

Table 5: Perceptions and attitudes of beef producers in Alberta toward wildlife.

Statement	% Agree	% Neutral	% Disagree
It is important for me to know that there are healthy populations of large carnivores in Alberta.	75	17	8
It is important for me to know that there are healthy populations of ungulates in Alberta.	83	11	6
Wildlife living amongst and moving through beef operations results in economic impacts to the landowner.	88	5	7
I feel I have to remove the problem wildlife causing the problem once the costs get too high.	81	10	9
The presence of wildlife on private property is a part of nature that comes with owning the land.	80	7	13
The responsibilities for ensuring healthy wildlife populations are borne unevenly by agricultural landowners.	71	18	11
The economic impacts I have experienced from wildlife to my beef operation is tolerable.	40	10	50

Research shows agricultural producers generally have a certain level of tolerance with respect to wildlife impacts. This study attempted to understand beef producers' tolerance level relative to economic losses. Producers were asked to identify the percentage of economic loss acceptable to their operation. For this analysis, only full-time beef producer responses were included. Data that included part-time producers had a large number of outliers and it was thought this may be the result of part-time producers not requiring the same level of economic return. Figure 2 presents the frequency of responses and highlights the diversity of opinion about economic tolerance of beef producers to wildlife. The results indicate that 25% of beef producers have zero tolerance toward economic loss due to wildlife. Figure 3 provides another way to illustrate the same data from Figure 2.

Figure 3 is a boxplot distribution of the percent loss tolerance, where there is a minimum acceptable percent loss of 0% to a maximum acceptable percent loss of 5%, with a few outliers between 5% and 25%. The boxplot shows the distribution is positively skewed, meaning there are a high number of very small values with a few exceptionally large values, indicating there is a high number of respondents with a very low tolerance level. As such, we use the median value to determine the middle percent tolerance of 1%. One percent is the mid-point of acceptable economic loss, whereby 50% of beef producers who responded to the survey are willing to accept 1% or less economic loss while 50% of beef producers are willing to accept 1% to 5% loss.

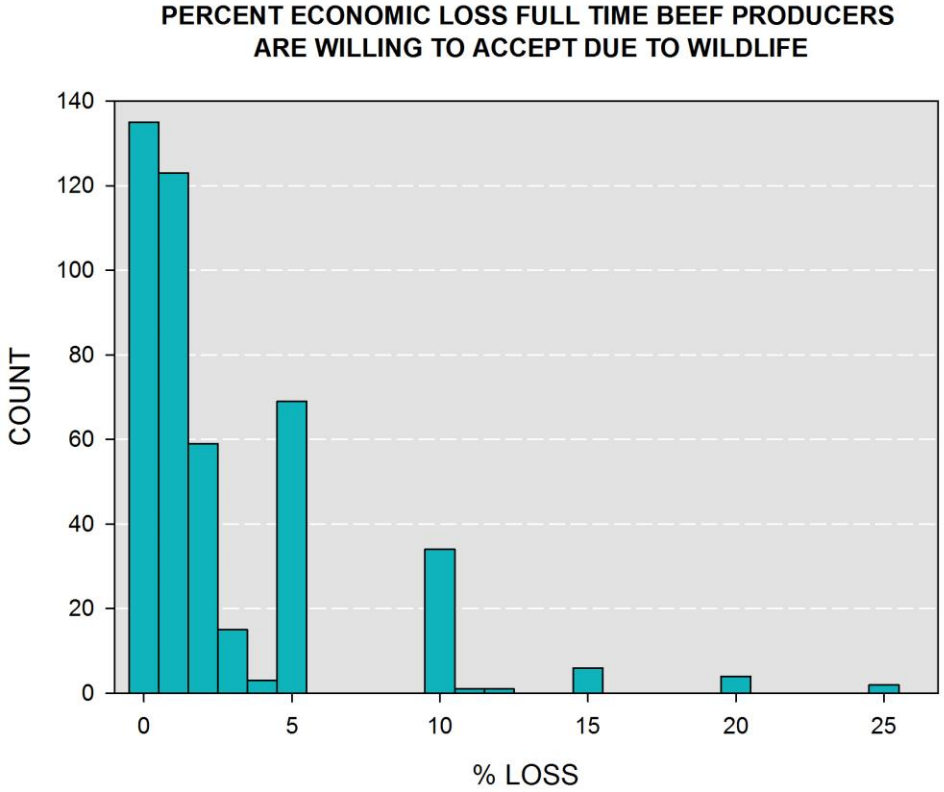

Figure 2: Frequency distribution of percent economic loss from wildlife acceptable to full time beef producers in Alberta.

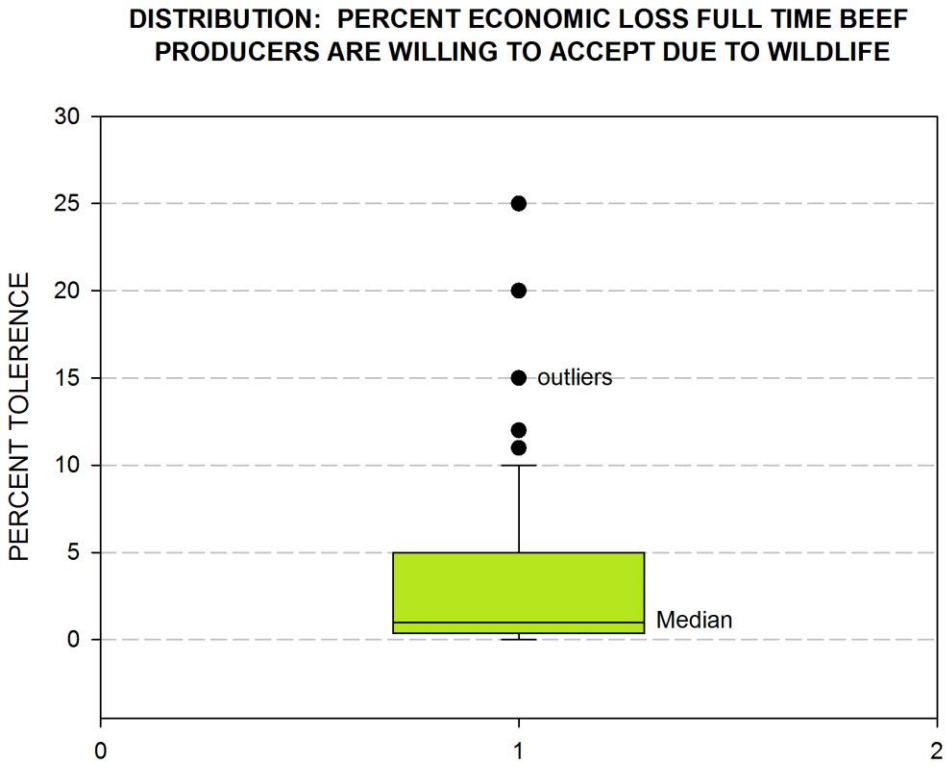

Figure 3: Boxplot of percent economic loss acceptable to full time beef producers in Alberta.

Context

Figure 4 represents beef producers' responses about which wildlife species are causing the most impact.

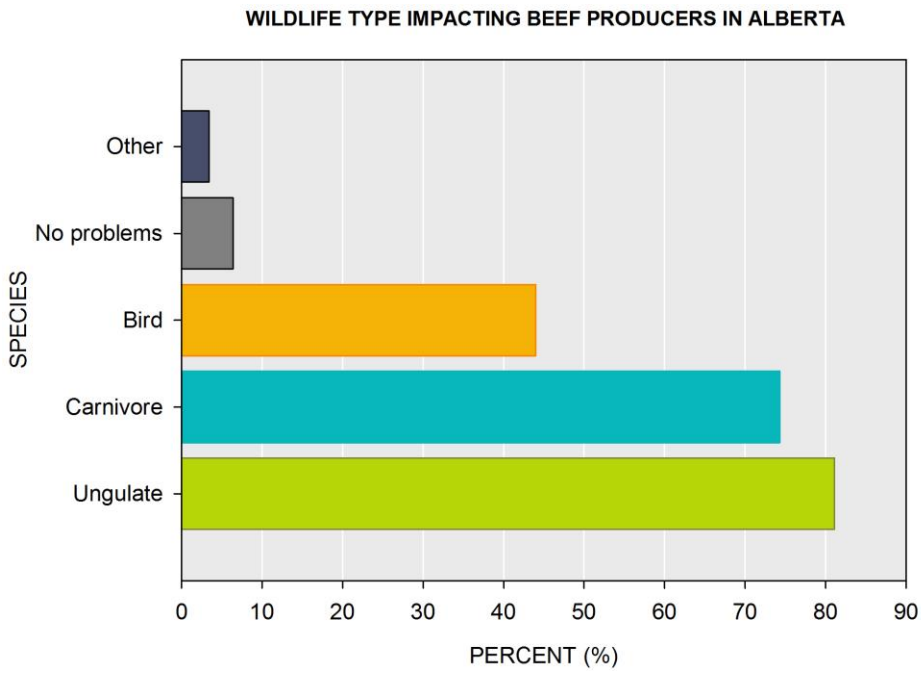

Figure 4: Species types causing most problems for beef producers in Alberta.

The highest number of wildlife issues was associated with ungulate species, with 81% of producers reporting impacts from ungulates. Impacts from carnivore species were a close second, with 74% of producers reporting impacts. Forty-four percent of respondents reported impacts from birds. A small percentage (6%) of producers reported no issues with wildlife. Twenty-three respondents included “other” as species that cause issues. Most commonly mentioned were holes that gophers and badgers dig which can result in cattle breaking their legs.

Also of interest in this study was to understand what about wildlife conflict was of most concern to beef producers in Alberta. Figure 5 shows that a majority (81%) of producers are concerned with the economic losses. Other findings include: 66% of producers are concerned with livestock safety; 62% are concerned with an increase in time required to manage for wildlife; 53% are concerned about disease transmission between wild and domestic animals; 37% are concerned about human safety; and 11% report no concerns.

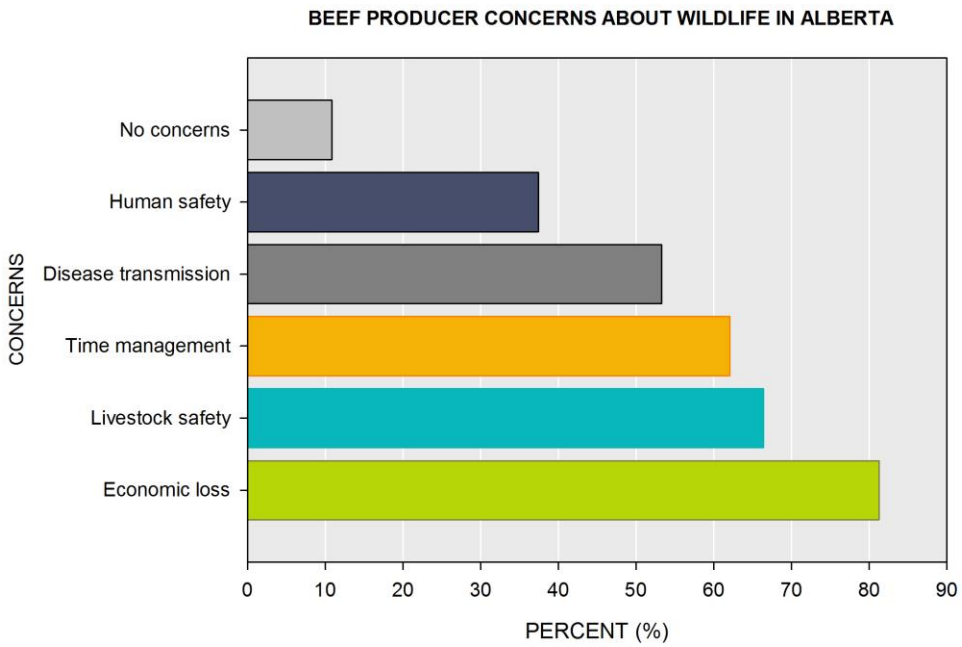

Figure 5: Beef producer concerns about wildlife in Alberta.

To better understand the root of wildlife-livestock conflict, beef producers were asked about the types of attractants are on their land. Producers reported attractants such as stored feed: 83% have hay yards, 38% have grain bins, 22% have silage pits, 18% have grain piles and 11% have grain bags (Figure 6). In addition, 60% of producers report swath grazing. Livestock dead piles were identified by 28% of producers as attractants on their operations. The responses provided in the “other” section for this question included the presence of cattle, calves and open spaces/good habitat as attractants. These responses were removed from the analysis as it was assumed all beef producers have these attractants.

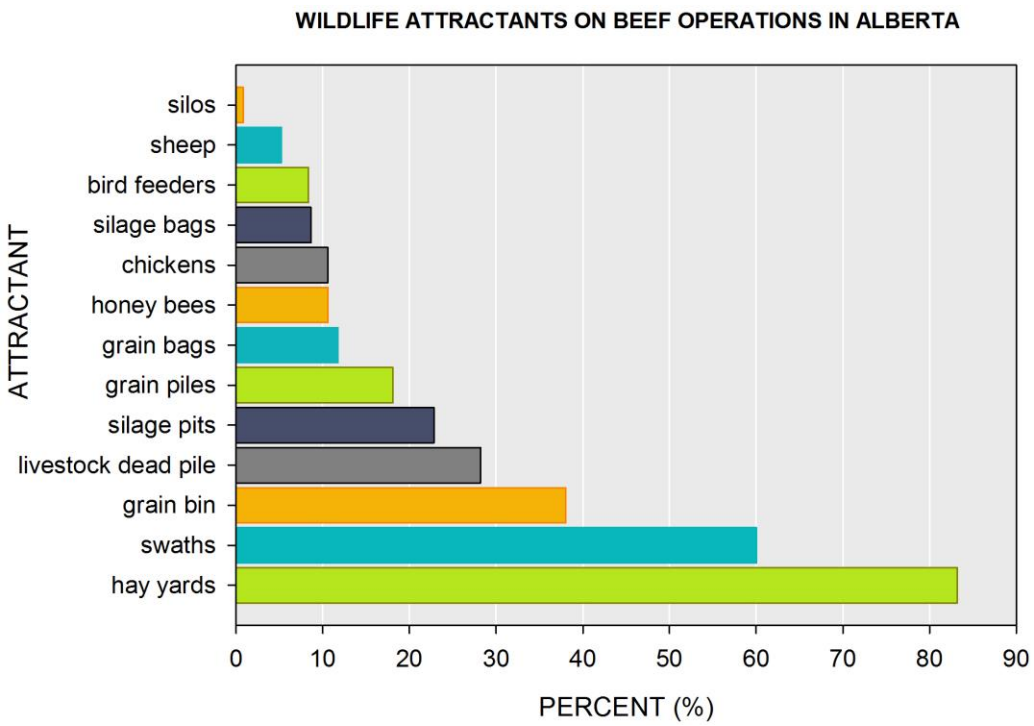

Figure 6: Wildlife attractants on beef operations in Alberta.

The results of the demographics, perceptions and attitudes, and context questions provide important context-setting data to help inform discussion about policy and programs intended to reduce livestock producer and wildlife conflict.

Results: Carnivore

In Alberta, 74% (margin of error is 3.4%) of beef producers experience economic losses from carnivore species. The following analysis is based on this subset of the beef producer population, and does not include the 26% of beef producers who do not experience carnivore impacts. Beef producers who identified having an issue with carnivores (74% of respondents) were asked to identify which carnivore species were involved in conflicts with cattle. Based on these 461 responses (74%), Figure 7 indicates the following species are involved in carnivore conflicts:

- 88% (margin of error 3.0%) of these beef producers experience impacts from coyote;
- 42% (margin of error 4.4%) of these beef producers experience impacts from wolves;
- 28% (margin of error 4.1%) of these beef producers experience impacts from cougars;
- 26% (margin of error 4.0%) of these beef producers experience impacts from black bears; and

- 19% (margin of error 3.6%) of these beef producers experience impacts from grizzly bears.

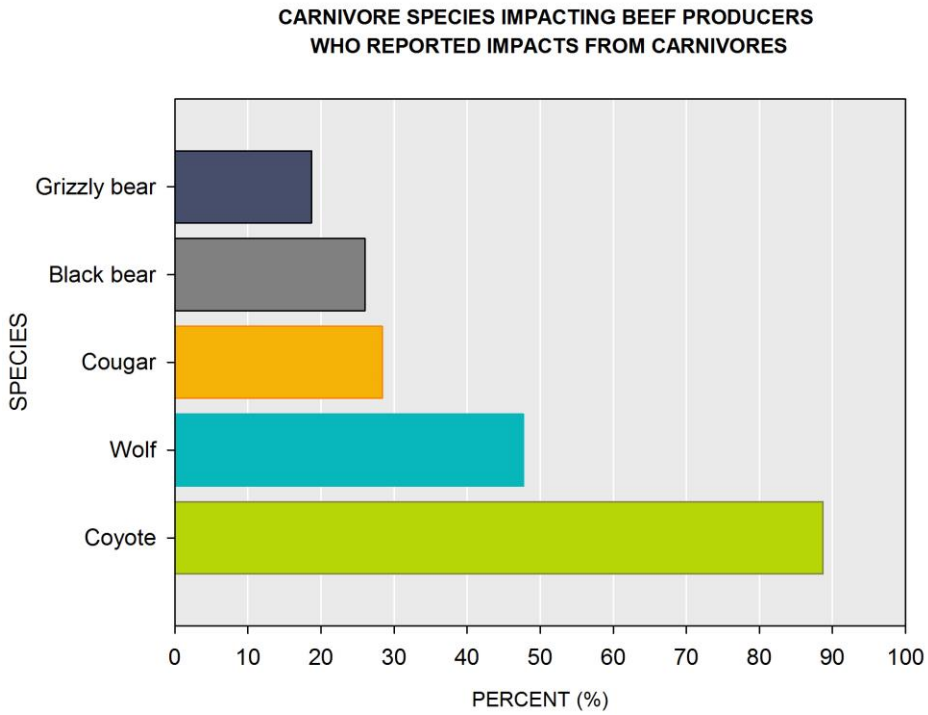

Figure 7: Carnivore species with the most impact to beef producers.

How do these numbers relate to the entire beef population in Alberta?

This is a subset of survey data extrapolated to the whole beef producer population in Alberta. 74% of beef producers in Alberta experience impacts from carnivore species.

The percentage of beef producers in Alberta impacted by carnivores species are as follows:

- coyote impact 65% of beef producers in Alberta;
- wolves impact 31% of beef producers in Alberta;
- cougar impact 21% of beef producers in Alberta;
- black bear impact 19% of beef producers in Alberta; and,
- grizzly bear impact 14% of beef producers in Alberta.

Economic impacts due to carnivores can be in the form of:

- economic losses e.g., livestock depredation and forage loss;
- property damage e.g., damage to grain bins and fencing; and,
- prevention and management e.g., measures implemented to reduce carnivore attractants.

ECONOMIC LOSSES - DEPREDATION

The following analysis is based on a subset of the beef producer population who reported suffering losses or impacts from carnivore species. Of the 74% of survey respondents who reported losses or impacts from carnivore species 86% (margin of error 3.2%) reported losses of cattle due to predation from carnivore species while 14% had not experienced a depredation loss.

Of the 86% of beef producers who reported loss of cattle due to depredation, calf losses were the most significant (Figure 8):

- 95% (margin of error 2.1%) of these beef producers reported experiencing depredation events on calves from 2011-2013;
- 21% (margin of error 4.0%) of these beef producers reported experiencing depredation events on feeders/yearlings between 2011-2013;
- 32% (margin of error 4.6%) of these beef producers reported experiencing depredation events of cows from 2011-2013; and,
- 7% (margin of error 2.3%) of these beef producers reported experiencing depredation events on bulls from 2011-2013.

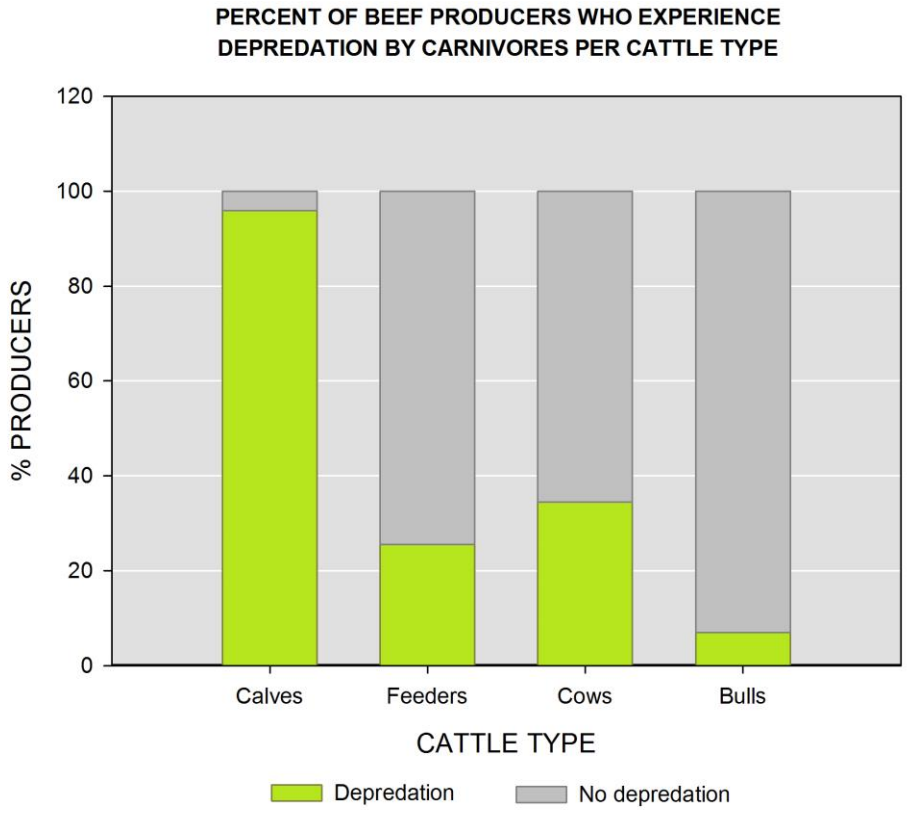

Figure 8: Percentage of beef producers who experience depredation events by carnivore per cattle type

How do these numbers relate to the entire beef population in Alberta?

This is a subset of survey data extrapolated to the whole beef producer population in Alberta. 64% of beef producers in Alberta experienced a depredation event; per cattle type:

- 61% have lost of calves;
- 20% have lost of cows;
- 14% have lost of feeder/yearlings; and,
- 4% have lost of bulls.

Calves

Of the 86% of beef producers who experienced animal losses from carnivore depredation, 95% (margin of error 2.1%) reported losses of calves. Survey participants were asked to report their total number of calves and the number of calves presumed lost due to carnivore depredation for 2011, 2012 and 2013. Calf loss was calculated by dividing the total number of calves the producer reported by the number reported as lost to depredation. The average percent loss was calculated for each year, as displayed in Table 6. Table 6 summarizes the reported data averaged over the three years as provided by producers to determine the expected number of losses per 100 calves. Based on 312 responses to this question, the estimated average annual loss of 2% and at a weight of 550 pounds per calf, the market value loss per 100 calves is $1,742 due to carnivore depredation. This may also be understood as an average cost of $17 per calf for those producers who have experienced calf depredation.

Table 6: Annual costs per 100 calves due to carnivore depredation for those producers impacted by depredation.

Year	Average # of calves / respondent	Mean rate of loss	# of calves lost	Loss per 100 calves	Cost per unit	Annual cost per 100 calves
2011	272	0.0220	5.97	2.20	$872.32	$1,918
2012	275	0.0181	4.98	1.81	$872.32	$1,580
2013	304	0.0198	6.02	1.98	$872.32	$1,726
Annual average		0.0200		2.00		**$1,742**

Although the mean percent loss of calves from depredation is calculated at 2% annually for calves, our results indicate that the distribution is uneven among producers, ranging from 0% to 14% loss for individual producers (Figure 9). Of note, seven percent of producers report calf depredation events greater than 5% annually.

