Ronald Lake Wood Bison Research Program:

2021 Semi-Annual Report

May 1, 2021

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Executive summary

The Ronald Lake bison herd (RLBH) is a culturally and ecologically significant population of wood bison (*Bison bison athabascae*) that is of management concern. The RLBH range is located on the northern fringe of the Alberta oil-sands region, within an area of historic natural resource exploration. The RLBH Technical Team, made up of representative members from regional Indigenous communities, industry, and federal and provincial governments, was formed to ascertain needed information for the sustainable management of the RLBH and its habitat. As part of their mandate, the Technical Team identified a series of knowledge gaps related to the herd's ecology that would inform management. Starting in 2013, researchers from the University of Alberta and Royal Alberta Museum were invited to develop a research program to help fill some of these knowledge gaps. Here, we provide an update on research activities conducted within this program since December 2020 (see prior year reports for description of previous work) and describe methodologies related to research activities scheduled for summer 2021. Specifically, questions related to knowledge gaps we report on here are:

> *How are wetlands used by bison in the winter?*
>
> *How does spring green-up influence the annual migration?*
>
> *What are the dynamics of wolf predation on bison?*

Our investigations into these questions yielded several interesting results. Firstly, our examination of winter wetland forage sites reinforced the bison's preference for a suite of sedges (e.g., *Carex atherodes C. utriculata*, *C. aquatilis*) as their primary winter forage. Examination of the herd's seasonal migration indicates that the timing of migration to the spring range is closely aligned with the onset and peak of spring, however, bison are not "surfing" the peak of spring while migrating. Additionally, we found that habitat selection when leaving the spring range is influenced by the rate of plant green-up and potential predation pressure. Bison represented 15% of wolves' winter diet, and predation pressure on bison increased later in the winter season when snow exceeded 30-cm in depth.

In the spring and summer of 2021, we plan to conduct fieldwork to monitor water dynamics in wetlands and their influence on bison's preferred forage. Additionally, analyses will continue to address knowledge gaps related to the influence of landscape disturbances on bison habitat selection, possible mechanisms related to changes in wolf predation pressure on bison and carrying capacity modelling under different scenarios.

Please note that with the COVID-19 pandemic, the fieldwork described here is conditional on meeting safety precautions outlined by the University of Alberta and in accordance with the Alberta Health Services protocols and the Government of Alberta.

Background

The Ronald Lake wood bison (*Bison bison athabascae*) herd (RLBH) is a small (ca. 186 individuals) free-ranging population located in northeastern Alberta, Canada, named after a large lake at the center of their annual range (Ball et al. 2016). The RLBH has a range that extends from the southern portion of Wood Buffalo National Park (WBNP), north of current Alberta oil-sands, east of the Birch Mountains and west of the Athabasca River. In addition to natural disturbances like wildfire, anthropogenic disturbances related to timber harvesting and oil exploration are present within the herd's range. The herd is also thought to have had significant recreational hunting pressure prior to 2017. A genetic inventory of bison herds in northern Alberta and Northwest Territories found that the RLBH is distinguishable from neighbouring herds in WBNP, with less genetic introgression from plains bison (*B. b. bison*; Ball et al. 2016). The RLBH is further distinguishable from neighbouring WBNP herds by the lack of diseases from domestic animals, including brucellosis and bovine tuberculosis (Shury et al. 2015). Additionally, the RLBH has significant ecological and cultural value, being central to the traditional practices of numerous Indigenous communities. These factors resulted in the herd receiving *Subject Animal* status under Alberta's Wildlife Act (AEP & ACA, 2017). Wood Bison are designated Special Concern under COSEWIC and Threatened on Schedule 1 of SARA.

The RLBH Technical Team, consisting of representative members from the regional Indigenous communities, industrial parties, and provincial and federal government agencies, was established to improve the ecological understanding of the RLBH and their habitat. The efforts of this collaboration are intended to guide the sustainable management of the herd. The Technical Team identified several significant ecological knowledge gaps (Table 1) and requested they be addressed by the University of Alberta and Royal Alberta Museum researchers under a grant supported by matching funds from industry and the federal government (NSERC). Between 2013 and 2021, Alberta Environment and Parks fitted 78 GPS telemetry radio-collars to 5 male and 69 female bison (4 females were re-collared in 2021). University and Royal Alberta Museum researchers also collared three wolf packs in the area from 2019–2020 to examine potential wolf predation of bison. Using data provided by these GPS radio-collars, researchers have investigated: (1) seasonal/annual bison ranges and wolf territories; (2) bison migration to a spring range with high quality forage; (3) conditions regulating the herd's range; (4) mechanisms influencing bison habitat selection; (5) reactions of bison to anthropogenic disturbances; and (6) seasonal changes in bison and wolf diet selection and nutrition (Tan et al. 2015, DeMars et al. 2015, DeMars et al. 2016, Belanger et al. 2017, Belanger et al. 2018, DeMars et al. 2020, Hecker et al. 2019a, Hecker et al. 2019b, Belanger et al. 2020, Dewart et al. 2020, Hecker et al. 2021, Sheppard et al. 2021). Notable conclusions from this work are that:

1. The same annual range is used regularly with predictable, seasonal changes;

2. All female bison do a spring migration to their western range, which is associated with their calving period, using two distinct corridors that follow legacy seismic lines;

3. The spring range contains higher quality forage compared to the rest of their annual range;

4. Summer habitats with high forage biomass have less stable footing and more biting insects creating possible trade-offs between forage and predation;

5. Females avoid disturbances with ongoing industrial activity (i.e., oil sands exploration and forestry), but not those without activity;

6. The small number of males sampled showed no response to anthropogenic activity;

7. Movement rates are marginally faster on linear disturbances compared to other habitats suggesting the use of these features are mostly for movement and less for forage;

8. Winter and spring diets are dominated by graminoids, while summer diets include more forbs and browse, but only winter diets have a significantly different nutritional content;

9. Deep snow (>30 cm) decreased bison's movement rates, while warmer temperatures facilitated an increase in their movements; and.

10. The RLBH herd experienced greater predation pressure from wolves when snow depth exceeded 30-cm in depth, and the herd contributed up to 15% of winter wolf diet.

In this semi-annual report, we summarize the research conducted since December 2020 (Dewart et al. 2020), build on earlier results, and describe the research planned for the remainder of 2021.

