Investigation of mortality in bison under normal production settings, with a special emphasis on Malignant Catarrhal Fever

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Abstract

In response to concerns voiced by bison industry members in Saskatchewan, a provincial Malignant Catarrhal Fever (MCF) task force recommended research on the relationship between the proximity of bison and sheep under typical commercial production settings and bison deaths due to MCF. Thus, the objective of the initial 18 month observational study was to evaluate all causes of death in bison herds in Saskatchewan, Canada and then compare the incidence of MCF in herds at varying exposure distances from sheep operations. Necropsies were completed on 76 of the 133 bison reported to have died during the initial 18 month study period, with a total of seven MCF deaths from two large herds within km of sheep operations. Mortality surveillance was then augmented to include Manitoba, Alberta and British Columbia bison herds for a continuing 18 month study period. Results of the secondary surveillance period demonstrate that the overall incidence of MCF deaths continued to be very low and confined to relatively few farm sites across three provinces. Additional cause of death included *Mycoplasma bovis*, non-pathogenic causes, parasitism and vitamin/mineral deficiencies.

Keywords: *Mortality surveillance, risk*

Introduction

Bison mortality due to Malignant Catarrhal Fever (MCF) associated with sheep proximity have sparked dissention between sheep and bison industries in North America, resulting in calls for municipal regions to legislate minimum distances between newly establishing farms. MCF is most commonly the result of infection with a gamma-herpesvirus known as ovine herpes virus-2 (OVH-2) which is carried by healthy sheep without clinical harm to the carrier; however, it can be lethal when transmitted to cattle and particularly bison (1). In 2011, in response to concerns from bison producers, the government of Saskatchewan set up a task force to develop recommendations to effectively manage the disease within the province (1). One of the key recommendations was to study the causes of mortalities in bison herds at varying distances from sheep flocks, with a specific emphasis on MCF.

While past MCF outbreaks have identified the main risk as exposure to sheep, the majority involved either sheep or bison in feedlot conditions, sale barns or other stressful environments (1,3-6). The potential risks for bison raised near sheep under typical production conditions on the Canadian prairies had not been previously been examined; therefore, the main objective was to report the relative risk of MCF deaths in commercially farmed bison across varying distances from typical commercial sheep herds. The findings would hopefully provide the industry with much needed evidence to minimize the risk of MCF transmission from sheep to bison. The second objective of the study was to estimate the relative frequency of the other most common causes of mortality in commercial bison herds. The project began with a focus on Saskatchewan but was later augmented to include herds from the remaining Canadian Prairie Provinces.

Materials and methods

This initial 18 month study period was conducted between 1 December 2012 and 31 May 2014 and was restricted to herds in Saskatchewan (7). The secondary 18 month study period was conducted between July 2015 and December 2016 with participation from herds in Saskatchewan, Manitoba, Alberta and British Columbia. Participating bison herds were recruited through advertisement with the Saskatchewan Bison and Canadian Bison Associations in both study periods.

Any animal that was born alive and then died on farm was eligible for submission for necropsy for the initial study period (excluded abortions and still births, and animals slaughtered for personal consumption). Submission was expanded to include abortions and stillbirths for the secondary study period. Herd owners provided information on herd size, management and location in relation to sheep herds at both the start and the end of the relevant study periods. All necropsied deaths were to be performed by the local veterinarian using a standard protocol and samples shipped to Prairie Diagnostic Services in Saskatoon, Saskatchewan for analysis. Processing of samples by the laboratory followed a standard protocol, with specific tests for MCF, mineral/vitamin panels and mycoplasma (secondary study period only). Individual necropsy results were provided back to the local veterinarian, who then communicated the findings back to the herd owner. Any subsequent management or treatment decisions were the responsibility of the herd owner.

Data were compiled in an Excel database, descriptive analysis included calculation of herd mortality risks (proportions) with exact 95% confidence intervals and proportional mortality. The proportional mortality was calculated for MCF and the other most common defined causes of death as a fraction of the total deaths submitted for necropsy. The case definition of a MCF death was any bison submitted for necropsy with a positive PCR test with or without specific

clinical symptoms in the history (i.e. "found dead" could have been the only clinical sign listed) and histopathological evidence supporting a diagnosis of MCF (7).

Using information from the initial study period, the association between proximity of each bison herd to sheep and whether MCF was identified in the herd during the study was examined using exact logistic regression after adjusting for average bison herd size (STATA-MP 13.1, Statacorp LP, Texas, USA) (7). A bison herd was classified as MCF positive if at least one bison from the herd was reported to have died from MCF during the study period. All other variables considered to be potentially important confounders were assessed to determine if adjustment for the variable resulted in a 20% change in the regression coefficient for proximity to sheep herds but no interaction terms were explored in the exact regression analysis. The estimate was reported as an odds ratio (median unbiased estimate; OR-MUE), with the p value calculated by the probability test. Predicted probabilities were graphed for each covariate pattern in the final model. Additional analysis was completed to examine the association between the count of MCF positive cases per herd and proximity to sheep operations using exact poisson regression with the average number of bison in each herd as the offset. Results were reported as a risk ratio (median unbiased estimate; RR-MUE) with p value calculated by the probability test (7).