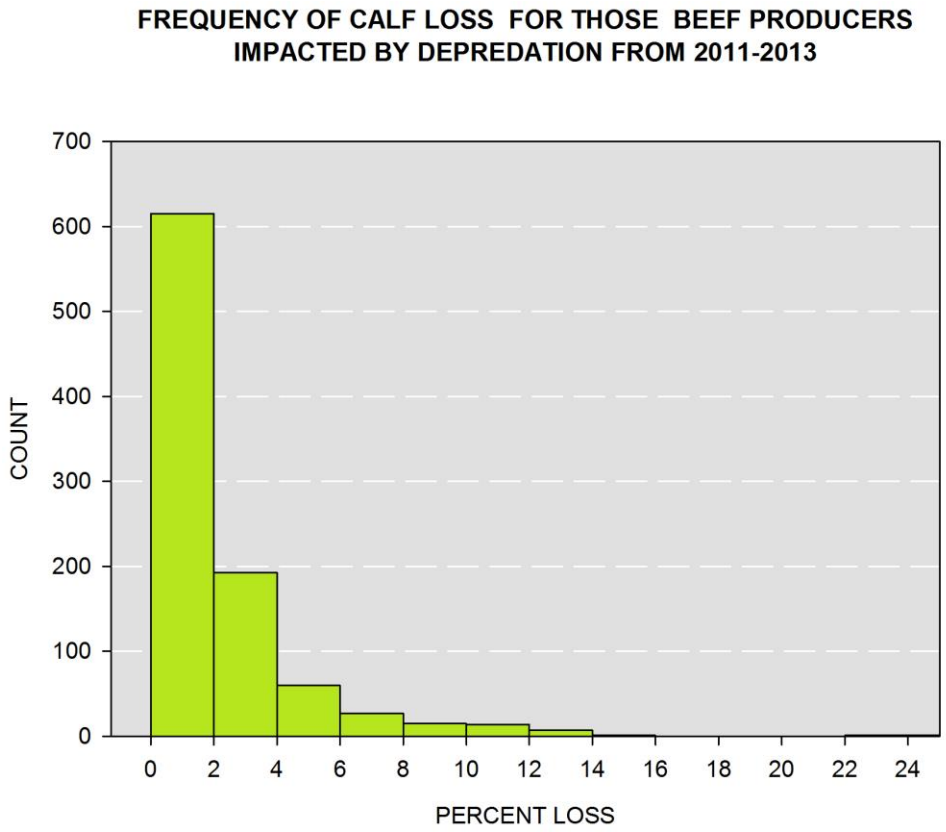

Figure 9: Frequency distribution of calf loss from those beef producers who reported impacts from depredation

Yearlings/Feeders

Of the 86% of beef producers who experienced a loss from carnivore depredation, 21% (margin of error 4.0%) report losses of yearlings/feeders. Table 7 summarizes the reported data averaged over the three years to determine the expected number of losses per 100 yearlings/feeders. Based on 86 responses to the survey, the 1.5% estimated average rate of loss and at an estimated weight of 850 pounds, the market value loss per 100 yearlings/feeders is $1,664 due to carnivore depredation. This may also be understood as an average cost of $17 per yearling/feeder for those producers who have experienced yearling/feeder depredation.

Table 7: Annual costs per 100 yearlings/feeders due to carnivore depredation for those producers impacted by depredation.

Year	Average # of yearlings	Mean rate of loss	# of yearlings lost	Loss per 100 yearlings	Cost per unit	Annual cost per 100 yearlings
2011	251	0.0198	4.95	1.98	$1,111	$2,196
2012	260	0.0148	3.84	1.48	$1,111	$1,644
2013	264	0.0104	2.73	1.04	$1,111	$1,151
Average annual		**0.0150**		**1.50**		**$1,664**

Similar to the calf results for feeders/yearlings, there was an uneven distribution of loss from depredation, with a few outliers or more extreme cases. Eight percent of producers report feeders/yearlings depredation events greater than 5% annually.

Cows

Of the 86% of beef producers who experienced a loss from carnivore depredation, 32% (margin of error 4.6%) report losses of cows. Table 8 summarizes the reported data averaged over the three years to determine the expected number of losses per 100 cows. Based on 127 responses to the survey, the estimated average annual loss of 0.5% and at a weight of 1,400 pounds, the market value loss per 100 cows is $535 due to carnivore depredation. One percent of producers experienced annual average depredation losses of greater than 5% for cows. This may also be understood as an average cost of $5 per calf for those producers who have experienced calf depredation.

Table 8: Annual costs per 100 cows due to carnivore depredation for those producers impacted by depredation.

Year	Average # of cows	Mean rate of loss	# of cows lost	Loss per 100 cows	Cost per unit	Annual cost per 100 cows
2011	252	0.0059	1.500	0.59	$1,029	$612
2012	273	0.0049	1.348	0.49	$1,029	$507
2013	269	0.0047	1.266	0.47	$1,029	$485
Average annual		**0.0052**		**0.52**		**$535**

Bulls

Of the 86% of beef producers who experienced a loss from carnivore depredation, 7% (margin of error 2.3%) report losses of bulls. Table 9 summarizes the reported data averaged over the three years to determine the expected number of losses per 100 bulls. Based on 26 responses to the survey, an estimated loss of 5% and at a weight of 2400 pounds, the market value loss per 100 bulls is $9,919 due to average annual loss from carnivore depredation. Because most beef producers do not have 100 bulls, we

estimated the annual value per 10 bulls (represents the mean number of bulls reported per producer) as $983 due to carnivore depredation per 10 bulls. The survey response rate for this question was low and one individual reported having one bull that was lost to depredation, resulting in a 100% depredation rate. Therefore the percent loss is likely overestimated by the survey.

Table 9: Annual cost per 100 bulls due to carnivore depredation for those producers impacted by depredation.

Year	Average # of bulls	Mean rate of loss	# of bulls lost	Loss per 100 bulls	Cost per unit	Annual cost per 100 bulls
2011	9	0.0816	0.734	8.16	$2,006	$16,363
2012	15	0.0338	0.506	3.38	$2,006	$6,771
2013	14	0.0330	0.462	3.30	$2,006	$6,623
Average annual		**0.0494**		**4.94**		**$9,919**

SUMMARY OF CATTLE DEPREDATION

To further discussion and understanding of the economic impact associated with depredation events, the total losses due to depredation were summed as reported by survey respondents. These numbers are a very conservative amount of loss as the values are based on the actual losses reported by survey respondents which represent approximately 3.5 % of the total number of beef producers in the province.

Calves

Three hundred and twelve producers reported depredation events of calves representing an annual average of 88,433 calves (2011-2013). The average rate of reported depredation for producers who experienced depredation events on calves was 2%; therefore of the 88,433 calves reported in the survey, 1769 calves were subjected to depredation. If each calf has a unit price of $872, then the average economic loss of calves for the survey respondents was $1,543,134 annually from 2011 to 2013.

Feeders/Yearlings

Eighty-six producers reported depredation events of feeders/yearlings representing an annual average of 18,330 feeders/yearlings (2011-2013). The average rate of reported depredation for producers who experienced depredation events on feeders/yearlings was 1.5%; therefore of the 18,330 feeders/yearlings reported in the survey, 275 feeders/yearlings were subjected to depredation. If each feeder/yearling has a unit price of $1,111, then the economic loss of feeders/yearlings for the survey respondents was $305,583 annually from 2011 to 2013.

Cows

One hundred and twenty-seven producers reported depredation events of cows representing an annual average of 30,216 cows (2011-2013). The average rate of reported depredation for producers who experienced depredation of cows was 0.5%; therefore of the 30,216 cows reported in the survey, 151 cows were subjected to depredation. If each cow has a unit price of $1,029, then the economic loss of cows for the survey respondents was $155,379 annually from 2011 to 2013.

Bulls

Twenty-six producers reported depredation events of bulls representing an annual average of 320 bulls (2011-2013). The average rate of reported depredation for producers who experienced depredation of bulls was 5%; therefore of the 320 bulls reported in the survey, 16 bulls were subjected to depredation. If each bull has a unit price of $2,006, then the economic loss of bulls for the survey respondents was $32,096 annually from 2011 to 2013.

This analysis indicates an annual loss of $2 million due to depredation events reported through survey responses (Table 10). The true value of loss is much greater, as these are reported losses only from survey participants (representing 3.5% of beef producers in Alberta). An effort to extrapolate these findings to a provincial value is shown in Appendix 3, where broader values are presented to help initiate a conversation.

Table 10: Total annual value of animals reported lost to depredation by survey respondents.

Cattle Type	Cost per unit	Mean % loss to dep. from survey reponses	Total number of cattle type reported in survey	Total number lost to depredation	Total value of animals reported by survey particpants lost to depredation
Calf	872	0.02	88,433	1769	$1,543,134
Yearling/feeder	1111	0.015	18,330	275	$305,583
Cows	1029	0.005	30,216	151	$155,379
Bulls	2006	0.05	320	16	$32,096
			Totals	**2211**	**$2,036,192**

DEPREDATION ON CROWN LAND

The survey asked the percentage of depredation events that occurred on crown land . Thirty six percent (36%) of respondents to this questions (n=540) experienced depredation events occur only on private land. Only producers who reported a

depredation event are included in this assessment. The majority of events, 64% occurred on private land with up to percent crown lease land (Figure 10).

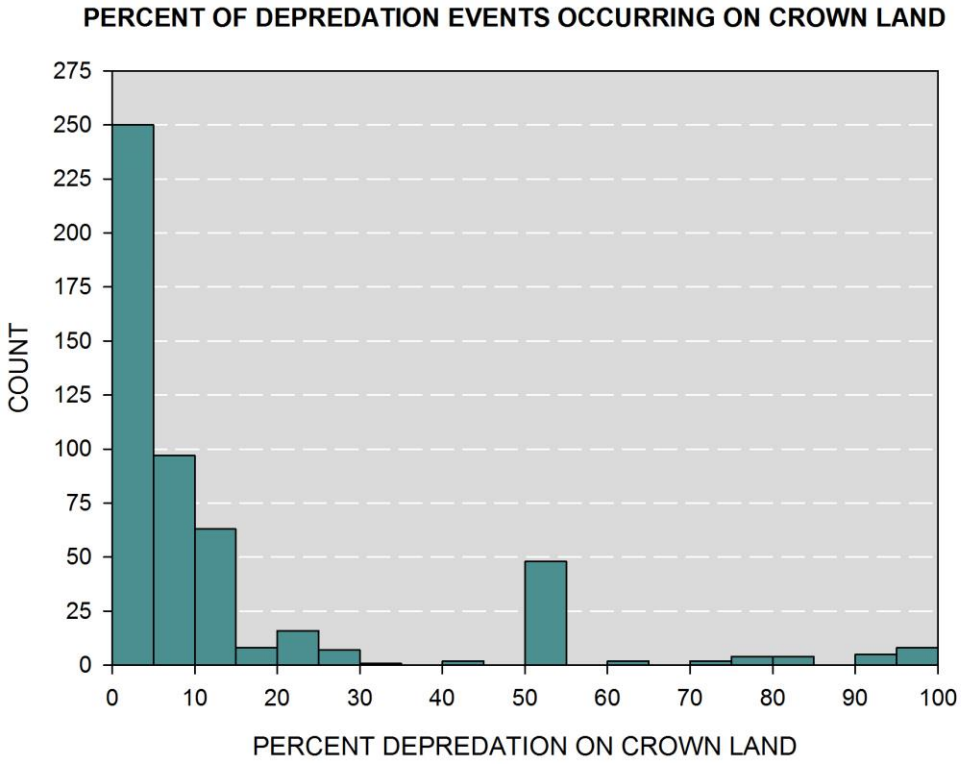

Figure 10: Percent of depredation events on crown land

WILDLIFE COMPENSATION PROGRAM SURVEY REVIEW

The 74% of beef producers who reported experiencing problems with carnivores were asked if they had reported depredation events included in the survey to AESRD to receive compensation. Based on 374 responses, 62% (margin of error 4.9%) said they had not reported, while 24% (margin of error 4.3%) reported some of the depredation events and 12% (margin of error 3.3%) said they reported all events. Producers were asked why they did not report any or some depredation events. The following themes were coded from 235 responses (Figure 11).

Burden of proof: Thirty-four percent of producers not reporting depredation events expressed concerns around the level of proof required for compensation claims to be accepted. This theme is further broken down into the following subthemes: depredation event could not be proven, carcass found too late, agency did not show up on time, carcass not found and producer unsure of nature of death. The number of times each subtheme was mentioned by producers is displayed in Figure 12.

Programmatic issues: Twenty-four percent of producers not reporting depredation events reported concerns about the compensation program. Their concerns focus around compensation policy including: carnivore responsible for depredation event not included in the compensation program (i.e. coyote), the process itself being too time consuming, a hassle to complete the claim, the return is not worth the process, and compensation policies are poor. The number of times each subcategory was mentioned is displayed in Figure13.

Impression of no action: Eighteen percent (18%) of producers not reporting depredation events expressed the opinion there would be no claim paid out, based on either past experience or the experience of their neighbors and friends.

Agency issues: Eleven percent (11%) of producers not reporting depredation events were concerned about agency staff, specifically mentioning problems relating to trust between producers and agency staff responsible for auditing claims. Others mentioned concerns that agency staff is non-responsive; some producers attributed this to the agency needing more staff.

Didn't know about the program: Nine percent (9%) of producers who did not report their depredation events indicated they were not aware of the Wildlife Predator Compensation Program.

Cost of doing business: Four percent (4%) of producers not reporting depredation events were of the opinion that sharing the landscape with wildlife was a cost of doing business and losses of cattle from depredation were therefore accepted by the producer.

Dealt with the problem myself: Four percent (4%) of producers who did not report depredation events indicated they handled the problem themselves and did not feel the need to contact the agency.

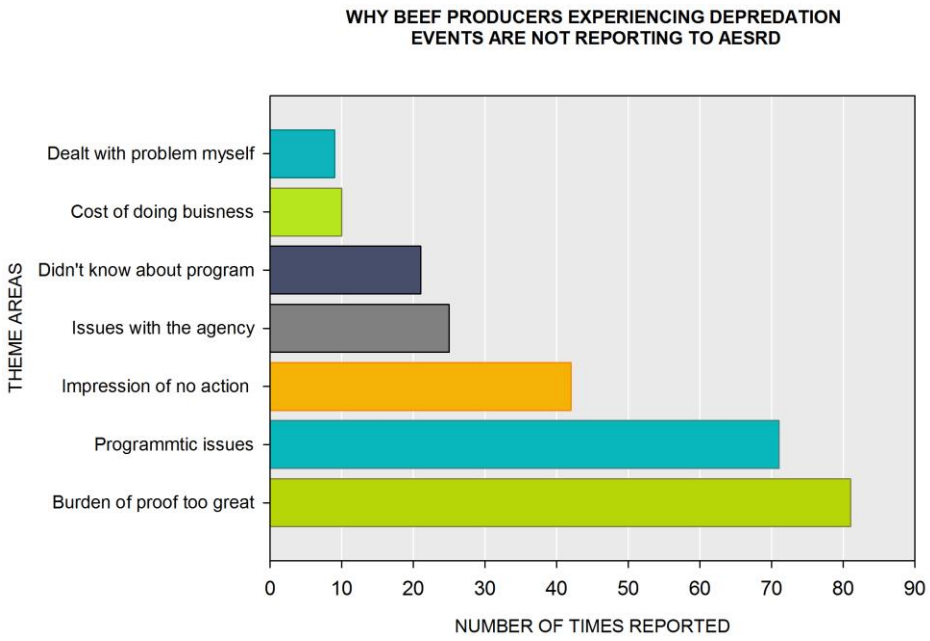

Figure 11: Reasons why beef producers are not reporting depredation events to the Wildlife Compensation Program.

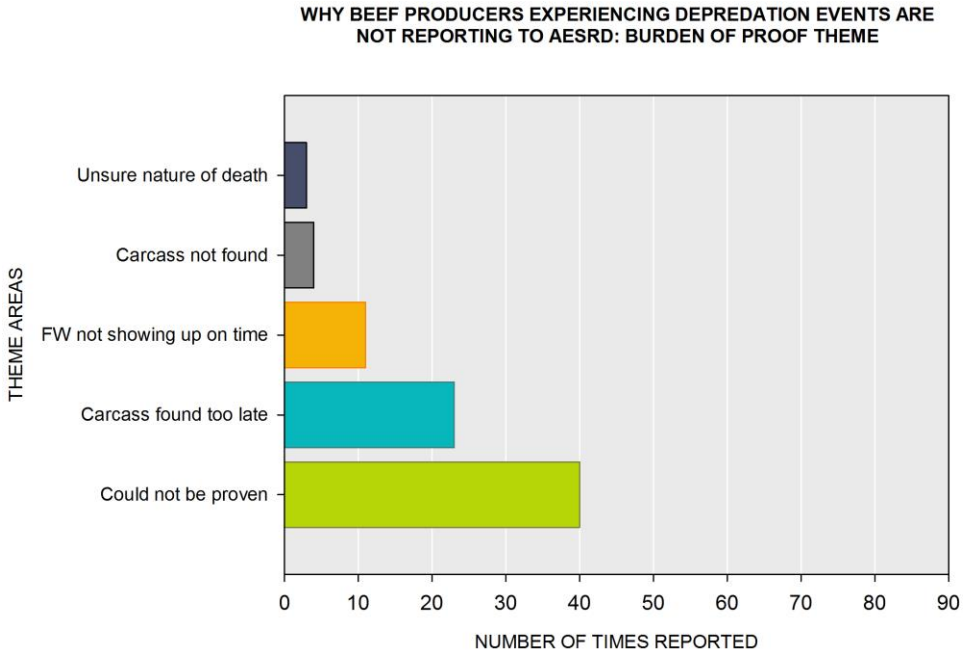

Figure 12: Subthemes of the “Burden of proof too great” theme.

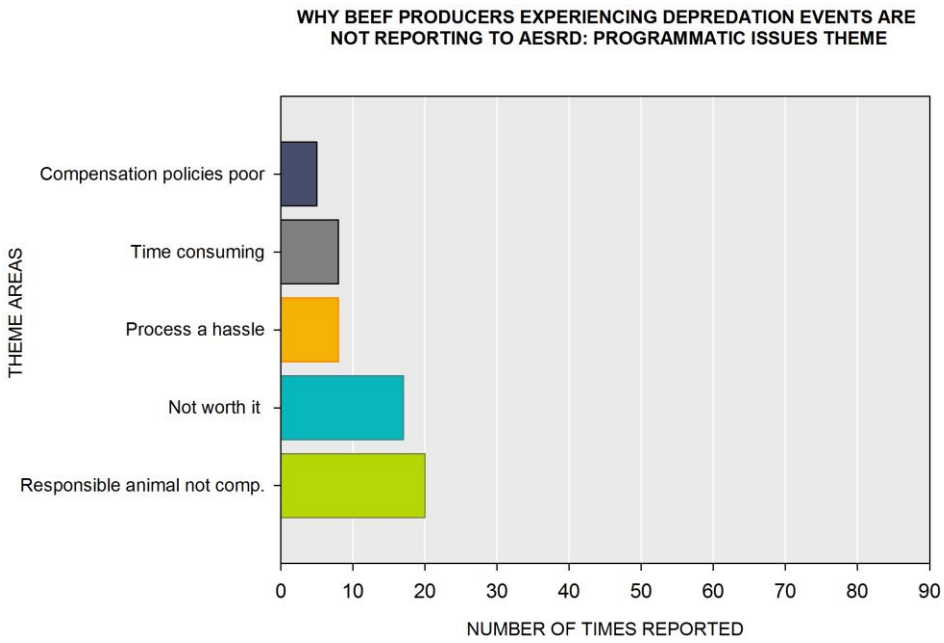

Figure 13: Subthemes of the "Programmatic issues" theme.

Economic Loss - Forage

The majority of producers who identified carnivores causing impact do not experience forage loss from carnivores. The percentage of these producers who identified forage losses by crop type is shown in Figure 14. This represents a subset of the producers who identify carnivores as having an impact on their operations. Forty (40) of the 426 producers who identified carnivores as having an impact on their operation skipped this question. In addition, "not applicable" responses were requested but removed from total responses to calculate the percentages of producers experiencing forage loss. The results indicate that within the 74% of producers who reported experiencing impacts from carnivores:

- 31% (margin of error 4.6%) of these producers reported experiencing forage oats damage due to carnivores;
- 16% (margin of error 3.7%) of these producers reported experiencing forage barley damage due to carnivores;
- 21% (margin of error 4.0%) of these producers reported experiencing forage hay damage due to carnivores; and
- 9% (margin of error 2.8%) of these producers reported experiencing silage damage due to carnivores.

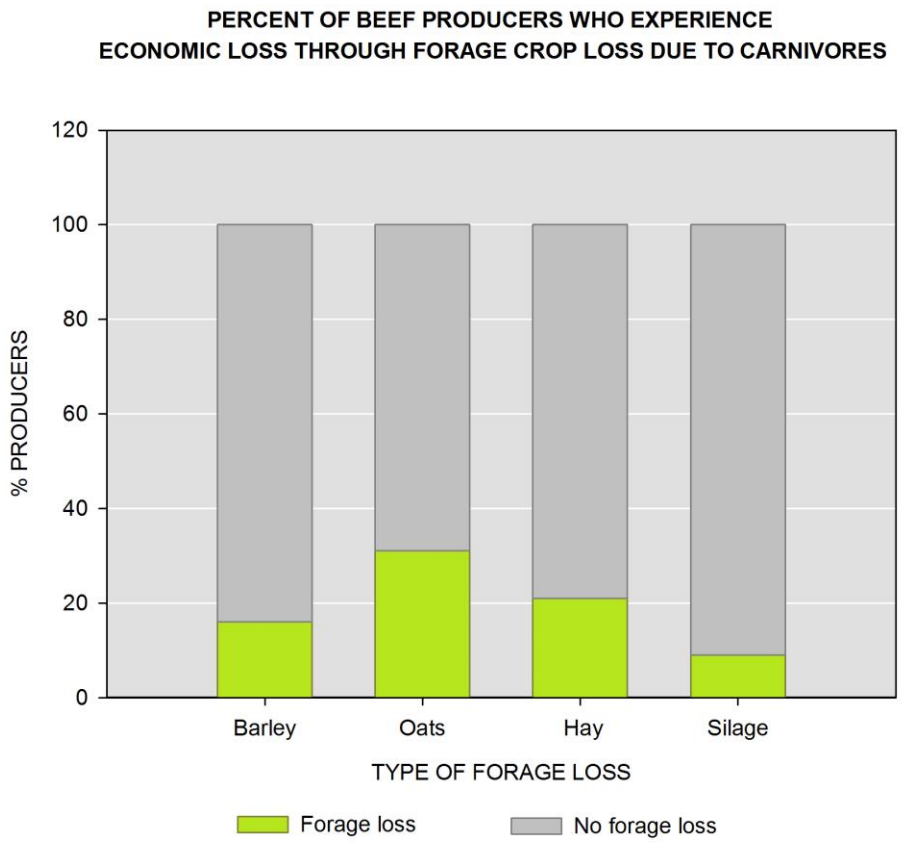

Figure 14: Percentage of beef producers who experience impacts from carnivores thatreport forage loss

In addition, producers were asked to report on estimated number of bushels or tonnes of lost forage barley, oats, hay and silage. Table 11 represents the average annual price in Alberta for each forage type derived from AFSC online 2011, 2012, and 2013 commodity price reports.

Table 11: Average commodity prices for forages in Alberta.

Forage type	**2011**	**2012**	**2013**	**Avg.**
Oats ($ /bu)	$2.84	$2.77	$3.79	$3.13
Barley ($ /bu)	$4.13	$5.09	$5.12	$4.78
Hay ($/Tonne)	$37.15	$42.10	$44.70	$41.32
Silage ($/Tonne)	$36.16	$37.01	$43.20	$38.79

To estimate the annual cost of forage loss, producers were asked to report on lost bushels of oats and barley, and lost tonnes of hay and silage due to carnivores for 2011, 2012 and 2013. The total loss per producer was then multipled by the value per unit (Table 10) to detemine the losses per producer for each year. The averge loss during three years was used to determine the mean annual forage loss per forage type.

Table 12 indicates the estimated annual cost in dollars for each forage type due to carnviores for those producers who reported forage loss.
Of the producers who reported impacts from carnivores:

- 31% (margin of error 4.6%) of these producers experienced losses of forage oats from carnivores, each losing an average of $1,047 annually;
- 16% (margin of error 3.7%) of these producers experienced losses of forage barley from carnivores, each losing an average of $1,121 annually;
- 21% (margin of error 4.0%) of these producers experienced losses of forage hay from carnivores, each losing an average of $1,774 annually; and,
- 9% (margin of error 2.8%) of these producers experienced losses of forage silage from carnivores, each losing an average of $862 annually.

Table 12: Value of average forage loss to producers who report impacts by carnivores.