Table 1: Knowledge gaps identified by the Ronald Lake Bison Herd Technical Team reported here, or completed, as conducted by the University of Alberta and Royal Alberta Museum researchers.

Theme	Gap #	Project	Status	Citation
Bison range	1A	Season & sex-specific ranges	Complete	DeMars et al. 2016
Bison range	1B	Northern extent (limits)	Complete	Hecker et al. 2019b
Bison range	1D	Migration routes	Complete	Hecker et al. 2019b
Habitat - Landcover	2A	Wetlands	Update in this report	Hecker et al. 2019b
Habitat - Landcover	2D	Natural disturbances (fire)	Complete	DeMars et al. 2016
Forage (bottom-up)	3A	Greenup/phenology	Update in this report	Hecker et al. 2019b
Forage (bottom-up)	3C	Forage quantity/quality	Complete	Dewart et al. 2020
Forage (bottom-up)	3E	Anthropogenic changes	Update in this report	Dewart et al. 2020
Habitat use	4B	Trade-offs (insects/ground)	Complete	Belanger et al. 2020
Habitat use	4C	Winter snow	Update in this report	Dewart et al. 2020
Popln ecol (top-down)	4C/8E	Wolf predation	Update in this report	Dewart et al. 2020

Research progress

How are wetlands used by bison in the winter?

Lead Investigator: Garrett J. Rawleigh

Research objectives

The objective of this work is to understand what environmental factors influence bison use of wetlands during winter. This is important as wood bison rely almost exclusively on graminoid-dominated wetlands for sustenance during winter due to a shortage of alternative forage (Strong and Gates 2009; Jung 2015). Since last reported, we added 132 field plots to our examination of bison's winter foraging behaviour and have begun analyzing these data. We are also monitoring wetlands using water-level loggers deployed in 2020 to quantify the environmental characteristics that foster communities of preferred forage species, as highlighted in previous reports (Dewart et al. 2020). Here, we examine how biotic (e.g., forage species) and abiotic (snow characteristics) influence the selection of wetlands in the winter.

Overview of research methods

To examine winter foraging activity, we visited recently foraged wetland areas using clusters of GPS locations from collared bison. These areas were selected by examining recent (i.e., less than seven days old) GPS locations and choosing points accessible by trail or snowmobile. When we arrived at these locations, we searched for recent craters, areas where bison have pushed snow aside to access the forage beneath. After locating craters, we measured a suite of environmental factors to understand how they influence foraging site selection. These factors include snow characteristics (i.e., depth, density, crust hardness), distance to cover, wetland area, and vegetation characteristics. We measured snow depth to the nearest 0.5-cm beyond the crater edge in undisturbed snow, and for large craters, we took the average of up to three snow depth measurements (Fortin 2005). Using a Snow-metrics snowboard sampler, we recorded snow density at each site using the same locations as the depth measurements (Snowmetrics 2021). Snow crust hardness was recorded as the presence or absence of a crust, and when present, hardness was measured using the hand-hardness test (Höller and Fromm 2010). We visually identified vegetation at the foraging site to the species level when possible and collected vegetation clippings to confirm identification in the laboratory. The crater area was also measured by walking the perimeter of craters with a handheld GPS unit. The crater area is being tested as a potential response variable to the type of vegetation present. We recorded the foraging intensity on each species present and assigned a numeric class on a scale of zero to four, with zero representing no foraging and four representing foraging to the ground level. Foraging intensity could be related to crater size or preference for specific forage species (Holecheck and Galt 2000). As a comparison, the same variables were measured at non-use sites located near each distinct crater.

Progress / results

During winter 2021, we added 132 paired sites to the 82 pairs sampled during winter 2020 (Figure 1). Early patterns suggest that bison prefer to forage on wheat sedge (*Carex atherodes*), water sedge (*C. aquatillis*), and common yellow lake sedge (*C. utriculata*) despite grass being the most encountered forage item (Figure 2). Wheat sedge was grazed at the highest average intensity, showing consistency with previous research (Jung 2015). Further, we are examining

patterns in snow conditions, broader wetland characteristics, and a combination of these factors to best identify why bison select specific areas within wetlands.

