BISON

Conservation Update, November 2020

National Park Service
U.S. Department of the Interior

Yellowstone National Park
Montana, Wyoming, Idaho

Bison Conservation Transfer Program
Engineering a Better Yellowstone
Home on the Range

Bison graze in the Lamar Valley in Yellowstone's northern range.

It's an exciting time to help lead bison recovery in Yellowstone National Park (YNP). In August 2019, we transferred 55 male bison from the Yellowstone population to the Fort Peck tribes. Spanning six days, 19 trailers carrying 3-year-old bison traveled across the Montana prairies returning bison to areas where they once roamed. It was the culmination of years of efforts, and the first ever transfer of bison directly from YNP to tribes. In a way, it was a microcosm of bison recovery. It took dedication, persistence, teamwork, and, above all else science as an objective lens to find common ground among people with diverse opinions.

Please enjoy reading this inaugural annual update to bison conservation in YNP. This issue discusses returning bison to tribes, ground-breaking research showing bison change the way spring comes to the park, engaging citizen scientists to help us detect new ways that bison shape the ecosystem, and current population management.

Chris Geremia
Lead Bison Biologist, Bison Program

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Be Safe Around Bison

Respect bison as wildlife. When bison are approached by people, they may react unpredictably.

Understand bison culture. Bison use postures and movements to display dominance and submission to interact, communicate, and form a society. Approaching an animal head-on challenges their position in the group. Submissive animals will run away, but dominant animals may accept the challenge.

Dominant behaviors include standing ground, staring, pawing, huffing, tail arching, head bobbing, and bellowing. Continued challenge may cause a dominant bison to charge.

Young bison approach people to test and learn their dominance in the bison society. When a younger animal approaches you, slowly walk away. If they follow, it is safest to intentionally turn away from them and continue walking away to show you are not interested in engaging in their dominance test. Stay calm and try to appear uninterested.

Older animals have established their position in the group and often don't test people like younger animals. Don't ever face and challenge older animals moving in your direction. Turn and walk away.

Spray bear spray and run away when an older bison charges or shows dominance behaviors (pawing, head bobbing, tail arched). Begin spraying when animals move within 15 feet.

Visit go.nps.gov/yellbison for more information about bison safety.

Bison Conservation Transfer Program

Society chooses the wild animals we conserve and those we do not. Our greatest success stories are those of the animals we brought back from the brink of extinction or returned to places from which they were lost. Take wolves for example. The single image of carrying wolves in trailers through the Roosevelt Arch and back into Yellowstone in 1995 stands as a symbol of what our society has done right.

During August 19-23, 2019, YNP moved 55 bison to the Fort Peck Indian Reservation in northeastern Montana.

It was the first direct relocation of bison to a new home as an alternative to slaughter. It was the culmination of eight years of compromise between the federal government, State of Montana, and Fort Peck Tribes. Those bison had been held in a rehoming facility in the park for the previous 17 months and undergone rigorous testing to show they did not have a disease called brucellosis. This moment was one of those rare instances where you could feel progress.

Trailers of bison leaving Yellowstone was as significant a moment as trailers of wolves entering the park.

Understanding the connection between wolf reintroduction and bison rehoming takes understanding the story of bison conservation in North America. After following a similar path as other charismatic large wildlife of near extinction followed by recovery, the bison story takes an unparalleled turn.

By 1900, there were only about 200-400 plains bison in North America, down from 30-70 million. Willful decimation nearly eliminated the bison. The forefathers of the National Park Service made a decision that forever changed the fate of bison by deciding to help avert their extinction. The military was brought in to protect about two dozen bison that remained in YNP. Also, 21 bison were reintroduced to begin a captive breeding and recovery program at what is now the Lamar Buffalo Ranch.

Decades of hard work led to a population in Yellowstone of about 3,000 bison by the late 1980s and 1990s. Bison were relearning migration routes and on the cusp of migrating back out of the park to the lands where they used to roam. At that point, as a society, we decided that was enough space for a species that once roamed nearly all of North America.

People raised concerns about disease transmission to livestock, damage to property, and competition for grass with cattle. Managers began shooting animals that migrated out of the park or rounding them up and shipping them to slaughter. People drew lines on the map beyond which bison were not allowed to roam, unlike all other wild animals in the area.

Controlling numbers is a fact of life for bison. Today there are around 400,000 plains bison in North America, with nearly 20,000 of them protected in about 60 publicly-owned conservation herds. The conservation herds grow exponentially and managers use roundups to keep the herds from overgrazing where they live. Unlike in Yellowstone where bison are sent to slaughter, rounded-up animals are moved to start or augment other bison herds.

Up until this year, rehoming bison has not been possible because of brucellosis.

Some Yellowstone bison are infected with the disease brucellosis. To help stop the spread of the disease, Montana law prohibits the live transfer of Yellowstone bison to new areas unless they are first certified as brucellosis-free. Brucellosis is a contagious disease that affects bison, elk, and domestic cows. It reduces production in livestock and marginally affects bison health.

Brucellosis-causing bacteria evade the immune system in early stages of disease so that an infected bison may not test positive for the first several months or longer after contracting the disease. Proving a bison does not have brucellosis takes much more than testing them one time when animals are rounded up. It takes placing them in fenced quarantine pastures with similarly aged animals and holding and repeatedly testing them for one to three years.

During 2005-2012, APHIS developed and verified procedures for identifying Yellowstone bison that don't have brucellosis. After, YNP, the Fort Peck Tribes, the State of Montana, and APHIS agreed on how to implement the procedures.

Yellowstone continues to roundup hundreds of bison that migrate out of the park each winter, but beginning in 2018, some captured bison are moved into the Bison Conservation Transfer Program.

Once in the program, animals are moved between facilities to undergo different testing phases. The first two phases of testing are completed in facilities in Yellowstone or on private lands leased by APHIS near the northern park boundary. APHIS and State of Montana animal health officials certify bison as brucellosis-free at the completion of Phase 2. Certification allows their transfer across the State of Montana to the Fort Peck Indian Reservation. Bison complete Phase 3 at the Fort Peck Indian Reservation.

After Phase 3, the Fort Peck Tribes transfer some bison to the InterTribal Buffalo Council who distribute them to member tribes throughout North America.

The Fort Peck Tribes started their Yellowstone herd by accepting bison that completed the 2005-2012 pilot study. Sixty-three animals were transferred in 2012 and 138 in 2014. Today the Fort Peck Tribes conserve 300-400 bison across more than 18,000 acres on their lands.

Yellowstone and APHIS transferred 93 bison to the Fort Peck Tribes in 2019 and 11 in 2020. A large family group of 50 males, females, and calves is scheduled to be moved to the Fort Peck tribes in January 2021.

The Bison Conservation Transfer Program has led to the largest transfer of Yellowstone bison among Native American tribes in history.

