

Plains Bison Reintroduction in Banff National Park

Pilot Project 2017-2022:



Photo: K. Heuer/Parks Canada

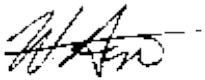
2019 Progress Report

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1.0 Introduction

2019 was the third year of a five-year pilot project to reintroduce wild bison to Banff National Park (Figure 1). The herd continued to anchor to the 1200 km² reintroduction zone during their first full year in the wild (Figure 2).

Bison movements in 2019 saw the main herd venture north from the Panther Valley into the Red Deer Valley in the northeast section of the reintroduction zone for the first time. While there, they explored side valleys like Divide and Tyrrell creeks, and came to favour grassy areas like Tyrrell Flats and Scotch pasture in the main Red Deer River Valley. They also returned to the Panther Valley several times and even revisited the Windy soft release pasture on a few occasions. All bison movements (save for a lone bull – see below) fell within a 30km radius of the soft release pasture.

Bison movements to and beyond the edges of the reintroduction zone were less frequent than the previous year. Drift fencing along the Panther and Red Deer rivers and/or gentle hazing by staff in the Divide and Tyrrell pass areas successfully redirected the main herd back into the reintroduction zone on several occasions except for one uncollared adult bull (M02) which left the reintroduction zone (and Banff National Park) via the Panther Valley in August 2019, and dispersed more than 60km in a northeasterly direction. A Parks Canada crew recaptured him 11 km from Sundre, Alberta, and relocated him to a captive herd at Rocky Mountain House National Historic Site where he remains today. This is the third bull to have undertaken such a dispersal movement since the animals were released. Like the others, he was lost to the project.

The body condition of all animals continues to be very good despite no supplementary feeding since the release. This suggests they are finding plenty of natural forage and minerals.

The herd continued to grow albeit at a much slower rate than the previous two years (3 calves born in 2019 vs 10 in each of the previous years). Of the 3 calves born in 2019 one was lost to unknown causes late in the year. This loss, in addition to the dispersed bull, resulted in overall herd size growing by only one animal in 2019. At the close of 2019 the herd numbered 35 animals.

This document reports on the cumulative progress on performance measures for the pilot project, as defined in the Detailed Environmental Impact Assessment (Heuer 2017; see Table 1). These measures attempt to address major concerns expressed by stakeholders before the project started and will be the basis for the 2022 assessment of whether or not longer term restoration of bison in the area is feasible.

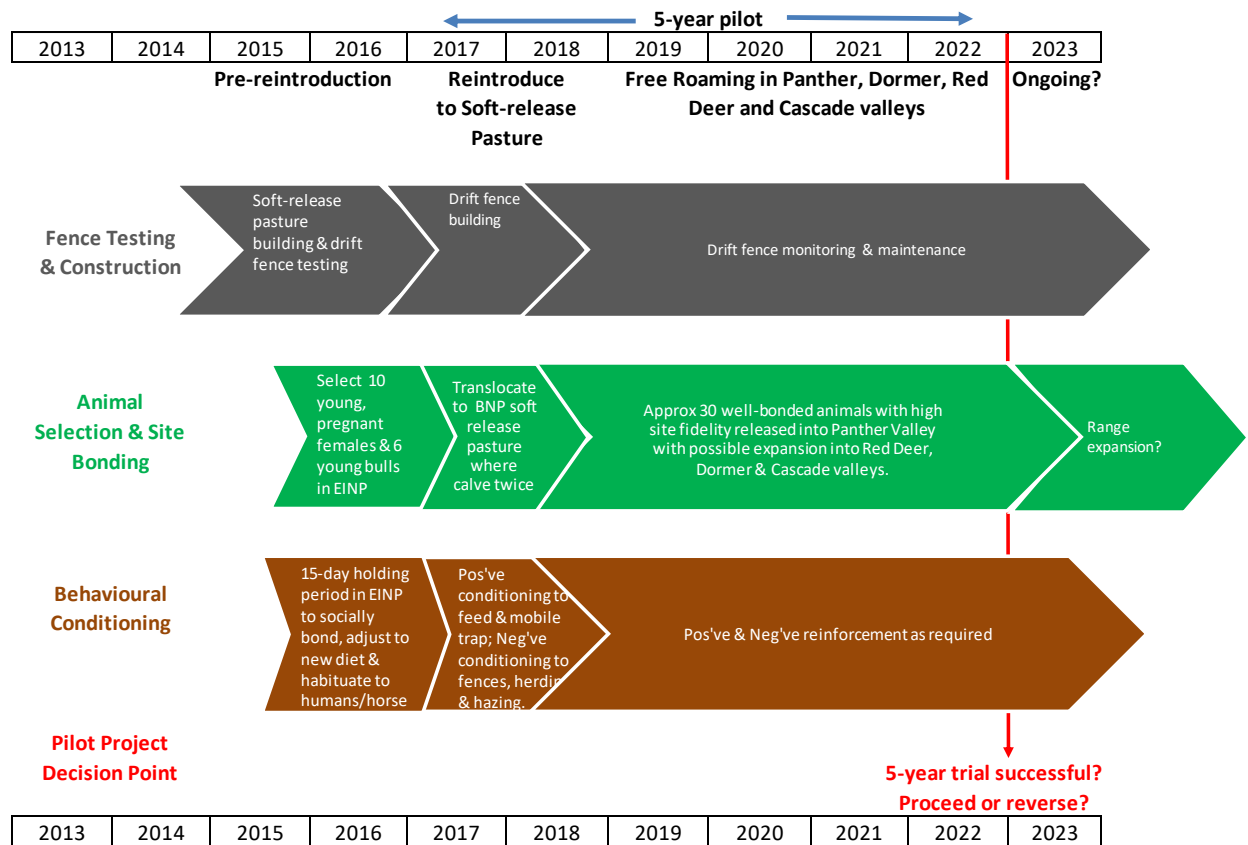


Figure 1: Timeline for 5-year bison reintroduction pilot project, Banff National Park.

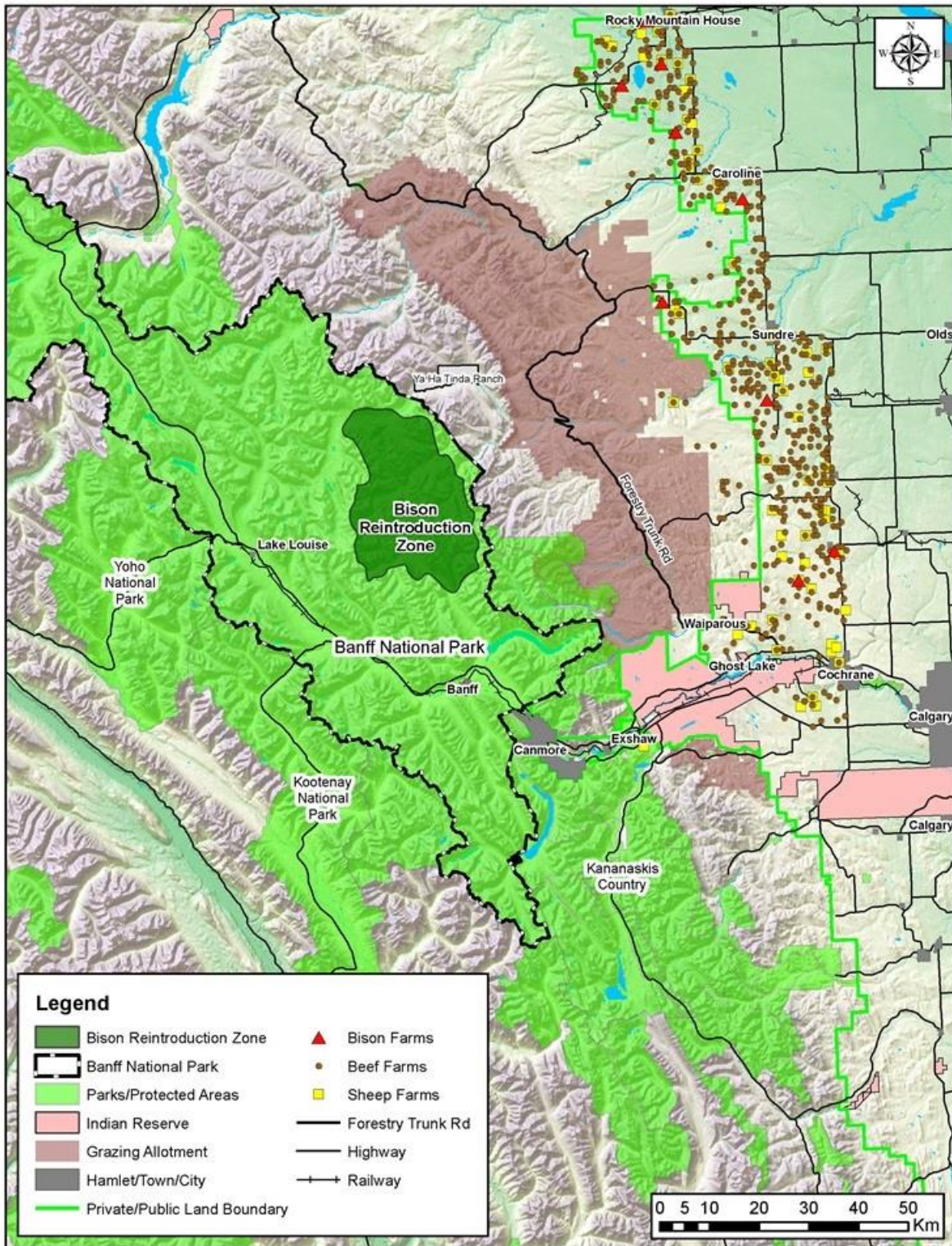


Figure 2: Bison reintroduction zone, Banff National Park (only westernmost farms and ranches identified north of Trans Canada Highway and west of Highway 22).

2.0 Summary of Performance Measures

A total of 29 performance measures are being tracked for the pilot reintroduction project. Cumulative progress for each one is summarized in Table 1.

Table 1: Performance measures for Banff Bison Reintroduction Project as of December 31 2019.

	ISSUES	Detailed Environmental Impact Assessment TARGET	DETAILS (as of December 31 2019)	STATUS	Section of Report
Wildlife	Bison Movements	Breeding population of wild bison remains in reintroduction zone;	<ul style="list-style-type: none"> • 36 animals have stayed inside the reintroduction zone and within 30km of the release site in the 1.5 years since being released; drift fences near the Panther and Red Deer boundaries, as well as active herding by staff when bison are on the periphery of the reintroduction zone, have been critical to this success; • Herding was used to move animals back into the core reintroduction zone from peripheral areas 14 times in 18 months. Animals were herded distances of a few hundred metres to 7.5km, mostly on foot. 95% of the trials were effective over the short term and desired animal movement persisted for 24 hours or more in 65% of the cases. Persistence was dependent on group size with larger groups being more amenable to being herded in the desired direction. • 23 bison interactions occurred with two drift fences in the 18 months since the animals were released. Of these, 4 interactions (17%) saw the animals go around or through the fences (see below excursions). 100% of fence interactions with groups of 4 or more bison successfully deflected them; 	Meeting	3.1
		No excursions of bison outside of reintroduction zone;	<ul style="list-style-type: none"> • 4 bison excursions involving a total of 6 animals have occurred since release of the animals; of these, 3 animals returned of their own accord (cow and two young) while the other 3 lone bulls dispersed beyond the reintroduction zone and park boundaries and were lost to the project. They were either recaptured and relocated elsewhere (N=2) or destroyed (N=1); 	Not Meeting	
	Bison Health and Reproduction	<p>Bison remain healthy with no detection of brucellosis or tuberculosis in bison or other species;</p> <p>Breeding population of wild bison remains within the reintroduction zone</p>	<ul style="list-style-type: none"> • All 16 adult bison tested clean for brucellosis prior to translocation and again prior to release. All 10 yearlings were also tested and were clean prior to release. All other blood chemistry was normal. • No notable bison injuries to date on the project; one mortality of a 2019 calf at ~3 months age of unknown natural causes; • All bison were treated twice for endoparasites and were tested prior to release (2017). Only Eimeria protozoa (which is universally present in the environment) was detected prior to release. • Body condition of adult animals dipped slightly immediately after release but recovered and has been steady and in the “Good” to “Very Good” range since. No animals have received supplemental feed since the release. • All 10 bison cows gave birth to calves in 2017 and 2018 and three more were born in 2019. The founder herd of 16 animals has now more than doubled to 35 individuals (includes loss of 3 bulls due to dispersal and one calf of unknown natural cause). • 7 female calves born in 2017 are approaching sexual maturity and will increase the number of breeding females in the next year. 	Meeting	3.2