Outstanding/upcoming work

In the summer and fall of 2021, we will retrieve the groundwater level loggers deployed in 2020 and take additional biomass and substrate samples. Data will be used to relate the environmental characteristics of wetlands to the abundance/biomass of preferred bison forage. We will also continue to analyze winter forage and site selection to explain why bison select specific foraging locations during the winter season.
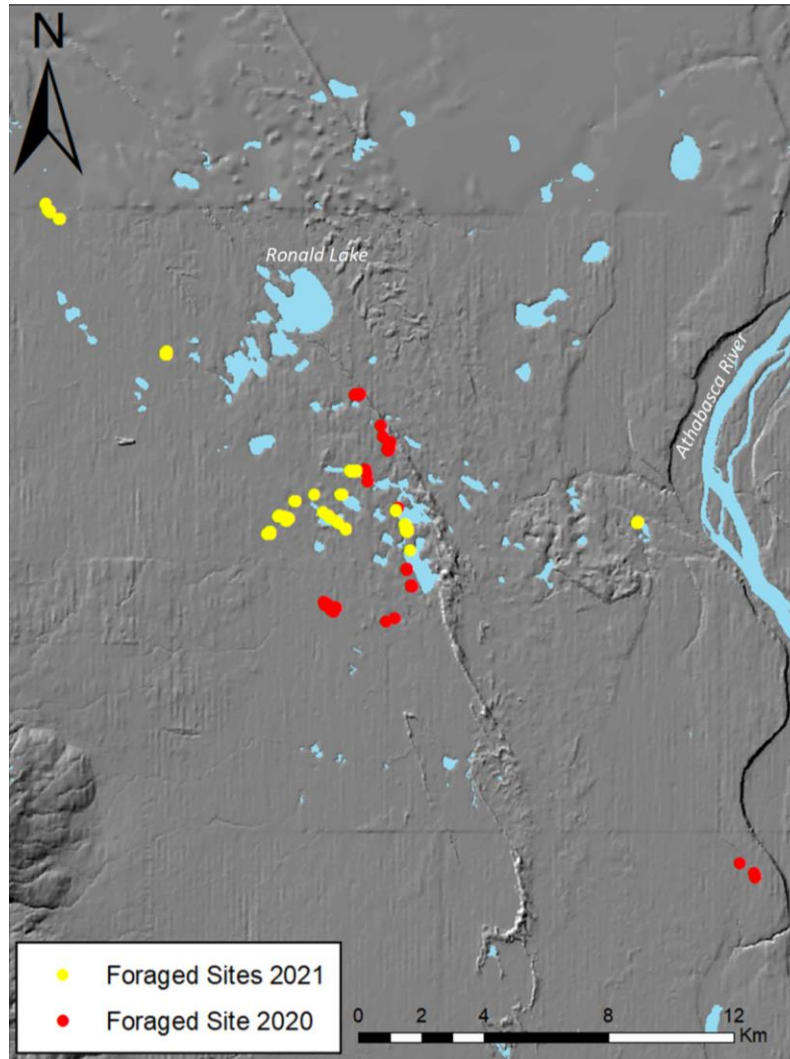
Figure 1: Map of forage locations sampled from the RLBH during the winter seasons of 2020 (red) and 2021 (yellow). Corresponding non-use (available) paired sites were also surveyed near each point shown.
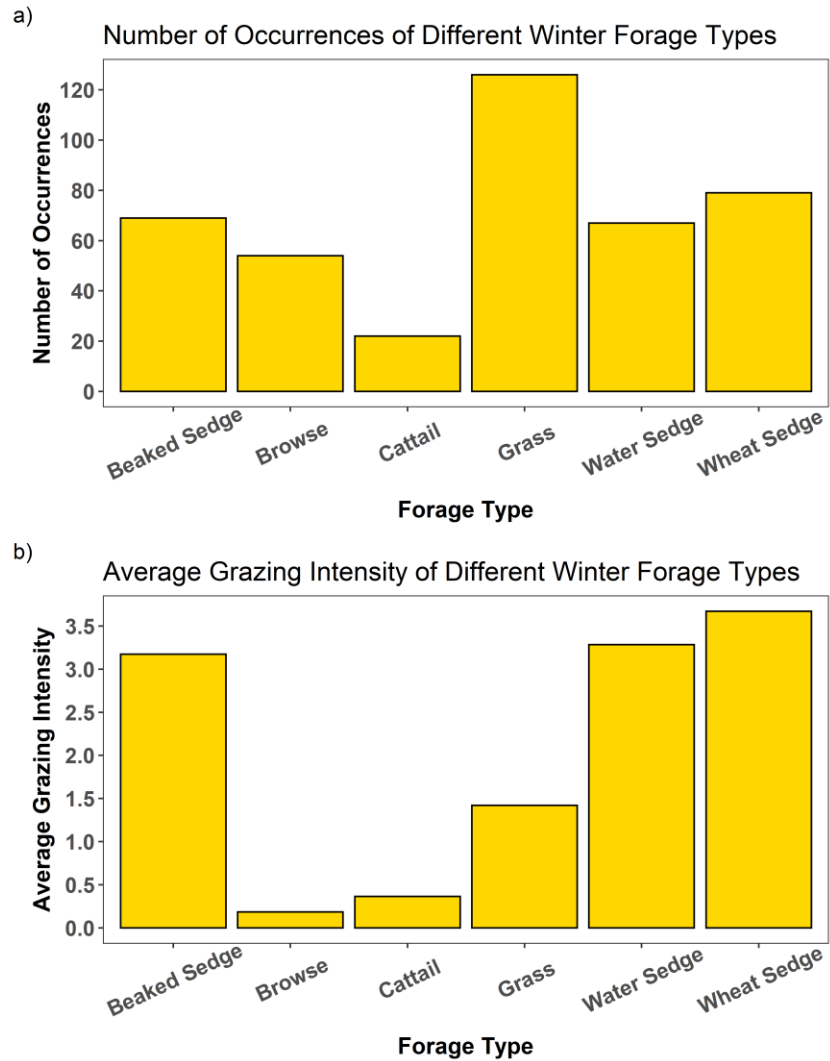
a)

b)

Figure 2: Bar graphs showing: (a) the number of encounters of each forage type in wetland craters of wood bison (*Bison bison athabascae*) during the winters of 2020 and 2021 in the Ronald Lake area, and (b) average grazing intensity of each forage type in a wetland crater of wood bison in the winter of 2020 and 2021.

How does spring green-up influence the annual migration?

Lead Investigator: Lee J. Hecker

Research objectives

Here, we seek to understand the ecological factors influencing the migration of the RLBH during spring. Annually, all collared females congregate in a spring range centered around an upland meadow near where the McIvor River exits the Birch Mountains (Tan et al. 2014, Hecker et al. 2019b). By late June, the herd has returned to its core range east of the Birch Mountains and centered around Ronald Lake. Previous research into this migratory behaviour has identified two migration corridors that follow legacy seismic lines into the upland meadow. Additionally, camera traps within the spring range have shown differences in seasonal habitat use by different mammals, with bison and black bears (*Ursus americanus*) in greater abundance during May and June and wolves (*Canis lupus*) from December through March (Belanger et al. 2017). We also found that forage quality at bison locations inside the spring range, defined by normalized difference vegetation index values, was higher than forages in the core range (Hecker et al. 2019b). Our objective here is to quantify the characteristics of this migration (i.e., distance, duration, speed, strategy), assess the timing of the migration relative to the green-up of vegetation in spring, and explore the influence of green-up and potential predation pressure on habitat selection during migration.

Overview of research methods

We used GPS location data provided by 58 collared female bison to assess migration characteristics from 2013–2019. We determined the migration period and strategy by calculating net-squared displacement (NSD) using two different starting locations (Bunnefeld et al. 2011). To determine the start and end dates of ingress (i.e., migration into the spring range) and egress (i.e., migration out of the spring range), we set the starting location as the centroid of a minimum convex polygon (MCP) calculated around all locations within the spring range (Tan et al. 2014). We considered the start of ingress to be the first location of a contiguous set of locations with decreasing NSD values (lower NSD indicates bison are closer to the spring range) and the end location as the first location in that set with an NSD value less than 100. Similarly, egress was defined as the first location of continuously increasing NSD values greater than 100 and the end of egress to the location with the greatest NSD value in that set. Then, we calculated step length (the distance in meters between two consecutive locations), duration (number of days between the start and end of ingress/egress), and speed in km/hr for the migratory periods. For speed statistics, we eliminated points >30-m apart because we were only interested in points that represented traveling behaviour (Merkle et al. 2019). To determine migration strategy, we used the starting location as the first ingress point and the end location as the final egress point and fit movement models to describe three migration strategies: (1) migration for bison that started and ended their migration in the same general area, (2) mixed migration, for bison that ended in a different location than they started, and (3) dispersers, for bison that arrived at the spring range at least 30 days before any other individual but then left the spring range with the rest of the herd (Bunnefeld et al. 2011).