The Fort Peck Tribes recently transferred 40 of the animals received in 2019 to the InterTribal Buffalo Council who distributed them to 16 member tribes across 9 states.

There are 110 other bison being held in the YNP and APHIS facilities undergoing testing, which could qualify for transfer to the Fort Peck Tribes within the next 1-2 years.

Conserving large herds is one of the greatest wildlife restoration challenges of our generation.

Yellowstone bison remain the model of restoring large, wild herds. There is not another bison population which, by their sheer numbers, restore lost ecosystem processes across large landscapes. The large herds provide unparalleled reconnection of people to the long-lost herds that once roamed the continent.

But the benefits of large numbers comes with the challenge of managing large numbers. The Bison Conservation Transfer Program cannot solve the dilemma of needing to remove large numbers of bison from the population each year. But it may go a long way to making conserving large herds more doable.

Yellowstone bison have some of the most valuable genetics for long-term conservation of the species and can only be augmented into other herds through the Bison Conservation Transfer Program.

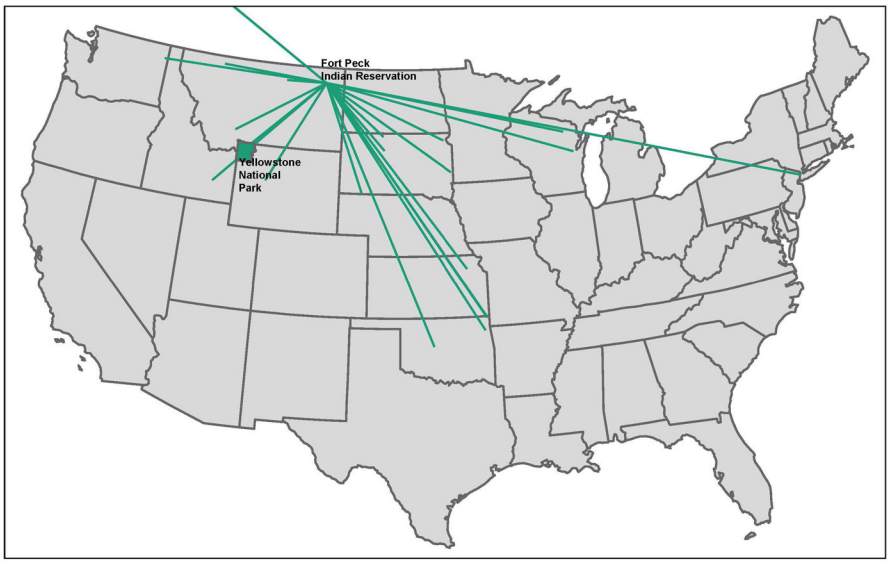
Bison completing the program are transferred to Native American tribes to help restore their lost cultures and ways of life. Yellowstone bison may mean more to them than most other people. Entire cultures are intertwined with bison and the great herds that once roamed North America.

"I longed for that time when Tatanka Sicun, Buffalo Spirit as ancestor, mingled with mine...then yesterday it came...it came in the form of trucks and trailers carrying sacred beings into the realm of our higher plains..."

— Lois Red Elk, member, Fort Peck Sioux

Many tribes see Yellowstone bison as uniquely linked to their ancestral descendants because they were never completely extirpated from the park. To many tribal members, returning bison to tribal lands goes well beyond finding an alternative to slaughter. It is about restoring a part of themselves that is missing.

Negotiating more tolerance for bison outside Yellowstone is going to take a long time. In fact, we may never find enough tolerance outside the park to eliminate the need for some population control. In the interim, identifying brucellosis-free bison and moving them to new homes may be part of the solution to giving bison some more room to roam. It's not more space for animals migrating out of Yellowstone, but a trailer ride to the Fort Peck Indian Reservation and over time more trailer rides to other tribes to augment and start new herds. It is the beginning of returning Yellowstone bison to the lands where they once roamed. The Bison Conservation Transfer Program is not only history in the making but it's the right thing to do.



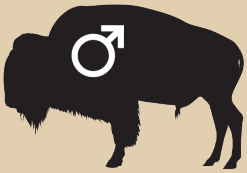
Transfers of Yellowstone bison to start new or augment existing herds.

Identifying Brucellosis-Free Bison

ANIMAL SELECTION: Bison corralled near the northern park boundary are tested for brucellosis. Some of those testing negative are placed into **TEST GROUPS** according to sex and age. Each test group lives in a separate fenced pasture in the **QUARANTINE FACILITY**.

0 DAYS

PHASE 1 requires testing the entire group every 30-45 days and removing all bison that test positive for brucellosis. About 80-85% of bison complete Phase 1.



DISEASE TESTING: Four blood tests are used to determine if an animal has brucellosis. Blood tests detect antibodies produced by an animal fighting infection. Animals that test positive are killed and necropsied to see if there is live bacteria in the body. A positive test from any animal in the test group at any point in Phase 2 or 3 returns the entire test group to Phase 1.

200 DAYS

PHASE 2 (*for males*) begins when the entire group tests negative. Tests are required at 30 days, 6 months, and 12 months after starting Phase 2. Bison are certified as brucellosis-free at the end of Phase 2.

500 DAYS

PHASE 2 (*for females*) begins when the entire group tests negative. All females must not be pregnant at testing. Females are mixed with males after this test.

565 DAYS

PHASE 3 (*for males*) requires two more tests 6 and 12 months after starting Phase 3.

810 DAYS

Females must calve and be confirmed negative within 5 days of giving birth. The dam and calf must also test negative 6 months later, and then they are certified as brucellosis-free.

930 DAYS

Males released to join new herds.

1,000 DAYS

PHASE 3 (*for females*) requires two more tests 6 and 12 months after starting Phase 3.

1,356 DAYS

Females and their calves released to join new herds.

Male bison in the quarantine facility in YNP.

Visit go.nps.gov/telemetry to listen to the story about the first live bison transfer.

Expanding the Bison Conservation Transfer Program

There is not enough space for all the animals that qualify for the program. The first two phases of testing require that animals are held within state and federally approved quarantine facilities. There are two such facilities, one inside YNP and the other on private land leased by Animal and Plant Health Inspection Service (APHIS) near the northern park boundary.

YNP wants to more than double the capacity of its facility. It now consists of a 10-acre pen that holds about 30 animals and a 20-acre pen that holds about 70 animals. We want to divide the 20-acre pen in half and construct at least two additional pens. Each pen requires double fencing to prevent nose-to-nose contact. The water infrastructure must be reconstructed to provide the amount needed for the larger number of animals. We also need to construct a low-stress handling corral to support the increased testing that comes with more animals.

These improvements will help eliminate sending program-eligible animals to slaughter. Right now, about 75% of program-eligible animals are sent to slaughter. These improvements will reduce that number towards 35%. We will be able to increase capacity from entering 100 to entering 250 animals over 3-year intervals and increase the number of bison transferred to new areas from 30 to 80 animals per year.