	# of responses	**Avg. loss**	**Min. cost**	**Max. cost**	**Annual mean cost**
Forage oats	80	275 bushels	$17	$6,859	$1,047
Forage barley	43	227 bushels	$41	$11,931	$1,121
Forage hay	60	37 tonnes	$12	$32,583	$1,774
Forage silage	29	22 tonnes	$15	$6,691	$862

CARNIVORE PROPERTY DAMAGE

The majority of producers who identified carnivores as causing impacts do not experience property damage from carnivores. Figure 15 represents the percentage of producers who identified property damage based on 426 responses. Forty producers who identified carnivores as having an impact on operations skipped this question. In addition, “not applicable” responses were requested but removed from total responses to calculate the percentages producers experiencing property damage. Of the 46% of survey respondents who report property damage:

- 39% (margin of error 4.8%) of these producers experience fence damage from carnivores; and
- 10% (margin of error 2.9%) of these producers experience shed or building damage from carnivore species.

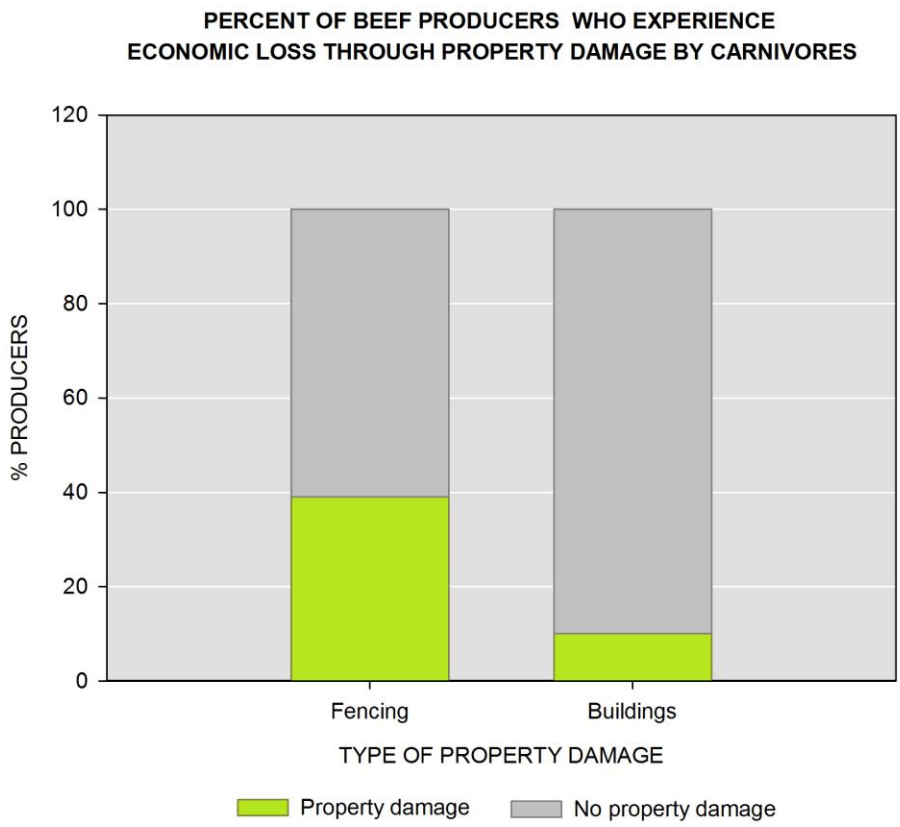

Figure 15: Percentage of beef producers with property damage of those producers impacted by carnivores.

How do these numbers relate to the entire beef population in Alberta?

This is a subset of survey data extrapolated to the whole beef producer population in Alberta. The survey results indicate that:

- 26% of producers in Alberta have experienced fencing damage from carnivore species.
- 20% of producers who grow oats in Alberta have experienced losses from carnivores;
- 14% of producers who grow hay in Alberta have experienced losses from carnivores;
- 10% of producers who grow barley in Alberta have experienced losses from carnivores;
- 7% of producers in Alberta have experienced shed /building damage from carnivores; and,
- 7% of producers who have silage in Alberta have experienced losses from carnivores.

Producers were asked to report their costs for equipment/materials and time in hours for fence, building and shed repairs as well as lost barley, oats and hay forage and silage due to damage by carnivores from 2011 to 2013. Table 13 shows average costs and time spent addressing property damage and forage loss. The values were calculated using the mean for each respondent over the three-year period.

Table 13: Annual costs of property damage per producer reporting property damage by carnivores.

	# of responses	**Min. cost ***	**Max. cost**	**Annual mean cost**	**Annual time (hrs)**
Fencing	131	$0	$9,250	$551	59
Building/shed	38	$0	$3,667	$422	18
* Minimum material cost was reported as zero in some causes but a time in hours was recorded.					

Of the producers who experience impacts from carnivores, 39% (margin of error 4.8%) report property damage to fencing costing approximately $551 annually in repair materials and spending 59 hours of time. In addition, 10% (margin of error 2%) of producers who experience impacts from carnivores report property damage to buildings and sheds costing approximately $422 annually in repair costs and spending 18 hours of time.

INDIRECT IMPACTS FROM CARNIVORES

Producers who reported experiencing impacts from carnivores (74%) were asked to identify indirect impacts from carnivores. In this subset of beef producers 83% of producers indicated they were concerned about indirect impacts. Based on 412 responses (52 respondents who identified carnivores as causing issues skipped this question), Figure 16 shows the percentage of beef producers concerned about indirect impacts of sharing the landscape with carnivore species. The most common concern (74% of respondents, margin of error 4.2%) expressed by survey respondents was increased time management due to carnivores.

Other indirect impacts from carnivores that are of less concern to beef producers are listed below.

- 37% (margin of error 4.7%) of producers who report impacts from carnivores reported concerns about decreased weaning weights due to carnivores;
- 23% (margin of error 4.1%) of producers who report impacts from carnivores reported concerns about increased disease transmission due to carnviores;
- 22% (margin of error 4.0%) of producers who report impacts from carnivores reported concerns about decreased conception rates due to carnviores; and,

- 17% (margin of error 3.6%) of producers who report impacts from carnivores reported concerns about increased cattle sickness due to carnivores.

Seventeen percent (17%) of beef producers (margin of error 3.6%) who report impacts from carnivores do not think there are any indirect impacts from carnivores.

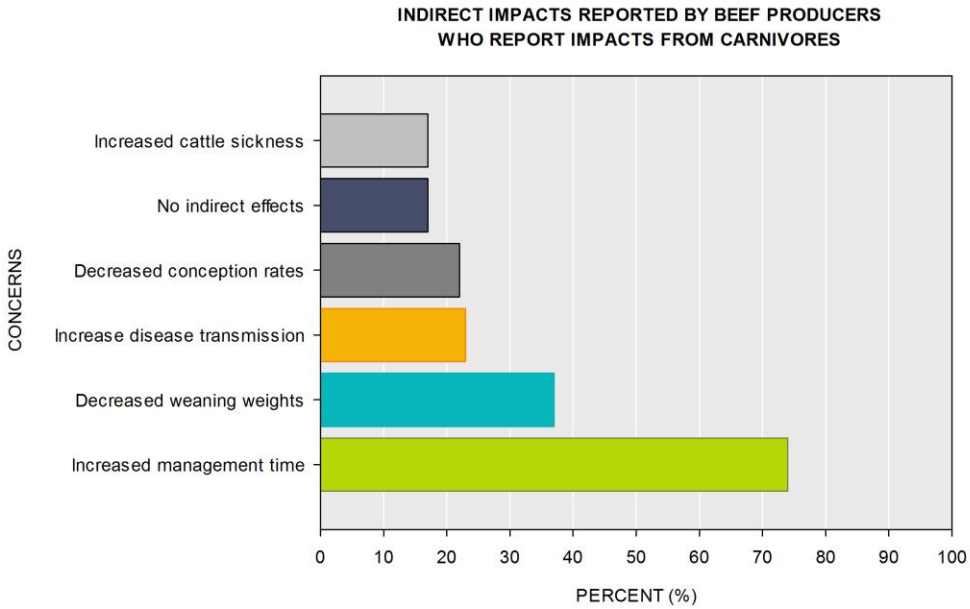

Figure 16: Percentage of beef producers who report impacts from carnivores concerned about various indirect impacts from carnivores.

How do these numbers relate to the entire beef population in Alberta?

This is a subset of survey data extrapolated to the whole beef producer population in Alberta.

The survey results indicate that 54% of beef producers in Alberta were concerned about indirect impacts of sharing the landscape with carnivore species, including:

- 49% of beef producers in Alberta are concerned about increases in time management due to carnivores;
- 24% of beef producers in Alberta are concerned about decreased weaning rates due to indirect impacts of carnivores;
- 15% of beef producers in Alberta are concerned about increased rates of disease transmission from carnivores;
- 24% of beef producers in Alberta are concerned about decreased conception rates due to indirect impacts of carnivores; and,
- 11%of beef producers in Alberta are concerned about increased cattle sickness due to indirect impacts of carnivores.

544 producers divided per *preventative measure* based on “yes, I have implemented this action”, “no, I have not implemented this action”, and “not applicable”.

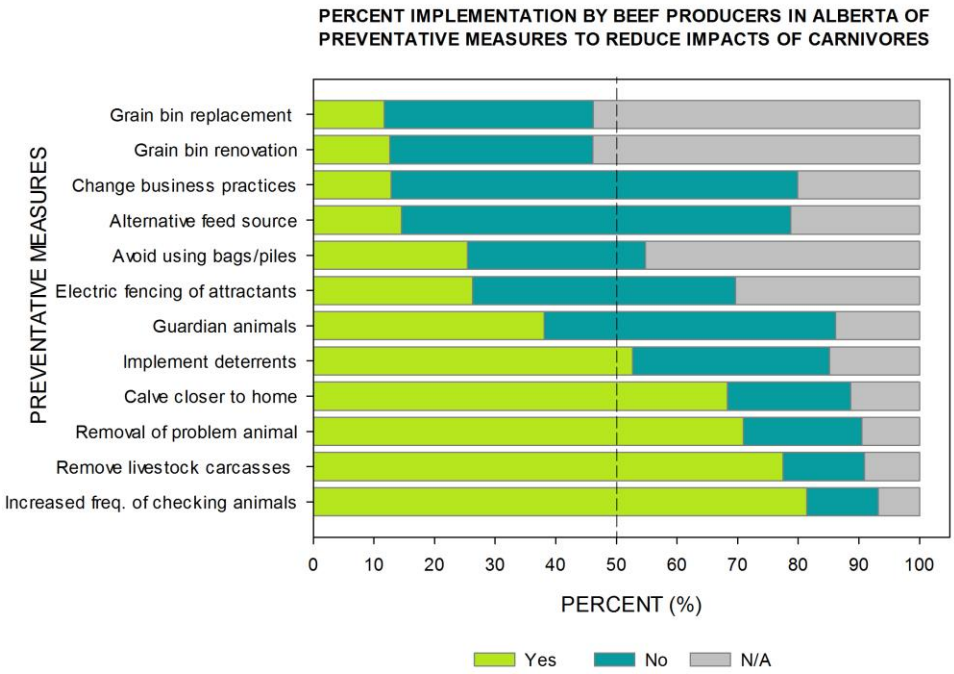

Figure 17: Percentage of beef producers in Alberta implementing preventative measures to reduce carnivore impacts.

To determine the percentage of beef producers who have implemented mitigation measures to reduce impacts from carnivore species, the “not applicable responses” were subtracted from the total response rate of 544 beef producers. These results highlight that the majority of beef producers in Alberta have implemented the following practices to reduce impacts of carnivores:

- 77% (margin of error 3.6%) have increased the frequency of checking on livestock;
- 75% (margin of error 3.8%) are removing dead livestock from landscape;
- 64% (margin of error 4.2%) are removing the problem animal themselves;
- 62% (margin of error 4.3%) have moved calving grounds closer to home;
- 42% (margin of error 4.4%) have implemented deterrents (yard lights, noise);
- 30% (margin of error 4.3%) have a guardian animal to protect livestock from carnviores;
- 22% (margin of error is 3.9%) have fenced off attractants with an electric fence; and,
- 23% (margin of error 4.2%) avoid using bags and piles to store feed.

Measures less commonly adopted by beef producers who reported impacts from carnivores include:

- 12% (margin of error 3.4%) of producers have renovated at least one grain bin;
- 12% (margin of error 3.4%) of producers have replaced at least one grain bin;
- 11% (margin of error 2.8%) have provided an alternative food source; and
- 9% (margin of error 2.6%) have changed business practices (e.g.,changed to a less attractive forage or cattle type).

These percentages are interesting and highlight where education and support might be helpful to encourage and implement preventative measures to reduce conflicts with carnivores. For example, Figure 6 shows 38% percent of producers have a grain bin acting as an attractant, yet Figure 17 shows only 24% of producers have replaced or renovated grain bins. Costs associated with preventative measures were more challenging to obtain from the survey. However, average annual expenditures for electric fencing and grain bin renovation reported by survey respondents are presented in Table 14.

Table 14: Average time in hours and costs in dollars of prevention measures.

	Number of responses	Min. cost	Max. cost	Total costs	Hours
Grain bin renovation	31	$0	$6,667	$851	14
Electric fence hay yard	73	$0	$20,000	$723	46

AESRD Compensation Program Summary

Compensation data was provided by the AESRD Problem Wildlife Specialist for the years 2011 to 2013. A summary of compensation data was provided for the province of Alberta with variables on cattle type and success of claims. In Alberta, claims are confirmed, probable (half payment) or denied by an Alberta Fish and Wildlife Officer. Claims are paid out by the Alberta Conservation Association. The data was averaged over three years to produce an annual average number of compensation payments. Table 15 summarizes the average of 272 claims (73% of which were confirmed, 15% were probable and 12% were denied). An average of $220,584 was paid out in compensation annually over the three year period. The majority of payouts were for confirmed depredation events on cows or feeders/yearlings (97%), with minimal annual compensation payouts for calves and bulls.

Table 15: Average compensation payments per cattle type (2011-2013)

Cattle type	Confirmed	Probable	Denied	Total	Total value
Calf	3	0	4	7	$1,088
Cow	95	23	19	138	$115,787
Feeder/yearling	98	16	9	123	$98,784
Bull	3	2	1	5	$4,925
Total	199	42	33	272	**$220,584**

The most commonly reported carnivore species involved in confirmed depredation events were wolves. Figure 18 shows carnivore species involved in confirmed depredation events averaged for a three-year period.

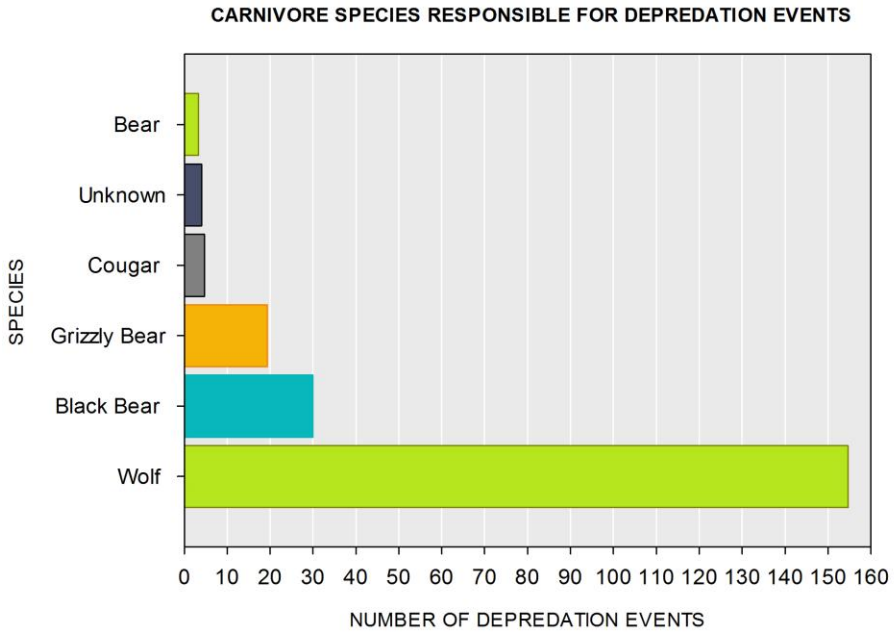

Figure 18: Carnivore species involved in confirmed depradation events based on three-year average.

The location of the claims is shown in Figure 19. Confirmed and probable claims was counted for each municipality for 2011 – 2013. Where claims were registered to a city or town, the number of claims were attributed to the surrounding rural municipality. A quintile approach was used to display the data whereby the number of claims per municipality was categorized into 20, 40, 60 and 80 percentiles, equating to very low (0-20%), low (20-40%), medium (40-60%), high (60-80%) and very high (80-100%). Municipalities with no claims were removed from the analysis. These results indicate carnivore depredation from wolf, cougar, black bear and grizzly bear are not distributed evenly around the province with some areas, such as the eastern slopes of the Rocky Mountains (from Waterton to the Peace Country), experiencing higher levels of depredation. These results do not include coyote depredation events.

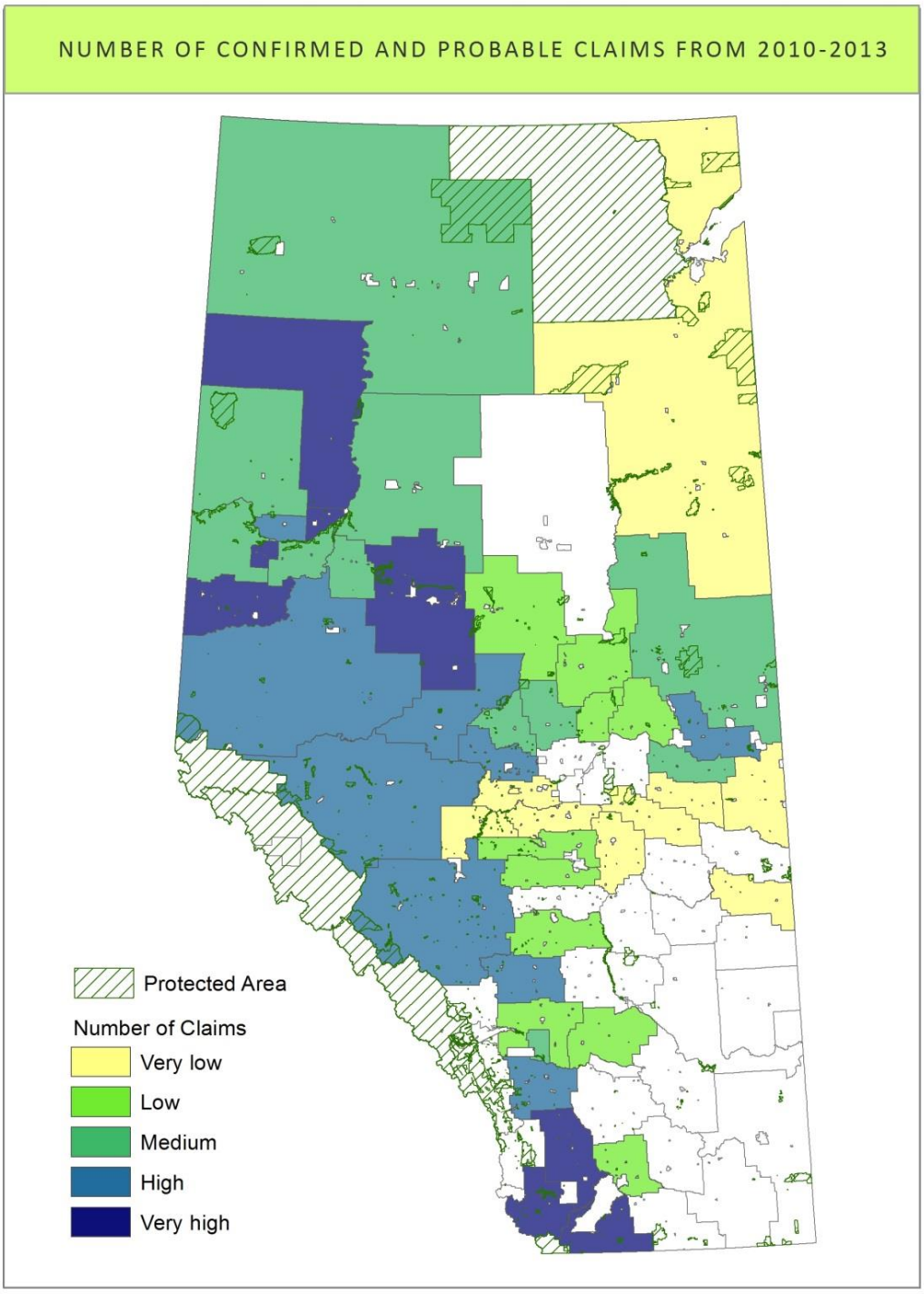

Figure 19: Number of confirmed and probable claims to AESRD per municipality represented as percentiles.

Results: Ungulates

FORAGE CROP COMPETITION

Seventy percent (70%, margin of error 3.8%) of beef producers in Alberta experience forage competition by ungulate species on their beef operations. A subset of those producers reported forage competition by ungulate species: 83% (margin of error 3.6%) reported forage competition by white-tailed deer and 74% (margin of error 4.3%) reported forage competition by mule deer (Figure 20). Fifty-four percent (54%, margin of error 4.8%) of these producers indicated elk involved in forage competition incidents. It should be noted that these results are averaged across the province and that in some regions elk are the main ungulate involved in forage competition. Moose and antelope are also regional in their ranges and are reported by 14% (margin of error 3.4%) and 5% (margin of error 2.1%) of these producers respectively. One percent of these producers reported other species (e.g., wild boars and free-roaming horses) as causing impact.

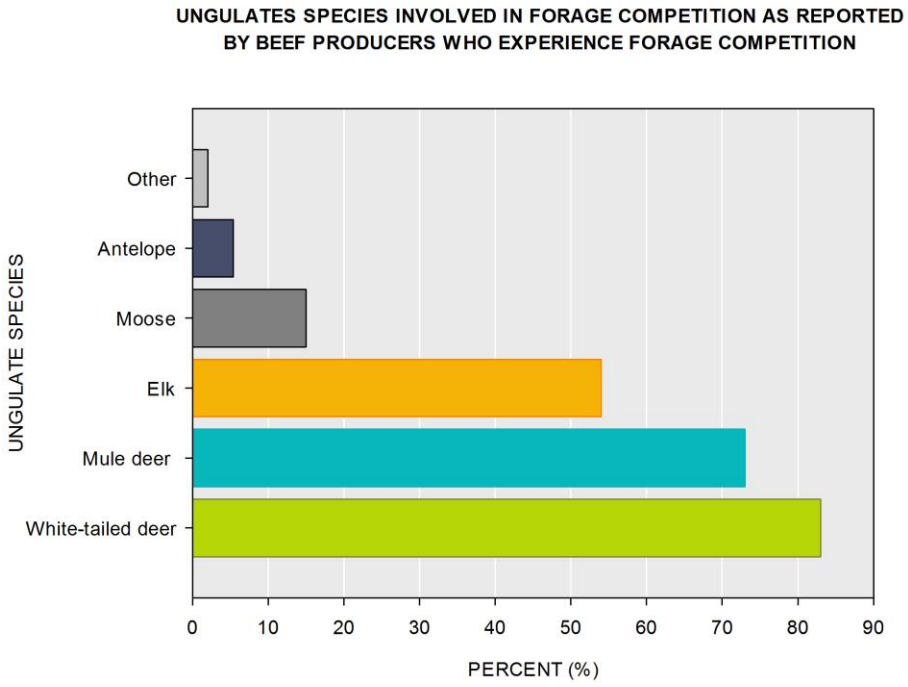

Figure 20: Ungulate species involved in forage competition from 2011-2013 as reported by beef producers who experience forage competition.

The survey results (Figure 21) show the following forage crops being impacted:

- 96% (margin of error 2.0%) of these producers report hay crops being impacted;

- 89% (margin of error 3.9%) of these producers report oat crops being impacted; and
- 82% (margin of error 5.3%) of these producers report barley crops being impacted.