We investigated the timing and ecological factors influencing migration using a three-pronged approach. First, we followed the methods of Bischof et al. (2012) and Merkle et al. (2017) to determine the start, peak, and end of spring by calculating the instantaneous rate of green-up (IRG) as the first derivative of the normalized difference vegetation index (NDVI). Then, we

calculated the difference between the Julian day of the start and end of ingress and egress and the median Julian day for the start, peak, and end of spring for 25 randomly selected points from within the calving range. Next, to determine if the bison are following, surfing, or leading the "green-wave" of increasing vegetation quality, we calculated the correlation between the Julian day that bison occupied a location while migrating and the Julian day of peak IRG at each location (Geremia et al. 2019). Lastly, to assess the influence of different ecological factors on migration, we used paired-logistic regressions with individual bison and year as random-effects. We compared habitat characteristics of bison (i.e., source) locations and 25 randomly placed available (i.e., target) locations within the mean step-length (275-m) for all bison locations during migratory periods (Merkle et al. 2017). We then created global models that included all explanatory variables known to influence bison movements: distance between source and target locations, landcover type (as defined by Duck's Unlimited Enhanced Wetland classification and using Upland Deciduous as the reference landcover type), ground-wetness (calculated using the compound topographic index) as a proxy for footing, NDVI, integrated NDVI (the sum of all NDVI values at a location, considered an estimation of biomass), and distance to linear disturbance (Pettorelli et al. 2005, Merkle et al. 2017, Belanger et al. 2020, DeMars et al. 2020). Then, using Akaike Information Criterion (AIC) to determine improvement in models, we added IRG values to the global model to see if the green-wave is a factor influencing migration (Burnham and Anderson, 2002). In 2019, we had wolves collared in two packs within the bison's range during the migration period. Therefore, we analyzed an additional set of models for 2019, adding predation pressure (calculated as cumulative Brownian bridge movement values; Horne et al. 2007), IRG, and both as additional predictors to the global model (Horne et al. 2007).

Progress / preliminary results

We found a minimal correlation between bison location Julian day and maximum IRG Julian day during ingress (Pearson's correlation = 0.19) and egress (Pearson's correlation = 0.13) (Figure 5). This result indicates minimal green-wave surfing. During ingress, IRG values did not improve the global paired-logistic regression model (ΔAIC = 0.64, relative to global model), but during egress, IRG values did improve the global model (ΔAIC = -42.14). In 2019, the global model for ingress was also not improved by adding IRG (ΔAIC = 0.88), predation pressure (ΔAIC = -1.97), or both IRG and predation pressure (ΔAIC = -0.89). However, 2019 egress global models were improved by the inclusion of predation pressure (ΔAIC = -148.24) and both IRG and predation pressure (ΔAIC = -148.86), but not IRG (ΔAIC = 0.69). From these models, we can conclude that IRG and predation pressure have a greater influence on the habitat selection during egress than ingress.

Outstanding/upcoming work

We consider this the conclusion of our investigation into how spring green-up influences the annual migration of the RLBH. The green-wave does influence the timing of bison migration, but only affects habitat selection along migration corridors during egress. We will be testing new sets of logistic regressions exploring the influence of IRG and predation on migration with random locations selected from a larger radius (third quantile around mean, upper limited of 95% confidence interval of mean, and mean, maximum distance moved in 90-min) around the target location. An update will be provided in the 2021 annual report describing if and how wider ranging random locations changes model results. Future studies could consider exploring the social mechanisms influencing the migration, predicting whether or not individuals are pregnant

based on movement behaviour, or the predation potential of black bears on calves (Belanger et al. 2017).
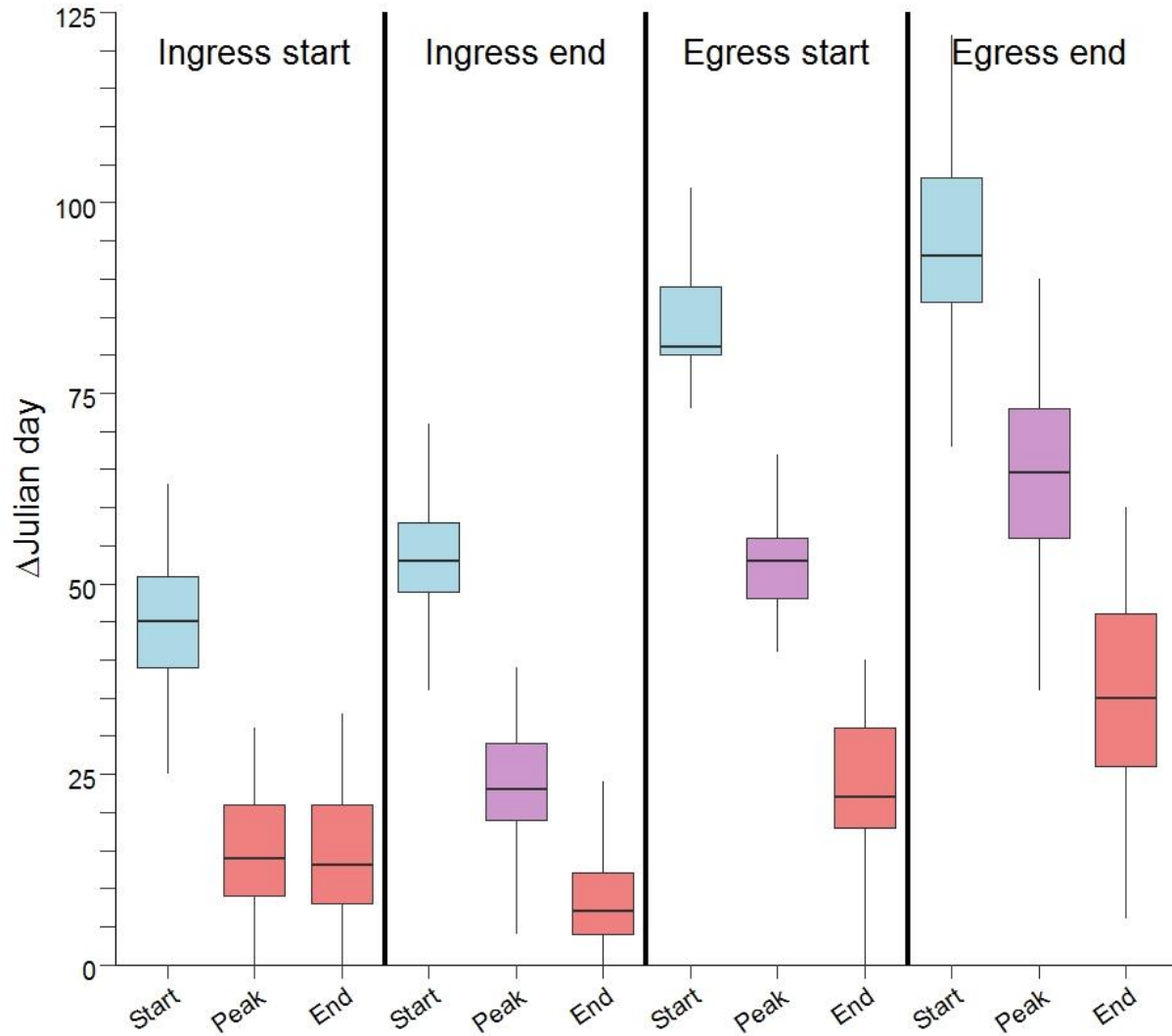