Yellowstone Forever, the Greater Yellowstone Coalition, Defender's of Wildlife, and other organizations want to work with the National Park Service and Fort Peck tribes to help expand the program. They are supporting tribal engagement, transporting animals, improving public awareness, and helping to increase program capacity.

Engineering a Better Yellowstone

We published findings from a 10-year study of bison migration in a leading scientific journal *Proceedings of the National Academy of Sciences* (PNAS). It had global significance, detected in 204 media outlets in eight countries, with a potential reach of 329 million people. The findings result from years of research, which included putting GPS collars on bison, setting up field experiments to evaluate plant growth and grazing intensity, and collecting dung and plant samples.

Bison do not just aimlessly eat grass.

We discovered that bison change the way spring happens across Yellowstone's vast grasslands. Without several thousands of bison moving freely on the landscape in sync, the springtime season of plant growth would be shorter, the land would not be as green, and the plants would not be as nutritious. On a typical June day in Yellowstone, it's not unusual to see thousands of bison grazing in the Lamar Valley. The groups appear aimlessly roaming back and forth across the historic valley. But as it turns out, that's far from the full picture.

Bison return to graze the same areas repeatedly at such intensity that it turns back the clock on forage green-up, hitting reset on springtime. For many years, scientists around the globe recognized that species like bison and wildebeest aggregate in large groups and intensely graze the same places, which creates grazing lawns. The behavior keeps plants growing, although the plants never appear more than a few inches tall. Short young plants provide the best foods for migrating animals.

Their grazing allows bison to migrate differently than other species. Evidence over the last decade supports the notion that migrating ungulates surf the green wave. The green wave is the progression of plants emerging in spring from river valleys to mountaintops. Many mule deer and elk, for example, have been shown to be in sync with spring green-up, which lets them eat high quality foods as they migrate. But bison and their intense grazing lets them fall behind the wave of spring because they create grazing lawns as an alternative. That finding sets bison apart from other North American ungulates. Put another way, bison are not just moving to find the best food, they are creating the best food by how they move.

The wave of spring across the park changed as the bison population increased to as many as 5,500 animals over the last decade. Images from NASA satellites of the same areas showed that when grazed more intensely by larger groups of bison, they greened-up earlier, faster, more intensely, and for a longer duration.

Their influence on the landscape affects the entire way spring moves through the mountains and valleys of Yellowstone. It makes you wonder what it meant for North America nearly 200 years ago when millions of animals moved together and what it would mean today if we could figure out how to provide bison room to roam across more of North America.

As we seek to reestablish bison, this study shows us what large bison herds are capable of when they can seek out the best forage and move freely across large landscapes. Restoring grassland ecosystems with bison means finding a way to provide large numbers of animals room to roam. The article is available at PNAS.

It's time to let nature decide.

There is no shortage of opinions about the number of bison in Yellowstone, their effects on the vegetation, and what defines healthy rangelands. Other scientists have claimed that bison are overgrazing and permanently damaging northern Yellowstone. Their research is available in the journals *Rangelands* and *Food Webs*. The debate stems from beliefs on what plant communities are supposed to look like, particularly because there are few bison-driven systems that parallel the scale of Yellowstone.

Northern Yellowstone produces 165-172 million pounds of plants, and supports 3-4 million pounds of bison, elk, pronghorn, mule deer, and bighorn sheep. Some people believe the best practice in managing rangeland for domestic livestock is to graze the land uniformly, at the right time, and using enough animals to eat 25% of the plant material produced.

Yellowstone's wild grazers eat about 30-35 million pounds of plants. That equates to only about 20% of the plant material produced, but free-ranging wildlife decide where and when they graze. They have developed finely tuned migrations to move and graze across the land to get the essential foods they need to raise young, survive harsh winters, and avoid predators. Nature decides who lives and dies, and the best moving and grazing strategies are passed on among generations.

When you give bison room to roam, they intentionally don't graze uniformly. Bison don't agree that 25% is the idealized grazing intensity: they

A Day in the Field

Crew members of the Bison Program begin summer days loading up cameras, soil moisture meters, fencing material, soil corers, squares constructed of plastic pipes, paper bags and an assortment of sledgehammers. A team of technicians travel to field sites nearly every day during April through October to measure soil and plant conditions.

We measure plant growth by taking pictures of small 1.5 feet by 1.5 feet plots using a camera adjusted to record only red, blue and near-infrared bands of light, the bands reflected by green vegetation. Back in the office, we use computer software to extract the greenness of each image, which tells us the weight of plant material. At each site, we install several plots just as snow melts. We place a fence around half of the plots to prevent grazing. We leave the other plots unfenced. We measure the amount of plant material when we set up each plot and again after 30 days. The fenced plots tell us the amount of plant growth during each 30-day period. The unfenced plots tell us how much grazers eat during the same time. We move these paired plots after every 30 days, which enables us to measure plant production and consumption for the entire summer. We also set up permanently fenced plots to measure plant production under no grazing.

We collect the top 4 to 8 inches of soils inside and outside of fenced areas to monitor soil nutrients, water holding potential, chemistry and microorganisms. We also install small membranes below the soil surface that record the amount of nutrients entering the soil. Samples are sent to Washington and Lee University for analysis by an undergraduate soils class mentored by Dr. Bill Hamilton, a long-time collaborator.

We clip plants in permanently fenced plots and unfenced plots to compare nutrition. Back in the office, plant samples are washed, dried, pulverized in a vortex grinder, and sent to Bill Hamilton and his class for analysis. We also lay transects and record the relative abundance of plants, recording 269 individual species to date.

Ramon Perez conducting fieldwork.

use 81% of northern Yellowstone at lower intensity, 9% of areas near 25%, and 10% of areas at higher intensities. This pattern makes northern Yellowstone a relic of North America prior to European settlement when bison dominated the continent. It is not waist high grasses and wildflowers backdropped by snowcapped mountains, but mosaics of dense mats of short-statured plants with dung piles peppering the land and wallows pitting the dense mats of grazed plants. Our research suggests Yellowstone is better off for it.

Soils are healthy and show long-term stability in their ability to let nutrients in and hold on to them. Soil textures and chemistries are within ranges which promote plant growth. Bulk densities are less than levels that diminish root growth or water penetrance. Soils show the same levels of nutrients over more than 60 years of grazing, while short-term experiments show grazing accelerates the recycling of nutrients back to soils. Soil organic matter, the decaying plant and animal material in soils, responsible for most water and nutrient flow, is unaffected by grazing.

Plant communities are diverse. They are made up of species that span broad ranges of plant traits, such as rooting depth, reproductive strategy, life history, growth pattern, growth timing, leaf area, and photosynthetic capacity. Diverse traits make for healthy plant communities. They are highly productive because the diverse traits allow them to effectively absorb and use soil nutrients. Experiments using small grazing exclosures show that grazing does not inhibit plant growth. On the contrary, the light to moderate grazing that occurs along migration routes increases the amount of plant material produced each year. Also, the intensely grazed short-dense lawns of plants on summer ranges are just as productive as they would be if bison weren't there.