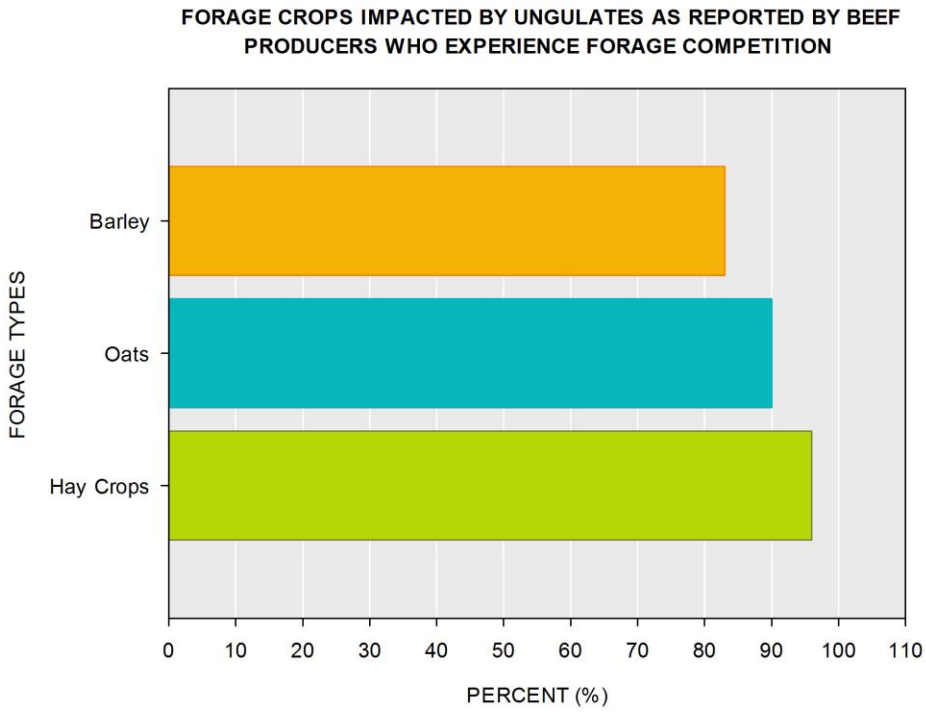

Figure 21: Forage crops impacted by ungulate competition as reported by affected beef producers.

How do these numbers relate to the entire beef population in Alberta?

This is a subset of survey data extrapolated to the whole beef producer population in Alberta. 70% of beef producers in Alberta experience forage crop competition by ungulates with:

- 60% of beef producers experience forage competition from white-tailed deer;
- 53% of beef producers experience forage competition from mule deer;
- 39% of beef producers experience forage competition from elk;
- 10% of beef producers experience forage competition from moose; and,
- 4% of beef producers experience forage competition from antelope.

- 62% of beef producers reporting competition in hay crops;
- 40% of beef producers reporting competition in oat crops; and,
- 30% of beef producers reporting competition in barley crops.

Other forage crops that respondents identified being impacted by ungulates included: corn, pasture (tame and native), wheat, rye, peas, triticale, millet, horticultural crops and durum.

Beef Producers who experience forage competition from ungulates planted an average of 356 acres of barley during 2011 – 2013. On average they lost 6% to competition by ungulates. As a result producers who reported being impacted by ungulates competing for barley lost an average of $5,460 annually. The minimum percentage loss reported was 0% and the maximum was 60% (Table 16).

Table 16: Barley forage crop loss of beef producers who experience forage competition from ungulates.

Year	Mean acres barley	Mean % lost	Mean total yield	Mean bu lost	Mean $/bu	Mean value of barley lost
2011	355	6	22,053	907	$4.06	$3,641
2012	331	6	19,011	1,043	$5.26	$6,491
2013	381	7	21,908	1,329	$4.48	$6,249
Average	**356**	**6**	**20,991**	**1,093**	**$4.60**	**$5,460**

Beef Producers who experience forage competition from ungulates planted an average of 154 acres of oats during 2011 – 2013. On average they lost 9% to competition by ungulates. As a result producers who reported being impacted by ungulates competing for barley lost an average of $3,647 annually. The minimum percentage loss reported was 0% and the maximum was 83% (Table 17).

Table 17: Oat forage crop loss of beef producers who experience forage competition from ungulates.

Year	Mean acres oats	Mean % lost	Mean total yield	Mean bu lost	Mean $/bu	Mean value of oats lost
2011	165	8	12,027	1,153	2.99	$3,431
2012	149	8	10,896	1,141	3.29	$3,876
2013	149	10	10,883	1,153	3.49	$3,633
Average	**154**	**9**	**11,269**	**1149**	**3.26**	**$3,647**

Beef Producers who experience forage competition from ungulates planted an average of 450 acres of hay during 2011 – 2013. On average they lost 6% to competition by ungulates. As a result producers who reported being impacted by ungulates competing for barley lost an average of $3,355 annually. The minimum percentage loss reported was 0% and the maximum was 50% (Table 18).

Table 18: Hay forage crop loss of beef producers who experience forage competition from ungulates.

Year	Mean acres hay	Mean % lost	Mean total yield (tons)	Mean tons lost	Mean $/ton	Mean value of hay lost
2011	428	6	685	39	76.84	$2,844
2012	454	7	727	50	80.60	$3,814
2013	469	6	751	42	85.27	$3,407
Average	**450**	**6**	**721**	**44**	**80.90**	**$3,355**

Summary of Actual Forage Crop Competition

To further discussion and understanding of the economic impact of ungulates to beef producers the number of acres grown for each type of forage crop identified was totaled and then the average losses directly from the survey results were applied. These numbers provide a very conservative picture of the impact from ungulates to beef producers as they are from a specific group of producers who provided this data in their survey responses (sample size n= shown for each crop).

Barley

There was an average of 35,772 acres of barley grown annually by survey respondents from 2011-2014. Using the provincial 10-year average of 62 bushels per acre (Makejovsky 2014) the total amount grown by survey respondents would be 2,225,018 bushels. The survey data shows an average yield loss of 6%, based on 41 responses. At an average price of $4.60 as reported by respondents for 2011-2013 the total loss to survey respondents of forage barley is $634,575 annually.

Oats

There was an average of 20,800 acres of oats grown annually by survey respondents from 2011-2014. Using the provincial 10-year average of 73 bushels per acre (Makejovsky 2014) the total bushels grown by survey respondents would be 1,518,371 bushels. The survey data shows an average yield loss of 9% based on 40 responses. At an average price of $3.20 as reported by respondents for 2011-2013 the total loss to survey respondents of forage oats is $437,291 annually.

Hay

There was an average of 100,988 acres of hay grown annually by survey respondents from 2011-2014. Using the provincial 10-year average of 16 tonne per acre (Makejovsky 2014) the total bushels grown by survey respondents would be 161,581 tonne. The survey data shows an average yield loss of 6% based on 160 responses. At an

average price of $80.80 as reported by respondents for 2011-2013 the total loss to survey respondents of forage hay is $783,340 annually.

This analysis indicates an annual loss of $1.9 million of hay, barley and oat forage crops due to forage competition with ungulates reported through survey responses. The true value of loss is much greater, as these are reported losses only from survey participants (representing 3.5% of beef producers in Alberta). An effort to extrapolate these findings to a provincial value is shown in Appendix 3, where broader values are presented to help initiate a conversation.

Forage Crop Competition Compensation

The 70% of beef producers impacted by ungulates competing for forage were asked if they reported ungulate damage to AFSC compensation programs.

- 80% (margin of error 3.9%) of these producers did not report losses;
- 15% (margin of error 3.5%) of these producers reported some losses; and
- 5% (margin of error 2.2%) of these producers reported all losses.

Through an open-ended question, these producers were asked why they did not report losses due to forage competition by ungulates. Figure 22 depicts the themes coded from 225 responses.

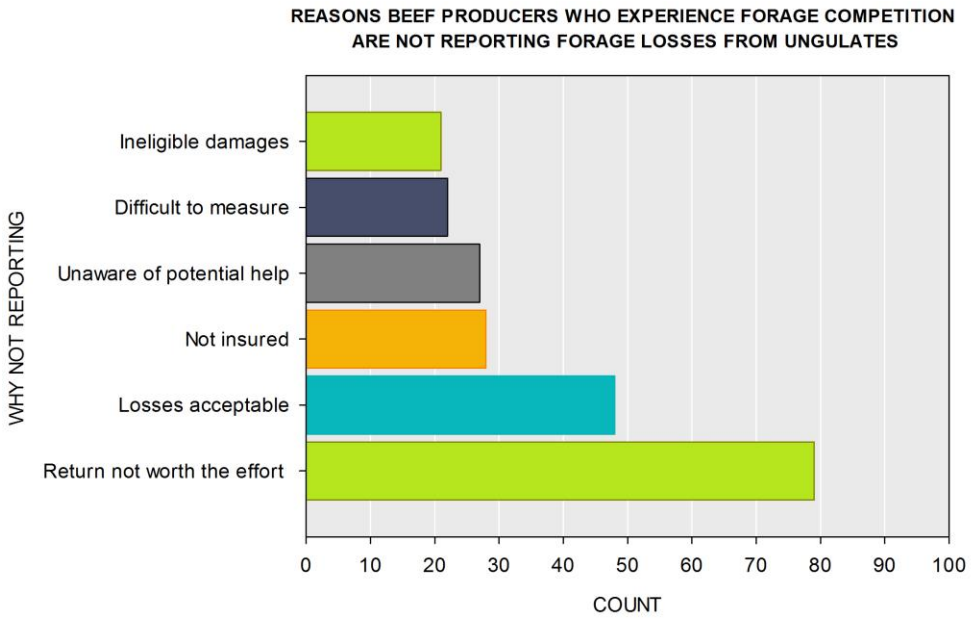

Figure 22: Depicts the count of responses from beef producers impacted by forage competition (n=225) of reasons for not reporting forage crop competition to AFSC compensation programs.

Return not worth it: Thirty-five percent (35%) of producers who responded to the open-ended question reported the amount of compensation was not worth the effort. This theme included responses indicating the process is too difficult and that no one returns phone calls or comes out to see the damage.

Losses acceptable: Twenty-one percent (21%) of producers who responded to the open-ended question report that the amount of loss they incurred as acceptable. This theme included responses indicating they prefer to see wildlife than not, that the loss was a small amount, and that they consider feeding ungulates a cost of their business.

Not insured: Thirteen percent (13%) of producers who responded to the open-ended question reported they were not insured. This also included people who reported not wanting to participate in such programs.

Unaware of potential help: Twelve percent (12%) of producers who responded to the open-ended question reported they are unaware of such programs. Some people said they were aware but did not know whom to call or were never able to speak with the right person.

Difficult to measure: Ten percent (10%) of producers who responded to the open-ended question said that the amount of damage was too difficult to measure or prove and as a result did not report.

Ineligible damages: Nine percent (9%) of producers who responded to the open-ended question reported that the forage crops being impacted are not eligible for compensation. Examples included native and tame pasture. Also reported was damage caused by species that are not covered such as wild boars.

STORED FEED

Seventy percent of beef producers in Alberta (70%, margin of error 3.8%) experience damage to or loss of stored feed by ungulate species. White-tailed deer and mule deer are shown in Figure 23 as the main two species involved in stored feed damage in Alberta (reported by 78% (margin of error 4.12%) and 69% (margin of error 4.6%) respectively). Forty-two percent (42%, margin of error 4.91%) of these producers experience elk involvement in loss of stored feed. It should be noted that these results are averaged across the province and that in some regions elk show as the main ungulate involved in stored feed damage. Moose and antelope are also regional in their ranges and are reported by 15% (margin of error 3.55%) and 1% (margin of error 0.99%) of respondents.

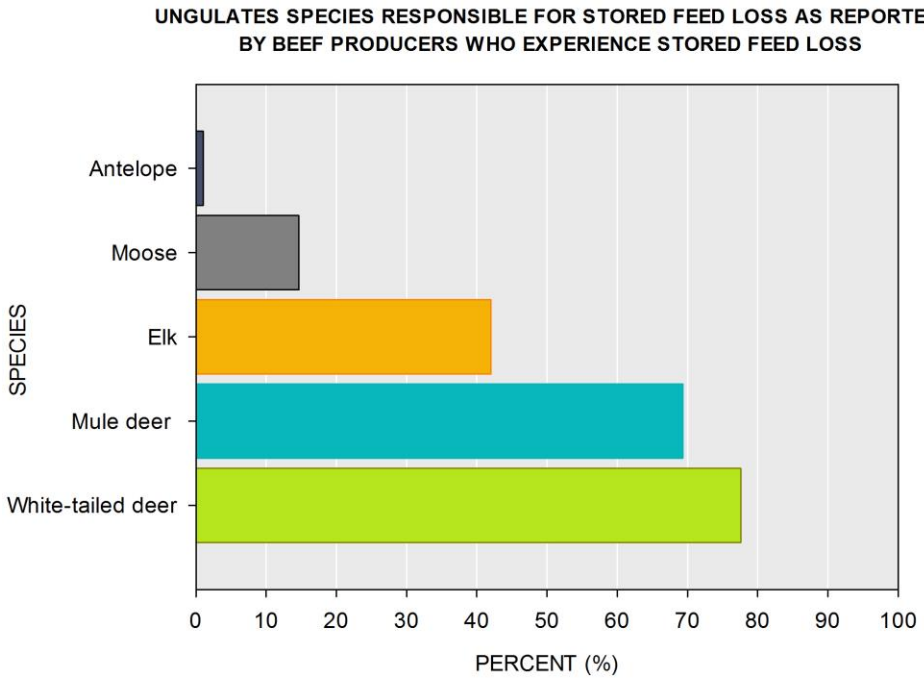

Figure 23: Ungulate species involved in stored feed loss from 2011-2013 as reported by beef producers who experience stored feed loss.

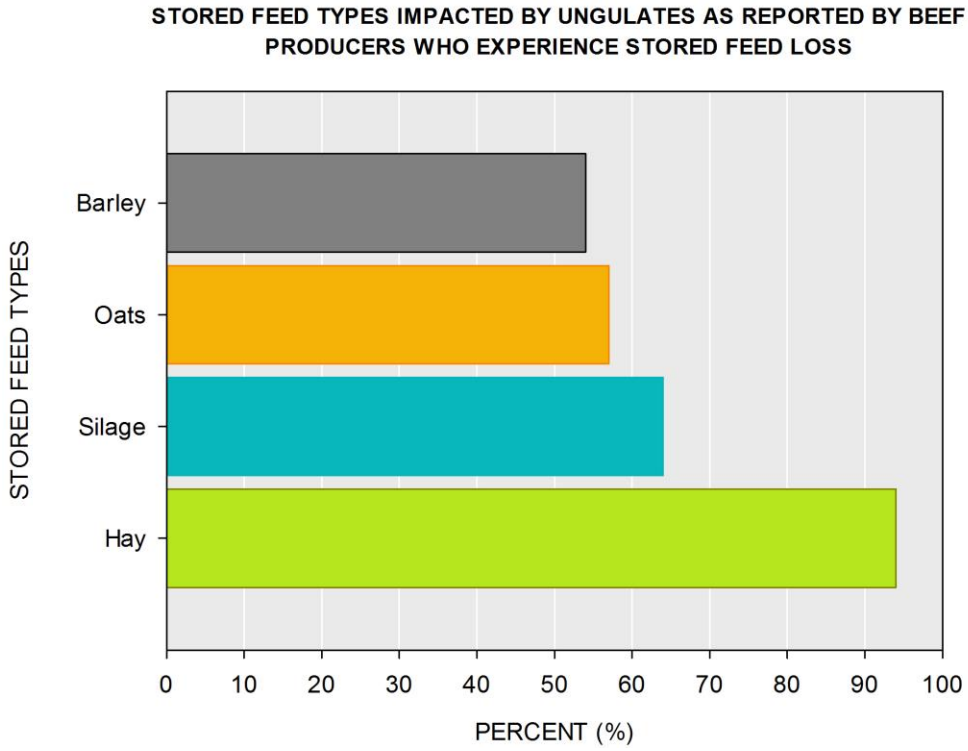

Figure 24: Stored feed types impacted by ungulate competition as reported by affected beef producers.

Stored Feed: Barley

Of the 70% of producers who experienced damage to stored feed, 54% (margin of error 7.28%) report loss or damage to stored barley (Figure 24). Respondents reported an average total stored barley value of $246,967, with an average loss of 1% from ungulates costing an average of $2,262. The range of percent loss was 0% to 35% from 2011-2013.

Stored Feed: Oats

Of the 70% of producers who experienced damage to stored feed, 57% (margin of erro 6.83%) report loss or damage to stored oats (Figure 24). Respondents reported an average total stored oats value of $26,131.28 with an average loss of 8% from ungulates costing an average of $1,994. The range of percent loss was 0% to 63% from 2011-2013.

Stored Feed: Hay

Of the 70% of producers who experienced damage to stored feed, 94% (margin of error 7.79%) report loss or damage to stored hay (Figure 24). Respondents reported an average total stored hay value of $49,047 with an average loss of 4% from ungulates costing an average of $2,021. The range of percent loss was 0% to 100% from 2011-2013.

Stored Feed: Silage

Of the 70% of producers who experienced damage to stored feed, 64% (margin of error 2.44) report loss or damage to stored silage (Figure 24). Respondents reported an average total stored hay value of $80,247 with an average loss of 4% from ungulates costing an average of $3,113. The range of percent loss was 0% to 100% from 2011-2013.

Other stored feed damaged by ungulates included: swath grazing, standing corn, pasture (tame and native) and greenfeed.

How do these numbers relate to the entire beef population in Alberta?

This is a subset of survey data extrapolated to the whole beef producer population in Alberta 70% of beef producers in Alberta experience stored feed damage by ungulates. Of these producers:

- 54% of beef producers experience stored feed loss from white-tailed deer;
- 48% of beef producers experience stored feed loss from mule deer;
- 39% of beef producers experience stored feed loss from elk;
- 11% of beef producers experience stored feed loss from moose; and,
- 1% of beef producers experience stored feed loss from antelope.

- 62% of beef producers in Alberta report stored hay damage;
- 21% of beef producers in Alberta report stored oats damage;
- 18% of beef producers in Alberta report stored barley damage; and,
- 17% of beef producers in Alberta report stored silage damage.

Summary of Actual Stored Feed Losses

To further discussion and understanding of the economic impact of ungulates to the beef industry the total average value of each type of stored feed was summed as was the total average value reported as lost by survey respondents. These numbers provide a very conservative picture of the impact as they are from a specific group of producers who provided this data in their survey responses.

Barley

The total average value of stored barley from 41 survey respondents was $9,736,627 and the total average total value loss of stored barley due to ungulates was $90,497.

Oats

The total average value of stored oats from 40 survey respondents was $979,992 and the total average value loss of stored oats due to ungulates was $74,838

Hay

The total average value of stored hay from 160 survey respondents was $7,620,242 and the total average value loss of stored hay due to ungulates was $314,728.

Silage

The total average value of stored silage for 47 survey respondents was $3,748,972 and the total average value loss of stored silage due to ungulates was $140,918.

This analysis indicates an annual loss of $620,000 of hay, barley and oat forage crops due to storage loss or damage from ungulates as reported through survey responses. The true value of loss is much greater, as these are reported losses only from survey participants (representing 3.5% of beef producers in Alberta).

Stored Feed Loss Compensation

Survey respondents were asked if they have reported ungulate stored feed damage to AFSC compensation programs. Out of the 327 survey responses about stored feed damage:

- 80% (margin of error 4.1%) did not report losses;
- 15% (margin of error 4.3%) reported some losses; and
- 6% (margin of error 2.4%) reported all losses.

Survey respondents were asked through an open-ended question why they did not report to AFSC. Responses were coded into themes for analysis (Figure 25).

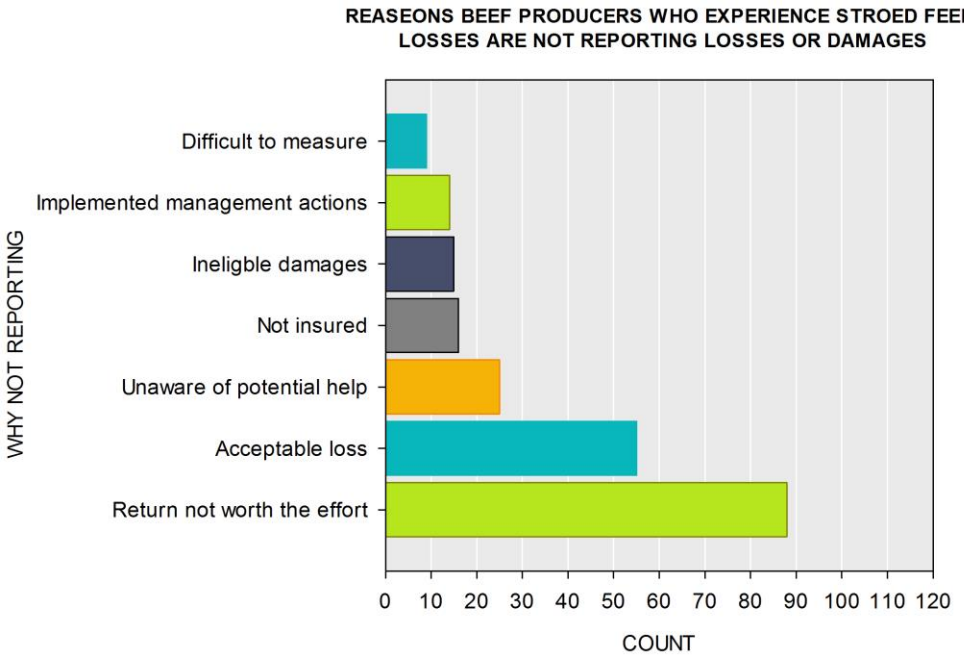

Figure 25: Depicts the count of responses from beef producers impacted by stored feed losses (n=213) of reasons producers are not reporting to the AFSC compensation programs.

Return not worth it: Forty-one percent (41%) of producers who responded to the open ended question indicated the amount of compensation was not worth the effort. Similar to forage crop competition, this theme included responses indicating the process is too

difficult, that no one returns phone call or comes out to see the damage, and no help is expected.

Losses acceptable: Twenty-six percent (26%) of producers who responded to the open ended question report that the amount of loss they incurred as acceptable. Similar to forage crop competition, this theme included responses indicating they prefer to see wildlife than not, that they felt it was their responsibility, and that they consider feeding ungulates a cost of business.

Unaware of potential help: Twelve percent (12%) of producers who responded to the open ended question reported they are unaware of such programs. Some people said they were aware but did not know who to call or were never able to speak with the right person.

Not insured: Eight percent (8%) of producers who responded to the open ended question reported they are not insured. This also included people who reported not wanting to participate in such programs.

Ineligible damages: Seven percent (7%) of producers who responded to the open ended question reported that the forage crops being impacted are not eligible for compensation (e.g., native and tame pasture). Also reported was damage caused by species that are not covered, such as wild boars.

Implemented management actions: Seven percent (7%) of producers who responded to the open ended question reported they had installed fencing, changed management practices (e.g., stopped swath grazing), or used guard dogs.

Difficult to measure: Four percent of producers (4%) who responded to the open ended question said that the amount of damage was too difficult to measure or prove and as such did not report.

CONCERN ABOUT DISEASE TRANSMISSION FROM UNGULATE TO LIVESTOCK

Fifty-five percent (55%, margin of error 4.16%) of beef producers in Alberta were concerned about the impact of disease transmission from wild ungulates to cattle. One hundred and seventy-four (174) respondents identified the diseases that give them greatest concern, and many listed more than one disease of concern.

The wildlife diseases of most concern to producers in Alberta were chronic wasting disease (17% of beef producers), brucellosis (7%), tuberculosis (4%) and diseases

caused by ticks (3%). A number of other diseases were each identified by 2% or less of respondents. These included: anthrax, blackleg, Johne's disease, BVD, lice, liver flukes and various parasites. A small number of respondents also expressed concern about beef animals transmitting disease to wild ungulates.

The survey also asked about the costs associated with disease transmission. Those who identified costs associated with disease transmission included the cost of: antibiotics, aborted calves, cattle death, reduced weight gain, and time required to manage sick animals. Very few respondents provided dollar values.

Management Activities Undertaken to Reduce Ungulate Impact

Eighty-five percent (85%, margin of error 3.33%) of beef producers in Alberta identified that they have implemented some kind of management activity to reduce the impacts of ungulates to their beef operations. Figure 26 highlights the main activities producers report implementing to reduce impacts from ungulates (based on those who reported the mitigation was applicable to their operation):

- 39% (margin of error 6.13%) report not using grain bags or piles for storage;
- 37% (margin of error 5.34%) report placing electric fencing around stored feed;
- 30% (margin of error 5.14%) report using an alternative or less attractive feed source (e.g., leave some in field, surround hay with straw bales, open grain bins with a poorer crop in it); and
- 22% (margin of error (5.08%) report changing business practices (e.g., no longer swath graze, minimize stored feed, move storage location based on where elk winter).