	ISSUES	Detailed Environmental Impact Assessment TARGET	DETAILS (as of December 31 2019)	STATUS	Section of Report
	Bison & other Wildlife	No negative bison effects on other wildlife	<ul style="list-style-type: none"> • Radio collared members of two wolf packs interacted with bison a dozen times in the five months after the bison were released before the wolves were snared outside of the Park. GPS collar data from the bison showed no response; similarly, recent remote camera imagery shows bison grazing unperturbed with wolves in their midst. • 47 radio-collared migratory elk overlapped minimally with the bison in the 18 months since the bison were released (15 of 74 weeks); • Anecdotal observations of bison within 200m of bighorn sheep were made on 3 occasions; neither showed signs of disturbance. A bighorn sheep study for the area was launched in 2019/20 with 15 sheep radio collared in the bison reintroduction zone. Research is ongoing. 	Unknown at this time	3-3
Vegetation	Non-native Vegetation (NNV)	No net increase in number and extent of NNV infestations	<ul style="list-style-type: none"> • Parks Canada vegetation team visited and controlled all 16 known NNV infestations in the reintroduction zone in 2018/2019 using mechanical, cultural and chemical methods; • The Windy pasture yellow toadflax infestation identified in 2017 was surveyed again in 2019, with no plants noted. The site will be surveyed again in 2020 before being considered eradicated. Tall buttercup infestations in the Windy pasture have rebounded without bison grazing and will continue to be controlled (native seeding, pulling, herbicide) in future years • A new infestation of yellow toadflax was identified and controlled at an old horse outfitter camp in the lower Panther Valley in 2018. Its discovery predates free roaming bison. 	Meeting	4.1
	Rare Plants	Conduct a rare plant survey of the reintroduction zone prior to releasing bison and mitigate for any rare plants	<ul style="list-style-type: none"> • Rare plant survey completed in August 2017; • 54 transects were surveyed over 5 days for a total survey area of 21.6 km² (54 transects x 100 m length x 4 m wide); • Only two rare plant species identified (Pink false dandelion and Narrow leaved blue grass); • No rare plant mitigations are required given the low incidence of rare plants, coupled with the native status of bison and the low concentrations they will occur during the course of the pilot project. 	Meeting	See Heuer, 2018
	Soft Release Pasture	Aggressively rehabilitate soft-release pasture as soon as practical once bison are released.	<ul style="list-style-type: none"> • The summer portion of the soft-release pasture was decommissioned in 2018 and 2019 with all materials flown out of the backcountry; • We implemented a targeted pasture restoration program, including soil de-compaction and native seeding of a handful of heavily impacted areas, in summer 2019 (Yakiwchuk, 2018); monitoring will determine if further restoration efforts are required; • Removal of fencing around the winter portion of the soft release pasture is yet to occur, likely in summer 2021. 	Meeting	4.3
	Riparian Vegetation	Bison will not damage riparian habitat	<ul style="list-style-type: none"> • As of Dec 2019, bison spent approximately 8.2% of their time in riparian areas (i.e. 8.2% of bison fixes were within 30m of water); no one riparian area received disproportionate use. 	Meeting	4.4

	ISSUES	Detailed Environmental Impact Assessment TARGET	DETAILS (as of December 31 2019)	STATUS	Section of Report
Aquatics	Water Quality	Water quality monitoring	<ul style="list-style-type: none"> We measured water quality in watersheds within the bison reintroduction zone (treatment) and outside the area (control) for 3 years prior to the reintroduction of bison (2014-2016); Post treatment samples will be collected and analyzed in 2021/22. 	Unknown at this time	5
Cultural	Vulnerable Archaeological Sites	Fence off three high-vulnerability archaeological sites to exclude damage from bison	<ul style="list-style-type: none"> Unnecessary at this time - No bison locations at known vulnerable archaeological sites up to December 2019. 	Meeting	6
		Monitor all moderately vulnerable sites every two years and assess for newly exposed artefacts.	<ul style="list-style-type: none"> First assessment to be completed in 2020. 	Unknown at this time	
		Monitor Federal Heritage Buildings due to bison rubbing behaviour	<ul style="list-style-type: none"> Bison came within 100m of Scotch patrol cabin (Federal Heritage Building) several times in late 2019 but did not rub against or cause any damage to it. There is an abundance of trees for bison to rub <u>u</u>-p against. 	Meeting	
Visitor Experience	Outreach and Education	Increase awareness and appreciation of bison and Parks Canada's role in restoration and conservation.	<ul style="list-style-type: none"> Reached over 118 million people between 2017-2019 with the bison reintroduction story via many communication channels, including digital storytelling, traditional media, documentary projects, and outreach events, including Indigenous blessing ceremonies, the Calgary Stampede, and partnership programming with the Calgary and Toronto zoos. 	Meeting	See Heuer, 2019
	Visitor Safety	Post Bison Safety Signage at all Trailheads and at Bison Fence Gates	<ul style="list-style-type: none"> Completed in spring 2018; updated signs and reposted in Spring 2019. 	Meeting	See Heuer, 2019
Integrate human-bison conflict prevention and response into BNP's existing human-wildlife conflict management program.		<ul style="list-style-type: none"> Bison Safety messaging has been integrated into all BNP handouts and websites as of 2018; Several BNP Wildlife staff are trained in bison handling/stockmanship, monitoring protocols, chemical immobilization, destruction and necropsy of bison and are familiar with the reintroduction area and BNP Bison Excursion Response Plan. Training of additional staff is ongoing. 	Meeting		
Wilderness Values	Human Use & Grizzly Bear Habitat Security	Minimally maintain trails	<ul style="list-style-type: none"> Maintenance of designated trails in reintroduction zone continues to be limited to annual clearing of deadfall and windfall. 	Meeting	8.1
		Manage human use to <100 human events/month on trails in reintroduction zone in the Panther and Red Deer valleys.	<ul style="list-style-type: none"> Human use in 2019 continued to be well below the 100 events/month. In fact remote cameras recorded fewer than 100 human use events per year. 	Meeting	8.2
		Reduce staff presence to 2 wks/month in Wilderness Zone once bison are free-roaming	<ul style="list-style-type: none"> Staff have been in the reintroduction zone fewer than 9 days/month since the bison were released . 	Meeting	
	Helicopter Use	Reduce helicopter use to <2.5hrs/month in Wilderness Zone once bison are free-roaming	<ul style="list-style-type: none"> Targets have been exceeded in all three years. They were exceeded by ~2.2 hours/month in 2019 due to fence decommissioning and bison excursions. 	Not Meeting	8.3

	ISSUES	Detailed Environmental Impact Assessment TARGET	DETAILS (as of December 31 2019)	STATUS	Section of Report
		Maintain flight elevation over 500 m above ground level	<ul style="list-style-type: none"> • Best practices for flight paths and elevations have been shared and are discussed with helicopter companies annually; • All flight elevations were at least 500m above ground level. 	Meeting	8.3
		Concentrate helicopter use in winter months	<ul style="list-style-type: none"> • Majority of helicopter use in 2017 occurred in winter but the summer months have been busiest in 2018 and 2019 due to fencing projects and unanticipated bison movements requiring hazing or excursion response. 	Not Meeting	8.3
Fencing	Drift Fences	Construct and maintain a total of 7.9 km of wire drift fencing in 15 sections ranging in length from 38m long to 2.5 km long.	<ul style="list-style-type: none"> • Total of 7.3 km of drift fencing in 13 sections constructed by Oct 2018; 2 sections (totalling 600m) deemed unnecessary and never built; • 5 sections of drift fencing deemed unnecessary after the bison were released and removed in 2018 and 2019. Total of 6.86 km of drift fencing remains on the landscape. 	Meeting	9
		The average percent of time that all fences are expected to be in bison holding mode is 1.02% in summer (range 0.27-2.09%) and 3.95% in winter (range 0.02-18.06%). Collectively, all 15 fence sections will be deployed in bison-holding mode <5% of the time.	<ul style="list-style-type: none"> • Average percent of time fences in bison holding mode since bison released: 13.96 % in summer (range 0-100%) and 13.98% in winter (range 0-100%); • Collectively, all 15 sections were deployed in bison holding mode 13.96% of the time 	Not Meeting	9
		No negative fence effects on other wildlife	<ul style="list-style-type: none"> • No wildlife injuries have been incurred along the fences. 	Meeting	9
		Install gates wherever wire fences cross trails	<ul style="list-style-type: none"> • Completed in 2017 and 2018 	Meeting	9
		Keep gates open when fences are in wildlife-permeable mode	<ul style="list-style-type: none"> • All gates are kept open when fences are in wildlife-permeable mode. 	Meeting	9
		Do not install fence posts in wetted channel.	<ul style="list-style-type: none"> • No fence posts occur in wetted channels. 	Meeting	9
		Ensure hanging chains and/or planks on river fences do not impede flow of water or fish	<ul style="list-style-type: none"> • Chains/planks abandoned for high-visibility netting which spans rivers and streams. The soft netting is strung above the water and does not impede the flow of water or fish and is easily avoided by birds; • These nets are deployed only when fences are in bison-holding mode. They are pulled back at other times. 	Meeting	9

3.0 Wildlife

3.1 Bison Movements

3.1.1 Radio Collars

All 16 adult animals from the founder herd were collared with Vectronics GPS radio collars in spring and early summer 2018 prior to being released. One-and-a-half years later only 3 of these original collars remain active. One bull (M2) and another cow (F14) ripped off their collars prior to the release, two other bulls (M5 and M19) had their collars removed when they were recaptured after dispersing from the Park in August 2018. Nine more collars were dropped over the last year when the aftermarket breakaway inserts wore through prematurely due to excessive rubbing by bison (Figure 3).



Figure 3: One of several ripped radio collars recovered in the Divide Creek area of the reintroduction zone in 2019 (photo: K. Heuer/Parks Canada).

Three additional collars have been deployed in the last 3 months using helicopter netgun capture techniques and have been affixed without the aftermarket inserts (collars are still programmed to drop off automatically after 4 years). As of mid January 2020, 6 of 35 animals (17% of the herd) are radio collared. The goal is to have at least 10% of the population radio collared until at least the end of the pilot project.

As in past years, all radio collars are programmed to record a location every two hours and to upload these locations every 22 hours to an Internet-based platform. In actuality, these uploads occur for each animal approximately every 1-3 days. Battery life of collars is expected to be approximately 3-4 years.

None of the original Sirtrack VHF eartag transmitters fitted on 6 bulls and 10 yearlings prior to the release remain functional. Antennas broke on the majority of these transmitters in the initial months after deployment but 3 still functioned as of December 31, 2018. The last one to function was on Bull M02 in August 2019.

3.1.2 Movements of Main Bison Herd

Parks Canada's strategy to hold the reintroduced bison in a backcountry pasture for 1.5 years before releasing them seems to be working: almost all the animals (36 of 39 (92%)) remained within 30km of the soft release pasture over the last 18 months (Figures 4 and 5). The exceptions are three lone bulls who dispersed from the area over the last 1.5 years (see Section 3.1.3 below).

Average daily bison movements range from 0-10 km/day with few exceptions (Figure 6). Except for the occasional lone bull and a couple of weeks where the main herd split temporarily, the animals have remained in a single herd. Over the latter part of 2019, the main herd consisted of the 10 founder cows, 10 two-year-olds, 10 yearlings, 3 calves and one or two founder adult bulls. The same bulls are not always associated with the main herd. For example, bull M30 was on his own for the first half of 2019 while M03 and M04 stayed with the main herd but then M03 was displaced and M30 took his place alongside M04 in the main herd for the summer. A fourth bull, M02, spent most of his time alone or in close association with M03 before he dispersed from the reintroduction zone (and the park) in August and was lost to the project (see below).

The bison have consistently explored the reintroduction zone in a northeast direction since being released (Figure 4). After spending the initial 7 months of their freedom in the Snow Creek, Panther and Elkhorn Summit areas, the main herd ventured into the Red Deer valley for the first time in late March 2019 and spent most of the rest of the year in that valley, exploring side drainages like Divide and Tyrrell creeks (Figure 4). They migrated to higher elevations in summer to access higher protein, emergent vegetation (Figure 7). Periodic forays back into previously used areas like the middle Panther Valley and to the soft release pasture suggest the animals are developing a home range (Figure 5).

3.1.2 Managing Herd Movements: Drift Fences and Hazing

The above patterns are not entirely a product of the free will of the animals; two drift fences near the eastern boundary of the Park and active herding by staff whenever the bison venture outside of the core zone have influenced their movements in peripheral areas of the reintroduction zone. These management tools encourage bison to anchor to the reintroduction zone and allow us to uphold commitments to agricultural stakeholders and the Government of Alberta to keep bison from wandering beyond the reintroduction area for the 5-year pilot project.