Most critics argue grazing has changed the plant communities in northern Yellowstone to the wrong ones. This belief stems from a long tradition in rangeland science for managing landscapes for a single plant community by limiting and spreading out grazing. Any deviation from this theorized community is taken as a sign of degradation.

When we give bison room to roam, they become ecosystem engineers that significantly modify their habitat. They change plant phenology and the timing and movement of spring green-up across the land. They manipulate plant productivity through increasing nutrient recycling and change the factors limiting plant growth to produce vegetation explosions during wet years. They also alter the composition of plant communities by changing the relative abundance of species with different physical traits.

The world endorsed the idea of trophic cascades in northern Yellowstone. It means that predators can affect their food's food. It is being tested with the restoration of wolves to see if their recovery changes plant communities by affecting elk behaviors and numbers. Such change would be championed as ecosystem recovery. Bison may play a similarly important role.

There is something unique about Yellowstone that isn't true anywhere else in North America. It has a large, healthy, valued bison population. We are learning that the same way predators can influence the system from the top down, bison can push on the system from the bottom up. Put another way, the influence of bison on plant communities in the park is as natural and important to the ecosystem as top predators like wolves.

Our findings result from nine years (2012-2020) of research. The core of our work revolves around 30 sites in grassland and shrubland areas where there is frequent grazing. Each site is about 1-acre in size and includes different types of small grazing exclosures. We measure soil health, plant growth, grazing intensity, and plant community composition. Our research is ongoing with some preliminary findings in the upcoming issue of Yellowstone Science. For enhanced information about bison movements and grazing including video interviews with our scientists and reference materials from this article, visit go.nps.gov/bisonconservationupdate.

Home on the Range

There is overwhelming national support for restoring bison. But that is not necessarily the case in areas where people may have to live with them. It comes down to people's concerns and values.

Overcoming concerns about living with bison takes teaching people how to be safe around bison. Managers must be there for people when they have bison on their land and don't want them there. It takes managing numbers of bison moving out of the park, which builds trust in the local community that the onus of wild bison doesn't fall on their shoulders alone. Yellowstone is proof in the making. As a result of two decades of hard work, public opinion surveys show that more and more local community members want wild bison outside the park.

Equally important is helping people value wild bison. Home on the Range is a citizen science effort aimed to bring youth to the park to empower them to use science to ask questions and find answers. Home on the Range is about what bison do for the ecosystem. It is some of the most exciting work we are doing. Yellowstone Forever has been an important supporter in seeing this program forward.

Bison replaced elk as the dominant grazer in northern Yellowstone over the last decade. Elk declined after predator recovery and a decade-long drought in the early 2000s. Bison numbers quadrupled over the same time frame.

We are learning from the bottom-up bison are profoundly changing the Yellowstone ecosystem. We now know their grazing alters patterns of plant growth across the entire ecosystem and improves plant nutrition. We now know that bison grazing alters the relative composition of certain plants in heavily grazed areas. We are just beginning to test if other large grazers like elk, pronghorn, mule deer, and bighorn sheep are using the foods bison stimulate through their grazing.

Through this program we placed radiocollars on 32 bison, 54 mule deer, 23 pronghorn, 16 bighorn sheep, and 16 elk beginning in 2017. These devices transmit the locations of animals to our computers every two hours. We download the data and create near real-time maps of animal locations and upload them to a virtual cloud accessible to citizen scientists. The citizen scientists are groups of high school or college students led by instructors from our partnering organizations Yellowstone Forever, Ecology Project International, and the Youth Conservation Corps. The educators download the maps to

(From top to bottom) Rick Wallen, retired NPS bison biologist, leads high school students from all over Montana tracking radiocollared bison, Yellowstone Forever participants collect fecal samples, and NPS bison biologist Lauren McGarvey leads the Gardiner High School biology class in Yellowstone. Photos: ©B. French & Ecology Project International.

handheld GPS devices and lead teams of students to collect fecal samples.

Samples are shipped to Brown University to undergo DNA (genetic) metabarcoding. The technique allows researchers to identify the plant-based DNA found in fecal samples. But the output is gibberish genetic code. To link it to actual plant identifications, we are working with the park's botanist to collect and mount plant specimens for the herbarium. A small amount of waste material is lost in mounting each specimen. We collect the waste material and send it to Brown University to create a reference DNA library of the plants in northern Yellowstone linking the genetic code to plant species. In the next year, we will be able to make unparalleled advances in understanding the diets of the large grazers of northern Yellowstone.

So far, 90 fecal samples have been analyzed for coarse diet composition using a technique called plant fragment analysis. Fecal matter is spread on a slide and analyzed under a microscope to identify plant parts. We are finding diets of bison, elk, and bighorn sheep overlap the most and more so during winter. Bison and elk eat primarily grasses, sedges, and rushes, with elk also eating more showy flowers and shrubs. Bison and elk diets also overlap in summer, when bison are improving food nutrition through their grazing. Bighorn sheep eat mostly grasses and shrubs. Rather than grasses, mule deer and pronghorn eat more showy flowers and shrubs. Mule deer also eat more conifers in winter.

We now know that bison create a landscape mosaic of low to extremely high grazing. A pattern of variable grazing diversifies plant habitats, which may increase the total species diversity of the Yellowstone landscape. We are collaborating with the park Bird Program to complete songbird point counts in areas surrounding sites where we have monitored bison grazing since 2015. We are also collecting soil microbe and insect samples to see how their diversity varies with bison grazing. This work is just getting underway, but preliminary results suggest bison grazing alters patterns of species occurrence.

Bison could also shift the composition of the grazing guild. Their effects may be so pronounced that they actually contribute to changing the number of elk, pronghorn, mule deer, and bighorn sheep in northern Yellowstone. We are

learning bison have incredibly high natural survival. Adult bison have a 98% chance of surviving at least one more year after we first fit them with collars. Mule deer have a 94% chance, pronghorn have a 80% chance, and bighorn sheep only have a 65% chance of surviving at least that long. Based on survival rates alone, it seems like the composition of the ungulate guild should naturally shift towards more bison.

But it may be more complicated because species reproduce at different rates. About 50-60% of adult female bison are observed with calves when those calves are one year old. This ratio combined with survival rates begins to explain the growth potential of populations.

Over the last two years nearly every Yellowstone Forever participant who took a field course or guided trip through the park contributed to learning about the large grazers of the park. The instructors spent time with their participants observing ungulates and recording the number of adult females and young of the year. They enter their observations using tablets into a cloud-based database accessible to our team. The Home on the Range program gives an unprecedented opportunity for thousands of participants to engage in cutting edge research that helps us understand bison and their role in the ecosystem. The work of these citizen scientists is creating annual estimates of young of the year to adult female ratios, which we will integrate into population models to monitor how these populations are doing.