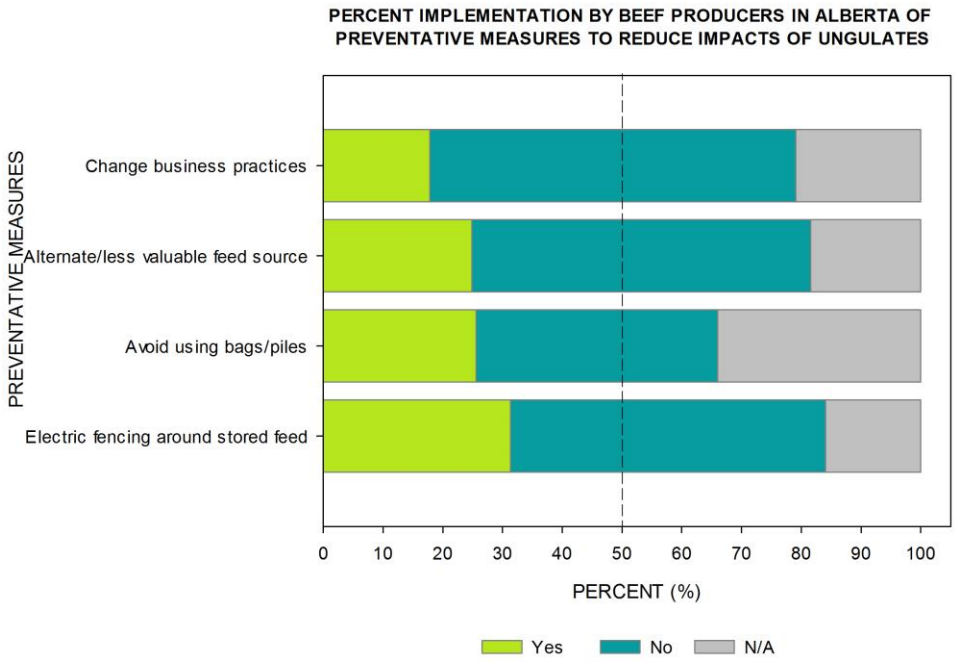

Figure 26: Implementation of methods to reduce impacts from ungulates.

Other actions mentioned in the open-ended question included using fencing or panels (non-electric) to protect feed. Deterrents (including noise-makers, pellet guns, guardian dogs, chasing, motion sensors and scents) were also used to reduce impacts from ungulates. In addition, a number of individuals report allowing hunting on their land to reduce the ungulate population.

Results: Birds

Forty-four percent (44%) (margin of error 4.1%) of beef producers in Alberta report impacts from birds. Figure 27 displays percentage subset of beef producers who report impacts from different species of birds. The bird species causing the most impact is ravens reported by 62% (margin of error 6.1%) of beef producers who are affected by birds. Additionally:

- 59% (margin of error 6.2%) of these producers report impacts from geese;
- 38% (margin of error 6.1%) of these producers report impacts from ducks;
- 17% (margin of error 4.7%) of these producers report impacts from magpies;
- 13% (margin of error 4.2%) of these producers report impacts from eagles;
- 7% (margin of error 1.0 %) of these producers report impacts from hawks; and,
- 1.6% (margin of error 1.6 %) of these producers report impacts from swans.

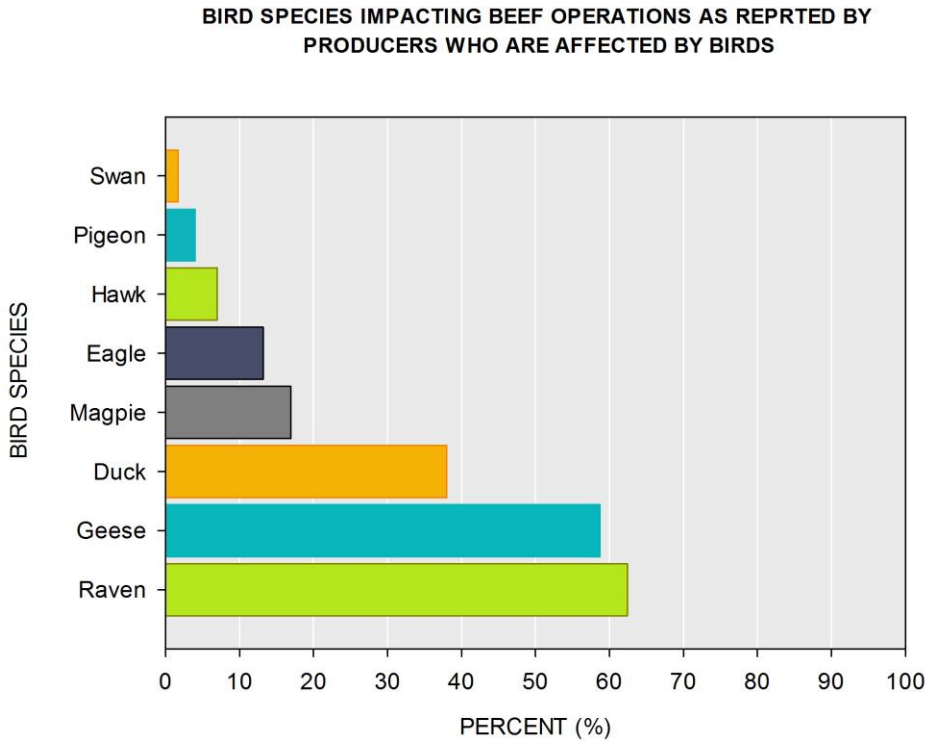

Figure 27: Types of bird species impacting beef producers who reported being impacted by birds.

Producers who reported impacts from birds (44%) were asked to select which impacts they had experienced (Figure 28). The biggest impact reported was calf depredation at 81% (margin of error 7.0%) of producers experiencing impacts from birds. Other bird-related impacts included:

- 66% (margin of error 8.5%) of these producers report forage competition in barley;
- 60% (margin of error 8.7%) of these producers report forage competition in oats;
- 42% (margin of error 10%) of these producers report stored feed damage to silage;
- 34% (margin of error 9.6%) of these producers report stored feed damage to oats;
- 31% (margin of error 9.8%) of these producers report stored feed damage to barley;
- 27% (margin of error 9.1%) of these producers report forage competition in hay crop;
- 23% (margin of error 8.8%) of these producers report straw damage;
- 23% (margin of error 9.6%) of these producers report forage competition in silage crop; and,
- 18% (margin of error 3.3%) of these producers report stored feed damage to hay.

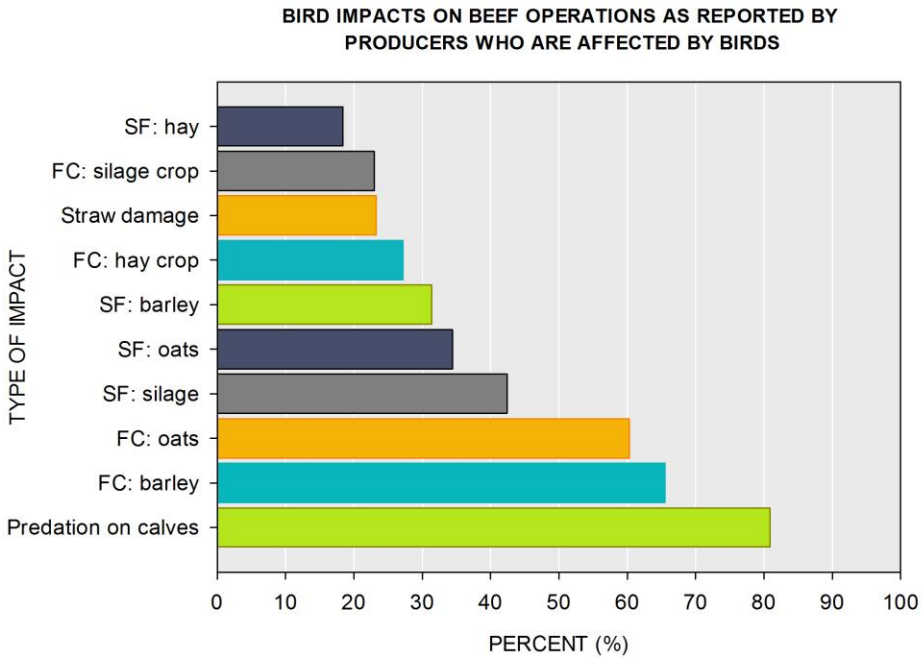

Figure 28: Percentage of beef producers who experience different types of bird impacts as reported by beef producers who are affected by birds (SF = stored feed, FC = forage competition).

How do these numbers relate to the entire beef population in Alberta?

This is a subset of survey data extrapolated to the whole beef producer population in Alberta. 44% of beef producers in Alberta experience damage from birds. A breakdown of species indicates:

- Ravens impact 27% of beef producers in Alberta;
- Geese impact 25% of beef producers in Alberta;
- Ducks impact 16.5% of beef producers in Alberta;
- Eagles impact 6% of beef producers in Alberta;
- Hawks impact 3% of beef producers in Alberta; and,
- Swans impact 0.7% of beef producers in Alberta.

- 24% of beef producers in Alberta experience predation on calves from birds;
- 15% of beef producers in Alberta experience losses from barley forage competition;
- 14% of beef producers in Alberta experience losses from oats forage competition;
- 5% of beef producers in Alberta experience losses from hay forage competition;
- 3% of beef producers in Alberta experience losses from silage crop competition;
- 5% of beef producers in Alberta experience barley stored feed loss;
- 6% of beef producers in Alberta experience oat stored feed loss;
- 3% of beef producers in Alberta experience hay stored feed loss;
- 7% of beef producers in Alberta experience silage loss; and;
- 4% of beef producers in Alberta experience straw damage.

IMPACTS OF WILD BIRDS

Producers were asked to provide information to assist the authors in determining the average annual costs associated with forage loss from birds. Unfortunately there were inconsistencies in the way information was reported. To address this challenge, entries that did not include requested information, and responses where numbers were not possible to interpret, had to be removed. For example, some people reported total value of loss instead of value of forage per bushel. In addition, the results show a highly skewed dataset as demonstrated by the results for stored barley (Figure 29). Producers reported total value of stored barley feed and the estimated percent loss of stored feed from birds from 2011 – 2013.

Figure 29 is a box plot of the distribution of percent loss as reported by producers who experience loss of stored barley by birds. Spaces between the different parts of the box (bottom T, box, mean line, median line and top T) indicate the degree of dispersion and skewedness in the data, and show outliers. The percent loss of stored barley by birds is skewed to the right (meaning there are a high number of people reporting higher losses), indicated here by the mean (average) being higher than the median (mid-point) and the longer T on the top end of the box. This shows a wider range of values (percent loss) for producers who report higher losses than those that report lower losses. In addition the plot indicates there are three outliers in the dataset. The higher percentage of losses and outliers, although representing very few individuals, are important to consider because it highlights more extreme cases of economic loss resulting from birds consuming stored feed which can negatively influence a producer's bottom line and tolerance toward wildlife.

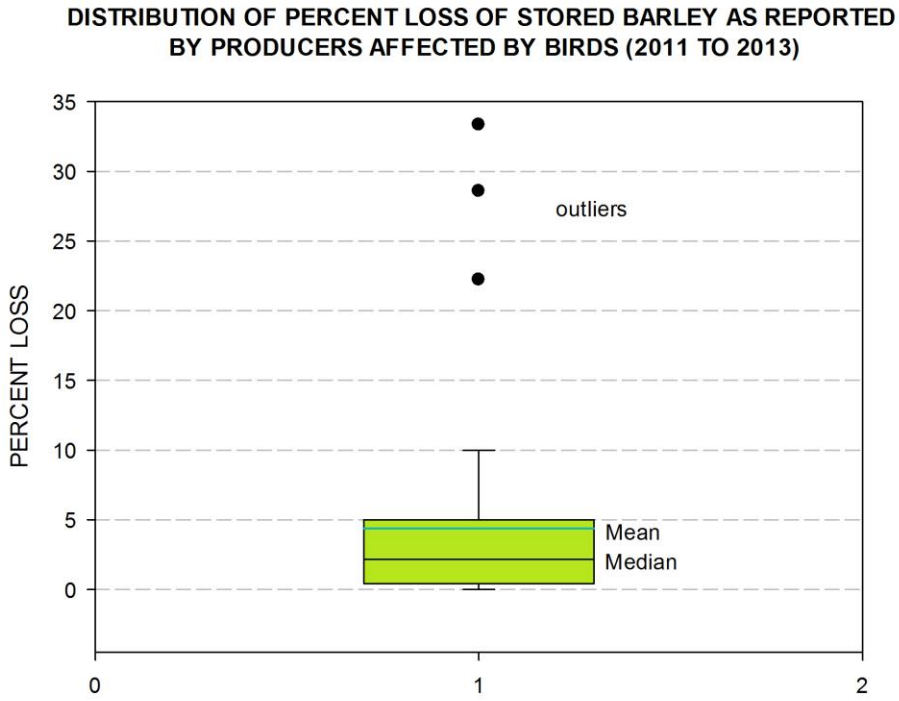

Figure 29: Box plot of average percent loss distribution of stored barley as reported by beef producers who are affected by birds.

Other impacts show similar results to stored barley, with most having outliers and being skewed to the right, indicating greater variability in percent loss for those who experience higher losses.
Despite the limitations of a low sample size for documenting the economic impact of birds on beef producers, the values are presented below as a starting point to engage in dialogue about impacts from birds.

Barley Forage

Of the 44% of beef producers who reported impact from birds, the 66% experiencing loss of forage barley due to birds were asked to identify the number of acres grown, the percent lost due to birds and the value of a bushel of barley from 2011-2013. There were 50 responses to this question.

The total number of bushels grown per producer was calculated using the number of acres reported grown, multiplied by the provincial 10-year average yield per acre (Matejovsky 2014) at 62.2 bushels of barley per acre. To determine the number of bushels lost to birds for each producer, the total number of bushels grown was multiplied by the percent loss reported by the producer. The value of barley lost was calculated by taking the total number of bushels lost to birds multiplied by the value of a bushel as reported by the producers.

The means were calculated for each year as presented in Table 19. The average over the three years was calculated as the average of 2011 to 2013. There was one report of 100 percent loss on 500 acres – this response was removed from the calculation as an outlier. It is still important to note this response as it indicates there are cases where losses from birds can be severe.

The average barley loss per producer who experienced losses from birds from 2011-2013 was 606 bushels at a value of $2,178.

Table19: Barley losses to producers experiencing impacts from birds due to forage competition.

	Mean # of acres of barley grown	Mean total yield (10 year average)	Mean % loss from birds	Mean # of bushels lost	Mean value of bushel	Mean value of barley lost to birds
2011	399	17,479	5.367	790	3.44	$2,477
2012	381	17,321	3.38	448	4.06	$1,920
2013	398	18,006	3.96	581	3.79	$2,137
Average	**393**	**17,602**	**4.24**	**606**	**3.76**	**$2,178**

Oats Forage

Of the 44% of beef producers who reported impact from birds, the 60% experiencing loss of forage oats due to birds were asked to identify the number of acres grown, the percent loss due to birds and the value of a bushel of oats from 2011-2013. There were 35 responses to this question.

The total number of bushels grown per producer was calculated using the number of acres reported grown multiplied by the provincial 10-year average yield per acre (Makejovsky 2014) at 73 bushels of oats per acre. To determine the number of bushels lost to birds for each producer, the total number of bushels grown was multiplied by the percent loss reported by the producer. The value of oats lost was calculated by taking the total number of bushels lost to birds multiplied by the value of a bushel as reported by the producer.

The means were calculated for each year, as presented in Table 20. The average over the three years was calculated as the average of 2011 to 2013.

The average oats lost per producer who experienced losses from birds from 2011-2013 was 573 bushels at a value of $1,679.

Table 20: Oat losses to producers experiencing impacts from birds due to forage competition.

	Mean # of acres of oats grown	Mean total yield (10 year average)	Mean % loss from birds	Mean # of bushels lost	Mean value of bushel	Mean value of oats lost to birds
2011	264	19272	4.5	565	2.75	$1,404
2012	170	12442	5.4	510	3	$1,560
2013	152	11143	6.7	645	2.93	$2,074
Average	**195**	**14286**	**5.53**	**573**	**2.89**	**$1,679**

Hay Forage

Of the 44% of beef producers who reported impact from birds, the 27% experiencing loss of forage hay due to birds were asked to identify the number of acres grown, the percent loss due to birds and the value of a tonne of hay from 2011-2013. There were 29 responses to this question.

The total number of bushels grown per producer was calculated using the number of acres reported grown multiplied by the provincial 10-year average yield per acre (Makejovsky 2014) at 1.6 tonnes of hay per acre. To determine the number of tonnes lost to birds for each producer, the total number of tonnes grown was multiplied by the percent loss reported by the producer. The value of hay lost was calculated by taking the total number of tonnes lost to birds multiplied by the average value of a tonne as reported by the producers.

The means were calculated for each year, as presented in Table 21. The average over the three years was calculated as the average of 2011 to 2013.

There was one report of 100 percent loss on 60 acres. This response was removed from the calculation as it is considered an outlier. It is still important to note as it indicates that occasionally individual producers are more heavily impacted than the norm.

The average hay loss per producer who experienced losses from birds from 2011-2013 was 6 tonnes at a value of $423.

Table 21: Hay losses to producers experiencing impacts from birds due to forage competition..

	Mean # of acres of hay grown	Mean total yield (10 year average)	Mean % loss from birds	Mean # of tonnes lost	Mean value of a tonne	Mean value of hay lost to birds
2011	478	764	0.91	5.57	77	$437
2012	525	839	0.6	6.06	83	$440
2013	491	786	0.54	5.27	90	$392
Average	**498**	**796**	**0.68**	**6**	**$83.33**	**$423**

Stored Feed: Silage

Of the 44% of producers who experienced damage from birds, 42% report loss or damage to silage. Respondents were asked to report the total value of the silage stored, and the value of the loss in dollars from 2011 to 2013. Fifteen producers reported an average of $85,070 in silage value, with an average loss of 1.5% from birds, an average per producer of $1,263 annually.

Stored Feed: Barley

Of the 44% of producers who experienced damage from birds, 31% report loss of barley as stored feed from birds. Respondents were asked to report the total value of the barley stored, and the value of the loss in dollars from 2011 to 2013. Fifteen producers reported an average of $108,589 in stored barley value, with a loss of 1.4% from birds costing an average per producer of $1,567 annually.

Stored Feed: Oats

Of the 44% of producers who experience damage from birds, 34% report loss/damage of oats as stored feed from birds. Respondents were asked to report the total value of oats stored, and the value of the loss in dollars from 2011 to 2013. Fifteen producers reported an average of $35,513 in stored oat value, with a loss of 4.2% from birds costing an average per producer of $1,501annually.

Stored Feed: Hay

Of the 44% of producers who experience damage from birds, 18% report loss/damage of hay as stored feed from birds. Respondents were asked to report the total value of hay stored, and the value of the loss in dollars from 2011 to 2013. Eleven producers

reported an average of $48,376 in stored hay value, with a loss of 2% from birds costing an average per producer of $998 annually.

Straw replacement

Of the 44% of producers who experience damage from birds, the 23% of producers who experience straw damage were asked to identify the value of replacement straw from 2011-2013. A total of 35 producers reported replacement straw valued at approximately $541 annually.

Impact from calf loss and injury

The 80% of producers who experience calf loss or injuries were asked to identify the percentage of calves lost or injured by birds from 2011 to 2013. The median percentage from 64 respondents was 1% of calves lost or injured annually. Outliers were removed from the analysis. There were eight reported incidents where depredation from birds was greater than 5% of their calves.

Discussion: Impacts from Wildlife

The survey results indicate that the majority of beef producers want to see healthy populations of carnivores (75% of respondents) and ungulates (83% of respondents) on the landscape. In addition, 80% of beef producers agree with the statement “the presence of wildlife is a part of owing the land”. However, 70% of producers feel the cost of supporting wildlife is borne unevenly by landowners and 80% support the statement that they remove problem wildlife when the costs get too high. Other studies support the notion that costs of wildlife are borne unevenly by landowners (Nyhus et al. 2003). The perception is that high levels of wildlife damage reduce a producer’s tolerance toward wildlife (Conover 1997). This begs the question, how do we know when costs are too high and a producer no longer has tolerance toward wildlife? The tolerance threshold is important to consider as it helps us understand the amount of damage landowners are willing to accept before producers remove wildlife to reduce impacts (Conover 2002). All of this is essential information when considering policy and programs to support wildlife coexistence.

Producers were asked if the current level of economic loss due to wildlife is acceptable. Fifty percent report economic losses are not currently acceptable, while 10% were neutral and 40% report economic losses to be currently acceptable. Conover (1998) found a similar result in a national survey of agricultural producers in the USA, where 80% experienced damage from wildlife and 56% said their tolerance toward wildlife damage had been exceeded. There are many reasons why agreement around acceptable levels of economic loss is variable. Tolerance is associated not only with

loss and with a producer's past experience, but with perceptions and attitudes toward wildlife, type of species causing the damage, and the level of impact from wildlife.

Producers were also asked what percent economic loss from wildlife they were willing to accept. Results were highly skewed: full-time producers ranged from 0 to 5% loss, with a few outliers where producers were willing to accept a loss up to 25%. The median was 1%, indicating 50% of producers will accept 1% or less loss and 50% will tolerate a loss from 1% to 5%. Interestingly, 25% of respondents report having zero tolerance for economic losses due to wildlife.
In Alberta, 81% of producers report impacts from ungulates, 74% report impacts from carnivores and 44% report impacts from birds. Only 6% of producers report no impacts from wildlife. These results are supported by other surveys, where 87% of producers report impacts from wildlife in Colorado and 80% of agricultural producers in the USA report wildlife impacts (Conover 1994, Conover 1998).

Impacts from Carnivores

The survey responses indicate that 74% of producers in Alberta experience impacts from carnivore species. Here we assessed the economic losses from depredation, forage loss, and property damage based on survey results. In addition, we present concerns associated with indirect economic losses and costs, and document prevention and management activities to reduce impacts from carnivores.

Depredation on individual livestock operations can have a significant monetary impact on beef producers (Bangs and Shivik 2001, Naughton-Treves et al. 2003). Numerous studies have attempted to measure the impact of depredation to beef producers (Muhly and Musisani 2009, Sommers et al. 2010) and the beef industry in specific regions (Pacific Analytics and Pacific Reduction Strategies 2011, OSCIA 2000). In Colorado, where total number of cattle is approximately 2,480,000, using market value for depredated cattle, the total cost of cattle depredation was estimated at $2.5 million (Hoag et al. 2011). Researchers then applied a multiplier of 2.5 to the total cost to account for under reporting and to the cumulative total added another multiplier of 1.6 to address indirect impacts from depredation to estimate the depredation cost at $10 million. Alberta has approximately double the number of cattle over Colorado on a similar landscape of foothills, forests and grasslands.

Of the 74% of producers who reported impacts from carnivores, 86% of beef producers report losses from depredation events, of which 95% lost calves, 32% lost cows, 21% lost feeders/yearlings and 7% lost bulls from 2011-2013. These results applied to the entire beef producer population in Alberta show 64% of producers report being affected by predation; 61% report calf losses, 20% report cow losses, 14% report feeder/yearling

losses and 4% report bull losses. As with other studies, calves are the most common depredated cattle types representing the largest monetary impact to producers (Sommers et al. 2010). Our survey results estimate a 2% average loss of calves, 1.5% average loss for feeders/yearlings, 0.5% average for cows and 5% average for bulls due to depredation events. Other studies also show variability in depredation rates per cattle type. In Ontario, depredation rates were estimated at 4.5% for calves and 1.3% for adult cattle (Ontario Soil & Crop Improvement Association 2000). In Idaho, a study estimated 1% of mature cattle deaths and 2% of calf deaths were from depredation (Muhly and Musiani 2009). Montana reported 1% of mature cows and 5% of calves, while Wyoming has the highest rates of depredation at 5% for mature cows and 11% for calves (Muhly and Musiani 2009, Oakleaf et al. 2003). These values indicate similar results to rates of depredation from our survey. It is important to note that we requested producers to report on all depredation events including coyotes, which are not included in the existing compensation program in Alberta. This is because our purpose is to understand the economic impacts of coexisting with wildlife regardless of whether it is a pest or species of management concern.

For individual producers, who experience depredation, a two percent loss (mean percent depredation loss from survey results) has an estimated market cost of $1,742 per year per 100 calves due to depredation. For feeders/yearling and cows the estimated economic costs were $1664 and $535 per year per 100 head respectively. In BC, a study estimated the loss per producer at $1092 annually due to depredation from carnivores with the assumption all producers experience equal rates of depredation (Pacific Analytics Inc. and Risk Reduction Strategies. 2011).

The total market value lost from depredation annually reported by survey respondents (representing 3.5% of beef producers in Alberta) based on the total number of cattle they reported and the average percent depredation rate equates to just over $2 million in losses annually. This value represents an extremely conservative amount of carnivore depredation (including coyotes) in Alberta. This value is limited to survey respondents and does not include the indirect impacts associated with sharing the landscape with carnivore species. In Ontario, the total cost of depredation was estimated at $828,813, representing 1.6% of the total cattle value in Ontario (Ontario Soil & Crop Improvement Association 2000).