Bison remained in the green (core) part of the reintroduction zone for 92% of the time since being released (497 of 538 days). One or more animals were within the hazing (yellow) zone 5% of the time (26 days) and one or more animals were beyond these zones 3% of the time (15 days) (Figures 5 and 8).

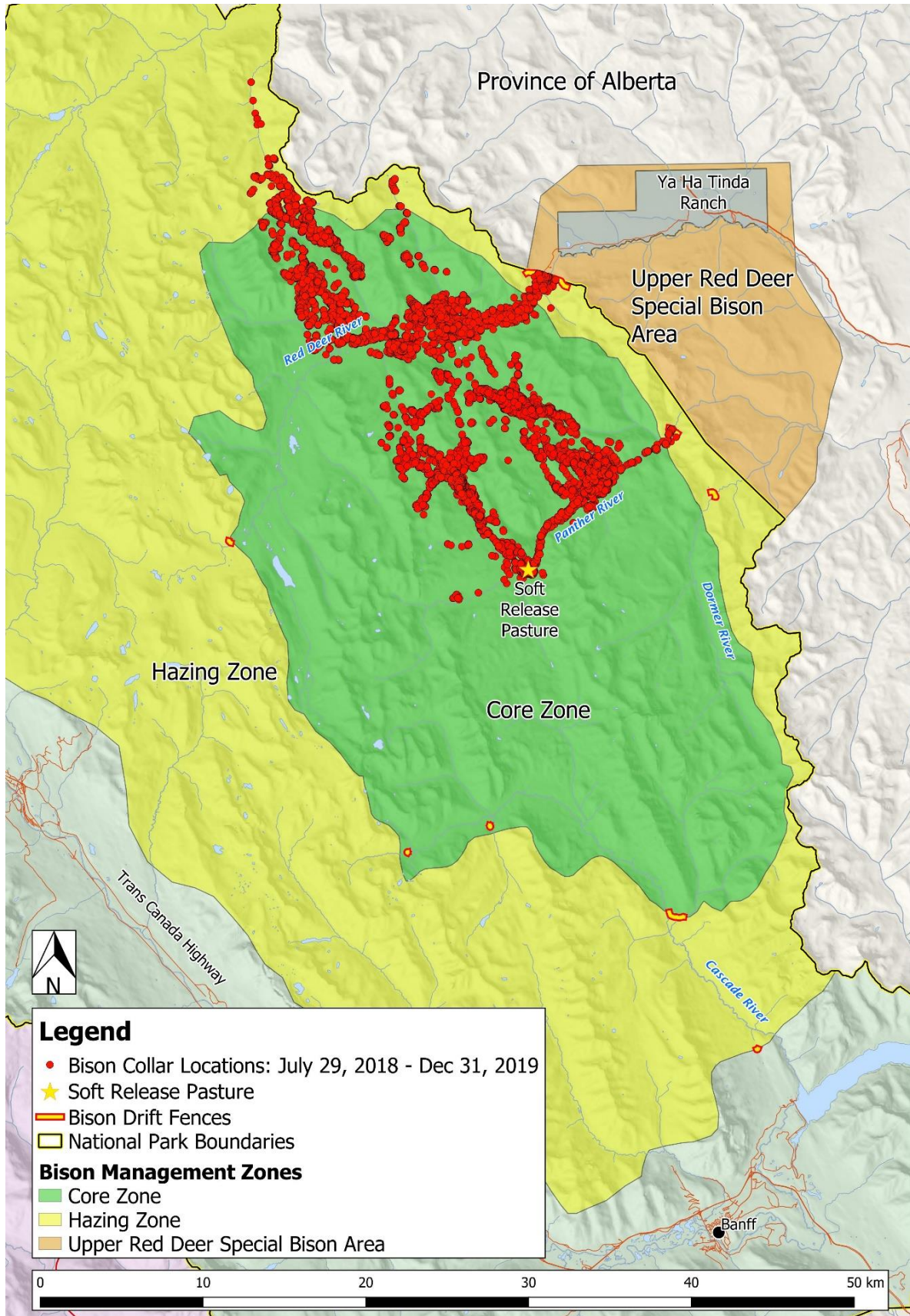


Figure 4: Movements of the main herd since release (July 29, 2018 to Dec 31, 2019). The Upper Red Deer Special Bison Area was established by the Government of Alberta in 2018 as a buffer area where bison are protected, should they leave the reintroduction area, until Parks Canada staff can redirect them back into the park

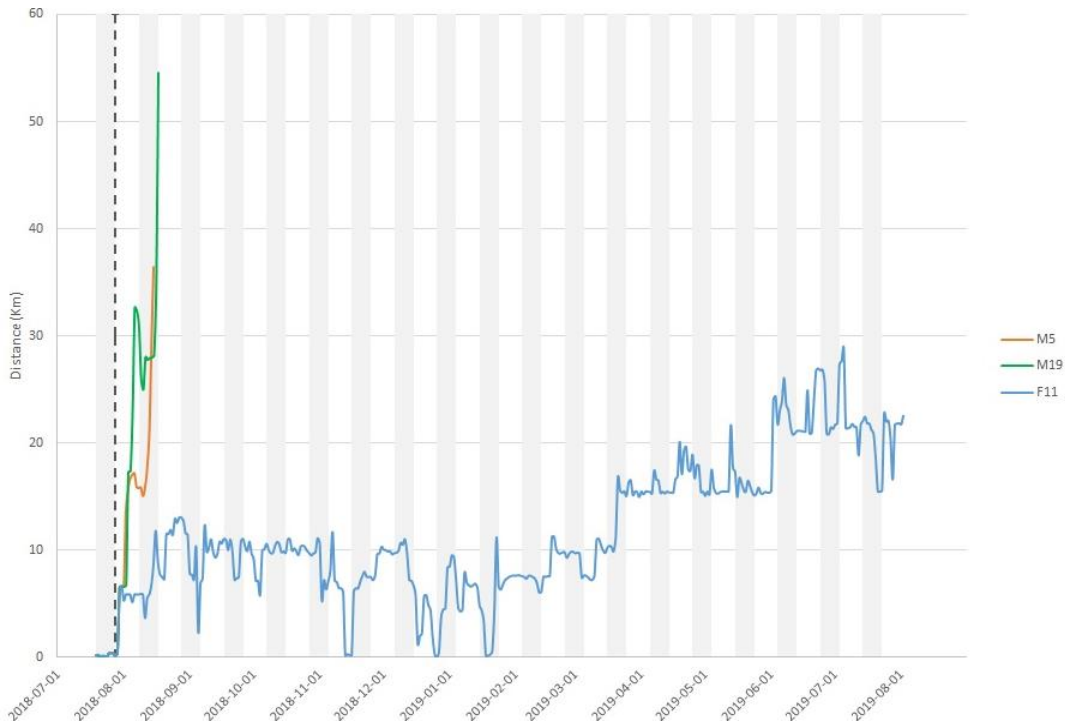


Figure 5: Distance from soft release pasture for bison in the first year of free roaming in Banff National Park. Female11 (blue line) represents movements of the main herd (all cows and young). Male5 (brown line) and Male19 (green line) dispersed from the area and were lost to the project.

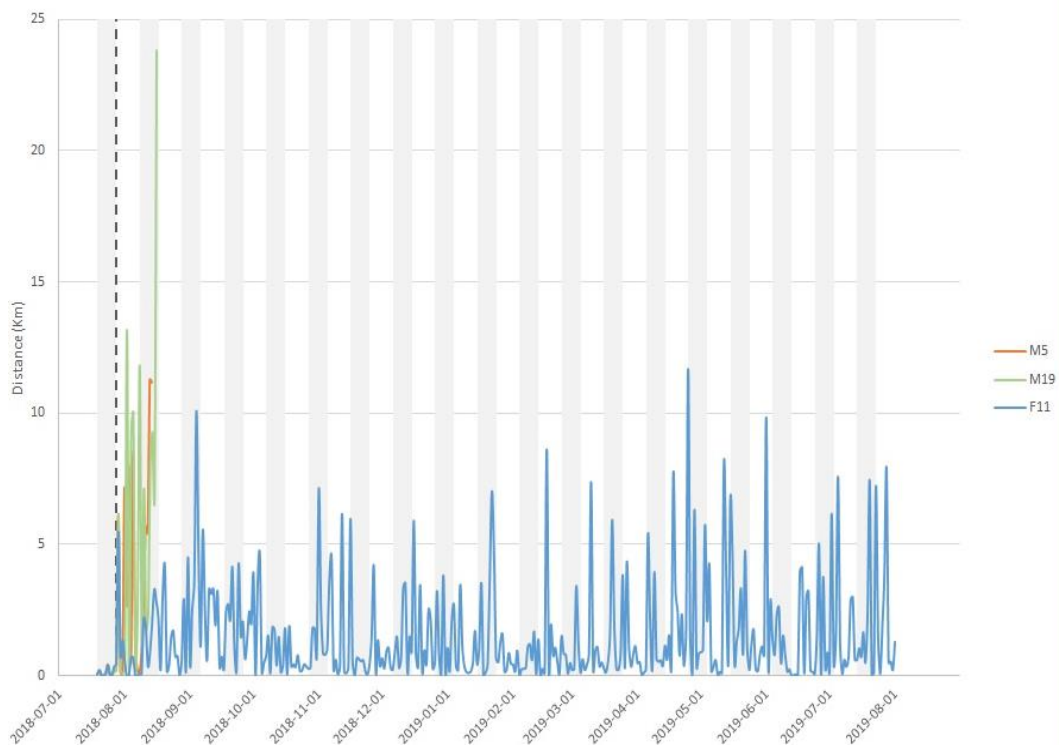


Figure 6: Daily walking distances for bison in the year since being released in Banff National Park. Female11 (blue line) represents movements of the main herd (all cows and young). Male5 (brown line) and Male19 (green line) dispersed from the area and were lost to the project.

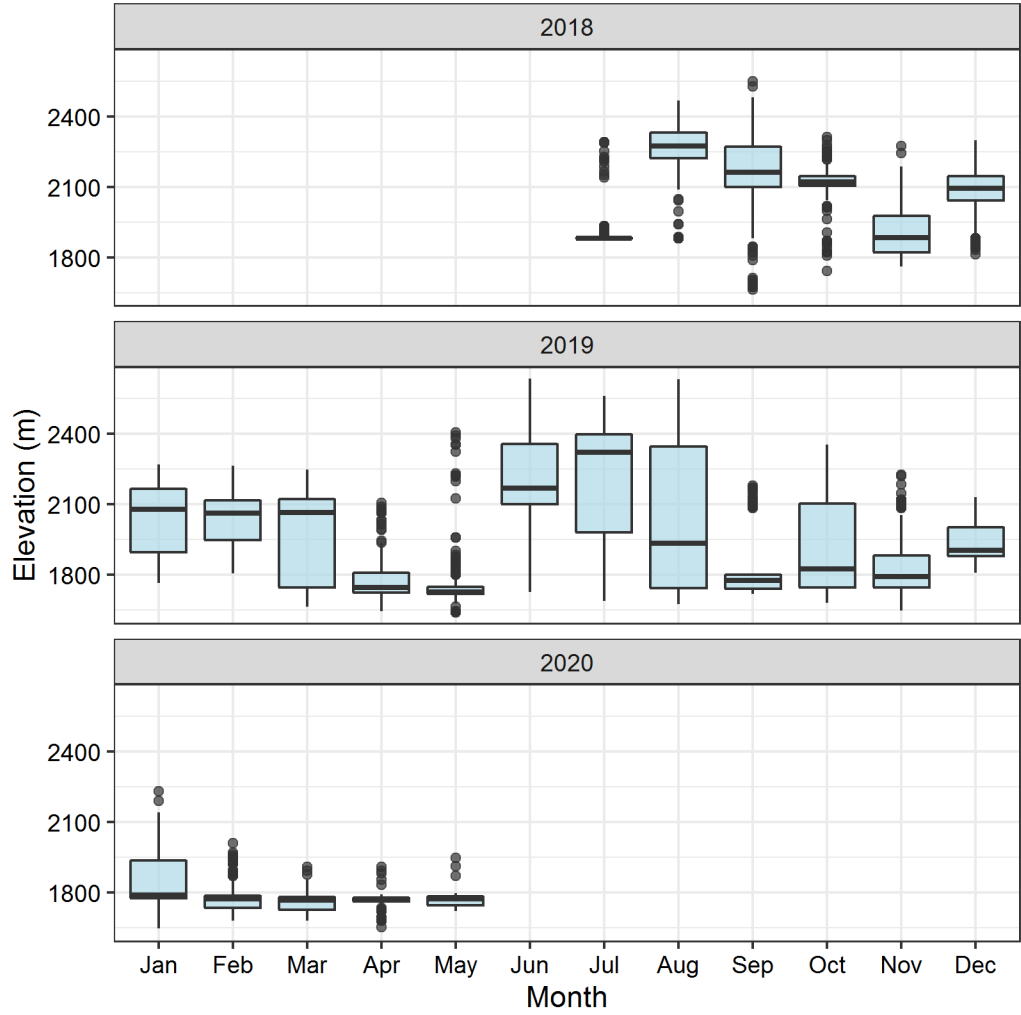


Figure 7: Seasonal trends in elevation for bison in the Banff reintroduction zone.