Ecology Project International has helped us engage local students in ways that we never could. They bring high school students from up to seven local communities to spend five days working alongside our team. These include students from the boundary communities of Gardiner and Livingston, Montana, and the tribal community of Wolf Point, Montana (Fort Peck Indian Reservation). In the last three years, we have had the opportunity to work with nearly every high school student in Gardiner. Not only do we engage with these students in the field, but we meet with them for an informal evening seminar to discuss what it means to live with wild bison. Through this program we are building the community involvement needed for small, rural communities to live with bison.

Thanks to Jim & Joellyn Barton, Elizabeth Webb, Lisa Volgenau, Yellowstone Forever, Erin Clark, Rachel Garwin, Joshua Theurer, & Robert Petty for their contributions and support.

Citizen Science Volunteer Hours				
Season	**Grazing Research (hours)**	**Tracking Ungulates (hours)**	**Ungulate Observations (number)**	**Fecal samples (number)**
Winter 2018	250	1,864	136	39
Summer 2018	611	1,457	226	51
Winter 2019	172	1,320	64	27
Summer 2019	554	1,085	119	19
Total	1,587	5,726	545	136

Number of Females with Young of the Year			
Species	**2018**	**2019**	**2020**
Mule deer	22% (12-32%)	30% (26-35%)	39% (34-44%)
Bighorn sheep	19% (7-31%)	22% (16-28%)	21% (12-29%)
Pronghorn	14% (9-18%)	31% (27-35%)	15% (12-18%)
Citizen scientists with Ecology Project International, Yellowstone Forever and the Youth Conservation Corps contributed 3,131 hours in 2019.			

Results of citizen science efforts in 2019.

State of the Herd

Population Status

The latest models predicted about 3,992 bison at the end of winter and 4,730 animals after calving in June 2020. Information from aerial surveys, birth and survival of radio-collared animals, records of animals corralled and slaughtered, and harvests reported by state agencies and tribal nations is inputed into sophisticated models to predict population numbers.

Bison from all over the park congregate into two main breeding areas during the summer. There is some interchange of animals between breeding areas among years. Bison that congregate in the Hayden Valley, Firehole Geyser Basins, and Pelican Valley make up the central herd. Bison that congregate across Yellowstone's northern range, particularly in the Lamar Valley and nearby higher elevation grasslands, make up the northern herd. In 2020, we counted about 1,250 bison in the central herd and 3,400 bison in the northern herd. Numbers across the population and in both herds have remained relatively stable over the past eight years.

The number of males in the population is increasing. As recently as 2016, the number of males equaled the number of females. Currently there are about 1.25 males for each female. The population is also becoming older, with animals younger than two years of age now making up about 25% of the population. Management reductions are causing these shifts in the

age and sex structure. Adult females and younger animals are more likely to migrate to wintering areas outside the park where they may be harvested or rounded up.

Current Issues

Since 2017, the managing agencies and tribes have focused on resolving three key issues that cross the individual jurisdictions of any one entity. These are some of the hardest issues to resolve because no single entity can solve it alone.

Hunting

Many people want hunting to become the primary way to manage bison population numbers similar to other large wildlife in the area. Hunts began during 2005-2006, with 44 hunters licensed by the State of Montana. Over time, seven tribes exercised treaty rights to hunt on public land outside the park, dramatically increasing the number of hunters. Increased hunters shot many more bison with 200-400 bison now harvested during most winters.

Increased hunting has raised some concerns. Most hunting occurs in the congested 10-20 acre areas immediately outside the park and adjacent to private land. Hunts often involve several individuals harvesting animals from the same group at the same time. Some residents are concerned for their safety due to fears of being struck by a stray bullet, encountering bears emerging from hibernation attracted to carcass remains, and being exposed to diseases carried by bison.

Some local business owners claim the hunts threaten their livelihoods. The hunts also create frustrations in some landowners that have to live with bison but have little chance to draw a license to hunt them.

The hunting tribes and State of Montana have ultimate authority over the hunts. Each entity defines their own hunting seasons, licensing and harvest practices. The U.S. Forest Service retains authority to close areas if hunting becomes unsafe. Yellowstone's primary role is balancing rounding up some animals with letting other animals move out of the park where they could be hunted. It is important to roundup animals in ways that meet objectives for population size, herd composition, and age and sex structure.

That said, all managers are working together to explore ways to improve the safety and quality of bison hunting. Local residents have been empowered to participate in working meetings where they can propose their own solutions.

Out of Park Conservation Zones

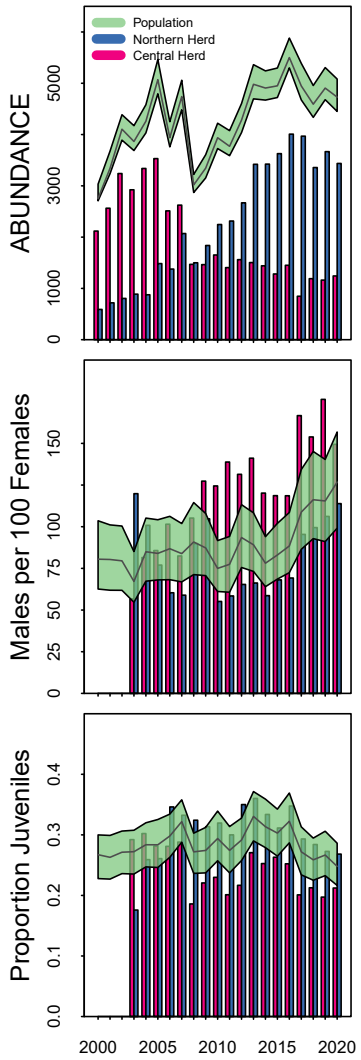
Bison can now roam over more than 75,000 acres outside the park. But bison have not explored into large areas west of the park. Local citizens are worried about managers unnaturally returning bison to these areas using trucks and trailers. But they generally support bison naturally finding their way there over time.

The State of Montana retains authority over how bison may be moved into these areas and how they are managed once they get there. Yellowstone has helped by developing habitat suitability models that identified likely migration routes bison could use to move into these areas.