A survey by the United States Department of Agriculture in 2007-2008 of 24 states representing 79.6% of US beef operations, estimated the average percent mortality of calves weaned or older is 1.5% (2010), with predators responsible for less than 0.01% of the mortality. Calf mortality was due to diseases, accidents, malnutrition, exposure to weather stress, unknown causes and predation. The USDA study suggests predation

from an industry perspective is not a significant issue. However, our results indicate the distribution of losses among individual beef produces is not borne evenly, for example 7% of producers lost more than 5% of calves in a given year to depredation. For an individual producer losing 5% of a calf crop can result in significant economic consequences. Rollins et al. (2004) also found that losses due to wildlife tend to be concentrated unevenly among producers. In addition, tolerance toward carnivores may be greatly influenced by these more dramatic losses or multiple depredation events in short time period, as individuals tend to focus on extreme events over average circumstances (Lehmkuhler et al., 2007). Therefore, if tolerance towards a species is important from a wildlife management perspective, situations where a large number of cattle are depredated need to be addressed through some type of support in a timely and efficient manner. In Alberta, carnivore depredation is supported through a Wildlife Predator Compensation Program.

Compensation

To address losses from depredation, the Government of Alberta has developed a Wildlife Predator Compensation Program, in which Alberta Conservation Association reimburses landowners who report and have Fish and Wildlife Officers assess "confirmed" or "probable" depredation events from carnivores (AESRD 2011). Compensation programs are commonly developed to help ease the economic impact of carnivores while building human tolerance toward carnivore species (Nyhus et al. 2003, Decker et al. 2006). It is important to outline the goals of a compensation program to enable evaluation of a program's success. Beeland (2008) highlights some of the common goals of compensation programs as:

- addressing the economic loss to local people;
- sharing the costs of conserving large carnivores more equitably;
- reducing producer motivation for removing carnivores;
- reducing mortality of livestock;
- increasing tolerance toward carnivores; and
- reducing attractants and promoting husbandry practices.

In the Northwestern United States compensation programs are heavily geared toward building tolerance for large carnivore restoration programs, specifically wolves and grizzly bears, by offsetting costs of lost livestock and other property (Treves et al. 2009).

The Alberta program is an "ex-post" compensation program where producers are compensated once the animal has been predated and Fish and Wildlife Officers confirm the depredation. Producers can be compensated for cattle loss of all types, if the species responsible for depredation event is a wolf, cougar, grizzly bear, black bear or

eagle. Coyotes are not eligible predators in Alberta's compensation program. The compensation value is paid out at 100% for confirmed kills, based on CANFAX value, and 50% for probable kills. In addition veterinary care of injured livestock is also paid for up to the value of the market animal as determined using CANFAX data (AESRD 2011). The program does not compensate for indirect costs associated with missing animals or when there is insufficient evidence to confirm a claim.

A review of claims made from 2011-2013 to the Wildlife Predator Compensation Program in Alberta show average annual payment of $220,584. Claims were predominately made for wolf kills of feeders/yearlings and cows. There were very few claims submitted for calves, with an average of just over $1,000 paid annually in compensation for calf mortality due to confirmed depredation events. Our survey indicates producers are not reporting calf depredation events to AESRD, since 95% percent report losses of calves from depredation and there were only seven reported calf depredation events to AESRD, during the same time period. This notion of under reporting is further supported by the survey, where 62% of producers who report experiencing depredation events say they did not report the event to AESRD.

Under reporting may occur for a variety of reasons, one factor may be the rate of depredation events where coyotes are responsible for the event, because coyote are not an eligible carnivore in the Alberta Wildlife Predator Compensation Program landowners. Of the producers who report experiencing impacts from carnivores, 88% report coyote as the carnivore causing the impact, the next most impacting species was wolf at 42%. Muhly and Musiani (2009) in a study in the northwestern US, noted that 60% of calf depredation events were caused by coyote, while 60% of depredation events on mature cows were from black bear, wolves and grizzly bears combined. In Colorado, coyote were responsible for 80% of depredation events on cattle (Hoag et al. 2011).

These findings are supported by the AESRD compensation summary, where cows and feeders/yearlings were the most commonly compensated animal and the species most commonly involved in depredation were wolves causing 75% of the confirmed events, black bears caused 19% and grizzly bears and cougar caused 9% and 2% respectively.

Other reasons for under reporting mentioned by producers in the survey include concerns around the verification process, such as the burden proof and the number of cases where there is insufficient evidence to make the claim. Producers reported carcass may be found too late to enable verification or Fish and Wildlife did not show up in a timely fashion to confirm if the depredation was from an eligible carnivore species. A review of Alberta's program by Lyster (2008) noted that the verification process is an

important component of the program as it provides an audit trail to ensure funding by Alberta Conservation Association (the program's fiscal agent) continues.

Producers also expressed concerns in regard to the compensation polices and process, which many deem as cumbersome and time consuming, and there was a perception it is generally not worth the effort to apply. These issues suggest many producers feel the value received from compensation is not high enough to warrant their participation. This is a common issue of ex-post compensation programs around the world, and may be associated with program sustainability in that the amount of money available for compensation payouts is not enough and yet to fully address the losses may be financially unsustainable for the government (Vaclavikova et al. 2011, Nyhus 2005, Ogra and Badola 2008).

Producers mentioned the ineligibility of coyotes from the program as an issue of concern, and the majority of producers, 88%, reported coyote as the carnivore causing impacts. A review by Morrison (2012) of compensation programs in Canada and United States, indicate coyotes are compensated in a number of other programs, such as British Columbia and Saskatchewan. It is important to understand the goals of a compensation program, to determine if it is appropriate to include coyotes. For example, in Idaho and Montana coyote are ineligible as programs are designed as part of the recovery process for large carnivore restoration and traditionally have been funded by ENGOs.

Similar issues were expressed by landowners in a 2010 southwestern Alberta regional survey on perceptions and attitudes towards carnivores (Lee, 2010). In addition, the producers in that survey noted the issue of non-consumptive losses as not included in the existing compensation program, such as impacts on weaning weights, conception rates, and time to manage carnivore issues.
To address the issue of under reporting some compensation programs have developed a multiplier to account for depredation events not reported or not identified.

Indirect Costs

The current Alberta compensation program does not address indirect losses, such as the stress to livestock from sharing the landscape with carnivores, which impacts weaning weights and conception rates, increases the spread of diseases and increases time spent by the producer to address impacts from carnivores. By not considering these types of losses, compensation programs may be substantially under supporting producers for economic losses associated with coexistence (Steele et al. 2013). However, research into the cost of indirect impacts to the producer is limited (Laporte et al. 2010, Rashford et al. 2010).

This survey indicates that 74% of producers who experience depredation events are most concerned about increased time management needed to coexist with carnivores. Producers were moderately concerned about other indirect impacts, with 37% of survey respondents expressing concern about decreased weaning rates, 22% concerned about decreases in conception rates, and 23% about increases in disease transmission. These issues are likely more prevalent in geographic areas where livestock are sharing the landscape with multiple large carnivore species, such as wolves, black bears, grizzly bears and cougars.

Time management issues include increased time checking on animals, increased time repairing fences and other infrastructure damaged by carnivores and increased time required to confirm the depredation event (Lehmkuhler et al. 2007, Sommers et al. 2010). Survey results support these findings, with 39% of producers reporting spending on average 59 hours annually mending fences and 18 hours mending buildings and sheds damaged by carnivores. In addition, there were estimated annual costs associated with property damage including $551 per year for fence repair and $422 for building and shed repair. We did not ask about time spent on preventative measures. A research study by Hoag et al. (2011) used a value of 85.6 hours per year spent on prevention and management due to carnivores.

Steele et al. (2013) used literature and unpublished studies to estimate the indirect impacts of wolf presence on decreased weaning weights, decreased conception rates and increased disease transmission in Wyoming. That study found indirect effects of decreased weaning weights and conception rates had a substantial effect on producers' finances, while increase in disease transmission from carnivore species did not have the same impact. Although based on limited data, Steele et al. (2013) suggest predation pressure can decrease calf weaning weights by 2-10% (i.e., 4 to 22kg). They concluded that indirect costs may conservatively be greater than those of direct loss, and recommended a conservative multiplier around three times greater than the existing multiplier used in Wyoming which is 7:1 for wolves. In Wyoming, for every one confirmed depredation loss by wolves, producers are paid seven times the value. The authors noted they did not consider efforts or expenses by landowner to reduce impacts, which over time could reduce the depredation rate (Steele et al. 2013).

Compensation Multiplier

Under reporting and non-compensated losses, have resulted in other programs applying a multiplier to "confirmed" depredation events to more accurately compensate producers. One of the most comprehensive multipliers is in the state of Wyoming, where increasing tolerance towards wolves and grizzly bears is a wildlife management goal.

Confirmed calf kills by wolves are paid out at seven times the market value of a calf (USFWS 2011). Confirmed grizzly bear kills are paid out at 4.2 times market value of a calf to address unverified losses of cattle As mentioned previously, in an effort to fully compensation landowners, researchers in Wyoming worked out a multiplier of 18:1 or 24:1 (depending on the severity of wolf depredation) to address under reporting and indirect impacts of wolf depredation events. In Wyoming there were 44 annual total confirmed depredation events by wolves, using the multiplier of 18:1 that equates to a $577,399 annual payout from the compensation program. In Alberta there were 155 average annual confirmed wolf depredation events (2011-2013) and payout was $147,458, a multiplier of 18:1 on wolves would cost $2,654,244. This amount would likely challenge the sustainability of the program, an important consideration when discussing a multiplier.

When assessing economic costs of depredation to producers, Sommers et al. (2010) applied a multiplier of 3.8 for confirmed grizzly bear depredation kills while Hoag et al. (2011) applied a 2.5 multiplier to all confirmed depredation events in Colorado due to under reporting and then added a 1.6 multiplier to address indirect costs from depredation.

In 2013, the Waterton Biosphere Reserve Association Carnivore Working Group with the support of a graduate student developed a series of recommendations to improve the existing compensation program in Alberta. After extensive meetings with landowners, a multiplier of 2.5 of the cattle market value for all confirmed depredation events was suggested (Morrison 2013). The report outlines how the multiplier would address under reporting as well as off-setting costs to landowners of indirect impacts, such as property damage, producer time, reduced weaning weights and conception rates.

Concerns of ex-post compensation programs include program sustainability and needs to be carefully considered if a multiplier is applied to more fairly address costs associated with depredation (Steele et al. 2013). Other concerns are associated with the lack of preventative measures required to receive compensation and the notion that if full compensation is paid out as suggested by the multiplier of 18:1 for wolves in Wyoming, producers may become less diligent in implementing preventative measures (Steel et al. 2013, Agarwala et al. 2010, Naughton-Treves 2003).

Forage Losses

Producers report additional losses of forage from carnivores, most likely from bears. Although depredation is a significantly larger issue for most producers, 31% of survey respondents who reported having impacts from carnivores on forage oats report annual

average losses of oats at a market value of $1,074; 16% report losses of barley at a market value of $1,121; 21% report annual average losses of hay at a market value of $1,774; and 8% report losses of silage at a market value of $862 annually from carnivores. Producers report much greater forage losses due to ungulate species.

Losses from carnivores consuming forage are not compensated in existing compensation programs. For those producers impacted by forage losses it adds to the cumulative impact for those living with bears.

Prevention and management

Producers identified a number of key attractants occurring on the landscape that attract wildlife including 83% have hay yards, 60% swath feed, 38% have grain bins, 28% have livestock dead piles, 23% have silage pits, 18% have grain piles, 12% have grain bags and 9% have silage bags. Attractant management is important for reducing the impacts of carnivores on producers.

In southwestern Alberta, Urmson and Morehouse (2012) report on occurrence records (provided by AESRD) for grizzly bear incidence from 1999-2011and found 62% are due to grain and dead stock attractants on the landscape. In addition, Morehouse and Boyce (2011) found 85% of wolf scavenging in southwestern Alberta was occurring at dead piles. There is evidence that prevention and mitigation can reduce interactions and costs associated with carnivores. Wilson (2007) from the Blackfoot Challenge in Montana, worked with 48 producers and installed electric fencing around feed storage and removed dead livestock from the landscape through development of a pick-up program and composting system, effectively reducing incidences with grizzly bears by 91%.

To address impacts from carnivore species, survey respondents were asked to identify methods they have used for prevention and management. The most commonly stated method to reduce carnivore impacts include: 77% of producers have increased frequency of checking on animals, 75% of producers have removed dead livestock from landscape, 64% of producers have removed the problem wildlife animal and 62% have moved calving grounds closer to home. These activities require producers' time. In a study in Colorado, researchers used 85.6 hours of time spent on preventative management annually, they used a value of $12.00 hour, equating to $1,027 cost (Hoag et al. 2011).

Lesser adopted measures include: 42% of producers have implemented deterrents (e.g., light, sound), 30% use guardian animals, 22% have installed electric fencing around attractants, 12% have either replaced or renovated at least one grain bin.

To better understand the costs landowners have invested in prevention and management we reviewed a report developed by Loosen et al. (2014) that highlights a number of landowner projects in southwestern Alberta to manage carnivore attractants (2014). The Waterton Biosphere Reserve Association in conjunction with landowner partner groups and cost sharing with AESRD, have implemented electric fencing projects, grain bin renovation and replacement projects and dead livestock drop off bins and composting program. The costs associated with these programs are outlined in Table 22, as extracted from Loosen et al. (2014).

Table 22: Costs of attractants management projects.

	# of projects	**Minimum**	**Maximum**
Electric fencing projects	5	$2,492.00	$9,912.00
Grain bin renovation	6	$590.00	$2,414.00
Grain bin replacement*	5	$4,435.00	$32,811.00

* some grain bin replacements included 2 bins

The values in Table 22 include time in hours reported by producers and valued at $35.00 per hour. The survey responses suggest an average of $723 is spend on electric fencing annually, if we add in the estimated 48 hours of time at $35 per hour, our survey results suggest annual cost to install and maintain electric fencing is $2,403. In addition, the survey responses suggest an annual expenditure for those who have renovated grain bins to be $852 annually, if we add in the estimated 14 hours of time at $35, the annual costs associated with grain bin renovations is $1,342.

The same partnership has also implemented a dead stock bin program enabling producers in the M.D. of Pincher Creek and Cardston County to drop livestock carcasses at one of twelve bins. The cost to purchase and set up the 12 bins was $31,000 (Loosen et al. 2014). In addition Cardston County and AESRD have partnered to develop a composting plant for livestock carcasses in southwestern Alberta. The cost to run the composting program is $20,000 annually and includes pick up of carcasses at the bins. It should be noted that there have been some problems associated with what to do with the composted soils due to concerns over specified risk material (SRM) content and the composting facility was closed for some time in 2014.

Wilson (2007) highlights the importance of investing in attractant management to help reduce the impacts of wildlife on producers. The Blackfoot Challenge in Montana and

efforts in Southwestern Alberta have included cost sharing between the government, NGOs and landowners. These working models have shown success in reducing attractants and therefore incidences with carnivores and highlight the importance of programs to support landowners implementing attractant management initiatives.

Discussion: Ungulates

Similar to Conover et al. (1998) study, where 80% of farmers reported damage from ungulates, survey responses indicate that 81% of producers in Alberta experience impacts from ungulate species. We assessed the direct loss of forage and stored feed to beef producers from ungulates based on survey responses. In addition, we evaluated the level of concern associated with disease transmission and documented efforts on prevention and management activities to reduce impacts from ungulates. We did not address other non-feed impacts, such as property damage, which has been identified as a concern in other studies, although feed related impacts represent the primary concern (Lacey et al. 1993).

Loss of forage can have a have a significant monetary impact on beef producers (Hoag et al. 2012, Torstenson et al. 2002, Lacey et al. 1993), for example the total cost of ungulates due to forage competition in Colorado State was estimated to represent $32.5 million annually (Hoag et al. 2012). In Alberta, of the 81% of producers who reported having ungulate damage, 70% reported experiencing competition in forage crops as an impact. Similar to Irby et al (1996) our study shows white-tailed deer and mule deer as most commonly involved in forage competition and damaging stored feed. This is not surprising as both deer species are widely distributed across the province. While the response rate was not high enough to assess the survey results on a regional basis, there were areas where elk impacts were greater than deer.

The majority of producers reported forage competition losses of hay, barley and oats from ungulates. Calculations generated from producers reporting annual losses averaged to $5,460 in barley value, $3,647 in oat value and $3,355 in hay value. Although, as similarly reported by Rollins et al. (2004), impacts in Alberta are borne unevenly across ranches, with some respondents reporting up to 83% loss of forage crop. It is difficult to determine if the values generated from this survey are comparable to other regions, but in Southwestern Montana, a study assessing the economic impact of elk on five ranches in 2002 due to forage competition ranged from $5,949 to $21,152, equating to between $8.55 to $14.51 per animal unit month (AUM) (Torstenson et al. 2002).These losses are primarily a concern when the beef producer’s threshold of acceptable loss is exceeded.

To address the challenge of losses due to forage competition with ungulates the Alberta Financial Services Corporation (AFSC) offers a wildlife compensation for crops program. Of the survey respondents who reported experiencing losses due to forage competition, 80% did not apply for compensation through AFSC. The top four reasons beef producers said they did not report were a perception the return was not worth the investment in time, losses were deemed acceptable, a perception they needed to be insured to apply for the program, or they were not aware of the program.

In 2012, AFSC paid out over $5 million dollars due to wildlife damage on crops in Alberta. This value represents all crops (cereal, forage, and fruit) but we are primarily interested in damage and loss to forage crops grown by beef producers. A ten year summary provided by AFSC indicates that approximately $10 million was paid out to farmers reporting forage crop damage, suggesting approximately $1 million annually paid out due to forage crop loss.

In Alberta, 70% of producers who reported impacts from ungulates experienced loss of stored feed. Similarly to forage competition, white-tailed and mule deer were the main concerns from a provincial perspective. Ninety nine percent of producers reported losses of stored hay, with an average annual value of $2,021, 64% reported losses of silage with an average annual value of $3,113, 57% reported losses of stored oats with an average annual value of $1,994 and 54% reported losses of stored barley with an average annual value of $2,264. As with VerCauteren et al. (2003) we did not find any citations on the economic costs of stored feed loss from ungulates.

A concern expressed in the literature is the potential loss from collateral damage of ungulates feeding on stored feed, for example if an ungulate breaks the plastic of a silage bag the feed is exposed to water, possibly resulting in spoilage (VerCauteren et al. 2003) or livestock sharing feed with an ungulate that may be a carrying a pathogen which increases the risk of disease transmission (Palmer et al. 2004).

Alberta offers compensation for losses of some types of stored feed through the wildlife damage and compensation on hay stacks program administered by AFSC which compensates for losses of stacked hay and haylage in pits and tubes. Within this program, AFSC links preventive action to compensation payout, proving an incentive for producers to mitigate the issue. As with forage competition, 80% of producers do not report losses to AFSC, for similar reasons as stated previously, the notion that the return is not worth the effort, losses were deemed acceptable, unaware of potential help and perception that they need to be insured to apply for program.

Another concern expressed by 55% of beef producers who identified experiencing ungulate impacts was about disease transmission from wildlife to livestock. The main diseases mentioned as a concern included 54% concerned about chronic wasting disease, 21% about brucellosis, 12% about tuberculosis, and 10% diseases caused by ticks.

Rhyan and Spranker (2010) note there is limited understanding of disease process and how to manage the wildlife-livestock interface. Miller et al. (2013) suggest an increased role of wildlife in human and livestock diseases due to changes in land use resulting in encroachment into wildlife habitat, increases in intensive livestock production, and increases in ungulate populations leading to more interaction with wildlife (Jones et al. 2008). In addition, pathogen transmission is bi-directional between livestock and wildlife; both bovine brucellosis and tuberculosis were passed historically from livestock to wildlife (Miller et al. 2013) making eradication complicated. Livestock diseases with a wildlife connection present in the United States that impact cattle in are listed in Table 23.

Table 23: Adapted from Table 2 in Miller et al. (2013).

Disease	**Wildlife host**	**Transmission**
Anthrax[c]	All mammals susceptible, environmental reservoirs	Direct
Bluetongue[sc]	Wild ovine species[a], cervids[a], pronghorn[a]	Arthropod-borne
Bovine anaplasmosis[c]	Cervids[r]	Arthropod-borne
Bovine babesiosis*	White-tailed deer[s]	Arthropod-borne
Bovine genital campylobacteriosis[c]	numerous[r]	Direct, indirect
Bovine tuberculosis[c]	White-tailed deer[r], feral swine[r], numerous spillover hosts	Direct, indirect
Bovine viral diarrhea[c]	White-tailed deer[r], mule deer[s], pronghorn[s], elk[s], moose[s], bison[s]	Direct, indirect
Brucellosis[c]	Bison[r], elk[r], numerous spillover hosts	Direct, indirect
Epizootic hemorrhagic[c-sc]	White-tailed deer[r], mule deer[s], pronghorn[s], other wild ruminant species[s]	Arthropod-borne
Paratuberculosis[c]	Wild ruminants[r], rabbits[r], wild mammals	Direct, indirect
Q fever[c-sc]	Numerous species including mammals[r], birds[r], and reptiles[r]	Direct, indirect, arthropod-borne
Vesicular stomatitis[c]	Numerous wildlife species susceptible including mammals and birds, reservoir species unknown	Direct, indirect, arthropod-borne

*Bovine babesiosis is not present in US cattle but the causative agent has been reported in wildlife.

[c] – clinical in cattle

^{sc} – subclinical in cattle
^{r} – reservoir
s - spillover

The direct and indirect economic cost of eradicating or managing diseases that can be transferred from wildlife ungulate populations is difficult to acquire (Miller et al. 2013). A few studies have looked at specific disease, such as the Michigan Department of Natural Resources which reported spending $15 million to define the extent of the bovine tuberculosis and an additional $23 million to manage the disease (O'Brien et al. 2011).

To address the impacts caused by ungulates such as forage competition, stored feed damage and loss and disease transmission, 85% of producers report implementing management activities to reduce ungulate impacts. There were a number of strategies producers reported implementing to reduce impacts, but none of the listed suggestions were implemented at a high rate. The most common management practice was 37% of beef producers reported installing electric fencing around stored feed, followed by 38% of beef producers who avoid using silage bags or pits. Thirty percent (30%) of beef producers reported putting out alternative feed sources to draw wildlife away from stored feed and 22% said they have changed their business practices to reduce impacts. Some other less commonly mentioned strategies included fencing off stored feed, allowing hunters onto land to reduce herd size and using deterrent or frightening devices (e.g., light or sound) or dogs to scare animals away.

It appears that more can be done by beef producers in relation to reducing ungulates access to attractants, especially around stored feed. In addition, more analysis on the effectiveness of techniques currently being employed would be beneficial. Research by VerCauteren et al. (2005) reviewed non-lethal techniques for controlling ungulates, including motion activated lights and noises, both of which proved to be completely ineffective at moving ungulates away from stored feed. However, Vercauteren et al. (2008) found that guardian dogs were effective at addressing two ungulate impacts: firstly, dogs reduced the frequency of deer feeding on concentrated cattle feed (haystacks) which in turn reduced economic losses. Secondly, dogs reduced the number of interactions between cattle and wildlife and therefore reduced the risk of pathogen infection through a shared feed source.

In Alberta, the government addresses impacts from ungulates to beef producers through AFSC compensation programs aimed at addressing forage loss and stored feed losses from ungulates and through wildlife management, where the primary tool is hunting to reduce populations. Research suggests that the risk of crop damage/loss is

influenced by ungulate densities; distance from cover (with forage crops further from cover less at risk) and type and location of the forage crop (Nixon et al 1989, Yoder 2002; Hegel et al. 2009). There is some recognition that to effectively address forage loss from ungulates there is a need to better understand the population structure at the subpopulation level to ensure management actions are aimed at the individuals causing the most damage as exemplified in the following case study (Hegel et al. 2009).

In the Cypress Hills of southeastern Alberta elk cause damage and loss of forage crops and stored feed as well as property damage on private lands highlighting the complexity of addressing these issues (Hegel et al. 2009). Three decades of issues has resulted in a low tolerance level toward elk in the region, potentially reducing acceptance of other wildlife conservation efforts in the region as well. The approach to address these challenges includes government support for fencing, compensation for loss, and population reduction through hunting. Hegel et al. (2009) proposed mitigation could be more effective if landowners change land use patterns, such as the location and choice of specific crops. In addition, these authors suggest that hunting problem wildlife is more effective if wildlife managers have an understanding of the wildlife population structure at a local level (subpopulations) to enable wildlife managers to target specific problem animals or animal groups (Hegel et al. 2009).

Although ungulates impact beef producers in Alberta, the level of impact varies across the province and is tied to ungulate densities, distance from cover, types of crops grown and to a certain extent the actions of the producer to reduce attractants. Some producers expressed the level of loss is acceptable while for others it is clearly not, again highlighting the need to address this issue in the local context.