Results

All herds were considered commercial bison operations where calves were produced and the majority were grazed or fed on pasture when available (7). Of the 26 herds to complete the initial study period, six were within 1km of sheep operation boundaries (high exposure group), nine were within 1km to 5.6km of sheep operation boundaries (low exposure group), and 11 were at distances greater than 5.6km from sheep operation boundaries (negligible exposure group). As MCF only occurred in herds within 1km, the low and negligible herds were combined into one category for analysis. Most herds were less than 150 bison (13 herds). Of the four herds with more than 500 bison, all were within 5.6km of sheep operation boundaries.

Not all bison that died during the study were suitable for sampling; these animals included those that were found dead and some that died in known circumstances (i.e. trauma related). In the initial study period, owners were asked to speculate on the causes of deaths for those 57 reported deaths that were not submitted for necropsy; 67% (38/57) were attributed to non-infectious causes like calving, nutritional issues and trauma. Of the 76 deaths submitted for necropsy in initial study period, 21 were in calves (less than 1 year of age) from 8 different herds, and 55 in subadults and adults from 14 different herds. There were seven MCF deaths, from two herd sites both of which were within 1km of sheep operations. Overall, 18.4% (14/76) of deaths could not be attributed to any specific cause and 21.1% (16/76) were attributed to calving, trauma or nutritional issues.

The primary relationship between MCF herd status (dichotomous outcome; positive and negative) and distance to sheep (less than 1km compared to greater than or equal to 1.0 km) produced an odds ratio unbiased median estimate (OR-MUE) of 9.4 (p=0.05) (7). When accounting for herd size, the OR-MUE for MCF herd status and sheep distance dropped to 6.9 (p=0.08) (7). When assessed with poisson regression using herd size as the offset, the resulting risk ratio median unbiased estimated (RR-MUE) suggested the risk of MCF death was 10.8 (p=0.005) times higher in herds within 1km of a sheep operations than in herds that were farther away (7). The overall MCF incidence risk for bison in the high exposure group was two deaths per 1000 animals (95% CI, 0.0005, 0.003) while the MCF incidence risk for low/negligible exposure group was nil deaths per 1000 animals (95% CI, 0.000, 0.001).

Forty-nine herds enrolled in the secondary study period; nine herds were continuations from the first sampling period. The majority of herds were either from Saskatchewan (22) or Alberta (19). Of the 218 submissions from the secondary study period, 33.5% (73/218) were diagnosed as caused as Mycoplasma bovis while 13.3% (29/218) had no definable cause and 8.7% (19/218) were defined as mineral deficiencies or toxicities. MCF was recorded as the cause of death in 5.5% (12/218) of the submissions, and represented five herds within 1km of sheep operations.

Discussion

The aim of this study was to describe the mortality risk of bison, with specific reference to Malignant Catarrhal Fever. This was the first study to assess the risk for commercial bison production in proximity to commercial sheep producers. Despite the overall low mortality risk of MCF occurrence, the study did identify that bison in herds less than 1km from sheep operation boundaries were found to be at a higher risk of mortality from MCF than those at greater distances from sheep operation boundaries. It should be noted that ascribing distances to sheep operations in this study was difficult as there was no way to ascertain the exact date of exposure for individual bison, there was no way to document the effects of wind speed or direction, nor the corresponding extent or timing of shedding of the virus in nearby sheep. Thus the minimum distance between fences of bison and sheep operations was the most reliable way to assess distance. In one of the MCF bison deaths, the maximum distance the bison could have been during the possible incubation period (ranging from one month to 200 days from the date of death (4)) was 2.5km. No study to date has clearly articulated the co-factors required for clinical disease expression but in addition to exposure to the virus, authors have speculated on the roles of stressors such as mixing of animals, or handling of bison for vaccination or taking of blood (1,3-6).

In the initial study period, copper deficiency was in the top five causes of death overall as well as a contributing factor in other causes of death, but was not as prominent in the secondary study period. During the secondary study period,

the addition of herds from Alberta changed the predominate causes of death to include *Mycoplasma bovis*. Finally, if this study had been completed during 2006, anthrax would most likely have been a key cause of death, but it was only reported once for a bison death that occurred during the secondary sampling period. These differences highlight the importance of sampling time and location in defining the major diseases of interest to the industry. In addition, defining causes of death based solely on necropsied animals down plays the role of calving, trauma and nutritional issues for which producers might be less inclined to submit animals for necropsy.

Finally, the results of this study suggest that while MCF can be a devastating disease for individual bison producers, the overall incidence within commercial settings is very low. Ultimately, depending on year and locations of herds in the study, different diseases contributed higher risks to a broader number of herds. It also supports caution against proposing production based buffer zones established solely on the criteria of distance to sheep, only one component in disease development. Currently, the bison industry has instead chosen to work with the sheep industry to educate both bison and sheep producers about the risks and mitigation strategies for MCF.

References

1. **Li H *et al.*** *J Vet Diagn Invest* 18, 119-23, 2006
2. **Province of Saskatchewan Malignant Catarrhal Fever Task Force.** Final report, Saskatchewan c2011 http://www.agriculture.gov.sk.ca/Default.aspx?DN=75a426f7-a0f9-462a-b7e0-c67fc969afd7
3. **Li H *et al.*** *Can Vet J* 49, 183-5, 2008
4. **Berezowski JA *et al.*** *J Vet Diagn Invest* 17, 55-8, 2005
5. **Schultheiss PC *et al.*** *J Vet Diagn Invest* 12, 497-502, 2000
6. **O'Toole D *et al.*** *J Vet Diagn Invest* 14, 183-193, 2002
7. **Epp T *et al.*** *Can Vet J* 57(1), 37-45, 2015