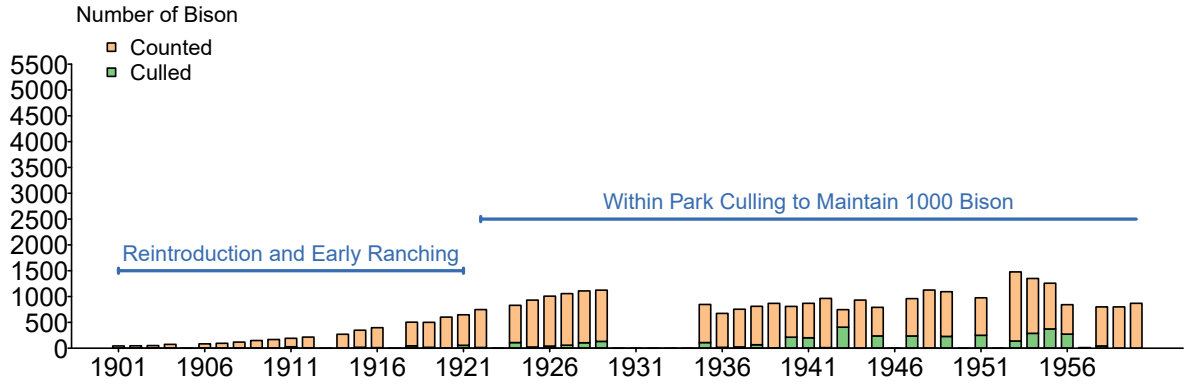
Conservation & Transfer Program

Of the current issues, managers made the most progress in establishing the conservation and transfer program. The program identifies bison that don't have brucellosis and transfers them to new areas as an alternative to sending them to slaughter.

The State of Montana, APHIS, YNP, and Fort Peck Tribes spent several years figuring out how and where to implement the program. The program is now underway. Since 2019, 104 bison have been transferred to the Fort Peck Tribes. Forty of those animals were transferred to 16 other tribes in 2020. Another 110 animals are in the program right now and will be transferred to the Fort Peck Tribes in the coming years.



Post-calving summer estimates (top) of the Yellowstone bison population. Numbers in the central and northern herd changed over time as the result of management reductions and immigration and emigration patterns. Population management goals are maintaining a viable population, more than 1,000 animals in each herd, (middle) an equal sex ratio, and (bottom) age structure of about 30% juveniles and 70% adults.



Making Sense of Numbers

The most common question I am asked as the leader of the bison program is,

"*If 3,000 bison is the carrying capacity, then aren't there too many bison in the park?*"

I always pause before answering this question. It is a fundamentally important question. The fact so many people ask me the same question shows me there is widespread misunderstanding of what that number represents.

When the Interagency Bison Management Plan was created nearly twenty years ago, it set 3,000 bison as a population target. That meant expecting about 3,400 bison after spring calving. As bison migrated out of the park in winter, enough animals would be rounded up to return the population to 3,000 animals before spring calving.

Managers identified that number based on research completed by the National Academy of Sciences. They found very few, if any, bison moved out of the park when there were fewer than 3,000 animals. When the population was above 3,000, the number of bison moving out of the park increased with snowpack severity.

Science uses the term carrying capacity to indicate when a population stabilizes around a number based on the amount of available food. As more animals eat more food, eventually there is not enough food for everyone. Some animals who don't get to eat as much have lower survival and birth rates. As a result, the number of animals born into the population equals the number that die of natural causes.

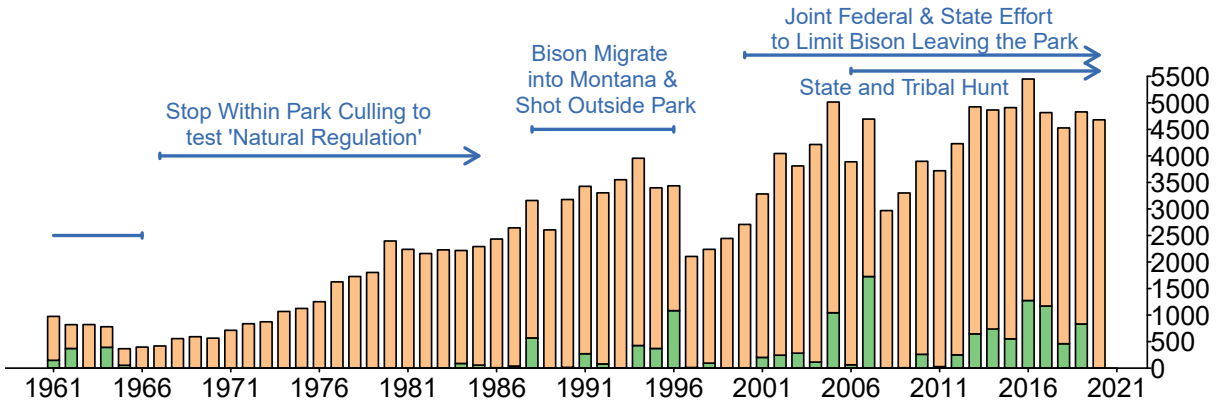
In 2005, biologists from Colorado State University, and the U.S. Geological Survey completed an evaluation of how many bison the park could support based on available food. Their models predicted about 8,000 bison with 5,000 elk or 6,200 bison with 20,000 elk. They found a lot of uncertainty in these numbers due to weather, grass production, and other random effects. My team recently used traditional rangeland management approaches to estimate numbers of bison that result in sustainable grazing. It equated to more than 10,000 bison in the park without accounting for elk.

The number 3,000 had everything to do with snow and the potential for large numbers of animals moving out of the park. It was never intended to be a carrying capacity. The number was established to reduce the chance of large exoduses of bison out of the park and, as a result, lessen conflict.

But it didn't work out as envisioned. We now know relatively few bison migrate out of the park even when there are somewhat more than 3,000 animals. The population grows as a result because not enough animals can be rounded up to offset natural population growth. This happens until the population is much larger than 3,000 animals, a mass exodus occurs, and 30-40% or more of the population is removed to reset numbers. Ten years of this approach during 2000-2010 created conflict rather than solved conflict. It fueled competing arguments of repeatedly not meeting population targets versus harm to the population from removing too many bison at once.

Over time, we've realized we can meet the goals of the management plan —to sustain a viable population and reduce the risk of exposing livestock to brucellosis—without targeting for 3,000 animals.

Improved understanding of brucellosis transmission supported by extensive data show bison outside the park do not increase the risk of brucellosis transmission to livestock. The National Academy of Sciences confirmed that separating bison and livestock works. We manage risk by constraining bison to conservation zones outside the park. Driving animals, roundups, and hunting are used to keep bison within these zones and limit numbers to manageable levels. Managers also respond to landowners when asked



Bison population over time.

to drive animals off private land within the conservation zones. There have been no brucellosis outbreaks in livestock originating from bison despite the population ranging from 2,500 - 5,500 bison since 2000. Bison and cattle have not intermingled outside the park since 2013. Hundreds of bison move into out-of-park conservation zones each year.

Conflicts are declining outside the park. Conservation zone boundaries were revised in 2015 based on improved understanding of brucellosis transmission risk. At the same time, hunting displaced hazing as the primary tool limiting numbers out of the park. The result was less hazing. It equated to about 10 hazings per year during the last five years compared to 90 hazings per year during the five years before then.