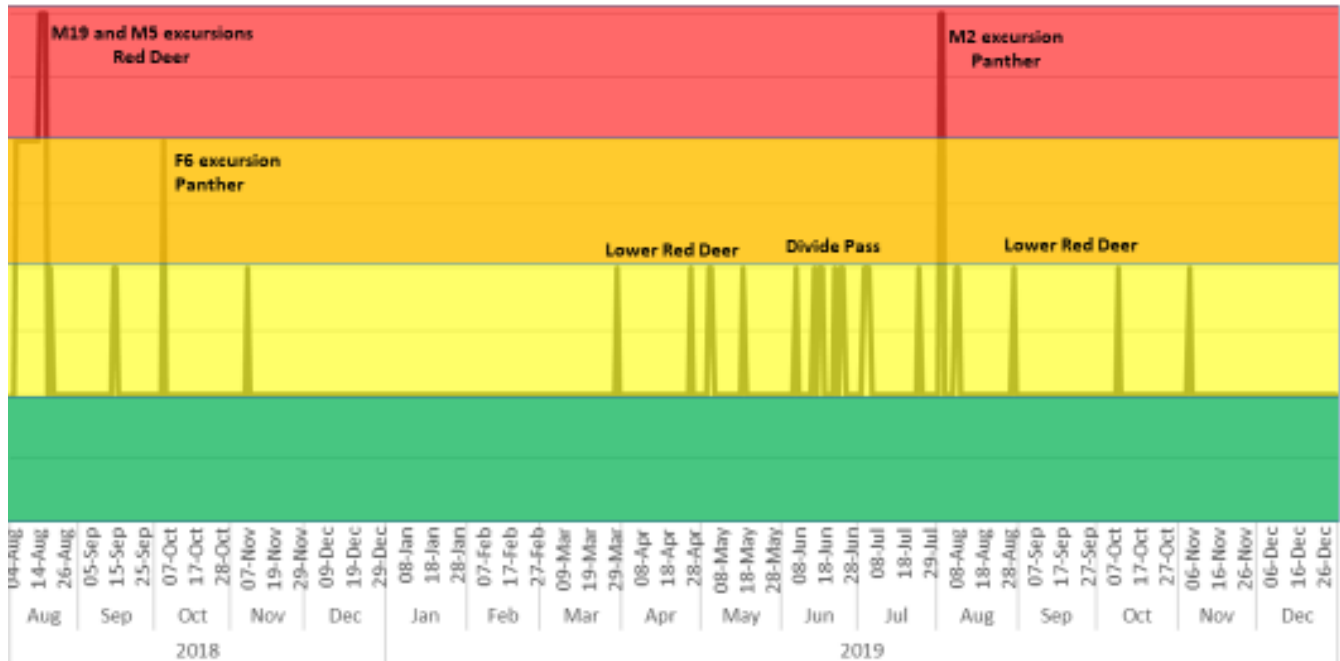


Figure 8: Time bison spent in the Core Reintroduction Zone (green), the Hazing Zone (yellow), the Alberta Special Bison Management Zone (orange) and beyond (red)) (July 29, 2018 to Dec 31 2019).

Our response to “excursions” outside of the core zone varied, depending on the situation. In cases where an adjustable bison-drift fence was nearby and was already deployed in “bison holding mode” (see Section 9), and we had recently checked it for integrity, we took a wait-and-see approach. Only two of ten drift fences have been deployed other than the initial 2 days after the release (Panther and Red Deer boundary fences). Bison visited these two fences 23 times in the 21 months since release. The fences have been 100% effective for groups of 4 or more bison (N=19) but lone bulls and small groups of cows/young have breached the fences on 4 occasions (17% of interactions – see Section 9). The number of fence visits varies among different marked animals, ranging from a low of 3 visits for Male #3 to 12 visits for Female #6 (Figure 9).

The frequency of fence visits and the time spent at the fence has not decreased over the last 18 months (Figure 10). However, two trends are noteworthy: small groups of bison (i.e. lone bulls) were more likely to visit (and possibly breach) the fences in summer (peak of the rut) whereas large groups of bison (i.e. the main herd of cows and young) were more likely to visit in spring, just before greenup of vegetation. This latter pattern also occurred with female bison along the west boundary of Yellowstone National Park where they seek lower elevations outside of the park as they approach the most nutritionally demanding part of their annual life cycle (calving and lactation) (C. Geremia, pers. comm.).

Although lightly built, by bison standards, the BNP drift fence design and integrity has been sufficient to deflect bison back into the reintroduction zone so far. This is partly due to an inherent respect for fences amongst these bison, no doubt learned in their initial years at Elk Island National Park (fenced perimeter) and while in the soft release pasture (where they were exposed to an electric drift fence). Trees falling on and compromising the drift fences, however, as well as the loss of an entire river section of the Red Deer fence due to flooding in 2019, suggests this will not always be the case.

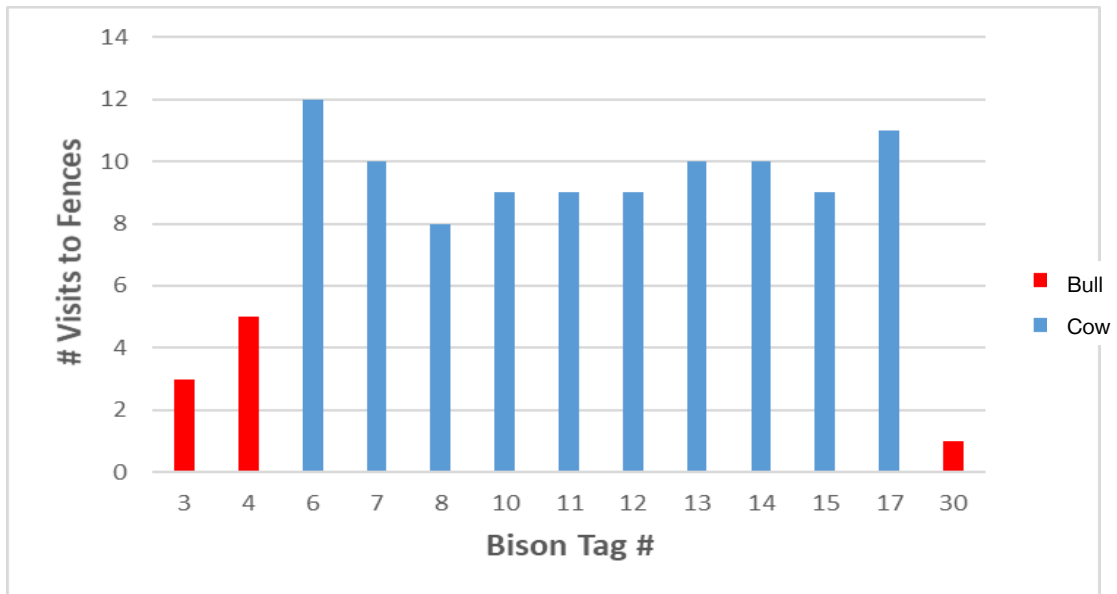


Figure 9: Number of fence visits by individual marked bison from July 29, 2018 to December 31, 2019.

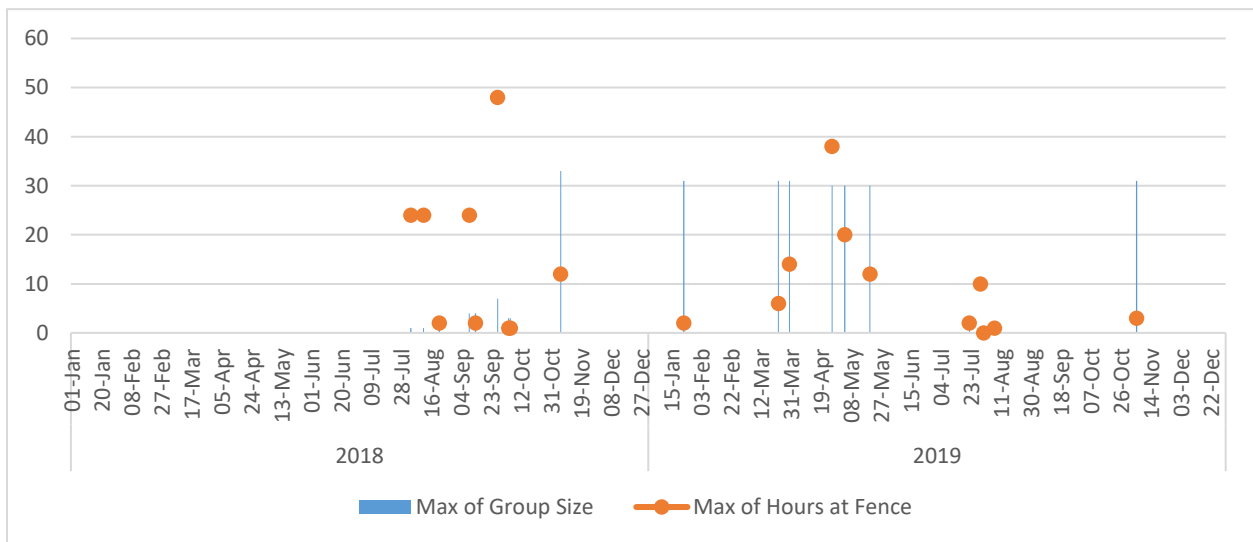


Figure 10: Timing, group size and hours spent at the fence for 23 bison-fence interactions (July 29, 2018 to Dec 31 2019).

We used low stress stockmanship techniques (McCann, 2015) to pressure lone bison and the main herd out of the hazing zone into the core reintroduction area 14 times in 18 months and once to move the main herd to high quality winter range in the reintroduction zone. Although some of these events involved the use of horses or a helicopter, the rugged nature of the terrain dictated that most herding occurred on foot (Figure 11).



Figure 11: Main bison herd being hazed south, back into the core (green) zone, headwaters of Tyrrell Creek, July 2019 (photo: K. Heuer/Parks Canada).

Ninety-five percent of the herding was effective over the short term and the desired movement persisted for 24 hours or more in 65% of the cases (Figure 12). This persistence of the desired behaviour was highly dependent on group size: all animals that reverted to moving in the undesired direction within 24 hours were lone bulls, pairs of bulls, or a cow with her two young. In contrast, the desired direction of movement persisted for more than 24 hours whenever the main herd (group of 30+ animals) was involved. In fact, herding of the main group often led to avoidance of the undesired area for weeks and months.

Animals were herded distances ranging from a few hundred metres to 7.5 km (Figure 13). All herding occurred in the summer and fall months, a time of year when abundant forage and lack of snow encourages exploration, and breeding season prompts bulls to search for new mates.

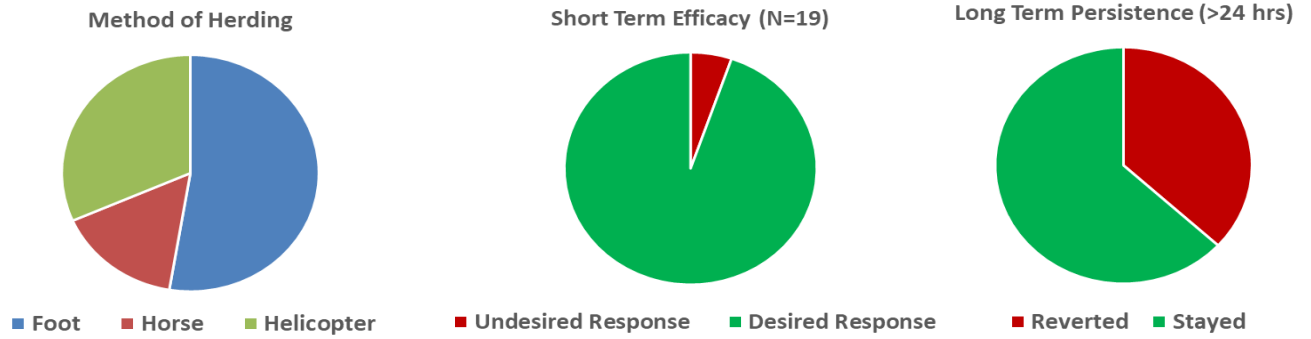


Figure 12: Proportional measures of herding methods (left), short term efficacy (centre) and long term persistence (right) for 19 herding events of bison in Banff National Park using low stress stockmanship techniques.