Figure 3: Boxplots showing the differences in the timing of various migration events (Ingress start, Ingress end, Egress start, Egress end) relative to the start, peak, and end of the spring green-up of vegetation as measured by the instantaneous rate of green-up. Differences were calculated as the absolute value of the difference in Julian date of the start, peak, and end of spring and the four Julian dates of the four migration events. Colours indicate boxes that are significantly different with blue boxes have significantly higher differences, red have significantly lower differences and purple are significantly different at an intermediate level.
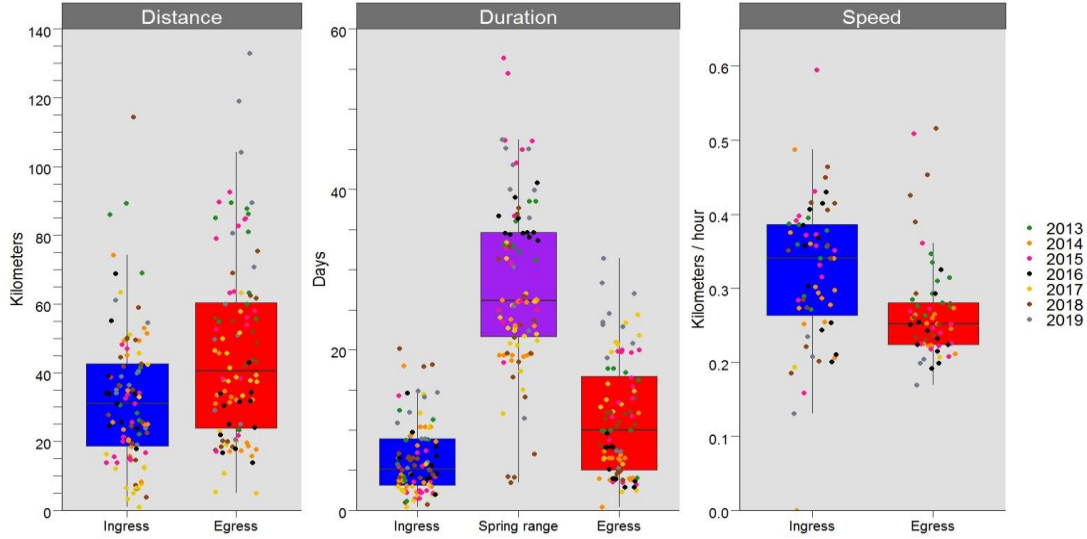
Figure 4: Summary statistics for migration metrics of distance, duration, and speed. Ingress (red) is the migration into the spring range (purple), and egress (blue) is the migration out of the spring range. Each dot represents the total distance travelled, total during of travel, or mean travel speed for an individual bison within a single year. The colours of each dot represent a single year.
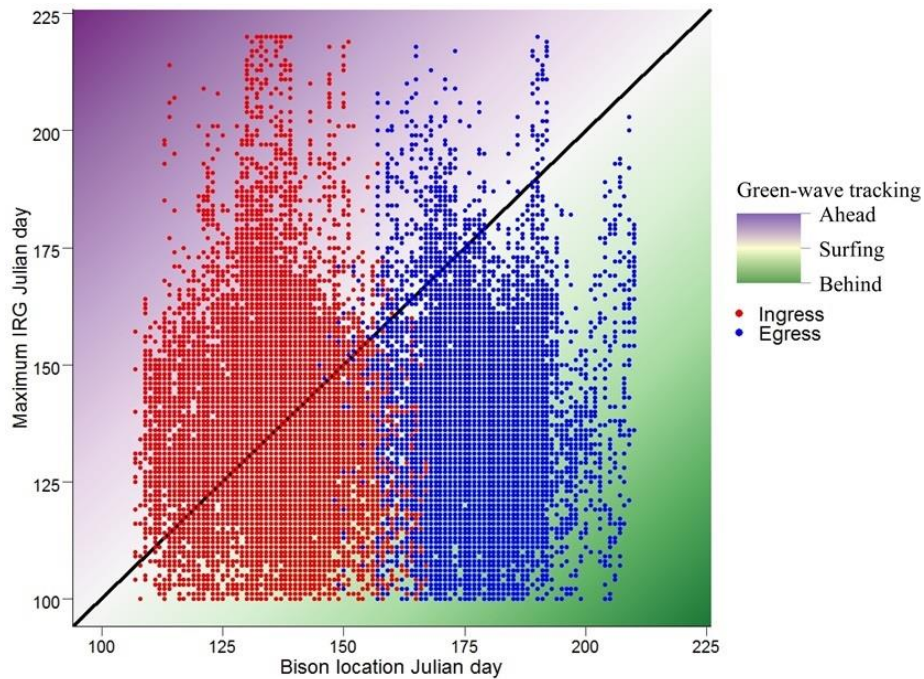

Figure 5: Relationship of Julian day of bison presence at a location and Julian day of the maximum IRG value at the same location. The top-left (purple) region of the plot indicates bison locations before the green-wave arrives, the central-diagonal (white) region is bison surfing the green-wave, and the bottom-right (green) region are bison at locations after the green-wave has passed. The black, diagonal line indicates a hypothetical perfect green-wave surfer. For reference: Julian day 100 is April 10, 125 is May 6, 150 is May 30, 175 is Jun 24, 200 is July 19, and 225 is August 13 (add one to each Julian day for leap years like 2016).