The number of bison-related private land complaints remained the same as hazing declined. We've learned most people living in surrounding communities now believe bison roaming outside the park doesn't increase the risk of brucellosis transmission. In fact, most people in surrounding communities want bison roaming outside the park.

Success in managing conflicts advanced ecological restoration of bison. The combination of bison and predators stabilized the food web, making the Yellowstone ecosystem healthier than it has been in more than a century. Predator recovery during the late 1990s reduced the biomass of hoofed herbivores in northern areas of the park. Bison and their invulnerability to predators filled this gap, with numbers in northern areas of the park quadrupling since 2006 and the total population averaging near 4,900 animals since 2013.

People care deeply for the Yellowstone herds. Seeing the largest free-ranging bison population in North America is one of the top reasons that people come to the park. People come not to see a few bison behind fences but to see thousands of animals moving across the vast park landscapes. They provide a sense of reconnection to those long-lost herds that once roamed the continent.

Higher numbers supported more hunting outside the park. Since 2012, hunters harvested nearly 2,500 bison outside the park, providing sporting opportunities and supporting local economies. Most hunters were Native Americans exercising century-old treaty rights to reconnect with bison on their traditional hunting grounds.

Higher numbers also protect the genetic health of the population. Conserving genetic diversity takes several thousands of animals, natural breeding competition, and continued adaptation to predators, other herbivores, and disease. Now, with the conservation and transfer program, these genetics can be returned to other bison herds.

We are learning it takes many more animals than we initially thought to stabilize the population around a target. It takes a certain number of animals in the population for bison to migrate out of the park every year. Snowpack hardening makes this number go up or down. The crux is to manage for a population size where enough bison migrate out of the park nearly every winter to remove the necessary number of animals to stabilize the population. That means during winters when snowpack is severe, managers will need to be ready to deal with the extra conflict that comes with more bison outside the park. Nonetheless, finding a way to stabilize the bison population would go a long way to finding common ground for one of the most contentious and complicated wildlife management issues of our generation.

Interagency Bison Management Plan

Bison migrate out of Yellowstone, which has led to one of the most complex wildlife issues of our generation. Court negotiation created a management plan in 2000 that shares management responsibility for Yellowstone bison between the federal government and State of Montana.

The management plan sets shared goals for bison conservation and outlines responsibilities across agencies. The management plan doesn't supersede federal or state laws that set legal responsibilities for individual agencies. It is more so a formal agreement among agencies to try to work together to resolve conflicts and find common ground. Over time, several Native American tribes joined the management team.

Management Goals

• Conserve a wild, wide-ranging bison population.

• Reduce the risk of exposing livestock to brucellosis.

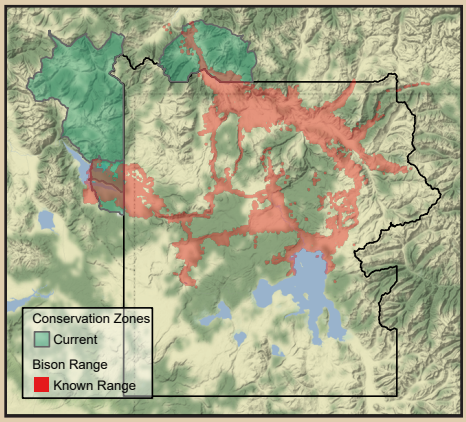
Implementation

The agencies and tribes hold three working meetings each year that are open to the public. The outcome of these meetings is an annual strategy for managing the bison population. In summer, the National Park Service reports the population size. In fall, the partners agree to a target number to remove and how to balance hunts and capture for slaughter and the transfer program. The spring meeting recaps winter management actions. The partners also discuss keys issues during these meetings, such as safe hunts, increasing use in conservation zones, and implementing the conservation and transfer program. All management decisions are by consensus, meaning all partners have broad agreement on issues, understand the decision, and realize the reasons for making it.

Limiting Numbers

The bison population naturally grows by 10-17% each year. The larger the bison population, the more bison migrate out of the park. The only way to keep the population from growing is to cull animals when they move out of the park. Animals are culled by hunting or corralling them. Corralled bison are sent to slaughter or entered into a multi-year conservation and transfer program to move brucellosis-free bison to other areas.

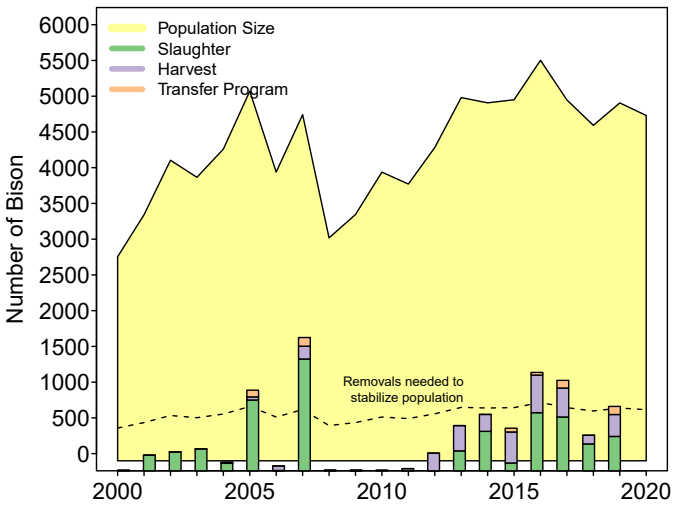
Since 2013, managers agreed to remove enough bison each winter to slightly decrease the population. This resulted in removing an average of 800 animals each winter. These efforts stabilized the bison population near 4,100 animals at the end of winter and 4,900 animals after calving. Today the bison population is about 4,730 animals and is slightly smaller than it was in 2013 when there about 5,000 animals.



Map of conservation zones and known bison range in and outside of YNP park boundaries.