Discussion: Birds

Although birds can contribute positively to beef operations, through provisions of ecosystem services such as pest control, they can also cause impacts from predation on livestock, forage crops and stored feed and may contribute to disease transmission (Triplett et al. 2012, Depenbusch et al. 2011, Carlson et al. 2011). In Alberta, 44% of survey respondents report experiencing some form of impact from birds.

Of those 44% who reported impacts from bird species, the biggest concern was the loss or injury of cattle from birds. Producers reported problems with ravens, magpies, eagles and hawks causing death or injury of cattle, mostly to calves shortly after birth. Ravens and magpies will sometime pick the eyes out of newborn cattle and may pick at open wounds, which can lead to infection and, in some cases, death (Hall 1994). Producers who experienced loss were asked to identify the percentage of the calves impacted by birds and reported an average of 2.4% of their calf herd injured or lost due to birds. Only

eagle depredation events are compensated for under the Alberta Livestock Predator Compensation Program. From 2011 to 2013, there was one confirmed depredation event by an eagle of a cow, with a payout of $756. All other bird species depredating on calves are not eligible for compensation in Alberta.

Programs in other areas that report loss or injury of cattle due to bird depredation, report challenges associated with lack of evidence that the animal was killed by the bird versus being scavenged after death (Margalida et al. 2014). A study on vulture depredation on cattle in Europe found that 69% of all reported events were not compensated due to lack of evidence.

Other key issues associated with birds include forage competition and damage and loss of stored feed (Allen et al. 2012, Shwiff et al. 2012). Producers who reported impacts from birds identified losses of barley, oats and hay. Table 24 summarizes the percent of producers who experience bird impacts that report loss of the different types of forage and the approximate value annually in dollars of the loss.

Table 24: Summary of forage losses from birds on Alberta beef operations impacted by birds.

Forage type	% producers reporting loss	% loss from birds	Value of forage lost per producer
Barley	64	4.24	$2,178
Oats	60	5.53	$1,679
Hay	42	0.68	$423

Other concerns include wild birds causing damage through consumption of livestock feed (Depenbusch et al. 2011, Schwiff et al. 2012, Twedt and Glahn 1982). Producers who reported impacts from birds reported losses of stored silage, barley and oats. Table 25 summarizes the percent of producers who experience bird impacts that report the different types of stored feed loss and the approximate value annually in dollars of the loss.

Table 25: Summary of stored feed losses from birds on Alberta beef operations impacted by birds.

Stored feed type	% producers reporting loss	% loss from birds	Value of stored feed lost per producer
Barley	31	1.34	$1,401
Oats	34	3.47	$1,234
Hay	27	2.03	$983
Silage	42	1.75	$1,931

Other concerns that were not explored in this survey, but that are documented in the literature include indirect impacts on nutritional health of cattle due to birds selecting highest quality feed and increased operation costs trying to manage bird impacts and transmission of diseases (Allen et al. 2012, Carlson et al. 2011).

Although impacts from wild birds are less than those reported for ungulate and carnivore, there appear to be cases in Alberta where beef operations experience a high level of impact from birds predating on cattle and consuming forage and stored feed. Although it appears the percentage of beef producers impacted by birds is low, there may be cases where by individuals experience more extreme impacts, and bare a significant financial burden. These cases are important in relation to tolerance of wildlife species and for compensation programs designed with an objective to reduce the economic impact from depredation on livestock, forage and stored feed by birds.

Economic Loss Scenarios: Four Ranches in Alberta

To better understand the economic losses described throughout this report, we present four economic loss scenarios applying the provincial average to four ranches randomly selected from the surveys. The purpose of the scenarios is to provide the individual beef producer with an understanding of the costs attributed to the producer from wildlife using values developed from the survey. This assessment does not include an evaluation of the total impact to each individual producer based on their gross receipts. Therefore we are not able to calculate the percent economic impact from wildlife to individual beef operations. In addition, numerous indirect costs are not included in this assessment, including indirect impacts from carnivore depredation, competition between ungulates and livestock on native prairie, time management involved in managing for wildlife and costs associated with preventative measures invested in by the landowner. Nor do the scenarios account for efforts by AESRD and AFSC to compensate landowners for wildlife impacts.

Four beef producer individual situations were selected from the survey. Selections were drawn randomly from zones 2, 3, 7 and 9; these zones were selected because they had the highest response rates. In addition, a filter was applied to the data to randomly select only from full time producers, with completed survey responses and at least one identified species type (carnivore, ungulates and birds) causing impacts.

Dollar values used in the scenarios were calculated using mean values from survey responses that appear throughout this report.

ALBERTA PRODUCER 1

Producer 1 reports carnivore depredation events have occurred on calves (120 head), but not on cows. The producer reports not having feeders/ yearlings or bulls. The producer also reports loss of forage barley from carnivores and fence damage.

Producer 1 did not experience ungulate impacts. But the producer does report losses from forage competition with barley and stored feed barley losses from birds. Table 26, highlights the economic losses associated with these impacts. Details of the calculation can be found in appendix 2.

Table 26: Producer 1 annual losses due to wildlife impacts.

Carnivore	$3,766
Ungulate	$0
Bird	$3,745
Total Cost of Wildlife Impacts	**$7,511**

ALBERTA PRODUCER 2

Producer 2 reports carnivore depredation events have occurred on calves (500 head), but not on feeders/yearlings, cows or bulls. The producer does not report any losses of forage or damage to property from carnivores.

Producer 2 did experience ungulate impacts, relating to competition on forage hay crop, but reported no losses of stored feed. Producer 2 also reported depredation on calves from birds, but no forage competition or stored feed losses. Table 27 highlights the economic losses associated with these impacts. Details of the calculation can be found in appendix 2.

Table 27: Producer 2 annual losses due to wildlife impacts.

Carnivore	$8,723
Ungulate	$3,355
Bird	$4,362
Total Cost of Wildlife Impacts	**$16,440**

ALBERTA PRODUCER 3

Producer 3 reports having no carnivore or bird impacts, but reports damage from ungulate associated with competition with forage hay crops. Table 28 highlights the economic losses associated with this impact. Details of the calculation can be found in appendix 2.

Table 28: Producer 3 annual losses due to wildlife impacts.

Carnivore	$0
Ungulate	$2,021
Bird	$0
Total cost of wildlife impacts	**$2,021**

ALBERTA PRODUCER 4

Producer 4 reports carnivore depredation events have occurred on calves (45 head), but not on feeders/yearlings, cows or bulls. The producer also reports forage oat crop losses and fence damage from carnivores.

Producer 4 also reports ungulate impacts, relating to competition on forage hay crop and stored hay. The producer reports no impacts from birds. Table 29 highlights the economic losses associated with these impacts. Details of the calculation can be found in appendix 2.

Table 29: Producer 4 annual losses due to wildlife impacts.

Carnivore	**$2,383.09**
Ungulate	$5,376
Bird	$0
Total Cost of Wildlife Impacts	**$7,759**

SUMMARY OF SCENARIOS

The economic loss scenarios help to place the costs associated with wildlife impacts into the perspective of an individual producer. The range from $2,021 to $16,440

illustrates the range of possible economic impacts associated with wildlife and support the understanding that wildlife impacts are not borne evenly among producers around Alberta.

What can Beef Producers do to Reduce Wildlife Impacts?

In order to provide guidance on improving coexistence between wildlife and beef producers, beef producers were asked to share ideas on how they can reduce livestock wildlife conflicts. Instructions requested participants to describe strategies or solutions to reduce the impact of wildlife on beef operations and to support coexistence of livestock and wildlife.

There were 337 responses, which were coded using HyperResearch software. Through a qualitative assessment, each response was reviewed and coded to a number of representative statements. Responses that were not solution or strategy oriented were not considered in this analysis. In addition, a single response could represent multiple strategies or solutions and therefore may be linked to multiple codes in the assessment.

Once all responses were assessed, the codes were reviewed and five theme areas emerged that represent broad solution areas for consideration. The four themes included:

1. Population reduction strategies;
2. Management by beef producers;
3. Improvement or changes to government planning and regulations; and,
4. Improved co-management opportunities.

To determine the frequency of each theme, representative codes for each theme were summed (Figure 30). Each theme area and representative code is described in more detail below.

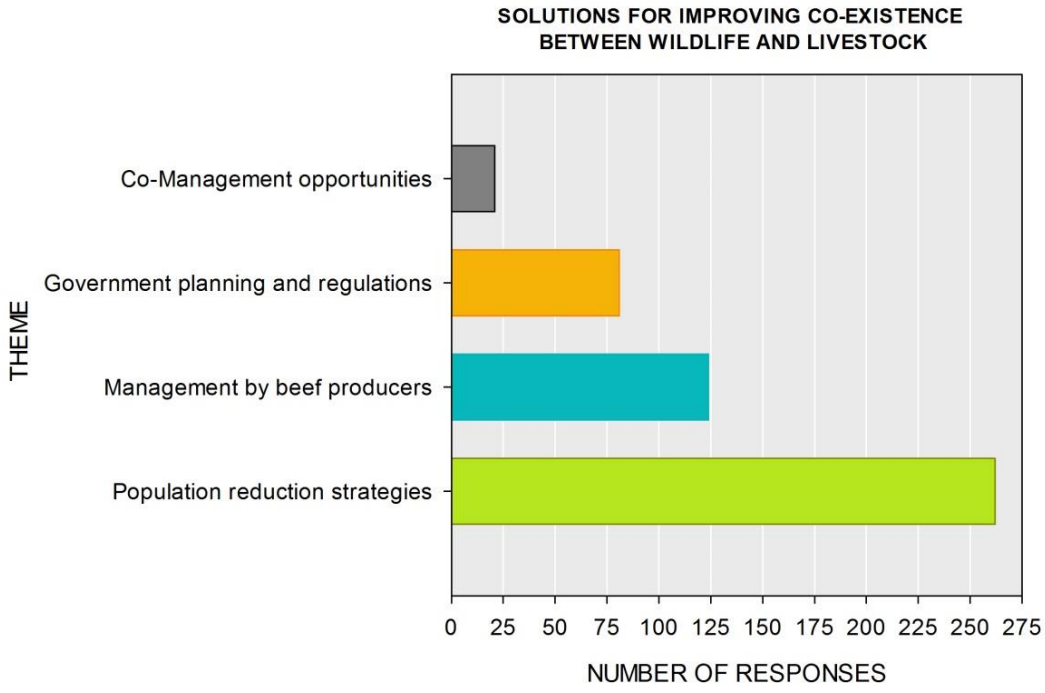

Figure 30: Solutions for improving the coexistence of wildlife and beef producers.

Population Reduction Strategies

The primary solution, with 262 responses, was strategies aimed at reducing wildlife populations involved in interactions with livestock or livestock forage/feed. Codes that were representative of this theme are displayed in Figure 31. Within this theme, survey participants called for a **reduction in populations, especially ungulates**, where populations are high and negative interactions with livestock are common. The primary strategy suggested reducing wildlife populations included changes to **existing hunting regulations**, with an increase in hunting tags and lengthening of the hunting season, as the most common suggestions.

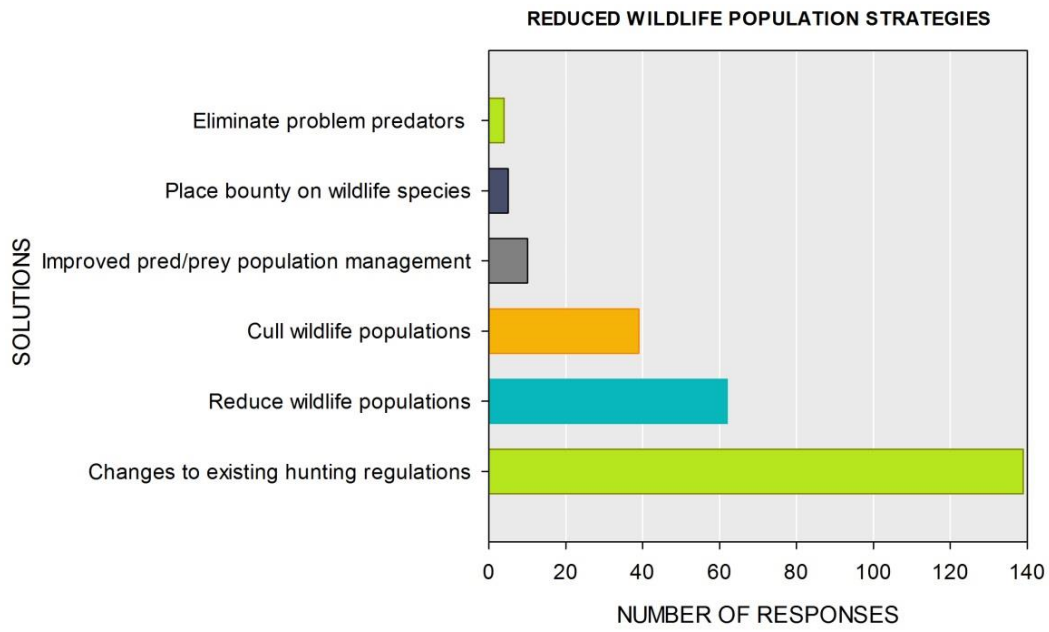

Figure 31: Strategies to reduce wildlife populations.

In addition to hunting, some producers suggested an organized **cull of specific herds** in over populated areas.

Other suggestions related to wildlife management, included **improved monitoring of wildlife populations, placing a bounty on problem wildlife** and **removal of problem predators**.

Management by Beef Producers

Many survey participants (125) recommended management practices that producers can implement to reduce interactions with wildlife. The most commonly suggested management practices, as displayed in Figure 32, related to feed management and animal husbandry practices.

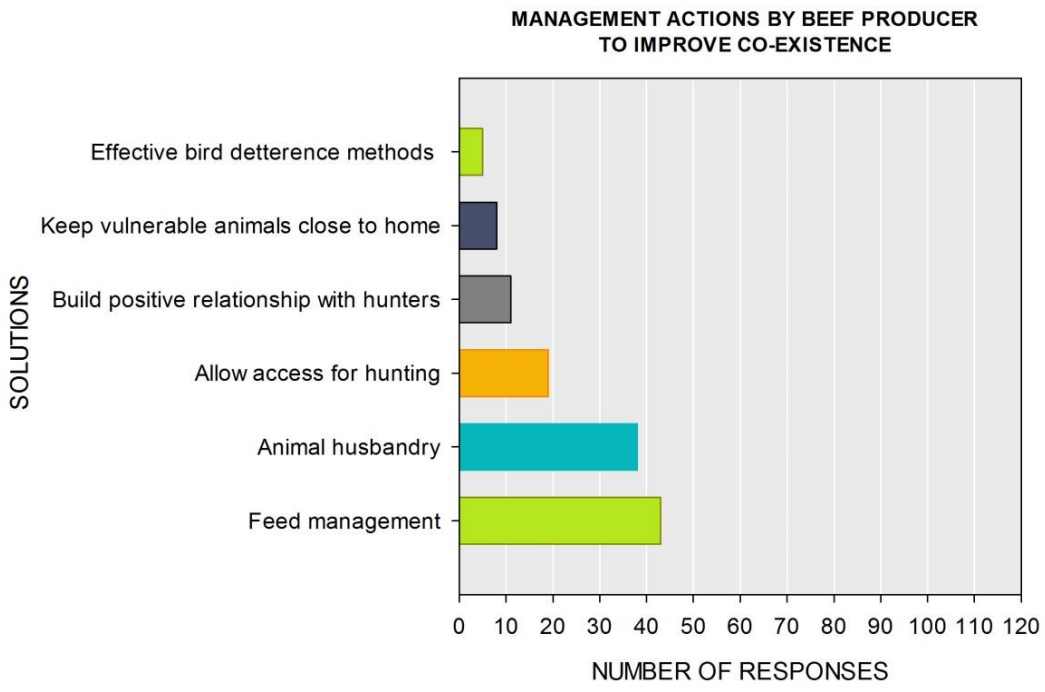

Figure 32: Management actions to improve coexistence with wildlife.

The **Feed management** code referred primarily to feed storage, such as use of game fencing. The following suggestions were also provided: keeping storage areas close to home; renovating grain bins; strategic bale stacking; shift to conventional feeding from swath gazing in particular during the snow season; and stop foraging in wildlife habitat.

Animal husbandry practices categorize a range of effective activities producers implement to minimize the wildlife damage on their property. They include but are not limited to having guardian dogs, and immediate removal of dead livestock & other attractants.

GOVERNMENT PLANNING AND REGULATIONS

A number of survey respondents (80) suggested improvements to existing government programs or regulations or the development of new programs. These include solutions related to improvements to existing compensation program, implementing a performance payment scheme, and improved land use planning (Figure 33).

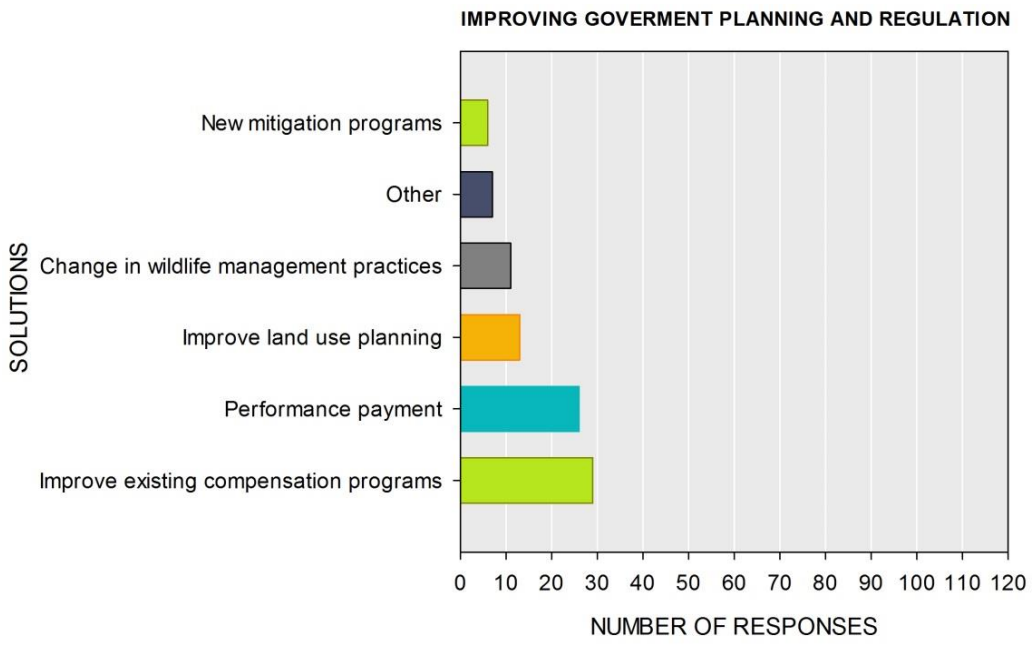

Figure 33: Actions for improving government planning and regulations.

The responses for **improving existing compensation programs** included the need to provide more compensation in return of the time and money the producers spend remediating and/or preventing wildlife conflicts. The current compensation procedure needs improvement as it is deemed insufficient in covering the economic impacts of wildlife. Some participants felt simplifying the process to prove predation would be helpful.

Another suggestion was to explore the concept of **performance payments** such as an ecological goods and services payment or environmental rebate on taxes for promoting coexistence. Up to 60 percent of the responses in this category think there needs to be more economic incentives in return for providing habitat and food for wildlife. Subsequently, alleviating habitat loss for wildlife through **improved land use planning** was the third most frequent code of this theme.

Changes in wildlife management practices included increase monitoring of wildlife population, removing translocations as a management action for addressing problem wildlife and increase funds for wildlife management.

A few survey participants suggested development of new and improved **mitigation programs** including cost sharing efforts to reduce wildlife and livestock interactions, such as fencing around stored feed, replacing grain bins. In addition, producers suggested support for development of a deadstock removal program.

The code “others” included the following responses: higher trespassing fines for hunters; more government staff; and fines for “inappropriate” ranching practices.

CO-MANAGEMENT OPPORTUNITIES

A less prominent theme included solutions relating to improved wildlife co-management opportunities. This theme focused on the need for flexibility in managing problem wildlife and some survey respondents expressed the need for more rights and freedom in dealing with errant wildlife on their property.

In summary, the majority of responses to this survey question acknowledged the impact of wildlife to be the problem and requested measures be taken to address losses. The survey responses outlined that while beef producers are taking mitigation measures to minimize the impacts of livestock wildlife conflict, a majority of beef producers believe in order to reduce conflicts with the ranching community, the government, specifically AESRD should adopt the following measures: adopt wildlife population reduction strategies, make significant improvements in areas of planning and regulations, and grant the producers more rights and freedom in dealing with errant wildlife**.**

CONCLUSION

This research was developed to improve our understanding of the interactions between beef producers and wildlife and the economic impacts of wildlife (ungulates, carnivores and birds) on beef producers in Alberta. Costs associated with wildlife include economic losses associated with depredation and forage competition loss, property damage and prevention and management actions. Our methods included the development of an online survey that was shared by ABP representatives, local media and word of mouth across Alberta. Because it was not possible to randomly select a sub-section of producers, results are subjected to voluntary response bias, whereby the survey may have attracted more individuals who have strong opinions on either side of an issue.

There were enough survey responses to statistically analyze the results from a provincial perspective but we were not able to assess results per ABP zone to better understand regional differences. In addition, the questions pertaining to economic losses enabled us to calculate average individual loss per type of wildlife damage per annum, but we were unable to determine the impact on the producers’ livelihood. In addition, the number of responses where producers provided economic values was low, reducing the reliability and our ability to provide a provincial perspective on costs of wildlife to producers. Despite these drawbacks, the survey results provide valuable

contextual information about the impact of wildlife on beef producers, and are a good starting point for understanding costs associated with the different types of impacts. The majority of producers in Alberta experience impacts from wildlife, with 81% of survey respondents reporting impacts from ungulates, 74% from carnivores and 44% from birds.

Although producers experience impacts from wildlife, the majority value and want to see healthy populations of ungulates and carnivores on the landscape and feel that living with wildlife is a part of doing business. However, a majority of producers agree with the notion that costs associated with living with wildlife are borne unevenly on producers and when these costs are judged to be too high most producers deal with problem wildlife themselves.

There was very little agreement amongst producers on whether the current level of economic loss is tolerable. This likely has to do with a multitude of factors impacting a person's individual experiences, personal values, costs of impacts and species causing the damage.

A further analysis on the total annual percentage of economic loss a producer was willing to accept, found that half of the producers were willing to accept between 1 to 5% in economic loses in a given year because of wildlife, while the other half were willing to accept less than 1% in losses. However, if should be noted a number of individuals reported they would not accept any economic loss.

To evaluate the key impacts from different wildlife types, we asked producers to identify and quantify impacts from carnivores, ungulates and birds. A primary impact to beef producers in terms of the number of producer's impacted and economic losses was forage competition with ungulates on hay, barley and oat crops. A majority of beef producers also report depredation of cattle by carnivores as a key issue, primarily losses of calves. The total economic losses represent 0.02 percent of cattle value in Alberta.

Two biggest data gaps in the research relate to the cost of indirect impacts from carnivore depredation and costs associated with management and elimination of disease transmission between cattle and wildlife. Indirect impacts from carnivores include increases in time management for the producer, property damage, decreased weaning weights and decreased conception rates. Recent research in Wyoming focused on the indirect effects of wolf depredation suggest the indirect costs are likely more than the direct costs and suggest using a multiplier on confirmed depredation events to compensate landowners for these losses.

A common finding in our study is the notion that costs are borne unevenly amongst producers, with a small percentage of producer reporting extreme losses. For example, seven percent of individuals who reported experiencing calf depredation, reported losses higher than 5% while the average producer experienced 2% losses in a given year due to depredation. These cases of extreme loss may be of importance for development of programs to compensate individuals for heavy losses to help maintain tolerance towards wildlife and support coexistence. Although birds were not identified as a concern for the majority of producers, a few individuals report extremely high percent losses of forage crops.

To address economic impacts the Government of Alberta has developed compensation programs. To address depredation losses, AESRD pays out about $200,000 annually to beef producers and AFSC pays out approximately $1 million annually for ungulate damage to forage crops. However, survey results indicate the majority of survey respondents (62%) don't report to the Wildlife Predator Compensation Program and 80% don't report to the AFSC programs to address forage competition and stored feed loss.

Some of the key reasons for not reporting included the burden of proof being too great, the investment in time not being worth the return, losses not considered high enough to report, impacts not eligible (coyote depredation event) and a perception that nothing will be done based on past experience. The current compensation programs are areas where improvements may need to be considered. For example, other programs have addressed issues with verification and under reporting by applying a multiplier to confirmed depredation events.