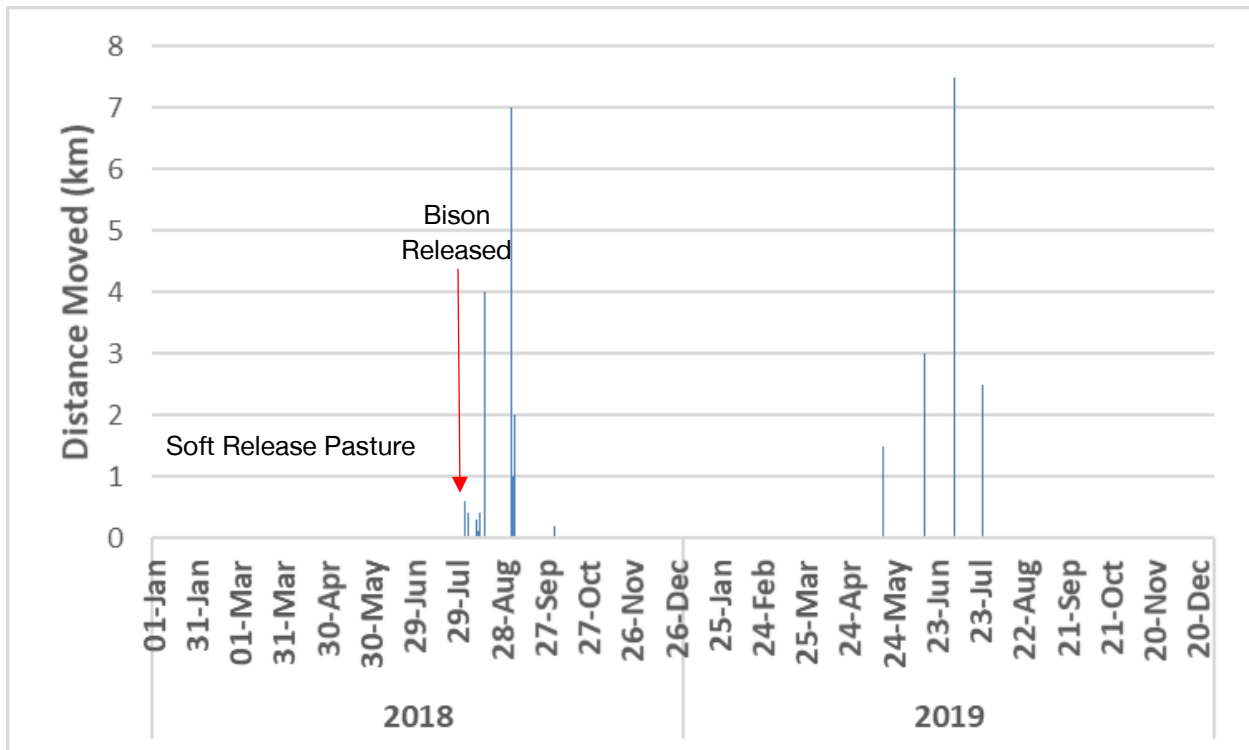


Figure 13: Timing of herding events and distances bison were moved since being released in Banff National Park.

3.1.3 Bison Excursions from Reintroduction Zone

There have been four bison “excursions” from the reintroduction zone since the animals were released in July 2018 (Figure 14). Three involved lone bulls in the month of August, during the rutting season. Two occurred in 2018 (M19 and M5) by way of the Red Deer Valley (one bull circumvented the drift fence and the other jumped it) and another (M2) left via the Panther Valley in 2019 (likely ducked the net that spans the river on the Panther drift fence). One of these bulls had to be destroyed due to trajectory, speed, and lack of a large enough helicopter to lift him whereas the other two were recaptured alive and were relocated to captive herds outside of the Banff area.

One other excursion involved a cow (F6) with her yearling and young-of-year calf in October 2018 when they also ducked the river component of the Panther River fence (Figure 13). After a day-long foray that saw them travel for 25 km in a northeast direction, they turned around, came back into the Park and rejoined the rest of the herd of their own accord. They have remained inside the reintroduction zone with the main herd ever since.

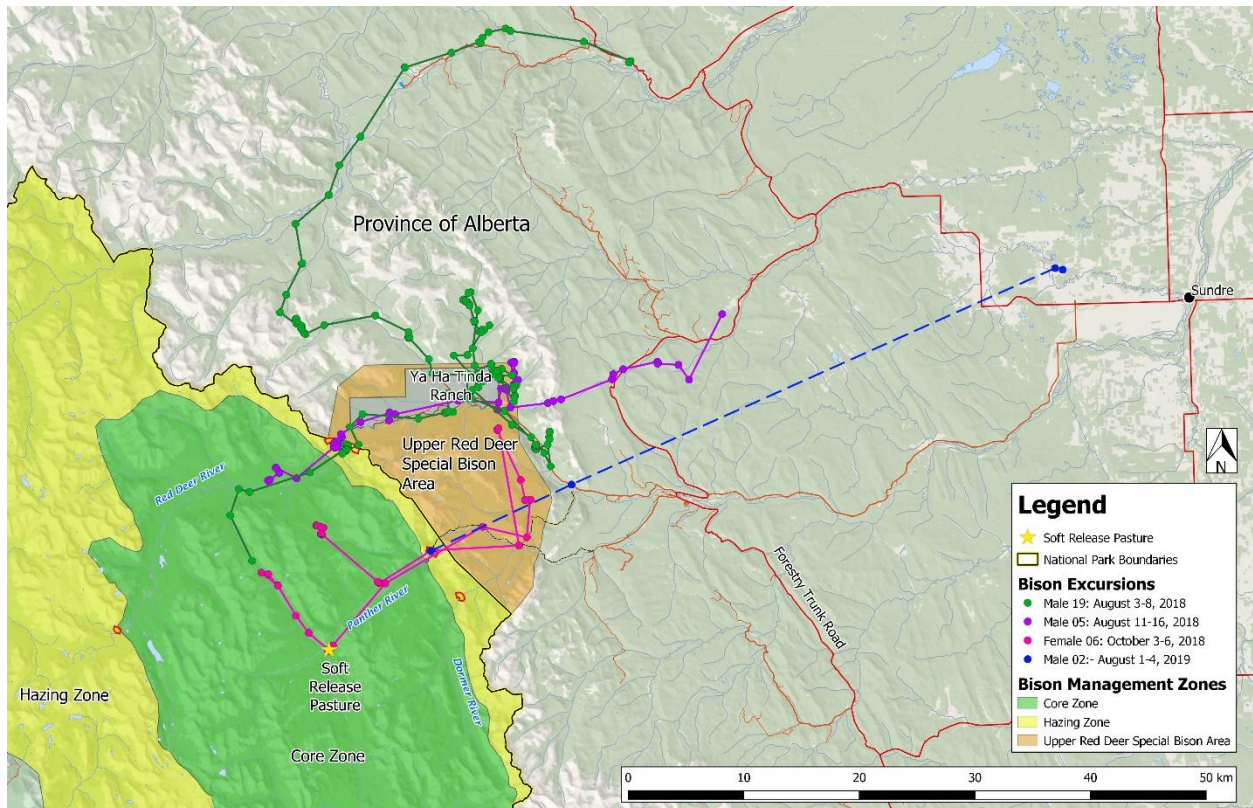


Figure 14: Bison excursions from BNP in 2018 and 2019.

3.2 Bison Health and Reproduction

3.2.1 Diseases and Parasites of Concern

Parks Canada staff collected blood from all 10 cows, all 6 bulls and all 10 yearlings while fitting radio collars and ear tags onto the animals between February and June 2018. All blood chemistry was normal and clean, including brucellosis testing by the Canadian Food Inspection Agency (CFIA). This confirms, and is additional to, the clean results obtained from tests prior to translocating the animals from Elk Island National Park in 2017. There has been no indication of health problems in the herd since their release in 2018.

We completed weekly visual health monitoring checks for all bison during the soft-release pasture phase of the project (Feb 2017-July 2018) and have continued on an opportunistic basis during the free-roaming phase via direct observations (with binoculars and/or spotting scope) and remote camera imagery. Testicular bumps were noted on two bulls (diagnosed as benign testicular fibrosis when inspected by veterinarians prior to the release) and an eye on another bull went cloudy due to direct trauma (possibly scratched by a stick or another bull's horn). Except for the occasional abrasion, no other injuries or abnormalities have been noted in any other bison.

As reported in 2017, all bison were treated twice for parasites and were tested prior to release. No parasites of concern were detected prior to releasing the animals. Bison carried the *Eimeria* protozoa, which was not a concern because it is universally present in the environment.

3.2.2 Body Condition

We assessed the body condition of each animal weekly during the soft release pasture phase of the project and then opportunistically via remote cameras and direct observations once the animals were free roaming. This involves assessing the extent to which ribs and hip bones are visible, as per standards developed by the National Farm Animal Care Council (2017).

As expected, there was a slight dip in body condition for both sexes shortly after they were released (no supplementary feeding has occurred since the animals started to roam freely). Body condition scores dipped again for cows during their first spring in the wild, a time of year when forage quality and availability is low but nutritional demands are high due to calving and lactation (Figure 15).

3.2.3 Herd Growth

All ten adult females had calves in both 2017 and 2018. Parturition dates were later in 2018 than 2017 which is normal for second-time mothers due to the demands of calving and lactation while still growing themselves. In contrast, only 3 calves were born in 2019, likely due to the chaos of the release occurring during the previous (2018) breeding season which probably disrupted mating opportunities. We expect better calving rates in 2020 representative of future years. Many of the 2017 female calves (N=7) will also be sexually mature and may also produce calves, greatly increasing reproduction over the next few years.

As of December 2019, the founder herd of 16 animals has more than doubled to 35 individuals (annual growth rate of 36%). This includes the loss of 3 dispersing bulls and a lone calf that died of unknown natural causes in 2019.

Annual growth rates of 20% are not uncommon in wild bison herds across North America, even those coexisting with major predators.