What are the dynamics of wolf predation on bison?

Lead investigator: Lindsey T. Dewart

Research objectives

To assess potential predation effects on the RLBH, we focused our analysis on wolf predation pressure. In systems with multiple abundant and accessible prey types, wolves will most often select for species that will not only offer sufficient biomass to sustain the pack, but that are easier to catch with relatively low risk of injury (Becker et al. 2008; Mattioli et al. 2011). Wolf prey selection is dynamic and highly variable in different systems and can often change seasonally due to changes in abundance, accessibility, and vulnerability (Carbyn et al. 1993; Huggard 2011; Smith et al. 2000). These drivers of prey selection can also motivate alternative selection within seasons, such as calving periods or harsh winter conditions. In systems that include bison, wolves often choose to hunt other prey species but may alter selection toward bison when they are more vulnerable in late winter (Jaffe 2001; Smith et al. 2000). Our objectives were to examine the diet of wolf packs whose territories overlapped the RLBH and temporal factors influencing their predation success on bison. Further, in the winter season, we examine wolf space use relative to bison by assessing wolf use of areas frequented by bison during times of varying bison vulnerability.

Overview of research methods

We affixed GPS radio-collars to wolves of three different packs whose territories overlapped the bison range. Movements of wolves and bison were monitored through the winter to determine the ranges and overlap of each species using locations and 99% utilization distributions (UDs) for early (1 November 2019 – 6 February 2020) and late (7 February – 17 April 2020) winter (Worton 1989). Cluster analysis was used to identify potential kill sites prioritized by handling time (i.e., continuous-time spent within a 200-m radius; Webb et al. 2008) for field investigation. Site investigations consisted of systematically searching for prey remains to identify species and evidence to confirm a wolf kill occurred, such as broken branches, blood, or signs of a struggle. Winter (1 November 2019 – 17 April 2020) wolf diets were quantified by both the percent occurrence and biomass of each prey species found at kill sites specific to each wolf pack.

Snow depth, temperature, and stage of the winter season (i.e., days since first snowfall) were examined separately in generalized linear models used to test for temporal patterns in successful wolf predatory events of bison. Daily snow depths were measured by averaging the snow depth recorded from four snow stations placed in different habitat types within the study area. Daily temperature measures were averaged between the two nearest weather stations to the study area (Aurora and Mildred Lake; Alberta Agriculture and Forestry 2020).

Progress / preliminary results

Wolf packs included the McIvor (n = 6 adults), Dianne (n = 2 adults), and Southline (n = 9 adults) packs, named for dominant landscape features within their ranges, and a sample of wolves from each pack were monitored with GPS collars from April 2019 – April 2020. In winter there were 321 GPS clusters, of which 58 were prioritized and visited on the ground. Confirmed kill sites of large mammals were discovered at 38 of the 58 sites (66%). Specifically, we visited 22 Dianne pack, 20 McIvor pack, and 16 Southline pack cluster sites, finding remains of 14 deer, 13 moose, six bison, three wolves, and two black bears at confirmed kill sites and an additional three scavenged moose.

Wolves consumed an average of 14.87 kg of prey biomass/pack/day and 2.69 kg of prey biomass/wolf/day. The Dianne pack killed the greatest number of prey over winter and consumed the most biomass per wolf but the least biomass per pack relative to the other packs (Figure 6). In contrast, the McIvor and Southline packs had a similar number of kills, but with significantly higher biomass consumed per pack relative to the Dianne pack (Figure 6). Total prey biomass consumed was variable between the three packs, with the Dianne pack consuming an estimated 6.29 kg per day in winter, the McIvor pack consuming 12.09 kg, and the Southline pack consuming 26.23 kg (Figure 6). Moose provided the most biomass of the prey types to the McIvor (53%) and Southline (60%) packs, while deer provided the most biomass to the Dianne pack (50%). The Southline pack showed the least diverse diet, with moose comprising an estimated 60% of their available biomass.

Bison represented 40% of McIvor pack killed biomass, while bison contributed 35% to the Southline pack total. Bison kills occurred later in winter relative to cervids, with the first record of a bison kill occurring on 3 March 2020 when snow depths exceeded 30-cm (Figure 7). To investigate this trend, winter conditions on days that bison kills occurred were compared to winter conditions over the rest of the winter to reveal possible temporal patterns associated with successful wolf predation events on bison. The probability of a bison kill on any given day in the winter season was best supported by the number of days since first snow accumulation (i.e., Winter day; Δ AIC = 0; β = 0.048; S.E. = 0.020, P = 0.015; pseudo R^2 = 0.25; Table 2). Results showed that the probability of wolves killing a bison began to increase in early February and increased further until mid-April during the initiation of snowmelt (Figure 8). Snow depth was also a significant predictor of the timing of bison kills (Δ AIC = 5.9; β = 0.150; S.E. = 0.080, P = 0.050; pseudo R^2 = 0.14), but was less supported than the number of days since first snow accumulation (Table 2). Results showed that the probability of wolves killing a bison began to increase at a 20-cm snow depth and continued to increase beyond 40-cm (Figure 8).