Beef producers identified a number of management actions implemented to reduce access to attractants and improve coexistence with wildlife. The majority of beef producers who reported impacts from carnivores have implemented some form of prevention or attractant management; including in order of highest number of producers, increased time checking on livestock, removing dead livestock from the landscape, dealing with the problem animals themselves and moving calving grounds closer to home. Interestingly, less than a half of producers had implemented management actions to address impacts from ungulates, such as fencing off stored feed, avoiding silage bags and pits, providing an alternative feed source and changing business practices.

When asked how to improve coexistence with wildlife, producers identified four strategies: reducing problem wildlife populations, improved management by beef producers, changes or improvements to government planning and programming, and

improved co-management opportunities. Although the top two suggestions, relate to current status quo for addressing problems with wildlife, there were also a number of innovative suggestions including changes to the current compensation programs, exploration of an ecosystem goods and services approach where producers are compensated for providing high quality wildlife habitat, improvements to land use planning in relation to wildlife habitat and consideration for a new mitigation program to cost share efforts to reduce attractants.

It is challenging to estimate the total costs for an average producer in Alberta, because no two producers have the same operation. Half of producers report they have reached their economic tolerance due to wildlife and once that tolerance is reached they remove the problem animal themselves. It is to the advantage of Albertans and the Government of Alberta to work with producers to reduce impacts and improve tolerance levels, specifically for species of management concern.

IMPACTS OF WILDLIFE RESEARCH GAPS

- This study did not consider the value of wildlife to society or to producers in economic terms, other studies have shown the costs of wildlife to producers are greatly outweighed by the value wildlife provides to society.

- This study did not fully assess the contribution made by the government of Alberta to assist producers with reducing impacts from wildlife. An analysis in Colorado, which assessed the investment by the state in programming to reduce wildlife impacts on agriculture, reported the total value of the programming to be *$14,478,523*. However, despite this spending, the total costs to agriculture associated with wildlife impacts was estimated at *$77,162,499*, indicating the government is addressing approximately 20% of the costs associated with wildlife (Hoag et al. 2012).

- Indirect impacts of depredation from carnivore on livestock are only starting to be understood. Initial research suggests the indirect costs associated with depredation, such as producers' time, decreased weaning weights and conception rates may be greater than the direct value of the livestock loss.

- Costs from wildlife are borne unevenly amongst producers in Alberta, with those living in areas with a variety of carnivore and ungulate species likely experiencing a greater degree of impact. The current study was not able to identify areas within the province where impacts are greater.

- Cost benefit of the value of implementing prevention and management initiatives has not been assessed.

- The competition between ungulates and livestock on native pasture was not assessed during this research. Some landowners expressed concern that competition with ungulates on native pasture is their largest economic impact.

- Research into the indirect impacts on nutritional health of cattle due to birds selecting highest quality feed, increased operation costs trying to manage bird impacts and transmission of diseases is limited and needs to be further investigated.

- Impacts from beavers that result in economic losses were not included in the survey, but were mentioned by a few producers in the survey and at ABP 2015 fall meetings as a concern.

- The costs to reduce disease transmission between wildlife and livestock (e.g., surveillance, animal management, etc.) are important to understand for individual producers and the industry. This is not captured in this study.

NEXT STEPS – CONSIDERATIONS FOR FURTHER CONVERSATION

The desire for coexistence between wildlife and people who make their living off the land, such as beef producers, is complicated by a myriad of issues. Wildlife is a valued public resource that relies on both private and public landscapes. While private landowners of working landscapes usually enjoy living among wildlife, their businesses may also be negatively impacted (often financially) as a result of wildlife on their land. The scope and scale of wildlife producer interactions is broad and diverse and ultimately maintaining healthy wildlife populations will depend on how a producer views the issue and the actions they take to address problems with wildlife. This study specifically illustrates wildlife impacts to beef producers, an important stakeholder in the discussion around wildlife issues in Alberta. It is intended to stimulate awareness and promote discussion on wildlife issues as they relate to individual beef producers in Alberta.

The results of this study could be used to lay the foundation for the development of an ABP work plan to move this discussion forward with policy makers, program designers, wildlife proponents, agricultural community and the public in an effort to create a beneficial situation for wildlife and those that are impacted by them. A work plan could

include three sections: 1) Communications and Outreach, 2) Collaboration Efforts and 3) Further Research.

1. Communications and Outreach

   The results of this survey help to provide context to the discussion on the impacts of wildlife to beef producers. The survey results help to establish an understanding of which impacts are most concerning to beef producers, a baseline on individual producer losses from wildlife, and evidences that producers want to be a part of the solution for reducing impacts. Steps forward could include:

   a. The need to communicate with the public about the impacts of wildlife to beef producers in general, and more specifically the potential for severe impacts of wildlife to some individual farming operations and the lost value this can incur to an individual This report could be used to facilitate public education and discussion around this issue

   b. There is an opportunity for industry groups (e.g., ABP and other producer groups) to support education and outreach efforts to ensure producers understand the value and process of compensation programs offered by Alberta Environment and Sustainable Resource Development (AESRD) and Agriculture Financial Services Corporation (AFSC).

   c. There is an opportunity for industry groups (e.g., ABP and other producer groups) to support education and outreach efforts about preventative measures especially for producers in areas who are experiencing new or increased impacts from wildlife. Many Agricultural Research and Extension Council of Alberta (ARECA) members and municipalities already include such items in their newsletters or support workshop so there may be some opportunity to support and collaborate with those efforts.

2. Collaboration Efforts

   The results of this survey as mentioned above provide valuable context for enabling discussion with agencies and other non-government organizations that are responsible for wildlife management or are working to address reducing impacts on the landscape. Numerous questions in the survey evaluate producer attitudes toward existing government programs aimed at reducing wildlife impacts

to producers. In addition the survey results provide suggestions for improvement to existing and the establishment of new programs. Next steps include:

a. Sharing the results with organizations in the province involved with wildlife and associated issues. This includes Alberta Environment and Sustainable Resources (AESRD) - Fish and Wildlife, the Alberta Fish and Game Association (AFGA), the Alberta Conservation Association (ACA), Hunting for Tomorrow, the Agriculture Financial Services Corporation (AFSC), Environment Canada, and others including but not limited to hunters and trappers.

b. Establishing clear goals and/or objectives regarding existing and or new programming and policy in Alberta (e.g., healthy wildlife populations, targeted wildlife species, reduction of financial burden, etc.).

c. Current compensation programs are not reflective of the amount of financial loss being incurred by agricultural producers. Farmers and ranchers are interested and willing to work with the community to address wildlife issues affecting their livelihoods. Discussions should be initiated with a multi-stakeholder group to better support private landowners who support wildlife and their habitat (benefitting a public good). This could be in the form of additional compensation or some other mechanism.

d. A provincial stakeholder working group could mimic the program in SW Alberta where the government, through Alberta Environment and Sustainable Resource Development (AESRD), financially supported a program to help producers implement mitigation measures to reduce conflicts with large carnivore species. Mitigation actions included electric fencing stored feed, bear-proofing grain bins and developing carcass removal programs. These initiatives are supporting co-existence by reducing carnivore and ungulate attractants on the landscape and the SW Alberta model could be explored for other areas in Alberta where conflicts are high.

e. Other jurisdictions have proposed a depredation multiplier as a solution for addressing unverified carnivore depredation records due to lack of evidence and to address the indirect impacts to the producer. Landowner groups in southwestern Alberta have proposed a multiplier of 2.5 for every confirmed depredation event. This concept warrants discussion, as long as it is set in the context of program sustainability.

f. Predators, including coyotes, are responsible for extensive damage and livestock deaths that are not recognized by government authorities. These losses need to be assessed as a business liability and a coexistence plan (including compensation) developed.

3. Further Research

The issue of wildlife and beef producer co-existence is complicated as multiple species, impacts and attitudes exist in relation to this issue. There are numerous areas where research is limited and the understanding of the impact is limited and difficult to quantify. Key next steps for supporting research gaps include:

a. This study dealt only with the impact of ungulates on forage and feed to beef producers; the impacts of ungulates on all crops should be assessed for beef and crop producers. There should also be a quantification of property damage caused by ungulates.

b. A project that maps ungulate ranges including wildlife forage offtake and is overlaid on Alberta municipalities and Grassland Vegetation Inventory (GVI) data would provide better understanding of the forage ungulates are consuming on privately owned rangelands (native and tame pasture).

c. Research is required to better understand the indirect impacts of carnivore presence on livestock production.

d. Alberta and Canadian research is required to better understand the risks of disease transmission between livestock and wildlife. A partnership with University of Calgary, Faculty of Veterinary Medicine, Department of Ecosystem and Public Health could provide an opportunity for Alberta specific research.

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APPENDIX 1: SURVEY OUTREACH PLAN

ABP and Miistakis outreach tools (emails, e-newsletters, and social media) and press releases

- 2 emails to all ABP delegates
- 2 emails to all municipal and county Agricultural Fieldmen
- 2 emails to all forage / extension associations
- 1 email to all purebred beef associations
- 2 emails to all producers who signed up at ABP falls meetings
- ABP press releases, website, Twitter
- Miistakis newsletter, Facebook, Twitter (reached over 4000 account holders through retweets with farm organizations)
- Grain News, Alberta Farmer (2), Western Producer, Rockyview Weekly, Mountain View Gazette (2), Warburg weekly
- Radio - AM 1140, FM 104.7, CKLY, Cattle County
- TV – Global, Lethbridge; CTV, Calgary
- Events – Alberta Forage Industry Network, Action For Agriculture, Bergen, Living with Wildlife (Cremona), a variety of events that ABP delegates participated in the survey and discussion

APPENDIX 2: SCENARIO SPREADSHEETS

Carnivores					
Depredation Events from carnivores	Num of cattle type	Rate of loss	Num lost	Cattle value	total value lost
Number of calves	120	0.02	2.4	$872	$2,094
Number of feeders/yearlings	n/a	0.015	0	$1,111	
Number of cows	0	0.005	0	$1,029	$0
Number of bulls	n/a	0.05	0	$2,006	
Forage losses and property damage from carnivores	Y,N,n/a	Value			
Forage Loss: Barley	Y	$1,121			$1,121
Forage Loss: Oats	N	$1,047			$0
Forage Loss: Hay	N	$1,774			$0
Forage: Silage	N	$862			$0
Fencing damage	Y	$551			$551
Building/shed damage	N	$422			$0
				Subtotal carnivore costs	**$3,766**
Ungulates					
Forage and stored feed losses from ungulates	Y,N,n/a				
Forage: Barley	N	$5,460			$0
Forage: Oats	N	$3,647			$0
Forage: Hay	N	$3,355			$0
Stored Feed: Silage	N	$3,113			$0
Stored Feed: Barley	N	$2,262			$0
Stored Feed: Oats	N	$1,994			$0
Stored feed: Hay	N	$2,021			$0
				Subtotal ungulate costs	**$0**
Birds					
Depredation event or injury from birds	Num. of cattle type	Rate of loss	Num. lost	cattle value	
Number of calves	N	0.01		$872.32	$0
Forage and stored feed losses from birds	Y,N,n/a	Annual Value			
Forage: Barley	Y	$2,178			$2,178
Forage: Oats	N	$1,679			$0
Forage: Hay	N	$423			$0
Stored Feed: Silage	N	$1,263			$0
Stored Feed: Barley	Y	$1,567			$1,567
Stored Feed: Oats	N	$1,501			$0
Stored feed: Hay	N	$998			$0
Straw	N	$541			$0
				Subtotal birds costs	**$3,745**
				Total cost of wildlife impacts	**$7,511**

Carnivores					
Depredation Events from carnivores	Num of cattle type	Rate of loss	Num lost	Cattle value	total value lost
Number of calves	0	0.02	0	$872	$0
Number of feeders/yearlings	0	0.015	0	$1,111	$0
Number of cows	0	0.005	0	$1,029	$0
Number of bulls	0	0.05	0	$2,006	$0
Forage losses and property damage from carnivores	Y,N,n/a	Value			
Forage Loss: Barley	N	$1,121			$0
Forage Loss: Oats	N	$1,047			$0
Forage Loss: Hay	N	$1,774			$0
Forage: Silage	N	$862			$0
Fencing damage	N	$551			$0
Building/shed damage	N	$422			$0
				Subtotal carnivore costs	**$0**
Ungulates					
Forage and stored feed losses from ungulates	Y,N,n/a				
Forage: Barley	N	$5,460			$0
Forage: Oats	N	$3,647			$0
Forage: Hay	N	$3,355			$0
Stored Feed: Silage	N	$3,113			$0
Stored Feed: Barley	N	$2,262			$0
Stored Feed: Oats	N	$1,994			$0
Stored feed: Hay	Y	$2,021			$2,021
				Subtotal ungulate costs	**$2,021**
Birds					
Depredation event or injury from birds	Num. of cattle type	Rate of loss	Num. lost	cattle value	
Number of calves	0	0.01	0	$872	$0
Forage and stored feed losses from birds	Y,N,n/a	Value			
Forage: Barley	N	$2,178			$0
Forage: Oats	N	$1,679			$0
Forage: Hay	N	$423			$0
Stored Feed: Silage	N	$1,263			$0
Stored Feed: Barley	N	$1,567			$0
Stored Feed: Oats	N	$1,501			$0
Stored feed: Hay	N	$998			$0
Straw	N	$541			$0
				Subtotal birds costs	**$0**
				Total cost of wildlife impacts	**$2,021**

Carnivores					
Depredation Events from carnivores	Num of cattle type	Rate of loss	Num lost	Cattle value	total value lost
Number of calves	45	0.02	0.9	$872	$785
Number of feeders/yearlings	0	0.015	0	$1,111	$0
Number of cows	0	0.005	0	$1,029	$0
Number of bulls	0	0.05	0	$2,006	$0
Forage losses and property damage from carnivores	Y,N,n/a	Value			
Forage Loss: Barley	N	$1,121			$0
Forage Loss: Oats	Y	$1,047			$1,047
Forage Loss: Hay	N	$1,774			$0
Forage: Silage	N	$862			$0
Fencing damage	Y	$551			$551.00
Building/shed damage	N	$422			$0.00
			Subtotal carnivore costs		**$2,383.09**
Ungulates					
Forage and stored feed losses from ungulates	Y,N,n/a				
Forage: Barley	N	$5,460			$0
Forage: Oats	N	$3,647			$0
Forage: Hay	Y	$3,355			$3,355
Stored Feed: Silage	N	$3,113			
Stored Feed: Barley	N	$2,262			
Stored Feed: Oats	N	$1,994			
Stored feed: Hay	Y	$2,021			$2,021
			Subtotal ungulate costs		**$5,376**
Birds					
Depredation event or injury from birds	Num. of cattle type	Rate of loss	Num. lost	cattle value	
Number of calves	0	0.01	0	$872.32	$0
Forage and stored feed losses from birds	Y,N,n/a	Annual Value			
Forage: Barley	N	$2,178			$0
Forage: Oats	N	$1,679			$0
Forage: Hay	N	$423			$0
Stored Feed: Silage	N	$1,263			$0
Stored Feed: Barley	N	$1,567			$0
Stored Feed: Oats	N	$1,501			$0
Stored feed: Hay	N	$998			$0
Straw	N	$541			$0
			Subtotal birds costs		**$0**
			Total cost of wildife impacts		**$7,759.09**

Carnivores					
Depredation Events from carnivores	Num of cattle type	Rate of loss	Num lost	Cattle value	total value lost
Number of calves	500	0.02	10	$872	$8,723
Number of feeders/yearlings	0	0.015	0	$1,111	$0
Number of cows	0	0.005	0	$1,029	$0
Number of bulls	0	0.05	0	$2,006	$0
Forage losses and property damage from carnivores	Y,N,n/a	Value			
Forage Loss: Barley	N	$1,121			$0
Forage Loss: Oats	N	$1,047			$0
Forage Loss: Hay	N	$1,774			$0
Forage: Silage	N	$862			$0
Fencing damage	N	$551			$0
Building/shed damage	N	$422			$0
				Subtotal carnivore costs	**$8,723**
Ungulates					
Forage and stored feed losses from ungulates	Y,N,n/a				
Forage: Barley	N	$5,460			$0
Forage: Oats	N	$3,647			$0
Forage: Hay	Y	$3,355			$3,355
Stored Feed: Silage	N	$3,113			$0
Stored Feed: Barley	N	$2,262			$0
Stored Feed: Oats	N	$1,994			$0
Stored feed: Hay	N	$2,021			$0
				Subtotal ungulate costs	**$3,355**
Birds					
Depredation event or injury from birds	Num. of cattle type	Rate of loss	Num. lost	cattle value	
Number of calves	500	0.01	5	$872	$4,362
Forage and stored feed losses from birds	Y,N,n/a	Annual Value			
Forage: Barley	N	$2,178			$0
Forage: Oats	N	$1,679			$0
Forage: Hay	N	$423			$0
Stored Feed: Silage	N	$1,263			$0
Stored Feed: Barley	N	$1,567			$0
Stored Feed: Oats	N	$1,501			$0
Stored feed: Hay	N	$998			$0
Straw	N	$541			$0
				Subtotal birds costs	**$4,362**
				Total cost of wildife impacts	**$16,440**

APPENDIX 3: EXTRAPOLATION: A CONVERSATION STARTER ON ECONOMIC IMPACTS OF WILDLIFE IN ALBERTA

SUMMARY DEPREDATION

To determine the impact of carnivore depredation from a provincial perspective is challenging, and less accurate than the numbers presented per individual producer because of reduced sample sizes in reporting and the need to make some assumptions such as there being an even distribution of animals across producers. Although there is a statistically significant sample size at the start of the survey, not all producers experience the same problems. As a result the sample size is reduced as the survey asked more detailed questions regarding losses. Lastly, producers skipped questions, particularly those where they were asked to report losses further reducing the sample size.

Although we were able to determine the percentage of producers in Alberta who experience depredation losses and we know the average number of cattle for these individuals. We did not gather information to calculate the average number of cattle for those producers who did not experience depredation events. As such we are unable to create a ratio of cattle that may experience depredation to those that may not. It is therefore problematic to calculate the number of cattle likely subjected to depredation in order to apply the depredation percentage. We therefore made the assumption that if cattle were distributed evenly among producers, then the percentage of producers who experience depredation per cattle type is the same as the percentage of cattle that may be subjected to a depredation event.

The total value of depredation during 2011 – 2013, from all carnivore species is estimated to be $**22,620,016** in Alberta, representing 0.45% of total cattle value in the province. These values were calculated for each cattle type using the following analysis:

- Calves: from 2011-2013 there were an average 1,626,000 calves annually (Table 3) in Alberta, if we assume the population of calves is distributed evenly among producers, then 61% (based on 381, the number of survey respondents who report experiencing depredation of calves divided by 630, the total number of survey respondents) of producers in Alberta report experiencing depredation of calves. Therefore 975,600 calves annually are subjected to a possible depredation event. If we expect a rate of loss of 2% (Table 6), then 19,512 may be lost to depredation annually, with a market value of $17,014,464 in losses based on unit price of $872 (Table 2). This value represents 1.2% of calf value in the province.

- Feeders/yearlings: from 2011-2013 there were an average 1,530,000 feeders/yearlings annually (Table 3) in Alberta, if we assume the population of feeders/yearlings is distributed evenly among producers, then 14% (86, the number of survey responses experiencing depredation of feeders/yearlings divided by 630, the total number of survey respondents) of producers report experiencing depredation of feeders/yearlings. Therefore 208,857 feeders/yearlings annually are subjected to a possible depredation event. If we expect a loss of 1.5% (Table 7), then 3,120 may be lost to depredation annually, with a market value of $3,480,604 in losses based on unit price of $1,111 (Table 2), representing 2% of feeder/yearling value in province.

- Cow: from 2011-2013 there were an average of 1,720,000 cows annually (Table 3) in Alberta, if we assume the population of cows is distributed evenly among producers, then 20% (127, the number of survey responses experiencing depredation of cows divided by 630, the total number of survey respondents) of producers report experiencing depredation of cows. Therefore 344,000 cows annually are subjected to a possible depredation event. If we expect a loss of 0.5% (Table 8), then 1,720 cows may be lost to depredation annually, with a market value of $1,769,880 in losses based on unit price of $1,029 (Table 28), representing 0.01% of cow value in province.

- Bulls: from 2011-2013 there were an average of 89,000 bulls annually (Table 3) in Alberta, if we assume the population of bulls is distributed evenly among producers, then 4% (26, the number of survey responses of depredation of bulls divided by 630, the total number of survey respondents) of producers report experiencing depredation of bulls. Therefore 3,560 bulls annually are subjected to a possible depredation event. If we expect a percent loss of 5% (Table 9), then 178 bulls may be lost to depredation annually, with a market value of $357,068 in losses based on unit price of $2,006 (Table 2), representing 0.02% of bull value in province.

Total cost of cattle lost to depredation

Cattle type	Total # in Alberta	$/animal	Total value of each type in Alberta	% of producers experiencing problems	# of cattle potentially impacted	Average % lost	Potential # of animals lost	Market value of loss	Average loss rate of depredation for province
Calf	1,626,000	$872	$1,417,872,000	61%	975,600	2%	19,512	$17,014,464	1.2%
Feeder/ yearling	1,530,000	$1,111	$1,699,830,000	14%	208,857	1.5%	3,120	$3,480,604	0.2%
Cows	1,720,000	$1,029	$1,769,880,000	20%	344,000	0.5%	1,720	$1,769,880	0.1%
Bulls	89,000	$2,006	$178,534,000	5%	3,560	5%	178	$357,068	0.2%
Total	4,965,000		$5,066,116,000					$22,622,016	

SUMMARY OF FORAGE CROP COMPETITION

Using the averages determined through the survey results and assuming an equal distribution of oat, barley and hay acres across beef producers the value of loss from ungulates due to forage competition to Alberta Beef Producers is $14,497,482,. These values were calculated for each forage type using the following analysis:

- Barley - Using data from the *Alberta Crop Report – Alberta 2013 Crop Season in Review* the average acres of barley grown in 2012 and 2013 were 3,710,000 acres. This number includes barley acres grown by beef and crop producers. There is no number of barley acres directly attribuTable to beef producers, as a proxy to estimate barley acres planted by beef producers we used the 2012/2013 average number of harvested acres of barley greenfeed and harvested acres of barley silage (450,000 acres). If we consider 70% of beef producers experience forage competition and 82% of them experience forage competition in barley and we have applied barley acreage equally across producers we determine 258,300 acres of barley are subjected to forage competition by ungulates. At a 10 year average yield of 62.2 bushels per acre, the total potential yield on acres that could be subjected to forage competition is 16,066,260 bushels. By applying an average of 6% loss results in a loss of 963,976 bushels provincially. The average

price reported in the survey was $4.60 per bushel. The total loss of barley to forage competition by ungulates is estimated to be $4,434,288.

- Oats – Using data from the *Alberta Crop Report – Alberta 2013 Crop Season in Review* the average acres of oats grown in 2012 and 2013 were 610,000 acres. This number includes oat acres grown by beef and crop producers. There is no number of oat acres directly attributable to beef producers, as a proxy to estimate oat acres planted by beef producers we used the total number of harvested acres of oat greenfeed and harvested acres of oat silage (212,500 acres). If we consider 70% of beef producers experience forage competition and 89% of them experience forage competition in oats and we have applied oat acreage equally across producers we arrive at 132,388 acres of oats are subjected to forage competition by ungulates. At a 10 year average yield of 73 bushels per acre, the total potential yield that could be subjected to forage competition is 9,531,936 bushels. By applying an average of 9% loss results in a loss of 857,874 bushels provincially. The average price reported in the survey was $3.26 per bushel. The total loss of oats to forage competition by ungulates is estimated to be $2,796,669.

- Hay - Using data from the *Alberta Crop Report – Alberta 2013 Crop Season in Review* the average acres of hay grown in 2012 and 2013 were 4,962,000 acres. This number includes hay acres grown by all agricultural producers (i.e., not just beef producers). The 2006 census identifies 71,660 farm operators in Alberta; if one considers there are 20,000 beef producers (28%) and we attribute equal hay acres across all producers 1,384,873 acres of hay can be attributed to beef producers. If we consider 70% of beef producers experience forage competition and 96% of them experience forage competition in hay and we have applied hay acreage equally across producers we arrive at 930,635 acres of hay are subjected to forage competition by ungulates. At a 10 year average yield of 1.6 tonne per acre, the total potential yield on acres that could be subjected to forage competition is 1,489,015 tonne. By applying an average of 6% loss results in a loss of 134,011 tonne provincially. The average price reported in the survey was $80.90 per tonne. The total loss of hay to forage competition by ungulates is estimated to be $7,227,681.