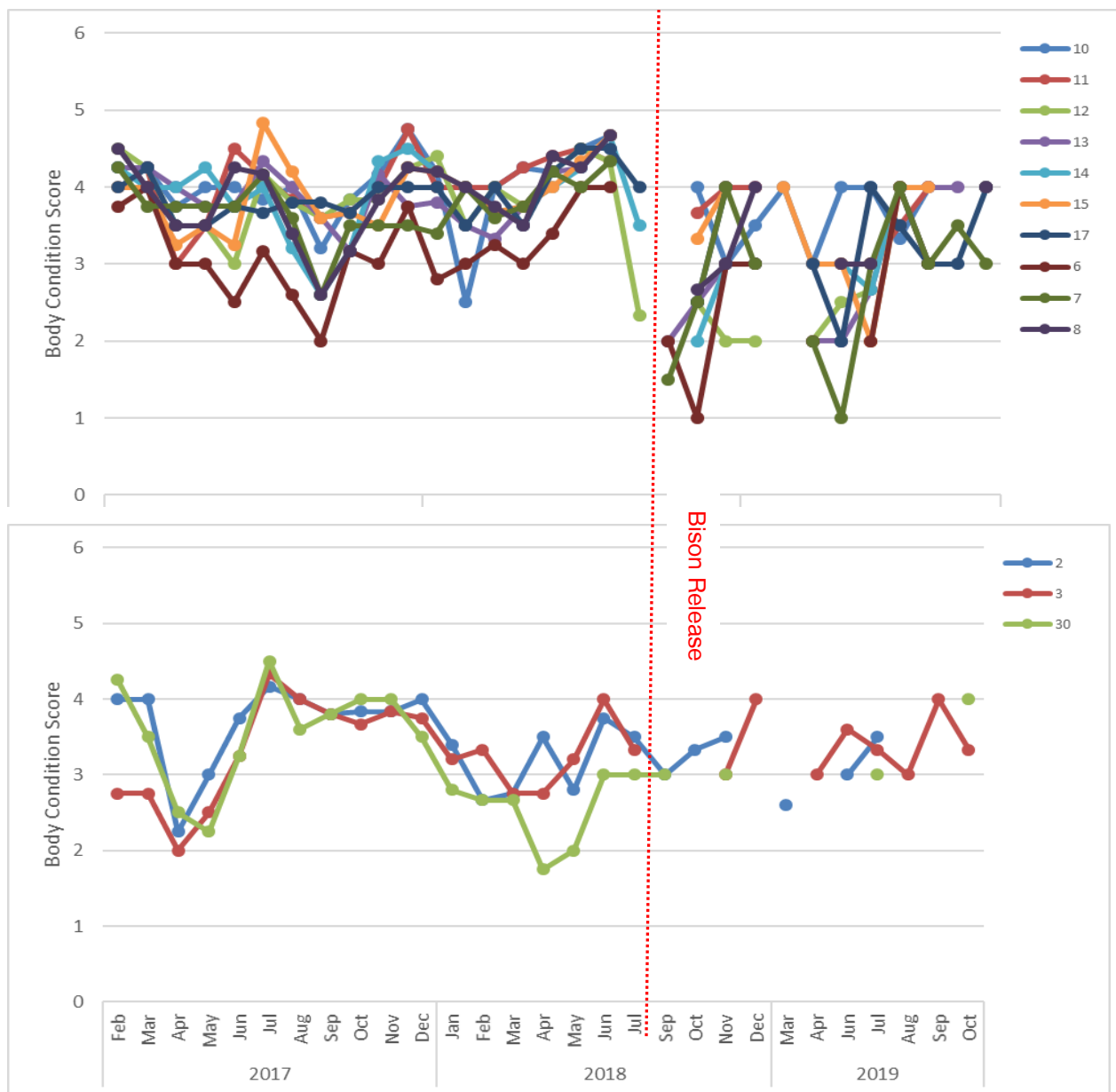


Figure 15: Average monthly Body Condition Scores (BCS) for 10 bison cows (top) and 3 bison bulls (bottom) from soft release pasture phase of the project to first 18 months of free roaming. 5= Excellent, 4=Very Good, 3=Good, 2=Fair, 1=Poor and 0=Emaciated. Red dotted line denotes time of release. Scores as per National Farm Animal Care Council (2017).

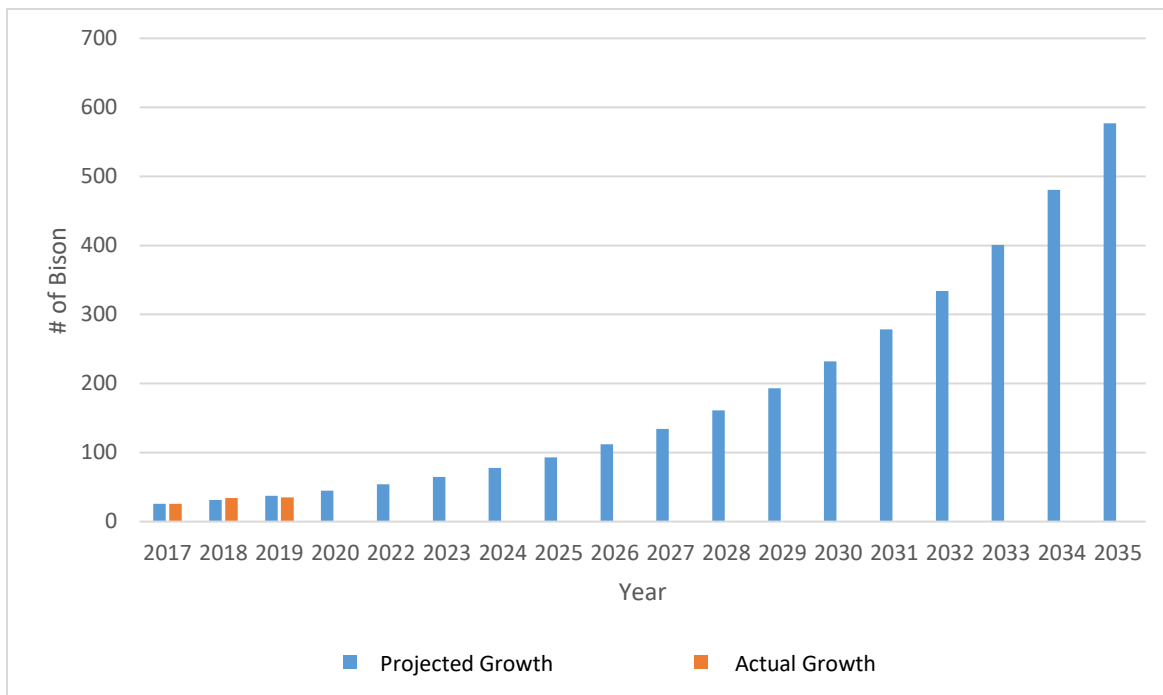


Figure 16: Projected (20%) and actual bison herd growth rates, Banff National Park.

3.3 Bison and Other Wildlife

3.3.1 Wolf-Bison Interactions

The territories of at least three wolf packs overlapped with portions of the area used by bison since their release (Red Deer, Panther-Cascade and Ya Ha Tinda packs). Parks Canada deployed 4 GPS radio collars on these wolf packs in early 2018 but one collar failed, one wolf died of natural causes, and the other two collared animals were legally snared and killed by a trapper east of the Park within a few months. Approximately a dozen wolf-bison interactions were noted in the five months that radio collared bison and wolves were all transmitting signals. Lone bison bulls and the main cow-calf herd were all approached by wolves on numerous occasions but no discernible bison displacements were noted. Remote camera imagery periodically records wolf-bison interactions as well, and has shown bison following wolves more than the other way around! There is no evidence of bison being killed by predators so far.

3.3.2 Other Species Interactions with Bison

Forty-seven radio-collared elk were also monitored in the bison reintroduction zone as part of a long-running study of the Ya Ha Tinda elk herd (e.g. Hebblewhite and Merrill, 2009). Several elk migrated into the bison reintroduction zone and used parts of the area in spring, summer and fall of both 2018 and 2019. They overlapped minimally in space and time with bison (15 of 74 weeks - Figure 17). Overlaps mostly occurred in the Elkhorn Summit, lower Tyrrell Creek, Divide Creek and Scotch Camp areas (Figure 17). The interaction between these species will continue to be monitored and assessed in future years.

Periods of co-occurrence of elk and bison since reintroduction: August 2018-January 2020

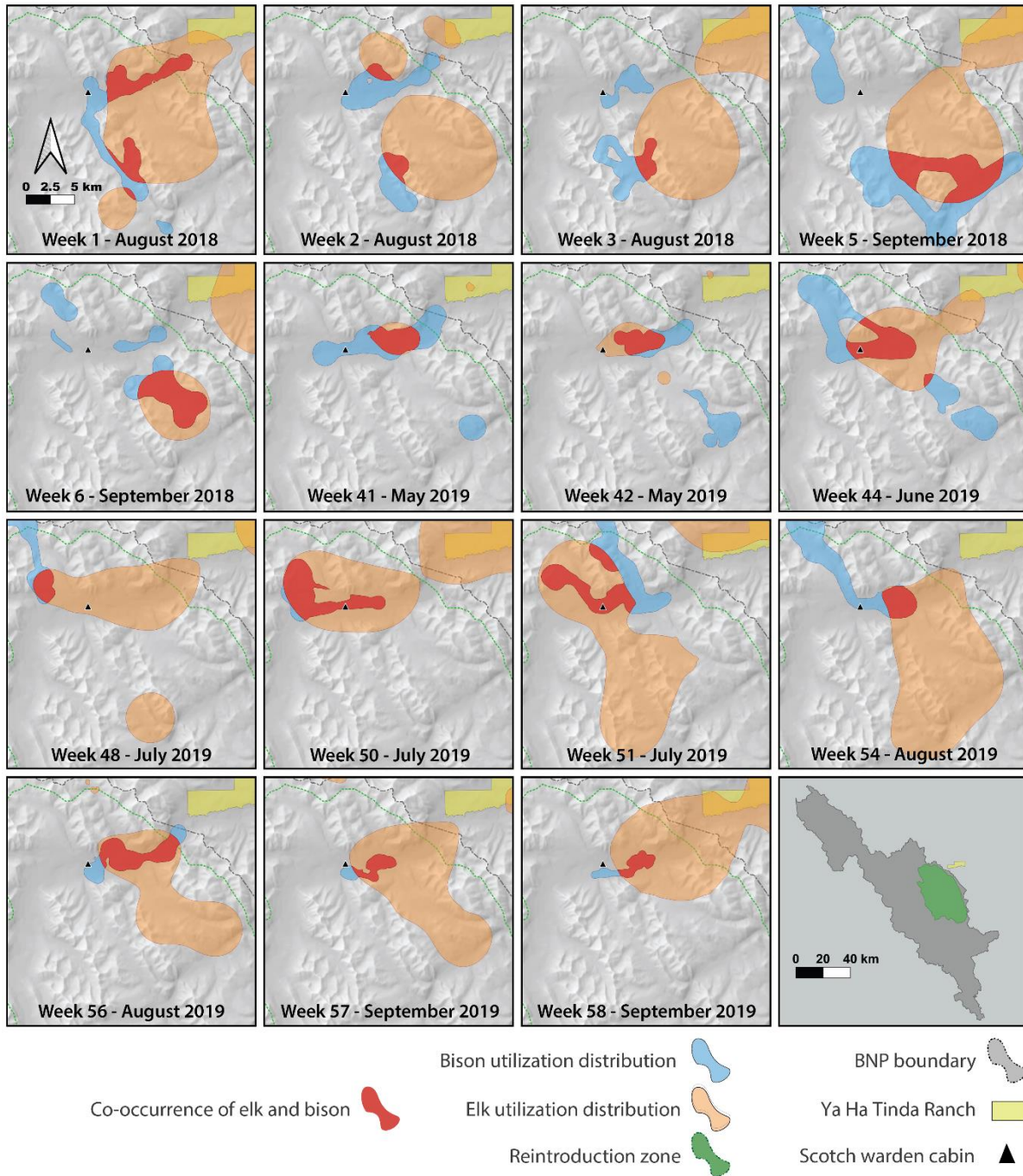


Figure 17: Bison and elk co-occurrences for the 74 weeks since the bison were released (July 2018 to Dec 2019). Weekly habitat utilization distributions (UD) for both species were derived from GPS collar locations and residence times. The UD for bison encompass areas used for travel, stopovers and extended foraging; the UD for elk encompass stopovers and regions of extended foraging (differential location fix-rates for each species). Overlap occurred in 15 of 74 weeks (20%).

Bighorn sheep and bison were anecdotally observed within 200m of each other on 5 occasions since the release. No avoidance behaviour was observed. We launched a long term bighorn sheep study late in 2019 and early in 2020 radio collared 15 sheep throughout the reintroduction zone. A further 9 sheep were radio collared outside of the reintroduction zone in the lower Bow and Cascade valleys. We collected health samples for all captured animals and are in the process of getting them analysed. Parasite loads will be assessed in summer 2020 by way of scat collection. The extent of habitat overlap between bison and sheep will be assessed in future years.

Just two anecdotal observations were made of bison and a grizzly bear sharing the same meadow. The two species calmly grazed in close proximity to each other and did not seem affected by each other's presence.

4.0 Vegetation

4.1 Non-Native Vegetation

Sixteen infestations of non-native vegetation were identified in the reintroduction zone prior to bison being released as part of the Detailed Environmental Impact Assessment (Heuer 2017). Parks Canada vegetation specialists visited and controlled 10 of these infestations in 2018 and 6 in 2019 using mechanical, cultural and chemical methods.

The Windy pasture yellow toadflax infestation identified in 2017 was surveyed again in 2019, with no plants noted. The site will be surveyed again in 2020 before being considered eradicated.

Tall buttercup infestations in the Windy pasture have rebounded without bison grazing and will continue to be controlled (native seeding, pulling, herbicide) in future years.

4.2 Restoration of Soft Release Pasture

Decommissioning of the soft release pasture at Windy cabin continued in 2019: staff and volunteers removed the remaining 2km of page wire fencing, pulled all posts, and decommissioned both river fences around the summer portion of the soft-release pasture. All materials were flown out of the backcountry.

Several areas of the winter portion of the soft release pasture were affected by one-and-a-half years of bison feeding, wallowing and bedding behaviour, and manure stockpiling (Figure 18). A targeted pasture restoration program, including soil de-compaction and native seeding of a handful of heavily impacted areas, was implemented in summer 2019 (Yakiwchuk, 2018). Removal of fencing around the winter portion of the soft release pasture will likely occur in summer 2021. In the meantime, 4 gates are being left open to allow access to wildlife.