Outstanding/upcoming work

We are currently examining wolf habitat use relative to bison within the bison range (Figure 9) and testing for significant changes between early (1 November 2019 – 6 February 2020) and late (7 February – 17 April 2020) winter, when bison predation risk begins to increase. Preliminary models indicate that although wolves used the RLBH home range more in early winter than late winter, they used areas of high bison utilization more in late winter when within the RLBH range.
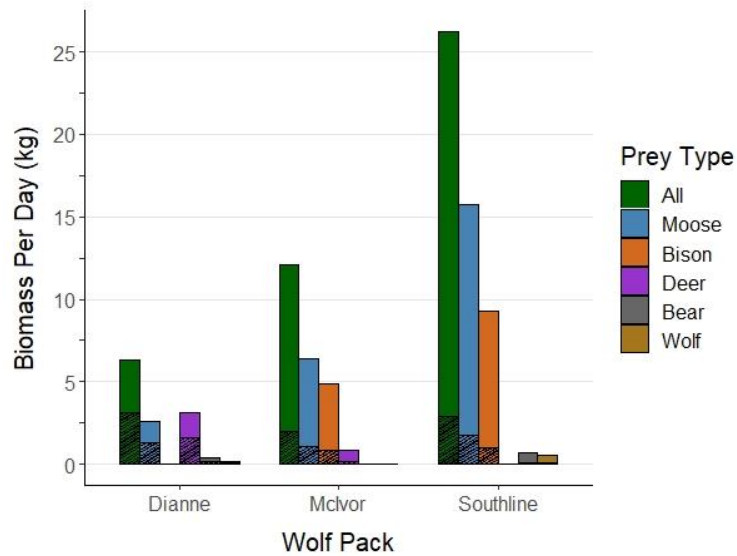
Figure 6: Winter (1 November 2019 – 17 April 2020) diet of the Dianne, McIvor, and Southline wolf packs in the Ronald Lake area of Alberta, Canada, analyzed by biomass consumed per day of each prey type for pack (coloured) and individual wolf (hashed).
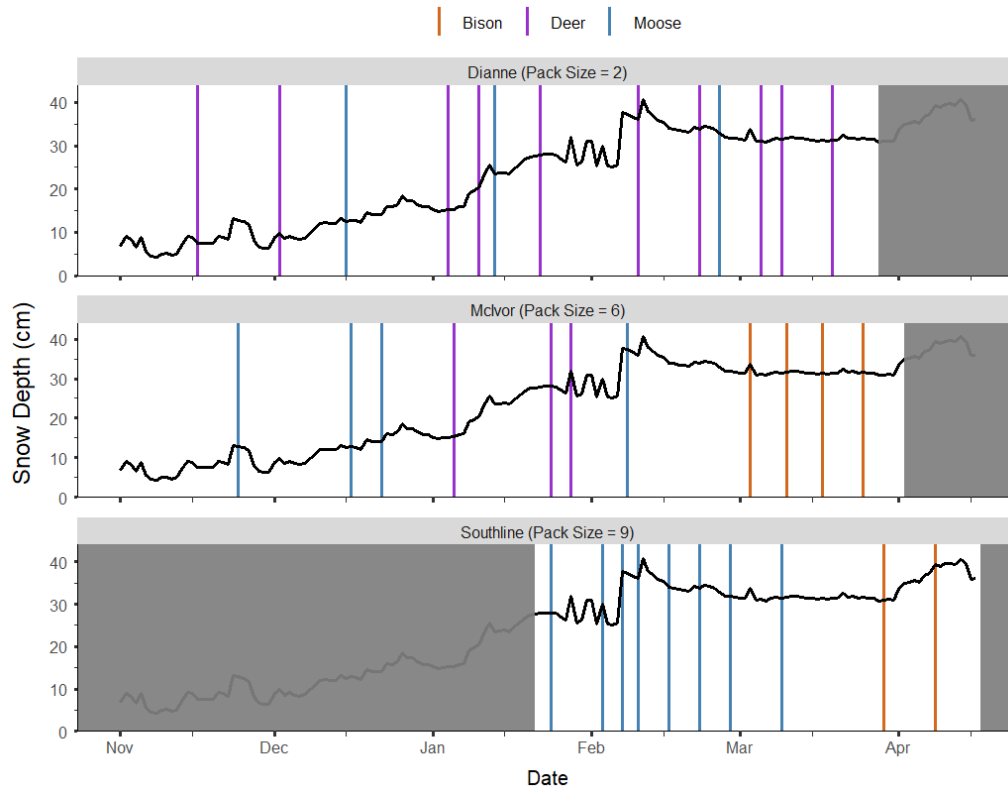

Figure 7: Timing of large prey kills (vertical lines) of the Dianne (top), McIvor (middle) and Southline (bottom) wolf packs in relation to snow depth (cm, continuous black line), grouped by prey type through the winter season (1 November 2019 – 17 April 2020) near Ronald Lake, Alberta, Canada. Grey areas represent the time that wolf packs were not monitored.

Table 2: Univariate generalized linear models testing the effects of snow depth, temperature, and winter day (days since first snow accumulation) on bison mortality events from wolves over the period from 1 November 2019 – 17 April 2020 near Ronald Lake, Alberta, Canada. Akaike Information Criteria (AIC) was used to rank support of models.