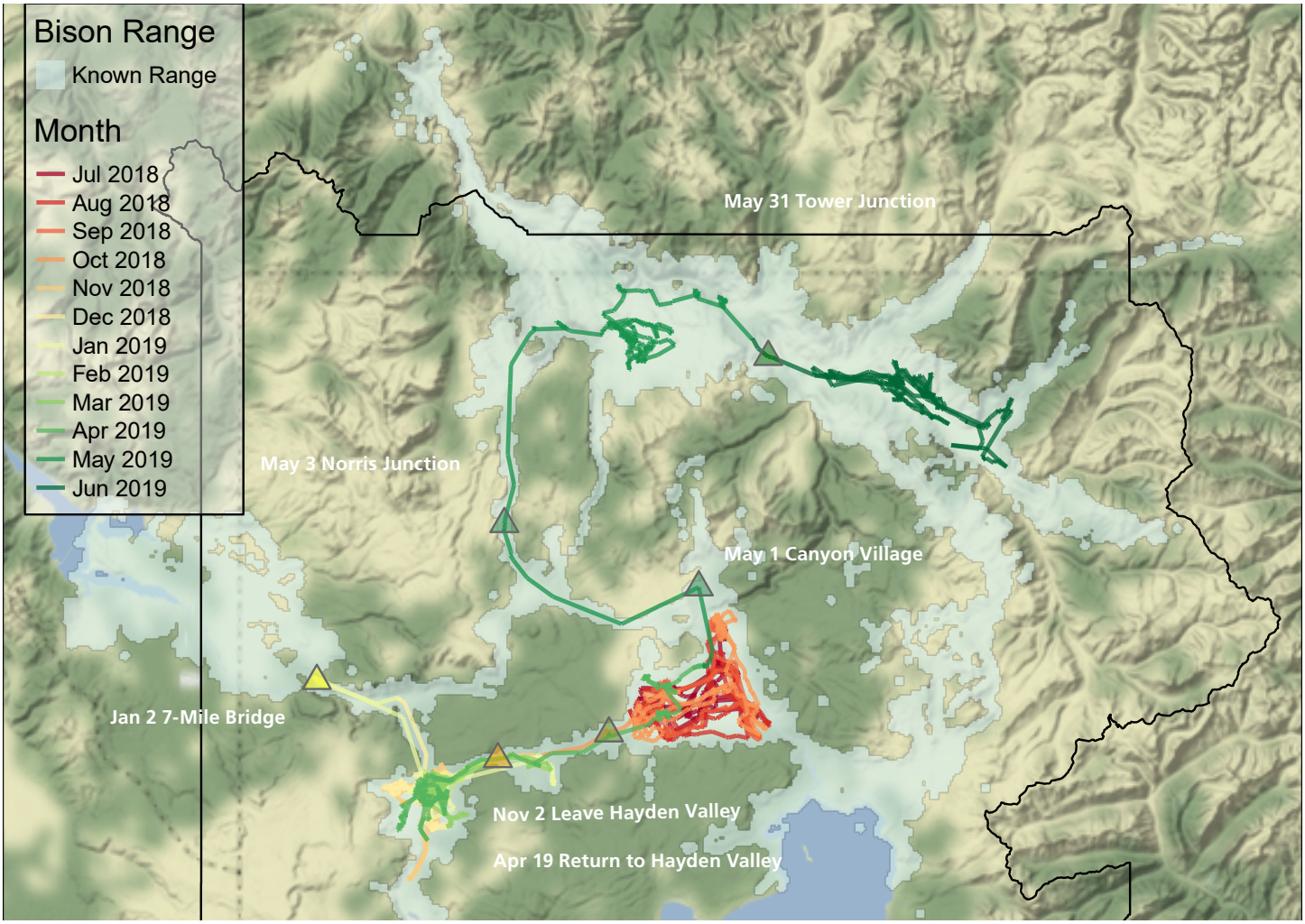
Limiting Where Bison Can Roam

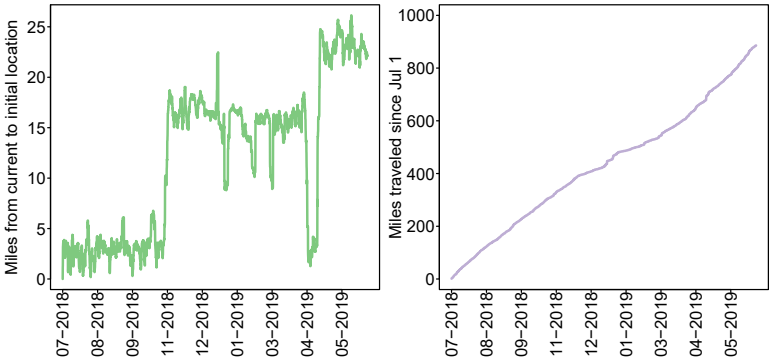
While bison can roam anywhere within Yellowstone, they are constrained to conservation zones outside the park. Conservation zones are geographic areas with limits on the number of bison using them. North and west of the park there are about 75,000 acres of mostly public land where bison can roam all year or are available to females seasonally. The State of Montana retains ultimate control over where bison can roam outside the park.



Relatively few bison migrated out of the park until numbers reached 4,500-5,000, at which time enough animals migrated each year to remove (bars) the necessary numbers of animals to stabilize the population (dotted line).

The Path of YELL-114





Path of travel, miles from initial location, and total miles traveled by YELL-114.

Bison are always on the move, covering more distance in a year than any other migratory ungulate in the park. They do this not by traveling great distances in one-way migrations like many deer and elk. Instead they roam back-and-forth in circles across large areas of park with those areas changing between seasons. For many bison, their movements take them across more than 800-1,000 miles of Yellowstone each year. Bison tend to make one of three migrations: North Lamar Valley to Gardiner, Montana; Central Hayden Valley to Geyser Basins and West Yellowstone, Montana; and Central to North Hayden Valley to Geyser Basins to Gardiner.

But each year we learn about new movements. Featured here is the migration of YELL-114 during July 1, 2018, to June 30, 2019. She spent the summer of 2018 in Hayden Valley for the breeding season generally remaining within 5 miles of the same location as the bird flies. She left Hayden Valley on November 2 traveling the Mary Mountain Trail to the Geyser Basins where she spent winter, other than a brief January foray to Madison Junction and as far west as 7-Mile Bridge along the West Entrance Road. By this point, she had traveled 500 miles for the year. She returned to Hayden Valley on April 19, but didn't stop there for summer. She traveled the Grand Loop Road, reaching Canyon village on May 1, passing Norris Junction on May 3, and reaching Mammoth Hot Springs on May 4. From there she continued east reaching Tower Junction on May 31 and, after 900 miles traveled for the year, arrived in the Lamar Valley.

To see enhanced content please visit: [go.nps.gov/bisonconservationupdate.](go.nps.gov/bisonconservationupdate)

Caravan of trailers carrying Yellowstone bison to their release location within the Fort Peck Indian Reservation on August 23, 2019.

Release of 55 Yellowstone bison on the Fort Peck Indian Reservation.

Staff

Chris Geremia is the lead bison biologist.

Ramon Perez leads the field team studying grazing, plant communities, and the population.

Dustin Sene leads corralling and handling bison.

Rick Wallen began the program in 2001, recently retiring in 2018.

Carly Segal studies grazing and leads plant inventorying and collection.

Brian Helms (top) and **Kevin Dooley** (below) protect wildlife within the park, coordinate with hunting parties in nearby areas of Montana, and coordinate with state agencies responding to bison conflicts outside the park.

PJ White leads developing research and conservation strategies and responding to litigation.

Tim Reid leads winter removal operations and coordinates staff among park divisions.

Lauren McGarvey is the research biologist and develops and oversees ecological studies.

Doug Blanton manages the quarantine facility and leads wildlife anesthesia and radio-collaring.

Spencer Alascio, Micaela Pineda, and Kyle Van Atta (left to right) study grazing and track radio-collared ungulates. Kyle also investigates how wallows affect plant communities.

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