Figure 48: Aerial view of backcountry bison soft-release pasture in Panther Valley in 2018 while still in use by bison (photo: A. Taylor/Parks Canada).

4.4 Riparian Vegetation

The impact of bison on riparian areas is of concern to some stakeholders. A simple analysis of 53,953 bison fixes between July 29, 2018 and Dec 31, 2019 shows the bison spent a minority of their time (approximately 8.2% of all locations) in riparian areas (within 30m of watercourses or water bodies).

To better understand the proportional impact of bison on riparian zones in any given area, we also calculated how much of the available riparian habitat was visited by bison in the valleys they frequented (9.7%). The similarity between these two percentages suggests they didn't use any particular riparian area for a long period of time.

5.0 Aquatics

5.1 Water Quality Monitoring

Water quality measurements were taken for watersheds within the bison reintroduction zone (treatment) and outside the area (control) for three years prior to the reintroduction of bison in 2014, 2015 and 2016. Samples will again be collected and analyzed in 2021/22 to assess for effects due to bison.

6.0 Cultural Resources

Concerns about the vulnerability of archaeological and historic sites to bison wallowing, trampling and rubbing behaviours were articulated in the Detailed Environmental Impact Assessment (see Appendix 6, Heuer 2017). Bison did not use areas of the Red Deer Valley where the 4 highly vulnerable sites were

identified. They started coming close to one heritage structure in late 2019 (Scotch cabin) but with so many trees around did not rub up against the buildings. An assessment of bison locations and known cultural sites is scheduled for 2020.

7.0 Public Outreach and Visitor Experience

7.1 Outreach and Education

A key goal of the project is to increase awareness and appreciation of bison and Parks Canada’s role in restoration and conservation. In 2019 we continued to bring the Banff bison reintroduction story to Canadians via a variety of communications channels, including digital storytelling, traditional media, documentary projects, outreach events, and bison-themed outreach at the Calgary Stampede and Calgary and Toronto zoos. Collectively, we have reached an estimated 118 million people with the Banff Bison story (Table 2).

Table 2: Outreach and Education Initiatives - Banff Bison Reintroduction Project, 2017-19

		2017 – 2019	Estimated Reach
Digital Storytelling	Video webisodes	12	90,000 viewers
	Social Media and Blogs	54 posts and 29 blogs	1.9 million
Traditional Media	Press conferences	3	
	Media requests	120	Over 109 million
Documentary Projects		11	Over 6 million
Outreach	Indigenous ceremonies	3	
	Out-of-park events (e.g. Calgary/Toronto zoos, Calgary Stampede)	28	505,000
TOTAL			118 million

7.2 Visitor Safety

Bison safety signs were posted at all trailheads from which the reintroduction zone can be accessed in Spring 2018 and were replaced with updated versions in 2019. Bison Safety messaging was integrated into all BNP handouts and websites in 2017, 2018 and 2019.

Approximately a dozen public groups have encountered bison in the backcountry over the last two summers. None have resulted in aggressive or problematic interactions. Bison generally fled (up to 5km) from groups on foot whereas they were mostly indifferent to those on horseback.

BNP Wildlife staff are continuing to receive training and hands-on experience in bison handling/stockmanship, monitoring, chemical immobilization, and necropsy of bison. Training in backcountry horse travel and familiarization of the reintroduction zone continued in 2019, and several wildlife staff assumed roles in an Incident Command Structure during our herding and excursion responses.

8.0 Wilderness Values

8.1 Maintenance and Use of Trails

Trails in the bison reintroduction zone continue to be primitive in character with many unbridged river crossings and some poorly defined sections. Maintenance of designated trails continues to be limited to annual clearing of deadfall and windfall.

8.2 Human Use and Grizzly Bear Habitat Security

Monthly human use (including Parks Canada staff) remains well below the 100 human events/month threshold for grizzly bear habitat security as per the BNP Management Plan. In fact, remote cameras record fewer than 100 human events *per year* at sites in the heart of the bison reintroduction zone (Figure 19). Human use in the lower Panther was virtually unchanged from 2018 and the majority of use is explained by staff checking the nearby Panther drift fence. Human use in the middle Panther declined sharply in the wake of the bison being released from the Windy soft release pasture in 2018. Human activity in the middle Red Deer Valley is slowly rising, perhaps due to a few groups looking for the bison which, as of 2019, were frequently in the area.

Even with frequent (i.e. monthly) drift fence inspections, staff presence in the reintroduction zone is low, well below the DEIA target of 2 weeks/month in the free-roaming phase of the project.

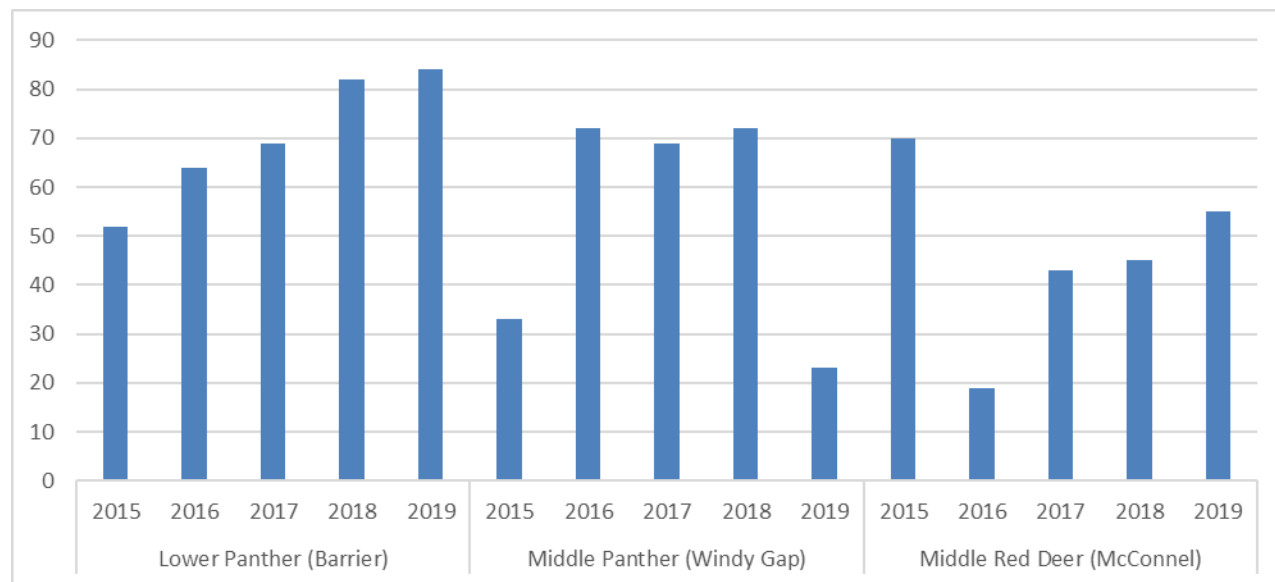


Figure 19: Annual Human events (including Parks Canada staff) at 3 remote cameras in the bison reintroduction zone, 2015-19. A human event is defined as the passage of a person or group of people, regardless of group size (range 1-10 people). Modes of travel include hiking, horseback riding and cross-country skiing. This is consistent with how human use is measured for the Park’s grizzly bear habitat use model.

8.3 Helicopter Use

Helicopter hours in 2019 exceeded targets set in the Detailed Environmental Impact Assessment to a lesser extent than past years (Figure 20). Instead of the targeted 6 hours of helicopter time forecasted for 2019, the project consumed 27 hours. The overrun occurred due to:

- Flying out decommissioned fencing from the soft release pasture and two drift fences (not forecasted);
- The need to extend the Stoney drift fence after learning how bison moved elsewhere in the reintroduction zone;
- Unanticipated bison movements and excursions from the reintroduction zone that demanded rapid responses (July and Aug);
- Poor forecasting that didn't account for project learnings and adaptive management.

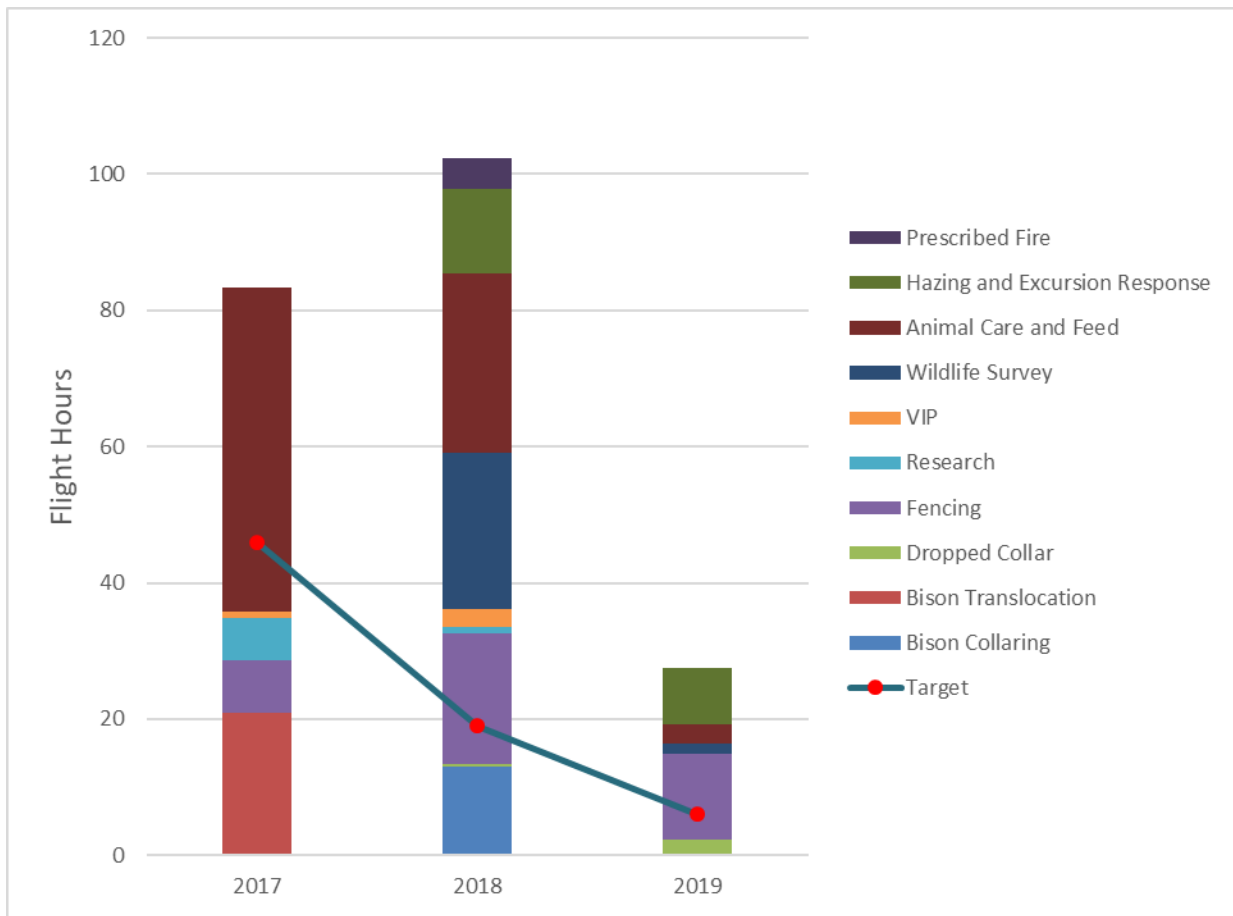


Figure 20: Actual helicopter use compared to targets for the Banff Bison Reintroduction Project, 2017-2019.

9.0 Drift Fences

Originally, we proposed to build fifteen adjustable drift fences that collectively span 7,923m, at squeeze points and breaks in rock ridges that otherwise naturally contain most of the reintroduction zone (Heuer 2017). Only 13 were constructed and 6 have since been decommissioned (Table 3). As a result, there is less drift fencing on the landscape now than was originally planned in the original DEIA (6,860m across 7 sites instead of 7,923m across 15 sites).

All drift fences were constructed to be adjustable between two modes: a) wildlife-permeable mode (2-wire design at 80cm and 100cm above the ground along game trails, and with open gates across human use trails); and b) bison-deflection mode (5 wires ranging from 50cm to 150cm above ground). The intent was for all fences to be in wildlife-permeable mode as a default and to put them in bison deflection mode when bison approached and were in the area. We set targets based on expectations from habitat modelling (Heuer 2017 and Table 3 below).