Predictor Variable	*df*	AIC	Δ AIC
Winter Day	2	42.7	-
Snow Depth	2	48.6	5.9
Null	1	53.8	11.1
Temperature	2	55.6	12.9
Number of Packs	2	55.8	13.1
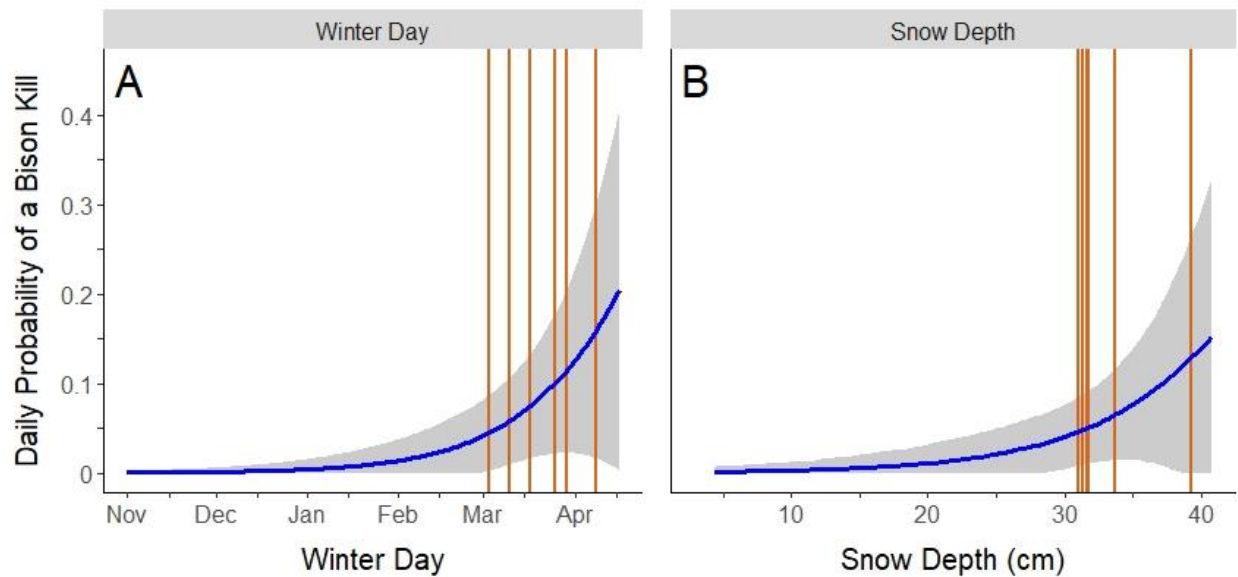
Figure 8: Predicted daily probability of a bison kill from wolves over the period 1 November 2019 – 17 April 2020 near Ronald Lake, Alberta, Canada, based on logistic regression models. (A) The effect of winter day (i.e., days since first snow accumulation); and (B) snow depth. The grey area and orange lines represent the 95% confidence intervals and bison kill events, respectively.
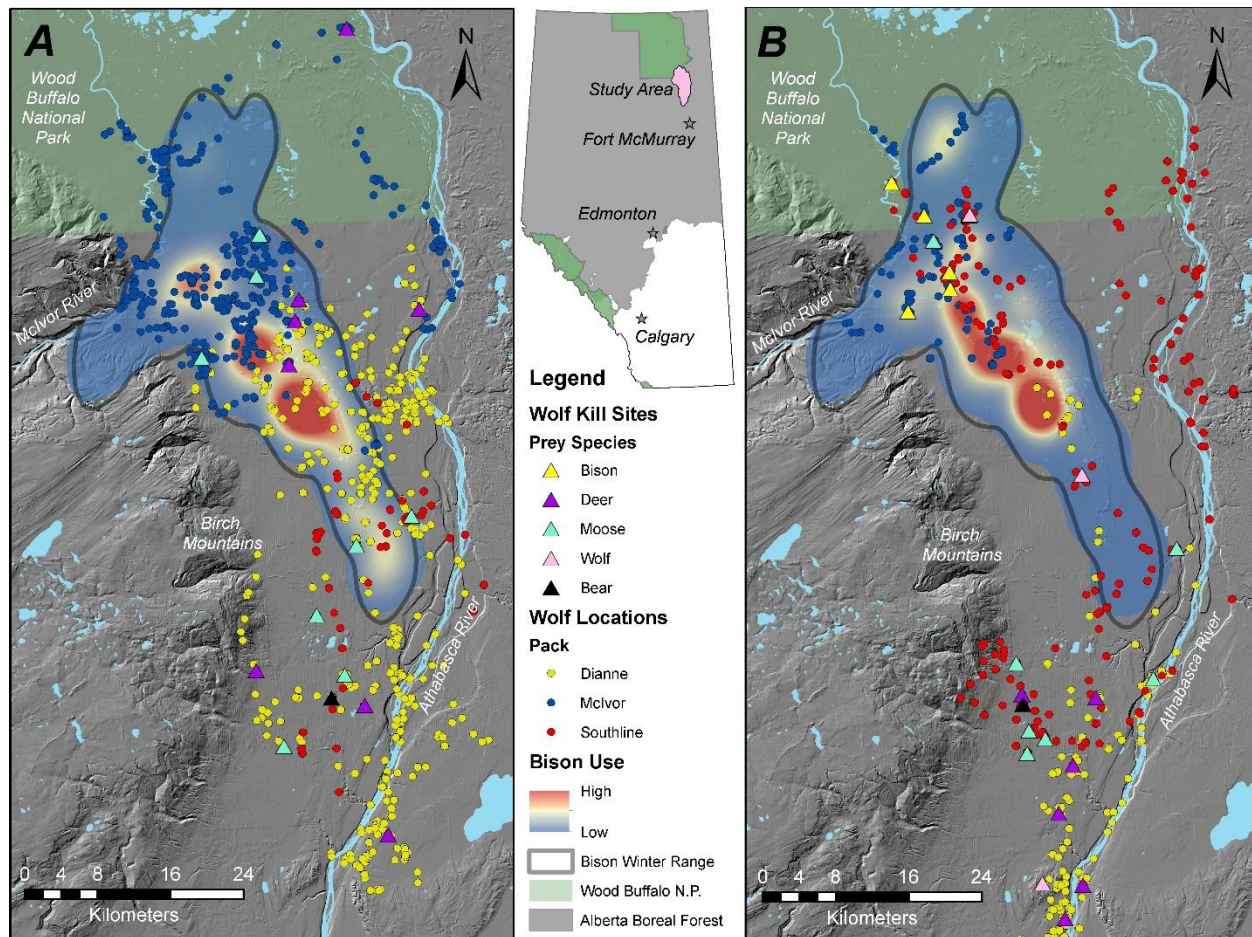
Figure 9: Dianne, McIvor, and Southline wolf pack predation sites and territory overlap with the bison range represented as 99% utilization distribution near Ronald Lake, Alberta, Canada. Panel A represents early winter (1 November 2019 – 6 February 2020), and panel B shows late winter (7 February – 17 April 2020), when the probability of a bison kill begins to increase.

Conclusion

Since December 2020, we have continued research on a set of selected knowledge gaps set forth by the RLBH Technical Team. Most recently, we have been investigating the relationship between bison and wetlands and their winter conditions, the seasonal migration of the RLBH, and predation pressure on the RLBH by resident wolf packs.

We can see early patterns of bison's forage preferences, with their selection of various sedge species as primary winter forage, with wheat sedge holding particular importance. Seasonal migration occurred in time with the peak onset of spring; however, there is no evidence suggesting that the RLBH is "surfing" this peak. Wolf predation pressure was shown to increase later in the winter season, specifically when snow exceeded 30-cm in depth. Also, bison were found to make up 15% of wolves' total diet.

We will be continuing our research through the spring and summer of 2021. This research includes monitoring wetland dynamics (i.e., water levels) to understand the vegetation structure of wetland communities and which environmental conditions are associated with bison's preferred winter forage. We will also continue to examine the influence of landscape disturbances on bison habitat selection and carrying capacity models under different landscape change scenarios. Finally, we will be finalizing our work on the possible mechanisms influencing wolf predation pressure on the herd.

Acknowledgements

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