Three drift fences were deployed in bison deflection mode beyond targets (red and yellow boxes in Table 3). Of these, one fence has since been decommissioned (Scotch) but the Red Deer and Panther fences remain deployed in bison deflection mode 100% of the time. This is due to the speed and unpredictability by which bison move to the edge of the reintroduction zone in these two valleys. As described in Section 3.1.2 above, bison moved to the eastern edge of the reintroduction zone and interacted with these fences 23 times over the last 18 months and often did so at a rate that saw them travel from the middle to the edge of the reintroduction zone within a few hours. GPS collar uploads, meanwhile, occur every 22 hours under optimal conditions.

When averaged across all sites, drift fences were deployed in bison-holding mode 14% of the time between July 29 and December 31, 2019, instead of the DEIA annual target of <5% (Table 3).

The use of fences in conservation can be controversial as they introduce artificial barriers that can impact natural movement (Bull et al., 2018). The effects of drift fences in both modes was evaluated in Banff using 34 remote cameras along and adjacent to fence lines, and with multiple years of GPS radio collar data from elk and wolves (Laskin et al., in review). This multiscale analysis showed that although the 2-wire, wildlife permeable fence design is better for most wildlife species, even the 5-wire, bison-deflection design does not significantly influence the movement of migratory elk (one of the most sensitive species to fences at other scales) (Figures 21 and 22). Except for a few lone bulls, the same fence design was very effective at deflecting bison (Figure 21). These fences continue to be vital tools for encouraging bison to explore and anchor to the target reintroduction zone.

Table 3: Drift fence status and time deployed in bison holding mode in 2018.

Fence Name and Length	Purpose	Status as of Dec 31 2019	Target time in bison-deflection mode	Actual time in bison deflection mode since release*
Red Deer Boundary (2,400 m)	Discourage bison from venturing east of reintro zone onto provincial lands.	Active – Constructed June 2018	1.17% summer 18.06% winter	100% summer 100% winter
Tyrrell Creek (230 m)	Discourage bison from exiting northern edge of reintro zone onto provincial lands.	Removed – Oct 2019	1.55% summer 13.65% winter	0.01% summer 7.80% winter
Panther Boundary (610 m)	Discourage bison from venturing east of reintro zone onto provincial lands.	Active – Constructed June 2016	0.87% summer 7.20% winter	100% summer 100% winter
Dormer Boundary (870 m)		Active – Constructed June 2018	0.65% summer 5.15% winter	0% summer 0% winter
Stoney Creek (2,500 m)	Discourage bison from venturing south of reintro zone into high-use areas of BNP.	Active – Constructed Oct 2017	1.08% summer 0.24% winter	0% summer 0% winter
Sawback Creek (230 m)		Active – Constructed Sept 2017	1.31% summer 0.19% winter	0% summer 0% winter
Cascade 3-mile (50 m)		Active – Constructed Oct 2017	N/A - outside of reintro zone.	0% summer 0% winter
Wigmore Creek (70 m)	Discourage bison from venturing into Cascade in initial years of free-roaming.	Removed – Sept 2019	1.34% summer 0.94% winter	0% summer 0% winter
N Fork Cascade (- 100 m)		Never constructed	0.27% summer 0.06% winter	0% summer 0% winter
Elkhorn Summit (-500 m)	Discourage bison from venturing north for first few years.	Never constructed	1.05% summer 0.35% winter	0% summer 0% winter
Scotch Camp (- 38 m)		Removed – Oct 2018	0.56% summer 0.02% winter	6.0% summer 1.93% winter
Divide Creek (-82 m)	Discourage bison from venturing north of reintro zone into BNP's Clearwater Valley.	Removed – Oct 2018	2.09% summer 3.57% winter	1.38% summer 0% winter
Drummond Creek (100 m)	Discourage bison from venturing west of reintro zone into high use areas of BNP.	Active – Constructed Sept 2017	1.01% summer 1.85% winter	0.69% summer 0% winter
Badger Pass (100 m)		Active – Constructed Sept 2017	0.29% summer 0.10% winter	0.25% summer 0% winter
Windy East (- 43 m)	Temporary drift fence in unlikely event bison escape soft-release pasture.	Removed – Oct 2018	N/A	1.10% summer 0% winter
TOTAL Active: 6,860m Removed: 463m Not Built: 600m		Average % of time all fences in bison holding mode	1.02% in summer (range 0.27-2.09%) and 3.95% in winter (range 0.02-18.06%)	13.96 % in summer (range 0-100%) 13.98% in winter (range 0-100%)

* summer = May-Sept inclusive; winter = Oct-April inclusive

Crossing Rates vs Fence Configuration

Proportion of crossings vs approaches within 1 km of fence

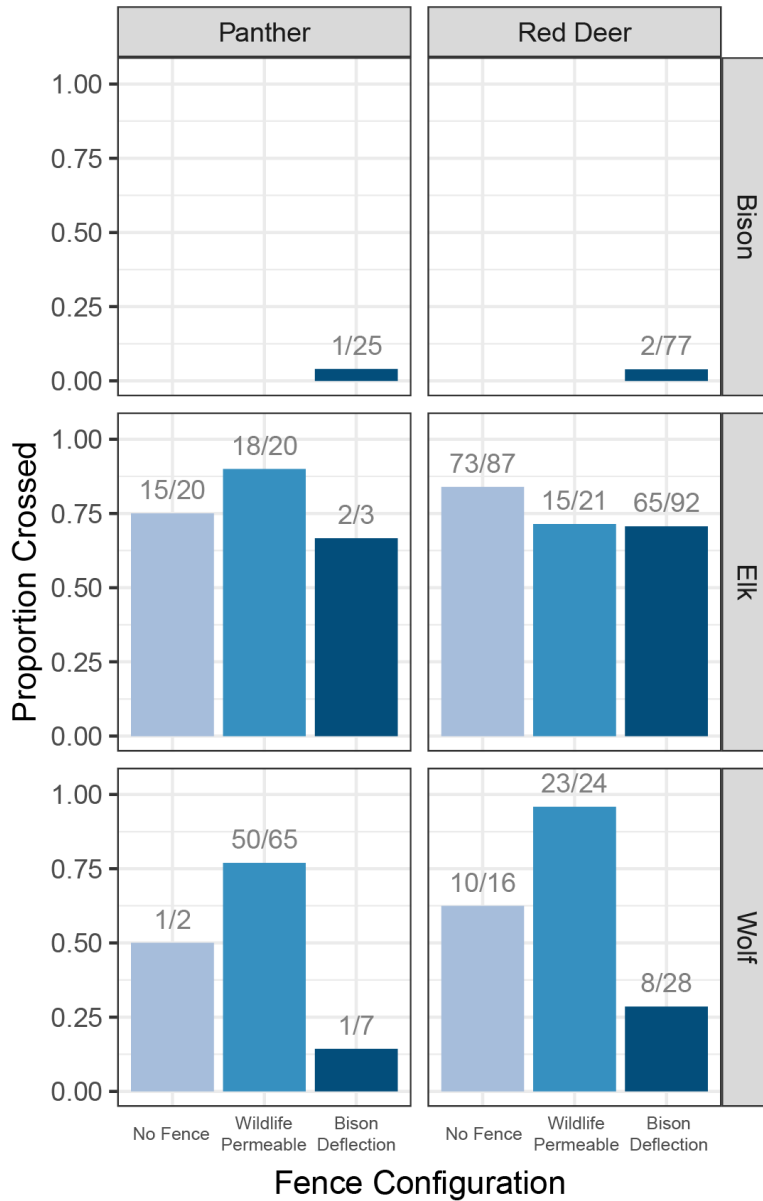


Figure 5: Proportion of animal movements that crossed the fence line compared to the number of movements within 1 km of the fence line. Numbers indicate sample sizes. GPS radio-collar data was collected from elk and wolves both before and after fence construction.

Travel Speed vs Fence Configuration

Species steps within 12 hours of crossing fence

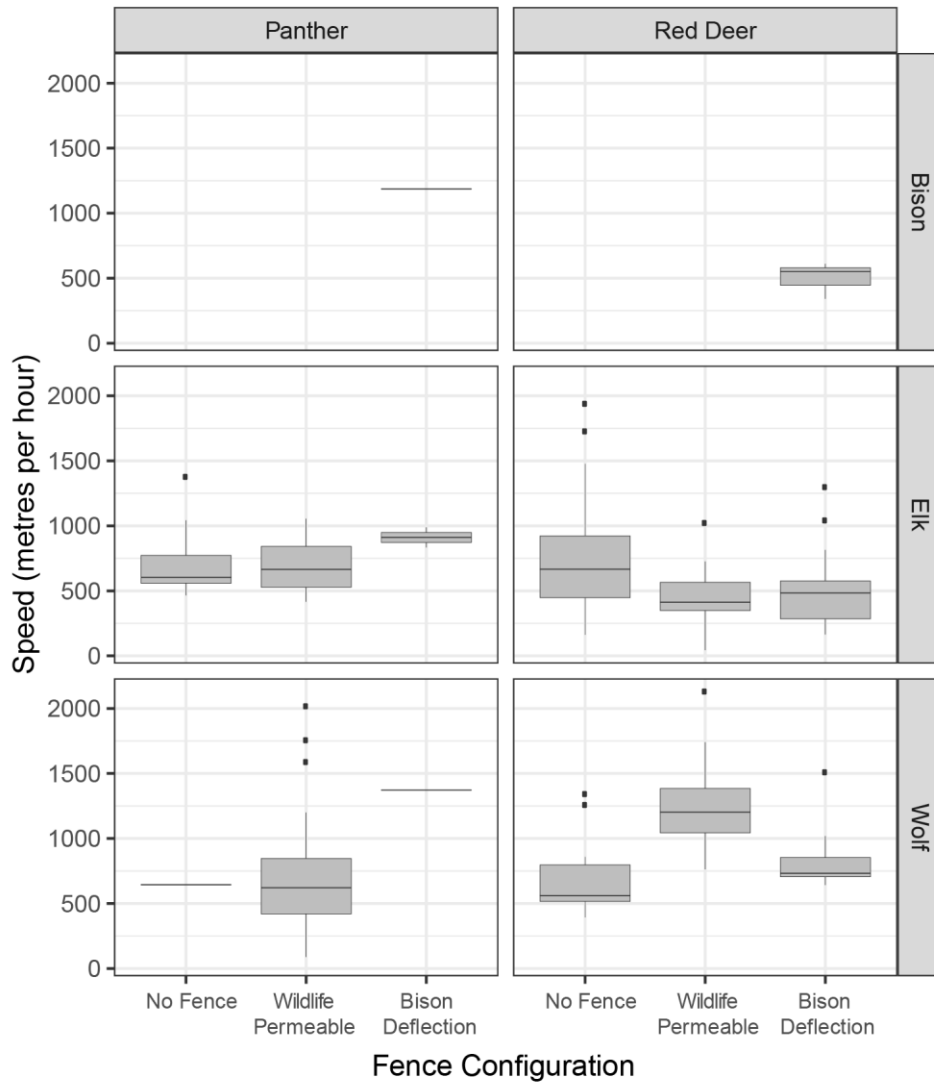


Figure 6: Boxplots showing the speed at which radio collared animals crossed the fence line before and after drift fences were installed and deployed. Travel speed was calculated using GPS data collected within 12 hours of crossing the fence line. GPS data for elk and wolves was collected both before and after fences were constructed.

10.0 Conclusion

Parks Canada's approach to reintroducing bison to Banff National Park is working so far; after 18 months of free-roaming, 35 of a possible 39 animals (90%) remain in the park and are in good health. They consistently use the northeastern third of the 1200 km² reintroduction zone. The bison's low vulnerability to wolf and grizzly bear predation, coupled with good forage, have contributed to herd growth. All but one of the 23 calves born over the last three years have survived.

Much of the project's initial success was likely due to starting with young, pregnant animals and holding them in a soft-release pasture for 18 months so they could calve twice and anchor to the area. The availability of high quality habitat throughout the reintroduction zone further anchored bison to the study area. Like many migrating ungulates, bison shifted to higher elevations to forage on protein rich, emergent vegetation during the summer.

Active management of bison movements with drift fences and herding by staff were required to periodically prevent excursions. Two of our drift fences were crucial and kept bison in the reintroduction zone 23 times over the last 18 months. We actively herded the animals away from peripheral areas of the reintroduction zone on 15 occasions.

Parks Canada will continue to monitor, investigate and assess the effects bison are having on their environment. This research will be our emphasis in the remaining 2 years of the pilot project, not just to inform the 2022 assessment of whether or not further bison restoration in this landscape is feasible, but also to share what we have learned in ways that will inspire others to undertake similar reintroduction efforts.

11.0 References

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